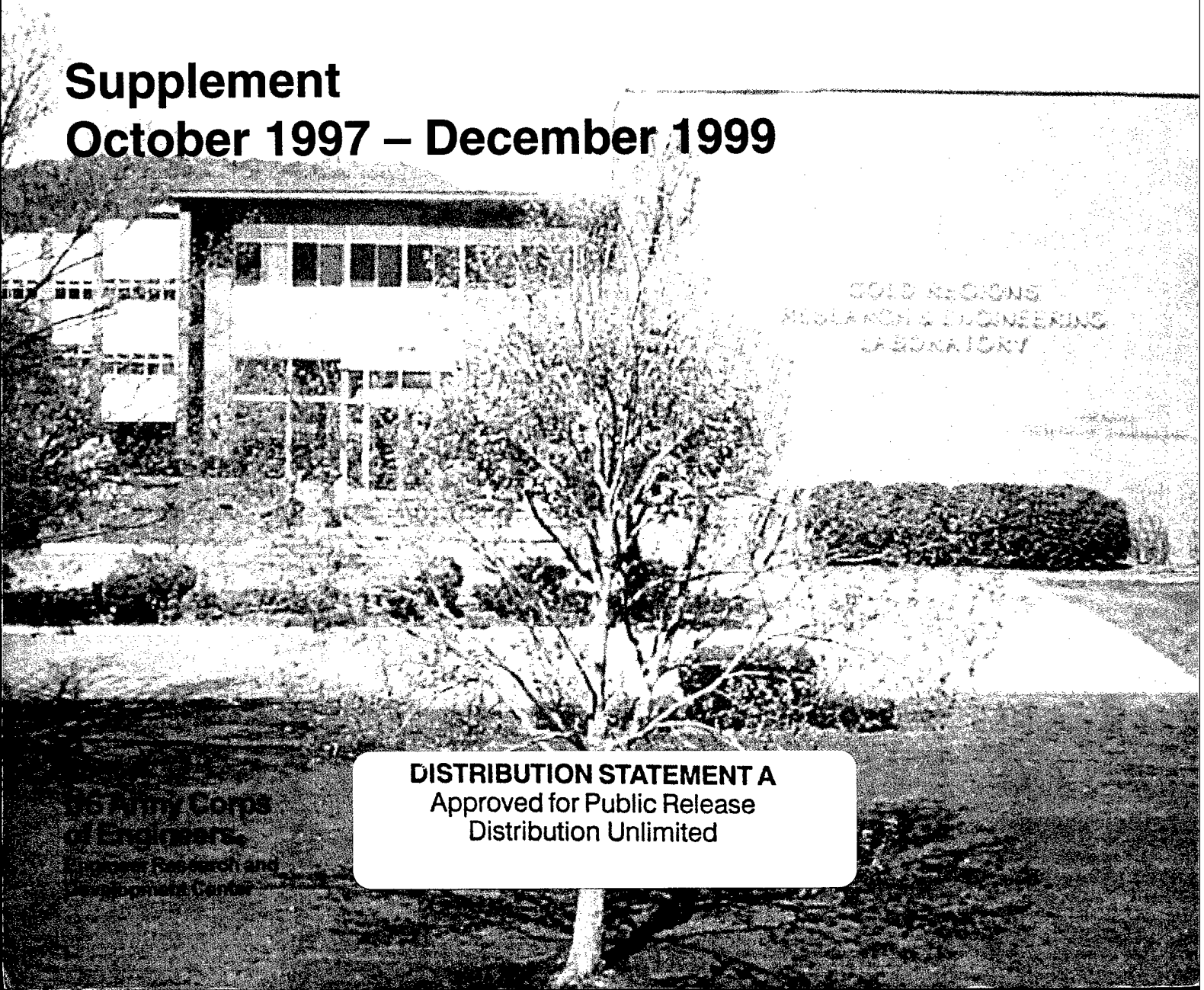
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CRREL Scientific and Technical Reports

Effective scientific and technical research depends on the transfer of information throughout the scientific community as well as the general dissemination of information to the public. CRREL has maintained an active publication program since its inception. This publication list is the supplement to the CRREL Publications List dated 1990-1996. The following descriptions are meant to clarify the CRREL report series.

CRREL Reports

The results of all major research efforts at CRREL are published in the CRREL report series.

Special Reports

The Special Report series contains a wide variety of reports that do not fall within the CRREL Report category, e.g. literature reviews, data compilations, interim reports.

Monographs

The Cold Regions Science and Engineering Monograph series comprises comprehensive reviews of a field of scientific or technical knowledge with analysis and evaluation. This series is not published on a regular basis and the numbers and frequency vary from year to year. Items in this series would be considered classics in the field of cold regions science and engineering.

Miscellaneous Publications

This series includes papers by CRREL authors that are published outside the laboratory but under CRREL funding. This series would include conference proceedings, contract reports, and journal articles.

Internal Reports and Technical Notes

Internal Reports are not listed in our publications list but frequently are referred to in literature cited by CRREL authors. These documents have not been published for reasons such as proprietary information, excessive expense, limited interest, or awkwardness of format. Copies are available for review in the CRREL Library or with the author's explicit release. Technical Notes are informal, preliminary, unedited, and frequently superceded by a more formal CRREL publication. These are also not available for external distribution without prior permission from the author.

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The *Bibliography on Cold Regions Science and Technology* has been sponsored at the Library of Congress by CRREL since 1951. This most important CRREL product has been published in volumes 1-15 as the *Bibliography on Snow, Ice and Permafrost,* SIPRE Report 12. Beginning with volume 16 the title was changed to *Bibliography on Snow, Ice and Frozen Ground*, with abstracts, and with volume 23 the current title was adopted. This publication differs from the CRREL Publications List because it includes all the world's cold regions research in addition to the CRREL in-house work.

Almost all the literature cited in the *Bibliography on Cold Regions Science and Technology* has been microfiched and is available in full text from the Library of Congress. If your requests number fewer than 10 you may borrow documents from the CRREL Library, 72 Lyme Road, Hanover, New Hampshire 03755-1290. Those interested in purchasing a photocopy of a document cited should write to the Library.

The *Bibliography* is available online and in a printed version:

- The printed version, currently in 53 volumes, is available for purchase from the National Technical Information Service (NTIS), Springfield, Virginia 22161 (phone 703-487-4650). The annual volume appears in two parts: author/subject index and the numerical listing. Periodically, a multi-year author/subject index is published to simplify the search process.
- The entire database — from the early 1950's to the present — can be searched online at the Library of Congress web site: lcweb.loc.gov/rr/scitech/coldregions/welcome.html

Current Literature — Cold Regions Science and Technology

Prior to publication in an annual volume, the monthly accessions to the *Bibliography on Cold Regions Science and Technology* are available for viewing on the CRREL Library Home Page: www.crrel.usace.army.mil/library/currentlits/curlit.html

Availability of CRREL Publications

The CRREL Reports, Special Reports, Monographs, and Technical Digests are all available for purchase from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The telephone number is 703-487-4650. Please refer to the next page for ordering information, or copy the form.

Most CRREL technical reports, from 1995 to date, are available full-text on the CRREL web site and can be downloaded, viewed, and printed.

CRREL REPORTS

CR 95-20
EFFECT OF CONDENSATION ON PERFORMANCE AND DESIGN OF EXTENDED SURFACES.
Lunardini, V.J., Aziz, A., Nov. 1995, 49p., ADA-302 744, Refs. p.45-49.
51-4743
HEAT TRANSFER, CONDENSATION, DESIGN, REFRIGERATION, DEHUMIDIFICATION, COLD WEATHER PERFORMANCE, HEAT TRANSFER COEFFICIENT, MATHEMATICAL MODELS
Heat transfer surfaces operating in cold regions often involve condensation. The analytical and experimental progress made in understanding the process of condensation on extended surfaces (fins) is reviewed in detail. The review covers condensation of pure vapor as well as dehumidification of air. The analytical models discussed range from simple Nusselt-type analysis to the three-dimensional conjugate approach, in which the conservation equations for the condensate film are tightly coupled to conduction in the fin. A separate section discusses the topic of dehumidification of air on finned cooling coils. Other topics reviewed include condensation on horizontal integral-fin tubes, convective condensation in internally finned tubes, and condensation in micro-fin tubes. Although condensation on horizontal integral-fin tubes appears to be well understood, the understanding of convective condensation in internally finned tubes, particularly the micro-fin tubes, is very limited. Furthermore, there exists no established methodology for designing extended surfaces for condensation applications. This report contains several examples illustrating the theoretical results that provide some insight into the design process.

CR 96-04
GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF THE HYDROGEOLOGY OF FORT WAINWRIGHT, ALASKA; PART I: CANOL ROAD AREA.
Lawson, D.E., Strasser, J.C., Strasser, J.D., Arcone, S.A., Delaney, A.J., Williams, C., May 1996, 24p., ADA-313 645, 11 refs.
51-512
ALLUVIUM, HYDROGEOLOGY, GROUND WATER, PERMAFROST DISTRIBUTION, BOREHOLES, RADAR, BEDROCK, SUPRAPERMAFROST GROUND WATER, SUBPERMAFROST GROUND WATER, WELLS, SEEPAGE, UNITED STATES—ALASKA—FORT WAINWRIGHT, UNITED STATES—ALASKA—CHENA RIVER
The hydrogeology of Fort Wainwright, AK, is extremely complex because of the relatively impermeable discontinuity of permafrost, which controls the distribution and dimensions of the aquifer. Aquifers occur above, below and adjacent to permanently frozen materials, as well as within thaw zones surrounded by permafrost. This complexity makes it difficult to predict the direction and rate of ground water flow, as well as its seasonal and annual variability. Considerable problems exist in locating suspected contaminant plumes, identifying source areas, defining transport paths and evaluating contaminant fate. This report summarizes the results of ongoing investigations of the permafrost and ground water conditions within the northwestern part of the Fort Wainwright cantonment area, north of the Chena River. Data from ground-penetrating radar, drilling, ground water flow sensors, aerial photographs and ground observations were used to delineate aquifer distribution and develop a conceptual physical model of hydrogeological conditions. Ground water seepage velocity and direction, which were measured during early to mid-winter 1994-95, reflect the role of local water sources and permafrost distribution in determining ground water flow patterns. Other factors, including the vertical and lateral extent of permafrost, a bedrock aquifer, and the alluvial origins of unfrozen sediments and landforms, are apparently more important than the subregional aquifer in determining ground water conditions during winter. Contaminant migration will be strongly affected by these factors as well.

CR 96-05
DEVELOPMENT AND RESULTS OF A NORTHERN SEA ROUTE TRANSIT MODEL.
Mulherin, N.D., Eppler, D.T., Proshutinskiĭ, T.O., Proshutinskiĭ, A.IU., Farmer, L.D., Smith, O.P., May 1996, 105p., ADA-311 979, 43 refs.
51-511
MATHEMATICAL MODELS, ICE NAVIGATION, MARINE TRANSPORTATION, COST ANALYSIS, SEA ICE, ECONOMIC ANALYSIS, COMPUTER APPLICATIONS, SIMULATION, ICEBREAKERS, SHIPS, TANKER SHIPS, NORTHERN SEA ROUTE
For a Corps of Engineers reconnaissance study, the authors developed a numerical model to estimate the time needed for various ship types to transit the Russian Northern Sea Route. They simulated liquid bulk, dry bulk, and container ship transits during the months of Apr., June, Aug. and Oct. In the model, probability distributions for various ice, ocean and atmospheric inputs are exercised by a Monte Carlo algorithm to generate combinations of conditions that affect ship speed. The speed, dependent on the established environment during each time and distance segment, is read from empirically derived lookup tables. Daily ship rates and Russian passage fees were applied to calculate the relative total costs for moving the various cargoes over the route. The model's development, limiting assumptions, simulation logic, data inputs, and resulting output are discussed.

CR 96-07
SEA ICE: PART I. BULK SALINITY VERSUS ICE FLOE THICKNESS.
Kovacs, A., June 1996, 16p., ADA-312 027, Refs. p.13-16.
51-513
SEA ICE, ICE COMPOSITION, SALINITY, ICE FLOES, ICE COVER THICKNESS, ANALYSIS (MATHEMATICS), ICE CORES, BRINES, ANTARCTICA, BEAUFORT SEA
Mathematical expressions have been established for estimating the bulk salinity of Arctic and antarctic sea ice vs. ice floe thickness. The ice salinity vs. thickness relationships are based on data for over 400 sea ice cores compiled from numerous sources. The results show that the bulk salinity of first-year sea ice decreases in an exponential trend with ice sheet thickness. A similar trend reoccurs as the winter ice passes through the melt season. The expression for the bulk salinity S_B in per mill for first-year sea ice from 10 to 200 cm thick is $S_B=4.606+91.603/T_F$, where T_F is the ice floe thickness in centimeters.

CR 96-08
SOURCE LOCATION AND TRACKING CAPABILITY OF A SMALL SEISMIC ARRAY.
Moran, M.L., Albert, D.G., June 1996, 34p., ADA-314 507, 19 refs.
51-1088
MILITARY OPERATION, VEHICLES, ORIENTATION, REMOTE SENSING, BOREHOLES, DETONATION WAVES, SOUND WAVES, DETECTION, WAVE PROPAGATION, SEISMIC REFLECTION, SEISMIC VELOCITY, SPECTRA, STATISTICAL ANALYSIS
Recordings of seismic wavefields from various sources were obtained using a small array of vertical-component geophones under winter conditions at Grayling, MI. These data were processed using a frequency-wavenumber domain Capon minimum variance beamformer to estimate the bearing angle and propagation velocity of the waves emitted from the source. The wave sources were sledgehammer blows on the ground surface, .45 caliber blank pistol shots, and an M60 tank moving along a road near the array. Reliable wavenumber spectra were obtained for all sources. Processing results for the hammer blows show that the dominant seismic arrival is a Rayleigh wave traveling at roughly 220 m/s. For the pistol shots, two arrivals corresponding to the airwave (338 m/s) and the air-coupled Rayleigh waves (220 m/s) were observed. For the moving vehicle, the dominant signals observed were Rayleigh waves (220 m/s). Accurate locations were obtained for this moving source, although the processing parameters had to be carefully selected, and the choice of frequency parameters affected the accuracy of the wavenumber results. The sensitivity of the wavenumber estimates to the frequency processing parameters seems to be related to the bias in the phase spectra of the signals and will potentially occur in any bearing estimation method that uses temporal frequency phase spectra.

CR 96-09
PHYSICAL SYSTEM DYNAMICS AND WHITE PHOSPHORUS FATE AND TRANSPORT, 1994, EAGLE RIVER FLATS, FORT RICHARDSON, ALASKA.
Lawson, D.E., Hunter, L.E., Bigl, S.R., Nadeau, B.M., Weyrick, P.B., Bodette, J.H., Aug. 1996, 63p., ADA-317 624, 53 refs.
51-2054
SOIL POLLUTION, WATER POLLUTION, ESTUARIES, WATER EROSION, SEDIMENT TRANSPORT, EXPLOSIVES, ENVIRONMENTAL IMPACT, MILITARY FACILITIES, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON
Eagle Rive Flats (ERF) is a subarctic estuarine salt marsh where human and natural forces are causing significant changes in the environment. Multiple internal and external forces govern the physical and chemical processes by actively altering surface conditions, sometimes in unpredictable ways. ERF is also used as an artillery range by the U.S. Army, where past use has resulted in white phosphorus (WP) contamination of the sediments within ponds and mudflats. Bottom-feeding waterfowl ingest this WP, which causes rapid death. This report documents analyses of the physical environment, describing the nature of the physical systems and factors controlling them. It includes data on sedimentation, erosion and hydrology. These investigations provide knowledge necessary to designing and evaluating remedial technologies. They also help determine the system's capacity to naturally attenuate the WP contamination.

CR 96-10
STRUCTURAL MECHANICS SOLUTIONS FOR BUTT JOINT SEALS IN COLD CLIMATES.
Ketcham, S.A., Aug. 1996, 12p., ADA-318 060, 24 refs.
51-2053
JOINTS (JUNCTIONS), SEALING, RUBBER, POLYMERS, WATERPROOFING, WEATHERPROOFING, STRUCTURAL ANALYSIS, THERMAL ANALYSIS, THERMAL STRESSES, COLD WEATHER TESTS
An effective, formed-in-placed joint seal will respond with elastic or viscoelastic behavior over a reasonable design life to any large movement of the joint without adhesive or cohesive failure. For a given joint movement, seals with lower stiffness are most able to deform without cohesive or adhesive failure of the seal or of the structure to which it is bonded. It is in recognition of this desirable response feature that lower-modulus, rubber-based elastomeric materials have been formulated and promoted as joint sealants. For a seal formed from an elastomeric sealant, it should generally be expected that the modulus of elasticity will depend upon temperature and loading rate, such that the modulus increases (sometimes dramatically) with a reduction in temperature and an increase in loading rate, and it should be expected that the seal stiffness will depend upon the material modulus and the shape of the seal. Measurements from testing techniques that are routinely used to evaluate the temperature and rate-dependent mechanical properties of rubber-like materials, together with simple structural mechanics solutions for the load vs. deflection behavior of rubber in the configuration of rectangular-shaped joint seals, allow these dependencies to be modeled, and form the basis of a practical analysis technique that could be used by civil and mechanical engineers for sealant selection and seal design.

CR 96-11
SEA ICE. PART II. ESTIMATING THE FULL-SCALE TENSILE, FLEXURAL, AND COMPRESSIVE STRENGTH OF FIRST-YEAR ICE.
Kovacs, A., Sep. 1996, 17p., ADA-317 247, 29 refs.
For Part 1 see 51-513.
51-2052
ICE COVER STRENGTH, ICE SALINITY, ICE DENSITY, ICE ELECTRICAL PROPERTIES, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE CREEP, ICE BREAKING, OFFSHORE STRUCTURES, MATHEMATICAL MODELS, BEAUFORT SEA
Sea-ice salinity, density, and temperature data were used to develop new methods for determining the bulk brine volume and porosity of sea-ice floes. Methods for estimating full-thickness ice sheet strength, based on large-scale field tests, are presented. The relationships among bulk sea-ice properties, strain rate, and strength are illustrated. A new constitutive equation was developed for predicting the full-thickness horizontal compressive strength of first-year sea ice as a function of the applied strain rate and bulk porosity. An estimate of the horizontal force that may develop between first-year sea ice and a 90-m wide structure is given. Estimating sea-ice strength based on remote ice conductivity measurements is also discussed conceptually.

CR 96-12
ICE ACTION ON RIPRAP: SMALL-SCALE TESTS.
Sodhi, D.S., Borland, S.L., Stanley, J.M., Sep. 1996, 64p., ADA-318 069, 20 refs.
51-2051
BANK PROTECTION (WATERWAYS), ROCK FILLS, ICE PUSH, ICE PILEUP, ICE OVERRIDE, ICE EROSION, ICE PRESSURE, ICE LOADS, ICE CONTROL, ENVIRONMENTAL TESTS
The authors conducted 35 small-scale experiments to assess the damage on riprap-covered banks by ice shoving. A review of literature on this subject revealed very little experience or guidance available for the design of riprap in the cold regions, where presence of moving ice can cause substantial damage to a riprapped bank. During the experimental program, the authors changed the slope of the model riprap bank, the size and the mix of rocks, and the thickness of model ice sheets. Results of these tests are presented in terms of measured horizontal and vertical forces, outcome of interaction as pileup or ride-up events, and damage to the model riprap bank. From the observations made during the tests, the damage to the riprap appears to take place during pileup events, because the incoming ice sheet is forced to go between the riprap and the piled-up ice, bringing with it rocks from the bottom to the surface of an ice pile. To sustain no damage to the riprapped protective layer, maximum rock size (D_{100}) should be twice the ice thickness for shallow slopes (1V:3H) and about three times the ice thickness for steeper slopes (1V:1.5H).

CR 96-13

PHYSICAL PROCESSES AND NATURAL ATTENUATION ALTERNATIVES FOR REMEDIATION OF WHITE PHOSPHORUS CONTAMINATION, EAGLE RIVER FLATS, FORT RICHARDSON, ALASKA.

Lawson, D.E., Hunter, L.E., Bigl, S.R., Dec. 1996, 65p., ADA-327 890, 37 refs.

51-5570

SOIL POLLUTION, WATER POLLUTION, ESTUARIES, EXPLOSIVES, ENVIRONMENTAL IMPACT, WASTE DISPOSAL, DRAINAGE, WATER EROSION, SEDIMENT TRANSPORT, MILITARY FACILITIES, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON

This report describes the results of investigations into the role of tidal flat physical systems in the natural attenuation of white phosphorus (WP) contamination in Eagle River Flats (ERF) on Fort Richardson, AK. Waterfowl feeding in ponds and marshes here ingest the WP and die. These investigations found that natural attenuation and in-situ degradation of the WP could result from certain physical phenomena operating within the ERF ecosystem. Specifically, the ongoing erosion and headward recession in the gullies will drain large areas of contaminated ponds in an estimated 1 to 10 years. Lowering of water levels should lead to in-situ WP degradation and natural attenuation as pond sediments dry. Annual sedimentation rates in some ponds and marshes are sufficient to bury WP in several years or more and thereby reduce the exposure to feeding waterfowl. Ice and water are also effective transporters of WP, moving it about ERF and into Eagle River and eventually into Knik Arm where its fate is unknown. Certain areas of ERF will require artificial drainage, but natural conditions can be restored following treatment. Recommendations are made for the use of natural attenuation and additional studies that are required to ensure the successful clean-up of ERF.

CR 96-14

MATERIAL TESTING AND INITIAL PAVEMENT DESIGN MODELING: MINNESOTA ROAD RESEARCH PROJECT.

Bigl, S.R., Berg, R.L., Sep. 1996, 45p., ADA-321 629, 26 refs.

51-2967

PAVEMENTS, PAVEMENT BASES, DESIGN, SUBGRADES, FROST HEAVE, FROST PENETRATION, COLD WEATHER PERFORMANCE, THAW DEPTH, COMPUTER PROGRAMS, MODELS

Between Jan. 1990 and Dec. 1994, a study verified and applied a Corps of Engineers-developed mechanistic design and evaluation method for pavements in seasonal frost areas as part of a Construction Productivity Advancement Research (CPAR) project between the Minnesota Department of Transportation (Mn/DOT) and the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL). The study involved four primary components. Mn/DOT constructed a full scale pavement test facility adjacent to Interstate 94, referred to as the Minnesota Road Research Project (Mn/ROAD). CRREL performed extensive laboratory tests on the base and subgrade materials from Mn/ROAD to characterize them and their behavior under seasonal frost conditions. Laboratory tests provided the input parameters necessary for the study's third component, modeling with the CRREL Mechanistic Pavement Design and Evaluation Procedure. The modeling effort was conducted in three phases, which investigated the effects of freeze season characteristics, water table position, asphalt model and subgrade characteristics on the predicted performance of selected Mn/ROAD test sections. Delays in construction on the Mn/ROAD facility prevented the completion of the study's fourth component—using performance data from Mn/ROAD to validate the mechanistic pavement design and evaluation procedure. The report details results from the other three components.

CR 96-15

DEVICE FOR MECHANICAL FREEZE-THAW CONDITIONING OF ALUM SLUDGE.

Martel, C.J., Affleck, R.T., Yushak, M.L., Dec. 1996, 21p., ADA-322 002, 15 refs.

51-2968

WATER TREATMENT, WASTE DISPOSAL, SLUDGES, DESIGN CRITERIA, FREEZE THAW TESTS, FREEZING RATE, GRAIN SIZE, COST ANALYSIS

This report contains the results of a study to develop a mechanical device for dewatering alum sludge by freeze-thaw. This proposed device is a combination of two conventional unit operations: a vacuum filter and a blast freezer. Bench-scale studies were conducted to evaluate this concept and develop preliminary design criteria. The results of filter leaf tests indicate that a suitable sludge layer could be collected on a cloth medium at a vacuum level of only 100 mm of Hg and a 5.0-minute filtration time. The volume of sludge was reduced by 67%. The freezing tests indicated that low freezing rate and a high initial solids content had a tendency to produce large alum sludge particles. However, fast freezing rates could be achieved without reducing the effective grain size below that of a fine sand. Curing time had no effect on grain size. The electrical cost of freezing sludge with this device was estimated to be $0.004/m^3, which is not expensive in relation to the total cost of water treatment which is approximately $0.25 to $0.50/m^3.

CR 97-01

COLLECTING MICROMETEORITES FROM THE SOUTH POLE WATER WELL.

Taylor, S., Lever, J.H., Harvey, R.P., Govoni, J., May 1997, 37p., ADA-327 829, 36 refs.

51-5571

WELLS, WATER SUPPLY, MELTWATER, ICE SAMPLING, IMPURITIES, COSMIC DUST, ANTARCTICA—AMUNDSEN-SCOTT STATION

A collector was designed and built to retrieve micrometeorites from the floor of the South Pole Water Well. The large volume of firn and ice being melted for the well and the low component of terrestrial material in antarctic ice make the South Pole Water Well an ideal place to collect micrometeorites. Because the age of the ice being melted is known, yearly or periodic collections provide large numbers of micrometeorites of known terrestrial age. The collector was designed to pose no threat to the well's water quality, to be reliable and easy to operate, and to collect particles larger than 50 μm. This report details how this collector was built and tested and documents the rationale behind some of the design choices. It also includes preliminary findings from the first deployment. (Auth.)

CR 97-02

RIVER ICE DATA INSTRUMENTATION.

Kay, R.L., White, K.D., June 1997, 40p., ADA-327 882, 70 refs.

51-5572

RIVER ICE, ICE JAMS, ICE CONDITIONS, ICE DETECTION, ICE SURVEYS, ICE REPORTING, ICE FORECASTING, FLOOD FORECASTING, RADAR TRACKING, MEASURING INSTRUMENTS, TELEMETERING EQUIPMENT, DATA TRANSMISSION

Ice processes are capable of causing damage to Corps of Engineers flood control, water control, and navigation projects each year. Monitoring of ice and other physical parameters is done by instrumentation in some instances but is usually done manually. Measurements that require personnel to go on an ice cover can be risky or impossible, depending on the ice cover's stability and the individual's training. This study seeks to identify and rank the field measurements needed during winter conditions and the instrumentation required to make the measurements. Existing and developing instrumentation was evaluated for in-situ and remote sensing capabilities. Methods of transmitting, storing, and retrieving various types of ice data were explored for feasibility and practicality. Recommendations are identified regarding the types of instrumentation, data transmission, and storage methods that need to be improved or developed.

CR 97-03

SNOW MECHANICS: REVIEW OF THE STATE OF KNOWLEDGE AND APPLICATIONS.

Shapiro, L.H., Johnson, J.B., Sturm, M., Blaisdell, G.L., Aug. 1997, 35p., ADA-330 695, Refs. p.14-20.

52-2236

SNOW MECHANICS, MECHANICAL PROPERTIES, CLASSIFICATIONS, SNOW ELECTRICAL PROPERTIES, SNOW DEFORMATION, MICROSTRUCTURE, SNOW STRENGTH, SNOW HARDNESS, SNOW PERMEABILITY, AVALANCHES, SNOW ROADS, RUNWAYS, SNOW (CONSTRUCTION MATERIAL)

A review of snow mechanics indicates that, with the exception of avalanche studies, it is seldom used. In this report the authors give their interpretation of why this is the case, and suggest ways to help expand the range of problems to which snow mechanics can be applied. Until the late 1960s, most experimental work in snow mechanics was devoted to finding values of the parameters for equations of linear elasticity, viscosity, and viscoelasticity. In about 1970, work on that approach stopped and since then the emphasis has been on 1) the development of nonlinear theories to describe the deformation and fracture of snow, and 2) attempts to develop constitutive relationships based on the study of the microstructural aspects of snow deformation. It is believed that the best hope of encouraging more applications for snow mechanics in the near term lies in improving and expanding the database on the response of snow to applied loads, and organizing it in a manner that makes it easy for potential users to determine the anticipated deformational behavior of snow in any particular application. It is suggested that a classification of snow based on physical properties and index parameters that give information about the bonding and microstructure be developed. Mechanical properties, constitutive relations under various loading conditions, and other relevant information can then be associated with each class.

CR 97-04

GEOPHYSICAL INVESTIGATIONS AT A BURIED DISPOSAL SITE ON FORT RICHARDSON, ALASKA.

Delaney, A.J., Strasser, J.C., Lawson, D.E., Arcone, S.A., Evenson, E.B., Sep. 1997, 14p., ADA-331 135, 7 refs.

52-2228

WASTE DISPOSAL, POLLUTION, RADAR ECHOES, GEOPHYSICAL SURVEYS, ELECTROMAGNETIC PROSPECTING, UNITED STATES—ALASKA—FORT RICHARDSON

The Poleline Road Disposal Area, located on Fort Richardson, AK, was a U.S. Army dump in the early 1950s. In 1990 it was identified as an area potentially contaminated with volatile organic compounds. CRREL conducted extensive geophysical investigations that delineated anomalous responses in many areas of burial within glacial outwash deposits. Ground penetrating radar and electromagnetic induction surveys were used prior and subsequent to excavation. Geophysical data collected on a 5 m grid defined locations for several anomalous areas containing both dispersed and large, discrete targets. Radar defined anomalous areas by the concentration of strong diffractions. The induction survey differentiated metallic from nonmetallic contaminations. The interpreted maximum depth of debris was 4 m. Uncontaminated areas were generally defined by continuous, horizontal radar reflections, suggesting undisturbed or compacted soil horizons. The anomaly maps produced from these surveys guided an excavation that removed hazardous material. The removed material included munitions, mustard gas cylinders, medical waste, steel drums, and other trash. The radar and electromagnetic surveys were repeated using a more closely spaced grid to verify that the excavated areas were clean and to define more precisely anomalies in the areas not excavated. That survey shows many targets of potential or present contamination that should be removed.

CR 97-05

FREZCHEM2: A CHEMICAL THERMODYNAMIC MODEL FOR ELECTROLYTE SOLUTIONS AT SUBZERO TEMPERATURES.

Mironenko, M.V., Grant, S.A., Marion, G.M., Farren, R.E., Oct. 1997, 40p., ADA-333 040, 14 refs.

52-2783

THERMODYNAMICS, MATHEMATICAL MODELS, COLD WEATHER OPERATION, COMPUTER PROGRAMS, DATA PROCESSING, SEA WATER, EVAPORATION, FREEZING, ICE FORMATION

This report documents a Fortran version of a chemical thermodynamic model for aqueous electrolyte solutions at subzero temperatures, FREZCHEM2, which is a further development of the FREZCHEM model. The model uses thermodynamic data of Spencer-Møller-Weare that permit the calculation of chemical equilibria in the Na-K-Ca-Mg-Cl-SO_4-H_2O system between -60 and 25°C at atmospheric pressure. It applies the Gibbs energy minimization method for chemical equilibrium computation combined with Pitzer equations for activity coefficients and water activity calculation. The model includes both the freezing (melting) reaction pathway at fixed water amount and the evaporation (dilution) pathway at fixed temperature. The FREZCHEM2 model can be extended with respect to independent components, electrolyte species, and solids, and if corresponding thermodynamic data are available, the model may be used to compute chemical equilibria in any systems that include aqueous-solution and/or one-component solid phases.

CR 97-06

ICE STRENGTH AS A FUNCTION OF HYDROSTATIC PRESSURE AND TEMPERATURE.

Fish, A.M., Zaretskiĭ, IU.K., Oct. 1997, 14p., ADA-333 030, 24 refs.

52-2782

ICE STRENGTH, ICE MELTING, COMPRESSIVE PROPERTIES, SHEAR STRENGTH, TEMPERATURE EFFECTS, PRESSURE, COHESION, MATHEMATICAL MODELS, INTERNAL FRICTION

A temperature model has been developed that describes the ice strength in a multiaxial stress state over a wide spectrum of negative temperatures. The model takes into account the anomalous behavior of ice under high hydrostatic pressure, when its strength reaches a maximum, and then gradually decreases with the pressure increase. It has been shown that strength of ice under high hydrostatic pressure is described by a parabolic yield criterion with only three fundamental parameters, ice cohesion, internal friction angle, and ice melting pressure, which all have a definite physical meaning and are functions of temperature. The model has been verified using test data on the strength of iceberg ice and laboratory-made polycrystalline freshwater ice under triaxial compression at strain rates between 10^{-3} and 10^{-5}/s over the temperature range between -1° and -40°C.

CR 97-07

UNSTEADY ICE JAM PROCESSES.

Zufelt, J.E., Ettema, R., Dec. 1997, 87p., ADA-334 991, 27 refs.

52-3444

RIVER ICE, ICE JAMS, FREEZEUP, ICE BREAKUP, ICE COVER THICKNESS, ICE MECHANICS, ICE LOADS, ICE COVER EFFECT, ICE WATER INTERFACE, RIVER FLOW, ICE FORECASTING, FLOOD FORECASTING, MATHEMATICAL MODELS

Ice jams cause flooding in northern temperate-climate areas, usually forming rapidly, often with little warning, constricting water flow and elevating water levels. Consequently, jam formation comprises highly unsteady processes: drifting ice pieces are brought to rest, accumulated ice sheets and thickens, and initial water depths and velocities change. Those processes are even more unsteady when a jam collapses. Prior simulations of ice jams, however, treat them as simply stationary, uniformly thick accumulations of ice pieces. No account is taken of the impact forces exerted by moving ice, an estimation that is further complicated by the need to couple equations describing water flow and ice movement. Under the dynamic conditions attendant to jam formation, water flow and ice movement interactively influence each other. This report evaluates the importance of ice momentum on ice jam thickness and thickness distribution using experiments conducted with laboratory flumes and a numerical model in which the equations of motion for one-dimensional flow of water and ice are solved as fully coupled. In this regard, the model is

unique, enabling simulation of the important unsteady interactions of water and ice, and determination of their effects on jam thickness. Ice momentum should be taken into account for most jams because it leads to significantly thicker jams and affects the thickness profile. A useful dimensionless parameter is identified for generalizing this finding.

CR 97-08

PROJECTING ICE-AFFECTED STREAMFLOW BY EXTENDED KALMAN FILTERING.

Holtschlag, D.J., Parker, C.T., Grewal, M.S., Dec. 1997, 40p., ADA-335 228, 10 refs.

52-3443

RIVER ICE, ICE JAMS, ICE COVER EFFECT, ICE WATER INTERFACE, RIVER FLOW, STREAM FLOW, FLOOD FORECASTING, STATISTICAL ANALYSIS, MATHEMATICAL MODELS

An extended Kalman filter was developed to automate the real-time projection of ice-affected streamflow, based on routine measurements of stage and air temperature and the relation between stage and flow during open-water conditions. The form accommodates three dynamic modes of ice effects: sudden formation-ablation, stable ice conditions, and final elimination. The filter was applied to historical data from two long-term streamflow-gaging stations. They were stable and parameters converged for both stations, producing estimates that were highly correlated with and linearly related to published streamflow values in a log-transformed metric. At St. John River at Dickey, ME, logarithms of projected streamflow values were within 8% of the logarithms of published values 87.2% of the time and within 15% of published values 96.6% of the time during periods of ice effects. At Platte River at North Bend, NE, logarithms of projected streamflow values were within 8% of the logarithms of published daily values 90.7% of the time and within 15%, 97.7% of the time during ice-affected conditions. This extended Kalman filter allows estimation of ice-affected streamflow at other gaging stations by adjusting filter parameters to site-specific conditions.

CR 97-09

LOCAL VARIATION IN WINTER MORNING AIR TEMPERATURE.

Hogan, A.W., Ferrick, M.G., Dec. 1997, 37p., ADA-335 124, 44 refs.

52-3442

AIR TEMPERATURE, TEMPERATURE INVERSIONS, SNOW AIR INTERFACE, SNOW COVER EFFECT, WEATHER FORECASTING, FROST FORECASTING, STATISTICAL ANALYSIS, UNITED STATES—NEW HAMPSHIRE

Results of temperature measurements, which may be applied to inference of winter temperatures in data-sparse areas, are presented. The morning air temperatures during three winters were measured at 80 places in a 10x30 km area along the Connecticut River. NOAA climatologies show this region to have complex spatial variation in mean minimum temperature. Frequency analysis techniques were applied to evaluate the differences in daily local temperature. Temperature lapse or temperature inversion in the study area was inferred from the difference of surface temperature measurements 100 and 300 m above river level. The frequency of inferred temperature lapse and the inferred lapse rate diminished as snow cover increased. The frequency of inferred temperature inversion and inversion strength increased as snow cover increased. When more than 20 cm of snow covered the ground, an additional surface inversion was frequent in the layer less than 100 m above river level, and two-thirds of river level temperatures less than -20°C occurred concurrent with these conditions. It is proposed that some meteorologically prudent inferences of surface temperature and near-surface temperature lapse or temperature inversion can be made for similar data-sparse areas.

CR 97-10

REVIEW OF SINTERING IN SEASONAL SNOW.

Colbeck, S.C., Dec. 1997, 11p., ADA-335 556, 34 refs.

52-3973

SNOW COVER STRUCTURE, SNOW STRATIGRAPHY, METAMORPHISM (SNOW), SNOW COMPRESSION, SNOW STRENGTH, ICE SINTERING, ICE CRYSTAL ADHESION

Strength and electrical pathways develop in snow as bonds grow among grains. Strong ice-to-ice bonds form in wet snow at low liquid contents but not in highly saturated wet snow. In freely draining wet snow, grain clusters form, and these require a certain configuration among the three phases of water. This depends somewhat on the number of grains in the cluster, but always leads to bonding. In dry snow, bonds form more slowly, but considerable strength can develop as long as rounded grains develop. The rate of bond growth is probably controlled by the temperature gradient, because both grains and bonds are observed to grow very slowly in dry snow in the absence of a temperature gradient. The basic shape of the bonds is dictated by the geometrical requirements of grain-boundary grooves and is not a simple concave neck. In dry snow, this shape, and possibly the processes, have been misunderstood.

CR 98-01

ANALYSIS OF LINEAR AND MONOCLINAL RIVER WAVE SOLUTIONS.

Ferrick, M.G., Goodman, N.J., Jan. 1998, 24p., ADA-336 342, 22 refs.

52-3972

RIVER FLOW, UNSTEADY FLOW, FLOW RATE, WATER WAVES, WAVE PROPAGATION, FLOOD FORECASTING, MATHEMATICAL MODELS

Linear dynamic wave and diffusion wave analytical solutions are obtained for a small, abrupt flow increase from an initial to a higher steady flow. Equations for the celerities of points along the wave profiles are developed from the solutions and related to the kinematic wave and dynamic wave celerities. The linear solutions are compared systematically in a series of case studies to evaluate the differences caused by inertia. These comparisons use the celerities of selected profile points, the paths of these points on the x-t plane, and complete profiles at selected times, indicating general agreement between the solutions. Initial diffusion wave inaccuracies persist over relatively short time and distance scales that increase with both the wave diffusion coefficient and Froude number. The nonlinear monoclinal wave solution parallels that of the linear dynamic wave but is applicable to arbitrarily large flow increases. As wave amplitude increases the monoclinal rating curve diverges from that for a linear wave, and the maximum Froude number and energy gradient along the profile increase and move toward the leading edge.

CR 98-02

DETERMINATION OF NITROAROMATIC, NITRAMINE, AND NITRATE ESTER EXPLOSIVES IN WATER USING SPE AND GC-ECD: COMPARISON WITH HPLC.

Walsh, M.E., Ranney, T.A., June 1998, 28p., ADA-353 441, 32 refs.

53-1810

EXPLOSIVES, WATER POLLUTION, WATER CHEMISTRY, CHEMICAL ANALYSIS

An analytical method for the determination of nitroaromatic, nitramine, and nitrate ester explosives and co-contaminants in water was developed based on SPE (solid-phase extraction) and GC-ECD (gas chromatograph-electron capture detector). Water samples are preconcentrated using either cartridge or membrane SPE followed by elution with acetonitrile. The acetonitrile extract is compatible with both liquid and gas chromatography, allowing direct comparison of concentration estimates obtained by different methods of determination. Quantitative GC analyses were obtained by using deactivated direct-injection-port liners, short wide-bore capillary columns, and high linear carrier gas velocities. Recoveries from spiked samples were 90% or greater for each of the nitroaromatics and nitrate esters, and greater than 70% for nitramines and amino-nitrotoluenes. Estimates of analyte concentrations in well-water extracts from military sites in the United States and Canada analyzed by GC-ECD and the standard HPLC (high performance liquid chromatography) method showed good agreement for the analytes most frequently detected (HMX [octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine], RDX [hexahydro-1,3,5-trinitro-1,3,5-triazine], TNT [2,4,6-trinitrotoluene], and TNB [1,3,5-trinitrobenzene]). The GC method provides lower method detection limits for most analytes than HPLC, but accurate calibration is more difficult. The ultraviolet detector used for the HPLC analysis has much greater linear range than the ECD used for GC analysis. The GC instrumentation requires more care than the LC: the injection port liner must be changed frequently to maintain accurate determination of the nitramines. Because the sample preparation technique yields extracts that are compatible with both GC and HPLC analysis, confirmation of analyte presence can be obtained based on different physical properties.

CR 98-03

STRUCTURAL ANALYSIS OF DEW LINE STATION DYE-2, GREENLAND: 1983-1988.

Walsh, M.R., Ueda, H.T., June 1998, 23p., ADA-353 518, 17 refs.

53-1811

STRUCTURAL ANALYSIS, FOOTINGS, STRESSES, SETTLEMENT (STRUCTURAL), STRUCTURAL CHANGES, LOADS (FORCES), SNOW COVER STABILITY, STATIONS, SITE SURVEYS, GREENLAND—DYE 2

DYE-2, a Distant Early Warning station, is located on the Greenland ice cap approximately along the Arctic Circle, 470 km from the west coast. The viscous nature of the material on which the structure is grounded made periodic monitoring and maintenance of the supporting structure necessary. This report analyzes the stresses developed within the structure from the last major maintenance operation, a 64 m sideways move in 1982 to a new foundation, to the final set of stress measurements taken at the abandoned site in 1988. Conclusions drawn from these measurements and the subsequent analysis were that the building system was continuing to tilt in one direction because of differential footing settlement caused by changing footing conditions, and high structural stresses would make it unsafe for reoccupation after Dec. 1988 unless emergency maintenance was performed. The U.S. Air Force officially abandoned the site in Aug. 1988 as a result of this analysis.

CR 98-04

FROST-SHIELDING METHODOLOGY AND DEMONSTRATION FOR SHALLOW BURIAL OF WATER AND SEWER UTILITY LINES.

Coutermarsh, B.A., Carbee, D.L., June 1998, 18p., ADA-350 992, 8 refs.

52-6758

UTILITIES, SEWAGE DISPOSAL, WATER PIPELINES, UNDERGROUND PIPELINES, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND TEMPERATURE, FROST PENETRATION, FROST PROTECTION, THERMAL INSULATION, COMPUTERIZED SIMULATION

Burying utility lines below the maximum frost penetration depth can be expensive when difficult digging conditions are encountered or where existing obstacles make the desired depth expensive to achieve. Protecting the pipeline from freezing by adding an insulation shield would allow a shallow burial option. This can reduce excavation costs or avoid the relocation costs of moving the pipeline to an unobstructed location. A finite-element program was developed to model various subterranean heat-flow situations. It was used to design frost shields for a water line in northern New Hampshire through a 4-year Construction Productivity Advancement Research project with the City of Berlin Water Works, the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), and the Owens-Corning Specialty and Foam Products Division as partners.

CR 98-05

DREDGING AS REMEDIATION FOR WHITE PHOSPHORUS CONTAMINATION AT EAGLE RIVER FLATS, ALASKA.

Walsh, M.R., Collins, C.M., Aug. 1998, 32p., ADA-354 017, 20 refs.

53-1809

DREDGING, SEDIMENTS, ATTENUATION, LAND RECLAMATION, MILITARY OPERATION, MILITARY FACILITIES, SWAMPS, EXPLOSIVES, ESTUARIES, GRAIN SIZE, WATER POLLUTION, SOIL POLLUTION, UNITED STATES—ALASKA—FORT RICHARDSON, UNITED STATES—ALASKA—EAGLE RIVER FLATS

The Eagle River Flats impact area is a Ft. Richardson Superfund site. It is a salt marsh that is contaminated with white phosphorus, and remediation of sediments in permanently ponded areas may require dredging. A remotely piloted dredging system was designed, constructed, and deployed at the Flats as part of the overall site remediation feasibility study. Experience gained over two years of engineering study and contract operation indicates that, although feasible and effective, this alternative is slow, difficult and very expensive.

CR 98-06

GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF THE HYDROGEOLOGY OF FORT WAINWRIGHT, ALASKA. PART II: NORTH-CENTRAL CANTONMENT AREA.

Lawson, D.E., et al, Aug. 1998, 66p., ADA-355 283, 23 refs. For part I see 51-512.

53-1812

HYDROGEOLOGY, GROUND WATER, DISCONTINUOUS PERMAFROST, SEEPAGE, RADIO ECHO SOUNDINGS, PERMAFROST DISTRIBUTION, UNITED STATES—ALASKA—FORT WAINWRIGHT, UNITED STATES—ALASKA—CHENA RIVER

Ongoing investigations of the permafrost and ground water conditions in the north-central area of the Fort Wainwright, AK, cantonment, north of the Chena River, show the hydrogeology of the site to be extremely complex. Permafrost, being impermeable and discontinuous, controls the distribution and dimensions of ground water aquifers to a great degree. Aquifers are above, below, and adjacent to permafrost, and in some locations are within unfrozen zones surrounded by it. This complexity makes it difficult to predict the direction and velocity of ground water flow, as well as its seasonal and annual variability. Data have been obtained from ground-penetrating radar surveys, borehole logs, and ground water instruments. They have then been combined with interpretations of aerial photographs and ground observations to delineate the permafrost and aquifer distribution. They have also been used to develop conceptual hydrogeological models of the area. This information is necessary to remediate ground water contamination, while furthering the basic understanding of aquifer distribution and ground water flow in discontinuous permafrost terrain.

CR 98-07

INVESTIGATIONS OF PLASTIC COMPOSITE MATERIALS FOR HIGHWAY SAFETY STRUCTURES.

Dutta, P.K., Aug. 1998, 73p., ADA-353 418, Refs. p.58-61.

53-1813

COMPOSITE MATERIALS, POLYMERS, SAFETY, COLD WEATHER PERFORMANCE, STRUCTURES, CONSTRUCTION MATERIALS, COMPRESSIVE PROPERTIES, STRESS STRAIN DIAGRAMS, TENSILE PROPERTIES, CREEP, HIGHWAY PLANNING, ROAD MAINTENANCE

This report presents a basic overview and assessment of different concepts and technologies of using polymer composites in structures generally used for highway safety. The structural systems included a

highway barrier guardrail with its posts and blockouts, sign posts, concrete reinforcing rebars, breakaway couplers, and crushable plastic cushions to protect errant drivers from roadside sign and utility posts, and small trees. The composites included fiber reinforced plastics (FRP) in laminated and bar forms, and commercially available recycled and reconstituted structural plastic composites. Commercially available FRP composites, recycled plastic composites, and several conceptual designs and prototype components were assessed and tested. The results showed many potential advantages of using composites in almost all the structures considered, but one-to-one replacement of conventional materials was not always found attractive. For deriving maximum benefits from fiber composites, the basic performance of the given structures should be reassessed and then composites should be designed at the materials level using innovative fiber architecture and appropriate manufacturing technologies that can meet those performance requirements.

CR 98-08
REMEDIATION OF WASTEWATER BY LAND TREATMENT: CONSIDERATION OF SOIL TEMPERATURES IN WINTER.
Peck, L., Aug. 1998, 18p., ADA-353 412, 23 refs.
53-1814
SOIL MICROBIOLOGY, CRYOBIOLOGY, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, FROZEN GROUND TEMPERATURE, TEMPERATURE MEASUREMENT, POROSITY, SOIL WATER, FROST PENETRATION, HEAT TRANSFER, WASTE TREATMENT, WATER TREATMENT, COLD WEATHER OPERATION, LAND RECLAMATION
The impact of the winter environment on land treatment of wastewater has been investigated in terms of predicted winter-long soil temperature histories and depths of frost penetration that were obtained from numerical modeling of heat transfer and phase change in sandy soil. Severity of the winter, soil porosity, and soil moisture content are varied to determine the depth-dependent changes in soil temperature that result. The impact of wintertime soil temperatures on nitrification and denitrification is presented in terms of thickness and persistence of a soil layer cold enough to severely inhibit microbial activity. The model WASTEN is used to predict concentrations of ammonium and nitrate in soil at the end of a remediation cycle. Rates of nitrification and denitrification are varied to be consistent with decreasing microbial activity as soil cools. Depending on soil temperature and thickness of the cold soil layer, peak concentrations of ammonium and nitrate remaining in the soil can be as much as 40-100% greater than under warm soil conditions.

CR 98-09
ACCOUNTING FOR CLOUDS IN SEA ICE MODELS.
Makshtas, A.P., Andreas, E.L., Sviashchennikov, P.N., Timachev, V.F., Dec. 1998, 32p., ADA-358 288, 51 refs.
53-2445
CLOUD COVER, RADIATION BALANCE, SEA ICE, ICE MODELS, MATHEMATICAL MODELS, DRIFT STATIONS, AIR TEMPERATURE, HEAT FLUX, ICE COVER THICKNESS, ICE AIR INTERFACE, ARCTIC BASIN, ANTARCTICA—WEDDELL SEA
Over sea ice in winter, the clouds, the surface-layer air temperature, and the longwave radiation are closely coupled. This report uses archived data from the Russian North Pole (NP) drifting stations and recent data from Ice Station Weddell (ISW) to investigate this coupling. Both arctic and antarctic distributions of total cloud amount are U-shaped: that is, observed cloud amounts are typically either 0-2 tenths or 8-10 tenths in the polar regions. These data obey beta distributions; roughly 70 station-years of observations from the NP stations yielded fitting parameters for each winter month. Although surface-layer air temperature and total cloud amount are correlated, it is not straightforward to predict one from the other, because temperature is normally distributed while cloud amount has a U-shaped distribution. Nevertheless, the report presents a statistical algorithm that can predict total cloud amount in winter from surface-layer temperature alone and, as required, produces a distribution of cloud amounts that is U-shaped. Because sea ice models usually need cloud data to estimate incoming longwave radiation, this algorithm may be useful for estimating cloud amounts and, thus, for computing the surface heat budget where no visual cloud observations are available but temperature is measured—from the arctic buoy network or from automatic weather stations, for example. The incoming longwave radiation in sea ice models is generally highly parameterized. The report evaluates five common parameterizations using data from NP-25 and ISW. The formula for estimating incoming longwave radiation that König-Langlo and Augstein developed using both arctic and antarctic data has the best properties but does depend nonlinearly on total cloud amount. This nonlinearity is crucial since cloud distributions are U-shaped, while common sources of cloud data tabulate only mean monthly values. The report therefore closes by using a one-dimensional sea ice model to investigate how methods of averaging cloud amounts affect predicted sea ice thickness in the context of the five longwave radiation parameterizations.

CR 99-01
CRREL SOUTH POLE TUNNELING SYSTEM.
Walsh, M.R., Jan. 1999, 22p., ADA-362 137, 12 refs.
53-3685
TUNNELING (EXCAVATION), SNOW TUNNELS, DESIGN, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, EQUIPMENT, MACHINERY, COLD WEATHER TESTS, ANTARCTICA—AMUNDSEN-SCOTT STATION
Facilities operations in a polar ice cap environment present many challenges. Coping with the extreme cold temperatures, associated wind chills, darkness during the long winter months, and blowing and drifting snow all hamper installation, maintenance and repair. For over 40 years, the concept of using tunnels for utilities and personnel has been tried with mixed results. In 1991, the U.S. Army Cold Regions Research and Engineering Laboratory initiated a project to design, develop, fabricate, test, build, and deploy a system for the machining of unlined tunnels at the Amundsen-Scott South Pole Station. The tunneling system as configured during the Jan. 1996 deployment was capable of operating at a maximum sustained production rate (>4 hr) of 1.5 m/hr for a 2x3x16-m tunnel. The maximum operating depth was approximately 16 m from surface to the tunnel floor. The maximum length tunneled during one shift was 13 m, and the maximum one-day progress was 21.3 m. The system is described in this report, along with suggestions to improve the current technology.

CR 99-02
CRREL ICE JAM DATABASE.
White, K.D., Eames, H.J., Feb. 1999, 17p., ADA-362 147, 38 refs.
53-3683
ICE JAMS, FLOODING, RIVER ICE, DATA PROCESSING, HISTORY, UNITED STATES
This report provides information on the CRREL Ice Jam Database and its potential use for analyzing ice-related flooding problems. Rivers in the northern United States are subject to ice jams that cause flooding; block hydropower and water supply intakes; delay or stop navigation; damage riverine structures such as locks, dams, bridges, dikes, levees, and wingwalls; and decrease downstream discharge. The lack of readily available information on historical ice events hinders rapid, effective response to ice jam flooding and other ice-related damage. The CRREL Ice Jam Database was developed to provide a centralized record of ice events.

CR 99-03
RAPID STABILIZATION OF THAWING SOILS FOR ENHANCED VEHICLE MOBILITY: A FIELD DEMONSTRATION PROJECT.
Kestler, M.A., Shoop, S.A., Henry, K.S., Stark, J.A., Affleck, R.T., Feb. 1999, 73p., ADA-364 193, 20 refs.
53-5216
SOIL STABILIZATION, GROUND THAWING, MILITARY OPERATION, ROADS, TRAFFICABILITY, GEOTEXTILES, SOIL TRAFFICABILITY, TIRES, VEHICLES
Thawing soil presents a formidable challenge for vehicle operations cross-country and on unsurfaced roads. To mitigate the problem, a variety of stabilization techniques were evaluated for their suitability for rapid employment to enhance military vehicle operations. A combination of mechanical stabilization methods including several lightweight fills, geosynthetics, and tire and wood mats, were constructed and tested during the annual training exercises of the 229th Engineers of the Wisconsin National Guard during the difficult conditions of spring thaw. The techniques were evaluated for their expediency, ease of construction, trafficability, and durability. In general, chunkwood was an excellent replacement for gravel fill in forested area; tree slash (or other vegetation) was effective but labor intensive; wood mats and pallets were effective and reasonably durable; tire mats were extremely rugged and effective. A loader or crane was needed to place the large wood mats, tire mats, and fascines. Geocomposite materials (Geonet) were quickly installed and could withstand limited traffic (50 passes) without additional cover material. Geosynthetics reduced the amount of cover material and enhanced placement, effectiveness and removal when used under other materials to spread the load and keep them from sinking into the mud. All materials were damaged during the severe motion of a tank cornering except the large, smooth wood mats, but these were slippery on slopes. Results are summarized in a decision matrix for choosing the best technique depending on site conditions, material and equipment availability and utilization criteria.

CR 99-04
INVESTIGATION OF THE ROOSEVELT ROAD TRANSMITTER SITE, FORT RICHARDSON, ALASKA, USING GROUND-PENETRATING RADAR.
Hunter, L.E., Delaney, A.J., Lawson, D.E., Mar. 1999, 16p., ADA-364 131, 10 refs.
53-5217
GEOPHYSICAL SURVEYS, MAPPING, RADAR ECHOES, UNITED STATES—ALASKA—FORT RICHARDSON
The Roosevelt Road Transmitter Site is the location of a decommissioned bunker on Fort Richardson, near Anchorage, AK. The site was used from World War II to the Korean War as part of an Alaskan communications network. The bunker and support buildings were vandalized following its decommissioning in the mid-1960s, resulting in PCB contamination of the bunker and soils around the above-ground transmitter annex. CRREL conducted a ground-penetrating radar (GPR) investigation of the site in June 1996, at the request of the Directorate of Public Works on Fort Richardson. Nine transect lines were established, each being profiled with 100- and 400-MHz antennas. Both antennas systems defined the extent of the bunker and identified the presence of buried utilidors. The 100-MHz antenna provided large-scale resolution of the bunker, limits of site excavation, and large stratigraphic horizons in the undisturbed sediments. The 400-MHz antenna provided finer resolution that allowed identification of steel reinforcement in the bunker ceiling, utilidor walls and floor, and the walls of the inner and outer bunker. High amplitude resonance and hyperbolas in the record characterize the response from the Transmitter Annex foundation, buried pipes, and utilities. The GPR survey shows its utility for detecting the extent of abandoned underground structures and identifying the extent of original ground excavations.

CR 99-05
EXISTENCE OF TRAVELING WAVE SOLUTIONS TO THE PROBLEM OF SOIL FREEZING DESCRIBED BY A MODEL CALLED M_1.
Nakano, Y., Apr. 1999, 33p., ADA-365 516, 47 refs.
53-5218
SOIL FREEZING, MATHEMATICAL MODELS, FROST HEAVE, SOIL WATER MIGRATION
The scientific study of soil freezing began in the early 1900s and an accurate mathematical description of the freezing process has been sought for nearly 80 years. Despite numerous publications on the subject, there is as yet no clear consensus on the mathematical model of soil freezing. In this report a mathematical model called M_1 is presented. The existence of traveling wave solutions to the problem is shown. For a given fine-grained soil, such solutions are shown to exhibit three distinct behaviors depending on given thermal and hydraulic conditions. When a frost front (0°C isotherm) advances, water is either attracted to the front or expelled from it. Under certain conditions an ice layer containing hardly any soil particles grows. The report describes how the traveling wave solutions have been used for the empirical verification of M_1.

CR 99-06
ICE JAMS IN RIVER CONFLUENCES.
Ettema, R., Muste, M., Kruger, A., May 1999, 61p., ADA-365 480, 43 refs.
53-5219
ICE JAMS, RIVER ICE, ICE MODELS, HYDRAULICS, RIVER FLOW, GROUNDED ICE, ICE COVER, UNITED STATES—MISSISSIPPI RIVER, UNITED STATES—MISSOURI RIVER
Two laboratory models of confluences are corroborated with observations interpreted from field observations of ice jams in the vicinity of confluences. One model was used to identify the processes whereby ice can jam in confluences and to determine how selected parameters (e.g., confluence angle) influence them. The confluences of primary interest were those formed by channels whose beds are at about the same level. The second model was used to examine ice jam formation in the confluence of the Mississippi and Missouri Rivers. Three relatively complex processes were found to lead to ice jams: the merging of ice runs, hydrodynamic pressure from a confluent flow impacting an ice run from the second confluent channel, and ice congestion at a confluence bar. The latter process is a significant factor triggering ice jams at the confluence of the Mississippi and Missouri Rivers. Also, three simple processes account for many ice jams at river confluences: ice blocked by an ice cover in the confluence, large ice pieces arching at the confluence, and ice entering a region of sluggish flow. The main practical contributions of the study are formulations for estimating the maximum rate of ice conveyance through channel confluences, and the confirmation of the efficacy of a series of bendway weirs to mitigate ice jam formation at the confluence of the Mississippi and Missouri Rivers. The bendway weirs have additional benefits, such as greatly reducing the amount of ice accumulating in the approach to the Chain-of-Rocks Canal, which is located at the confluence exit.

CR 99-07
TWO-DIMENSIONAL ANALYSIS OF NATURAL CONVECTION AND RADIATION IN UTILIDORS.
Richmond, P.W., June 1999, 67p., ADA-365 668, Refs. p.50-52.
54-446
UTILITIES, HEATING, CONVECTION, RADIATION, HEAT TRANSFER, MATHEMATICAL MODELS, THERMAL CONDUCTIVITY, HEAT FLUX, INSULATION, THERMOCOUPLES, DESIGN
Central heating plants are often used on large building complexes such as university campuses or military bases. Utilidors can be used to contain heat distribution lines and other utilities between a utility station and serviced buildings. Traditional thermal analysis of utilidors is one-dimensional, with heat transfer correlations used to estimate the effects of convection, radiation, and two-dimensional geometric effects. The expanding capabilities of computers and numerical methods suggest that more detailed analysis and possibly more energy-efficient designs could be obtained. This work examines current methods of estimating the convection and radiation that occur across an air space in square and rectangular enclosures and compares them with numerical and experimental data.

CR 99-08
SYNOPSIS AND COMPARISON OF SELECTED SNOWMELT ALGORITHMS.
Melloh, R.A., July 1999, 17p., ADA-366 395, 49 refs.
54-440
SNOWMELT, RUNOFF, HYDROLOGY, SURFACE ENERGY,

WATERSHEDS, MATHEMATICAL MODELS, MELTWATER, SNOW PERMEABILITY, SNOW DEPTH, POROSITY, COMPUTER PROGRAMS

One-dimensional snowpack algorithms in major operational snowmelt models used in the United States (HEC-1, SSARR, NWSRFS, SRM and PRMS) are reviewed and contrasted with two U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) algorithms (SNTHERM and SNAP) that are candidates for use in distributed operational models. In contrast to current operational models, the CRREL algorithms provide more detail in snowpack processes and require no calibration. The CRREL algorithms also include a full surface energy balance that requires more meteorological data than most operational models. Simpler surface energy balances could be used with the CRREL models. In future modeling systems, it would be preferable for the surface energy balance algorithms to be made independent of the internal snowpack process algorithms, so that available meteorological data can be used to drive a snowpack model of choice. Improvements are needed in the way that forest canopies and other groundcovers are accounted for in the surface energy balances of the CRREL models.

CR 99-09

ECOLOGICAL LAND SURVEY FOR FORT WAINWRIGHT, ALASKA.

Jorgenson, M.T., et al, Sep. 1999, 83p., ADA-368 158, Refs. p.62-66.

54-445

ECOSYSTEMS, MAPPING, SURVEYS, GEOMORPHOLOGY, HYDROLOGY, VEGETATION PATTERNS, CLASSIFICATIONS, PERMAFROST DISTRIBUTION, SOIL MAPPING, TOPOGRAPHIC MAPS, SOIL SURVEYS, TOPOGRAPHIC SURVEYS, NATURAL RESOURCES, UNITED STATES—ALASKA—FORT WAINWRIGHT

An ecological land survey (ELS) of Fort Wainwright land was conducted to map ecosystems at three spatial scales to aid in the management of natural resources. In an ELS, an attempt is made to view landscapes not just as aggregations of separate biological and earth resources, but as ecological systems with functionally related parts that can provide a consistent conceptual framework for ecological applications. Field surveys at 109 sites along 11 toposequences, and at an additional 131 ground-reference locations, were used to identify relationships among physiography, geomorphology, hydrology, permafrost and vegetation. The association among ecosystem components also revealed effects of fire and geomorphic processes, such as groundwater discharge, floodplain development, permafrost degradation and paludification. Ecosystems were mapped at three spatial scales. Ecotypes (1:50,000 scale), delineated areas with homogeneous topography, terrain, soil, surface-form, hydrology and vegetation. Ecosections (1:100,000 scale) are homogeneous with respect to geomorphic features and water regime and, thus, have recurring patterns of soils and vegetation. Ecodistricts (1:500,000) are broader areas with similar geology, geomorphology and physiography. Development of the spatial database within a geographic information system will facilitate numerous management objectives such as wetland protection, integrated-training-area management, permafrost protection, wildlife management, and recreational area management.

CR 99-10

ENHANCED NATURAL REMEDIATION OF WHITE-PHOSPHORUS-CONTAMINATED WETLANDS THROUGH CONTROLLED POND DRAINING.

Walsh, M.R., Walsh, M.E., Collins, C.M., Nov. 1999, 24p., 31 refs.

54-618

MILITARY OPERATION, ENVIRONMENTAL IMPACT, WATER POLLUTION, PUMPS, LAND RECLAMATION, PONDS, WETLANDS, UNITED STATES—ALASKA—EAGLE RIVER FLATS

Detonation of projectiles containing white phosphorus, a smoke-producing munition, contaminated Eagle River Flats (ERF), a salt marsh located on Fort Richardson, AK. Ingestion of the highly toxic white phosphorus residues by dabbling ducks and swans resulted in significant waterfowl mortality, leading to the suspension of Army training with white phosphorus in wetlands and designation of ERF as a Superfund site. The permanent ponds at ERF are ideal for long-term storage of the millimeter-size particles of white phosphorus ejected from detonated mortar and howitzer shells. With the goal of reducing waterfowl mortality, several treatment methods have been tested, the most promising of which is in-situ remediation by temporary removal of water from permanent ponds. A developmental semiautonomous pumping system was fielded in 1997. Methods for fielding, placement, and operation of several pumping systems were developed and demonstrated in 1998. The controls were refined to optimize operations, and features added to reduce fuel consumption. Performance has continued to be refined, and results from the first two years of remediation indicate that the remediation method is highly effective.

SPECIAL REPORTS

SR 43/9

ICE THICKNESS OBSERVATIONS: NORTH AMERICAN ARCTIC AND SUBARCTIC, 1974-75, 1975-76 AND 1976-77.

Bilello, M.A., Lunardini, V.J., May 1996, 221p., ADA-310 887, 7 refs. For earlier data (from 1958 through 1974) see 24-3436, 26-2299, 27-674, 30-126 and 46-4002.

51-515

SEA ICE, LAKE ICE, RIVER ICE, ICE COVER THICKNESS, ICE CONDITIONS, ICE BREAKUP, ICE FORMATION, FREEZEUP, ICE REPORTING, SNOW DEPTH, SUBARCTIC LANDSCAPES, CANADA, UNITED STATES—ALASKA

This is the ninth in a series of reports on lake and river ice and landfast sea ice. It presents ice thickness measurements taken throughout the North American arctic and subarctic during the 1974-75, 1975-76 and 1976-77 winter seasons. Information on surface ice conditions, dates of first ice, freeze-over, breakup and observed maximum ice thicknesses are also included.

SR 94-32

CREEP AND STRENGTH OF FROZEN SOIL UNDER TRIAXIAL COMPRESSION.

Fish, A.M., Dec. 1994, 13p., ADA-302 885, 49 refs.

51-5227

FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, SOIL CREEP, ICE STRENGTH, ICE DEFORMATION, SOIL TESTS, STRAIN TESTS, STRESS STRAIN DIAGRAMS, ULTIMATE STRENGTH, RHEOLOGY, MATHEMATICAL MODELS

A combined creep and strength model has been developed for the entire (primary, secondary and tertiary) creep and the long-term strength of frozen soil under multiaxial stress at both constant stresses and constant strain rates by a single (unified) constitutive equation. Secondary creep is assumed to be an inflection point of a creep curve defining time to failure. Secondary creep rate is described by a new flow law, the stress function of which includes the first invariant of the stress tensor. The model consists of four principal elements: a constitutive equation, a viscous flow equation and a yield criterion, all united by a time-to-failure function. The yield criterion is selected either in the form of a parabolic (extended) von Mises-Drucker-Prager model or a parabolic (extended) Mohr-Coulomb rupture model. The criteria take into account that, at a certain magnitude of the mean normal stress (σ_{max}), the shear strength of frozen soil reaches a maximum. The yield criteria are included in the time-to-failure function, the shape parameters of which are independent of the loading regime. The model has been verified using test data on creep and the long-term strength of frozen soil under triaxial compression at -10°C.

SR 96-10

ON-SITE ANALYSIS FOR HIGH CONCENTRATIONS OF EXPLOSIVES IN SOIL: EXTRACTION KINETICS AND DILUTION PROCEDURES.

Jenkins, T.F., Schumacher, P.W., Mason, J.G., Thorne, P.G., May 1996, 12p., ADA-313 704, 19 refs.

51-534

EXPLOSIVES, SOIL POLLUTION, SOIL ANALYSIS, MILITARY OPERATION

Soils containing high concentrations (>10%) of secondary explosives might detonate from shock or flame, resulting in human injuries or equipment damage during remediation activities. In lieu of expensive and time-consuming protocols involving impact tests, friction tests, and shock gap tests, compositional analysis has been recommended as an expedient method to assess the risk of detonation from heavily contaminated soils. A number of methods now available allow determination of TNT and RDX on site. All of these methods specify solvent extraction with either acetone or methanol to transfer the analyte from the soil matrix to a solvent as the first step in the determination. The rate of extraction of TNT and RDX, when present at percent levels in soil, has not been determined. Protocols currently in use specify very short extraction times (one to three minutes) and results could be biased low if extraction kinetics are slow. The objective of this work was to document the rate of extraction of secondary explosives by acetone and methanol and make recommendations for possible modification of current protocols if warranted. Because solvent extracts from highly contaminated soils will have very high concentrations of secondary explosives, compared with the range of concentrations that can be determined using the various on-site methods, large dilutions will be required. Recommendations are made for a field-expedient method making appropriate dilutions.

SR 96-11

EVALUATING THE SESOIL MODEL FOR BENZENE LEACHING ASSESSMENT IN ALASKA.

Brar, G.S., May 1996, 11p., ADA-311 199, 34 refs.

51-535

MODELS, SIMULATION, SOIL MECHANICS, ACCURACY, ADSORPTION, PERMEABILITY, POROSITY, SOIL POLLUTION, GROUND WATER, SOIL WATER, DEGRADATION, UNITED STATES—ALASKA

SESOIL is a seasonal soil compartment model. A one-dimensional vertical transport model is designed to predict seasonal solute distribution in the soil profile and watershed. CRREL received a request from the U.S. Army Engineer District, Alaska, Environmental Technical Engineering Office, to provide technical assistance in evaluating the SESOIL model for helping to assess benzene leaching in the Alaskan environment. The major tasks outlined in the request were as follows: work an example problem for a diesel-contaminated site, do analytical checks and do manual SESOIL analytical calculations for one cycle. The SESOIL model requires 57 input variables supplied by the user. An additional 8 parameters are required for the execution file. This study did sensitivity analyses on soil bulk density, intrinsic permeability, disconnectedness index, porosity, organic carbon, adsorption coefficient on organic carbon, and biodegradation rates of solid and liquid phases. The model is very sensitive to all the parameters studied. Despite its several difficulties, the model is popular among regulators and users because of its simplicity compared to research models. It can be used as a screening-level tool in assessing chemical movement in the soil column with considerable site-specific calibrations.

SR 96-12

PCC AIRFIELD PAVEMENT RESPONSE DURING THAW-WEAKENING PERIODS: A FIELD STUDY.

Janoo, V.C., Berg, R.L., May 1996, 38p., ADA-310 423, 13 refs.

51-536

AIRPORTS, PAVEMENTS, CONCRETE PAVEMENTS, COLD WEATHER PERFORMANCE, THAW WEAKENING, THERMOCOUPLES, SURFACE TEMPERATURE, SUBGRADES, LOADS (FORCES), UNITED STATES—ALASKA

This investigation is part of CRREL's on-going characterization of pavement performance in seasonal frost areas. As part of the research, CRREL conducted several field studies for the Federal Aviation Administration (FAA) on the response of airport pavements during thaw-weakening periods at three civil airports in Wisconsin where the design freezing index in the area was around 900 to 1100°C-days and frost penetration ranged between 1250 and 2000 mm. This study focused on the performance of Portland Cement Concrete (PCC) pavements during the spring thaw-weakening period. The sites were instrumented with subsurface thermocouples and Falling Weight Deflectometer (FWD) tests were conducted during the spring thaw period at the center of the slab and across the joints. An analysis of the FWD data and backcalculation of the layer moduli using ILLIBACK and WESDEF was conducted. Unique relationships between the FWD deflections and the subgrade modulus and coefficient of subgrade reaction were obtained. Additional relationships were developed using the FWD deflections, PCC thickness and the horizontal tensile stress at the bottom of the PCC layer. A relationship between load transfer across joints and FWD deflections was also developed. On the basis of the relationships obtained in this study, a methodology for evaluating PCC pavements during spring thaw was developed. However, this methodology needs to be verified for other subgrade types and areas with other design freezing indices.

SR 96-13

SOIL PHYSICAL ENVIRONMENT AND ROOT GROWTH IN NORTHERN CLIMATES.

Brar, G.S., Reynolds, C.M., May 1996, 23p., ADA-311 060, Refs. p.17-23.

51-537

ROOTS, PLANT PHYSIOLOGY, PLANTS (BOTANY), MODELS, MATHEMATICAL MODELS, ARCTIC LANDSCAPES, SOIL TEMPERATURE, SOIL WATER

Understanding the growth and function of plant roots in cold climates is critical, but examination of root systems to elucidate their link to production is expensive and labor-intensive. Limited information is available on the root growth and functions of plants grown in northern climates. The objective is to present an overview of the influence of physical edaphic factors on plant root systems with special emphasis on models that are available for simulating root growth. This report summarizes the impact of the soil physical environment (soil water, soil temperature, soil air, physical impedance, and spatial variability) on root uptake and growth. Roots grow because new cells are formed in the meristematic tissue near the root tip, and these newly formed cells increase in volume, pushing the root tip forward if growth conditions are satisfactory. Rapid elongation of primary roots, combined with well-developed secondary roots, allows the plants to exploit moisture and nutrients from a greater soil volume. Root and shoots are strongly interdependent. The roots receive photosynthates and growth hormones from shoots and in return furnish water and nutrients to the shoots. Several root growth models have been developed during the past decade; however, none addresses the problems associated with cold regions. The models reported in the literature can be classified as 1) simple models, 2) carbon partition models, 3) growing degree day-based models, 4) soil parameter-based models, and 5) arctic plant growth models.

SR 96-14

ESTABLISHING A RELATIONSHIP BETWEEN PASSIVE SOIL VAPOR AND GRAB SAMPLE TECHNIQUES FOR DETERMINING VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., Sep. 1996, 9p., ADA-318 014, 17 refs.

51-2050

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS

A passive soil vapor and an in-vial sample handling and analysis method were compared for estimating volatile organic compound (VOC) contamination in the near-surface vadose zone. These two methods of VOC site characterization, although very different operationally, established very similar trends for trichloroethylene (TCE) contamination. The correlation (r^2=0.944) of the results from these two methods shows a much better agreement than what has been reported between comparisons of in-vial methods (or solvent immersion) and conventional soil sample collection and handling methods often used for site characterization activities. The strong correlation between these two methods and from grab samples taken 15 cm apart indicates that this analyte is homogeneously distributed as compared to metals and semivolatile organic compounds. For contaminants such as TCE, soil vapor measurement technologies offer a promising means of estimating subsurface concentrations in locations where grab samples cannot be easily obtained.

SR 96-15

ASSESSMENT OF SAMPLING ERROR ASSOCIATED WITH COLLECTION AND ANALYSIS OF SOIL SAMPLES AT EXPLOSIVES-CONTAMINATED SITES.

Jenkins, T.F., Grant, C.L., Brar, G.S., Thorne, P.G., Ranney, T.A., Schumacher, P.W., Sep. 1996, 38p., ADA-318 015, 26 refs.

51-2049

SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, SOIL TESTS, EXPLOSIVES, WASTE DISPOSAL, STATISTICAL ANALYSIS

This study is an assessment of short-range heterogeneity in contaminant concentrations within surface soils at explosives-contaminated sites. Intensive sampling was conducted over short distances. Discrete and composite samples were analyzed by both on-site colorimetric methods and standard laboratory protocols. To improve the quality of site characterization data, emphasis should be placed on reducing sampling error by the use of composite sampling strategies. Characterization of explosives-contaminated sites using composite sampling, in-field sample homogenization, and on-site analysis is an efficient method of producing data that are accurate and precise, and also representative of the area.

SR 96-16

DEVELOPMENT OF AN ANALYTICAL METHOD FOR WHITE PHOSPHORUS (P_4) IN WATER AND SEDIMENT USING SOLID-PHASE MICROEXTRACTION.

Walsh, M.E., Taylor, S., Thorne, P.G., Aug. 1996, 12p., ADA-317 623, 32 refs.

51-2048

WATER POLLUTION, SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, WATER CHEMISTRY, EXPLOSIVES, CHEMICAL ANALYSIS

Headspace solid-phase microextraction (SPME) methods were developed for white phosphorus in water and sediment/soil to minimize waste generated by methods based on solvent extraction. Headspace SPME provided a rapid, non-exhaustive extraction, based on equilibrium, of white phosphorus. Comparison of results obtained by headspace SPME and solvent extraction shows that headspace SPME may be used quantitatively for some water matrices and qualitatively for more complex matrices such as sediment/soil. Because detection limits appear to be similar to those obtained by solvent extraction, headspace SPME can be used to rapidly screen samples for contamination, eliminating the need to solvent-extract most samples.

SR 96-17

EFFECTS OF ICE BOOM GEOMETRY ON ICE CAPTURE EFFICIENCY.

Gooch, G., Sep. 1996, 9p., ADA-318 968, 10 refs.

51-2646

ICE BOOMS, ICE JAMS, DESIGN, DESIGN CRITERIA, ICE COVER, RIVER ICE, ICE FORMATION

An ice boom's geometry is critical to the collection and retention of ice in small, fast-moving streams and rivers. Ice booms are designed to quickly form a solid ice cover much earlier than the ice cover would form naturally. Once formed, the ice cover insulates the river, eliminating the production of frazil ice locally. Frazil leads to thick ice deposits, which reduce the river's available flow area and contribute to midwinter and spring flooding. Model experiments, conducted at the Ice Engineering Facility at the Cold Regions Research and Engineering Laboratory, have varied the ice boom geometry to speed up the process of ice cover formation. Model simulations have used floating plastic beads to simulate real ice particles to determine what ice boom design works best. Under controlled laboratory conditions, boom geometry clearly affects the boom's ability to capture more beads. Comparison of field and laboratory tests indicates similar results.

SR 96-18

METHOD FOR PRODUCING PERFORMANCE EVALUATION SOIL/SEDIMENT SAMPLES FOR WHITE PHOSPHOROUS ANALYSIS.

Walsh, M.E., Sep. 1996, 12p., ADA-318 509, 13 refs.

51-2047

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, EXPLOSIVES, CHEMICAL ANALYSIS

The analysis of performance evaluation samples is a routine part of most quality assurance programs. However, performance evaluation samples are not commercially available for many contaminants. This report describes the development of performance evaluation samples for white phosphorus (P_4) analysis. To represent the wide range of concentrations that have been measured in field-contaminated sediment/soil samples, two types of performance evaluation samples were prepared. High concentration samples contained particulate white phosphorus in wet soil, and concentrations were stable for over 100 days. Low concentration soil samples containing white phosphorus dissolved in water or organic solvent were unstable. When silt-size glass beads were substituted for the soil, and a solution of white phosphorus in mineral oil added, concentrations were stable for over two months.

SR 96-19

RESILIENT MODULUS TESTING OF MATERIALS FROM MN/ROAD, PHASE 1.

Berg, R.L., Bigl, S.R., Stark, J.A., Durell, G.D., Sep. 1996, 93p., ADA-321 627, 9 refs.

51-2965

SUBGRADES, PAVEMENT BASES, COLD WEATHER TESTS, FREEZE THAW TESTS

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) conducted resilient modulus tests on materials from the Mn/ROAD test site for the Minnesota Department of Transportation. Materials tested included samples of the lean clay subgrade at the site and the two extreme grades of base designed specifically for Mn/ROAD. Some specimens were tested in both frozen and subsequently "thawed" conditions; others were tested at room temperature without ever having been frozen. Researchers performed linear regression analysis on the data to develop equations that predict frozen modulus based on unfrozen water content and unfrozen modulus based on stress, degree of saturation and density. The authors also reanalyzed data from two previously tested materials. CRREL can use the study's equations in the Mechanistic Pavement Design and Evaluation Procedure under development at CRREL to predict estimated damage in some Mn/ROAD test sections.

SR 96-20

TESTING OF MATERIALS FROM THE MINNESOTA COLD REGIONS PAVEMENT RESEARCH TEST FACILITY.

Bigl, S.R., Berg, R.L., Sep. 1996, 37p., ADA-319 640, 17 refs.

51-2647

PAVEMENTS, DESIGN, DESIGN CRITERIA, COLD WEATHER TESTS, COMPACTION, GRAIN SIZE, HYDRAULICS, UNFROZEN WATER CONTENT, FROST RESISTANCE, SUBGRADES, FROST PENETRATION

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) conducted various laboratory tests on pavement materials from the Mn/ROAD facility. The tests helped to characterize the behavior of materials under season frost conditions, and to provide input necessary for modeling the materials with the Mechanistic Pavement Design and Evaluation Procedure under development at CRREL. This report describes test results that define the physical characteristics, such as grain size, specific gravity, Atterberg limits, organic content, and compaction, as well as hydraulic properties, such as moisture retention and hydraulic conductivity, frost susceptibility, and unfrozen moisture content of two subgrade samples and two base materials from Mn/ROAD.

SR 96-21

MODELING OF MN/ROAD TEST SECTIONS WITH THE CRREL MECHANISTIC PAVEMENT DESIGN PROCEDURE.

Bigl, S.R., Berg, R.L., Sep. 1996, 42p., ADA-319 596, 25 refs.

51-2648

PAVEMENTS, DESIGN, DESIGN CRITERIA, COLD WEATHER PERFORMANCE, BITUMENS, FROST RESISTANCE, SUBGRADES, FROST PENETRATION, THAW DEPTH, FROST HEAVE, WATER TABLE, DAMAGE

The U.S. Army Cold Regions Research and Engineering Laboratory is developing a mechanistic pavement design procedure for use in seasonal frost areas. The procedure was used to predict pavement performance of some test sections at the Mn/ROAD facility. Simulations were conducted in three phases, investigating the effects on predictions of water table position, subgrade characteristics, asphalt model, and freeze season characteristics. The procedure predicted significantly different performance by the different test sections and highly variable results depending on the performance model applied. The simulated performance of the test sections also was greatly affected by the subgrade conditions, e.g., density, soil moisture, and water table depth. In general, predictions for the full-depth asphalt sections indicate that they will not fail due to cracking, but two of the three criteria for subgrade rutting indicate failure before the five- or 10-year design life of the sections. Conventional sections are predicted not to fail due to subgrade rutting; however, sections including the more frost-susceptible bases in their design are predicted to fail due to asphalt cracking relatively early in their design life, and sections with non-frost-susceptible bases are predicted to fail towards the end of the design life.

SR 96-22

DREDGING IN AN ACTIVE ARTILLERY IMPACT AREA; EAGLE RIVER FLATS, ALASKA.

Walsh, M.R., Chamberlain, E.J., Henry, K.S., Garfield, D.E., Sorenson, E., Sep. 1996, 45p., ADA-318 812, 17 refs.

51-2649

SEDIMENTS, DREDGING, EXPLOSIVES, MILITARY FACILITIES, ENVIRONMENTAL IMPACT, WATER POLLUTION, SOIL POLLUTION, LAND RECLAMATION, UNITED STATES—ALASKA—EAGLE RIVER FLATS, UNITED STATES—ALASKA—FORT RICHARDSON

Remediation of sediments in permanently ponded areas at Eagle River Flats, a salt marsh contaminated with white phosphorus (WP), may require dredging. Because the Flats were used as a firing range impact area for over 40 years by the U.S. military, there is much unexploded ordnance, which will require that any dredging equipment be remotely controlled. To treat the sediment pumped from dredged areas, a spoils retention basin was designed, constructed, and tested. This basin contains several innovations, including a natural remediation of the WP. The dredging system was deployed in Oct. of 1994, with sampling indicating that WP-contaminated areas were removed from the dredging area. An early snowfall curtailed operations shortly after initiation.

SR 96-23

1994 ARCTIC OCEAN SECTION: THE FIRST MAJOR SCIENTIFIC CROSSING OF THE ARCTIC OCEAN.

Tucker, W.B., ed, Cate, D., ed, Sep. 1996, 117p., ADA-322 259.

51-3613

GLOBAL CHANGE, WATER POLLUTION, ENVIRONMENTAL IMPACT, ICEBREAKERS, AIR ICE WATER INTERACTION, OCEANOGRAPHY, SEA ICE, MARINE BIOLOGY, BACTERIA, PLANKTON, ALGAE, RADIOACTIVITY, REMOTE SENSING, ICE NAVIGATION, EXPEDITIONS, OCEAN CURRENTS, GEOCHEMISTRY, ARCTIC OCEAN

In the summer of 1994 seventy scientists aboard two icebreakers—the USCGC *Polar Sea* and the CCGS *Louis S. St-Laurent*—participated in the U.S.-Canada Arctic Ocean Section, the first major scientific crossing of the Arctic Ocean. The purpose of the expedition was to increase understanding of the Arctic Ocean in the context of global change and to gather baseline data on contaminants. Data were collected at 39 locations, beginning just north of Nome, AK, crossing the North Pole, and finishing east of Greenland. Fifty individual research projects resulted in measurements of the seafloor, the ocean, the ice and the atmosphere, producing a comprehensive view of the Arctic Ocean never before available.

SR 96-24

PLANT GROWTH REGULATORS' EFFECT ON GROWTH OF MIXED COOL-SEASON GRASS STANDS AT FORT DRUM.

Palazzo, A.J., Zang, P., Duell, R.W., Cary, T.J., Hardy, S.E., Sep. 1996, 9p., ADA-319 796, 10 refs.

51-2650

GRASSES, PLANT PHYSIOLOGY, GROWTH, COUNTERMEASURES, COLD WEATHER PERFORMANCE

Mowing is one of the more expensive operations in managing roadside and other low-maintenance turfgrass areas. The objective of this study was to evaluate the performance of two plant growth regulators (PGRs)—mefluidide (Embark) and imidazolinone (Event)—in reducing the development of seedheads and inhibiting the vertical growth (plant height) of mixed turf swards at multiple sites over a two-year period. Mefluidide applied at the manufacturer's recommended rate (2.3 L/ha or 2 pints/acre) provided the best general control of plant height and seedhead development compared to mefluidide at lower rates or imidazolinone at both recommended and lower rates or a combination of mefluidide and imidazolinone at lower rates. Within the control areas (no PGR), plant height did not correlate with plant weight. Therefore, the timing of treatments is critical since increases in plant height and weight occur at different times during the spring. At the early May application time, mefluidide applied at the recommended rate inhibited both plant height and weight. The effects of this treatment on plant growth were similar in most of the eight sites tested. However, PGR performance was affected by the presence of earlier maturing grasses in the sward, microclimatic factors, and broadleaf weeds. There was no difference in the effectiveness of the treatments when the materials were applied again during the following season. Despite some variation in its effect, the mefluidide treatment at the recommended rate was consistent enough among all test locations, turf species, and microclimates to recommend using this technique in the demonstration stage of the trial.

SR 96-25

STATE OF THE ART OF MODELING MILLIMETER-WAVE REMOTE SENSING OF THE ENVIRONMENT.

O'Neill, K., Oct. 1996, 27p., ADA-319 226, Refs. p.22-26.

51-2651

REMOTE SENSING, SCATTERING, COMPUTER PROGRAMS, COMPUTERIZED SIMULATION, MODELS

A survey was undertaken of models for millimeter-wave (MMW) scattering and emission from environmental features, particularly in the vicinities of 35 and 94 GHz. The ultimate objective was to identify models suitable for current or near-future application in scene generation. The ideal model would be based on first principles, would be readily available in facilitated software, and would have reasonable requirements in terms of computational resources and input parameters. At MMW frequencies, these requirements push the frontiers of current science and technology. In most applications, one must accept as a first approximation the approaches currently under development in research settings. This report reviews the basic methods and approaches underlying all available models in terms of volume scattering, treatment of surfaces and transitions, and the development of statistical quantities from rational physics. Very rough surfaces, locally steep surface slopes, and low-angle incidence can rarely be treated entirely successfully, but recent developments offer the prospect of significant progress. Volume and combined surface-volume scattering and emission models are reviewed for application to land, water, vegetation, snow, and ice environments. Most are essentially works in progress, with theory and validation currently building from earlier work at C and X bands. Very sound capabilities are available for treatment of common atmospheric features, with recent progress in modeling more complex meteorological events. Limiting consideration to truly available codes, a list is provided for each of the above areas of models and their sources. Because it is the most comprehensive and is currently facilitated in terms of software, the MIT EMSARS model is the foremost candidate to serve as a platform for future addition and development.

SR 96-26

FURTHER STUDIES ON THE SOFTENING OF RIGID PVC BY AQUEOUS SOLUTIONS OF ORGANIC SOLVENTS.

Parker, L.V., Ranney, T.A., Oct. 1996, 22p., ADA-319 436, 15 refs.

51-2652

WELL CASINGS, POLYMERS, SOLUTIONS

In this study, small pieces of PVC well casing were exposed to relatively low activities (or relative solubilities) of TCE and methylene chloride for 12 months. PVC pieces were also exposed to aqueous solutions containing several organic chemicals that were either solvents or swelling agents of PVC. In addition, small pieces of PVC were exposed to aqueous solutions containing organic chemicals that were either PVC solvents or swelling agents and were totally miscible in water. These studies revealed that there is an interactive effect among these chemicals when dissolved in water. However, softening does not appear to occur in any solutions where the sum of the relative solubilities is less than 0.1.

SR 96-27

GLACIERS, ICE SHEETS AND VOLCANOES: A TRIBUTE TO MARK F. MEIER.

Colbeck, S.C., ed, Oct. 1996, 120p., ADA-321 342, Refs. passim. For selected papers see 51-3140 through 51-3156. Presented at special sessions at the 1995 Fall Meeting of the American Geophysical Union.

51-3139

GLACIERS, ICE SHEETS, VOLCANOES, GLACIER SURVEYS, GLACIER THICKNESS, GLACIER MASS BALANCE

SR 96-28
FREEZING TEMPERATURE PROTECTION ADMIXTURE FOR PORTLAND CEMENT CONCRETE.
Korhonen, C.J., Brook, J.W., Oct. 1996, 38p., ADA-321 468, 11 refs.
51-2966
CONCRETE ADMIXTURES, COLD WEATHER CONSTRUCTION, WINTER CONCRETING, COUNTERMEASURES, CONCRETE STRENGTH, CONCRETE HARDENING, THERMAL INSULATION
A number of experimental admixtures were compared to Pozzutec 20 admixture for their ability to protect fresh concrete from freezing and for increasing the rate of cement hydration at below-freezing temperatures. The commercial accelerator and low-temperature admixture Pozzutec 20 served as the reference admixture for this project as it has been a successful product of Master Builders for winter concreting during the past several years. Over thirty-five experimental admixture candidates were tested. Of these, one experimental admixture, code-named EY-11, a nonchloride admixture, outperformed all the others and was selected as the admixture to be considered for future commercialization. It was demonstrated by laboratory evaluation that the Pozzutec 20 admixture did not contribute to corrosion of embedded steel reinforcement. The EY-11 admixture, although still under examination, also did not contribute to corrosion in a newer and different laboratory test. Based on a knowledge of its constituents, EY-11 is not expected to contribute to corrosion under laboratory conditions or in the field. The low and medium dosages (60 and 100 mL/kg), of EY-11 produced freeze-thaw-durable concrete, but the highest dosage examined, 160 mL/kg, did not. The middle dosage (100 mL/kg) protected concrete down to the low-temperature goal of this project, -5°C. The prototype admixture, EY-11, affords superior low-temperature protection compared to existing accelerating admixtures, as well as good durability. Unfortunately, it did not provide the desirable rapid setting and strength gain of concrete at above-freezing temperatures that field engineers and concrete technicians would like.

SR 96-29
BALLISTIC PERFORATION OF GRAPHITE/EPOXY COMPOSITE.
Dutta, P.K., Farrell, D., Taylor, S., Tadayon, A., Hui, D., Dec. 1996, 8p., ADA-321 109, 13 refs.
51-3607
IMPACT TESTS, COMPOSITE MATERIALS, FRACTURING, BRITTLENESS
This report documents the experimental details of impact studies performed on graphite/epoxy laminated plates by spherical projectiles. The mechanism of failure and energy absorption were studied by macro- and microscopic examination of the surfaces of the laminates. Fragments were examined under scanning electron microscope to determine presence of any characteristic fracture surface pattern. The influence of laminate orientations was studied using unidirectional and quasi-isotropic laminates. The scanning electron microscopic examination of the fragments from the impact shows that the fracture surfaces of the matrix have some characteristic hackle marks. A discussion is provided to explain the characteristics and texture of these hackle marks and relate them to the impact velocity, material brittleness, and energy absorption of the impact.

SR 97-01
FROST SHIELDING PROTECTION OF A WATER LINE, BERLIN, NEW HAMPSHIRE.
Coutermarsh, B.A., Jan. 1997, 15p., ADA-322 268, 7 refs.
51-3611
FROST PENETRATION, PIPELINE FREEZING, PIPELINE INSULATION, UNDERGROUND PIPELINES, FROST PROTECTION, DESIGN, MATHEMATICAL MODELS
The standard practice of burying water and sewer lines beneath the frost line in cold regions can be expensive when ledge or other difficult material is within the burial depth. If the pipeline can be buried at a shallower depth and still be protected from freezing, a significant savings in excavation costs can be realized. A finite element (FE) program was developed to predict frost penetration depth around buried utility pipelines. The program was used to design and assess the feasibility of various insulation configurations around a water line buried within the frost-susceptible depth in Berlin, NH. Extensive temperature monitoring was performed to evaluate both the insulation design and the prediction accuracy of the FE program. The first-year results are very promising, showing good accuracy between the FE results and actual temperatures.

SR 97-02
SAMPLING TRACE-LEVEL ORGANICS WITH POLYMERIC TUBINGS: DYNAMIC STUDIES.
Parker, L.V., ed, Ranney, T.A., ed, Jan. 1997, 22p., ADA-322 645, 30 refs. See also 50-5672.
51-3612
PIPES (TUBES), LEACHING, GROUND WATER, PLASTICS
This study is the second phase of a two-year effort to determine the effects that sampling tubings have on organic analyte concentrations. In the first year, 20 different tubings were compared, under static conditions, with respect to sorption of organic contaminants and leaching of organic constituents. In this study, the authors examined what occurs under dynamic conditions when TCE-contaminated water is pumped through several different types of polymeric tubings. Sorption of organic solutes, leaching of organic constituents, and desorption of sorbed organic contaminants were all examined. Five tubings were selected for this study: a rigid fluoropolymer, a flexible fluoropolymer, low-density polyethylene (LDPE), and two plasticized polypropylene tubings. These materials were selected because the static studies had shown that these tubings leached little or no organic constituents (as determined by HPLC analyses with an ultraviolet [UV] detector) and ranged from being the least sorptive tubings tested to among the most highly sorptive. The effects of tubing length and flow rate were examined. Results from these studies indicate that if water is pumped through tubing at a slow flow rate (100 mL/min), fluoropolymers should be used to prevent extensive losses of TCE and more sorptive analytes, especially if the tubing is 50 ft or longer. If a faster flow rate (1 L/min) is used, it appears that LDPE tubing can be used to sample TCE and other less sorptive analytes, although time for equilibration (2-4 hr) should be allowed to reduce losses in the deepest wells.

SR 97-03
DISPERSION BY CHEMICAL REACTION OF ROCKY MOUNTAIN ARSENAL BASIN F WASTE SOILS.
Payne, J.R., Marion, G.M., Feb. 1997, 16p., ADA-323 602, 9 refs.
51-3609
SOIL POLLUTION, SLUDGES, LEACHING, LAND RECLAMATION, WASTE TREATMENT, SOIL CHEMISTRY
Many military installations have soil contamination problems that range from heavy metals to petroleum products. Rocky Mountain Arsenal (RMA) Basin F contains high concentrations of salts, heavy metals, ammonia, urea, and organics. The Dispersion by Chemical Reaction (DCR) process leads to a reduction in the mobility of the organic and inorganic constituents by first removing volatile constituents via steam stripping and volatilization, then trapping the nonvolatile contaminants in a nonmobile phase (microencapsulation), and finally compacting the treated material into large soil bodies (macroencapsulation). This report summarizes the results of the DCR testing of soil-amended Basin F sludge from RMA. The primary focus of this study is on pesticide leachability. The DCR process used to treat the Basin F waste soil produced a dry, homogeneous, soil-like material with desirable physical properties that on compaction achieved the following remediation goals: reduction of all leachable volatiles to nondetectable levels, confinement of all metals to below Resource Recovery and Conservation Act Toxic Characteristics Leaching Procedure (RCRA TCLP) levels, and a decrease in pesticide leachability to levels approaching RCRA standards.

SR 97-04
SELECTION OF CONFLUENCE SITES WITH ICE PROBLEMS FOR STRUCTURAL SOLUTIONS.
Tuthill, A.M., Mamone, A.C., Mar. 1997, 23p., ADA-325 468, 21 refs.
51-4745
RIVER ICE, ICE JAMS, RIVERS, CHANNELS (WATERWAYS), LOCKS (WATERWAYS), LAKES, RESERVOIRS, FLOODING, COUNTERMEASURES, UNITED STATES—OHIO RIVER, UNITED STATES—ILLINOIS RIVER, UNITED STATES—KANKAKEE RIVER, UNITED STATES—DES PLAINES RIVER, UNITED STATES—MISSOURI RIVER, UNITED STATES—MISSISSIPPI RIVER, UNITED STATES—SALMON RIVER, UNITED STATES—CONNECTICUT RIVER, UNITED STATES—AROOSTOOK RIVER, UNITED STATES—CHAGRIN RIVER, UNITED STATES—ST. CLAIR RIVER
This study examines a broad range of ice problems at river confluence sites, grouping the sites into four categories. Weighted criteria were used to select two representative sites from each category for detailed analysis. This report describes the ice problems at the eight selected sites, focusing on the relationship between channel geometry, hydrometeorological factors, and the historical record of ice events. For each site, tentative structural solutions are proposed.

SR 97-05
INVESTIGATION OF THE KINETICS AND PRODUCTS RESULTING FROM THE REACTION OF PEROXONE WITH AMINODINITROTOLUENES.
Spanggord, R.J., Yao, D., Mill, T., Feb. 1997, 13p., ADA-323 601, 7 refs.
51-3608
OZONE, WASTE TREATMENT, GROUND WATER
The reaction between peroxone and two isomers of aminodinitrotoluene (ADNT) was studied with respect to kinetics of reaction and the products formed. The ADNTs react rapidly with ozone and hydroxyl radical, the principal components of peroxone. At fairly high ADNT concentrations (ppm), hydroxyl radical competes with ozone in pure water systems. Reactions of both the 2- and 4-ADNT isomers result in the formation of pyruvic acid, nitrate ion, and nitrite ion. A reaction mechanism consistent with these products is proposed.

SR 97-06
STRIPPING VOLATILE ORGANIC COMPOUNDS AND PETROLEUM HYDROCARBONS FROM WATER BY TRAY AERATION.
LaBranche, D.F., Collins, M.R., Mar. 1997, 15p., ADA-323 603, 23 refs.
51-3610
GROUND WATER, WATER POLLUTION, CRUDE OIL, HYDROCARBONS, WASTE DISPOSAL, LAND RECLAMATION
Volatile organic compounds (VOCs) and petroleum products are ubiquitous groundwater contaminants. Petroleum products, e.g., diesel fuel, contain a wide array of volatile, semivolatile, and long-chain hydrocarbon compounds. This research sought to determine whether air stripping can provide a site-specific treatment solution for petroleum-contaminated groundwaters and to document the abilities and limitations of tray-type (ShallowTray) air stripping technology. Full factorial experimental trials were conducted to determine the influence of inlet water flow rate and temperature on trichloroethylene (TCE), perchloroethylene (PCE) and total petroleum hydrocarbon (TPH) removal. As expected, TPH removal controlled air stripper performance, and liquid temperature affected removal more than flow rate. The mass transfer rate of TCE and PCE from water to air was controlled by the compound's volatility, while the TPH mass transfer rate was controlled by the compound's concentration gradient. Results indicate that economical air stripping of VOC and TPH compounds can be achieved using low liquid flow rates (20-75L/min) and medium liquid temperatures (16-28°C) in tray-type air strippers.

SR 97-07
SHALLOW INSULATED FOUNDATION AT GALENA, ALASKA: A CASE STUDY.
Danyluk, L.S., Mar. 1997, 12p., ADA-325 471, 3 refs. For another source see 51-2667.
51-4742
FOUNDATIONS, HEAT LOSS, FROST PENETRATION, THERMAL INSULATION, ISOTHERMS, DESIGN, BUILDINGS, FOOTINGS, FROST PROTECTION, COLD WEATHER CONSTRUCTION, MILITARY FACILITIES, BUILDING CODES
A 2000-ft^2 addition to an aircraft control tower was constructed at Galena, AK, during the summer of 1990. Because of limited resources, a shallow insulated foundation (SIF) was specified instead of a traditional foundation (one in which the bottom of the footing is placed lower than the anticipated depth of frost penetration). An SIF design allows the footing to be placed at a much shallower depth by incorporating the use of strategically placed insulation around the foundation. The insulation utilizes heat from the building and surrounding soil, redirects it to the area around the foundation, and thus reduces the frost penetration.

SR 97-08
DETECTING METALLIC PRIMARY EXPLOSIVES WITH A PORTABLE X-RAY FLUORESCENCE SPECTROMETER.
Hewitt, A.D., Apr. 1997, 9p., ADA-325 530, 7 refs.
52-3971
SOIL POLLUTION, SOIL CHEMISTRY, EXPLOSIVES, CHEMICAL ANALYSIS, X RAY ANALYSIS
X-ray fluorescence spectrometry (XRF) analysis is a practical means of performing *in-situ* screening to establish the presence of high concentrations (>0.1% or 1000 ppm) of lead (Pb) and/or mercury (Hg). These two metals are of special military interest because they are constituents in three primary explosives: lead azide [$Pb(N_3)_2$], lead styphnate ($C_6HO_6N_3Pb$), and mercury fulminate [$Hg(CNO)_2$]. The success of *in-situ* XRF analysis to perform this task depends on instrumental sensitivity, selectivity, effective sample volume, transportability, and user friendliness. Laboratory experiments established that the MAP-3 XRF spectrum analyzer (SCITEC Corporation) is well-suited for this application. This instrument is self-contained, portable, and equipped with a Co-57 source that allows for a simultaneous analysis of both the K and L energy lines of Pb and Hg, among other metals. Laboratory experiments established that high concentrations of Pb and Hg could be detected in an active sample area of cylindrical shape, approximately 1.0 cm in diameter and 1.5 cm in depth.

SR 97-09
DEVELOPING NEW LOW-TEMPERATURE ADMIXTURES FOR CONCRETE: A FIELD EVALUATION.
Korhonen, C.J., Charest, B., Romisch, K., Apr. 1997, 10p., ADA-325 475, 5 refs. For another source see 51-2665.
51-4744
CONCRETE ADMIXTURES, WINTER CONCRETING, COLD WEATHER CONSTRUCTION, FREEZE THAW CYCLES, ANTIFREEZES, CONCRETE CURING, CONCRETE STRENGTH, CONCRETE FREEZING, CONCRETE PLACING, FROST PROTECTION
Two new admixtures, capable of preventing water from freezing, as well as increasing the hydration rate of cement at below-freezing temperatures, were field tested at Sault Ste. Marie, MI. Concrete made with the admixtures was placed on a frozen subgrade during a cold winter day and was allowed to cure thermally, unprotected in

the cold. Comparison to control concrete placed inside a heated shelter showed that the unprotected, admixtured concrete was equal to the control in strength and appearance. Work is continuing on the development of these admixtures for commercial use.

SR 97-10
PROCEEDINGS.
International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997, Iskandar, I.K., ed, Wright, E.A., ed, Radke, J.K., ed, Sharratt, B.S., ed, Groenevelt, P.H., ed, Hinzman, L.D., ed, Apr. 1997, 573p., ADA-326 007, Refs. passim. For individual papers see 51-5376 through 51-5467.
51-5375
SOIL FREEZING, GROUND THAWING, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, SOIL COMPOSITION, SOIL CONSERVATION, SOIL WATER MIGRATION, SOIL MICROBIOLOGY, SNOWMELT

SR 97-11
PREPARING SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUND ANALYSIS.
Hewitt, A.D., Apr. 1997, 20p., ADA-326 015, 32 refs.
51-5550
OIL SPILLS, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
Three equilibrium headspace and three solvent extraction methods of preparing soil samples for determining volatile organic compounds (VOCs) were compared. Soil samples were spiked with five gasoline range aromatic compounds and four chlorinated compounds using two different laboratory procedures that limit volatilization and biodegradation losses. All comparisons were made with sample triplicates of one or more soil types. Recovery efficiencies for the preparation methods depended on soil organic carbon content, octanol-water partition coefficients of specific analytes, length of solvent extraction, and the spiking procedure used. In general, methanol extraction was the most robust method for recovering spiked VOCs. Recovery efficiencies for VOCs with tetraethylene glycol dimethyl ether and poly(propylene)glycol, as well as three equilibrium headspace methods, varied with the parameters tested.

SR 97-12
ESTIMATING THE TOTAL CONCENTRATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL: A DECISION TOOL FOR SAMPLE HANDLING.
Hewitt, A.D., Lukash, N.J.E., Apr. 1997, 11p., ADA-326 037, 22 refs.
51-5549
OIL SPILLS, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
This report describes an on-site method of estimating the total concentration of Volatile Organic Compounds (VOCs) in soil, relative to a site-specific 0.2-mg/kg standard. This decision tool allows on-site sampling activities to incorporate the appropriate soil sample collection and handling protocols required by different methods of instrumental analysis. Coupling a rapid method for estimating the total VOC concentration with sampling procedures that limit substrate disaggregation and exposure complements efforts to achieve site-representative estimates for vadose zone contamination.

SR 97-13
EVALUATION OF AIRPORT SUBSURFACE MATERIALS.
Janoo, V.C., Eaton, R., Barna, L., May 1997, 26p., ADA-327 880, 26 refs.
51-5754
RUNWAYS, PAVEMENTS, SUBGRADE SOILS, SOIL TRAFFICABILITY, SOIL TESTS, FREEZE THAW TESTS, FROST HEAVE, THAW WEAKENING, FROST RESISTANCE, FROST PROTECTION, DRAINAGE, SOIL STABILIZATION
Pavement structures located in regions with seasonal changes encounter regular cycles of freezing and thawing. Such environmental factors must be considered so that it can be certain that the pavement can accommodate continuous aircraft loading. Eleven subsurface materials specified by the Federal Aviation Administration (FAA) were examined to determine their susceptibility to frost heave and thaw-weakening. All but two of the materials were found to be frost-susceptible under the U.S. Army Corps of Engineers criterion that no more than 3% of fines be smaller than 0.02 mm (0.78 x 10^3/in.). The frost-susceptible materials were also evaluated using Asphalt Institute criteria, which also categorized them as frost-susceptible. The 11 materials were evaluated for susceptibility to thaw-weakening using a drainage model which focuses on the permeability of the drainage layer. The final recommendations (which are based only on a literature review) are that, to reduce frost-susceptibility and thaw-weakening, the amount passing the no.200 sieve should be kept lower than 2% and drainage layers should be installed below the pavement.

SR 97-14
RIPPING FROZEN GROUND WITH AN ATTACHMENT FOR DOZERS.
Sellmann, P.V., Hill, D.R., June 1997, 15p., ADA-327 813, 11 refs.
51-5753
TRACKED VEHICLES, TRACTORS, CONSTRUCTION EQUIPMENT, MILITARY EQUIPMENT, FROZEN GROUND STRENGTH, EXCAVATION, TRENCHING, EARTHWORK, FORTIFICATIONS
Ripping of hard and frozen ground is commonly done by using crawler tractors with rear-mounted rippers that are usually a permanent part of the machine. Ripping is an attractive alternative to other methods of breaking a hard surface layer that restricts excavation, since it utilizes existing equipment and personnel, and a tractor that can be used for the excavation project. A simple ripper attachment for use on the blade of a dozer was used to determine if this easily installed tool could provide some ripping capability when machines with rear-mounted rippers are not available. This ripper attachment was used in a range of frozen soils that could not be excavated with a dozer, and was used on tractors ranging in size from small commercial dozers to a large military dozer with a suspension system. In all cases, at the sites used, the ripper attachment provided the machines with some ripping capability. The ripper was also easy to install, with no modifications required to the tractors or the rippers.

SR 97-15
GROUND FREEZING EFFECTS ON SOIL EROSION OF ARMY TRAINING LANDS; PART 1: INITIAL TEST RESULTS.
Gatto, L.W., Aug. 1997, 32p., ADA-331 845, Refs. p.29-32.
52-2227
SOIL EROSION, SOIL FREEZING, MILITARY OPERATION, RUNOFF, SOIL COMPACTION, FREEZE THAW CYCLES
Military maneuvers damage vegetation and compact and rut soils on training lands, thereby increasing the likelihood of hillslope runoff and soil erosion. Soil Freeze-Thaw (FT) processes can change the hydraulic geometry and roughness of vehicular ruts and reduce soil compaction, which often partially restores the water infiltration rate that existed before compaction. The efficiency of these FT-induced "repairs" depends on soil water content and FT intensity. Initial tests showed that 1) an experimental soil bin designed and constructed for rut experiments allows acceptable simulation of field soil FT, and 2) the hydraulic geometry of a rectangular rill in a fine silt soil with an initial volumetric water content of 36% changes dramatically due to rill sideslope slumping during thaw. Future experiments will compare differences in the response of natural rills and vehicular ruts to FT-induced soil failure, and investigate the effects of FT on soil erodibility and the influences of snow cover on soil erosion processes in the spring.

SR 97-16
INCREASING COLD WEATHER MASONRY CONSTRUCTION PRODUCTIVITY.
Korhonen, C.J., Thomas, R.D., Cortez, E.R., Aug. 1997, 53p., ADA-330 536, 5 refs.
52-2232
COLD WEATHER CONSTRUCTION, THERMAL INSULATION, ANTIFREEZES, FREEZE THAW CYCLES, MORTARS, ADMIXTURES, STANDARDS
The thermal protection requirements for cold weather masonry, as established in current industry specifications, were evaluated. Experiments were conducted to define the most relevant factors in the process of freezing of newly placed mortar. The effect of unit absorption on the moisture content of mortar during the first hours after assembly was assessed. Correlations of moisture content with time were developed for mortar in contact with masonry units. Frost immunity thresholds in terms of mortar moisture content and in terms of maturity were determined. The test results provided the basis for new proposed guidance on when fresh mortar can be safely exposed to freezing temperatures. Test methods for evaluation of the freeze-thaw resistance of masonry units were evaluated. A new test was proposed and adopted by ASTM as a new standard test for the freeze-thaw testing of masonry units. In addition, several chemicals were evaluated for their potential as antifreeze admixtures for masonry mortar. Antifreeze admixtures were first developed for use in concrete, but the practicality of using antifreeze admixtures in masonry mortars was demonstrated in a field application in Michigan during the winter.

SR 97-17
BIBLIOGRAPHY ON NORTHERN PIPELINES IN THE FORMER SOVIET UNION.
Smallidge, E.R., Aug. 1997, 25p., ADA-330 750, Refs. p.4-25.
52-2229
BIBLIOGRAPHIES, PIPELINES, DATA PROCESSING, GAS PIPELINES, CRUDE OIL, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, SAFETY, ACCIDENTS, RUSSIA, CIS
In 1993 a pilot project between the Defense Technical Information Center and the U.S. Army Cold Regions Research and Engineering Laboratory resulted in a proposal to conduct a state-of-the-art review of technology and techniques for building, operating, and maintaining arctic natural gas and liquid petroleum pipelines in the former Soviet Union. This bibliography was compiled to meet the objectives of the pipeline review. References were compiled on dates of construction, location, route conditions, design, construction, maintenance, environmental impact, accidents, and production management. The bibliography is divided into three sections: Oil and Gas Pipelines, Construction of Oil and Gas Pipelines, and Accidents; it was compiled using commercially available databases. Subjects searched included information on pipelines in the former Soviet Union, primarily in the eastern and western areas of Siberia. References were eliminated that were not of direct interest to the pipeline study.

SR 97-18
SITE REMEDIATION VIA DISPERSION BY CHEMICAL REACTION (DCR).
Marion, G.M., Payne, J.R., Brar, G.S., Aug. 1997, 21p., ADA-330 681, 52 refs.
52-2234
LAND RECLAMATION, SOIL POLLUTION, WASTE DISPOSAL, WASTE TREATMENT, SOIL ANALYSIS, UNITED STATES—PENNSYLVANIA—PALMERTON, UNITED STATES—ALASKA—SHEMYA ISLAND, UNITED STATES—COLORADO—DENVER
The DCR (Dispersion by Chemical Reaction) technologies are a group of patented waste treatment processes using CaO (quicklime) for the immobilization of heavily oiled sludges, oil-contaminated soils, acid-tars, and heavy metals in $Ca(OH)_2$ and $CaCO_3$ matrices. The objectives of this project were to 1) evaluate the DCR process for remediating soils contaminated with pesticides, petroleum hydrocarbons (oils and fuels), and heavy metals in cold regions and 2) evaluate DCR-treated oil-contaminated soil as a non-frost-susceptible (NFS) construction material. Three major studies evaluated the DCR process to remediate 1) hydrocarbons at Eareckson Air Force Station on Shemya in the Aleutians, 2) pesticide-contaminated soils from Rocky Mt. Arsenal, and 3) heavy-metal contaminated soils from a former zinc smelter site at Palmerton, PA. The DCR process was successful in stabilizing liquid organics and heavy metals in contaminated soils. The chemical properties of soils contaminated by solid organics (asphalt tar and pesticides) were not generally improved by the DCR process, but even in these cases, the physical properties were improved for potential reuse as construction materials. Following laboratory verification for a specific waste, the DCR process for the field remediation of liquid organics and heavy-metal-contaminated materials can be recommended.

SR 97-19
EFFECTS OF TEMPERATURE ON GERMINATION OF ELEVEN *FESTUCA* CULTIVARS.
Palazzo, A.J., Brar, G.S., Aug. 1997, 6p., ADA-330 578, 23 refs.
52-2233
TEMPERATURE EFFECTS, PLANT PHYSIOLOGY, PLANTS (BOTANY)
Many studies have shown that water potential at planting affects the germination rate and final germination of *Festuca* cultivars. Limited information is available about the extent of variability in temperature-dependence of germination among different *Festuca* cultivars. The objective of the authors was to study germination at five temperatures for a wide range of *Festuca* cultivars. *Festuca* seeds were screened for germination during 28 days in polyethylene growth pouches held at constant temperatures of 10, 15, 20, 25, or 30°C. The germination percentage significantly ($p<0.05$) increased as the temperature increased from 10 to 15°C, when averaged across the cultivars, and decreased thereafter. The cultivar "Clemfine" tall fescue *(Festuca arundinacea* Schreb.) had the greatest germination percentage, and "Arctared" red fescue (*Festuca rubra* L.) had the least when averaged across the five temperatures. Conversely, the average time to germination (A_{tg}) was greatest at 10°C and least at 30°C. Reaching a germination level of 80% or more of the seeds required 14 days at 10°C, 9 d at 15°C, 8 d at 20°C, and 7 d at 25 or 30°C. Base temperatures required for germination of *Festuca* species were 3.2°C for rapid germinators, 3.6 to 6°C for medium germinators, and 4 to 6°C for poor germinators. Heat units (growing degree-days>10°C) calculated for the rapid germinators were 129°C-d, 120 to 140°C-d for medium germinators, and 135 to 191°C-d for the poor germinators. Germination decreased as heat units were increased.

SR 97-20
SOIL REMEDIATION DEMONSTRATION PROJECT: BIODEGRADATION OF HEAVY FUEL OILS.
Reynolds, C.M., Bhunia, P., Koenen, B.A., Aug. 1997, 8p., ADA-331 246, 7 refs.
52-2230
SOIL POLLUTION, OIL SPILLS, LAND RECLAMATION, COLD WEATHER OPERATION, CRUDE OIL, FUELS, AGRICULTURE, COST ANALYSIS
Treatment of oil-contaminated soils is necessary to protect water supplies, human health, and environmental quality; but because of limited funds, cleanup costs are often prohibitive. High costs are exacerbated in cold regions such as Alaska, where spills are often in areas inaccessible to heavy equipment and where there is limited infrastructure. Owing to the lack of infrastructure, widespread fuel distribution systems, and the need for heating in the cold climate, there are numerous small-scale oil spills. Low-cost treatments applicable to small-scale spills are needed. The object of this CPAR project was to examine using cost-effective, on-site bioremediation techniques for heavy-oil-contaminated soil in cold regions. Both

heavy-oil and diesel-contaminated soils were used to compare landfarming, a low-intensity treatment, to pile bioventing, a costlier treatment. For each soil-contaminant combination, nutrient additions were compared to a control with no nutrient additions. Under the conditions of this study, landfarming with nutrient additions was as effective for treating diesel-contaminated soil as was bioventing with nutrient additions. For heavy oils, landfarming with nutrients resulted in lower soil concentrations after one year, but differences among treatments were not statistically significant. Because landfarming does not require pumps, electricity, or plumbing, all costs are less than for bioventing. The minimal requirements for infrastructure also make landfarming attractive in remote sites typical of cold regions.

SR 97-21
ON-SITE ANALYSIS OF EXPLOSIVES IN SOIL: EVALUATION OF THIN-LAYER CHROMATOGRAPHY FOR CONFIRMATION OF ANALYTE IDENTITY.
Nam, S.I., Aug. 1997, 14p., ADA-330 616, 34 refs.
For another version see 51-5537.
52-2231
MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
Two colorimetric-based methods are commonly used for on-site analysis of explosives in soil. For the TNT method, acetone soil extracts are reacted with base to produce reddish-colored Janowsky ions. For RDX, acetone extracts are acidified and reacted with zinc to reduce RDX to nitrous acid, and the nitrous acid is determined by reacting the resulting solution with a Griess reagent. The TNT method is subject to interference from the presence of other polynitroaromatic compounds such as TNB, tetryl, and the isomers of DNT. Likewise, the RDX method is interfered with by the presence of other nitramines such as HMX and tetryl, and organonitrate esters such as NG, PETN, and NC. This study investigates the use of thin-layer chromatography (TLC) as a simple on-site method to confirm the identity of analytes detected using colorimetric on-site methods. Separations using both laboratory-grade and locally available solvents were developed. The major limitation of this method is detection capability, which was estimated to be about 0.1 µg of analyte. This corresponds to a concentration of 17 µg/g when using 30 µL of spotting volume, or 500 µg/g when using 1 µL of spotting volume.

SR 97-22
ASSESSMENT OF SAMPLING ERROR ASSOCIATED WITH COLLECTION AND ANALYSIS OF SOIL SAMPLES AT A FIRING RANGE CONTAMINATED WITH HMX.
Jenkins, T.F., et al, Sep. 1997, 52p., ADA-330 661, 19 refs.
52-2235
EXPLOSIVES, SOIL POLLUTION, MILITARY OPERATION, SOIL ANALYSIS, SOIL TESTS, SOIL CHEMISTRY
Short-range and mid-range (grid size) spatial heterogeneity in explosives concentrations within surface soils was studied at an active antitank firing range at the Canadian Force Base-Valcartier, Val-Bélair, Quebec. The range has been in use for over 20 years. Sixteen grids were installed. Four area-integrated surface samples were formed into piles, one in each quadrant of each grid, using a circular pattern that included about 10% of the top 5 cm of the quadrant. After *in-situ* homogenization of a pile, several random aliquots were combined to form a representative sample. Replicates were collected to assess the representativeness achieved. In addition, grid composites were prepared by combining equal portions of the four subgrid samples for each of 16 grids. In nine of the subgrids, a second area integrated sample was prepared. On-site analysis showed concentrations of HMX ranging from as high as 1640 mg/kg near one target to 2.1 mg/kg at a distance of 15 m from the target. On the other hand, TNT concentrations were much lower than would be expected based on the 70:30 composition ratio of HMX to TNT in the melt-cast explosive used on site. A colorimetric method, originally developed to analyze for RDX, was found to provide concentration estimates for HMX that were in excellent agreement with laboratory results. Spatial heterogeneity of HMX concentrations was large on both short- and mid-range scales and this factor dominated the overall uncertainty associated with site characterization. Relatively minor uncertainties were due to analytical error.

SR 97-23
FLORISTIC INVENTORY AND SPATIAL DATABASE FOR FORT WAINWRIGHT, INTERIOR ALASKA.
Racine, C., Lichvar, R., Murray, B., Tande, G., Lipkin, R., Duffy, M., Oct. 1997, 68p., ADA-333 255, Refs. p.23-30.
52-2777
SITE SURVEYS, PLANTS (BOTANY), MOSSES, LICHENS, TUNDRA VEGETATION, WETLANDS, STEPPES, GRASSES, DATA PROCESSING, ENVIRONMENTAL IMPACT, UNITED STATES—ALASKA—FORT WAINWRIGHT
An inventory of the vascular and ground-inhabiting cryptogam flora of Fort Wainwright was conducted during the summer of 1995 to support land management needs related to the impact of training. Primary plant collecting, identification and verification were conducted by the Alaska National Heritage Program and the University of Alaska Museum. The work was supervised and the data compiled into a geographic information system by the USA Cold Regions Research and Engineering Laboratory and the USA Waterways Experiment Station. Fort Wainwright covers 370,450 hectares (915,000 acres). Over 100 sites were visited, with habitats ranging from very dry south-facing slopes to forest, floodplains, wetlands, and alpine tundra. Vascular collections represented 491 species, included about 26% of Alaska's vascular flora, and are considered to be relatively complete. The cryptogam collections included 219 species, representing 92 mosses, 117 lichens, and 10 liverworts. The flora is characteristic of the circumpolar boreal forest and wetlands of both North America and Eurasia, but it also contains alpine and dry-grassland and steppe species.

SR 97-24
DECONTAMINATING MATERIALS USED IN GROUNDWATER SAMPLING DEVICES.
Parker, L.V., Ranney, T.A., Oct. 1997, 29p., ADA-332 735, 36 refs.
52-2779
GROUND WATER, SAMPLING, PUMPS, COLD WEATHER PERFORMANCE, WATER POLLUTION
In these studies, the efficiency of various decontamination protocols was tested by using small pieces of materials commonly used in groundwater sampling devices. Three types of materials that ranged in their ability to sorb organic solutes were tested: stainless steel, polyvinyl chloride, and polytetrafluoroethylene (PTFE). Generally, contact times for sorption and desorption were 10 minutes and 24 hours. These results indicate that, generally, organic contaminants are removed from these materials simply by washing with a hot detergent solution and rinsing with hot water. The exceptions were low-density polyethylene tubing that was exposed to a pesticide test solution for 24 hours and allowed to desorb for 24 hours, and PTFE that was exposed to volatile organics for 24 hours. For these, a hot detergent water wash and rinse followed by oven drying at ca. 105°C was the most effective treatment. With this treatment, VOCs were not detected desorbing from the PTFE, and pesticide contamination desorbing from LDPE was substantially reduced. Solvent rinsing did not improve removal of VOCs and only marginally improved removal of pesticides from LDPE.

SR 97-25
DECONTAMINATING GROUNDWATER SAMPLING DEVICES.
Parker, L.V., Ranney, T.A., Oct. 1997, 20p., ADA-332 657, 34 refs.
52-2781
GROUND WATER, SAMPLING, PUMPS, COLD WEATHER PERFORMANCE, WATER POLLUTION
These studies are the second part of a two-year project that examines decontaminating groundwater sampling devices. In the first year, the efficiency of various decontamination protocols was tested using small test pieces of materials that are commonly used in groundwater sampling devices. Those tests showed that a hot detergent wash and rinse followed by hot air drying (105°C) was the most effective decontamination protocol. Two groundwater sampling devices, a bailer and a bladder pump, were used to sample groundwater that was contaminated with either trichloroethylene, munitions, or pesticides. These studies showed that a hot detergent wash and hot water rinse followed by hot air drying is an effective method for decontaminating these sampling devices.

SR 97-26
ANTIFREEZE ADMIXTURES FOR CONCRETE.
Korhonen, C.J., Cortez, E.R., Durning, T.A., Jeknavorian, A.A., Oct. 1997, 46p., ADA-332 653, 8 refs.
52-2780
ANTIFREEZES, CONCRETE ADMIXTURES, WINTER CONCRETING, COLD WEATHER CONSTRUCTION, THERMAL INSULATION, LOW TEMPERATURE TESTS
The goal of this project was to develop a chemical admixture that would reduce the need for wintertime thermal protection of freshly placed concrete. Chemicals were investigated for their ability to promote strength gain in concrete cured below 0°C. Laboratory strength tests established that 2 prototype admixtures were capable of protecting concrete down to -5°C. Results from other laboratory tests show that the chemicals pose no harm to the concrete or embedded ferrous metals. Concrete containing the prototype admixtures passes standard freeze-thaw tests, does not shrink unusually, does not contain harmful alkalis, and does not produce irregular hydration products. Field tests showed that working with these new admixtures requires no new skills. The concrete can be mixed at lower temperatures, saving energy. The admixtures are easily dosed into the mixing trucks and concrete is finished in the usual manner. Estimates show that the 2 prototype admixtures can extend the construction season by as much as 3 months in the contiguous U.S. The prototype has proved that low-temperature admixtures are possible. The industry partner sees the need to develop admixtures that will work to -10°C before going commercial with this technology.

SR 97-27
TIME-DOMAIN REFLECTOMETRY OF WATER CONTENT IN PORTLAND CEMENT CONCRETE.
Korhonen, C.J., Janoo, V.C., Berini, C.M., Nov. 1997, 15p., ADA-333 010, 8 refs.
52-2776
WATER CONTENT, WINTER CONCRETING, CONCRETES, CEMENTS, DIELECTRIC PROPERTIES
Time-domain reflectometry is useful for measuring the moisture content of solids. However, little information exists on its use with portland cement concrete. By monitoring the response from TDR sensors embedded in concrete as the concrete dried, a second-order polynomial equation that relates dielectric constant to moisture content was developed. The study is valid for the specific concrete studied.

SR 97-28
CURRENT AND PROPOSED PRACTICES FOR NONDESTRUCTIVE HIGHWAY PAVEMENT TESTING.
Kestler, M.A., Nov. 1997, 7p., ADA-332 987, 3 refs.
52-2778
PAVEMENTS, TESTS, COMPUTER PROGRAMS
In Sep. 1994 the U.S. Army Cold Regions Research and Engineering Laboratory distributed a short survey on nondestructive testing practices to each of the 50 state Departments of Transportation (DOTs). The compilation of results constituted Phase I of a multiphase effort intended to lead toward the development of a method for optimizing falling weight deflectometer (FWD) test point spacing. Planned spatial statistical analyses on selected data sets will yield (site-specific) optimal FWD test point spacing for road network evaluation and pavement overlay design. Optimal FWD test point spacing reduces conservative overdesign due to undertesting and reduces overtesting. Both of these ultimately reduce expenditures. Although the above effort has not been completed, this interim report outlines the proposed process. Also included (and perhaps of more immediate interest to state DOTs) are direct survey facts and figures, including number of states with nondestructive testing devices, average number of miles of annual overlay design, average number of miles of network/inventory testing, and back-calculation programs and overlay design procedures used. All facts and figures are generic and honor state anonymity.

SR 97-29
FROST RESISTANCE OF COVER AND LINER MATERIALS FOR LANDFILLS AND HAZARDOUS WASTE SITES.
Chamberlain, E.J., Erickson, A.E., Benson, C.H., Dec. 1997, 23p., ADA-335 133, 13 refs.
52-3441
WASTE DISPOSAL, EARTH FILLS, CLAY SOILS, PERMEABILITY, SEEPAGE, WATERPROOFING, SOIL STABILIZATION, LININGS, GEOTEXTILES, FROST RESISTANCE, FROST PROTECTION, FREEZE THAW TESTS, COST ANALYSIS
The common method of preventing the contamination of groundwater by landfills and hazardous waste is to encapsulate the waste material in a compacted clay liner and cover system. The frost resistance of compacted clay in landfills has been the subject of controversy for many years. Laboratory studies have frequently shown that freezing and thawing significantly increase the hydraulic conductivity of compacted clay soils. However, there has not been any corroborating field evidence. This study more closely examines this problem, and identifies cover and liner materials that would be frost resistant to increase construction productivity and save costs. The effects of freezing and thawing on the hydraulic conductivity of two compacted natural clay soils, one compacted sand-bentonite mixture, and three geosynthetic clay liners (GCLs) were examined. Both field and laboratory tests were performed on these materials. Results showed that freeze-thaw caused large increases (greater than 1000x) in hydraulic conductivity in compacted natural clay, but little measurable change in hydraulic conductivity of the GCLs or the sand-bentonite mixture. GCLs and sand-bentonite mixtures are suitable frost resistant substitutes for compacted clay soils. Considerable cost savings can result if compacted clay soils are replaced with GCLs or sand-bentonite mixtures.

SR 97-30
COMPOSITE SAMPLING OF SEDIMENTS CONTAMINATED WITH WHITE PHOSPHOROUS.
Walsh, M.E., Collins, C.M., Bailey, R.N., Grant, C.L., Dec. 1997, 19p., ADA-335 137, 25 refs.
52-3440
SOIL POLLUTION, WATER POLLUTION, EXPLOSIVES, WASTE DISPOSAL, LAND RECLAMATION, SOIL TESTS, SOIL CHEMISTRY, CHEMICAL ANALYSIS, WETLANDS, MILITARY FACILITIES, UNITED STATES—ALASKA—FORT RICHARDSON
White phosphorus from exploded munitions is a difficult contaminant to characterize in the environment. Spatial heterogeneity of concentration estimates is extreme, varying over many orders of magnitude for closely spaced discrete samples. To provide cost-effective data upon which decisions may be made, two composite sampling methods were designed to aid in characterizing the site and

monitoring the remedial process for an area contaminated by white phosphorus. For each method, closely spaced discrete samples were collected on a grid pattern and pooled to form composites. The composites were then divided by size fractions. Mean white phosphorus concentrations were estimated for the fine-grain-size fraction that was obtained by suspension with water. The presence of highly toxic solid white phosphorus particles, the form that may be ingested by feeding waterfowl, was determined in the coarse-grain-size fraction that was obtained by sieving.

SR 97-31

FROST-SUSCEPTIBILITY TESTING AND PREDICTIONS FOR THE RAYMARK SUPERFUND SITE.

Janoo, V.C., Barna, L.A., Orchino, S.A., Dec. 1997, 16p., ADA-334 935, 8 refs.

52-3439

SOIL POLLUTION, WASTE DISPOSAL, EARTH FILLS, LAND RECLAMATION, PAVEMENTS, SUBGRADE SOILS, FROST RESISTANCE, FROST HEAVE, FREEZE THAW TESTS, COMPUTERIZED SIMULATION, UNITED STATES—CONNECTICUT

This project was conducted to assist in predicting the effects of freeze-thaw cycling on Tilcon common granular fill during the freezing season. This material is being used as the subbase material in the proposed pavement structure at the Raymark Superfund site in Stratford, CT. Based on the initial laboratory results of the Tilcon material performed at CRREL, the amount of fines passing the no.200 sieve was found to be in the vicinity of 20%, of which approximately 14% was finer than 0.02 m. Results from the frost heave tests indicate that when the Tilcon material is saturated, based on the rate of heave, the material is classified a high to very high frost-susceptible material. In the saturated condition, the material is classified as a low to medium frost-susceptible material. Computer simulations were run to predict the amount of frost heave and frost penetration that may be expected on this site during the freezing season. Results from the laboratory frost-susceptibility tests and computer simulations were then used to estimate the amount of cumulative damage to the pavement structure during its design life.

SR 97-32

EVALUATION OF COMMERCIAL ENZYME IMUNOASSAYS FOR THE FIELD SCREENING OF TNT AND RDX IN WATER.

Thorne, P.G., Myers, K.F., Dec. 1997, 15p., ADA-334 972, 14 refs.

52-3438

MILITARY FACILITIES, WELLS, GROUND WATER, SOIL POLLUTION, WATER POLLUTION, EXPLOSIVES, WATER CHEMISTRY, CHEMICAL ANALYSIS

Water samples from 44 monitoring wells at three military installations were analyzed for the high explosives TNT and RDX using immunoassay test kits. The accuracy and precision of the kit determinations were compared with results obtained using the RP-HPLC, EPA method 8330. Most of the kits achieved a ±50% relative percent difference criterion over 85% of the time. One of the kits failed this test over half the time. Careful consideration must be given to interferences that may be present and unique for each application.

SR 97-33

RESULTS OF STABILIZED WASTE MATERIAL TESTING FOR THE RAYMARK SUPERFUND SITE.

Janoo, V.C., Barna, L.A., Orchino, S.A., Dec. 1997, 25p., ADA-336 129, 6 refs.

52-3970

SOIL POLLUTION, WASTE DISPOSAL, LAND RECLAMATION, SUBGRADE SOILS, SOIL STABILIZATION, PAVEMENTS, SOIL CEMENT, EARTH FILLS, FREEZE THAW TESTS, FROST PENETRATION, FROST RESISTANCE, FROZEN GROUND STRENGTH, UNITED STATES—CONNECTICUT

This project was conducted to assist in predicting the effects of freeze-thaw cycling on stabilized hazardous waste material during the 1996-97 freezing season. The Raymark Superfund site in Stratford, CT, is under remediation with the intent of using the area for commercial development. The site was classified as a Superfund site in 1995. The onsite soil contains asbestos, lead, PCBs, volatile organic compounds (VOCs), semi-Vocs, and solvents. These contaminants are by-products of the manufacturing process for heat-resistant automotive parts. The stabilized waste material is being used as the subgrade material in the pavement structure. Field testing was conducted to determine the unconfined compressive strength of the stabilized material before and after the freezing season. Testing was completed using the Clegg impact soil tester and dynamic cone penetrometer. Additionally, thermocouples were installed to estimate the depth of frost penetration that could be expected, and to ensure that the overlying layers in the pavement structure would be adequate to prevent frost penetration into the stabilized layer.

SR 97-34

FACTORS INFLUENCING ICE CONVEYANCE AT RIVER CONFLUENCES.

Ettema, R., Muste, M., Kruger, A., Zufelt, J.E., Dec. 1997, 30p., ADA-335 571, 8 refs. For another version see 52-701.

52-3969

RIVER ICE, ICE JAMS, ICE WATER INTERFACE, ICE COVER EFFECT, RIVER FLOW, HYDRAULICS, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS

This report documents preliminary findings concerning ice jam conditions in river confluences, using two laboratory approaches. First is categorizing the different conditions of ice discharge into a confluence based on two general classifications: free drift of ice and movement of contiguous ice accumulations. The two most common causes of jams seem to be sluggish water velocities in the outflow channel and local bathymetric features. The second approach examines how confluence geometry and flow processes affect ice discharge—for example, the influence on ice discharge of bathymetric features. The approach uses a large hydraulic model of a two-channel confluence, which is adaptable to a variety of channels, and particle image velocimetry (PIV) for determining and mapping whole fields of water and ice velocities in a confluence. PIV, which is becoming extensively used, lends itself very well here. This study is the first demonstration of the PIV method for ice movement through a two-river confluence.

SR 98-01

QUANTIFICATION OF SHAPE, ANGULARITY, AND SURFACE TEXTURE OF BASE COURSE MATERIALS.

Janoo, V.C., Jan. 1998, 22p., ADA-335 673, 29 refs.

52-3968

PAVEMENTS, PAVEMENT BASES, SUBGRADE SOILS, AGGREGATES, EARTH FILLS, GRAVEL, PARTICLE SIZE DISTRIBUTION, SOIL TEXTURE, SOIL STRENGTH, SOIL CREEP, SUBGRADE MAINTENANCE, ROAD MAINTENANCE

A state-of-the-art review was conducted to determine existing test methods for characterizing the shape, angularity, and surface texture of coarse aggregates. The review found direct methods used by geologists to determine these characteristics. These methods involve physical measurements of individual aggregates and are very laborious and time consuming. Engineers have developed index tests (indirect methods) to quantify the combined effect of the shape, angularity, and surface texture of coarse aggregates in terms of changes in the voids in the aggregate bulk. A description of both the direct and indirect methods is provided in the report. Also, the effect of shape, angularity, and surface texture of coarse aggregates on the base course performance was reviewed. It was found that there is some contradiction in the published data on resilient modulus. Shape, angularity, and surface texture of coarse aggregates clearly influence the angle of internal friction.

SR 98-02

SOIL MOISTURE DETERMINATIONS USING CAPACITANCE PROBE METHODOLOGY.

Atkins, R.T., Pangburn, T., Bates, R.E., Brockett, B.E., Jan. 1998, 42p., ADA-337 497, 3 refs.

52-3967

SOIL WATER, WATER CONTENT, MOISTURE DETECTION, MOISTURE METERS, ELECTROMAGNETIC PROSPECTING, SOIL TEMPERATURE, SOIL TESTS, FREEZE THAW CYCLES, STATISTICAL ANALYSIS

Determining soil moisture content by measuring the dielectric constant of the soil is not a new concept. However, determining the dielectric constant by measuring capacitance directly rather than through the use of time domain reflectometry (TDR) systems is a relatively new approach to soil moisture measurements. A unique probe assembly and a readout device that measures voltage drop and phase shift were developed and used for direct capacitance measurements. The capacitance measurement was calibrated using known capacitors and resistors. Soil moisture measurements were calibrated by adding known amounts of distilled water to dry soil enclosed in a known volume. Soil moisture measurements through an entire winter's freeze-thaw cycle demonstrated the feasibility of using this capacitance measurement system. The conclusions drawn from these tests are that this measurement technique could and should be developed as an easier, more economical, and more easily automated and calibrated system for soil moisture measurement.

SR 98-03

LABORATORY STUDY OF VOLATILE ORGANIC COMPOUND PARTITIONING: VAPOR/AQUEOUS/SOIL.

Hewitt, A.D., Feb. 1998, 16p., ADA-337 494, 23 refs.

52-3966

SOIL POLLUTION, SOIL COMPOSITION, SOIL CHEMISTRY, SOIL TESTS, CHEMICAL ANALYSIS

A laboratory experiment measured the concentrations of volatile organic compounds (VOCs) existing in a vapor, water, and bulk soil media after several weeks of exposure to a contaminant source. The experimental design included quiescent conditions, hydrated mineral surfaces, and a constant temperature of 11°C. The findings show that similar to Henry's law, fairly constant ratios are likely to exist between soil vapor and bulk soil VOC concentrations. These results are encouraging for those attempting to use active soil gas measurements to predict bulk VOC concentrations in the vadose zone.

SR 98-04

OVERVIEW OF ON-SITE ANALYTICAL METHODS FOR EXPLOSIVES IN SOIL.

Crockett, A.B., Jenkins, T.F., Craig, H.D., Sisk, W.E., Feb. 1998, 30p., ADA-351 073, Refs. p.26-30.

52-6756

MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS

On-site methods for explosives in soil are reviewed. Current methods emphasize the detection of TNT and RDX. Methods that have undergone significant validation fall into two categories: colorimetric-based methods and enzyme immunoassay methods. Discussions include considerations of specificity, detection limits, extraction, cost, and ease of use. A discussion of the unique sampling design considerations is also provided as well as an overview of the most commonly employed laboratory method for analyzing explosives in soil. A short summary of ongoing development activities is provided.

SR 98-05

BIOREMEDIATION OF HYDROCARBON-CONTAMINATED SOILS AND GROUNDWATER IN NORTHERN CLIMATES.

Reynolds, C.M., Braley, W.A., Travis, M.D., Perry, L.B., Iskandar, I.K., Mar. 1998, 18p., ADA-342 625, 23 refs.

52-5985

LAND RECLAMATION, GROUND WATER, HYDROCARBONS, SOIL POLLUTION, WATER POLLUTION, WATER TREATMENT, COST ANALYSIS, LEACHING, UNITED STATES—ALASKA—FAIRBANKS

A field demonstration and research project was conducted in Fairbanks, AK, to demonstrate, evaluate, and document the construction and operation of three selected bioremediation technologies—landfarming, recirculating leachbeds, and infiltration galleries. Landfarming involves adding water and nutrients to contaminated soil to stimulate microbial activity and contaminant degradation. Infiltration galleries are dynamic *in-situ* treatment systems designed to stimulate microbial activity and subsequent hydrocarbon degradation by circulating nutrient- and oxygen-amended water through petroleum-contaminated soil. Recirculating leachbeds, in a way similar to slurry reactors, aerate and mix nutrients with contaminated soil, and can be built as on-site bioreactors. Estimated biotreatment costs in the landfarm were between $20 to $30 per cubic yard. Nutrient placement has been demonstrated to be a critical factor, even though the site is tilled and mixed frequently. Success of the infiltration gallery was more difficult to document. Benzene was detected at less than 2 ppb and BTEX levels were less than 5 ppb for water extracted from the pumping well during 1992, which is significantly lower than the 1991 levels. Problems were encountered during the brief operation of the recirculating leach bed, but a similar system has performed well. Relatively simple, low-cost techniques provided significant potential for improving degradation rates.

SR 98-06

ICE DAMAGE TO CONCRETE.

Schulson, E.M., Apr. 1998, 48p., ADA-351 076, Refs. p.19-22.

52-6757

CONCRETE DURABILITY, CONCRETE FREEZING, CONCRETE PAVEMENTS, BRIDGES, FROST ACTION, FROST RESISTANCE, SALTING, CORROSION, CRACKING (FRACTURING), ROAD MAINTENANCE

Concrete is a porous material. When saturated with water and then cooled to below 0°C, it cracks internally. Upon repeated freezing and thawing, the cracks grow, interact, and lead eventually to macroscopic degradation, termed ice damage. This report reviews the phenomenon and considers the underlying mechanisms. New explanations are given for the deleterious effect of deicer salts and for the beneficial effect of entrained air.

SR 98-07

SOIL-VAPOR VERSUS DISCRETE SOIL SAMPLE MEASUREMENTS FOR VOCS IN THE NEAR-SURFACE VADOSE ZONE: FEASIBILITY STUDY.

Hewitt, A.D., June 1998, 9p., ADA-351 051, 24 refs.

53-1815

SOIL POLLUTION, SOIL ANALYSIS, SOIL TESTS, SOIL CHEMISTRY, MEASURING INSTRUMENTS, DESIGN

Soil vapor samples were taken from 1 m beneath the ground surface at 16 different locations. Measured trichloroethene (TCE) in these samples was compared to that obtained for a collocated sample of the soil matrix. The linear slope (0.806) and strong correlation (r^2=0.950) obtained for this comparison of soil vapor (mg TCE/L) to soil mass (mg TCE/kg) concentrations are in good agreement with recent theoretical and empirical models for this volatile organic compound (VOC) in a low organic carbon soil matrix. This strong relationship suggests that active soil-vapor measurements could be used as an alternative to collecting and analyzing discrete soil samples for establishing both the presence and concentration of VOCs during site characterization and monitoring. The techniques and instruments described here are robust, simple to use, and designed to enhance the reliability of soil-gas surveys to characterize vadose

zone VOC contamination.

SR 98-08

GROUND FREEZING EFFECTS ON SOIL EROSION OF ARMY TRAINING LANDS. PART 2: OVERWINTER CHANGES TO TRACKED-VEHICLE RUTS, YAKIMA TRAINING CENTER, WASHINGTON.

Halvorson, J.J., McCool, D.K., King, L.G., Gatto, L.W., July 1998, 46p., ADA-354 121, 30 refs. For pt.1 see 52-2227.

53-1818

SOIL EROSION, SOIL FREEZING, MILITARY OPERATION, TRACKED VEHICLES, ENVIRONMENTAL IMPACT, FREEZE THAW CYCLES, SOIL COMPACTION

Two areas were monitored at the Yakima Training Center in central Washington to measure changes in M1A2 Abrams tank-rut surface geometry, and in- and out-of-rut saturated hydraulic conductivity (K_{fs}), soil penetration resistance (SPR), and bulk density over the 1995-96 winter. Profile meter data show that rut cross-sectional profiles smoothed significantly and that turning ruts did so more than straight ruts. Rut edges were zones of erosion and sidewall bases were zones of deposition. K_{fs} values were similar in and out of ruts formed on soil with 0-5% water by volume, but were lower in ruts formed on soil with about 15% water. Mean SPR was similar in and out of ruts from 0- to 5-cm depth, increased to 2 MPa outside ruts and 4 MPa inside ruts at 10- to 15-cm depth, and decreased by 10-38% outside ruts and by 39-48% inside ruts at the 30-cm depth. Soil bulk density was similar in and out of ruts from 0- to 2.5-cm depth, and below 2.5 cm it was generally higher in ruts formed on moist soil, with highest values between 10- and 20-cm depth. Conversely, density in ruts formed on dry soil was similar to out-of-rut density at all depths. This information is important for determining impacts of tank ruts on water infiltration and soil erosion, and for modifying the Revised Universal Soil Loss Equation and the Water Erosion Prediction Project models to more accurately predict soil losses on Army training lands.

SR 98-09

SITE CHARACTERIZATION FOR EXPLOSIVES CONTAMINATION AT A MILITARY FIRING RANGE IMPACT AREA.

Jenkins, T.F., et al, Aug. 1998, 40p., ADA-353 433, 19 refs.

53-1816

EXPLOSIVES, ENVIRONMENTAL IMPACT, SOIL POLLUTION, SOIL ANALYSIS, SITE SURVEYS, MILITARY OPERATION

A study was conducted at the inland firing ranges at Fort Ord to determine the current levels of explosives residues and to recommend appropriate future site characterization techniques. A set of 280 soil samples was collected on the basis of the locations of current and former targets, and included an area away from specific targets and a background area, not affected by local detonations. HMX was the explosives residue present at the highest concentration. Much lower concentrations of RDX, TNT, and two isomers of aminodinitrotoluene were also detected. Explosives residues were largely confined to surface soils near tank targets. A major problem for site characterization was found to be the large spatial heterogeneity present. Composite samples very effectively provided representative samples for 5x5 m size grids. A colorimetric on-site method gave reliable results for HMX, relative to SW846 Method 8330. No currently available on-site method for RDX was found to be adequate in the presence of much higher concentrations of HMX.

SR 98-10

INTERNATIONAL CONFERENCE ON SNOW HYDROLOGY: THE INTEGRATION OF PHYSICAL, CHEMICAL, AND BIOLOGICAL SYSTEMS; ABSTRACTS.

International Conference on Snow Hydrology: The Integration of Physical, Chemical, and Biological Systems, Brownsville, VT, Oct.6-9, 1998, Hardy, J., ed, Albert, M., ed, Marsh, P., ed, Aug. 1998, 112p., ADA-359 332, One-page abstracts of 109 papers presented at the conference.

53-2442

SNOW HYDROLOGY, SNOW COVER, SNOW COMPOSITION, SNOW WATER EQUIVALENT, SNOWMELT, SNOW PHYSICS, FROZEN GROUND, ECOLOGY, TUNDRA, METAMORPHISM (SNOW), MODELS

This report comprises the abstracts of all papers presented at a special four-day conference on snow hydrology held in Vermont, USA, Oct. 6-9, 1998. The purpose of this conference was to provide a forum for sharing new knowledge on snow-cover properties and processes, chemical processes in the seasonal snow cover, biotic interactions with the seasonal snow cover, distributed snowmelt models, and scaling problems in snow hydrology. To encourage exchange between disciplines, papers were sought that addressed the relation between processes—physical, chemical and biological—and the integration and distribution of these processes over different spatial and temporal scales.

SR 98-11

ICETHK USER'S MANUAL: VERSION 1.

Tuthill, A.M., Wuebben, J.L., Gagnon, J.J., Sep. 1998, 26p., ADA-355 159, 11 refs.

53-1817

ICE MODELS, COMPUTER PROGRAMS, COMPUTERIZED SIMULATION, ICE JAMS, ICE COVER THICKNESS, RIVER ICE, UNITED STATES—VERMONT—WINOOSKI RIVER

This report describes the ICETHK computer model that is used in conjunction with the HEC-2 backwater model to simulate equilibrium ice jam profiles. The ICETHK model fulfills an important need in studies that require the calculation of ice-jam-affected stage. This report presents the theory and limitations of ICETHK and serves as a user's manual, and concludes with a discussion of river ice modeling using ICETHK.

SR 98-12

TECHNICAL ASSESSMENT OF MAGLEV SYSTEM CONCEPTS; FINAL REPORT BY THE GOVERNMENT MAGLEV SYSTEM ASSESSMENT TEAM.

Lever, J.H., ed, Oct. 1998, 215p., ADA-358 293, Refs. p.195-197.

53-2444

RAILROADS, COST ANALYSIS, COLD WEATHER PERFORMANCE, PERFORMANCE, TRANSPORTATION, MAINTENANCE, DESIGN, SAFETY

The Government Maglev System Assessment Team operated from 1991-93 as part of the National Maglev Initiative. The authors assessed the technical viability of four U.S. maglev system concepts, using the French TGV high-speed train and the German TR07 maglev system as assessment baselines. Maglev in general offers advantages that include high speed potential, excellent system control, high capacity, low energy consumption, low maintenance, modest land requirements, low operating costs, and ability to meet a variety of transportation missions. Further, the U.S. maglev concepts could provide superior performance to TR07 for similar cost or similar performance for less cost. They also could achieve both lower trip times and lower energy consumption along typical U.S. routes. These advantages result generally from the use of large-gap magnetic suspensions, more powerful linear synchronous motors and tilting vehicles. Innovative concepts for motors, guideways, suspension, and superconducting magnets all contribute to a potential for superior long-term performance of U.S. maglev systems compared with TGV and TR07.

SR 98-13

MOISTURE IN THE ROOFS OF COLD STORAGE BUILDINGS.

Tobiasson, W., Greatorex, A., Nov. 1998, 36p., ADA-358 258, 5 refs.

53-2441

MOISTURE, ROOFS, AIR LEAKAGE, THERMAL INSULATION, VAPOR DIFFUSION, COLD STORAGE, BUILDINGS, FREEZE THAW CYCLES

The low-slope roofs of 10 cold storage buildings in the Dallas area were examined visually and thermographically from above and below. Cores were taken to verify infrared findings and 12x12-in. specimens of many of the insulations were removed for laboratory studies of their thermal properties. Insulations included fibrous glass, fiberboard, perlite, wood fiber, expanded and extruded polystyrene, isocyanurate, and phenolic. Areas of wet insulation were found in 8 of the 10 roofs. Some wetness was due to leaks caused by flaws in the roofing membranes and their flashings, but some was associated with infiltration of warm, moist outside air at roof-wall intersections without effective air seals. Of all the insulations examined, permeable fibrous glass was the most susceptible to wetting by air infiltration. Sustained one-way vapor drive, the sealing-in of moisture at the base of insulation in roofs of cold storage buildings by freezing, and the limited opportunities for drying wet insulation in such roofs provide incentives to use insulation that is very resistant to wetting. Its very low rates of moisture gain by vapor diffusion and its resistance to wetting in the presence of freeze-thaw cycles make extruded polystyrene insulation particularly appealing for use in the roofs of cold storage buildings.

SR 98-14

NONSTRUCTURAL ICE CONTROL.

Haehnel, R.B., Dec. 1998, 36p., ADA-358 268, Refs. p.33-36.

53-2443

EXPLOSIVES, ICE CONTROL, ICE JAMS, ICEBREAKERS, ICE CUTTING, SAWS, ALBEDO, RIVER ICE, COST ANALYSIS, PERFORMANCE, DUSTING, ICE BLASTING, THERMAL REGIME, UNITED STATES—WISCONSIN—OCONTO RIVER, UNITED STATES—KANKAKEE RIVER

Nonstructural ice control measures are used for reducing the frequency and severity of ice jam damages that do not rely on the use of a structure placed in the river. This report is a comprehensive review of current nonstructural ice control methods in use. Both advance measures and emergency response methods are addressed. Where possible, the effectiveness of these methods has been assessed, and cost of application has been tabulated. In terms of development, some of these are still in their infancy, while others are well advanced in terms of available guidance and field experience. Nonstructural methods can be used to extend the operating envelope of structural measures and can play a role in an ice control strategy that uses both structural and nonstructural components to provide the desired results. There is little guidance currently available to predict the reduction in ice jam potential due to application of any of these measures. Further work in this area should focus on developing governing relationships that relate ice and river properties and meteorological conditions to ice jam potential and severity.

SR 99-01

FLUIDIZED-BED ADSORPTION BIOREACTOR FOR THE TREATMENT OF GROUNDWATER CONTAMINATED WITH SOLVENTS AT LOW CONCENTRATION.

Miyares, P.H., Teeter, C.V., Martel, C.J., Jan. 1999, 13p., ADA-359 347, 5 refs.

53-2523

GROUND WATER, WATER POLLUTION, SOIL POLLUTION, ENVIRONMENTAL IMPACT, LAND RECLAMATION, WATER TREATMENT, ADSORPTION, WASTE TREATMENT, SOIL MICROBIOLOGY, BACTERIA, DECOMPOSITION

Volatile organic compounds are a major source of water contamination in the U.S. They pose a threat to the environment and are a potential hazard to human health. Trichloroethylene (TCE) is the most common of these pollutants. TCE is usually remediated through pumping and treating it, using either air stripping or granular activated carbon. Bioremediation is an alternative treatment that uses microbes to convert hazardous substances into nonhazardous compounds. A fluidized bed adsorption bioreactor is examined here for the treatment of groundwater contaminated at low concentrations. This pilot study showed that the packed absorbent bed could be loaded in approximately 36 hours at a flow rate of 120 mL/min. The remediation phase of the process took approximately 13 days. The reduction in the TCE concentration in the sorbent during each round indicated that it was being remediated by the microbiological process. Areas that need to be improved are the rate of remediation and the loading capacity of the adsorption beds. Currently, each complete cycle of loading and remediating requires 2 weeks while only mineralizing 58 mg of TCE per column.

SR 99-02

EFFECT OF DISSOLVED NACL ON FREEZING CURVES OF KAOLINITE, MONTMORILLONITE, AND SAND PASTES.

Grant, S.A., Boitnott, G.E., Tice, A.R., Jan. 1999, 28p., ADA-360 406, 34 refs.

53-3684

SOIL FREEZING, UNFROZEN WATER CONTENT, CAPILLARITY, NUCLEAR MAGNETIC RESONANCE, ANALYSIS (MATHEMATICS), THERMODYNAMICS, LIQUID PHASES, FREEZING POINTS, SOLID PHASES

The authors developed a chemical-thermodynamic procedure for calculating the capillary pressures of aqueous NaCl solutions in a porous medium at temperatures below 0°C by extending the treatment by Brun et al. (1977). Ice in the porous medium was assumed to be a pure phase with thermophysical properties identical to bulk hexagonal ice. The thermophysical properties (and the attendant derivative and integral properties) of the electrolyte solutions were calculated with the Pitzer model as parameterized by Archer (1992). Experiments were conducted to test this procedure. Pastes of kaolinite clay, montmorillonite, and quartz sand were prepared by washing repeatedly with aqueous solutions of 0.1-, 0.01- and 0.001-mol/kg NaCl. The molar unfrozen water contents of these pastes were measured by pulsed nuclear magnetic resonance (NMR) in the temperature range -0.14°C to -66.6°C. The relationships between ice-solution capillary pressures and specific solution volumes for frozen pastes of each mineral were plotted for all initial solution molalites. While some systemic errors were evident, these plots indicated that the capillary pressure-volume relationships were consistent for pastes of the three minerals and, as expected from theory, unaffected by initial equilibrating solution molality.

SR 99-03

INVESTIGATIONS OF EXPLOSIVES AND THEIR CONJUGATED TRANSFORMATION PRODUCTS IN BIOTREATMENT MATRICES.

Thorne, P.G., Leggett, D.C., Feb. 1999, 12p., ADA-361 904, 27 refs.

53-3579

EXPLOSIVES, SOIL POLLUTION, LAND RECLAMATION

Samples of soil that had been aerobically composted or anaerobically digested were extracted with solvent, then hydrolyzed with base and then acid. The concentrations of extractable TNT and its monoamino and diamino transformation products fell rapidly after the first days of treatment. Hydrolysis of the solvent-extracted residues released significant quantities of intact transformation products. The concentrations of RDX and HMX were reduced in a similar fashion without the appearance of significant quantities of transformation products. A generalized approach to biotreatment matrices analyses was developed. Spike-recovery studies indicated that analyses of bioremediation matrices should be considered as a qualitative descriptor of the progress of humification and the capacity to covalently conjugate transformation products rather than as a quantitative measure of the absolute amounts of various analytes present.

SR 99-04

FROST INHIBITION ON TURFGRASS.

Palazzo, A.J., Cary, T.J., Hardy, S.E., Nagle, J.A., Apr. 1999, 4p., ADA-362 232, 5 refs.

53-5220

FROST RESISTANCE, FROST PROTECTION, GRASSES, COLD TOLERANCE

Frost is a common problem for golf courses in the early morning hours in the spring and fall. Walking on frosted turf turns it a dark bluish color initially and kills the leaf tissue, eventually causing an unsightly appearance. The objective of this study was to conduct a series of experiments to evaluate the effectiveness of a recently introduced frost-inhibition product called FROST-B-GONE (FBG) in preventing the formation of frost and subsequent damage to turfgrass. The material was studied at concentrations of 0, 5, 10, 15 and 20% and applied at a rate of 1629 L/ha. The results of these experiments showed that the FBG compound was effective in preventing frost on a bentgrass turf used for greens. Application of FBG at concentrations of 10, 15 and 20% six hours before frosting conditions was consistently effective in reducing the occurrence of frost on bentgrass leaf surfaces. FBG also had a residual frost-inhibition effect when the sod was frosted a second time without re-treatment. The frost-producing technique developed in these experiments proved successful with herbaceous plants and may be used to prepare plants for cold-tolerance or satellite-identification studies.

SR 99-05

STORAGE AND PRESERVATION OF SOIL SAMPLES FOR VOLATILE COMPOUND ANALYSIS.

Hewitt, A.D., May 1999, 21p., ADA-363 601, 22 refs.

53-4316

COLD STORAGE, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, SOIL POLLUTION, SOIL CHEMISTRY, PRESERVING, STORAGE

Traditionally, soil samples obtained for characterizing or monitoring sites for volatile organic compounds (VOCs) have been transported off site before initiating the preparation steps necessary for analysis. In the most recent regulatory guidance, only a two-day holding period at 4±2°C is recommended before a sample should be preserved, so as to allow storage up to 14 days prior to instrumental analysis. The transportation and storage of soil samples were evaluated for (1) covered core barrel liners, (2) En Core samplers and (3) empty volatile organic analysis (VOA) vials under different conditions. Core barrel liners covered with either of two formulations of Teflon sheeting or aluminum foil failed to prevent rapid losses of VOCs. En Core samplers and otherwise empty VOA vials were suitable transportation and storage chambers for samples. These chambers not only meet the initial requirement to retain VOCs for two days when held at 4±2°C for transportation purposes, but frequently showed no significant loss of VOCs after placing in a freezer and storing at -12±3°C for an additional 12 days.

SR 99-06

PAINTED ROCK RESERVOIR: 1993 WATER SURFACE AREA AND STORAGE CAPACITY ESTIMATE DERIVED FROM LANDSAT DATA CLASSIFICATION.

Bryant, E.S., et al, June 1999, 48p., ADA-365 909, 8 refs.

54-444

LANDSAT, RESERVOIRS, REMOTE SENSING, WATER STORAGE, DATA PROCESSING, UNITED STATES—ARIZONA—PAINTED ROCK RESERVOIR

The Painted Rock Reservoir, southwest of Phoenix, AZ, had a storage capacity of about 2.5 million acre-ft in 1959, when dam closure was made. It was projected that the reservoir would lose about 200,000 acre-ft of its capacity to sedimentation over 50 years. When the flood of record occurred in 1993, however, it was feared that as much as 500,000 acre-ft of capacity had been lost, and an updated capacity estimate was needed. Because a proposed conventional reservoir survey turned out to be prohibitively expensive, it was decided to investigate the use of Landsat Thematic Mapper remotely sensed data, acquired at multiple reservoir levels, to obtain an updated capacity estimate at a more reasonable cost. Nineteen Landsat Thematic Mapper scenes from 1993 and 1995 were obtained, including reservoir elevations ranging from empty to 5 ft above spillway elevation. Water surface area was determined for each Landsat scene using computer classification of the digital imagery. These surface area values, together with reservoir elevation records for the time of the Landsat data acquisitions and 1985 survey information, were used to generate an updated elevation vs. surface area curve for the reservoir, which in turn was used to compute an updated elevation vs. storage capacity curve. Investigation results indicate that the Painted Rock Reservoir lost approximately 157,000 acre-ft of storage capacity to sedimentation between 1953 and 1993, significantly less than the 500,000 acre-ft previously feared lost. This technique of using remotely sensed data to update area and capacity curves could be applied to other reservoirs, if (among other conditions) there is a record of reservoir elevation at the time of acquisition of the remotely sensed data, and if cloud-free data are available for the entire range of reservoir elevations from full to empty.

SR 99-07

GEOTEXTILE REINFORCEMENT OF LOW-BEARING-CAPACITY SOILS: COMPARISON OF TWO DESIGN METHODS APPLICABLE TO THAWING SOILS.

Henry, K.S., June 1999, 28p., ADA-370 635, 23 refs.

54-619

GEOTEXTILES, GROUND THAWING, BEARING STRENGTH, DESIGN, SOIL STRENGTH, STATIC LOADS, SUBGRADE SOILS, SOIL STABILIZATION, VEHICLES, TENSILE PROPERTIES

Thawing fine-grained soils are often saturated and have extremely low bearing capacity. Geosynthetics are used to reinforce unsurfaced roads on weak, saturated soils and therefore are good candidates for use in stabilization of thawing soils. To stabilize the soil, a geotextile is placed on it, then the geotextile is covered with aggregate. Design involves selection of aggregate thickness and geotextile. There are two commonly used design techniques for geotextile reinforcement of low-volume roads, and the Army uses one of them. The theory and use of the two design methods for static loading (i.e., up to 100 vehicle passes) are presented and compared in this report. The design method not used by the Army offers the potential to reduce aggregate thickness over the geotextile because it accounts for the fact that the geotextile helps support the traffic load (when in tension) and confines the soil between the wheels and the subgrade. However, this alternative method appears to be unconservative with respect to stresses estimated at the subgrade surface. Thus, the current Army design technique should be used until more research is conducted. In the meantime, straightforward design curves for Army 10- and 20-ton trucks as well as vehicle loading and tire pressure information for a number of other vehicles are included in this report to help make the current design method easy to use. Future work should consider adopting a hybrid design method that provides realistic estimates of stresses at the subgrade and accounts for the tensile properties of geotextiles. In addition, aggregates other than the high-quality crushed rock that is inherently assumed by each design method should be accounted for in new design development.

SR 99-08

FLOW CONTROL TO MANAGE RIVER ICE.

Tuthill, A.M., July 1999, 25p., ADA-366 402, 38 refs.

54-443

RIVER ICE, ICE JAMS, ICE BREAKUP, RIVER FLOW, FLOW CONTROL, ELECTRIC POWER, ICE NAVIGATION, ICE COVER, FREEZEUP, ICE FORMATION, FORECASTING, ICE SOLID INTERFACE, DAMS, LOCKS (WATERWAYS)

This report describes flow-control methods for reducing ice problems in rivers. Objectives include reducing ice interference with winter hydroelectric production and navigation, ice jam, flood mitigation, as well as ensuring minimum winter flows for fish and water supply. The winter season is divided into three periods. During early winter, the main objective of flow control is to promote the rapid formation of a smooth, stable ice cover. For the midwinter period, the aim of the river regulation is to maintain an intact ice cover and avoid premature ice breakup. During the final winter period, the goal is to minimize adverse effects of ice breakup. Examples illustrate the methods and objectives, emphasizing innovative approaches. Available flow regulation planning tools are described and valuable directions identified.

SR 99-09

ON-SITE METHOD FOR MEASURING NITROAROMATIC AND NITRAMINE EXPLOSIVES IN SOIL AND GROUNDWATER USING GC-NPD: FEASIBILITY STUDY.

Hewitt, A.D., Jenkins, T.F., Aug. 1999, 14p., ADA-367 069, 33 refs.

54-386

EXPLOSIVES, SOIL POLLUTION, GROUND WATER, WATER POLLUTION

An on-site method has been developed for estimating concentrations of TNT, RDX, 2,4-DNT, and the two most commonly encountered environmental transformation products of TNT,2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene, in soil and groundwater using gas chromatography and the nitrogen-phosphorus detector (NPD). Soil samples (20 g) are extracted by shaking with 20 mL of acetone, and extracts are filtered through a Millex SR (0.5-µm) filter. Groundwater samples (1 L) were passed through SDB-RPS extraction disks that were subsequently extracted with 5 mL of acetone. A 1-µL volume of a soil or water extract is manually injected into a field-transportable gas chromatography equipped with a NPD and a heated injection port. Separations are conducted on a Restek Crossbond 100% dimethyl polysiloxane column, 6 m x 0.53 mm i.d., 1.5 mm, using nitrogen carrier gas at 9.5 mL/min. Retention times range from 3.0 min. for 2,4-dinitrotoluene (2,4-DNT) to 5.6 min. for 2-amino-4,6-dinitrotoluene. Method detection limits were less than 0.16 mg/kg for soil and less than 1.0 µg/L for groundwater. One of the major advantages of this method, over currently available colorimetric and enzyme immunoassay on-site methods, is the ability to quantify individual target analytes that often coexist in soils and groundwater contaminated with explosive residues. This method will be particularly useful at military antitank firing ranges where it is necessary to quantify residual concentrations of RDX in the presence of high concentrations of HMX, and when the transformation products of TNT need to be identified.

SR 99-10

RADAR INVESTIGATIONS OF PROPOSED UTILIDOR SITES AT SOUTH POLE STATION.

Delaney, A.J., Arcone, S.A., Rand, J.H., Aug. 1999, 7p., ADA-367 042, 3 refs.

54-385

RADAR ECHOES, REMOTE SENSING, SITE SURVEYS, SNOW TUNNELS, STATIONS, TUNNELING (EXCAVATION), ANTARCTICA—AMUNDSEN-SCOTT STATION

At South Pole Station, ground penetrating radar profiles were recorded along the surveyed S-N and W-E routes of two proposed snow tunnels that would function as future water and sewer utilidors. The radar system was operated from within the cab of a tracked vehicle that towed two antennas in a sled. The two antennas transmitted pulses centered near 900 and 400 MHz to provide near-surface detail to penetration depths of 4.1 and 15.0 m, respectively. Eight longitudinal profiles, 518 m long, were recorded along the proposed S-N water line route, and 12 longitudinal profiles, 366 m long, were recorded along the proposed W-E sewer line route. Additional S-N profiles were recorded on the W-E route to delineate a particularly intense reflection. The profiles show that both proposed corridors contain many large and small buried items. Multiple targets at depths of 3.0 to 4.9 m occur along the S-N line. Along the W-E lines, there are multiple targets at similar depths. A particular area is densely cluttered and large targets appear on multiple parallel lines. Near the dome isolated targets appear at depths as great as 7.6 m.

SR 99-11

PROCEDURES FOR THE EVALUATION OF SHEET MEMBRANE WATERPROOFING.

Korhonen, C.J., Buska, J.S., Cortez, E.R., Greatorex, A.R., Aug. 1999, 67p., PB99-164717, 20 refs.

54-439

BRIDGES, WATERPROOFING, TENSILE PROPERTIES, WATER VAPOR, ADHESION, PERMEABILITY, SALTING, CHEMICAL ICE PREVENTION, DAMAGE

Sheet membrane waterproofing has been used to protect bridge decks against water and deicing salts by transportation agencies in New England for more than two decades. Though such membranes have proven useful at extending the useful life of bridge decks, there are no convenient methods to evaluate one membrane against another. This report details the genesis of blisters, a major problem for membranes, and defines test procedures to evaluate sheet membranes based on their ability to adhere to concrete, accommodate strain, resist puncturing, and pass water vapor. The results of these tests allow an engineer to compare sheet membranes based on material properties but they, alone, cannot be used to predict how well a membrane will perform in practice. Because a laboratory environment does not reflect the complex combination of forces and deterioration mechanisms a membrane is exposed to in the field, a follow-on study of the installation/design process and long-term performance of membranes in actual bridges needs to be conducted. This report provides a needed step toward the ability to predict sheet membrane service life.

SR 99-12

DETERMINATION OF NITROAROMATIC, NITRAMINE, AND NITRATE ESTER EXPLOSIVES IN SOILS USING GC-ECD.

Walsh, M.E., Ranney, T.A., Aug. 1999, 41p., ADA-368 184, 20 refs.

54-438

EXPLOSIVES, SOIL ANALYSIS, SOIL POLLUTION, MINES (ORDNANCE), DETECTION

Nitroaromatic, nitramine, and nitrate ester explosives are analytes of interest for hazardous waste site characterization and land mine detection. Traditionally determined by high-performance liquid chromatography (HPLC), these thermally labile analytes may be determined by gas chromatography (GC) by using direct injection into a deactivated liner and a short (6-m) wide-bore capillary column. Gas chromatography-electron capture detector (GC-ECD) and HPLC-ultraviolet (UV) concentration estimates of these compounds in field-contaminated soils from hazardous waste sites were compared, and excellent correlation (r>0.97) was found between the two methods of analysis for the compounds most frequently detected: 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4-dinitrotoluene (2,4-DNT), 1,3-dinitrobenzene (1,3-DNB), 1,3,5-trinitrobenzene (TNB), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX). GC-ECD method detection limits (MDL) were about 1 µg/kg for the di- and trinitroaromatics, about 10 µg/kg for the mononitroaromatics, 3 µg/kg for RDX, 25 µg/kg for HMX, and between 10 and 40 µg/kg for the nitrate esters (NG and PETN).

SR 99-13

EAGLE RIVER FLATS REMEDIATION PROJECT: COMPREHENSIVE BIBLIOGRAPHY—1950 TO 1998.

Nam, S.I., Walsh, M.R., Collins, C.M., Thomas, L., Aug. 1999, 99p., ADA-367 854, Annotated refs. p.5-91.

54-442

WETLANDS, BIBLIOGRAPHIES, ENVIRONMENTAL IMPACT, POLLUTION, LAND RECLAMATION, MILITARY FACILITIES, MILITARY OPERATION, DREDGING, ENVIRONMENTAL PROTECTION, UNITED STATES—

ALASKA—EAGLE RIVER FLATS, UNITED STATES—ALASKA—FORT RICHARDSON

White phosphorus (WP) has been implicated in the deaths of thousands of waterfowl annually at Eagle River Flats (ERF), an estuarine salt marsh located on Fort Richardson near Anchorage, AK. The source of WP contamination at ERF was the firing of WP-containing munitions into the area by the U.S. military. WP is a well-known toxicant and is lethal to a wide range of species. However, WP contamination at ERF is the first documented case of a U.S. Army munitions impact area contaminated with WP particles. This has led to the designation of ERF as a Superfund site by the U.S. Environmental Protection Agency, and the Army must follow guidelines of remediation set by the Comprehensive Environmental Response, Compensation, and Liability Act. Numerous studies have been conducted to better characterize the nature and the extent of WP contamination, and treatability studies for remediation processes are currently being implemented. This comprehensive bibliography provides all publications related to WP contamination remediation project at Eagle River Flats through 1998.

SR 99-14

RESILIENT MODULUS FOR NEW HAMPSHIRE SUBGRADE SOILS FOR USE IN MECHANISTIC AASHTO DESIGN.

Janoo, V.C., Bayer, J.J., Jr., Durell, G.D., Smith, C.E., Jr., Sep. 1999, 35p., ADA-368 644, 6 refs.

54-441

SUBGRADE SOILS, SOIL TESTS, GROUND THAWING, SOIL WATER, DESIGN CRITERIA, GRAVEL, FREEZE THAW TESTS, ROADS, PAVEMENTS, CLAYS, SANDS, GLACIAL TILL

Resilient modulus tests were conducted on five subgrade soils commonly found in the state of New Hampshire. Tests were conducted on samples prepared at optimum density and moisture content. To determine the effective resilient modulus of the various soils for design purposes, tests were conducted at room temperature and at freezing temperatures. The AASHTO TP 46 test protocol was used for testing room temperature and thawing soils. At freezing temperatures, the CRREL test protocol was used. The results from this test program are presented in this report. In addition, suggested effective resilient modulus for the five soils are presented.

SR 99-15

COMPARISONS OF DIGITAL TERRAIN DATA FOR WETLAND INVENTORY ON TWO ALASKAN ARMY BASES.

Melloh, R.A., Racine, C.H., Sprecher, S.W., Greeley, N.H., Weyrick, P.B., Nov. 1999, 21p., 17 refs.

54-630

WETLANDS, LANDSAT, SOIL MAPPING, TOPOGRAPHIC MAPS, SOIL WATER, TERRAIN IDENTIFICATION, TAIGA, PERMAFROST DISTRIBUTION, DISCONTINUOUS PERMAFROST, UNITED STATES—ALASKA—FORT RICHARDSON, UNITED STATES—ALASKA—FORT WAINWRIGHT

The nation's military installations encompass undeveloped lands that have become increasingly important as wildlife habitats. Resource managers of the installations need wetland inventories to improve stewardship of these lands. Digital geographic data are readily available to land managers. The use of these data to inventory wetlands has not been demonstrated. As part of a project to integrate wetlands into the ITAM (Integrated Training Area Management) program for managing Army lands, wetland inventory methods using existing digital geographic information for two terrains on Army installations in Alaska were explored: (1) glacial moraine depressions and estuarine marsh on Fort Richardson, and (2) discontinuous permafrost and taiga forest on Fort Wainwright's Yukon Command training site. The results show that (1) existing geographic data used to infer wetland locations (Landsat Thematic Mapper [TM], National Wetland Inventory [NWI] maps, and hydric soil maps) only partly agree, and (2) optimum Landsat TM band combinations for wetland inventory vary on a site-specific basis. Landsat TM classifications (unsupervised) of Fort Richardson wetlands compared reasonably well (0.73 Kappa Index of Agreement [KIA]) with the NWI map as long as the band combinations included at least one visible and the near-infrared wavelength band (e.g., bands 3, 4, and 5 or bands 2, 3, and 4). The Fort Richardson hydric soils map indicates more extensive wetlands than indicated by the NWI (0.64 KIA). The Landsat TM classification could be made to agree fairly well the NWI map (0.73 KIA). At Fort Wainwright, use of the thermal wavelength band (6, 4, and 2 composite) improved Landsat TM classification agreement with the NWI (0.67 KIA) because of warmer apparent brightness temperatures of lowland wetland sites compared to upland forested sites. Topographic position in the taiga forest plays a strong role in determining soil moisture, dominant vegetation, and whether or not the site is underlain by permafrost; therefore, a wet terrain map derived from a digital elevation model agreed nearly as well to the NWI map (0.64 KIA) as did the Landsat TM classification (0.67 KIA). Existing geographic information can serve as an initial wetland map. However, accurate wetland maps will require field mapping.

SR 99-16

SAMPLING AND ON-SITE ANALYTICAL METHODS FOR VOLATILES IN SOIL AND GROUNDWATER: FIELD GUIDANCE MANUAL.

Hewitt, A.D., Myers, K.F., Nov. 1999, 14p., 26 refs.

54-631

MANUALS, GROUND WATER, SAMPLING, SOIL ANALYSIS, SOIL POLLUTION, WATER POLLUTION, WATER CHEMISTRY

Volatile organic compounds (VOCs) are among the most frequently identified contaminants in soil and groundwater samples obtained during the investigation of suspected hazardous waste sites. Because some VOCs and their degradation products are potentially mutagenic, carcinogenic, or teratogenic, their concentrations in these two matrices are key factors in the risk assessment process. Furthermore, when risk-based corrective actions are deemed necessary, the subsequent selection and implementation of the appropriate remediation technologies rely heavily upon the VOC concentrations established during site characterization activities. This report briefly addresses procedures, equipment, and logistics for the collection and timely (less than 48 hr) on-site analysis of VOCs in discrete soil and groundwater samples. The collection, preservation, and preparation procedures presented strive to acquire and maintain analyte concentrations that are representative of the location and medium from which the sample was removed.

MONOGRAPHS

M 96-01
OPTICAL PROPERTIES OF SEA ICE.
Perovich, D.K., May 1996, 25p., ADA-310 586, Refs. p.21-23.
51-514
SEA ICE, ICE OPTICS, ALBEDO, SCATTERING, AIR ICE WATER INTERACTION, BRINES, ABSORPTION, ICE MODELS, LIGHT TRANSMISSION, SNOW COVER EFFECT, SOLAR RADIATION, ANTARCTICA—WEDDELL SEA
Sea ice is a translucent material with an intricate structure and complex optical properties. Understanding the reflection, absorption, and transmission of shortwave radiation by sea ice is important to a diverse array of scientific problems, including those in ice thermodynamics and polar climatology. Radiative transfer in sea ice is a combination of absorption and scattering. Differences in the magnitude of sea ice optical properties are due primarily to differences in scattering. Spectral variations are mainly a result of absorption. Changes in such optical properties as the albedo, reflectance, transmittance, and extinction coefficient are directly related to changes in the state and structure of the ice. Physical changes that enhance scattering, such as the formation of air bubbles due to brine drainage, result in larger albedos and extinction coefficients. The albedo is quite sensitive to the surface state. If the ice has a snow cover, albedos are large. In contrast, the presence of liquid water on a bare ice surface causes a decrease of albedo, which is more pronounced at longer wavelengths. Sea-ice optical properties depend on the volume of brine and air and on how the brine and air are distributed.

M 96-02
ATMOSPHERIC BOUNDARY LAYER OVER POLAR MARINE SURFACES.
Andreas, E.L., June 1996, 38p., ADA-313 642, Refs. p.34-38.
51-533
AIR ICE WATER INTERACTION, ATMOSPHERIC BOUNDARY LAYER, MATHEMATICAL MODELS, TURBULENCE, SNOW COVER EFFECT, SEA ICE, POLAR ATMOSPHERES, SURFACE ROUGHNESS, HEAT TRANSFER COEFFICIENT, ANTARCTICA—WEDDELL SEA
The Atmospheric Boundary Layer (ABL) over polar marine surfaces is, in ways, simpler and, in other ways, more complex than ABLs in other environments. It is simpler because topographic effects are rarely a concern, the surface is fairly homogeneous, and roughness lengths over sea ice and the ocean are much smaller than they are over land. It is complex because the stratification is usually stable, and stable ABLs have not yielded to quantification as readily as convective ABLs have. This report reviews some of these characteristics of ABLs over polar marine surfaces, including the Weddell Sea. The ABL, by definition, is the turbulent layer between the Earth's surface and the (generally) nonturbulent free atmosphere. Hence, the emphasis is on turbulence processes—in particular, the turbulent transfer of momentum and sensible and latent heat over sea ice. As such, this report reviews both the theoretical and observational bases for the understanding of the mean structure of the ABL. Understanding this structure then allows predicting the turbulent surface fluxes of momentum and sensible and latent heat. (Auth.)

M 98-01
CONSTRUCTION, MAINTENANCE, AND OPERATION OF A GLACIAL RUNWAY, MCMURDO STATION, ANTARCTICA.
Blaisdell, G.L., Lang, R.M., Crist, G., Kurtti, K., Harbin, R.J., Flora, D., Mar. 1998, 122p., ADA-348 091, Refs. passim.
52-5984
ICE RUNWAYS, ICE (CONSTRUCTION MATERIAL), COLD WEATHER CONSTRUCTION, COLD WEATHER OPERATION, MAINTENANCE, SITE SURVEYS, ICE STRENGTH, LOGISTICS, ANTARCTICA—MCMURDO STATION
On Feb. 7, 1994, a C-141 departed Christchurch, New Zealand, and landed on the 3050 m Pegasus glacial ice runway, located on the Ross Ice Shelf. This event marked the final test for a five-year development program to demonstrate the feasibility of a semipermanent glacial ice runway capable of supporting heavy wheeled aircraft at a site easily accessible to McMurdo. In the later phases of developing the glacial ice runway, numerous working flights of LC-130s operating on wheels moved cargo more efficiently to the South Pole, and the LC-130 and a C-130 carried larger passenger loads to Christchurch. The primary benefit of the Pegasus runway to the U.S. Antarctic Program is its ability to support heavy wheeled aircraft for most of the period of mid-Jan. through Nov. In the past, only ski-equipped aircraft could land in the McMurdo area during this time period. The Pegasus runway allows increased payloads for the LC-130 and provides access for virtually any conventional aircraft. The technology for siting, constructing, maintaining, and operating such a runway is now well understood and is described in detail in this comprehensive report. (Auth.)

TECHNICAL DIGESTS

TD 92-01
WINTERIZATION AND WINTER OPERATION OF AUTOMOTIVE AND CONSTRUCTION EQUIPMENT.
Diemand, D., Sep. 1992, 28p., 16 refs.
52-1925
MOTOR VEHICLES, ENGINES, ENGINE STARTERS, ANTIFREEZES, LUBRICANTS, WINTER MAINTENANCE, COLD WEATHER OPERATION

MISCELLANEOUS PUBLICATIONS

MP 3828
DETRENDING TURBULENCE TIME SERIES WITH WAVELETS.
Andreas, E.L., Treviño, G., Workshop on Nonstationary Random Processes and Their Applications, 2nd, San Diego, CA, June 11-12, 1995. Proceedings. Current topics in nonstationary analysis, Singapore, World Scientific Publishing Co., 1996, p.35-73, 23 refs.
51-1064
ATMOSPHERIC PHYSICS, CLIMATOLOGY, ATMOSPHERIC BOUNDARY LAYER, TURBULENCE, DETECTION, WAVE PROPAGATION, PERIODIC VARIATIONS, MATHEMATICAL MODELS, SPECTRA, STATISTICAL ANALYSIS, CORRELATION
Wavelets are a new class of basis functions that are finding wide use for analyzing and interpreting turbulence data. Here the authors describe a new use for wavelets: identifying trends in turbulence time series. The inverted Haar wavelet and the elephant wavelet are used, respectively, to estimate the first-order and second-order coefficients in the trend polynomial. The analysis shows that wavelet trend detection is roughly half as accurate as least-squares trend detection when accuracy is evaluated in terms of the mean-square error in estimates of the first-order and second-order trend coefficients. Wavelet trend detection is first demonstrated with artificial data and then with various data collected in the atmospheric surface layer. Guidelines are provided on when linear and quadratic trends are "significant" enough to require removal from turbulence series. (Auth. mod.)

MP 3829
PERSISTENCE OF WHITE PHOSPHORUS (P_4) PARTICLES IN SALT MARSH SEDIMENTS.
Walsh, M.E., Collins, C.M., Racine, C.H., *Environmental toxicology and chemistry,* 1996, 15(6), p.846-855, 19 refs.
51-1065
WETLANDS, ESTUARIES, WATER POLLUTION, BOTTOM SEDIMENT, SOIL POLLUTION, EXPLOSIVES, AEROSOLS, SEDIMENTATION, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, SAMPLING, TEMPERATURE EFFECTS, SATURATION
Remediation of sediments at Eagle River Flats, AK, a salt marsh contaminated with solid particles of white phosphorus (P_4), may require severe alterations of the wetland by dredging, draining, or covering. However, some sediments may undergo decontamination naturally in areas that are seasonally subaerially exposed. The persistence of millimeter-size P_4 particles was studied in laboratory and field experiments. White phosphorus particles were found to be persistent in saturated sediments. In unsaturated sediments, loss was rapid (within 24 h) at 20°C, and was retarded by low temperatures. (Auth. mod.)

MP 3889
ELEMENTAL MOBILITY THROUGH SMALL TUNDRA WATERSHEDS.
Marion, G.M., *Arctic and alpine research,* Aug. 1996, 28(3), p.339-345, 39 refs.
51-110
ECOSYSTEMS, TUNDRA SOILS, WATERSHEDS, TUNDRA VEGETATION, SOIL CHEMISTRY, LEACHING, NUTRIENT CYCLE, GEOCHEMICAL CYCLES, SIMULATION, STATISTICAL ANALYSIS
This paper summarizes a 4-yr irrigation-fertilization experiment designed to evaluate elemental mobility through small tundra watersheds and examines the "leaky ecosystem-nutrient" hypothesis. Soil solutions were saturated with respect to gibbsite, suggesting that a gibbsite-like mineral may control Al solubility in these arctic soils. Comparisons of elemental concentrations among tundra ecosystems indicate that weathering rates are highly individualistic, depending critically on soil parent material. Furthermore, tundra ecosystems are leaky with respect to nutrients, which may have ramifications well beyond the disturbance both with respect to time and space, and warrants attention in assessing the future response of tundra ecosystems.

MP 3890
ELECTROTHERMODYNAMIC MODEL WITH DISTRIBUTED PROPERTIES FOR EFFECTIVE PERMITTIVITIES OF SEA ICE.
Nghiem, S.V., Kwok, R., Kong, J.A., Shin, R.T., Arcone, S.A., Gow, A.J., *Radio science,* Mar.-Apr. 1996, 31(2), p.297-311, 26 refs.
51-153
SEA ICE, ICE PHYSICS, THERMODYNAMIC PROPERTIES, ELECTROMAGNETIC PROPERTIES, WAVE PROPAGATION, SCATTERING, ICE MICROSTRUCTURE, ICE MODELS, ICE DIELECTRICS, SOLUTIONS, ANISOTROPY, MATHEMATICAL MODELS
This paper presents a model to calculate the temperature dependence of effective permittivities for sea ice, a heterogeneous medium containing multiphase scatterers. With the strong permittivity fluctuation approach, the model accounts for the electrodynamic scattering effect together with the quasi-static characteristics of multiple species and subspecies of inhomogeneities with distributed orientations, sizes, and shapes. Because of a preferential direction in the orientation distribution, the medium is effectively anisotropic. The size distribution is described with a probability density function in terms of normalized volumetric sizes. Scatterer shapes are nonuniform and have a general ellipsoidal form characterized by arbitrary axial ratios of correlation lengths which are related to physical geometries of the scatterers. In this formulation, sea ice consisting of solid ice, liquid brine, and gaseous inclusions is modeled to derive effective permittivities with thermodynamic phase redistribution and structural metamorphism. Theoretical results are in good agreement with experimental data at the C band frequency of 4.8 GHz for saline ice undergoing warming and cooling cycles. A competitive effect between the increase of liquid brine and the shape rounding of ellipsoidal scatterers at increasing temperatures explains the trend observed in measured data. Sensitivities of effective permittivities to structural and physical parameters characterizing sea ice are also studied.

MP 3891
METAMORPHISM OF POLAR FIRN: SIGNIFICANCE OF MICROSTRUCTURE IN ENERGY, MASS AND CHEMICAL SPECIES TRANSFER.
Davis, R.E., Arons, E.M., Albert, M.R., Chemical exchange between the atmosphere and polar snow. North Atlantic Treaty Organization. Advanced Science Institutes. NATO ASI Series I, Vol.43. Edited by E.W. Wolff and R.C. Bales, Berlin, Springer-Verlag, 1996, p.379-401, Refs. p.398-401.
51-189
POLAR ATMOSPHERES, ATMOSPHERIC COMPOSITION, SNOW AIR INTERFACE, SNOW COMPOSITION, SNOW HEAT FLUX, METAMORPHISM (SNOW), DEPTH HOAR, FIRN STRATIFICATION, ICE COMPOSITION, ICE MICROSTRUCTURE
Energy, mass transfer and grain recrystallization processes show the most dynamic variation in the upper few meters of polar firn. The understanding of processes in dry snow and polar firn shows that feedback mechanisms exist between microstructure changes and energy and mass transfer coefficients. Differences between the predominant processes in the short polar summer and the winter cause sharp textural discontinuities in the stratigraphic columns at many polar locations. This distinctive layering forms the basis of studies on accumulation rates, layer ages and other investigations pertinent to firn and ice core analysis. Processes forming the stratification of firn are not completely understood, nor are the associated loading patterns of chemical species. Past research on energy and mass transfer in near-surface polar firn is briefly surveyed. Current research focuses on processes controlled by the geometry of the ice and pore phases in the snow and firn. An overview is given of some of this work.

MP 3892
FIRN PROPERTIES AFFECTING GAS EXCHANGE AT SUMMIT, GREENLAND: VENTILATION POSSIBILITIES.
Albert, M.R., Arons, E.M., Davis, R.E., Chemical exchange between the atmosphere and polar snow. North Atlantic Treaty Organization. Advanced Science Institutes. NATO ASI Series I, Vol.43. Edited by E.W. Wolff and R.C. Bales, Berlin, Springer-Verlag, 1996, p.561-565, 13 refs.
51-196
POLAR ATMOSPHERES, ATMOSPHERIC COMPOSITION, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW COMPOSITION, FIRN STRATIFICATION, SNOW PERMEABILITY, AIR FLOW, VAPOR DIFFUSION, GREENLAND
The processes by which chemical species in the atmosphere become incorporated in firn depend both upon the nature of the forcing from the atmosphere and upon the properties of the firn itself. These processes include both diffusion and advection (the transport of heat, vapor, and chemical species by air flow within the snow and firn). In this paper the authors present recent field measurements of firn properties relevant to the transport processes, and use simplified model calculations to investigate the possibility of advection at Summit. Advective processes include the result of wind-driven air flow through the snow and firn, also called ventilation or wind-pumping. If present in the firn, the air flow would advect heat, mass, and chemical species through the firn at rates far greater than diffusive processes permit. In a theoretical analysis, Colbeck concluded that surface topography would be the main driver of ventilation, and suggested that the majority of the flow may be within the surface features themselves. In another theoretical analysis, Clarke and Waddington showed that pressure disturbances due to wind turbulence over flat terrain attenuate with depth, depending on both the temporal and spatial frequency content of the pressure signal. Albert and McGilvary showed that the temperature profile resulting from ventilation is controlled by a balance between heat carried by the dry air flow and heat conduction due to boundary temperatures.

MP 3893
BREAKAGE OF FLOATING ICE BY COMPRESSED GAS BLASTING.
Mellor, M., Kovacs, A., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, July 1971, 50p., 12 refs. For another version see 27-2529.
51-256
ICE BREAKING, ICE BLASTING, ICE NAVIGATION, EXPLOSIVES

MP 3894
THERMAL PERFORMANCE OF AN UNATTENDED SEISMOLOGICAL OBSERVATORY NEAR FAIRBANKS, ALASKA.
Berg, R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Feb. 1970, 106p., 6 refs.
51-257
SEISMIC SURVEYS, BOREHOLE INSTRUMENTS, PERMAFROST BENEATH STRUCTURES, THAW DEPTH, FROST PROTECTION, COLD WEATHER PERFORMANCE, UNITED STATES—ALASKA—FAIRBANKS

MP 3895
INTRUSION-DETECTION SENSORS IN A COLD ENVIRONMENT, LORING AFB TEST SITE, MARCH-JUNE 1971.
Stevens, H.W., Bates, R.E., Ricard, J., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Aug. 1971, 131p.
51-258
MILITARY FACILITIES, DETECTION, SENSORS, WARNING SYSTEMS, COLD WEATHER TESTS, UNITED STATES—MAINE

MP 3896
ON THE MESOSCALE INTERACTION OF LEAD ICE AND FLOES.
Hopkins, M.A., *Journal of geophysical research,* Aug. 15, 1996, 101(C8), p.18,315-18,326, 16 refs.
51-260
OCEANOGRAPHY, SEA ICE DISTRIBUTION, ICE COVER THICKNESS, PACK ICE, ICE OPENINGS, DRIFT, ICE MECHANICS, ICE DEFORMATION, PLASTIC DEFORMATION, PRESSURE RIDGES, STRESS CONCENTRATION, COMPUTERIZED SIMULATION, ICE MODELS, MATHEMATICAL MODELS
This paper constructs a mesoscale (10-100 km) granular model of the central arctic ice pack. The mesoscale model is based on a dynamic particle simulation in which individual multiyear ice floes and surrounding parcels of first-year ice are explicitly modeled as discrete, convex polygons in a two-dimensional domain. The paper focuses on the results of numerical experiments performed with the mesoscale model. In the experiments the model ice pack is biaxially deformed at constant strain rates. The principal strain rates are varied to create deformation states ranging from pure shear to uniform compression. The results define the shape and magnitude of the plastic yield surface, the strain rate vectors associated with points on the yield surface, the partition of energy dissipation between ridging and in-plane sliding, and the changes in the ice thickness distribution associated with various deformation states. (Auth. mod.)

MP 3897
PHYSICAL CONTROLS ON THE DEVELOPMENT AND CHARACTERISTICS OF ANTARCTIC SEA ICE BIOLOGICAL COMMUNITIES—A REVIEW AND SYNTHESIS.
Ackley, S.F., Sullivan, C.W., Advanced Study Institute on the Physics of Ice Covered Seas, Savonlinna, Finland, June 6-17, 1994. Selected papers, Savonlinna, 1994, 24p. + figs., Refs. p.16-23. For another

version see 49-1792 or 23J-51832.
51-265
MARINE BIOLOGY, ECOSYSTEMS, PACK ICE, FRAZIL ICE, ICE MICROSTRUCTURE, BIOMASS, ALGAE, SEASONAL VARIATIONS, SNOW COVER EFFECT
Ice structures found in antarctic sea ice and related morphological processes are summarized, including: frazil ice growth; the flooded snow layer; pressure ridge induced flooding; thermally driven brine drainage; and platelet-ice formation. The associated colonization, physiological adaptation and growth of sea ice biota within these structures, to the levels presently identifiable, also are reviewed. A strong interaction exists between the physical processes that form, evolve and deteriorate sea ice and the biological communities located within it. Variability of ice structure and associated biological communities over small spatial scales necessitated analysis of the biological component in combination with physical and chemical properties of the sea ice. The ice microstructure provides indications of the growth and evolution of the ice properties and initially defines how ice biota colonize the ice. The light, temperature, space and nutrient fields within which ice biota subsequently adapt and grow are the other key determinants of the biology. (Auth. mod.)

MP 3898
BREAKTHROUGH LOADS OF FLOATING ICE SHEETS.
Sodhi, D.S., *Journal of cold regions engineering.* Mar. 1995, 9(1), p.4-22, 28 refs.
51-278
FLOATING ICE, LAKE ICE, RIVER ICE, ICE SOLID INTERFACE, BEARING STRENGTH, DYNAMIC LOADS, SHEAR STRENGTH, CRACKING (FRACTURING), ICE DEFORMATION, ICE MECHANICS, FLEXURAL STRENGTH, PENETRATION TESTS, MATHEMATICAL MODELS
In this paper, a theoretical formulation is presented to derive an expression for floating ice sheet breakthrough lead using plastic limit analysis. The velocity field in the vicinity of a distributed load is assumed, and the stresses induced in the columnar ice are assumed to be the biaxial strength, which depends on the strain rate derived from assumed velocity field. The breakthrough load is obtained by equating the rate of work done by the load to the rate of energy dissipation during compression of ice caused by radial and circumferential wedging of ice during deformation. The agreement between the theoretical estimates and the experimental breakthrough loads is good if energy dissipation due to radial deformation along circumferential cracks is ignored.

MP 3899
COMMENTS ON "THE TEMPERATURE OF EVAPORATING SEA SPRAY DROPLETS".
Kepert, J.D., Andreas, E.L., *Journal of the atmospheric sciences,* June 1, 1996, 53(11), p.1634-1645, 22 refs. Includes reply. For pertinent paper see 49-5389.
51-289
MARINE ATMOSPHERES, CLOUD PHYSICS, CLOUD DROPLETS, TURBULENT BOUNDARY LAYER, SEA SPRAY, EVAPORATION, WATER TEMPERATURE, TEMPERATURE VARIATIONS, FORECASTING, STATISTICAL ANALYSIS, COMPUTERIZED SIMULATION, ANALYSIS (MATHEMATICS)
The time evolution of a single sea spray droplet can be conveniently understood in terms of the time for the droplet temperature to change from the sea surface temperature to its evaporation temperature T_{ev}. Andreas (1995, henceforth A95) derives and presents a set of reasonable approximations to T_{ev}, which are useful for part of the relevant parameter space. Here are presented two alternative approximations, derived in a mathematically somewhat more formal manner, which are more accurate than those of A95, are valid over a much wider range of the parameter space, and are computationally of similar efficiency.

MP 3900
SPRING THAW AT THE MINNESOTA ROAD RESEARCH PROJECT TESTING FACILITY.
Kestler, M.A., Berg, R.L., Schrader, C., Johnson, G., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1995, 15p., 12 refs. To be presented at the 4th International Symposium on Unbound Aggregates in Roads (UNBAR4), Nottingham, England, July 17-19, 1995.
51-301
PAVEMENTS, SUBGRADE SOILS, SOIL TRAFFICABILITY, FROST PENETRATION, THAW DEPTH, THAW WEAKENING, BEARING STRENGTH, IMPACT TESTS, ROAD MAINTENANCE, UNITED STATES—MINNESOTA
The Minnesota Road Research Project (Mn/ROAD), approximately 64 km (40 mi) northwest of Minneapolis, MN, comprises forty 150-m (500-ft) long pavement test cells. The cells were designed for several different service lives, and are composed of a variety of thicknesses and materials. An intensive monitoring program was undertaken in Mar. and Apr. 1994 to assess variations in pavement strength through spring thaw. Observations were conducted on 14 test cells by the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) and Minnesota Department of Transportation (Mn/DOT). For six weeks, soil moisture, frost depths and thaw depths were measured and Heavy Weight Deflectometer (HWD) tests were conducted. A multivariate analysis was conducted on these data for a test cell comprising 146 mm (5.75 in.) of asphalt concrete and 838 mm (33 in.) of aggregate base course. From the analysis, correlations between various parameters were determined and simple indices for estimating layer moduli from HWD data were developed.

MP 3901
COLD WEATHER OPERATIONS—CAN SIMULATION BE THE ROAD TO VICTORY.
Link, L.E., Jr., Hill, D.R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1995, 15p., Refs. passim. Presented at the Army Operations Research Symposium, Fort Lee, VA, Oct 10-12, 1995.
51-302
COLD WEATHER OPERATION, MILITARY OPERATION, MILITARY RESEARCH, ENVIRONMENT SIMULATION

MP 3902
COLD REGIONS ENVIRONMENTAL MODELING FOR DISTRIBUTED INTERACTIVE SIMULATION.
Fiori, J.E., Davis, R.E., Koenig, G.G., Henson, J., Bates, R.E., Workshop on Standards for the Interoperability of Distributed Simulations, 13th DIS (Distributed Interactive Simulation), Orlando, Sep. 18-22, 1995. Vol.1. Position papers, Orlando, University of Central Florida, Institute for Simulation and Training, 1995, p.79-83, 15 refs.
51-365
MILITARY OPERATION, COLD WEATHER OPERATION, MILITARY RESEARCH, SNOW COVER EFFECT, INFRARED RECONNAISSANCE, RADAR TRACKING, TERRAIN IDENTIFICATION, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, DATA PROCESSING
A demonstration has been developed to show high fidelity Environmental Effects (EE) and their dynamics related to seeker performance and surveillance. Spatially distributed model results from a 72 hour period over snow cover and thaw conditions were animated. This model component was driven by meteorological measurements, which were used to calculate surface energy and mass budgets, material maps and Digital Terrain Elevation Data (DTED). Infrared (IR) and Millimeter Wave (MMW) signatures were predicted from output of the energy and mass transfer model, and were used to generate scenes from a similar perspective. These scenes were also animated. The IR and MMW scene animations demonstrate large temporal and spatial variations over relatively short time intervals and spatial scales on the order of meters. While the IR component of EE simulations is currently physically based, the MMW component relies on an expert system consisting of a hybrid physical-empirical model. Physically-based MMW modules are currently under development. Because of constraints on computing outlay required for these predictions in real time, the authors propose conceptual methods to pass Protocol Data Units (PDUs) describing EE to Distributed Interactive Simulations (DIS). This concept is based on the client-server model, where PDUs are drawn by an expert system from precalculated data, based on attributes passed in from other DIS servers.

MP 3903
WINTER IN DISTRIBUTED INTERACTIVE SIMULATION.
Johnston, D.J., Bates, R.E., Workshop on Standards for the Interoperability of Distributed Simulations, 12th DIS (Distributed Interactive Simulation), Orlando, Mar. 13-17, 1995. Vol.1. Position papers, Orlando, University of Central Florida, Institute for Simulation and Training, 1995, p.119-127, 2 refs.
51-366
MILITARY OPERATION, COLD WEATHER OPERATION, MILITARY RESEARCH, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION
This paper reports on a study that was conducted to define winter requirements for Distributed Interactive Simulation (DIS). The objective was accomplished by enumerating a set of environmental features and embedded processes that uniquely define winter conditions; identifying factors that affect the performance of simulated battlefield functions; and by describing how winter conditions influence those factors. The study used TRADOC Pamphlet 11-9, *Blueprint of the Battlefield*, as its starting point to identify battlefield functions that are performed in the tactical level of war, are likely to be simulated in DIS, and are directly subject to winter conditions. It then associated these functions with battlefield tasks which are critical to their performance, and identified factors that affect those tasks. It then described how the environmental features and embedded process which are unique to the winter environment influence these factors. The results are intended to provide guidance to workshop attendees who are considering architectural enhancements to the DIS standard, and to developers, who are implementing dynamic environmental effects in DIS applications.

MP 3904
SEA ICE.
Ackley, S.F., Encyclopedia of Applied Physics. Vol.17, New York, VCH Publishers, Inc., [1996], p.81-103, 15 refs.
51-406
SEA ICE, ICE STRUCTURE, ICE FORMATION, PHYSICAL PROPERTIES, ICE WATER INTERFACE, AIR ICE WATER INTERACTION, ICE COVER EFFECT, ICE HEAT FLUX, MARINE BIOLOGY, CLIMATIC FACTORS
The properties of sea ice are sensitive to the growth conditions and, after formation of the initial ice cover, its thermal and dynamic history. These conditions are both spatially and temporally variable, leading to significant differences in sea-ice behavior from location to location and season to season. The theme of this entry is to develop the relationship between these processes and the resulting ice properties and ice distribution, and then review how the sea ice interacts with the geophysical and biological environments. (Auth. mod.)

MP 3905
VALIDATION OF WEERTMAN'S THEORY OF BASAL MORAINE FORMATION BY BOTTOM FREEZING BENEATH POLAR ICE SHEETS.
Gow, A.J., Johannes Weertman Symposium. Edited by R.J. Arsenault et al, 1995, p.331-335, 14 refs.
51-407
GLACIAL GEOLOGY, ICE SHEETS, SEDIMENTATION, STRATIGRAPHY, BOTTOM ICE, MELTWATER, REGELATION, MORAINES, ICE SOLID INTERFACE, DRILL CORE ANALYSIS, ISOTOPE ANALYSIS, THEORIES
Weertman postulated on theoretical grounds that wet-bottomed ice sheets could, by refreezing of basal meltwater generated by geothermal and frictional heating, incorporate debris from the underlying bed. This "freeze-in" of basal moraine was offered as an alternative mechanism to that of "shearing-in" to explain the origin of so-called shear moraines at the margin of the Greenland Ice Sheet. A viable test of Weertman's "freeze-in" hypothesis came several years later with the successful drilling to bedrock of the Antarctic Ice Sheet at Byrd Station. The nature and disposition of this basal moraine, together with stable isotope and entrapped gas analyses of the enclosing ice, are consistent only with a "freeze-in" mechanism as first postulated by Weertman. Formation of debris-laden ice in cores from the bottom of the Greenland Ice Sheet at Camp Century has also been attributed to freeze-in of bed sediment, further reinforcing the notion that it is likely the predominant mechanism of basal moraine formation in ice sheets at their pressure melting points. (Auth. mod.)

MP 3906
TEMPORAL AND SPATIAL FLUCTUATIONS IN GROUND COVER SURFACE TEMPERATURE AT A NORTHERN NEW ENGLAND SITE.
Peck, L., *Atmospheric research,* 1996, Vol.41, p.131-160, 22 refs.
51-408
CLIMATOLOGY, SURFACE TEMPERATURE, SOIL AIR INTERFACE, TEMPERATURE MEASUREMENT, RADIOMETRY, HEAT FLUX, ALBEDO, RADIANCE, UPWELLING, SNOW COVER EFFECT, VEGETATION FACTORS, SEASONAL VARIATIONS, DIURNAL VARIATIONS
Ground cover surface temperature at a field site in South Royalton, VT, is calculated from 30-minute averages of upwelling longwave (3-50 μm) radiation measured with a pyrgeometer, resulting in 48 estimations of surface temperature each day. The ground covers are a seasonal sequence of (1) dormant grass prior to snowfall, (2) snow cover, (3) an irregular distribution of thatch, exposed soil and new-growth grass following final snowmelt and (4) lush, continuous grass cover. Diurnal variation in ground cover surface temperature and also seasonal differences in temperature spread and rate of temperature change are evident. An indication of relative spatial uniformity of surface temperature for these ground covers is obtained by monitoring the surface with a second instrument, a passive infrared sensor system that responds to differential changes in thermal radiance from the ground cover. The snow cover is a thermally uniform background (on the scale of field of view of the passive infrared sensor system), and the grass-thatch-soil is thermally the most diverse, while the lush grass is thermally heterogeneous when sunlit grass blades blow in the wind. The use of such a passive system provides information on the variability of ground cover surface temperature, and by implication, on changes in radiant-energy loading and heat exchange processes, on a spatial scale larger than that of a standard ground-based pyrgeometer. (Auth. mod.)

MP 3907
ANTARCTIC ZONE FLUX EXPERIMENT.
McPhee, M.G., Ackley, S.F., *American Meteorological Society. Bulletin,* June 1996, 77(6), p.1221-1232, 39 refs.
51-409
CLIMATOLOGY, OCEANOGRAPHIC SURVEYS, AIR ICE WATER INTERACTION, SEA ICE DISTRIBUTION, HEAT TRANSFER, TURBULENT EXCHANGE, TURBULENT BOUNDARY LAYER, ICE HEAT FLUX, ICE COVER EFFECT, SOUNDING, DRIFT STATIONS, WIND FAC-

TORS, ANTARCTICA—WEDDELL SEA
Understanding what environmental conditions could again trigger widespread oceanic overturn may be an important key in determining the role of high latitudes in deep-ocean ventilation and global atmospheric warming. During the Antarctic Zone Flux Experiment in July and Aug. 1994, response of the Weddell Sea upper ocean and its ice cover to a series of storms was measured at two drifting stations supported by the National Science Foundation research icebreaker *Nathaniel B. Palmer.* This article describes the experiment, in which fluxes of heat, mass and momentum were measured in the upper ocean, sea ice and lower-atmospheric boundary layer. Initial results illustrate the importance of oceanic heat flux at the ice undersurface for determining the character of the sea ice cover. They also show how the heat flux depends both on high levels of turbulent mixing during intermittent storm events and on large variability in the stratified upper ocean below the mixed layer. (Auth. mod.)

MP 3908
FRACTURE OF RIVER ICE COVERS BY RIVER WAVES.
Daly, S.F., *Journal of cold regions engineering,* Mar. 1995, 9(1), p.41-62, 26 refs.
51-410
RIVER ICE, ICE MECHANICS, ICE BREAKUP, FLEXURAL STRENGTH, ICE COVER STRENGTH, CRACKING (FRACTURING), CRACK PROPAGATION, WAVE PROPAGATION, WATER WAVES, ICE WATER INTERFACE, UNSTEADY FLOW, DYNAMIC LOADS, MATHEMATICAL MODELS, WAVE PROPAGATION
The stresses induced in ice covers by river waves are investigated as a possible mechanism for causing transverse cracks during breakup. The maximum stress levels that river waves can cause in ice cover are determined over the entire spectrum of waves that may be present at breakup. The ice cover is analyzed as a continuous elastic plate. The calculations indicate that the celerities of propagating waves are always less than the celerity of free waves of the same wavelength and as a result, only the first maximum is possible. The global minimum wave amplitude required to cause cracks is therefore found at a wavelength of $2\pi l$. At this wavelength, a simple expression describing the minimum wave amplitude causing cracks can be derived.

MP 3909
LOCATION OF BLUE ICE RUNWAY SITES—REPORT ON AIR PHOTO SEARCH.
Swithinbank, C., U.S. Army Cold Regions Research and Engineering Laboratory. CRREL project No.88-4a, Aug. 1988, n.p., 3 refs.
51-411
COLD WEATHER CONSTRUCTION, RUNWAYS, GEOLOGICAL SURVEYS, ORIENTATION, SITE SURVEYS, PHOTOINTERPRETATION, OBLIQUE PHOTOGRAPHY, LOGISTICS, GLACIER SURFACES, TOPOGRAPHIC FEATURES, ANTARCTICA—BLACKBURN, MOUNT, ANTARCTICA—GOODALE, MOUNT
The author examined some 7,000 aerial photographs obtained for mapping purposes by the U.S. Navy for the U.S. Geological Survey in Antarctica between latitudes 84°S and 88°S, longitudes 160°E and 120°W. While thousands of km^2 of essentially snow-free bare ice are identifiable, most are unsuitable for large wheeled aircraft because of slope, grade change, length, crevasses, or obstructed approaches. However, all these factors were predictable and expected. The same problems were encountered in both areas where earlier (successful) searches were made for bare ice runways. Ice sheets and outlet glaciers are driven by gravity flow: slopes are normal and over many areas exceed reasonable criteria for transport aircraft. The only possible landing place where the surface is completely level is a frozen lake with dimensions of 1x4 km at 85° 25'S, 147° 40'W. This should be investigated. (Auth. mod.)

MP 3910
QUANTITATIVE DESCRIPTION OF SEA ICE INCLUSIONS.
Perovich, D.K., Gow, A.J., *Journal of geophysical research,* Aug. 15, 1996, 101(C8), p.18,327-18,343, 54 refs.
51-412
OCEANOGRAPHY, SEA ICE, ICE PHYSICS, PHYSICAL PROPERTIES, ICE MICROSTRUCTURE, POROSITY, GAS INCLUSIONS, BUBBLES, BRINES, TEMPERATURE EFFECTS, STATISTICAL ANALYSIS, THIN SECTIONS, ICE OPTICS
Photomicrographs of sea ice thin sections were analyzed using a personal computer-based image-processing system to determine the number of inclusions, the inclusion size distributions, and statistics for brine pockets in younger ice and first-year ice and for air bubbles in a multiyear hummock. Inclusions ranging in size from thousandths of mm^2 to a few mm^2 were measured. In all cases a two-parameter lognormal distribution fits the cumulative inclusion size distributions well (correlation coefficient greater than 0.99). Increase in brine pocket size is particularly pronounced for brine volumes greater than 10% as individual brine pockets coalesce. Air bubbles are much larger than brine pockets, with mean major axis lengths of the order of millimeters for air bubbles and tenths of a millimeter for brine pockets. Observations of inclusion shape factors indicate that, in general, brine pockets are more elongated than air bubbles.

MP 3911
INTERFEROMETRIC SYNTHETIC APERTURE RADAR (IFSAR) FOR FAST, ACCURATE DIGITAL ELEVATION MAPPING.
Chadwick, D.J., Bolus, R.L., McKim, H.L., Thematic Conference on Remote Sensing for Marine and Coastal Environments, 3rd, Seattle, WA, Sep. 18-20, 1995. Proceedings. Vol.2, Ann Arbor, Environmental Research Institute of Michigan (ERIM), [1995], p.783-790, 5 refs.
51-487
TOPOGRAPHIC SURVEYS, TOPOGRAPHIC MAPS, FLOODPLAINS, FLOOD FORECASTING, SHORE EROSION, AERIAL SURVEYS, SPACEBORNE PHOTOGRAPHY, SYNTHETIC APERTURE RADAR, RADIO ECHO SOUNDINGS, HEIGHT FINDING, IMAGE PROCESSING, STATISTICAL ANALYSIS
Interferometric Synthetic Aperture Radar (IFSAR) systems can rapidly generate digital elevation data with a higher resolution and accuracy than presently existing digital data sets. Although improvements in vertical resolution are still required, this technology may be extremely beneficial for coastal studies, including monitoring coastal and barrier island erosion, and for flood and storm surge prediction. The U.S. Army Corps of Engineers' Remote Sensing/GIS Center participated in a test of the accuracy of the IFSAR system developed by the Environmental Research Institute of Michigan (ERIM) and the Jet Propulsion Laboratory (JPL). In this study, elevations for points derived by interferometry were compared with field-surveyed elevations. A root mean square error of 1.89 m and a maximum error of 2.92 m were found for the 11 points in this study, conducted in the flood plain of the Iowa River. These results are comparable with previous studies of IFSAR technology.

MP 3912
DROPLET SIZING INSTRUMENTATION USED IN ICING FACILITIES.
Society of Automotive Engineers, Jones, K.F., *SAE aerospace information report,* 1994, AIR 4906, 45p., 47 refs. K.F. Jones was one of the contributors to this report.
51-488
AIRCRAFT ICING, ICE ACCRETION, ICE FORECASTING, ICE DETECTION, SUPERCOOLED CLOUDS, CLOUD DROPLETS, PARTICLE SIZE DISTRIBUTION, LASERS, WIND TUNNELS

MP 3913
THOUGHTS ON A STRUCTURE FOR ASSEMBLING BALLOON EXPERIMENTS AT WILLIAMS FIELD, ANTARCTICA.
Tobiasson, W., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Apr. 1989, 19p.
51-496
BALLOONS, METEOROLOGICAL INSTRUMENTS, TELEMETERING EQUIPMENT, TOWERS, WOODEN STRUCTURES, COLD WEATHER CONSTRUCTION, SNOW LOADS, WIND PRESSURE, COST ANALYSIS, ANTARCTICA—MCMURDO STATION
In 1989, a 20-ft high wooden panel structure with a 16-ft by 20-ft floor supported by steel beams, was proposed to fit out a 12-ft high gondola for balloon experiments at Williams Field, McMurdo Station. The gondola would be suspended from a laminated veneer wooden roof beam. The structure would be capable of withstanding high winds and heavy snowdrifts. Ski assemblies could be attached at the four corners so that the entire structure could be towed by a tracked vehicle to a new location. The total cost estimate in 1989 was $21,500.

MP 3914
PRELIMINARY REPORT ON THE CONDITION OF THE SOUTH POLE STATION.
Tobiasson, W., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, [1989], 10p., Prepared for Division of Polar Programs, National Science Foundation.
51-497
STATIONS, BUILDINGS, SNOWDRIFTS, SNOW LOADS, SETTLEMENT (STRUCTURAL), COLD WEATHER CONSTRUCTION, ANTARCTICA—AMUNDSEN-SCOTT STATION
In 1989, the Amundsen-Scott Station at the South Pole was scheduled to be replaced by a new station by the end of 1996. The main facilities of the existing station are housed in a 164-ft-diameter, 53-ft-high aluminum geodesic dome and a 726-ft-long, 46-ft-diameter metal arch. It is recommended that the new station consist of a cluster of extensible or movable steel-frame, sandwich-panel buildings, 2 stories high with a floor plan of 38 ft by 64 ft, elevated on columns about 8 ft above the surface, and less susceptible to snow loads and differential settlement from snow loads than the existing dome and arch. The dome could be used as a warehouse and portions of the arch could be used for fuel storage for the new station.

MP 3915
MAPPING MONTANE SNOW COVER AT SUB-PIXEL RESOLUTION FROM THE LANDSAT THEMATIC MAPPER.
Rosenthal, C.W., Santa Barbara, University of California, 1993, 70p., WDCA 95000169, M.A. thesis. 70 refs. Partially funded by the U.S. Army Cold Regions Research and Engineering Laboratory under Contract No.DACA89-92-K-0008.
51-499
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, RUNOFF FORECASTING, TERRAIN IDENTIFICATION, SPACEBORNE PHOTOGRAPHY, IMAGE PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—CALIFORNIA—SIERRA NEVADA
A fully automated method uses Landsat Thematic Mapper data to map snow cover in the Sierra Nevada and make quantitative estimates of the fractional snow covered area within each pixel. A 1986 reference scene was modeled as a linear mixture of image endmember spectra to produce the response variables for tree-based regression and classification models. Decision trees identify cloud cover, snow extent, and fractional snow covered area. The algorithm is tested on a new Thematic Mapper scene against high resolution, large format, color aerial photography. The accuracy of the automated classification of Thematic Mapper data equals that obtainable from the photographs, but is faster, cheaper, and covers a vastly larger area. Mapping of snow supports the linear spectral mixing assumption. The mapping method is insensitive to the choice of lithologic or vegetation endmembers and to the water equivalent of the snow pack.

MP 3916
NEW FORMULATION FOR THE BOWEN RATIO OVER SATURATED SURFACES.
Cash, B.A., Andreas, E.L., Symposium on Boundary Layers and Turbulence, 11th, Charlotte, NC, Mar. 27-31, 1995, Boston, American Meteorological Society, 1995, p.110-113, 20 refs. For another version see 50-6570.
51-1099
TURBULENT BOUNDARY LAYER, MARINE METEOROLOGY, HEAT FLUX, VAPOR PRESSURE, WATER VAPOR, SATURATION, ICE AIR INTERFACE, SURFACE TEMPERATURE, INDEXES (RATIOS), THERMODYNAMIC PROPERTIES
In this paper the authors formulate new expressions for the Bowen ratio (Bo) in terms of Bo_* for the cases in which sensible heat (H_s) and latent heat (H_L) are both positive or both negative and show that Bo_* is an important parameter when H_s is negative and H_L is positive. These formulations are based on 17 tabulations of H_s, H_L, and surface temperature (T_s) taken from data sets that came from over-water experiments in the open ocean, the marginal seas, and the Great Lakes and from over-snow experiments on sea ice and frozen ground. T_s ranged from -41° to 28°C. The analysis yields one functional form for Bo versus Bo_* that spans this entire temperature range for each of the three cases given, unifying the prediction of Bo over any saturated surface, provided the signs of H_s and H_L are known a priori.

MP 3917
DETERMINATION OF THE ACOUSTIC PROPERTIES OF FROZEN SOILS.
Nakano, Y., Smith, M., Martin, R., Stevens, H., Knuth, K., *U.S. Army Cold Regions Research and Engineering Laboratory,* May 1971, 72p., ARPA No.1525, Refs. passim.
51-1125
FROZEN GROUND PHYSICS, ACOUSTIC MEASUREMENT, WAVE PROPAGATION, SOUND TRANSMISSION, VELOCITY MEASUREMENT, ULTRASONIC TESTS, VISCOELASTICITY, RESONANCE, OSCILLATIONS, STATISTICAL ANALYSIS, SIMULATION
The acoustic properties of frozen earth materials were investigated. The study consists of four different efforts described in four sections. In the first part the velocities of dilatational waves were measured with the pulse first-arrival technique. In the second part a linear viscoelastic constitutive equation was obtained by the use of the resonance column technique. In the third part the method of free oscillation of spherical specimens was developed. In the last part the acoustic properties were determined by the use of a critical angle tank.

MP 3918
TWENTY-YEAR AEROSOL RECORD AT SOUTH POLE.
Hogan, A.W., Bodhaine, B.A., Conference on Polar Meteorology and Oceanography, 4th, Dallas, TX, Jan. 15-20, 1995. Preprints, Boston, American Meteorological Society, 1995, p.8-12, 11 refs.
51-1163
POLAR ATMOSPHERES, ATMOSPHERIC COMPOSITION,

AEROSOLS, STATISTICAL ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION
A Nolan-Pollak photoelectric nucleus counter was installed in the auroral observatory at South Pole on Jan. 26, 1974. It was moved to an interim observatory near the domed Amundsen-Scott Station in Jan. 1975, and to the clean air facility predominantly upwind of station activities in Jan. 1977. This instrument is used as an on-site standard to calibrate automatic or recording aerosol detectors, and is also used to measure the ambient aerosol concentration twice daily. This paper presents a comparison of the 20-year aerosol record with those published at five and ten years of observation. It also presents a statistical analysis of the record.

MP 3919
IN SITU MEASUREMENTS OF THE SURFACE TEMPERATURE IN THE WESTERN WEDDELL SEA.
Claffey, K.J., Andreas, E.L., Makshtas, A.P., Ivanov, B.V., Conference on Polar Meteorology and Oceanography, 4th, Dallas, TX, Jan. 15-20, 1995. Preprints, Boston, American Meteorological Society, 1995, p.86-90, 8 refs.
51-1180
POLAR ATMOSPHERES, RADIATION BALANCE, SURFACE TEMPERATURE, ICE AIR INTERFACE, ICE HEAT FLUX, DRIFT STATIONS, TEMPERATURE MEASUREMENT, RADIOMETRY, RADIATION MEASURING INSTRUMENTS, ANTARCTICA—WEDDELL SEA
On Ice Station Weddell (ISW) in 1992, the authors had the opportunity to compare typical Russian and American instruments used to measure the components of the radiation balance *in situ* over sea ice. Here, they focus especially on the emitted longwave flux, since this yields the surface temperature. The surface temperature, in turn, is one of the most important parameters of sea ice because it is remotely monitorable and because it is intimately related to the surface heat budget. The longwave flux and both the turbulent sensible and latent heat fluxes depend strongly on surface temperature. From the time series of ISW radiation components and surface temperatures, the authors use a new variation of the Bowen ratio method to estimate the time series of sensible and latent heat fluxes on ISW.

MP 3920
LOW-LEVEL ATMOSPHERIC JETS OVER THE WESTERN WEDDELL SEA.
Andreas, E.L., Claffey, K.J., Makshtas, A.P., Conference on Polar Meteorology and Oceanography, 4th, Dallas, TX, Jan. 15-20, 1995. Preprints, Boston, American Meteorological Society, 1995, p.252-257, 15 refs.
51-1215
POLAR ATMOSPHERES, MARINE METEOROLOGY, ATMOSPHERIC BOUNDARY LAYER, ATMOSPHERIC CIRCULATION, WIND (METEOROLOGY), WIND VELOCITY, DRIFT STATIONS, WEATHER STATIONS, ANTARCTICA—WEDDELL SEA
A common theme in the literature is that the polar regions are ideal "laboratories" for studying atmospheric processes. The authors reiterate that theme and demonstrate it with a study of the stable atmospheric boundary layer (ABL) on Ice Station Weddell (ISW). Understanding of the stable boundary layer lags behind that of the convective boundary layer because, in more temperate latitudes, stable boundary layers are strictly nighttime phenomena and, thus, are rarely in steady state. On ISW, however, over 96% of the radiosoundings showed that the lower atmosphere was stably stratified. The authors, thus, had the opportunity to observe repeatedly, and in detail, the structure of the stable boundary layer. They found that the main feature of the stable boundary layer over the western Weddell Sea was a low-level jet. Almost 80% of the soundings revealed this jet, which frequently engulfed and battered their tethered radiosounding balloon. The authors document the characteristics of the jet and offer a mathematical explanation for its dynamics.

MP 3921
RADAR CROSS-SECTION MEASUREMENTS OF SNOW AND ICE FOR DESIGN OF SEV PILOTAGE SYSTEM.
Hoekstra, P., Spanogle, D., *U.S. Army Cold Regions Research and Engineering Laboratory*, June 1971, 84p., ARPA No.1615, 12 refs.
51-1124
AIR CUSHION VEHICLES, ICE NAVIGATION, ICE DETECTION, SEA CLUTTER, FALLING SNOW, ICE DIELECTRICS, SNOW COVER EFFECT, PROFILES, RADAR ECHOES, BACKSCATTERING, SENSORS, DESIGN CRITERIA, PERFORMANCE, POLARIZATION (WAVES), ANTENNAS
In the Advanced Research Projects Agency (ARPA) program to develop a surface effect vehicle (SEV) for use in the Arctic, serious consideration is being given to the pilotage of the vehicle, particularly to the problem of the avoidance of pressure ridges on the sea ice. In bad weather conditions, a radar system is needed for reliable detection, because radar can penetrate snow and fog. For the design of this radar, the following environmental parameters are required to optimize the system: the terrain clutter from snow and ice surfaces at low grazing angles at various frequencies and the radar cross section of ice and snow objects. A test program was designed to measure these parameters. The radar frequencies 10, 35, and 95 GHz were chosen because of their availability. The tests were performed on a frozen snow-covered lake at Lyme, NH, 10 miles north of USA CRREL. The tests were conducted from Jan. 10, 1971 to Mar. 15, 1971. The site was snow covered during the entire testing period.

MP 3922
CYCLIC LOADING RESPONSE OF ALIGNED FIRST-YEAR SEA ICE.
Cole, D.M., Johnson, R.A., Durell, G.D., IAHR International Symposium on Ice, 13th, Beijing, China, Aug. 27-31, 1996. Proceedings. Vol.1, Beijing, Chinese Hydraulic Engineering Society, 1996, p.1-7, 16 refs.
51-1323
ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE ELASTICITY, ICE DEFORMATION, ICE MICROSTRUCTURE, ICE CRYSTAL STRUCTURE, DISLOCATIONS (MATERIALS)
This paper presents methodology to determine the average shear stress resolved on the basal planes for ice polycrystals and demonstrates the validity of the analysis for core specimens of aligned first-year sea ice. Careful examination of the constitutive behavior of the ice using laboratory cyclic loading experiments revealed that the elastic and anelastic (time-dependent recoverable) strains varied systematically with the calculated orientation factor. Analysis employing a mechanistic model of the cyclic loading response shows very good agreement between theory and observation. The findings quantify an important link between the microstructure of first-year sea ice and its mechanical properties, and indicate that the anelastic behavior of sea ice can be largely explained by basal plane slip alone.

MP 3923
COARSE-PARTICLE TRANSPORT IN A GRAVEL-BED RIVER.
Emmett, W.W., Burrows, R.L., Chacho, E.F., Jr., *International journal of sediment research*, Aug. 1996, 11(2), p.8-21, 4 refs.
51-1823
RIVER FLOW, HYDRAULICS, CHANNELS (WATERWAYS), SEDIMENT TRANSPORT, GRAVEL, PARTICLE SIZE DISTRIBUTION, VELOCITY MEASUREMENT, FLOODPLAINS, TELEMETERING EQUIPMENT, GEOMORPHOLOGY
Movement of bed material in the Toklat River, AK, was monitored during 1988 and 1989 by measuring transport rates with a Helley-Smith bedload sampler and by tracking and locating coarse sediment using radio transmitters implanted in natural sediment particles. Median bedload size was about 8 mm and transport rates ranged from less than 10 to nearly 3000 megagrams per day. Transport rate related to about the 1.6 power of water discharge in excess of discharge required to initiate tractive sediment motion. As transport rate increased, mean and maximum sizes of bedload tended to increase. Radio-tagged particles, mostly about 90 mm in diameter, moved distances between about 500 and 2,000 m during the 6-8 week periods of high flow. Limited data suggest that for moving rocks, large particles are likely to move as far as small particles (and at about the same speed).

MP 3924
MODELING HEAT, MASS, AND SPECIES TRANSPORT IN POLAR FIRN.
Albert, M.R., *Annals of glaciology*, 1996, Vol.23, International Symposium on Ice Sheet Modelling, Chamonix, France, Sep. 18-22, 1995. Papers. Edited by K. Hutter, p.138-143, 22 refs.
51-1859
SNOW AIR INTERFACE, SNOW PERMEABILITY, SNOW HEAT FLUX, SNOW COMPOSITION, SNOW ICE INTERFACE, FIRN STRATIFICATION, GLACIER ICE, ICE COMPOSITION, ICE CORES, MATHEMATICAL MODELS, GREENLAND
A finite-element model for simulating multi-dimensional air flow with heat, mass and chemical species transport through firn is discussed. The model is applied to an investigation of near-surface layering effects on ventilation rates. Field measurements of permeability at Summit, Greenland, are presented that show that permeability varies by at least a factor of 10 over the top 3 m, with the surface windpack having much lower permeability, in general, than the underlying firn. The effect of a lower-permeability surface layer is to decrease the air flow in the underlying firn, yet there is still sufficient air flow in the top meters of the firn so that ventilation must be considered for species transport. Channeling, or increased air flow in a layer overlain by a less-permeable layer, can occur even if the microstructure of each layer is isotropic. Conventional estimates of chemical transport due to diffusion alone are likely to underestimate transport, while estimates of ventilation that consider the firn as a homogeneous half-space may overestimate ventilation effects at the near-surface. Effects of firn layering are important for ventilation and must be considered for accurate assessment of firn-air transport mechanisms.

MP 3925
IN-SITU ELECTRONIC SENSORS TO DETERMINE ANALYTES IN COLD-REGIONS SOILS.
Brundage, G., Reno, NV, Phionics, Inc., 1995, 16p., ADA-302 860, 4 refs. Funded by U.S. Army Cold Regions Research and Engineering Laboratory under Contract No.DACA39-95-C-0029.
51-1897
TUNDRA SOILS, SOIL POLLUTION, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, SOIL ANALYSIS, SOIL MICROBIOLOGY, LAND RECLAMATION, ELECTRICAL LOGGING

MP 3926
***ICE AND CONSTRUCTION* EDITED BY L. MAKKONEN.**
Jones, K.F., Richter-Menge, J.A., Sodhi, D.S., Andreas, E.L., *Royal Meteorological society. Quarterly journal A*. Apr. 1996, 122(531), p.792-793, 6 refs. For book being reviewed see 50-399.
51-1898
ICE (CONSTRUCTION MATERIAL), ICE STRENGTH

MP 3927
REVIEW OF THE FRICTION OF SNOW.
Colbeck, S.C., Physics of sliding friction, Dordrecht, Netherlands, Kluwer Academic Publishers, 1996, p.275-291, 42 refs. Presented at a NATO Advanced Research Workshop and Adriatico Research Conference, Miramare, Trieste, Italy, June 20-23, 1995.
51-1900
WOOD SNOW FRICTION, PLASTICS SNOW FRICTION, SNOW SURFACE, WATER FILMS, SKIS, SLIDING
Snow friction results from a mixture of processes, depending on the amount of meltwater present. With little meltwater, the surfaces are partially separated; with too much water, the contact area increases and there may be capillary attachments. Heat is generated by friction and solar radiation absorption at the interface and is conducted away by both slider and ice particles. The remaining heat is available to generate meltwater which acts as a lubricant. The important processes operate at the ski base temperature that is highly dependent on such things as snow-surface temperature, load and speed. Electrical charges are generated but are drained away quickly on most surfaces. The roughness elements, film thicknesses and contact areas must be characterized better before the basic processes can be understood further.

MP 3928
PREDICTING BREAKUP ICE JAMS USING LOGISTIC REGRESSION.
White, K.D., *Journal of cold regions engineering*, Dec. 1996, 10(4), p.178-189, 18 refs.
51-1983
RIVER ICE, ICE JAMS, ICE BREAKUP, FORECASTING, CLASSIFICATIONS, STATISTICAL ANALYSIS, MODELS, ACCURACY
Breakup ice jams form suddenly and with little warning. The lack of forewarning hinders emergency response and ice jam mitigation efforts. Present knowledge of breakup jam processes does not allow for the development of a deterministic ice jam prediction model. Probabilistically based prediction models include linear regression, discriminant function analysis, and empirical cluster-type analyses. In this paper, the use of logistic regression to predict breakup ice jam occurrence is presented, with an example application for the Platte River at North Bend, NE.

MP 3929
MOTION CHARACTERISTICS OF COARSE SEDIMENT IN A GRAVEL BED RIVER.
Chacho, E.F., Jr., Burrows, R.L., Emmett, W.W., Federal Interagency Sedimentation Conference, 6th, Las Vegas, NV, Mar. 10-14, 1996. Proceedings, Reston, VA, U.S. Geological Survey. Interagency Advisory Committee on Water Data. Subcommittee on Sedimentation, 1996, p.V/1-V/8, 4 refs.
51-2016
RIVER FLOW, BOTTOM SEDIMENT, SUSPENDED SEDIMENTS, ALLUVIUM, SEDIMENT TRANSPORT, FLOOD FORECASTING, TELEMETERING EQUIPMENT, DATA TRANSMISSION
Radio transmitters were implanted in natural river gravel to locate and track the movement of coarse sediment (39 mm or larger) through a natural river reach. An automatic data acquisition system was developed to continuously monitor the radio-implanted sediment particles to determine the travel time of the rocks through a 362-m study reach. A total of 24 radio-tagged rocks was monitored either continuously or by periodic location surveys. The travel time of the rocks through the study reach is better related to specific gravity than weight of the particles. In addition the automatic data acquisition system continuously monitors the periods of motion and rest of natural river gravel implanted with radio transmitters equipped with motion sensors. The capabilities of the system are demonstrated by describing the motion and rest periods of a single rock for a two-month period

including a number of flood events.

MP 3930
QUANTITATIVE HEAT LOSS DETERMINATION BY MEANS OF INFRARED THERMOGRAPHY—THE TX MODEL.
Zinko, H., et al, International Energy Agency. IEA District Heating and Cooling Project. Annex 4, Sittard, Netherlands, Netherlands Agency for Energy and the Environment (NOVEM), 1996, 114p., 22 refs.
51-2017
HEAT PIPES, UNDERGROUND PIPELINES, UTILITIES, HEAT LOSS, HEAT TRANSFER, SOIL TEMPERATURE, TEMPERATURE MEASUREMENT, SUBSURFACE INVESTIGATIONS, INFRARED PHOTOGRAPHY, COMPUTER PROGRAMS

MP 3931
DEVELOPMENT OF A HIGH ACCURACY RESISTANCE AND TEMPERATURE METER FOR FIELD USE.
Landmann, W.S., Northvale, NJ, Inrad, Inc., Aug. 1992, 25p., Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under the SBIR (Small Business Innovative Research) Program Contract No.DACA-39-89-C-0002.
51-2040
TEMPERATURE MEASUREMENT, RESISTANCE THERMOMETERS, THERMISTORS, COMPUTER APPLICATIONS, COLD WEATHER PERFORMANCE

MP 3932
HEAD UP DISPLAY PANEL METER FEATURING LIVE NTSC VIDEO WITH SUPERIMPOSED CONCURRENT MEASUREMENT DATA.
Burch, C.A., Ramsey, NJ, Micro Devices Corporation, Jan. 1993, 14p., 4 refs. Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under the SBIR (Small Business Innovative Research) Program Contract No.DACA33-91-C-0014.
51-2043
IMAGE PROCESSING, DATA PROCESSING, DATA TRANSMISSION, TELEMETERING EQUIPMENT, PHOTOGRAPHIC EQUIPMENT, PHOTOGRAPHIC RECONNAISSANCE, ICE CONDITIONS, ICE REPORTING

MP 3933
LIGHT TRANSMISSION THROUGH FLOATING ICE COVERS: SUBMERSIBLE ICE SPECTRORADIOMETER.
Curtiss, B., Goetz, A.F.H., Boulder, CO, Analytical Spectral Devices, Inc., June 1993, 24p., 14 refs. Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under the SBIR (Small Business Innovative Research) Program Contract No.DACA33-93-C-0007.
51-2044
ICE OPTICS, ICE COVER EFFECT, ICE WATER INTERFACE, SUBGLACIAL OBSERVATIONS, LIGHT TRANSMISSION, LIGHT SCATTERING, OPTICAL ABSORPTION, PHOTOMETRY

MP 3934
FIBEROPTIC SENSOR TO MEASURE PRESSURE IN FREEZING AND THAWING SOILS.
Twersky, M., Lincoln, NE, Management Information Resources, Sep. 1992, 29p., 19 refs. Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under the SBIR (Small Business Innovative Research) Program Contract No.DACA33-91-C-0011.
51-2045
SOIL FREEZING, GROUND THAWING, FROST PENETRATION, THAW DEPTH, SOIL PRESSURE, SOIL TESTS, FREEZE THAW TESTS, FROST RESISTANCE

MP 3935
DEVELOPMENT OF ADVANCED INSTRUMENTATION FOR DROP SIZE AND LIQUID WATER CONTENT MEASUREMENTS IN CLOUDS.
Aerometrics, Inc., Sunnyvale, CA, Aug. 1992, 74p., Refs. p.64-74. Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under the SBIR (Small Business Innovative Research) Program Contract No.DACA33-87-C-0027.
51-2046
AIRCRAFT ICING, ICE FORECASTING, SUPERCOOLED CLOUDS, CLOUD DROPLETS, PARTICLE SIZE DISTRIBUTION, UNFROZEN WATER CONTENT, MOISTURE DETECTION, LASERS

MP 3936
CRREL INVESTIGATES EXTRATERRESTRIAL PARTICLES.
Darling, M., *Engineer update,* Dec. 1996, 20(12), p.2.
51-2055
COSMIC DUST, IMPURITIES, ICE SAMPLING, WELLS, ANTARCTICA—AMUNDSEN-SCOTT STATION

MP 3937
METHODS OF PREPARING SOIL SAMPLES FOR HEADSPACE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS: EMPHASIS ON SALTING OUT.
Hewitt, A.D., Waste Testing and Quality Assurance Symposium, 12th, Washington, D.C., July 23-26, 1996. Proceedings, Washington, D.C., American Chemical Society, 1996, p.322-329, 12 refs.
51-2056
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
Three equilibrium and two solvent extraction methods of preparing and analyzing volatile organic compounds (VOCs) in soil by headspace gas chromatography (HS/GC) were compared. The samples studied were triplicates of four different soil types spiked with an aqueous solution containing BTEX and four chlorinated compounds. Solvent extraction was found to be superior for recovering spiked VOCs, followed by: direct heating; an aqueous solution preserved with $NaHSO_4$; and lastly, an aqueous solution saturated with NaCl and acidified with phosphoric acid. The findings indicated that correction factors may be necessary for equilibrium HS/GC determinations of VOCs in soils.

MP 3938
GUIDANCE FOR CHARACTERIZING EXPLOSIVES CONTAMINATED SOILS: SAMPLING AND SELECTING ON-SITE ANALYTICAL METHODS.
Crockett, A.B., Craig, H.D., Jenkins, T.F., Sisk, W.E., Waste Testing and Quality Assurance Symposium, 12th, Washington, D.C., July 23-26, 1996. Proceedings, Washington, D.C., American Chemical Society, 1996, p.37-43, 15 refs.
51-2057
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, EXPLOSIVES, WASTE DISPOSAL
A large number of defense-related sites are contaminated with elevated levels of secondary explosives. Levels of contamination range from barely detectable to levels above 10% that need special handling due to the detonation potential. Characterization of explosives-contaminated sites is particularly difficult due to the very heterogeneous distribution of contamination in the environment and within samples. To improve site characterization, several options exist including collecting more samples, providing on-site analytical data to help direct the investigation, compositing samples, improving homogenization of samples, and extracting larger samples. On-site analytical methods are essential to more economical and improved characterization. On-site methods might suffer in terms of precision and accuracy, but this is more than offset by the increased number of samples that can be run.

MP 3939
SAMPLE REPRESENTATIVENESS: A NECESSARY ELEMENT IN EXPLOSIVES SITE CHARACTERIZATION.
Jenkins, T.F., Grant, C.L., Brar, G.S., Thorne, P.G., Schumacher, P.W., Ranney, T.A., Waste Testing and Quality Assurance Symposium, 12th, Washington, D.C., July 23-26, 1996. Proceedings, Washington, D.C., American Chemical Society, 1996, p.30-35, 4 refs.
51-2058
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, EXPLOSIVES, WASTE DISPOSAL
Explosives-contaminated sites are generally characterized by collecting discrete grab samples of surface soil and shipping them to off-site laboratories for analysis. Decisions as to whether or not site remediation is needed are made based on the results of these analyses, assuming they represent site conditions over fairly large grids. This study was conducted to assess the degree of short-range heterogeneity in analyte concentrations present at explosives-contaminated sites. This information is essential if sampling methods are to be established that provide representative samples on which informed decisions can be based.

MP 3940
PHYSICAL MODELLING.
Wuebben, J.L., Primer on hydraulics of ice covered rivers. Edited by K.S. Davar, S. Beltaos, and B. Pratte, Ottawa, Environment Canada, Environmental Citizenship (Ecocivisme), 1996, p.105-129, 37 refs. Chapter 6 in book. For another version see 50-789.
51-2063
RIVER ICE, ICE COVER STRENGTH, ICE BREAKUP, ICE JAMS, ICE LOADS, ICE FRICTION, ICE CONTROL, ICE MODELS, RIVER FLOW, HYDRAULIC STRUCTURES, ENVIRONMENT SIMULATION, ENVIRONMENTAL TESTS

MP 3941
SNOW ROAD ENHANCEMENT.
Diemand, D., Alger, R., Klokov, V., *Transportation research record,* 1996, No.1534, Geosynthetics: cold regions, flexible pavements, and other issues, p.1-4, 2 refs.
51-2075
SNOW ROADS, SNOW (CONSTRUCTION MATERIAL), SNOW COMPACTION, SNOW STRENGTH, TRAFFICABILITY, GEOTEXTILES, CELLULAR MATERIALS
Snow roads are used extensively in areas where seasonal access to remote areas would otherwise be difficult or impossible for wheeled vehicles. Forestry operations in Scandinavia and Canada, petroleum operations in Alaska and Canada, and almost all activities in Antarctica make extensive use of this technology. Many techniques of preparing snow roads and runways have been used and studied, but the most intractable problems remain unsolved: how to extend the service life of the road as the warm season approaches and how to bridge damaged or transitional sections. Other, less important problems include sinkage of parked vehicles, damage to heavily trafficked areas, damage caused by fluid spills and infiltration by saltwater, and use limited to vehicles with low tire pressures. Research addressing these problems was conducted, and the preliminary results are encouraging. A short test section of road was constructed with geocells. This material is designed for use with sand or gravel but, instead, the cells were filled with packed snow. The resulting surface was very hard, stable, and resistant to damage by repeated passes by wheeled traffic. Paving blocks were also prepared by converting snow directly to ice by using very high compaction pressures in a hydraulic press. The material was very strong and was resistant to the infiltration of fluids of all kinds. The application of these two techniques would greatly reduce most problems encountered in the use of snow roads and runways.

MP 3942
GEOTEXTILES TO MITIGATE FROST EFFECTS IN SOILS: A CRITICAL REVIEW.
Henry, K.S., *Transportation research record,* 1996, No.1534, Geosynthetics: cold regions, flexible pavements, and other issues, p.5-11, 23 refs.
51-2076
SUBGRADE SOILS, SOIL FREEZING, SOIL STABILIZATION, FROST HEAVE, FROST RESISTANCE, FROST PROTECTION, THAW WEAKENING, GEOTEXTILES, VAPOR BARRIERS, FREEZE THAW TESTS
The use of geotextiles to mitigate frost effects in soils has been studied, but few techniques have been developed. Guidelines developed for the placement of granular capillary barriers are presented to serve as preliminary guidelines for geotextile capillary barriers. Laboratory research shows that pore size distribution, wettability, and, for some geotextiles, thickness influence capillary barrier performance in a given soil. Geotextiles that easily wet do not reduce frost heave and may even exacerbate it. On the basis of the literature reviewed, guidance for selection of geotextile capillary barriers in field trials is given. If geotextiles function as capillary barriers during freezing and reinforce or separate and filter the subgrade at the base course interface during thaw, then the potential exists for their use in a combination of functions to reduce frost-related damage in geotechnical structures. It was found that properly designed geotextiles have the potential to reduce frost heave by functioning as capillary barriers, they can be filters for capillary barriers, and they can provide reinforcement or separation or filtration (or all of these) of the subgrade soil to reduce thaw-related damage.

MP 3943
HIGH RESOLUTION OF GLACIAL ICE STRATIGRAPHY: A GROUND-PENETRATING RADAR STUDY OF PEGASUS RUNWAY, MCMURDO STATION, ANTARCTICA.
Arcone, S.A., *Geophysics,* Nov.-Dec. 1996, 61(6), p.1653-1663, 31 refs.
51-2173
ICE RUNWAYS, GLACIER ICE, ICE STRUCTURE, BRINES, WATER CONTENT, SOUNDING, RADAR ECHOES, WAVE PROPAGATION, POLARIZATION (WAVES), PROFILES, ICE COVER STRENGTH, GEOPHYSICAL SURVEYS, RESOLUTION, ANTARCTICA—MCMURDO STATION
Ground-penetrating radar has been used to detect areas of present or potential structural weakness beneath a 3.2 km snow-covered ice runway on the Ross Ice Shelf. The data show many horizons up to tens of meters long and occurring to about a 9 m depth, below which a brine intrusion limits penetration. The presence of porous ice or dispersed water is interpreted from wavelet phase. The water may be associated with apparent deepening and fading of the brine horizon. If the above interpretation is correct, water occurs at depths to 3.5 m and extends as much as 40 m horizontally, which is greater and deeper than known previously. Migration of the diffractions with a single-layer migration scheme shows all horizons above the brine layer to be small dielectric perturbations within the ice. (Auth. mod.)

MP 3944
DEFLECTION ANALYSIS OF RADIALLY CRACKED FLOATING ICE SHEETS.
Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 15th, 1996. Proceedings. Edited by W.A. Nixon, D.S. Sodhi, K.P. Kennedy, H. Yamaguchi, and W. Bugno, New York, American Society of Mechanical Engineers, 1996, p.97-101, 20 refs.
51-2189
ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE ELASTICITY, ICE DEFORMATION, ICE CRACKS, CRACK PROPAGATION, MATHEMATICAL MODELS
A deflection analysis of radially cracked floating ice sheets by the finite element method is presented. The results of this analysis are used to obtain the elastic energy release rate (or the crack extension force) for radial cracks that form when the maximum stress in an intact ice sheet exceeds the flexural strength of the ice. The elastic energy release rate goes to zero when the radial cracks are about two times the characteristic length of a floating ice sheet. The lengths of the radial cracks obtained from this analysis are in agreement with those observed during full-scale and small-scale experiments.

MP 3945
SNOWMELT, ENERGY BALANCE, AND PREDICTION: MORMON MOUNTAIN, ARIZONA.
Gwilliam, B.L., Tempe, Arizona State University, 1990, 66p., M.A. thesis. Refs. p.58-66. Partially supported by the U.S. Army Cold Regions and Research Laboratory.
51-2192
SNOW SURVEYS, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW HYDROLOGY, SNOWMELT, RUNOFF FORECASTING, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, UNITED STATES—ARIZONA—MOGOLLON RIM

MP 3946
REMOVAL OF OBSCURANT CLOUD PARTICLES BY FALLING SNOW.
Cragin, J.H., Hewitt, A.D., Smoke/Obscurants Symposium, 11th, Laurel, MD, Apr. 21-23, 1987. Proceedings. Vol.3. Unclassified section, Aberdeen Proving Ground, MD, Office of the Project Manager Smoke/Obscurants, 1987, p.619-635, 8 refs.
51-2193
FALLING SNOW, SNOWFLAKES, SNOW OPTICS, SCAVENGING, VISIBILITY, SMOKE GENERATORS, MILITARY OPERATION
Experiments conducted within a smoke chamber show that the average scavenging efficiency of several different types of snowflakes and ice crystals for infrared screener EA5763 is approximately 30%. This high efficiency produces rapid obscurant cloud clearing for high mass precipitation rates. Model calculations predict cloud half-lives of 2-20 minutes for snow precipitation rates of 2.5 to 0.5 cm/hr. Scavenging efficiencies are higher for three-dimensional crystals such as spatial dendrites than for planar crystals such as stellars and hexagonal plates. The primary scavenging mechanism for this screener is inertial impaction and it is expected that other obscurants of similar particle size distributions would be scavenged by the same mechanism with comparable efficiency.

MP 3947
SMOKE-SNOW SYNERGISM.
Farmer, W.M., Gerard, S., Cragin, J.H., Smoke/Obscurants Symposium, 11th, Laurel, MD, Apr. 21-23, 1987. Proceedings. Vol.3. Unclassified section, Aberdeen Proving Ground, MD, Office of the Project Manager Smoke/Obscurants, 1987, p.637-649, 4 refs.
51-2194
FALLING SNOW, SNOWFLAKES, SNOW OPTICS, SCAVENGING, VISIBILITY, SMOKE GENERATORS, MILITARY OPERATION
Synergistic effects between smoke and snow can drastically alter how smokes/obscurants performed under winter conditions compared to predictions based on obscurant characteristics under temperate weather conditions. Effects such as snowflake scavenging of smoke/obscurant particles, contrast effects on imaging systems, and disorientation of personnel operating white smoke in a snow background can synergistically work in a snow/cold environment to improve or degrade smoke/obscurant performance. A summary of existing data relative to smoke/snow synergistic effects, an analysis of the parameters that should be measured to evaluate smoke particle scavenging by snow, and the potential operation effects of scavenging are presented. Results of the analysis reveal potentially significant increases in transmittance levels as a result of snow scavenging of smoke particles. Tests being conducted by the Cold Regions Research and Engineering Laboratory to acquire data for evaluating the scavenging capability of snow indicate that because of scavenging effects, significantly higher smoke/obscurant concentrations may be required in snow or cold weather over those normally used for effective warm weather obscuration.

MP 3948
ROLE OF ALBE IN SMOKE AND OBSCURANTS.
Aitken, G.W., Hogan, A.W., Seagraves, M.A., Smoke/Obscurants Symposium, 11th, Laurel, MD, Apr. 21-23, 1987. Proceedings. Vol.3. Unclassified section, Aberdeen Proving Ground, MD, Office of the Project Manager Smoke/Obscurants, 1987, p.737-743.
51-2195
ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, TOPOGRAPHIC SURVEYS, TERRAIN IDENTIFICATION, WEATHER FORECASTING, MILITARY OPERATION, RESEARCH PROJECTS
The U.S. Army Corps of Engineers initiated the AirLand Battlefield Environment (ALBE) program to focus and coordinate Army technology base efforts in the areas of atmospheric, terrestrial and topographic sciences to ensure that the resulting research products are effectively exploited in the research, development and acquisition process and in combat operations. These tech base efforts include many related to smoke and obscurants.

MP 3949
RISK-EQUIVALENT SEASONAL DISCHARGE PROGRAMS FOR ICE-COVERED RIVERS. DISCUSSION.
Ferrick, M.G., Calkins, D.J., *Journal of water resources planning and management*, Nov.-Dec. 1996, 122(6), p.442-444, 3 refs. For pertinent paper see 49-5730.
51-2198
RIVER FLOW, FLOW CONTROL, WATER CHEMISTRY, OXYGEN, AERATION, RIVER ICE, ICE WATER INTERFACE, ICE COVER EFFECT, SEASONAL VARIATIONS, STATISTICAL ANALYSIS, MODELS, ACCURACY
Models of dissolved oxygen (DO) in rivers covered by ice are not yet well established in the literature. The authors modeled the DO response of a 92 km reach of the St. John River using Streeter-Phelps (1958). Based on the results of this model, they concluded that the summer season for this river always had more critical DO conditions than the ice-covered season. However, the authors used minimal data to calibrate their model, simulated a very short river reach in which a DO minimum may not occur, and did not present any data for verification of model results and support of conclusions derived from it. Four primary issues are addressed in this discussion: (1) the assumptions and limitations of the Streeter-Phelps model; (2) existing ice-covered river data for model evaluation; (3) the appropriate hydraulic representation for ice-covered rivers; and (4) available data for the study reach of the St. John River.

MP 3950
EFFECT OF TEMPERATURE ON THE STRENGTH AND VISCOSITY OF ICE.
Zaretskiĭ, IU.K., Fish, A.M., *Soil mechanics and foundation engineering*, Sep. 1996, 33(2), p.46-52, Translated from Osnovaniia, fundamenty i mekhanika gruntov. 13 refs.
51-2151
ICE PHYSICS, ICE STRENGTH, SHEAR STRENGTH, ICE MECHANICS, VISCOSITY, TEMPERATURE EFFECTS, MATHEMATICAL MODELS, FROZEN GROUND MECHANICS

MP 3951
ICE JAM DYNAMICS.
Zufelt, J.E., Iowa City, University of Iowa, 1996, 230p., University Microfilms order No.DA9629745, Ph.D. thesis. 26 refs.
51-2133
RIVER ICE, ICE JAMS, FREEZEUP, ICE BREAKUP, ICE FRICTION, ICE PRESSURE, ICE PILEUP, ICE DEFORMATION, ICE COVER THICKNESS, ICE WATER INTERFACE, ICE MODELS, ICE FORECASTING, RIVER FLOW, MATHEMATICAL MODELS, COMPUTER PROGRAMS

MP 3952
REMOTE SENSING OF OIL SPILLS NEAR THE KOLVA RIVER, RUSSIA.
Chadwick, D.J., Bolus, R.L., McKim, H.L., Link, L.E., 1995, 15p., 5 refs. Unpublished paper presented at the 2nd International Oil Spill Research and Development Forum, Fostering International Co-operative Research, May 23-26, 1995, London, England.
51-2371
REMOTE SENSING, OIL SPILLS, PIPELINES, CRUDE OIL, COLD WEATHER OPERATION, SPECTRA, ACCURACY, WATER POLLUTION, WETLANDS, SPACECRAFT, SYNTHETIC APERTURE RADAR, RUSSIA—KOLVA RIVER, RUSSIA—KOMI

MP 3953
PROCESSING SNOW FOR HIGH STRENGTH ROADS AND RUNWAYS.
Lang, R.M., Blaisdell, G.L., D'Urso, C., Reinemer, G., Lesher, M., *Cold regions science and engineering*, Jan. 1997, 25(1), p.17-31, 21 refs.
51-2375
SNOW (CONSTRUCTION MATERIAL), MECHANICAL TESTS, SNOW ROADS, ICE RUNWAYS, MACHINERY, SNOW COMPACTION, SNOW HARDNESS, BEARING STRENGTH, DENSITY (MASS/VOLUME), HARDNESS TESTS, IMAGING, COMPRESSIVE PROPERTIES
Using a variety of conventional snow processing equipment in deep snow fields in West Yellowstone, MT, the authors studied snow processing techniques having the potential for producing high-strength snow roads and runways. The test location and timing were selected to simulate conditions in polar regions. Four separate test sites, each with a different treatment, were established using the snow processing equipment. Observations were made for 12 weeks after construction to monitor the snow's hardness (strength) and its temperature distribution. Plane sections were taken at each site on a weekly basis to allow comparison of bond density and strength. Image analysis was used to find which critical microstructural properties correlate best with compressive strength changes. Test results indicate that a powered tiller with a relatively dense tooth population provided the highest strength snow. This snow was strong enough to easily support contact loads greater than 700 kPa, which could allow the use of conventional aircraft and wheeled vehicles in areas of deep snow.

MP 3954
MOISTURE MIGRATION DURING FREEZE AND THAW OF UNSATURATED SOILS: MODELING AND LARGE SCALE EXPERIMENTS.
Shoop, S.A., Bigl, S.R., *Cold regions science and engineering*, Jan. 1997, 25(1), p.33-45, 19 refs.
51-2376
GEOCRYOLOGY, FROZEN GROUND THERMODYNAMICS, SOIL WATER MIGRATION, MOISTURE TRANSFER, FROST HEAVE, FROST PENETRATION, UNFROZEN WATER CONTENT, FREEZE THAW TESTS, ICE WATER INTERFACE, INTERFACIAL TENSION, SIMULATION, PHASE TRANSFORMATIONS, MATHEMATICAL MODELS, FORECASTING
A coupled heat flow and moisture flow model (FROSTB) was used to simulate large-scale freeze-thaw experiments to assess its ability to predict soil moisture conditions. The experimental data consist of temperature and soil moisture profiles measured during freeze-thaw cycles in a 1 m layer of frost-susceptible silty sand over roughly 2 m of gravelly sand. Two experimental conditions were modeled: (1) where the soil was fairly wet and the water table was shallow (1 m below surface), and (2) where the soil moisture was lower than specific retention and the water table was deep. Overall, the model predicts the frost penetration and heave quite well; however, it tends to overpredict ice formation. The authors propose improvements through using a "pseudo" three-phase flow potential and calculating volumetric segregated ice content starting at 90% of saturation. The effects of changing the constants related to hydrologic properties are also discussed.

MP 3955
MODELING OF FORESTED AREAS FOR REAL AND SYNTHETIC APERTURE IMAGING RADAR SIMULATION.
Stuopis, P.A., Henson, J.M., Davis, R.E., Hall, K., International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1996, p.254-256, 5 refs.
51-2438
FOREST CANOPY, FOREST LAND, VEGETATION PATTERNS, TERRAIN IDENTIFICATION, SIDE LOOKING RADAR, SYNTHETIC APERTURE RADAR, RADAR PHOTOGRAPHY, PHOTOGRAPHIC RECONNAISSANCE, ENVIRONMENT SIMULATION, IMAGE PROCESSING
The following paper provides a discussion of several procedures for generating elevation and terrain category database information for the modeling of deciduous, coniferous, and mixed forested areas. Specifically, techniques for the geometric modeling of individual pine and oak trees, based on measured or estimated location, height, and canopy diameter are presented. Techniques for randomly populating forested areas at user specified densities with individual trees are discussed. Considerable simulated imagery has been developed for both solid canopy forest and individual tree forest models. In the case of forests modeled as collections of individual trees, imagery has been developed for forests with varying tree densities. Simulated image presentations (grey level and pseudo-color) include sidelooking SAR range and ground range imagery and forward scan B-Scope and P-Scope range and ground range imagery. All modeling and simulation was accomplished using the Synthetic Aperture Reconnaissance, Tactical, and Camouflage (SARTAC) imaging radar simulation and analysis tool developed at the University of Nevada with the support of the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (USACE/CRREL) and the U.S. Army Corps of Engineers Waterway Exper-

iment Station (USACE/WES).

MP 3956
ELECTROMAGNETIC SCATTERING BASED ON PAIR DISTRIBUTION FUNCTIONS RETRIEVED FROM PLANAR SNOW SECTIONS.
Zurk, L.M., Tsang, L., Shi, J.C., Davis, R.E., International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1996, p.754-756, 6 refs.
51-2453
SNOW CRYSTAL STRUCTURE, SNOW COVER STRUCTURE, SNOW DENSITY, SNOW ELECTRICAL PROPERTIES, ICE CRYSTAL REPLICAS, ICE CRYSTAL SIZE, PARTICLE SIZE DISTRIBUTION, WAVE PROPAGATION, SCATTERING, STEREOPHOTOGRAPHY, STATISTICAL ANALYSIS
Electromagnetic wave propagation and scattering in dense media depends on the 3-D pair distribution function of particle positions. Recent efforts in the snow community have concentrated on analyzing planar snow sections to obtain 2-D stereological data. In this paper the authors calculate the volume 3-D pair distribution function from the 2-D stereological data. A log-normal distribution of particle sizes is assumed for the ice grains in snow with the distribution parameters derived from stereological measurements. The 3-D pair function can be expressed as a weighted sum of size specific pair functions which are necessary for scattering calculations. The authors choose a small number of representative particle sizes and use a least squares non-linear fit to decompose the 3-D pair function into pair functions for those particles.

MP 3957
MODELING OF ELECTROMAGNETIC WAVE SCATTERING FROM TIME-VARYING SNOW-COVER.
Ding, K.H., Yang, Y.E., Shih, S.E., Kong, J.A., Davis, R.E., International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1996, p.757-759, 7 refs.
51-2454
SNOW COVER STRUCTURE, METAMORPHISM (SNOW), SNOW DENSITY, SNOW HEAT FLUX, SNOW ELECTRICAL PROPERTIES, BACKSCATTERING, RADAR ECHOES, COMPUTERIZED SIMULATION
In this paper, a study of the effects of time-varying snowcovers on the radar backscatter signatures is presented. To this objective, a snow physics model, known as SNTHERM, is applied to enable the simulation of the dynamical behavior of snowpacks. The SNTHERM model can provide thermal and physical properties such as the temperature profile, liquid water content, and the layering structure which affect the electromagnetic properties of snowpacks. To calculate the backscattering coefficients from snowcovers, the authors employ the dense medium radiative transfer (DMRT) theory with a clustered snow grain microstructure. This coupled model is then used to predict the influence of environmental variation on the millimeter wave radar response, and compare simulation results with snow backscatter measurements. Good agreement is obtained between model and measured data in both timing and magnitude.

MP 3958
COMPARISON OF SPATIAL STATISTICS OF SAR-DERIVED AND IN-SITU SOIL MOISTURE ESTIMATION.
Hirsave, P.P., et al, International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1996, p.1073-1075, 8 refs.
51-2467
SOIL SURVEYS, SOIL WATER, MOISTURE DETECTION, SYNTHETIC APERTURE RADAR, SPACEBORNE PHOTOGRAPHY, IMAGE PROCESSING, STATISTICAL ANALYSIS
The technology of using spaceborne SAR systems for soil moisture estimation has been refined over the last few years. In order to reduce the confounding effects of surface roughness on soil moisture inversion, multifrequency SAR systems have shown promise. The Shuttle Imaging Radar (SIR-C) has an onboard SAR system operating at L, C, and X bands for high resolution imaging of the earth's surface. Over the early part of Oct. 1994, the SIR-C SAR collected radar reflectance data from two sites near Concord, NH. SIR-C data were collected on four consecutive days and concurrent ground truth measurements were also made of the actual soil moisture distribution at the test sites. The objective of the study was to evaluate the radar system's ability not only to estimate soil moisture, but also to characterize its spatial variability. The SIR-C derived and the *in situ* soil moisture estimates compared well not only for the mean soil moisture of each pixel, but also for the spatial statistical parameters, such as correlation lengths and the gradients of soil moisture.

MP 3959
OBSERVATIONS OF SEA ICE PHYSICAL PROPERTIES DURING THE SEA ICE ELECTROMAGNETICS INITIATIVE.
Gow, A.J., Perovich, D.K., International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1996, p.1184-1186, 2 refs.
51-2470
ICE SURVEYS, SEA ICE, SALT ICE, ARTIFICIAL ICE, ICE MICROSTRUCTURE, ICE ELECTRICAL PROPERTIES, ICE SALINITY, ICE TEMPERATURE, ICE DENSITY, ENVIRONMENTAL TESTS, RADIOMETRY, STATISTICAL ANALYSIS
An Office of Naval Research sponsored sea ice electromagnetics research initiative has been directed towards relating the observed variability in sea ice electromagnetic signatures to changes in sea ice physical properties, and then using this information to develop forward and inverse models. In this paper the authors present an overview of laboratory and field observations made of sea ice physical properties during the past three years. This description included a statistical characterization of the ice microstructure. The authors present these observations in the context of tracing the development of sea ice. The laboratory studies included *in situ* measurements of the physical and electromagnetic properties of young ice sheets grown under both quiescent and active conditions.

MP 3960
SEA ICE POLARIMETRIC BACKSCATTER SIGNATURES AT C BAND.
Nghiem, S.V., et al, International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1996, p.1190-1192, 4 refs.
51-2472
ICE SURVEYS, SEA ICE, ICE DETECTION, ICE ELECTRICAL PROPERTIES, ICE TEMPERATURE, ICE STRUCTURE, SYNTHETIC APERTURE RADAR, BACKSCATTERING
This paper presents C-band polarimetric backscatter signatures of sea ice measured during CRRELEX (Cold Regions Research and Engineering Laboratory Experiment) from 1993 to 1995. Observed radar backscatter of sea ice is related to sea ice physical characteristics. Complex scattering models for sea ice are developed and used to interpret measured radar data with sea ice physical parameters. These results for sea ice at C-band are important for applications to remote sensing data acquired with many airborne and spaceborne C-band synthetic aperture radars.

MP 3961
MULTISENSOR ESTIMATION OF VEGETATION CHARACTERISTICS.
Zhang, J., et al, International Geoscience and Remote Sensing Symposium, Lincoln, NE, May 27-31, 1996. IGARSS'96. Remote sensing for a sustainable future. Vol.4, New York, Institute of Electrical and Electronics Engineers, 1996, p.2375-2376, 5 refs.
51-2516
FOREST ECOSYSTEMS, PLANT ECOLOGY, VEGETATION PATTERNS, FOREST CANOPY, BIOMASS, TERRAIN IDENTIFICATION, SYNTHETIC APERTURE RADAR, SPACEBORNE PHOTOGRAPHY, IMAGE PROCESSING, UNITED STATES—NEW HAMPSHIRE
The case for a multisensor approach to estimate and monitor vegetation characteristics has been well-established. SAR sensors have shown promise in not only classifying vegetation types but also in estimating parameters such as biomass, canopy height, and diameter at breast height (dbh). The accuracy with which vegetation types can be classified and the above parameters estimated can be significantly improved by using data from other optical sensor systems such as color-infrared (IR) imagery and satellite photography. The authors have obtained contemporaneous and coregistered SIR-C SAR and airborne color-IR images as well as satellite photographs of a forested area in New Hampshire. Bayesian classification technique is being investigated in order to classify vegetation into broad classes. Inversion algorithms are also being developed for estimating specific vegetation parameters once broad classes have been delineated. The added benefit of integrating optical sensor data with the SAR imagery is being studied in terms of classification and estimation accuracy.

MP 3962
ARCTIC RESEARCH OF THE UNITED STATES, VOL.10, FALL/WINTER, 1996.
U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Haugh, J., ed, Cate, D.W., ed, Valliere, D.R., ed, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1996, 60p., Refs. passim. For selected papers see 51-2545 and 51-2546.
51-2544
RESEARCH PROJECTS, ORGANIZATIONS, INTERNATIONAL COOPERATION, REGIONAL PLANNING, MEETINGS, LEGISLATION, COST ANALYSIS

MP 3963
MODEL OF VISCOPLASTIC DEFORMATION OF FROZEN AND UNFROZEN SOILS AND ICE.
Zaretskii, IU.K., Fish, A.M., International Offshore and Polar Engineering Conference, 6th, Los Angeles, CA, May 26-31, 1996 Proceedings. Vol.2. Edited by J.S. Chung, M. Sayed, R.E. Hobbs, and D.R. Yoerger, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1996, p.291-296, 23 refs.
51-2578
RHEOLOGY, PLASTIC DEFORMATION, FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, SOIL STRENGTH, SOIL CREEP, ICE STRENGTH, ICE PRESSURE, ICE PLASTICITY, ICE DEFORMATION, ICE CREEP, MATHEMATICAL MODELS
A mathematical model for visco-plastic deformations, a new criterion for the long-term strength of frozen and unfrozen soils, and a criterion for the long-term (creep) strength of ice were developed on the basis of a combination of compression and torsion constant-deformation-rate tests, and relaxation tests. The analysis of test data on the kinetics of the generation and development of microdefects in the structure of ice during creep made it possible to formulate a generalized criterion for the creep strength of ice. Physical interpretation and a quantitative evaluation procedure are presented of the anomalous behavior of ice under high confining pressure, when its strength reaches a maximum, then gradually decreases with continued pressure increase. These studies allowed the temperature effect on the viscoplastic flow and the long-term strength of frozen soils and ice under high pressures to be taken into account as well.

MP 3964
MECHANICAL PROPERTIES OF FIRST-YEAR SEA ICE AT TARSIUT ISLAND—DISCUSSION AND CLOSURE.
Richter-Menge, J.A., Schulson, E.M., *Journal of cold regions engineering*, Mar. 1997, 11(1), p.93-98, 31 refs. For paper under discussion see 51-2641.
51-2643
ARTIFICIAL ISLANDS, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE ELASTICITY, ICE DEFORMATION, STRESS CONCENTRATION, STRAIN TESTS, BEAUFORT SEA

MP 3965
U.S., CANADIAN RESEARCHERS EXPLORE ARCTIC OCEAN.
Aagaard, K., Tucker, W.B., *Eos*, May 28, 1996, 77(22), p.209,213.
51-1275
OCEANOGRAPHIC SURVEYS, GLOBAL CHANGE, CLIMATOLOGY, OCEAN CURRENTS, ATMOSPHERIC COMPOSITION, RADIATION BALANCE, MARINE BIOLOGY, GEOCHEMICAL CYCLES, SEA ICE DISTRIBUTION, WATER POLLUTION, ENVIRONMENTAL TESTS, ARCTIC OCEAN

MP 3966
SHEBA: A RESEARCH PROGRAM ON THE SURFACE HEAT BUDGET OF THE ARCTIC OCEAN SCIENCE PLAN.
Moritz, R.E., ed, Perovich, D.K., ed, *University of Washington, Seattle. Applied Physics Laboratory. Polar Science Center. Arctic System Science Ocean-Atmosphere-Ice Interactions ARCSS/OAII report*, July 1996, No.5, 60p., Refs. p.49-54.
51-2664
RESEARCH PROJECTS, DRIFT STATIONS, POLAR ATMOSPHERES, ATMOSPHERIC CIRCULATION, OCEAN CURRENTS, AIR ICE WATER INTERACTION, ICE HEAT FLUX, HEAT BALANCE, GLOBAL WARMING, COMPUTERIZED SIMULATION

MP 3967
DEVELOPING NEW LOW-TEMPERATURE ADMIXTURES FOR CONCRETE: A FIELD EVALUATION.
Korhonen, C.J., Charest, B.A., Romisch, K., Corps of Engineers Structural Engineering Conference, Aug. 28-30, 1995, San Antonio, TX. Vol.1, Washington, D.C., U.S. Army Corps of Engineers, Directorate of Engineering and Construction, 1996, p.535-545, 7 refs.
51-2665
CONCRETE FREEZING, WINTER CONCRETING, CONCRETE ADMIXTURES, CONCRETE PLACING, CON-

CRETE CURING, CONCRETE STRENGTH, FROST PROTECTION, ANTIFREEZES
Two new admixtures, capable of preventing water from freezing and increasing the hydration rate of cement at below-freezing temperatures, were field-tested at Sault Ste. Marie, MI. Concrete made with the admixtures was placed on a frozen subgrade during a cold winter day and was allowed to cure thermally unprotected in the cold. Comparison to control concrete placed inside a heated shelter showed that the unprotected admixtured concrete was equal to control concrete in strength and appearance. Work is continuing on the development of these admixtures for commercialization.

MP 3968
IMPROVEMENTS TO SNOW LOAD DESIGN CRITERIA.
Tobiasson, W., Corps of Engineers Structural Engineering Conference, Aug. 28-30, 1995, San Antonio, TX. Vol.2, Washington, D.C., U.S. Army Corps of Engineers, Directorate of Engineering and Construction, 1996, p.1181-1189, 6 refs.
51-2666
SNOW LOADS, SNOW DEPTH, SNOW ACCUMULATION, SNOWFALL, MILITARY FACILITIES, STATISTICAL ANALYSIS, DESIGN CRITERIA, BUILDING CODES, STANDARDS, MANUALS
American Society of Civil Engineers (ASCE) Manual 7, "Design Loads for Buildings and Other Structures," is the resource document for Army Technical Manual (TM) 5-809-1, "Structural Design Criteria, Loads" (U.S. Department of the Army, 1992). ASCE Manual 7 is updated every 5 years and is to be reissued in 1995, after which, TM 5-809-1 will be withdrawn. The new Manual 7 will include updated site-specific snow load information gathered by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) from military installations. All design values will be determined statistically based on measurements rather than as at present, some determined by local practice with no indication which is which. Where local practice values differ, they will be indicated in parentheses.

MP 3969
SHALLOW INSULATED FOUNDATIONS FOR PRE-ENGINEERED METAL BUILDINGS.
Danyluk, L.S., Khosrownia, G., Corps of Engineers Structural Engineering Conference, Aug. 28-30, 1995, San Antonio, TX. Vol.2, Washington, D.C., U.S. Army Corps of Engineers, Directorate of Engineering and Construction, 1996, p.1213-1223, 9 refs.
51-2667
BUILDINGS, FOUNDATIONS, FOOTINGS, FROST PENETRATION, FROST PROTECTION, THERMAL INSULATION, COLD WEATHER CONSTRUCTION, MILITARY FACILITIES, BUILDING CODES
For building construction projects in the cold regions of the world, depth of frost penetration has been a major factor in the expense and design difficulty of foundations. Often, deep foundations are used in areas of deep seasonal frost, but in some instances a deep foundation creates problems with the design of a building. Such is the case in metal buildings, whose selection as a building system is primarily due to function, speedy construction, and economy. These same characteristics are what make a shallow foundation design an attractive alternative over a conventional deep foundation. For three decades, the Scandinavian countries have researched, developed, and implemented shallow insulated foundations (SIF). However, their use in the United States is still new and somewhat limited. Most U.S. building codes require footings to be placed below the expected depth of frost. In recognition of the potential of shallow insulated foundations, research is being performed by various universities, private industries, and government agencies, including the U.S. Army Cold Regions Research Engineering Laboratory, in an effort to better understand the SIF system and to recommend changes in U.S. building codes to allow for its use and implementation. A large laundry/changing facility to be built for toxic chemical disposal personnel at the Umatilla Army Depot in Hermiston, OR, is described.

MP 3970
THEORETICAL EVALUATION OF MINERAL STABILITY IN DON JUAN POND, WRIGHT VALLEY, VICTORIA LAND.
Marion, G.M., *Antarctic science,* Mar. 1997, 9(1), p.92-99, 29 refs.
51-2687
SALT LAKES, THERMODYNAMIC PROPERTIES, MINERALS, STABILITY, GEOCHEMISTRY, ICE FORMATION, ICE MODELS, ANTARCTICA—DON JUAN POND
Don Juan Pond is the most saline of the antarctic lakes, being a near-saturated $CaCl_2$ solution. As a consequence of this high salinity, Don Juan Pond generally remains unfrozen in winter, even at temperatures below -50°C. Don Juan Pond is the site where antarcticite ($CaCl_2 \cdot 6H_2O$) was first identified forming naturally. The objective of this paper is to demonstrate the utility of a chemical thermodynamic model (FREZCHEM) by developing theoretical stability diagrams for ice, halite (NaCl), hydrohalite ($NaCl \cdot 2H_2O$), and antarcticite in Don Juan Pond, using experimental data collected on 34 days between 1961 and 1983. The model is compatible with the experimental data, and predicts the formation of ice during rare high water periods, halite, and antarcticite. These solid phases have all been reported from Don Juan Pond. The model also predicts the formation of hydrohalite at subzero temperatures; hydrohalite has never been observed at Don Juan Pond, but this may simply reflect that most sampling was done during the summer when halite is thermodynamically more stable than hydrohalite. The FREZCHEM model may prove useful in elucidating the physicochemical behavior, the origin of salinity, and the evolution of antarctic lakes. (Auth. mod.)

MP 3971
MODELING ICE PASSAGE AT LOCKS AND DAMS.
Tatinclaux, J.C., Rand, J.H., Gooch, G.E., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* July 1992, No.1, 4p., 2 refs.
51-2707
RIVER ICE, ICE CONTROL, ICE PASSING, LOCKS (WATERWAYS), DAMS, SLUICES (HYDRAULIC ENGINEERING), HYDRAULIC STRUCTURES, ENVIRONMENTAL TESTS

MP 3972
ICE JAM STATISTICS RECORDED ON DATA BASE.
White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Nov. 1992, No.2, 4p.
51-2708
RIVER ICE, ICE JAMS, DATA PROCESSING

MP 3973
ICE MOTION DETECTOR SYSTEM.
Zufelt, J.E., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Sep. 1993, No.4, 4p.
51-2710
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE DETECTION, ICE FORECASTING, FLOOD FORECASTING, ELECTRICAL LOGGING, MONITORS, WARNING SYSTEMS

MP 3974
FREEZEUP ICE JAM CONTROL.
White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Jan. 1994, No.5, 4p., 8 refs.
51-2711
RIVER ICE, FREEZEUP, FRAZIL ICE, ICE JAMS, ICE CONTROL, ICE BOOMS

MP 3975
FIELD MEASUREMENT OF ICE FORCES AND BED EROSION DURING BREAKUP.
Zabilansky, L.J., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Apr. 1994, No.6, 4p.
51-2712
BRIDGES, PIERS, ACCIDENTS, RIVER ICE, ICE BREAKUP, ICE LOADS, ICE EROSION, ICE SCORING, MONITORS, RADIO BEACONS, UNITED STATES—VERMONT—WHITE RIVER JUNCTION

MP 3976
WEAKENING ICE BY DUSTING WITH LEAVES.
Haynes, F.D., Haehnel, R.B., Clark, C.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* July 1994, No.7, 4p.
51-2713
RIVER ICE, ICE CONTROL, ICE DETERIORATION, ICE MELTING, ARTIFICIAL MELTING, DUSTING, ALBEDO

MP 3977
LOW-COST BREAKUP ICE CONTROL STRUCTURE.
Lever, J.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Mar. 1995, No.8, 4p.
51-2714
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE CONTROL, FLOOD CONTROL, HYDRAULIC STRUCTURES, ROCK FILLS, FLOODPLAINS, COST ANALYSIS

MP 3978
CHARACTERIZING ICE JAMS IN NEW HAMPSHIRE AND VERMONT USING THE CRREL ICE JAM DATABASE.
White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* June 1995, No.9, 4p., 4 refs.
51-2715
RIVER ICE, FREEZEUP, ICE BREAKUP, ICE JAMS, ACCIDENTS, FLOODS, FLOOD FORECASTING, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—NEW HAMPSHIRE, UNITED STATES—VERMONT

MP 3979
INTRODUCING THE ICE JAM ARCHIVE.
Herrin, L., Balch, E., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Sep. 1995, No.10, 4p., 4 refs.
51-2716
RIVER ICE, ICE JAMS, DATA PROCESSING, STATISTICAL ANALYSIS

MP 3980
BREAKING RIVER ICE TO PREVENT ICE JAMS.
Haehnel, R.B., Haynes, F.D., Clark, C.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Oct. 1995, No.11, 4p.
51-2717
RIVER ICE, ICE JAMS, ICE BREAKING, AMPHIBIOUS VEHICLES, COST ANALYSIS

MP 3981
BRIDGE PIER DESIGN FOR ICE FORCES.
Haynes, F.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Dec. 1995, No.12, 4p., 6 refs.
51-2718
BRIDGES, PIERS, RIVER ICE, ICE SOLID INTERFACE, ICE LOADS, ICE PRESSURE, ICE FRICTION, DESIGN CRITERIA

MP 3982
SAFE LOADS ON ICE SHEETS.
Haynes, F.D., Carey, K.L., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Jan. 1996, No.13, 4p., 3 refs.
51-2719
RIVER ICE, LAKE ICE, ICE COVER STRENGTH, ICE LOADS, ICE COVER THICKNESS, ICE CRACKS, ICE BREAKING, ICE ROADS, ICE CROSSINGS, SAFETY

MP 3983
DRILLING HOLES IN ICE TO REDUCE ICE JAM POTENTIAL.
Haehnel, R.B., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Feb. 1996, No.14, 4p., 1 ref.
51-2720
RIVER ICE, ICE JAMS, ICE DRILLS, ICE CUTTING, ICE BREAKING, ICE CONTROL, AUGERS, COST ANALYSIS, UNITED STATES—WISCONSIN—OCONTO

MP 3984
WINTER MORNING AIR TEMPERATURE.
Hogan, A.W., Ferrick, M.G., *Journal of applied meteorology,* Jan. 1997, 36(1), p.52-69, 43 refs.
51-2721
SNOW COVER EFFECT, SNOW AIR INTERFACE, AIR TEMPERATURE, SURFACE TEMPERATURE, TEMPERATURE INVERSIONS, TEMPERATURE GRADIENTS, DIURNAL VARIATIONS, WEATHER FORECASTING, STATISTICAL ANALYSIS, UNITED STATES—CONNECTICUT RIVER
Results of temperature measurements, which may be applied to inference of winter temperatures in data-sparse areas, are presented. The morning air temperatures during three winters were measured at 80 places in a 10 km x 30 km area along the Connecticut River. NOAA climatologies show this region to have complex spatial variation in mean minimum temperature. Frequency analysis techniques were applied to evaluate the differences in daily local temperature. Temperature lapse or temperature inversion in the study area was inferred from the difference of surface temperature measurements 100 and 300 m above river level. The frequency of inferred temperature lapse and the inferred lapse rate diminished as snow cover increased. The frequency of inferred temperature inversion and inversion strength increased as snow cover increased. When more than 20 cm of snow covered the ground, an additional surface inversion was frequent in the layer less than 100 m above river level, and two-thirds of river level temperatures less than -20°C occurred concurrent with these conditions. The daily temperature differences at the individual points, with respect to a defined point, were lognormally distributed. The magnitude and geometric standard deviation of temperature differences throughout the study area were larger on mornings when inversion was inferred. With respect to topography, temperature differences and the geometric standard devia-

tion of temperature differences were smaller along flats or among basins than along or atop slopes on mornings when inversion was inferred. It is proposed that some meteorologically prudent inferences of surface temperature and near-surface temperature lapse or temperature inversion can be made for similar data-sparse areas.

MP 3985
LABORATORY AND ANALYTICAL METHODS FOR EXPLOSIVES RESIDUES IN SOIL.
Walsh, M.E., Jenkins, T.F., Thorne, P.G., *Journal of energetic materials*, 1995, Vol.13, p.357-383, 90 refs.
51-2722
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, CHEMICAL ANALYSIS, EXPLOSIVES, MILITARY FACILITIES, WASTE DISPOSAL, LAND RECLAMATION
Standard analytical methods have been developed to characterize explosives residues in soil at U.S. Department of Defense installations. The laboratory analysis is conducted using RP-HPLC, and the most commonly found analytes are TNT and RDX. Other analytes commonly detected are the environmental transformation products of TNT including TNB, dinitroaniline, and the isomers of amino-DNT, and the manufacturing by-products DNB and the isomers of amino-DNT. Field methods designed to detect TNT and RDX have enhanced site characterization by providing rapid on-site results for a greater number of samples than would be economically feasible by depending solely on off-site laboratory analyses for all samples. Attempts may be made to use both laboratory and field methods to analyze treatment matrices such as incinerator ash and compost, but further analytical method development is needed to enhance extraction and minimize interferences.

MP 3986
REVIEW ON AGEING OF FIBER REINFORCED POLYMER COMPOSITES.
Ganga Rao, H.V.S., Dutta, P.K., Middle East Workshop on Structural Composites, 1st, Sharm El-sheikh, Egypt, June 14-15, 1996. Advanced composite materials state-of-the-art report, Cairo, Egypt, Egyptian Society of Engineers, 1996, p.45-58.
51-2723
COMPOSITE MATERIALS, POLYMERS, CONSTRUCTION MATERIALS, STRUCTURAL ANALYSIS, WEATHERING, FATIGUE (MATERIALS)
Advanced composite materials are expected to perform satisfactorily over a period of at least fifty years. To gain some level of confidence of using these materials in large quantities, accelerated ageing procedures are needed to predict the long term material performance limits. The long term material performance in terms of mechanical properties depend on environmental conditions, chemical exposures, and load applications. It has been found that materials can be treated in an accelerated manner in hot-wet conditions and under certain pressures to predict mechanical property for very long times ahead. The salient issues governing the strength, stiffness, and durability of continuous fiber reinforced polymer composites under mechanical and environmental loads are briefly reviewed. For example, degradation rates of strength and stiffness under typical environmental conditions and service conditions are given for hybrid structural members, i.e., conventional materials reinforced with composite shells. In addition, attention is drawn to the effects of pH levels, applied stress, chemical reactions and hygrothermal fluctuations in understanding ageing of polymer composites. The ageing of fiber reinforced polymer composites is briefly discussed and an accelerated ageing procedure for predicting the long-term behavior is described.

MP 3987
SNOW COVER EFFECTS ON IMPULSIVE NOISE PROPAGATION IN A FOREST.
Albert, D.G., International Congress on Noise Control Engineering, 25th, Liverpool, England, 1996. Inter-noise 96, Poughkeepsie, NY, Noise Control Foundation, 1996, p.663-668, 20 refs.
51-2724
SNOW ACOUSTICS, SNOW DEPTH, SNOW AIR INTERFACE, SNOW COVER EFFECT, FOREST LAND, NOISE (SOUND), SOUND TRANSMISSION, SOUND WAVES, WAVE PROPAGATION
The amplitude and waveform shape of atmospheric acoustic pulses propagating horizontally over a seasonal snow cover are profoundly changed by the air forced into the snow pores as the pulses move over the surface. This interaction greatly reduces the pulse amplitude and elongates the waveform compared to propagation above other ground surfaces. A comparison of experimentally observed blank pistol shot waveforms with waveforms theoretically calculated using a rigid porous media model for the snow and ground can be used to determine the snow cover properties. By varying the source and receiver positions during the experimental measurements, the spatial variations in snow properties near the edge of a forest were sampled at the site of the 1995 Norwegian winter blast tests. An inversion procedure that automatically matches the observed waveforms revealed a very shallow area of snow, just inside the forest, caused by the warming effect of the trees which absorb and reradiate solar energy. These acoustic measurements were in agreement with direct depth measurements and snow pit observations. The waveform inversion procedure is able to accurately determine the snow cover conditions even in the highly variable region at the edge of the forest.

MP 3988
ON WAVELET ANALYSIS OF NONSTATIONARY TURBULENCE.
Treviño, G., Andreas, E.L., *Boundary-layer meteorology*, 1996, Vol.81, p.271-288, 24 refs.
51-2725
ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENCE, WAVE PROPAGATION, DATA PROCESSING, IMAGE PROCESSING, STATISTICAL ANALYSIS, MATHEMATICAL MODELS
Wavelets are new tools for turbulence analysis that are yielding important insights into boundary-layer processes. Wavelet analysis, however, has some as yet undiscussed limitations: failure to recognize these can lead to misinterpretation of wavelet analysis results. Here the authors discuss some limitations of wavelet analysis when applied to nonstationary turbulence. The main point is that the analysis wavelet must be carefully matched to the phenomenon of interest, because wavelet coefficients obscure significant information in the signal being analyzed. For example, a wavelet that is a second-difference operator can provide no information on the linear trend in a turbulence signal. Wavelet analysis also yields no meaningful information about nonlinear behavior in a signal—contrary to claims in the literature—because, at any instant, a wavelet is a single-scale operator, while nonlinearity involves instantaneous interactions among many scales.

MP 3989
ASSESSING THE SIGNIFICANCE OF SUBGRADE VARIABILITY ON TEST SECTION PERFORMANCE.
Kestler, M.A., Uncertainty in the geologic environment: from theory to practice. Geotechnical special publication, No.58. Uncertainty '96, July 31-Aug. 3, 1996. Proceedings. Vol.1, New York, American Society of Civil Engineers, 1996, p.685-694, 15 refs.
51-2726
SUBGRADE SOILS, GROUND THAWING, THAW DEPTH, THAW WEAKENING, SOIL STRENGTH, SOIL TRAFFICABILITY, SUBGRADE MAINTENANCE, ROAD MAINTENANCE, SOIL STABILIZATION, SOIL TESTS, ENVIRONMENTAL TESTS, STATISTICAL ANALYSIS
Variations in subgrade moisture and strength are suspected to be reflected in variations in test section performance. Using relatively simple statistics and geostatistics, this paper mathematically shows that this was indeed the case at one particular field demonstration site. Additionally, a range of influence was quantified for the site. During the 1995 spring thaw season, a variety of expedient surfaces were constructed to demonstrate rapid stabilization techniques for thawing soils as part of a cooperative field project at Fort McCoy, WI. Mechanical stabilizing techniques evaluated include chunkwood, tire chips, gravel, wooden mats, tire mats, geosynthetics, and slash (brush, tree branches and limbs). Materials were used both separately and in combination with each other. Surfacing materials were then subjected to two sets of 50 vehicle passes (wheeled and tracked), and test sections were rated for performance both during and after trafficking. Prior to test section construction, a sampling and testing program was established, and tests were conducted to define preconstruction variability as functions of subgrade strength, moisture, density, and thaw depth. This paper focuses on site variability aspects of the overall field demonstration project, and applies statistical and geostatistical techniques to evaluate the significance of preconstruction site variability on variations in test section performance.

MP 3990
RAPID STABILIZATION OF THAWING SOILS: A DEMONSTRATION PROJECT.
Kestler, M.A., Shoop, S.A., Henry, K.S., Stark, J.A., *U.S. Forest Service. North Central Forest Experiment Station, St. Paul, MN. General technical report*, 1996, NC-186, Planning and implementing forest operations to achieve sustainable forests, p.166-178, 9 refs. Presented at the joint meeting of the Council on Forest Engineering and International Union of Forest Research Organizations, Marquette, MI, July 29-Aug. 1, 1996.
51-2727
GROUND THAWING, THAW WEAKENING, SOIL TRAFFICABILITY, SOIL STABILIZATION, GEOTEXTILES, MILITARY ENGINEERING, ROAD MAINTENANCE, ENVIRONMENTAL TESTS
The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) conducted a field demonstration project in which a variety of expedient surfaces were constructed and trafficked to test stabilization techniques for thawing soils. The project was conducted at Fort McCoy, WI, during the 1995 spring thaw. Cooperating partners included the Wisconsin National Guard, the U.S. Army Engineer School, the USDA Forest Service (USFS), Terramat, and Uni-Mat International, Inc. As part of the overall project, the stabilizing techniques were evaluated for expediency, ease of construction, performance during trafficking, and vehicle mobility enhancement. The test and evaluation program generated recommendations for construction of expedient roads under thawing conditions to be incorporated into military engineering decision aids and simulations. The information is also applicable for non-military purposes such as timber- and pipeline-access in the logging, oil and gas industries. This paper provides a general description of the techniques tested and installation methods used as well as some difficulties associated with each. It also briefly describes the tests performed and types of data gathered.

MP 3991
EXTENSION AND COMPRESSION OF ELASTOMERIC BUTT JOINT SEALS.
Ketcham, S.A., Niemiec, J.M., McKenna, G.B., *Journal of engineering mechanics*, July 1996, 122(7), p.669-677, 21 refs.
51-2728
RUBBER, JOINTS (JUNCTIONS), SEALING, ELASTIC PROPERTIES, TENSILE PROPERTIES, COMPRESSIVE PROPERTIES, STRAIN TESTS, LOW TEMPERATURE TESTS, STRESS STRAIN DIAGRAMS, STRUCTURAL ANALYSIS, MATHEMATICAL MODELS
The conventional practice for the design of elastomeric butt joint seals in pavement and building expansion joints is based primarily on standard tests of model seals. The practice does not incorporate structural analysis and does not utilize mechanical properties of the sealant. This study concerns the applicability of a particular load versus deflection equation for the extension and compression design of these seals, i.e., an elementary large compression equation for bonded rubber blocks. The study demonstrates, using experiments to measure strain energy density functions for two sealants, by application of these functions in finite-element analyses and by comparison of the finite-element and elementary analysis results, the capabilities and limitations of the load versus deflection equation. In the process, the study introduces an efficient experimental technique for evaluating coefficients of the Rivlin strain energy density polynomial for general application to the analysis of elastomeric structures, and demonstrates the utility of the finite-element-based approach for extension and compression analysis of butt joint seals.

MP 3992
DISTRIBUTED MILLIMETER-WAVE RADAR MODELING FOR THE WINTER BATTLEFIELD.
Davis, R.E., Henson, J.M., Koenig, G.G., Army Science Conference, 20th, Norfolk, VA, June 24-27, 1996. Science and technology for Force XXI. Proceedings. Vol.2, Washington, D.C., U.S. Department of the Army, Assistant Secretary for Research, Development and Acquisition, 1996, p.857-861, 10 refs.
51-2729
SNOW COVER EFFECT, RADAR TRACKING, RADAR PHOTOGRAPHY, RADAR ECHOES, BACKSCATTERING, TERRAIN IDENTIFICATION, MILITARY OPERATION, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, IMAGE PROCESSING
Winter battlefield conditions present a range of backgrounds to a radar seeker/sensor varying from hostile to friendly, depending on the spectral range of the sensor and the state (e.g., thawed/frozen) of the snow or soil. Millimeter-wave radar sensing of the winter battlefield presents a special challenge because snow exhibits a huge range in backscatter intensity and polarization. Wet snow provides a relatively dark background at non-nadir views, while refrozen snow presents one of the brightest natural land covers. An image processing, GIS-like approach aggregates information layers into patches for model calculations. These consist of similar land cover and terrain attributes. Physics-based models of snow and soil processes couple to models of radar cross section. Time series of solutions map back into data layers and couple to a radar scene generator. Scenes can represent virtually any forward scan or sidelooking radar system of interest, viewing the test area from a fixed point over time. Validation of the modeling system followed an incremental plan. Predicted snow and soil properties, radar cross sections, and generated scenes compare favorably against measurements from extensive field tests. Examples from a 3-day simulation period show much of the dynamic range and spatial heterogeneity observed on winter battlefields.

MP 3993
COLD REGIONS TACTICAL SHELTER.
Flanders, S.N., Tobiasson, W., *Military engineer*, Sep.-Oct. 1978, No.457, p.332-333, 1 ref.
51-2730
SHELTERS, MODULAR CONSTRUCTION, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, MILITARY EQUIPMENT

MP 3994
SOME THOUGHTS ON SNOWLOADS.
Tobiasson, W., *Roofing Industry Educational Institute, Englewood, CO. Information letter*, Winter 1995,

No.50, p.1-3, For another version see 49-3171.
51-2731
SNOW LOADS, ROOFS, WATERPROOFING, DESIGN CRITERIA

MP 3995
VEHICLE MOTION RESISTANCE DUE TO SNOW.
Richmond, P.W., Army Science Conference Proceedings, June 12-15, 1990. Vol.3, Washington, D.C., U.S. Department of the Army, Assistant Secretary for Research, Development and Acquisition, 1990, p.125-136, 5 refs.
51-2732
MOTOR VEHICLES, TRACKED VEHICLES, VEHICLE WHEELS, SNOW VEHICLES, RUBBER SNOW FRICTION, METAL SNOW FRICTION, TRACTION, MILITARY EQUIPMENT, MILITARY ENGINEERING, COLD WEATHER TESTS, ENVIRONMENTAL TESTS

MP 3996
ANTI-ICING FIELD EVALUATION.
Ketcham, S.A., Minsk, L.D., International Symposium on Snow Removal and Ice Control Technology, 4th, Reno, NV, Aug. 11-16, 1996. Preprints. Vol.1, Washington, D.C., National Research Council, Transportation Research Board, 1996, 10p., 4 refs.
51-2733
ROAD ICING, SNOWSTORMS, ICE STORMS, CHEMICAL ICE PREVENTION, SALTING, SANDING, SNOW REMOVAL, RUBBER SNOW FRICTION, RUBBER ICE FRICTION, COLD WEATHER TESTS, ROAD MAINTENANCE

MP 3997
CORPS LAB EMPLOYS DISABLED STUDENTS.
Darling, M., *Engineer update,* Jan. 1997, 21(1), p.9.
51-2734
ORGANIZATIONS, LABOR FACTORS, EDUCATION, HUMAN FACTORS ENGINEERING, HEALTH

MP 3998
CESIUM-137 CONTAMINATION IN ARCTIC SEA ICE.
Meese, D.A., Cooper, L.W., Larsen, I.L., Tucker, W.B., Reimnitz, E., Grebmeier, J.M., International Symposium on Environmental Radioactivity in the Arctic, Oslo, Norway, Aug. 21-26, 1995. Edited by P. Strand, et al, Østerås, Norway, Norwegian Radiation Protection Authority (Statens Strålevern), 1995, p.195-198.
51-2735
RADIOACTIVE WASTES, FALLOUT, WATER POLLUTION, SEA ICE, ICE COVER EFFECT, ICE COMPOSITION, IMPURITIES, DRIFT

MP 3999
PERFORMANCE OF GROUND-COUPLED HEAT PUMPS AT PATUXENT RIVER NAS—LESSONS LEARNED AND PROCUREMENT GUIDANCE.
Phetteplace, G., Monaghan, S.K., Garg, S., *U.S. Naval Facilities Engineering Service Center, Port Hueneme, CA. Site specific report,* Oct. 1996, SSR-2268-E&U, 63p., 12 refs.
51-2736
MILITARY FACILITIES, BUILDINGS, HEAT PUMPS, HEAT PIPES, HEAT TRANSFER, HEAT RECOVERY, GEOTHERMY, RADIANT HEATING, COOLING SYSTEMS, UNITED STATES—MARYLAND—PATUXENT RIVER NAVAL AIR STATION
The primary objective of this project was to determine the performance of the ground-coupled heat pump HVAC systems installed as part of the building renovation to Building 2189 at Patuxent Naval Air Station. Of particular interest was the net heat extracted from the ground, the electrical energy input to the heat pumps, and the net thermal effect delivered to the building space in both the heating and cooling mode. Also of concern was the operating performance of the heat pumps and the ground coupling loops. The finding of this study will be used in determining the suitability of such systems for use on other Navy facilities.

MP 4000
INSTRUCTIONS FOR MONITORING INSTRUMENTATION IN THE THULE HANGARS.
Tobiasson, W., Flax, D., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Apr. 1972, 75p.
51-2737
MILITARY FACILITIES, AIRPORTS, BUILDINGS, FLOORS, FROZEN GROUND TEMPERATURE, SOIL TEMPERATURE, THAW DEPTH, THAW WEAKENING, SETTLEMENT (STRUCTURAL), TEMPERATURE MEASUREMENT, THERMOCOUPLES, MONITORS, GREENLAND

MP 4001
SURVEY OF ICING PROBLEMS AT CORPS PROJECTS.
DenHartog, S.L., Haynes, F.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* June 1993, No.3, p.1-2, 1 ref.
51-2738
RIVER ICE, ICE LOADS, ICE CONTROL, HYDRAULIC STRUCTURES

MP 4002
HORIZONTAL THERMOSYPHONS.
DenHartog, S.L., Haynes, F.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* June 1993, No.3, p.2-4.
51-2739
HOT OIL LINES, SUSPENDED PIPELINES, PERMAFROST BENEATH STRUCTURES, PERMAFROST PRESERVATION, HEAT PIPES, HEAT TRANSFER

MP 4003
ICE JAM DYNAMICS.
Zufelt, J.E., Ettema, R., *Iowa. University. Iowa Institute of Hydraulic Research. IIHR technical report,* July 1996, No.380, 203p., 27 refs. Funded by the U.S. Army Cold Regions Research and Engineering Laboratory. For Ph.D. thesis of same title see 51-2133.
51-2786
RIVER ICE, ICE JAMS, FREEZEUP, ICE BREAKUP, ICE FRICTION, ICE PRESSURE, ICE PILEUP, ICE COVER THICKNESS, ICE FORECASTING, ICE WATER INTERFACE, RIVER FLOW, FLOOD FORECASTING, MATHEMATICAL MODELS, COMPUTER PROGRAMS

MP 4004
RHIZOSPHERE ENHANCED BIOREMEDIATION FOR COLD REGIONS: CONTAMINANT EFFECTS ON ROOT DISTRIBUTION.
Reynolds, C.M., Beyrouty, C.A., Wolf, D.C., Walworth, J.L., Techniques and Technologies for Hydrocarbon Remediation in Cold and Arctic Climates [Workshop], Kingston, Ontario, June 6-7, 1995. Conference proceedings, Kingston, Ontario, Royal Military College of Canada, [1995], p.36-49, 12 refs.
51-3161
OIL SPILLS, SOIL POLLUTION, SOIL CHEMISTRY, SOIL MICROBIOLOGY, REVEGETATION, PROTECTIVE VEGETATION, ROOTS, PLANT PHYSIOLOGY, PLANT ECOLOGY, WASTE TREATMENT, LAND RECLAMATION
Increased microbial activity in rhizosphere soil compared to non-rhizosphere soil suggests opportunities for enhancing bioremediation by using plants. Plant-based systems would involve minimal initial cost and low maintenance. Because mass-transfer rates in soil may limit bioremediation, the success of rhizosphere-based soil treatment depends on the spatial relationship between contaminated soil and roots. Increasing the spatial density and distribution of roots would increase the amount of soil beneficially influenced by rhizosphere effects, yet the influence of contaminated soil zones on root distribution is relatively unknown. The authors are investigating the impact of soil contamination on plant growth, root growth, root distribution, and rhizosphere-associated microbial activity in contaminated soils. It is suggested that, due to increased percentages of contaminant degraders in the rhizosphere, there is potential for rhizosphere stimulation of bioremediation. Moreover, roots can penetrate into soil zones contaminated with organic compounds, but the degree of root growth is related to contaminant, plant species, and interactions with soil factors such as soil moisture, which may likewise be influenced by contaminant zones. These processes may impact both the effective use and monitoring of rhizosphere-enhanced phytoremediation.

MP 4005
NEUTRON MOISTURE PROBE MEASUREMENTS OF FLUID DISPLACEMENT DURING IN-SITU AIR SPARGING.
McKay, D.J., Acomb, L.J., Currier, P.M., Techniques and Technologies for Hydrocarbon Remediation in Cold and Arctic Climates [Workshop], Kingston, Ontario, June 6-7, 1995. Conference proceedings, Kingston, Ontario, Royal Military College of Canada, [1995], p.169-190, 18 refs.
51-3170
OIL SPILLS, SOIL POLLUTION, SOIL CHEMISTRY, GROUND WATER, WATER POLLUTION, WASTE DISPOSAL, WATER TREATMENT, AERATION, LAND RECLAMATION, NEUTRON PROBES, UNITED STATES—ALASKA—HINCHINBROOK ISLAND
Strawberry Point, located on Hinchinbrook I., AK is the site of a Federal Aviation Administration air navigation facility that is contaminated with gasoline- and diesel-range hydrocarbons in soil and groundwater. Air sparging and bioventing systems were installed to promote bioremediation in the zone of seasonal groundwater fluctuation where the contaminant is concentrated. The air sparging system is being evaluated to determine groundwater region of influence and optimum frequency of operation. The system will also be evaluated for oxygen transfer efficiency and microbial uptake. The sparge wells were installed in a homogeneous formation consisting of fine-grain beach and eolian sands. Neutron probe borehole measurements of percent fluid displacement during sparging at two wells revealed dynamic air distributions defined by an initial and relatively rapid expansion phase followed by a consolidation phase. Air distribution was stable within 12 hours after startup, reaching a peak air saturation of greater than 50%. The radius of peak expansion varied with time and depth. The percent air saturation stabilized within 1 hour following cutoff of the air flow, leaving pockets of entrapped air near the water table. When air injection was resumed, air saturation levels were found to be repeatable. The findings for this site indicated that frequent pulsing is needed to optimize oxygen distribution.

MP 4006
REFLECTION PROFILING OF ARCTIC LAKE ICE USING MICROWAVE FM-CW RADAR.
Arcone, S.A., Yankielun, N.E., Chacho, E.F., Jr., *IEEE transactions on geoscience and remote sensing,* Mar. 1997, 35(2), p.436-443, 24 refs.
51-3080
ICEBOUND LAKES, ICE SURVEYS, LAKE ICE, ICE COVER THICKNESS, PROFILES, RADIO ECHO SOUNDINGS, REFLECTIVITY, GROUNDED ICE, ANTENNAS, AIRBORNE RADAR, ICE WATER INTERFACE, ICE SOLID INTERFACE, SCATTERING
X- and C-band FM-CW radar reflection profiles were obtained across frozen lakes in northern Alaska using a single elevated high-gain antenna. Clear returns were obtained from the air/snow, snow/ice, ice/water, and ice/ground interfaces. Surface-to-bottom signal intensity ratios are within ranges predicted by plane wave reflection theory, use of which also gives plausible permittivity values for the ice-rich bottom silts. Scattering losses are interpreted for the X-band ice-bottom signals, but evidence of increased volumetric scattering loss with increasing ice thickness may have been masked by changes in bottom dielectric contrasts. The results suggest that this type of radar is superior to conventional GPR systems for this application and ice grounded to almost any type of bottom sediments could be profiled from an airborne platform. (Auth. mod.)

MP 4007
EVOLUTION IN POLARIMETRIC SIGNATURES OF THIN SALINE ICE UNDER CONSTANT GROWTH.
Nghiem, S.V., et al, *Radio science,* Jan.-Feb. 1997, 32(1), p.127-151, 44 refs.
51-3177
SEA ICE DISTRIBUTION, ICE MODELS, REMOTE SENSING, ICE SURVEYS, ICE GROWTH, BRINES, ICE COVER THICKNESS, SALT ICE, RADAR ECHOES, ICE DIELECTRICS, ELECTROMAGNETIC PROPERTIES, BACKSCATTERING, POLARIZATION (WAVES), SIMULATION, CORRELATION
An experiment is carried out to measure polarimetric backscatter signatures at C band together with physical characteristics of thin saline ice grown at a constant rate under quiescent conditions. The objectives are to investigate the electromagnetic scattering mechanism in saline ice, to relate the polarimetric backscatter to ice physical characteristics, and to assess the inversion of ice thickness from backscatter data. Controlled laboratory conditions are utilized to avoid complicated variations in interrelated characteristics of saline ice and the environment. The ice sheet was grown in a refrigerated facility at the U.S. Army Cold Regions Research and Engineering Laboratory. Growth conditions, thickness and growth rate, temperatures and salinities, and internal and interfacial structures of the ice sheet were monitored. Measurements indicate that the laboratory saline ice has characteristics similar to thin sea ice in the Arctic. Backscattering coefficients of the saline ice sheet are shown to be similar to airborne radar measurements of thin sea ice growing in a newly opened lead in the Beaufort Sea. For the inversion the large increase in backscatter indicates that the ice thickness is retrievable for thin ice grown under the conditions in this experiment. More complicated conditions should be considered in future experiments to study their effects on the retrieval of sea ice parameters. (Auth. mod.)

MP 4008
PROPERTIES AND PROCESSES AFFECTING SUBLIMATION RATES IN LAYERED FIRN.
Albert, M.R., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Oct. 1996, SR 96-27, p.1-4, ADA-321 342, 5 refs.
51-3140
FIRN, SUBLIMATION, SNOW PERMEABILITY, AIR FLOW, MASS TRANSFER, GREENLAND—SUMMIT

MP 4009
SNOW COVER CHARACTERIZATION USING MULTIBAND FMCW RADARS.
Koh, G., Yankielun, N.E., Baptista, A.I., *Hydrological processes,* 1996, Vol.10, p.1609-1617, 7 refs.
51-3210
SNOW SURVEYS, SNOW COVER STRUCTURE, REMOTE SENSING, AIRBORNE RADAR, RADIO ECHO SOUNDINGS, DEPTH HOAR, ICE DETECTION, GRAIN SIZE, SNOW CRYSTAL STRUCTURE, PROFILES, FREEZE THAW CYCLES, METAMORPHISM (SNOW)
A promising radar technique for snow cover studies is the frequency modulated continuous wave (FMCW) radar. The use of a multiband radar approach for snow cover studies was investigated in order to fully exploit the capabilities of FMCW radars. FMCW radars were used to obtain radar profiles over a wide range of snow cover conditions. These frequency-dependent radar signatures were used to identify important snow cover features such as ice and depth hoar layers. Snow grain size information was also obtained from the frequency-dependent scattering losses that were observed in the snow cover. Several case studies of FMCW radar profiles are presented in order to demonstrate the advantages of a multiband radar approach for monitoring the spatial and temporal variability of snow cover properties and/or processes over an extended area. (Auth. mod.)

MP 4010
LABORATORY STUDY OF THE EFFECT OF FROST FLOWERS ON C BAND RADAR BACKSCATTER FROM SEA ICE.
Nghiem, S.V., Martin, S., Perovich, D.K., Kwok, R., Drucker, R., Gow, A.J., *Journal of geophysical research,* Feb. 15, 1997, 102(C2), p.3357-3370, 13 refs.
51-3213
SEA ICE, YOUNG ICE, SURFACE STRUCTURE, ICE CRYSTAL GROWTH, DENDRITIC ICE, ICE NEEDLES, SLUSH, SYNTHETIC APERTURE RADAR, RADAR PHOTOGRAPHY, BACKSCATTERING, ICE OPTICS, ICE COVER EFFECT, BRIGHTNESS, SIMULATION
C band images of arctic sea ice taken by synthetic aperture radar show transitory regions of enhanced radar backscatter from young sea ice. Published field observations associate this increase with frost flower growth and the capture of blowing snow by the flowers. Laboratory experiments were conducted on the response of C band radar backscatter to frost flowers growing on the surface of newly formed saline ice. The experiment took place in a 5 m by 7 m by 1.2 m deep saline water pool located in a two-story indoor refrigerated facility at the Cold Regions Research and Engineering Laboratory. Sodium chloride ice was grown in this pool at an air temperature of -28°C. The frost flowers first appeared on the ice surface as dendrites and then changed to needles as the ice sheet grew thicker and the surface temperatures became colder. Far-field radar measurements of the backscatter from the ice were made at incident angles from 20° to 40° and at approximately 6-hour intervals throughout the 3-day period of the experiment. A backscatter minimum occurred early in the flower growth at the time coincident with an abrupt doubling in the ice surface salinity. Crystal flowers have little impact on the backscatter, while the underlying slush patches yield a backscatter increase of 3-5 dB over that of bare ice. The laboratory results that this relative backscatter increase of approximately 5 dB can be used as an index to mark the full areal coverage of frost flowers.

MP 4011
COMPLEX DIELECTRIC CONSTANT OF ICE AT 1.8 GHZ.
Koh, G., *Cold regions science and technology,* Mar. 1997, 25(2), p.119-121, 6 refs.
51-3233
REMOTE SENSING, ICE PHYSICS, ICE DIELECTRICS, DIELECTRIC PROPERTIES, MICROWAVES, OPTICAL ABSORPTION, ICE OPTICS, REFRACTIVITY, SIMULATION
The complex dielectric constant of bubble-free ice grown from deionized water was determined at 1.8 GHz using an interference technique. The interference pattern was produced by measuring the reflected signals from bubble-free ice slabs of varying thickness at normal incident angle. The wavelength and loss factor in the bubble-free ice samples were obtained from the resulting interference pattern. The real and imaginary components of the dielectric constant were determined to be 3.17 and 0.003, respectively. (Auth.)

MP 4012
SKI FRICTION AND THERMAL RESPONSE.
Warren, G.C., Colbeck, S.C., International Snow Science Workshop, Whistler, B.C., Canada, Oct. 12-15, 1988. Proceedings. A Merging of Theory and Practice, Vancouver, B.C., ISSW Committee, 1988, p.223-225.
51-3315
SKIS, FRICTION, HEAT FLUX, MELTWATER

MP 4013
OBSERVATIONS OF THE ANNUAL CYCLE OF SEA ICE TEMPERATURE AND MASS BALANCE.
Perovich, D.K., Elder, B.C., Richter-Menge, J.A., *Geophysical research letters,* Mar. 1, 1997, 24(5), p.555-558, 14 refs.
51-3446
OCEANOGRAPHY, SEA ICE, ICE TEMPERATURE, MASS BALANCE, TEMPERATURE MEASUREMENT, SEASONAL VARIATIONS, THERMISTORS, ICE DETERIORATION, SNOW THERMAL PROPERTIES, THERMAL CONDUCTIVITY, SNOW COVER EFFECT
A vertical array of thermistors coupled with an autonomous data-logging system was used to obtain a 15-month record of ice temperature profiles in a multiyear floe in the Beaufort Sea. This record was used to monitor atmosphere, ice and ocean temperatures, determine changes in the ice mass balance, and infer estimates of the ocean heat flux and the snow thermal conductivity. Ablation during the summer melt season consisted of approximately 0.3 m of snow melt, 0.67 m of ice surface ablation and 0.25 m of bottom ablation. There was 0.45 m of bottom accretion during the growth season. The annually averaged ocean heat flux was 4 W/m^2, with a summertime value of 9 W/m^2. Comparing these results to earlier studies conducted in the same region showed considerable interannual variability in summer melting. The thermal conductivity of snowcover was approximately 0.3 W/m/K during winter. (Auth.)

MP 4014
BUILDING HEAT MAY REDUCE DEPTH OF FROST PENETRATION.
Danyluk, L., *American Public Works Association. APWA reporter,* Nov. 1996, 63(10), p.16,18,19, 3 refs.
51-3497
BUILDINGS, FOUNDATIONS, FROST PENETRATION, FROST PROTECTION, THERMAL INSULATION, HEAT FLUX, COLD WEATHER CONSTRUCTION

MP 4015
CAPILLARY BONDING OF WET SURFACES—THE EFFECTS OF CONTACT ANGLE AND SURFACE ROUGHNESS.
Colbeck, S.C., *Journal of adhesion science and technology,* 1997, 11(3), p.359-371, 7 refs.
51-3498
WATER FILMS, LIQUID SOLID INTERFACES, INTERFACIAL TENSION, CAPILLARITY, ADHESION, PROTECTIVE COATINGS, LUBRICANTS, SURFACE ROUGHNESS
Capillary bonding of wet solids through a water film is common and important for a variety of problems. An existing experimental technique for the measurement of capillary bonding forces was improved and used to show how fractional wetted area and capillary bonding force vary with water 'tension' for glass, polyethylene, and aluminum on porous ceramic. The effects of contact angle and roughness were explored. The results show that increasing the contact angle clearly reduces the capillary bonding, but the effects of surface roughness were much more complicated. Roughness can increase or decrease capillary bonding, depending on the exact conditions.

MP 4016
EVALUATION OF THE SCINTILLATION METHOD FOR OBTAINING FLUXES OF MOMENTUM AND HEAT.
Hill, R.J., et al, *U.S. National Oceanic and Atmospheric Administration. Environmental Research Laboratories. Environmental Technology Laboratory. NOAA technical memorandum,* Jan. 1997, ERL ETL-275, 55p., 20 refs.
51-3500
SOIL AIR INTERFACE, HEAT FLUX, ATMOSPHERIC BOUNDARY LAYER, ATMOSPHERIC DENSITY, ATMOSPHERIC ATTENUATION, HUMIDITY, WIND VELOCITY, SCINTILLATION, METEOROLOGICAL INSTRUMENTS
The flux of sensible heat between the surface and the atmosphere was determined from a variety of different instruments and methods. These instruments were a Bowen-ratio station, a three-axis sonic anemometer-thermometer, a single-axis sonic anemometer with a thermocouple, and scintillometers. The methods employed were, respectively, energy balance, eddy correlation, and indirect dissipation. Comparison of the resulting sensible heat fluxes shows that they are in good agreement. Momentum flux is expressed in terms of the friction velocity and was obtained from several of the instruments by different methods. Friction velocity was obtained using eddy correlation of the three-axis sonic anemometer-thermometer data. The surface roughness was obtained from this data by application of Monin-Obukhov similarity theory. Using this roughness length, friction velocity was obtained from wind speed and heat flux measured at the Bowen station by application of Monin-Obukhov similarity. Friction velocity was also obtained from the scintillometer data using the indirect dissipation method, which is an application of Monin-Obukhov similarity. Scatter in the derived roughness length depends on stability. The data suggest that the accepted Monin-Obukhov similarity relationships are inaccurate for the experiment site; this might be caused by the inhomogeneity of the surface.

MP 4017
SAMPLING ERROR ASSOCIATED WITH COLLECTION AND ANALYSIS OF SOIL SAMPLES AT TNT-CONTAMINATED SITES.
Jenkins, T.F., Grant, C.L., Brar, G.S., Thorne, P.G., Schumacher, P.W., Ranney, T.A., *Field analytical chemistry and technology,* 1997, 1(3), p.151-163, 25 refs.
51-3501
EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS
This study assessed short-range spatial heterogeneity of TNT concentrations in surface soils at explosives-contaminated sites. Discrete and composite samples were analyzed by both on-site colorimetric techniques and standard laboratory protocols. Three locations were sampled at each of three installations, and the results were used to estimate the relative contributions of analytical error and sampling error. Overall, this study indicates that characterization of explosives-contaminated sites with the use of a combination of composite sampling, infield sample homogenization, and on-site colorimetric analysis is an efficient method of obtaining accurate and precise mean concentration estimates that are representative of the area.

MP 4018
FIELD METHOD FOR QUANTIFYING AMMONIUM PICRATE AND PICRIC ACID IN SOIL.
Thorne, P.G., Jenkins, T.F., *Field analytical chemistry and technology,* 1997, 1(3), p.165-170, 32 refs.
51-3502
EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, CHEMICAL ANALYSIS
A simple field method for the determination of ammonium picrate and picric acid in soil was developed. Picric acid is a strong acid with a pKa=0.80, and is colorless when dissolved in an organic solvent, whereas its anion (picrate) is bright yellow. Picric acid and picrate ions were extracted from undried soil by shaking with acetone; any picric acid extracted was rapidly converted to picrate in the wet acetone. Picrate was extracted from the acetone soil extracts by passing the solutions through a solid-phase anion exchanger to remove interferences. Acidified acetone was used to convert the picrate to picric acid and elute it from the ion exchanger. The absorbance of the solution at 400 nm was measured; then the picric acid was converted to the colored picrate ion by diluting the eluent with water. Absorbance at 400 nm was measured again and the concentration of picrate was obtained from the difference in the absorbance measurements, corrected for dilution. The method detection limit is 1.3 µg/g of soil. Field-contaminated soils were assayed, and the results compared favorably to those from HPLC analyses in the range of 10-4400 µg/g. The method is simple to use, can be implemented under field conditions, and complements on-site methods for TNT, RDX, and 2,4-DNT.

MP 4019
COMPARISON OF FIBERGLASS AND OTHER POLYMERIC WELL CASINGS, PART I: SUSCEPTIBILITY TO DEGRADATION BY CHEMICALS.
Ranney, T.A., Parker, L.V., *Ground water monitoring and remediation,* Winter 1997, 17(1), p.97-103, 28 refs.
51-3503
SOIL POLLUTION, GROUND WATER, WATER POLLUTION, WATER CHEMISTRY, HYDROGEOCHEMISTRY, CHEMICAL ANALYSIS, WELL CASINGS, POLYMERS
Previous research has shown that the most commonly used well casing materials—stainless steel, polyvinyl chloride (PVC), and polytetrafluoroethylene (PTFE)—are not suited for all monitoring environments and applications. This study is part of a series of experiments that were conducted to determine the suitability of four other polymeric well casing materials—acrylonitrile butadiene styrene (ABS), fluorinated ethylene propylene (FEP), fiberglass-reinforced epoxy (FRE), and fiberglass-reinforced plastic (FRP)—for use in ground water monitoring wells. In these studies, these four materials were compared with two other commonly used polymeric well casings, PVC and PTFE. Part I of these studies examines the resistance of these materials to degradation by chemicals. The two fluorinated polymers (FEP and PTFE) were not degraded by any of the test chemicals. Among the nonfluorinated products tested, FRE was the most inert. ABS was the most readily degraded material tested. By the end of the study, only the acid and alkaline solutions had little effect on ABS. FRP was more severely degraded by the organic chemicals than FRE but was less affected than PVC. FRP and FRE lost weight when exposed to the highly acidic conditions.

MP 4020
EVALUATION OF AIR-ENTRY PRESSURE DURING IN SITU AIR SPARGING: A POTEN-

TIALLY RAPID METHOD OF FEASIBILITY ASSESSMENT.
Baker, R.S., Pemmireddy, R., McKay, D., International Symposium on In Situ Air Sparging for Site Remediation, 1st, Las Vegas, NV, Oct. 24-24, 1996. Proceedings, Potomac, MD, International Network for Environmental Training, Inc., 1p., Abstract only.
51-3505
SOIL POLLUTION, GROUND WATER, AERATION, WASTE DISPOSAL, LAND RECLAMATION

MP 4021
SIZING ATTIC VENTILATION TO PREVENT ICE DAMS.
Tobiasson, W., Buska, J., Greatorex, A., *Journal of light construction*, Dec. 1996, p.54.
51-3507
BUILDINGS, ROOFS, ICE PREVENTION, VENTILATION, COLD WEATHER CONSTRUCTION

MP 4022
FREEZE-THAW CYCLING AND HYDRAULIC CONDUCTIVITY OF BENTONITIC BARRIERS.
Kraus, J.F., Benson, C.H., Erickson, A.E., Chamberlain, E.J., *Journal of geotechnical and geoenvironmental engineering*, Mar. 1997, 123(3), p.229-238, 24 refs.
51-3531
LININGS, SOIL TESTS, CLAY MINERALS, GEOTEXTILES, FREEZE THAW CYCLES, FREEZE THAW TESTS, PERMEABILITY, WATER FLOW, ICE FORMATION, SOIL WATER MIGRATION, COLD WEATHER TESTS, FROST RESISTANCE
Hydraulic conductivity tests were conducted in the laboratory and field on geosynthetic clay liners (GCLs) and a sand-bentonite mixture to determine if their hydraulic conductivity is affected by freezing and thawing. In the laboratory, specimens of three GCLs were frozen and thawed 20 times, and no increase in hydraulic conductivity was measured. The hydraulic conductivity of the compacted sand-bentonite also did not increase after freezing and thawing. In the field, two types of GCLs and a sand-bentonite test pad (constructed with the same mixture used in the laboratory) were exposed to one or two winters of freeze-thaw cycling. No large increase in hydraulic conductivity was measured for the field test conducted with the sand-bentonite mixture. An increase in hydraulic conductivity was observed in only one of the field tests with GCLs. Examination of thawed GCLs and specimens of the sand-bentonite mixture showed no evidence of cracking that is commonly found in thawed compacted clays.

MP 4023
LOCALIZED SURFACE-ICE WEAKNESS ON A GLACIAL ICE RUNWAY.
Lang, R.M., Blaisdell, G.L., *Journal of glaciology*, 1996, Vol.42, p.426-439, 16 refs.
51-3562
GLACIOLOGY, ICE (CONSTRUCTION MATERIAL), ICE RUNWAYS, MECHANICAL TESTS, ICE STRENGTH, ICE DETERIORATION, PONDS, MELTWATER, THIN SECTIONS, ICE SOLID INTERFACE, STRESS STRAIN DIAGRAMS, BRITTLENESS, COMPRESSIVE PROPERTIES
Following construction of a glacial ice runway on the Ross Ice Shelf, and prior to flight operations, the runway was proof-rolled. The proof exercise was designed to simulate typical heavy aircraft. Initial testing produced numerous brittle surface failures in the runway ice. Thin sections of ice cores taken from the failed areas showed large crystals of clear, blue ice with long, vertical bubbles, indicative of ice formed directly from meltwater. Uniaxial unconfined compression tests on core samples were used to compare runway ice strength with published data for polycrystalline laboratory ice. Since the frequent failure of surface ice had not been expected, it was critical to understand the formation and mechanical properties of the weak ice to prevent its occurrence in the future and to strengthen the existing problem areas. Likely scenarios for development of weak ice on the airstrip and the physical properties of this type of ice are discussed. (Auth. mod.)

MP 4024
PARALLEL DATA CHARACTERIZATION METHODS FOR ENVIRONMENTAL FACTORS.
LaPotin, P.J., McKim, H.L., International Seminar on Environmental Problems of Demilitarization, 2nd, Naroch, Republic of Belarus, Apr.17-20, 1995, 1995, p.2-19, 33 refs.
51-3642
GEOPHYSICAL SURVEYS, REMOTE SENSING, IMAGING, DETECTION, SPECTRA, RESOLUTION, CLASSIFICATIONS, DATA PROCESSING, COMPUTER APPLICATIONS, STATISTICAL ANALYSIS, ENVIRONMENTAL TESTS, ACCURACY
Parallel Data Characterization (PDC) algorithms produce high level descriptions of multispectral and/or hyperspectral data sets acquired from active and passive remote sensing systems. The descriptions include measures of central tendency (expectation), variation, elasticity, curvature, and distribution (skewness and kurtosis). PDC measures are used to build a single discriminant function f that is the subject of a formal supervised or unsupervised classification. PDC is shown to be distinctly superior to traditional maximum likelihood classifications since PDC methods can be equally applied when two or more band combinations measure nearly identical spectral features without loss of precision or computational efficiency. In this paper, the foundations of the PDC algorithm are derived and case studies are presented for the discrimination of vegetation and toxic/hazardous wastes using Digital Multispectral Video data and Hyperspectral Airborne Visible/Infrared Imaging Spectrometer data.

MP 4025
PASSIVE RESONANCE ROOF MOISTURE DETECTOR.
Yankielun, N.E., Flanders, S.N., *Journal of thermal insulation and building envelopes*, July 1997, Vol.21, p.45-67, 3 refs.
52-1435
ROOFS, MOISTURE DETECTION, SENSORS, ELECTRICAL MEASUREMENT, ELECTRONIC EQUIPMENT, ELECTRICAL RESISTIVITY, RESONANCE, OSCILLATIONS, DESIGN, PERFORMANCE
A new, simple, and inexpensive prototype moisture sensor (patent pending) has been developed and tested in a small mockup of a low-sloped roof. The sensor comprises an inductor and a moisture-sensitive capacitor; it requires neither batteries nor wire connections. It is intended to be placed at locations within low sloped roofs that might become wet from a leak, and remain operational for the life of the roof and automatically reset if the roof becomes dry again. The moisture status of the sensor can be detected by a simple electronic circuit that is passed within 3 cm of the sensor. Preliminary tests have been performed that indicate the potential for electromagnetically and remotely polling the sensor to determine moisture status.

MP 4026
ABSTRACTS.
Frozen Ground Workshop, Hanover, NH, Dec. 9-11, 1995: Our current understanding of processes and ability to detect change, Hallet, B., ed, Black, P.B., ed, Woods Hole, MA, International Permafrost Association, c/o Jerry Brown, P.O. Box 7, 46p., Abstracts only. Co-hosted by Dartmouth College and the U.S. Cold Regions Research and Engineering Laboratory.
51-3721
MEETINGS, RESEARCH PROJECTS, PERMAFROST, FROZEN GROUND, SOIL FREEZING, PERIGLACIAL PROCESSES, CLIMATIC CHANGES

MP 4027
EFFECTIVE MEDIUM APPROXIMATIONS FOR SNOW THERMAL AND AC ELECTRICAL CONDUCTIVITIES.
Arons, E.M., Colbeck, S.C., McGilvary, W.R., Petrenko, V.F., International Snow Science Workshop, Snowbird, UT, Oct. 1994. ISSW '94. Proceedings. Merging of theory and practice, 1994, p.1, Abstract only included.
51-3753
SNOW PHYSICS, SNOW THERMAL PROPERTIES, SNOW ELECTRICAL PROPERTIES, ELECTRICAL RESISTIVITY, THERMAL CONDUCTIVITY, MODELS, MICROSTRUCTURE
The goal of this research was to develop a physical model to explain how the thermal and AC electrical conductivities of snow are affected by fundamental geometric attributes of its microstructure. Existing models require geometric simplifications that are so dramatic that they are unable to be directly linked to observable characteristics of snow and thus can not be used as predictors or be validated experimentally. Furthermore, these geometric simplifications are too extreme to permit the modeling of changes in thermal conductivity that arise from snow metamorphism. This paper introduces an effective medium approximation from random resistance network theory and showed that it can be used to identify precisely the real geometric quantities that determine thermal and AC electrical conductivities and to model changes in conductivity that occur in nature. The authors developed an apparatus to measure the thermal and AC electrical conductivities of snow and used it to show that the effective medium approximation gives useful predictions of those conductivities. It is concluded that effective medium theory explains the relationship between snow microstructure and conductivity. It provides an essential link between observable characteristics of snow and the theoretical understanding of physical processes that occur in this material.

MP 4028
DETERMINING THE EQUIVALENT EXPLOSIVE EFFECT FOR DIFFERENT EXPLOSIVES.
Johnson, J.B., International Snow Science Workshop, Snowbird, UT, Oct. 1994. ISSW '94. Proceedings. Merging of theory and practice, 1994, p.31-39, 7 refs.
51-3757
AVALANCHE TRIGGERING, EXPLOSIVES, EXPLOSION EFFECTS, MECHANICAL PROPERTIES, DETONATION WAVES, VELOCITY
Explosives with different amounts of available chemical energy per unit mass (specific energy) have the same explosive effect when the total available chemical energy (detonation energy) for the explosives are equivalent. The effectiveness of a low detonation speed explosive will be similar to that of a high detonation speed explosive when their total detonation energies are the same. The perception that high detonation speed explosives are more effective than low detonation speed explosives at causing snow avalanche failure is a result of comparing explosives with equivalent mass rather that equivalent total energy and the fact that the Chapman-Jouguet pressure of an explosive is strongly dependent on detonation speed.

MP 4029
MODEL FOR AVALANCHES IN THREE SPATIAL DIMENSIONS: COMPARISON OF THEORY TO EXPERIMENTS.
Lang, R.M., Leo, B.R., International Snow Science Workshop, Snowbird, UT, Oct. 1994. ISSW '94. Proceedings. Merging of theory and practice, 1994, p.360-384, 44 refs.
51-3783
SNOW PHYSICS, FLUID FLOW, AVALANCHE MECHANICS, AVALANCHE MODELING, AVALANCHE TRACKS, MASS FLOW, RHEOLOGY, ICE FRICTION, PHASE TRANSFORMATIONS, THEORIES, MATHEMATICAL MODELS
A three-dimensional theory is derived to describe the temporal behavior of gravity currents of cohesionless granular media, in an attempt to model the motion of dense, flow-type snow avalanches, ice and rock slides. A Mohr-Coulomb yield criterion is assumed to describe the constitutive behavior of the material, and the basal bed friction is described similarly by a Coulomb type of friction. Data from laboratory simulations are compared to a series of numerical studies based on the aforementioned theory. Two different numerical models are developed, tested and compared to experimental values. The results indicate that the model can account for flow transitions by inclusion of the drag term when the initial inclination angle is large enough to affect boundary drag. Furthermore, the temporal and spatial evolution of the granulate and final runout position can be predicted to values well within the experimental error.

MP 4030
APPLICATION OF CLASSIFICATION AND REGRESSION TREES: SELECTION OF AVALANCHE ACTIVITY INDICES AT MAMMOTH MOUNTAIN.
Davis, R.E., Elder, K., International Snow Science Workshop, Snowbird, UT, Oct. 1994. ISSW '94. Proceedings. Merging of theory and practice, 1994, p.285-294, 26 refs.
51-3776
AVALANCHE FORECASTING, AVALANCHE MODELING, SNOW SURVEYS, SNOW COURSES, CLASSIFICATIONS, SNOW DEPTH, METEOROLOGICAL FACTORS, STATISTICAL ANALYSIS, INDEXES (RATIOS), ACCURACY, CORRELATION
This report emphasizes the importance of the parameters describing the degree of avalanche activity. Classification and regression trees were trained on weather, snow plot and avalanche occurrence observations from the Sierra Nevada, CA, a maritime influenced region. Avalanche activity was characterized by the total number of releases, the sum of the sizes and the maximum size class. The number of cases for the data set was 482. The accuracy of overall classification depended on which activity parameter was selected, while the ranking of the critical input variables remained identical. The probability of correct classification was the highest for the maximum size class, followed by the sum of the sizes, and the total number of releases.

MP 4031
PROCESSING A HIGH STRENGTH SNOW FOR SOUTH POLE COMPACTED SNOW RUNWAY: TEST RESULTS FROM WINTER 1992-1993.
Lang, R.M., Blaisdell, G.L., D'Urso, C., Reinemer, G., Lesher, M., International Snow Science Workshop, Snowbird, UT, Oct. 1994. ISSW '94. Proceedings. Merging of theory and practice, 1994, p.156-175, 15 refs.
51-3767
RUNWAYS, SNOW ROADS, SNOW (CONSTRUCTION MATERIAL), SNOW COMPACTION, SNOW MANUFACTURING, BEARING STRENGTH, SNOW DENSITY, HARDNESS, MICROSTRUCTURE, MECHANICAL TESTS, COMPRESSIVE PROPERTIES, SNOW VEHICLES, ANTARCTICA—AMUNDSEN-SCOTT STATION
Field studies were required in order to identify the optimum snow processing technique that will produce a compact and bonded snow suitable for the construction of high strength snow roads and runways. Improving the strength of the snow runway at Amundsen-Scott Station would be required if the United States Antarctic Program considers wheeled aircraft as a possible delivery system. The types of conventional snow processing equip-

ment that produces the highest snow strength were quantitatively verified using image analysis techniques and other on-site testing methods. Tests were performed in West Yellowstone, MT where the snow properties and winter ambient temperatures are as analogous as possible to those at Amundsen-Scott during the austral summer and in other arctic and antarctic regions. The processed snow was tested for hardness (strength) using a soil penetrometer, and strength values were correlated to bond density. The temperature distributions in the processed snow were monitored using a thermocouple stack and CR10 datalogger and are correlated to strength increases or decreases. Test results indicate that a powered tiller with a relatively dense tooth population provided the highest strength snow. (Auth. mod.)

MP 4032
INVESTIGATION OF DYNAMIC SEA ICE PROCESSES IN THE WEDDELL SEA DURING 1992.
Geiger, C.A., Hanover, Dartmouth College, 1996, 378p., University Microfilms order No. 96-39440, Ph.D. thesis. This thesis was partially funded by CRREL (No. 5-36686.140). Refs. p.369-378.
51-3875
SEA ICE DISTRIBUTION, ICE DEFORMATION, ICE MODELS, RHEOLOGY, ICE WATER INTERFACE, AIR WATER INTERACTIONS, OCEANOGRAPHIC SURVEYS, METEOROLOGICAL DATA, MATHEMATICAL MODELS, DATA PROCESSING, ANTARCTICA—WEDDELL SEA
Through a series of case studies, signal processing and statistical tools, analyses of dynamic sea ice processes of drift, deformation, and ice pack expansion and decay are investigated for the Weddell Sea region during 1992. Cavitating fluid (CAV) and viscous-plastic (VP) models are the most widely used ice models in sea ice, ocean and climate communities. Examination of these and observations are presented in order to identify the external (air/ocean) and internal (ice) forces that affect specific processes. Inconsistencies between processes in models and observations are isolated and examined with suggestions given for the next generation of ice models. Key findings are as follows: Observationally, from ISW 1992, ice velocity in western Weddell is found to be driven by low frequency forcing (>one day), while subdaily frequencies drive ice deformation. Mechanistic studies increase understanding in simulated ice performance under idealized conditions. In the models, annual expansion during winter months is dominated by air temperature at the ice edge and storms in the interior where sensible/latent heat fluxes are large, especially in leads. Suggestions for next generation models include a reformulation of the boundary layer and incorporation of high frequency tidal forcing. (Auth. mod.)

MP 4033
DUSTING PROCEDURES FOR ADVANCE ICE-JAM MITIGATION MEASURES.
White, K.D., Kay, R.L., *Journal of cold regions engineering*, June 1997, 11(2), p.130-145, 27 refs.
51-3922
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE COVER STRENGTH, DUSTING, RADIATION ABSORPTION, REFLECTIVITY, ICE MELTING, COUNTERMEASURES, AIRPLANES, ICE CONDITIONS, FORECASTING, TESTS
In areas where damaging spring breakup ice jams are recurring events, advance mitigation measures should be considered. One mitigation measure that might be used in advance of ice breakup is aerial dusting of the ice, which enhances the natural weakening process. Because there may be limited time in which to organize and implement advance measures for ice jams, dusting operations should be planned beforehand. This paper provides a brief overview of the physical processes involved in ice dusting and discusses important aspects of a dusting plan. Experiences from two dusting programs in Nebraska were used as the basis for developing a set of guidelines for planning dusting operations. A spreadsheet for estimating dusting costs was also developed, and is presented with actual data from a 1994 dusting operation.

MP 4034
SOUTH POLE TUNNELING SYSTEM. OPERATION AND MAINTENANCE MANUALS. VOLUME 1: GENERAL EQUIPMENT DESCRIPTION, SET-UP, OPERATION, AND MAINTENANCE.
Walsh, M.R., ed, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Mar. 1997, 41p., Prepared for the U.S. National Science Foundation, Division of Polar Programs, and Antarctic Support Associates.
51-4121
SNOW TUNNELS, TUNNELING (EXCAVATION), UNDERSNOW FACILITIES, ICE CUTTING, MACHINERY, CONSTRUCTION EQUIPMENT, SNOW REMOVAL EQUIPMENT, MANUALS, ANTARCTICA—AMUNDSEN-SCOTT STATION
This is Vol.1 of 4 volumes of manuals for the South Pole Tunneling System (SPoTs), a system to excavate unlined tunnels beneath the snow for use as utility corridors or personnel passageways. The tunneling system was first deployed in Jan. 1996 at the Amundsen-Scott Station. Work was suspended for the season and then resumed in Nov. 1996 when a 400'-long, 6'-wide by 10'-high unlined tunnel 43' below the snow surface, for the station's wastewater facility, was completed. The tunneler is a modified Bobcat Model 231 tracked mini-excavator with the dipper stick and bucket removed and replaced with a hydraulically-powered horizontal cutter drum 6' wide by 2' in diameter. The cutter drum is positioned horizontally across the width of the tunnel at right angles to the side walls during excavation, but can be rotated to a vertical position to mill the side walls. The excavated snow is transported through a series of telescoping and flexible ducts to a snow blower on the surface.

MP 4035
SOUTH POLE TUNNELING SYSTEM. OPERATION AND MAINTENANCE MANUALS. VOLUME 2: ELECTRICAL AND ELECTRONIC SYSTEMS MANUAL.
Arnold, T.W., Morse, J.S., Williams, C.R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Mar. 1997, Var. p.
51-4122
SNOW TUNNELS, TUNNELING (EXCAVATION), ICE CUTTING, MACHINERY, CONSTRUCTION EQUIPMENT, ELECTRIC EQUIPMENT, ELECTRIC POWER, ENGINES, ENGINE STARTERS, SPECIFICATIONS, MANUALS
This is Vol.2 of 4 volumes of manuals for the South Pole Tunneling System. This volume includes specifications, block diagrams, schematics, and manufacturers' manuals for the electrical and electronic systems. The equipment covered includes the motor systems; soft starter; electronic controls, installation and operation of the caterpillar generator set (genset); control cab and boom inclinometer; temperature controller; heaters; and laser leveler. Also included are 32 color photographs of the equipment.

MP 4036
SOUTH POLE TUNNELING SYSTEM. OPERATION AND MAINTENANCE MANUALS. VOLUME 3: HYDRAULIC AND MECHANICAL SYSTEMS MANUAL.
Walsh, M.R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Mar. 1997, 268p.
51-4123
SNOW TUNNELS, TUNNELING (EXCAVATION), ICE CUTTING, SNOW REMOVAL EQUIPMENT, ENGINES, ELECTRIC EQUIPMENT, MACHINERY, CONSTRUCTION EQUIPMENT, SPECIFICATIONS, MANUALS
This is Vol.3 of 4 volumes of manuals for the South Pole Tunneling System. This volume includes specifications, block diagrams, schematics, and manufacturers' manuals for the hydraulic and mechanical power control and transmission systems of the tunneler and snow blower. Equipment covered in detail includes motors, pumps, valves, hydraulic oil, and gearboxes. Also included are a number of color photographs passim of the equipment.

MP 4037
SOUTH POLE TUNNELING SYSTEM. OPERATION AND MAINTENANCE MANUALS. VOLUME 4: OPERATOR'S MANUAL.
Walsh, M.R., Arnold, T.W., Lambert, D.J., Morse, J.S., Williams, C.R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Mar. 1997, 51p.
51-4124
SNOW TUNNELS, TUNNELING (EXCAVATION), ICE CUTTING, SNOW REMOVAL EQUIPMENT, MACHINERY, CONSTRUCTION EQUIPMENT, MANUALS
This is Vol.4 of 4 volumes of manuals for the South Pole Tunneling System. This volume is the operator's manual for the entire tunneling system. Operations covered include controls, starting, machining adjustments, laser alignment, maintenance, and shutdown of the tunneler; operation and configuration of the ducts, transition sled, and snow blower for the snow chip removal system; operation and safety procedures for the drill rig for drilling vertical access holes to the tunnel (the drill rig is particularly dangerous and can be life threatening if not handled properly); and the startup, operation, monitoring, and shutdown of the generator set.

MP 4038
ARCTIC RESEARCH AT THE COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL).
U.S. Army Cold Regions Research and Engineering Laboratory, *Witness the Arctic*, Spring 1997, 5(1), 4p., Loose insert.
51-4141
ORGANIZATIONS, RESEARCH PROJECTS, EDUCATION

MP 4039
FLORISTIC INVENTORY OF VASCULAR AND CRYPTOGAM PLANT SPECIES AT FORT RICHARDSON, ALASKA.
Lichvar, R., Racine, C., Murray, B., Tande, G., Lipkin, R., Duffy, M., *U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. Technical report*, Mar. 1997, EL-97-4, 23p. + appends., Refs. passim.
51-4146
VEGETATION PATTERNS, PLANT ECOLOGY, FOREST TUNDRA, MOSSES, LICHENS, TREES (PLANTS), MILITARY FACILITIES, SITE SURVEYS, UNITED STATES—ALASKA—FORT RICHARDSON
The Army Land-Condition Trend Analysis (LCTA) program, an inventory of vascular and cryptogam plant species, was undertaken to support both the LCTA sampling teams and other natural resource programs at Fort Richardson, AK. This inventory provides the baseline record of the existing flora for LCTA. Specimens were collected for vascular plants and cryptogams. Collection of cryptogam plants was restricted to ground-inhabiting cryptogams (mosses, lichens, and liverworts).

MP 4040
ESTIMATING THE FULL-SCALE FLEXURAL AND COMPRESSIVE STRENGTH OF FIRST-YEAR SEA ICE.
Kovacs, A., *Journal of geophysical research*, Apr. 15, 1997, 102(C4), p.8681-8689, 28 refs.
51-4155
SEA ICE, ICE FLOES, ICE MECHANICS, ICE COVER STRENGTH, ICE COVER THICKNESS, COMPRESSIVE PROPERTIES, FLEXURAL STRENGTH, ICE SOLID INTERFACE, STRAINS, BRINES, POROSITY, ELECTRICAL RESISTIVITY, ELECTRICAL MEASUREMENT, SOUNDING
Sea ice salinity, density, and temperature data were used to develop new methods for determining the bulk brine volume and porosity of sea ice floes. Methods for estimating full-thickness ice sheet strength, based on large-scale field tests, are presented. The relationships among bulk sea ice properties, strain rate, and strength are illustrated. A new constitutive equation was developed for predicting the full-thickness horizontal compressive strength of first-year sea ice as a function of the applied strain rate and bulk porosity. An example of the first-year sea ice indentation force against a 90-m wide structure is given. Estimating sea ice strength based on remote ice conductivity measurements is also discussed conceptually.

MP 4041
FIELD VALIDATION OF THERMAL STRESS RESTRAINED SPECIMEN TEST: SIX CASE HISTORIES.
Zubeck, H.K., Zeng, H.Y., Vinson, T.S., Janoo, V.C., *Transportation research record*, Nov. 1996, No.1545, p.67-74, 6 refs.
51-4298
PAVEMENTS, BITUMINOUS CONCRETES, THERMAL STRESSES, MECHANICAL TESTS, CRACKING (FRACTURING), LOW TEMPERATURE TESTS, TEMPERATURE MEASUREMENT, COLD WEATHER PERFORMANCE, STATISTICAL ANALYSIS, TEMPERATURE EFFECTS, FORECASTING
Construction histories, cracking observations, and temperature data were collected for five test roads in Alaska, Pennsylvania, and Finland. A full-scale and fully controlled low-temperature cracking test program was conducted at the U.S. Army Cold Regions Research and Engineering Laboratory. Specimens were fabricated in the laboratory with original asphalt cements and aggregates from the test roads. The thermal stress restrained specimen test (TSRST) results obtained for these samples were correlated with the field observations. On the basis of a statistical analysis of the data, the TSRST fracture temperature is associated with the field cracking temperature and crack frequency for the test roads where mixture properties dominated low-temperature cracking. It was concluded that the TSRST can be used to simulate low-temperature cracking of asphalt concrete mixtures.

MP 4042
FIELD SAMPLING AND SELECTING ON-SITE ANALYTICAL METHODS FOR EXPLOSIVES IN SOIL.
Crockett, A.B., Craig, H.D., Jenkins, T.F., Sisk, W.E., U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Report EPA/540/R-97-501, Washington, D.C., Nov. 1996, 32p., Refs. p.28-32.
51-4388
SOIL POLLUTION, SOIL TESTS, EXPLOSIVES, SAMPLING, DETECTION, ENVIRONMENTAL TESTS, SAFETY, LABORATORY TECHNIQUES, CHEMICAL ANALYSIS, STANDARDS

MP 4043
DREDGE REMOVAL OF PHOSPHORUS-CONTAMINATED SEDIMENTS AT EAGLE RIVER FLATS, ALASKA.
Walsh, M.R., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York,

American Society of Civil Engineers, 1997, p.139-142, 5 refs.
51-4626
MILITARY FACILITIES, ESTUARIES, WETLANDS, SOIL POLLUTION, WATER POLLUTION, DREDGING, WASTE DISPOSAL, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON

MP 4044
INITIAL FIELD RESULTS FOR RHIZOSPHERE TREATMENT OF CONTAMINATED SOILS IN COLD REGIONS.
Reynolds, C.M., Koenen, B.A., Perry, L.B., Pidgeon, C.S., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.143-146, 3 refs.
51-4627
OIL SPILLS, SOIL POLLUTION, SOIL MICROBIOLOGY, SOIL CHEMISTRY, WASTE DISPOSAL, LAND RECLAMATION, GRASSES, ROOTS, REVEGETATION, PROTECTIVE VEGETATION, PLANT PHYSIOLOGY

MP 4045
RAPID QUALIFICATION OF AIR SPARGING FOR SITE REMEDIATION.
McKay, D.J., Baker, R.S., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.163-166, 6 refs.
51-4631
SOIL POLLUTION, GROUND WATER, WATER POLLUTION, SOIL SURVEYS, SOIL CHEMISTRY, SOIL TESTS, AERATION, WASTE DISPOSAL, LAND RECLAMATION

MP 4046
POND DRAINING TO TREAT WHITE PHOSPHORUS-CONTAMINATED SEDIMENTS AT EAGLE RIVER FLATS, ALASKA.
Collins, C.M., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.179-182, 4 refs.
51-4635
MILITARY FACILITIES, WETLANDS, ESTUARIES, PONDS, BOTTOM SEDIMENT, EXPLOSIVES, SOIL POLLUTION, WATER POLLUTION, DRAINAGE, WASTE DISPOSAL, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON

MP 4047
COLD REGIONS CENTER OF EXPERTISE OF THE U.S. ARMY CORPS OF ENGINEERS.
Smallidge, P.D., Hardy, D.L., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.265-268.
51-4644
ORGANIZATIONS, RESEARCH PROJECTS, REGIONAL PLANNING, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, DATA PROCESSING, DATA TRANSMISSION

MP 4048
REDUCING DAMAGE TO LOW-VOLUME ROADS BY USING LOWER TIRE PRESSURES DURING SPRING THAW.
Kestler, M.A., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.469-472, 7 refs.
51-4688
PAVEMENTS, THAW WEAKENING, TIRES, HIGHWAY PLANNING, ROAD MAINTENANCE, COLD WEATHER OPERATION, COMPUTERIZED SIMULATION

MP 4049
SLUDGE SLED: A NEW DEVICE FOR REMOVING SLUDGE FROM LAGOONS.
Martel, C.J., International Symposium on Cold Region Development, 5th, Anchorage, AK, May 4-10, 1997. ISCORD '97. Edited by H.K. Zubeck, C.R. Woolard, D.M. White, and T.S. Vinson, New York, American Society of Civil Engineers, 1997, p.657-660, 1 ref.
51-4735
PONDS, DREDGING, SLUDGES, SEWAGE DISPOSAL, WASTE DISPOSAL, WATER TREATMENT, SANITARY ENGINEERING, COLD WEATHER OPERATION

MP 4050
SCREENING OF 12 *FESTUCA* CULTIVARS FOR RAPID ROOT DEVELOPMENT.
Palazzo, A.J., Brar, G.S., *Journal of turfgrass management.* 1997, 2(1), p.15-25, 27 refs.
51-4746
GRASSES, PLANT PHYSIOLOGY, ROOTS, BIOMASS
Establishment of cool season grass seedlings in sandy soils is difficult due to lack of sufficient water in the seed zone. The objective of this study was to quantify the root growth rate of two cultivars of each of six *Festuca* species in the greenhouse. *Festuca* cultivars differed in rooting depth, root elongation rates, root length density, root mass density, root area, shoot biomass, leaf area, leaf length, and leaf number. The deepest root system and greatest cumulative root elongation rates were observed for 'Clemfine' tall fescue *(Festuca arundinacea* Schreb.) Visible root depth within the tube wall was significantly correlated with the root length observed after soil washing. The results show that plants with aggressive root elongation rates had the deepest and best developed root and shoot systems.

MP 4051
FIELD DEMONSTRATION OF ON-SITE ANALYTICAL METHODS FOR TNT AND RDX IN GROUND WATER.
Craig, H.D., et al, HSRC/WERC Joint Conference on the Environment, Albuquerque, New Mexico, 21-23 May 1996. Proceedings, Albuquerque, New Mexico, 1996, p.204-219, 19 refs.
51-4747
EXPLOSIVES, GROUND WATER, WATER POLLUTION, WATER TREATMENT, ACCURACY, PERFORMANCE, MILITARY OPERATION
A field demonstration was conducted to assess the performance of eight commercially-available and emerging colorimetric, immunoassay, and biosensor on-site analytical methods for explosives 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in ground water and leachate at the Umatilla Army Depot Activity, Hermiston, OR and U.S. Naval Submarine Base, Bangor, WA, Superfund sites. Ground water samples were analyzed by each of the on-site methods and results compared to laboratory analysis using high performance liquid chromatography with EPA SW-846 Method 8330. The commercial methods evaluated include the EnSys, Inc., TNT and RDX colorimetric test kits (EPA SW-846 Methods 8515 and 8510) with a solid phase extraction step, the DTECH/EM Science TNT and RDX immunoassay test kits (EPA SW-846 Methods 4050 and 4051), and the Ohmicron TNT immunoassay test kit. The emerging methods tested include the antibody-based Naval Research Laboratory (NRL) Continuous Flow Immunosensor (CFI) for TNT and RDX, and the Fiber Optic Biosensor (FOB) for TNT. Accuracy of the on-site methods was evaluated using linear regression analysis and relative percent difference comparison criteria. Over the range of conditions tested, the colorimetric methods for TNT and RDX showed the highest accuracy of the commercially-available methods, and the NRL CFI showed the highest accuracy of the emerging methods for TNT and RDX. The colorimetric method was selected for routine ground water monitoring at the Umatilla site, and further field testing on the NRL CFI and FOB biosensors will continue at both Superfund sites. The primary use for these analytical methods would be for influent and effluent monitoring for granular activated carbon ground water and leachate treatment systems, which are projected to operate for a period of 10 to 30 years.

MP 4052
USING WAVELETS TO DETECT TRENDS.
Andreas, E.L., Treviño, G., *Journal of atmospheric and oceanic technology,* June 1997, 14(3)pt.1, p.555-564, 26 refs.
51-4892
CLIMATOLOGY, AIR TEMPERATURE, WIND VELOCITY, PERIODIC VARIATIONS, OSCILLATIONS, SPECTRA, STATISTICAL ANALYSIS, MATHEMATICAL MODELS, DETECTION, CORRELATION
Wavelets are a new class of basis functions that are finding wide use for analyzing and interpreting time series data. This paper describes a new use for wavelets—identifying trends in time series. The general signal considered has a quadratic trend. The inverted Haar wavelet and the elephant wavelet, respectively, provide estimates of the first-order and second-order coefficients in the trend polynomial. This paper demonstrates wavelet trend detection using artificial data and then various turbulence data collected in the atmospheric surface layer, and last, provides guidelines on when linear and quadratic trends are "significant" enough to require removal from a time series. Anemometer data from Weddell Station, Antarctica is used in the analysis. (Auth. mod.)

MP 4053
ON-SITE ANALYTICAL METHODS FOR EXPLOSIVES IN SOILS.
Crockett, A.B., Craig, H.D., Jenkins, T.F., *American environmental laboratory,* May 1997, p.27-30, 29 refs.
51-4903
MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS

MP 4054
METHOD FOR FORMING A SLOPED FACE ICE CONTROL STRUCTURE.
Lever, J.H., Gooch, G.E., Foltyn, E.P., *U.S. Patent Office. Patent,* Oct. 22, 1996, 4 col., USP-5,567,078, 8 refs.
51-4940
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE CONTROL, FLOOD CONTROL, RIVER FLOW, FLOW CONTROL, HYDRAULIC STRUCTURES, ROCK FILLS
The present invention pertains to sloped-faced ice control elements that are each spaced apart across a riverbed adjacent to a floodplain region. The elements arrest a breakup ice run. The size and spacing of the ice-resisting elements can vary with river size and average ice piece size diameter. The ice-resisting elements, for example, can comprise three or four quarried granite blocks buried in the riverbed in a relatively narrow river of 100 feet or less. This arrangement allows gaps between each ice-resisting element for easy canoe and fish passage. These gaps prevent the ice pieces of the ice jam from passing through during breakup ice runs. The ice-resisting elements may be formed from various materials such as quarried rock, poured concrete, rock-filled cribs, etc. After the ice-resisting elements have retained and stabilized the ice jam, water levels recede and warming water temperatures melt the ice in place behind the ice-resisting elements.

MP 4055
MICROWAVE DOPPLER RADAR SYSTEM FOR DETECTION AND KINEMATIC MEASUREMENTS OF RIVER ICE.
Yankielun, N.E., Ferrick, M.G., *U.S. Patent Office. Patent,* Dec. 17, 1996, 10 col., USP-5,585,799, 5 refs.
51-4941
RIVER ICE, ICE BREAKUP, DRIFT, ICE DETECTION, ICE FORECASTING, ICE REPORTING, FLOOD FORECASTING, WARNING SYSTEMS, RADAR TRACKING
The present invention pertains to a microwave continuous wave (CW) Doppler radar system for river ice motion detection and real-time kinematic data acquisition using digital signal processing equipment for processing, storing and displaying such data. With less complex electronic signal processing hardware, a Doppler radar ice motion detection and alarming system can be used in conjunction with the system. River ice kinematic measurements are fundamental to analyses of river/ice dynamics. The system herein can be rapidly deployed, requires minimal operator interaction, and can continuously acquire, process, store and display ice kinematic data regardless of visibility conditions. Use of the Doppler radar system is an effective, efficient and precise method and apparatus for obtaining river ice kinematic data.

MP 4056
GEOSYNTHETIC BARRIER TO PREVENT WILDLIFE ACCESS TO CONTAMINATED SEDIMENTS.
Henry, K.S., *U.S. Patent Office. Patent,* Feb. 11, 1997, 4 col., USP-5,601,906, 5 refs.
51-4942
SOIL POLLUTION, SOIL STABILIZATION, LAND RECLAMATION, ANIMALS, ENVIRONMENTAL PROTECTION, GEOTEXTILES
A geosynthetic barrier adapted to deny wildlife access to contaminated sediments (CS), includes a geocomposite formed of a top layer juxtaposed on a bottom layer which is adapted to be placed on the sediments. The top layer includes a geosynthetic drainage matrix having a plurality of openings, and the bottom layer includes a geotextile having a plurality of openings formed so as to allow gases to escape from the contaminated sediments on which said geocomposite is placed. The openings in the bottom layer of the geosynthetic barrier have a size in the range up to 200 cm and are spaced apart on centers having a range of between 6 cm to 600 cm, for example. The geosynthetic drainage matrix may be a geonet, a geogrid or a geomesh, fabricated from polyethylene, polypropylene, high density polyethylene, low density polyethylene, polystyrene, or high impact polystyrene. The top and bottom layers may be either separate layers, or may be joined together to produce a unified geocomposite web; may be held in place by a gravel layer (G) or other means; may be used in a subaqueous (W) or a non-subaqueous environment; and may provide a suitable environment through which vegetation (V) can be rooted.

MP 4057
CLAPEYRON THERMOMETER.
Black, P.B., *U.S. Patent Office. Patent,* Mar. 11,

1997, 4 col., USP-5,609,418, 9 refs.
51-4943
TEMPERATURE MEASUREMENT, LIQUID SOLID INTERFACES, SOLID PHASES, LIQUID PHASES, ICE WATER INTERFACE, ICE PRESSURE, WATER PRESSURE, MEASURING INSTRUMENTS
A high resolution thermometer operated by the pressure of a solid/liquid phase mixture is characterized by a vessel containing the mixture, a pressure sensor and a pressure indicator. A relatively small change in the temperature to be measured causes the proportion of solid and liquid in the vessel to change, thereby producing a dramatic change in pressure which can be measured with greater accuracy than the relatively small temperature change. Temperature is determined by converting the pressure to temperature using the appropriate thermodynamic relationship.

MP 4058
WIND, TEMPERATURE AND ICE MOTION STATISTICS IN THE WEDDELL SEA (A COMPILATION BASED ON DATA FROM DRIFTING BUOYS, VESSELS, AND OPERATIONAL WEATHER ANALYSES).
Kottmeier, C., Ackley, S.F., Andreas, E.L., *World Meteorological Organization. Technical document,* Jan. 1997, WMO/TD-No.797, World Climate Research Programme (WCRP). International Programme for Antarctic Buoys (IPAB), 48p., 32 refs.
51-4944
SEA ICE DISTRIBUTION, DRIFT, ICE AIR INTERFACE, AIR ICE WATER INTERACTION, WIND VELOCITY, AIR TEMPERATURE, ATMOSPHERIC PRESSURE, DRIFT STATIONS, STATISTICAL ANALYSIS, ANTARCTICA—WEDDELL SEA
The data from sea ice buoys, which were deployed during the Winter Weddell Sea Project 1986, the Winter Weddell Gyre Studies 1989 and 1992, the Ice Station Weddell in 1992, the Antarctic Zone Flux Experiment in 1994, and several ship cruises in austral summers, are uniformly reanalyzed by the same objective methods. The buoys were capable of monitoring atmosphere pressure, air and ice temperatures, as well as position. The buoys were frequently arranged within groups of three to seven to allow calculation of reliable estimates of geostrophic winds and ice motion and under favorable conditions their spatial derivatives. Geostrophic winds for buoys operational regions are derived after matching of the buoy pressure data with the surface pressure fields of the European Centre for Medium Range Weather Forecasts. Historical data from drifting ships are included in the temperature, air pressure and ice drift analyses. This report documents the mean structure as well as the variability of ice motion and spatial derivatives of ice motion, the statistics of surface pressure, geostrophic winds and air temperatures in the sea ice covered part of the Weddell Sea. (Auth. mod.)

MP 4059
ON THE RELATIONSHIP BETWEEN THE PHYSICAL AND MECHANICAL PROPERTIES OF SEA ICE.
Cole, D.M., IAHR International Symposium on Ice, 13th, Beijing, China, Aug. 27-31, 1996. Post-symposium proceedings. Vol.3, Beijing, Chinese Hydraulic Engineering Society, [1997], p.913-930, 49 refs.
51-5027
SEA ICE, ICE MICROSTRUCTURE, ICE SALINITY, ICE COVER STRENGTH, ICE LOADS, ICE ELASTICITY, ICE CREEP, ICE DEFORMATION, ICE CRACKS, ICE MODELS, ENVIRONMENTAL TESTS, RESEARCH PROJECTS
This paper focuses on recent findings from laboratory and in-situ experiments that shed light on the relationship between the physical and mechanical properties of sea ice. The links between the elastic and anelastic (delayed elastic) components of strain and brine and gas porosities are examined and quantified. The elastic response is found to be a linear function of gas porosity, whereas the brine porosity has a complex influence on both the elastic and anelastic response. These effects are modeled and shown to produce predications that are in good agreement with experimental observations. The paper reviews the results of a recent program of large-scale in-situ experiments that show the significance of brine drainage structures in determining scale effects on the fracture behavior of first-year sea ice. The topics of laboratory and field testing methods and the use of constant microstructure experiments also receive attention.

MP 4060
SYNTHESIS OF WARM AIR ADVECTION TO THE SOUTH POLAR PLATEAU.
Hogan, A.W., *Journal of geophysical research,* June 27, 1997, 102(D12), p.14,009-14,020, 47 refs.
51-5091
CLIMATOLOGY, POLAR ATMOSPHERES, SYNOPTIC METEOROLOGY, ATMOSPHERIC BOUNDARY LAYER, SURFACE TEMPERATURE, SNOW TEMPERATURE, ATMOSPHERIC CIRCULATION, WIND DIRECTION, AEROSOLS, ADVECTION, ANTARCTICA—HOWE, MOUNT
Surface temperature and wind chronologies of varying length and 10 m snow temperatures have been used to produce a synthesis of airflow into Antarctica. This synthesis shows relatively warm air over Ellsworth Land, which appears to enter the South Polar Plateau through a slightly lower-lying trough between the summit of the Transantarctic Mountains and the Polar Plateau. Comparison of recent automatic weather station (AWS) records from Mount Howe with four AWS surrounding South Pole at 89°S show that this upslope inflow is a frequent and persistent phenomenon. (Auth.)

MP 4061
OCCURRENCE FREQUENCY OF THICKNESS OF ANNUAL SNOW ACCUMULATION LAYERS AT SOUTH POLE.
Hogan, A.W., Gow, A.J., *Journal of geophysical research,* June 27, 1997, 102(D12), p.14,021-14,027, 34 refs.
51-5092
CLIMATOLOGY, PRECIPITATION (METEOROLOGY), SNOW ACCUMULATION, SNOW STRATIGRAPHY, LAYERS, THICKNESS, AEROSOLS, STATISTICAL ANALYSIS, PERIODIC VARIATIONS, METAMORPHISM (SNOW), AGE DETERMINATION, ANTARCTICA—AMUNDSEN-SCOTT STATION
Analysis of 2,000 annual snow accumulation layers at the South Pole is applied to objective extraction of meteorological parameters from the Amundsen-Scott Station accumulation record. The authors have compared the 100-year "snow mine" accumulation record of Giovinetto and Schwerdtfeger and a 2000-layer pit and core record obtained in 1982. Frequency analysis of the number of occurrences of layers with respect to thickness or mass of the layer showed the logarithms of thickness or mass to be normally distributed. The snow accumulation and marine aerosol (sodium) accumulation in recent annual layers with the station meteorological record and the surface aerosol record may be transformable to provide an index of this meridional transport. It is proposed that the magnitude of snow accumulation, with respect to frequency of that accumulation, provides an objective criterion for comparing individual years of meteorological history and that the geometric standard deviation of accumulation provides an objective index for estimation of climatic fluctuation during the period of accumulation. (Auth. mod.)

MP 4062
ARCTIC RESEARCH OF THE UNITED STATES, VOL.11, SPRING/SUMMER 1997.
U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Haugh, J., ed, Cate, D.W., ed, Washington, D.C., 1997, 82p., For selected papers see 51-5115 through 51-5122.
51-5114
RESEARCH PROJECTS, INTERNATIONAL COOPERATION, ORGANIZATIONS, ENVIRONMENTAL PROTECTION, REMOTE SENSING, GEOLOGICAL SURVEYS, ECONOMIC DEVELOPMENT, HYDROCARBONS, ECOSYSTEMS
This journal presents an assessment of current research projects conducted by the United States in arctic and subarctic regions.

MP 4063
RELATED EFFECTS ON FROST ACTION: FREEZING AND SOLAR RADIATION INDICES.
Dysli, M., Lunardini, V.J., Stenberg, L., International Symposium on Ground Freezing, 8th, and Frost Action in Soils, 3rd, Luleå, Sweden, Apr. 15-17, 1997. Ground freezing 97. Edited by S. Knutsson, Rotterdam, A.A. Balkema, 1997, p.3-23, 35 refs.
51-5128
SOIL FREEZING, FREEZING FRONT, FROST PENETRATION, FROST ACTION, FROZEN GROUND THERMODYNAMICS, FREEZING INDEXES, SOIL AIR INTERFACE, SURFACE TEMPERATURE, SOLAR RADIATION, INSOLATION, MATHEMATICAL MODELS
The freezing index has its origin in the very old Stefan's solution for the equation of thermal diffusion which permits, in particular, the calculation of the depth of the freezing front. The temperature of the soil surface is the value which should be used in the calculation of the depth of the freezing front; however, air temperature is generally used because it is the measured meteorological parameter. In the calculation of the freezing front, the freezing index of the air is corrected by a factor or a summation parameter. Besides the temperature of the air, the temperature of the soil surface depends on numerous meteorological parameters such as wind, solar radiation, surface radiation, change of phase phenomena. With the exception of arctic and subarctic regions and if the average wind speed is not too high, solar radiation is probably the parameter which has the largest effect on the soil surface temperature. The cumulative curve of winter temperatures is used for the determination of the freezing index. This curve may have several peaks and, therefore, the determination of the freezing index of the air may vary from country to country and according to different standards. The report will endeavor to propose a standard procedure for the calculation of the freezing index of the air. This report is the result of a group effort with the aim of providing a practical, rather than a theoretical, treatment of the subject.

MP 4064
MATHEMATICAL MODEL CALLED M_1 AND THE GILPIN MODEL OF SOIL FREEZING.
Nakano, Y., International Symposium on Ground Freezing, 8th, and Frost Action in Soils, 3rd, Luleå, Sweden, Apr. 15-17, 1997. Ground freezing 97. Edited by S. Knutsson, Rotterdam, A.A. Balkema, 1997, p.139-146, 22 refs.
51-5145
SOIL FREEZING, FREEZING FRONT, ICE LENSES, FROZEN GROUND THERMODYNAMICS, SOIL WATER MIGRATION, SOIL PRESSURE, MATHEMATICAL MODELS
The property of a frozen fringe described by the Gilpin model is studied analytically when an ice layer is growing. The frozen fringe described by the Gilpin model is shown to be essentially one special case of the model M_1 introduced by Nakano in 1990. By comparing the behavior of the Gilpin's frozen fringe with experimental data of two kinds of porous media, the author shows that the Gilpin model is too restrictive to accurately describe their behavior.

MP 4065
CAPILLARY RISE OF WATER IN GEOTEXTILES.
Henry, K.S., Holtz, R.D., International Symposium on Ground Freezing, 8th, and Frost Action in Soils, 3rd, Luleå, Sweden, Apr. 15-17, 1997. Ground freezing 97. Edited by S. Knutsson, Rotterdam, A.A. Balkema, 1997, p.227-233, 13 refs.
51-5158
SOIL FREEZING, FROST HEAVE, FROST PROTECTION, GEOTEXTILES, SOIL STABILIZATION, SOIL WATER MIGRATION, CAPILLARITY, VAPOR BARRIERS, WATERPROOFING
Capillary barriers can reduce frost heave in soils when they are placed above the water table and below the depth of freezing. Past guidance for the use of granular capillary barriers suggests that they should be thicker than the height of capillary rise of water in them. However, a review of capillary physics indicates that a porous material can be a capillary barrier when its base is placed above the water table at a distance greater than the capillary rise of water in it. The authors tested this idea experimentally and present results that support it. Geotextile capillary barriers may lose effectiveness when soil particles become emplaced in them. This could be mitigated by using either geotextiles with increased thickness or smaller pore sizes, or both, or geocomposite capillary barriers.

MP 4066
DEFORMATION OF A RETAINING WALL BY GROUND FREEZING.
Danyluk, L.S., Ketcham, S.A., International Symposium on Ground Freezing, 8th, and Frost Action in Soils, 3rd, Luleå, Sweden, Apr. 15-17, 1997. Ground freezing 97. Edited by S. Knutsson, Rotterdam, A.A. Balkema, 1997, p.421-426.
51-5190
EARTH DAMS, EARTH FILLS, CONCRETE STRUCTURES, WALLS, SOIL FREEZING, FROST RESISTANCE, FROST HEAVE, FROST ACTION, SOIL PRESSURE, DISLOCATIONS (MATERIALS)
Field measurements were made of the horizontal movement of a large retaining wall in Hopkinton, NH, USA. The reinforced concrete retaining wall is part of an earthen dike on the downstream side of an earth-filled dam. The dike is used to separate an existing wood-cribbed dam and its associated forebay pool from the outlet channel of the earth dam. Previous surveys have indicated that outward displacements at the top of the wall occur during the winter and rebound partially during the spring. Observations of the wall show severe, permanent deformation. Prior to the 1995-96 winter season, the US Army Cold Regions Research and Engineering Laboratory installed various sensors on and behind the wall to continuously measure these displacements and to provide information for the repair strategy. The measurements indicate that the movement is frost related. Horizontal movement at the top of the wall of 20 mm, and increased earth pressure behind the wall of almost 200 kPa, were measured during the period of frost penetration. As the frost subsided in the spring, the earth pressure approached pre-winter values. Although the displacement at the top of the wall did rebound, it did not recover completely.

MP 4067
THAWING OF FROZEN SOIL WITH A LINEARLY INCREASING SURFACE TEMPERATURE.
Lunardini, V.J., International Symposium on Ground Freezing, 8th, and Frost Action in Soils, 3rd, Luleå, Sweden, Apr. 15-17, 1997. Ground freezing 97. Edited by S. Knutsson, Rotterdam, A.A. Balkema, 1997, p.127-130, 4 refs.
51-5143
GROUND THAWING, THAW DEPTH, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND TEMPERATURE, SOIL TEMPERATURE, SURFACE TEMPERATURE,

STEFAN PROBLEM, MATHEMATICAL MODELS
The Neumann solution, valid for a surface temperature that instantaneously increases, has been used for many years to estimate freeze/thaw depths. If the surface temperature varies with time, the Neumann solution can be used with an equivalent surface temperature. This can give reliable results for the total depth of freeze/thaw, but is significantly in error at intermediate times. An analytic solution to the problem with the surface temperature increasing linearly with time is presented here and compared to the results predicted by the Neumann solution. If the Stefan number is small, the growth of the thawed zone is nearly linear in time, but as the Stefan increases, it becomes increasingly nonlinear. The Neumann solution greatly exaggerates the thermal changes during the early growth and underpredicts them during the latter part of the warming. These results can lead to significant errors in calculating the effects of warming on frozen ground.

MP 4068
PROCEEDINGS OF THE 53RD ANNUAL EASTERN SNOW CONFERENCE, WILLIAMSBURG, VA, MAY 2-3, 1996.
Eastern Snow Conference, Albert, M.R., ed, Taylor, S., ed, 213p., Refs. passim. For selected papers see 51-5246 through 51-5265.
51-5245
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOWFALL, SNOW DEPTH, SNOWMELT, SNOW HYDROLOGY, CLIMATIC CHANGES, SPACEBORNE PHOTOGRAPHY, RADIOMETRY

MP 4069
SNOW COVER CHARACTERIZATION USING MULTIBAND FMCW RADARS.
Koh, G., Yankielun, N.E., Baptista, A.I., *Eastern Snow Conference. Proceedings,* 1996, 53rd, p.125-131, 7 refs.
51-5257
SNOW SURVEYS, SNOW COVER STRUCTURE, SNOW STRATIGRAPHY, SNOW WATER EQUIVALENT, RADAR ECHOES, RADIO ECHO SOUNDINGS
The use of radars to characterize the physical properties of a snow cover offers an attractive alternative to manual snow pit measurements. Radar techniques are noninvasive and have the potential to characterize large areas of a snow-covered terrain. A promising radar technique for snow cover studies is the frequency modulated continuous wave (FMCW) radar. The use of a multiband radar approach for snow cover studies was investigated in order to fully exploit the capabilities of FMCW radars. FMCW radars operating at and near the C-, X-, and K_a-bands were used to obtain radar profiles over a wide range of snow cover conditions. These frequency-dependent radar signatures were used to identify important snow cover features such as ice and depth hoar layers. Snow grain size information was also obtained from the frequency-dependent scattering losses that were observed in the snow cover. Several case studies of FMCW radar profiles are presented in order to demonstrate the advantages of a multiband radar approach for monitoring the spatial and temporal variability of snow cover properties and/or processes over an extended area.

MP 4070
PRELIMINARY TRIALS OF THE USE OF IMMUNOASSAY SCREENING FOR CHLORDANE IN ARCTIC SEA ICE CORES.
Thorne, P.G., *Eastern Snow Conference. Proceedings,* 1996, 53rd, p.177-180, 6 refs.
51-5262
AIR POLLUTION, WATER POLLUTION, SUSPENDED SEDIMENTS, BOTTOM SEDIMENT, SEA ICE, ICE CORES, ICE COMPOSITION, IMPURITIES, MELTWATER, WATER CHEMISTRY, CHEMICAL ANALYSIS
Twelve ice-pack surface sediments and three ice cores taken during the 1994 AOS TransArctic Cruise were assayed for chlordane using a commercial immunoassay. The total chlordane ranged from 38 to 400 ng/g in sediments and 128 to 430 ng/L in ice. No gas chromatography/electron capture detection (GC/ECD) confirmations were performed; however, spike-recovery tests indicated that it may be possible to obtain contamination estimates for chlordane from single ice cores.

MP 4071
INFERRING DYNAMIC WINTER VARIABLES.
Hogan, A.W., *Eastern Snow Conference. Proceedings,* 1996, 53rd, p.205-212, 8 refs.
51-5265
SNOWFALL, SNOW DEPTH, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW COVER EFFECT, AIR TEMPERATURE, SOIL TEMPERATURE, STATISTICAL ANALYSIS
A majority of winter environmental data is measured or observed at meteorological or hydrological stations that coexist with other activities. It is often necessary to infer the air, snow, or ground temperature in a natural setting from the observations available at these stations. There are dynamic exchanges of heat, chemicals and water substances in natural settings that are quite complex. There is exchange near treetop level, at the air/snow interface, and at the snow/ground interface. These exchanges interact on differing times scales, making it difficult to synthesize the overall response to a dynamic change in the troposphere above. Air, snow, and soil temperatures have been measured at the margin of a regenerating forest for several winters. This paper examines spatial, temporal, and dimensionless scaling of winter temperatures. An interesting preliminary result is the response of the environment to some statistical "outliers" in the temperature of the air above the snow. The use of the proposed scaling methods to examine the sudden loss of New England snow coincident with heavy Pennsylvania rains described by the keynote speakers has been added to the paper.

MP 4072
BIOSOLIDS AND SLUDGE MANAGEMENT.
Krogmann, U., Boyles, L.S., Martel, C.J., McComas, K.A., *Water environment research,* 1997, 69(4), p.534-550, Refs. p.545-550.
51-5305
WASTE TREATMENT, WATER TREATMENT, WASTE DISPOSAL, SLUDGES, EARTH FILLS, ENVIRONMENTAL PROTECTION, BIBLIOGRAPHIES
This paper summarizes recent research on wastewater sludge and biosolids use in international waste disposal management practices.

MP 4073
PHYSICS, CHEMISTRY, AND ECOLOGY OF FROZEN SOILS IN MANAGED ECOSYSTEMS: AN INTRODUCTION.
Sharratt, B.S., Radke, J.K., Hinzman, L.D., Iskandar, I.K., Groenevelt, P.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.1-7, 45 refs.
51-5376
SOIL FREEZING, GROUND THAWING, FROZEN GROUND STRENGTH, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND CHEMISTRY, SOIL AIR INTERFACE, SOIL CONSERVATION, SOIL MICROBIOLOGY, ECOLOGY, ENVIRONMENTAL PROTECTION, REGIONAL PLANNING
Some of the world's most productive soils lie within cold regions. To enhance the productivity and quality of soil resources within these regions, knowledge must be advanced concerning the impact of freezing and thawing on soil properties and processes. The International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils is a step toward broadening the knowledge of frozen soil processes. This paper emphasizes the physical nature of frozen soil and the importance of freezing and thawing to the transport of water and heat at the Earth's surface. The authors also discuss the chemistry and biology of the soil system as affected by freezing and thawing. Ascertaining changes in ecosystem structure and productivity in response to perturbations in climate or management depends primarily on the use of models; these models require the acquisition of new knowledge to better define linkages among the physical, chemical, and biological components in cold regions. New knowledge concerning the dynamics of the frozen soil system will allow global societies and industries to develop sustainable and environmentally-safe management systems.

MP 4074
FREEZE-THAW EFFECTS ON THE HYDROLOGIC CHARACTERISTICS OF RUTTED AND COMPACTED SOILS.
Gatto, L.W., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.189-198, 36 refs.
51-5405
SOIL STRENGTH, SOIL EROSION, WATER EROSION, GULLIES, SEEPAGE, SOIL FREEZING, GROUND THAWING, FROST ACTION, FREEZE THAW TESTS
U.S. Army training exercises compact and often rut soils, which can increase hillslope runoff and concentrate surface flows, and enhance soil erosion. The objectives are to determine the effects of freeze-thaw (FT) on vehicular ruts, which concentrate flows and often erode to gullies. A noncohesive silt was rutted with a pickup truck, then frozen and thawed three times. Frost heave, rut geometry, soil compression, shear strength, and infiltration were measured. Results show that 1) ruts start to freeze later and thaw slower than uncompacted soil; 2) once ruts start to freeze, they freeze faster than unrutted soil; 3) the ruts heave an average of 0.2 to 3.2 mm more than unrutted soil; 4) the infiltration in ruts increases by 62%, unconfined compression strength decreases by 16% and shear strength by 14%, and rut hydraulic radius decreases an average of 9% after three FT cycles. These results suggest that the volume of water flowing in these ruts would be lower, the rut soils would be weaker (more erodible) and the rut flow velocity would be lower after the FT cycles. Future experiments will investigate rut and rill responses in different soils at variable FT rates.

MP 4075
PHYSICAL CHEMISTRY OF GEOCHEMICAL SOLUTIONS AT SUBZERO TEMPERATURES.
Marion, G.M., Grant, S.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.349-356, 25 refs.
51-5430
SALINE SOILS, SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, SOIL STRUCTURE, POROSITY, CAPILLARITY, PERMAFROST THERMAL PROPERTIES, PERMAFROST HYDROLOGY, SOIL MICROBIOLOGY, CRYOBIOLOGY, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS
Theoretical developments, specifically the Pitzer equations and thermoporometry, coupled with improved experimental data on the thermophysical properties of supercooled solutions indicate that quantitative estimates are possible for the thermophysical properties of aqueous electrolyte solutions in frozen porous media. The Pitzer equations are statements of a solution's excess Gibbs energy. When fully parameterized, the Pitzer equations allow the calculation of activity coefficients, osmotic coefficients, enthalpies, entropies, Gibbs energies, heat capacities, and molal volumes of highly concentrated aqueous electrolyte solutions to temperatures below -50°C. While developed to calculate capillary pressures for pure pore liquids, the theoretical development that yielded thermoporometry can be extended directly to pore solutions composed of complex electrolyte solutions, by which freezing behavior of chemically realistic natural soils can be calculated. Application of the FREZCHEM model to an arctic permafrost soil demonstrated that significant amounts of water may remain liquid in saline soils as the result of salt exclusion from ice during the freezing process and the formation of brine pockets. These simulations also demonstrated that environmental conditions are marginally suitable for microbial activity in frozen soils under extreme conditions. Frozen soils have the potential to serve as a refugium for life.

MP 4076
GROUND FREEZING FOR CONTAINMENT OF HAZARDOUS WASTE: ENGINEERING ASPECTS.
Iskandar, I.K., Sayles, F.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.361-369, 12 refs.
51-5432
SOIL FREEZING, ARTIFICIAL FREEZING, SOIL POLLUTION, SOIL STABILIZATION, SOIL CONSERVATION, WASTE DISPOSAL, ENVIRONMENTAL PROTECTION
The use of frozen soils has been proposed as an alternative method to contain hazardous waste. This technology has recently been advanced and adopted for application, and several demonstration projects are proposed. This paper describes engineering aspects of artificial soil freezing for containment of hazardous waste, geological conditions, environmental issues, advantages and limitations, performance monitoring and research needs.

MP 4077
USE OF FROZEN-GROUND BARRIERS FOR CONTAINMENT AND IN-SITU REMEDIATION OF HEAVY-METAL CONTAMINATED SOIL.
Boitnott, G.E., Iskandar, I.K., Grant, S.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.409-416, 11 refs.
51-5440
SOIL POLLUTION, SOIL FREEZING, ARTIFICIAL FREEZING, PERMAFROST PRESERVATION, FROZEN GROUND CHEMISTRY, WASTE DISPOSAL, LAND RECLAMATION
Barriers formed from artificially frozen ground have been proposed for isolating heavy-metal contaminated soils. In this bench-top study, the authors examined the effectiveness of a frozen-ground barrier in containing heavy-metal-laden liquid generated during soil remediation. A soil, artificially contaminated with Cd, Cu, Ni, and Zn, was placed above a frozen water-saturated uncontaminated soil layer. The temperature of the frozen layer was maintained at -3°C. The contaminated soil was flushed with a 0.1 M EDTA solution. Over 90% of the Cu and Zn and over 80% of the Cd and Ni were recovered from the unfrozen layer. Most of the remaining metals were found in a narrow zone of soil at the boundary between the frozen and unfrozen layers, while

smaller amounts appear to have migrated into the barrier, apparently by diffusion in liquid-water films. The experiments demonstrated that the frozen-soil barrier prevented the migration of most of the metal-EDTA complexes, even at only -3°C. While the mechanism for the movement of small amounts of metals into this layer remains unclear, the authors suspect cooling below -3°C would improve the barrier's performance.

MP 4078
INVESTIGATION OF AN ABANDONED DIESEL STORAGE CAVITY IN PERMAFROST.
Spaans, E.J.A., Baker, J.M., Iskandar, I.K., Koenen, B.A., Pidgeon, C.S., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.436-442, 4 refs.
51-5444
FUELS, WASTE DISPOSAL, OIL SPILLS, SOIL POLLUTION, PERMAFROST PRESERVATION, PERMAFROST THERMAL PROPERTIES, PERMAFROST HYDROLOGY, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, LAND RECLAMATION
In 1974 an experiment was conducted to test the feasibility of storing diesel fuel in an unlined cavity created in permafrost. A test cavity was excavated, and at the conclusion of the experiment the diesel was not removed, but sawdust was added to adsorb the diesel, and the shaft leading from the cavity to the surface was backfilled with gravel. In 1994, diesel fuel was observed on the soil surface in the vicinity of the shaft. The entire gravel shaft was contaminated with diesel; the soil outside the shaft exhibited much lower levels of contamination. A video camera lowered into the cavity showed massive ice on all cavity walls. The authors tentatively conclude that during the years 1975-1994 water entered the gravel shaft, migrated downward to the cavity, and displaced the diesel fuel which moved upward through the shaft. The permafrost cavity failed to provide an environmentally sound enclosure for the diesel.

MP 4079
FREEZE-THAW APPARATUS AND TESTING OF TIME DOMAIN REFLECTOMETRY (TDR) AND RADIO FREQUENCY (RF) SENSORS.
Kestler, M.A., Bull, D., Wright, B., Hanek, G., Truebe, M., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.558-564, 5 refs.
51-5465
PAVEMENTS, FROST HEAVE, FROST PENETRATION, FROST FORECASTING, SOIL WATER, UNFROZEN WATER CONTENT, MOISTURE METERS, MOISTURE DETECTION, ELECTROMAGNETIC PROSPECTING, ROAD MAINTENANCE
Time domain reflectometry (TDR) is gaining rapid acceptance in the United States as a nonradioactive technique for measuring volumetric moisture content, and TDR sensors are increasingly being used to determine the effect that fluctuations in moisture content have on pavement systems. Although not as common, radio frequency (RF) sensors can also be used to monitor changes in moisture content in pavement systems. To evaluate the accuracy and repeatability of both TDR and RF moisture sensors installed in pavements experiencing seasonal freezing, the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) and the U.S. Department of Agriculture Forest Service (USFS) have developed a simple, inexpensive laboratory freeze-thaw moisture sensor testing device. The following paper discusses the test apparatus design and construction, test procedure, and observations resulting from a series of freeze-thaw tests using a sandy-silt.

MP 4080
PHYSICS, CHEMISTRY, AND ECOLOGY OF SEASONALLY FROZEN SOILS: A WRAP-UP DISCUSSION.
Radke, J.K., Sharratt, B.S., Hinzman, L.D., Groenevelt, P.H., Iskandar, I.K., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report,* Apr. 1997, SR 97-10, International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils, Fairbanks, AK, June 10-12, 1997. Proceedings. Edited by I.K. Iskandar, et al, p.571-573.
51-5467
SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, SOIL MICROBIOLOGY, SOIL CONSERVATION, RESEARCH PROJECTS
Seasonally frozen soils occur over a large portion of the Northern Hemisphere and include some of the most productive and also the most fragile soils in the world. Research reported from 12 countries at the International Symposium on Physics, Chemistry, and Ecology of Seasonally Frozen Soils covered a wide range of topics and represented many disciplines. While the knowledge of frozen soils is vast, much remains to be learned. Future frozen soils research needs include: 1) measurement techniques, 2) changes in soil microstructure, 3) adaptation of soil organisms, 4) new simulation models and management tools, 5) interdisciplinary research, and 6) applied research for managing ecosystems. The big task for the future is to integrate knowledge gained through frozen soils research into useful tools for the development of new management systems for the global ecosystems.

MP 4081
FROST PENETRATION IN SOIL WITH AN INCLUSION OF SAND: DEPENDENCE ON SOIL MOISTURE CONTENT AND WINTER SEVERITY.
Peck, L., O'Neill, K., *Canadian geotechnical journal,* June 1997, 34(3), p.368-383, With French summary. 15 refs.
51-5468
FROZEN GROUND MECHANICS, PHASE TRANSFORMATIONS, SOIL FREEZING, FREEZING FRONT, FROST PENETRATION, SOIL TEMPERATURE, SANDS, WATER CONTENT, ADMIXTURES, THERMAL CONDUCTIVITY, HEAT TRANSFER, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION
An innovative numerical method was developed for calculating multidimensional heat conduction with phase change. The method can easily be included in standard finite element and finite difference heat transfer programs. Simulations of one- and two-dimensional heat transfer in soil with an inclusion of sand were done to investigate the disruption in frost and thaw penetration due to the presence of a dry, low thermal conductivity sand. The dependence of frost depth on weather conditions was investigated by using four different (coldest, cold, warm, warmest) winter-long temperature histories for the soil surface boundary condition. With details depending on the moisture content of the soil, significant effects on the time history of frost penetration were observed when a wide sand inclusion is present. Frost penetration actually proceeds more rapidly through the sand at first because it is dry and, therefore, has a lower latent heat and heat capacity; initial frost depth is greater when a sand inclusion is present. Freezing of the soil below the sand inclusion is subsequently impeded by the slow removal of heat at the base of the sand as a consequence of its lower thermal conductivity; thus, the maximum frost depth is greater in soil without a sand inclusion.

MP 4082
ESTIMATING THE TOTAL CONCENTRATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL SAMPLES.
Hewitt, A.D., Lukash, N.J.E., Annual Waste Testing and Quality Assurance Symposium, 13th, Arlington, VA, July 6-9, 1997. Proceedings, Washington, D.C., American Chemical Society, 1997, p.98-104, 10 refs.
51-5535
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
This manuscript describes an on-site method of estimating the total concentration of volatile organic compounds (VOCs) in soil, relative to a site-specific 0.2 mg/kg working standard. The purpose of this decision tool is to allow on-site sampling activities to incorporate the appropriate soil sample collection and handling protocols necessary for high- and low-level gas chromatography/mass spectrometry analysis. Combining rapid on-site analysis with sampling procedures that limit substrate disaggregation and exposure improves efforts to achieve site-representative estimates for vadose zone contamination.

MP 4083
DETERMINATION OF NITROAROMATIC, NITRAMINE, AND NITRATE ESTER EXPLOSIVES IN WATER USING SOLID PHASE EXTRACTION AND GC-ECD.
Walsh, M.E., Ranney, T.A., Annual Waste Testing and Quality Assurance Symposium, 13th, Arlington, VA, July 6-9, 1997. Proceedings, Washington, D.C., American Chemical Society, 1997, p.113-124, 12 refs.
51-5536
MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, WELLS, WATER POLLUTION, WATER CHEMISTRY, CHEMICAL ANALYSIS
SW-846 Method 8330, the current USEPA method for the analysis of 14 nitroaromatic and nitramine explosives and co-contaminants, uses a liquid chromatograph (LC) equipped with a UV detector. In many environmental laboratories, gas chromatographs (GCs) are the most commonly used instruments because the majority of SW-846 methods for organics are gas chromatographic methods. The desire to make maximum use of GC naturally leads to attempts to substitute GCs for LCs when analyzing for explosives. However, quantitative analysis of explosives by GC is complicated by the thermal lability of some of the analyses, particularly the nitramines. The authors have found, by using high linear carrier gas velocities, deactivated injection port liners, and short wide-bore capillary columns, that the Method 8330 analyses plus nitroglycerin, PETN, and dinitroaniline may be analyzed quantitatively by GC-ECD (gas chromatography-electron capture detector). The GC method provides greater sensitivity than LC, but accurate calibration is more difficult. The UV detector used for the LC analysis has much greater linear range than the ECD used for GC analysis. In addition, the GC instrumentation requires more care than the LC. Specifically, the injection port liner must be changed frequently to maintain accurate determination of the nitramines. Perhaps the most valuable asset of the GC determination, when used in conjunction with LC, is the ability to confirm analyte presence based on two different physical properties: vapor pressure with GC and polarity with LC. When detection is ambiguous using LC, confirmation by GC will be very useful. Documentation and performance data will be submitted to the Office of Solid Waste for consideration of this method as a standard for inclusion in SW-846.

MP 4084
ON-SITE ANALYSIS OF EXPLOSIVES IN SOIL: EVALUATION OF THIN-LAYER CHROMATOGRAPHY FOR CONFIRMATION OF ANALYTE IDENTITY.
Nam, S.I., Leggett, D.C., Jenkins, T.F., Stutz, M.H., Annual Waste Testing and Quality Assurance Symposium, 13th, Arlington, VA, July 6-9, 1997. Proceedings, Washington, D.C., American Chemical Society, 1997, p.132-140, 18 refs.
51-5537
MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, CHEMICAL ANALYSIS
Two colorimetric-based methods are commonly used for on-site analysis of explosives in soil. For the TNT method, acetone soil extracts are reacted with base to produce reddish Janowsky anions. For the RDX method, acetone extracts are acidified and reacted with zinc metal to reduce RDX to nitrous acid, which is further reacted with a Griess reagent to produce a reddish product. In both cases, concentrations are estimated using absorbance measurements at 540 or 507 nm, respectively. The limitations on positive analyte identification with these procedures are that the TNT method also reacts with other polynitroaromatics, such as TNB and DNT, and the RDX method reacts with other nitramines (HMX) and nitrate esters (NG and PETN). The ability to qualitatively differentiate among the various analyses that produce positive responses would greatly enhance the usability of these methods. This study investigated the use of thin-layer chromatography (TLC) as a simple, on-site method to confirm the identity of analyses detected using the colorimetric procedures. Separations using both laboratory-grade and locally available solvents were developed. The combination of petroleum ether:isopropanol (4:1) provided the best separation for the nitroaromatics, and petroleum ether:acetone (1:1) produced the best separation for the nitramines and nitrate esters. Various types of visualization schemes were also investigated. The most sensitive were $TiCl_3$ with dimethylaminocinnamaldehyde for the nitroaromatics, and the Griess reagent with UV exposure for the nitramines. The major limitation of TLC confirmation analysis is that it does not currently provide an analyte detection capability comparable to the colorimetric tests. Using plates with a preconcentration zone and high ratios of soil to solvent, detection levels of about 10 mg/kg seem attainable.

MP 4085
VECTOR FEATURE EXTRACTION USING ADAPTIVE PARALLEL PROCESSING.
LaPotin, P.J., McKim, H.L., Comati, J.C., International Airborne Remote Sensing Conference and Exhibition, Copenhagen, Denmark, July 7-10, 1997. Proceedings. Vol.2, Ann Arbor, MI, ERIM (Environmental Research Institute of Michigan) International, Inc., 1997, p.300-304, 6 refs.
51-5538
DATA PROCESSING, IMAGE PROCESSING, COMPUTER PROGRAMS
In this paper optimal routing algorithms are proposed for the design and implementation of feedforward neural networks and parallel processors. Feedforward architectures are the focus of the analysis since their organization clearly separates sequential tasks from parallel tasks, and optimal algorithms can be applied to the larger class of recurrent designs. Within the optimal routing algorithms, adaptation methods are used to govern the introduction and distribution of individual processors. The purpose of the adaptation sequence is to produce parallel architectures that are capable of recognizing portrayed test patterns in k≥2 multispectral/hyperspectral bands. Within the adaptation sequence, weight adjustment is used to reward or penalize processing units based upon sampling criteria, architecture size, and pattern classification. Generalized gradient descent algorithms are examined and operating properties are reviewed for use within multiple layer vector extraction models. The operating characteristics of these designs are demonstrated using recursive programming techniques.

MP 4086
DESIGN AND IMPLEMENTATION OF THE BELARUS AN-26 REMOTE SENSING SYSTEM.
LaPotin, P.J., McKim, H.L., Ellis, J.N., Kamely, D.,

International Airborne Remote Sensing Conference and Exhibition, Copenhagen, Denmark, July 7-10, 1997. Proceedings. Vol.2, Ann Arbor, MI, ERIM (Environmental Research Institute of Michigan) International, Inc., 1997, p.694-698, 4 refs.
51-5539
MILITARY FACILITIES, SOIL POLLUTION, PLANT ECOLOGY, PLANT PHYSIOLOGY, PHYSIOLOGICAL EFFECTS, VEGETATION PATTERNS, TERRAIN IDENTIFICATION, AERIAL SURVEYS, AIRBORNE EQUIPMENT, PHOTOGRAPHIC EQUIPMENT, MAPPING, BELARUS
In this paper, the technical specifications for the Antonov AN-26 Remote Sensing Platform are provided, and detailed technical guidelines are presented for the design and implementation of the installed sensor suite within the Former Soviet Union Republic of Belarus. The airborne remote sensing platform includes three major systems: (1) Leica RC-30 Aerial Mapping Camera with digitally controlled mount, (2) Digital MultiSpectral Video (DMSV) System with digitally controlled mount, and (3) Trimble Sensor GPS and Navigational GPS. Each system is designed to evaluate specific environmental factors. The Leica RC-30 Aerial Mapping Camera acquires scaled color and color-infrared imagery to precise specifications for the monitoring and evaluation of land use conditions. The DMSV System acquires digital data for the monitoring and detection of vegetative stress. The stress conditions are correlated within specific toxicological samples from the field and are used to create scaled maps of the environmental features found within the Former Strategic Rocket Force (FSRF) installations. The Trimble Sensor GPS and Navigational GPS register the individual frames of data acquired from the Leica RC-30 and DMSV.

MP 4087
IS BLASTING OF ICE JAMS AN EFFECTIVE MITIGATION STRATEGY?
White, K.D., Kay, R.L., *Journal of cold regions engineering*, Sep. 1997, 11(3), p.171-179, 12 refs.
51-5578
RIVER ICE, FLOODING, ICE JAMS, ICE BLASTING, ICE CONTROL, EXPLOSIVES, EXPLOSION EFFECTS, SAFETY, PERFORMANCE, STANDARDS
There are few mitigation measures that can be used for emergency response to ice jam flooding other than traditional techniques such as sandbagging and evacuation. Among these ice-jam-specific measures are ice breaking, mechanical ice removal, and blasting. Options may be further limited for grounded ice jams, jams located on wide, shallow rivers, or jams located in areas with poor access. In such cases, blasting of an ice jam may be the most effective or efficient ice jam mitigation measure. In some cases, blasting is the only mitigation measure that can be applied. Blasting operations are hazardous because of the potential for disaster associated with the use of explosives, such as untimely detonation of charges leading to serious injury or death. Liability issues now appear to be the greatest obstacle to the use of blasting in ice jam emergency mitigation. Blasting can be an effective ice jam mitigation measure when a plan that has been prepared in advance is put into action rapidly, while there is still sufficient flow to move the blasted ice.

MP 4088
LOW-COST ICE-CONTROL STRUCTURE.
Lever, J.H., Gooch, G., Tuthill, A., Clark, C., *Journal of cold regions engineering*, Sep. 1997, 11(3), p.198-220, 18 refs.
51-5580
RIVER ICE, ICE JAMS, ICE BREAKUP, FLOODPLAINS, FRAZIL ICE, ICE CONTROL, HYDRAULIC STRUCTURES, CONCRETE STRUCTURES, PIERS, CONSTRUCTION, COST ANALYSIS, MODELS, SIMULATION
A new, low-cost structure appears to be well suited to control breakup ice jams on small rivers. It consists of massive sloped blocks, partially buried in riprap, placed across the river adjacent to a natural floodplain. The blocks will arrest a breakup ice run and form a stable, partially grounded ice jam. Trees or boulders on the floodplain retain ice pieces in the river channel while allowing flow to bypass the structure. Large gaps between blocks allow easy fish and canoe passage. Refrigerated hydraulic model tests indicate that the structure should perform well even during severe breakup events. A prototype built in Hardwick, VT, has performed well during the four mild breakup events experienced to date. Its cost of $3,600/m of river width represents about an order-of-magnitude reduction compared with previous ice-control structures.

MP 4089
MODELING ICE PASSAGE AT STARVED ROCK LOCK AND DAM ON ILLINOIS WATERWAY.
Tuthill, A., Gooch, G., *Journal of cold regions engineering*, Sep. 1997, 11(3), p.232-243, 6 refs.
51-5582
LOCKS (WATERWAYS), DAMS, RIVER ICE, CHANNELS (WATERWAYS), NAVIGATION, ICE PASSING, ICE CONTROL, HYDRAULIC STRUCTURES, SUBSURFACE STRUCTURES, BUBBLING, SIMULATION, MODELS, UNITED STATES—ILLINOIS—ILLINOIS WATERWAY
A physical hydraulic model study, using real ice, investigated the design and operation of submergible gates for ice passage at the U.S. Army Corps of Engineers Starved Rock Lock and Dam on the Illinois Waterway. Alternative gate locations were tested for a range of gate discharges and ice conditions. The effects of hydropower diversions, navigation, and high-flow air screens on ice passage were examined. The study found that, under some ice conditions, submergible gates alone may not be adequate for ice passage. During these times, tow and barge transits through the lock and deflector bubbler operation would need to be coordinated with submergible gate operation to pass ice.

MP 4090
EFFECTS OF RESERVOIR REGULATION ON ICE JAM THICKNESS.
Zufelt, J.E., Congress of the International Association for Hydraulic Research (IAHR), 27th, San Francisco, CA, Aug. 10-15, 1997. Water for a changing global community. Energy and water: sustainable development, New York, American Society of Civil Engineers (ASCE), 1997, p.156-161, 1 ref.
51-5609
RESERVOIRS, RIVER FLOW, FLOW CONTROL, RIVER ICE, ICE WATER INTERFACE, ICE JAMS, ICE COVER THICKNESS, ICE FORECASTING, ICE CONTROL, MATHEMATICAL MODELS
Hydropower operations alter the natural levels of discharge in a river. In a seasonal sense, the effect of hydropower regulation is to average the flow, cutting off the very high and very low periods of discharge that may result in flooding or drought conditions. Peaking operations, however, may reverse this trend, resulting in flows that are much higher or lower than the natural flow levels for that time of the year. During winter, natural discharge levels are typically low and regulation for hydroelectric generation may result in brief periods of abnormally high and possibly low discharge under ice-covered conditions. Large variations in discharge over the hydropower cycling period may result in ice movement or grounding. Therefore, the range of discharge fluctuation is often limited during ice formation and breakup periods when the ice cover is most likely to move. This paper looks at the effects of these unsteady discharge fluctuations on the resulting ice cover thickness through the use of a numerical model. Two reservoir configurations are presented, which help examine the effects of hydropower regulation on the ice cover thickness in the reaches upstream and downstream from a hydropower facility.

MP 4091
ICE EFFECTS ON RIPRAP: SMALL-SCALE TESTS.
Sodhi, D.S., Borland, S., Stanley, J.M., Donnelly, C.J., Congress of the International Association for Hydraulic Research (IAHR), 27th, San Francisco, CA, Aug. 10-15, 1997. Water for a changing global community. Energy and water: sustainable development, New York, American Society of Civil Engineers (ASCE), 1997, p.162-167, 2 refs.
51-5610
BANK PROTECTION (WATERWAYS), ROCK FILLS, ICE PUSH, ICE EROSION, ICE FRICTION, ICE LOADS, ICE CONTROL, ENVIRONMENTAL TESTS
The authors conducted model tests to simulate interaction between floating ice sheets and sloping banks protected with riprap stones. Two series of tests were conducted, representing ice action against model riprap bank protection when the ice sheet moves perpendicular and at an angle of 45° to the shoreline. The first series of tests simulates ice shoving action, while the second series of tests incorporated both shoving and shearing actions of ice in equal proportion. They conducted 35 tests during the first series and 53 tests during the second series. The results indicate that the size of maximum stone (D_{100}) should be about 2.5 times the ice thickness to avoid damage from ice action either perpendicular or at an angle of 45° to the shoreline. The data on the probability of riprap failure indicate that the likelihood of riprap damage increases with the slope of a riprap protected bank.

MP 4092
ICE JAM MITIGATION FOR SMALL STREAMS.
Lever, J.H., Congress of the International Association for Hydraulic Research (IAHR), 27th, San Francisco, CA, Aug. 10-15, 1997. Water for a changing global community. Energy and water: sustainable development, New York, American Society of Civil Engineers (ASCE), 1997, p.168-173, 16 refs.
51-5611
STREAMS, RIVER ICE, ICE JAMS, ICE BOOMS, ICE CUTTING, ICE BREAKING, ICE CONTROL, FLOOD CONTROL, COST ANALYSIS
Small streams can cause severe ice-jam flooding. Ice booms can mitigate freezeup ice jams for low cost and environmental impact provided suitable low-velocity pools are available. Low-cost breakup ice-control structures also exist, although work remains to quantify their effectiveness. Ice weakening could provide effective breakup ice-jam mitigation at very low cost and environmental impact. However, large natural variability in ice hydraulic conditions, lack of suitable theory and incomplete field data make it difficult to quantify their effectiveness.

MP 4093
ICE RETENTION WITH ARTIFICIAL ISLANDS ON THE ST. MARYS RIVER.
Tuthill, A.M., Carey, K.L., Congress of the International Association for Hydraulic Research (IAHR), 27th, San Francisco, CA, Aug. 10-15, 1997. Water for a changing global community. Energy and water: sustainable development, New York, American Society of Civil Engineers (ASCE), 1997, p.180-185, 4 refs.
51-5613
RIVER ICE, ICE NAVIGATION, ICE BOOMS, ICE CONTROL, ROCK FILLS, ARTIFICIAL ISLANDS, UNITED STATES—MICHIGAN—ST. MARYS RIVER
For the past two decades, a navigation ice boom has alleviated ice problems at the head of the Little Rapids Cut, a channel constriction on the St. Marys River near Sault Ste. Marie, MI. This study assesses the feasibility of replacing portions of the ice boom with artificial islands constructed of quarried stone.

MP 4094
ICE CONTROL AT LOCKS AND DAMS.
Haynes, F.D., Congress of the International Association for Hydraulic Research (IAHR), 27th, San Francisco, CA, Aug. 10-15, 1997. Water for a changing global community. Energy and water: sustainable development, New York, American Society of Civil Engineers (ASCE), 1997, p.186-191, 4 refs.
51-5614
LOCKS (WATERWAYS), DAMS, SLUICES (HYDRAULIC ENGINEERING), ICE ACCRETION, ICE LOADS, ICE PREVENTION, ICE CONTROL, BUBBLING, HEATING, ARTIFICIAL MELTING
Locks and dams have problems with ice every winter, especially those in the north. The most severe problem is ice accumulation in the miter gate recess. The second most severe problem around locks is ice in the upper approach. Another severe icing problem is water leaking past J-seals and subsequently freezing on cold surfaces, such as trunnion arms and adjacent concrete walls. In this paper, solutions to some of the most severe problems are presented, such as bubblers or some type of heater.

MP 4095
LOGISTICS RECOMMENDATIONS FOR AN IMPROVED U.S. ARCTIC RESEARCH CAPABILITY.
Schlosser, P., ed, Tucker, W.B., ed, Flanders, N.E., ed, Warnick, W.K., ed, U.S. Arctic Research Commission, Fairbanks, AK, Arctic Research Consortium of the United States (ARCUS), 1997, 88p., 35 refs.
51-5645
RESEARCH PROJECTS, LOGISTICS, STATIONS, EXPEDITIONS, REGIONAL PLANNING

MP 4096
THERMAL CONDUCTIVITY OF SEASONAL SNOW.
Sturm, M., Holmgren, J., König, M., Morris, K., *Journal of glaciology*, 1997, 43(143), p.26-41, 65 refs.
51-5649
SNOW PHYSICS, SNOW THERMAL PROPERTIES, THERMAL CONDUCTIVITY, SNOW DENSITY, MICROSTRUCTURE, TEMPERATURE EFFECTS, TEMPERATURE MEASUREMENT, ANALYSIS (MATHEMATICS), STANDARDS, STATISTICAL ANALYSIS, ACCURACY
Twenty-seven studies on the thermal conductivity of snow have been published since 1886. Combined, they comprise 354 values and have been used to derive over 13 regression equations predicting thermal conductivity vs. density. Due to large (and largely undocumented) differences in measurement methods and accuracy, sample temperature and snow type, it is not possible to know what part of the variability in this data set is the result of snow microstructure. The authors present a new data set containing 488 measurements for which the temperature, type and measurement accuracy are known. A quadratic equation can be fit to the new data. Within the data set, snow types resulting from kinetic growth show density-independent behavior. Rounded-grain and wind-blown snow show strong density dependence. The new data set has a higher mean value of density but a lower mean value of thermal conductivity than the old set. This shift is attributed to differences in snow types and sample temperatures in the sets. Both data sets show that there are well-defined limits to the geometric configurations that natural seasonal snow can take.

MP 4097
VAPOR TRANSPORT, GRAIN GROWTH AND DEPTH-HOAR DEVELOPMENT IN THE SUBARCTIC SNOW.
Sturm, M., Benson, C.S., *Journal of glaciology*, 1997, 43(143), p.42-59, 45 refs.
51-5650
SNOW PHYSICS, METAMORPHISM (SNOW), SNOW COVER STRUCTURE, GRAIN SIZE, SNOW CRYSTAL

GROWTH, DEPTH HOAR, WATER VAPOR, VAPOR TRANSFER, SNOW AIR INTERFACE, ISOTOPE ANALYSIS, MATHEMATICAL MODELS
Measurements from the subarctic snowpack are used to explore the relationship between grain growth and vapor flow, the fundamental processes of dry-snow metamorphism. Due to extreme temperature gradients, the subarctic pack undergoes extensive depth-hoar metamorphism. By the end of the winter a five-layered structure with a pronounced weak layer near the base of the snow evolves. Grain-size increases by a factor of 2-3, while the number of grains per unit mass decreases by a factor of 10. Calculated layer-to-layer vapor fluxes are ten times higher than interparticle fluxes, which implies that depth-hoar grain growth is limited by factors other than the vapor supply. This finding suggests that gain and loss of water molecules due to sublimation from grains takes place at a rate many times higher than the rate at which grains grow, and it explains why grains can metamorphose into different forms so readily.

MP 4098
MODEL OF WIND PUMPING FOR LAYERED SNOW.
Colbeck, S.C., *Journal of glaciology,* 1997, 43(143), p.60-65, 16 refs.
51-5651
SNOW PHYSICS, SNOW AIR INTERFACE, SNOW PERMEABILITY, SNOW COVER STRUCTURE, LAYERS, DEPTH HOAR, AIR FLOW, VENTILATION, ATMOSPHERIC PRESSURE, WIND FACTORS, MATHEMATICAL MODELS
Layering affects the air flow through snow caused by surface pressure variations. The horizontal and total fluxes are high in hoar layers but the pressure perturbations and vertical components of the flow do not penetrate as deeply as in homogeneous snow. That is because the layers "pipe" the flow horizontally toward the area of low pressure. An ice layer at the surface reduces the total flow everywhere. The flow decreases as ice-layer thickness increases and, in general, flow changes with permeability. However, the magnitude of the effect is proportionately weaker when the ice layers are further from the surface. The residence time is reduced when hoar layers are present due to shorter flow paths, reduced penetration into the deeper snow and higher speeds.

MP 4099
CONSTRUCTION APPLICATIONS OF FIBER REINFORCED POLYMER COMPOSITES: A SURVEY.
Kant, T., Ramana, V.P.V., Dutta, P.K., Mukherjee, A., Desai, Y., International Offshore and Polar Engineering Conference, 7th, Honolulu, May 25-30, 1997. Proceedings. Vol.4, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1997, p.657-663, 107 refs.
51-5751
COMPOSITE MATERIALS, SYNTHETIC MATERIALS, CONSTRUCTION MATERIALS, POLYMERS, PLASTICS, REINFORCED CONCRETES
A review is made of the different applications of fiber reinforced polymer composite (FRPC) materials and carbon fiber reinforced plastic (CFRB) cables in construction. The potential FRPC application areas are classified into three groups, namely: repair and rehabilitation of structural elements using FRPC sheets; FRPC bars as a reinforcement material for concrete structural elements; and structural elements made of FRPC. Literature relevant to FRPC material in construction is divided into the above three groups. This review focuses on experimental research only. No attempt has been made to identify different analytical studies available on FRPC. Sub-topics of the above three areas are mentioned along with partial references.

MP 5000
MICROMECHANICAL STUDY OF THE FREEZE-THAW BEHAVIOR OF POLYMER COMPOSITES.
Dutta, P.K., International Offshore and Polar Engineering Conference, 7th, Honolulu, May 25-30, 1997. Proceedings. Vol.4, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1997, p.672-676, 5 refs.
51-5752
POLYMERS, COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, FREEZE THAW TESTS, THERMAL STRESSES, COLD WEATHER CONSTRUCTION, MATHEMATICAL MODELS
The essential quality of a good polymer composite is that the bond between the fiber and the matrix is well established and is continuous both around the fiber and along its length. When a load is applied in the direction of the fiber, the ratio of the load share depends on the relative elastic modulus of the fiber and the matrix. However, the elastic modulus of the polymer matrix is significantly influenced by the temperature. At low temperature the modulus of elasticity increases considerably, and thus load sharing changes between the fibers and the matrix. Also, because of the mismatch of coefficient of thermal expansion (CTE) of matrix and fiber, the matrix is usually stretched in the fiber direction during curing, and develops internal tensile stress, interfacial shear stress, hoop stress, and radial stress. On further cooling during the freezing process, the magnitude of all these induced stresses would usually increase, developing potential microcracks. The change in the radial or clamping stress which controls the crack development and propagation (fracture) both across and along the fiber would also change the composite's fracture behavior in the low temperature regime. More complex stresses are developed when the composites are constructed as laminates with each lamina (layers of fibers) having fiber orientations different from the adjacent ones. Reductions of strength and modulus of composites, following freeze-thaw cycling, as evident in experimental results, support this micromechanical theory of composites degradation.

MP 5001
TEMPERATURE EFFECT ON STRENGTH OF ICE UNDER TRIAXIAL COMPRESSION.
Fish, A.M., Zaretskiĭ, IU.K., International Offshore and Polar Engineering Conference, 7th, Honolulu, May 25-30, 1997. Proceedings. Vol.2. Edited by J.S. Chung, R.M.W. Frederking, H. Saeki, and A.T. Bekker, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1997, p.415-422, 22 refs.
51-5711
ICE STRENGTH, ICE THERMAL PROPERTIES, ICE TEMPERATURE, ICE PRESSURE, ICE FRICTION, ICE CREEP, ICE DEFORMATION, ICEBERGS, REGELATION, MATHEMATICAL MODELS
A temperature model has been developed that describes the ice strength in a multiaxial stress state over a wide spectrum of negative temperatures. The model takes into account the anomalous behavior of ice under high hydrostatic pressure, when its strength reaches a maximum, and then gradually decreases with the pressure increase. It has been shown that strength of ice under high hydrostatic pressure is described by an extended Drucker-Prager (parabolic) strength criterion with only 3 fundamental parameters, ice cohesion, internal friction angle, and ice melting pressure, which all have a definite physical meaning and are functions of temperature. The model has been verified using test data on the strength of iceberg ice and laboratory-made polycrystalline freshwater ice under triaxial compression at strain rates between 10^{-3} and 10^{-5}/s over the temperature range between -1°C and -40°C.

MP 5002
DEVELOPMENT OF A MODERN HEAVY-HAUL TRAVERSE FOR ANTARCTICA.
Blaisdell, G.L., Richmond, P.W., Kaiser, F.C., Alger, R.G., International Offshore and Polar Engineering Conference, 7th, Honolulu, May 25-30, 1997. Proceedings. Vol.2. Edited by J.S. Chung, R.M.W. Frederking, H. Saeki, and A.T. Bekker, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1997, p.529-536, 5 refs.
51-5730
LOGISTICS, TRAVERSES, ROUTE SURVEYS, CREVASSE DETECTION, TRACKED VEHICLES, SLEDS, ICE ROADS, SNOW ROADS, TRAFFICABILITY
An integrated, interdisciplinary study was completed to assess the feasibility of an oversnow route from McMurdo to the Amundsen-Scott Station. Currently the only means of supplying the Amundsen-Scott Station is by specialized aircraft. Air photo and satellite imagery were used extensively, along with ground-penetrating impulse radar (deployed from a helicopter) to make preliminary determinations of the suitability of glaciers in the Transantarctic Mountains for heavy tractor access from the Ross Ice Shelf to the polar plateau. These were followed by ground reconnaissance and data gathering. Modern traverse equipment was also developed and tested as part of this study. Tractor performance and terrain information were used to compare two potential traverse routes and to calculate delivered payload, fuel consumption, and travel time. (Auth.)

MP 5003
SNOW PROPERTIES AND MEASUREMENT: FOR USE IN MOBILITY ALGORITHMS.
Richmond, P.W., *U.S. Army Corps of Engineers. Waterways Experiment Station. Miscellaneous paper,* Jan. 1997, GL-97-3, North American Workshop on Modeling the Mechanics of Off-Road Mobility, 2nd, Vicksburg, MS, Mar. 13-15, 1996. Proceedings. Edited by D.A. Horner, G.L. Mason, N. Deliman and R.A. Jones, p.C8-C13, 9 refs.
51-5778
SNOW COVER EFFECT, SNOW STRENGTH, SNOW DEPTH, SNOW DENSITY, TRAFFICABILITY

MP 5004
STUDY OF THE EVOLUTION OF THE UNDER-ICE WATER LAYER DURING SUMMER MELT PHASE IN AN ARCTIC BAY.
Rajan, S.D., Laible, H., Tucker, W.B., *Journal of geophysical research,* June 15, 1997, 102(C6), p.12,587-12,592, 2 refs.
52-11
OCEANOGRAPHY, ICE ACOUSTICS, ACOUSTIC MEASUREMENT, SOUND WAVES, VELOCITY MEASUREMENT, ATTENUATION, ICE WATER INTERFACE, MELTWATER, STRATIFICATION, ICE COVER EFFECT
An acoustic ice tomography experiment which extended over a 12-month period was conducted in the Sabine Bay area of the Canadian Archipelago. Acoustic transmitter and receiver arrays were deployed in the ice for this experiment. The vertical arrays penetrated through the ice and extended into the water column. The acoustic data collected from the transmitter/receiver pairs in the water column are analyzed to investigate the changes in the sound speed structure of the water column. Analysis of the acoustic data shows significant changes in the sound speed structure in the upper 2 m of the water column during the summer melt phase. These changes in sound speed with the influx of fresh water are caused by the melting of ice cover, snow, and runoff from rivers. The analysis presented is a demonstration of the usefulness of this technique to monitor the changes that take place in the region beneath the ice cover.

MP 5005
SLIDING TEMPERATURES OF ICE SKATES.
Colbeck, S.C., Najarian, L., Smith, H.B., *American journal of physics,* June 1997, 65(6), p.488-492, 5 refs.
52-72
ICE PHYSICS, ICE SOLID INTERFACE, SLIDING, METAL ICE FRICTION, HEAT TRANSFER, THERMOCOUPLES, TEMPERATURE MEASUREMENT, TEMPERATURE VARIATIONS, MECHANICAL TESTS, THEORIES, THERMAL INSULATION, THERMAL ANALYSIS
The two theories developed to explain the low friction of ice, pressure melting and frictional heating, require opposite temperature shifts at the ice-skate interface. The arguments against pressure melting are strong, but only theoretical. A set of direct temperature measurements shows that frictional heating is the dominant mechanism because temperature behaves in the manner predicted by the theory of frictional heating. Ice skates are warmed by sliding and then cool when the sliding stops. The temperature increases with speed and with thermal insulation. The sliding leaves a warm track on the ice surface behind the skate and the skate sprays warm ejecta.

MP 5006
USE OF RECYCLED HIGH DENSITY POLYETHYLENE FIBERS AS SECONDARY REINFORCEMENT IN CONCRETE SUBJECTED TO SEVERE ENVIRONMENT.
Auchey, F.L., Dutta, P.K., International Offshore and Polar Engineering Conference, 6th, Los Angeles, CA, May 26-31, 1996. Proceedings. Vol.4. Edited by J.F. Dos Santos, I. Langen, Y. Ueda and R.S. Puthli, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1996, p.287-291, 9 refs.
52-124
POLYMERS, CONSTRUCTION MATERIALS, CONCRETE STRUCTURES, COLD WEATHER PERFORMANCE, FREEZE THAW CYCLES, COLD WEATHER TESTS, REINFORCED CONCRETES

MP 5007
RETROFITTING AND STRUCTURAL REPAIR WITH ADVANCED POLYMER MATRIX COMPOSITE MATERIALS.
Arockiasamy, M., Dutta, P.K., International Offshore and Polar Engineering Conference, 6th, Los Angeles, CA, May 26-31, 1996. Proceedings. Vol.4. Edited by J.F. Dos Santos, I. Langen, Y. Ueda and R.S. Puthli, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1996, p.336-340, 28 refs.
52-125
COMPOSITE MATERIALS, POLYMERS, CONSTRUCTION MATERIALS, FLEXURAL STRENGTH, REINFORCED CONCRETES

MP 5008
DATABASE AND METHODOLOGY FOR CONDUCTING SITE SPECIFIC SNOW LOAD CASE STUDIES FOR THE UNITED STATES.
Tobiasson, W., Greatorex, A., International Conference on Snow Engineering, 3rd, Sendai, Japan, May 26-31, 1996 Proceedings. Snow engineering: recent advances. Edited by M. Izumi, T. Nakamura, and R.L. Sack, Rotterdam, A.A. Balkema, 1997, p.249-256, 3 refs.
52-308
SNOW SURVEYS, SNOWFALL, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW LOADS, WEATHER STATIONS, METEOROLOGICAL DATA, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES
The authors have developed data and a methodology for determining the ground snow load at locations not covered in the

ground snow load map of the United States due to extreme local snow load variations in the area. The elevation, the years of record available, the maximum observed value and the "50-year" ground snow load at a number of nearby sites are considered. A plot of elevation vs. load is often helpful.

MP 5009
EFFECTS OF HYDROPOWER PEAKING OPERATIONS ON THE THICKNESS OF ICE ACCUMULATIONS.
Zufelt, J.E., Workshop on the Hydraulics of Ice Covered Rivers, 8th, Aug. 16-18, 1995, Kamloops, British Columbia. Proceedings. Winter environments of regulated rivers. Edited by D.D. Andres, Kamloops, British Columbia, Committee on River Ice Processes and the Environment, Canadian Geophysical Union, Hydrology Section, 1997, p.43-57, 2 refs.
52-434
ELECTRIC POWER, RIVER ICE, ICE COVER THICKNESS, WATER LEVEL, MATHEMATICAL MODELS, DAMS
Hydropower operations alter the natural levels of discharge in a river. In general, the effect of a hydropower dam is to average the flow, cutting off the very high and very low periods of discharge which may result in flooding or drought conditions on a seasonal scale. Peaking operations, however, may reverse this trend, resulting in flows that are much higher or lower than the natural daily flow levels for that time of the year. During winter, natural discharge levels are low, and peaking operations may result in periods of abnormally high and low discharge in rivers under ice-covered conditions. These large variations in discharge may cause ice movement or grounding over the course of the cycling period. Therefore, the range of cycling is often limited during ice formation and breakup periods when the ice cover is most likely to move. Restrictions are often based on the peak discharge in the cycle and the water levels expected downstream. Due to the additional resistance offered by an ice cover, the attenuation of the peaking wave as it travels downstream can be much greater than for open-water conditions. This paper examines the effects of this attenuation on the peak discharge, water levels, and ice thickness experienced downstream of the hydropower facility.

MP 5010
ICE JAM FLOODING NEAR THE CONFLUENCE OF THE MISSOURI AND YELLOWSTONE RIVERS.
Wuebben, J.L., Workshop on the Hydraulics of Ice Covered Rivers, 8th, Aug. 16-18, 1995, Kamloops, British Columbia. Proceedings. Winter environments of regulated rivers. Edited by D.D. Andres, Kamloops, British Columbia, Committee on River Ice Processes and the Environment, Canadian Geophysical Union, Hydrology Section, 1997, p.207-224, 2 refs.
52-440
FLOODING, RIVER ICE, ICE JAMS, ICE BREAKUP, ICE CONDITIONS, HYDROLOGY, UNITED STATES—MISSOURI RIVER, UNITED STATES—YELLOWSTONE RIVER
This investigation focused on ice-related flooding along the Missouri River, just below the confluence with the Yellowstone River near Williston, ND. This area is at the upper end of Lake Sakakawea. With the closure of Garrison Dam in 1953, Lake Sakakawea began filling, reaching operational levels in 1965. Changes in the hydraulics, sedimentation and ice regime of the Missouri River caused by the impoundment have led to an increase in the potential for overbank flooding. This paper presents an evaluation of the ice regime of the Missouri and Yellowstone Rivers using historical and recent information on ice processes and ice-related flooding. A scheme for estimating the potential for ice-related flooding based on a correlation of weather and hydraulic data is outlined. The method has been used in two subsequent winters to estimate the timing and severity of river ice breakup.

MP 5011
ASSESSING THE EFFECTS OF ALTERNATIVE PROJECT OPERATION ON UPSTREAM ICE CONDITIONS: AROOSTOOK RIVER AT FORT FAIRFIELD, MAINE.
White, K.D., Acone, S.E., Workshop on the Hydraulics of Ice Covered Rivers, 8th, Aug. 16-18, 1995, Kamloops, British Columbia. Proceedings. Winter environments of regulated rivers. Edited by D.D. Andres, Kamloops, British Columbia, Committee on River Ice Processes and the Environment, Canadian Geophysical Union, Hydrology Section, 1997, p.259-273, 10 refs.
52-444
RIVER ICE, ICE CONDITIONS, FLOODING, DAMS, ICE COVER THICKNESS, FREEZEUP, HYDRAULICS, UNITED STATES—MAINE—AROOSTOOK RIVER
Breakup ice jams in the Aroostook River have caused severe flooding in Fort Fairfield, ME. In general, the most damaging jams halt in the area between Fort Fairfield and the international border. It has been suggested that the backwater of Tinker Dam, which extends into Fort Fairfield, contributes to the formation or stopping of ice jams in the reach between the dam and the town. This report presents the results of an investigation of the effects of river geometry on the ice regime of the Aroostook River upstream from Tinker Dam, and whether dam operations or some type of dredging might affect this regime. Results show that present dam operations at freezeup are preferable to lowering the water level. Current gate operations are also preferable to lowering the gates at breakup when flows are greater than 283 m^3/s. Observed frazil deposition in the upper reaches of the pool correlates well with the location of jam stoppages. The modeled channel improvement scheme that showed the most promise for decreasing ice thickness at the critical location is to remove the island-shoal area at the McDonald Brook confluence.

MP 5013
ICE SHEET DEVELOPMENT IN CENTRAL GREENLAND: IMPLICATIONS FROM THE ND, SR AND PB ISOTOPIC COMPOSITIONS OF BASAL MATERIAL.
Weis, D., Demaiffe, D., Souchez, R., Gow, A.J., Meese, D.A., *Earth and planetary science letters*, July 1997, 150(1-2), p.161-169, 24 refs.
52-512
ICE SHEETS, ICE FORMATION, ORIGIN, GLACIAL GEOLOGY, ICE CORES, ICE COMPOSITION, BEDROCK, SEDIMENTS, ISOTOPE ANALYSIS, DRILL CORE ANALYSIS, GREENLAND
The Nd, Sr and Pb isotopic compositions of silt particles from the basal silty ice of the two deep ice cores in central Greenland, GISP 2 and GRIP, are compared to those of the subglacial rock material at GISP 2 (dolerite boulder, till and granitic bedrock). The silt particles embedded in the GRIP basal ice result from the reworking of the subglacial till unit overlying granitic bedrock at GISP 2, 28 km to the east. This implies that the till unit is continuous in central Greenland. The silt particles embedded in the GISP 2 basal ice result from local erosion of the granitic bedrock. This study supports the hypothesis that the Greenland Ice Sheet in the Summit area did not result from in situ growth from local snowbanks. The composition of the dolerite boulder points to East Greenland as the most probable source region for the ice sheet.

MP 5014
CLIMATIC WARMING AND THE DEGRADATION OF WARM PERMAFROST.
Lunardini, V.J., *Permafrost and periglacial processes*, Oct.-Dec. 1996, 7(4), Frozen Ground Workshop, Hanover, New Hampshire, Dec. 9-11, 1995. Selected papers, p.311-320, With French summary. 22 refs. For another version see 50-6482.
52-540
CLIMATOLOGY, GLOBAL WARMING, PERMAFROST THERMAL PROPERTIES, PERMAFROST TRANSFORMATION, DEGRADATION, GEOTHERMAL THAWING, THAW DEPTH, FREEZE THAW CYCLES, MATHEMATICAL MODELS, FORECASTING, THEORIES
Permafrost—a widespread constituent of the terrestrial environment—by definition is dependent upon the ambient temperature for its existence and properties. Thus, it is very sensitive to climatic changes. Simple relations based upon conductive heat transfer, with thawing and geothermal heat flow, are presented to predict the transient effects of surface temperature increases on the thermal state of permafrost. The results indicate that, based on the usual global warming scenarios, relatively small amounts of permafrost will disappear within 50-100 years. This is specifically shown for the most thermally sensitive cases, that is, warm or relict permafrost.

MP 5015
REMOTE DETECTION AND AVOIDANCE OF INFLIGHT ICING.
Ryerson, C.C., *U.S. Federal Aviation Administration. Office of Aviation Research, Washington, D.C. Report*, Aug. 1996, DOT/FAA/AR-96/81, FAA International Conference on Aircraft Inflight Icing, Springfield, VA, May 6-8, 1996. Proceedings. Vol.2, p.179-190, ADA-316 441, 49 refs.
52-579
AIRCRAFT ICING, ICE FORECASTING, ICE DETECTION, CLOUD PHYSICS, SUPERCOOLED CLOUDS, CLOUD DROPLETS, PARTICLE SIZE DISTRIBUTION, UNFROZEN WATER CONTENT, LIDAR, RADAR TRACKING, RADIO ECHO SOUNDINGS, WARNING SYSTEMS
Icing forecasts are not sufficiently accurate to prevent all icing mishaps. Remote detection of icing potential ahead of aircraft may allow avoidance and escape from icing encounters. Remote detection is intended to identify and assess icing potential ahead of an aircraft, with regard to aircraft type and airspeed, and provide guidance for avoidance in a manner similar to current wind shear and thunderstorm avoidance systems. Remote detection requires mapping of temperature and cloud liquid water magnitude by droplet size in the flight path ahead of the aircraft. Two promising technologies include multiple field-of-view lidar and differential attenuation radar. Both technologies have had limited testing. The advantage of radar is its ability to penetrate clouds and measure liquid water, and lidar is able to detect cloud droplet size spectra. Several other potential technologies, and the potential and problems of icing prediction detection, are assessed.

MP 5016
MEASUREMENTS OF SUPERCOOLED LIQUID WATER AND APPLICATIONS TO AIRCRAFT INFLIGHT ICING.
Hill, G.E., *U.S. Federal Aviation Administration. Office of Aviation Research, Washington, D.C. Report*, Aug. 1996, DOT/FAA/AR-96/81, FAA International Conference on Aircraft Inflight Icing, Springfield, VA, May 6-8, 1996. Proceedings. Vol.2, p.339-351, ADA-316 441, Partially supported by the U.S. Army Cold Regions Research and Engineering Laboratory.
52-592
AIRCRAFT ICING, ICE FORECASTING, ICE DETECTION, CLOUD PHYSICS, SUPERCOOLED CLOUDS, CLOUD DROPLETS, UNFROZEN WATER CONTENT, MOISTURE DETECTION, METEOROLOGICAL INSTRUMENTS
An expendable instrument attached to radiosondes has been developed to measure vertical profiles of supercooled liquid water (SLW). A vibrating wire is exposed to the air as the balloon rises through a cloud. Changes in vibration frequency due to ice collection are used to find SLW concentrations. Comparisons are made with independent SLW measurements by microwave radiometers and by aircraft. It is found that with cold clouds ($T < -10°C$) the vibrating wire yields accurate results, but with warmer clouds the instrument underestimates the SLW by about a factor of two on average.

MP 5017
EVIDENCE FOR RADIONUCLIDE TRANSPORT BY SEA ICE.
Meese, D.A., Reimnitz, E., Tucker, W.B., Gow, A.J., Bischof, J., Darby, D., *Science of the total environment*, Aug. 25, 1997, 202(1-3), Symposium and International Conference on Environmental Radioactivity in the Arctic, 2nd, Oslo, Norway, Aug. 21-25, 1995. Proceedings. Edited by P. Strand et al, p.267-278, 26 refs.
52-679
OCEANOGRAPHIC SURVEYS, RADIOACTIVITY, WATER CHEMISTRY, SEA ICE, ICE COMPOSITION, BOTTOM SEDIMENT, ICE RAFTING, CLAY MINERALS, ICE CORES, SAMPLING, RADIOACTIVE ISOTOPES, ENVIRONMENTAL TESTS
Ice and ice-borne sediments were collected across the Arctic Basin during a recent US/Canada trans-Arctic expedition. Sediments were analyzed for ^{137}Cs, clay mineralogy and carbon. Concentrations of ^{137}Cs ranged from 5 to 73 Bq/kg in the ice-borne sediments. Concentrations of ice samples without sediment were all less than 1 Bq/m^3. The sediment sample with the highest ^{137}Cs concentration was collected in the Beaufort Sea. This concentration was significantly higher than in bottom sediments collected in the same area, indicating an ice transport mechanism from an area with correspondingly higher concentrations. Recent results from the application of ice transport models and sediment analyses indicate that it is very likely that sediments are transported by ice, from the Siberian shelf areas to the Beaufort Sea.

MP 5018
OPERATION OF A PEAKING HYDROPOWER PLANT IN WINTER: ESTIMATING DOWNSTREAM WATER-SURFACE PROFILES AND RELEASE CONSTRAINTS.
Daly, S.F., Tuthill, A., McGilvary, R.M., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.55-72, 3 refs.
52-697
ELECTRIC POWER, DAMS, RIVER ICE, ICE COVER EFFECT, RIVER FLOW, ICE MODELS, SIMULATION, UNITED STATES—MISSOURI RIVER, UNITED STATES—SOUTH DAKOTA—PIERRE
This study estimated the stage frequency at selected cross sections in the Missouri River downstream of Oahe Dam. Also estimated were release constraints on the operation of Oahe Dam by simulating the flow conditions in the Missouri River for a selected period of each of the 27 historical winter seasons (1967-68 through 1993-94) that the dam has been in operation. The selected periods corresponded to each year's most severe ice conditions. The simulations were done with the unsteady flow model UNET and used a) the recorded Oahe Dam hourly release rates, b) the best estimate of the Missouri River ice conditions, and c) the Missouri River cross-section geometry calibrated to 1994 conditions. The simulations were also done for the estimated future aggraded Missouri River cross section geometry. Three sets of stage frequencies were produced for each selected cross section under the existing channel conditions, and three sets were produced under the estimated future conditions. An estimate was also made of the expected duration of constraints to the Oahe Dam releases caused by the presence of ice on the Missouri River

each winter. This was done by selecting a specific position of the leading edge of the river ice cover as the indicator of when the Oahe Dam releases would need to be constrained. The statistics of the constraint duration were then developed on the basis of the length of time that the river ice cover extended upstream of both of these locations over the period of record. The statistics of the estimated constraints on the total volume released, for both the 25,000 and 35,000 cfs maximum-release scenarios, were also estimated for existing and future (year 2036) channel conditions.

MP 5019
EFFECTS OF UNCERTAINTY IN ICE ROUGHNESS ON EQUILIBRIUM ICE THICKNESS AND STAGE.
White, K.D., Daly, S.F., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.89-99, With French summary. 14 refs.
52-699
ICE JAMS, ICE COVER THICKNESS, ICE BREAKUP, MATHEMATICAL MODELS, ICE MODELS
The U.S. Army Corps of Engineers requires the use of risk and uncertainty methods in the analysis and design of hydraulic and flood control structures. When the uncertainties are quantified, the risk associated with different levels of protection can be quantified as well. At the present time, these methods address the uncertainties encountered in developing discharge-probability functions and stage-discharge functions for gaged and ungaged watersheds in open-water conditions. There are no established methods to perform similar analyses in ice-affected rivers. The additional sources of error include ice roughness, ice thickness, and ice properties such as porosity and cohesion. In addition, discharge measurement errors present in open-water cases are compounded by the measurement errors caused by the presence of ice, such as frozen recorders and ice-affected stages leading to overly high discharge estimates. This paper addresses the additional complexities introduced when risk and uncertainty analyses are attempted for ice-covered conditions. In particular, the effects of uncertainty in ice roughness on the calculated equilibrium ice jam thickness and stage are explored.

MP 5020
FACTORS INFLUENCING ICE CONVEYANCE AT RIVER CONFLUENCES.
Ettema, R., Muste, M., Kruger, A., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.111-124, 2 refs. Funded by the U.S. Army Cold Regions Research and Engineering Laboratory under contract No.DACA 4303900.
52-701
RIVERS, RIVER ICE, ICE JAMS, HYDRAULICS, RIVER FLOW, ICE COVER EFFECT, MATHEMATICAL MODELS, UNITED STATES—MISSISSIPPI RIVER, UNITED STATES—MISSOURI RIVER
This paper presents the preliminary findings of a study aimed at evaluating the factors influencing ice conveyance and incipient ice jamming in river confluences. The paper begins by categorizing the different conditions of ice conveyance at a confluence. The categorization is based on two-part general classification; free drift of ice into confluences, and the movement of contiguous accumulations of ice into confluences. Sub-categories of each general category also are identified. The variables defining ice conveyance for the two general categories then are assembled by means of dimensional analysis into two sets of non-dimensional parameters. Next, the paper briefly presents preliminary results from a hydraulic model used to investigate flow and ice through the confluence of the Missouri and Mississippi Rivers, a confluence with an occasional, though severe, jam problem. The model makes use of particle image velocimetry to determine and map whole fields of water and ice velocities in the confluence. The categories of possible confluent ice conditions, together with the non-dimensional parameters and the results from the hydraulic model, are used to make a preliminary evaluation of the actual extent of ice-jam problems at confluences. The evaluation suggests that the three most common causes of ice jams are sluggish water velocities in the outflow channel from a confluence, the presence of an ice cover in the outflow channel, and local bathymetric features typical of confluences.

MP 5021
BREAKUP ICE CONTROL STRUCTURE FOR THE SALMON RIVER IN CONNECTICUT.
Tuthill, A.M., White, K.D., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.125-139, 11 refs.
52-702
ICE JAMS, RIVER ICE, ICE BREAKUP, COUNTERMEASURES, DAMS, ICE CONTROL, PIERS, UNITED STATES—CONNECTICUT RIVER, UNITED STATES—SALMON RIVER, UNITED STATES—CONNECTICUT—EAST HADDAM
This paper presents a conceptual design for a breakup ice control structure on the Salmon River at East Haddam, CT. Ice jams initiate just downstream of a small neighborhood, where the Salmon River transitions to a flat tidal reach above its confluence with the Connecticut River. Ice jam flood severity has increased since 1979, when a dam located upstream of the community was lowered. The Salmon River watershed is small and relatively steep, responding rapidly to rainfall and snowmelt events. As a result, the ice breakup can be extremely dynamic. Design development relied on equilibrium ice jam modeling to simulate worst case existing conditions and estimate the performance of structural ice control alternatives under two ice breakup scenarios. The first breakup scenario assumed that a semi-intact ice sheet would rest against the piers and retain a floating equilibrium jam upstream, allowing water discharge to pass beneath. Under a second, and worst case scenario, a grounded jam in direct contact with the piers would divert water flow around the structure via an armored channel in the overbank area. The proposed ice retention structure consists of a row of concrete piers, spaced across the main channel, 60 m upstream of an existing dam.

MP 5022
ANCHOR ICE FORMATION AND GROWTH ON GRAVEL CHANNEL BED.
Kerr, D.J., Shen, H.T., Daly, S.F., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.153-171, 9 refs.
52-704
BOTTOM ICE, ICE FORMATION, ICE GROWTH, HEAT LOSS, FRAZIL ICE
Preliminary results of a laboratory study on anchor ice formation and growth on gravel channel bed are presented. The study showed that the anchor ice formed in supercooled turbulent flow from the accumulation of frazil ice on the bed. In-situ thermal growth was not observed. The location of the initiation of anchor ice accumulation relative to the bed gravel and the growth pattern of the anchor ice accumulations varied with the flow condition. The growth of anchor ice generally consisted of an initial stage of localized frazil deposition, followed by a transition stage, then the final stage of continued uniform growth. Three types of anchor ice forms were observed during the initial stage of growth. The anchor ice can accumulate in forms of tails, scales, or balls. During the transition stage, flattening or releasing of anchor ice occurred. If the anchor ice was not released during the transition stage, an anchor ice blanket would form and grow in thickness at a steady rate with respect to the heat loss rate.

MP 5023
ICE JAM PROGRESSION ON THE UPPER ST. JOHN RIVER.
Zufelt, J.E., Tuthill, A.M., Stanley, J.M., Jr., Workshop on River Ice, 9th, Sep. 24-26, 1997, Fredericton, N.B. Proceedings. Edited by S. Ismail, Fredericton, New Brunswick Power Corporation, 1997, p.257-268, 5 refs.
52-711
ICE BREAKUP, ICE JAMS, RIVER ICE, FLOODING, FORECASTING, UNITED STATES—MAINE, SAINT JOHN RIVER
The upper St. John River in northern Maine typically experiences a dynamic ice breakup. Ice jams and flooding occur annually at many locations along this generally uninhabited reach of the river. Dickey, ME, is the most upstream community on the St. John River and, therefore, does not receive warning from upstream communities that an ice run has begun or that there is potential of damaging ice jams and flooding. In Apr. 1991, a severe ice jam in Dickey caught residents unprepared, with many residents being stranded as ice and water surrounded their homes and destroyed the only bridge across the St. John River for 100 km. While downstream communities may receive some warning that an ice run or jam has occurred in Dickey and is on its way downstream, the warning time may be minimal. This paper describes observations of the ice breakup progression along the St. John River upstream of Dickey and how this information might be used in forecasting ice runs or breakup at Dickey and communities downstream.

MP 5024
FROST HEAVE LOADING OF CONSTRAINED FOOTING BY CENTRIFUGE MODELING.
Ketcham, S.A., Black, P.B., Pretto, R., *Journal of geotechnical and geoenvironmental engineering,* Sep. 1997, 123(9), p.874-880, 22 refs.
52-793
FOUNDATIONS, FROST HEAVE, SOIL FREEZING, FROZEN GROUND MECHANICS, SOIL TESTS, MECHANICAL TESTS, MASS TRANSFER, LOADS (FORCES), STRESS CONCENTRATION, SIMULATION, MODELS
This paper presents measurements and results of three centrifuge experiments that model the uplift loading of a constrained footing by the frost heaving of a layer of freezing, saturated silt. The experiments were performed at different scales to investigate the validity of scale factors predicted for small-scale frost heave modeling. The working hypothesis was that the developing frost heave forces measured in the different models should, using the predicted scale factors, scale to the same full-scale response. Results from the tests support this hypothesis and provide an indication that the centrifuge modeling technique is applicable to frost heave loading of structures.

MP 5025
EXTENDED ABSTRACTS.
International Conference on the Biogeochemistry of Trace Elements, 4th, University of California, Berkeley, CA, June 23-26, 1997, Iskandar, I.K., ed, Hardy, S.E., ed, Chang, A.C., ed, Pierzynski, G.M., ed, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1997, 785p., For selected papers see 52-972 through 52-974.
52-971
SOIL POLLUTION, SOIL CHEMISTRY, GEOCHEMISTRY, LAND RECLAMATION, PLANT PHYSIOLOGY

MP 5026
HEAVY METAL REMEDIATION VIA THE DISPERSION BY CHEMICAL REACTION PROCESS.
Marion, G.M., Brar, G.S., Pelton, D.K., Palazzo, A.J., Payne, J.R., International Conference on the Biogeochemistry of Trace Elements, 4th, University of California, Berkeley, CA, June 23-26, 1997. Extended abstracts. Edited by I.K. Iskander, et al, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1997, p.413-414, 6 refs.
52-972
SOIL POLLUTION, SOIL CHEMISTRY, WASTE TREATMENT, LIMING, LAND RECLAMATION, PLANT PHYSIOLOGY

MP 5027
ROOT GROWTH AND METAL UPTAKE OF PLANTS GROWN ON ZINC-CONTAMINATED SOILS AS INFLUENCED BY SOIL TREATMENT AND PLANT SPECIES.
Palazzo, A.J., Lee, C.R., International Conference on the Biogeochemistry of Trace Elements, 4th, University of California, Berkeley, CA, June 23-26, 1997. Extended abstracts. Edited by I.K. Iskander, et al, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1997, p.441-442, 3 refs.
52-973
SOIL POLLUTION, SOIL CHEMISTRY, WASTE TREATMENT, LAND RECLAMATION, ROOTS, PLANT PHYSIOLOGY, REVEGETATION

MP 5028
MODELING THE REACTIVITY AND TRANSPORT OF COPPER IN SOILS.
Selim, H.M., Ma, L., Iskandar, I.K., Amacher, M.C., International Conference on the Biogeochemistry of Trace Elements, 4th, University of California, Berkeley, CA, June 23-26, 1997. Extended abstracts. Edited by I.K. Iskander, et al, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1997, p.747-748, 3 refs.
52-974
SOIL POLLUTION, SOIL CHEMISTRY, GEOCHEMISTRY, ION EXCHANGE

MP 5029
ICE JAM DATABASE.
White, K.D., Griffin, G.E., *Military engineer,* Aug.-Sep. 1997, 89(586), p.39-41.
52-1042
RIVER ICE, ICE JAMS, PERIODIC VARIATIONS, FLOOD FORECASTING, STATISTICAL ANALYSIS, COMPUTER APPLICATIONS, COMPUTER PROGRAMS, DATA PROCESSING

MP 5030
DIELECTRIC PROPERTIES OF ICE AT MILLIMETER WAVELENGTHS.
Koh, G., *Geophysical research letters,* Sep. 15, 1997, 24(18), p.2311-2313, 14 refs.
52-1053
ICE PHYSICS, ICE DIELECTRICS, DIELECTRIC PROPERTIES, RADIO WAVES, ICE OPTICS, TRANSMISSIVITY, REFRACTIVITY, RADIATION ABSORPTION, COLD CHAMBERS, SIMULATION
The use of radars to study the geophysical features in a polar environment requires reliable information about the dielectric permittivity of ice at microwave and millimeter-wave frequencies. To address this requirement, ε (relative complex dielectric permittivity) of ice at millimeter wavelengths was obtained using an interference technique. The interference pattern was produced by measuring the transmittance through bubble-free ice slabs at normal incident angle as the frequency was swept from 75 to 110 GHz. From the resulting interference patterns, ε' was determined

to be 3.17 and virtually independent of frequency.

MP 5031
EXPLORATION OF INNOVATIVE RADAR SENSING SCHEMES FOR SUBSURFACE OBJECT DETECTION.
O'Neill, K., International Geoscience and Remote Sensing Symposium, Singapore, Aug. 3-8, 1997. IGARSS'97. Remote sensing—a scientific vision for sustainable development. Vol.3, New York, Institute of Electrical and Electronics Engineers, 1997, p.1135-1137, 2 refs.
52-1115
MINES (ORDNANCE), ELECTROMAGNETIC PROSPECTING, SUBSURFACE INVESTIGATIONS, RADIO ECHO SOUNDINGS, RADAR ECHOES, ENVIRONMENT SIMULATION, STATISTICAL ANALYSIS
The problem of abandoned landmines and unexploded ordnance is particularly acute when these objects are near the surface, so that their radar returns cannot easily be separated from the ground surface response. To address this, the author pursues simulations here designed to test methods of sensor deployment and data processing that exploit angular, positional, and frequency diversity for detection of metallic targets that are on the order of the subsurface wavelength in size. Rigorous 2-D computations were performed and results processed for the angular correlation function (ACF) approach, in which one performs a coherent average of received signals from two incidence and observation angles. Simulations pursue the behavior of the ACF under realistic ground roughness and moisture content, target geometry, and highest practical resolution GPR frequencies. To achieve an expanded ensemble of cases, given a single subject ground surface, the author averages both over frequencies and overlapping incident beam locations.

MP 5032
RADAR DETECTION OF NEAR-SURFACE BURIED METALLIC REFLECTORS IN WET SOIL.
O'Neill, K., International Geoscience and Remote Sensing Symposium, Singapore, Aug. 3-8, 1997. IGARSS'97. Remote sensing—a scientific vision for sustainable development. Vol.3, New York, Institute of Electrical and Electronics Engineers, 1997, p.1288-1290, 4 refs.
52-1119
MINES (ORDNANCE), ELECTROMAGNETIC PROSPECTING, SUBSURFACE INVESTIGATIONS, RADIO ECHO SOUNDINGS, RADAR ECHOES, STATISTICAL ANALYSIS
For ground penetrating radar (GPR) sensing, with antennas positioned safely or conveniently above the surface, one must contend with the ground surface reflection as well as reflections from targets sought below it. Employing low enough frequencies to penetrate moist soil means resolution that will often not allow one to distinguish the surface from target return. New measurements at CRREL were analyzed using innovative methods to successfully reveal buried mine and mine-like targets in wet, rocky soil. With broad band short pulse illumination, one method used a simple model that predicted the expected waveforms when surface and target echoes interacted. The other method treated the same cases but proceeds from the observation that the total overlapping surface plus target return is distended in time relative to a reflection from the surface alone. By processing to define and isolate cumulative energy return over time, one could distinguish cases in which targets lay just below the surface. Both methods were successful with moist loamy soil. Performance of the second approach was also good in an extreme case, when seasonal effects were exploited.

MP 5033
ANALYSIS OF WEATHER AND AVALANCHE RECORDS FROM ALTA, UTAH AND MAMMOTH MOUNTAIN, CALIFORNIA USING CLASSIFICATION TREES.
Davis, R.E., Elder, K., Howlett, D., Bouzaglou, E., International Snow Science Workshop, Banff, Canada, Oct. 6-11, 1996. Proceedings, Banff, ISSW Committee, 1996, p.14-18, 6 refs.
52-1144
AVALANCHE MECHANICS, CLIMATIC FACTORS, AVALANCHE FORMATION, DATA PROCESSING, AVALANCHE FORECASTING, WIND FACTORS, SNOW DEPTH, UNITED STATES—UTAH—ALTA, UNITED STATES—CALIFORNIA—MAMMOTH MOUNTAIN

MP 5034
OBSERVATIONS ON BURIED SURFACE HOAR—PERSISTENT FAILURE PLANES FOR SLAB AVALANCHES IN BRITISH COLUMBIA, CANADA.
Davis, R.E., Jamieson, B., Hughes, J., Johnston, C., International Snow Science Workshop, Banff, Canada, Oct. 6-11, 1996. Proceedings, Banff, ISSW Committee, 1996, p.81-85, 14 refs.
52-1157
AVALANCHES, DEPTH HOAR, METAMORPHISM (SNOW), SNOW STRENGTH, SHEAR STRENGTH, SNOW SLIDES, CANADA—BRITISH COLUMBIA
To relate shear strength of buried surface hoar to metamorphic changes, prominent layers of surface hoar buried on Jan. 7, 1995 and Dec. 28, 1995 in the Cariboo Mountains of British Columbia were sampled for section plane analysis, tested with shear frame and photographed approximately every ten days for two months. Initially both layers were very unstable and were the failure planes for many dry slab avalanches. The photographs and section planes show the metamorphic changes associated with the changes in strength and stability during the winter. Initially, well-developed surface hoar provides an "umbrella" effect, effectively preventing subsequent snowfall particles from contacting (and sintering to) the underlying layer. For a strengthening layer, preliminary results show that the surface hoar crystals growing larger bonds to the grains below, while the overall thickness of the surface hoar layer decreases.

MP 5035
CREEP AND FAILURE OF ALPINE SNOW: MEASUREMENTS AND OBSERVATIONS.
Conway, H., Breyfogle, S., Johnson, J.B., Wilbour, C., International Snow Science Workshop, Banff, Canada, Oct. 6-11, 1996. Proceedings, Banff, ISSW Committee, 1996, p.107-112, 24 refs.
52-1163
SNOW CREEP, AVALANCHE MECHANICS, AVALANCHE FORECASTING, AVALANCHE TRIGGERING, SLOPE PROCESSES, SNOW SLIDES, RAIN
The authors investigated the creep behavior of alpine snow in an effort to help understand and predict the timing of avalanche release. Measurements of motion of glide shoes buried within a natural snowpack show strains within low density snow are typically large. The rate of deformation increases with temperature and is especially rapid in the presence of liquid water. Creep rates decrease rapidly as the snow densifies. The slope-parallel shearing component of motion is much smaller than expected from the usual constitutive assumptions for snow. Even when snow is first wetted and on slopes up to 36°, the resultant direction of motion is typically close to vertical. They explain this apparently anomalous behavior by considering the effects of metamorphic processes and "capillary strain" (when liquid water is present) which cause deformation independently of gravity. The authors discuss how capillary induced shrinkage at the surface might alter the distribution of stress through the slab sufficiently to cause existing zones of deficit to extend in length. A rain induced surface alteration occurs rapidly over a wide region and has the potential to perturb all existing zones of deficit simultaneously, thereby increasing the possibility of slope failure. The analysis predicts slope failure is more likely if the overlying slab is thin and the stability is already close to critical. Field observations of behavior at the onset of rain support this prediction.

MP 5036
MESOSCALE SIMULATION OF THE ARCTIC ICE PACK.
Hopkins, M.A., ACSYS Conference on the Dynamics of the Arctic Climate System, Göteborg, Sweden, Nov. 7-10, 1994. Proceedings. Edited by P. Lemke, L. Anderson, R. Barry, and V. Vuglinskii, Geneva, Switzerland, World Meteorological Organization, 1996, p.300-303, 6 refs.
52-1266
SEA ICE, ICE COVER THICKNESS, ICE MODELS, SIMULATION

MP 5037
INTERACTION OF SOLAR RADIATION WITH SUMMER SEA ICE.
Perovich, D.K., Tucker, W.B., ACSYS Conference on the Dynamics of the Arctic Climate System, Göteborg, Sweden, Nov. 7-10, 1994. Proceedings. Edited by P. Lemke, L. Anderson, R. Barry, and V. Vuglinskii, Geneva, Switzerland, World Meteorological Organization, 1996, p.322-326, 13 refs.
52-1270
SOLAR RADIATION, SEA ICE, ALBEDO, MELTWATER, ICE MELTING, ABSORPTION

MP 5038
RELATING ARCTIC PACK ICE STRESS AND STRAIN AT THE 10KM SCALE.
Richter-Menge, J.A., Elder, B.C., Overland, J.E., Salo, S., ACSYS Conference on the Dynamics of the Arctic Climate System, Göteborg, Sweden, Nov. 7-10, 1994. Proceedings. Edited by P. Lemke, L. Anderson, R. Barry, and V. Vuglinskii, Geneva, Switzerland, World Meteorological Organization, 1996, p.327-331, 10 refs.
52-1271
SEA ICE, PACK ICE, STRESS STRAIN DIAGRAMS, ICE DEFORMATION, ICE MODELS

MP 5039
MELT POND EVOLUTION ON SUMMER SEA ICE.
Tucker, W.B., Perovich, D.K., ACSYS Conference on the Dynamics of the Arctic Climate System, Göteborg, Sweden, Nov. 7-10, 1994. Proceedings. Edited by P. Lemke, L. Anderson, R. Barry, and V. Vuglinskii, Geneva, Switzerland, World Meteorological Organization, 1996, p.342-346, 4 refs.
52-1274
SEA ICE, ICE COVER, ICE MELTING, MELTWATER, ICE COVER EFFECT, RADIATION ABSORPTION, ALBEDO, AIR ICE WATER INTERACTION

MP 5040
POLARIMETRIC BACKSCATTER FROM FRESH AND METAMORPHIC SNOWCOVER AT MILLIMETER WAVELENGTHS.
Chang, P.S., Mead, J.B., Knapp, E.J., Sadowy, G.A., Davis, R.E., McIntosh, R.E., *IEEE transactions on antennas and propagation*, Jan. 1996, 44(1), p.58-73, 31 refs.
52-1357
SNOW COVER STRUCTURE, MICROSTRUCTURE, CLASSIFICATIONS, ANISOTROPY, METAMORPHISM (SNOW), GRAIN SIZE, REMOTE SENSING, RADAR ECHOES, BACKSCATTERING, POLARIZATION (WAVES), SNOW OPTICS, BACKSCATTERING, MATHEMATICAL MODELS
This paper presents polarimetric radar backscatter data from snowcover. It compares measured backscatter data with detailed *in situ* measurements of the snowcover including microstructural anisotropies within the snowpack. Observations of backscatter were made during melt-freeze cycles, and measurable differences in the normalized radar cross section between older metamorphic snow and fresh low-density snow were observed. A simple backscatter model based on measured particle size and anisotropy is found to predict the Mueller matrix for dry snowcover with reasonable accuracy.

MP 5041
ANTI-ICING: LOWER THE COST OF SAFER ROADS. *Public works*, July 1997, 128(8), p.46-47, Excerpted from 50-6060.
51-5039
ROAD MAINTENANCE, WINTER MAINTENANCE, ROAD ICING, ICE PREVENTION, ICE CONTROL, COLD WEATHER OPERATION, LOGISTICS, MANUALS

MP 5042
ANTI-ICING: LOWER THE COST OF SAFER ROADS, PART 2. *Public works*, Aug. 1997, 128(9), p.44-46, Excerpted from 50-6060. For part 1, see 51-5039.
52-730
ROAD ICING, WINTER MAINTENANCE, COLD WEATHER OPERATION, SNOW REMOVAL, SALTING, CHEMICAL PROPERTIES, MODIFICATION, LOGISTICS, CLASSIFICATIONS, WEATHER FORECASTING, MANUALS

MP 5043
ANTI-ICING: LOWER THE COST OF SAFER ROADS, PART 3. *Public works*, Sep. 1997, 128(10), p.72-74., Excerpted from 50-6060. For part 1, see 51-5039; for part 2, see 52-730.
52-731
ROAD ICING, ICE CONTROL, ICE PREVENTION, SALTING, COLD WEATHER OPERATION, SNOW REMOVAL EQUIPMENT, COLD WEATHER PERFORMANCE, METEOROLOGICAL FACTORS, FORECASTING, COST ANALYSIS

MP 5044
TRANSITION FROM FORCED TO FREE CONVECTION.
Andreas, E.L., Cash, B.A., Symposium on Boundary Layers and Turbulence, 12th, Vancouver, British Columbia, July 28-Aug. 1, 1997. Preprints, Boston, American Meteorological Society, 1997, p.32-33, 9 refs.
52-1399
ICE OPENINGS, POLYNYAS, ICE HEAT FLUX, AIR ICE WATER INTERACTION, ATMOSPHERIC BOUNDARY LAYER, CONVECTION

MP 5045
FROZEN PATTERNS OF BOUNDARY LAYER TURBULENCE.
Treviño, G., Andreas, E.L., Symposium on Boundary Layers and Turbulence, 12th, Vancouver, British Columbia, July 28-Aug. 1, 1997. Preprints, Boston,

American Meteorological Society, 1997, p.196-197.
52-1400
ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENCE, MATHEMATICAL MODELS

MP 5046
MODELING THE ROLE OF SEA SPRAY ON AIR-SEA HEAT AND MOISTURE EXCHANGE.
Edson, J.B., Andreas, E.L., Symposium on Boundary Layers and Turbulence, 12th, Vancouver, British Columbia, July 28-Aug. 1, 1997. Preprints, Boston, American Meteorological Society, 1997, p.490-491, 6 refs.
52-1401
MARINE ATMOSPHERES, ATMOSPHERIC BOUNDARY LAYER, AIR WATER INTERACTIONS, SEA SPRAY, HEAT FLUX, MOISTURE TRANSFER

MP 5047
DEVELOPING IMPROVED PLANT MATERIALS AND APPROPRIATE SEED MIXTURES FOR ARID, COLD TRAINING LANDS.
Jensen, K.B., et al, Land Rehabilitation and Maintenance (LRAM)/Integrated Training Area Management (ITAM) Workshop, 5th, LaCrosse, WI, Aug. 1996. Proceedings, Stevens Point, University of Wisconsin, College of Natural Resources, [1996], p.79-84.
52-1402
MILITARY FACILITIES, SOIL EROSION, SOIL CONSERVATION, LAND RECLAMATION, REVEGETATION, PROTECTIVE VEGETATION, INTRODUCED PLANTS, PLANT ECOLOGY, GRASSES
Research was initiated in 1994 to establish a broad genetic base to aid in the development of improved native and introduced grasses and forbs that are capable of providing plant cover and stabilizing highly erodible sites disturbed by heavy military use and to develop appropriate seed mixtures based on the soil type, annual precipitation, and type of military training taking place. Specific objectives include improved establishment, recovery, and persistence under infertile and compacted soils as well as drought and cold temperatures. Broad-based evaluation trials are being conducted at two to three sites each at Fort Carson, CO and the U.S. Army Training Center at Yakima, WA. Extensive native plant collections (156 collections from Ft. Carson and 119 collections from Yakima Training Center) were made during the summers of 1994 and 1995 at both training sites with emphasis on indigenous plants that are adapted to high use training areas.

MP 5048
REHABILITATION OF SANDY SOILS IN COLD REGIONS.
Palazzo, A.J., Zang, P., Cary, T.J., Land Rehabilitation and Maintenance (LRAM)/Integrated Training Area Management (ITAM) Workshop, 5th, LaCrosse, WI, Aug. 1996. Proceedings, Stevens Point, University of Wisconsin, College of Natural Resources, [1996], p.85-87, 7 refs.
52-1403
MILITARY FACILITIES, SANDS, SOIL EROSION, SOIL CONSERVATION, LAND RECLAMATION, REVEGETATION, PROTECTIVE VEGETATION, GRASSES
Sandy soils in cold regions are difficult to rehabilitate due to their low moisture and nutrient holding capacities, the short growing season, and the drying effects of winds. A series of research studies were conducted on sandy soils at Fort Drum to develop techniques to obtain a vegetative cover that is quick to establish, long lasting, and of low maintenance. The results show that suitable species are available for reseeding these soils, but there are restrictions in terms of seeding season, time required for establishment, and length of persistence.

MP 5049
IMPROVED SOIL EROSION PREDICTION ON COLD REGIONS MILITARY TRAINING LANDS.
Gatto, L.W., Palazzo, A.J., Nissen, P., Land Rehabilitation and Maintenance (LRAM)/Integrated Training Area Management (ITAM) Workshop, 5th, LaCrosse, WI, Aug. 1996. Proceedings, Stevens Point, University of Wisconsin, College of Natural Resources, [1996], p.157-161, Abstract and slide presentation only.
52-1404
MILITARY FACILITIES, SOIL EROSION, FROST ACTION, SOIL CONSERVATION
Military land managers need soil erosion prediction capability to make management decisions on training land capacity and use, and improve soil erosion control. However, data on past patterns cannot necessarily be used as predictors of future erosion because precipitation, runoff erosivity, land use and soil erodibility change with time. The Revised Universal Soil Loss Equation (RUSLE) and the Water Erosion Prediction Project (WEPP) are presently used to predict soil erosion on non-military, low maintenance lands, but CRREL's initial RUSLE and WEPP simulations suggest that the models are currently not configured for use on training lands. They do not account for changes in water runoff and soil erodibility induced by soil freeze-thaw processes and by vehicular and foot trafficking during maneuvers, but it was determined they can be modified to do so with appropriate data.

MP 5050
FREEZE-THAW DURABILITY OF COMMON ROOF INSULATIONS.
Tobiasson, W., Young, B., Greatorex, A., International Symposium on Roofing Technology, 4th, Sep. 17-19, 1997. Proceedings. Challenges of the 21st century, Rosemont, IL, National Roofing Contractors Association, 1997, p.352-359, 11 refs.
52-1405
ROOFS, THERMAL INSULATION, VAPOR BARRIERS, WATERPROOFING, FROST PROTECTION, FROST RESISTANCE, COLD WEATHER CONSTRUCTION, FREEZE THAW TESTS
Specimens of extruded and expanded polystyrene, polyurethane, polyisocyanurate, sprayed polyurethane, phenolic, fibrous glass, cellular glass, lightweight concrete, fiberboard, perlite, and cork insulation were frozen in air and thawed in water up to 948 times. Their moisture contents were determined periodically, and relationships developed previously at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) were used to determine the effect of that moisture on their insulating ability. Most insulations became quite wet, which caused them to lose much of their insulating ability.

MP 5051
TWO NEW ROOF MOISTURE SENSOR TECHNOLOGIES.
Flanders, S.N., Yankielun, N.E., International Symposium on Roofing Technology, 4th, Sep. 17-19, 1997. Proceedings. Challenges of the 21st century, Rosemont, IL, National Roofing Contractors Association, 1997, p.360-367, 13 refs.
52-1406
ROOFS, WATERPROOFING, MOISTURE DETECTION, MOISTURE METERS
The authors have devised two prototype leak sensors for low-slope roofs that can both detect the presence of moisture in the roof material and identify the location of the wetted area. One uses flat, inexpensive cable and is ready for commercial development and the other uses inexpensive, autonomous passive sensors imbedded in the roof, which requires further development. Both are patent pending.

MP 5052
NEUTRON MOISTURE PROBE MEASUREMENTS OF FLUID DISPLACEMENT DURING IN SITU AIR SPARGING.
McKay, D.J., Acomb, L.J., *Ground water monitoring and remediation,* 1996, 16(4), p.86-94, 18 refs. For another version see 51-3170.
52-1436
LAND RECLAMATION, GROUND WATER, WATER POLLUTION, SOIL POLLUTION, HYDROCARBONS, AERATION, AIR FLOW, SOIL AIR INTERFACE, PROBES, MOISTURE DETECTION, WELLS, AIR FLOW, SATURATION, ENVIRONMENTAL PROTECTION
Strawberry Point, AK is contaminated with gasoline- and diesel-range hydrocarbons in soil and ground water. An air sparging system was installed to promote bioremediation in the zone of seasonal ground water fluctuation where the contaminant is concentrated. Neutron probe borehole measurements of percentage of fluid displacement during sparging at two wells revealed dynamic air distributions defined by an initial and relatively rapid expansion phase followed by a consolidation phase. The observations at this site indicated that the effective region of influence is relatively small and that frequent pulsing is needed to optimize oxygen distribution.

MP 5053
ENHANCEMENT AND INHIBITION OF SOIL PETROLEUM BIODEGRADATION THROUGH THE USE OF FERTILIZER NITROGEN: AN APPROACH TO DETERMINING OPTIMUM LEVELS.
Walworth, J.L., Woolard, C.R., Braddock, J.F., Reynolds, C.M., *Journal of soil contamination,* 1997, 6(5), p.465-480, 23 refs.
52-1359
SOIL TESTS, ADMIXTURES, SOIL POLLUTION, SOIL MICROBIOLOGY, CRUDE OIL, DEGRADATION, SOIL WATER, SALINITY, WATER CONTENT, SIMULATION, ENVIRONMENTAL PROTECTION

MP 5054
CRREL TEACHES ARCTIC SURVIVAL.
Darling, M., *Engineer update,* Mar. 1995, 19(3), p.5.
52-1643
COLD WEATHER SURVIVAL, EDUCATION

MP 5055
SIMULATOR TESTS PAVEMENTS AT CRREL.
Darling, M., *Engineer update,* May 1997, 21(5), p.3.
52-1645
RESEARCH PROJECTS, VEHICLES, SIMULATION, PAVEMENTS, LOW TEMPERATURE TESTS, MECHANICAL TESTS, LOADS (FORCES), FROST ACTION, FREEZE THAW CYCLES

MP 5056
CRREL RESEARCHERS SAIL TO NORTH POLE.
Darling, M., *Engineer update,* Nov. 1994, 18(11), p.6.
52-1646
EXPLORATION, RESEARCH PROJECTS, OCEANOGRAPHIC SURVEYS, EXPEDITIONS, INTERNATIONAL COOPERATION, ARCTIC OCEAN, NORTH POLE

MP 5057
ICE RESEARCHER WINS COOL AWARD.
Darling, M., *Engineer update,* Oct. 1994, 18(10), p.11.
52-1647
RESEARCH PROJECTS, GLACIOLOGY

MP 5058
OPEN-TOP DESIGNS FOR MANIPULATING FIELD TEMPERATURE IN HIGH-LATITUDE ECOSYSTEMS.
Marion, G.M., et al, *Global change biology,* Dec. 1997, 3(Sup.1), p.20-32, 33 refs.
52-1866
TUNDRA CLIMATE, GLOBAL WARMING, ECOSYSTEMS, TUNDRA VEGETATION, ENVIRONMENTAL TESTS, AIR TEMPERATURE, TEMPERATURE MEASUREMENT, TEMPERATURE CONTROL, SIMULATION, STRUCTURES, DESIGN, PERFORMANCE
This paper examines the performance of 4 open-top chambers for altering temperature at 6 sites in the Arctic and Antarctic. Most of the heating effect was due to daytime warming above ambient. The mean daily temperatures at four arctic sites were generally increased by 1.2-1.8°C; at the antarctic site, mean daily soil temperatures were increased by +2.2°C. Wind speed had a generally negative impact on mean daily temperature. The effect of chambers on snow accumulation was variable. Selection of a passive temperature-enhancing system requires balancing the temperature enhancement desired against potential unwanted ecological effects. Open-top chambers alter temperature significantly and minimize most unwanted ecological effects; as a consequence, these chambers are a useful tool for studying the response of high-latitude ecosystems to warming. (Auth. mod.)

MP 5059
ARCTIC SOILS AND THE ITEX EXPERIMENT.
Marion, G.M., Bockheim, J.G., Brown, J., *Global change biology,* Dec. 1997, 3(Sup.1), p.33-43, 27 refs.
52-1867
TUNDRA SOILS, SOIL ANALYSIS, ARCTIC LANDSCAPES, ECOSYSTEMS, GLOBAL WARMING, SOIL CLASSIFICATION, CHEMICAL PROPERTIES, ORGANIC SOILS, SOIL WATER, GEOCHEMISTRY, NUTRIENT CYCLE
The objectives of this paper are broadly to examine arctic soils and specifically to examine soil properties at ITEX sites. The Arctic is dominated by cold, wet, shallow soils often characterized by surficial organic horizons. Seven of 11 soil taxonomic orders are present in the circumarctic and alpine zones of the ITEX Project. Soil organic matter is highly correlated to soil carbon, soil moisture, and soil nitrogen. Because of these vital roles, soil organic matter is a keystone that will influence the future response of arctic ecosystems to climate change.

MP 5060
CALCULATION OF DENSITIES OF AQUEOUS ELECTROLYTE SOLUTIONS AT SUBZERO TEMPERATURES.
Mironenko, M.V., Grant, S.A., Marion, G.M., *Journal of solution chemistry,* May 1997, 26(5), p.433-460, 30 refs.
52-1888
SOLUTIONS, SEA WATER FREEZING, DIELECTRIC PROPERTIES, ION DENSITY (CONCENTRATION), SOLUBILITY, TEMPERATURE EFFECTS, LOW TEMPERATURE TESTS, THERMODYNAMIC PROPERTIES, MATHEMATICAL MODELS, COMPUTER PROGRAMS
The authors developed a FORTRAN program based on the Pitzer equations to calculate densities of electrolyte solutions at subzero temperatures. Data from the published literature were used to

calculate the Pitzer-equation parameters and to evaluate model performance. Three approaches to estimating the molar volume of the solute at infinite dilution were evaluated: (1) extrapolation of apparent molar volumes to zero square-root ionic strength; (2) calculation with the Tanger and Helgeson model; and (3) global fit of the data in which the molar volume of the solute at infinite dilution was estimated along with the Pitzer-equation parameters. Pitzer-equation parameters estimated for subzero temperatures should be viewed as conditional until improved measurements of single-electrolyte solution densities at subzero temperatures are made.

MP 5061

USACRREL RIVER ICE GUIDE.

White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Jan. 1977, No.15, 2p.

52-1896

RIVER ICE, TERMINOLOGY

MP 5062

PREDICTION OF TEMPERATURE AND MOISTURE CHANGES IN PAVEMENT STRUCTURES.

Simonsen, E., Janoo, V.C., Isacsson, U., *Journal of cold regions engineering,* Dec. 1997, 11(4), p.291-307, 22 refs.

52-1900

PAVEMENTS, BITUMINOUS CONCRETES, PERMEABILITY, COLD WEATHER TESTS, FROST HEAVE, THAW WEAKENING, SETTLEMENT (STRUCTURAL), SOIL TEMPERATURE, WATER CONTENT, FREEZE THAW CYCLES, SIMULATION, MATHEMATICAL MODELS, FORECASTING

In this study, a coupled mass and heat transfer model, FROSTB, developed by the U.S. Army Cold Regions Research and Engineering Laboratory was tested and evaluated with respect to parameters critical to thaw weakening. With the main focus on soil moisture and temperature, the results were compared with data from an instrumented test road. The results indicate the soil temperature is predicted very well and soil moisture relatively well during freezing and thawing. Although a time lag was observed between observed and predicted start of thaw, the results suggest that the FROSTB model may serve as a good tool for many engineering purposes involving the freezing and thawing of pavement structures in cold regions.

MP 5063

PREDICTION OF PAVEMENT RESPONSE DURING FREEZING AND THAWING USING FINITE ELEMENT APPROACH.

Simonsen, E., Janoo, V.C., Isacsson, U., *Journal of cold regions engineering,* Dec. 1997, 11(4), p.308-324, 18 refs.

52-1901

PAVEMENTS, BITUMINOUS CONCRETES, SUBGRADES, THAW WEAKENING, FREEZE THAW CYCLES, SEASONAL FREEZE THAW, COLD WEATHER TESTS, LOADS (FORCES), DEFORMATION, COMPUTER PROGRAMS, STRUCTURAL ANALYSIS, FORECASTING

In this study, an initial attempt to implement a commercially available finite element code in an analysis procedure for pavements in seasonal frost areas is presented. The results, compared with data from an extensively instrumented test road, show that surface deflections and the relative change in pavement stiffness, indicated by the subgrade strength index, are predicted very accurately. Although a time lag between maximum measured and predicted surface deflection is observed during thawing, the procedure is found to be promising and further research is warranted.

MP 5064

FROST SUSCEPTIBILITY OF CRUSHED GLASS USED AS CONSTRUCTION AGGREGATE.

Henry, K.S., Morin, S.H., *Journal of cold regions engineering,* Dec. 1997, 11(4), p.326-333, 14 refs.

52-1902

CONSTRUCTION MATERIALS, AGGREGATES, MECHANICAL PROPERTIES, PAVEMENTS, ABRASION, FROST RESISTANCE, FROST PENETRATION, GRAIN SIZE, STANDARDS, MECHANICAL TESTS, DESIGN CRITERIA

The frost susceptibility for 100% glass cullet specimens and 30% by weight glass cullet-aggregate specimens was determined using ASTM D 5918. The cullet has negligible to very low frost susceptibility, and it did not increase the frost susceptibility of the aggregate. Based on a comparison of grain size distributions of the cullet and aggregates with the work of others, it is concluded that the material tested represents typical cullet for which other engineering properties have been determined; therefore, this information can be added to the current body of knowledge about the engineering properties of glass cullet.

MP 5065

PORTABLE ASPHALT STRESS AND STRAIN MEASURING DEVICE.

Walsh, M.R., *U.S. Patent Office. Patent,* Sep. 28, 1993, n.p., USP-5,248,200.

52-2037

PAVEMENTS, BITUMENS, THERMAL STRESSES, STRAIN MEASURING INSTRUMENTS, ROAD MAINTENANCE

MP 5066

TOWABLE ALL-TERRAIN SNOWPLOW. [Bogserbar snöplog för terrängkörning]

Walsh, M.R., *Sweden Patent Office. Patent,* June 23, 1997, n.p., No.9302987-4, In Swedish.

52-2038

SNOW REMOVAL EQUIPMENT, ALL TERRAIN VEHICLES, TRACKED VEHICLES, TRACTORS, ROAD MAINTENANCE

MP 5067

TRAILABLE SNOW PLOW FOR OFF ROAD USE.

Walsh, M.R., *U.S. Patent Office. Patent,* Sep. 21, 1993, n.p., USP-5,245,771.

52-2039

SNOW REMOVAL EQUIPMENT, ALL TERRAIN VEHICLES, TRACKED VEHICLES, TRACTORS, ROAD MAINTENANCE

MP 5068

DREDGING CONTAMINATED SEDIMENTS AT AN ACTIVE IMPACT RANGE: AN ORDNANCE AVOIDANCE SUCCESS.

Walsh, M.R., *U.S. Army Engineering and Support Center, Huntsville, AL. Ordnance and explosives environment newsletter,* Jan.-Mar. 1997, 4(1), p.4-5.

52-2048

MILITARY FACILITIES, EXPLOSIVES, SOIL POLLUTION, WATER POLLUTION, ESTUARIES, DREDGING, WASTE DISPOSAL, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON

MP 5069

COMPARISON OF ENVIRONMENTAL CHEMICAL RESULTS FOR SPLIT SAMPLES ANALYZED IN DIFFERENT LABORATORIES.

Grant, C.L., Jenkins, T.F., Mudambi, A.R., *Association of Official Analytical Chemists (AOAC) International. Journal,* 1997, 80(5), p.1129-1138, 10 refs.

52-2051

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS

Data comparisons were made for split or co-located samples analyzed in contract laboratories and quality assurance (QA) laboratories during environmental studies directed by the U.S. Army Corps of Engineers. Archived results were analyzed statistically as concentration ratios (contract laboratory/QA laboratory). Concentrations ratios were found to be lognormally distributed, and this was the model used for comparisons. For metals in soils and volatile organic compounds (VOCs) in groundwater, 10.2% of metal ratios in soils and 5.6% of VOC ratios in groundwater exceeded limits of 0.40-2.50. For VOCs, total petroleum hydrocarbons (TPHs), and explosives in soils, limits of 0.25-4.00 are suggested with the understanding that large improvements are badly needed. Even with these wide limits, approximately 42% of VOCs, 14% of TPHs, and 11% of explosives contract laboratory/QA laboratory ratios were outside these limits.

MP 5070

GUIDELINES FOR MAPPING VEGETATION ON MILITARY LANDS.

O'Neil, J., Hill, A., Campbell, M., Racine, C.H., Dubois, P., Woodson, W., Tri-Service Environmental Technology Workshop, St. Louis, MO, June 10-12, 1997. Proceedings, Aberdeen Proving Ground, MD, U.S. Army Environmental Center, 1997, p.123-127.

52-2052

MILITARY FACILITIES, SITE SURVEYS, VEGETATION PATTERNS, MAPPING, DATA PROCESSING

MP 5071

SAMPLING STRATEGY FOR SITE CHARACTERIZATION AT EXPLOSIVES-CONTAMINATED SITES.

Jenkins, T.F., et al, Tri-Service Environmental Technology Workshop, St. Louis, MO, June 10-12, 1997. Proceedings, Aberdeen Proving Ground, MD, U.S. Army Environmental Center, 1997, p.321-329, 6 refs.

52-2053

MILITARY FACILITIES, EXPLOSIVES, SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS

This study assessed sampling strategies for characterization of explosives-contaminated sites as impacted by substantial short- and mid-range spatial heterogeneity of analyte distribution. Soil samples were collected and analyzed individually and as composites by colorimetric and immunoassay-based on-site methods, as well as standard laboratory protocols. Short-range heterogeneity was assessed at 10 sampling sites on four installations contaminated with TNT, DNT, HMX, or ammonium picrate. Mid-range heterogeneity was investigated at an active antitank range contaminated with residues of HMX and TNT. In all cases, results from on-site analysis were compared with those from laboratory analysis to assess how well sites could be characterized using on-site methods. An active antitank range was characterized for explosives concentrations using a combination of "area-integrated" sampling, in-field sample homogenization, compositing to produce representative grid samples, and on-site analysis. The depth of contamination and the dimensions of sampling grids were determined using on-site methods. Overall this approach appears to be an efficient, cost-effective means of providing representative data for making remediation decisions at sites contaminated with residues of high explosives.

MP 5072

SCATTERING FROM GROOVE PATTERNS IN A PERFECTLY CONDUCTING SURFACE.

Schiavone, G.A., O'Neill, K., Paulsen, K.D., *Optical Society of America. Journal A,* Sep. 1997, 14(9), p.2212-2222, 28 refs.

52-2054

SCATTERING, BACKSCATTERING, RADAR ECHOES, POLARIZATION (WAVES), WAVE PROPAGATION, IMAGE PROCESSING, MATHEMATICAL MODELS

Electromagnetic scattering is investigated for assemblages of parallel open cavities recessed in a perfectly conducting ground plane. Cavities of a variety of shapes are treated, with cross-sectional dimensions of the order of one or two electromagnetic wavelengths. Under the assumption that the cavities form grooves of effectively infinite length, a two-dimensional analysis treats transverse incidence under both E- and H-polarized illumination (E and H fields parallel to groove axis, respectively). For the most part, any coupling between cavity responses on the surface produces negligible effects on far-field diffraction patterns, even when cavities are extremely close together and when induced currents flow between adjacent cavities. Thus one may usually construct diffraction patterns for assemblages of grooves by simply superposing responses calculated for each cavity in isolation. Despite possibly substantial differences among the individual scattering patterns from contributing cavities, regularly spaced arrangements of two or more cavities produced grating-type diffraction patterns. This allows inference of the distance between grooves, based on separation between the pattern's peaks and troughs.

MP 5073

SAMPLING ERROR ASSOCIATED WITH COLLECTION AND ANALYSIS OF SOIL SAMPLES AT EXPLOSIVES-CONTAMINATED SITES.

Jenkins, T.F., et al, Specialty Conference on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV, Jan. 29-31, 1997. Proceedings, Pittsburgh, Air & Waste Management Association, 1997, p.85-94, 8 refs.

52-2055

EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS

This study assessed short-range spatial heterogeneity of explosives concentrations in surface soils. Samples collected 61 cm apart were analyzed individually and as composites by both colorimetric on-site methods and standard laboratory protocols. Ten locations were sampled at four installations and the results were used to estimate the relative contributions of analytical and sampling error. The major contaminant at seven of the ten sampling locations was TNT while 2,4-DNT, HMX, and ammonium picrate were each the major contaminant at one of the other three. Results from colorimetric on-site analysis were in excellent agreement with laboratory results, particularly for TNT and HMX. Site characterization was substantially improved using a composite sampling strategy. Overall, characterization of explosives-contaminated sites using a combination of composite sampling, in-field sample homogenization, and on-site colorimetric analysis is an efficient method of obtaining accurate and precise results that are representative of the area sampled.

MP 5074

FIELD SCREENING OF SOILS CONTAMINATED WITH EXPLOSIVES USING ION MOBILITY SPECTROMETRY.

Atkinson, D.A., Crockett, A.B., Jenkins, T.F., Specialty Conference on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV, Jan. 29-31, 1997. Proceedings, Pittsburgh, Air & Waste Management Association, 1997, p.308-316, 3 refs.

52-2056

EXPLOSIVES, SOIL POLLUTION, SOIL CHEMISTRY,

SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS
This study involved the comparison of IMS screening with EPA's standard method for explosives, Method 8330. The U.S. Army Corps of Engineers provided a large number of soil samples that had been collected from three locations at each of three explosive contaminated installations. The samples had been dried, ground, homogenized and analyzed in duplicate by Method 8330. Duplicate two gram aliquots of these samples were extracted with 10 mL of acetone by shaking for three minutes, allowed to settle, then analyzed by IMS for Method 8330 compounds. Half of the extracts from one location have also been analyzed in duplicate by IMS for TNT. Results from TNT contaminated soils look extremely promising. Correlation between IMS and EPA Method 8330 results was very high (r=0.99). Based on these results, the intention is to further develop and evaluate IMS for simultaneously quantifying multiple analytes. IMS throughput and cost per sample makes it an attractive technique. The ultimate objective is to provide adequate validation data to EPA for inclusion of the method as a screening procedure in SW-846.

MP 5075
RAPID METHOD FOR ESTIMATING THE TOTAL CONCENTRATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL SAMPLES.
Hewitt, A.D., Lukash, N.J.E., Specialty Conference on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV, Jan. 29-31, 1997. Proceedings, Pittsburgh, Air & Waste Management Association, 1997, p.386-392, 10 refs.
52-2057
SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS
This report describes an on-site method of estimating the total concentration of volatile organic compounds (VOCs) in soil, relative to a site-specific 0.2 mg/kg standard. The purpose of this decision tool is to allow on-site sampling activities to incorporate the appropriate soil sample collection and handling protocols necessary for high- and low-level gas chromatography/mass spectrometry analysis. Combining rapid on-site analysis with sampling procedures that limit substrate disaggregation and exposure improves efforts to achieve site-representative estimates for vadose zone contamination.

MP 5076
PASSIVE SOIL VAPOR VERSUS GRAB SAMPLES FOR DETERMINING VOLATILE ORGANIC COMPOUND CONCENTRATIONS.
Hewitt, A.D., Specialty Conference on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV, Jan. 29-31, 1997. Proceedings, Pittsburgh, Air & Waste Management Association, 1997, p.393-397, 11 refs.
52-2058
SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS
The GORE-SORBER Module, a passive soil vapor method, and the mean of two colocated grab samples handled and analyzed using an in-vial method were compared for estimating volatile organic compound contamination in the near-surface vadose zone. The strong semi-log correlation between these two methods (r^2=0.944) and equally strong linear correlation for grab samples taken 15 cm apart (r^2=0.957) indicate a fairly homogeneous distribution existed for this contaminant, and that this passive soil vapor technology offers a promising means of estimating subsurface concentrations in locations where grab samples cannot be easily obtained.

MP 5077
UNEVALUATED SITE CHARACTERIZATION "TOOLBOX".
Stutz, M.H., Jenkins, T.F., Robitaille, G., Specialty Conference on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV, Jan. 29-31, 1997. Proceedings, Pittsburgh, Air & Waste Management Association, 1997, p.658-663.
52-2059
SOIL POLLUTION, SOIL TESTS, SOIL ANALYSIS, COST ANALYSIS
In todays economic environment, many facilities do not have the wherewithal to perform a traditional characterization in order to determine whether their site is contaminated. In addition, they may not have personnel with adequate knowledge as to what procedures to use or even the capability to determine what technologies are available. Many sites, either previously ignored or thought to be uncontaminated are now becoming subject to regulatory review, possibly as a result of changes in proposed use or reuse. With the tremendous advances in field portable technologies that can generate real-time measurement data as well as the development of innovative field analytical, sampling, and sample handling techniques, the tools are now available, or will soon be available, to allow for comparatively inexpensive site characterizations that meet regulatory requirements. The objective of this effort was to provide the procedures necessary to enhance a performer's ability to determine contamination in a cost effective manner. It takes the form of a series of steps that include: the performance of a preliminary assessment, the decision making process for selecting the appropriate options, the more detailed description of the options, and what to do with the results.

MP 5078
EFFECTS OF FROST ACTION ON COMPACTED CLAY BARRIERS.
Chamberlain, E.J., Erickson, A.E., Benson, C.H., Geoenvironment 2000: characterization, containment, remediation, and performance in environmental geotechnics. Vol.1. Geotechnical special publication, No.46, New York, American Society of Civil Engineers, 1995, p.702-717, 17 refs. Proceedings of a specialty conference, New Orleans, Feb. 24-26, 1995.
52-2060
WASTE DISPOSAL, LININGS, EARTH FILLS, CLAY SOILS, FROST ACTION, FROST RESISTANCE, FREEZE THAW TESTS, SOIL WATER MIGRATION, PERMEABILITY, SEEPAGE, COLD WEATHER PERFORMANCE
Laboratory tests were conducted to determine the effect of frost action on the hydraulic conductivity of soils from two compacted clay covers. Test specimens were taken from field test sections before, during, and after freezing and thawing. Hydraulic conductivity tests were conducted on laboratory prepared specimens before and after freeze-thaw cycling. Test results obtained using laboratory freeze-thaw permeameters showed large increases (three to four orders of magnitude) in the hydraulic conductivity of clay materials after freeze-thaw cycling. Flexible-wall permeameter tests performed on specimens cored during freezing and on block specimens taken after thawing showed similar increases. Hydraulic conductivities of specimens obtained with thin-wall tubes after thawing were less than one order of magnitude greater than those measured before thawing. Thin sections of frozen core materials showed ice lenses and ice-filled shrinkage cracks. Thin sections of the laboratory frozen specimens showed similar features but in a much finer, more differentiated soil structure. The discontinuities left by the ice lenses and the ice-filled shrinkage cracks are the cause for the large increase in hydraulic conductivity after thawing.

MP 5079
INFLUENCE OF STIFFNESS INCREASE ON A WAVY SINGLE FIBER COMPOSITE.
Dutta, P.K., Madhukar, M.S., International Conference on Composite Materials (ICCM), 11th, Gold Coast, Australia, July 14-18, 1997. Proceedings. Vol.4, 1997, p.623-632, 4 refs.
52-2061
COMPOSITE MATERIALS, TENSILE PROPERTIES, STRESS STRAIN DIAGRAMS, CRACKING (FRACTURING), LOW TEMPERATURE TESTS
Experiments were conducted by using composite specimens containing a single carbon fiber embedded in an epoxy matrix. The fibers were cast in curved geometries, and the specimens were loaded in tension. Increasing the tensile load on the single fiber-epoxy specimens broke the embedded fiber into small fragments. Specimens with higher matrix stiffness had long matrix cracks at the broken fiber ends, which were perpendicular to the fiber axis. These matrix cracks tend to propagate perpendicular to the fiber axis, increasing the composite's cold sensitivity. The major conclusions are as follows: 1) when fibers are wavy, they are not loaded to their full capacity because of premature interfacial debonding started by the interfacial shear stresses and the transverse tensile stresses. The transverse tensile stresses at the interface are not present in the straight fiber specimens. 2) At higher stiffness and lower toughness values, the matrix cracks emanating at the broken fiber ends make the composite weaker. These two sources lower the strength of unidirectional composites at low temperatures.

MP 5080
CREEP STUDY OF FRP COMPOSITE REBARS FOR CONCRETE.
Dutta, P.K., Hui, D., International Conference on Composite Materials (ICCM), 11th, Gold Coast, Australia, July 14-18, 1997. Proceedings. Vol.4, 1997, p.944-955, 36 refs.
52-2062
REINFORCED CONCRETES, COMPOSITE MATERIALS, POLYMERS, CREEP, STRAIN TESTS, LOW TEMPERATURE TESTS
Fiber-reinforced plastic (FRP) rebars, containing by volume about 55% E-glass fiber and about 45% thermoset resin, have been successfully applied as concrete reinforcement in many construction applications. However, creep, fatigue, and corrosion from alkaline environment of concrete are areas of concern for any large-scale application. In this investigation the creep study was limited to determine whether the commercially available FRP rebars would creep under a sustained tensile load over a wide range of temperatures: low temperature (-23°C, -10°F), room temperature (21°C, 70°F), and high temperature (49°C, 120°F). For the room temperature test, strain was measured for 1800 hours (75 days) and over this period the strain did not show any trend to continue to increase. The low temperature test was continued for 3,552 hours and again no discernible trend of increasing strain was observed. The high temperature test was performed for 3,792 hours (158 days), in which a very small trend of increasing strain could be observed.

MP 5081
EFFECTS OF COLD REGIONS ENVIRONMENT ON STRUCTURAL COMPOSITES.
Dutta, P.K., Hui, D., International Conference on Advanced Technology in Experimental Mechanics, Wakayama, Japan, 1997. Proceedings, Tokyo, Japan Society of Mechanical Engineers, 1997, p.61-64, 2 refs.
52-2063
COMPOSITE MATERIALS, POLYMERS, LOW TEMPERATURE TESTS, THERMAL STRESSES, COLD WEATHER CONSTRUCTION
Effects of cold regions environment on structural composites are discussed. Low temperature induces thermal stresses in the matrix and interfaces of polymer composites which may degrade its performance, durability, and reliability. Moisture absorption at room temperature has opposite effects but at subzero temperature may accelerate the degradation. The micromechanical processes involved are summarized, and a number of investigations to show these effects are briefly presented.

MP 5082
REDUCING DAMAGE TO LOW-VOLUME ROADS BY USING TRUCKS WITH REDUCED TIRE PRESSURES.
Kestler, M.A., Berg, R.L., Moore, T.L., *Transportation research record,* 1997, No.1589, p.9-18, 16 refs.
52-2064
PAVEMENTS, THAW WEAKENING, TIRES, HIGHWAY PLANNING, ROAD MAINTENANCE, COLD WEATHER OPERATION, COMPUTERIZED SIMULATION
Heavy-volume highways in seasonal frost areas are designed to resist the effects of spring thaw. However, timber access roads, county roads, and other low-volume roads with thin bituminous surfaces can be quite susceptible to pavement damage during midwinter- and spring-thaw periods. To reduce damage to low-volume roads, towns, cities, and states typically either post reductions in allowable load or completely prohibit hauling during damage-susceptible periods. Associated economic impact can be significant. To evaluate the effects of tire pressure on cumulative road damage, a mechanistic pavement design procedure developed by the U.S. Army Corps of Engineers for use in seasonal frost areas was used on a matrix of tire pressures, low-volume pavement cross sections, and environmental conditions. A series of computer simulations showed (a) trucks operating with conventional tire pressures can cause excessive damage, particularly in the form of cracking, to low-volume roads with thin bituminous surfaces during relatively short thaw periods; (b) pavement damage could be reduced substantially by restricting hauling to trucks operating with reduced tire pressures; and (c) there are "threshold" tire pressures under which only minimal damage occurs, even during critical spring thaw. These results could influence guidelines for hauling restrictions and, in turn, associated economics.

MP 5083
ARCTIC RESEARCH OF THE UNITED STATES, VOL.11, FALL/WINTER 1997.
Myers, C.E., ed, Haugh, J., ed, Cate, D.W., ed, Arlington, VA, National Science Foundation, 1997, 76p.
52-2080
RESEARCH PROJECTS, GEOPHYSICAL SURVEYS, POLAR ATMOSPHERES, ENVIRONMENTAL TESTS, CLIMATOLOGY, OCEANOGRAPHY, ORGANIZATIONS, LEGISLATION

MP 5084
PROCEEDINGS. VOLUME IV. ARCTIC/ POLAR TECHNOLOGY.
International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 15th, Florence, Italy, June 16-20, 1996, Nixon, W.A., ed, Sodhi, D.S., ed, Kennedy, K.P., ed, Yamaguchi, H., ed, Bugno, W., ed, New York, American Society of Mechanical Engineers, 1996, 123p., Refs. passim. For individual papers see 51-2189, and 52-2099 through 52-2112.
52-2098
ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE COVER STRENGTH, ICE ELASTICITY, ICE DEFORMATION, ICE BREAKING, ICE SOLID INTERFACE, OFFSHORE STRUCTURES

MP 5085
TIDEWATER TERMINUS DYNAMICS IN GLACIER BAY, ALASKA.
Hunter, L.E., *Ohio State University. Byrd Polar Research Center. BPRC report,* 1997, No.15, Calving glaciers. Edited by C.J. Van der Veen, p.85-94, 23 refs. Presented at a workshop, Feb. 28-Mar. 2,

1997.
52-2120
GLACIER SURVEYS, GLACIER OSCILLATION, GLACIER FLOW, GLACIER FRICTION, GLACIER BEDS, GLACIER TONGUES, CALVING, SEDIMENT TRANSPORT, MORAINES, UNITED STATES—ALASKA—GLACIER BAY
Asynchronous and complex behavior of glaciers with tidewater termini can often be attributed to the glacier's response to calving. Any external forcing that can cause the balance between the terminal ice flux and calving flux to shift can influence advance, retreat and stillstand phases. Recent studies in Glacier Bay, Alaska, document periods of terminus stabilization and moraine formation. In this paper, the recent histories of Grand Pacific and Muir glaciers are presented. Grand Pacific Glacier advanced through most of the last half century while Muir Glacier only recently stabilized after 100 years of retreat. Their dynamics appear unrelated to climatic forcing, but instead reflect internal adjustments to calving and glacier dynamics.

MP 5086
PROCEEDINGS. VOLUME IV. ARCTIC/ POLAR TECHNOLOGY.
International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 16th, and International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC), 14th, Yokohama, Japan, Apr. 13-17, 1997, Yamaguchi, H., ed, Izumiyama, K., ed, Sodhi, D.S., ed, Nixon, W.A., ed, Kitagawa, H., ed, New York, American Society of Mechanical Engineers, 1997, 478p., Refs. passim. For individual papers see 52-2154 through 52-2213.
52-2153
ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE SOLID INTERFACE, ICE COVER STRENGTH, ICE DEFORMATION, ICE BREAKING, ICE NAVIGATION, METAL ICE FRICTION, ICEBREAKERS, SHIPS, OFFSHORE STRUCTURES

MP 5087
FUTURE JOINT CONFERENCE.
Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 16th, and International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC), 14th, Yokohama, Japan, Apr. 13-17, 1997. Proceedings. Vol.4. Edited by H. Yamaguchi, K. Izumiyama, D.S. Sodhi, W.A. Nixon, and H. Kitagawa, New York, American Society of Mechanical Engineers, 1997, p.1, Abstract only.
52-2154
RESEARCH PROJECTS, ORGANIZATIONS, INTERNATIONAL COOPERATION, MEETINGS, ICE MECHANICS

MP 5088
BULK SALINITY OF ARCTIC AND ANTARCTIC SEA ICE VERSUS THICKNESS.
Kovacs, A., International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 16th, and International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC), 14th, Yokohama, Japan, Apr. 13-17, 1997. Proceedings. Vol.4. Edited by H. Yamaguchi, K. Izumiyama, D.S. Sodhi, W.A. Nixon, and H. Kitagawa, New York, American Society of Mechanical Engineers, 1997, p.271-281, 84 refs.
52-2188
SEA WATER FREEZING, ICE WATER INTERFACE, ICE STRUCTURE, ICE COMPOSITION, ICE GROWTH, ICE COVER THICKNESS, ICE SALINITY, CORE SAMPLERS, BRINES, MATHEMATICAL MODELS, STATISTICAL ANALYSIS
Mathematical expressions have been established for estimating the bulk salinity of arctic and antarctic sea ice vs. ice floe thickness. The ice salinity vs. thickness relationships are based on data for over 400 sea ice cores compiled from numerous sources. The results show that the bulk salinity of first-year sea ice decreases in an exponential trend with ice sheet thickness. A similar trend reoccurs as the winter ice passes through the melt season. The expression for the bulk salinity S_B in per mill for first-year sea ice from 10 to 200 cm thick is $S_B=4.606 + 91.603/T_F$, where T_F is the ice floe thickness in centimeters. (Auth.)

MP 5089
CORRELATION OF ICE CRUSHING FORCES IN SEGMENTS OF AN INDENTOR.
Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 16th, and International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC), 14th, Yokohama, Japan, Apr. 13-17, 1997. Proceedings. Vol.4. Edited by H. Yamaguchi, K. Izumiyama, D.S. Sodhi, W.A. Nixon, and H. Kitagawa, New York, American Society of Mechanical Engineers, 1997, p.423-430, 22 refs.
52-2207
ICE SOLID INTERFACE, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE BREAKING, PENETRATION TESTS, IMPACT TESTS, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS, STATISTICAL ANALYSIS
Indentation tests were conducted by pushing segmented indentors into the edges of freshwater ice sheets at different velocities. Ice crushing forces were measured independently in each segment. The results of these tests indicate that there is simultaneous generation of forces on all segments during low-velocity indentation, whereas there is a non-simultaneous force acting on the segments during high-velocity indentation. For brittle crushing of ice at a high indentation rate, the effective pressures measured during these tests are in the range of pressures measured in the field during the impact of ice floes against large structures. Under the assumption that the size of crushing zones becomes small with increasing indentation speed, a statistical model is used to determine the correlation between the forces measured in different segments in terms of a correlation length parameter. Comparing the trends in the plots of experimental data with theoretical results shows that the correlation length parameter decreases as the reciprocal of the indentation velocity. Under the assumption of the similarity principle, according to replica modeling, an estimate of the correlation length parameter is empirically obtained in terms of ice thickness and indentation velocity.

MP 5090
ELECTRIC HEATING SYSTEMS FOR COMBATING ICING PROBLEMS ON METAL ROOFS.
Buska, J., Tobiasson, W., Greatorex, A., Fyall, W., International Symposium on Roofing Technology, 4th, Sep. 17-19, 1997. Proceedings. Challenges of the 21st century, Rosemont, IL, National Roofing Contractors Association, 1997, p.153-162, 6 refs.
52-2239
BUILDINGS, ROOFS, ICICLES, ICE PREVENTION, SNOW MELTING, ARTIFICIAL MELTING, ELECTRIC HEATING, VENTILATION, DRAINAGE, COLD WEATHER CONSTRUCTION
Icicles and ice dams may develop on metal roofs that drain to cold eaves. Meltwater that backs up behind such icings may leak into buildings, causing serious damage. Large icings are also a safety hazard. Electric heating systems may be needed to provide a path for meltwater to drain safely off such roofs.

MP 5091
DIURNAL THERMAL CYCLING EFFECTS ON MICROWAVE SIGNATURES OF THIN SEA ICE.
Nghiem, S.V., et al, *IEEE transactions on geoscience and remote sensing*, Jan. 1998, 36(1), p.111-124, 31 refs.
52-2336
SEA ICE, SURFACE PROPERTIES, REMOTE SENSING, RADAR ECHOES, INSOLATION, SALINITY, ICE GROWTH, DIURNAL VARIATIONS, MICROWAVES, BACKSCATTERING, BRIGHTNESS, SIMULATION
An experiment to investigate effects of diurnal thermal cycles on C-band polarimetric backscatter and millimeter-wave emission from sea ice was carried out at the outdoor Geophysical Research Facility in the Cold Regions Research and Engineering Laboratory. The ice sheet grew from open sea water to a thickness of 10 cm in 2.5 days. Polarimetric backscatter data was taken with a C-band scatterometer, interlaced with brightness temperature measurements at 90 GHz in conjunction with meteorological and sea ice characterizations. Ice temperature profiles clearly showed the diurnal response in the ice sheet with a lag of 2.5 h behind the time of the maximum short-wave incident solar radiation. The diurnal cycles in backscatter indicated that the dominant scattering mechanism related to thermodynamic processes in sea ice is reversible. This work shows that diurnal effects are important for inversion algorithms to retrieve sea ice geophysical parameters from remote sensing data acquired with a satellite synthetic aperture radar or scatterometer on sun-synchronous orbits.

MP 5092
ELECTROMAGNETIC SCATTERING CALCULATED FROM PAIR DISTRIBUTION FUNCTIONS RETRIEVED FROM PLANAR SNOW SECTIONS.
Zurk, L.M., Tsang, L., Shi, J.C., Davis, R.E., *IEEE transactions on geoscience and remote sensing*, Nov. 1997, 35(6), p.1419-1428, 29 refs.
52-2468
REMOTE SENSING, SNOW PHYSICS, MICROSTRUCTURE, SCATTERING, PARTICLES, AGGREGATES, PARTICLE SIZE DISTRIBUTION, ANALYSIS (MATHEMATICS), STATISTICAL ANALYSIS, SIMULATION
Electromagnetic wave scattering in dense media, such as snow, depends on the three-dimensional (3-D) pair distribution function of particle positions. In snow, two-dimensional (2-D) stereological data can be obtained by analyzing planar sections. In this paper, the volume 3-D pair distribution functions are calculated from the 2-D stereological data by solving Hanisch's integral equation. Monte Carlo simulations for multisize particles are used to verify the procedure. The procedure is also applied to available planar snow sections. A family of 3-D pair distribution functions are derived and substituted into dense media scattering theory to calculate scattering. The computed scattering rates are comparable to those calculated under the Percus-Yevick approximation of pair distribution functions of multiple sizes.

MP 5093
MODELING OF MILLIMETER WAVE BACKSCATTER OF TIME-VARYING SNOWCOVER—SUMMARY.
Shih, S.E., et al, *Journal of electromagnetic waves and applications*, Sep. 1997, 11(9), p.1289-1298, 18 refs.
52-2491
REMOTE SENSING, SNOW SURVEYS, SNOW COVER STRUCTURE, SNOW SURFACE TEMPERATURE, SNOW AIR INTERFACE, METAMORPHISM (SNOW), RADAR ECHOES, BACKSCATTERING, SIMULATION, MODELS
This paper applies a model of cohesive spherical particles to account for the clustering feature of snow grains, and takes into account the reflection and refraction at snow-snow interfaces by using appropriate boundary conditions, quadrature points and weights to solve the multilayer DMRT (dense medium radiation transfer) equations. A dynamic scattering model of snowcover, with a more realistic snow microstructure, based on DMRT and SNTHERM, is developed. This coupled model is then applied to enable the simulation of temporal radar response of snowcover under changing environmental conditions.

MP 5094
SCIENTISTS PARTICIPATE IN ARCTIC STUDY.
Perovich, D.K., *Engineer update*, Jan. 1998, 22(1), p.1.
52-2700
RESEARCH PROJECTS, DRIFT STATIONS, POLAR ATMOSPHERES, AIR ICE WATER INTERACTION, ICE COVER EFFECT, ICE HEAT FLUX, HEAT BALANCE

MP 5095
VISUAL-STRATIGRAPHIC DATING OF THE GISP2 ICE CORE: BASIS, REPRODUCIBILITY, AND APPLICATION.
Alley, R.B., Meese, D.A., Gow, A.J., Elder, B., *Journal of geophysical research*, Nov. 30, 1997, 102(C12), p.26,367-26,381, Refs. p.26,379-26,381.
52-2733
GLACIOLOGY, ICE SHEETS, ICE CORES, ICE DATING, ACCURACY, ICE STRUCTURE, STRATIGRAPHY, BUBBLES, DEPTH HOAR, BRITTLENESS, SEASONAL VARIATIONS, LABORATORY TECHNIQUES, GREENLAND—SUMMIT
Annual layers are visible in the Greenland Ice Sheet Project 2 ice core from central Greenland, allowing rapid dating of the core. Changes in bubble and grain structure caused by near-surface, primarily summertime formation of hoar complexes provide the main visible annual marker in the Holocene, and changes in "cloudiness" of the ice correlated with dustiness mark Wisconsinan annual cycles. Layer counts are reproducible between different workers and for one worker at different times, with 1% error over century-length times in the Holocene. Cumulative ages from visible stratigraphy are not significantly different from independent ages of prominent events for ice older than the historical record and younger than approximately 50,000 years.

MP 5096
GREENLAND ICE SHEET PROJECT 2 DEPTH-AGE SCALE: METHODS AND RESULTS.
Meese, D.A., et al, *Journal of geophysical research*, Nov. 30, 1997, 102(C12), p.26,411-26,423, 46 refs.
52-2736
PLEISTOCENE, ICE SHEETS, ICE CORES, ICE DATING, GLACIER THICKNESS, CORRELATION, STRATIGRAPHY, AEROSOLS, ISOTOPE ANALYSIS, THIN SECTIONS, ICE OPTICS, ACCURACY, GREENLAND—SUMMIT
The Greenland Ice Sheet Project 2 (GISP2) depth-age scale is presented based on a multiparameter continuous count approach using parameters never used to this extent. The ice is dated at 110,000 years B.P. with an estimated error ranging from 1-20%. Parameters used to date the core include visual stratigraphy, oxygen isotopic ratios of the ice, electrical conductivity measurements, laser-light scattering from dust, volcanic signals, and major ion chemistry. GISP2 ages for major climatic events agree with independent ages based on varve chronologies, calibrated radiocarbon dates, and other techniques within the combined uncertainties.

MP 5097
110,000-YEAR HISTORY OF CHANGE IN CONTINENTAL BIOGENIC EMISSIONS AND RELATED ATMOSPHERIC CIRCULATION INFERRED FROM THE GREENLAND ICE SHEET PROJECT ICE CORE.
Meeker, L.D., Mayewski, P.A., Twickler, M.S., Whit-

low, S.I., Meese, D.A., *Journal of geophysical research,* Nov. 30, 1997, 102(C12), p.26,489-26,504, 39 refs.
52-2741
PALEOCLIMATOLOGY, ATMOSPHERIC CIRCULATION, BIOMASS, PALEOECOLOGY, AEROSOLS, ICE SHEETS, ICE CORES, ION DENSITY (CONCENTRATION), ION DIFFUSION, INSOLATION, CORRELATION, STATISTICAL ANALYSIS, GREENLAND—SUMMIT
The 110,000-year record of ammonium concentrations from the Greenland Ice Sheet Project 2 (GISP) ice core provides the basis for an analysis of terrestrial biological production and atmospheric circulation patterns involved in the transport of biologically produced ammonium to the Greenland atmosphere. Analysis of the ammonium concentration series shows that maxima in background levels of ammonium in the Greenland atmosphere are strongly related to and synchronous with summer forcing associated with the precessional cycle of insolation. During warmer periods ammonium transport to Greenland is similar to present patterns. Under coldest conditions the low levels of ammonium transported to Greenland are the result of extreme southerly excursions of the predominantly zonal polar circulation. The rapid transitions (≈200 years) between these two climatic conditions appear to be associated with a critical volume or extent of the continental ice sheets.

MP 5098
PHYSICAL AND STRUCTURAL PROPERTIES OF THE GREENLAND ICE SHEET PROJECT 2 ICE CORE: A REVIEW.
Gow, A.J., Meese, D.A., Elder, B.C., *Journal of geophysical research,* Nov. 30, 1997, 102(C12), p.26,559-26,575, 32 refs.
52-2748
PALEOCLIMATOLOGY, PLEISTOCENE, ICE SHEETS, ICE CORES, ICE COMPOSITION, STRATIGRAPHY, PROFILES, BOTTOM ICE, ICE MICROSTRUCTURE, ICE DENSITY, ICE DENSITY, SEDIMENTS, DIFFUSION, THIN SECTIONS, PERMAFROST INDICATORS, GREENLAND—SUMMIT
Substantial data sets have been collected on the relaxation characteristics, density, grain size, *c* axis fabrics, and ultrasonic velocities of the Greenland Ice Sheet Project 2 (GISP2) core to its contact with bedrock at 3053.4 m. Changes in all these properties paralleled closely those found in cores from Byrd Station and Dye 3, Greenland. Beginning at about 2800 m, layers of coarse-grained ice intermixed with the much finer-grained matrix ice are observed. Below 3000 m the ice became very coarse grained. This change, attributed to annealing recrystallization at elevated temperatures in the ice sheet, was accompanied by a dispersed or ring-like redistribution of the *c* axes about the vertical. There is evidence that disturbed structure in the GISP2 cores begins little more than 70% of the way through the ice sheet. This disturbance increases with depth until it becomes large enough to cast suspicion on features lasting centuries or more in the bottom 10% of the ice sheet.

MP 5099
GRAIN-SCALE PROCESSES, FOLDING, AND STRATIGRAPHIC DISTURBANCE IN THE GISP2 ICE CORE.
Alley, R.B., Gow, A.J., Meese, D.A., Fitzpatrick, J.J., Waddington, E.D., Bolzan, J.F., *Journal of geophysical research,* Nov. 30, 1997, 102(C12), p.26,819-26,830, 44 refs.
52-2770
GLACIOLOGY, ICE SHEETS, DRILL CORE ANALYSIS, GLACIER FLOW, ICE MECHANICS, SHEAR STRESS, ICE DEFORMATION, ICE CRYSTAL STRUCTURE, ORIENTATION, THIN SECTIONS, STRATIGRAPHY, GREENLAND—SUMMIT
Flow disturbances have been shown to alter stratigraphic order in the lower part of the ice sheet in central Greenland. Vertical thin sections of the Greenland Ice Sheet Project 2 ice core show that in the lower 30%, the expected *c* axis-vertical fabric is interrupted by planes of grains ("stripes") with *c* axes oriented approximately in the dip directions of the planes. Stripe-parallel shear produces small-scale folds. The stripes can be explained qualitatively by a simple nucleation-and-growth model based on the strong anisotropy of ice-crystal deformation. Stripes are modeled to affect the ice viscosity, so variations in stripe density may contribute to viscosity contrasts that might produce larger deformational features and loss of stratigraphic order.

MP 5100
POLAR ENGINEERING TECHNOLOGY.
U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, June 1977, 14p.
52-2788
COLD WEATHER CONSTRUCTION, COLD WEATHER OPERATION, ORGANIZATIONS, RESEARCH PROJECTS, COST ANALYSIS

MP 5101
UNITED STATES COMMITMENT TO ARCTIC RESEARCH.
National Research Council. Polar Research Board. Ad Hoc Committee on Arctic Research Policy, Roederer, J.G., Johnson, P.L., Pierce, C.M., Roots, E.F., Washburn, A.L., Weeks, W.F., Washington, D.C., National Academy Press, 1982, 17p., 12 refs.
52-2832
RESEARCH PROJECTS, REGIONAL PLANNING, INTERNATIONAL COOPERATION

MP 5102
THERMAL ICE GROWTH: REAL-TIME ESTIMATION.
Daly, S.F., *Journal of cold regions engineering,* Mar. 1998, 12(1), p.11-28, 24 refs.
52-2926
LAKE ICE, ICE GROWTH, ICE COVER THICKNESS, ICE HEAT FLUX, ICE WATER INTERFACE, ICE AIR INTERFACE, MATHEMATICAL MODELS, FORECASTING, STATISTICAL ANALYSIS, ACCURACY, THERMAL CONDUCTIVITY, UNITED STATES—ALASKA—SNOWSHOE LAKE, UNITED STATES—NEW HAMPSHIRE—POST POND
The quasi-steady thermal ice growth model was recast in state-space form and used with the Kalman filter to estimate ice thickness and to recursively estimate the model parameters for thermal ice growth. The model was applied to two widely separated sites from which ice thickness measurements were available for a number of winters: Post Pond, NH, and Snowshoe Lake, AK. The parameters required by the Kalman filter were estimated through numerical experiments and were consistent between both locations. The Kalman filter was able to produce better results, as measured by a least-squares criterion, than a model using parameter values that had been determined using all data at each location.

MP 5103
LABORATORY TESTING TO EVALUATE CHANGES IN HYDRAULIC CONDUCTIVITY OF COMPACTED CLAYS CAUSED BY FREEZE-THAW: STATE-OF-THE-ART.
Othman, M.A., Benson, C.H., Chamberlain, E.J., Zimmie, T.F., Symposium on Hydraulic Conductivity and Waste Contaminant Transport in Soil, San Antonio, TX, Jan. 21-22, 1993. Edited by D.E. Daniel and S.J. Trautwein, Philadelphia, PA, American Society for Testing and Materials (ASTM), 1994, p.227-254, 35 refs. For another version see 48-1110.
52-2963
WASTE DISPOSAL, EARTH FILLS, CLAY SOILS, SOIL COMPACTION, LININGS, SOIL STABILIZATION, SOIL WATER MIGRATION, SEEPAGE, PERMEABILITY, FROST RESISTANCE, FREEZE THAW TESTS
Several laboratory studies have shown that the hydraulic conductivity of compacted clay may increase up to three orders of magnitude when subjected to freeze-thaw. In this paper, methods to freeze and thaw specimens of compacted clay are reviewed and compared. Methods to measure the hydraulic conductivity of the specimens are also reviewed. Only naturally formed clay soils are considered; soil-bentonite mixtures and other amended soils are not included. A review of testing conditions present during freeze-thaw and their effect on hydraulic conductivity is also included. Testing conditions that are addressed include availability of an external supply of water (closed vs. open system), dimensionality of freezing (one-dimensional vs. three-dimensional), rate of freezing, ultimate temperature, number of freeze-thaw cycles, and state of stress. The rate of freezing, number of freeze-thaw cycles, and state of stress appear to have the largest effect on hydraulic conductivity.

MP 5104
RAPID STABILIZATION OF THAWING SOILS: FIELD EXPERIENCE AND APPLICATIONS.
Shoop, S.A., Kestler, M.A., Stark, J.A., Ryerson, C.C., European ISTVS Conference, 7th, Ferrara, Italy, Oct. 8-10, 1997. Proceedings, Hanover, NH, International Society for Terrain-Vehicle Systems (ISTVS), 1997, p.69-76, 12 refs.
52-3020
GROUND THAWING, THAW WEAKENING, SOIL TRAFFICABILITY, SOIL STABILIZATION, SOIL CEMENT, LIMING, ROAD MAINTENANCE, MILITARY OPERATION
Thawing soils can severely restrict vehicle travel on unpaved surfaces. However, a variety of materials and construction techniques can be used to stabilize thawing soils to reduce immobilization problems. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) and the Wisconsin National Guard evaluated several stabilization techniques in a field demonstration project during spring thaw at Fort McCoy, WI, in 1995. Additional tests on chemical stabilizing techniques were conducted at CRREL in Hanover, NH. The results of these test programs were expressed as a decision matrix for stabilizing thawing ground, which was used during the deployment of U.S. troops in Bosnia during Jan. and Feb. of 1996. This paper is an overview of the stabilization work conducted by CRREL and its application. Although the experiments were performed with military vehicles in mind, the techniques are suitable for many civilian applications such as forestry, construction, mining, and oil exploration.

MP 5105
USING REDUCED TIRE PRESSURES TO REDUCE THAW DAMAGE TO LOW-VOLUME ROADS: BACKGROUND, DESIGN, CONSTRUCTION, AND DEMONSTRATION PROJECT TEST PLAN.
Kestler, M.A., International Symposium on Thin Pavements, Surface Treatments, and Unbound Roads, Fredericton, New Brunswick, June 24-25, 1997. Proceedings, Fredericton, University of New Brunswick, 1997, p.257-264, 12 refs.
52-3021
PAVEMENTS, THAW WEAKENING, TIRES, HIGHWAY PLANNING, ROAD MAINTENANCE, COLD WEATHER OPERATION, COMPUTERIZED SIMULATION
Low volume roads with thin bituminous surfaces are highly susceptible to damage during spring thaw. To reduce road damage, towns, cities and states typically post load restrictions. However, the resulting economic impact can be significant. The benefits of using reduced tire pressures to reduce damage to unsurfaced and gravel-surfaced low volume roads have been extensively investigated. Although similar work for bituminous-surfaced low volume roads has been limited, results look extremely promising. Using the U.S. Army Corps of Engineers mechanistic pavement design procedure for areas of seasonal frost, the U.S. Army Cold Regions Research and Engineering Laboratory computed cumulative pavement damage from trucks operating with variable tire pressures during spring thaw. Computer simulations showed that for thin pavements, using trucks with reduced tire pressures could significantly decrease damage to thin, bituminous-surfaced pavements and increase pavement life.

MP 5106
ATTIC VENTILATION GUIDELINES TO MINIMIZE ICINGS AT EAVES.
Tobiasson, W., Buska, J., Greatorex, A., *Interface,* Jan. 1998, 16(1), p.17-24, 8 refs.
52-3022
BUILDINGS, ROOFS, ICICLES, ICE PREVENTION, VENTILATION, COLD WEATHER CONSTRUCTION
In cold regions, icicles and ice dams may develop on roofs that slope to cold eaves. Ventilating the space below the snow-covered roof with outdoor air to create a "cold" ventilated roof is often an effective way to avoid such problems. Several buildings in northern New York were instrumented to determine how their attic temperature influenced icing. The authors observed that problematic icings developed very slowly, if at all, when the outside temperature was above 22°F. Such icings can be avoided by sizing natural, and if necessary, mechanical attic ventilation systems to maintain an attic temperature of 30°F when the outside temperature is 22°F.

MP 5107
SOIL MOISTURE STRENGTH PREDICTION MODEL VERSION II (SMSP II).
Sullivan, P.M., et al, *U.S. Army Waterways Experiment Station, Vicksburg, MS. Geotechnical Laboratory. Technical report,* Aug. 1997, GL-97-15, 104p., 49 refs.
52-3024
SOIL WATER, SOIL STRENGTH, SOIL TRAFFICABILITY, PRECIPITATION (METEOROLOGY), EVAPORATION, SNOW COVER EFFECT, FROST PENETRATION, THAW DEPTH, MATHEMATICAL MODELS, COMPUTER PROGRAMS
Soil strength is a crucial terrain parameter in the prediction of a vehicle's potential for immobilization. The Soil Moisture Strength Prediction Model Version II and its cold regions counterpart, the Cold Regions Soil Moisture Strength Prediction Model, were developed as first-generation models designed to accept a minimal set of weather and terrain data to make a prediction of soil strength based on soil moisture. This effort consolidates the myriad submodules available to process weather and terrain data into one system which allows users to have all of the necessary climatic and terrain data needed for any scenario. Additionally, these models incorporate default inference techniques to account for the absence of daily climatic records and the remote evaluation of site characteristics.

MP 5108
OBSERVATIONS IN NONURBAN HEAT ISLANDS.
Hogan, A.W., Ferrick, M.G., *Journal of applied meteorology,* Feb. 1998, 37(2), p.232-236, 9 refs.
52-3050
CLIMATOLOGY, SURFACE TEMPERATURE, PROFILES, TEMPERATURE VARIATIONS, TEMPERATURE MEASUREMENT, SNOW COVER EFFECT, LANDSCAPE TYPES, BUILDINGS, RIVER ICE, ICE GROWTH, ICE

HEAT FLUX, ENTHALPY, ICE AIR INTERFACE, ANALYSIS (MATHEMATICS), UNITED STATES—NEW HAMPSHIRE—HANOVER
A data field containing more than 100 individual winter morning air temperature measurement points was examined for areas characteristically warmer than surrounding areas. The very small "downtown" of Hanover, NH, was found to be 1-2°C warmer than nearby open areas at the same elevation. The same technique was applied to examine the morning air temperature within nearby hamlet consisting of about 60 wooden buildings. The bulk of observations and observations stratified by snow and sky cover showed no systematic difference between hamlet air temperatures and those obtained in surrounding terrain. Morning air temperatures along a freezing river were measured and found to be systematically warmer than nearby air temperatures for several days, until a significant snowfall diminished the ice growth rate. A thorough examination of temperature profiles near the river showed that the increase in air temperature beneath the overnight inversion during this freezing period was proportional to the heat release resulting from river ice growth.

MP 5109
RHIZOSPHERE AND NUTRIENT EFFECTS OF REMEDIATING SUBARCTIC SOILS.
Reynolds, C.M., Koenen, B.A., Carnahan, J.B., Walworth, J.L., Bhunia, P., International In Situ and On-site Bioremediation Symposium, 4th, New Orleans, LA, Apr. 28-May 1, 1997. Collected papers, Vol.1, Columbus, Battelle Press, 1997, p.297-302, 10 refs.
52-3174
SOIL POLLUTION, ATTENUATION, SUBARCTIC LANDSCAPES, HYDROCARBONS, SOIL MICROBIOLOGY, GRASSES, ROOTS, NUTRIENT CYCLE, ENVIRONMENTAL PROTECTION, SOIL TESTS, CHEMICAL ANALYSIS, SAMPLING, UNITED STATES—ALASKA
Increased microbial activity in rhizosphere soil may be useful in enhancing bioremediation rates and endpoints. Rhizosphere-based remediation systems would be inexpensive to implement and maintain, and applicable to remote or permafrost sites. Field data that compare rhizosphere-enhanced bioremediation rates to other alternatives are needed for evaluating the acceptability of rhizosphere-based treatment systems. A field study was conducted in Fairbanks, AK, to compare the effects of nutrients and vegetation on rhizosphere-enhanced bioremediation of soils contaminated with either diesel or crude oil. Replicate soil samples were taken prior to fertilization and seeding and at the end of the first growing season. Soil extracts were analyzed for total petroleum hydrocarbon by gas chromatography. The greatest total petroleum hydrocarbon reduction rates during the initial 54 days were from Annual Ryegrass and Arctared Fescue with nutrients.

MP 5110
GUIDANCE FOR SUCCESSFUL ANTI-ICING OPERATIONS BASED ON U.S. EXPERIENCE.
Blackburn, R.R., Ketcham, S.A., Minsk, L.D., *National Research Council. Transportation Research Board. Conference proceedings,* 1997, No.16, International Symposium on Snow Removal and Ice Control Technology, 4th, Reno, NV, Aug. 11-16, 1996. Selected papers, p.43.
52-3249
ROAD ICING, CHEMICAL ICE PREVENTION, SNOW REMOVAL, ROAD MAINTENANCE, MANUALS, UNITED STATES

MP 5111
ANTI-ICING FIELD EVALUATION.
Ketcham, S.A., Minsk, L.D., *National Research Council. Transportation Research Board. Conference proceedings,* 1997, No.16, International Symposium on Snow Removal and Ice Control Technology, 4th, Reno, NV, Aug. 11-16, 1996. Selected papers, p.44-52, 4 refs. For another source see 51-2733.
52-3250
ROAD ICING, CHEMICAL ICE PREVENTION, SALTING, SANDING, SNOW REMOVAL, SNOWSTORMS, ICE STORMS, RUBBER ICE FRICTION, RUBBER SNOW FRICTION, ROAD MAINTENANCE, MANUALS, UNITED STATES
Anti-icing is the snow and ice control practice of preventing the formation or development of bonded snow and ice by timely applications of a chemical freezing-point depressant. This definition derives from U.S. snow and ice control practice observed in anti-icing field evaluations for the Strategic Highway Research Program and FHWA. The FHWA project and the implications of its results for implementation of an anti-icing program are described. This definition and the diversity of operations that can lead to anti-icing success are the focus of this paper. A framework for communication and technology transfer among practitioners is provided to complement guidance contained in the project's manual of practice.

MP 5112
MODEL ALLOWS TESTING OF FROST SHIELDS FOR BURIED UTILITY LINES.
Coutermarsh, B.A., Pfaefflin, S.L., *APWA reporter,* Oct. 1997, 64(10), p.16-17.
52-3301
UTILITIES, WATER PIPELINES, UNDERGROUND PIPELINES, FROST PROTECTION, COVERING, THERMAL INSULATION, SOIL TEMPERATURE, FORECASTING, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION
Through the University of New Hampshire, the U.S. Army Cold Regions Research and Engineering Laboratory has developed a finite element program to aid in the design of frost shields. The program allows the shield designer to model almost any utility line and insulation configuration in most soils or rock materials under a variety of environmental temperature conditions, and to test several different insulation configurations and assess their effectiveness for existing environmental conditions.

MP 5113
ANALYSIS OF THERMAL IMAGERY COLLECTED AT YUMA 1, YUMA, ARIZONA.
Rivera, S., Jr., *U.S. Army Cold Regions Research and Engineering Laboratory. Smart Weapons Operability Enhancement Joint Test and Evaluation Program Office. SWOE report,* Aug. 1994, No.94-12, 89p. + appends., ADA-286 829, 8 refs.
52-3434
INFRARED RECONNAISSANCE, INFRARED PHOTOGRAPHY, TERRAIN IDENTIFICATION, ENVIRONMENT SIMULATION, IMAGE PROCESSING, MILITARY OPERATION, MILITARY RESEARCH, UNITED STATES—ARIZONA
The purpose of the Smart Weapons Operability Enhancement (SWOE) Joint Test and Evaluation Program is to validate the SWOE synthetic scene generation procedure. Once validated, this procedure will hopefully change the design-test-redesign approach to smart weapons development, test, and evaluation. Using the SWOE process, smart weapons designers will be able to evaluate their sensor algorithms on simulated scenes with a greater degree of variability than is often presented during the test phase of the design process. The SWOE process will also allow for the smart weapons design to be evaluated for different environments without the need for expensive and time-consuming data collection exercises. This report is an analysis of thermal data collected by the U.S. Army Engineer Waterways Experiment Station during the Yuma 1 field program exercise Mar. 15-Apr. 30, 1993. The report aids in understanding variations in terrain features' infrared signatures using image metrics and presents the data in a format that could be used for synthetic scene validation tasks. The report also describes in graphical format the meteorological and terrain data at the time the infrared imagery data were collected.

MP 5114
SUBGLACIAL ICE GROWTH, BASAL ACCRETION, AND DEBRIS ENTRAINMENT AT THE MATANUSKA GLACIER, ALASKA.
Strasser, J.C., Bethlehem, PA, Lehigh University, 1996, 137p., University Microfilms order No.9629382, Ph.D. thesis. Refs. passim. D.E. Lawson and S.A. Arcone of the U.S. Army Cold Regions Research and Engineering Laboratory, were among the coauthors of papers included as separate chapters.
52-3436
GLACIAL HYDROLOGY, SUBGLACIAL DRAINAGE, GLACIER BEDS, GLACIER ALIMENTATION, GLACIER ICE, ICE GROWTH, ICE ACCRETION, REGELATION, GLACIAL TILL, MORAINES, SEDIMENT TRANSPORT, UNITED STATES—ALASKA—MATANUSKA GLACIER

MP 5115
VARIATION OF SNOW COVER ABLATION IN THE BOREAL FOREST: A SENSITIVITY STUDY ON THE EFFECTS OF CONIFER CANOPY.
Davis, R.E., et al, *Journal of geophysical research,* Dec. 26, 1997, 102(D24), p.29,389-29,395, 30 refs.
52-3618
FOREST ECOSYSTEMS, FOREST CANOPY, RADIATION BALANCE, SOLAR RADIATION, SURFACE ENERGY, SNOW HYDROLOGY, SNOWMELT, SNOW AIR INTERFACE, TURBULENT EXCHANGE, SNOW COVER EFFECT, MODELS, VEGETATION FACTORS, WIND FACTORS, CANADA—MANITOBA—THOMPSON
Characteristics of conifer canopies exert important control on the energy exchange at the forest floor, which in turn controls snow cover processes such as melting. This analysis investigated the role of the conifer tree characteristics, including height and canopy density. Canopy and snow models estimated radiation incoming to the snow surface, the net energy budget of the snow, and melting rates of snow cover under conifer forests with different canopy density and tree height. Measurements during winter and thaw in 1994 of incoming solar and longwave radiation, humidity, and wind speed above the forest canopy provided input to the models, along with air temperature measured in the canopy. Results showed the importance of canopy density and tree height as the first-order controls on cumulative incoming solar radiation at the forest floor. The combined canopy and snow models showed a large range of snow ablation within conifers, which showed the trade-offs between canopy density and tree height.

MP 5116
SNOW ABLATION MODELING AT THE STAND SCALE IN A BOREAL JACK PINE FOREST.
Hardy, J.P., et al, *Journal of geophysical research,* Dec. 26, 1997, 102(D24), p.29,397-29,405, 34 refs.
52-3619
FOREST ECOSYSTEMS, FOREST CANOPY, SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOWMELT, SOLAR RADIATION, WATER BALANCE, SURFACE ENERGY, RADIATION BALANCE, SNOW WATER EQUIVALENT, SNOW AIR INTERFACE, VEGETATION FACTORS, MODELS
The purpose of this study is to predict spatial distributions of snow properties important to the hydrology and the remote sensing signatures of the boreal ecosystem. This study is part of the Boreal Ecosystems Atmosphere Study of central Saskatchewan and northern Manitoba. Forested environments provide unique problems for snow cover process modeling due to the complex interactions among snow, energy transfer, and trees. These problems are approached by coupling a modified snow process model with a model of radiative interactions with forest canopies. Additionally, a tree well model describes the influence of individual trees on snow distribution on the ground. Field data consisted of measured meteorological parameters above and within the canopy, spatial variability of snow properties, and variations of incoming solar irradiance beneath the forest canopy. Results show that the area beneath tree canopies accumulated 60% of the snow accumulated in forest openings. Peak solar irradiance on the snow cover was less than one half that measured above the canopy. Model runs are compared between the open and the forested sites.

MP 5117
ACCURACY OF NWS 8" STANDARD NONRECORDING PRECIPITATION GAUGE: RESULTS AND APPLICATION OF WMO INTERCOMPARISON.
Yang, D.Q., et al, *Journal of atmospheric and oceanic technology,* Feb. 1998, 15(1)pt.1, p.54-68, 36 refs.
52-3641
PRECIPITATION (METEOROLOGY), PRECIPITATION GAGES, STANDARDS, ACCURACY, RAIN, SNOW ACCUMULATION, WIND VELOCITY, PERFORMANCE, CORRELATION, STATISTICAL ANALYSIS, UNITED STATES—ALASKA—BARROW
The standard 8" nonrecording precipitation gauge has been used by the National Weather Service as the official precipitation measurement instrument of the U.S. climate station network. From 1986 to 1992, the accuracy and performance of this gauge were evaluated during the WMO Solid Precipitation Measurement Intercomparison at 3 stations in the U.S. and Russia, representing a variety of climate, terrain, and exposure. The double-fence intercomparison reference was the reference standard used at all the intercomparison stations in the Intercomparison project. The Intercomparison data collected at different sites are compatible with respect to the catch ratio for the same gauges, when compared using wind speed at the height of gauge orifice during the observation period. The effects of environmental factors, such as wind speed and temperature, on the gauge catch were investigated. Wind speed was found to be the most important factor determining gauge catch when precipitation was classified into snow, mixed, and rain. The regression functions of the catch ratio versus wind speed at the gauge height on a daily time step were derived for various types of precipitation. Independent checks of the equations have been conducted at these intercomparison stations and good agreement was obtained. Application of the correction procedures for wind, wetting loss, and trace amounts was made daily at Barrow, AK, for 1982 and 1983, and, on average, the gauge-measured precipitation was increased by 20% for rain and 90% for snow.

MP 5118
TOWARDS IMPROVING THE PHYSICAL BASIS FOR ICE-DYNAMICS MODELS.
Richter-Menge, J.A., *Annals of Glaciology,* 1997, Vol.25, International Symposium on Representation of the Cryosphere in Climate and Hydrological Models, Victoria, British Columbia, Aug. 12-15, 1996. Papers. Edited by J.E. Walsh, et al, p.177-182, 16 refs.
52-3730
ICE FLOES, PACK ICE, ICE COVER STRENGTH, ICE FRICTION, ICE PRESSURE, ICE CREEP, DRIFT, ICE DEFORMATION, ICE TEMPERATURE, THERMAL STRESSES, ICE MODELS, COMPUTERIZED SIMULATION, UNITED STATES—ALASKA, BEAUFORT SEA
In situ measurements of ice stress were made on a multi-year floe in the Alaskan Beaufort Sea over a 6 month period, beginning in Oct. 1993. The data suggest that, in this region of the Arctic during this experiment, there were two main sources of stress: a thermally induced stress caused by changes in air temperature, and a stress generated by ice motion. Due to the natural damping of the snow and ice above the sensor, the thermally-induced stresses are low frequency (order of days). Stresses associated with periods

of ice motion have both a high-frequency (order of hours), and low-frequency, content. The relative significance of these sources of stress is seasonal, reflecting the changes in the strength and continuity of the pack.

MP 5119
YEAR-ROUND PACK ICE IN THE WEDDELL SEA, ANTARCTICA: RESPONSE AND SENSITIVITY TO ATMOSPHERIC AND OCEANIC FORCING.
Geiger, C.A., Ackley, S.F., Hibler, W.D., III, *Annals of Glaciology,* 1997, Vol.25, International Symposium on Representation of the Cryosphere in Climate and Hydrological Models, Victoria, British Columbia, Aug. 12-15, 1996. Papers. Edited by J.E. Walsh, et al, p.269-275, 21 refs.
52-3746
PACK ICE, SEA ICE DISTRIBUTION, ICE COVER THICKNESS, ICE EDGE, ICE HEAT FLUX, AIR ICE WATER INTERACTION, POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, AIR TEMPERATURE, HUMIDITY, OCEAN CURRENTS, ICE MODELS, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, ANTARCTICA—WEDDELL SEA
Using a dynamic-thermodynamic numerical sea-ice model, external oceanic and atmospheric forcings on sea ice in the Weddell Sea are examined to identify physical processes associated with the seasonal cycle of pack ice, and to identify further the parameters that coupled models need to consider in predicting the response of the pack ice to climate and ocean-circulation changes. The primary influence on the winter ice-edge maximum extent is air temperature. Ocean heat flux has more impact on the minimum ice-edge extent and in reducing pack-ice thickness. Low relative humidity enhances ice growth in thin ice and open-water regions. The modeled extent of the Weddell summer pack is equally sensitive to ocean heat flux and atmospheric relative humidity variations with the more dynamic responses being from the atmosphere. Ocean heat-transport variability is shown to lead to overall ice thinning in the model response and is a known feature of the actual system. (Auth. mod.)

MP 5120
ARCTIC SEA-ICE CONDITIONS AND THE DISTRIBUTION OF SOLAR RADIATION DURING SUMMER.
Perovich, D.K., Tucker, W.B., *Annals of Glaciology,* 1997, Vol.25, International Symposium on Representation of the Cryosphere in Climate and Hydrological Models, Victoria, British Columbia, Aug. 12-15, 1996. Papers. Edited by J.E. Walsh, et al, p.445-450, 23 refs.
52-3776
ICE SURVEYS, SEA ICE DISTRIBUTION, ICE CONDITIONS, ICE SURFACE, ICE MELTING, ICE HEAT FLUX, ICE OPENINGS, PONDS, AIR ICE WATER INTERACTION, RADIATION BALANCE, AERIAL SURVEYS
Understanding the interaction of solar radiation with the ice cover is critical in determining the heat and mass balance of the arctic ice pack, and in assessing potential impacts due to climate change. Because of the importance of the ice-albedo feedback mechanism, information on the surface state of the ice cover is needed. Observations of the surface state of sea ice were obtained from helicopter photography missions made during the 1994 Arctic Ocean Section cruise. Photographs from one flight, taken during the height of the melt season (July 31, 1994) at 76°N, 172°W, were analyzed in detail. Bare ice covered 82% of the total area, melt ponds 12%, and open water 6%. While leads make up only a small portion of the total area, they are the source of virtually all of the solar energy input to the ocean.

MP 5121
TRANSMISSION OF SOLAR RADIATION IN BOREAL CONIFER FORESTS: MEASUREMENTS AND MODELS.
Ni, W.G., Li, X.W., Woodcock, C.E., Roujean, J.L., Davis, R.E., *Journal of geophysical research,* Dec. 26, 1997, 102(D24), p.29,555-29,566, 35 refs.
52-3929
CLIMATOLOGY, ATMOSPHERIC BOUNDARY LAYER, FOREST ECOSYSTEMS, FOREST CANOPY, SOLAR RADIATION, RADIATION BALANCE, RADIANCE, LIGHT SCATTERING, VEGETATION PATTERNS, VEGETATION FACTORS, MATHEMATICAL MODELS
A combined geometric-optical and radiative transfer model allows incorporation of multiple scales of clustering in conifer canopies on the estimation of radiation transmission. Consideration of clustering of branches into whorls is the latest addition to this model. Whorl orientation distributions are derived from multidirectional measurements using a geometric optical mutual shadowing model. For BOREAS test stands, model estimates and vertical measurements of photosynthetically active radiation transmittance within the canopy show (1) general decreases in transmission as solar zenith angles increase in the range of solar zenith angles dominated by beam irradiance, (2) increases in PAR transmission at very high solar zenith angles where diffuse skylight is dominant, and (3) maximum scattering and absorption occur in the middle of the canopy.

MP 5122
TEST AND EVALUATION PROJECT NO.28: ANTI-ICING TECHNOLOGY, FIELD EVALUATION REPORT.
Ketcham, S.A., Minsk, L.D., Danyluk, L.S., *U.S. Federal Highway Administration. Office of Engineering Research and Development. Report,* Mar. 1998, FHWA-RD-97-132, 284p., 19 refs.
52-3975
ROAD ICING, CHEMICAL ICE PREVENTION, SALTING, SANDING, ICE STORMS, SNOWSTORMS, WEATHER FORECASTING, ROAD MAINTENANCE, SAFETY, HIGHWAY PLANNING, COLD WEATHER TESTS, COST ANALYSIS
Highway anti-icing is the snow and ice control practice of preventing the formation or development of bonded snow and ice by timely applications of a chemical freezing-point depressant. Its operations consist of chemical applications and coordinated plowing. The prefix "anti" signifies the preventive nature of anti-icing and distinguishes it from deicing, which is the traditional practice of mechanically or chemically removing compacted snow or ice that is already bonded to pavement. Anti-icing practices have been in use for many years. The term has evolved to mean a modern and efficient snow and ice control practice that makes use of technologies such as road weather information systems, site-specific weather and pavement forecasts, portable pavement temperature sensors, and sophisticated spreader equipment. Anti-icing can provide two major benefits: efficient use of labor and materials, and increased traffic safety.

MP 5123
REMOVING SLUDGE FROM WASTEWATER LAGOON WITH A SLUDGE SLED.
Hardy, S.E., Martel, C.J., *U.S. Army Center for Public Works, Alexandria, VA. Facilities Engineering Applications Program. User guide,* Feb. 1998, FEAP-UG-CRREL-98/01, 6p.
52-3974
SEWAGE TREATMENT, WATER TREATMENT, WASTE DISPOSAL, SLUDGES, PONDS, DREDGING, MILITARY FACILITIES, COST ANALYSIS

MP 5124
ROCK BEHAVIOUR AT LOW TEMPERATURE CONDITIONS AND ITS RELEVANCE TO MINING IN COLD REGION.
Dhar, B.B., Dube, A.K., Soni, A.K., Dutta, P.K., International Symposium on Mining in the Arctic, 4th, Longyearbyen, Svalbard, July 27-30, 1996. Proceedings. Edited by A.M. Myrvang and J. Vik, Trondheim, Norway, SINTEF Rock and Mineral Engineering, 1996, p.183-191, 13 refs.
52-4038
FROZEN ROCK STRENGTH, FROZEN GROUND COMPRESSION, PERMAFROST THERMAL PROPERTIES, ENGINEERING GEOLOGY, MINING, MINE SHAFTS, LOW TEMPERATURE RESEARCH, ENVIRONMENTAL TESTS, STRAIN TESTS
Compressive and tensile strength properties of granite, limestone and sandstone at low temperature are analyzed. The properties of antarctic rocks are examined during Indian research efforts directed towards revealing the behavior of rocks of the region. The paper also highlights the design and development aspects of "environmental chamber" developed at Central Mining Research Institute (CMRI) for cryogenic studies. Also highlighted are the joint R&D programs involving CMRI-CRREL collaboration. (Auth. mod.)

MP 5125
FLOOD-FREEZE CYCLES AND MICROALGAL DYNAMICS IN ANTARCTIC PACK ICE.
Fritsen, C.H., Ackley, S.F., Kremer, J.N., Sullivan, C.W., *American Geophysical Union. Antarctic research series,* 1998, Vol.73, Antarctic sea ice: biological processes, interactions and variability. Edited by M.P. Lizotte and K.R. Arrigo, p.1-21, Refs. p.19-21.
52-4047
MICROBIOLOGY, ALGAE, MARINE BIOLOGY, ICE MODELS, ICE GROWTH, ICE COMPOSITION, PACK ICE, AIR TEMPERATURE, SEA ICE, FREEZE THAW CYCLES
Dynamics of surface and bottom-ice microalgal communities were investigated using a numerical model of ice growth, ice hydrostatics, radiative transfer processes, nutrient exchange processes, and microalgal growth. Annual simulations showed a general succession of ice properties and microalgal dynamics related to flood-freeze cycles. Specifically, microalgal blooms were predicted to accumulate on the bottom of first-year ice during the austral autumn when ice was actively thickening yet thin enough to allow sufficient light penetration for algal growth. During the austral spring, simulations showed flooding of seawater onto the surface of the ice due to snow loading, which resulted in algal blooms in the flooded snow. In ice that survived a summer melting season, the model predicted an additional growth of surface algae during the autumnal period when the flooded snow froze. During subsequent spring-summer periods, little or no growth or accumulation of algae was predicted at the bottom of the ice due to frequent ice ablation and a predominantly low-light environment. (Auth. mod.)

MP 5126
WINTER SNOW COVER OF THE WEST ANTARCTIC PACK ICE: ITS SPATIAL AND TEMPORAL VARIABILITY.
Sturm, M., Morris, K., Massom, R., *American Geophysical Union. Antarctic research series,* 1998, Vol.74, Antarctic sea ice: physical processes, interactions and variability. Edited by M.O. Jeffries, p.1-18, Refs. p.17-18.
52-4182
SNOW COVER EFFECT, SNOW COVER STRUCTURE, SNOW ICE INTERFACE, SNOW TEMPERATURE, MODELS, PACK ICE, ICE COVER THICKNESS, ANTARCTICA—BELLINGSHAUSEN SEA, ANTARCTICA—AMUNDSEN SEA, ANTARCTICA—ROSS SEA
The snow cover on the sea ice of the Bellingshausen, Amundsen and Ross seas was examined during one autumn and two winter cruises in 1994-95. The snow was extremely heterogeneous, being composed of depth hoar, soft slabs, icy layers, slush, and new snow, often all present at a single location. These dissimilar snow types resulted from cycling between cold, calm periods and warm, windy periods with rain-on-snow and melt events. Local snow heterogeneity also resulted from sea water flooding. At virtually every location, the bottom 9 cm of snow pack was saline and lay on snow-ice as thick as the snow. A diagenetic model of snow pack development is proposed in which snow-ice formation produces locally heterogeneous conditions in the snow pack, but at a regional scale tends to produce homogeneous conditions for the combined ice and snow system. The homogeneity is manifested in regional heat flux measurements from the ice surface. (Auth. mod.)

MP 5127
SEA ICE DRIFT AND DEFORMATION PROCESSES IN THE WESTERN WEDDELL SEA.
Geiger, C.A., Ackley, S.F., Hibler, W.D., III, *American Geophysical Union. Antarctic research series,* 1998, Vol.74, Antarctic sea ice: physical processes, interactions and variability. Edited by M.O. Jeffries, p.141-160, 19 refs.
52-4188
SEA ICE, DRIFT, ICE DEFORMATION, BOTTOM TOPOGRAPHY, OCEAN CURRENTS, WIND FACTORS, DATA PROCESSING, ANTARCTICA—WEDDELL SEA
Data from Ice Station Weddell during 1992 are used to examine sea ice drift and deformation activity to identify relevant external forces responsible for driving specific sea ice processes. Power spectra results from wind, sea ice, and ocean current measurements together with deformation analysis of sea ice reveal that the drift of sea ice in the western Weddell region is a low frequency dynamic process driven primarily by low frequency forcing in the form of moderate steady ocean currents and intermittent strong winds from high energy storm activity and that, higher frequencies, specifically diurnal and semi-diurnal tidal/inertial oscillation frequencies, are the main contributors to sea ice deformation in this region. Ice drift and deformation seem particularly sensitive to the forcing caused by topographic change as enhanced by ocean currents. (Auth. mod.)

MP 5128
PHYSICAL AND STRUCTURAL PROPERTIES OF LAND-FAST SEA ICE IN MCMURDO SOUND, ANTARCTICA.
Gow, A.J., Ackley, S.F., Govoni, J.W., Weeks, W.F., *American Geophysical Union. Antarctic research series,* 1998, Vol.74, Antarctic sea ice: physical processes, interactions and variability. Edited by M.O. Jeffries, p.355-374, Refs. p.373-374.
52-4199
FAST ICE, ICE PHYSICS, ICE STRUCTURE, ICE COVER THICKNESS, ICE COMPOSITION, OCEAN CURRENTS, ICE WATER INTERFACE, ANTARCTICA—MCMURDO SOUND
The physical properties of land-fast sea ice in McMurdo Sound were investigated in cores drilled to the bottom of the ice at 27 widely separated sites. Three major ice types were identified, including an upper transition layer, representing 15% of the total ice thickness, that consisted mainly of ice formed during the earliest stages of growth of congelation ice. Most of the underlying ice consisted of columnar congelation ice exhibiting aligned c-axes horizontal fabrics which transitioned into platelet ice forming the base of the ice sheet. These observations imply near-surface current circulation changes, possibly related to the onset of growth of the sub-ice platelet layer. Platelet ice appears to form by direct attachment to the bottom of the ice sheet and its morphological characteristics are consistent with formation from adiabatically supercooled water originating from beneath the Ross Ice Shelf. (Auth. mod.)

MP 5129
MELTING ICE WITH SPACE HEATERS.
Haehnel, R.B., Haynes, F.D., Clark, C.H., *U.S. Army Corps of Engineers. Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. REMR bulletin,* Dec. 1997, 14(3), p.6-9.
52-4234
LOCKS (WATERWAYS), ICE MELTING, ARTIFICIAL MELTING, ICE CONTROL, ICE PREVENTION, ICE REMOVAL, RADIANT HEATING

MP 5130
ACCRETION RATE OF COSMIC SPHERULES MEASURED AT THE SOUTH POLE.
Taylor, S., Lever, J.H., Harvey, R.P., *Nature,* Apr. 30, 1998, 392(6679), p.899-903, 30 refs.
52-4271
COSMIC DUST, SPHERES, MICROSTRUCTURE, ANTARCTICA—AMUNDSEN-SCOTT STATION
Described here is the collection of thousands of well preserved and dated micrometeorites from the bottom of the South Pole water well, which supplies drinking water for Amundsen-Scott Station. Using this collection, precise estimates have been made of the flux and mass distribution for 50-700-μm cosmic spherules (melted micrometeorites). Allowing for the expected abundance of unmelted micrometeorites in the samples, the results indicate that about 90% of the incoming mass of submillimeter particles evaporates during atmospheric entry. The data indicate the loss of glass-rich and small stony spherules from deep-sea deposits, and they provide constraints for models describing the survival probability of micrometeoroids. (Auth. mod.)

MP 5131
COMMUNITY IMPROVEMENT FEASIBILITY REPORT, KIVALINA, ALASKA.
U.S. Army Corps of Engineers. Alaska District, Smith, O.P., Hardy, D.L., Martel, C.J., Affleck, R.T., Tuthill, A.M., Chacho, E.F., Jr., Anchorage, AK, Apr. 1988, 55p. + appends., 22 refs.
52-4314
REGIONAL PLANNING, URBAN PLANNING, SITE SURVEYS, UTILITIES, SANITARY ENGINEERING, WATER SUPPLY, SEWAGE DISPOSAL, WASTE DISPOSAL, HEALTH, HUMAN FACTORS ENGINEERING, COST ANALYSIS, UNITED STATES—ALASKA—KIVALINA

MP 5132
ISOLATION OF RADIOACTIVE WASTES IN PERMAFROST ROCK.
Grant, S.A., Kazakov, A.N., Lobanov, N.F., Mironenko, M.V., Shapkin, A.I., Joint Russian-American Hydrogeology Seminar, Berkeley, CA, July 8-9, 1997. Proceedings. Edited by C.F. Tsang, V.A. Mironenko, and S. Pozdniakov, Berkeley, University of California, Lawrence Berkeley National Laboratory, Russian-American Center for Contaminant Transport Studies, 1997, p.162-193, Extended abstract only.
52-4325
RADIOACTIVE WASTES, WASTE DISPOSAL, UNDERGROUND STORAGE, PERMAFROST PRESERVATION, FROZEN ROCK STRENGTH, FROZEN GROUND STRENGTH, ENVIRONMENTAL PROTECTION, INTERNATIONAL COOPERATION, RUSSIA—NOVAYA ZEMLYA

MP 5133
ICE CONTROL TECHNIQUES FOR CORPS PROJECTS.
Haynes, F.D., Haehnel, R., Clark, C., Zabilansky, L., *U.S. Army Corps of Engineers. Waterways Experiment Station, Vicksburg, MS. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. Technical report,* Sep. 1997, REMR-HY-14, 18p. + figs., ADA-329 402, 9 refs.
52-4370
LOCKS (WATERWAYS), DAMS, HYDRAULIC STRUCTURES, ICE CONTROL, ICE PREVENTION, BUBBLING, ELECTRIC HEATING, RADIANT HEATING
This investigation was performed by the U.S. Army Cold Regions Research and Engineering Laboratory for Headquarters, U.S. Army Corps of Engineers. The overall objective of the study was to provide much more efficient methods for controlling and removing ice at locks and dams. Twelve serious ice problems at locks were identified, the most severe being ice accumulation in the miter gate recess. Fifteen ice problems around dams were identified, the most severe being ice accumulation upstream of a dam. The most common method of dealing with ice problems has previously been chipping the ice off, a labor-intensive, time-consuming, and hazardous practice. Other more efficient and more effective methods such as air bubbler systems and panel heaters were studied herein. The rationale has been to prevent ice from forming, or, if this is not possible, provide efficient, economical solutions. Future research should focus on optimizing panel heater size and power requirements in problem areas for ice buildup. Also, additional work should be done with bubblers and water cannons for moving ice.

MP 5134
RECONSTRUCTION OF WINDSOR BRIDGE PIERS.
Pierce, P.C., Mieczkowski, J.J., Gannon, E.J., Korhonen, C.J., *Transportation research record,* Nov. 1996, No.1544, p.46-54, 8 refs.
52-158
BRIDGES, PIERS, PROTECTION, SHELLS, DESIGN CRITERIA, FREEZE THAW CYCLES, FREEZE THAW TESTS, FREEZING POINTS, DAMAGE, LOW TEMPERATURE TESTS, THERMAL ANALYSIS

MP 5135
STRUCTURAL ICE CONTROL: A REVIEW.
Tuthill, A.M., *Journal of cold regions engineering,* June 1998, 12(2), p.33-51, 45 refs.
52-4549
RIVER ICE, ICE NAVIGATION, ICE JAMS, COUNTERMEASURES, ICE CONTROL, HYDRAULIC STRUCTURES, OFFSHORE STRUCTURES, ICE BOOMS, ARTIFICIAL ISLANDS, ICE BREAKUP, ICE SOLID INTERFACE, CLASSIFICATIONS, PERFORMANCE
This paper reviews the state of the art in structural ice control, addressing the ranges as well as the limitations of ice retention methods in use today. Structural techniques are grouped according to the main purposes of ice formation and breakup ice control. The objectives and performance of a range of existing ice retention structures are discussed, with special attention given to innovative methods. Typical hydraulic conditions of application for different types of structures are considered, and possible future directions in structural ice control research and development are discussed.

MP 5136
SNOW AND ICE CONTROL MANUAL FOR TRANSPORTATION FACILITIES.
Minsk, L.D., New York, McGraw-Hill, 1998, 289p., Refs. p.263-268.
52-4710
ROAD ICING, CHEMICAL ICE PREVENTION, SALTING, SNOW REMOVAL, SNOW REMOVAL EQUIPMENT, RUBBER ICE FRICTION, RUBBER SNOW FRICTION, ROAD MAINTENANCE, MANUALS, COST ANALYSIS

MP 5137
VARIABILITY IN ARCTIC SEA ICE OPTICAL PROPERTIES.
Perovich, D.K., Roesler, C.S., Pegau, W.S., *Journal of geophysical research,* Jan. 15, 1998, 103(C1), p.1193-1208, 40 refs.
52-4736
SEA ICE, ICE STRUCTURE, OPTICAL PROPERTIES, PHYSICAL PROPERTIES, MELTWATER, ICE OPTICS, LIGHT TRANSMISSION, RADIANCE, ALBEDO, RADIATION ABSORPTION, ATTENUATION, SNOW COVER EFFECT, ARCTIC OCEAN
During a field experiment at Barrow, AK, the horizontal variability of spectral albedo and transmittance as well as the vertical variability of in-ice radiance were examined. Temporal changes were monitored under cold conditions in Apr. and during the onset of melt in June. Physical properties, including ice structure and concentrations of particulate and dissolved material, were measured to provide a context for understanding the observed temporal, horizontal, vertical, and spectral variability in optical properties. For snow-covered first-year ice in Apr., wavelength-integrated albedos were high and spatially uniform, but there was considerable variability in transmittance. At the onset of melt in June, the ice surface rapidly evolved into a variegated mixture of melting snow, bare ice, and melt ponds. Albedos were much lower and exhibited considerable spatial variability, ranging from 0.2 to 0.5 over distances of a few meters concomitant with the variation in surface characteristics. Transmission increased over the spring transition as surface characteristics evolved to decrease albedo and as in-ice structure was altered by heating to reduce attenuation within the ice. Variability in the in-ice spectral radiance values was observed between nearby sites in both first-year and multiyear ice. Not only was there a strong shift in the spectral nature of the radiance as a function of horizontal distance, but there also existed large changes vertically within the ice. The vertical variability in the radiance attenuation coefficient was spatially coherent with variations in both the physical structure of the ice, especially grain size, and the concentrations of particulate and dissolved materials entrapped in the ice.

MP 5138
FIBER-REINFORCED POLYMER COMPOSITE MATERIALS SYSTEMS TO ENHANCE REINFORCED CONCRETE STRUCTURES.
Marshall, O.S., Jr., Dutta, P.K., *U.S. Army Construction Engineering Research Laboratories, Champaign, IL. Technical report,* Feb. 1998, USACERL TR 98/47, 70p. + appends., Refs. p.63-67. Appendix E: Low-temperature evaluation of FRP composites bonded to concrete, 109p., describes studies at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH.
52-4946
CONCRETE STRUCTURES, REINFORCED CONCRETES, CONCRETE STRENGTH, CONCRETE DURABILITY, POLYMERS, COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, COLD WEATHER TESTS, FREEZE THAW TESTS, STRAIN TESTS, STRUCTURAL ANALYSIS, DESIGN CRITERIA
The use of fiber-reinforced polymer (FRP) composites was investigated for purposes of enhancing, protecting, repairing, or upgrading reinforced concrete structures. Design methods and repair applications were addressed, as were durability issues and in-field test methods for performance verification. Investigations included shear rehabilitation techniques for concrete beams, in-field test methods to determine the bond strength of FRP composites, and low-temperature evaluation of FRP performance. Field demonstrations included evaluation of carbon fiber-reinforced polymer tendons for post-tensioning of double-tee beams and wall repair at a sewage treatment facility. Also, a feasibility study and laboratory tests were performed to evaluate glass fiber-reinforced polymer cables as tie-back tension members, and a test fixture was designed and fabricated to evaluate post-stressing tendon drape angle performance. Design examples were developed for shear upgrade of concrete beams, post-tensioning of double-tee beams, and tie-back rod arrangements. Finally, a model was developed to predict failure mechanisms for reinforced concrete beams with FRP sheets or plates bonded to the bottom tensile face.

MP 5139
3D COMPRESSION OF CIRCULAR ICE FLOES: COMPARING EXPERIMENTS AND SIMULATIONS.
Hopkins, M., Tuhkuri, J., Hansen, E., Symposium on Mechanics of Deformation and Flow of Particulate Materials, Evanston, IL, June 29-July 2, 1997. Proceedings. Edited by C.S. Chang et al, New York, American Society of Civil Engineers, 1997, p.290-298, 12 refs.
52-4950
SEA ICE, RIVER ICE, ICE MECHANICS, ICE FLOES, ICE DEFORMATION, COMPRESSIVE PROPERTIES, ICE SOLID INTERFACE, ICE OVERRIDE, SLIDING, ICE FRICTION, PRESSURE RIDGES, COMPUTERIZED SIMULATION, MECHANICAL TESTS
The compression of ice fields made up of thin floes is central to the processes of ice jam formation in northern rivers, pressure ridge formation in northern seas, and the dynamics of ice fields in antarctic marginal seas. Model experiments were performed in which a floating layer of thin, circular ice floes, confined in a rectangular domain, were uniaxially compressed. The forces exerted by the ice against the moving boundary were measured. Geometrically similar, three-dimensional computer simulations were performed and the calculated forces are compared with the forces measured in the model experiments.

MP 5140
USE OF COMPOSITES IN INFRASTRUCTURE.
Hui, D., Dutta, P.K., North Atlantic Treaty Organization. Advanced Science Institutes. ASI Series, Partnership Sub-Series 3: High technology, Vol.43. Advanced multilayered and fibre-reinforced composites. Edited by Y.M. Haddad, Dordrecht, Netherlands, Kluwer Academic Publishers, 1998, p.3-11, 25 refs. Presented at a NATO Advanced Research Workshop, Kiev, Ukraine, June 2-6, 1997.
52-4974
CONCRETE STRUCTURES, REINFORCED CONCRETES, CONCRETE DURABILITY, CONCRETE STRENGTH, COMPOSITE MATERIALS, STRUCTURAL ANALYSIS
Construction engineering history may have reached a new stage with the advent and availability of the new, low-cost, high-performance structural composites. Not only the fiber-reinforced plastic (FRP) 'pultruded' sections can replace steel in many load bearing structures, but strengthening of concrete beams with internally or externally bonded FRPs has also been proved feasible to increase the load carrying capacity and stiffness of existing structures. Composites made with glass, aramid, or carbon fibers are being increasingly considered for pretensioning, post-tensioning, or reinforcing concrete. To replace the corroding steel rebars, FRP system may eventually be used in concrete bridge decks or other outdoor concrete flooring structures. However, quantitative guidelines for applications of composites in structures or reinforcement of concrete are not available. This paper reviews the current state of composite applications in infrastructure including concrete reinforcement and focuses on the R&D thrusts the lack of which appears to be hindering the development of the quantitative guidelines.

MP 5141
THERMO-MECHANICAL BEHAVIOR OF POLYMER COMPOSITES.
Dutta, P.K., North Atlantic Treaty Organization.

Advanced Science Institutes. ASI Series, Partnership Sub-Series 3: High technology, Vol.43. Advanced multilayered and fibre-reinforced composites. Edited by Y.M. Haddad, Dordrecht, Netherlands, Kluwer Academic Publishers, 1998, p.541-554, 6 refs. Presented at a NATO Advanced Research Workshop, Kiev, Ukraine, June 2-6, 1997.

52-4975

POLYMERS, COMPOSITE MATERIALS, ELASTIC PROPERTIES, TENSILE PROPERTIES, THERMAL STRESSES, COLD STRESS, CRACKING (FRACTURING), STRUCTURAL ANALYSIS, LOW TEMPERATURE TESTS, FREEZE THAW TESTS

In polymer composites high elastic modulus fibers are incorporated into a lower elastic modulus matrix to achieve structural reinforcement. Most common fibers are E-glass, carbon or graphite, and aramids (kevlar). Typically the elastic modulus and strength of these fibers are of a magnitude higher than the polymer matrix in which these fibers are embedded. The essential quality of a good composite is that the bond between the fiber and the matrix is well established and is continuous both around the fiber and its length. Thus, a good composite's performance essentially depends on the interfacial bond quality. When a load is applied in the direction of the fiber orientation of the composite, the load is shared both by the fiber and the polymer matrix. The ratio of this load share depends on the relative elastic modulus of the fiber and the matrix. However, the elastic modulus of the polymer matrix is significantly influenced by the temperature. At lower temperature the modulus of elasticity increases considerably, and thus it is expected that load sharing between the fibers and the matrix would also change. The purpose of this paper is to briefly discuss the micromechanical aspects of the low temperature responses expected from the polymer composites.

MP 5142

SAMPLING AND ANALYTICAL CONSIDERATIONS FOR SITE CHARACTERIZATION AT MILITARY FIRING RANGES.

Jenkins, T.F., et al, Biennial International Conference on Chemical Measurement and Monitoring of the Environment, 2nd, Ottawa, Ontario, May 11-14, 1998. Proceedings. EnviroAnalysis, Ottawa, Ontario, Carleton University, Chemistry Department, 1998, p.37-42, 8 refs.

52-4976

MILITARY FACILITIES, SITE SURVEYS, EXPLOSIVES, SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS

Site characterization has been conducted at several explosives-contaminated military firing ranges in Canada and the United States. Unlike other areas, such as ammunition plants and explosive ordnance disposal areas, the contaminant present at highest concentration at firing ranges is often HMX (1,3,5,7-tetrahydro-1,3,5,7-tetranitrotetrazocine). The presence of HMX on these ranges is due to the firing of M72 Lightweight Anti-Armor Weapons (LAW), which have an abnormally high dud rate, and which sometimes break open on impact, spilling solid explosives on the site. The LAW rockets contain octol, a melt-cast explosive composed of a 70:30 mixture of HMX and TNT. The largest problem associated with characterization of these firing ranges is the enormous spatial heterogeneity in concentration distribution that is present at all distances. This problem is so extreme that single discrete samples are not representative of even small geographically defined areas. Composite sampling and use of commercially available, colorimetric-based, on-site methods for HMX and TNT have been shown to provide acceptably accurate and precise results for characterization of the soils at these firing ranges.

MP 5143

DEVELOPMENT OF A CONTINUOUSLY MONITORING RESISTIVITY PROBE FOR FREE-PHASE PETROLEUM HYDROCARBONS.

Shoop, S.A., Berini, C.M., Guyer, R., Symposium on the Application of Geophysics to Engineering and Environmental Problems, Keystone, CO, Apr. 28-May 2, 1996. Proceedings. Edited by R.S. Bell and M.H. Cramer, Wheat Ridge, CO, Environmental and Engineering Geophysical Society, [1996], p.11-18, 10 refs.

52-4977

OIL SPILLS, SOIL POLLUTION, GROUND WATER, WELLS, WATER POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, SOIL TESTS, ELECTROMAGNETIC PROSPECTING, PROBES, MONITORS

An *in-situ* electrical resistivity probe was evaluated for use in monitoring the vertical distribution of petroleum hydrocarbon in contaminated soil. By installing the probe to intersect the water table, it continuously monitors the presence of free-phase hydrocarbons by detecting electrical resistivity changes corresponding to the degree of oil saturation in the sediment pores. At a field site where diesel contamination occurs within a fine-grained sand, the results from the probe were compared to chemical analysis of total petroleum hydrocarbons of soil borings and measured free product (light non-aqueous phase liquid (LNAPL)) thickness and groundwater level in wells. The resistivity probe was also used to study LNAPL behavior under fluctuating water table conditions in a controlled laboratory environment. Results from the resistivity probe reflect the distribution of the contaminant within the sediment on a continuous basis and more accurately than contaminant thickness measurements in wells.

MP 5144

COMPARISON OF TRICHLOROETHYLENE CONCENTRATIONS IN VAPOR AND DISCRETE SOIL SAMPLES.

Hewitt, A.D., Biennial International Conference on Chemical Measurement and Monitoring of the Environment, 2nd, Ottawa, Ontario, May 11-14, 1998. Proceedings. EnviroAnalysis, Ottawa, Ontario, Carleton University, Chemistry Department, 1998, p.7-11, 13 refs.

52-4978

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS

A linear (slope=0.806) and strong correlation (r^2=0.950) was obtained for the comparison of soil vapor (µg TCE/L) to soil mass (µg TCE/kg) trichloroethylene concentrations. This strong relationship supports the concept that active soil vapor measurements could be used as an alternative to the collection and analysis of discrete soil samples for establishing both the presence and concentration of volatile organic compounds on a mass/mass basis.

MP 5145

RHIZOSPHERE-ENHANCED BIOREMEDIATION.

Reynolds, C.M., Koenen, B.A., *Military engineer,* Aug.-Sep. 1997, 89(586), p.32-33.

52-4979

MILITARY FACILITIES, OIL SPILLS, SOIL POLLUTION, SOIL MICROBIOLOGY, WASTE DISPOSAL, LAND RECLAMATION, PLANT ECOLOGY, PLANT PHYSIOLOGY, ROOTS, UNITED STATES—ALASKA

MP 5146

NEW TECHNOLOGY FOR DISASTERS.

Bruzewicz, A.J., *Military engineer,* Aug.-Sep. 1997, 89(586), p.25-26.

52-4980

SITE SURVEYS, TERRAIN IDENTIFICATION, ENVIRONMENT SIMULATION, FLOOD FORECASTING, ACCIDENTS, RESCUE OPERATIONS, LAND RECLAMATION, IMAGE PROCESSING, DATA PROCESSING, DATA TRANSMISSION

MP 5147

CHOOSING A DURABLE ROOFING SYSTEM.

Tobiasson, W., *Interface,* June 1997, 15(6), p.6-8.

52-4981

BUILDINGS, ROOFS, WEATHERPROOFING, WATERPROOFING, COLD WEATHER CONSTRUCTION, DESIGN CRITERIA

Indoor and outdoor climates influence durability, as do conditions during construction. Cost is almost always a very important aspect of choosing a durable roofing system, and life-cycle costs are the most important costs to consider. The word "sustainable" connotes preservation of the environment. A host of other issues must be considered when the aspect of sustainability is included in the decision-making process. Governments have enacted environmental laws that limit choices, but governments have also contributed research and development funds that have helped advance the roofing industry. A vast array of information is available to assist in choosing durable roofing systems, some of it contradictory. Less risk is involved when proven roofing systems are chosen. Careful consideration of details also can significantly reduce risks. For most situations, a few systems are available that will provide excellent durability. The trick is to avoid the materials and systems that are unsuitable for each situation. Choosing a durable roofing system is a challenge.

MP 5148

LABORATORY-PRODUCED PANCAKE ICE COVER IN A TWO-DIMENSIONAL WAVE FIELD.

Shen, H.H., Ackley, S.F., *Antarctic journal of the United States,* 1995, 30(5), p.106-108, 2 refs.

52-5033

ICE FORMATION, ICE COVER THICKNESS, EXPERIMENTATION

The formation of a pancake ice cover in a wave field was investigated in an outdoor pond 18.3 m long, 7.62 m wide, and 2.44 m deep. Video recording continuously monitored the ice cover. This study lasted for 12 hours. In the first hour, a layer of frazil ice quickly formed. The whole surface had the consistency of a slushy soup. This initial uniform frazil ice cover grew in thickness for several hours without apparent change of surface character. Then, as the whole surface became about 3 cm thick, pancake ice suddenly appeared. This study gave a complete picture of the formation of an ice cover through the pancake ice growth. It is believed that in a wave field, ice cover may form only through pancake growth. The rate of pancake growth and the effect of this growth on the wave field conceivably can change under different environmental conditions such as the air temperature, the wave amplitude, and wave length.

MP 5149

SEA-ICE MEASUREMENTS DURING ANZFLUX.

Ackley, S.F., Lytle, V.I., Kuehn, G.A., Golden, K.M., Darling, M.N., *Antarctic journal of the United States,* 1995, 30(5), p.133-135, 6 refs.

52-5045

SEA ICE, ICE FORMATION, ICE MELTING, ICE DEFORMATION, ICE WATER INTERFACE

The objective of the study was to understand the sea-ice growth, melt, and deformation processes in a high-ocean heat flux environment. To achieve this objective, the authors made estimates of the large-scale ice concentration and ice characteristics along the R/V *Nathaniel B. Palmer* cruise track during July and Aug. 1994 by making visual ice observations and establishing short-term ice sampling stations contemporaneously with the conductivity-temperature-depth casts. Results show that the ocean heat flux does not slow the freezing of the surface slush because that heat is being dissipated by the bottom ice ablation. Thus, during the winter period, the ice cover may act as a vertical conveyor belt: ice is added on the top by slush freezing, and at a similar rate, it is melted from below by the high ocean heat flux.

MP 5150

PROCEEDINGS OF THE NASA-LERC/CRREL/FAA INFLIGHT REMOTE SENSING ICING AVOIDANCE WORKSHOP, APRIL 1-2 1997. SUMMARIES AND PRESENTATIONS.

Bond, T.H., ed, Reehorst, A.L., ed, Ryerson, C.C., ed, Cleveland, Ohio Aerospace Institute, [1997], n.p.

52-5063

AIRCRAFT ICING, ICE DETECTION, ICE FORECASTING, WEATHER FORECASTING, SUPERCOOLED CLOUDS, CLOUD DROPLETS, CLOUD PHYSICS, METEOROLOGICAL INSTRUMENTS, RADAR TRACKING, WARNING SYSTEMS, SAFETY

MP 5151

NEW INSTRUMENT FOR AUTOMATIC MEASUREMENT OF CLOUD LIQUID WATER CONTENT AND DROPLET SIZE.

Cormack, R.H., Lawson, R.P., Boulder, CO, Stratton Park Engineering Company, Inc. (SPECinc), 1993, 34p., 58 refs. Submitted to the U.S. Army Cold Regions Research and Engineering Laboratory under SBIR (Small Business Innovative Research) Contract No.DACA33-93-C-0006.

52-5071

AIRCRAFT ICING, ICE ACCRETION, ICING RATE, ICE FORECASTING, CLOUD PHYSICS, SUPERCOOLED CLOUDS, CLOUD DROPLETS, UNFROZEN WATER CONTENT, METEOROLOGICAL INSTRUMENTS, PARTICLE SIZE DISTRIBUTION

Reliable automated measurements of liquid water content (LWC) and drop size in icing conditions have been notoriously difficult to make. Such measurements are needed to predict icing rates and loading on structures, power lines, off-shore oil rigs, forests and airplanes. In Phase I, the objective was to design, build and test a laboratory breadboard model of an instrument that demonstrated promise for making good automatic measurements of LWC and drop size. A laboratory prototype of a new optical instrument that measures with high angular resolution the forward scattered light from an ensemble of cloud drops was built in Phase I. The new instrument measured accurately the (known) size distribution of 3-30 µm polystyrene spheres in aqueous solution. Comparisons of LWC measurements in an icing wind tunnel were also very good. The instrument has the unique ability to automatically correct for optical misalignment and contamination in software. It is anticipated that a fully-automated, computer-controlled version of the instrument capable of operation in harsh environmental conditions can be built in Phase II.

MP 5152

REPORT TO CONGRESS ON ADVISABILITY AND CAPABILITY OF THE ARMY CORPS OF ENGINEERS TO IMPLEMENT SANITATION PROJECTS FOR RURAL AND NATIVE VILLAGES IN ALASKA.

Hardy, D.L., ed, Anchorage, U.S. Army Corps of Engineers, Alaska District, Cold Regions Center of Expertise (CRCX), Mar. 1998, 91p. + appends., 7 refs. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH, is a partner in the Cold Regions Center of Expertise (CRCX), a joint venture of staff and resources of both CRREL and the Corps' Alaska District.

52-5075

SANITARY ENGINEERING, WATER SUPPLY, WATER TREATMENT, SEWAGE DISPOSAL, WASTE DISPOSAL, UTILITIES, HEALTH, REGIONAL PLANNING, LEGISLATION, COST ANALYSIS, UNITED STATES—ALASKA

MP 5153
HOW GLACIERS ENTRAIN AND TRANSPORT BASAL SEDIMENT: PHYSICAL CONSTRAINTS.
Alley, R.B., Cuffey, K.M., Evenson, E.B., Strasser, J.C., Lawson, D.E., Larson, G.J., *Quaternary science reviews*, Nov. 1997, 16(9), p.1017-1038, Refs. p.1034-1038.
52-5187
GLACIAL GEOLOGY, GLACIAL HYDROLOGY, GLACIER FLOW, SUBGLACIAL DRAINAGE, SEDIMENT TRANSPORT, SEDIMENTATION, GLACIER BEDS, ICE SOLID INTERFACE, DEFORMATION, REGELATION, CLASSIFICATIONS, THEORIES, ANALYSIS (MATHEMATICS)
Simple insights from the physics of ice, water and sediment place constraints on the possible sediment-transport behavior of glaciers and ice sheets. Because glaciers concentrate runoff, streams generated by glaciers transport much sediment and may erode bedrock rapidly. Deforming glacier beds also can transport much sediment, particularly in marginal regions. Rapid sediment entrainment producing thick debris-rich basal zones may occur by regelation into subglacial materials, and by freeze-on from rising supercooled waters. Numerous other mechanisms may be important but primarily near ice margins, especially those of advancing or fluctuating glaciers. Several sediment-entrainment mechanisms may be active beneath a single glacier, but one process is likely to be dominant at any place and time.

MP 5154
TOWARD DEVELOPING A STANDARD SHEAR TEST FOR ICE ADHESION.
Mulherin, N.D., Haehnel, R.B., Jones, K.F., International Workshop on Atmospheric Icing of Structures, 8th, Reykjavik, Iceland, June 8-11, 1998. Proceedings. IWAIS '98. Edited by Á.J. Eliasson, Reykjavík, RARIK Iceland State Electricity, 1998, p.73-79, 16 refs.
52-5298
ICE SOLID INTERFACE, ICE ACCRETION, ICE ADHESION, ICE LOADS, ICE STRENGTH, ICE PREVENTION, PROTECTIVE COATINGS, SHEAR STRENGTH, STRAIN TESTS
Lack of a standardized method for testing the adhesive strength of ice has hampered efforts to understand ice adhesion and develop low-adhesion materials. The authors report on their efforts in adapting the 0° cone test as a standard method for measuring the adhesive strength of ice. Particular care was used in controlling the strain rate, temperature, ice growth, and test surface treatment. The experimental scatter is typical of other types of ice adhesion tests. It is reasonably rapid and easy to perform so that a large sample size can be obtained to increase the significance of the results. The procedure is described and preliminary results for ice bonded to stainless steel, aluminum, and several low-energy surface coatings are offered.

MP 5155
REMOTE SENSING OF AIRCRAFT ICING CLOUD.
Ryerson, C.C., International Workshop on Atmospheric Icing of Structures, 8th, Reykjavik, Iceland, June 8-11, 1998. Proceedings. IWAIS '98. Edited by Á.J. Eliasson, Reykjavik, RARIK Iceland State Electricity, 1998, p.81-85, 18 refs.
52-5299
AIRCRAFT ICING, ICE ACCRETION, ICE DETECTION, ICE FORECASTING, CLOUD PHYSICS, SUPERCOOLED CLOUDS, CLOUD DROPLETS, WATER CONTENT, LIDAR, AIRBORNE EQUIPMENT, WARNING SYSTEMS
Inflight icing is a serious hazard, as attested by recent crashes of aircraft with onboard ice protection. Remote sensing of icing conditions would provide an avoid and escape capability similar to that currently possible for thunderstorms and wind shear. Development of ground-based and aircraft-based sensing systems is occurring. Improved characterization of cloud and precipitation liquid water content, drop size spectra and temperature are necessary for sensor development. Multi-band, and differential attenuation, radars hold promise for range resolving liquid water and elements of drop size spectra. Range-resolved remote sensing of temperature in the horizontal remains a difficult problem.

MP 5156
ICE ACCRETION MEASUREMENTS FROM THE AUTOMATED SURFACE OBSERVING SYSTEM (ASOS).
Ramsay, A.C., Ryerson, C.C., International Workshop on Atmospheric Icing of Structures, 8th, Reykjavik, Iceland, June 8-11, 1998. Proceedings. IWAIS '98. Edited by Á.J. Eliasson, Reykjavik, RARIK Iceland State Electricity, 1998, p.127-130, 5 refs.
52-5306
ICE ACCRETION, ICING RATE, ICE LOADS, ICE DETECTION, ICE FORECASTING, ICE STORMS, WEATHER FORECASTING, WARNING SYSTEMS, SENSORS, MONITORS, DATA TRANSMISSION
This paper presents results of recent field testing of an automated icing detector used on the Automated Surface Observing System. Examples of ice-mass estimates are provided in the paper, in addition to a description of a potential method for disseminating reports of the mass and rate of accretion and the type ice being detected. Continued development and implementation of this capability are dependent upon statements of requirements from user communities.

MP 5157
USING U.S. WEATHER DATA FOR MODELING ICE LOADS FROM FREEZING RAIN.
Lott, J.N., Jones, K.F., International Workshop on Atmospheric Icing of Structures, 8th, Reykjavik, Iceland, June 8-11, 1998. Proceedings. IWAIS '98. Edited by Á.J. Eliasson, Reykjavik, RARIK Iceland State Electricity, 1998, p.157-162, 7 refs.
52-5311
ICE ACCRETION, ICE LOADS, ICING RATE, ICE FORECASTING, ICE STORMS, WIND VELOCITY, WIND PRESSURE, WEATHER FORECASTING, WEATHER STATIONS, METEOROLOGICAL DATA, DATA PROCESSING, UNITED STATES
In the last few years a number of researchers have developed models for determining the amount of ice accreted on structures in freezing rain storms. However, little attention has been paid to the weather data that drives these models. The authors have an ongoing project to determine design ice loads for structures throughout the United States, for which they are using historical weather data. This paper describes in detail the weather data that are collected by agencies in this country, focusing on the weather elements that are significant in modeling ice loads in freezing rain. Meteorological instruments, data accuracy and problems, data archival, and decisions that must be made by users of the data in modeling ice loads are discussed.

MP 5158
COMPARISON OF MODELED ICE LOADS IN FREEZING RAIN STORMS WITH DAMAGE INFORMATION.
Jones, K.F., International Workshop on Atmospheric Icing of Structures, 8th, Reykjavik, Iceland, June 8-11, 1998. Proceedings. IWAIS '98. Edited by Á.J. Eliasson, Reykjavik, RARIK Iceland State Electricity, 1998, p.163-168, 10 refs.
52-5312
ICE STORMS, POWER LINE ICING, ICE ACCRETION, ICING RATE, ICE LOADS, ICE FORECASTING, WEATHER FORECASTING, ACCIDENTS, DAMAGE, METEOROLOGICAL DATA, DATA PROCESSING, STATISTICAL ANALYSIS, DESIGN CRITERIA, UNITED STATES
Historical weather data are used with ice accretion models to determine ice loads from past freezing rain storms. These modeled ice loads can then be used in an extreme value analysis to calculate extreme ice loads for the design of power lines or communication towers. The design ice load is dependent on the assumptions made in choosing the storms to model as well as on the ice accretion model applied to the data. The author compares ice loads in apparently severe freezing rain storms in the eastern United States with storm damage information. This qualitative information is used to improve the algorithm for choosing storms in which ice accretes. The effect of the improved algorithm on the extreme ice loads is shown and other applications for qualitative storm information in mapping extreme ice loads are discussed.

MP 5159
PCC AIRFIELD PAVEMENT EVALUATION FOR SPRING THAW CONDITIONS.
Janoo, V.C., International Conference on the Bearing Capacity of Roads and Airfields, 5th, Trondheim, Norway, July 6-8, 1998. BCRA'98. Proceedings. Vol.1. Edited by R.S. Nordal and G. Refsdal, Trondheim, Norwegian University of Science and Technology, 1998, p.141-148, 8 refs.
52-5381
RUNWAYS, CONCRETE PAVEMENTS, SUBGRADES, THAW WEAKENING, TRAFFICABILITY, BEARING STRENGTH, HARDNESS TESTS, IMPACT TESTS, COMPUTERIZED SIMULATION, UNITED STATES—WISCONSIN
This paper presents an evaluation procedure for Portland cement concrete (PCC) airfield pavements in cold regions. This procedure is based on the results from field tests at two regional airports in Wisconsin and can be used to determine the bearing capacity and the load transfer across joints of PCC pavements during spring thaw. The pavement structure was instrumented with temperature sensors, and periodic surface deflection measurements using a falling weight deflectrometer (FWD) were conducted during the spring thaw period. The deflection data were used to back-calculate the coefficient of subgrade reaction (k) and the layer elastic modulus using ILLIBACK. Several relationships between FWD data, k and the subgrade modulus were developed. In addition, relationships were developed between FWD data, pavement thickness and the horizontal tensile stress at the bottom of the PCC layer for different aircraft expected to use the airport. Also, a relationship between load transfer efficiency across joints and FWD data was developed.

MP 5160
SUBGRADE FAILURE CRITERIA.
Janoo, V.C., Irwin, L.H., Eaton, R.A., Richter, C.A., International Conference on the Bearing Capacity of Roads and Airfields, 5th, Trondheim, Norway, July 6-8, 1998. BCRA'98. Proceedings. Vol.2. Edited by R.S. Nordal and G. Refsdal, Trondheim, Norwegian University of Science and Technology, 1998, p.695-703, 3 refs.
52-5383
PAVEMENTS, SUBGRADE SOILS, SOIL TRAFFICABILITY, SOIL STRENGTH, SOIL TESTS, BEARING TESTS, STRAIN TESTS, SUBGRADE MAINTENANCE, ROAD MAINTENANCE
An international group of researchers is developing a generalized subgrade failure criterion for use in mechanistic designs/evaluation of pavements. This paper presents the preliminary results from accelerated pavement testing using the heavy vehicle simulator in the Frost Effects Research Facility at the U.S. Army Cold Regions Research and Engineering Laboratory. Tests are being conducted on four soils, each tested at several moisture contents. The test sections are instrumented with stress, strain, moisture and temperature sensors. In addition, surface deformation is obtained periodically. This paper presents preliminary results from the first two (out of twelve) test sections.

MP 5161
PREDICTION OF PAVEMENT RESPONSE IN COLD REGIONS.
Simonsen, E., Janoo, V.C., Isacsson, U., International Conference on the Bearing Capacity of Roads and Airfields, 5th, Trondheim, Norway, July 6-8, 1998. BCRA'98. Proceedings. Vol.2. Edited by R.S. Nordal and G. Refsdal, Trondheim, Norwegian University of Science and Technology, 1998, p.959-968, 16 refs.
52-5389
PAVEMENTS, SUBGRADE SOILS, SEASONAL FREEZE THAW, SOIL FREEZING, FROST ACTION, FROST HEAVE, THAW WEAKENING, FROST RESISTANCE, TRAFFICABILITY, BEARING STRENGTH, HIGHWAY PLANNING, ROAD MAINTENANCE, COMPUTER PROGRAMS
Although the effects of climate on pavement structures are recognized as a major contributor to the deterioration of cold region pavements, only a few predictive pavement response models concerned with seasonal freezing and thawing have been developed. This paper presents a procedure for predicting response on pavements subject to seasonal freezing and thawing. The adopted procedure is based on a climatic effect analysis and a structural response analysis. The climatic effect analysis, calculating soil moisture and temperature profiles, is performed using a coupled mass and heat transfer model, FROSTB, developed by the Cold Regions Research and Engineering Laboratory. Based on results obtained, a structural response analysis is performed using ABAQUS, a commercially available all-purpose finite element computer code.

MP 5162
AROUND THE CORPS. ICE JAMS. *Engineer update*, Apr. 1996, 20(4), p.11.
52-5465
RIVER ICE, ICE JAMS, ICE CONTROL, INTERNATIONAL COOPERATION, LATVIA

MP 5163
ANALYSIS OF LINEAR AND MONOCLINAL RIVER WAVE SOLUTIONS.
Ferrick, M.G., Goodman, N.J., *Journal of hydraulic engineering*, July 1998, 124(7), p.728-741, 22 refs. For another version see 52-3972.
52-5516
RIVER FLOW, HYDRAULICS, CHANNELS (WATERWAYS), WATER WAVES, WAVE PROPAGATION, UNSTEADY FLOW, DYNAMIC PROPERTIES, FLUID MECHANICS, DIFFUSION, PROFILES, ANALYSIS (MATHEMATICS)
Linear dynamic wave and diffusion wave analytical solutions are obtained for a small, abrupt river flow increase from an initial to a higher steady flow. Equations for the celerities of points along the wave profiles are developed from the solutions and are related to the kinematic wave and dynamic wave celerities. The linear solutions are compared systematically in a series of case studies to evaluate the differences caused by inertia. These comparisons use the celerities of selected profile points, the paths of these points on the x-t plane, and complete profiles at selected times, and indicate general agreement between the solutions. A monoclinal-diffusion solution for the diffusion wave equations is developed and dynamic wave-diffusion wave comparisons are made over a range of amplitudes with the same case studies used for linear waves. Inertial effects on the monoclinal profiles occur near the leading edge, increase with the wave amplitude and Froude number, and are responsible for the differences between the dimensionless profiles.

MP 5164
PROCEEDINGS OF THE JOINT 54TH ANNUAL EASTERN SNOW CONFERENCE AND 65TH ANNUAL WESTERN SNOW CONFERENCE, BANFF, ALBERTA, MAY 4-8, 1997.
Eastern Snow Conference and Western Snow Conference, Albert, M.R., ed, Taylor, S., ed, 372p., Refs. passim. For individual papers see 52-5521 through 52-5558.
52-5520
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOWFALL, SNOW ACCUMULATION, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, RUNOFF FORECASTING

MP 5165
SPATIALLY-DISTRIBUTED MODELING OF SNOW IN THE BOREAL FOREST: A SIMPLE APPROACH.
Davis, R.E., Woodcock, C.E., Hardy, J.P., Ni, W.G., Jordan, R., McKenzie, J.C., *Eastern Snow Conference and Western Snow Conference. Proceedings,* 1997, Joint 54th and 65th, p.20-28, 31 refs.
52-5523
SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOW MELTING, SNOW COVER EFFECT, SNOW AIR INTERFACE, SNOW HEAT FLUX, TAIGA, FOREST LAND, FOREST CANOPY, VEGETATION FACTORS, RADIATION BALANCE, STATISTICAL ANALYSIS, COMPUTERIZED SIMULATION
Simulations using physics-based, coupled canopy-snow models provided the basis for developing simple regression models of net energy transfer to snow cover in the boreal forest. The simple models were driven by incoming solar radiation to the top of forest canopies, forest species, tree height and canopy density. Maps of the forest characteristics provided the basis for spatially distributing snow predictions over two test areas in the boreal forest. Over both test areas, variation of incoming solar radiation explained much of the variance in net energy transfer to snow cover. The authors found the strongest correlations for the relatively open, discontinuous canopies of the northern boreal forest.

MP 5166
ESTIMATING THE SPATIAL DISTRIBUTION OF SNOW WATER EQUIVALENCE IN A MONTANE WATERSHED.
Elder, K., Rosenthal, W., Davis, R.E., *Eastern Snow Conference and Western Snow Conference. Proceedings,* 1997, Joint 54th and 65th, p.29-41, 35 refs.
52-5524
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW DENSITY, SNOW WATER EQUIVALENT, SNOW HYDROLOGY, SNOWMELT, RUNOFF FORECASTING, STATISTICAL ANALYSIS, IMAGE PROCESSING, COMPUTERIZED SIMULATION, UNITED STATES—CALIFORNIA—SIERRA NEVADA
The authors describe an approach to model distributed snow water equivalence (SWE) that merges field measurements of depth and density with remotely sensed snow-covered area (SCA). In 1993 two teams conducted a snow survey in the Blackcap Basin of the Kings River. They measured snow depth and density. Regression tree models showed that net radiation, elevation, and slope angle account for 60-70% of the variance in the depth and density measurements. The gridded depth estimates combined with modeled density produced spatially distributed estimates of SWE. An unsupervised spectral unmixing algorithm estimated snow cover fractions from Landsat-5 Thematic Mapper data acquired at the time of the snow survey. This method provides a snow cover fraction estimate for every pixel. The authors used this subpixel map as their best estimate for SCA and combining it with the SWE map allowed them to compute SWE volume. They compared the estimated volume using the subpixel SCA map with several SCA maps produced with simulations of binary SCA mapping techniques.

MP 5167
FIELD MEASUREMENTS OF SNOWDRIFT DEVELOPMENT RATE.
Haehnel, R.B., Lever, J.H., Tabler, R.D., *Eastern Snow Conference and Western Snow Conference. Proceedings,* 1997, Joint 54th and 65th, p.61-68, 18 refs.
52-5527
SNOWDRIFTS, BLOWING SNOW, SNOW EROSION, WIND EROSION, SNOW FENCES, SNOW LOADS, WIND TUNNELS, ENVIRONMENTAL TESTS
For successful snow drift modeling, similitude of drift geometry and development rate must be preserved between model and prototype. Earlier work revealed that field data documenting drift development are scarce, yet such data are necessary to validate proposed modeling methods. This requires measurement of the evolving drift topography and concurrent measurement of the incident mass transport and flow field throughout the drifting event. The authors established a field program to measure drift development on a two-dimensional solid fence during the winters of 1996 and 1997 at two field sites located in Wyoming. The developing drift topography was measured using graduated snow stakes placed around the objects. The incident mass transport was measured using a Wyoming snow fence as a snow trap. The incident flow field was also documented. The authors compare prototype drift geometries and development rates with corresponding preliminary model data obtained in a snow drifting wind tunnel. The field data revealed some inaccuracies in the model drift geometry and development rate which might result from distortion in snow transport concentrations and particle trajectory lengths. Further work is required to minimize the effects of model distortions. The field data obtained in this work will serve as benchmark data for evaluating modeling methodologies.

MP 5168
SNOW ABLATION MODELING IN CONIFER AND DECIDUOUS STANDS OF THE BOREAL FOREST.
Hardy, J.P., Davis, R.E., Jordan, R., Ni, W.G., Woodcock, C.E., *Eastern Snow Conference and Western Snow Conference. Proceedings,* 1997, Joint 54th and 65th, p.114-124, 28 refs.
52-5532
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW ACCUMULATION, SNOW HYDROLOGY, SNOW HEAT FLUX, SNOW MELTING, SNOW AIR INTERFACE, SNOW EVAPORATION, TAIGA, FOREST LAND, FOREST CANOPY, LITTER, VEGETATION FACTORS, INTERCEPTION, ALBEDO, COMPUTERIZED SIMULATION
Both coniferous and deciduous forests alter the energy exchange and the accumulation and ablation of snow on the ground. Snow ablation modeling at the stand scale presents challenges to account for the variability in snow cover and the large variations of solar and thermal radiation incident to the forest floor. Previous work by the authors coupled a one-dimensional snow process model (SNTHERM), modified for forested conditions, with a model of radiation interactions with forest canopies to successfully predict snow ablation in a mature jack pine stand. Now, the authors use the same approach and model snow ablation in black spruce and aspen stands and verify the modeling effort by comparison with field data. A new routine is added to SNTHERM to account for forest litter on the snow surface, thereby affecting the albedo. They measured incoming solar and thermal irradiance beneath the forest canopy. At peak accumulation, snow depths in black spruce tree wells were approximately 65% of that measured in forest gaps. Snow in the aspen stand ablated 26 days before snow in the black spruce stand and both results compare favorably with available measured data.

MP 5169
OPERATIONAL DISTRIBUTED SNOW DYNAMICS MODEL FOR THE SAVA RIVER, BOSNIA.
Melloh, R.A., Daly, S.F., Davis, R.E., Jordan, R., Koenig, G.G., *Eastern Snow Conference and Western Snow Conference. Proceedings,* 1997, Joint 54th and 65th, p.152-162, 21 refs.
52-5536
SNOWSTORMS, SNOWFALL, SNOW DEPTH, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, RIVER FLOW, STREAM FLOW, RUNOFF FORECASTING, FLOOD FORECASTING, COMPUTERIZED SIMULATION, BOSNIA, SAVA RIVER
A method of estimating and forecasting snow pack dynamics for a large remote basin in Bosnia was developed and consists of a highly automated, spatially distributed model for operational simulation and forecasting of snow pack depth, snow water equivalent, soil freeze-thaw state, and flux of snow melt and rain infiltration to the base of the pack. The model, applied to hydrologic forecasts in Bosnia during the winter of 1996-97, has potential use in domestic flood and water supply forecasting. SNTHERM, a complex one-dimensional energy balance model that takes into account most physical processes within the snow cover, was used for snow pack computations. The model was distributed across the landscape by 1-km pixels, using a categorical classification of the basin into 216 slope, aspect and meteorology types. The model system was highly automated. Runoff ratios (runoff/rainfall) for the winter of 1996-97 compared well to long term average runoff coefficients, indicating precipitation data used to drive the model were reasonable. Supporting research issues are discussed.

MP 5170
STATUS OF ASCE STANDARD ON DESIGN AND CONSTRUCTION OF FROST PROTECTED SHALLOW FOUNDATIONS.
Danyluk, L.S., Crandell, J.H., Innovative Design and Construction for Foundations and Substructures Subject to Freezing and Frost, Minneapolis, MN, Oct. 5-8, 1997. Proceedings. Edited by C.K. Tan and Geotechnical Special Publication No.73, Reston, American Society of Civil Engineers, 1997, p.19-31, 15 refs.
52-5573
COLD WEATHER CONSTRUCTION, BUILDINGS, FOOTINGS, FOUNDATIONS, INSULATION, FROST HEAVE, HEAT TRANSFER, FROST PROTECTION, STANDARDS, BUILDING CODES, DESIGN CRITERIA
A Frost-Protected Shallow Foundation (FPSF) is a practical alternative to deeper, more costly foundations in cold regions having seasonal ground freezing and the potential for frost heave. An FPSF incorporates strategically placed insulation to raise the frost depth around a building, thereby allowing foundations as shallow as 16 in., even in the most severe climates. This procedure has been used extensively in the Scandinavian countries over the last 40 years. ASCE is currently developing a Standard that would be used in the design of FPSFs. The Standard is based on proven Scandinavian practices and various studies performed in the U.S., including computer modeling and field verification tests.

MP 5171
ICE FOOT DEVELOPMENT AT TEMPERATE TIDEWATER MARGINS IN ALASKA.
Hunter, L.E., Powell, R.D., *Geophysical research letters,* June 1, 1998, 25(11), p.1923-1926, 29 refs.
52-5582
GLACIOLOGY, GLACIER ICE, GLACIER BEDS, ICE EDGE, ICE WATER INTERFACE, BOTTOM ICE, ICEBERGS, CALVING, SEDIMENTATION, PROFILES, ORIGIN, UNITED STATES—ALASKA—GLACIER BAY
This paper presents evidence demonstrating ice feet at tidewater margins in Glacier Bay, AK. Ice feet are likely sources of many submarine icebergs originating at the ice margin. The cause of ice foot development is unclear, but may represent a change in fracture behavior near the bed where higher debris concentrations affect fracture propagation and calving. Ice foot formation can be favored by englacial discharge and sediment ramps along the glacier margin that can cause differential melting of the ice cliff. The presence of ice feet is important to understanding ice-proximal sediment dynamics because they are a primary source of debris-rich icebergs and their calving affects sediment redistribution patterns.

MP 5172
FREEZE-THAW EFFECTS ON VEHICULAR RUTS AND NATURAL RILLS: IMPORTANCE TO SOIL-EROSION AND TERRAIN MODELLING.
Gatto, L.W., *International Association of Hydrological Sciences. IAHS publication,* 1998, No.249, Modelling soil erosion, sediment transport and closely related hydrological processes. Edited by W. Summer, E. Klaghofer, and W. Zhang, p.71-79, 14 refs. Proceedings of an international symposium in Vienna, July 13-17, 1998.
52-5620
SOIL FREEZING, FROST ACTION, FROST PENETRATION, SOIL STRENGTH, SOIL TRAFFICABILITY, FROST RESISTANCE, FREEZE THAW TESTS, SOIL EROSION, WATER EROSION, GULLIES
Overland flows in vehicle ruts and naturally formed rills can be the dominant carriers of sediment down a hillslope. This research addresses the effects of soil freeze-thaw (FT) on rill and rut geometry, soil density, and infiltration, which partially determine water runoff quantity and velocity, and soil erodibility. Laboratory experiments and field observations showed that soil FT (a) decreased the channel hydraulic radius of a rectangular rill and wheel ruts up to 33%, (b) increased infiltration in wheel ruts by 62%, (c) decreased unconfined compression strength and shear strength in wheel ruts up to 81% and 57%, respectively, and unconfined compression strength in track ruts up to 60%, and (d) formed a V-shaped, 11-cm deep rill in a track rut on a 17° slope during spring thaw, while uncompacted soil adjacent to that rut showed no evidence of rill formation. These results can be used in soil-erosion and terrain-evolution models to account for overwinter modifications to hillslope hydrology and soils.

MP 5173
PHYSICALLY BASED MODELING OF ATMOSPHERE-TO-SNOW-TO-FIRN TRANSFER OF H_2O_2 AT SOUTH POLE.
McConnell, J.R., Bales, R.C., Stewart, R.W., Thompson, A.M., Albert, M.R., Ramos, R., *Journal of geophysical research,* May 20, 1998, 103(D9), p.10,561-10,570, 31 refs.
52-5669
CLIMATOLOGY, POLAR ATMOSPHERES, GASES, SNOW AIR INTERFACE, VAPOR DIFFUSION, MASS TRANSFER, VENTILATION, SNOW COMPOSITION, PHOTOCHEMICAL REACTIONS, SEASONAL VARIATIONS, SAMPLING, PROFILES, MODELS, ANTARCTICA—SOUTH POLE
A unique, 2 year set of year-round surface snow samples at South Pole and snow pits, with associated accumulation histories, were used to test a physically based model for atmosphere-to-firn transfer of H_2O_2. The model, which extends previous transfer modeling at South Pole into the snowpack, is based on the advection-dispersion equation and spherical diffusion within representative snow grains. Required physical characteristics of the snowpack, such as snow temperature and ventilation, were estimated independently using established physical models. The surface snow samples and related model simulations show that there

is a repeatable annual cycle in H_2O_2 in the surface snow at South Pole. The snow pits and associated model simulations point out the importance of accumulation timing and annual accumulation rate in understanding the deposition and preservation of H_2O_2 and $\delta^{18}O$ at South Pole. Long-term snowpack simulations suggest that the firn continues to lose H_2O_2 to the atmosphere for at least 10-12 years after burial at current South Pole temperatures and accumulation rates. (Auth. mod.)

MP 5174
OBSERVATIONS OF THE POLARIZATION OF LIGHT REFLECTED FROM SEA ICE.
Perovich, D.K., *Journal of geophysical research,* Mar. 15, 1998, 103(C3), p.5563-5575, 35 refs.
52-5790
SEA ICE, ICE OPTICS, SNOW OPTICS, ELECTROMAGNETIC PROPERTIES, SOLAR RADIATION, RADIANCE, SPECULAR REFLECTION, POLARIZATION (WAVES), ALBEDO, SURFACE ROUGHNESS, SNOW COVER EFFECT, RADIOMETRY, SPECTROSCOPY
As part of a large, interdisciplinary program investigating the electromagnetic properties of sea ice, the authors made spectral measurements of the albedo, reflectance, and Stokes vector of the reflected radiance field. The overall program encompassed observations of sea ice physical properties, optical properties and microwave properties, plus an extensive modeling effort. Measurements were made of an evolution sequence including young sea ice, pancake ice, snow-covered ice, first-year ice and ponded ice. The effects of surface roughness were investigated by artificially roughening part of a smooth, young ice sheet. Spectral and total albedos were sensitive to surface conditions. Stokes vector observations exhibited the greatest variability in the plane of incidence of the solar beam. Smoother surfaces, such as melt ponds, pancakes and bare ice, exhibited a larger increase than the snow-covered cases with their "rougher" surfaces. Specularly reflected light was highly polarized. In the "smooth" ice cases, there was significant polarization associated with the increase in reflectance, implying a substantial contribution from specular reflection. This contribution was greater at longer wavelengths, where specular reflection was a larger component of the reflected radiance.

MP 5175
STATISTICS OF SURFACE-LAYER TURBULENCE OVER TERRAIN WITH METER-SCALE HETEROGENEITY.
Andreas, E.L., Hill, R.J., Gosz, J.R., Moore, D.I., Otto, W.D., Sarma, A.D., *Boundary-layer meteorology,* 1998, Vol.86, p.379-408, 50 refs.
52-5822
METEOROLOGY, TURBULENT BOUNDARY LAYER, SOIL AIR INTERFACE, TURBULENT DIFFUSION, AIR TEMPERATURE, HUMIDITY, HEAT SINKS, DIURNAL VARIATIONS, WIND FACTORS, TOPOGRAPHIC EFFECTS, MATHEMATICAL MODELS, STATISTICAL ANALYSIS, INDEXES (RATIOS)
The Sevilleta National Wildlife Refuge has patchy vegetation in sandy soil. During midday and at night, the surface sources and sinks for heat and moisture may thus be different. Although the Sevilleta is broad and level, its meter-scale heterogeneity could therefore violate an assumption on which Monin-Obukhov similarity theory (MOST) relies. To test the applicability of MOST in such a setting, the authors measured the standard deviations of vertical and longitudinal velocity, temperature and humidity, the temperature-humidity covariance and the temperature skewness. Dividing the former five quantities by the appropriate flux scales yielded nondimensional statistics with magnitudes and variations with stability similar to those reported in the literature and, thus, seem to obey MOST.

MP 5176
STABILITY DEPENDENCE OF THE EDDY-ACCUMULATION COEFFICIENTS FOR MOMENTUM AND SCALARS.
Andreas, E.L., Hill, R.J., Gosz, J.R., Moore, D.I., Otto, W.D., Sarma, A.D., *Boundary-layer meteorology,* 1998, Vol.86, p.409-420, 29 refs.
52-5823
METEOROLOGY, TURBULENT BOUNDARY LAYER, STABILITY, HEAT FLUX, TURBULENT EXCHANGE, AIR FLOW, VAPOR TRANSFER, WIND VELOCITY, MATHEMATICAL MODELS, ANALYSIS (MATHEMATICS), SAMPLING, INDEXES (RATIOS)
From a set of turbulence data collected with a three-axis sonic anemometer/thermometer, the authors simulate the eddy-accumulation process for sensible heat and momentum fluxes. The resulting eddy-accumulation coefficient for momentum clearly depends on surface-layer stability; at neutral stability, its value is 0.63. Supplementation of the scalar eddy-accumulation coefficients derived from sensible heat flux data with values of sensible and latent heat flux coefficients reported by Businger and Oncley reveals that scalar eddy-accumulation coefficients depend on stability, though more weakly than does the momentum coefficient. The coefficients for sensible and latent heat show no significant difference, and are fitted with one function of stability whose value is 0.52 for neutral stratification.

MP 5177
ATMOSPHERIC ICE ABLATION PROCESSES ON MT EQUINOX, VERMONT, USA.
Ryerson, C.C., Kenyon, P., *Atmospheric research,* 1998, Vol.46, p.75-86, 16 refs. For another version see 50-5375.
52-5825
SYNOPTIC METEOROLOGY, ICE ACCRETION, GLAZE, HOARFROST, ABLATION, CLASSIFICATIONS, ICE SUBLIMATION, ICE SOLID INTERFACE, ICE AIR INTERFACE, WIND DIRECTION, WIND FACTORS, ICE COVER EFFECT, MASS TRANSFER, UNITED STATES—VERMONT—EQUINOX, MOUNT
The goal of this study is to identify local and synoptic-scale weather conditions associated with rime and glaze ablation. A total of 77 ablation periods were recorded by time-lapse video for 2 winters on Mt. Equinox, VT, USA. Weather information was acquired from on-site measurements, radiosondes and synoptic charts. Sublimation was the slowest process, whereas melt and mechanical ablation events were the most rapid. Ablation occurred principally during daylight hours. Wind speeds were similar and slowest during sublimation and melt, with sublimation occurring primarily in westerly winds, and melt occurring within southerly winds. Sublimation air temperatures and relative humidities were lowest, with medians of -11°C and 57%, respectively. In general, melt is most frequent as storms approach, and sublimation is most common as storms depart.

MP 5178
METEORITIC EVENT RECORDED IN ANTARCTIC ICE.
Harvey, R.P., et al, *Geology,* July 1998, 26(7), p.607-610, 24 refs.
52-6236
GLACIOLOGY, ICE SHEETS, ICE DATING, SEDIMENTS, PROJECTILE PENETRATION, STRATIGRAPHY, GEOCHRONOLOGY, ANTARCTICA—ALLAN HILLS
During systematic sampling of volcanic ash (tephra) layers at a well-known antarctic meteorite collection site (the Allan Hills main ice field), a band of unusually dark and rounded (many spheroidal) particles was discovered. This debris layer (BIT-58) extends parallel to the stratigraphy of the ice established from the tephra bands, apparently marking a single depositional event. The shapes, internal texture, major element composition, and levels of cosmogenic nuclides of particles from within BIT-58 all strongly suggest that this material represents ablation debris from the passage of a large H-group ordinary chondrite. Preliminary cosmogenic isotope dating suggests an age of 2.8 Ma, implying that the East Antarctic ice sheet has been stable since that time. (Auth. mod.)

MP 5179
HOLOCENE-YOUNGER DRYAS TRANSITION RECORDED AT SUMMIT, GREENLAND.
Taylor, K.C., Gow, A.J., Meese, D.A., *Science,* Oct. 31, 1997, 278(5339), p.825-827, 26 refs.
52-5829
PLEISTOCENE, PALEOCLIMATOLOGY, CLIMATIC CHANGES, ICE SHEETS, ICE CORES, ATMOSPHERIC CIRCULATION, WATER VAPOR, ISOTOPE ANALYSIS, GEOCHRONOLOGY, SAMPLING, GREENLAND

MP 5180
CONTRAPTION MAKES ICE FLY AT SOUTH POLE: NEW CRREL DIGGER GREAT SUCCESS, MAKES TUNNELING FAST, SAFE.
Walsh, M.R., *Engineer update,* Feb. 1997, 21(2), p.10.
52-5869
SNOW TUNNELS, TUNNELING (EXCAVATION), ICE CUTTING, MACHINERY, CONSTRUCTION EQUIPMENT, ANTARCTICA—AMUNDSEN-SCOTT STATION

MP 5181
ICE JAMS IN ALASKA.
Eames, H.J., White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Feb. 1997, No.16, 4p., 8 refs.
52-5870
RIVER ICE, FREEZEUP, ICE BREAKUP, ICE JAMS, ACCIDENTS, FLOODS, FLOOD FORECASTING, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—ALASKA

MP 5182
ICE JAMS, WINTER 1995-96.
Eames, H.J., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Aug. 1997, No.17, 4p., 9 refs.
52-5871
RIVER ICE, FREEZEUP, ICE BREAKUP, ICE JAMS, ACCIDENTS, FLOODS, FLOOD FORECASTING, DATA PROCESSING, STATISTICAL ANALYSIS, COST ANALYSIS, UNITED STATES

MP 5183
DESIGN ISSUES FOR COMMERCIAL-SCALE GROUND-SOURCE HEAT PUMP SYSTEMS.
Phetteplace, G., Kavanaugh, S., Heartland Technology Transfer Conference, Kansas City, MO, June 1-4, 1998, Washington, D.C., U.S. Army Corps of Engineers, 1998, 14p., 10 refs.
52-5903
BUILDINGS, HEAT PUMPS, HEAT RECOVERY, GEOTHERMY, RADIANT HEATING, COOLING SYSTEMS, DESIGN CRITERIA

MP 5184
PERFORMANCE OF A HYBRID GROUND-COUPLED HEAT PUMP SYSTEM.
Phetteplace, G., Sullivan, W., *American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Transactions,* 1998, 104(pt.1), 8p., 4 refs.
52-5904
BUILDINGS, HEAT PUMPS, GEOTHERMY, HEAT RECOVERY, RADIANT HEATING, AIR CONDITIONING, COOLING SYSTEMS, COOLING TOWERS
In climates dominated by air conditioning, a few so-called "hybrid" ground-coupled heat pump (GCHP) systems have been built. The hybrid system uses both a ground-coupled heat exchanger and a cooling tower, thereby reducing the amount of ground-coupling heat exchanger necessary. Although this concept has been shown to be feasible, the performance of such a system has not been measured in detail. Since it may be possible to achieve significant performance improvements in such systems by modifying the design and operational practices, detailed performance monitoring of such systems is needed. This paper describes a project that has been undertaken to collect performance data from a hybrid GCHP system at Fort Polk, LA. This paper presents performance data for a period of about 22 months, including data from portions of two heating and cooling seasons. The energy input to the GCHPs themselves will be presented, as well as the energy rejected to the ground in the cooling mode and that extracted from the ground in the heating mode. Energy flows in the cooling tower also will be addressed, along with the power consumption of the circulating pumps and the cooling tower.

MP 5185
LOW TEMPERATURE BEHAVIOR OF THERMALLY CYCLED GLASS-FIBER-REINFORCED POLYMER CONCRETE.
Dutta, P.K., Hui, D., Saranayan, N.C., International SAMPE Symposium and Exhibition, 39th, Anaheim, CA, Apr. 11-14, 1994. Moving forward with 50 years of leadership in advanced materials. Vol.39. Book 1, Covina, CA, Society for the Advancement of Material and Process Engineering, 1994, p.334-346, 6 refs.
52-5905
REINFORCED CONCRETES, POLYMERS, COMPOSITE MATERIALS, CONCRETE CURING, CONCRETE STRENGTH, LOW TEMPERATURE TESTS, FREEZE THAW TESTS
This paper presents a preliminary evaluation of the observed mechanical behavior of several mixes of glass-fiber-reinforced polymer concrete at subzero temperatures and after a series of freeze-thaw cycles. Before evaluating at low temperature (-20°C) these materials were subjected to soaking in 33 parts per thousand concentration of salt water for 72 hours and then thermally cycled for 50 cycles between 30°C and -20°C. The results showed that both compressive and tensile strengths increased significantly as a result of thermal cycling. The increase in strength was observed both at room temperature (24°C) and at low temperature (-20°C), with the low temperature strength showing the maximum increase. In almost all cases the tensile strengths of the composite increased after thermal cycling. These results indicate a potentially improved curing of the material under low temperature thermal cycling and beneficial effects of the polymer additives for low temperature concrete.

MP 5186
EFFECT OF LOW TEMPERATURE ON THE FLEXURAL FATIGUE AND FRACTURE OF UNIDIRECTIONAL GRAPHITE/EPOXY COMPOSITES.
Dutta, P.K., Army Symposium on Solid Mechanics, 12th, Plymouth, MA, Nov. 4-7, 1991. Proceedings. Synergism of mechanics, mathematics and materials, Columbus, OH, Battelle Press, [1991], p.573-581, 3 refs.
52-5906
COMPOSITE MATERIALS, POLYMERS, LOW TEMPERATURE TESTS, STRAIN TESTS, FLEXURAL STRENGTH, FATIGUE (MATERIALS)

MP 5187
SAMPLING FOR IN-VIAL ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN SOIL.
Hewitt, A.D., Lukash, N.J.E., *American environmental laboratory,* Aug. 1996, 8p., 23 refs.
52-5907
SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS

MP 5188
ON-SITE ESTIMATION OF THE TOTAL CONCENTRATION OF VOCS IN SOIL: A DECISION TOOL FOR SAMPLE HANDLING.
Hewitt, A.D., Current protocols in field analytical chemistry, New York, John Wiley & Sons, Inc., 1998, p.1A.3.1-1A.3.8, 13 refs.
52-5908
SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS
This protocol describes an on-site screening procedure using a battery-operated photoionization detector to estimate the total concentration of volatile organic compounds (VOCs) in soil, relative to a site-specific working standard at a concentration of 0.2 mg/kg. The intent of this procedure is to provide a decision tool that will allow sampling activities to incorporate the appropriate in-vial soil sample preparation protocol for conventional laboratory VOC analysis. Coupling such a method for estimating the total VOC concentration in soil with sampling procedures that limit substrate disaggregation and exposure complements efforts to achieve site-representative estimates for contamination of the vadose zone (that region between the ground surface and the saturated zone).

MP 5189
COLORIMETRIC DETERMINATION OF TNT AND RDX IN SOIL.
Jenkins, T.F., Walsh, M.E., Current protocols in field analytical chemistry, New York, John Wiley & Sons, Inc., 1998, p.2D.2.1-2D.2.9, 12 refs.
52-5909
SOIL POLLUTION, EXPLOSIVES, SOIL CHEMISTRY, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS
Simple colorimetric tests for onsite determination of 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in soil are based on the Janowsky reaction (for TNT) and the Griess and Franchimont reaction (for RDX). In both cases, the development of a visible reddish color indicates the presence of the target analytes, and their concentrations are estimated from absorbance measurements at 540 nm for TNT and 507 nm for RDX.

MP 5190
DIELECTRIC CONSTANTS OF SEA ICE AT MICROWAVE FREQUENCIES.
Ackley, S.F., Lytle, V.I., Accelerated Research Initiative (ARI). Electromagnetic properties of sea ice. 3-year summary, Arlington, VA, U.S. Office of Naval Research, Jan. 1996, p.16-23, 2 refs.
52-5910
SEA ICE, ICE MICROSTRUCTURE, ICE SALINITY, ICE DIELECTRICS, ICE ELECTRICAL PROPERTIES, BRINES, MICROWAVES, RADAR ECHOES

MP 5191
ELECTROMAGNETICS AND OPTICS ADVANCED RESEARCH INITIATIVE: LABORATORY AND FIELD INVESTIGATIONS INTO THE STRUCTURAL AND PHYSICAL CHARACTERISTICS OF SALINE ICE SHEETS AND THEIR ELECTROMAGNETIC PROPERTIES.
Gow, A.J., Perovich, D.K., Accelerated Research Initiative (ARI). Electromagnetic properties of sea ice. 3-year summary, Arlington, VA, U.S. Office of Naval Research, Jan. 1996, p.60-70.
52-5911
SALT ICE, ICE STRUCTURE, ICE DENSITY, ICE SALINITY, ICE TEMPERATURE, ICE ELECTRICAL PROPERTIES, ARTIFICIAL ICE, ENVIRONMENTAL TESTS, RADIOMETRY, RADAR ECHOES

MP 5192
RELATIONSHIPS OF OPTICAL PROPERTIES AND ICE STRUCTURE.
Perovich, D.K., Accelerated Research Initiative (ARI). Electromagnetic properties of sea ice. 3-year summary, Arlington, VA, U.S. Office of Naval Research, Jan. 1996, p.101-107.
52-5912
SEA ICE, ICE STRUCTURE, ICE OPTICS, SNOW ICE INTERFACE, ICE MELTING, ALBEDO, RESEARCH PROJECTS

MP 5193
ICE CORE CONTRIBUTION TO GLOBAL CHANGE RESEARCH: PAST SUCCESSES AND FUTURE DIRECTIONS.
U.S. National Science Foundation. Ice Core Working Group (ICWG), Mayewski, P.A., Meese, D.A., Durham, University of New Hampshire, Science Management Office, National Ice Core Laboratory, May 1998, 48p., Refs. p.40-48. P.A. Mayewski was the chairman and D.A. Meese of CRREL was a member of the working group.
52-5940
ICE CORES, ICE COMPOSITION, ICE DATING, DRILL CORE ANALYSIS, ATMOSPHERIC COMPOSITION, ATMOSPHERIC CIRCULATION, PALEOCLIMATOLOGY, GLOBAL CHANGE, RESEARCH PROJECTS
This booklet summarizes current studies on reconstructing paleoclimates and predicting future global climate change from arctic and antarctic ice core records. The Ice Core Working Group proposes a schedule of antarctic ice core research activities by the United States through the year 2006, which includes U.S. ITASE, the U.S. contribution to the International Trans Antarctic Scientific Expedition, and WAISCORES, drilling on the West Antarctic Ice Sheet at Siple Dome and at a site to be selected near the inland ice divide. Further information on WAISCORES is available at http://www.maxey.dri.edu/WRC/waiscores.

MP 5194
COMPOSITE GRIDS FOR REINFORCEMENT OF CONCRETE STRUCTURES.
Dutta, P.K., et al, *U.S. Army Construction Engineering Research Laboratories. Technical report,* June 1998, No.98/81, Construction Productivity Advancement Research (CPAR) Program, 158p., Refs. p.86-92.
52-5950
COMPOSITE MATERIALS, POLYMERS, PLASTICS, REINFORCED CONCRETES, CONCRETE STRENGTH, CONCRETE DURABILITY, BEARING STRENGTH, FLEXURAL STRENGTH, STRAIN TESTS, STRUCTURAL ANALYSIS
This research investigated a new concept that uses fiber-reinforced plastic (FRP) composite grid to reinforce concrete structural members. Prefabricated two- and three-dimensional FRP grid structures were investigated as a possible alternative to conventional one-dimensional steel reinforcement rods. Current available commercial grid manufacturing techniques were found to be inadequate due to material flaws, poor fiber volume fraction, and low strength and stiffness. Through laboratory investigations, significant improvements in fiber volume fraction in orthogrid and isogrid systems were achieved. Laboratory-scale samples demonstrated excellent results under loading tests. Concurrent investigations showed that although the FRP grid-reinforced concrete is more flexible than steel-reinforced concrete, its postfailure deformation was pseudo-ductile, characterized by continuous structural deformation through multiple low-level brittle failures before the onset of catastrophic failure. It was also found that a combined concrete/composite reinforcement structure, with a higher volume of FRP composite fraction in the concrete, would substantially increase stiffness, load capacity, and postfailure concrete containment.

MP 5195
WATER RETENTION FUNCTIONS OF FOUR NONWOVEN POLYPROPYLENE GEOTEXTILES.
Stormont, J.C., Henry, K.S., Evans, T.M., *Geosynthetics international,* 1997, 4(6), p.661-672, 11 refs.
52-6032
GEOTEXTILES, SOIL STABILIZATION, SYNTHETIC MATERIALS, POLYMERS, WATER RETENTION, SATURATION, WATER FLOW, CAPILLARITY, SURFACTANTS, MECHANICAL TESTS
The water retention functions of four nonwoven polypropylene geotextiles were measured. Each of the four geotextile types were tested in two conditions: new and cleaned. The water retention functions of each geotextile specimen were found to be hysteretic. The new geotextile specimens always contained more water at comparable suction heads than the cleaned geotextile specimens. At zero suction head, the new specimens approached saturation, whereas the cleaned specimens were less than 20% saturated.

MP 5196
MEASUREMENT OF THE CONTACT ANGLE OF WATER ON GEOTEXTILE FIBERS.
Henry, K.S., Patton, S., *Geotechnical testing journal,* Mar. 1998, 21(1), p.11-17, 16 refs.
52-6034
GEOTEXTILES, SYNTHETIC MATERIALS, POLYMERS, SOIL STABILIZATION, WETTABILITY, CAPILLARITY, LIQUID SOLID INTERFACES, INTERFACIAL TENSION, INDEXES (RATIOS), MECHANICAL TESTS, MEASUREMENT
The contact angle of water on geotextile fibers significantly influences capillary behavior. Measurements of the dynamic contact angle of tap water on geotextile fibers are reported for two geotextiles, as received from the manufacturer and after they had been treated (cleaned). There is considerable hysteresis between advancing and receding contact angles, as expected. Fibers from one geotextile have significantly lower contact angle cosines than the other, indicating that it is less wettable. The cleaning of geotextiles resulted in significant reduction in the advancing contact angles of fibers from one of the geotextiles but not the other. The heights of water capillary rise in strips of the geotextiles were also measured. Results showed that the contact angle measurements are helpful; but, information on pore sizes is also needed to predict capillary behavior.

MP 5197
SEASONALLY INSTALLED WEIR TO CONTROL FREEZEUP ICE JAMS.
Lever, J.H., Gooch, G., Foltyn, E.P., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.3-9, 5 refs.
52-6087
RIVER ICE, FRAZIL ICE, FREEZEUP, ICE JAMS, ICE CONTROL
Frazil ice production in small, steep rivers can lead to thick freezeup ice jams and consequent flooding. One way to control these ice jams is to collect frazil ice and promote ice-cover propagation in a safe location upstream. The authors developed a seasonally installed weir that can assist an ice boom or natural ice arching to arrest frazil floes. This "tension weir" consists of a 0.9-m high impermeable fabric mounted on wire mesh, held in shape under tension by wire rope connected to deadman anchors. Model tests were used to optimize the weir shape, seals and scour protection. Field tests of the structure showed that it performs well during both freezeup and breakup conditions. This paper describes the design, construction, and testing of the tension weir and possible improvements on its design.

MP 5198
PHYSICAL MODEL STUDY OF ICE RETENTION BOOMS.
Tuthill, A.M., Gooch, G., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.61-66, 9 refs.
52-6096
RIVER ICE, ICE CONTROL, ICE BOOMS, ICE LOADS, ICE WATER INTERFACE, RIVER FLOW, ENVIRONMENTAL TESTS
A major disadvantage of conventional ice control booms is their limited effectiveness at water velocity above about 0.7 m/s and Froude number greater than about 0.1. A 1:25 scale hydraulic model study of a generic rectangular channel investigated alternatives for ice retention at open water velocities in the 0.6 to 1.0 m/s (prototype) range. Alternative boom unit geometries and boom configurations were tested, using a plastic ice material and natural ice. Boom cable tensions were measured as ice accumulated upstream of the structures. The study focused on ice restraint capacity of the boom, ice entrainment and ice erosion velocities, as well as the effect of ice friction along the channel sides. Although it was possible to increase the ice restraint capacity of model booms beyond conventional levels, ice entrainment and under ice erosion limited boom performance at higher water velocities.

MP 5199
SIMULATION OF RIVER ICE JAM FORMATION.
Daly, S.F., Hopkins, M.A., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.101-108, 19 refs.
52-6101
RIVER ICE, ICE JAMS, ICE FLOES, ICE FRICTION, ICE COVER THICKNESS, ICE LOADS, ICE WATER INTERFACE, RIVER FLOW, ICE FORECASTING, ICE CONTROL, FLOOD FORECASTING, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS
A three-dimensional discrete element ice model has been coupled with a one-dimensional unsteady channel flow model and used to simulate ice jam formation at an ice control structure. The ice control structure consisted of three cylindrical piers placed across a straight, rectangular channel. The discrete element model is capable of modeling the behavior of several thousand, three-dimensional disk-shaped floes by resolving the inter-floe contact forces, fluid drag force, gravitational force, and buoyancy force acting on each floe. The unsteady flow model is capable of modeling open water flow, flow under an ice jam, and high Reynolds number seepage flow through an ice jam. Two types of ice jams were simulated. The first began with a single layer of floes, evenly distributed on the water surface, moving downstream in a steady, uniform flow. The second began with the release of an upstream impoundment of floes carried downstream by the resulting surge of water. During each simulation the river stage, dis-

charge, forces, and ice jam profiles were calculated at uniformly spaced cross-sections and time intervals.

MP 5200
STABLE ENVIRONMENTAL ISOTOPES IN LAKE AND RIVER ICE CORES.
Ferrick, M.G., Calkins, D.J., Perron, N.M., Kendall, C., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.207-214, 11 refs.
52-6116
LAKE ICE, RIVER ICE, ICE FORMATION, ICE GROWTH, SNOW ICE, ICE COMPOSITION, ICE CORES, ISOTOPE ANALYSIS, MATHEMATICAL MODELS, UNITED STATES—NEW HAMPSHIRE
In this paper the relationship between the stable isotopic signatures of river- and lake-ice cores and corresponding ice formation processes are sought. A parameter that must be determined to establish these relationships is the variable isotopic fractionation during ice growth. Ice cores obtained near the times of maximum thickness from a river impoundment and a small lake were composed predominantly of snow ice and congelation ice. Snow cover and water samples, ice thicknesses, flow velocities, and meteorological data were also obtained throughout the growth period to support the analysis. The time of initial ice cover formation differed between the two sites by about a week, and as a result the ice formation processes differed significantly. In addition, snow ice formation and highly variable met conditions led to isotopic signatures of the congelation ice that were different from others that have been reported. A diffusion model developed to simulate solute rejection by crystals grown from the melt, was used to interpret the data. The model was consistent with the field data.

MP 5201
ICE-TANK STUDIES OF PHYSICAL AND BIOLOGICAL SEA-ICE PROCESSES.
Eicken, H., Ackley, S.F., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.363-370, 16 refs.
52-6139
SEA WATER FREEZING, SEA ICE, ICE GROWTH, ICE MICROSTRUCTURE, ICE COMPOSITION, ICE COVER EFFECT, BIOMASS, BACTERIA, ALGAE, CRYOBIOLOGY, ECOLOGY, RESEARCH PROJECTS, ENVIRONMENTAL TESTS
Ice-growth experiments were carried out in an Environmental Test Basin to study the evolution of the microstructure and physico-chemical characteristics of the ice as well as the growth and development of sea-ice biological communities as a function of the relevant boundary conditions (thermal forcing, current velocity, waves etc.). Linkages between salt and heat fluxes and ice evolution were assessed through microstructural analyses, involving also improvement of sampling and analysis techniques. As testified by measurements of biomass as well as primary and bacterial production, a viable community of arctic sea-ice organisms could be established in the ice. While currents had a considerable impact on ice structural evolution, ice organisms were mostly affected by thermal forcing and the light regime. In separate enclosures, bioremediation strategies in oil-polluted sea ice were studied. A further component of the experimental program was devoted to particle entrainment into the ice cover and wave-ice interaction.

MP 5202
LABORATORY AND FIELD STUDIES ON RIDGING OF AN ICE SHEET.
Tuhkuri, J., Lensu, M., Hopkins, M.A., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.397-404, 18 refs.
52-6144
ICE FLOES, PRESSURE RIDGES, ICE OVERRIDE, ICE PRESSURE, ICE FRICTION, ICE LOADS, ICE COVER STRENGTH, ICE DEFORMATION, ICE COVER THICKNESS, ENVIRONMENTAL TESTS
Ridging and rafting of model ice sheets have been studied. In an ice basin, model ice sheets of uniform thickness always rafted and did not form ridges. However, in nature the thickness of level ice may not be as uniform as in the laboratory and, therefore, a non-uniform model ice field consisting of floes of thickness t_1 and thin ice of thickness t_2 connecting these floes was used in the experiments. During a test, a strip of non-uniform model ice was compressed with a pusher plate and a ridge formed at an initial cut made across the strip. The shape of the ridges that formed in the laboratory was very similar to those seen in the northern Baltic, with typical sinusoidal arches.

MP 5203
MODEL FOR ICE THRUST ON DAM WALLS.
Sodhi, D.S., Carter, D., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.433-439, 10 refs.
52-6149
RESERVOIRS, DAMS, LAKE ICE, ICE FLOES, ICE SOLID INTERFACE, ICE LOADS, ICE PUSH, ICE PRESSURE, ICE COVER STRENGTH, ICE CRACKS, ICE DEFORMATION, STRUCTURAL ANALYSIS, MATHEMATICAL MODELS
The authors briefly describe a field program to measure both the ice thrust on dam walls and stress in the middle of an ice sheet. On the basis of good correlation found between the development of ice thrust and the rise in water level in a reservoir, and observations of parallel cracks along a dam wall, they present two theoretical models. The first estimates the upper bound force per unit width for the rotation of an ice floe between two parallel cracks, and the second is for buckling of two ice floes between three parallel cracks. They consider the wedging action attributable to the rotation of ice blocks in both cases. They postulate that it is possible for wedging to develop during the rotation of an ice floe between two cracks, but this possibility is small for two ice floes in a buckled position between three cracks. For the case of two ice floes between three parallel cracks, the estimated thrust from gravitational forces is close to the maximum ice thrust measured at two sites.

MP 5204
BOND STRENGTH OF AN ICE-SOLID INTERFACE LOADED IN SHEAR.
Haehnel, R.B., Mulherin, N.D., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.597-604, 22 refs.
52-6171
STEEL STRUCTURES, PROTECTIVE COATINGS, ICE PREVENTION, ICE SOLID INTERFACE, ICE ACCRETION, ICE ADHESION, ICE LOADS, ICE STRENGTH, SHEAR STRENGTH, STRAIN TESTS
Lack of a standardized method for testing the adhesive strength of ice has hampered efforts to understand ice adhesion and development of low-adhesion materials. However, there are numerous standards for testing adhesive joints. The authors describe an adaptation of the 0° cone test for measuring the adhesive strength of ice in shear, substituting ice for the adhesive. The main advantage is its simplicity in sample preparation and testing. This paper describes the test procedure and results for ice bonded to stainless steel, aluminum, and several coatings applied to aluminum. This study found that the measured adhesive shear strength of ice bonded to stainless steel increased with strain rate, which follows the same general trend as the cohesive shear in ice, except that the failure strengths were about one tenth that of the estimated cohesive shear strength. Coating aluminum reduced the bond strength by a factor of 3. There was little difference in the bond strength measured for the coatings that were tested. The adhesive strength of ice bonded to stainless steel is about the same as for coated aluminum.

MP 5205
SIMULATION OF RIDGING AND RAFTING IN FIRST-YEAR ICE.
Hopkins, M.A., Tuhkuri, J., International Symposium on Ice, 14th, Potsdam, NY, July 27-31, 1998. Proceedings. Ice in surface waters. Vol.1. Edited by H.T. Shen, Rotterdam, A.A. Balkema, 1998, p.623-630, 7 refs.
52-6174
ICE FLOES, PRESSURE RIDGES, ICE OVERRIDE, ICE PILEUP, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE BREAKING, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS
When two floating ice sheets are pushed together they either raft or ridge. In this work both processes are simulated using a two-dimensional discrete element model. During ridge formation blocks broken from the sheets accumulate to form the ridge sail and keel. During rafting events one sheet overrides the other. Frequently, the two processes alternate. The accuracy of the simulations is assessed by comparison with a series of similar model experiments. Following this comparison the computer model is used to perform simulations to explore the effect of the thickness and the thickness inhomogeneity of the ice sheets on the likelihood of occurrence of ridging and rafting. Inhomogeneity is treated using sheets composed of two thicknesses. The transitional behavior between ridging and rafting is characterized through an analysis of the energetics.

MP 5206
EFFECTIVE MEDIUM APPROXIMATION FOR THE CONDUCTIVITY OF SENSIBLE HEAT IN DRY SNOW.
Arons, E.M., Colbeck, S.C., *International journal of heat and mass transfer,* Sep. 1998, 41(17), p.2653-2666, 27 refs.
52-6242
SNOW PHYSICS, SNOW COVER STRUCTURE, METAMORPHISM (SNOW), MICROSTRUCTURE, GRAIN SIZE, SINTERING, SNOW THERMAL PROPERTIES, THERMAL CONDUCTIVITY, LATENT HEAT, MATHEMATICAL MODELS
The authors developed an inductive model for thermal conductivity of sensible heat of deposited snow using random resistance network theory and parametric statistics. The model identifies the geometric quantities that determine this physical property. It allows quantitative conductivity linkage to natural transformations that are known to change conductivity and increases ability to test such theories experimentally. They are now able to show how microstructural quantities such as grain size distribution and average coordination number interact with each other to govern conductivity. These results may easily be extended to other porous geological and industrial materials.

MP 5207
ATMOSPHERIC ICING AND COMMUNICATION TOWER FAILURE IN THE UNITED STATES.
Mulherin, N.D., *Cold regions science and technology,* Apr. 1998, 27(2), p.91-104, 6 refs.
52-6335
TOWERS, ANTENNAS, TELECOMMUNICATION, ICE STORMS, ICE ACCRETION, ICE COVER EFFECT, DAMAGE, WIND FACTORS, FATIGUE (MATERIALS), PERIODIC VARIATIONS, METEOROLOGICAL DATA, STATISTICAL ANALYSIS, STRUCTURAL ANALYSIS, CLASSIFICATIONS, UNITED STATES
The U.S. Army Cold Regions Research and Engineering Laboratory has established a database of communication tower collapses that have occurred in the United States due to atmospheric ice accretion. The information was compiled primarily from newspaper articles and telephone interviews but also from a multitude of other sources. The database currently lists 140 such failures of towers dating as far back as 1959. For each case, the following information is being compiled: (1) structural characteristics of the tower, (2) the geographic location and topography, (3) a description of the collapse, (4) concurrent weather and (5) damage.

MP 5208
3-D SIMULATION OF SUBSURFACE PEC SENSING FOR DISCRIMINATION ENHANCEMENT USING BISTATIC POSITIONAL, ANGULAR, AND POLARIZATION DIVERSITY.
Haider, S.A., O'Neill, K., Paulsen, K.D., International Geoscience and Remote Sensing Symposium, Seattle, WA, July 6-10, 1998. IGARSS'98. Sensing and managing the environment. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1998, p.520-523, 8 refs.
52-6475
MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, LAND RECLAMATION, ELECTROMAGNETIC PROSPECTING, SUBSURFACE INVESTIGATIONS, RADIO ECHO SOUNDINGS, ENVIRONMENT SIMULATION
This paper presents results intended to improve understanding of the gains to be made in subsurface electromagnetic discrimination by employing bistatic positional, angular, and polarization diversity. Applying a 3-D finite element approach eliminates any restriction to axisymmetric geometries in targets and environment; and recent numerical innovations allow us to perform meaningful 3-D simulations at the workstation level. For specificity the authors assume an incident wave polarized in the (X,Z) plane of incidence, where Z is aligned with longitudinal target axis, for orientable targets. The simulations show physically explicable gains in discrimination from bistatic, polarimetric, multi-angle observation, even at a single frequency, with wavelengths an order of magnitude larger than characteristic target dimensions.

MP 5209
DEVELOPMENT OF INTERACTIVE FLY-THROUGH IMAGING AND ANIMATION TECHNIQUES FOR P-SCOPE IMAGING RADAR SIMULATION.
Henson, J.M., Stuopis, P.A., Davis, R.E., Hall, K., International Geoscience and Remote Sensing Symposium, Seattle, WA, July 6-10, 1998. IGARSS'98. Sensing and managing the environment. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1998, p.1109-1111, 5 refs.
52-6486
AERIAL SURVEYS, AIRBORNE RADAR, RADAR PHOTOGRAPHY, PHOTOGRAPHIC RECONNAISSANCE, TERRAIN IDENTIFICATION, ENVIRONMENT SIMULATION

MP 5210
REMOTE SENSING OF SEA ICE SURFACE THERMAL STATES UNDER CLOUD COVER.
Nghiem, S.V., et al, International Geoscience and Remote Sensing Symposium, Seattle, WA, July 6-10, 1998. IGARSS'98. Sensing and managing the environment. Vol.4, New York, Institute of Electrical and

Electronics Engineers, 1998, p.2219-2221, 8 refs.
52-6540
SEA ICE, ICE DETECTION, ICE AIR INTERFACE, ICE HEAT FLUX, ICE TEMPERATURE, SURFACE TEMPERATURE, CLOUD COVER, ALBEDO, SYNTHETIC APERTURE RADAR, RADIO ECHO SOUNDINGS, RADIOMETRY, BACKSCATTERING, SPACEBORNE PHOTOGRAPHY
It is necessary to know sea ice surface thermal states under cloud cover to evaluate cloud effects in the overall climatic feedback mechanisms in polar regions. The challenge is that traditional methods using radiometers such as AVHRR for surface temperature measurements fail under cloudy conditions. The authors present a new method combining C-band radar data to study sea ice surface temperature change and visible/infrared radiometer data to identify clouds. C-band radar backscatter is sensitive to sea ice surface thermal states. This relationship is utilized to develop the methodology for the sea ice surface temperature study. SAR data show an increase in sea ice surface temperature, caused by an excess in the surface heat balance under cloud cover. The method is applicable to arctic first-year ice. For antarctic sea ice, this method is particularly appropriate since the antarctic ice cover consists of vast regions of first-year ice where salinity levels are generally higher than those of arctic sea ice of similar age and structure. (Auth. mod.)

MP 5211
RECENT PROGRESS IN RIVER ICE ENGINEERING RESEARCH AT CRREL.
Tatinclaux, J.C., *Journal of cold regions engineering,* Sep. 1998, 12(3), p.114-137, 52 refs.
52-6566
ENGINEERING, RIVER ICE, ICE NAVIGATION, ICE JAMS, ICE CONTROL, ICE FORECASTING, ICE MECHANICS, HYDRAULIC STRUCTURES, SIMULATION, MECHANICAL TESTS, RESEARCH PROJECTS
This paper reviews and summarizes the results of the research and development efforts in river ice engineering conducted at the U.S. Army Cold Regions Research and Engineering Laboratory over the past decade and their applications to the Civil Works mission of the U.S. Army Corps of Engineers. Topics covered include winter operation of navigation projects on the major northern U.S. waterways; river ice processes, namely ice transport and accumulation; ice jam documentation, prediction, and mitigation; and bed and bank erosion due to ice. The paper concludes with a brief discussion of future challenges and areas of needed research in river ice engineering.

MP 5212
PCC AIRFIELD PAVEMENT RESPONSE DURING THAW-WEAKENING PERIODS.
Janoo, V.C., Berg, R.L., *Journal of cold regions engineering,* Sep. 1998, 12(3), p.138-151, 13 refs.
52-6567
RUNWAYS, CONCRETE PAVEMENTS, CONCRETE SLABS, CEMENTS, SUBGRADE SOILS, FROST PENETRATION, THAW WEAKENING, JOINTS (JUNCTIONS), DYNAMIC LOADS, BEARING STRENGTH, ELASTIC PROPERTIES, MECHANICAL TESTS
A field study was performed at two regional airports in Wisconsin during spring thaw to determine its effects on portland cement concrete (PCC) airport pavements. This study was part of a research program to model the performance of airfield pavements for the Federal Aviation Administration. Subsurface temperature and falling weight deflection measurements of the pavement structures were taken at both airports and used to calculate the frost penetration depths, the changes in bearing capacity, and the joint and load transfer efficiencies. This paper summarizes the findings of this study and includes several relationships between various engineering properties of the subsurface layers below the PCC layer, along with a procedure for evaluating pavement performance using falling weight deflection data for PCC pavements during spring thaw.

MP 5213
SCANNING ELECTRON MICROSCOPE EXAMINATION OF GROWING ICE NEEDLES ON FREEZING BENTONITE.
Kumai, M., Conference on Snow, Ice and Frozen Soils, Kushiro, Japan, Oct. 4-7, 1987, Tokyo, Japanese Society of Snow and Ice, [1987], p.154, Extended abstract only.
52-6742
CLAY SOILS, FROZEN GROUND THERMODYNAMICS, GROUND ICE, ICE NEEDLES, ICE CRYSTAL GROWTH, LOW TEMPERATURE RESEARCH, SCANNING ELECTRON MICROSCOPY

MP 5214
ONSHORE ICE PILE-UP: A COMPARISON BETWEEN EXPERIMENTS AND SIMULATIONS.
Hopkins, M.A., *Cold regions science and technology,* Dec. 1997, 26(3), p.205-214, 7 refs.
52-6725
SEA ICE, PACK ICE, PRESSURE RIDGES, ICE STRENGTH, ICE MECHANICS, ICE PILEUP, SLIDING, TOPOGRAPHIC EFFECTS, ICE SOLID INTERFACE, LOADS (FORCES), COMPUTERIZED SIMULATION, MECHANICAL TESTS
Recently computer models have been used to simulate the arctic pressure ridging process. However, there has been no experimental data available to establish the accuracy of the simulations. This lack of data is due to the difficulty of modeling the pressure ridging process in the laboratory and of measuring ridge formation in the field. In this work the results of computer simulations of the closely related process of ice pile-up on an inclined ramp are directly compared with the results of a similar series of physical experiments conducted in an ice basin. In the experiments and simulations an inclined ramp is pushed against a long, stationary strip of intact, floating ice. The forces exerted on the ramp, the total energy expended, and the increase in the potential energy of the ice piled on the ramp are measured.

MP 5215
SCOUR MEASUREMENTS UNDER ICE.
Zabilansky, L.J., International Water Resources Engineering Conference, Memphis, TN, Aug. 3-7, 1998. Proceedings. Vol.1, Reston, VA, American Society of Civil Engineers, Water Resources Engineering Division, 1998, p.151-156, 5 refs.
52-6737
RIVER ICE, ICE BREAKUP, ICE SCORING, ICE EROSION, BRIDGES, PIERS, MONITORS, SUBGLACIAL OBSERVATIONS
The accuracy of numerical and physical models of scour around bridge piers is compromised by the lack of real-time field data correlating rate of scour with the hydrograph. Performance of scour instrumentation that penetrates through the water surface or uses an umbilical instrumentation cable is in jeopardy of damage when ice and debris are present. To minimize damage from impact, a bottom-founded, robust, radio-based scour monitoring system was developed at the Cold Regions Research and Engineering Laboratory (CRREL) and installed in the White River at White River Junction, VT. A series of tethered motion-sensitive radio transmitters were buried in the sediment upstream of a bridge pier.Although the approach was crude, it was effective in incrementally detecting depth of scour during an ice breakup event.

MP 5216
INNOVATIVE INSTRUMENTATION TECHNIQUES FOR DETECTING AND MEASURING THE EFFECTS OF SEDIMENT SCOUR UNDER ICE.
Yankielun, N.E., Zabilansky, L.J., International Water Resources Engineering Conference, Memphis, TN, Aug. 3-7, 1998. Proceedings. Vol.1, Reston, VA, American Society of Civil Engineers, Water Resources Engineering Division, 1998, p.204-209, 7 refs.
52-6738
RIVER ICE, ICE SCORING, ICE EROSION, BOTTOM SEDIMENT, BOTTOM TOPOGRAPHY, BRIDGES, PIERS, SUBGLACIAL OBSERVATIONS, SENSORS, TELEMETERING EQUIPMENT
Sediment scour is a severe problem that creates millions of dollars of damage to bridge piers and related infrastructure annually. The effects of scour intensify during high-energy water flow beneath an ice cover. Very little is known of the dynamics of scour under these conditions, principally due to the lack of appropriate instrumentation. The authors present several innovative instrumentation techniques that were developed specifically for detecting and measuring scour under an ice cover but can also be applied to scour measurement in general. These techniques include the application of tethered, neutrally buoyant, motion-sensitive telemetry "fish", an umbilical cable-based time domain reflectometry (TDR) sensor, and a wireless frequency-modulated continuous-wave (FM-CW) reflectometry sensor. The "fish" sensor has a spatial resolution of 12 cm. The TDR- and FM-CW based sensors have spatial resolutions of 2 cm. All sensors provide continuous, unattended operation and can be uncovered and reburied by multiple sediment erosion and deposition events.

MP 5217
EFFECTS OF WIND DIRECTION ON PH AND ELECTROLYTIC CONDUCTIVITY OF SNOW IN NEW HAMPSHIRE.
Kumai, M., Conference on Climate and Water Management—a critical era and Conference on the Human Consequences of 1985's Climate, Asheville, NC, Aug. 4-7, 1986. Preprint volume, Boston, American Meteorological Society, [1986], p.142-146, 7 refs.
52-6740
AIR POLLUTION, WIND DIRECTION, AEROSOLS, SNOWFALL, SCAVENGING, SNOW COMPOSITION, SNOW IMPURITIES, SNOW ELECTRICAL PROPERTIES, UNITED STATES—NEW HAMPSHIRE
This paper presents the results of an investigation of snowfalls in Hanover, NH; the pH and electrolytic conductivity of snow; fly ash and aerosol examinations by scanning electron microscope and energy dispersive x-ray analyzer; and the effects of wind direction on pH and electrolytic conductivity of snow in New Hampshire.

MP 5218
OPERATIONAL PARAMETERS FOR MECHANICAL FREEZING OF ALUM SLUDGE.
Martel, C.J., Affleck, R.T., Yushak, M., *Water research,* 1998, 32(9), p.2646-2654, 12 refs.
53-4
ICE PHYSICS, SEWAGE TREATMENT, WASTE TREATMENT, SLUDGES, FREEZE THAW CYCLES, ICE CRYSTAL GROWTH, ICE SOLID INTERFACE, PARTICLES, GRAIN SIZE, FREEZING RATE, MECHANICAL TESTS, EQUIPMENT, COST ANALYSIS
Freezing tests were conducted with alum sludge that had been dewatered to a solids content typically produced by a gravity thickener, vacuum filter and belt press. These sludges were then frozen at various rates in thin layers to simulate a horizontal belt freezer. The tests indicate that a low freezing rate and a high initial solids content produce larger alum sludge particles. Curing time has no effect on grain size. The maximum freezing rates for the gravity-thickened, vacuum-filtered and belt-pressed sludges were 6.6, 15.5 and 19.8 kg/h/m^2, respectively. The electrical cost of freezing sludge with this device was estimated to be $0.004/m^3. These tests show that dewatering prior to freezing not only saves energy because it reduces the amount of sludge to be frozen, but it improves the final product in terms of a larger effective grain size.

MP 5219
MODELING THE CYCLIC LOADING RESPONSE OF SEA ICE.
Cole, D.M., *International journal of solids and structures,* Nov. 1998, 35(31-32), p.4067-4075, 22 refs.
53-205
SEA ICE, ICE MODELS, ICE MECHANICS, ICE SOLID INTERFACE, STRAIN TESTS, DYNAMIC LOADS, ICE RELAXATION, POROSITY, BRINES, ELASTIC PROPERTIES, MATHEMATICAL MODELS
This paper describes a physically based model of the elastic and anelastic behavior of sea ice subjected to zero-mean-stress cyclic loading. It incorporates the influence of porosity and fabric. The work demonstrates that despite the complexity of the sea ice microstructure, it is possible to develop links between its physical and mechanical properties through careful experimentation and detailed physical properties measurements. The model accounts directly for the influence of temperature on the effective elastic properties (both through the lattice constants and through the total porosity), and on the dominant dislocations and grain boundary relaxation processes. It is shown via compliance measurements that the strength of the dislocation relaxation (and by inference the grown-in dislocation density) increases dramatically with the brine porosity. Discussion centers on the physical basis of the model and it is shown that the model predictions compare favorably with the available experimental data.

MP 5220
COLD-WEATHER CLEAN.
Martel, C.J., *Water environment & technology,* Aug. 1998, 10(8), p.50-53.
53-242
WATER TREATMENT, WASTE TREATMENT, COLD WEATHER OPERATION, SLUDGES, FREEZE THAW CYCLES, SUBLIMATION, SNOW MANUFACTURING, ARTIFICIAL SNOW, STORAGE, HYDRAULIC STRUCTURES, AIR TEMPERATURE
After several years of research, the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH, developed the freezing bed as a low-cost method of sludge dewatering at U.S. Army and U.S. Air Force bases in cold regions. The bed consists of an in-ground concrete structure deep enough to freeze several layers of sludge. The ramp on one end evenly distributes incoming sludge within the bed and allows vehicle access. The opposite end of the bed is equipped with an overflow gate or drain valves to draw off excess sludge or supernatant produced during thaw. The bottom of the bed is covered with 60 to 100 mm of sand, which allows the meltwater to drain. The meltwater is then collected in the sump and pumped back to the head of the plant. The bed is covered with a roof to keep out rain and snow, preventing snow from insulating the bed and slowing the freezing rate. It also stops rain from rewetting the sludge after it has thawed and the water has drained. The freezing bed is used to dewater sludge, and snowmaking is used to treat and store wastewater in the form of ice.

MP 5221
PRECIOUS PIPE.
Coutermarsh, B.A., *Water environment & technology,* Aug. 1998, 10(8), p.55-57.
53-243
WATER PIPELINES, UNDERGROUND PIPELINES, FROST RESISTANCE, FROST PROTECTION, EXCAVATION, PIPELINE INSULATION, POLYMERS, SHELLS, COMPUTER PROGRAMS, PERFORMANCE
In general, engineers are uncomfortable with insulating pipe and burying it at a shallow depth. Instead of empirical case studies,

they want hard data. The U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory in Hanover, NH, has provided such data. Researchers at the Cold Regions Lab believe shallow burial technology has merit for the U.S. construction industry and the municipal governments it serves. If a sound procedure can be developed to keep pipelines from freezing, utility installations can be sped up, saving in labor costs, especially where pipe must be buried in ledge. Because ledge has a generally higher thermal conductivity than soil, pipes in ledge must be buried deep to be protected from freezing. A shallow burial option would avoid the extra time and considerable expense associated with blasting and excavating ledge.

MP 5222

SEA ICE GROWTH IN ANTARCTIC LEADS: TOP FREEZING VS. BOTTOM MELTING.

Ackley, S.F., *Naval research reviews*, 1998, No.1, p.17-18, 4 refs.

53-247

OCEANOGRAPHY, ICE OPENINGS, SEA ICE, HEAT FLUX, ICE GROWTH, ICE MELTING, ICE WATER INTERFACE, ICE COVER EFFECT, MODELS, ANTARCTICA

Ice growth in leads (covered with thin ice) is typically treated as a one-dimensional heat transfer problem, with the energy balance at the bottom ice surface balanced between three terms: conduction of heat upward through the overlying ice, upward ocean heat flux and the latent heat of the phase change from water to ice at the ice bottom. Observations, however, show a radically different behavior for ice growth in antarctic sea ice leads than is currently used in models. During the winter Antarctic Zone Flux Experiment, the authors installed thermistor strings and ice thickness gauges into leads and sea ice at the beginning of two drift experiments. The sites were measured at 15 minute intervals for temperature, twice daily for ice thickness changes and periodically for ice structure during the experiment. Two dilemmas summarize the conflict of the observations with some models: the direct melting of sea ice by the ocean heat flux is observed rather than ventilation through leads, and ice of observed mean thickness or thinner is predicted to melt prematurely when typical heat flux models are used.

MP 5223

OPTICAL PROPERTIES OF SEA ICE.

Perovich, D.K., Advanced Study Institute-Summer School on Physics of Ice-Covered Seas, Savonlinna, Finland, June 6-17, 1994. Lecture notes. Vol.1. Edited by M. Leppäranta, Helsinki, University, Department of Geophysics, 1998, p.195-230, Refs. p.226-230.

53-307

SEA ICE, ICE OPTICS, ICE HEAT FLUX, SOLAR RADIATION, LIGHT SCATTERING, LIGHT TRANSMISSION, OPTICAL ABSORPTION, RADIATION BALANCE, ALBEDO

MP 5224

ATMOSPHERIC BOUNDARY LAYER OVER POLAR MARINE SURFACES.

Andreas, E.L., Advanced Study Institute-Summer School on Physics of Ice-Covered Seas, Savonlinna, Finland, June 6-17, 1994. Lecture notes. Vol.2. Edited by M. Leppäranta, Helsinki, University, Department of Geophysics, 1998, p.715-773, Refs. p.767-773.

53-320

POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC BOUNDARY LAYER, WIND PRESSURE, ICE AIR INTERFACE, ICE HEAT FLUX, ICE COVER EFFECT, TURBULENT EXCHANGE, ATMOSPHERIC CIRCULATION, HEAT BALANCE, MATHEMATICAL MODELS

MP 5225

BROAD SPECTRAL, INTERDISCIPLINARY INVESTIGATION OF THE ELECTROMAGNETIC PROPERTIES OF SEA ICE.

Jezek, K.C., Perovich, D.K., *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1633-1641, 30 refs.

53-389

REMOTE SENSING, SEA ICE, GEOPHYSICAL SURVEYS, ICE OPTICS, SURFACE STRUCTURE, BACKSCATTERING, ELECTROMAGNETIC PROPERTIES, SPECTRA, MODELS, SIMULATION, RESEARCH PROJECTS

This paper highlights the interrelationship of research completed by a team of investigators and presented in the several individual papers comprising this Special Section on the Office of Naval Research, Arlington, VA, Sponsored Sea Ice Electromagnetics Accelerated Research Initiative. The objectives of the initiative were the following: understand the mechanisms and processes that link the morphological and physical properties of sea ice to its electromagnetic (EM) characteristics; develop and verify predictive models for the interaction of visible, infrared, and microwave radiation with sea ice; and develop and verify inverse scattering techniques applicable to problems involving the interaction of EM radiation with sea ice. Along with describing results from experiments and modeling efforts, possible paradigms for using broad spectral data in developing algorithms for analyzing remote-sensing data in terms of ice concentration, age, type, and possibly thickness are briefly discussed.

MP 5226

EVOLUTION OF ELECTROMAGNETIC SIGNATURES OF SEA ICE FROM INITIAL FORMATION TO THE ESTABLISHMENT OF THICK FIRST-YEAR ICE.

Grenfell, T.C., Gow, A.J., Perovich, D.K., *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1642-1654, 38 refs.

53-390

SEA ICE, REMOTE SENSING, ICE OPTICS, RADIOMETRY, BACKSCATTERING, YOUNG ICE, ICE GROWTH, ICE COVER THICKNESS, ELECTROMAGNETIC PROPERTIES, STATISTICAL ANALYSIS, SPECTRA, SENSORS, CORRELATION

The objective of the present work is to characterize the temporal evolution of the electromagnetic signatures of sea ice from initial formation through the development of first-year ice on the basis of the temporal variations in the physical properties of the ice. The time series of young sea ice signatures, including microwave emissivity, radar backscatter, and visible and infrared spectral albedo, has been measured at successive stages in the growth and development of sea ice, both under laboratory and field conditions. Mutually consistent theoretical models covering the entire wavelength range of the observations are applied to selected cases and successfully match the observations. Principal component analysis of the data set suggests combinations of the set of frequencies to effectively distinguish among different stages in the temporal evolution of the sea ice.

MP 5227

FIELD OBSERVATIONS OF THE ELECTROMAGNETIC PROPERTIES OF FIRST-YEAR SEA ICE.

Perovich, D.K., et al, *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1705-1715, 28 refs.

53-393

REMOTE SENSING, SPACEBORNE PHOTOGRAPHY, SEA ICE, ICE OPTICS, ELECTROMAGNETIC PROPERTIES, ALBEDO, RADAR ECHOES, MICROWAVES, BACKSCATTERING, ICE MICROSTRUCTURE, SNOW COVER EFFECT, SIMULATION

An interdisciplinary field experiment was conducted during Apr. and May of 1994 at Point Barrow, AK, to investigate the relationship between the electromagnetic and physical-biological properties of first-year sea ice. Electromagnetic signatures of bare and snow-covered first-year ice were measured over a broad spectral range, including ultraviolet through near-infrared albedo, microwave emissivity, and radar backscatter. Observations indicated that the scattering of visible light varied significantly with depth in response to changes in the size and orientation of the ice crystals and in the number of brine and air inclusions. Passive microwave emissivities showed a substantial difference between snow-covered and snow-free sites due to the effects of impedance matching at lower frequencies and volume scattering at higher frequencies produced by the snow.

MP 5228

LABORATORY MEASUREMENTS OF SEA ICE: CONNECTIONS TO MICROWAVE REMOTE SENSING.

Kwok, R., Gow, A.J., Perovich, D.K., *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1716-1730, 35 refs.

53-394

REMOTE SENSING, SEA ICE, YOUNG ICE, ICE COVER THICKNESS, ELECTROMAGNETIC PROPERTIES, SPACEBORNE PHOTOGRAPHY, RADAR ECHOES, BACKSCATTERING, POLARIZATION (WAVES), SIMULATION, CORRELATION

The connections between laboratory measurements and remote-sensing observations of sea ice are explored. The focus of this paper is on thin ice, which is more easily simulated in a laboratory environment. Results of C-band scatterometer measurements and their use in the interpretation of remote-sensing data are discussed. The potential of polarimetric radar measurements in the retrieval of thickness of thin ice and the importance of low-frequency passive measurements with respect to the thickness of thin ice are considered.

MP 5229

MODELING LIGHT PROPAGATION IN SEA ICE.

Mobley, C.D., Cota, G.F., Grenfell, T.C., Maffione, R.A., Pegau, W.S., Perovich, D.K., *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1743-1749, 21 refs.

53-396

REMOTE SENSING, SEA ICE, ICE OPTICS, ELECTROMAGNETIC PROPERTIES, LIGHT SCATTERING, DIFFUSION, RADIATION ABSORPTION, ANALYSIS (MATHEMATICS), SIMULATION, FORECASTING

This paper outlines the process by which it is possible to begin with the physical properties of sea ice (such as the size distributions of brine pockets and air bubbles), then predict the optical absorption and scattering properties of the ice, and finally use these inherent optical properties in radiative transfer models to predict light propagation within the ice. Each step of this entire process is illustrated by application to a comprehensive data set of sea ice physical and optical properties. Agreement is found between measured and modeled beam spread functions, albedos and transmittances.

MP 5230

ROLE OF SNOW ON MICROWAVE EMISSION AND SCATTERING OVER FIRST-YEAR SEA ICE.

Barber, D.G., Perovich, D.K., Gow, A.J., *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1750-1763, 22 refs.

53-397

REMOTE SENSING, SEA ICE, YOUNG ICE, ELECTROMAGNETIC PROPERTIES, MICROWAVES, SCATTERING, SNOW OPTICS, SNOW ELECTRICAL PROPERTIES, SNOW COVER EFFECT, SIMULATION, THERMODYNAMICS, MODELS

The primary objective of this paper is to investigate the geophysical and thermodynamic effects of snow on sea ice in defining the electromagnetic interaction within the microwave portion of the spectrum. The authors combine observational evidence of both the physical and thermodynamic characteristics of snow with direct measurements of scattering and emission at a variety of frequencies. They explain observational results using various "state-of-the-art" forward scattering and emission models. The thermodynamic effects of snow on microwave scattering and emission are driven by the role that thermal diffusivity and conductivity play in the definition of brine volumes at the ice surface and within the snow volume. Once water in liquid phase appears within the snow cover, both emission and scattering are directly affected by the high complex permittivity of this volume fraction within the snow layer.

MP 5231

ELECTROMAGNETIC AND PHYSICAL PROPERTIES OF SEA ICE FORMED IN THE PRESENCE OF WAVE ACTION.

Onstott, R.G., et al, *IEEE transactions on geoscience and remote sensing*, Sep. 1998, 36(5)pt.II, p.1764-1783, 16 refs.

53-398

REMOTE SENSING, RADIOMETRY, RADAR ECHOES, BACKSCATTERING, SEA ICE, YOUNG ICE, ICE FORMATION, ELECTROMAGNETIC PROPERTIES, PHYSICAL PROPERTIES, WATER WAVES, CLASSIFICATIONS, ICE AIR INTERFACE, SIMULATION

In this paper, the physical and electromagnetic properties of sea ice, formed under wave-agitated conditions, are studied and compared with results obtained from ice formed under quiescent conditions. A variety of sensors, both active and passive, optical and microwave, were used to perform this characterization. Results showed that emission, backscatter, and albedo all take different signature paths during the transformation from saline water to young sea ice and that the paths depend on sea surface state during ice formation.

MP 5232

ICE FORCES ON A DOWNWARD-BREAKING CONICAL STRUCTURE FROM PARTIALLY CONSOLIDATED RUBBLE ICE.

Sodhi, D.S., International Conference on Port and Ocean Engineering under Arctic Conditions, 13th, Murmansk, Russia, Aug. 15-18, 1995. Proceedings. POAC 95. Vol.4, St. Petersburg, Russia, 1995, p.72-83, 3 refs.

53-450

ICE LOADS, ICE SOLID INTERFACE, ICE MODELS, OFFSHORE STRUCTURES, FLEXURAL STRENGTH, TESTS

Model tests were conducted to determine the forces that are generated during interaction between partially consolidated rubble ice and a downward-breaking conical structure. The model structure broke ice in flexure when the ice contacted the structure at a sloping surface. Other failure modes were observed when the ice contacted vertical surfaces, resulting in high ice forces. The ice forces measured during model tests are presented. These forces compare well with those predicted by theoretical models. No ice jamming was observed during the model tests.

MP 5233

OBSERVATIONS OF BRINE DRAINAGE NETWORKS AND MICROSTRUCTURE OF FIRST-YEAR SEA ICE.

Cole, D.M., Shapiro, L.H., *Journal of geophysical research*, Sep. 15, 1998, 103(C10), p.21,739-21,750,

34 refs.
53-550
SEA ICE, ICE MECHANICS, ICE MICROSTRUCTURE, BRINES, SUBSURFACE DRAINAGE, CHANNELS (WATERWAYS), ICE WATER INTERFACE, POROSITY, PHYSICAL PROPERTIES, THIN SECTIONS, CHUKCHI SEA
Brine drainage networks and the microstructure of first-year sea ice have been examined at two locations near Barrow, northern Alaska. A method for obtaining full-depth sections of ice sheets up to 1.8 m thick is presented and shown to provide information on the spatial distribution and geometry of brine drainage networks on a scale of meters. A number of such sections from the two test sites are presented which reveal a greater variety of main channel and side branch configurations than is typically observed in ice grown in the laboratory. Vertical and horizontal micrographs and thin section photographs were obtained at a test site in the relatively protected Elson Lagoon. The resulting time series of photographic records provide detailed information on the size, shape and spatial distribution of the brine- and gas-filled inclusions and a means to quantify their size and shape changes with time. An example of the changes with time in inclusion sizes and aspect ratios in the vertical and horizontal directions for a depth of 0.2 m, with a given thermal history is also presented.

MP 5234
CYCLIC LOADING AND CREEP RESPONSE OF ALIGNED FIRST-YEAR SEA ICE.
Cole, D.M., Johnson, R.A., Durell, G.D., *Journal of geophysical research,* Sep. 15, 1998, 103(C10), p.21,751-21,758, 31 refs.
53-551
SEA ICE, ICE MECHANICS, ICE STRENGTH, ICE CORES, ELASTIC PROPERTIES, ICE CREEP, DYNAMIC LOADS, SHEAR MODULUS, ORIENTATION, MECHANICAL TESTS, ICE SOLID INTERFACE, ICE MODELS
Characteristics such as brine and gas porosity and crystallographic features can have a profound impact on the mechanical properties of first-year sea ice. A program of laboratory experiments on field cores of first-year sea ice has been conducted to aid in the development of constitutive ice models. A thorough assessment of the bulk physical properties and microstructural characteristics of the ice has been carried out in conjunction with a detailed set of cyclic loading and creep experiments. Methodology was developed to calculate an orientation factor that determines the average shear stress resolved on the basal planes, given the background normal stress. Examination of the constitutive behavior using laboratory cyclic loading and constant load creep experiments revealed that the elastic, anelastic (time-dependent recoverable), and viscous strains varied systematically with the orientation factor. The observations also indicate significant brine porosity effects on the elastic, anelastic and viscous components of strain. A recently developed constitutive model was expanded to include a frequency- and orientation-dependent viscous straining term, and the model predictions agreed well with the experimental observation.

MP 5235
CHARACTERISTICS OF PACK ICE STRESS IN THE ALASKAN BEAUFORT SEA.
Richter-Menge, J.A., Elder, B.C., *Journal of geophysical research,* Sep. 15, 1998, 103(C10), p.21,817-21,829, 36 refs.
53-557
SEA ICE, PACK ICE, ICE MECHANICS, STRESS CONCENTRATION, THERMAL STRESSES, TENSILE PROPERTIES, ICE TEMPERATURE, TEMPERATURE EFFECTS, MECHANICAL TESTS, SENSORS, STATISTICAL ANALYSIS, CORRELATION, BEAUFORT SEA
Ice stresses in a multiyear floe were continuously monitored over 6 months in the fall-winter-spring of 1993-94. Stresses sensors were installed at sites near the edge and at the center of the floe, which was located in the pack ice of the Alaskan Beaufort Sea. Compressive stresses in the major principal stress component varied significantly among the measurement sites, being of greater magnitude and exhibiting more high-frequency variations at the edge than at the center of the floe. Maximum compressive stresses, measured at a site 400 m from the edge of the floe, ranged from 100 to 300 kPa. Tensile stresses and the minor principal stress component were relatively constant at all measurement sites. A cross-correlation analysis indicates that the minor principal stress is strongly correlated to changes in the ice temperature. This result suggests that the minor principal stress component provides a good first-order approximation of thermally induced stresses. Ice-motion-induced stresses, distinguished by variations in magnitude of the order of hours, also have a significant low-frequency content similar to the thermal stresses. These low-frequency changes occur over a period of days. Seasonal variations in the characteristics of the stress were also evident and are likely to reflect the developing continuity of the pack as the winter season progresses.

MP 5236
MOTION-INDUCED STRESSES IN PACK ICE.
Lewis, J.K., Richter-Menge, J.A., *Journal of geophysical research,* Sep. 15, 1998, 103(C10), p.21,831-21,843, 23 refs.
53-558
SEA ICE, PACK ICE, ICE MECHANICS, SHEAR STRESS, STRESS CONCENTRATION, TENSILE PROPERTIES, ICE DEFORMATION, AIR ICE WATER INTERACTION, MATHEMATICAL MODELS, SIMULATION, BEAUFORT SEA
The authors consider motion-induced stresses in pack ice through the analyses of a variety of observations collected during the Sea Ice Mechanics Initiative study conducted in the Beaufort Sea during 1993. Motion-induced components of *in situ* stress from stress gauge data are compared to stresses calculated as residuals based on a force balance argument using observed wind, current and ice motion data. There are three significant stress events determined by the force balance calculations, but only the one event in the north-south direction has a strong corresponding signal in the stress gauge data. The results suggest that to effectively develop an understanding of the role that point stress measurements can play in developing the understanding of the process of ice deformation, it may be necessary to couple the stress measurements with models of the patterns of motion-induced stresses within a floe.

MP 5237
FOUR STAGES OF PRESSURE RIDGING.
Hopkins, M.A., *Journal of geophysical research,* Sep. 15, 1998, 103(C10), p.21,883-21,891, 17 refs.
53-561
SEA ICE, ICE COVER STRENGTH, ICE COVER THICKNESS, ICE MECHANICS, PRESSURE RIDGES, ICE PILEUP, CLASSIFICATIONS, DRIFT, ICE SOLID INTERFACE, ELASTIC PROPERTIES, COMPUTERIZED SIMULATION
The pressure ridging process is simulated using a two-dimensional particle model. Blocks are broken from an intact sheet of relatively thin lead ice pushed against a thick, multiyear floe at a constant speed. The blocks of ice rubble accumulate to form the ridge sail and keel. During the simulations the energy consumed in ridge growth, including dissipation, is explicitly calculated. On the basis of the results of simulations performed with the model, the ridging process can be divided into four distinct stages. The results of simulations establish the dependence of ridging energetics on the thickness of the ice sheet and the amount of ice pushed into the ridge. The average profiles of the simulated ridges delineate the growth process in the first, second and third stages. Lead ice extents of up to 1300 m are pushed into ridges to determine maximum sail heights, keel drafts and ridging forces.

MP 5238
LARGE-SCALE SEA ICE DRIFT AND DEFORMATION: COMPARISON BETWEEN MODELS AND OBSERVATIONS IN THE WESTERN WEDDELL SEA DURING 1992.
Geiger, C.A., Hibler, W.D., III, Ackley, S.F., *Journal of geophysical research,* Sep. 15, 1998, 103(C10), p.21,893-21,913, 22 refs.
53-562
OCEANOGRAPHY, ICE MECHANICS, MECHANICAL PROPERTIES, SHEAR PROPERTIES, SEA ICE DISTRIBUTION, DRIFT, ICE DEFORMATION, VELOCITY MEASUREMENT, DRIFT STATIONS, MATHEMATICAL MODELS, STATISTICAL ANALYSIS, RHEOLOGY, CORRELATION, ANTARCTICA—WEDDELL SEA
Statistical comparison between numerical sea ice models and an observed large-scale strain array in the western Weddell Sea during 1992 are used to evaluate the performance of three of the more generally utilized sea ice rheology formulations. Results show that sea ice velocity is reproduced with relatively high accuracy in models having high-quality atmospheric forcing fields. Inclusion of both compressive and shear stresses is important in attaining a proper probability distribution of deformation relative to observations. Additional analysis shows that adjustments to specific model parameters improve the model results for either drift or select deformation components, but no best solution could be found, given the models examined here. Results suggest that inclusion of more physically based processes, such as subdaily tidal and inertial oscillations, reconsideration of the boundary layer formulation, and consideration of anisotropy, may be necessary to include in next-generation sea ice models, especially those that are intended for coupling with high-resolution (eddy resolving) ocean models.

MP 5239
EXPEDIENT COLD-WEATHER CONCRETING.
Korhonen, C., *Engineer,* Nov. 1997, Vol.27, p.25-27.
53-629
WINTER CONCRETING, CONCRETE STRENGTH, TEMPERATURE EFFECTS, ANTIFREEZES

MP 5240
SINTERING IN A DRY SNOW COVER.
Colbeck, S.C., *Journal of applied physics,* Oct. 15, 1998, 84(8), p.4585-4589, 10 refs.
53-886
SNOW PHYSICS, SNOW STRENGTH, SNOW COVER STRUCTURE, SNOW CRYSTAL GROWTH, SNOW CRYSTAL STRUCTURE, MICROSTRUCTURE, SINTERING, DIFFUSION, PHYSICAL PROPERTIES, ANALYSIS (MATHEMATICS), THEORIES
The basic shape of bonds in snow is dictated by the geometrical requirements of grain-boundary grooves and is not a simple concave neck as has long been assumed. In fact, all of the earlier work on the theory of sintering in snow was based on an incorrect assumption about the geometry. A theory of the growth of bonds in snow is given here based on observations of their actual shape which is dominated by grain-boundary grooves. The theory describes the growth of the bond by the removal of water molecules from the grain boundary by diffusion due to the stress gradient. Three-dimensional grains are described and the dihedral angle is allowed to increase with time.

MP 5241
CONSIDERATIONS FOR DEACTIVATING ARMY BUILDINGS IN ALASKA.
Flanders, S.N., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.86-95, 2 refs.
53-916
MILITARY FACILITIES, BUILDINGS, UTILITIES, COLD WEATHER CONSTRUCTION, WEATHERPROOFING, THERMAL ANALYSIS, COST ANALYSIS, UNITED STATES—ALASKA
Three buildings on Army bases in Alaska (a barracks and a theater at Fort Richardson, near Anchorage, and a single-family housing unit at Fort Greely, near Delta Junction and 90 miles southeast of Fairbanks) were deactivated to study strategies to allow them to be unheated and subsequently reactivated with minimum expense. The study demonstrated that draining plumbing systems, recharging them with propylene glycol, and redraining them effectively minimized damage. Damage to interior finish was minimal after 2.3 years. Life-cycle energy cost calculations indicated that deactivating a single-family dwelling would save between $3,800 and $7,300 per year, depending on location, and that deactivating a barracks would save between $17,300 and $33,400 per year, depending on location, versus keeping them heated. The product of the study was an easy-to-follow *Handbook for Activation and Deactivation of Buildings.*

MP 5242
SNOW DEFORMATION BENEATH A VERTICALLY LOADED PLATE FORMATION OF PRESSURE BULB WITH LIMITED LATERAL DISPLACEMENT.
Shoop, S.A., Alger, R.G., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.143-150, 5 refs.
53-921
SNOW STRENGTH, SNOW HARDNESS, SNOW COMPRESSION, SNOW DENSITY, SNOW DEFORMATION, SNOW VEHICLES, TRAFFICABILITY, BEARING TESTS
The development of models to predict mobility over snow-covered terrains relies on a thorough understanding of the reaction of a snow mass to a vehicle load. Field experiments analyzing snow deformation under vehicles presented questions regarding the extent of lateral deformation beneath a track or wheel and the cause of lateral deformation. Thus, experiments to examine the deformation of snow under a vertically loaded plate were performed in the laboratory. The experiments show that there is often very little lateral movement of the snow even though the vertical deformation extends beyond the boundaries of the plate, giving the appearance of lateral deformation. The existence of any lateral deformation is limited and is dependent on the snow density, aging, and possibly the load rate. Lateral expansion did not occur in snow with densities less than 0.25 g/cc. Also, dependent upon the degree of particle disturbance, aging of as little as 2 hours can cause what appears to be lateral displacement, but is more likely the particles acting as a bonded mass instead of as individuals.

MP 5243
LOW-TEMPERATURE REPAIR OF THE ICE CONDENSER FLOOR SLAB AT THE SEQUOYAH NUCLEAR POWER PLANT.
Korhonen, C.J., Hughes, J., Best, F., Mass, G., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.258-270, 7 refs.
53-932
NUCLEAR POWER, COOLING SYSTEMS, FLOORS, LIGHTWEIGHT CONCRETES, CONCRETE SLABS, CONCRETE FREEZING, CONCRETE CURING, CONCRETE PLACING, WINTER CONCRETING, CONCRETE ADMIXTURES, ANTIFREEZES, WATER CEMENT RATIO, FROST RESISTANCE, FROST PROTECTION, UNITED STATES—

TENNESSEE—CHATTANOOGA
A lightweight portland cement concrete was pumped more than 100 m horizontally and 10 m vertically and placed, finished, and cured at below-freezing temperatures with minimal thermal protection. A low-temperature accelerator, two plasticizers, and a low w/cm (water/cementitious) ratio produced the desired results.

MP 5244
NATURAL DEWATERING OF ALUM SLUDGE IN FREEZING BEDS.
Martel, C.J., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.282-291, 9 refs.
53-934
SLUDGES, WATER TREATMENT, WASTE TREATMENT, SEWAGE DISPOSAL, FREEZE DRYING, ARTIFICIAL FREEZING, ARTIFICIAL THAWING, PONDS, SANITARY ENGINEERING
After several years of research, the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) has developed a new unit operation for dewatering sludge called a sludge freezing bed. It differs from other natural freezing operations in that it maximizes the amount of sludge that can be frozen. The freezing bed is a particularly attractive alternative for dewatering alum sludge, because no conditioning chemicals are required and the remaining granular material can be left to accumulate in the bed for several years. Equations are presented that can be used to size the freezing bed according to local climatic conditions.

MP 5245
DETECTING ICE JAM EVENTS.
Zufelt, J.E., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.362-372, 10 refs.
53-941
RIVER ICE, ICE JAMS, ICE DETECTION, ICE FORECASTING, ICE CONTROL, WARNING SYSTEMS
Ice jams result in over $125 million in damages annually across the northern United States. In many communities, ice jams are a recurrent threat, prompting mitigation measures to minimize their impact. Some ice jam control measures are designed to operate successfully with little or no human intervention or control, such as an ice control structure designed to retain ice upstream of a community. Other forms of ice control may require operational measures: a crane or backhoe placed at a bridge and only utilized when ice becomes jammed in the opening during an ice run. Identification of when and where ice jams occur is key to the successful design, construction, and operation of ice jam mitigation schemes. This paper presents a compilation of methods used to infer or detect when and where an ice jam has occurred or is impending.

MP 5246
MODELING ICE-COVERED RIVERS USING HEC-RAS.
Daly, S.F., Brunner, G.W., Piper, S., Jensen, M., Tuthill, A.M., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.373-383, 14 refs.
53-942
RIVER ICE, ICE JAMS, ICE COVER THICKNESS, ICE CONDITIONS, ICE LOADS, ICE WATER INTERFACE, RIVER FLOW, ICE FORECASTING, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION
The ability to model ice-covered channels has been added to the Hydrologic Engineering Center's River Analysis System (HEC-RAS). The ice cover thickness and hydraulic roughness can be entered by the user, or the ice cover can be modeled as a wide-river ice jam, in which case the jam thickness is estimated by HEC-RAS. For the wide-river jam, the user enters the material properties of the ice jam and its extent. Information describing the ice cover and ice properties can be entered for each individual cross section using an ice information editor or can be entered for a number of cross sections using a table. Results can be viewed in tabular or graphical form. Graphical output includes cross section plots, profile plots, and perspective plots displaying the ice cover extent and thickness. In addition, profile plots of other ice information, such as thickness and volume, can be readily displayed.

MP 5247
REDUCING FROST HEAVE WITH CAPILLARY BARRIERS: INTERIM RESULTS.
Henry, K.S., Holtz, R.D., Ellis, E., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.434-436.
53-947
SUBGRADE SOILS, SOIL FREEZING, FROST HEAVE, FROST PROTECTION, SOIL WATER MIGRATION, CAPILLARITY, GEOTEXTILES, SOIL STABILIZATION, VAPOR BARRIERS, WATERPROOFING, SUBGRADE MAINTENANCE, ROAD MAINTENANCE
Capillary barriers are placed between the water table and the freezing front in soils to potentially reduce/prevent frost heave above the barrier by restricting water flow to the freezing front. Research about the use of geosynthetic capillary barriers in pavements so that fine-grained soils might be allowed in the structural section is now being conducted. Geotextiles and geocomposites were placed in frost-susceptible soil that was frozen at conditions representative of those in the field. Results indicate that geotextiles as received from the manufacturer were effective capillary barriers, but they were markedly less effective after they are moistened and have soil fines in them. Moistened geocomposites containing soil fines were more effective capillary barriers than moistened geotextiles for the soil and conditions tested.

MP 5248
ICE-COVER THICKENING AT RIVER-RESERVOIR CONFLUENCES: A CASE STUDY.
White, K.D., Acone, S.E., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.457-466, 17 refs.
53-950
RIVER ICE, ICE BREAKUP, FRAZIL ICE, ICE GROWTH, ICE JAMS, ICE FORECASTING, RESERVOIRS, FLOOD FORECASTING, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, UNITED STATES—MAINE—FORT FAIRFIELD
Breakup ice jams commonly form at locations where the river slope changes from steep to mild, such as river-reservoir confluence areas. Several mechanisms favor the formation of ice jams at these locations, including hydraulic (e.g., changes in discharge and stage may result in breakup of the ice cover on the river but not on the reservoir). In some cases, frazil ice deposition results in thicker ice at the confluence than in the river upstream, thus providing increased resistance to the breakup and transport of ice through the confluence area. The Aroostook River at Fort Fairfield, ME, provides an example of this situation. Breakup ice jams that form at the confluence of the river and the pool formed by Tinker Dam have caused severe flooding in Fort Fairfield. The present analysis addresses two possible causes of ice thickening at the confluence: shoving during initial ice-cover formation and frazil deposition after initial ice-cover formation. The location and thickness of frazil ice deposits has traditionally been predicted using a critical velocity criterion. However, in a number of locations, including the Aroostook River, field data indicate that this criterion is inadequate. Recently developed frazil transport theory shows promise as a more accurate predictor of frazil deposition.

MP 5249
WINTER TENTING OF HIGHWAY PAVEMENTS.
Kestler, M.A., Krat, A.S., Roberts, G., International Conference on Cold Regions Engineering, 9th, Duluth, MN, Sep. 27-30, 1998. Proceedings. Cold regions impact on civil works. Edited by D.E. Newcomb, Reston, VA, American Society of Civil Engineers (ASCE), 1998, p.501-512, 6 refs.
53-954
PAVEMENTS, SUBGRADE SOILS, FROST RESISTANCE, FROST ACTION, FROST HEAVE, SALTING, CRACKING (FRACTURING), COLD WEATHER TESTS, ROAD MAINTENANCE
It is estimated that pavements subjected to seasonal freezing have approximately 50% of the maintenance free life of pavements in non-frost areas. Non-uniform frost heaving during the winter and early spring and loss of pavement strength during thawing result in a variety of pavement distresses including cracking and rutting. In contrast to these distresses, which over the years have received considerable attention in the literature, tenting has received very little attention. Tenting consisted of localized heaving in the immediate vicinity of transverse cracks. It typically produces a highly irregular riding surface, particularly toward the end of the winter season, and can lead to rapid premature deterioration of the pavement surface. There have been unofficial estimates of as much as 10 cm of rise over a horizontal distance of approximately 3.3 m. In contrast to most frost-related distresses, tenting is not unique to low volume roads; it occurs just as frequently on highways that have been designed for high volumes of traffic and for withstanding freezing and thaw weakening. Furthermore, it is frequently exhibited by pavements that are in otherwise good condition. The distribution of salinity (from road salt) within the base course is suspected to be a primary contributor toward tenting. This paper discusses results from field and lab testing and theorizes about the causes and mechanics of tenting.

MP 5250
PHASE II REMEDIAL INVESTIGATION FOR COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL), HANOVER, NEW HAMPSHIRE.
Arthur D. Little, Inc., Cambridge, MA, Lamb, R.N., ed, Rice, J.E., ed, 1994, 3 vols. (Var. p.), Vol.1: ADA-281 933, Vol.2: ADA-281 934, Vol.3: ADA-281 935, Vol.1: main report, Vols. 2 and 3: appendixes. Refs. Vol.1, p.8/1-8/5.
53-1018
GROUND WATER, PETROLEUM PRODUCTS, HYDROCARBONS, WASTE DISPOSAL, WATER POLLUTION, OIL SPILLS, SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, LAND RECLAMATION, HEALTH, UNITED STATES—NEW HAMPSHIRE

MP 5251
ICE THRUST IN RESERVOIRS.
Carter, D., Sodhi, D.S., Stander, E., Caron, O., Quach, T., *Journal of cold regions engineering*, Dec. 1998, 12(4), p.169-183, 24 refs.
53-1392
RESERVOIRS, ICE MECHANICS, ICE SOLID INTERFACE, DAMS, ICE FLOES, ICE PUSH, STATIC LOADS, STRESS CONCENTRATION, CRACKING (FRACTURING), COMPRESSIVE PROPERTIES, MECHANICAL TESTS, MATHEMATICAL MODELS
A three-year program was undertaken to measure the magnitude of static ice forces in four reservoirs located in central and northern Quebec. These static forces may be generated by a temperature change or may arise from such other mechanisms as water level variations, wind, and current drag force. Field observations have revealed two important facts: ice covers have circumferential cracks caused either by water level variations or thermal contraction; and the static ice forces are, in some instances, sufficient to trigger an instability of the broken ice covers by buckling. Noting that an ice cover cannot transmit a force to a structure larger than its own resistance, an upper bound for static forces was derived by determining the in-plane compression force at which a fragmented ice cover collapses. Empirical formulas are presented for three typical structure shapes: retaining walls, sluice gates, and piers. These formulas correlate well with the field data collected from the four dam sites, and suggest that the maximum ice thrust may simply be defined as a function of ice thickness and contact geometry.

MP 5252
STRUCTURAL ICE CONTROL ALTERNATIVES FOR MIDDLE MISSISSIPPI RIVER.
Tuthill, A.M., Mamone, A.C., *Journal of cold regions engineering*, Dec. 1998, 12(4), p.202-220, 15 refs.
53-1394
RIVER FLOW, RIVER ICE, ICE WATER INTERFACE, ICE JAMS, FRAZIL ICE, ICE CONDITIONS, PROFILES, ICE CONTROL, ICE BOOMS, HYDRAULIC STRUCTURES, COMPUTERIZED SIMULATION, UNITED STATES—MISSOURI—MISSISSIPPI RIVER
The middle Mississippi River, which extends from the mouth of the Missouri River near St. Louis to the confluence with the Ohio River at Cairo, IL, is a critical navigation route throughout the year. During cold periods, the ice accumulations and ice jams that form on this reach can delay or suspend winter navigation, incurring great costs to industry as well as cities and towns whose economies depend on river commerce. Much of this ice originates in the Missouri River. With the onset of warmer air temperatures, the rapid release of these ice accumulations can result in substantial damage to river structures such as dikes, revetments, and levees. This study analyzed historical data and used numerical hydraulic models to assess the possibility of structural solutions to these ice problems. The study identified reach locations where structural ice control might be possible. A simple computer model then simulated the upstream progression of ice covers on the middle Mississippi to assess the feasibility of various ice control alternatives. An ice retention structure located on the Missouri River near its mouth was found to be the most favorable of the structural ice control options considered.

MP 5253
PERCOLATION PHASE TRANSITION IN SEA ICE.
Golden, K.M., Ackley, S.F., Lytle, V.I., *Science*, Dec. 18, 1998, 282(5397), p.2238-2241, 30 refs.
53-1495
SEA ICE, ICE STRUCTURE, SEA WATER, SLUSH, PHASE TRANSFORMATIONS, ANTARCTICA—EAST ANTARCTICA, ANTARCTICA—WEDDELL SEA
Sea ice exhibits a marked transition in its fluid transport properties at a critical brine volume fraction p_c of about 5%, or temperature T_c of about -5°C for salinity of 5 parts per thousand. For temperatures warmer than T_c, brine carrying heat and nutrients can move through the ice, whereas for colder temperatures the ice is impermeable. This transition plays a key role in the geophysics, biology and remote sensing of sea ice. Percolation theory can be used to understand this critical behavior of transport in sea ice. The similarity of sea ice microstructure to compressed powders is

used to theoretically predict p_c of about 5%.

MP 5254
NEW SEA SPRAY GENERATION FUNCTION FOR WIND SPEEDS UP TO 32 M S^{-1}.
Andreas, E.L., *Journal of physical oceanography,* Nov. 1998, 28(11), p.2175-2184, 62 refs.
53-1561
OCEANOGRAPHY, SEA SPRAY, AEROSOLS, BUBBLES, DROPS (LIQUIDS), TURBULENT BOUNDARY LAYER, WIND VELOCITY, AIR WATER INTERACTIONS, HEAT FLUX, MOISTURE TRANSFER, LATENT HEAT, MATHEMATICAL MODELS
The sea spray generation function quantifies the rate at which spray droplets of a given size are produced at the sea surface. As such, it is important in studies of the marine aerosol and its optical properties and in understanding the role that sea spray plays in transferring heat and moisture across the air-sea interface. The emphasis here is on this latter topic, where uncertainty over the spray generation function, especially in high winds, is a major obstacle. This paper surveys the spray generation functions available in the literature and, on theoretical grounds, focuses on one by M.H. Smith et al. that has some desirable properties but does not cover a wide enough droplet size range to be immediately useful for quantifying spray heat transfer. With reasonable modifications and extrapolations, however, the paper casts the Smith function into a new form that can be used to predict the production of sea spray droplets with radii from 2 to 500 μm for 10 m winds from 0 to 32.5 m/s. The paper closes with sample calculations of the sensible and latent heat fluxes carried by spray that are based on this new spray generation function.

MP 5255
THEORETICAL MODELING OF SEISMIC NOISE PROPAGATION IN FIRN AT THE SOUTH POLE, ANTARCTICA.
Albert, D.G., *Geophysical research letters,* Dec. 1, 1998, 25(23), p.4257-4260, 21 refs.
53-1708
SEISMOLOGY, GEOPHYSICAL SURVEYS, SNOW PHYSICS, FIRN, BOREHOLES, SENSORS, SEISMIC REFRACTION, WAVE PROPAGATION, ATTENUATION, NOISE (SOUND), MODELS, THEORIES, COUNTERMEASURES, ANTARCTICA—AMUNDSEN-SCOTT STATION
The problem of interfering noise (produced by ground vehicles) on teleseismic arrivals recorded by Global Seismic Network sensors at Amundsen-Scott Station is addressed. Using the wavenumber integration method, theoretically calculated seismograms show that installing the GSN sensors in a borehole 200 to 300 m deep, 10 km away from the station, will significantly reduce the vehicle-generated noise and improve signal quality. Because the intrinsic attenuation of seismic waves propagating in the polar firn is low, most of the predicted noise reduction results from wavefront spreading, Rayleigh wave amplitude decay with depth, and from placing the sensors below the refractive waveguide that traps much of the seismic energy in the near surface layers.

MP 5256
ARCTIC RESEARCH OF THE UNITED STATES, VOL.12, SPRING/SUMMER 1998.
U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Haugh, J., ed, Cate, D.W., ed, Valliere, D.R., ed, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1998, 152p.
53-1725
ORGANIZATIONS, RESEARCH PROJECTS, REGIONAL PLANNING, COST ANALYSIS

MP 5257
GROUND-PENETRATING RADAR REFLECTION PROFILING OF GROUNDWATER AND BEDROCK IN AN AREA OF DISCONTINUOUS PERMAFROST.
Arcone, S.A., Lawson, D.E., Delaney, A.J., Strasser, J.C., Strasser, J.D., *Geophysics,* Sep.-Oct. 1998, 63(5), p.1573-1584, 37 refs.
53-1801
GEOPHYSICAL SURVEYS, DISCONTINUOUS PERMAFROST, SUBPERMAFROST GROUND WATER, RADAR ECHOES, ATTENUATION, SEDIMENTS, ALLUVIUM, BEDROCK, UNFROZEN WATER CONTENT, PROFILES, INTERFACES, DIELECTRIC PROPERTIES, WELL LOGGING, SNOW COVER EFFECT, UNITED STATES—ALASKA—FORT WAINWRIGHT
Ground-penetrating radar was used to profile the depth to permafrost, to groundwater beneath permafrost, and to bedrock within permafrost in alluvial sediments of interior Alaska. Well log data were used to aid the interpretations and to calculate dielectric permittivities for frozen and unfrozen materials. Interfaces between unfrozen and frozen sediments above permafrost were best resolved with wavelet bandwidths centered at and above 100 MHz. The resolution also required consideration of antenna configuration, season, and surface conditions. Depths to subpermafrost groundwater were profiled where it was in continuous contact with the bottom of the permafrost, except near transitions to unfrozen zones, where the contact appeared to dip steeply. The complexity of the responses to intrapermafrost bedrock, detected at a maximum depth of 47 m, appears to distinguish these events from those of subpermafrost saturated sediments. The relative dielectric permittivity ranged between 4.4 and 8.3 for the permafrost, and between 12 and 45 for partially to fully saturated, unfrozen silts and sands. Scattering losses are evident from intrapermafrost diffractions and from the improved penetration achieved by lowering the midband radar frequency from 100 to 50 MHz.

MP 5258
SAMPLING TRACE-LEVEL ORGANIC SOLUTES WITH POLYMERIC TUBING: PART I. STATIC STUDIES.
Parker, L.V., Ranney, T.A., *Ground water monitoring review,* 1997, Fall, p.115-124, 23 refs.
53-1802
GROUND WATER, WATER POLLUTION, HYDROCARBONS, SOLUTIONS, PIPES (TUBES), POLYMERS, SAMPLING, ACCURACY, TENSILE PROPERTIES, ABSORPTION, LEACHING, CORRELATION
Twenty polymeric tubings were filled with a test solution containing eight organic solutes. The test solutions were monitored for losses, indicating that sorption had occurred, and for signs that leaching of organic constituents had occurred. The tubings tested included seven flexible products and eight fluoropolymers. Among the rigid tubings tested, three fluoropolymers (fluorinated ethylene propylene [FEP], FEP-lined polyethylene, polyvinylidene fluoride) were the least sorptive tubings. However, even these tubings readily sorbed some of the analytes. Among the flexible tubings tested, a fluoroelastomer tubing and a tubing made of a copolymer of vinylidene fluoride and hexafluoropropylene were the least sorptive. Several of the tubings tested leached constituents into the test solution. The polyurethane, polyamide, flexible polyvinyl chloride (PVC), polyester-lined PVC, and silicone-modified thermoplastic elastomer tubings were found to leach the most constituents. The authors were unable to detect any constituents leaching from the polyethylene tubings, the rigid fluoropolymer tubings, and one of the plasticized polypropylene tubings.

MP 5259
SAMPLING TRACE-LEVEL ORGANIC SOLUTES WITH POLYMERIC TUBING: PART 2. DYNAMIC STUDIES.
Parker, L.V., Ranney, T.A., *Ground water monitoring review,* 1998, Winter, p.148-155, 12 refs.
53-1803
GROUND WATER, WATER POLLUTION, HYDROCARBONS, POLYMERS, PUMPS, PIPES (TUBES), SOLUTIONS, FLOW RATE, LIQUID SOLID INTERFACES, ABSORPTION, LEACHING, TENSILE PROPERTIES, SAMPLING, CLASSIFICATIONS
This is the second part of a study conducted to determine whether polymeric sampling tubing can affect organic analyte concentrations during a sampling event. The authors looked for sorption and desorption of trichloroethylene (TCE) and leaching of organic constituents in water pumped through five types of polymeric tubing. The materials tested were a rigid fluoropolymer, a flexible fluoropolymer, low-density polyethylene (LDPE), and two plasticized polypropylene tubings. The effects of tubing length and flow rate were examined. The least sorptive tubings, both initially and at equilibrium, were the fluoropolymers. In some instances the LDPE tubing had little effect on TCE concentrations. This was when a slow flow rate was used to sample relatively shallow wells (50 feet or less) or when a faster flow rate (1 L/min) was used to sample wells that are less than 500 feet. Further testing is recommended using more sorptive analytes. High performance liquid chromatography did not detect any constituents leaching from any of the tubings used in these studies, even when a slow flow rate was used. However, desorption of sorbed analytes is a concern for all the tubings tested, including the rigid fluoropolymer.

MP 5260
COMPARISON OF FIBERGLASS AND OTHER POLYMERIC WELL CASINGS: PART II. SORPTION AND LEACHING OF TRACE-LEVEL ORGANICS.
Ranney, T.A., Parker, L.V., *Ground water monitoring review,* 1998, Spring, p.107-112, 16 refs.
53-1804
GROUND WATER, SAMPLING, WATER POLLUTION, HYDROCARBONS, WELL CASINGS, POLYMERS, HYDROCARBONS, LEACHING, ABSORPTION, DEGRADATION, CHEMICAL COMPOSITION, CLASSIFICATIONS
This paper contains the results of a laboratory study that was designed to compare sorption of low concentrations of 11 organic solutes by six polymeric materials (acrylonitrile butadiene styrene [ABS], fluorinated ethylene propylene [FEB], fiberglass-reinforced epoxy [FRE] and fiberglass-reinforced plastic [FRP], polyvinyl chloride [PVC], and polytetrafluoroethylene [PTFE]). During this six-week study, ABS sorbed analytes much more rapidly and to a greater extent than did the other materials, and PVC and FRE sorbed analytes more slowly and to a lesser extent than the other materials tested. As the study progressed, an increasing number of spurious peaks were found in the high performance liquid chromatography chromatograms of some samples, indicating that leaching of some constituents had occurred. By the end of the study, there were 11 additional peaks in the ABS samples, five in the FRP samples, and one in the FRE samples. Analysis by purge and trap gas chromatography/mass spectrometry of those samples and of well water samples that were exposed to the casings for 500 hours revealed the identity of some of the leached constituents: acrylonitrile and styrene (components of ABS), chloroform and ethylbenzene (an intermediate in the production of styrene) from the ABS pipe, and toluene, 1,1,1-trichloroethane, and ethylbenzene from the FRP casing.

MP 5261
COMPARISON OF FIBERGLASS AND OTHER POLYMERIC WELL CASINGS: PART III. SORPTION AND LEACHING OF TRACE-LEVEL METALS.
Ranney, T.A., Parker, L.V., *Ground water monitoring review,* 1998, Summer, p.127-133, 21 refs.
53-1805
GROUND WATER, WATER POLLUTION, WELL CASINGS, POLYMERS, CELLULAR PLASTICS, CHEMICAL COMPOSITION, LEACHING, ABSORPTION, METALS, CLASSIFICATIONS, PERFORMANCE
This series of experiments was initiated to determine the overall suitability of three alternative polymeric well casing materials (fluorinated ethylene propylene [FEP], fiberglass-reinforced epoxy [FRE], and fiberglass-reinforced plastic [FRP] for use in ground water monitoring wells and to compare these materials with polyvinyl chloride (PVC) and polytetrafluoroethylene (PTFE) well casings. This paper focuses on sorption and leaching of metals. Generally, the fiberglass materials leached more metal contaminants than PVC, FEP, and PTFE. However, with one exception (Pb leaching from FRP), leached concentrations were below maximum allowable limits set by the U.S. Environmental Protection Agency for drinking water. With respect to sorption, none of the polymers sorbed the anions tested, but all of them sorbed one or more of the cations tested. FEP and PTFE were much less sorptive than the other materials.

MP 5262
ELECTRIC VEHICLE TRACTION AND ROLLING RESISTANCE IN WINTER.
Shoop, S.A., *Tire science and technology,* Apr.-June 1998, 26(2), p.64-83, 17 refs.
53-1806
VEHICLES, TIRES, TRACTION, SLIDING, ICE SOLID INTERFACE, SNOW SURFACE TEMPERATURE, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS, DYNAMOMETERS, CLASSIFICATIONS
Low rolling resistance tires help optimize the economy of electric vehicle (EV) operation. Five types of EV tires were evaluated under cold weather conditions and compared with traditional winter tires in terms of traction and rolling resistance. Other contributions to vehicle resistance (brake drag, wheel bearing resistance, driveline resistance, and air drag) were also measured and used to estimate changes in total vehicle resistance and associated changes in range with temperature. At low speeds, tire rolling resistance is the primary contribution to increased vehicle resistance at cold temperatures, with snow tires having both higher resistance and a stronger dependence on temperature than low rolling resistance tires. Lowering tire pressure increases both resistance and temperature dependence for most tires but also improves traction and therefore may serve as a temporary safety measure in winter conditions.

MP 5263
FAST, PHYSICALLY BASED POINT SNOWMELT MODEL FOR USE IN DISTRIBUTED APPLICATIONS.
Albert, M., Krajeski, G., *Hydrological processes,* 1998, Vol.12, p.1809-1824, 20 refs.
53-1807
SNOW HYDROLOGY, SNOW PHYSICS, SNOWMELT, RAIN, ICE WATER INTERFACE, SURFACE ENERGY, WATER FLOW, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, THEORIES, RUNOFF FORECASTING
A new mathematical solution to the problem of water flow through snow is presented and its implementation in a snowmelt model, SNAP, is discussed. An analytical solution for vertical water flow through homogeneous snow is developed and formulae that allow the solution to accommodate time-varying surface input from rain or snowmelt are derived. This facilitates use of the technique in a computer snowmelt model. Because the new technique requires no matrix computation, it is sufficiently computationally efficient to be a candidate for use in watershed-scale, distributed forecasting systems. Because it is a physically-based model that takes into account the effect of the snow itself on the timing and magnitude of outflow, the model allows more accurate prediction of the magnitude and timing of snowmelt than in currently employed operational models. Results of the new model agree well with previous theoretical solutions and with field measurements of melt and rain-on-snow events in a seasonal snow pack.

MP 5264
SYSTEM AND METHOD FOR DETECTING ACCRETION OF FRAZIL ICE ON UNDERWATER GRATINGS.
Yankielun, N.E., Gagnon, J.J., *U.S. Patent Office. Patent,* Nov. 24, 1998, 6 col., USP-5,841,289, 12 refs.
53-1832
WATER INTAKES, FRAZIL ICE, ICE ACCRETION, ICE DETECTION, MONITORS, TELEMETERING EQUIPMENT
A system for detecting accretion of frazil ice on underwater gratings comprises a pair of parallel electrically conductive bars mounted side-by-side, for disposition beneath a water surface and spaced from but proximate an underwater intake grating. The system further includes a coaxial transmission line connected at a first end to the pair of bars for extension from the bars upwardly above the water surface, and a time domain reflectometer disposed above the water surface for generating electromagnetic pulses and having a second end of the transmission line fixed thereto. The transmission line facilitates propagation of the pulses to the bars for further travel to distal ends of the bars, and back to the reflectometer. The reflectometer is adapted to compute pulse round trip travel time in the bars and to compute changes in the round trip travel time, from which can be determined absence, presence, and build-up of frazil ice on the bars, providing an indication of same on the grating. The invention further contemplates a method for detecting accretion of frazil ice on underwater gratings, utilizing the above-described system.

MP 5265
CAPACITOR FOR WATER LEAK DETECTION IN ROOFING STRUCTURES.
Yankielun, N.E., Flanders, S.N., *U.S. Patent Office. Patent,* Sep. 8, 1998, 4 col., USP-5,804,721, 12 refs.
53-1833
ROOFS, LEAKAGE, MOISTURE DETECTION, MOISTURE METERS, ELECTRICAL MEASUREMENT
A pair of metal plates having a space therebetween are surrounded by a flexible enclosure which is waterproof and which is filled with a dry gas. A pair of electrical conductors connected to the plates extend through and are water-tight sealed to the enclosure. A water-deformable element which expands in the presence of moisture is disposed around the enclosure, and a rigid housing having holes therethrough is disposed around the water-deformable element so that moisture passing through the holes into the water-deformable element causes it to expand to move the enclosure and at least one plate so as to reduce the space between the plates to change the capacitance of the capacitor.

MP 5266
DOPPLER VELOCIMETER FOR MONITORING GROUNDWATER FLOW.
Yankielun, N.E., *U.S. Patent Office. Patent,* Aug. 18, 1998, 6 col., USP-5,796,679, 4 refs.
53-1834
GROUND WATER, WATER FLOW, FLOW MEASUREMENT, ACOUSTIC MEASUREMENT, BOREHOLE INSTRUMENTS, SUBSURFACE INVESTIGATIONS
Groundwater velocity and direction of flow are determined by insertion into a borehole below the water table of a sound source and a plurality of sound sensors. A periodic sound signal is emitted by the sound source, which is submerged in ground water at the bottom of the borehole. The sound signals are sensed by the sound sensors, which are also submerged in the water in the vicinity of the sound source. Owing to the Doppler effect, there is a shift in the frequency of the sound signals observed by the different sound sensors. The differences in frequency are determined by pulse counters and used to compute the components of groundwater velocity along north-south and east-west axes. The velocity of groundwater flow and its direction are determined by vector addition of the groundwater velocity components. These computational processes are carried out by an appropriately programmed microprocessor.

MP 5267
WATER/SEDIMENT INTERFACE MONITORING SYSTEM USING FREQUENCY-MODULATED CONTINUOUS WAVE.
Yankielun, N.E., Zabilansky, L.J., *U.S. Patent Office. Patent,* Aug. 4, 1998, 6 col., USP-5,790,471, 12 refs.
53-1835
BRIDGES, PIERS, RIVER FLOW, SUSPENDED SEDIMENTS, ALLUVIUM, WATER EROSION, MONITORS, TELEMETERING EQUIPMENT
The water/sediment interface in a body of water near bridge piers and similar structures exposed to scour, is sensed and transformed by a frequency-modulated continuous wave method into an audio frequency signal that is related to the water/sediment interface elevation, which is transmitted by radio signal to a remote monitoring station. Radio signals received at the monitoring station are transmitted to a computer, which is programmed to compute the water/sediment interface elevation and to store such computed results for later use. A remote monitoring station may be equipped to monitor several water/sediment interface sensors.

MP 5268
TIME DOMAIN REFLECTOMETRY SYSTEM FOR REAL-TIME BRIDGE SCOUR DETECTION AND MONITORING.
Yankielun, N.E., Zabilansky, L.J., *U.S. Patent Office. Patent,* July 21, 1998, 6 col., USP-5,784,338, 12 refs.
53-1836
BRIDGES, PIERS, RIVER FLOW, WATER EROSION, ICE SCORING, ICE EROSION, MONITORS, TELEMETERING EQUIPMENT, WARNING SYSTEMS
An apparatus for detecting and monitoring scouring around a structural member uses time-domain reflectometry to measure the level of sediment around the submerged portion of a structural member such as a bridge pier, dock, utility crossing, or similar structure. The apparatus includes an electrical pulse generator which transmits a series of electrical pulses, a sensor which is connected with the pulse generator, and a signal analyzer which receives and interprets the portion of the electrical pulses reflected back to the source from an interface, such as water/air or water/gravel, to calculate the position of the interface along the sensor. Knowledge of the position of the interfaces before and after a scouring event and of the dielectric constants of the surrounding media allows the user to detect and monitor the level of erosion caused by scouring.

MP 5269
WATERFOWL MORTALITY IN EAGLE RIVER FLATS, ALASKA: THE ROLE OF MUNITIONS COMPOUNDS AND HUMAN HEALTH RISK ASSESSMENT.
Bird, S.T., et al, Caribbean HAZTECH International Conference and Exhibition, San Juan, Puerto Rico, Nov. 13-15, 1991, [1991], p.1A/1-1A/15, 15 refs.
53-1841
MILITARY FACILITIES, EXPLOSIVES, WATER POLLUTION, SOIL POLLUTION, PHYSIOLOGICAL EFFECTS, HEALTH, ESTUARIES, WETLANDS, BOTTOM SEDIMENT, UNITED STATES—ALASKA—FORT RICHARDSON, UNITED STATES—ALASKA—EAGLE RIVER FLATS

MP 5270
DEVELOPMENT AND DEMONSTRATION OF FRP COMPOSITE FENDER, LOADBEARING, AND SHEET PILING SYSTEMS.
Lampo, R.G., et al, *U.S. Army Construction Engineering Research Laboratories, Champaign, IL. Technical report,* Sep. 1998, USACERL TR 98/123, Construction Productivity Advancement Research (CPAR) Program, 81p. + appends., Refs. p.79-81.
53-1920
COMPOSITE MATERIALS, POLYMERS, PILES, PILE STRUCTURES, PIERS, WHARVES, LOW TEMPERATURE TESTS, STRUCTURAL ANALYSIS, PILE LOAD TESTS
Traditional piling systems are inherently unsuited for harsh waterfront environments. Deterioration of wood, concrete, and steel piling systems is estimated to cost the U.S. military and civilian marine and waterfront communities over $1 billion annually. Fiber-reinforced polymer (FRP) composites represent an alternative construction material without many of the performance disadvantages of traditional materials as described above. A proposal was submitted to develop composite piling systems under the U.S. Army Corps of Engineers' Construction Productivity Advancement Research (CPAR) Program. This CPAR Project developed, tested, and demonstrated high-performance polymer composite fender, load-bearing, and sheet pile (bulkheads) systems for marine/waterfront civil engineering applications. In phase one, mechanical, operating, and physical performance requirements were established. In phase two, laboratory tests were conducted to assess the preliminary designs. Promising designs were further developed and tested. Selected fender piles that met the established requirements, as determined by the laboratory tests, were installed in a field demonstration. Development and adoption of industry consensus specifications and standards for composite piling systems was initiated. The Composites Institute and member manufacturers have promoted and will continue to promote the commercialization of the composite pilings developed under this project.

MP 5271
ENGINEERING AND DESIGN. RUNOFF FROM SNOWMELT.
U.S. Army Corps of Engineers, Pangburn, T., *Engineer manual,* Mar. 31, 1998, EM 1110-2-1406, Var. p., Refs. p.A/1-A/9.
53-1921
SNOW HYDROLOGY, SNOW HEAT FLUX, SNOW WATER EQUIVALENT, SNOW MELTING, SNOWMELT, STREAM FLOW, RUNOFF FORECASTING, MATHEMATICAL MODELS, STATISTICAL ANALYSIS, MANUALS

MP 5272
PROCEEDINGS OF THE 51ST ANNUAL EASTERN SNOW CONFERENCE, DEARBORN, MI, JUNE 15-16, 1994.
Eastern Snow Conference, Albert, M.R., Taylor, S., 1994, 173p., Refs. passim. For selected papers see 53-1954 through 53-1970.
53-1953
SNOW SURVEYS, SNOWFALL, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW COVER EFFECT, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, WEATHER FORECASTING, RUNOFF FORECASTING

MP 5273
ANALYSIS OF THE WINTER LOW-FLOW BALANCE OF THE SEMI-ARID WHITE RIVER, NEBRASKA AND SOUTH DAKOTA.
Ferrick, M.G., Mulherin, N.D., Calkins, D.J., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.31-43, 19 refs. For other versions see 49-6505 and 50-1074.
53-1957
RIVER BASINS, RIVER ICE, ICE GROWTH, ICE (WATER STORAGE), ICE COVER EFFECT, RIVER FLOW, STREAM FLOW, GROUND WATER, WATER TABLE, WATER BALANCE, STATISTICAL ANALYSIS, UNITED STATES—NEBRASKA—WHITE RIVER, UNITED STATES—SOUTH DAKOTA—WHITE RIVER
Low-flow studies improve understanding of flow paths during critical base-flow periods and are needed to assess the effects of water consumption on stream flow, water quality, groundwater resources, and contaminant transport. The inflows to a river from its subbasins and corresponding alluvial aquifers in a semi-arid cold region are most readily quantified in winter. The authors investigated the low-flow water balance of eight subbasins of the White River at a monthly time scale over seven consecutive winters. Water going into or out of storage as ice or melt, obtained with a temperature index model, can be a dominant component of the water balance. The point estimate method is used to account for parameter uncertainty and variability, providing the mean, variance and limits of dependent variables such as water storage as ice and inflow from a subbasin. Negative water yield from subbasins of several thousand square kilometers occurred regularly through the period, indicating a significant flow from the river to the alluvial aquifers. The authors discuss the winter water balance by subbasin and between years. The results suggest a perched river or a coupled surface water-groundwater hydrologic system in particular subbasins, consistent with the field investigations of Rothrock (1942). The winter flow exchange between the surface and subsurface can be used to estimate the annual exchange for both conditions.

MP 5274
ICE FORMATION IN AN ALASKAN ESTUARINE SALT MARSH.
Taylor, S., Racine, C.H., Collins, C.M., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.55-66, 5 refs.
53-1959
ESTUARIES, FLOODPLAINS, WETLANDS, PONDS, ALLUVIUM, BOTTOM SEDIMENT, SUSPENDED SEDIMENTS, ICE FORMATION, ICE GROWTH, BOTTOM ICE, ICE CORES, ICE SALINITY, ICE COMPOSITION, UNITED STATES—ALASKA—EAGLE RIVER FLATS
An extensive ice sheet builds up during the winter in a salt marsh complex (Eagle River Flats) at the mouth of the Eagle River near Anchorage, AK. Ice cores were taken along a transect beginning in a 0.5-m deep pond along the edge of the salt marsh and traversing marsh, shallow pond and subaerial mudflats closer to the river to elucidate how snow accumulation, periodic tidal flooding and freshwater flow contribute to the ice cover formation. The ice structure and chemistry at Eagle River Flats vary vertically and spatially. Salt and sediment content are correlated, indicating that most of the sediment is deposited by tidal flooding. Generally the ice thickness decreases, and the salt and sediment content increases, with proximity to the river. Except in the deeper pond at the periphery of the Flats, the ice appears to be grounded. The ice builds from the ground upward and thickens when tidal waters flow over the previously flooded, now frozen, surface. The ice appears to be well bonded to the underlying sediment.

MP 5275
LOCAL AND REGIONAL ESTIMATION OF SNOW USING SNOTEL.
Gwilliam, B.L., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.75-82, 16 refs.
53-1961
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, FOREST CANOPY, WEATHER STATIONS, DATA PROCESSING, STATISTICAL ANALYSIS, RUNOFF FORECASTING, UNITED STATES—ARIZONA—MOGOLLON RIM
One aspect of snow research is concerned with understanding the spatial distribution of snow. Snow distribution includes the influence of locational attributes such as latitude, longitude, elevation and canopy cover. The 1990 snow data from six USDA Soil Conservation Service Snow Telemetry (SNOTEL) sites on the Mogollon Rim of Arizona provide an opportune case study of snow distribution as a function of locational attributes. Study results show that percent canopy cover effectively describes the variation between the study sites and a derived regional average. Canopy

cover is included in a locationally adjusted spatial snow cover model, which provides strong predictive estimates of snow cover as shown by concurrently collected snow course data.

MP 5276
ORGANIC CHEMICAL PERMEATION AND STORAGE IN SEASONAL SNOW.
Hogan, A.W., Leggett, D.C., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.115-120, 8 refs.
53-1966
EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, VAPOR TRANSFER, SNOW COVER EFFECT, SNOW PERMEABILITY, SNOW COMPOSITION, SNOW IMPURITIES
Experiments were conducted near the laboratory, where shallow trays or inverted containers containing nitroaromatic compounds as vapor sources were placed in contact with the surface prior to snowfall. Snow was allowed to accumulate over the sources, and the temperature profile within the adjacent snow and soil was recorded. After several days snow blocks were collected at 5 cm intervals above the trays. Snow densities, particle sizes, and grain character were determined on site. Nitroaromatic compounds in the meltwater were determined in the laboratory by liquid chromatography. Their concentrations were examined with respect to temperature gradient, snow density, and grain size distribution and found to vary systematically with distance from the source. None of the specimens analyzed contained the equivalent of a monolayer of compound based on the estimated specific surface of the snow. The front of instrumental detection of nitroaromatics was a function of the vapor pressure of the particular source compound; DNT permeated about 1 cm/day in "dry" snow.

MP 5277
SURFACE HOARFROST MEASUREMENT AND CLIMATOLOGY.
Ryerson, C.C., Claffey, K.J., Lemieux, G.E., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.121-130, 8 refs.
53-1967
HOARFROST, GLAZE, ICE ACCRETION, ICE DETECTION, ICE FORECASTING, FROST FORECASTING, WARNING SYSTEMS
Surface hoarfrost modifies snowpacks and reduces travel safety, and it is neither measured nor forecast by weather services. The objectives of the authors are to show the reliability of hoarfrost measurements made with an ice detector and to simulate hoarfrost events. During evaluation of a Rosemount glaze ice detector, they found that it reliably indicated hoarfrost accretion. The ice detector probe's frequency was compared to the accreted frost weight on vertically and horizontally oriented metal test plates on 22 mornings. Ice detector probe frequency drop and plate frost weight correlated with $R^2>0.6$. The ice detector probe's vertical axis indicated the onset of frost accretion on vertical surfaces well, but horizontal surfaces typically began to frost a few hours earlier. Weather conditions at the onset and cessation of frost events were used to develop a rule-based forecast technique that successfully predicted most frost events observed by the ice detector.

MP 5278
TEMPORAL AND SPATIAL VARIABILITY OF WINTER THERMAL BACKGROUND SCENES.
Peck, L., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.131-141, 11 refs.
53-1968
SNOW OPTICS, SNOW SURFACE TEMPERATURE, SNOW COVER EFFECT, GRASSES, VEGETATION FACTORS, SOIL TEMPERATURE, SURFACE TEMPERATURE, INFRARED RECONNAISSANCE, WARNING SYSTEMS
This paper contrasts three winter backgrounds at a northern New England site in terms of surface temperature range, rate of temperature change, and spatial homogeneity. Ground cover surface temperatures usually are expressed as averages over several hours or days, which makes seasonal differences in thermal radiance apparent but obscures shorter-term variations that affect energy exchanges and infrared sensor systems. For this study, surface temperatures of the three winter ground covers are determined at half-hour intervals. The early winter background is a uniform grass cover following the end of the growing season. By late winter this has become a heterogeneous ground cover of thatch, new-growth grass, and exposed soil, which is a dynamic thermal background with strong daytime/nighttime differences. The midwinter snow cover is a stable thermal background because of its typically low rates of temperature change and low thermal radiance. It is shown that these three backgrounds produce distinctly different responses by passive infrared thermal devices (PIRs) that are sensitive to the spatial variability of changes (both magnitude and rate of change) in thermal radiance from the area being viewed. It is proposed that a PIR could be used to determine remotely the nature of the ground cover (grass, snow, grass-thatch-soil) and particularly to detect early and late winter transient snow covers.

MP 5279
MEASUREMENT AND DATA ANALYSIS OF WEATHER AND AVALANCHE RECORDS: RECENT DIRECTIONS AND PERSPECTIVES WITH CASE STUDIES.
Davis, R.E., Elder, K., *Eastern Snow Conference. Proceedings,* 1994, 51st, p.143-150, 24 refs.
53-1969
SNOW SURVEYS, SNOWFALL, SNOW DEPTH, SNOW WATER EQUIVALENT, METEOROLOGICAL FACTORS, AVALANCHE FORECASTING, DATA PROCESSING, COMPUTERIZED SIMULATION, STATISTICAL ANALYSIS
Records of avalanche occurrence and control efforts have traditionally been correlated to snow and weather observations from local study plots. Recent attempts to rank or score the sensitivity of various study plot and meteorological observations to avalanche activity are reviewed with discussion on the utility of different methods of analysis. The discussion is expanded by showing examples using decision-tree methodology on data from a site under a maritime climate regime. It is shown that characterization of avalanche activity does not seem to affect the ranking of important variables, but it is important to overall classification accuracy. The rank order of the five primary variables was: new snow (24 hr) depth, snow water equivalent of the storm snow, storm total snow depth, average wind speed and total snow depth. The probability of correct classification was much higher for the maximum size class, compared with the total number of avalanche releases.

MP 5280
PRELIMINARY NUMERICAL INVESTIGATION OF THE MICROMECHANICS OF SNOW COMPACTION.
Johnson, J.B., *Annals of glaciology,* 1998, Vol.26, International Symposium on Snow and Avalanches, Chamonix Mont-Blanc, France, May 26-30, 1997. Papers. Edited by D.M. McClung, et al, p.51-54, 15 refs.
53-1982
SNOW COVER STRUCTURE, MICROSTRUCTURE, SNOW DENSITY, SNOW STRENGTH, SNOW ELASTICITY, SNOW PLASTICITY, SNOW DEFORMATION, SNOW CREEP, SNOW COMPACTION, SNOW COMPRESSION, COMPUTERIZED SIMULATION
A dynamic finite-element computer program was used to examine the evolution of microstructure and its effect on continuum-scale deformation for the constant-speed uniaxial-strain compaction of an aggregate of roughly spherical elastic-plastic particles. Simulation results are used to explain some micromechanical aspects of snow compaction. Different compaction rates were used to examine the limits of quasi-static response and the effects of inertial stresses. Four stages of microstructurally controlled compaction were observed for quasi-static loading: particle re-arrangement, elastic deformation and two stages of plastic deformation. Observed pressure-density profiles for polar snow exhibit the same features of critical density and changes in the pressure-density ratio as found in the simulation and consist of four compaction stages: particle re-arrangement and three stages of creep particle deformation each following a critical density. Shear stresses appear to enhance the compaction during the stage III creep deformation of snow.

MP 5281
CONSTANT-SPEED PENETROMETER FOR HIGH-RESOLUTION SNOW STRATIGRAPHY.
Schneebeli, M., Johnson, J.B., *Annals of glaciology,* 1998, Vol.26, International Symposium on Snow and Avalanches, Chamonix Mont-Blanc, France, May 26-30, 1997. Papers. Edited by D.M. McClung, et al, p.107-111, 16 refs.
53-1993
SNOW COVER STRUCTURE, SNOW STRATIGRAPHY, SNOW STRENGTH, SNOW HARDNESS, SNOW COVER STABILITY, AVALANCHE FORECASTING, PENETRATION TESTS, PENETROMETERS, SNOW SURVEY TOOLS, SNOW SAMPLERS
A new constant-speed penetrometer for field and laboratory measurements has been developed. The initially independent work of SFISAR and CRREL has been brought together, and a portable field device is now in an advanced stage of testing. The new penetrometer has high rigidity and a high-resolution large dynamic range force sensor. It uses a much smaller sensing head (5 mm) than previous designs and has a constant-speed drive. With this construction, the penetration resistance of very fine layers and the influence of the bonding strength between snow grains can be more accurately determined than is possible with the rammsonde or Pandalp. Artificial foam layers as thin as 2 mm and thin layers in snow have been detected by the penetrometer. Thin snow layers detected from penetration-resistance profiles have been correlated to fine layering as determined from plane-section microphotographs of samples taken adjacent to the profile. The instrument's measurements are highly repeatable and the lack of subjective decisions when operating the penetrometer makes the penetration resistance a quantitative measure of snow stratigraphy.

MP 5282
DIFFERENCES IN COMPACTION BEHAVIOR OF THREE CLIMATE CLASSES OF SNOW.
Sturm, M., Holmgren, J., *Annals of glaciology,* 1998, Vol.26, International Symposium on Snow and Avalanches, Chamonix Mont-Blanc, France, May 26-30, 1997. Papers. Edited by D.M. McClung, et al, p.125-130, 22 refs.
53-1996
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW MORPHOLOGY, SNOW COMPACTION, SNOW COMPRESSION, SNOW DENSITY, SNOW WATER EQUIVALENT, CLIMATIC FACTORS, METEOROLOGICAL DATA, DATA PROCESSING, STATISTICAL ANALYSIS
In a recent paper (Sturm et al., 1995), a global seasonal snow-cover classification system was developed with each class defined by snow properties like grain-size and type. Here, characteristic bulk density vs time curves are assigned to three classes using snow-course data from Alaskan and Canadian sites. Within each class, curves have similar slopes and intercepts but between classes they are different. The relationship between slope, intercept and snow rheology has been investigated using a finite-difference model in which snow layers are assumed to behave as viscous fluids. Using observed slopes, the density-dependent compactive viscosity of each class has been determined. These are consistent with published values. Results indicate that load and load history are less important to the compaction behavior than grain and bond characteristics, snow temperature and wetness. The study suggests that differences in compaction behavior arise primarily from differences in rheology, the result of climatically controlled differences in the character of the snow. This finding explains why regional snow densities have been successfully predicted from air temperature and wind speed alone, without considering snow depth.

MP 5283
PASSIVE SNOW REMOVAL WITH A VORTEX GENERATOR AT THE PEGASUS RUNWAY, ANTARCTICA.
Lang, R.M., Blaisdell, G.L., *Annals of glaciology,* 1998, Vol.26, International Symposium on Snow and Avalanches, Chamonix Mont-Blanc, France, May 26-30, 1997. Papers. Edited by D.M. McClung, et al, p.231-236, 10 refs.
53-2015
ICE SHELVES, ICE RUNWAYS, SNOW ICE INTERFACE, SNOW REMOVAL, SNOW REMOVAL EQUIPMENT, SNOW FENCES, WIND EROSION, SNOW EROSION, ANTARCTICA—MCMURDO ICE SHELF
During the construction phase of the Pegasus runway on the McMurdo Ice Shelf, relatively large amounts of snow and ice were cleared to meet basic grade requirements for the runway surface. A considerable amount of material remains adjacent to the runway in two north-south extending mounds (berms). The runway was originally constructed on an experimental basis so attention was not focused on developing and executing a snow-removal/accumulation plan. After the runway was successfully constructed and supporting routine flight operations, concern developed over the possibility of snow accumulation adjacent to the berm area eventually inundating the runway. The intent of this project was to analyze snow accumulation and to recommend passive methods for removing some of the berm material and snow adjacent to the berm. The authors found that large quantities of excess snow could be removed by use of vortex fences which cause erosion on the leeward side of the fence. The vortex fence was designed to be portable (unlike traditional jet or blower fences) and self-orienting into the wind to allow snow removal regardless of the wind direction. The vortices generated by the fence do not dissipate rapidly, providing effective and sustained erosion.

MP 5284
EXTENSIVE MEASUREMENTS OF SNOW DEPTH USING FM-CW RADAR.
Holmgren, J., Sturm, M., Yankielun, N.E., Koh, G., *Cold regions science and technology,* Feb. 1998, 27(1), p.17-30, 15 refs.
53-2061
SNOW SURVEYS, TUNDRA TERRAIN, RADAR ECHOES, SNOW DEPTH, PROBES, COMPUTERIZED SIMULATION, SPECTRA, DATA PROCESSING, STATISTICAL ANALYSIS, FILTERS, ACCURACY
A sled-mounted X-band FM-CW radar and field data reduction system was developed and field tested. An integral part of the measurement program was the use of a computer algorithm to pick peak radar amplitudes, which were needed to convert radar data into depths in the field. A set of field protocols, designed to collocate radar and hand-probe depth measurements, were used with the algorithm to locally calibrate the radar because, without local calibration, depths were unreliable. Mean snow depths determined using the calibrated radar agreed with mean depths determined by hand to within 3% but had a consistently larger variance because of radar measurement errors. An analysis of the errors indicates that they are random and can be removed by filtering using an Optimal (Wiener) filter, thereby producing both the same mean and variance in snow depth from the radar as that

obtained by hand-probing.

MP 5285

SEASONAL STRUCTURE OF TALIKS BENEATH ARCTIC STREAMS DETERMINED WITH GROUND-PENETRATING RADAR.

Arcone, S.A., Chacho, E.F., Delaney, A.J., International Conference on Permafrost, 7th, Yellowknife, Northwest Territories, June 23-27, 1998. Proceedings. Edited by A.G. Lewkowicz and M. Allard, Sainte-Foy, Québec, Université Laval, Centre d'études nordiques, 1998, p.19-24, 13 refs.

53-2143

FLOODPLAINS, PERMAFROST BENEATH RIVERS, PERMAFROST SURVEYS, PERMAFROST HYDROLOGY, TALIKS BENEATH RIVERS, ELECTROMAGNETIC PROSPECTING, RADIO ECHO SOUNDINGS, SUBSURFACE INVESTIGATIONS, UNITED STATES—ALASKA—SAGAVANIRKTOK RIVER

The authors interpret the structure and development of taliks beneath stream channels from 375-MHz ground-penetrating radar profiles obtained in Jan. and Apr. within the Sagavanirktok River floodplain in Alaska. The upper surfaces appear smooth, often show an ice layer, and vary in depth with channel bathymetry. Partial freezing within taliks appears to cause weak reflections from the talik surface, internal reflections, and a distorted talik radar image. The taliks shrink as they propagate downward through the winter. Some taliks completely freeze by mid-Apr. Others may exist at 3.7 m beneath a typical, 1.8-m deep frozen channel, and deeper beneath channels that do not freeze completely. The persistent though diminishing flow from drill holes demonstrates their permeability.

MP 5286

EFFECT OF CONVECTIVE HEAT TRANSFER ON THAWING OF FROZEN SOIL.

Lunardini, V.J., International Conference on Permafrost, 7th, Yellowknife, Northwest Territories, June 23-27, 1998. Proceedings. Edited by A.G. Lewkowicz and M. Allard, Sainte-Foy, Québec, Université Laval, Centre d'études nordiques, 1998, p.689-695, 13 refs.

53-2246

GROUND THAWING, FROZEN GROUND THERMODYNAMICS, PERMAFROST HEAT TRANSFER, SOIL WATER MIGRATION, CONVECTION, THAWING RATE, THAW DEPTH, STEFAN PROBLEM, MATHEMATICAL MODELS

Most analyses of the thawing of frozen soil are based on purely conductive heat transfer, a very good assumption in most cases, but vertical and horizontal water flows occur frequently in permafrost regions. The effect of vertical water movement on the rate of thaw and the thermal regime of the soil is quantified. An exact similarity solution only occurs when the vertical water velocity is proportional to the rate of thaw. This solution indicates that seepage flows (the magnitude of the water velocity is near that of the rate of thaw) have little effect upon the thaw process. Approximate solutions are also given for the case of constant water velocity, using the heat balance integral and quasi-steady methods; they agree with the exact solution if the Stefan number is not too large. Thaw can be greatly accelerated or retarded if the water velocity (Peclet number) is large. The effect upon thawing for the case of horizontal water flow is less than that for the same magnitude of vertical flow.

MP 5287

THERMOKARST VEGETATION IN LOWLAND BIRCH FORESTS ON THE TANANA FLATS, INTERIOR ALASKA, U.S.A.

Racine, C.H., Jorgenson, M.T., Walters, J.C., International Conference on Permafrost, 7th, Yellowknife, Northwest Territories, June 23-27, 1998. Proceedings. Edited by A.G. Lewkowicz and M. Allard, Sainte-Foy, Québec, Université Laval, Centre d'études nordiques, 1998, p.927-933, 15 refs.

53-2279

PERMAFROST HYDROLOGY, GROUND THAWING, THERMOKARST DEVELOPMENT, TAIGA, FOREST ECOSYSTEMS, WETLANDS, SWAMPS, PEAT, PALUDIFICATION, VEGETATION PATTERNS, REVEGETATION, PLANT ECOLOGY, UNITED STATES—ALASKA—FAIRBANKS, UNITED STATES—ALASKA—TANANA RIVER

The thawing of ice-rich permafrost beneath birch forests in the Tanana Flats area of interior Alaska has produced thermokarst features colonized by a range of species and wetland vegetation types. As the forest drowns along its border with fens, an open-water moat is colonized by minerotrophic species and a floating mat develops. At the same time, thawing in the birch forest interior produces water-filled pits and collapse scar bogs in which ombrotrophic vegetation develops through several stages to Sphagnum bogs. As the thawing front moves into the birch forest from the fen, these latter features are incorporated into the floating mat, accelerating the expansion of fens.

MP 5288

CHARACTERISTICS OF PERMAFROST IN THE TANANA FLATS, INTERIOR ALASKA.

Walters, J.C., Racine, C.H., Jorgenson, M.T., International Conference on Permafrost, 7th, Yellowknife, Northwest Territories, June 23-27, 1998. Proceedings. Edited by A.G. Lewkowicz and M. Allard, Sainte-Foy, Québec, Université Laval, Centre d'études nordiques, 1998, p.1109-1114, 15 refs.

53-2306

PERMAFROST SURVEYS, PERMAFROST DISTRIBUTION, PERMAFROST HYDROLOGY, PERMAFROST FORECASTING, GROUND THAWING, THERMOKARST DEVELOPMENT, VEGETATION PATTERNS, VEGETATION FACTORS, FOREST LAND, PEAT, WETLANDS, SWAMPS, PALUDIFICATION, UNITED STATES—ALASKA—FAIRBANKS, UNITED STATES—ALASKA—TANANA RIVER

The Tanana Flats is a wetland region located on the distal slopes of an extensive alluvial fan complex built out of the Alaska Range. Vegetation in the Flats consists of a mosaic of fen, birch forest, black spruce forest, shrub, and bog. Permafrost is not present in the fen and bog areas, but it exists on the bordering forested or shrub areas 0.5 to 2 m above water level. The authors' studies show that permafrost in the Flats is relatively warm at -0.2 to -0.7°C, and that the distribution and characteristics of permafrost are related to the geobotanical conditions at a specific site. In general, permafrost is more ice rich and shows higher secondary porosity where finer-grained sediments (silts) are abundant. These are environments characterized by birch forest vegetation. Permafrost in areas of birch forest appears more susceptible to thaw and is currently showing signs of extensive degradation.

MP 5289

SNOW ABLATION MODELLING IN A MATURE ASPEN STAND OF THE BOREAL FOREST.

Hardy, J.P., Davis, R.E., Jordan, R., Ni, W., Woodcock, C.E., *Hydrological processes*, Aug.-Sep. 1998, 12(10-11), p.1763-1778, 38 refs.

53-2343

TAIGA, FOREST CANOPY, LITTER, VEGETATION FACTORS, ALBEDO, SNOW HEAT FLUX, SNOW HYDROLOGY, SNOW AIR INTERFACE, SNOW EVAPORATION, SNOW MELTING, SNOWMELT, COMPUTERIZED SIMULATION, CANADA—SASKATCHEWAN—PRINCE ALBERT NATIONAL PARK

Snow ablation modelling at the stand scale must account for the variability in snow cover and the large variations of components of energy transfer at the forest floor. The authors' previous work successfully predicted snow ablation in a mature jack pine stand by using a one-dimensional snow process model and models predicting radiation below forest canopies. This work represents a second test of their basic modelling scenario by predicting snow ablation in a leafless, deciduous aspen stand and verifying the results with field data. New modifications to the snow model accounted for decreased albedo owing to radiation penetration through optically thin snowpacks. A provisional equation estimates litter fall on the snowpack, thereby reducing the areal averaged albedo. The authors showed that subcanopy radiation measurements can be used with a canopy model to estimate a branch area index for defoliated aspen as an analogue to the foliage area index used for conifers. Modelled incoming solar and long-wave radiation showed a strong correlation with measurements, with r^2=0.96 and 0.91 for solar and long-wave radiation, respectively. Model results demonstrate that net radiation overwhelms turbulent exchanges as the most significant driving force for snowmelt in aspen forests. Predicted snow ablation in the aspen stand compared very favorably with available data on snow depth.

MP 5290

ESTIMATING THE SPATIAL DISTRIBUTION OF SNOW WATER EQUIVALENCE IN A MONTANE WATERSHED.

Elder, K., Rosenthal, W., Davis, R.E., *Hydrological processes*, Aug.-Sep. 1998, 12(10-11), p.1793-1808, 34 refs. For another version see 52-5524.

53-2345

SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW DENSITY, SNOW WATER EQUIVALENT, SNOW HYDROLOGY, SNOWMELT, RUNOFF FORECASTING, STATISTICAL ANALYSIS, COMPUTERIZED SIMULATION, UNITED STATES—CALIFORNIA—SIERRA NEVADA

An approach to model distributed snow water equivalence (SWE) that merges field measurements of depth and density with remotely sensed snow-covered area (SCA) is described. In 1993, two teams conducted an intensive snow survey in the 92.8 km^2 Blackcap Basin of the Kings River. Snow depth was measured at 709 points and density in five snow pits and along five transects using a Federal Sampler. Sample locations were chosen to be representative of the range of elevation, slope and aspect of the basin. Regression tree models showed that net radiation, elevation and slope angle account for 60-70% of the variance in the depth measurements. Density was distributed over the basin on a 30 m grid with a multiple linear regression model that explained 70% of the observed variance as a function of the same three variables. The gridded depth estimates, combined with modelled density, produced spatially distributed estimates of SWE. An unsupervised spectral unmixing algorithm estimated snow cover fractions from Landsat-5 Thematic Mapper data acquired at the time as the snow survey. This method provides a snow cover fraction estimate for every pixel. This subpixel map was used as the best estimate for SCA and, combining it with the SWE map, allowed computation of the SWE volume. The estimated volume using the subpixel SCA map was compared with several SCA maps produced with simulations of binary SCA mapping techniques. Thresholds of 40, 50 and 60% fractional cover were used to map binary cases of full snow cover or no snow cover. The difference in basin SWE volume was up to 13% depending on the threshold used to classify snow-covered versus snow-free areas. The percentage differences in volumes show a significant correlation to the percentage differences in SCA between the methods.

MP 5291

EVALUATION OF TECHNOLOGIES FOR THE DESIGN OF A PROTOTYPE IN-FLIGHT REMOTE AIRCRAFT ICING POTENTIAL DETECTION SYSTEM.

Mead, J.B., Pazmany, A., Goodberlet, M., *U.S. Federal Aviation Administration. Office of Aviation Research, Washington, D.C. Report*, Dec. 1998, DOT/FAA/AR-98/72, 55p., PB99-130262, 38 refs. Administered by the U.S. Army Cold Regions Research and Engineering Laboratory.

53-2448

AIRCRAFT ICING, ICE FORECASTING, ICE DETECTION, CLOUD PHYSICS, CLOUD DROPLETS, WATER CONTENT, MOISTURE DETECTION, RADIOMETRY, AIRBORNE RADAR, RADAR TRACKING, LIDAR, COMPUTERIZED SIMULATION

This document presents the results of an investigation of remote sensing technologies applicable to the problem of remote aircraft icing potential detection. The long-term goal is to develop an aircraft mounted sensor capable of detecting dangerous levels of supercooled liquid water tens of kilometers ahead of the aircraft. Instruments capable of mapping range profiles of cloud liquid water content and mean particle size were investigated, specifically multifrequency radar and lidar (light detection and ranging). Multifrequency radar provided to be the most promising method for detecting liquid water content and parameters related to particle size. Backscattered power measurements at one, two and three frequencies were input to a neural network trained to estimate liquid water content and two sizing parameters. This investigation showed that both two- and three-frequency radars were able to extract liquid water content and particle size parameters for various trial distributions of clouds and precipitation. Accuracy was highest for the three-frequency algorithm, especially in the estimation of liquid water content. Instruments capable of providing horizontal profiles of air temperature were also investigated, because they potentially provide a means of detecting regions of warmer air, free of supercooled drops. The technologies studied for temperatures profiling were oxygen band radiometry and a radar-acoustic sensor. Neither of these technologies was deemed promising enough to warrant further development within the current program.

MP 5292

METHOD OF DETECTING ACCRETION OF FRAZIL ICE ON WATER.

Yankielun, N.E., *U.S. Patent Office. Patent*, Jan. 19, 1999, 4 col., USP-5,861,756, 18 refs.

53-2449

WATER INTAKES, FRAZIL ICE, ICE ACCRETION, ICE LOADS, ICE ELECTRICAL PROPERTIES, ICE DIELECTRICS, ICE DETECTION, MONITORS, WARNING SYSTEMS

The spaced plates of a capacitor are immersed in water adjacent water intake grating so that water flowing toward the grating passes between and in contact with the plates; in this way frazil ice may accrete on the facing surfaces of the plates. As accretion occurs, the capacitance changes to indicate the amount of accretion of frazil ice which is detected, thereby providing an indication of the amount of accretion of frazil ice on the grating.

MP 5293

DURABILITY OF FRP COMPOSITES.

Dutta, P.K., International Conference on Fibre Reinforced Structural Plastics in Civil Engineering at Indian Institute of Technology, Madras, Dec. 18-20, 1995. Proceedings, New Delhi, Tata McGraw-Hill Publishing Company Limited, [1995], p.360-370, 22 refs.

53-2450

COMPOSITE MATERIALS, PLASTICS, POLYMERS, REINFORCED CONCRETES, CONCRETE STRENGTH, CONCRETE DURABILITY, FREEZE THAW TESTS, LOW TEMPERATURE TESTS, FROST RESISTANCE, THERMAL STRESSES

The polymer matrix composite is the most mature of all composite technologies and is currently proving attractive as a structural material to replace metals. However, there are concerns about the durability of polymer composites, especially in extreme environ-

ment. Temperature and moisture influence its properties and life cycle. Influence of alkaline and saline environment may be detrimental. Ultraviolet rays, repetitive freezing and thawing, load cycling, and creep under sustained load are known to have degrading effects. Fire hazards and flammability issues also must be addressed. This paper reviews and summarizes these issues.

MP 5294
DESIGN OF FIBER REINFORCED PLASTIC (FRP) STRUCTURAL MEMBERS.
Ganga Rao, H.V.S., Lopez-Anido, R., Dutta, P.K., Trovillion, J.C., International Conference on Fibre Reinforced Structural Plastics in Civil Engineering at Indian Institute of Technology, Madras, Dec. 18-20, 1995. Proceedings, New Delhi, Tata McGraw-Hill Publishing Company Limited, [1995], p.481-489.
53-2451
COMPOSITE MATERIALS, PLASTICS, POLYMERS, STRUCTURAL ANALYSIS, DESIGN CRITERIA.
The use of FRP structural members in civil applications requires a full understanding of the mechanical response. A general approach for characterization of structural FRP shapes was introduced. This methodology considers also different levels of analysis. This work is intended to assist structural engineering practitioners in the design of FRP structures. Within this approach, an application to design of wide-flange and box shapes was presented. In this application, the fiber architecture of existing shapes is optimized.

MP 5295
FRP COMPOSITE GRID/FRAME STRUCTURES FOR REINFORCED CONCRETE.
Dutta, P.K., Bailey, D.M., International Conference on Fibre Reinforced Structural Plastics in Civil Engineering at Indian Institute of Technology, Madras, Dec. 18-20, 1995. Proceedings, New Delhi, Tata McGraw-Hill Publishing Company Limited, [1995], p.499-507, 6 refs.
53-2452
COMPOSITE MATERIALS, PLASTICS, POLYMERS, REINFORCED CONCRETES, CONCRETE SLABS, CONCRETE STRENGTH, CONCRETE DURABILITY, STRUCTURAL ANALYSIS, DESIGN CRITERIA
This paper describes the use of continuous composite grid frames for applications as reinforcement for concrete. Potential applications are bridge decks, slabs, pile caps, and any other flat or curved concrete structures where the pace of construction must be fast. Alternative fiber systems and fabrication techniques are discussed. Preliminary design approach, analysis, and limited initial experimental data are presented.

MP 5296
EVALUATION OF THREE HELICOPTER PREFLIGHT DEICING TECHNIQUES.
Ryerson, C.C., Gilligan, T.W., Koenig, G.G., Reston, VA, American Institute of Aeronautics and Astronautics (AIAA), 1999, 9p., AIAA-99-0499, 6 refs. Presented at the AIAA 37th Aerospace Sciences Meeting and Exhibit, Reno, NV, Jan. 11-14, 1999.
53-2454
HELICOPTERS, AIRCRAFT ICING, ICE ACCRETION, ICE LOADS, ARTIFICIAL MELTING, ICE REMOVAL, DEFROSTING, INFRARED EQUIPMENT, HEATING
Procedures for preflight deicing of helicopters have not been refined nor standardized. Parked helicopters are often exposed to weather, allowing freezing precipitation and snow to accumulate on airframe and blade surfaces. Unless removed, snow and ice may linger after precipitation ends, grounding aircraft for hours to days, depending upon temperature. Newer helicopters with composite blades and fuselage components are susceptible to damage from deicing operations because thermal and mechanical damage can cause delamination. In addition, glycol-based deicing fluids may cause corrosion of critical rotor head components. Therefore, there is a need to develop different ground deicing techniques for helicopters. This paper describes an experimental evaluation of the use of infrared radiation, hot water and hot air to deice helicopters before flight. The purpose of the experiment was to evaluate the effectiveness of each deicing method, and to assess the potential thermal effects of each on rotor blade composites. The authors' greatest interest was the potential for using infrared radiation as a deicing agent, a technique that has been used to deice fixed-wing aircraft, but not helicopters.

MP 5297
PROCEEDINGS OF THE 55TH ANNUAL EASTERN SNOW CONFERENCE, JACKSON, NH, JUNE 2-3, 1998.
Eastern Snow Conference, Taylor, S., ed, Hardy, J.P., ed, *Eastern Snow Conference. Proceedings,* 1998, 55th, 173p., Refs. passim. For individual papers see 53-2625 through 53-2642.
53-2624
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOWFALL, SNOW ACCUMULATION, SNOW HYDROLOGY, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW WATER EQUIVALENT, SNOWMELT, ATMOSPHERIC CIRCULATION, WEATHER FORECASTING, RUNOFF FORECASTING

MP 5298
USING RARE EARTH ELEMENTS AS CHEMICAL TRACERS IN SNOW STUDIES.
Taylor, S., Feng, X., Klaue, B., Albert, M.R., Kirchner, J., *Eastern Snow Conference. Proceedings,* 1998, 55th, p.13-20, 19 refs.
53-2627
SNOW COMPOSITION, SNOW HYDROLOGY, SNOW MELTING, SNOWMELT, SNOW SAMPLERS, WATER CHEMISTRY, ISOTOPIC LABELING
The authors used rare earth element (REE) tracers to study snowpack dynamics at the Sleepers River Research Watershed, Vermont. REEs are ideal tracers for snow because they have very low natural abundances in snow, are soluble in natural precipitation, and can be detected at part-per-trillion concentrations. There are 14 different REEs available to mark snow layers. These elements have not previously been used as tracers in snow, and the preliminary observations confirmed their usefulness. Fresh snow was sampled after each major storm during the winter of 1997-98, and chemical analyses of five REEs (Ce, Dy, Pr, Tm and La) show that their natural background ranges from 1 to 10 ppt (ng/L). After each storm, spike solutions of these REEs were sprayed onto the snowpack overlying a lysimeter and an adjacent test area. Snow cores were taken from the test area before the main melt event. The distributions of REEs in the snow cores clearly mark the snow layers on which the tracers were applied. Some fraction of each tracer was lost from the snowpack before the main melt, but there was no sign of bleeding throughout the snowpack. The tracers near the top of the pack are eluted out earlier than tracers near the base, and refreezing of meltwater, as it moves through subzero sections of the snowpack, may cause some of the high tracer concentrations observed at low melt rates. This work is part of a larger study aimed at understanding stable isotopic variability and snow solute chemistry in snowpacks and in snowmelt.

MP 5299
AUTOMATED PROCEDURE FOR PLOTTING SNOW STRATIGRAPHY.
Shultz, E.F., Albert, M.R., *Eastern Snow Conference. Proceedings,* 1998, 55th, p.147-151, 3 refs.
53-2640
SNOW SURVEYS, SNOW SURVEY TOOLS, SNOW SAMPLERS, SNOW STRATIGRAPHY, SNOW MORPHOLOGY, COMPUTER PROGRAMS
Because snowpack stratigraphy influences the behavior of the pack, reports of research on snow often present illustrations of stratigraphy of the snowpack. Producing snowpack profiles by traditional manual methods is costly and time consuming. This paper describes a new, easy-to-use procedure for automatically plotting snowpack stratigraphy, either from one pit or from a series of pits; employing the software SnowPit98, the authors' macro (program) and custom font for the commercially-available software, Excel97. The custom font is used to label the snow layering with the International Snow Classifications symbols. This paper describes the software, provides a user guide to its use, and shows example snow stratigraphy plots that can be generated. This software should be useful to snow physicists, hydrologists and chemists and avalanche forecasters.

MP 5300
VARIATIONS IN SNOW ACCUMULATION IN THE SOUTHERN BOREAL FOREST: PRELIMINARY ANALYSIS OF 1993-1994 AND 1994-1995 MEASUREMENTS.
Davis, R.E., Metcalfe, J.R., Hardy, J.P., Goodison, B., *Eastern Snow Conference. Proceedings,* 1998, 55th, p.153-164, 32 refs.
53-2641
TAIGA, FOREST CANOPY, SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW ACCUMULATION, SNOW HYDROLOGY, SNOWMELT, INTERCEPTION, SNOW EVAPORATION, SNOW WATER EQUIVALENT, CANADA—SASKATCHEWAN
Snow measurements were made during the 1993-94 and 1994-95 snow cover seasons in the southern study areas of the Boreal Ecosystem Atmosphere Study to examine spatial distribution and snow accumulation on the ground. Snow water equivalent (SWE) measured along snow courses in conifer stands was less than SWE measured in an open area and an aspen stand during the accumulation period, an indication of the effect of sublimation of intercepted snow. Differences increased with time to maximum accumulation. A weighted combination of snow course and undercrown measurements was used to estimate SWE for the stands. Differences in total accumulation between the two years were large; 1993-94 had significantly less snow than 1994-95. The black spruce stand had 36 mm water equivalent less than the open area in both years. The mature jack pine stand had 28 mm and 27 mm less than the open area in both years, while the young jack pine had 22 mm less the first year and 9 mm less the second. There was essentially no difference in accumulation between the open area and the snow course in the aspen stand in each of the two years.

MP 5301
DETERMINATION OF NITROAROMATIC, NITRAMINE, AND NITRATE ESTER EXPLOSIVES IN WATER USING SOLID-PHASE EXTRACTION AND GAS CHROMATOGRAPHY-ELECTRON CAPTURE DETECTION: COMPARISON WITH HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY.
Walsh, M.E., Ranney, T.A., *Journal of chromatographic science,* Aug. 1998, 36(8), p.406-416, 26 refs.
53-2665
EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, WELLS, WATER POLLUTION, WATER CHEMISTRY, CHEMICAL ANALYSIS, MILITARY FACILITIES, ENVIRONMENTAL IMPACT
An analytical method for nitroaromatic, nitramine, and nitrate-ester explosives and co-contaminants in water based on solid-phase extraction (SPE) and gas chromatograph-electron capture detector (GC-ECD) is described. Samples are preconcentrated using cartridge or membrane SPE followed by elution with acetonitrile. Quantitative GC analyses are obtained with deactivated direct-injection port liners, short wide-bore capillary columns, and high linear carrier gas velocities. Recoveries are 90% or greater for each of the nitroaromatics and nitrate esters and greater than 70% for nitramines and amino-nitrotoluenes. Concentration estimates for well water extracts from military sites analyzed by GC-ECD and high-performance liquid chromatography (HPLC) methods show good agreement for the analytes most frequently detected. The GC provides lower method detection limits than HPLC for most analytes, but accurate calibration is more difficult. The ultraviolet detector used for HPLC has a much greater linear range than the ECD. The GC requires more care than the HPLC.

MP 5302
BIOREMEDIATION OF HYDROCARBON-CONTAMINATED SOILS AND GROUNDWATER IN NORTHERN CLIMATES; FINAL REPORT.
Reynolds, C.M., Braley, W.A., Travis, M.D., Perry, L.B., Iskandar, I.K., *U.S. Army Cold Regions Research and Engineering Laboratory,* Mar. 1998, Construction Productivity Advancement Research (CPAR) Program, 18p., 23 refs. For another source see 52-5985.
53-2681
LAND RECLAMATION, GROUND WATER, HYDROCARBONS, SOIL POLLUTION, WATER POLLUTION, WATER TREATMENT, COST ANALYSIS, LEACHING, DESIGN, UNITED STATES—ALASKA—FAIRBANKS

MP 5303
HEC-RAS RIVER ANALYSIS SYSTEM: HYDRAULIC REFERENCE MANUAL, VERSION 2.2.
Brunner, G.W., *U.S. Army Corps of Engineers. Hydraulic Engineering Center,* Sep. 1998, CPD-69, Var. p.(251p.), PB99-501363 (CD-ROM), 40 refs. P.11-1 through 11-8 written by S.F. Daly, CRREL.
53-2685
MANUALS, COMPUTER PROGRAMS, RIVERS, RIVER ICE, ICE JAMS, HYDRAULICS, RIVER FLOW, BRIDGES, CULVERTS, MODELS, COMPUTERIZED SIMULATION, SPILLWAYS
This manual describes the theory and data requirements for the hydraulic calculations performed by HEC-RAS. Equations are presented along with the assumptions used in their derivation. Discussions are provided on how to estimate model parameters, as well as guidelines on various modeling approaches. Routines for modeling ice cover and wide river ice jams are included.

MP 5304
HEC-RAS RIVER ANALYSIS SYSTEM: USER'S MANUAL, VERSION 2.2.
Brunner, G.W., *U.S. Army Corps of Engineers. Hydraulic Engineering Center,* Sep. 1998, CPD-68, Var. p.(243p.), PB99-501363 (CD-ROM), 19 refs. P.6-68 through 6-73 written by S.F. Daly, CRREL.
53-2686
MANUALS, COMPUTER PROGRAMS, DATA PROCESSING, COMPUTERS, RIVERS, RIVER ICE, ICE JAMS, HYDRAULICS, RIVER FLOW, BRIDGES, CULVERTS, MODELS, STREAMS, SPILLWAYS
This manual is a guide to using the HEC-RAS. The manual provides an introduction and overview of the modeling system, installation instructions, how to get started, simple examples, detailed descriptions of each of the major modeling components, and how to view graphical and tabular output. Instructions for entering and editing river ice data and setting tolerances for ice jam calculations are included.

MP 5305

HEC-RAS RIVER ANALYSIS SYSTEM: APPLICATIONS GUIDE, VERSION 2.2.

Warner, J.C., Brunner, G.W., *U.S. Army Corps of Engineers. Hydraulic Engineering Center,* Sep. 1998, CPD-70, Var. p.(283p.), PB99-501363 (CD-ROM), 12 refs. P.14-1 through 14-9 written by S.F. Daly, CRREL.

53-2687

MANUALS, COMPUTER APPLICATIONS, COMPUTER PROGRAMS, COMPUTERS, RIVERS, RIVER ICE, ICE COVER, ICE JAMS, HYDRAULICS, RIVER FLOW, BRIDGES, CULVERTS, MODELS, STREAMS, SPILLWAYS

This document contains a series of examples that demonstrate various aspects of the HEC-RAS. Each example consists of a problem statement, data requirements, general outline of solution steps, displays of key input and output screens, and discussions of important modeling aspects. Example 14 presents an ice-covered river, including ice cover and ice jam analysis.

MP 5306

USE OF GEOSYNTHETICS TO MITIGATE FROST HEAVE IN SOILS.

Henry, K.S., Seattle, University of Washington, 1998, 333p., University Microfilms order No.DA99-16667, Ph.D. thesis. Refs. p.149-156.

53-2750

GEOTEXTILES, COMPOSITE MATERIALS, CAPILLARITY, FROST HEAVE, PAVEMENTS, FREEZING FRONT, WATER TABLE, SOIL WATER, SOIL FREEZING, HEAT FLUX, FROST PENETRATION, THERMODYNAMICS, SOIL STABILIZATION, FROST PROTECTION

A capillary barrier is a layer of coarse, porous material placed in soil above the water table to prevent unsaturated water flow across the layer. Capillary barriers reduce frost heave in soils and pavement systems when they are located between the water table and the freezing front. Due their large pore sizes, geotextiles and geocomposites are capillary barrier candidates. The objectives of this research were to determine (1) the range of soil and thermal conditions under which geosynthetic capillary barriers can reduce frost heave, and (2) geosynthetic properties required for capillary barrier performance. Based on estimates of heat flux in the field and freezing test results, capillary barriers should be beneficial in most cold regions. The frost heave of soil specimens with and without geosynthetic capillary barriers was examined through freezing tests of frost-susceptible soils. Theory, capillary rise, and water retention tests showed that moist geotextiles that contain soil fines take on and transmit water more easily than geotextiles as received from the manufacturer; this was verified by freezing tests. Moist geocomposites containing soil fines effectively cut off frost heave in highly frost-susceptible soil when the soil above the capillary barrier was 75% saturated or less, but they did not work when the soil above them was more than 80% saturated. The geocomposites consisted of combinations of two different geotextiles and two different nets, and the results were not product dependent. Filtration tests verified that the geotextiles used as filters on the geocomposite performed adequately as filters in a frost-susceptible soil.

MP 5307

PHYSICAL CHARACTERISTICS OF SUMMER SEA ICE ACROSS THE ARCTIC OCEAN.

Tucker, W.B., Gow, A.J., Meese, D.A., Bosworth, H.W., Reimnitz, E., *Journal of geophysical research,* Jan. 15, 1999, 104(C1), p.1489-1504, 64 refs.

53-2931

OCEANOGRAPHIC SURVEYS, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE STRUCTURE, PHYSICAL PROPERTIES, CHEMICAL PROPERTIES, ALBEDO, ICE CORES, PONDS, SEDIMENT TRANSPORT, ICE RAFTING, RADIOMETRY, THIN SECTIONS, ARCTIC OCEAN

Sea ice characteristics were investigated during July and Aug. on the 1994 transect across the Arctic Ocean. Properties examined from ice cores included salinity, temperature and ice structure. Salinities measured near zero at the surface, increasing to 3-4 per mill at the ice-water interface. Ice crystal texture was dominated by columnar ice, comprising 90% of the ice sampled. Surface albedos of various ice types, measured with radiometers, showed integrated shortwave albedos of 0.1 to 0.3 for melt ponds, 0.5 for bare, discolored ice, and 0.6 to 0.8 for a deteriorated surface or snow-covered ice. Aerial photography was utilized to document the distribution of open melt ponds, which decreased from 12% coverage of the ice surface in late July at 76°N to almost none in mid-Aug. at 88°N. Most melt ponds were shallow, and depth bore no relationship to size. Sediment was pervasive from the southern Chukchi Sea to the north pole, occurring in bands or patches. It was absent in the Eurasian Arctic, where it had been observed on earlier expeditions. Calculations of reverse trajectories of the sediment-bearing floes suggest that the southernmost sediment was entrained during ice formation in the Beaufort Sea while more northerly samples probably originated in the East Siberian Sea, some as far west as the New Siberian Islands.

MP 5308

LATE 20TH CENTURY INCREASE IN SOUTH POLE SNOW ACCUMULATION.

Mosley-Thompson, E., Paskievitch, J.F., Gow, A.J., Thompson, L.G., *Journal of geophysical research,* Feb. 27, 1999, 104(D4), p.3877-3886, 49 refs.

53-2950

CLIMATOLOGY, GLOBAL CHANGE, GLOBAL WARMING, POLAR ATMOSPHERES, PRECIPITATION (METEOROLOGY), SNOW ACCUMULATION, SNOW WATER EQUIVALENT, ICE CORES, ISOTOPE ANALYSIS, SEASONAL VARIATIONS, STATISTICAL ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION

A compilation of the 37-year history of net accumulation at the South Pole suggests an increase in net annual accumulation since 1965. This record is sporadic and its quality is compromised by spatially restricted observations and nonsystematic measurement procedures. Results from a new, spatially extensive network of 236 accumulation poles document that the current 5-year (1992-97) average annual net accumulation at the South Pole is 84.4±8.9 mm water equivalent (w.e.). This accumulation rate reflects a 30% increase since the 1960s when the best, although not optimal, records indicate that it was 65 mm w.e. Identification of two prominent beta radioactivity horizons (1954-55 and 1964-65) in six firn cores confirms an increase in accumulation since 1965. Viewed from a longer perspective of accumulation provided by ice cores and a snow mine study, the net accumulation of the 30-year period, 1965-1994, is the highest 30-year average of this millennium. Limited data suggest this recent accumulation increase extends beyond the South Pole region and may be characteristic of the high East Antarctic Plateau. Enhanced accumulation over the polar ice sheets has been identified as a potential early indicator of warmer sea surface temperatures and may offset a portion of the current rise in global sea level.

MP 5309

FIELD TESTING OF STABILIZED SOIL.

Janoo, V.C., Firicano, A.J., Barna, L.A., Orchino, S.A., *Journal of cold regions engineering,* Mar. 1999, 13(1), p.37-53, 8 refs.

53-2966

SOIL TESTS, PAVEMENT BASES, SUBGRADE SOILS, SOIL STRENGTH, BEARING STRENGTH, COMPRESSIVE PROPERTIES, SOIL STABILIZATION, FREEZE THAW CYCLES, FROST PENETRATION, PENETRATION TESTS

Remediation of a Superfund site in Stratford, CT, involved stabilization of the subgrade with portland cement. Part of the remediation site was to be used as a parking area. The stabilized soil was to be covered with natural base/subbase course materials and capped with an asphalt concrete cover. During the course of the remediation, a base-course layer could not be placed prior to the onset of winter. A field study was conducted to quantify any changes in the mechanical properties of the open stabilized subgrade subjected to freeze-thaw cycling during the winter of 1996-97. Field evaluation was conducted with pavement industry tools: the Clegg impact hammer and the dynamic cone penetrometer. Evaluation results show the viability of the Clegg hammer as an instrument for quality assurance and also show that there can be up to 50% loss in compressive strength of the subgrade within the uppermost layer of the material caused by freeze-thaw cycling.

MP 5310

ON THE FREQUENCY DISTRIBUTION OF NET ANNUAL SNOW ACCUMULATION AT THE SOUTH POLE.

Van der Veen, C.J., Whillans, I.M., Gow, A.J., *Geophysical research letters,* Jan. 15, 1999, 26(2), p.239-242, 11 refs.

53-2980

PALEOCLIMATOLOGY, GEOCHRONOLOGY, PRECIPITATION (METEOROLOGY), POLAR ATMOSPHERES, SNOW ACCUMULATION, SNOW STRATIGRAPHY, THICKNESS, SEASONAL VARIATIONS, STATISTICAL ANALYSIS, ACCURACY, ANTARCTICA—SOUTH POLE

The frequency distribution of stratigraphic layer thickness in cores and a snowmine at South Pole is not compatible with a significant number (>1%) of missing layers associated with zero-accumulation years inferred from pole-height measurements. A reconciliation of these data sets is needed if observed stratigraphic records are to be used as reliable paleoclimate indicators. Three explanations for the discrepancy are offered, namely (i) during a significant number of years, a visible stratigraphic horizon does not form or is not identified, (ii) the true distribution is characterized by two maxima, with a secondary maximum centered around zero layer thickness, or (iii) the pole-height measurements are misinterpreted and there are very few zero-accumulation years at South Pole. With the currently available data, it is not possible to discriminate among these three possibilities.

MP 5311

FLOATING DEBRIS CONTROL SYSTEMS FOR HYDROELECTRIC PLANT INTAKES.

Perham, R.E., *U.S. Army Corps of Engineers. Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. REMR bulletin,* Sep. 1986, 3(2), p.1-3.

53-3064

WATER INTAKES, WASTE DISPOSAL, CRANES (HOISTS), RIVER FLOW, FLOW CONTROL

MP 5312

LATE QUATERNARY DETRITAL CARBONATE (DC-) LAYERS IN BAFFIN BAY MARINE SEDIMENTS (67°-74°N): CORRELATION WITH HEINRICH EVENTS IN THE NORTH ATLANTIC?

Andrews, J.T., Kirby, M.E., Aksu, A., Barber, D.C., Meese, D.A., *Quaternary science reviews,* Dec. 1998, 17(12), p.1125-1137, Refs. p.1134-1137.

53-3093

PLEISTOCENE, QUATERNARY DEPOSITS, MARINE DEPOSITS, MARINE GEOLOGY, GLACIER OSCILLATION, ICE RAFTING, DRILL CORE ANALYSIS, STRATIGRAPHY, GEOCHRONOLOGY, RADIOACTIVE AGE DETERMINATION, ICE AGE THEORY, CANADA—NORTHWEST TERRITORIES, ATLANTIC OCEAN, BAFFIN BAY

Episodes of glaciation in the region north of Baffin Bay resulted in the erosion of Paleozoic carbonate outcrops in NW Greenland and the Canadian High Arctic. These events are recognized in the marine sediments of Baffin Bay (BB) as a series of detrital carbonate-rich (DC-) layers. BBDC-layers thin southward within Baffin Bay; thus, the contribution of Baffin Bay ice-rafted carbonate-rich sediments to the North Atlantic is probably slight, especially compared with sediment output from Hudson Strait during Heinrich events. The authors reexamine a series of nine piston cores from the axis of Baffin Bay and across the Davis Strait sill and provide a suite of 21 AMS ^{14}C dates on foraminifera which bracket the ages of several DC-layers. The onset of the last DC event is dated in six cores and has an age of ca. 12.4 ka. In northern and central Baffin Bay a thick DC-layer occurs at around 4 m in the cores and is dated >40 ka. There were three to six DC intervening events. The youngest BBDC event (possibly a double event) lags Heinrich event 1 (H-1) off Hudson Strait, dated at 14.5 ka, but it is coeval with the pronounced warming seen in GISP2 records from the Greenland Ice Sheet during interstadial #1. The authors hypothesize that BBDC episodes are coeval with major interstadial $\delta^{18}O$ peaks from GISP2 and other Greenland ice core records and are caused by or associated with the advection of Atlantic Water into Baffin Bay and the subsequent rapid retreat of ice streams in the northern approaches to Baffin Bay.

MP 5313

LABORATORY TESTS OF CABLE-BASED ROOF MOISTURE DETECTION SYSTEM.

Flanders, S.N., Yankielun, N.E., *Journal of architectural engineering,* Dec. 1998, 4(4), p.135-141, 7 refs.

53-3105

ROOFS, LEAKAGE, MOISTURE DETECTION, MOISTURE METERS

The authors have devised a prototype cable-based roof moisture detection and location system (U.S. Patent 5,648,724) that was tested in simulated conditions. The detection system can use a variety of principles to monitor roofing for the presence of moisture. The location system uses a metallic time-domain reflectometer (MTDR) to locate a suspected wet area by sending an electromagnetic pulse or step signal down the sensor cable and looking for reflections caused by a change in the dielectric constant surrounding the cable due to the presence of a wet area. Tests revealed the MTDR technique to be sensitive and able to locate the position of less than 1 L of water within 0.3 m over 30.5 m of cable. Where multiple regions of wetting were present along the length of the cable, it was possible to locate each boundary between wet and dry.

MP 5314

COMPOSITE MATERIALS FOR CIVIL ENGINEERING STRUCTURES. *U.S. Army Corps of Engineers. Engineer technical letter,* Mar. 31, 1997, ETL 1110-2-548, Var. p., 45 refs. Chapter 6: Durability, by P.K. Dutta.

53-3114

COMPOSITE MATERIALS, PLASTICS, POLYMERS, CONSTRUCTION MATERIALS, REINFORCED CONCRETES, CONCRETE STRENGTH, CONCRETE DURABILITY, STRAIN TESTS, STRUCTURAL ANALYSIS, DESIGN CRITERIA

MP 5315

OVERVIEW OF THE SHEBA ATMOSPHERIC SURFACE FLUX PROGRAM.

Andreas, E.L., Fairall, C.W., Guest, P.S., Persson, P.O.G., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.411-416, 10 refs.

53-3115

RESEARCH PROJECTS, DRIFT STATIONS, POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, AIR ICE WATER INTERACTION, ICE COVER EFFECT, ICE HEAT FLUX, HEAT BALANCE

MP 5316
MEDIUM-SCALE INDENTATION TESTS ON SEA ICE AT VARIOUS SPEEDS.
Sodhi, D.S., Takeuchi, T., Nakazawa, N., Akagawa, S., Saeki, H., *Cold regions science and technology,* 1998, 28(3), p.161-182, 74 refs.
53-3160
ICE SOLID INTERFACE, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE COVER STRENGTH, ICE DEFORMATION, ICE CREEP, ICE BREAKING, STRAIN TESTS, PENETRATION TESTS
As part of a five-year program involving laboratory and field tests in Japan, the authors conducted medium-scale indentation tests on sea ice in the harbor of Lake Notoro, Hokkaido, by pushing a segmented indentor against the edge of a floating ice sheet. Measurements on each 10-cm wide segment included forces in three directions and the moment about a horizontal line parallel to the indentor face. During the tests in 1998, the authors also installed four pressure-sensing panels on the face of the segmented indentor and measured interfacial pressure during indentation tests at three speeds. They present the results from the load cells and the pressure-sensing panels. They obtained data on the actual contact area and the magnitude of interfacial pressures from the pressure-sensing panels. They observed both a 'line-like' contact during high-speed (3- and 30-mm/s) indentation tests, and a gradually enlarging contact area attributable to creep deformation of the ice during low-speed (0.3-mm/s) indentation tests. Using the results of a brittle flaking model from the literature, the authors estimate the apparent fracture toughness of the ice from the data on interfacial pressure and the width of the contact area. Taking creep and fracture properties into account, they present a theoretical model to estimate the speed at which the transition from ductile to brittle failure of ice takes place during ice-structure interaction.

MP 5317
REGISTRATION OF "CD-II" CRESTED WHEATGRASS.
Asay, K.H., et al, *Crop science,* 1997, Vol.37, p.1023, 1 ref.
53-3201
GRASSES, PLANTS (BOTANY), INTRODUCED PLANTS, PLANT PHYSIOLOGY, PLANT TISSUES, PLANT ECOLOGY, AGRICULTURE

MP 5318
COPING WITH SPATIAL HETEROGENEITY EFFECTS ON SAMPLING AND ANALYSIS AT AN HMX-CONTAMINATED ANTITANK FIRING RANGE.
Jenkins, T.F., et al, *Field analytical chemistry and technology,* 1999, 3(1), p.19-28, 24 refs.
53-3202
MILITARY FACILITIES, SITE SURVEYS, EXPLOSIVES, SOIL POLLUTION, SOIL TESTS, SOIL ANALYSIS, SOIL CHEMISTRY, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS
Short-range and mid-range (grid size) spatial heterogeneity in explosives concentrations within surface soils was studied at an active antitank firing range. Intensive sampling was conducted adjacent to two target tanks by establishing sixteen 6 m^2 grids. Each grid was subdivided into four quadrants, and in each quadrant an area-integrated surface sample was formed into a pile that included about 10% of the top 5 cm of soil in the quadrant. After in situ homogenization, random aliquots were combined to form replicate representative samples. Grid composites were also prepared by combining equal portions of soil from the four quadrants for each grid. In nine of the quadrants, a second area-integrated sample was prepared. On-site analysis showed concentrations of HMX ranging from as high as 2160 mg/kg near one target to ≤1 mg/kg at a distance of 20 m from the target. TNT concentrations, ranging from ≤1 to 23 mg/kg, were much lower than would be expected based on the 70:30 composition ratio of HMX to TNT in the melt-cast explosive used on site. On-site concentration estimates for HMX and TNT were in excellent agreement with laboratory HPLC results; correlation coefficients were 0.992 and 0.975, respectively. Spatial heterogeneity of HMX concentrations was large on both short- and mid-range scales, and this factor dominated the overall uncertainty associated with site characterization. Greater emphasis on sampling is urgently needed to improve the representativeness of explosives residue determinations in soil.

MP 5319
TEMPERATURE AND GERMINATION RELATIONSHIPS OF *FESTUCA* VARIETIES.
Brar, G.S., Palazzo, A.J., *Plant varieties and seeds,* 1997, Vol.10, p.103-111, 25 refs.
53-3203
GRASSES, INTRODUCED PLANTS, PLANTS (BOTANY), PLANT ECOLOGY, PLANT PHYSIOLOGY, PLANT TISSUES, REVEGETATION, SOIL CONSERVATION
Many studies have shown that water potential at planting will affect the germination rate and final germination of *Festuca* varieties. Limited information is available about the extent of variability in temperature dependence of germination among different *Festuca* varieties. The objective of the authors was to study germination at five temperatures for a wide range of *Festuca* varieties. *Festuca* seeds were screened for germination during 28 days in polyethylene growth pouches held at constant temperatures of 10, 15, 20, 25 or 30°C. The germination percentage significantly (P<0.05) increased as the temperature increased from 10° to 15°C and decreased thereafter. The variety 'Clemfine' tall fescue *(Festuca arundinacea* Schreb) had the greatest germination percentage and 'Arctared' red fescue *(Festuca rubra* L.) had the least when averaged across the five temperatures. Conversely the average time to germination (A_{tg}) was greatest at 10°C and least at 30°C. Reaching a germination level of 80% or more of the seeds required 14 d at 10°C, 9 d at 15°C, 8 d at 20°C and 7 d at 25°C or 30°C. Base temperatures required for germination of *Festuca* species were 3.2°C for rapid germinators, 3.6 to 6°C for medium germinators, and 4 to 6°C for slow germinators. Heat units calculated for the rapid germinators were 129°C d, 120 to 140°C for medium germinators, and 135 to 191°C d for the slow germinators. Germination decreased as heat units increased. The A_{tg} and heat units regressions explained 91% and 66% of the variations in germination, respectively. The optimum temperature for germination of *Festuca* varieties was 15°C. Seeding time for some *Festuca* varieties could be varied based on expected seed zone temperatures for particular locations. Rapidity and total germination are the most obvious factors distinguishing *Festuca* varieties. This study demonstrates the variability in rate and extent of varieties germination in response to temperatures.

MP 5320
UXO DETECTION AT JEFFERSON PROVING GROUND USING GROUND-PENETRATING RADAR.
Arcone, S.A., Delaney, A.J., Sellmann, P.V., O'Neill, K., UXO (Unexploded Ordnance) Forum '98, Anaheim, CA, May 5-7, 1998, Alexandria, VA, U.S. Department of Defense Explosives Safety Board, 1998, p.1-24, 23 refs.
53-3204
MILITARY FACILITIES, EXPLOSIVES, SITE SURVEYS, ELECTROMAGNETIC PROSPECTING, RADIO ECHO SOUNDINGS, SUBSURFACE INVESTIGATIONS, UNITED STATES—INDIANA—JEFFERSON PROVING GROUND
The authors have used ground-penetrating radar (GPR) to detect unexploded ordnance (UXO) and non-ordnance on the 40-acre site (lot 54) of Jefferson Proving Ground, IN. The UXO are buried within about 1 m deep in a clayey silt for which the soil water content ranged from moist near the surface to near saturation at about 1 m. The authors used a 16-bit radar to profile along previously established lines, and transects over artificial targets that were emplaced. Data was recorded at 48-64 traces/s with minimal towing speeds during both dry and rainy weather. Target responses at about 300 (time range of 50 ns) and 600 MHz (30 ns) ranged from discrete diffractions to short reflection segments. The loss of the soil greatly attenuated diffraction hyperbolas. Theoretical analyses of these hyperbolas give an average soil dielectric constant of 10 at both 300 and 600 MHz. The phase polarity of many of the reflected and diffracted wavelets indicate targets with wave impedances higher than that of the soil. The authors assume these targets to be metallic and the responses of some, whose locations correlate with the position of UXO on burial maps, are shown in detail. Theoretical modeling of wavelet propagation for this soil confirms the high rate of attenuation (47-66 dB/m round trip), the maintenance of waveform, a shift in wavelet local frequency, and response to a typical UXO. It is concluded that GPR is effective for finding targets in this type of soil to no more than 2 m depth. The authors recommend that future surveys utilize high trace acquisition rates to capture the full target responses and a prowed, heavy dielectric antenna sled to improve antenna-to-ground coupling and deflect surface obstacles such as vegetation.

MP 5321
PARENT-PROGENY RELATIONSHIPS FOR CARBON ISOTOPE DISCRIMINATION AND RELATED CHARACTERS IN CRESTED WHEATGRASS.
Asay, K.H., Johnson, D.A., Palazzo, A.J., *International journal of plant sciences,* 1998, 159(5), p.821-825, 25 refs.
53-3205
GRASSES, INTRODUCED PLANTS, PLANTS (BOTANY), PLANT PHYSIOLOGY, PLANT TISSUES, PLANT ECOLOGY, REVEGETATION, AGRICULTURE, SOIL CONSERVATION, LAND RECLAMATION
Improved cultivars of perennial grasses developed for natural resource conservation and forage production on semiarid rangelands of western North America must persist under extreme environmental stress and make efficient use of limited water resources. A close negative relationship has been documented between carbon isotope discrimination (Δ) and water use efficiency (WUE) in temperate (C_3) grasses, and preliminary evidence indicates that Δ would be a promising indirect selection criterion to improve WUE in crested wheatgrass, *Agropyron cristatum* (L.) Gaertner and *Agropyron desertorum* (Fisch. ex Link) Schultes, a widely used grass on semiarid rangelands. The authors determined the magnitude of genetic variability and parent-progeny relationships for Δ and the correlation of this attribute with forage yield in a genetically broad-based crested wheatgrass breeding population. Significant differences (P<0.01) were found among clonal and progeny lines for Δ of the leaves and seeds. Broad-sense heritability values for leaf and seed Δ computed on a mean basis across two years exceeded 90%. Narrow-sense heritability for leaf Δ, based on parent-progeny regression analysis across two years, was 60%. Broad- and narrow-sense heritability values for dry matter yield (DMY) were substantially less than the corresponding values for Δ. The correlations between Δ and DMY were generally low and nonsignificant. These data confirm earlier, preliminary conclusions that selection for Δ to improve WUE would be a worthy breeding objective in crested wheatgrass and that genetic advances in Δ and DMY could be achieved concurrently.

MP 5322
FINE FESCUE SPECIES DETERMINATION BY LASER FLOW CYTOMETRY.
Huff, D.R., Palazzo, A.J., *Crop science,* Mar.-Apr. 1998, Vol.38, p.445-450, 34 refs.
53-3206
GRASSES, PLANTS (BOTANY), PLANT PHYSIOLOGY, PLANT TISSUES, AGRICULTURE
The close morphological resemblance among fine fescues *(Festuca* spp.) makes identification and classification of species a difficult problem for turfgrass and taxonomic scientists. Determining ploidy level has become a major taxonomic tool for identifying species of fine fescues. The present study used laser flow cytometry to determine ploidy levels of 48 fine fescue populations (accessions) and thereby infer species classification based on observed and previously reported chromosome numbers. The 10 species of fine fescues examined were strong creeping red fescue *(F. rubra* L. spp. *rubra*), slender creeping red fescue *(F. rubra* var. *littoralis* Vasey), Chewings fescue *[F. rubra* spp. *fallax* (Thuill.) Nyman], hard fescue *(F. brevipila* Tracey), sheep fescue *[F. ovina* L. ssp. *hirtula* (Hackel ex Travis) Wilkinson], hair fescue *(F. filiformis* Pourret), false sheep fescue *(F. pseudovina* Hackel ex Wiesb), alpine fescue *(G. brachyphylla* Schultes), bluebunch fescue *(F. idahoensis* Elmer), and tundra fescue *(F. lenesis* Drobov). Significant differences were observed between species (P<0.01) and among populations within species (P<0.05). DNA content among the 10 species was observed to be highly positively correlated with observed or reported chromosome numbers (r=0.97, n=10, P<0.01). Linear regression analysis predicted 2C DNA content values for each of the four ploidy levels to be 5.31 pg for diploids, 8.53 pg for tetraploids, 11.75 pg for hexaploids and 14.98 pg for octoploids. The observations and results of the present study are consistent with current taxonomic treatments of hard and sheep fescue species as well as the other fine fescue species examined. The information presented should aid breeders in accurately and easily determining primary breeding germplasm with respect to ploidy levels. It may also enable the turfgrass industry to define reliably seed products and the plant collector to begin to assign native and/or naturalized accessions to their proper species categories.

MP 5323
ENVIRONMENTAL EFFECTS ON DETECTION OF BURIED MINES AND UXO.
Detsch, R.M., Jenkins, T.F., Arcone, S.A., Koh, G., O'Neill, K., *SPIE—The International Society for Optical Engineering. Proceedings. Part 2,* 1998, Vol.3392, Conference on Detection and Remediation Technologies for Mines and Minelike Targets III, Orlando, FL, Apr. 13-17, 1998, p.1261-1264, 4 refs.
53-3207
MINES (ORDNANCE), EXPLOSIVES, FROZEN GROUND CHEMISTRY, CHEMICAL ANALYSIS, SNOW COVER EFFECT, RADIO ECHO SOUNDINGS, ELECTROMAGNETIC PROSPECTING, INFRARED PHOTOGRAPHY, SUBSURFACE INVESTIGATIONS
Several studies are under way at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) to define environmental effects on detection and classification of buried mines and unexploded ordnance (UXO). Ground that is very wet, frozen, or snow covered can pose severe constraints on demining operations. The qualitative and quantitative nature of chemical signatures of buried land mines is being documented. Research to date indicates that although 2,4,6-trinitrotoluene constitutes over 99% of military-grade TNT, it is a minor component of the vapor signature at ground level. CRREL operates a year-round test site to determine the effect of weather on radar and IR systems used to detect buried mines. The New England site experiences many of the weather conditions likely to interfere with mine detection around the world. Short-pulse ground penetrating radar (GPR) was used to profile both ordnance and non-ordnance targets at the 40-acre UXO site at Jefferson Proving Ground. Analysis of the data indicates that future systems will have to operate at faster data acquisition rates. Radar modeling is being used to simulate the effects of the environment and identify new techniques for finding and classifying buried ferrous objects.

MP 5324
PLANT AND MICROBIAL INFLUENCE ON BIOREMEDIATION OF HYDROCARBON-CONTAMINATED SOILS.
Beyrouty, C.A., Reynolds, C.M., Rogers, H.B.,

Nichols, T.D., Wolf, D.C., International Petroleum Environmental Conference, 3rd, Albuquerque, NM, Sep. 24-27, 1996. Proceedings. Vol.1, Washington, D.C., U.S. Department of Energy, [1996], p.465-474, 3 refs.
53-3208
OIL SPILLS, SOIL POLLUTION, GRASSES, ROOTS, PLANT PHYSIOLOGY, PROTECTIVE VEGETATION, REVEGETATION, SOIL MICROBIOLOGY, BACTERIA, NUTRIENT CYCLE, LAND RECLAMATION
The rhizosphere soil adjacent to the plant root exhibits high microbial activity that may enhance hydrocarbon contaminant biodegradation. The authors amended a soil with an organic contaminant mixture (OCM) containing equimolar amounts of benzoic acid, hexadecane, 2,2-dimethyl 4,n-propyl-benzene, phenanthrene, pyrene, and *cis*-decahydronaphthalene or cycloheptane to evaluate plant species that can satisfactorily grow in contaminated soils and enhance the potential for microbial decomposition of contaminants in the rhizosphere. In a plant screening of four legumes, four grasses, and one composite exposed to 0, 1000, 2000, 4000 or 8000 mg OCM/kg, plant growth was reduced at the 4000 and 8000 mg/kg rates. At 1000 and 2000 mg OCM/kg, root length and root dry weight of alpine bluegrass *(Poa alpina* L.) increased. Root growth for the remaining plant species generally decreased as OCM rate increased. These studies demonstrated that plants can germinate and grow in contaminated soil, that relative to the bulk soil there is an increase in the percentage of the rhizosphere microbial population capable of degrading contaminants, and that roots of select plants can explore contaminated soil. These data support the hypothesis that bioremediation of petroleum contaminated-soil can be enhanced by growth of appropriate plant species.

MP 5325
PHYTOREMEDIATION OF HYDROCARBON CONTAMINATED SOILS.
Reynolds, C.M., et al, International Petroleum Environmental Conference, 4th, San Antonio, TX, Sep. 9-12, 1997. Proceedings, Washington, D.C., U.S. Department of Energy, [1997], 10p., 16 refs.
53-3209
OIL SPILLS, SOIL POLLUTION, GRASSES, ROOTS, PLANT PHYSIOLOGY, PROTECTIVE VEGETATION, REVEGETATION, SOIL MICROBIOLOGY, BACTERIA, NUTRIENT CYCLE, LAND RECLAMATION
Using plants and their associated rhizosphere microorganisms to enhance biodegradation of organic contaminants may provide a viable, low-cost remediation option well-suited to remote sites or fragile ecosystems. The authors investigated changes in the microbial populations of a Captina silt loam with or without bahiagrass *(Paspalum notatum* Flugge, var. Argentine), amended with 0 or 2000 mg pyrene/kg soil, and incubated for 10 weeks. Microbial numbers were not significantly influenced by the pyrene level, but were greater in the rhizosphere compared to the bulk soil. Bacterial numbers were 5.9×10^6 and 3.6×10^8 CFU/g in the bulk and rhizosphere soil, respectively. The authors developed and used a "soil sock" technique in a field study to determine the effects of nutrient addition and plants on bacterial numbers and remediation of soil contaminated with diesel. Initial data from the study showed that addition of nutrients and plants together resulted in significantly higher bacterial numbers than the control and the greatest decrease in total petroleum hydrocarbon (TPH) levels. An Annual ryegrass *(Lolium multiflorum,* Lam.) and Arctared red fescue *(Festuca rubra,* L.) mixture was effective in reducing TPH levels. These studies have demonstrated plant germination and growth in hydrocarbon-contaminated soil, the importance of rhizosphere microbial populations in pyrene degradation, and plants and nutrient stimulation of TPH biodegradation in the field. These data support the use of phytoremediation of hydrocarbon-contaminated soils as a technology especially well-suited to remote sites and fragile ecosystems.

MP 5326
PLANT ENHANCEMENT OF INDIGENOUS SOIL MICRO-ORGANISMS: A LOW-COST TREATMENT OF CONTAMINATED SOILS.
Reynolds, C.M., et al, *Polar record,* Jan. 1999, 35(192), Conference on Contaminants in Freezing Ground, Cambridge, UK, July 13-15, 1997. Selected papers, p.33-40, 20 refs.
53-3360
SOIL POLLUTION, OIL SPILLS, SOIL MICROBIOLOGY, GRASSES, ROOTS, BIOMASS, SOIL CONSERVATION, REVEGETATION, PERMAFROST PRESERVATION, PROTECTIVE VEGETATION, COST ANALYSIS
The United States has more than 1000 individual areas of petroleum-contaminated soil at formerly used defense sites located in cold regions. This paper investigates biotreatment systems based on exploiting naturally occurring phenomena in the rhizosphere—the soil adjacent to and influenced by plant roots. Rhizosphere-based remediation systems would be inexpensive to implement and maintain and would be applicable to remote or permafrost sites. This paper provides the rationale for using rhizosphere-based biotreatment systems and some initial results. In both laboratory and field studies, successful plant germination, plant growth, and root intrusion into and through contaminated soil are demonstrated. Using a Captina silt loam in a 10-week laboratory study, the effects of vegetation and contamination on microbial numbers were compared. The vegetation treatments included an unvegetated control and a vegetated treatment seeded with bahiagrass *(Paspalum notatum).* The contamination treatments included an uncontaminated control and a treatment with 2000 mg pyrene/kg soil added. Microbial numbers at 10 weeks were not significantly influenced by the contaminant level of 2000 mg pyrene/kg soil compared to the control. However, microbial numbers were greater in the rhizosphere of the bahiagrass-vegetated soil compared to the unvegetated soil. In a 34-week field study, total petroleum hydrocarbon (TPH) concentrations of a diesel-contaminated soil decreased significantly more in the rhizosphere+nutrient treatment compared to the control that was not vegetated or fertilized. Bacterial numbers in the field study were 287 times greater in the rhizosphere+nutrient treated soils than in the control treatments. Measurable TPH compounds in the plant tissue were insignificant. The data demonstrated that rhizosphere-enhanced treatment of organic-contaminated soils can be effective in reducing soil petroleum concentrations and may be a cost-effective strategy particularly suited for treating cold-region sites where remediation options are limited by cost, remoteness of the site, and/or brevity of the treatment season.

MP 5327
ECONOMIC PLACEMENT OF WATER LINES IN COLD REGIONS.
Coutermarsh, B.A., *Public works,* Feb. 1999, 130(2), p.36,38.
53-3455
COLD WEATHER CONSTRUCTION, WATER PIPELINES, UNDERGROUND PIPELINES, EXCAVATION, FROST PROTECTION, PIPELINE INSULATION, CELLULAR PLASTICS, COST ANALYSIS, COLD WEATHER TESTS

MP 5328
NONSIMULTANEOUS CRUSHING DURING EDGE INDENTATION OF FRESHWATER ICE SHEETS.
Sodhi, D.S., *Cold regions science and technology,* June 1998, 27(3), p.179-195, 37 refs.
53-3501
ICE SHEETS, FLOATING ICE, ICE MECHANICS, ICE SOLID INTERFACE, ICE DEFORMATION, ICE BREAKING, LOADS (FORCES), IMPACT TESTS, DYNAMIC PROPERTIES, VELOCITY MEASUREMENT, STATISTICAL ANALYSIS, FRACTALS, CORRELATION
Indentation tests were conducted by pushing segmented indentors into the edge of freshwater ice sheets at different velocities. Ice crushing forces were measured independently in each segment. Results of these tests indicate that there is simultaneous generation of forces on all segments during low-velocity indentation, whereas there is a nonsimultaneous force acting on the segments during high-velocity indentation. For brittle crushing of ice at a high indentation rate, the effective pressures measured during these tests are in the range of pressures measured in the field during the impact of ice floes against large structures. Under the assumption that the size of crushing zones becomes small with increasing indentation speed, a statistical model is used to determine the correlation between the forces measured in different segments in terms of a correlation length parameter. A comparison of the trends in the plots of experimental data with theoretical results shows that the correlation length parameter decreases as the reciprocal of the indentation velocity. Under the assumption of the similarity principle, according to replica modeling, an estimate of the correlation length parameter is empirically obtained in terms of ice thickness and indentation velocity.

MP 5329
OVERVIEW OF ICE FORCES ON OFFSHORE STRUCTURES.
Sodhi, D.S., International Workshop on Rational Evaluation of Ice Forces on Structures, Mombetsu, Japan, Feb. 2-4, 1999. Proceedings, Mombetsu, Japan, Ship Research Institute, Ministry of Transport, 1999, p.7-9, Abstract only.
53-3764
OFFSHORE STRUCTURES, ICE SOLID INTERFACE, ICE LOADS, ICE EDGE, ICE CREEP, SEA ICE

MP 5330
DUCTILE-TO-BRITTLE TRANSITION SPEED DURING ICE INDENTATION TESTS.
Sodhi, D.S., Takeuchi, T., Nakazawa, N., Akagawa, S., Saeki, H., International Workshop on Rational Evaluation of Ice Forces on Structures, Mombetsu, Japan, Feb. 2-4, 1999. Proceedings, Mombetsu, Japan, Ship Research Institute, Ministry of Transport, 1999, p.249-263, 27 refs.
53-3784
ICE COVER STRENGTH, ICE CREEP, ICE DEFORMATION, ICE PRESSURE, ICE COVER THICKNESS, ICE MECHANICS, JAPAN—HOKKAIDO
As part of a five-year program involving laboratory and field tests in Japan, the authors conducted medium-scale indentation tests on sea ice in the harbor of Lake Notoro, Hokkaido, by pushing a segmented indentor against the edge of a floating ice sheet. Measurements on each 10-cm wide segment included forces in three directions and the moment about a horizontal line parallel to the indentor face. During the tests in 1998, the authors also installed four tactile sensors on the face of the segmented indentor and measured interfacial pressure during indentation tests at three speeds. They present the results from the load cells and the tactile sensors. They obtained data on the actual contact area and the magnitude of interfacial pressures from the tactile sensors. The authors observed both a "line-like" contact during high-speed (3- and 30-mm/s) indentation tests, and a gradually enlarging contact area attributable to creep deformation of the ice during low-speed (0.3-mm/s) indentation tests. Using the results of a brittle flaking model from the literature, the authors estimate the apparent fracture toughness of the ice from the data on interfacial pressure and the width of the contact area. Taking creep and fracture properties into account, they present a theoretical model to estimate the speed at which the transition from ductile to brittle fracture of ice takes place during ice-structure interaction.

MP 5331
HEAT BUDGET OF SNOW-COVERED SEA ICE AT NORTH POLE 4.
Jordan, R.E., Andreas, E.L., Makshtas, A.P., *Journal of geophysical research,* Apr. 15, 1999, 104(C4), p.7785-7806, Refs. p.7804-7806.
53-3813
DRIFT STATIONS, SEA ICE, SNOW ICE INTERFACE, SNOW AIR INTERFACE, SNOW COVER EFFECT, ICE HEAT FLUX, SNOW HEAT FLUX, SURFACE TEMPERATURE, SNOW TEMPERATURE, ICE TEMPERATURE, ICE MODELS, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS, NORTH POLE, ARCTIC OCEAN
The Russian drifting station North Pole 4 (NP-4) was within 5° latitude of the North Pole from Apr. 1956 to Apr. 1957. The authors use a wide-ranging set of snow and meteorological data collected at 3-hourly intervals on NP-4 during this period to investigate energy and mass transfer in the snow, sea ice, and atmospheric surface layer in the central Arctic. SNTHERM, a one-dimensional energy and mass balance model, synthesizes these diverse NP-4 data and thereby yields energetically consistent time series of the components of the surface heat budget. To parameterize the sensible heat flux during extremely stable stratification, the authors replace the usual log-linear stability function with the "Dutch" formulation and introduce a windless coefficient in the bulk parameterization. This coefficient provides sensible heat transfer at the surface, even when the mean wind speed is near zero, and thereby prevents the surface temperature from falling to unrealistically low values, a common modeling problem when the stratification is very stable. Several other modifications to SNTHERM introduce procedures for creating a realistic snowpack that has continuously variable density and is subject to erosion and wind packing. The NP-4 data provide for two distinct simulations: one on 2-year ice and one on multiyear ice. They validate the modeling by comparing simulated and observed temperatures at various depths in the snow and sea ice. Simulations for both sites show the same tendencies. During the summer, the shortwave radiation is the main term in the surface heat budget. Shortwave radiation also penetrates into the snow and causes a subsurface temperature maximum that both the data and the model capture. During the winter, the net longwave balance is the main term in the surface heat budget. The snow and sea ice cool in response to longwave losses, but the flux of sensible heat from the air to the surface mitigates these losses and is thus nearly a mirror image of the emitted longwave flux.

MP 5332
GEOTEXTILES TO STABILIZE THAWING, LOW-BEARING-CAPACITY SOILS: A COMPARISON OF TWO DESIGN METHODS FOR USE BY THE US ARMY.
Henry, K.S., Holtz, R.D., Geosynthetics '99, Boston, MA, Apr. 28-30, 1999. Conference proceedings. Vol.1, Roseville, MN, Industrial Fabrics Association International, 1999, p.427-440, 16 refs.
53-3829
SUBGRADE SOILS, GROUND THAWING, THAW WEAKENING, BEARING TESTS, SOIL TRAFFICABILITY, AGGREGATES, GEOTEXTILES, SOIL STABILIZATION, SUBGRADE PREPARATION, SUBGRADE MAINTENANCE, ROAD MAINTENANCE
Thawing fine-grained soils are often saturated and have extremely low bearing capacity. Geotextiles reinforce unsurfaced roads on weak, saturated soils and therefore are good candidates for stabilization of thawing soils. To stabilize the soil, a geotextile is placed on it, then the geotextile is covered with aggregate. Design involves selection of aggregate thickness and geotextile. The US Army uses one of two commonly used design techniques for geotextile reinforcement of low-volume roads. The other method, which offers potential to reduce aggregate thickness over the geotextile by accounting for the tensile properties of the geotextile, was compared with the Army method. Although it offers considerable aggregate savings over the current method, it may be unconservative with respect to stresses estimated at the subgrade surface. Future work should consider adopting a method that provides realistic estimates of stresses at the subgrade as well as aggregate savings through accounting for the tensile properties of geotextiles.

MP 5333
EFFECTIVENESS OF GEOSYNTHETICS FOR ROADWAY CONSTRUCTION IN COLD REGIONS: RESULTS OF A MULTI-USE TEST SECTION.
Hayden, S.A., Humphrey, D.N., Christopher, B.R., Henry, K.S., Fetten, C., Geosynthetics '99, Boston, MA, Apr. 28-30, 1999. Conference proceedings. Vol.2, Roseville, MN, Industrial Fabrics Association International, 1999, p.847-862, 6 refs.
53-3831
SUBGRADE SOILS, SOIL FREEZING, FROST RESISTANCE, FROST PROTECTION, GEOTEXTILES, COMPOSITE MATERIALS, SOIL STABILIZATION, DRAINAGE, COLD WEATHER TESTS, SUBGRADE MAINTENANCE, ROAD MAINTENANCE, UNITED STATES—MAINE
The Maine Department of Transportation has reconstructed a 3.0 km portion of U.S. Route 1A within the towns of Frankfort and Winterport, ME. This roadway is plagued with poor subgrade soils (A-6) and has been historically known for its poor pavement performance. The reconstruction project is providing an excellent opportunity to evaluate the effectiveness of alternative pavement sections incorporating varying geosynthetics in differing applications under northern climatic conditions. Multiple test sections encompassing the entire length of the project have been constructed using different combinations of geosynthetics including: single and multiple layers of geogrids as reinforcements with and without separation layers; high strength woven geotextile as reinforcement; woven and nonwoven geotextiles as separation/stabilization layers; and, geocomposites to provide horizontal drainage and act as a capillary barrier. A control section with no geosynthetics was also constructed. Each test section is instrumented. Along with an overview of the project, this interim paper presents the reinforcement and drainage data collected during installation and after the first year of monitoring.

MP 5334
INITIAL EVALUATION OF GEOTEXTILES FOR WASTEWATER FILTRATION AT TEMPORARY BASE CAMPS.
Martel, C.J., Pelton, D.K., Henry, K.S., Geosynthetics '99, Boston, MA, Apr. 28-30, 1999. Conference proceedings. Vol.2, Roseville, MN, Industrial Fabrics Association International, 1999, p.1005-1016, 14 refs.
53-3832
MILITARY FACILITIES, WATER TREATMENT, WASTE DISPOSAL, SEWAGE DISPOSAL, SANITARY ENGINEERING, GEOTEXTILES, FILTERS, COST ANALYSIS, BOSNIA
The Army has identified a need for a deployable wastewater treatment system for use at temporary base camps such as those in Bosnia. This study evaluated a new concept for wastewater treatment that features the use of disposable geotextiles for filtration of wastewater. The advantage of this concept is that it eliminates the need for large settling tanks and sludge dewatering operations. Cost estimates indicate that geotextile filtration of wastewater is approximately one-third the cost of conventional treatment. In this bench scale study, up to 70% of the total suspended solids (TSS) and 40% of the biochemical oxygen demand from raw wastewater (sewage) were removed, demonstrating that nonwoven geotextiles are very good filters. The hydraulic capacity varied from 646 L/m^2 to 3138 L/m^2 depending on the TSS concentration. Approximately one-half of the hydraulic capacity was restored by cleaning. Calculations indicate that the graywater (sewage minus water from latrines) produced by a 550 soldier unit would require 116 m^2 of geotextile per day, which would mean several manual filter changes each day. The alternative is to automate the filter change as it becomes clogged.

MP 5335
PROTOCOL FOR THE CHARACTERIZATION OF EXPLOSIVES-CONTAMINATED SITES.
Thiboutot, S., et al, *Canada. Defence Research Establishment Valcartier, Quebec. Report,* Apr. 1998, DREV-R-9721, 73p., With French summary. 75 refs.
53-3961
MILITARY FACILITIES, SITE SURVEYS, EXPLOSIVES, SOIL POLLUTION, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, GROUND WATER, WATER POLLUTION, HEALTH, CANADA
Many activities of the Canadian Forces, such as firing, demolition procedures and destruction of obsolete ammunition by open burning and open detonation may lead to the dispersion of energetic compounds in the environment. These compounds are being closely examined due to their highly specific physical, chemical and toxicological properties. In Canada, limited effort has been devoted to examine this particular environmental threat. In this context, R&D was dedicated towards the establishment of a protocol that will allow reliable and safe characterization of sites potentially contaminated with explosives. This protocol was based on Defence Research Establishment Valcartier research efforts and expertise in the chemistry of energetic materials, on the current existing literature, on the experience gained in practical field sampling and on collaborative work with BRI and CRREL. The protocol detailed in the present report covers all aspects related to surface and subsurface sampling, extraction, analysis, field-screening methods and environmental fate related with these specific contaminants. Furthermore, safety procedures are described that take into account the explosive and toxic nature of these compounds. This protocol will serve as a reference guide for future sampling campaigns on sites that are potentially contaminated with explosives.

MP 5336
SYSTEM AND METHOD FOR DETECTION OF FRAZIL ICE ON UNDERWATER GRATING.
Yankielun, N.E., *U.S. Patent Office. Patent,* May 4, 1999, 8 col., USP-5,900,820, 13 refs.
53-3969
WATER INTAKES, FRAZIL ICE, ICE ACCRETION, ICE LOADS, ICE DETECTION, MONITORS, TELEMETERING EQUIPMENT
A system for detecting accretion of frazil ice on underwater gratings includes a housing for disposition beneath a water surface and spaced from but proximate an underwater intake grating. A pair of parallel electrically conductive bars are mounted side-by-side in the housing and extend therefrom. The bars are in communication with an electromagnetic wave generator in the housing. A coaxial transmission line is connected at a first end to the housing and in communication with the pair of bars for extension from the housing upwardly above the water surface. A monitoring station is disposed above the water surface for receiving signals from the bars, the monitoring station having a second end of the transmission line fixed thereto. The wave generator propagates electromagnetic waves to the bars for further travel to distal ends of the bars, and back to the housing and thence to the monitoring station. The monitoring station is adapted to compute wave round trip travel time in the bars and to compute changes in the round trip travel time, from which is determined absence, presence, and build-up of frazil ice on the bars, thereby providing an indication of same on the grating.

MP 5337
VERTICAL PENETRATION OF FLOATING ICE SHEETS.
Sodhi, D.S., *International journal of solids and structures,* Nov. 1998, 35(31-32), p.4275-4294, 29 refs.
53-3970
ICE COVER STRENGTH, BEARING STRENGTH, ICE ELASTICITY, ICE LOADS, ICE CREEP, ICE DEFORMATION, ICE CRACKS, ICE BREAKING, PENETRATION TESTS, STRAIN TESTS
Existing failure criteria for the bearing capacity of floating ice sheets predict the load for the occurrence of the first radial crack or a circumferential crack, when the maximum stress obtained from an elastic analysis in the ice equals the tensile strength. From full-scale and small-scale tests, the ultimate load to cause complete penetration of a floating ice sheet is much higher than that to cause the first radial crack. This can be attributed to wedging action during deformation of a radially cracked ice sheet. The author presents three approaches taken to determine the ice penetration force: plastic limit analysis, small-scale experiments and full-scale measurements in the field. Small-scale experiments were conducted with freshwater ice in a laboratory basin to understand the wedging action during the vertical loading of floating ice sheets. Results of the following experiments are presented: beams with fixed ends, paired cantilever beams arranged free-end to free-end and loaded together, beams with an apparatus inserted between the free ends of paired cantilever beams to measure the in-plane force during vertical loading, and vertical downward loading of floating ice sheets with fixed and free boundaries. Analysis of the data from the beam tests reveals that the wedging action results in the development of wedging pressure in the top or bottom third of the ice thickness, and this results in a resisting moment that counters the deformation of a cracked ice sheet. An ice sheet attached to the basin wall inhibits the propagation of radial cracks because of the wedging action, whereas an ice sheet free at the edges from the surrounding ice sheet fails by the propagation of radial cracks all the way to the ice sheet's free boundary. The difference between the two breakthrough loads of the free and the fixed ice sheets can be attributed to wedging action. The results of the beam tests are used in the results of plastic limit analysis to predict the breakthrough loads of floating ice sheets, which are in agreement with loads measured during full-scale and small-scale experiments.

MP 5338
CLOSURE FOR ANALYSIS OF BOUNDARY LAYER TURBULENCE CORRELATIONS.
Treviño, G., Andreas, E.L., Conference on Boundary Layers and Turbulence, 13th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.609-611, 7 refs.
53-3972
ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENCE, MATHEMATICAL MODELS, STATISTICAL ANALYSIS

MP 5339
FIELD SAMPLING AND SELECTING ON-SITE ANALYTICAL METHODS FOR EXPLOSIVES IN WATER.
Crockett, A.B., Craig, H.D., Jenkins, T.F., *U.S. Environmental Protection Agency. Office of Research and Development. Office of Solid Waste and Emergency Response. Federal Facilities Forum. Issue paper,* May 19, 1999, EPA/600/S-99/002, 48p., Refs. p.41-48.
53-4039
MILITARY FACILITIES, SITE SURVEYS, EXPLOSIVES, WASTE DISPOSAL, WATER POLLUTION, SOIL POLLUTION, WELLS, GROUND WATER, HYDROGEOCHEMISTRY, WATER CHEMISTRY, CHEMICAL ANALYSIS

MP 5340
USING INFRARED THERMOGRAPHY FOR CONDITION ASSESSMENT OF BURIED DISTRICT HEATING PIPING SYSTEMS.
Phetteplace, G., International Symposium on District Heating and Cooling, 7th, Lund, Sweden, May 18-20, 1999. Proceedings, 1999, p.1-11, 13 refs.
53-4040
UTILITIES, HEATING, HEAT TRANSMISSION, HEAT PIPES, HEAT LOSS, UNDERGROUND PIPELINES, SOIL TEMPERATURE, INFRARED PHOTOGRAPHY
Infrared thermography has been used successfully for many years to find problem areas on buried district heating systems. While such information is useful for locating areas of major failures, for planning purposes some quantification of the results from an infrared survey of major portions of a district heating system would be advantageous. Some recent progress has been made toward this end by two International Energy Agency District Heating projects in which the US Army Cold Regions Research and Engineering Laboratory (CRREL) has participated with colleagues from the Nordic countries. The objective of these projects was to develop a method that would allow quantification of heat losses from the temperature profile of the ground's surface above the buried heat distribution pipeline. Basically, the method uses the integral of the temperature distribution at the ground's surface along with climatological and system data to arrive at an empirical estimate of the heat loss. Using this method, CRREL has conducted infrared surveys of two facilities. Results have been good, and the facilities have been provided with both heat loss estimates and prioritized replacement lists. This paper describes the "TX method," as it is called, and its use. Sample results from the surveys done to date will also be presented.

MP 5341
PROBLEMS WITH SURFACE LAYER SIMILARITY THEORY IN THE ARCTIC.
Guest, P.S., Andreas, E.L., Fairall, C.W., Persson, P.O.G., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.132-135.
53-4041
POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, ATMOSPHERIC BOUNDARY LAYER, AIR ICE WATER INTERACTION, ICE HEAT FLUX, TURBULENT EXCHANGE, CLOUD COVER, HEAT BALANCE

MP 5342
OBSERVATIONS OF LARGE THERMAL TRANSITIONS DURING THE ARCTIC NIGHT FROM A SUITE OF SENSORS AT SHEBA.
Persson, P.O.G., Uttal, T., Intrieri, J., Fairall, C.W., Andreas, E.L., Guest, P.S., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.306-309, 8 refs.
53-4042
POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, DRIFT STATIONS, CLOUD COVER, AIR ICE WATER INTERACTION, SNOW ICE INTERFACE, SNOW HEAT FLUX, ICE HEAT FLUX, HEAT BALANCE

MP 5343
INTERCOMPARISON OF DOWNWARD LONGWAVE FLUX MEASUREMENTS DURING THE FIRST TWO MONTHS OF SHEBA.
Russell, C.A., et al, Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.314-318, 2 refs.
53-4043
DRIFT STATIONS, POLAR ATMOSPHERES, RADIATION BALANCE, INFRARED RADIATION, RADIATION MEASUREMENT, RADIATION MEASURING INSTRUMENTS, RADOMES, ICE REMOVAL, DEFROSTING

MP 5344
SURFACE ENERGY BUDGET DURING THE ONSET OF THE MELT SEASON ON THE ARCTIC ICEPACK DURING SHEBA.
Persson, P.O.G., Andreas, E.L., Fairall, C.W., Guest, P.S., Ruffieux, D.R., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.321-326, 15 refs.
53-4044
POLAR ATMOSPHERES, AIR ICE WATER INTERACTION, SNOW ICE INTERFACE, ICE HEAT FLUX, ICE MELTING, ICE BREAKUP, RADIATION BALANCE

MP 5345
SURFACE ENERGY BUDGET AND ATMOSPHERIC EFFECTS OF A FREEZING LEAD AT SHEBA.
Pinto, J.O., et al, Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.397-400, 5 refs.
53-4045
POLAR ATMOSPHERES, AIR ICE WATER INTERACTION, SNOW ICE INTERFACE, ALBEDO, ICE HEAT FLUX, ICE OPENINGS, SEA WATER FREEZING, HEAT BALANCE

MP 5346
SURFACE TEMPERATURE MEASUREMENTS AT SHEBA.
Claffey, K.J., Andreas, E.L., Perovich, D.K., Fairall, C.W., Guest, P.S., Persson, P.O.G., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.327-332, 4 refs.
53-4046
POLAR ATMOSPHERES, AIR TEMPERATURE, SURFACE TEMPERATURE, SNOW ICE INTERFACE, SNOW SURFACE TEMPERATURE, ICE HEAT FLUX, TEMPERATURE MEASUREMENT, THERMISTORS, HYGROMETERS, RADIATION MEASURING INSTRUMENTS

MP 5347
ROLE OF SURFACE-LAYER TURBULENT INTERACTIONS IN THE LONGWAVE FLUX/SURFACE TEMPERATURE FEEDBACK DURING SHEBA.
Fairall, C.W., Persson, P.O.G., Andreas, E.L., Guest, P.S., Conference on Polar Meteorology and Oceanography, 5th, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.421-424, 2 refs.
53-4047
POLAR ATMOSPHERES, ATMOSPHERIC CIRCULATION, ATMOSPHERIC BOUNDARY LAYER, AIR ICE WATER INTERACTION, CLOUD COVER, ALBEDO, ICE HEAT FLUX, TURBULENT EXCHANGE, HEAT BALANCE

MP 5348
EFFECTS OF SEA SPRAY ON TROPICAL CYCLONE INTENSITY.
Andreas, E.L., Emanuel, K.A., Conference on Hurricanes and Tropical Meteorology, 23rd, Dallas, TX, Jan. 10-15, 1999. Preprint volume, Boston, American Meteorological Society, 1999, p.22-25, 21 refs.
53-4048
MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, AIR WATER INTERACTIONS, SEA SPRAY, EVAPORATION, HEAT TRANSFER, MOISTURE TRANSFER, TURBULENT EXCHANGE, ATMOSPHERIC DISTURBANCES, STORMS

MP 5349
EFFECT OF TURBULENCE ON FLUIDELASTIC INSTABILITY IN TUBE BUNDLES: A NONLINEAR ANALYSIS.
Rzentkowski, G., Lever, J.H., *Journal of fluids and structures*, July 1998, 12(5), p.561-590, 25 refs.
53-4049
PIPES (TUBES), HEAT PIPES, PIPE FLOW, TURBULENT FLOW, FLUID FLOW, FLUID DYNAMICS, MATHEMATICAL MODELS
This paper is concerned with the behavior of a tube bundle subjected to combined fluidelastic and turbulence excitation. Here, the authors formulate the fluidelastic forces based on a simplified, nonlinear model for a single flexible tube surrounded by rigid neighbors and constrained to move transverse to the mean flow. They use a flat power spectral density function to express the turbulence excitation. The resulting system they first examine heuristically, based on a superposition of both excitation mechanisms. They then assess the merits of this approach via direct numerical integration of the equation of motion. Lastly, they perform a nonlinear investigation into the sensitivity of the fluidelastic stability boundary on variations in the random field of turbulence and generate a stability map. The analysis shows that the fluidelastic stability boundary defined by an unstable bifurcation may be reduced by turbulence; for long-term operation, the threshold reduction may approach the size of a hysteresis region. This effect increases with turbulence intensity and decreases with unstable-limit-cycle amplitude. For a stable bifurcation, the fluidelastic stability boundary is virtually unaffected by turbulence. In the latter case, the effect of turbulence is through practical stability definitions made using amplitude-response curves.

MP 5350
LABORATORY TESTS OF A TIME-DOMAIN REFLECTOMETRY SYSTEM FOR FRAZIL ICE DETECTION.
Yankielun, N.E., Gagnon, J.J., *Canadian journal of civil engineering*, Apr. 1999, 26(2), p.168-176, With French summary. 18 refs.
53-4050
WATER INTAKES, FRAZIL ICE, ICE ACCRETION, ICE LOADS, ICING RATE, ICE ELECTRICAL PROPERTIES, ICE DIELECTRICS, ICE DETECTION, MONITORS, TELEMETERING EQUIPMENT
A prototype, electromagnetic-based frazil ice detection system (patent pending) has been developed and tested under simulated frazil ice accretion conditions in an environmentally controlled flume. The system employs a time-domain reflectometer (TDR) and specially designed transmission line sensor to monitor the accretion of frazil ice by measuring the propagation time along the sensor when it is submerged. Changes in the round-trip travel time of the TDR pulse result from a decrease in the localized bulk dielectric constant as frazil ice accretes and displaces water around the sensor. Two frazil detection sensor configurations were tested, a parallel transmission line probe and a semicylindrical mesh coaxial probe. During 2 h long experiments, the TDR clearly indicated a decreasing probe propagation time as frazil ice continued to accrete. This is indicative of the decreasing bulk dielectric constant of the frazil ice and water mix. Continuous real-time data from the TDR were recorded. From these data, an estimate of volumetric ice fraction was calculated using a simple linear dielectric mixing equation. Volumetric ice fractions estimates for both probe configurations were calculated to increase from approximately 0.02 to 0.18 during the test. The system shows promise for detection and measurement of frazil ice growth and accretion in freshwater bodies.

MP 5351
ARCTIC RESEARCH OF THE UNITED STATES, VOL.6. FALL 1992.
Myers, C.E., ed, Cate, D.W., ed, Valliere, D.R., ed, Washington, D.C., 1992, 91p.
53-4122
ORGANIZATIONS, RESEARCH PROJECTS, REGIONAL PLANNING, HEALTH, HUMAN FACTORS, ECONOMIC DEVELOPMENT, UNITED STATES—ALASKA

MP 5352
ARCTIC RESEARCH OF THE UNITED STATES, VOL.2. FALL 1988.
Brown, J., ed, Cate, D., ed, Valliere, D., ed, Washington, D.C., 1988, 102p.
53-4123
ORGANIZATIONS, RESEARCH PROJECTS, MEETINGS

MP 5353
COLD WEATHER CONCRETING.
Korhonen, C., *Military engineer*, Aug.-Sep. 1998, 90(593), p.47-48.
53-4231
WINTER CONCRETING, CONCRETE ADMIXTURES, WATER CEMENT RATIO, FREEZING POINTS, CONCRETE CURING, FROST PROTECTION

MP 5354
WATER EXPULSION DURING SOIL FREEZING DESCRIBED BY A MATHEMATICAL MODEL CALLED M_1.
Nakano, Y., *Cold regions science and technology*, 1999, Vol.29, p.9-30, 46 refs.
53-4233
SOIL FREEZING, MATHEMATICAL MODELS, FREEZING FRONT, WATER TRANSPORT, SOIL WATER, SATURATION
It has been shown empirically that when a freezing front advances through a saturated and unfrozen soil, soil water may either be attracted to the freezing front or expelled, depending upon soil type, applied confining pressure, and rate of freezing. In this work, the problem of water expulsion is studied analytically based on a mathematical model called M_1. The condition of water expulsion is found to depend on the properties of a given soil, given thermal and hydraulic conditions. The theoretical predictions are compared with data of Kanto loam and the agreement between them is found to be satisfactory.

MP 5355
DEPTH-HOAR GROWTH RATES NEAR A ROCKY OUTCROP.
Arons, E.M., Colbeck, S.C., Gray, J.M.N.T., *Journal of glaciology*, 1998, 44(148), p.477-484, 15 refs.
53-4257
DEPTH HOAR, ICE CRYSTAL GROWTH, ROCKS, MATHEMATICAL MODELS, SEASONAL VARIATIONS, SNOW COVER, SNOW DENSITY, SNOW THERMAL PROPERTIES, SOIL TEMPERATURE, THERMAL CONDUCTIVITY, SNOW DEPTH
Observations of slab-avalanche releases in alpine terrain have led to the hypothesis that rocky outcrops can influence the spatial distributions of temperature and heat flow in dry alpine snow covers and thus control the local distribution of depth hoar. The authors investigate the effects of terrain on crystal growth by using a two-dimensional finite-element model of heat flow coupled with a model of crystal growth from vapor. The model is used to examine the influence of snow properties, terrain geometry and snow depth on this phenomenon. The effect is stronger in the early winter than in the late winter, because the rock has then had time to cool. In all cases, it was found that depth-hoar growth occurs preferentially over the rock. This suggests that snow-pit investigations made over soil can be misleading if rocky outcrops are present.

MP 5356
SNOW-TRANSPORT MODEL FOR COMPLEX TERRAIN.
Liston, G.E., Sturm, M., *Journal of glaciology*, 1998, 44(148), p.498-516, Refs. p.514-515.
53-4259
MATHEMATICAL MODELS, SNOW DEPTH, SNOW COVER DISTRIBUTION, SHEAR STRESS, SUBLIMATION, TUNDRA TERRAIN, SNOW WATER EQUIVALENT, WIND FACTORS, BLOWING SNOW, COMPUTERIZED SIMULATION, SNOWDRIFTS, SNOW EROSION, WIND EROSION, UNITED STATES—ALASKA—BROOKS RANGE
As part of the winter environment in middle- and high-latitude regions, the interactions between wind, vegetation, topography and snowfall produce snow covers of non-uniform depth and snow water-equivalent distribution. A physically based numerical snow-transport model is developed and used to simulate this three-dimensional snow-depth evolution over topographically variable terrain. The mass-transport model includes processes related to vegetation snow-holding capacity, topographic modification of wind speeds, snow-cover shear strength, wind-induced surface-shear stress, snow transport resulting from saltation and suspension, snow accumulation and erosion, and sublimation of the blowing and drifting snow. The model simulates the cold-season evolution of snow-depth distribution when forced with inputs of vegetation type and topography, and atmospheric forcings of air temperature, humidity, wind speed and direction, and precipitation. Model outputs include the spatial and temporal evolution of snow depth resulting from variations in precipitation, saltation and suspension transport, and sublimation. Using 4 years of snow-depth distribution observations from the foothills north of the Brooks Range in Arctic Alaska, the model is found to simulate closely the observed snow-depth distribution patterns and the interannual variability.

MP 5357
GLACIOHYDRAULIC SUPERCOOLING: A FREEZE-ON MECHANISM TO CREATE STRATIFIED, DEBRIS-RICH BASAL ICE: I. FIELD EVIDENCE.
Lawson, D.E., Strasser, J.C., Evenson, E.B., Alley, R.B., Larson, G.J., Arcone, S.A., *Journal of glaciology*, 1998, 44(148), p.547-562, 62 refs.
53-4263
GLACIAL HYDROLOGY, SUPERCOOLING, GLACIER BEDS, FRAZIL ICE, GLACIAL DEPOSITS, ICE GROWTH, SUBGLACIAL OBSERVATIONS, SUBGLACIAL DRAINAGE, GLACIAL TILL, SEDIMENT TRANSPORT, UNITED STATES—ALASKA—MATANUSKA GLACIER
Debris-laden ice accretes to the base of Matanuska Glacier, AK, USA, from water that supercools while flowing in a distributed drainage system up the adverse slope of an overdeepening. Frazil ice grows in the water column and forms aggregates, while other ice grows on the glacier sole or on substrate materials. Sediment is trapped by this growing ice, forming stratified debris-laden basal ice. Growth rates of >0.1 m/a of debris-rich basal ice are possible. The large sediment fluxes that this mechanism allows may have implications for interpretation of the widespread deposits from ice that flowed through other overdeepenings, including Heinrich events and the till sheets south of the Laurentian Great Lakes.

MP 5358
GLACIOHYDRAULIC SUPERCOOLING: A FREEZE-ON MECHANISM TO CREATE STRATIFIED, DEBRIS-RICH BASAL ICE: II. THEORY.
Alley, R.B., Lawson, D.E., Evenson, E.B., Strasser, J.C., Larson, G.J., *Journal of glaciology*, 1998,

44(148), p.563-569, 48 refs.
53-4264
GLACIAL HYDROLOGY, SUPERCOOLING, GLACIER BEDS, SUBGLACIAL OBSERVATIONS, SUBGLACIAL DRAINAGE, MATHEMATICAL MODELS, REGELATION, GLACIER ICE, ICE ACCRETION, GLACIAL TILL, SEDIMENT TRANSPORT, UNITED STATES—ALASKA—MATANUSKA GLACIER
Simple theory supports field observations that subglacial water flow out of overdeepenings can cause accretion of layered, debris-bearing ice to the bases of glaciers. The large meltwater flux into a temperate glacier at the onset of summer melting can cause rapid water flow through expanded basal cavities or other flow paths. If that flow ascends a sufficiently steep slope out of an overdeepening, the water will supercool as the pressure-melting point rises, and basal-ice accretion will occur. Diurnal, occasional or annual fluctuations in water discharge will cause variations in accretion rate, debris content of accreted ice or subsequent diagenesis, producing layers. Under appropriate conditions, net accretion of debris-bearing basal ice will allow debris fluxes that are significant in the glacier sediment budget.

MP 5359
SNOW LOADS ON GABLE ROOFS—DISCUSSION AND CLOSURE.
Tobiasson, W., *Journal of structural engineering,* Apr. 1999, 125(4), p.470-472, 1 ref. For paper under discussion see 52-2526.
53-4321
ROOFS, SNOW DEPTH, SNOW LOADS

MP 5360
GROWTH OF A PANCAKE ICE COVER IN A WAVE FIELD.
Shen, H.H., Leonard, G.H., Ackley, S.F., International Symposium on Okhotsk Sea and Sea Ice, 14th, Mombetsu, Hokkaido, Japan, Jan. 31-Feb. 4, 1999. Abstracts, Mombetsu, Okhotsk Sea and Cold Ocean Research Association, 1999, p.106-111, 7 refs.
53-4338
SEA WATER FREEZING, FRAZIL ICE, ICE FORMATION, ICE GROWTH, ICE WATER INTERFACE, ICE COVER EFFECT, OCEAN WAVES, AIR TEMPERATURE, WATER TEMPERATURE, AIR ICE WATER INTERACTION
Experimental results of pancake ice growth and the associated wave field evolution are presented. From these results, a conceptual theory that describes natural growth of pancake ice in a wave field is suggested. Three experiments were conducted in two laboratory wave tanks in Jan. 1995, 1996 and Feb. 1997. In these experiments, various wave conditions, some with wind and current, were generated. The observed parameters were the ice cover and the wave amplitude evolutions. It is found that ice cover morphology is sensitively dependent on both the wave spectrum and the air and water temperatures.

MP 5361
CLAY BARRIERS, CHEMICAL AND MINERALOGICAL ANALYSES.
Inyang, H.I., Fang, H.Y., Choquette, M.R., Iskandar, I.K., Encyclopedia of environmental analysis and remediation, Vol.2, New York, Wiley, 1998, p.1158-1165, 12 refs.
53-4455
WASTE DISPOSAL, EARTH FILLS, LAND RECLAMATION, LININGS, CLAY SOILS, SOIL ANALYSIS, CHEMICAL ANALYSIS, SOIL COMPOSITION, CLAY MINERALS, MINERALOGY

MP 5362
LAB FORMS 6,000-MILE EDUCATION PARTNERSHIP.
Darling, M., *Engineer update,* Apr. 1997, 21(4), p.4.
53-4456
RESEARCH PROJECTS, EDUCATION, ORGANIZATIONS, REGIONAL PLANNING, UNITED STATES—ALASKA—BARROW

MP 5363
ROOF MOISTURE SENSING SYSTEM AND METHOD FOR DETERMINING PRESENCE OF MOISTURE IN A ROOF STRUCTURE.
Yankielun, N.E., Flanders, S.N., *U.S. Patent Office. Patent,* Oct. 6, 1998, 6 col., USP-5,818,340, 14 refs.
53-4457
ROOFS, LEAKAGE, MOISTURE METERS, MOISTURE DETECTION
A roof moisture sensing system includes (1) a radio frequency pulse transmitter, (2) a moisture sensor disposed on a roof and (3) a radio receiver adapted to monitor resonance of the moisture sensor activated by a pulse transmitted by the pulse transmitter. The receiver is adapted to analyze the resonance of the sensor to determine the presence of moisture in the sensor. The transmitter and the receiver can be remote from the sensor and the roof.

MP 5364
GEOSYNTHETIC BARRIERS TO PREVENT POISONING OF WATERFOWL.
Henry, K.S., Stark, J.A., International Conference on Soil Mechanics and Foundation Engineering, 14th, Hamburg, Germany, Sep. 6-12, 1997. Proceedings, Rotterdam, A.A. Balkema, 1997, p.1819-1822, 9 refs.
53-4458
PONDS, WATER POLLUTION, BOTTOM SEDIMENT, EXPLOSIVES, SOIL POLLUTION, LAND RECLAMATION, SOIL STABILIZATION, ANIMALS, ENVIRONMENTAL PROTECTION, GEOTEXTILES
The feasibility of using geosynthetics to cover contaminated pond sediments and prevent waterfowl access to them was studied. Geosynthetic barriers were placed in ponds, the water above them was vigorously stirred, and the barriers were loaded by dropping a mass onto them to determine their ability to retain sediment below them and withstand damage. The barriers reduced the amount of sediment resuspended during stir and loading tests by at least 30%, and sustained no damage. Thus, they can probably prevent waterfowl from accessing and eating toxic particles contained in the sediment below them.

MP 5365
PERFORMANCE OF WATER SPREAD LIMITING AND LOOSE FILL INSULATION: FEDERAL AGENCY APPROVED HEAT DISTRIBUTION SYSTEMS.
Phetteplace, G., Monaghan, S.K., Pedrick, G., International District Heating Association Annual Conference, 89th, San Antonio, TX, June 13-16, 1998. Proceedings, Washington, D.C., International District Heating Association, [1998], p.181-195, 9 refs.
53-4459
MILITARY FACILITIES, UTILITIES, HEATING, HEAT TRANSMISSION, HEAT PIPES, HEAT LOSS, UNDERGROUND PIPELINES, PIPELINE INSULATION, EARTH FILLS, THERMAL INSULATION, COST ANALYSIS, UNITED STATES
The U.S. Army Cold Regions Research and Engineering Laboratory has conducted an in-depth field study of water spread limiting and loose fill insulation types of underground heat distribution systems at 20 sites throughout the U.S. This research originated with interest in the performance of Federal Agency prequalified underground heat distribution systems. The water spread limiting (WSL) system investigated has preinsulated pipe sections that are sealed on each end and uses a composite insulation with no air space between the insulation and casing. Adjacent pipe sections are joined by a coupling assembly that allows the pipe sections to expand and contract freely. The loose fill insulation (LFI) system investigated places an uninsulated pipe in formed trenches and fills the trench with a calcium carbonate powder insulation, covering it with a vapor barrier and backfilling. At each site, potential problem areas were identified using infrared imaging. The study excavated and instrumented 11 WLS installations and four LFI systems ranging from under one to 21 years of age. Estimates of heat losses based on field measurements and other observations are presented.

MP 5366
CONDITION ASSESSMENT FOR BURIED HEAT DISTRIBUTION SYSTEMS USING INFRARED THERMOGRAPHY.
Phetteplace, G., Pedrick, G., Monaghan, S.K., International District Heating Association Annual Conference, 89th, San Antonio, TX, June 13-16, 1998. Proceedings, Washington, D.C., International District Heating Association, [1998], p.219-229, 12 refs.
53-4460
UTILITIES, HEATING, HEAT TRANSMISSION, HEAT PIPES, HEAT LOSS, UNDERGROUND PIPELINES, SOIL TEMPERATURE, TEMPERATURE MEASUREMENT, INFRARED PHOTOGRAPHY, UNITED STATES
It has been known for some time that infrared thermography could find problem areas on buried heat distribution systems, just as it has for roofs and electrical distribution systems. While such information is useful for locating areas of major failures, for planning purposes some quantification of the results from an infrared survey of major portions of a heat distribution system would be advantageous. Some recent progress has been made toward this end by two International Energy Agency District Heating projects in which the US Army Cold Regions Research and Engineering Laboratory (CRREL) has participated. The objective of these projects was to develop a method that would allow quantification of heat losses from the temperature profile of the ground's surface above the buried heat distribution pipeline. Basically, the method uses the integral of the temperature distribution at the ground's surface along with climatological and system data to arrive at an empirical estimate of the heat loss. Using this method, CRREL has conducted infrared surveys of two facilities. Results have been good, and the facilities have been provided with both heat loss estimates and prioritized replacement lists. This paper describes the "TX method," as it is called, and its use. Sample results from the surveys done to data are also presented.

MP 5367
HEAT LOSS DETERMINATION FOR DISTRICT HEATING SYSTEMS USING SURFACE TEMPERATURE MEASUREMENTS.
Phetteplace, G., *Technical University of Denmark, Lyngby. Department of Energy Engineering. [Report],* Oct. 1998, ET-ES 98-13, 22p., 15 refs.
53-4461
UTILITIES, HEATING, HEAT TRANSMISSION, HEAT PIPES, HEAT TRANSFER, HEAT LOSS, UNDERGROUND PIPELINES, SOIL TEMPERATURE, SURFACE TEMPERATURE, TEMPERATURE MEASUREMENT, INFRARED PHOTOGRAPHY, MATHEMATICAL MODELS, UNITED STATES
It has been known for some time that surface temperature measurements via infrared thermography could find problem areas in the buried piping of district heating systems. While such information is useful for locating areas of major failures, for planning purposes some quantification of the results is needed. Some recent progress has been made towards this end by two International Energy Agency (IEA) District Heating projects. The objective of these projects was to develop a method that would allow quantification of heat losses from the temperature profile of the ground's surface above the buried heat distribution pipeline. Basically, the method uses the integral of the temperature distribution at the ground's surface along with climatological and system data to get an empirical estimate of the heat loss. The IEA projects developed and proposed several models that correlated heat loss from buried district heating pipes to the temperature distribution at the ground surface above those pipes. In each case the so called "TX" models were "empirically" determined by fitting parameters to results obtained by detailed numerical simulations. These models were tested against field data obtained from test sites in Sweden, Denmark, Finland and the U.S. The investigators felt that within a limited range of parameter values and under appropriate conditions for the infrared measurements results could be expected to be within ±20%. Using the proposed methods the US Army Cold Regions Research and Engineering Laboratory has conducted infrared surveys of two district heating systems. While in general the results of these studies have been useful, it was often necessary to extrapolate the input parameter values of the method beyond the range originally used in the simulations as well as the range defined by the experimental measurements. Thus, the confidence of the method could be improved by extending its known range of applicability. Some extensions to the original TX models were proposed. These extensions provided a form for the model that would appear to be more intuitive when basic heat transfer theory is considered. This report describes further potential improvements to the methods proposed by the earlier investigators based primarily on the heat transfer theory for buried line sources.

MP 5368
TESTING OF FIBERGLASS COMPOSITE BRIDGE DECK PANELS.
Harik, I., et al, International Conference on Boundary Element Technology, 13th, 1999 (BETECH 99), incorporating Computational Methods and Testing for Engineering Integrity, Southampton, England, International Society for Boundary Elements, 1999, p.663-672, 3 refs.
53-4462
BRIDGES, COMPOSITE MATERIALS, PLASTICS, DYNAMIC LOADS, IMPACT TESTS, BEARING TESTS, STRAIN TESTS, DESIGN CRITERIA
Experimental investigations are carried out on fiberglass composite bridge deck panels under a three-point bending test. A rectangular patch load, which represents the AASHTO standard HS25 truck wheel load, is applied at the center of each panel. The breadth of all panels is 36 in. The depths of the panels are 8.5 in, 9 in and 9.5 in. The span lengths of the panels are 86 in, 120 in and 144 in. The in-plane deformations and out-of-plane deflections are measured using strain gages and linear variable deflection transducers. The measured deflections of the panels under service load are compared with allowable deflection limits. The response of the panels under cyclic loading, the load at failure, and the deformability and mode of failure are reported. It is found that the fiberglass composite deck panels satisfy the allowable deflection criteria, and the factor of safety against collapse is greater than 6.5 for all panels.

MP 5369
REMOVING SPRING THAW LOAD RESTRICTIONS FROM LOW-VOLUME ROADS: DEVELOPMENT OF A RELIABLE, COST-EFFECTIVE METHOD.
Kestler, M.A., Hanek, G., Truebe, M., Bolander, P., *Transportation research record,* 1999, No.1652, International Conference on Low-Volume Roads, 7th, Baton Rouge, LA, May 23-26, 1999, p.188-197, 15 refs.
53-4463
PAVEMENTS, THAW DEPTH, THAW WEAKENING, TRAFFICABILITY, MOISTURE METERS, MOISTURE DETECTION, HIGHWAY PLANNING, ROAD MAINTENANCE, UNITED STATES

Low-volume roads in areas of seasonal freezing are highly susceptible to damage from trafficking during spring thaw. To minimize pavement damage, many agencies and states impose load restrictions during periods in which damage is most likely to occur. However, the magnitude and duration of reduced or prohibited hauling vary widely among agencies, and an optimal balance between maximizing local economy and minimizing road damage is rarely achieved. The U.S. Department of Agriculture Forest Service and the U.S. Army Cold Regions Research and Engineering Laboratory are evaluating a quantitative technique for removing load restrictions by developing correlations between pavement stiffness and soil moisture. Laboratory tests of the moisture sensors showed them to be accurate and repeatable under adverse freeze-thaw cycling. Preliminary analysis of field data showed that permanently installed time domain reflectometry and radio frequency soil moisture sensors strategically located throughout the forest road network will provide an affordable method for quantitatively determining when to remove load restrictions. Load restriction practices are reviewed, economic ramifications on the forest industry are briefly discussed, and laboratory and field test programs conducted to monitor soil moisture and pavement stiffness are outlined. In addition, instrumentation used for the study is described, observations from one of four national forest pavement test sites are presented, and the ongoing research to develop a method to remove load restrictions is discussed.

MP 5370
ICE EVENTS IN THE ST. LOUIS DISTRICT.
White, K.D., Mulherin, N.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Feb. 1999, No.20, 4p., 10 refs.
53-4464
RIVER ICE, ICE JAMS, FLOODS, COST ANALYSIS, DATA PROCESSING, UNITED STATES—MISSOURI, UNITED STATES—ILLINOIS

MP 5371
ICE JAMS, WINTER 1996-97.
Peterson, E.K., Herrin, L., White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* June 1998, No.18, 4p., 4 refs.
53-4465
RIVER ICE, ICE JAMS, FLOODS, DATA PROCESSING, UNITED STATES

MP 5372
REGISTRATION OF RWR-TETRA-1 TETRAPLOID RUSSIAN WILDRYE GERMPLASM.
Jensen, K.B., Asay, K.H., Johnson, D.A., Horton, W.H., Palazzo, A.J., Chatterton, N.J., *Crop science,* 1998, Vol.38, p.1405, 5 refs.
53-4466
GRASSES, PLANTS (BOTANY), INTRODUCED PLANTS, PLANT PHYSIOLOGY, PLANT TISSUES, PLANT ECOLOGY, AGRICULTURE

MP 5373
SIMPLE TEST FOR THE SUITABILITY OF EQUILIBRIUM THICKNESS.
Zufelt, J.E., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.1-14, 15 refs.
53-4468
RIVER ICE, ICE JAMS, ICE COVER THICKNESS, ICE COVER STRENGTH, ICE COVER EFFECT, ICE FRICTION, ICE DEFORMATION, ICE BREAKUP, ICE FORECASTING, ICE WATER INTERFACE, RIVER FLOW, FLOOD FORECASTING, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION
Equilibrium ice thickness theory provides for a simple calculation of ice jam thickness given some basic information on river characteristics. There are several assumptions attendant with the use of equilibrium theory that may be violated by some numerical models. Highly unsteady flow situations demand the use of unsteady flow models in the determination of jam thickness. Gradually varying discharge situations, however, may find the use of equilibrium theory perfectly suitable, with minimal error in calculated jam thickness. A dimensionless parameter is proposed and demonstrated for use in determining whether simple equilibrium thickness calculations or a more complex unsteady model is required for the calculation of ice jam thickness.

MP 5374
FORECASTING SYSTEMATIC ICE JAM OCCURRENCE ALONG THE YUKON RIVER, ALASKA.
White, K.D., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.30-43, 11 refs.
53-4470
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE REPORTING, ICE FORECASTING, FLOOD FORECASTING, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—ALASKA—YUKON RIVER
Many long northern rivers experience a single, snowmelt-driven, ice-cover breakup that progresses downstream and results in the occurrence of ice jams. For example, the ice jams that form annually on the Yukon River generally occur during May and June and progress from east (upstream) to west (downstream). In some years, the jamming progresses in an orderly, systematic fashion, and in others the jam occurrence is marked by long delays. Since most development in the Yukon River basin is clustered along the river, the ice jams may cause flooding and damage to structures as well as disrupt transportation. Long-term empirical forecasts of the likelihood of spring ice-related flooding are made by the National Weather Service Alaska River Forecast Center. Combining this long-term forecast of jam likelihood with near-term forecasts of jam occurrence could improve ice jam mitigation and reduce damages. This paper presents a forecast matrix based on observed jam dates that can be used in preparing near-term forecasts of systematic ice jam occurrence along the Yukon River.

MP 5375
DISCRETE ELEMENT MODELING OF RIVER ICE AT NAVIGATION STRUCTURES.
Hopkins, M.A., Daly, S.F., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.59-69, 8 refs.
53-4472
LOCKS (WATERWAYS), SLUICES (HYDRAULIC ENGINEERING), HYDRAULIC STRUCTURES, RIVER ICE, ICE LOADS, ICE FRICTION, ICE NAVIGATION, ICE PASSING, ICE CONTROL, BUBBLING, COMPUTERIZED SIMULATION
Recent advances in discrete element modeling now allow the direct simulation of brash ice in a lock entrance approach. Ice in the lock approach interferes with the miter gate operation and delays barge transiting because separate lockages are needed to pass the accumulated ice. Discrete element simulation resolves the contact and body forces acting on thousands of individual floes at each time step to model the movement of brash ice floes. The movement of ice in the lock approach is largely affected by the opening of the upstream lock miter gates, the operation of high-flow air bubblers, and the transiting of barges. All of these phenomena are included in the simulation. This allows the effectiveness of the high-flow bubblers in managing ice to be assessed, and the interaction of the ice floes and the barges to be studied. Discrete element simulation promises to be an important tool for investigating ice in lock approaches and designing ice-management measures.

MP 5376
SIMULATING WINTER ENVIRONMENTS FOR AQUATIC LIFE IN THE CRREL REFRIGERATED FLUME.
White, K.D., Daly, S.F., Gagnon, J.J., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.85-96, 13 refs.
53-4474
RIVER ICE, ICE CONDITIONS, FRAZIL ICE, BOTTOM ICE, ICE COVER EFFECT, PHYSIOLOGICAL EFFECTS, ANIMALS, ECOLOGY, COLD WEATHER SURVIVAL, ENVIRONMENTAL TESTS, ENVIRONMENT SIMULATION
Winter creates potentially stressful conditions for fish in northern rivers where frazil ice is produced. It has been hypothesized that the most adverse conditions are found in rivers that are partially ice covered. These rivers experience larger fluctuations in water temperature and ice conditions, including more frequent overcooling and frazil ice events. While little is known about the response of freshwater fish to frazil ice and the supercooled water associated with it, it is known that these fish do not contain the antifreeze compounds found in the blood of marine fish. Fish kills have been reported after supercooling events, yet no clear causal relationships have been found. Fish may be adversely affected by frazil ice accumulating in their gills, anchor ice forming on the bed, and frazil being deposited under the ice cover. Anchor ice can cover and smooth the substrate that provides both food and hiding places for the fish. Frazil ice deposition beneath an ice cover may change the hydraulics of the river, decreasing the availability of slow-moving areas in a riffle-pool stream. Traditional field methods of examining frazil effects on aquatic fish are time-consuming and expensive, and often provide only a small indigenous sample population from which to infer behavior. The CRREL refrigerated flume provides a facility capable of testing a range of riverine conditions, which will allow researchers to design careful experiments to observe ice effects on fish. This paper reports on the conditions attained in the flume during a preliminary test series with rainbow trout, including bed slope, water depth and velocity, water temperature, and the type, size, and distribution of typical substrate materials.

MP 5377
BLOOD CHEMISTRY AND SWIMMING ACTIVITY OF RAINBOW TROUT EXPOSED TO SUPERCOOLING AND FRAZIL ICE.
Brown, R.S., Brodeur, J.C., Power, G., Daly, S.F., White, K.D., McKinley, R.S., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.97-110, 25 refs.
53-4475
RIVER ICE, ICE CONDITIONS, FRAZIL ICE, BOTTOM ICE, ICE COVER EFFECT, SUPERCOOLING, PHYSIOLOGICAL EFFECTS, ANIMALS, ECOLOGY, COLD TOLERANCE, COLD WEATHER SURVIVAL
Adult and juvenile rainbow trout *(Oncorhynchus mykiss)* were exposed to supercooled temperatures, frazil ice and anchor ice in a refrigerated flume at the Cold Regions Research and Engineering Laboratory (Hanover, NH). The blood chemistry of the fish was measured before and after they were exposed to a frazil ice event. Plasma chloride, sodium and potassium levels were significantly reduced in juvenile rainbow trout after 6.5 h of exposure to supercooling, frazil ice and anchor ice. Plasma lactate did not vary but plasma glucose was increased although not in a statistically significant manner. Blood parameters of adult fish varied in a similar way as in juveniles but none of the changes were statistically significant. The swimming activity of half of the adult fish (measured by electromyogram telemetry) was significantly lower while exposed to frazil and anchor ice, and none were more active. The escape response of adult rainbow trout was decreased when they were exposed to supercooled water and frazil and anchor ice. This reduction in activity and escape response may increase the likelihood of avian or mammalian predation during subsurface ice events. These sublethal effects observed during exposure to supercooling and frazil ice suggest that further research is needed to determine how such events might impair fish survival.

MP 5378
CAZENOVIA CREEK ICE CONTROL STRUCTURE: A COMPARISON OF TWO CONCEPTS.
Lever, J.H., Gooch, G., Workshop on River Ice, 10th, Winnipeg, Manitoba, June 8-11, 1999. Proceedings. River ice management with a changing climate: dealing with extreme events. Edited by J.C. Doering, Winnipeg, University of Manitoba, 1999, p.303-317, 11 refs.
53-4491
RIVER ICE, ICE BREAKUP, ICE JAMS, HYDRAULIC STRUCTURES, PIERS, SPILLWAYS, CHANNEL STABILIZATION, ICE CONTROL, FLOOD CONTROL, COST ANALYSIS, UNITED STATES—NEW YORK
In 1984, CRREL conducted model tests of a structure to control breakup ice jams on Cazenovia Creek in West Seneca, NY. It consisted of a 1.8-m-high weir with 9 ice-retaining piers, an excavated pool to store ice pieces, and a prepared floodway. Although the model structure performed well, the prototype was not built because the community could not afford its portion of the project cost of $2.1M (1986 dollars). The authors recently completed model tests of a new ice-control structure for Cazenovia Creek. It consists of nine 3-m-tall x 1.5-m-diameter cylindrical piers spaced across the main channel at the same site. It does not require a weir or excavated pool, and it uses the adjoining tree floodplain as a natural bypass channel. Consequently, it should cost substantially less than the original structure. Test results show that the new structure retains ice at least as well as the original one.

MP 5379
WYOMING PLOWS MORE AT SAFE SPEEDS.
Better roads, June 1999, 69(6), p.18-19, Phone numbers are provided for S.A. Ketcham, L.D. Minsk, and L.S. Danyluk at CRREL, as contact persons.
53-4594
SNOWSTORMS, SNOW REMOVAL, SAFETY, COLD WEATHER OPERATION, ROAD MAINTENANCE, UNITED STATES—WYOMING

MP 5380
***INTRODUCTION TO COLD REGIONS ENGINEERING* BY D.R. FREITAG AND T. MCFADDEN.**
Sodhi, D.S., *Journal of cold regions engineering,* Mar. 1998, 12(1), p.29-30, For book being reviewed see 51-4767.
53-4681
COLD WEATHER CONSTRUCTION, ENGINEERING GEOLOGY, FROZEN GROUND STRENGTH, FROZEN GROUND THERMODYNAMICS, PERMAFROST BENEATH ROADS, PERMAFROST BENEATH STRUCTURES, BUILDINGS, WATER SUPPLY, SANITARY ENGINEERING

MP 5381
CLIMATE SIMULATIONS WITH THE DOE PARALLEL CLIMATE MODEL (PCM).
Washington, W.M., Weatherly, J.W., Symposium on Global Change Studies, 10th, Dallas, TX, Jan. 10-15, 1999. Preprints, Boston, American Meteorological Society, 1999, p.365-368, 11 refs.
53-4766
ATMOSPHERIC CIRCULATION, OCEAN CURRENTS, AIR ICE WATER INTERACTION, ICE MODELS, GLOBAL WARMING, COMPUTERIZED SIMULATION

MP 5382
CHARACTERIZATION OF ANTITANK FIRING RANGES AT CFB VALCARTIER, WATC WAINWRIGHT AND CFAD DUNDURN.
Thiboutot, S., et al, *Canada. Defence Research Establishment Valcartier, Quebec. Report,* Oct. 1998, DREV-R-9809, 54p., ADA-356 304, With French summary. 17 refs.
53-4794
MILITARY FACILITIES, SITE SURVEYS, EXPLOSIVES, SOIL POLLUTION, GROUND WATER, WATER POLLUTION, SOIL TESTS, SOIL ANALYSIS, CHEMICAL ANALYSIS, CANADA
Some operational activities of the Canadian Forces such as firing practice may cause the dispersion of energetic compounds in the environment. These compounds should be closely monitored due to their highly specific physical, chemical and toxicological properties. In Canada, limited effort has been spent to examine this particular environmental threat. In this context, the characterization of many firing ranges potentially contaminated with explosives has been performed during the last few years. Air-to-ground ranges and ground-to-ground ranges have been characterized and, in general, low levels of multi-contamination by explosives were found. However, antitank firing ranges sampled showed high levels of contamination by HMX, a high explosive used in many antitank rockets. This report details the characterization of five antitank ranges located at Canadian Forces Base Valcartier, Western Area Training Center Wainwright and Canadian Forces Ammunition Depot, Dundurn. The sampling and analytical methods are described and the results are presented. This work should help the Canadian Forces to pursue their operational activities, while minimizing the impacts on the environment by providing a better comprehension of the source of contamination and helping to minimize the environmental impacts in the future.

MP 5383
SOILS AND GROUNDWATER POLLUTION AND REMEDIATION: ASIA, AFRICA, AND OCEANIA.
Huang, P.M., ed, Iskandar, I.K., ed, Boca Raton, FL, CRC Press LLC, 1999, 386p., Refs. passim. Chapters 3 and 4, p.80-95, and 96-125, respectively, have p.82-95 and 96-114 missing, and 115-125 duplicated. Chapter 5, p.126-149, is complete but has p.126-146 duplicated in chapters 3 and 4.
53-4828
SOIL POLLUTION, GROUND WATER, WATER POLLUTION, WASTE DISPOSAL, ENVIRONMENTAL IMPACT, HEALTH, ENVIRONMENTAL PROTECTION, LAND RECLAMATION

MP 5384
ARCTIC RESEARCH OF THE UNITED STATES, VOL.13, SPRING/SUMMER 1999.
U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Korsmo, F., ed, Haugh, J., ed, Cate, D.W., ed, Valliere, D.R., ed, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1999, 54p., Refs. passim. For selected papers see 53-4848 and 53-4849.
53-4847
ORGANIZATIONS, RESEARCH PROJECTS, REGIONAL PLANNING, INTERNATIONAL COOPERATION

MP 5385
COLD REGIONS ENGINEERING: PUTTING RESEARCH INTO PRACTICE; PROCEEDINGS.
International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999, Zufelt, J.E., ed, Reston, VA, American Society of Civil Engineers (ASCE), 1999, 901p., Refs. passim. For individual papers see 53-5122 through 53-5203.
53-5121
COLD WEATHER CONSTRUCTION, STATIONS, UTILITIES, BUILDINGS, FOUNDATIONS, ROAD MAINTENANCE, PAVEMENTS, PERMAFROST BENEATH STRUCTURES, PERMAFROST PRESERVATION, FROZEN GROUND STRENGTH, SUBGRADE SOILS, SOIL FREEZING, FROST HEAVE, THAW WEAKENING, SOIL STABILIZATION, FROST PROTECTION, RIVER ICE, ICE LOADS, ICE CONTROL, POWER LINE ICING
This proceedings is a compilation of the technical papers presented at the Tenth International Conference on Cold Regions Engineering held in Lincoln, NH on Aug. 16-19, 1999. Nine topic areas discuss the application of cold regions research in over 80 papers. The South Pole Redevelopment Project section discusses the design and construction involved in the modernization and upgrade of facilities at the U.S. Amundsen-Scott South Pole Station. Design and construction problems in frozen ground and permafrost are addressed in the Frozen Ground Engineering section. The Environmental Engineering in Cold Regions section addresses water and wastewater systems, bioremediation, and contaminant analysis in cold regions. The use of satellite and airborne imagery for detection of oils spills and environmental degradation are discussed in the Remote Sensing Applications in Cold Regions section. The Cold Regions Transportation Issues section covers the solutions to problems effecting pavements, railroads, airfields, and snow-covered roads. The River Ice, Hydrology, and Hydraulics section addresses snowmelt, runoff, ice control, and modeling of ice-covered rivers. Structural and foundation problems are addressed in the Construction in Cold Regions section. The Atmospheric Icing section covers tree and power line damage due to freezing rain and ice storms. Finally, the Snow and Ice Engineering section looks at sea ice forces on structures and the effects of ice on riprap. The papers presented in this proceedings should provide a state-of-the-art look at cold regions engineering research and its application to realworld problems.

MP 5386
SOUTH POLE STATION REDEVELOPMENT PROJECT.
Rand, J., Brier, F., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.1-10, 9 refs.
53-5122
STATIONS, SITE SURVEYS, COLD WEATHER CONSTRUCTION, BUILDINGS, HUMAN FACTORS ENGINEERING, SAFETY, COST ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION
The National Science Foundation Office of Polar Programs, the lead agency for the U.S. Antarctic Program, has completed the design and started construction of a replacement station at the geographic South Pole, Antarctica. This paper provides a historical review of the concept development, design process and project management procedures for the South Pole Redevelopment Project.

MP 5387
CONSTRUCTION OF UNLINED TUNNELS FOR ICECAP STATIONS.
Walsh, M.R., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.94-105, 12 refs.
53-5130
SNOW TUNNELS, ICE TUNNELS, TUNNELING (EXCAVATION), SNOW REMOVAL EQUIPMENT, ICE CUTTING, MACHINERY, CONSTRUCTION EQUIPMENT, UTILITIES, ANTARCTICA—AMUNDSEN-SCOTT STATION
Facilities operations in a polar icecap environment present many unique challenges. Coping with the extreme cold temperatures, the darkness during the long winter months, and blowing and drifting snow all hamper installation, maintenance and repair operations. For over 40 years, the concept of using tunnels for utilities and personnel in polar environments has been tried with mixed results. In 1991, the U.S. Army Cold Regions Research and Engineering Laboratory initiated a project to develop, fabricate, test, build and deploy a system for the machining of unlined tunnels at the Amundsen-Scott South Pole Station. A system based on a modified tracked excavator was deployed to Antarctica in Jan. 1996 for testing. The system was modified and redeployed the following summer to create a subsurface utilidor. A 120 m long, 2-m by 3-m tunnel was machined into the firn at the station over the course of 10 days. The tunnel, at a maximum depth of 16 m, is currently being used for the main station's wastewater discharge line. At a near-constant -40°, the well-lit tunnel, secure from the elements, has already proven its worth during routine and emergency maintenance operations during the harsh polar winters since 1996. Further tunnels have been planned as part of the new U.S. South Pole Station.

MP 5388
COMPARISON OF DELIVERY SCENARIOS FOR A LONG ANTARCTIC TRAVERSE.
Blaisdell, G.L., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.106-117, 4 refs.
53-5131
LOGISTICS, ROUTE SURVEYS, TRAVERSES, SNOW ROADS, TRACKED VEHICLES, TRACTORS, COST ANALYSIS, ANTARCTICA—MCMURDO STATION, ANTARCTICA—AMUNDSEN-SCOTT STATION
A recently completed interdisciplinary study assessed the feasibility of a 1600 km oversnow trail connecting McMurdo Station to Amundsen-Scott South Pole Station. Aircraft (specialized ski-wheel Hercules or airdrop) are currently the only means of delivering large volumes of materials to the South Pole. In addition to personnel and their needs (food, scientific equipment, etc.), more than 1.1M liters of fuel are needed annually and 1.1M kg of construction supplies for station modernization are required annually for the next 8 years. This airlift seriously taxes the current US Antarctic Program's air resources during the 100-day South Pole flight season and constitutes a significant expense. Preliminary calculations suggested that a oversnow transportation system could provide considerable life-cycle cost savings. Results are reported elsewhere of the field study to determine feasible candidate routes and what driving conditions are likely to be encountered. This paper describes a) the process of determining the appropriate vehicle(s) for such a long, unsupported traverse, b) comparison of the two best candidate routes, and c) calculations of roundtrip travel time, consumed fuel and deliverable payload. The latter statistics are compared to the current air delivery system and show the traverse to be twice as efficient, if speed of delivery isn't required.

MP 5389
RENEWABLE ENERGY FIELD TESTS AT THE SOUTH POLE.
Norton, G., Linton, E., Rand, J., Williams, C., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.148-159.
53-5135
UTILITIES, WIND POWER GENERATION, SOLAR RADIATION, ELECTRIC POWER, ELECTRIC EQUIPMENT, WIND PRESSURE, COLD WEATHER TESTS, COST ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION
The U.S. operates the Amundsen-Scott South Pole Station for scientific research. Due to the high costs, logistical constraints and environmental risks of transporting large quantities of diesel fuel to the antarctic interior, the National Science Foundation has supported practical investigations into the use of wind and solar energy to reduce the amount of fuel needed to meet the power requirements of the station. Following an introduction to the South Pole operating environment, this paper provides summaries of two recent field test projects. These projects evaluated the technical feasibility of deploying commercially available renewable energy hardware at the Pole, as a prelude to considering larger scale installations. One set of tests, performed by Northern Power Systems, involved installation and operation of a wind turbine at the Pole. The second project, carried out by the U.S. Army Cold Regions Research and Engineering Laboratory, included an operational evaluation of photovoltaic panels mounted on one of the structures of the Amundsen-Scott Station.

MP 5390
GROWTH CONDITION OF ICE LENSES AND APPLICATIONS.
Nakano, Y., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.187-198, 40 refs.
53-5138
SUBGRADE SOILS, SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND STRENGTH, FREEZING FRONT, SOIL WATER MIGRATION, FROST PENETRATION, ICE LENSES, FROST RESISTANCE, FROST PROTECTION, THERMAL INSULATION, SOIL STABILIZATION, MATHEMATICAL MODELS
As the 1990s arrived, there were many models of ice segregation, but they all suffered from the common fault of little or no experimental verification. Research efforts became focused on experimental evaluation of multiple hypotheses used in these models and significant progress was made toward quantitative understanding of ice segregation in the past decade. As knowledge advanced, research results became more mathematically oriented and less accessible to engineers. The objective of this paper is to present the current knowledge of ice lens growth with minimum number of equations and to explore practical ways to mitigate ice lens formation.

MP 5391
EFFECT OF DISSOLVED SOLIDS ON FREEZE-THAW CONDITIONING.
Martel, C.J., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.309-316, 9 refs.
53-5149
SLUDGES, WATER TREATMENT, WASTE TREATMENT, SEWAGE DISPOSAL, SANITARY ENGINEERING, ARTIFICIAL FREEZING, FREEZE DRYING, ICE CRYSTAL

GROWTH, ICE CRYSTAL STRUCTURE
The purpose of this study was to investigate the effect of dissolved solids on the size of aggregated particles produced by freeze-thaw conditioning of alum sludge. The dissolved solids content was varied by adding 0-2000 mg/L NaCl to samples of alum sludge. The effect of the dissolved solids was observed by taking photographs of thin sections of each frozen sample and measuring the resulting aggregated particle sizes. The results of this study indicate that a relatively small amount of dissolved solids (500 mg/L NaCl or less) will cause ice crystal growth to change from columnar to dendritic. As a result, the mean aggregated particle size was reduced by approximately 50%. These results explain why the aggregated particles from alum sludge are large and easier to dewater than those produced from wastewater sludge. Generally, alum sludge contains very little dissolved-solids, so crystal growth is columnar. Conversely, wastewater sludges usually contain a significant amount of dissolved solids so that crystal growth becomes dendritic. Thin sections photographed between cross polarizers reveal that most of the aggregated particles were trapped within individual ice crystals and not at the crystal boundaries.

MP 5392
REDUCING DAMAGE TO LOW VOLUME ASPHALT-SURFACED ROADS, AND IMPROVING LOCAL ECONOMIES: UPDATE ON VARIABLE TIRE PRESSURE PROJECT.
Kestler, M.A., Nam, S.I., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.461-471, 13 refs.
53-5163
PAVEMENTS, THAW WEAKENING, TIRES, HIGHWAY PLANNING, ROAD MAINTENANCE, COLD WEATHER OPERATION, ENVIRONMENTAL TESTS, COMPUTERIZED SIMULATION
Spring thaw adversely affects both pavement life and local economies throughout the northern United States and Canada. Each year significant damage is done to bituminous-surfaced low volume roads from trafficking during thaw-weakened periods. To prevent higher maintenance and reconstruction costs, many road agencies impose load restrictions limiting loads or closing low volume roads to trucks during these damage-susceptible periods. Companies whose livelihood depends on trucking can suffer economic losses while waiting for thawing roads to recover, and for load restriction signs to be removed. A group of concerned federal agencies, departments of transportation, and private companies throughout the United States and Canada has organized an effort to verify computer simulations that suggest using reduced tire pressures on thaw-weakened asphalt-surfaced low volume roads can reduce pavement damage. Full-scale tests using a heavy vehicle simulator are underway at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH, in which a variety of tire pressures are being applied to several pavement test sections subjected to thawing. In addition to reducing road maintenance costs and extending pavement life, the pooled-fund test program discussed in this paper has the potential to affect current guidelines that restrict hauling, thereby extending the haul season in the springtime.

MP 5393
LARGE AIRCRAFT OPERATIONS AT SMALL AIRPORTS: WHEN CAN HEAVIER-THAN-DESIGN AIRCRAFT USE THIN FROZEN PAVEMENTS.
Kestler, M.A., Cortez, E.R., Berg, R.L., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.472-486, 13 refs.
53-5164
RUNWAYS, PAVEMENTS, SUBGRADE SOILS, SOIL FREEZING, FREEZING INDEXES, FROST PENETRATION, FROST RESISTANCE, THAW DEPTH, FROZEN GROUND STRENGTH, BEARING TESTS, TRAFFICABILITY, COMPUTERIZED SIMULATION, UNITED STATES—NORTH DAKOTA—WILLISTON
In response to a request by airport officials in Williston, ND, to allow heavier-than-design aircraft to operate at Sloulin Field on frozen runway pavements during winter months, the Federal Aviation Association contacted the U.S. Army Cold Regions Research and Engineering Laboratory, and a research project was implemented. Instrumentation was installed at Sloulin Field during Oct. 1992, and subsurface temperature, soil moisture content, and pavement stiffness were monitored for the following four years. Using these data, the development of a simple index (based upon frost or thaw depths, freeze-thaw cycles, and other environmental factors) that can be used to roughly estimate pavement strength was investigated. Additionally, a thaw prediction model was developed. The computer program provides recommendations on whether a plane can land on the runway or park on the apron during the ensuing five days without causing unacceptable pavement damage. Although the frozen pavement at Sloulin Field can support heavier-than-design aircraft, it still may not be able to support the level of increase that some pavements could because the pavement modulus is so variable spatially and the subsurface structure at Sloulin Field tends to be quite dry (lowering the potential increase in modulus upon freezing). Consequently, the heavier-than-design aircraft considered in this study refers to aircraft in the 74,000-80,000 lb range with characteristics similar to those of the BAe 146-100. This report outlines the background, describes the test program and provides simple guidelines for (and limitations on) computer program use. Investigations leading to the development of a lookup table based on easy-to-measure environmental parameters will be discussed separately. The prediction model is site-specific to Sloulin Field. However, techniques similar to those used provide a valuable tool from which other site-specific or general models can be readily developed.

MP 5394
FINITE ELEMENT ANALYSIS OF A WHEEL ROLLING IN SNOW.
Shoop, S.A., Haehnel, R.B., Kestler, K., Stebbings, K., Alger, R., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.519-530, 13 refs.
53-5168
VEHICLE WHEELS, TIRES, TRACTION, RUBBER SNOW FRICTION, SNOW DENSITY, SNOW HARDNESS, SNOW STRENGTH, SNOW DEFORMATION, ENVIRONMENTAL TESTS, COMPUTERIZED SIMULATION
A three-dimensional model of a wheel moving through snow was generated using commercial finite element software (ABAQUS). Because of the large deformation of the snow relative to the tire, a rigid wheel was used to simplify computations. The snow was modeled as both an elastic-plastic material and as a crushable foam material. Models of uniaxial compression and plate sinkage tests in snow were used to explore the snow material model and match measured and observed snow deformation to model results. These constitutive models were then applied to the three-dimensional tire-snow model. New Arbitrary Lagrangian-Eulerian adaptive meshing formulations were also evaluated for improvements in handling the large deformations encountered in tire-snow interactions. Modeled snow deformation is compared to sinkage, displacement, and changes in snow densities. The modeled reaction forces on the wheel are compared with tire forces measured using the CRREL Instrumented Vehicle.

MP 5395
DISTRIBUTED SNOW PROCESS MODEL FOR USE WITH HEC-HMS.
Daly, S.F., Ochs, E.S., Brooks, P.F., Pangburn, T., Davis, E.M., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.538-549, 6 refs.
53-5170
WATERSHEDS, SNOW HYDROLOGY, SNOW WATER EQUIVALENT, SNOWMELT, RUNOFF FORECASTING, COMPUTER PROGRAMS
The Distributed Snow Process Model (DSPM) is a new approach to estimating runoff from snowmelt. The DSPM estimates the snowmelt in an area defined by a Standard Hydrologic Grid (SHG) using the SSARR_grid snow process model. A watershed can contain many separate SHG cells, depending on the size of the watershed and the size of the SHG selected. The SSARR_grid snow process model evaluates the snowmelt in each grid cell on the basis of the snow condition, elevation, temperature, and precipitation for that grid cell and the watershed properties. The snow conditions in each grid cell—snow melt, snow water equivalent, liquid water content, cold content, antecedent temperature index, and the antecedent melt index—are stored each time step in a gridded HEC-DSS database. The DSPM is a stand-alone program that provides input data to the Hydrologic Engineering Center's Hydrologic Modeling System through the gridded database. Sample results are included to demonstrate the type and range of output available from the DSPM.

MP 5396
DIURNAL VARIATION IN DISSOLVED OXYGEN MEASUREMENTS DURING LATE WINTER ICE-COVERED PERIOD, SLEEPER'S RIVER, VERMONT.
White, K.D., Melloh, R.A., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.550-560, 22 refs.
53-5171
RIVER ICE, ICE COVER EFFECT, ICE WATER INTERFACE, OXYGEN, AERATION, WATER CHEMISTRY, PHOTOSYNTHESIS, PLANT PHYSIOLOGY, PLANT ECOLOGY, MICROBIOLOGY, BIOMASS, DIURNAL VARIATIONS, UNITED STATES—VERMONT
Dissolved oxygen, a critical element in riverine systems, is required to support aquatic life and maintain good water quality. Previous research has documented the occurrence of oxygen depressions in ice-covered rivers that coincide with ice cover formation. These oxygen sags have been attributed to lack of reaeration because of the ice cover, oxidation of organic material, and inputs of oxygen-depleted groundwater. Diurnal variations in dissolved oxygen are key to understanding the oxygen balance processes of a stream, and previous studies provide only limited data in this regard. The present study incorporates continuous, high-temporal-resolution sub-ice water quality data and photosynthetically active radiation data for a gaged site in the Sleeper's River Research Watershed, VT. The first winter's observations, collected during late winter through spring breakup, are presented here. These data describe in detail the in-stream water quality environment during spring breakup and reveal a pronounced diurnal cycling of dissolved oxygen in the period just prior to breakup that appears to be the result of biological processes.

MP 5397
BREAKUP ON THE UPPER ST.JOHN RIVER.
Zufelt, J.E., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.561-575, 5 refs.
53-5172
RIVER ICE, ICE BREAKUP, ICE JAMS, ICE FORECASTING, FLOOD FORECASTING, WARNING SYSTEMS, UNITED STATES—MAINE—SAINT JOHN RIVER
The Upper St. John River flows through primarily uninhabited forestlands in northwest Maine. Its dynamic ice breakup results in annual ice jams and flooding at many locations along this reach of the river. Dickey, ME, is the most upstream community on the St. John River and, therefore, does not receive warning from upstream communities that an ice run has begun or that there is potential of damaging ice jams and flooding. In Apr. 1991, a severe ice run and jam at Dickey caught residents unprepared, with many residents being stranded as ice and water surrounded their homes, destroying the only bridge across the St. John River for 100 km. The communities downstream receive some warning that an ice run or jam has occurred in Dickey and is on its way downstream, although the warning time may be minimal. A properly placed sensor upstream of Dickey could give an early warning to residents that breakup has begun and ice jamming might occur. This paper describes experiments to track the ice breakup along the St. John River upstream of Dickey and how this information might be used to provide early warning of ice runs or jams at Dickey and communities downstream.

MP 5398
ABUTMENT SCOUR AT SMALL, SEVERELY CONTRACTED BRIDGES.
Niezgoda, S.L., Johnson, P.A., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.600-611, 13 refs.
53-5175
RIVER FLOW, FLOODPLAINS, BRIDGES, PIERS, FOUNDATIONS, WATER EROSION, COMPUTER PROGRAMS
Abutment scour at small, severely contracted bridges is not specifically addressed in current scour guidelines. Many of the abutments at these bridges are vertical and set along the main channel banks. The long roadway approach section and narrow bridge opening force floodplain waters to re-enter the main channel at the bridge, causing a severe contraction in flow area that results in both contraction and local scour. Current scour guidelines assume that contraction and local scour processes are independent and are determined separately and summed for a total scour depth. Because of the severe contraction in flow area, independent scour processes cannot be assumed. Thus, the practice of assuming independence may result in significant over-estimations of scour depth at severely contracted bridges. In this study, a relatively new scour model, ABSCOUR, is tested to determine its ability to provide more realistic scour estimates at severely contracted bridges by accounting for flow non-uniformity in a single total scour equation. The program format is also examined to determine its applicability to a wide range of environments. The results showed that scour depth predictions at prototype bridges were excellent, and that program applicability to a variety of environmental conditions was promising.

MP 5399
MODELING RIVER ICE USING DISCRETE PARTICLE SIMULATION.
Daly, S.F., Hopkins, M.A., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.612-622, 13 refs.
53-5176
RIVER ICE, ICE JAMS, ICE WATER INTERFACE, RIVER FLOW, HYDRAULIC STRUCTURES, PIERS, FLOW CON-

TROL, ICE CONTROL, ICE MODELS, MATHEMATICAL MODELS
Recent advances in discrete element modeling now allow the direct simulation of river ice dynamics. By resolving the contact and body forces acting on thousands of individual floes at each time step, the initiation, grounding, and formation of river ice jams can be simulated and studied. The attendant water flow is modeled using a coupled unsteady hydraulic model, with feedback provided between floes and water by water drag and blockage of the channel flow area by ice. The regimes of water flow that are modeled include open-channel flow area by ice. The regimes of water flow that are modeled include open-channel flow with no ice, flow under moving or stationary ice, and high-Reynolds-number porous flow through grounded and floating ice masses. The use of variable channel geometry, which allows realistic channel sections to be modeled, is described here. Results are presented for a simulation of the arrest of a large ice run by an ice-control structure consisting of nine evenly spaced, cylindrical piers. Discrete element simulation promises to be an important tool in the design and implementation of ice-control measures.

MP 5400
SOO LOCKS ICE PROBLEMS AND POSSIBLE SOLUTIONS.
Tuthill, A.M., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.623-630, 3 refs.
53-5177
LOCKS (WATERWAYS), RIVER ICE, ICE NAVIGATION, ICE CONTROL, ICE PASSING, BUBBLING, UNITED STATES—MICHIGAN—ST. MARYS RIVER
The Soo Locks at Sault Ste. Marie, MI allow passage of deep draft vessels from Lake Superior to the lower Great Lakes and St. Lawrence River system. Although the locks are closed to winter-long navigation, operators face serious ice problems following the reopening of the locks in early spring. Broken lake ice pushed ahead of downbound ships can make it difficult or impossible for the vessels to enter the locks. Existing solutions such as locking the ice separately through the main lock or an adjacent smaller lock result in delays and increased costs to the navigation industry. A physical model study at the Cold Regions Research and Engineering Laboratory will examine a range of alternatives aimed at improving ice passage at the Soo Locks. This paper describes the ice problems at the Soo as well as the objectives of the physical model study.

MP 5401
LOW-COST ICE CONTROL STRUCTURES FOR SMALL RIVERS.
Lever, J.H., Gooch, G.E., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.631-640, 17 refs.
53-5178
RIVER ICE, FREEZEUP, ICE BREAKUP, ICE JAMS, ICE CONTROL, FLOOD CONTROL, HYDRAULIC STRUCTURES, COST ANALYSIS
Control of ice jams on small rivers must balance the competing requirements of low cost and reliable performance. Using a refrigerated hydraulic laboratory, the authors have developed three new low-cost structures that should meet these requirements. One is a seasonally installed "tension weir" that creates a small pool to promote early ice-cover formation and consequently reduces freezeup ice jams downstream. It performed well during four seasons of field trials. The other two structures, consisting of a few large elements spaced across a river adjacent to a natural floodplain, control breakup ice jams. A breakup structure consisting of four massive sloped blocks has performed well since its construction in Hardwick, VT, in 1994. Based on model tests, a similar structure consisting of cylindrical piers should provide greater ice-restraining capacity, albeit at higher cost.

MP 5402
EFFECTS OF HOLES DRILLED IN A RIVER ICE COVER ON THE HEAT TRANSFER AT THE ICE/WATER INTERFACE.
Haehnel, R.B., Clark, C.H., Daly, S.F., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.641-652, 11 refs.
53-5179
RIVER ICE, ICE JAMS, ICE CUTTING, ICE DRILLS, ICE WATER INTERFACE, ICE HEAT FLUX, HEAT TRANSFER, ARTIFICIAL MELTING, ICE BREAKING, ICE CONTROL, FLOOD CONTROL, MATHEMATICAL MODELS, UNITED STATES—WISCONSIN—OCONTO RIVER
Drilling holes in a river ice cover has been used on the Oconto River to reduce ice jam flooding in the city of Oconto, WI, since the spring of 1988. Though this technique appears to have been successful at preventing ice jam flooding, it is not clear what physical processes are responsible for its success. This study explores the effects of the holes on enhancing the turbulent heat transfer at the ice/water interface, thereby advancing the deterioration of the ice cover. The heat transfer coefficient between a flat ice sheet (with and without holes) and flowing water was measured in the refrigerated flume facility at CRREL. The results show no change in the bulk Nusselt number due to the presence of the holes in the ice sheet. However, the local Nusselt number (measured in the vicinity of the holes) was initially much higher than the bulk number, but decays with time as local melting streamlines the hole. This local modification of the heat transfer has the effect of accelerating the melting of the ice in the region surrounding the hole, streamlining the hole. This work suggests that the reduction in ice volume caused by this effect is negligible in comparison to the total ice volume in the river, and likely has no effect on reducing ice jam potential.

MP 5403
EFFECTS OF LOW TEMPERATURE ON CONCRETE STRENGTH.
Korhonen, C.J., Orchino, S.A., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.677-683, 7 refs.
53-5182
CONCRETE FREEZING, WINTER CONCRETING, CONCRETE CURING, CONCRETE HARDENING, CONCRETE STRENGTH, TEMPERATURE EFFECTS, LOW TEMPERATURE TESTS, FROST RESISTANCE, FROST PROTECTION
Temperature affects the way concrete gains strength. High temperatures tend to accelerate early age strengths but decrease later strengths, while low temperatures retard early age strengths and increase later strengths. It is well known that freezing concrete at an early age can result in permanent damage. What is not well known or appreciated is that concrete can benefit from the cold. Cold weather often results in concrete of superior strength, compared to concrete cast during warm weather, and if fresh concrete is frozen at an early age, it can recover full potential strength when thawed. The problems as well as the opportunities of low temperature concreting are discussed.

MP 5404
FROST HEAVE PROBLEMS INSIDE A NUCLEAR POWER PLANT.
Korhonen, C.J., Hughes, J., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.684-691, 1 ref.
53-5183
NUCLEAR POWER, FLOORS, CONCRETE SLABS, FROST HEAVE, ICE LENSES, THERMAL INSULATION, ARTIFICIAL FREEZING, ARTIFICIAL THAWING, DRAINAGE, DRAINS, PUMPS, FROST PROTECTION
The ice condenser floors of a nuclear power plant had heaved upward and were binding against steam-vent doors. By drilling wells into the floors, insulating them, and thawing the ice beneath them, a large amount of water was pumped from the insulation beneath the floors. As a result, they dropped and created needed floor-to-door clearance. Although the partially dewatered floors are heaving again, they should not rise enough to become the problems they once were. In addition, the wells are in place for periodic dewatering should the need arise.

MP 5405
ICE STORMS, TREES AND POWER LINES.
Jones, K.F., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.757-767, 9 refs.
53-5191
ICE STORMS, POWER LINE ICING, ICE ACCRETION, ICE LOADS, ICE FORECASTING, TREES (PLANTS), MATHEMATICAL MODELS, UNITED STATES
Ice storms can cause prolonged outages in the supply of electric power to residents and industry. As the authors have become more dependent on electric power for lighting, heat, water, and communications, disruptions in the power supply have more severe consequences. This paper reviews a simple ice accretion model for forecasting ice loads in freezing-rain storms. Then, starting from information on the distribution of branch and twig diameters, the relative weights of ice on trees and on wires are compared. Finally, the areas of severe ice storms that have occurred in the southeastern United States are used to show the frequency of ice storms of large and small extents in that region. Utilities can use this kind of information to evaluate their ability to respond to damaging ice storms.

MP 5406
ICE EFFECTS ON RIPRAP: MODEL TESTS.
Sodhi, D.S., Donnelly, C.J., International Conference on Cold Regions Engineering, 10th, Lincoln, NH, Aug. 16-19, 1999. Proceedings. Putting research into practice. Edited by J.E. Zufelt, Reston, VA, American Society of Civil Engineers (ASCE), 1999, p.824-837, 9 refs.
53-5198
RIVER ICE, BANK PROTECTION (WATERWAYS), ROCK FILLS, ICE EROSION, ICE PUSH, ICE PILEUP, ICE OVERRIDE, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE CONTROL, CHANNEL STABILIZATION, ENVIRONMENTAL TESTS
The authors conducted 50 model tests to simulate the ice action on a riprap-protected bank and to determine the riprap damage caused during the interaction. The tests were conducted with the model riprap banks in different orientations relative to the direction of ice motion, at three different slopes, with two mixes of riprap stones, and with model ice sheets of different thicknesses. Because the tests used two model riprap banks with different stone sizes in the experiment setup, data for two ratios of ice thickness to median stone size were obtained from each test. The data on riprap damage is presented in tabular and graphical forms. The authors give plots of cumulative probability and a damage parameter for riprap failure with respect to the ratio of ice thickness to median stone size. The results indicate that riprap failure takes place when ice thickness is equal to, or thicker than, the median stone size. Accepting some (15%) probability of riprap failure, the authors find that the median stone size needs to be 2-3 times the ice thickness to protect a bank from an ice action.

MP 5407
INFRARED THERMOGRAPHY FOR CONDITION ASSESSMENT OF BURIED DISTRICT HEATING PIPING.
Phetteplace, G., *American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Transactions,* 1999, 105(pt.2), 6p., 13 refs.
53-5212
UTILITIES, HEATING, HEAT TRANSMISSION, HEAT PIPES, UNDERGROUND PIPELINES, HEAT LOSS, SOIL TEMPERATURE, INFRARED PHOTOGRAPHY
Infrared thermography has been used successfully for many years to find problem areas on buried district heating systems. While such information is useful for locating areas of major failures, for planning purposes some quantification of the results from an infrared survey of major portions of a district heating system would be advantageous. Some recent progress has been made toward this end by two International Energy Agency District Heating projects in which the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) has participated with colleagues from the Nordic countries. The objective of these projects was to develop a method that would allow quantification of heat losses from the temperature profile of the ground's surface above the buried heat distribution pipeline. Basically, the method uses the integral of the temperature distribution at the ground's surface along with climatological and system data to arrive at an empirical estimate of the heat loss. Using this method, CRREL has conducted infrared surveys of two facilities. Results have been good, and the facilities have been provided with both heat loss estimates and prioritized replacement lists. This paper describes the "TX method," as it is called, and its use. Sample results from the surveys done to date will also be presented.

MP 5408
ICE EVENTS IN THE SUSQUEHANNA RIVER BASIN.
White, K.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Ice engineering information exchange bulletin,* Apr. 1999, No.21, 6p., 10 refs.
53-5213
RIVER BASINS, RIVER ICE, ICE JAMS, ICE FORECASTING, FLOODS, FLOOD FORECASTING, COST ANALYSIS, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—SUSQUEHANNA RIVER

MP 5409
PROMOTING LATE-FALL ESTABLISHMENT OF TALL FESCUE WITH ARTIFICIAL SOIL COVERS TO MINIMISE SOIL EROSION.
Palazzo, A.J., *Environmental geochemistry and health,* 1994, 16(1), p.3-7, 13 refs.
53-5214
GRASSES, PROTECTIVE VEGETATION, REVEGETATION, COVERING, SOIL EROSION, SOIL CONSERVATION, SOIL STABILIZATION, LAND RECLAMATION
Frequently, turfgrass seedings have been sown in the late fall, which usually results in a poor vegetative stand and the possibility of soil erosion the following spring. This study evaluates the effects of a spun-bonded polyester soil cover placed over a late-fall seeding on subsequent seedling growth and overwintering. Clemfine, Mustang, Rebel and Rebel II cultivars of tall fescue *(Festuca arundinacea* Schreb.) were sown on a silt loam soil in late fall (17 Oct. in 1989 and 19 Oct. in 1990) and allowed to grow with and without a soil cover until June. In the spring the temperature under the soil cover was greater than 2°C warmer than the uncovered soil from mid-Apr. through May. Over the winter, leaf and root weights showed no detrimental effects from being under the cover. Individual cultivars grown under the cover produced 2

to 11 times greater leaf yields and 38 to 270% better stand establishment than those sown on the exposed soil. However, plant winter injury was observed under the soil cover in small soil depressions which accumulated water originating from thawing. All cultivars had similar amounts of growth under the cover. However, leaf yields for Rebel were 30-55% less than the other cultivars when grown under the cover and this was probably related to a low seed germination rate. The covers also promoted weed growth, which comprised from 34-65% of total leaf weights and was found to be negatively correlated (r= -0.66) to the yields of the sown grass. The soil cover was found to be beneficial to improving the success of seedling establishment of late seedings of tall fescue in cold areas.

MP 5410
HIGH STRAIN RATE IMPACT RESPONSE OF POLYCARBONATE BACKED COMPOSITE LAMINATES.
Vaidya, U.K., Hosur, M.V., Haque, A., Kulkarni, M., Mayer, A., Dutta, P.K., International Conference on Advanced Composites, Hurghada, Egypt, Dec. 15-18, 1998. ICAC 98, [1998], p.3-16, 8 refs.
53-5215
AIRCRAFT, WINDOWS, COMPOSITE MATERIALS, PLASTICS, POLYMERS, RESINS, IMPACT TESTS, IMPACT STRENGTH, STRESS STRAIN DIAGRAMS
Impact damage is of critical concern in aircraft structures using laminated carbon epoxy composites. Polycarbonate sheeting offers high impact resistance and is used in windshields and canopies. In the current study a hybrid construction of carbon epoxy composite laminate backed by polycarbonate sheeting has been investigated for its low velocity and high strain rate impact response. An instrumented drop weight impact tester has been used to investigate the low velocity impact response on 36 ply composite-polycarbonate samples. A compression Split Hopkinson Pressure Bar with 0.75" incident and transmission bars "with" and "without" dynamic recovery technique has been adopted in conducting the high strain rate experiments on 8, 16, 24, 32 and 48 ply-polycarbonate samples. In the absence of the dynamic recovery mechanism (referred to as the momentum trap gap), the specimen is subjected to multiple reflected stress waves. In the dynamic recovery technique, the sample is subjected to a controlled single compressive pulse, providing a better understanding of the damage evolution mechanisms. Between two configurations considered, with respect to the side facing the incident bar; in the first, the polycarbonate sheeting faced the incident bar, while in the second, the carbon/epoxy laminate faced the same. Damage evolution using both test configurations was investigated. The strain rates were varied from 108 to 544 per second.

MP 5411
THERMOGRAPHIC EVALUATION OF WINDOW STRUCTURES FOR ANTARCTIC ENVIRONMENT.
Dutta, P.K., *SPIE—The International Society for Optical Engineering. Proceedings*, 1999, Vol.3585, Nondestructive Evaluation of Aging Materials and Composites III, Newport Beach, CA, Mar. 3-5, 1999, p.73-83, 2 refs.
53-5224
BUILDINGS, WINDOWS, COMPOSITE MATERIALS, PLASTICS, POLYMERS, THERMAL INSULATION, WEATHERPROOFING, FROST PROTECTION, COLD WEATHER CONSTRUCTION, FROST RESISTANCE, LOW TEMPERATURE TESTS, THERMAL ANALYSIS, THERMAL STRESSES, ANTARCTICA—AMUNDSEN-SCOTT STATION
This study evaluates the performance of three different prototype commercial windows at extremely low temperature by exposing them to an environment similar to the condition in the US South Pole Station building in Antarctica. While the interior of the building will have a temperature of 24°C, the outside temperature will vary from -70°C to about -5°C on a sunny day. The differential expansion or contraction of the component materials may produce unacceptably high stresses, which may cause either the failure of the components, or degradation of performance over time. This investigation was an effort to assess such degradation, if any. Simultaneous evaluation tests were performed on four windows, two from one manufacturer, and one each from two other manufacturers.

MP 5412
STRENGTH AND CREEP OF ICE IN TERMS OF MOHR-COULOMB FRACTURE THEORY.
Fish, A.M., Zaretskiĭ, IU.K., International Offshore and Polar Engineering Conference, 8th, Montreal, May 24-29, 1998. Proceedings. Vol.2. Edited by J.S. Chung, R.M.W. Frederking, H. Saeki, and H. Moshagen, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1998, p.416-424, 35 refs.
54-200
ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE CREEP, ICE DEFORMATION, ICE CRACKS, ICE BREAKING, FROZEN GROUND STRENGTH, SOIL CREEP, FRACTURING, STRESS STRAIN DIAGRAMS, MATHEMATICAL MODELS
A constitutive model for secondary creep and strength of ice (and frozen soil) under multiaxial stress has been developed by combining two principal concepts: the Eiring-Frenkel rate process theory and the Mohr-Coulomb fracture theory. The strength of ice is described by a parabolic strength criterion, expanded by the authors from the Mohr-Coulomb yield criterion with only three fundamental, physically well-founded parameters: ice cohesion c^*, angle of internal friction ϕ^*, and ice melting pressure p^*. It is shown that all these parameters are functions of temperature, and the ice cohesion and friction angle are also functions of strain rate. A mathematical relationship was investigated between the strength parameters of ice determined by the Von Mises-Sruckler-Prager and Mohr-Coulomb fracture theories. The validity of the model was verified using uniaxial compression field and laboratory, triaxial compression, and indentation tests of ice in the temperature range of -1° to -40°C and the strain rate range of 10^{-7} and 10^{-2}/s.

MP 5413
EVALUATION OF POLYMERIC COMPOSITE WINDOW STRUCTURES FOR ANTARCTIC ENVIRONMENT.
Dutta, P.K., Haynes, D.F., International Offshore and Polar Engineering Conference, 8th, Montreal, May 24-29, 1998. Proceedings. Vol.4. Edited by P. Grundy, J. Koo, I. Langen, and J.M. Roesset, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1998, p.199-205, 1 ref.
54-232
BUILDINGS, WINDOWS, POLYMERS, COMPOSITE MATERIALS, THERMAL INSULATION, WEATHERPROOFING, FROST PROTECTION, COLD WEATHER CONSTRUCTION, COLD WEATHER TESTS, LOW TEMPERATURE TESTS, ANTARCTICA—AMUNDSEN-SCOTT STATION
A method to evaluate structural durability and performance of windows for use at the U.S. Amundsen-Scott Station is developed. Four commercial windows were mounted on a special test chamber simulating the antarctic conditions. The windows were instrumented with heat flux sensors, thermocouples and strain gauges. The superiority of one product against the other was established on the basis of frost buildup, maintainability of thermal insulation and structural integrity.

MP 5414
DAMAGE PROCESS OF CFRP COMPOSITES-CONCRETE INTERFACE UNDER FATIGUE LOADING AT LOW TEMPERATURES.
Arockiasamy, M., Thayer, C.C., Dutta, P.K., International Offshore and Polar Engineering Conference, 8th, Montreal, May 24-29, 1998. Proceedings. Vol.4. Edited by P. Grundy, J. Koo, I. Langen, and J.M. Roesset, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1998, p.211-218, 22 refs.
54-233
PLASTICS, POLYMERS, COMPOSITE MATERIALS, REINFORCED CONCRETES, CONCRETE DURABILITY, CONCRETE STRENGTH, FROST RESISTANCE, COLD WEATHER CONSTRUCTION, LOW TEMPERATURE TESTS, STRUCTURAL ANALYSIS, FATIGUE (MATERIALS)
This paper presents the experimental and theoretical studies on the feasibility of using CFRP laminates for strengthening damaged reinforced concrete beams in cold environment. Experimental work includes investigation on fatigue strength, ultimate capacity and failure modes of repaired reinforced concrete beams in cold environment and room temperature. The study also includes investigation of thermal response of repaired plain concrete beams with CFRP laminates subjected to thermal cycles. Repaired reinforced concrete beams with CFRP laminates bonded with Sikadur 30 and Hysol 9330 adhesives were subjected to fatigue loading up to 1 million cycles in a cold environment (-20°C). The crack propagation was faster in beams tested in room temperature than those at cold temperatures. Analytical studies on the distributed shear forces and peeling forces of repaired reinforced concrete beams were carried out to analyze the interaction between the laminate and the concrete interface. The temperature distribution and strains developed by the temperature differential are determined and the analytical results compared with the measured values.

MP 5415
INFLUENCE OF MOISTURE AND LOW TEMPERATURE ON NOTCHED IZOD IMPACT TOUGHNESS IN A PULTRUDED REINFORCED COMPOSITE.
Kellogg, K.G., Kallmeyer, A.R., Chinnam, R.B., Dutta, P.K., International Offshore and Polar Engineering Conference, 9th, Brest, France, May 30-June 4, 1999. Proceedings. Vol.4. Edited by P. Grundy, J. Koo, I. Langen and Y. Ueda, Cupertino, CA, International Society of Offshore and Polar Engineers (ISOPE), 1999, p.270-275, 8 refs.
54-288
COMPOSITE MATERIALS, PLASTICS, POLYMERS, STRUCTURAL ANALYSIS, FRACTURING, IMPACT TESTS, LOW TEMPERATURE TESTS
A preliminary assessment was made of the influence of low temperature on the impact-generated fracture of a commercial glass-reinforced polymer composite produced by the pultrusion process. Impact tests were performed using an Izod testing machine on the composite specimens with a V-notch resulting in a fracture surface parallel to the fiber direction. Tests were conducted at 25°, -5°, -25°, and -50°C on both dry (as received) and wet (submerged for 12 hours) specimens. This paper reviews the existing data in the literature on low temperature fracture behavior of composites and compares the data obtained from these tests. Special emphasis was given to the influence of subzero temperatures on fracture behavior.

MP 5416
COMMENT ON "TIME-FREQUENCY ANALYSIS WITH THE CONTINUOUS WAVELET TRANSFORM," BY W. CHRISTOPHER LANG AND KYLE FORINASH [AM. J. PHYS. 66 (9), 794-797 (1998)].
Treviño, G., Andreas, E.L., *American journal of physics*, Oct. 1999, 67(10), p.934-935, 12 refs.
54-470
ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENCE, WAVE PROPAGATION, DATA PROCESSING, STATISTICAL ANALYSIS, MATHEMATICAL MODELS

MP 5417
CORPS CLEANS UP ALASKA SALT WATER MARSH.
Darling, M., *Engineer update*, Oct. 1999, 23(10), p.13.
54-471
MILITARY FACILITIES, WETLANDS, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, WATER POLLUTION, LAND RECLAMATION, UNITED STATES—ALASKA—FORT RICHARDSON

MP 5418
REAL-TIME WEATHER/SOIL DATA COLLECTION NETWORK.
Hardy, S.E., Palazzo, A.J., *U.S. Army Environmental Center, Aberdeen Proving Ground, MD. Integrated Training Area Management (ITAM) Program. The bridge*, Winter 1999, No.8, p.2-3.
54-472
MILITARY FACILITIES, WEATHER STATIONS, METEOROLOGICAL DATA, HUMIDITY, AIR TEMPERATURE, SOIL AIR INTERFACE, SOIL WATER, SOIL TEMPERATURE, SOIL EROSION, DATA PROCESSING, DATA TRANSMISSION

MP 5419
BIOSOLIDS AND THEIR EFFECTS ON SOIL PROPERTIES.
Olness, A., Clapp, C.E., Liu, R.L., Palazzo, A.J., Handbook of soil conditioners: substances that enhance the physical properties of soil, New York, Marcel Dekker, Inc., 1998, p.141-165, Refs. p.161-165.
54-473
WASTE DISPOSAL, SEWAGE DISPOSAL, SLUDGES, AGRICULTURE, PLANT PHYSIOLOGY, SOIL CHEMISTRY, SOIL MICROBIOLOGY, SOIL CONSERVATION, LAND DEVELOPMENT, LAND RECLAMATION, NUTRIENT CYCLE, BIOMASS

MP 5420
VENTILATING CATHEDRAL CEILINGS TO PREVENT PROBLEMATIC ICINGS AT THEIR EAVES.
Tobiasson, W., Tantillo, T., Buska, J., North American Conference on Roofing Technology, Toronto, Canada, Sep. 16-17, 1999. Proceedings, Rosemont, IL, National Roofing Contractors Association, 1999, p.84-97, 8 refs.
54-474
BUILDINGS, ROOFS, THERMAL INSULATION, VAPOR BARRIERS, VENTILATION, SNOW RETENTION, ICICLES, ICE PREVENTION, COLD WEATHER CONSTRUCTION, DESIGN CRITERIA, MATHEMATICAL MODELS
Building heat from an unventilated steep-slope roof system can cause bottom melting of snow on that roof's surface. This often creates icicles, ice dams, leaks and structural damage at cold eaves. A prior study of attics showed that, to minimize such problems, attic ventilation systems should be sized to keep the underside of the roof below freezing when it is 22°F (-5.6°C) outside. When it is colder than that, it is easier to ventilate with outside air, and when it is warmer than 22°F (-5.6°C), meltwater seldom

refreezes at eaves. In this paper, mathematical expressions for sizing airways of cathedral ceilings of various slopes, lengths and insulating abilities are presented. Coldroom tests of 16-foot-long airways, some undersized and some oversized, show that the mathematics produces airways that do indeed perform as expected. In some of these tests, airways were blocked by expanding fibrous glass insulation. Air barriers and rigid insulation boards are shown to offer solutions to this problem. Design guidelines in the form of graphs make the task of sizing cathedral ceiling airways, as well as their inlet and exhaust openings, quick and easy.

MP 5421
INTRODUCTION TO COMPUTER MODELS FOR GEOTHERMAL HEAT PUMPS.

Sanner, B., Phetteplace, G., Hellström, G., Workshops: International Geothermal Days, Oregon, 1999. Proceedings. Small-scale electric power generation and geothermal heat pumps, Klammath Falls, Oregon Institute of Technology, Geo-Heat Center, 1999, p.175-181, 30 refs.

54-475

HEAT PUMPS, HEAT TRANSFER, GEOTHERMY, DESIGN CRITERIA, COMPUTER PROGRAMS

Design of ground heat exchangers for heat pumps is increasingly done with the support of easy-to-use, fast computer programs. These programs vary widely in calculation approach and accuracy. This paper gives a short overview of the early development, and focuses mainly on programs based on the g-function-method. This method is a suitable compromise between rules of thumb and tables on one hand and time-consuming numerical simulation on the other hand. Other programs are also discussed briefly, and a study on the reliability of such programs is discussed.

MP 5422
ACCOUNTING FOR CLOUDS IN SEA ICE MODELS.

Makshtas, A.P., Andreas, E.L., Sviashchennikov, P.N., Timachev, V.F., *Atmospheric research,* 1999, Vol.52, p.77-113, 60 refs. For another version see 53-2445.

54-476

POLAR ATMOSPHERES, MARINE ATMOSPHERES, ATMOSPHERIC CIRCULATION, CLOUD COVER, DRIFT STATIONS, AIR TEMPERATURE, SURFACE TEMPERATURE, RADIATION BALANCE, AIR ICE WATER INTERACTION, SEA ICE, ICE HEAT FLUX, ICE GROWTH, ICE COVER THICKNESS, ICE MODELS, MATHEMATICAL MODELS, ARCTIC OCEAN, ANTARCTICA—WEDDELL SEA

Over sea ice in winter, the clouds, the surface-layer air temperature, and the long-wave radiation are closely coupled. The authors use archived data from the Russian North Pole (NP) drifting stations and their wn data from Ice Station Weddell (ISW) to investigate this coupling. Both arctic and antarctic distributions of total cloud amount are U-shaped: observed cloud amounts are typically either 0-2 tenths or 8-10 tenths in the polar regions. The authors fitted these data with beta distributions and, using roughly 70 station-years of observations from the NP stations, compute fitting parameters for each winter month. Although they found that surface-layer air temperature and total cloud amount were correlated, it is not straightforward to predict one from the other because temperature is normally distributed while cloud amount has a U-shaped distribution. Nevertheless, they develop a statistical algorithm, that can predict total cloud amount in winter from surface-layer temperature alone and, as required, produces a distribution of cloud amounts that is U-shaped. Because sea ice models usually need cloud data to estimate incoming long-wave radiation, this algorithm, may be useful for estimating cloud amounts and, thus, for computing the surface heat budget where no visual cloud observations are available but temperature is measured—from arctic buoy network or from automatic weather stations, for example. The incoming long-wave radiation in sea ice models is generally highly parameterized. The authors evaluate five common parameterizations using data from NP-4, NP-25, and ISW. The formula for estimating incoming long-wave radiation that König-Langlo and Augstein developed using both arctic and antarctic data has the best properties but does depend nonlinearly on total cloud amount. This nonlinearity is crucial since cloud distributions are U-shaped while common sources of cloud data tabulate only mean monthly values. Lastly, they use a one-dimensional sea ice model to investigate how methods of averaging cloud amounts affect predicted sea ice thickness in the context of the five long-wave radiation parameterizations. König-Langlo and Augstein's formula performs best, and using daily averaged cloud data yields more realistic results than using monthly averaged cloud data that have been interpolated to daily values.

MP 5423
ESTIMATING ROLLING FRICTION OF LOOSE TILL FOR AIRCRAFT TAKEOFF ON DIRT RUNWAYS.

Shoop, S.A., Richmond, P.W., Eaton, R.A., International Conference of the ISTVS, 13th, Munich, Germany, Sep. 14-17, 1999. Proceedings. Vol.1., Hanover, NH, International Society for Terrain-Vehicle Systems (ISTVS), 1999, p.421-428, 6 refs.

54-477

RUNWAYS, AIRCRAFT LANDING AREAS, AIRPLANES, VEHICLE WHEELS, TIRES, FRICTION, TRACTION, GLACIAL TILL, GRAVEL, SOIL STRENGTH, SOIL TRAFFICABILITY, MATHEMATICAL MODELS

The objective of this project was to explore methods to estimate the rolling resistance of the airfield to predict takeoff distance. This paper compares different methods for calculating rolling resistance in loose soil and compares these to rolling resistance forces measured on the C-17 aircraft. The authors also explore the possibility of the use of a ground vehicle to measure the low speed effects of rolling friction, and correcting for high speed to relate this to aircraft performance.

MP 5424
DELIVERY SCENARIOS FOR A LONG ANTARCTIC OVERSNOW TRAVERSE.

Blaisdell, G.L., International Conference of the ISTVS, 13th, Munich, Germany, Sep. 14-17, 1999. Proceedings. Vol.2., Hanover, NH, International Society for Terrain-Vehicle Systems (ISTVS), 1999, p.919-926, 4 refs.

54-478

LOGISTICS, TRACKED VEHICLES, ROUTE SURVEYS, TRAVERSES, SNOW ROADS, ICE ROADS, COST ANALYSIS, ANTARCTICA—MCMURDO STATION, ANTARCTICA—AMUNDSEN-SCOTT STATION

A recently completed interdisciplinary study assessed the feasibility of a 1600 km oversnow trail connecting McMurdo Station to Amundsen-Scott South Pole Station. Aircraft (specialized ski-wheel Hercules or airdrop) are currently the only means of delivering large volumes of materials to the South Pole. In addition to personnel and their needs (food, scientific equipment, etc.), more than 1.1 M liters of fuel are needed annually and 1.1 M kg of construction supplies for station modernization are required annually for the next eight years. This airlift seriously taxes the current US Antarctic Program's air resources during the 100-day South Pole flight season and constitutes a significant expense. Preliminary calculations suggested that an oversnow transportation system could provide considerable life-cycle cost savings. Results are reported elsewhere of the field study to determine feasible candidate routes and what driving conditions are likely to be encountered. This paper describes: the process of determining the appropriate vehicle(s) for such a long, unsupported traverse; comparison of the two best candidate routes; and calculations of round-trip travel time, consumed fuel and deliverable payload. The latter statistics are compared to the current air delivery system and show the traverse to be twice as efficient, if speed of delivery isn't required.

MP 5425
RANDOM AMPLIFIED POLYMORPHIC DNA (RAPD) VARIATION AMONG NATIVE LITTLE BLUESTEM [*SCHIZACHYRIUM SCOPARIUM* (MICHX.) NASH] POPULATIONS FROM SITES OF HIGH AND LOW FERTILITY IN FOREST AND GRASSLAND BIOMES.

Huff, D.R., Quinn, J.A., Higgins, B., Palazzo, A.J., *Molecular ecology,* 1998, Vol.7, p.1591-1597, 37 refs.

54-479

GRASSES, PLANT ECOLOGY, PLANT PHYSIOLOGY, INTRODUCED PLANTS, REVEGETATION, PLAINS, FOREST ECOSYSTEMS, MOLECULAR STRUCTURE, STATISTICAL ANALYSIS

Random amplified polymorphic DNA (RAPD) markers were used to provide estimates of the comparative genetic variation within and among four native populations of *Schizachyrium scoparium.* Genotypes were collected from high- and low-fertility sites in both New Jersey (forest biome) and in Oklahoma (grassland biome), USA, and propagated in the greenhouse. Four oligonucleotide primers, 10 pb in length, produced a total of 60 RAPD markers, with the minimum marker difference between any two individuals being 14 markers. Euclidean metric distances were calculated among all individuals, and the analysis of molecular variance technique was used to apportion the total genetic variation among individuals within populations, populations within fertility levels, populations within biomes, fertility levels, and biomes. Even though most genetic variation resided within populations, statistically significant differences were detected between populations within each biome. Furthermore, genetic distances between high and low fertility levels within biomes were equal to or greater than biome distances. Therefore, in this wide-ranging and highly variable species, RAPD analysis suggests that local site differences in fertility and ecological history can promote genetic differentiation equal to or greater than geographical differentiation.

MP 5426
IN-SITU CHEMICAL OXIDATION OF TRICHLOROETHYLENE USING POTASSIUM PERMANGANATE.

McKay, D.J., Assessment and Remediation of Contaminated Sites in Arctic and Cold Climates (ARCSACC), Edmonton, Alberta, 1999, 1999, p.157-165, 10 refs.

54-480

SOIL POLLUTION, WASTE DISPOSAL, SOIL CHEMISTRY, LAND RECLAMATION

A full-scale demonstration of in-situ chemical oxidation using a solution of potassium permanganate is in the final stage of preparation at the U.S. Army Cold Regions Research and Engineering Laboratory (Hanover, NH). Current efforts are focused on treating immiscible-phase trichloroethylene (TCE) in the unsaturated zone between 4 and 10 m below the ground surface. The water table is approximately 40 m below the surface. The lacustrine formation is predominately silt with discontinuous distributions of clay bedding as well as fine sands. The low permeability clay lenses are nearly saturated with water and also contain the highest measured concentrations of TCE (up to 6% w/w). Air-based remediation methods were thus deemed to be of limited utility because of restrictive capillary effects. The permanganate solution is to be delivered to the target zones in 1.5-m increments of depth through an array of 5.1-cm diameter well screens placed inside 7.6-cm boreholes. Each well screen is 1.5 m long and isolated above by an inflatable borehole packer that enables delivery of the oxidant under pressure. A 1.5% solution is to be prepared in an automated batch mixing plant with a capacity of 20,000 L of permanganate. The oxidant will then be transferred to two automated distribution buildings, each designed to deliver 10,000 L/day to the contaminated soil through a system of 32 (total) injection points. Prior to construction, the contaminant at each injection location was characterized through continuous profile sampling using direct push techniques. Post-treatment performance is to be monitored by collection of soil samples near the injection point and by collection of pore water samples at selected locations. Chemical analyses include determinations of TCE, manganese, potassium, chloride, pH, alkalinity, and cation exchange capacity. Physical analyses consist of measurements to establish stratigraphic profiles and quantify changes to soil permeability.

MP 5427
RAFTING AND RIDGING OF THIN ICE SHEETS.

Hopkins, M.A., Tuhkuri, J., Lensu, M., *Journal of geophysical research,* June 15, 1999, 104(C6), p.13,605-13,613, 11 refs.

54-481

SEA ICE, ICE COVER THICKNESS, ICE COVER STRENGTH, ICE PRESSURE, ICE DEFORMATION, ICE OVERRIDE, PRESSURE RIDGES, COMPUTERIZED SIMULATION

Rafting and pressure ridging are important processes in the deformation of sea ice that occur when two ice sheets are pushed together. In this study a two-dimensional computer model of the rafting and ridging process is used to simulate a situation in which two identical ice sheets are pushed together at constant speed. Each model ice sheet is composed of two thicknesses of ice. The ratio of the thicknesses is varied to obtain degrees of inhomogeneity. The accuracy of the simulations is assessed by comparison with a series of similar physical experiments performed in a refrigerated basin. Following this comparison, the computer model is used to perform an extensive series of simulations to explore the effect of the thickness and the thickness inhomogeneity of the model ice sheets on the likelihood of occurrence of ridging and rafting. During the simulations the energy consumption and forces are explicitly calculated. The energy consumed during the simulations is used to demonstrate the smooth transition between ridging and rafting that occurs when the homogeneity of the sheets is varied.

MP 5428
COMPRESSION OF FLOATING ICE FIELDS.

Hopkins, M.A., Tuhkuri, J., *Journal of geophysical research,* July 15, 1999, 104(C7), p.15,815-15,825, 18 refs.

54-482

ICE FLOES, ICE COVER STRENGTH, ICE PRESSURE, ICE FRICTION, ICE LOADS, ICE DEFORMATION, ICE JAMS, PRESSURE RIDGES, COMPUTERIZED SIMULATION

The compression of ice fields made up of thin floes is central to the processes of ice jam formation in northern rivers, pressure ridge formation in northern seas, and the dynamics of ice fields in arctic and antarctic marginal seas. This work describes the results of computer simulations in which a floating layer of circular floes, confined in a rectangular channel, is compressed by a pusher plate moving at a constant speed. The accuracy of the simulations is assessed by comparison with a series of similar physical experiments performed in a refrigerated basin. Following this comparison, the computer model is used to perform an extensive series of simulations to explore the effect of variations in channel length and width, the ratio of floe diameter to thickness, floe on floe friction coefficients, and the distribution of floe diameters on the force required to compress the floes. The results show that reducing the aspect ratio of the floes or increasing the friction coefficient increases the force needed to compress the floes. Both changes increase the force by changing the dominant failure mechanism in the layer of floes from rafting to underturning. Increasing channel width reduced the compressive force (per unit channel width) by reducing the relative importance of frictional drag at the channel edges. Last, the results of a simulation using a distribution of floe diameters was indistinguishable from those of

a simulation using floes with a single diameter equal to the average diameter of the distribution.

MP 5429

ANALYSIS OF BIOVENTING AT EIELSON AIR FORCE BASE, ALASKA.

McKay, D., International In Situ and On-Site Bioremediation Symposium 5th, San Diego, CA, Apr. 19-22, 1999. In situ bioremediation of petroleum hydrocarbon and other organic compounds, Columbus, OH, Battelle Press, 1999, p.169-175.

54-483

OIL SPILLS, WASTE DISPOSAL, SOIL POLLUTION, SOIL CHEMISTRY, SOIL MICROBIOLOGY, NUTRIENT CYCLE, AERATION, LAND RECLAMATION, UNITED STATES—ALASKA—EIELSON AIR FORCE BASE

Source zone removal is a necessary precursor to effective ground water treatment through natural attenuation. Two sites undergoing active vadose zone remediation at Eielson Air Force Base, AK, were studied to compare conventional bioventing of unsaturated soils with bioventing accompanied by air sparging. Here, an investigation of injected air distribution is described. The shallow water table at each site has a typical seasonal fluctuation of 0.6 m, normally limiting the available range of air distribution for soil oxygenation and subsequent aerobic respiration. At site ST20 E-9, air is injected in wells screened above the seasonal high water table. The system installed at ST10 introduces air through screens that are completely submerged below the seasonal low water table. Air sparging tests were conducted at both sites to assess the benefit or potential benefit of sparging to enhance biodegradation in the seasonally saturated smear zone. Methods to evaluate airflow distribution included neutron probe air saturation tests, helium tracer tests, and measurements of soil pressures and oxygen levels near the water table. At ST20 E-9, saturated zone airflow followed lateral preferential pathways below the targeted smear zone, yielding desultory effects near the water table. It was thus concluded that bioventing at this site would not receive value added from the introduction of air below the water table. The data support the use of sparging at ST10 however, due in large part to the macroscale uniformity of soil properties.

MP 5430

SEISMIC SIGNAL ANALYSIS FROM MOVING TRACKED VEHICLES.

Moran, M.L., Boulanger, P.M., Greenfield, R.J., Meeting of the IRIS (Infrared Information Symposia) Specialty Group on Acoustic and Seismic Sensing, John Hopkins University, Applied Physics Laboratory, Laurel, MD, Sep. 29-Oct. 1, 1998, Ann Arbor, Environmental Research Institute of Michigan, Infrared Information Analysis Center, [1998], 10p., 2 refs.

54-484

TRACKED VEHICLES, TANKS (COMBAT VEHICLES), MILITARY OPERATION, MILITARY RESEARCH, SEISMIC VELOCITY, WAVE PROPAGATION, SENSORS, ACOUSTIC MEASUREMENT, STATISTICAL ANALYSIS

The ability to estimate a range to tracked ground vehicles is of critical importance to passive battlefield systems. The objective of this paper is to demonstrate the efficacy of seismic range estimation. The authors compare seismic and acoustic range estimates obtained from broadband signal amplitudes. A key assumption is that seismic propagation parameters can be determined as needed for each site. For the purposes of this study they determine the needed constants by a least squares model fit to a sequence of T72 runs at 25 kph. This set of data is defined as the nominal operational state of the vehicle. All results discussed use the constants from the nominal data set. The data was collected in Oct, 1997 at Aberdeen Proving Grounds, MD. During these tests acoustic and seismic propagation conditions were nearly ideal. Target range and range errors (from GPS) are calculated for T72 speeds between 10 and 40 kph. Seismic and acoustic range estimates from the calibration data were accurate out to 450 m. For the nominal data set the mean seismic range error was 22 m. The acoustic results for the nominal runs showed equally good agreement with a mean range error of 23 m. Range estimates are presented for off nominal vehicle states (fast and slow speeds). At tank speeds of 40 kph with vehicle ranges between 30 and 400 m, seismic range estimates were generally accurate with a mean range error of 44 m. The mean acoustic range error was 65 m. For tank speeds of 10 kph with the vehicle ranges again between 30 and 450 m, the mean seismic range error was 33 m, while the mean acoustic range error was 56 m. As a final comparison the authors simulate ranging with a misclassified target by range tracking on an M1 tank moving at 25 kph. In this case acoustic range was grossly over estimated. The mean acoustic error over four vehicle runs was 65 m. In contrast the seismic range estimates were very accurate. The four run mean seismic range error was 23 m. In summary, in every case examined seismic range estimates showed equal or better accuracy than acoustically based range estimates. Extension to these results to other test data sets, winter settings, and larger tracking ranges are under investigation.

MP 5431

3-D MIGRATION/ARRAY PROCESSING USING GPR DATA.

Moran, M.L., Arcone, S.A., Delaney, A.J., Greenfield, R.J., International Conference on Ground-Penetrating Radar, 7th, Lawrence, KS, May 27-30, 1998. Proceedings. Vol.1, Lawrence, University of Kansas, Radar Systems and Remote Sensing Laboratory, 1998, p.225-231, 8 refs.

54-485

ELECTROMAGNETIC PROSPECTING, RADIO ECHO SOUNDINGS, RADAR ECHOES, SUBSURFACE INVESTIGATIONS, WAVE PROPAGATION, DATA PROCESSING, STATISTICAL ANALYSIS

Several array processing methods are compared for synthetic data. The methods include two-dimensional (2-D) monostatic, three-dimensional (3-D) monostatic, and 3-D bistatic Kirchhoff migration. The migration algorithm is modified to include the radiation pattern for interfacial dipoles. The data generation model includes spatially coherent noise sources that yield nonstationary signal statistics like those observed in geologic settings that produce high-noise GPR signals. Array results clearly indicate that resolution and noise suppression performance increases as array dimensionality increases from 2-D monostatic through 3-D bistatic data coverage's. Time domain beamforming using the Maximum-Likelihood (ML) method is also applied to synthetic data. Preliminary ML results show strong noise suppression and preservation of polarity characteristics in the first few cycles of the waveform.

MP 5432

SENSOR SITING TO OPTIMIZE INTRUSION DETECTION.

Peck, L., Annual NDIA Security Technology Symposium, 15th, Norfolk, VA, June 14-17, 1999, Arlington, VA, National Defense Industrial Association, 1999, 8p., 3 refs.

54-486

SENSORS, DETECTION, WARNING SYSTEMS, INFRARED RECONNAISSANCE

The level of physical security attained with exterior intrusion detection systems (IDSs) varies with their operating environment. Weather undermines the effectiveness of an IDS by reducing its detection capability or by causing nuisance alarms. By judicious placement of IDSs, however, it is possible to improve intrusion detection through decreasing the likelihood of environment-caused nuisance alarms. In a location where the likelihood of weather-related nuisance alarms is low, an IDS may be operated at high sensitivity, thus increasing its probability of detecting an intruder. If the location also is one where environment-dependent variability in an intruder's signature is small, an additional advantage is detection capability that is consistent and predictable. CRREL is developing software that will support security planning by relating IDS detection capability to site conditions.

MP 5433

NIZHNII TAGIL MINE TAILINGS RESOURCE RECOVERY AND RECLAMATION PROJECT.

Ceto, N., Marcy, K., Palazzo, A.J., Felitti, B., Oslamenko, V.V., Starkova, I., International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe, 4th, Warsaw, Poland, Sep. 15-17, 1998. Proceedings, [1998], 7p., 2 refs.

54-487

MINING, TAILINGS, WASTE DISPOSAL, SOIL POLLUTION, AIR POLLUTION, HEALTH, REVEGETATION, LAND RECLAMATION, COST ANALYSIS, RUSSIA—NIZHNIY TAGIL

This paper reviews the collaborative efforts undertaken by the United States Environmental Protection Agency, the Institute for Sustainable Communities, local and regional government in Russia, and the VGOK mining enterprise to identify and implement a program to mitigate environmental and human health concerns posed by the release of windblown tailings from an inactive tailings pond adjacent to the city of Nizhniy Tagil, Russia. Nizhniy Tagil, located just east of the Ural Mountains, is a city with a long history of mining, mineral processing and manufacturing. The area has been designated by Russian authorities as a priority for environmental improvement projects. Numerous studies conducted by leading environmental specialists in the US and elsewhere have documented an unambiguous dose-response relationship between particulates, notably the PM-10 fraction, and adverse human health effects. Risk assessment and air modeling work in Nizhniy Tagil have confirmed that the tailings pond is a significant source of human health risk. The site consists of a wind-blown sandy soil that has a very low moisture and nutrient holding capacity that is a poor substrate for plant establishment and growth. After evaluation of a number of reclamation alternatives the project team proposed that the surface of the 250 hectare tailings impoundment be revegetated. Factors considered in selection of the reclamation strategy included: compatibility with citywide efforts to address particulates as a priority environmental health problem and efforts to reprocess the tailings in order to recover residual mineral values; effectiveness in minimizing wind transport of tailings; local availability of equipment, resources and expertise to implement the strategy, and demonstration of a low cost/high effectiveness methodology to address a common significant environmental problem in the Russian Federation. Several field trials were established to identify soil treatments which would promote establishment of a vegetative cover on the impoundment surface. Initial results indicate that hydraulic application of a clay layer over the tailing "sands" in conjunction with additions of biosolids and commercial fertilizer has the potential to support a vegetative cover that will mitigate the release of windblown tailings to the surrounding community. This reclamation strategy may have application, and potential for replication, at other mine sites in the region as a means of controlling both wind and water erosion of tailings.

MP 5434

ENVIRONMENTALLY DEPENDENT COUNTERMEASURES TO PASSIVE INFRARED DETECTION.

Peck, L., Lacombe, J., Meeting of the IRIS (Infrared Information Symposia) Specialty Group on Camouflage, Concealment and Deception, Fort Belvoir, VA, Dec. 1-3, 1998. Proceedings. Vol.1, Ann Arbor, Environmental Research Institute of Michigan (ERIM International, Inc,) Infrared Information Analysis Center, 1999, p.75-87, 4 refs.

54-488

MILITARY OPERATION, MILITARY RESEARCH, INFRARED RECONNAISSANCE, SENSORS, DETECTION, WARNING SYSTEMS, COUNTERMEASURES, SNOW COVER EFFECT

Simple countermeasures against passive (thermal) infrared intrusion detection systems (IDSs) and thermal imagers were tested in winter by U.S. Army Special Forces soldiers working with personnel of the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL). Under certain site conditions, the countermeasures were very effective, enabling intruders to pass undetected by the infrared IDSs or unnoticed by observers viewing thermal imagery of the site. An awareness of the interplay between environment, countermeasure, and sensor system is crucial both in identifying when a sensor system is vulnerable to countermeasures and in selecting the appropriate countermeasure. This paper explains which environmental factors during the Special Forces/CRREL intrusions determined the success or failure of a countermeasure. It also predicts the general effectiveness of similar countermeasures as a function of the operating environment of a thermal infrared sensor system.

MP 5435

DEPARTMENT OF DEFENSE EVALUATES GENETIC DIVERSITY ON MILITARY LANDS AND BREEDS NEW PLANTS FOR ARMY TRAINING GROUNDS.

Palazzo, A.J., Hardy, S.E., *Diversity*, 1998, 14(3&4), p.28-30, Newsletter of the U.S. Department of Agriculture, Laboratory for Information Science in Agriculture, National Plant Germplasm System (NPGS), Fort Collins, CO.

54-489

MILITARY FACILITIES, GRASSES, PLANT PHYSIOLOGY, PLANT ECOLOGY, REVEGETATION, INTRODUCED PLANTS, PROTECTIVE VEGETATION, SOIL CONSERVATION, LAND RECLAMATION

MP 5436

SELECTION OF SILT FENCE FILTER TO RETAIN SUSPENDED TOXIC PARTICLES.

Henry, K.S., Walsh, M.R., Morin, S.H., *Geotextiles and geomembranes*, Oct.-Dec. 1999, 17(5-6), p.371-387, 15 refs.

54-490

MILITARY FACILITIES, WETLANDS, DREDGING, EXPLOSIVES, WATER POLLUTION, SUSPENDED SEDIMENTS, WASTE DISPOSAL, LAND RECLAMATION, FILTERS, GEOTEXTILES, UNITED STATES—ALASKA—FORT RICHARDSON

A silt fence filter was required to retain potentially toxic particles of 0.1 mm-diameter and larger that could become suspended in water decanted from contaminated dredge spoils. An experimental study was performed to select it. The experiments consisted of two parts. Part 1 tests were conducted according to an accepted engineering standard to compare four candidate geotextiles. Part 2 tests simulated expected field conditions, and were conducted to determine whether one geotextile selected from the Part 1 tests was likely to perform well. The geotextile selected for Part 2 tests retained particles of 0.1 mm and larger, and was installed as a silt fence filter in the field. The silt fence filter was removed shortly after dredging began because it clogged, primarily due to unexpected, high amounts of suspended sediment in the supernatant. The design of the support structure for the silt fence did not permit maintenance of the filter, which may have prevented its failure. The failure may also have been prevented if salt or other materials used to promote flocculation of the dredged spoils were readily available and used on the spoils. The selection procedure described may be helpful because the conditions tested for in the laboratory are likely to occur or could be induced.

MP 5437
DESIGNING FROST SHIELDS FOR SHALLOW BURIAL OF WATER AND SEWER LINES.
Coutermarsh, B.A., Collection Systems Rehabilitation and O&M Specialty Conference, Salt Lake City, Aug. 1-4, 1999. Proceedings, Alexandria, VA, Water Environment Federation, 1999, 17p., 9 refs.
54-491
UTILITIES, WATER PIPES, WATER PIPELINES, UNDERGROUND PIPELINES, PIPELINE FREEZING, FROST PENETRATION, THERMAL INSULATION, TRENCHING, FROST PROTECTION
Frost shielding is the practice of protecting water or sewer lines from freezing by installing insulation around them. This technique allows the utility line to be buried above the depth of maximum frost penetration in climates where there is a risk of freezing to these lines. This has largely been an ad hoc practice used out of necessity to insulate small sections of pipe that had to be brought above the recommended burial depth. The amount of insulation and its configuration have usually been empirically determined at each locale. The Corps of Engineers Cold Regions Research and Engineering Laboratory, in a Construction Productivity Advancement Research project, used finite element modeling to model and install an insulation shield around a 20.3-cm water line in Berlin, NH. By experimenting with different insulation configurations and burial depths, a shield was designed that allowed a water line to be buried on top of ledge at about 1.22 m where the normal burial depth is about 1.83 m. The modeling predictions were verified by temperature measurements taken during the project. This paper will describe the shield design procedure and look at the effect different insulation thickness and configuration will have on the frost shield performance. It will show, through the finite element modeling, different temperature performance tradeoffs in the design of a shield. The effect of pipe temperature, climate, shield configuration, and burial depth can all be adjusted during the modeling to arrive at the desired performance for the shield.

MP 5438
PROGRESS ON DETERMINING THE VAPOR SIGNATURE OF A BURIED LANDMINE.
George, V., et al, *SPIE—The International Society for Optical Engineering. Proceedings,* 1999, Vol.3710, Conference on Detection and Remediation Technologies for Mines and Minelike Targets IV, Orlando, FL, Apr. 1999, p.258-269, 14 refs.
54-492
MINES (ORDNANCE), EXPLOSIVES, DETECTION, SENSORS, SUBSURFACE INVESTIGATIONS, SOIL POLLUTION, SOIL AIR INTERFACE, SOIL CHEMISTRY, CHEMICAL ANALYSIS
The goal of the DARPA "Dog's Nose" program is to develop a sensor capable of detecting explosives contained in all buried landmines. In support of the DARPA program, the purpose of the Explosives Fate and Transport experiments is to define in detail the accessible trace chemical signature produced by the explosives contained in buried landmines. The authors intend to determine the partitioning (soil, air, water), composition, and quantity of explosive related chemicals (ERC) which emanate from different kinds of landmines (predominantly plastic-cased with TNT as the main charge) buried in multiple soil types and exposed to various climatic events. They are also developing a computer model that will enable them to predict the composition and quantity of ERC under a much wider range of environmental conditions than they are able to test experimentally.

MP 5439
DETECTION OF TRINITROTOLUENE (TNT) EXTRACTED FROM SOIL USING A SURFACE PLASMON RESONANCE (SPR)-BASED SENSOR PLATFORM.
Strong, A.A., Stimpson, D.I., Bartholomew, D.U., Jenkins, T.F., Elkind, J.L., *SPIE—The International Society for Optical Engineering. Proceedings,* 1999, Vol.3710, Conference on Detection and Remediation Technologies for Mines and Minelike Targets IV, Orlando, FL, Apr. 1999, p.362-372, 15 refs.
54-493
MINES (ORDNANCE), EXPLOSIVES, SOIL POLLUTION, DETECTION, SENSORS, SUBSURFACE INVESTIGATIONS, SOIL CHEMISTRY, CHEMICAL ANALYSIS
An antibody-based competition assay has been developed using a surface plasmon resonance (SPR) sensor platform for the detection of trinitrotoluene (TNT) in soil extract solutions. The objective of this work is to develop a sensor-based assay technology to use in the field for real-time detection of land mines. This immunoassay combines very simple bio-film attachment procedures and a low-cost SPR sensor design to detect TNT in soil extracts. The active bio-surface is a coating of bovine serum albumin that has been decorated with trinitrobenzene groups. A blind study on extracts from a large soil matrix was recently performed and results from this study will be presented. These will include demonstrated sensitivity to 1 ppm TNT, in a variety of soils, with no false negatives. Potential interferants studied included 2,4-dinitrophenol, 2,4-dinitrotoluene, ammonium nitrate, and 2,4-dichlorophenoxyacetic acid. Cross-reactivity with dinitrotoluene will be discussed. Also, plans to reach sensitivity levels of 1 ppb TNT in soil will be described.

MP 5440
SEA ICE INVESTIGATIONS ON ICE STATION WEDDELL #1. I. ICE DYNAMICS.
Ackley, S.F., Lytle, V.I., Elder, B., Bell, D., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 11p., 7 refs. For another version see 48-3778.
54-495
DRIFT STATIONS, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE CONDITIONS, ICE COVER THICKNESS, ICE LOADS, ICE DEFORMATION, DRIFT, AIR ICE WATER INTERACTION, ICE CRACKS, ICE OPENINGS, PRESSURE RIDGES, ANTARCTICA—WEDDELL SEA

MP 5441
ICE OBSERVATIONS IN THE WESTERN WEDDELL SEA (NBP 92-2).
Darling, M.N., Lytle, V.I., Ackley, S.F., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 11p., 5 refs. For another version see 48-3772.
54-497
DRIFT STATIONS, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE CONDITIONS, ICE COVER THICKNESS, ICE FLOES, ICE EDGE, ANTARCTICA—WEDDELL SEA

MP 5442
ICE CORE STUDIES IN THE WESTERN WEDDELL SEA (NBP 92-2).
Gow, A.J., Lytle, V.I., Bell, D., Ackley, S.F., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 7p., 4 refs. For another version see 48-3771.
54-498
DRIFT STATIONS, SEA ICE, ICE SAMPLING, CORE SAMPLERS, ICE COVER THICKNESS, ICE STRUCTURE, ICE COMPOSITION, ICE DENSITY, ICE SALINITY, ICE TEMPERATURE, ANTARCTICA—WEDDELL SEA

MP 5443
SNOW PROPERTIES AND SURFACE ELEVATION PROFILES IN THE WESTERN WEDDELL SEA, (NBP92-2).
Lytle, V.I., Ackley, S.F., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 9p., 9 refs. For another version see 48-3773.
54-499
DRIFT STATIONS, SNOW SAMPLERS, SNOW DEPTH, SNOW TEMPERATURE, SNOW DENSITY, SLUSH, SNOW ICE INTERFACE, DEPTH HOAR, SEA ICE, ICE HEAT FLUX, ICE FORMATION, ICE GROWTH, ANTARCTICA—WEDDELL SEA

MP 5444
SEA ICE INVESTIGATIONS ON *NATHANIEL B. PALMER*: CRUISE 92-2.
Ackley, S.F., Gow, A.J., Lytle, V.I., Darling, M.N., Yankielun, N.E., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 9p., 9 refs. For another version see 48-3770.
54-500
ICE SURVEYS, SEA ICE DISTRIBUTION, ICE CONDITIONS, ICE SAMPLING, CORE SAMPLERS, RESEARCH PROJECTS, ANTARCTICA—WEDDELL SEA

MP 5445
SEA ICE INVESTIGATIONS ON ICE STATION WEDDELL #1. II. ICE THERMODYNAMICS.
Ackley, S.F., Lytle, V.I., Preliminary reports: sea ice studies on Ice station Weddell and Cruise NBP92-2, *N.B. Palmer* January-June 1992, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, 1992, 10p., 6 refs. For another version see 48-3777.
54-501
DRIFT STATIONS, ICE SURVEYS, ICE SAMPLING, SEA ICE DISTRIBUTION, ICE COVER THICKNESS, ICE CONDITIONS, ICE STRUCTURE, ICE TEMPERATURE, ICE HEAT FLUX, ANTARCTICA—WEDDELL SEA

MP 5446
MILLIMETER-WAVE RADAR BACKSCATTER MEASUREMENTS OVER WEDDELL SEA PACK ICE (NBP92-2).
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