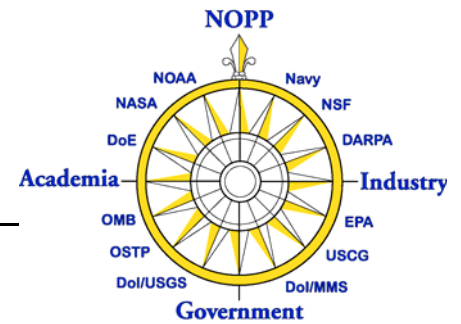


National Oceanographic Partnership Program

NAVY NOAA NSF NASA DoE DARPA OMB EPA OSTP USCG DoI/USGS DoI/MMS



Report to the U.S. Congress on the National Oceanographic Partnership Program (Fiscal Year 1999)

on behalf of the

***National Ocean Research Leadership Council
(NORLC)***

The Honorable Richard Danzig
Secretary of the Navy
Chair of the NORLC

The Honorable D. James Baker
Under Secretary of Commerce
for Oceans and Atmosphere
Vice-Chair of the NORLC

1 March 1999

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I. INTRODUCTION

The National Oceanographic Partnership Program [NOPP] was established in Fiscal Year 1997 through Public Law 104-201. Supplemental legislation for appointments to the NOPP oversight body, the National Ocean Research Leadership Council [NORLC] and the Ocean Research Advisory Panel [ORAP] is contained in Public Law 105-85, the FY 1998 Defense Authorization Act.

The Secretary of the Navy is charged in Subtitle E of title II, Division A, Public Law 104-201 to establish a National Oceanographic Partnership Program to:

- 1) promote the national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean; and
- 2) to coordinate and strengthen oceanographic efforts in support of those goals by -
 - a) identifying and carrying out partnerships among Federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication, and
 - b) reporting annually to Congress on the Program.

This report of the Fiscal Year 1999 Partnership Program meets that statutory requirement.

II. SUMMARY

As the National Oceanographic Partnership Program [NOPP] moves into its third year, Program activities to date are summarized below:

The successful FY 1997-98 Partnership Program continues and consists of twenty-three research and education projects, over eight-hundred academic survey ship days, and support to the MEDEA Ocean Panel. The FY 1998 Research Project Summary is at Appendix 1 and Appendix 2 contains Academic Ship Survey Schedules for FY 1998 and FY 1999. Primary support for these projects is from ONR and NSF, with participation by the other NOPP Agencies.

The National Ocean Research Leadership Council met April 6, 1998 and October 26, 1998. The Minutes of those meetings are at Appendix 3;

The Ocean Research Advisory Panel convened for the first time September 9, 1998. Minutes of that meeting and a list of members are at Appendix 4;

The Fiscal Year 1999 Partnership Program Research Solicitation [Broad Agency Announcement] was issued November 16, 1998. That call is at Appendix 5. Sixty-nine proposals were received on February 9, 1999 and following Council Approval, awards are expected to be in place by June 1999;

Ongoing interagency activities continue, including Year of the Ocean [YOTO] actions and liaison with other established Federal coordination groups, such as the MEDEA Ocean Panel, the Federal Oceanographic Fleet Coordination Council, and the National Science and Technology Council (NSTC) Committee on Environment and Natural Resources;

A response to the request contained in Conference Report H.R. 105-736 for an assessment of four issues related to the use of Sound Surveillance System [SOSUS] data for civil research and education is at Appendix 6;

The Program is responding to a Congressional request to the National Ocean Research Leadership Council to “propose a plan to achieve a truly integrated ocean observing system”. A Task Team, Co-chaired by Worth Nowlin, Texas A&M University, and Thomas Malone, University of Maryland was established under the NOPP Ocean Research Advisory Panel to prepare a draft response. That response entitled “Toward a U.S. Plan for an Integrated Sustained Ocean Observing System” is being forwarded under separate cover.

The Partnership Program funded over one-hundred Ocean Drifter Buoys as part of the international Year of the Ocean Program serving both science and education. A summary of that ongoing effort is at Appendix 7.

The Program opened discussions with the Sloan Foundation regarding a “Census of Marine Life” initiative fostered by the Foundation. The agencies expressed interest in the concept and have undertaken a collaboration to address two major challenges to such an initiative; adequate observational techniques, and a sufficient modelling/theoretical framework for assessing the observations. It was agreed to seek co-sponsorship of proposals this year that might be submitted under the NOPP solicitation(s).

III. FISCAL YEAR 1998 ACTIVITIES

Merit based competitive procedures were employed to select twelve Partnership Program Research Projects in FY 1998 involving sixty-one institutions in seventeen states. This

1998 Program encumbered \$17M for the following science and technology partnership efforts:

- Coastal and Open Ocean Observational Systems – to establish the means for continuous, high-resolution measurements of oceanic processes;
- Sensors and Sensing – sensors and instrumentation compatible with future systems;
- Regional Scale Coastal and Open Ocean Prediction Systems – to integrate and/or network military and civil systems to capitalize on future capabilities;
- Education, Training and Outreach - a continuation of FY 1997 projects;
- MEDEA Ocean Panel – continuation of ocean-related declassification for national needs;
- Partnership Program Office - current contract continues on annual options.

The FY 1998 Partnership Program Summaries are at Appendix 1.

The University-National Oceanographic Laboratory System [UNOLS], working with the Naval Oceanographic Office, developed a comprehensive \$7.5M oceanographic ship survey program that employed 397 academic ship survey days to address validated Navy operational requirements. The 1998 survey schedule is at Appendix 2a.

The Ocean Research Advisory Panel met on 9 September 1998. This statutory Panel is established under the Federal Advisory Committee Act to advise the National Ocean Research Leadership Council regarding administration, policy and procedures for the Partnership Program. Fourteen members were present at this inaugural meeting and they selected Dr. John Knauss, University of Rhode Island as Chair and Dr. Robert Frosch, Harvard University, as Vice Chair. The primary goal of the Panel is to identify the most important and useful ocean research and education topics to be addressed by the Partnership Program. Initial findings from the Panel included:

- the duration of the grants, which the ORAP felt should be increased;
- the need to embed education efforts into the program;
- and the need for greater communication about and outreach on NOPP to groups beyond the scientific research community.

A report of the inaugural Panel meeting and biographies of Panel Members is at Appendix 4. The next meeting is scheduled for April 12, 1999. The Panel has reviewed the Ocean Observations Report that was prepared in response to the request from Congressmen Saxton and Weldon.

The NOPP oversight body, the National Ocean Research Leadership Council (NORLC) met in April and October 1998. The Minutes of those meetings are at Appendix 3. The Council approved the following actions at the April meeting:

- Process for NORLC Chair/Vice Chair designation;
- NOPP Review Process;
- ORAP Process;

- FY 1999 Plans;
- NOPP promotion actions.

The Council approved the following at the October meeting:

- Re-election of the NORLC Chair/Vice Chair ;
- Development of an Ocean Observation Plan in response to a request from Congressmen Saxton and Weldon;
- Development of a SOSUS Data Plan in response to Congressional report language;
- A plan for response to Congressional language regarding NSF and the Ocean Studies Board (OSB) Report.

IV. FY 1999 ACTIVITIES/PLANS

The FY 1999 National Oceanographic Partnership Program contains the following elements:

- \$14M for the following Science and Technology Partnership Program Topical Areas:
 - Data Assimilation and Modeling – to foster a community-wide “hub” and “node” structure for model development and use as well as data assimilation techniques;
 - Ocean Observation Capabilities – for innovative sensors and measurement techniques to obtain chemical, biological, and optical oceanographic variables in 3-D space and time to augment physical oceanography data;
 - Program Office - current contract continues.
- \$7.5M for oceanographic ship survey operations. The University-National Oceanographic Laboratory System [UNOLS] and the Naval Oceanographic Office have again developed a schedule using academic research vessels to address validated Navy requirements. That survey schedule can be found in Appendix 2b.

The FY 1999 Partnership Program Research Solicitation [Broad Agency Announcement] was released November 16, 1998 through the Office of Naval Research. Sixty-nine research proposals were received on February 9, 1999 and a comprehensive peer-review process is currently underway. Upon approval by the National Ocean Research Leadership Council, research awards are expected to be in place by June 1999.

Congressmen Curt Weldon (R-PA) and James Saxton (R-NJ), Chairs of the House Subcommittee on Military Research and Development and the House Subcommittee on Fisheries Conservation, Wildlife, and Oceans respectively, requested the Chair and Vice Chair of the National Ocean Research Leadership Council to “propose a plan to achieve a truly integrated ocean observing system.” This request followed from a number of YOTO activities but particularly the National Oceans Conference in June of 1998 and a House hearing on ocean observations in July of 1998. Dr. Baker, as Vice-Chair, agreed to take the lead for the Council to prepare a plan in response to this request. A Task Team, Co-chaired by Worth Nowlin, Texas A&M University, chair of the Steering Committee for the international Global Ocean Observing System (GOOS), and Thomas Malone, University of Maryland, chair of the U.S.

Coastal GOOS Steering Committee, was established under the NOPP Ocean Research Advisory Panel to prepare a draft response. That response entitled “Toward a U.S. Plan for an Integrated Sustained Ocean Observing System” is being forwarded under separate cover. This first step toward an interagency plan is likely to become a “living document” and a regular component of future NOPP annual Reports. The primary Task Team Members were:

<u>Name</u>	<u>Institution</u>
Worth Nowlin	Texas A&M University
Tom Malone	University of Maryland Horn Point
Jonathan Berkson	US Coast Guard
Mel Briscoe	Navy/ONR
Mike Fogarty	University of Maryland, Chesapeake Bay Laboratories, Solomons
Linda Glover	Navy/Oceanographer
Keith Good	Mineral Management Services
Fred Grassle	Rutgers
Eric Lindstrom	NASA
Bob Molinari	NOAA
Paul Pan	EPA
Tom Spence	NSF Geosciences

Contributions from many others, including public comments from a web posting, have been incorporated.

An assessment of data from the Sound Surveillance System [SOSUS] for research and education was prepared in response to a request contained in H.R. Report 105-736, the Conference Report accompanying the FY 1999 Defense Authorization Act. A Task Team was established under Navy auspices to address the issue and that assessment with the list of Task Team Members, is at Appendix 6.

V. FISCAL YEAR 2000 PLANS

The President’s FY00 budget request includes the following NOPP requests (funds indicated) and the following examples of NOPP-related agency investments pertaining to ocean observation, instrumentation development, ocean modeling and data assimilation:

ONR/Navy - \$10M for ongoing and new NOPP efforts on modeling, data access/assimilation.

NOPP-related activities include:

- Ocean modeling and assimilation for Naval tactical uses
- Complimentary autonomous underwater sensor and vehicle developments
- Coordinated ocean instrumentation for research and for tactical uses
- Operational forecasts and surveys for Fleet use

NOAA - \$4M in designated NOPP funding to construct, deploy, and operate an array of 1000 profiling autonomous floats for real-time basin-wide measurements

NOPP-related activities include:

- An additional \$13.5M in new funding to implement ocean and coastal ecosystem monitoring
- Ongoing funding to detect and forecast oceanic components of climate variability, facilitate safe and efficient marine transportation, preserve and restore healthy marine ecosystems, manage living resources for sustainable use, mitigate natural hazards, and ensure public health

NSF

- Approximately \$2M for ongoing and new NOPP efforts

NOPP related activities include:

- Support for the development of new technology and instrumentation including in situ sensors
- Support for extensive ocean observations including several long time series
- Support for a variety of assimilation activities and model development for ocean climate, biogeochemical and ecological data

NASA

- Approximately \$2M designated for NOPP

NOPP related activities include:

- Focus on GODAE
- Develop partnership between data global assimilation team and coastal applications

DoE

NOPP-related activities include:

- Ocean research activity focusing on the use of microbiology tools to explore carbon and nitrogen cycle linkages in marine microbes

USCG

NOPP-related activities include:

- Waterways Management and Vessel Traffic Management
- Short-Range Aids-To-Navigation
- Detection and Identification of Icebergs
- Marine Environmental Protection and Pollution Prevention and Abatement

USGS

NOPP-related activities include:

- Ocean research underway in modeling of coastal and nearshore geologic and sediment transport processes

VI. INTERAGENCY COORDINATION ACTIVITIES

Ongoing interagency activities continue, including Year of the Ocean [YOTO] actions and liaison with other established Federal coordination groups, such as MEDEA Ocean Panel, the Federal Oceanographic Fleet Coordination Council, the ad hoc Ocean Principals Group and the NSTC Committee on the Environment and Natural Resources. A partial listing of key inter-

agency cooperative efforts complementary to the National Oceanographic Partnership Program are listed below.

- A. U. S. Global Change Research Program [USGCRP]
www.gcrio.gov
- B. The Global Ocean Observing Systems [GOOS]
www.usgoos.noaa.gov
- C. The Global Ocean Data Assimilation Experiment [GODAE]
www.bom.gov.au/bmrc/mrlr/nrs/oopc/godae/homepage.html
- D. The University-National Oceanographic Laboratory System [UNOLS]
www.gso.uri.edu/unols
- E. Climate Variability and Predictability [CLIVAR]
www.dkrz.de/CLIVAR
- F. Year of the Ocean [YOTO]
www.YOTO98.noaa.gov
- G. Ecology and Oceanography of Harmful Algal Blooms [ECOHAB]
<http://www.redtide.whoi.edu/hab/nationplan/ECOHAB/ECOHABhtml.html>

These represent a range of example activities and planning on an interagency basis.

Appendix 1. - NOPP Partnership Summaries

The Prediction of Wind-Driven Coastal Circulation

Oceanographic and Fisheries Data Collection and Telemetry From Commercial Fishing Vessels

Oceans of Earth and Beyond: Expanding Student and Teacher Access to Ocean Science Research

Enhancing K-12 Science Education Via Satellite-televised Interactive Technologies

NEPTUNE: A Fiber Optic Telescope to Inner Space

Oceanographic-Systems for Chemical, Optical, and Physical Experiments (O-SCOPE)

A near-real-time, high-resolution, ocean-surface-current mapping system

Demonstration of a Relocatable Ocean Atmosphere Modeling System with Coastal Autonomous Sampling Networks.

Multi-Scale Model-Driven Sampling with Autonomous Systems at a National Littoral Laboratory.

NOPP Coastal and Marine Aerosol Transformation Processes

SeaNet: Extending the Internet to the Oceanographic Research Fleet

Federation of Ocean Acoustic Observatories

The Innovative Coastal-Ocean Observing Network (ICON)

Development of a National Littoral Ocean Observing and Predictive System: Field Estimation via Interdisciplinary Data Assimilation

South Atlantic Bight Synoptic Offshore Observational Network

Monitoring the North Pacific for Improved Ocean, Weather and Climate Forecasts

Consortium for Oceanographic Activities for Students and Teachers (COAST)

Coastal Marine Demonstration of Forecast Information to Mariners for the U.S. East Coast

TITLE: The Prediction of Wind-Driven Coastal Circulation

J. S. Allen and J. A. Barth

College of Oceanic and Atmospheric Sciences

Oregon State University

104 Ocean Admin Bldg

Corvallis, OR 97331-5503

phone: 541-737-2928 fax: 541-737-2064 e-mail: jallen@oce.orst.edu

phone: 541-737-1607 fax: 541-737-2064 e-mail: barth@oce.orst.edu

Senior Investigators at OSU: J. Allen, J. Barth, T. Boyd, D. Caldwell,
G. Egbert, A. Huyer, P. M. Kosro, M. Levine, R. Miller, J. Moum, R. Samelson,
E. Skyllingstad

Government Partners: W. Peterson (NOAA NMFS, Newport), J. Wilczak and
J. Harlan (NOAA Environmental Technology Laboratory, Boulder)

Industrial Partners: J. Svejksky (Ocean Imaging), D. Barrick and B. Lipa
(CODAR Ocean Sensors)

LONG-TERM GOAL

To develop forecast systems for wind-driven coastal ocean flow fields.

OBJECTIVES

To understand the dynamics of, and to build a predictive capability for, wind-driven mesoscale oceanographic processes (2-50 km horizontal space scales, 2-10 day time scales) over the continental shelf as influenced by temporal and spatial variability of the atmospheric forcing, by spatial variability of the continental margin, and by internal mixing related to small-scale turbulence. The ocean variability of interest involves the most energetic motion over the shelf and includes the physical processes associated with alongshore coastal jets, upwelling and downwelling fronts, and eddies.

APPROACH

This National Oceanographic Partnership Program project combines modeling, data assimilation and an observational program off Oregon built around deployment of the existing OSU Coastal Radar System. A high-resolution, three-dimensional coastal ocean circulation model (POM - Princeton Ocean Model) is being applied to an Oregon coastal region centered on Newport for direct simulations, data assimilation and process studies. The ocean model is being forced initially by observed winds and heat flux and the results compared with observations. Ultimately, the ocean model will be coupled to the atmosphere by a high-resolution coastal atmospheric model, forced by an operational large-scale weather prediction model. Inverse methods, or data assimilation techniques, that test models against data in a scientifically rigorous fashion are being developed.

The observational program involves long-term measurements from the OSU Coastal Radar System presently deployed near Newport. From April to September 1999, the land-based radar and other continuous measurements will be augmented by additional observations. The NOAA Environmental Technology Laboratory (ETL) will install additional coastal radar stations and will measure vertical profiles of winds at the coast using an upward-looking profiler. Small-boat hydrographic and velocity surveys will provide three-dimensional fields to the modeling and data assimilation efforts. Satellite-sensed sea surface temperature (via AVHRR) and roughness (via SAR) will be made available by Ocean Imaging during the six-month observational period. During the last three months of this period, three moorings equipped with current, temperature and conductivity sensors throughout the water column will be installed off Newport. One of these moorings will also measure surface winds, pressure, air temperature and solar insolation.

During July 1999, we will conduct a three-week intensive sampling program using the R/V Wecoma. We will collect high-resolution hydrographic, velocity and microstructure data throughout the water column in a region near Newport matching the coverage of the land-based radar, roughly 50 by 50 km. The high-resolution hydrographic fields obtained with a towed, undulating measurement package (SeaSoar) and velocity fields measured by a shipboard ADCP will be used to initialize and provide ongoing data for assimilation into the high-resolution coastal model. The microstructure data, consisting of cross-shelf sections of kinetic energy and temperature dissipation rates, will be used with the model to assess the role of small scale turbulence in determining the mesoscale structure of the flow and hydrographic fields. Atmospheric soundings will be collected twice daily from a coastal station near the NOAA ETL wind profiler.

WORK COMPLETED

Modeling and data assimilation studies of coastal circulation off Oregon were begun in late 1998 and will build toward the April-September 1999 field experiment. Initial runs with a regional, high-resolution atmospheric model (Univ. of Oklahoma Advanced Regional Prediction System - ARPS) have been made. This nonhydrostatic, mesoscale atmospheric model is initialized and forced with the National Center for Environmental Prediction (NCEP) Eta model operational forecast and analysis. Data from Oregon State University's land-based HF radar have been collected continuously since November 1997. Near-surface currents measured by a mid-shelf upward-looking ADCP and those from the HF radar are highly correlated for subtidal motions (0.84, 0.94 for eastward, northward components respectively) with standard deviations of the differences of about 0.10 m/s in each component. The ADCP and HF radar current measurements are being analyzed statistically for use in the model data assimilation. In addition, relevant statistical relations are being computed from POM model runs for comparison with, and extension of, observed values and for use in assimilation.

RESULTS

New start. Anticipated results include a major increase in understanding of the dynamics of wind-driven mesoscale oceanographic processes on the continental shelf.

TITLE: Oceanographic and Fisheries Data Collection and Telemetry From Commercial Fishing Vessels

Ann Bucklin, Director, UNH Sea Grant

University of New Hampshire; Durham, NH 03824

Tel: (603) 862-0122; Fax: (603) 862-0243; email: acb@christa.unh.edu

Peter H. Wiebe

Woods Hole Oceanographic Institution; Woods Hole, MA 02543

Tel: (508) 289-2313; Fax: (508) 457-2169; email: pwiebe@whoi.edu

Chrys Chrysostomidis, Director, MIT Sea Grant

Massachusetts Institute of Technology; Cambridge, MA 02139

Tel: (617) 253-7131; Fax: (617) 258-5730; email: chrys@deslab.mit.edu

Joseph B. Novello

Alphatron Manufacturing, Inc.; 145 Ward Hill Ave., Haverhill, MA 01835

Tel. (978) 373-9800; Fax: (978) 373-1792; email: JBNOVEL@aol.com

W. Gary Williams

Clearwater Instrumentation, Inc.; 304 Pleasant Street, Watertown, MA 02172

Tel: (617) 924-2708 ; Fax: (617) 924-2724; email: wgwill@world.std.com

Craig A. Pendleton

Portland Fish Exchange; 31 Seaside Ave., Saco, ME 04072

Tel. (207) 284-5374; Fax: (207) 284-1355; email: nama@lamere.net

LONG-TERM GOALS

This partnership will work toward building full cooperation among the commercial fish harvesting community, federal and state coastal resource managers, private industry, and the ocean research community for the collection, distribution, analysis, and assimilation of environmental data collected by commercial fishing vessels.

OBJECTIVES

Objective 1: To develop a collaboration between commercial fishermen, private marine industries, oceanographers, and coastal resource managers for the collection, real-time telemetry, analysis, assimilation, distribution, and use of environmental and fisheries data from coastal regions off the northeastern US.

Objective 2: To design and produce an integrated sensor system (including navigational, hydrographic, and meteorological components) for use onboard commercial fishing vessels; to assemble, integrate, and test prototype versions of the system on a small number of vessels; and to establish land-based centers for collection, analysis and assimilation of data.

Objective 3: To demonstrate system feasibility and function by means of sea trials involving one- to three-day trips by two commercial fishing vessels in Gloucester, MA and Portland, ME.

WORK COMPLETED

Coordination of the project: Regular meetings among all partners have been held since June 1998. Meetings have been held at MIT Sea Grant (June 10 and August 21) and at Clearwater Instrumentation (July 7). The next meeting is planned for November 24. In addition to email traffic and communication via the private website, these meetings have been crucial to developing a working partnership characterized by mutual respect and shared goals.

Partnership building with federal agencies and programs: During our Partnership meetings, we have worked to identify individuals, agencies, and programs that have missions consistent with Partnership goals, in fisheries management and regulation, coastal monitoring and prediction, climate research, or other concerns. We are maintaining a database of people and organizations, who may become partners in this effort or customers for its products. We have contacted a number of them, and are engaging them through exchange of information and updates on progress, and/or through invitations to our Partnership meetings. At the August 21st Partnership meeting, Charlie Anderson (from the Massachusetts Division of Marine Fisheries) reported on the Atlantic Coastal Cooperative Statistics Program (ACCSP) and David McCarron (also from the Massachusetts Division of Marine Fisheries) discussed the Massachusetts Fish Auction Project.

Outreach to commercial fishing community: We decided that formal workshops were not going to provide the necessary information on fishermen's needs. Instead, NOPP outreach workers met fishermen "on their turf" - individually, in small groups, informally on the docks, and at scheduled fishermen's meetings. We also designed a questionnaire for distribution by leaders in the commercial fishing community, concentrating on ports with large, "trip" boats. We learned that fishermen are most interested in bottom water temperature; telemetry of oceanographic and weather information to WHOI (and getting that information back) are also appealing. Some fishermen were concerned about telemetry of catch data. The results will be tabulated and analyzed this winter.

Sensor system design concept: Partnership meetings to date have focused primarily on design of the sensor system. The goal is to design a flexible, customizable sensor system that may be used for simple environmental measurements (e.g., just water temperature) or for more complicated sensor packages for collection of climate-quality data. We are in the final stages of system controller specification and selection. We continue to refine our design to ensure integration with related programs.

IMPACT

This Partnership provides a mechanism for bringing together those involved in the fishing industry, the oceanographic community, and the federal agencies responsible for resource assessment and management. Successful completion will entail broad cooperation among coastal resource managers in programs and agencies across the Departments of Commerce, Defense, and Transportation. The environmental and fisheries data that will be collected will be available to all stakeholders for their individual missions: management, marketing, assessment, prediction, modeling, regulation, enforcement, and research. We expect that the acquisition of biological and physical information - available in real time - regarding the immediate status and dynamics of the ocean environment will create new opportunities and useful new products for the oceanographic and fisheries communities.

TITLE : Oceans of Earth and Beyond: Expanding Student and Teacher Access to Ocean Science Research

JASON Foundation for Education

Dr. Robert D. Ballard, Principal Investigator

Project Completed 1998

With support from NOPP, the JASON Foundation for Education participated in an independently supported research cruise aboard Atlantis III involving the ROV JASON and deep submergence vehicle ALVIN. Researchers on this expedition will be studying the Guaymas Basin area. The JASON Project curriculum, interactive Internet components, and field research opportunities for students produced for this expedition will be tied to the research being undertaken by scientists aboard the Atlantis III. Participating students also studied deep-sea structure, marine chemistry, and geological and biological oceanography. Students also will learn about the ways in which hydrothermal systems develop.

JASON IX featured research on deep-water and mid-water systems within the Bay and Monterey Canyon, including sea surface chemical mapping of phytoplankton, acoustic telemetry for organisms within the water column, tectonic and hydrologic studies of deep-water venting systems, geochemical analysis of bottom substrate, mid-winter ecology (1km) above Monterey Canyon, deep-sea benthic bacterial studies, and benthic ecology of Monterey Canyon and cold seep ecology. Additional research in eutrophic systems including kelp beds, soft bottom, shelf and Elkhorn slough was conducted by other members of the Monterey Bay Marine Sanctuary.

JASON IX will also featured research conducted on site in Bermuda. Students learned that Bermuda consists of a diversity of habitat sites. Generally nutrient poor, these sites include blue-water/deep-sea, slope, mid-water, coral reefs and surface systems. Researchers explained their studies on nutrient cycling, including phytoplankton circulation and geochemical analysis; water quality; and mid- and deep-water ecology, including bacteria, zooplankton, protozoan and larger organisms (via acoustic telemetry). Each research program was incorporated into the Bermuda Atlantic Time Series program (BATS) which monitors each of the different habitats over time and provides a global perspective of change including climatic change. Additional affiliated research activities include preservation of an island and its original inhabitants (among which are many seabirds which were believed to be extinct), freshwater quality, Karst limestone caves, and acoustic research on humpback whales.

The research conducted on this expedition highlighted the structure of the oceans by showing that they consist of shallow-, mid-, and deep-water systems. Students learned about the surface, pelagic, and benthic components of each system and the different habitats that can be found within each component, based on the variability of the substrates and nutrients available. For example, comparisons were made between the nutrient-poor systems of Bermuda, including coral reefs which recycle nutrients efficiently, the eutrophic condition of Monterey Bay, and the active conditions of the East Pacific Rise. Students also observed how monitoring these systems could provide a general understanding of global change within the oceans and the oceans' role in climate change.

Each of the four tasks that the JASON Foundation engaged in with support from NOPP augmented a comprehensive educational program which brought the expedition directly into schools and communities throughout the United States and abroad via satellite and Internet technologies. The narrative provided below for each task includes a description of teacher and student access to the expedition research.

Task I: Establish Internet Access to the East Pacific Rise Expedition

With support from NOPP, the JASON Foundation broadened the delivery of live, interactive expedition activities to include direct Internet access by students at schools throughout the United States to remote research locations. This effort to augmented the existing satellite telecast to accommodate and promote the increased levels of interaction now possible through the Internet. For the Guaymas Basin expedition, the JASON Foundation used the Internet to provide students with a virtual window into the researchers' world on board Atlantis III. The JASON Foundation facilitated an active communication between working scientists and the students, allowing students to actually access and analyze the expedition's emerging data.

To accomplish this goal, the JASON Foundation designed and established the system necessary to capture the researchers' data and provide students with access to it via the Internet. This entailed procuring and configuring shipboard hardware and software components that allow for the capture, digitization, and transmission of video and audio streams, as well as traditional text-based data via the Internet. These segments required careful planning and pre-production activities by both the curriculum developers and expedition team to ensure that the interactive sequences are engaging, instructive, and permit a high degree of interactivity and communication.

Ensuring that schools had the ability to access and interact with the expedition on the Internet was critical. Well in advance of the expedition, the JASON Foundation prepared and posted on its Internet homepage technical support materials for students and teachers who planned to participate in the interactive Internet component of the expedition. The JASON Foundation provided guidance on its homepage to assist project participants in downloading StreamWorks, a software application which enables schools to receive live audio and video images through the Internet. The JASON Foundation also provided information to schools equipped with CU See Me technology for accessing live program components.

For this task, JASON provided all planning, design, and logistical services for the development and implementation of the Internet component. Internet support was provided by the National Geographic Society. Satellite uplink technology was provided by EDS. The task leaders for this component were the JASON Foundation, supported by National Geographic Society and EDS. Additional support was provided by the expedition team and curriculum developers to ensure that the curriculum and Internet components of the project were compatible.

Task 2: Establish Permanent, Interactive Access to Researchers at Their Labs and Institutions

Traditionally, JASON Project Expeditions have presented students and teachers with broad levels of information about the expedition sites and the research approaches of participating scientists through live telecasts and specific activities that link to the Project's themes. Past projects have not, however, included a post-expedition component that allows participants to continue to follow the work of scientists once they return to work at their laboratories and research institutions. For the first time, the JASON Foundation expanded the scope of its Project Expeditions by enabling students and teachers to follow the researchers back to their labs. There, participants could see first-hand the culmination of the expedition research to learn how scientists use and analyze the data they collected in the field and report on their findings.

By extending the period of contact between the expedition scientists and students, the JASON Foundation engaged students in a deeper understanding of the significance of the research conducted during the Guaymas Basin expedition.

In addition to establishing the interactive stations, the JASON Foundation also supported its Manager of Educational Systems, who was the dedicated project coordinator for this component. This individual was responsible for overseeing the procurement and installation of the systems at each of the facilities, as well as coordinating the delivery of programs that augmented the Guaymas Basin part of the expedition curriculum. Early in the project, this work will involved extensive coordination with the expedition team and project's curriculum developers, who provided design and development support for all curriculum components of the JASON Foundation's expedition website. In addition, this individual established and disseminated the project schedule to participating schools, established standardized Internet procedures and protocols to maximize opportunities for student interactivity, and provided general logistical and technical support to participating schools.

For this task, four major institutions hosted post-expedition interactive stations: the Institute for Exploration, Monterey Bay Research Aquarium, Mote Marine Laboratory, and the Bermuda Biological Research Station. The JASON Foundation and its curriculum development team supported the stations through the design and development of coordinated project materials that were distributed both traditionally (i.e., print) and via the Internet.

The JASON Foundation for Education provided all planning, design, and logistical services for the development of the Internet component of this task. Content development was led by the JASON Foundation in collaboration with the Institute for Exploration. The National Geographic Society hosted the site on its servers, and provided additional technical and logistical support. Satellite uplink technology was provided by EDS. The task leads for this component were the JASON Foundation for Education and the Institute for Exploration, who coordinated the establishment of the interactive stations, developed programmatic content, and provided technical and logistical support to participating schools. The expedition scientists and researchers also played a leading role in the development of interactive program materials.

Task 3: Develop Advanced Program and Curriculum Modules Designed Specifically for the Internet

With support from NOPP, the role of the JASON Project homepage has been significantly expanded to more actively engage students in interactive projects that promote critical thinking. In collaboration with our partners, we developed new modules that provided students with advanced Internet-based learning opportunities in ocean science and enabled them to design their own research projects related to the oceans. In addition, professional development opportunities for teachers have been offered through a for-credit course in ocean science at the University of Wisconsin-Milwaukee.

Teacher Development Course. In collaboration with the University of Wisconsin-Milwaukee, the JASON Foundation offered through the Internet a professional development course for teachers. To design the course, University of Wisconsin curriculum developers collaborated with both the JASON Project curriculum team and the expedition scientists to design a professional development program for teachers of science. Using the expedition site as a case study, the course covered deep-sea structure, marine chemistry, geological and biological oceanography, and the development of hydrothermal systems. The course also provided teachers with training in the development and use of innovative strategies for effectively presenting ocean-based curriculum materials in the classroom.

The course consisted of text and video lectures, video clips, and audio sequences accessible through the JASON Project's homepage to enrolled teachers. The course also consisted of chat sessions among teachers and researchers and provided participants with a host of related resources upon which they could draw for assignments and reports. Teachers enrolled in this program also developed, submitted, shared, and discussed lesson plans for course credit with their peers throughout the United States.

Internet-Based High School Course for Students. The University of Nebraska at Lincoln designed and delivered an accredited high school course on ocean science through its Communications, Learning, and Assessment in a Student-centered System (CLASS) Project partnership. This university-based, fully accredited independent study high school is the only such institution in the United States. CLASS is a unique project designed to allow students worldwide to take interactive University of Nebraska-Lincoln high school and college courses via the World Wide Web. For this project, the JASON Foundation collaborated with the University of Nebraska's independent study high school to develop an ocean studies course that incorporated electronic interaction among students, instructors, field researchers, and other external resources. The program was designed to encourage independent learning by allowing students to personalize courses by exploring paths through a variety of materials, including global digital libraries, video and audio clips, and customized course materials.

Task 4: Create Five Statewide School-Based Interactive Telecommunication Centers

With the assistance of NOPP, the JASON Foundation has established statewide presence and interactive capabilities in Rhode Island, Connecticut, Nebraska, Massachusetts, and Mississippi. In addition, California, Wisconsin and Florida benefited directly from this project through support for institutions of higher education, and outreach programs.

The JASON Foundation has significantly increased each state's capacity to receive the full range of JASON IX program components for the Guaymas Basin expedition. Specifically, teachers in these states will be able to participate in professional development opportunities offered through the University of Wisconsin-Milwaukee. Students gained access to both the satellite and Internet-based components of the program, including the live satellite telecasts, Internet access during and after the expedition, and distance-learning opportunities offered through the University of Nebraska at Lincoln.

Summary

The program built upon an extensive educational and research infrastructure developed by the JASON Foundation for Education and its partners for implementation during the 1997-98 school year. For JASON IX: Oceans of Earth and Beyond, Bermuda and Monterey Bay were chosen as expedition venues because they are centers of oceanographic research. The Bermuda Biological Research Station (BBRS) and the Monterey Bay Aquarium Research Institute (MBARI) are leading research institutions that will act as research partners and hosts for JASON IX. BBRS has established a long-term monitoring project, the Bermuda Atlantic Time Series (BATS), which tracks the connection between ocean systems and climate change. Much of MBARI's research focuses on the Monterey Bay National Marine Sanctuary (MBNMS), administered by the National Oceanographic and Atmospheric Association (NOAA), which is also an institutional partner and host for JASON IX. Selected scientists affiliated with BBRS, MBARI, and MBNMS joined JASON IX as host scientists or researchers, and the expedition will focus on their research.

JASON has already developed an extensive network of partners related to the JASON IX expedition, including the partners collaborating on this proposal. JASON also receives a broad range of technology support for its expedition broadcasts and Internet programming. Principal providers of this support are the National Geographic Society (NGS), which hosts JASON's Internet site, Electronic Data Systems (EDS), a JASON founding sponsor that provides equipment and support for live expedition broadcasts. Additional technical partners include the U.S. Navy's Office of Naval Research (ONR), which supplied JASON with research equipment and vessel access, and Eastern Research Group (ERG), an environmental consulting company that conducted an evaluation of JASON IX.

JASON also has a variety of partners that deliver JASON programming and provide educational support on a regional level, including Primary Interactive Network Sites (PINS) and the Florida and Connecticut state departments of education. The twenty-three PINS include educational, research, and cultural institutions such as the Clark County School District (Las Vegas, NV), the NASA-Johnson Space Center (Houston, TX), the Denver Museum of Natural History, and the University of Wisconsin-Milwaukee. These sites recruit teachers and schools to participate in JASON expeditions, host professional development workshops for teachers, show the expedition broadcasts for large groups of students, and offer other services depending on their capabilities. Connecticut and Florida include JASON expedition broadcasts and other JASON programming on their statewide networks, available to all classrooms by broadcast or video.

PINS estimates, expedition evaluations, and Internet activity suggests that JASON reaches approximately two million students and 15,000 teachers each year. Almost all of these teachers receive some professional development training from JASON, through workshop attendance or video, and approximately 350,000 students participate comprehensively in the expedition by attending an expedition broadcast and conducting related curriculum and Internet activities.

TITLE: Enhancing K-12 Science Education Via Satellite-televised Interactive Technologies

Dr. Paula G. Coble, Assistant Professor
Dr. Sarah Tebbens
Teresa Greely
Dr. Margaret Hewitt
Department of Maine Science
University of South Florida
140 Seventh Ave. S.
St. Petersburg, FL 33701
(727)553-1631
(727)553-1189FAX
Award # N00014-97-1-1040
<http://www.marine.usf.edu/pjocean>

LONG-TERM GOAL

To support of the goals of the NOPP Education, Outreach, and Training activities by providing a telepresence for science education and developing K-12 marine science curriculum and supplemental activities.

OBJECTIVES

Expansion of outreach activities via television represents a new partnering between a research university and public education. Expected results include increased participation by under-represented groups by providing all telecasts and supporting educational materials at no charge to schools of all sizes anywhere in the U.S.

APPROACH

Project Oceanography, a televised program on a variety of Ocean Science topics, is designed to provide recent, relevant research results embedded with the required physics, chemistry, geology, biology, or mathematics needed by the student to fully comprehend the causes and implications of the real-world environmental problems. Presented by the actual research scientists, middle school science students and teachers are exposed to the wealth of knowledge, resources, and state-of-the-art facilities of the Ocean Science research community. Real-time interactivity is possible via two-way audio and video technologies, and programs can originate virtually anywhere on the planet.

WORK COMPLETED

During the past year, we have produced 29 half-hour live broadcasts on various topics in Marine Science, including Coral Reefs, Ocean Drifters (Plankton Ecology), Ocean in Motion (currents, carbon dioxide and CFCs in seawater, weather and climate, El Nino and hurricanes), Natural Disasters (Lightning , Tornadoes, and Tsunamis) Aquaculture/ Habitat Restoration with an emphasis on scallops, Careers, and YOTO Drifters. In addition, we wrote, printed and distributed background information packets for each of units listed above, totaling over 268 pages. Videotapes of all programs were edited and distributed. Copies of all videotape and written materials are available on request. Evaluation of program's impact on teachers and students is underway.

RESULTS

We experienced a 75% increase in number of registered sites from 97 to 250, as of 12/15/98. Our estimated weekly viewership is roughly 1,600,000 in approximately 2,650 schools.

Results of teacher surveys:

Content of broadcasts is appealing to all grades of middle school students, and all types of learners, including gifted students, students with physical and emotional disabilities, and at-risk students in Juvenile Welfare (drop-out prevention) programs.

Complete, well-designed packets support state and national science standards. Materials emphasize broad concepts and integrate well across science disciplines. Activities are included which require higher-order thinking skills and engage students in 'hands-on' investigations.

Broadcasts bring research science to students, which is something that is otherwise lacking in their science education experience.

The abundance and completeness of materials allow the teacher to pick and choose activities which best meet certain standards, and also help teachers offer an interdisciplinary unit. Many teachers intend to incorporate materials into their curriculum in future years.

Web-based information would be extremely beneficial.

Overall program rating from teachers is A-.

Results of content surveys distributed to students before and after our Natural Disasters series showed a 22% increase in knowledge among magnet students, and a 40% increase among students with specific learning disabilities (SLD).

PUBLICATIONS

Tebbens, S.F., P.G. Coble, and T. Greely, 1998. "Teaching Marine Science to the Next Generation: from summer camps to weekly nationwide distance learning broadcasts" EOS 79:137. Project Oceanography, 1997. Vol. I, Numbers 1-28. Dept. Marine Science, USF, St. Petersburg, FL. 193p. Videotapes and written materials.

Project Oceanography, 1998. Vol. II, Numbers 1-29. Dept. Marine Science, USF, St. Petersburg, FL. 268p. Videotapes and written materials.

TITLE: NEPTUNE: A Fiber Optic Telescope to Inner Space

Principal Investigator: John R. Delaney
School of Oceanography

University of Washington
Seattle, WA 98195

Partners:

School of Oceanography, University of Washington
Woods Hole Oceanographic Institution
Pacific Marine Environmental Laboratory, NOAA
The Jet Propulsion Laboratory, Caltech-NASA

Objectives: The objective of the program is to complete an engineering design study of the NEPTUNE concept. NEPTUNE stands for North East Pacific Time-series Undersea Networked Experiments. The intent is to use a fiber optic network connecting the subsea environment with land-based internet investigators and the public for the purpose of establishing at the scale of the Juan de Fuca plate, a series of interactive natural laboratories to study oceanographic and plate tectonic processes in real-time. This type of science will fundamentally shift the manner in which oceanic research will be conducted in that the system will provide power to the users, real-time data flow with a huge bandwidth, and intervention capability using autonomous vehicles.

Anticipated Results: We will produce comprehensive report that will address all of the essential technical, scientific and educational opportunities and challenges embodied in the NEPTUNE concept.

Activities to Date: A great deal has been accomplished since the project was initiated. We have completed a first cut study of the scientific drivers for developing the NEPTUNE facility off the coast of Washington and British Columbia. This product is presented on the NEPTUNE site: <http://www.ocean.washington.edu/neptune/>. We have also completed two planning meetings of the entire group of partners and have a complete outline of the report with writing assignments and research assignments defined. Small working groups are engaged in solving major issues such as the main trunk line, the science interface, the management and operations plan and the educational outreach portion of the program. Scientific specificity regarding the many and diverse types of time-series studies that will be conducted is arising from deliberations among selected members of research communities that involve the following programs: NOAA Vents program, RIDGE, MARGINS, GLOBEC, COOP, NMFS, ATOC, Canadian Institute of Ocean Sciences and groups related to defense issues. The principal technical difficulties will involve managing the power and data flow in the network as the demand load shifts in response to changes conditions, defining the relationship between the science community and the operational community, and providing long term support for the program.

TITLE: OCEANOGRAPHIC-SYSTEMS FOR CHEMICAL, OPTICAL, AND PHYSICAL EXPERIMENTS (O-SCOPE)

Tommy D. Dickey
Ocean Physics Laboratory
University of California at Santa Barbara
6487 Calle Real, Suite A
Goleta, CA 93117
phone: (805) 893-7354 fax: (805) 967-5704 email: tommy@icess.ucsb.edu
Award #: N00014-98-1-0803

Other O-SCOPE investigators include:

Nick Bates, Bermuda Biological Station for Research (BBSR)
Robert Byrne, University of South Florida
Francisco Chavez, Monterey Bay Aquarium Research Institute (MBARI)
Richard Feely, Pacific Marine Environment Laboratory (PMEL)
Casey Moore, WET Labs, Inc.
Rik Wanninkhof, Atlantic Ocean and Meteorological Laboratory (AOML)

LONG-TERM GOALS

The National Ocean Partnership Program (NOPP) sponsored Ocean-Systems for Chemical, Optical, and Physical Experiments (O-SCOPE) program addresses the need for next-generation, autonomous, near real-time, long-term, time-series measurements in critical regions of the world oceans. To systematically obtain high-resolution, interdisciplinary oceanic data, in analog to the Mauna Loa atmospheric CO₂ time series, there is need to improve the variety, quantity, quality, and cost-effectiveness of observations using a network of strategically placed moorings. Impacts of O-SCOPE relate to the development of the proposed technologies which can be used to quantify 1) trends in biogeochemical and bio-optical variables and 2) seasonal, interannual, and decadal changes in upper ocean biogeochemical and bio-optical variability and carbon fluxes. The O-SCOPE interdisciplinary sensor suites (e.g., pCO₂ sensors, nitrate analyzers, and spectral optical sensors) will be tested on testbed moorings near Bermuda and Monterey Bay. The newly developed systems will also be placed on the new NOPP mooring located at Ocean Weather Station "P" in the North Pacific.

SCIENTIFIC OBJECTIVES

Scientific objectives related to the development of the proposed technologies include:

- * Quantification of 1) trends in biogeochemical and bio-optical variables which could be caused by major changes in thermohaline circulation and 2) seasonal, interannual, and decadal changes in upper ocean biogeochemical and bio-optical variability and carbon fluxes.
- * Monitoring trends in "ocean health" in the form of chemical, biological, and optical indicators.

APPROACH

Strategically located moorings can be envisioned as a continuous early warning system to global change in the ocean. It is our intent to capitalize on recent technological advances. Our project can accelerate the implementation of a plan to instrument (i.e., network) critical regions of the ocean with long-term interdisciplinary moorings. This plan will include optimal sampling strategies. For example, we will utilize subsampling of testbed mooring data in optical spectral bands and in time to design next-generation systems to maximize information return and

minimize costs and complexity. It will be necessary to extrapolate mooring time series using remote sensing and models. Thus, we will also develop an integrated system of near real-time data distribution to the oceanographic community (for education as well as research) via the INTERNET. We will capitalize on two ongoing testbed mooring programs (near Bermuda and Monterey Bay), transitioning next generation technologies to the recently funded NOPP mooring located at Ocean Weather Station "P" in the Pacific. The O-SCOPE project will allow us to apply our partnership's expertise to develop, test, and transition requisite next-generation technologies to the oceanographic community (e.g., national agencies such as ONR, NOAA, NSF, NASA) for long-term monitoring and research of biogeochemical as well as physical processes.

WORK COMPLETED

The O-SCOPE project was only recently initiated. The first workshop for O-SCOPE investigators and collaborators was held September 14 and 15, 1998 at the Pacific Marine Environmental Laboratory (PMEL) in Seattle. The planning meeting was used to: 1) refine selection of key variables to be measured, determine capabilities and limitations of available sensors, and define specifications of next-generation sensors and systems, 2) summarize tasks of individual partners, and 3) discuss complementary activities and technical issues relevant to the test sites (Bermuda Testbed Mooring, BTM, MBARI moorings, and NOPP Ocean Station "P" mooring).

RESULTS

The project has just begun, so no results have been obtained at this point.

IMPACT/APPLICATION

The O-SCOPE activity will accelerate capabilities in measuring high frequency chemical, optical, and physical variability in remote oceanic regions for long time periods. Long-term as well as episodic and periodic changes in the ocean will be better resolved using the new O-SCOPE technologies.

RELATED PROJECTS

Our study is highly complementary to other activities including the Bermuda Testbed Mooring program, the MBARI mooring program, the NOPP Ocean Station "P" mooring program, and upcoming ONR programs including HyCODE.

TITLE: A near-real-time, high-resolution, ocean-surface-current mapping system

P.I.: Dr. T. M. Georges, NOAA/ETL, 325 Broadway, Boulder, CO 80303

Partners: (1) U.S. Navy Fleet Surveillance Support Command, (2) Raytheon Electronic Systems, (3) University of Colorado/CCAR

Objectives: (1) Demonstrate high-resolution, long-range surface-current mapping using existing U.S. Navy over-the-horizon radars; (2) find efficient ways to increase the radars' space-time

coverage; (3) acquire enough ocean surface-current data to increase understanding of the flow through critical passages of the Intra-Americas Sea.

Progress: Raytheon has collected ROTHr data for us nearly weekly, although substantial gaps exist. Focus has been on the Yucatan Channel, and in addition, good surface current data were obtained in the vicinity of hurricanes Bonnie and Georges. These data can be viewed on our website: <http://www1.etl.noaa.gov/othr/98rothr.html> . Several good surface current maps in the Yucatan Channel show new details of eddies and backflow in the channel, at a time when the Gulf of Mexico Loop Current is virtually absent. More ROTHr data should clarify the connection, if any, between Loop Current intrusion into the GOM and details of the circulation in the Channel.

We have some preliminary results of a comparison of ROTHr-derived currents with those obtained with drifting buoys and radar altimetry. Geostrophic currents derived from satellite altimetry (provided by Dr. Leben at CCAR) agreed with ROTHr-derived currents on two days sampled, with a correlation coefficient of 0.78. YOTO lagrangian drifters confirm several surface circulation features seen with the ROTHr, specifically, the presence of eddies in the Yucatan Channel and southward flow off the western tip of Cuba. Eulerian and lagrangian views of the circulation are complementary but difficult to compare quantitatively.

Our radar map of surface currents driven by hurricane Georges as it passed over Key West showed interesting details of the interaction of the storm with the Florida Current. Further analysis should clarify those details. Preliminary results will be shown at the Interdepartmental Hurricane Conference in February 1999. A current map obtained near Bonnie showed the same kind of current surge driven ahead of the storm as we saw with Hortense. Such current maps near hurricanes have never been seen before and are not available from any other sensor.

We have not made any progress in convincing the Navy to increase the priority of implementing the double-sized radar-dwell region. This would double the ocean area covered per dwell, as we have already shown in a few tests. But implementing it operationally requires an engineering change that is not a high priority.

Preliminary results suggest that autoregressive and parametric spectral estimators do not improve the accuracy of the radar-derived current estimation, compared with an FFT. Although "modern" spectral estimators better resolve multiple signals in noise, they do not give more accurate estimates of the frequency of an isolated spectral peak. This result is predicted by spectral estimation theory, which says that the maximum-likelihood estimate of a monochromatic signal in noise is given by the periodogram. This result is disappointing, in that we were looking for an improved spectral estimator that could be used on shorter data samples, thereby increasing radar coverage efficiency.

Some increase in the coverage per radar dwell seems likely by innovative processing. We are testing a way to extend the dual-radar vector-current map into the single-radar coverage area, by assuming 2D continuity.

We are planning ROTH data collections during hydrographic surveys in the Yucatan that are planned by Americans, Mexicans, and Cubans in 1999.

It is clear that this partnership, which allows us to piggyback on a Navy radar system, is a very cost-effective way to demonstrate this new current-mapping technology. But this is not a long-term monitoring solution, because of the radar's high counter-drug taskload. We are allowed only about 4 minutes of actual radar time per week, and this is not likely to increase significantly. So our goal of substantially increasing radar coverage will probably not be met. We are therefore working (outside of this contract) on the design of a low-cost OTH radar dedicated to ocean monitoring.

TITLE: Demonstration of a Relocatable Ocean Atmosphere Modeling System with Coastal Autonomous Sampling Networks.

Scott M. Glenn, Rutgers University, Institute of Marine & Coastal Sciences, 71 Dudley Rd., New Brunswick, NJ 08901-8521.

PARTNERS: Rutgers University, Woods Hole Oceanographic Institution, Naval Undersea Warfare Center, Webb Research Corporation, CODAR Ocean Sensors, RD Instruments, United States Geological Survey.

Objective:

Construct a coupled Regional Ocean Atmosphere Modeling System (ROAMS), demonstrate the system at LEO-15 during a July 1999 Coastal Predictive Skill Experiment, and transition the system to the USGS for Gulf of Maine ECOHAB applications in 2000. The 1999 experiment will focus on improving forecast skill through improved boundary conditions (a) at the surface, by inclusion of a high resolution atmospheric model, (b) at the bottom, by including a combined wave and current bottom boundary layer model, and (c) offshore, by using AUV gliders to improve lateral boundary conditions.

Anticipated Results:

- 1) Development, evaluation and initial transitioning of a new state-of-the-art ROAMS for coastal applications.
- 2) Improvements to autonomous/remote sensing systems, including: (a) addition of high-resolution capabilities to LEO-node and REMUS ADCPs, (b) addition of fluorometers to REMUS and SLOCUM Glider AUVs (c) new wind and multi-scale current algorithms for CODAR systems.
- 3) Integration of new meteorological, remote sensing and in situ sensors in the real-time adaptive sampling network.
- 4) Evaluation of CODAR for verifying surface boundary conditions, REMUS AUVs for verifying bottom boundary conditions, and AUV gliders for updating offshore boundary conditions.
- 5) Co-located adaptive sampling of physical and bio-optical properties with ships and AUVs.

- 6) Assessment of model particle tracking capabilities and its relation to observed phytoplankton distributions.
- 7) Physical interpretations of the 1998 and 2000 Gulf of Maine ECOHAB datasets.

Activities to date:

- 1) Parallel version of Regional Atmosphere Model System (RAMS) is being configured for the Middle Atlantic Bight and prepared for coupling to ROMS.
- 2) Latest version of Bottom Boundary Layer Model (Styles and Glenn, 1999) is being packaged as a self-contained system for coupling to ROMS.
- 3) A new turbulent closure scheme was developed by modifying the KPP method (Large et al., 1994) to include bottom boundary layers. Idealized upwelling with modified KPP turbulence closure predicts similar vertical eddy viscosities to REMUS observations, but larger eddy diffusivities. New closure with coupled BBLM is being implemented in ROMS.
- 4) Open lateral boundary conditions now available in ROMS have been developed and shown to allow simultaneous external forcing due to both tides and lower-frequency (general circulation) motions.
- 5) An offshore weather/hyper-spectral buoy is being constructed.
- 6) Existing SeaWiFS Case II algorithms are being adjusted for use at LEO, with plans to implement new NRL-Stennis algorithms initiated.
- 7) CODAR modifications ongoing for adaptive software/hardware interfacing that will allow variable resolution within the surface current mapping area.
- 8) Modification of ship-towed systems include testing of real-time data transmissions via RF-modem. Ship-deployed bio-optical systems are being prepared for coordinated adaptive sampling.
- 9) Constructing 2 electric coastal SLOCUM Glider AUVs and testing in local Woods Hole waters. Tested Webb Multi-Trip CTD at LEO-15 in preparation for Glider deployments in 1999.
- 10) Fabricating six additional navigation buoys and twelve 6-unit thermistor strings for the REMUS navigation buoy network.
- 11) Lowered noise floor on REMUS Turbulence AUV shear probes through improvements to electronic isolation and mechanical damping of probes (shortened cantilever). Preparing for summer 1998 with test logistical deployments in Narragansett Bay, including constant AUV-altitude runs.
- 12) Mode 5 High Resolution capability added to NODE ADCP via fiber-optic cable while instrument was still deployed. Mode 5 capability being added to REMUS ADCPs at factory. Improved software for sending LEO-15 node ADCP data to web site using TCP/IP connection being developed.

- 13) Developed Gulf of Maine model grids and began diagnostic testing of ROMS in the ECOHAB domain, focusing on assessment of vertical mixing schemes for river plume problems.

TITLE: Multi-Scale Model-Driven Sampling with Autonomous Systems at a National Littoral Laboratory.

J. Frederick Grassle, Scott M. Glenn & Dale B. Haidvogel
Rutgers University, Institute of Marine & Coastal Sciences
71 Dudley Rd.
New Brunswick, NJ 08901-8521.

PARTNERS: Rutgers University, Woods Hole Oceanographic Institution, Naval Undersea Warfare Center, CODAR Ocean Sensors and RD Instruments.

Objective:

Construct a relocatable observation and forecasting system for the littoral ocean and demonstrate the system at LEO-15 during a July 1998 Coastal Predictive Skill Experiment. The 1998 experiment focused on improving nowcast skill using real-time remote sensing surface data and data assimilation for subsurface adaptive sampling with multiple ships and REMUS Autonomous Underwater Vehicles (AUVs).

Anticipated Results:

- 1) Evaluation of operational atmospheric forecasts (NOGAPS/NORAPS) for coastal ocean forecasting.
- 2) Validation of CODAR surface currents and their use as a nowcasting tool for adaptive sampling.
- 3) Development of ship/AUV subsurface current sampling strategies where tides, inertial and sub-inertial currents are similar in magnitude.
- 4) Evaluation of competing turbulence closure schemes based on AUV observations.
- 5) Development of data assimilation methodologies for currents and temperature/salinity in a Regional Ocean Modeling System (ROMS).

Activities to date:

- 1) Regional Ocean Modeling System (ROMS) reconfigured in collaboration with colleagues at UCLA for improved algorithmic performance and accuracy, including extensive restructuring for sustained performance on SMP-class parallel-computing platforms and quasi-monotone algorithms for tracer advection.
- 2) ROMS equipped with several options for data assimilation, including nudging, optimal interpolation, and the reduced-state Kalman filter.

- 3) Successful completion of July 1998 Coastal Predictive Skill Experiment, demonstrating adaptive sampling with ships and multiple AUVs based on real-time observations and data-assimilative model forecasts.
- 4) Windfield comparisons indicate the need for higher resolution atmospheric forecast models.
- 5) New AVHRR cloud detection algorithms developed to improve SST assimilation datasets.
- 6) Initial CODAR surface current validations submitted for publication, real-time and assimilation products developed for raw, tidal, inertial and sub-inertial currents.
- 7) Ship-towed SWATH ADCP and Undulating CTD systems developed and operated on 52 cross-shelf adaptive sampling transects, leading to the discovery of a near-shore, southward-flowing, subsurface jet that advects phytoplankton into the upwelling center.
- 8) REMUS Survey AUV operated within a network of navigation buoys, demonstrating real-time tracking via RF-link on 15 cross-shelf surveys, with a maximum range of 60 km on lithium batteries.
- 9) Conducted multiple docking tests with a REMUS Docking AUV and a LEO-Node Docking Station, demonstrating navigation, battery charging, data downloading and mission reprogramming.
- 10) REMUS Turbulence AUV established as a viable platform for coastal turbulence data acquisition on 4 data-directed survey legs. Shear probe data compare well with the universal spectrum, resolving dissipation rates of 10^{-8} W/kg. Estimates of dissipation rates of order 10^{-7} , with lower values in the upwelling center compared with the offshore gyre leg. Vertical eddy viscosities of 10^{-3} to 10^{-1} m²/sec in the upwelling center, 10^{-3} m²/sec in the offshore leg. Vertical diffusivities of 10^{-5} m².sec in the upwelling center, 10^{-4} in the offshore leg.
- 11) REMUS ADCP data verified with moored ADCPs. REMUS and Towed ADCP datasets are being merged to develop methodologies for separating observed subsurface currents into tidal (barotropic and nonstationary baroclinic), inertial and sub-inertial components.
- 12) Datasets are being used for model assimilation studies (including the assimilation of CODAR radial velocity components to increase coverage), sensor intercomparisons, and fusion with biological/optical/chemical datasets collected through other programs.
- 13) Preliminary results reported in 13 talks at the February ASLO meeting in Santa Fe. Discussions for a special LEO-15 issue initiated with JGR editors.

TITLE: NOPP Coastal and Marine Aerosol Transformation Processes

Dr. William Hoppel, Naval Research Laboratory, Washington, DC.

Tel: (202)767-2951; FAX: (202)404-8011; e-mail whoppel@ccf.nrl.navy.mil

List of NOPP Partners:

Calspan, University of Buffalo Research Center (CUBRIC)

Naval Research Laboratory (NRL)

University of Washington

National Center for Atmospheric Research (NCAR)

Aerodyne Corporation

University of Delaware

Atmospheric Environmental Service of Canada

Objectives: The proposed experiments support the broad goal of developing a marine and coastal aerosol model which can be included in meteorological models to predict radiative transfer within the atmospheric marine boundary layer (MBL). The Calspan 600 m³ environmental chamber will be used to study (1) the effect of cloud processing on the MBL aerosol size distribution, (2) formation and growth of aerosols resulting from the oxidation of Dimethyl Sulfide (DMS), given off by phytoplankton, to nonvolatile sulfate, (3) nucleation of MBL aerosol directly from involatile products produced by oxidation of SO₂ and hydrocarbons of atmospheric importance, and (4) heterogeneous oxidation of SO₂ by ozone in sea-salt aerosol. The Calspan 600 m³ chamber offers a unique capability in that it can function not only as a photolysis chamber but also as a cloud chamber, and is large enough to support the number of investigators required to obtain closure.

Anticipated Results: These remain as stated in the original proposal. Briefly stated they are: (1) To study and determine the rate constants for liquid-phase conversion of SO₂ to sulfate in cloud droplets by various natural oxidants. (2) To determine the aerosol yield resulting from oxidation of DMS and SO₂ under conditions appropriate for the MBL. (3) To measure the rate constant for oxidation of SO₂ by ozone in wet sea-salt particles. (4) Results of nucleation experiments will permit the assessment of the validity of various nucleation models. (5) To explore the role of atmospheric hydrocarbons in the formation of aerosols.

Activities to Date: (1) Three weeks of chamber characterization experiment were carried out in the Calspan 600 cubic meter environmental chamber during 4-18 May 1998. The characterization experiments were a necessary prerequisite to the main aerosol process studies carried out in the Fall of 1998. Only the first three institutions named above were involved in the chamber characterization experiments. A sixty page report on the characterization experiments was prepared and circulated by the end of June to all partners participating in the Fall aerosol process studies experiments.

(2) The main aerosol process studies experiments were carried out during two, three week periods in the Fall of 1998 (5-24 October and 2-20 November) and involved all the partners listed above. These experiments were very successful and produced a large data base which is now being initially analyzed by the individual groups.

(3) A data coordination and planning meeting involving all the participants has been planned for 17 and 18 February. At this meeting responsibility for the data integration, assignment of a

lead scientist for coordinating each of the process studies, and for report writing will be determined.

Documentation: The following informal, internal documents are available from the PI for anyone desiring additional information:

- (1) Science and Implementation Plan for the Chamber Characterization Experiments.
- (2) Report on the Characterization of Calspan's 600 m³ Chamber in preparation for the NOPP Aerosol Processes Experiments.
- (3) Science and Implementation Plan for Fall Aerosol Processes Experiments
- (4) Weekly Summaries for the October and November Deployments
- (5) Index of Experiments by Type for October and November Deployments to the Calspan Chamber

TITLE: SeaNet: Extending the Internet to the Oceanographic Research Fleet

Collaborating Institutions: Joint Oceanographic Institutions, Woods Hole Oceanographic Institution, Lamont-Doherty Earth Observatory, Omnet, Inc., Naval Postgraduate School

SeaNet installations on UNOLS vessels

- * A letter to all UNOLS vessel operators was sent in March 1998 asking them to (1) provide information about their ship's current satellite communications system(s) and (2) provide a letter proposal to JOI to become of the ships outfitted with a SeaNet unit this year. Ellen Kappel sent out the eight proposals received for peer review, received written evaluations, and then convened a review committee conference call in early July to make the final recommendation. After consultation with ONR and NSF program managers regarding the committee's recommendations, the five ships to obtain the first SeaNet installations are the: Atlantis, Ewing, Melville, Seward Johnson and Pelican. SeaNet units for all ships have been ordered, and are in various stages of installation (some fully installed, others only have antenna installed or have only had their ship site survey completed. It is anticipated that all units should be fully operational by spring of this year.

SeaNet hardware

- * Much effort went into researching hardware for the SCN as well as the need for an Uninterruptable Power Supply (UPS). We also investigated companies selling INMARSAT B/HSD units and made the decision to go with Nera units. At present, we are finalizing institutional ownership and use agreements for the SeaNet-purchased SCN units.

SeaNet software development and testing

- * Three SeaNet personnel participated on D. Yoerger's (WHOI) Jason cruise to the Guyamas basin in mid-April 1998. New software developed by WHOI SeaNet personnel in the fall 1997 was tested on this cruise, and was very successful. The software now runs on a PC (it was previously coded to work on a Sun) and the "front end" was redesigned to make more user-friendly. Scientists were able to update shore-based web pages and transfer large data sets. Lessons learned from the Jason cruise have been incorporated into the next version of

the SeaNet Communications Node software release. That software, with additional enhancements is currently being installed on all SeaNet ships.

- * Specifications for a SeaNet electronic mail system and message filtering were written.

SeaNet shoreside operations

- * Several meetings with COMSAT, MCI, and SeaNet representatives were arranged by Omnet, and COMSAT agreed at the spring 1998 meeting to provide free COMSAT use for the Jason SeaNet test at WHOI. Initial rates for SeaNet access via the Omnet NIC/NOC were established. We discussed possible arrangements for dedicated land lines from MCI, though after MCI was purchased by WorldCom, the arrangements we had made with MCI were no longer valid
- * Initial SeaNet shoreside architecture has been designed and has been through one revision. We are presently working with a consultant with connections with the Naval Post-Graduate School who has provided us with a further independent assessment.
- * Omnet is having on-going discussions with Station 12 for possible alternative INMARSAT-B access as well as talking with AMSC about possible cheaper coverage in the coastal regions using AMSC. Omnet will talk with Iridium and other LEO's as appropriate, in future.
- * Omnet has applied for Accounting Authority status from the Federal Communications Commission, which will allow Omnet to handle SeaNet billing.
- * Billing software for the project was specified. The software will compare COMSAT or Station 12 billing data and data that will be stored in the seaboard SCN, and generate invoices.
- * Early on the SeaNet collaborative grappled with the framework and initial content of www.seanet.int. More recently we have held discussions about SeaNet trademark infringements. Omnet is maintaining the seanet.int domain and nameserver and hosting the SeaNet web site. Omnet programmed a web-based SeaNet technical document submission/numbering system.
- * Numerous contacts with possible commercial SeaNet customers have been made.

TITLE: Federation of Ocean Acoustic Observatories

John A. Orcutt
Cecil H. & Ida M. Green Institute of Geophysics & Planetary Physics
Scripps Institution of Oceanography
La Jolla, CA 92093

Naval Postgraduate School
Pacific Marine Environmental Laboratory/NOAA
Scripps Institution of Oceanography
University of Washington/Applied Physics Laboratory

The Federation has had an active initial year with a number of major accomplishments including the upgrade of the amplifiers at San Nicholas Island and Barbers Point, the installation of a continuous recording system at Pt Sur, a meeting between the Navy and the Federation on planning cable repairs using UNOLS vessels, the installation of a T1 link between Pt Sur and NPS, the recording of an intense earthquake swarm beginning only days ago, and the archiving of more than 200 Gbytes of SOSUS data for future use. We fully expect to complete the proposed project by the end of the second year's funding although it will be essential to continue the collection of data at the sites which have been activated, to enhance secure digital communications between the partners, and to process and analyze the data which are being regularly collected.

With the support of the Federation, the members at APL have installed 80 donated Navy hydrophone amplifiers at San Nicholas Island. We have also replaced the optical disk drives with a more reliable magnetic system. UW/APL is planning a number of improvements to the Barbers' Point site. We have installed a new cabinet containing a panel of isolated outputs so that other users may connect to the system. The cabinet will also house a communications PC providing a direct remote connection to each synchronous detector and to various board resets throughout the system. Power fluctuations have also been a major problem at Barber's Point, so we will install a large primary-source line filter before the UPS. The new cabinet will also have space available to other users.

On December 14, Jim Mercer at APL hosted a Federation meeting between APL, NOAA/PMEL, SPAWAR and Lucent Technologies. The Navy is serious about joint efforts to repair cables at selected coastal receivers. Given our past experience, Class I academic research vessels are quite capable of carrying out cable laying and repair efforts and this is especially true in shallow water where breaks often occur. It is our expectation that the cost for maintenance of these cables can be greatly reduced in the future.

The installation of a full-time, 24-bit recording package at Pt Sur (by the SIO partner in cooperation with NPS) was completed in early January. This package records data at 200 samples/s continuously on all operating hydrophones and the data are being archived at a classified digital mass store at Scripps. NPS has developed and installed a UNIX-based multi-channel data acquisition system at Pt Sur. The system was recently upgraded with additional

filters and digitization hardware to achieve full-array data sampling capability. NPS has continued to supply unclassified (single-phone) data collection and distribution to approved official users, and has begun continuous classified (full-array) data archival.

NPS has continued to monitor the erosion patterns at the array cable headland. The headland area south of the existing concrete cap (of the working array) is starting to show significant sinking and erosion onto the beach. A coordination effort to repair a known hydrophone cable suspension-fault at 0.86 NM from shore over 33 m of water has begun.

The implementation of the ocean-margin tomography observational network to study the California Current will involve the deployment of a Scripps' HLF-5 sound source on top of the Hoke Seamount, 600 km off shore. The signal transmissions will be monitored by (former) SOSUS receiver arrays at Pt Sur, San Nicholas and Barbers Point. In coordination with Dr. Worcester at Scripps, the planning of the April cruise has been completed.

SIO has been monitoring whale activity off Kauai in conjunction with the operation of the ATOC source. The instruments being used are IGPP data loggers (Low-Cost Hardware for Earth Applications and Physical Oceanography - L-CHEAPO) recording a single hydrophone with a sampling frequency of 4 kHz. The duty cycle for recording is 91s every 10 minutes and the data are compressed before writing to a 9 GB disk. The February recovery has just been completed and another two instruments are in place.

In 1998 the NOAA/PMEL partner digitized and archived 204 Gbytes of SOSUS omnidirectional hydrophone and beam data. The hydrophone data have been processed, and 5,159 earthquakes were detected and located throughout the Pacific basin.

On January 25, 1998 at 11:33Z, an intense swarm of earthquakes associated with a seafloor volcanic eruption was detected and located using the SOSUS hydrophone arrays along the summit caldera of Axial Seamount. Axial Seamount is a hotspot volcanic edifice that encompasses the central segment of the Juan de Fuca Ridge, a spreading center located in the NE Pacific Ocean. The earthquake swarm lasted a total of eleven days and produced 1,037 earthquakes. During the course of the eruption, earthquake epicenters migrated ~60 km southward along the southern flank of the volcano at a rate of ~0.2 m/s. Epicenter migration is characteristic of a lateral magma dike injection, and very similar to previous seafloor spreading episodes detected by the acoustic monitoring network. Evidence from hydrothermal plume distribution, chemical sampling, and seafloor tilt-sensors indicates lava erupted from beneath the southeast corner of the summit caldera, and the caldera floor subsided ~3m.

Data acquisition systems at NOPF Whidbey Island were upgraded in January 1999 to handle the Y2K problem. The autonomous hydrophone array in the eastern tropical Pacific was successfully serviced in April and October 1998. On February 29, 1999, Dr. Christopher Fox of NOAA/PMEL briefed Commander, Undersea Surveillance on Federation use of Pacific SOSUS and discussed strategies for Federation assistance in maintaining the long-term viability of the system.

SOSUS plans for 1999 include the installation of full-time recording equipment at the San Nicholas and Barber's Point arrays using the IGPP 24-bit recording packages. In the future, a significant effort will be made to support the transfer of full-channel broadband data from San Nicholas, Point Sur, and Barber's Point to processing and archiving sites. This will allow, for example, the NOAA system at PMEL to include these arrays in earthquake, volcano and marine mammal detection and tracking and scientists at any of the other Federation sites to conduct research on the full suite of hydrophone data in real time.

SIO and UW/APL have made considerable progress in understanding and modeling the excitation and propagation of T-phases. The growing catalog of data is essential.

TITLE: The Innovative Coastal-Ocean Observing Network (ICON)

Jeffrey D. Paduan, Code OC/Pd
Dept. of Oceanography
Naval Postgraduate School, Monterey, CA 93943
(831) 656-3350; paduan@oc.nps.navy.mil

A partnership between governmental, academic, and industrial scientists working around Monterey Bay has been created to show how a diverse suite of ocean instrumentation can be successfully integrated into a real-time ocean observation network. The program, named an Innovative Coastal-Ocean Observing Network (ICON), was initiated in August 1998 and will continue under NOPP funding for two years. The partnering institutions and their primary responsibilities are shown in Table 1.

Table 1. ICON Partner Institutions and Primary Responsibilities

Naval Postgraduate School Tomography	Moored Obs, HF Radar Obs, Acoustic
University of Michigan	HF Radar Obs. and Construction
California State University Monterey Bay	HF Radar Obs.
University of Southern Mississippi	Circulation Modeling and Data Assimilation
Naval Research Laboratory	Bio-Phys. Modeling
HOBi Labs, Watsonville, CA	Moored Optics Sensors, Bio-Phys. Modeling
Monterey Bay Aquarium Research Institute	Mooring Deployment, Bio-Phys. Modeling
Codar Ocean Sensors, Ltd., Los Altos, CA	HF Radar maintenance and algorithm development

ICON involves both creative application of well-established observing techniques and the development of new instrumentation and algorithms. Moored, single-point time series observations, remotely-sensed data, ocean acoustic tomography, and two-dimensional vector fields obtained from HF radars are being integrated into a cohesive picture of the coastal environment via a nested, high resolution numerical model. The sensor data and model output are being linked via Internet web pages for immediate application by coastal managers, defense analysts, emergency response teams, and commercial and recreational use (<http://www.oc.nps.navy.mil/~icon>).

This Monterey Bay program fits well in the cooperative, interagency partnering framework of NOPP. Many of the observing systems in ICON were in place already. NOPP funding is making it possible to use them in a more coordinated way, and to evaluate the impact of these systems on numerical model simulations of coastal ocean circulation and primary productivity. The target processes to be evaluated involve the evolution of mesoscale upwelling filaments and eddies. Focus is being placed on how well the week-to-week variations of the locations and strengths of these features can be tracked and modeled over an entire seasonal cycle. This includes attention to numerical circulation model results both with and without data assimilation, and an initial assessment of imbedded biological modeling for key observing sites.

The major components of ICON are shown in Figure 1. The satellite-derived sea surface temperature pattern during November 1994 is shown schematically on the figure. This outlines an anticyclonic (warm) feature off the mouth of Monterey Bay and cold water at the upwelling centers to the north and south, particularly offshore of Pt. Sur. HF radar-derived surface velocity vectors reflect the anticyclonic sweep around the warm feature and the strong currents expected across the mouth of Monterey Bay. (In this example, approximately, every third vector has been shown for clarity.) This situation, involving two or three mesoscale features, is common. Furthermore, these physical features evolve on a week-to-week time scale, which strongly influences the biological activity for any given location, such as the heavily sampled mooring location M1 near the center of Monterey Bay.

During the first few months of this project, 400 kHz sound sources have been deployed on Davison and Pioneer Seamount, construction has begun on the new M4 mooring and a new HF radar for the Granite Canyon site. Archival data from five years of HF radar measurements in Monterey Bay have been assembled and work has begun to organize over ten years of mooring data from the MBARI M1 site plus other sites in the region. The numerical circulation model has been set up and initial testing of boundary conditions is underway. In addition to the several investigators and staff involved with ICON activities, three new full-time personnel have been hired, including two technicians and a postdoctoral researcher.

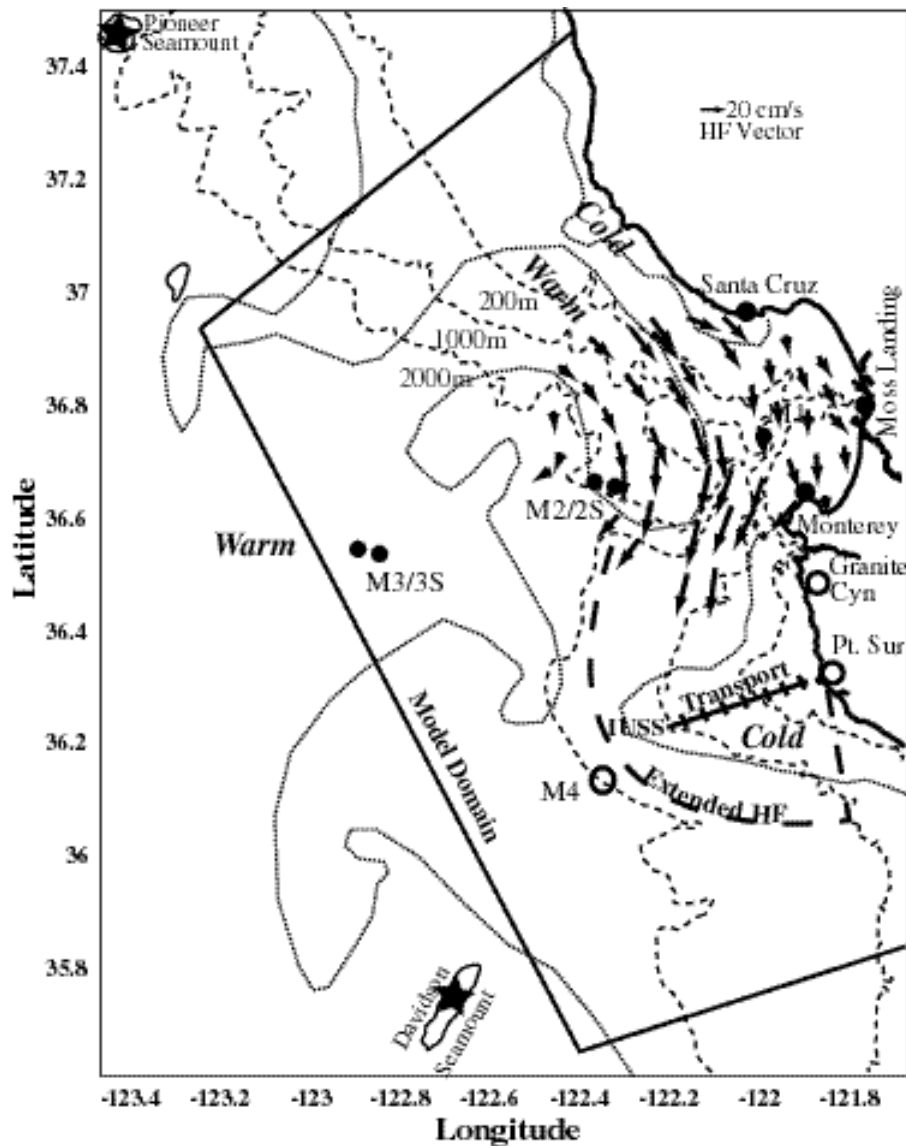


Figure 1. Overview of ICON observational systems and modeling domain with sea surface temperature patterns from 0200 GMT, 3 November 1994, including subsamples from the daily averaged map of surface current vectors from the three-site CODAR/SeaSonde network around Monterey Bay (•) and the extended HF radar coverage area (---) from future sites south of Monterey Bay (m). Real-time acoustic tomography sections will be available via the IUSS hydrophones cabled to shore at Pt. Sur, while mass transport estimates will be computed using cable voltage drops. Meteorological data, profiles of temperature, salinity, and current, and spectral-resolving optical properties will be telemetered to shore from existing (M1, M2, M3) and future (M4) mooring sites, while a high resolution primitive equation model will be forced by input from a regional-scale model, observed winds, and assimilated surface current fields.

TITLE: DEVELOPMENT OF A NATIONAL LITTORAL OCEAN OBSERVING AND PREDICTIVE SYSTEM: FIELD ESTIMATION VIA INTERDISCIPLINARY DATA ASSIMILATION

Prof. Allan R. Robinson (PI), Harvard University, Division of Engineering and Applied Sciences, Department of Earth and Planetary Sciences, 29 Oxford Street, Cambridge, MA 02138 (617)495-2819; robinson@pacific.harvard.edu

PARTNERS:

J. Bellingham, MIT Sea Grant; C. Chrysosostomidis, MIT Sea Grant; T.D. Dickey, UC Santa Barbara; D.V. Holliday, Tracor Applied Sci; E. Levine, NUWCDIUNPT; N.M. Patrikalakis, MIT Ocean Engin; D.L. Porter, JHU/APL; B. Rothschild, UMass-Dartmouth; H. Schmidt, MIT Ocean Engin.; K. Sherman, NMFS-NOAA

Objectives

Develop the concept of a generic, versatile and portable national littoral laboratory system, the Littoral Ocean Observing and Predictive system, including: the overall integrated systems concept, consisting of: a modular structure for linking observational networks and data assimilation algorithms; an efficient and robust integrated system software architecture and infrastructure. The system will act as the scientific and technical basis for: the application of LOOPS to scientific research and societal needs; the portability of LOOPS to diverse regions of the global coastal ocean.

Results

The partners have developed significant collaborative experience during the previous two years. This experience has developed in the areas of architecture and infrastructure conceptual design, systems integration, interdisciplinary multiscale data assimilation and interactive processes. real-time demonstration of concept and analysis of multiscale data base for coastal processes. The accomplishments are summarized in the table which follows.

The concept development effort has focused on: (1) defining and developing the conceptual basis for the software and database components; (2) researching and designing data and software standards; and, (3) designing the LOOPS architecture as a distributed, modular, flexible, and scaleable system that is compatible with a wide range of hardware and operating system platforms. The LOOPS system architecture uses CORBA for transparent communication between heterogeneous distributed oceanographic data and software resources. Ongoing development includes: (1) Metadata for data and programs. A prototype web-based dedicated system has been developed permitting creation and modification of a marine ontology for terms relevant to the ocean sciences, engineering, and management. (2) The development of an executive system concept for creating and executing workflows. (3) Wrappers for oceanographic simulation and analysis. Simple wrappers have been developed for two modules of HOPS (Harvard Ocean Prediction System) and an acoustic model used by the MIT Ocean Engineering Acoustics Lab. (the RAM PE developed at NRL).

Collaboration between the partners has led to the development of a fundamentally new formulation of the integral acoustic measurement problem. The result is an integrated ocean acoustic now- and forecasting capability with consistent handling of measurement and model errors (Acoustic Data Assimilation (ADA)). Also, research towards efficient parameterizations of sub-grid scale processes was initiated, tuning the scale-dependent eddy diffusions and viscosities of the HOPS Shapiro filter based on REMUS AUV turbulence/optics measurements.

The Massachusetts Bay Sea Trial (MBST-98) took place from 15 Sep. - 5 Oct., 1998. The sea trial's objectives included: engineering trials; system integration (sensors and platforms, observations and models); demonstration of concept (real time multifield nowcasting and forecasting). The scientific focus was *phytoplankton* and *zooplankton patchiness*, in particular, the *spatial variability of zooplankton and its relationship to physical and phytoplankton variabilities*. The specific scientific objectives were to: (1) obtain simultaneous synoptic physical and biological data sets in 4 dimensions, in order to characterize the spatial structures and variabilities, and the time evolution, of the physical fields and the concentrations of zooplankton and phytoplankton over a range of spatial scales; (2) assimilate data into a set of coupled interdisciplinary nested models to provide real time forecasts useful for adaptive sampling, and to validate the physical forecasts and evaluate the biological forecasts; and, (3) analyze and interpret the data, and interdisciplinary simulations with assimilated data, in order to generate testable hypotheses concerning dominant dynamical interactions among the circulation, productivity and ecosystem systems.

Statistical error models previously developed for other regions of the world's ocean were calibrated and verified for use in Mass Bay. Forecast and adaptive sampling methodologies were carried out in real-time for two months. The multiscale sampling strategies were based on ocean field forecasts assimilating all prior data (regions of most active or interesting dynamics) and on forecasts of errors and of data optimals (the future observation sensors and patterns that are expected to minimize the error variance forecast), subject to weather and operational constraints.

Table of Accomplishments

Concept Development

- defined conceptual basis for LOOPS software and databases
- researched data and software standards
- designed distributed LOOPS architecture around the CORBA concept and wrappers for legacy models
- web-based editors for metadata and executive system for workflows under development

Systems Integration

- implemented a prototype CORBA based system for HOPS and MIT acoustic models
- integrated UCSB optical sensors on MIT Odyssey AUVs
- identified technical issues for integration of HOPS and AUV simulation software

Interdisciplinary Multiscale Data Assimilation and Interactive Processes

- developed acoustical/physical data assimilation (ADA)
- research to determine model subgridscale parameterizations from turbulence measurements underway
- designed sea trial for coupled variabilities among physical, phytoplankton and zooplankton fields
- carried out OSSE in Mass. Bay for the Sea Trial with sensitivity analyses

Real-Time Demonstration of Concept

- Massachusetts Bay Sea Trial 15 Sep. - 5 Oct., 1998
 - *3 ships, Odyssey AUVs, REMUS AUV obtained 400+ CTDs; optical backscatter; fluorometer; acoustic zooplankton profiler; optical plankton counter; continuous plankton recorder; turbulence; AUV based CTD, fluorometer, ADCP, optical backscatter
 - *multiple streams of remotely sensed data
 - *HOPS set up in multiple two-way nested domains
 - *forecasted fields and errors
 - *real-time adaptive sampling (yesterday's data used today for tomorrow's forecast)

Analysis of Multiscale Data Base for Coastal Processes

- unique multiscale interdisciplinary data set to serve as basis of:
 - *interactive process analysis
 - *coupled biological/physical data assimilation
 - *OSSE data for next predictive skill experiment
- results to date include:
 - *identification of new patterns of circulation
 - *new understanding of interactions of wind flow and buoyancy flow events
 - *energetic fall biological blooms due to wind forcing, tidal mixing and external advection
 - *modeled chlorophyll variability is in general agreement with observations - processes under study

Group of Interdisciplinary Ocean Scientists and Engineers Experienced in Communication and Collaboration

TITLE: SOUTH ATLANTIC BIGHT SYNOPTIC OFFSHORE OBSERVATIONAL NETWORK

Harvey E. Seim, Lead Investigator
Skidaway Institute of Oceanography
Savannah, Ga

Partners: Skidaway Institute of Oceanography; Southeast Tactical Aircrew Training Service, U.S. Navy; University of North Carolina; University of Georgia; South Carolina Department of Natural Resources

Objective: To develop a multidisciplinary observational network based at eight platforms owned by the U.S. Navy in the South Atlantic Bight. High bandwidth two-way communication will allow real-time transmission of data to shore and remote control of the instrument systems. Observations will be distributed to scientific investigators, the weather services, and made available to the public.

Anticipated results: Measurements of atmospheric and oceanic properties and circulation will be used to study along- and cross-shelf exchange, air-sea interactions, nutrient dynamics, the fate of terrestrial organic matter on the shelf, bio-optical variability, and shelf primary production. A continuous underwater video system will also be deployed for monitoring the abundance and behavior of commercially important fish, contributing a new approach to regional fisheries management. The network will establish a monitoring system in the coastal ocean for assessing long-term trends while the real-time observations will assist forecasters in weather prediction. A data-assimilating circulation model will provide a synthesis of the observations and begin the development of a regional ocean forecast system.

Activities to date: All system components have been designed and are being fabricated and/or purchased and installed. During Phase 1 a single platform will be fully instrumented to test all system components and instruments. A prototype deployment system for the in-water sensors, which can be serviced without ship support, is to be installed in mid-February. A T1-bandwidth communications system has been designed and components are being installed or are on order. A suite of meteorological instruments based on the IMET system will be deployed by mid-March. Conductivity/temperature sensors, chlorophyll fluorometers, pressure sensors, acoustic doppler current profilers, PAR sensors, DOM fluorometers and a profiling attenuation meter have been purchased or are on order. Addressable serial communications interfaces are being used wherever possible within the data acquisition system, which is currently being constructed. Re-design of a time-series water sampler is nearly complete, which will permit conditional water sampling based on monitoring or predefined criteria. Permits for installation of an artificial reef near the platform for the fisheries video studies are being processed. Fabrication of the prototype underwater TV system is nearing completion, and various video compression algorithms are being investigated. Antifouling strategies for optical sensors and video equipment have been identified, and protocols for servicing and calibrating instruments have been defined.

Model developments including the ability to assimilate data from ADCPs, current meter and hydrography were successfully tested in an OSSE (Observational System Simulation Experiment) held at the North Carolina Supercomputing Center (NCSC) in December of 1998. We have begun to assemble and analyze hydrographic data for the SABSOON study site with the purpose of establishing a climatology of the temperature and salinity fields from the coast to the Gulf Stream. These fields will be available at least as a function of season and will form the background hydrography against which the data assimilation in the SABSOON project will take place. Design of the model mesh and the examination of bathymetry for the region has begun. The placement of the model boundaries and the internal model resolution is being examined in light of the structure of the bottom bathymetry, the location of the main coastal river discharge sites, and the spatial structure of the five principal astronomical tide constituents.

A series of atmospheric deposition collectors have been deployed on two of the offshore towers to assess atmospheric input of nutrients to South Atlantic Bight shelf waters. These collections began on an opportunistic basis in January 1998 and were expanded in August 1998. Analyses to date suggest that atmospheric inputs of fixed nitrogen and reactive phosphate greatly exceed river inputs to the SAB shelf.

TITLE: Monitoring the North Pacific for Improved Ocean, Weather and Climate Forecasts

Robert C. Spindel
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98006

Partners: Applied Physics Laboratory, University of Washington
Pacific Marine Environmental Laboratory, NOAA
National Environmental Satellite Data Service, NOAA
Naval Research Laboratory, Stennis Space Center
Scripps Institution of Oceanography

Objectives: The goal is to bring together a unique set of observational and modeling opportunities that currently exist within the partnering institutions and agencies to monitor the North Pacific Ocean. The ultimate purpose is to understand the effects of seasonal and decadal variability in the Pacific Ocean on short-term North American weather and climate to enhance forecasting and prediction.

Within this overall long-term goal, the specific objective of this initial partnership effort is to extend the current equatorial TAO array observations North of 20 N, and current ATOC acoustic measurements of integrated heat content to the south and west Pacific, and to combine these measurements with altimetric data in eddy-resolving ocean circulation models to produce optimal nowcasts and forecasts. Particular emphasis is placed on understanding the impact of the so-called Pacific Decadal Oscillation (PDO).

Anticipated Results: The result of this partnership will be improved short-term North American weather and climate forecasts.

Activities to Date: Substantial progress has been made:

An engineering test mooring was designed, instrumented and deployed at Ocean Weather Station Papa (50 N, 145 W). Real-time data from this mooring --wind speed, direction, humidity, air and sea temperature, rain rate, barometric pressure, subsurface currents and conductivity--have been made available to operational weather forecasters through GTS and are already being assimilated into weather forecast models in the US and Canada.

Acoustic data from the ATOC transmitters off California and Hawaii has been received at OWS Papa. Representative acoustic data has been supplied to NRL/SSC for assimilative testing.

NOAA/NESDIS is now supplying ERS-2 and GEOSAT Follow-On (GFO) data to the Navy for incorporation into NRL/SSC's eddy resolving Pacific models. This data has also been incorporated into NAVOCEANO's Altimeter Data Fusion Center. Real-time ERS-2 data is now included in the assimilation scheme of the global layered ocean model running at FNMOC.

The Pacific Decadal Oscillation has been studied using historical NCEP/NCAR data to assess the impact of SST anomalies on the atmosphere over the North Pacific, leading to the conclusion that the effect is significant and important.

TITLE: Consortium for Oceanographic Activities for Students and Teachers (COAST)

Sharon H. Walker, Ph.D., Associate Director for Outreach, The University of Southern Mississippi-Institute of Marine Sciences

P.O. Box 7000 Ocean Springs, Mississippi 39566-7000

E-Mail Address: sharonw@oar31.oar.noaa.gov

Phone: 301-713-2431 (ext. 148) and 228-374-5550 Fax: 301-713-0799 and 228-374-5559

Partner Institutions: The Office of Naval Research; The University of Southern Mississippi; Mississippi State University; St. Norbert College; the National Oceanic and Atmospheric Administration's (NOAA) National Sea Grant College Program; the National Marine Educators Association; the Command, Naval Meteorology and Oceanography Command; the Naval Oceanographic Office; the Office of the Oceanographer of the Navy; the State Sea Grant College Programs of Hawaii, Wisconsin, Washington, Delaware, New York, Mississippi-Alabama, Maine-New Hampshire, Minnesota, North Carolina, Oregon, and Virginia; North Carolina State University, Oregon State University; the University of Washington; the University of Minnesota; the University of Wisconsin; the University of New Hampshire; Cornell University; the College of William and Mary; the University of Delaware; the University of Hawaii; the Virginia Institute of Marine Sciences; the Hatfield Marine Science Center; the J.L. Scott Marine Education Center and Aquarium; NOAA's National Environmental Satellite, Data, and Information System; Palmer Johnson, Inc.; Butterfly Books;

the National Geographic Society; Silicon Graphics, Inc.; Web Services, Inc.; and up to 180 precollege teachers each of two years representing various public and private schools from this country's coastal and Great Lakes states, to include teachers from the U.S. territories of Puerto Rico and the Pacific Island Network.

Objectives: COAST is a working collaborative designed to effectively deliver oceanographic and coastal processes education to K-12 teachers. Each of the three, primary COAST sponsors offers expertise in different areas and through focused efforts at specific educational levels using the broadest spectrum of methodologies and materials for ocean science education, as well as a nationwide telecommunications infrastructure. The COAST partners include: Operation Pathfinder, represented by The University of Southern Mississippi, the National Sea Grant College Programs, 29 State Sea Grant College Programs, and the National Marine Educators Association, is a national inservice program for elementary and middle school teachers of predominantly minority students and the development of curricular materials; the Ocean Voyagers Program, represented by St. Norbert College, is a middle school teacher preservice training system featuring integrated curriculum development, World Wide Web page construction and maintenance, and teachers-to-sea (Sea Scholars) experiences; and STARBOARD (Stimulating Teachers About Resources for Broad Oceanographic Research Delivery), represented by Mississippi State University, is a high school level effort combining training with teacher-student research partnerships to leverage computational science tools for ocean science research.

Accomplishments: Each of these programs individually creates bridges between ongoing naval and academic research and formal and informal learning environments through focused precollege teacher education. Together, the COAST collaboration fuses the strengths of each partner to provide ocean science activities ranging from hands-on experiences aboard U.S. Navy survey ships and research vessels belonging to Institutions of Higher Learning, through Web-based instruction, curricular resources, and video-teleconferencing, to computational science and visualization of the highest quality. Each consortium partner is actively forging connections between research and the classroom in ways that all of the others may leverage and which may serve as national models. Operation Pathfinder provides hands-on experiences in marine research and empowers teachers to make these experiences relevant and exciting for their students. Ocean Voyagers works to place marine and ocean studies in a broad curricular context using, for example, literature, music, art, history, geography, and/or economics to provide participants with personally meaningful points of access to oceanographic studies. STARBOARD transforms U.S. Navy unclassified data and NOAA data into visual representations of complex problems and conditions in ways which make those data engaging, understandable, and useful in local contexts.

During the 1998 summer, 133 precollege teachers (128 graduate and five undergraduate students) attended one of six, 14-day Operation Pathfinder Institutes which were offered for college credit in six different regions of this country. The six content topics which were taught in each region encompassed: marine and aquatic habitats, deep sea technologies, marine and aquatic pollution, physical parameters, marine and aquatic resources, and plate tectonics. To enhance content implementation, this collaboration "brought in" 123 scientists, educators, social scientists, environmental managers, U.S. Navy and Coast Guard personnel, and commercial

fisherpersons to provide instruction and content re-enforcement. Participants in each regional Institute were involved in experiential learning through field trips for three, different days.

All Operation Pathfinder participants received grades based on staff development and homework presentations, one essay exam, a journal, and participation. All grades were A's and B's. Pre- and posttests were also administered to each participant using a t-test. Each region, at the .05 level indicated significance in comparison of the pre- to the posttest results. A Likert-scale attitudinal evaluation was administered to each participant in each region. The scale ranged from Very Valuable, to Valuable, to Average Value, to Limited Value, to Very Limited Value. All participating teachers rated the six content areas, their presenters, and the field-trips between 79-97 percent Very Valuable/Valuable and their perceptions at the Average/Limited Value varied from three to 21 percent.

When adding the 133 regional 1998 Operation Pathfinder participants to those teachers involved in these Institutes since 1993, there are 549 alumni. The "multiplier effect" of these teachers teaching an additional 20 teachers in their respective staff development programs translates into an additional 11,000 precollege teachers. These 11,549 teachers have the potential of reaching approximately five million precollege students over a five-year teaching career.

The Ocean Voyager team (in five of the six regions) focused on the development and implementation of integrated curriculum, using literature, geography, and history, directed at the marine sciences. This team also provided basic web navigation instruction and an introduction in the use of computer technology as a resource for developing ocean-related curricula. Prior to the 14-day regional Institutes, the Ocean Voyager team conducted a five-day workshop for 20 teachers, informal educators, and naval personnel. The focus of this workshop was on oceanographic and integrative curricular content, the development of program strategies, and the formation of long-term school partnerships. Additionally, prior to and following the Operation Pathfinder Institutes, 29 additional precollege teachers sailed on U.S. Navy oceanographic survey ships in the Atlantic Ocean, the Mediterranean Sea, and in the Gulf of Mexico for periods of four to ten days. Six high school students (five were winners of the 1998 National Ocean Sciences Bowl and one represented the Navy's State Science Fair Finalist in Mississippi for having the "best" oceanographic/meteorology project) also had the opportunity to experience this adventure during the 1998 Sea Scholars/Project Marco Polo adventure.

The STARBOARD component obtained six data sets from the U.S. Navy and NOAA. Based on these data sets, application development was focused primarily on an ocean data translator, an ocean current simulator, and a watershed experimentation tool. Participating teachers in each regional Institute were able to use these virtual interpretations to define the coordinates of latitude and longitude, ocean currents, Earth texture maps, and watersheds. Further, the STARBOARD team's sessions within the 14-day Institutes allowed interaction with teachers as they implemented visualization tools, 3-D objects, video and image capturing, digital imaging, presentation software, Web-page design, and an introduction to grant writing. The STARBOARD team has developed several modules for their Website which have been placed in two major categories: Physical and Chemical Parameters and Processes and Biota and Biotic Processes.

The 1998 teaches used for the first time the “best of the best” *Oceanography and Coastal Processes Resource Guide* which represented 79 of 1,410 activities which had been developed and field-tested by former Operation Pathfinder participants during 1993-1997. All 549 Operation Pathfinder alumni have copies of this *Resource Guide*. This *Resource Guide* will be place on CD-ROM in 1999 for greater distribution and cost efficiency.

The COAST homepage is <http://www.coast-nopp.org/> Each of the three COAST components has a Web address. These addresses are as listed below:

Operation Pathfinder’s homepage is <http://ims.ums.edu/~jlscott/>

Ocean Voyagers’ homepage is <http://voyager.snc.edu/>

STARBOARD’s homepage is <http://www.coast.nopp.org/starbord/>

At the end of December 1998, thirteen presentations had been made by the COAST partners at regional or national meetings or conferences. Six additional graduate students have been involved in this science education research effort. Five of these students are at Mississippi State University and one is at The University of Southern Mississippi.

Anticipated Results: It is anticipated that up to 180 teachers may be enrolled in the six 1999 Operation Pathfinder Institutes with similar implementation as described in 1998. Teacher recruitment is currently underway in each COAST region. The Ocean Voyager team, in combination with the Naval Oceanographic Office, is attempting to determine vessels of opportunity for placing teachers-to-sea during 1999. The STARBOARD team continues in coordinating visualization and electronic technology for additional interactive materials to be used by participants this summer on the interactive *Oceanography and Coastal Processes Resource Guide CD-ROM*.

**TITLE: Coastal Marine Demonstration of Forecast Information to Mariners for the U.S.
East Coast**

Leonard J. Walstad Horn Point Laboratory, University of Maryland Center for Environmental Science, PO Box 775, Cambridge, MD 21613-0775, 410.221.8477 fax: 410.221.8490, walstad@hpl.umces.edu.

George L. Mellor Program in Atmospheric and Oceanic Sciences, Department of Geosciences, Princeton University, Princeton, NJ 08544-0710, 609.258.6570 fax: 609.258.2850, glm@splash.princeton.edu.

Isaac Ginis Graduate School of Oceanography, University of Rhode Island, 215 South Ferry Road, Narragansett, RI 02882, 401.874.6484 fax: 401.874-6728, ig@cone.gso.uri.edu.

Glenn J. Szilagyi Litton-TASC, 4801 Stonecroft Blvd., Chantilly, VA 20151, 703.633.8300-x4875 fax: 703.449.1080, gjszilagyi@tasc.com.

Joseph S. D'Aleo	Weather Services International, 4 Federal Street, Billerica, MA 01921, 508.670.5165 fax:508.670.5100, jsdaleo@wsicorp.com.
Frank Aikman III	Coast Survey Development Laboratory, NOAA/NOS, N/CS13, Rm 7821, SSMC3, 1315 East-West Highway, 301.713.2809 x101 fax:301.713.4501, frank.aikman@noaa.gov
Laurence C. Breaker	Environmental Modeling Center, NOAA/NCEP, 5200 Auth Road, Camp Springs, MD 20748, 301.763.8133 fax:301.763.8545 lbreaker@sun1.wwb.noaa.gov.
Jeffery T. McQueen	Air Resources Laboratory, NOAA/OAR, SSMC3, Room 3152, Silver Spring, MD 20910, 301.713.0295 x135, jeffery.msqueen@noaa.gov.

LONG-TERM GOAL

Our long term goal is to estimate and predict the coastal and estuarine environment. Relevant atmospheric variables include wind, temperature, humidity, and visibility. Oceanic variables of interest include waves, currents, temperature, salinity, and water level.

OBJECTIVES

This collaboration will (1) demonstrate our current capability for estimating and predicting the environment in the Chesapeake Bay and the coastal ocean of the Mid-Atlantic Bight, (2) develop and apply new techniques for delivering marine information to users, and (3) continue to improve our ability to estimate the marine environment. Chesapeake Bay and the neighboring coastal ocean are heavily used for military, commercial, and recreational purposes. Marine environmental information is needed for safe and efficient operation in these waters. This is also a region for which there have been efforts to develop estimation and prediction capabilities. The Coastal Ocean Forecast System (COFS) (Aikman et al., 1996) has been applied to the East Coast of the United States for several years. The Chesapeake Area Forecast Experiment (CAFE) (Bosley and Hess, 1997) has been developed and evaluated as well. Other tools are now available including the Local Analysis and Prediction System (LAPS) (Albers, 1996) and the mesoscale ETA model (Black, 1994). At the same time, regional real-time observational systems are expanding and providing the data necessary for mesoscale forecasts.

APPROACH

We will conduct two demonstration periods. The first is scheduled for June-July, 1999. During these periods, estimates and forecasts will be delivered to participating users. Developing new methods for the delivery of these products is a significant component of this collaboration. Users need information in a form that is easily transmitted and effectively communicated. While new communications channels are attractive, most users will want information delivered through existing channels. The volume of information emanating from analysis and forecast systems may be overwhelming. Delivered information must be customized and synthesized. Examples of this type of customization are available at the Intellicast web site (<http://www.intellicast.com/>) which is a product of Weather Services International.

Our analysis and forecast suite includes COFS, LAPS, CAFE, and meso-ETA. A significant component of this project is the connecting of data streams between these systems. The GLERL

(Schwab, 1984) and SWAN (Holthuijsen et al., 1993) models are being applied to estimate the surface wave field. The output of these models and analyses will be delivered to the users as described above.

WORK COMPLETED

We are just beginning this project. Initial progress has been made on implementation of the LAPS, and we are making the connections between our models. Assimilation methodology continues to improve as partners collaborate.

Appendix 2.

Fiscal Year 1998 and 1999 NOPP funded University-National Oceanographic Laboratory System [UNOLS] Academic Ship Survey Schedules

2a - FY 1998 Academic Ship Survey Schedule

Ship	Institution	Dates	Days	Location
CAPE HATTERAS	Duke University/ University of North Carolina	4/3-5/1 10/28-11/25	56	Florida Coast
CAPE HENLOPEN	University of Delaware	5/25-6/15 11/1-11/21	42	Mid-Atlantic Physical Oceanography
KNORR	Woods Hole Oceanographic Institution	6/15 - 7/2	20	Autec Range
NEW HORIZON	Scripps Institution of Oceanography	4/28-6/9 10/3-11/18	86	Southern California
PELICAN	LUMCON	5/12-5/25 10/29-11/9	24	Gulf of Mexico
REVELLE	Scripps Institution of Oceanography	5/26-10/6	135	North Pacific Gravity Survey
SPROUL	Scripps Institution of Oceanography	4/21-5/4	14	Tanner Banks
THOMPSON	University of Washington	4/21-6/5 11/16-11/30	60	North Pacific Gravity Survey Northwest Coast Survey
WECOMA	Oregon State University	3/16-3/30	15	Littoral Ocean Pacific Northwest

2b - FY 1999 Academic Ship Survey Schedule

Ship	Institution	Dates	Days	Location
Pelican	LUMCON	2/8-2/22 5/13-5/22 11/5-11-20	40	Gulf of Mexico
Point Sur	Moss Landing Marine Lab	1/15-1/20 11/-11/23	30	Pacific coast, Monterey Bay
Cape Henlopen	University of Delaware	1/3-1/20 11/1-11/18	36	Mid Atlantic coast
Cape Hatteras	Duke University/ University of North Carolina	1/27-2/24 10/27-11/24	56	Mid Atlantic coast
New Horizon	Scripps Institution of Oceanography	1/5-1/24 3/30-4/18 11/1-11/20	60	Pacific coast
Revelle	Scripps Institution of Oceanography	2/19-5/4 7/20-10/8	150	W. Pacific, Sea of Japan
Thompson	University of Washington	4/28-5/16 9/24-10/13	40	Pacific N. W.
Melville	Scripps Institution of Oceanography	4/22-5/24	36	Central Pacific

Appendix 3. - National Ocean Research Leadership Council [NORLC] Meeting Minutes

21 April 1998

MEMORANDUM FOR THE RECORD

Subj: MINUTES OF THE 6 APRIL 1998 NATIONAL OCEAN RESEARCH
LEADERSHIP COUNCIL MEETING

1. These are the minutes of the third National Oceanographic Partnership Program (NOPP) National Ocean Research Leadership Council (NORLC) meeting held in the Truman Room of the White House Conference Center on 6 April 1987.

The Chair called the meeting to order at 2:10 p.m. and welcomed Council members to the third NORLC meeting. Attending:

Mr. John Dalton, Secretary of the Navy (Chair)

Dr. D. James Baker, Administrator, National Oceanic and Atmospheric Administration
(Vice-Chair)

Dr. Joseph Bordogna, representing the Director, National Science Foundation

Dr. Robert Schiffer, representing the Administrator, National Aeronautics and Space
Administration

Dr. Lawrence Reiter, representing the Administrator, Environmental Protection Agency

RADM James Hull, representing the Commandant, United States Coast Guard

Dr. Bonnie McGregor, representing the Director, United States Geological Survey

CAPT John Polcari, USN, representing the Director, Defense Advanced Research
Projects Agency

Ms. Cynthia Quartermann, Director, Minerals Management Service

Dr. Duncan Moore, representing the Director, Office of Science and Technology Policy

Dr. Ari Patrinos, representing the Deputy Secretary, Department of Energy

Mr. Kenneth Schwartz, representing the Director, Office of Management and Budget

2. Opening Remarks

The Chair welcomed all participants and, after asking all attendees to introduce themselves, introduced Dr. Steven E. Ramberg, chair of the NOPP Interagency Working Group. Dr. Ramberg provided the NORLC with the final list of individuals recommended as nominees to serve on the Ocean Research Advisory Panel (ORAP) and indicated that all have agreed to serve if asked.

3. Consent Calendar

The consent calendar was approved as presented and included the following items:

- Process for NORLC Chair/Vice Chair designation
- NOPP Review Process
- ORAP Process
- FY 1999 Plans

4. Review of NOPP Progress To Date

Dr. Ramberg reviewed the status of the FY 1997 program and the FY 1998 proposal review process.

The FY97 funded science and education projects are well underway, including field efforts. Progress reports have been received for all eleven projects (and were provided to all members of the NORLC) - six scientific and five educational - as well as for MEDEA.

The NOPP FY98 proposal selection process has been completed. There were 72 proposals received in response to the Broad Agency Announcement - 54 in Topic A (Observations) and 18 in Topic B (Prediction). Approximately \$110 million was requested and \$91 million in cost sharing was proposed. The review process for this year involved individual peer reviews solicited by mail and peer review panels. On average each proposal received almost three reviews. The panel reviews (separate for Topic A and Topic B) involved 2 panel chairs plus 13 panelists. The panels recommended their top proposals for funding and the NOPP IWG reviewed these final recommendations. The final package of proposals recommended by the IWG included six efforts in Observational Systems (\$8.6M total), two efforts in Sensors (\$2.3M total), four efforts in Modeling and Data Assimilation (\$8M total) over the next two years, and included supplemental funding committed by the National Science Foundation. A list of the specific proposals is as follows:

Observational Systems

- “South Atlantic Bight Synoptic Offshore Observational Network”
 - Harvey E. Seim, Skidaway Institute of Oceanography
 - US Marine Corps, U. Georgia, South Carolina Dept. Marine Resources, U. North Carolina, NOAA, EPA
 - ~\$1.6M over 2 years
- “Ocean Acoustic Observatory Federation”
 - John A. Orcutt, Scripps Institution of Oceanography
 - NOAA, Oregon State University, Naval Postgraduate School, Univ. Washington
 - ~\$2.7M over 2 years
- “Developing Long Range Autonomous Underwater Vehicles for Monitoring Arctic Ocean Hydrography”
 - J.G. Bellingham, Massachusetts Inst. of Technology
 - Florida Atlantic Univ., Woods Hole Oceanographic Inst., Scientific Solutions, Inc., Fuel Cell Technologies, Inc., NOAA/PMEL
 - ~\$2.7M over 2 years
- “A Near-Real-Time, High-Resolution, Ocean-Surface-Current Mapping System”
 - Thomas M. Georges, NOAA/ETL
 - U.S. Navy, Raytheon, Univ. Colorado
 - ~\$500K over 2 years
- “Design Study for NEPTUNE: A Fiber Optic Telescope to Inner Space”
 - John R. Delaney, University of Washington
 - Woods Hole Oceanographic Inst., NOAA/PMEL, NASA/JPL
 - ~\$500K over 2 years

- “Oceanographic and Fisheries Data Collection and Telemetry From Commercial Fishing Vessels”
 - Ann Bucklin, University of New Hampshire
 - Massachusetts Inst. Technology, Woods Hole Oceanographic Inst.,
Alphatron Mfg. Inc., Clearwater Instrumentation, Inc., Portland Fish Exchange
 - ~\$645K over 2 years

Sensors and Sensing

- “Oceanographic-Systems for Chemical, Optical, and Physical Experiments”
 - Tommy D. Dickey, University of California, Santa Barbara
 - NOAA/PMEL, NOAA/AOML, Monterey Bay Aquarium Research Inst.,
Bermuda Biological Station for Research, Univ. South Florida, WET Labs, Inc.
 - ~\$2.0M over 2 years
- “Low Cost Modular Telemetry for Coastal Time-Series Data”
 - Bradford Butman, U.S. Geological Survey/ Woods Hole
 - Woods Hole Oceanographic Institution, RD Instruments, Inc.,
Massachusetts Water Resources Authority, U.S. Coast Guard
 - ~\$290K over 2 years

Modeling and Data Assimilation

- “An Innovative Coastal-Ocean Observing Network (ICON)”
 - Jeffrey D. Paduan, Naval Postgraduate School
 - Univ. Michigan, California State Univ. at Monterey, Univ. Southern Mississippi,
Naval Research Lab, HOBI Labs, Inc., Monterey Bay Aquarium Research Inst.,
CODAR Ocean Sensors, Ltd.
 - ~\$2.4M over 2 years
- “Demonstration of a Relocatable Regional Ocean Atmosphere Modeling System with Coastal Autonomous Sampling Networks”
 - Scott M. Glenn, Rutgers University
 - Woods Hole Oceanographic Inst., Naval Undersea Warfare Ctr., Webb Research Corp., CODAR Ocean Sensors, Ltd., RD Instruments, Inc., US Geological Survey
 - ~\$990K over 1.5 years
- “The Prediction of Wind-Driven Coastal Circulation”
 - Allen, John S., Oregon State University
 - Ocean Imaging, Inc., CODAR Ocean Sensors, Ltd., NOAA/NMFS, NOAA/ETL
 - ~\$3.0M over 2 years
- “Coastal Marine Demonstration of Forecast Information to Mariners for the U.S. East Coast”
 - Leonard Walstad, University of Maryland
 - TASC, Inc., Weather Services International, Inc., Princeton Univ., Univ. Rhode Island, Naval Research Lab, Naval Meteorology and Oceanography Ctr.,
USN/COMNAVSURFLANT, Inst. Of Technology and Graduate Studies, Commercial fisheries
 - ~\$2.0M over 2 years

These projects represent 61 institutions in 17 states (plus Bermuda).

The NORLC approved this package of proposals and agreed to have initiate funding accordingly.

5. Year of the Ocean (YOTO) Activities

The IWG Vice-Chair, Dr. D. James Baker reported on federal activities for the International Year of the Ocean. The NOAA YOTO Discussion Papers (white papers) have been completed and delivered to Members of Congress and 2000 other individuals. The complete text should be available on the World Wide Web by the end of April. The Heinz Center YOTO workshops have been completed and the issue papers are almost completed. The themes of these papers are science and technology, sustainable coasts, and marine fisheries. The preliminary findings include the importance of balancing use and conservation for a sustainable future and rethinking how we do business to advance that goal. The papers should be available by the end of May. A National Oceans Conference has been scheduled for 11-12 June at the Naval Postgraduate School in Monterey, CA. There will be 800 invitees, including Cabinet Secretaries, members of Congress, and individuals representing federal agencies, the private sector, non-governmental organizations, and academia. Other activities celebrating the Year of the Oceans include the National Ocean Sciences Bowl; the USGS Open House and Earth Day celebration; the MMS National Conference of State Legislators; the World Exposition in Lisbon, Portugal; the NASA/NOAA International Conference on Satellites, Oceanography, and Society, in Lisbon; the EPA/NOAA/Center for Marine Conservation Coast Week and National Estuary Day; the Ocean Studies Board symposium of NSF's role in 50 years of ocean science; the Marine Technology Society Ocean Community Conference in Baltimore, MD; and the USGS/NOAA Powers of Nature travelling exhibit on earthquakes, storms, and volcanoes.

Dr. Ellen Prager, USGS, presented an update on the NOPP YOTO Drifter Project. The project will deploy 208 drifters - 116 in the Caribbean, 80 in the tropical Atlantic Ocean, two in the north Atlantic, and 10 to be released in other locations as opportunities arise. All 208 will provide information on location and sea surface temperature; ten will also bear sensors, which will provide information on windspeed, and another ten will also bear sensors that will provide information on ocean color. Agencies, which are providing additional funding to the project or in-kind services, are ONR, NSF, MMS, USGS, DOE, USCG, and NOAA. Other contributors of in-kind services to the project include the GLOBE program, NOPP education project leaders, scientists from universities or government laboratories, and the National Geographic Society.

Scientific benefits of this project will include:

- Multi-use data acquisition for ocean research (ocean currents; transport of heat, sediment, larvae, pollutants; climate modeling, ground-truthing of remotely-sensed data)
- Mechanism to translate science to broad audience
- Network hub for drifter databases worldwide

Education benefits of this project will include:

- Improvement in ocean science education
- Enhancement of science and math instruction
- Facilitation of student use of scientific data and methods
- Interactions among teachers, students, and research scientists

- Connections to geography, environment and pollution, fisheries, weather and climate, and geology

In order to aid with all of the above, the Drifter Project has, with the help of the DOE Oak Ridge National Laboratory, established a website at drifters.doe.gov which will contain direct links for data, drifter positions and tracks as well as to other drifter databases; educational activities such as track-a-drifter, build your own drifter, and ask-an-oceanographer; and reference images and explanatory text.

6. Outyear NOPP Plans

Dr. Don Scavia, NOPP IWG Vice-Chair provided an update on the Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) program which is jointly sponsored by NOAA, NSF, EPA, ONR, NASA, and USDA. This program has been made a part of NOPP this year. ECOHAB will have \$4 million this year, of which \$3 million is designated for research on the toxic dinoflagellate, *Pfiesteria piscicida* and Pfiesteria-like organisms. FY97 funds have been used and the remaining FY98 funds will be used for regional projects and comparative studies, and smaller, targeted studies. This year, the review process for proposals is similar to last year's and to this year's NOPP process. The mail-in peer reviews are due to NOAA and the NOPP Program Office at CORE by 24 April. The review panel will be held on 5-7 May 1998 at the NOPP Program Office. The announcement of awards should be made this summer.

Dr. Ramberg, IWG Chair, presented the final version of the NOPP 2000 report which will be discussed with the Ocean Research Advisory Panel. NORLC members felt that the document needed more focus and a greater emphasis on how NOPP differs from other ocean science research programs. These comments will be passed on to the ORAP for consideration.

At the request of the Chair, agencies summarized their out-year plans for the Council. The plans for all agencies were discussed by Council members; the following elements are included in those plans:

- ONR has requested \$10 million for NOPP in the FY99 6.2 budget line
- NSF has requested \$5.5 million for partnership programs, including NOPP, in its proposed FY99 budget
- NOAA has requested \$2 million in its FY99 budget for ECOHAB and the Gulf of Mexico initiative, both of which will be part of NOPP
- All other agencies indicated an intent to develop long term support for NOPP, and a high level of satisfaction with the interagency activity in the program to date.
- OMB suggested that agency requests for NOPP funding be tabulated and submitted as an integrated program in order to make it easier for that office to see where the funds are being requested
- OSTP has a technology group which meets weekly to discuss emerging issues; one focus is on marine technology. NOPP agencies are encouraged to submit suggestions to this group.

The Chair invited Admiral James D. Watkins, USN (Ret), President of the Consortium for Oceanographic Research and Education to comment on current activities in ocean research. Admiral Watkins indicated that the National Academy of Sciences is preparing a statement of 'Grand Challenges' for ocean research. In citing the pending report from the Ocean Studies Board on Oceans and Human Health, and the ongoing Congressional Science Policy study (directed by Rep. Ehlers), Admiral Watkins noted that this year could provide unique opportunities for making strong arguments in support of ocean research.

7. Oceans Act Update

The Vice-Chair provided a status report on Congressional activity related to the development of an Ocean Commission (several bills are in debate in both the House and the Senate). All versions are supportive of the establishment of a short-term Commission. The Vice-Chair recommended that the NORLC begin to think about individuals who could be nominated to serve on such a commission.

8. Other Business/ Summary

The Chair indicated a desire to have the NOPP promoted more strongly within the scientific community. The Chair requested that the IWG schedule the next NORLC meeting for the fall. There was no further discussion. The Chair thanked all participants for attending and the meeting adjourned at 3:45 p.m.

Summary of Approvals/ Actions

Approved for Action:

- Process for NORLC Chair/Vice Chair designation
 - The Executive Steering Committee will develop nominations by 01 Oct 98
 - The NORLC will confirm the next Chair/Vice Chair at the Fall 98 meeting
- NOPP Review Process
 - The IWG will establish a formal NOPP review procedure in consultation with the ORAP, for NORLC approval at the Fall 98 meeting
- ORAP Process
 - The IWG will initiate the ORAP process, immediately after the ORAP is officially established
- FY 1999 Plans
 - The IWG will prepare solicitations for release by 1 SEP 98
- NOPP promotion
 - The IWG will develop a campaign of meetings, conferences and related opportunities for promoting NOPP within the scientific community. The plan will be presented for approval at the Fall 98 meeting.

Approved:

- FY 1998 Proposal Package

13 November 1998

MEMORANDUM FOR THE RECORD

Subj: MINUTES OF THE 26 OCTOBER 1998 NATIONAL OCEAN RESEARCH
LEADERSHIP COUNCIL MEETING

1. These are the minutes of the fourth National Ocean Research Leadership Council (NORLC) meeting held in the Truman Room of the White House Conference Center on 26 October 1998. The Chair called the meeting to order at 10:00 a.m.

Attending:

Mr. John Dalton, Secretary of the Navy (Chair)

Dr. D. James Baker, UnderSecretary of Commerce for Oceans and Atmosphere (Vice-Chair)

Dr. Michael Purdy, representing the Director, National Science Foundation

Dr. Robert Schiffer, representing the Administrator, National Aeronautics and Space
Administration

Captain Dennis Ihnak, representing the Commandant, United States Coast Guard

Dr. Thomas Casadevall, Acting Director, United States Geological Survey

Captain Albert C. Myers, USN, representing the Director, Defense Advanced Research
Projects Agency

Ms. Cynthia Quarterman, Director, Minerals Management Service

Dr. Michael Riches, representing the Deputy Secretary, Department of Energy

The US Environmental Protection Agency, the Office of Science and Technology Policy and the Office of Management and Budget were not represented.

AGENDA

2. Opening Remarks

The Chair welcomed all participants and, after asking all attendees to introduce themselves, and introduced Dr. Steven E. Ramberg, chair of the NOPP Interagency Working Group to address the next Agenda item.

3. Consent Calendar

Two Consent Calendar items were approved as presented:

- NORLC Chair/Vice Chair designation
- NOPP Proposal Review Process

The substance of these two items are:

The Secretary of the Navy and the Undersecretary of Commerce for Oceans and Atmosphere shall continue as Council Chair and Vice Chair respectively, through Fiscal Year 2000.

The procedures for review and selection of proposals as developed by the NOPP IWG were approved.

4. Update and Plans

A. FY98 and FY98 Update

Dr. Ramberg provided a brief update on Partnership projects funded in FY97 and FY98. The NORLC questioned if the research community is supporting this program. Dr. Ramberg reported general community support, but suggested wider dissemination about Partnership Program opportunities would benefit all concerned. The NORLC indicated satisfaction with the existing program, but cautioned the Program must grow to survive.

B. FY1999 Broad Agency Announcement

A summary of potential research topics to be funded in this fiscal year's NOPP program was presented. Three potential research areas were discussed:

i) Data Assimilation and Modelling Initiative.

This topic will include two types of proposals and would be supported by NSF, NASA, ONR, and possibly NOAA.

ii) Ocean Observation Capabilities.

This topic will focus on sensors and measurement techniques for chemical, optical, and biological variables in three-dimensional space and time. Support from ONR, NSF, and NOAA is anticipated.

iii) Hypoxia in the Gulf of Mexico.

This topic will focus regional field and modeling studies that will examine the effects on

hypoxic zone in the Gulf of Mexico. This effort would be supported by NOAA and EPA. Dr. Scavia, Senior Scientist for NOAA's National Ocean Service and Vice Chair of the NOPP, indicated that NOAA will not be able to support this effort in FY99 due to cuts in the NOAA budget request. This topic will not, therefore, be contained in the BAA when it is released in early November.

Other FY99 NOPP issues, including the Year of the Oceans Drifter Project and the oceanographic surveys being conducted using University National Oceanographic Laboratory System (UNOLS) research vessels were discussed.

Dr. Ramberg informed the Council of the Office of Naval Research decision to target one of its FY99 Small Business Innovative Research (SBIR) topics on an area of interest to NOPP. There was discussion regarding the application of this approach by other NOPP Agencies through their SBIR programs.

C. Ocean Research Advisory Panel Update

Dr. John Knauss, Chair of the ORAP, presented a brief summary of the results of the first meeting of the ORAP, held 9 September 1998 in Washington, DC. The ORAP believes that its primary role is to identify the most important and useful ocean research and education topics to be addressed by the Program. Concerns about the Program raised by the Panel included:

- the duration of the grants, which the ORAP felt should be increased;
- the need to embed education efforts into the program;
- and the need for greater communication about and outreach on NOPP to groups beyond the scientific research community.

The ORAP also considered the request from Congressmen Saxton and Weldon for an integrated ocean observations plan. The Panel felt that this request was timely and needs to be addressed in a very focused way. At the next ORAP meeting, tentatively scheduled for April or May 1999, the ORAP will discuss the plan for an ocean observation system and has requested that more information be provided on the success (or lack of success) of NOPP projects.

It was noted that the FY99 NOPP Research Solicitation was changed in response to ORAP concerns. The proposal/project duration is longer and education/outreach efforts are sought as integrated parts of the proposed research projects.

5. Legislative Actions

A. Ocean Observations Plan

The Chair and Vice Chair of the NORLC received letters in August 1998 from Congressmen Curt Weldon (R-PA) and James Saxton (R-NJ), the Chairs of the Subcommittee on Military Research and Development and the Subcommittee on Fisheries Conservation, Wildlife, and Oceans, respectively. These letters requested the NORLC to “propose a plan to achieve a truly integrated ocean observing system”. NOAA volunteered to take the lead on behalf of the NORLC to prepare a plan in response to this request, which is due by 15 January 1999, and provided a proposal to respond to the request. The response would consist of two separate documents. First would be a letter presenting the broad outline of an integrated ocean observations plan to be provided by the 15 January deadline (or after submission of the President’s budget if staffers concur). The second document would be a fuller version of the plan to be presented later, preferably by May/June 1999. Both the broad outline and the more detailed plan will be developed by a working group chaired by Dr. Worth Nowlin, Texas A&M University, the chair of the international Global Ocean Observation System (GOOS) Committee. This working group will consist of both federal and non-federal scientists who have familiarity with related efforts already underway, (GODAE, CLIVAR, etc.). The plan will be reviewed by the ORAP and forwarded to the NORLC for approval.

B. Sound Surveillance System Data Plan

Language in the Conference Report to the FY99 Defense Appropriations bill (H.R. 3616) requested the Chair of the NORLC to conduct an assessment for a variety of purposes of the Sound Surveillance System (SOSUS) arrays run by the Navy. The Chair is requested to report on this issue in the FY99 NOPP Report to Congress (due 1 March 1999). The NORLC agreed that certain aspects of this issue may be addressed through the development of the overall ocean observation system but that the request must be addressed in the Annual Report. The IWG will handle this issue and report to the NORLC on its progress.

C. National Science Foundation/ Ocean Studies Board Report

The FY99 VA-HUD Appropriations Bill (H.R. 4194) conference report contained language requesting the NSF Director to “communicate the findings of the [Ocean Studies Board ‘Grand Challenges’] report and counsel with the National Ocean Leadership Council . . . to define ocean science initiatives that will help realize the economic and environmental benefits described in the report”. The representative from NSF indicated that Director of NSF will report on this issue to the NORLC at the Spring 1999 meeting.

6. Other Business

ADM J. Watkins, President of the Consortium for Oceanographic Research and Education, spoke briefly on the failure of Congress to pass the Oceans Act. Comments from the NORLC on this issue were requested. The NORLC indicated that Congress seemed generally to feel that the Act was a good idea and that its failure to be passed was more the result of lack of time rather than a lack of popularity. The view was expressed that it may be reintroduced in the next Congress.

Secretary Dalton announced that on he will step down as Secretary of the Navy 16 November 1998. He will be replaced by Richard Danzig, who will assume the Council Chair.

Secretary Dalton was presented with a letter from Congressman Curt Weldon expressing thanks and appreciation for his work as Chair of the NORLC.

The next meeting of the NORLC will be in Spring 1999. At this meeting, the IWG will report on the FY99 funding recommendations, if the review process has been completed by then; the NOPP ocean observations plan; and the response to the SOSUS data and NSF/OSB language.

6. Summary of Approvals/ Actions:

Approved for Action:

- The Secretary of the Navy and the UnderSecretary of Commerce for Oceans and Atmosphere shall continue as NORLC Chair and Vice Chair, respectively.
- NOPP Review Process
 - The NOPP shall implement the proposal review process as approved by the NORLC, beginning with the FY99 submitted proposals.
- Ocean Observation Plan
 - On behalf of NOPP, NOAA will coordinate the effort.
 - The NOPP IWG and ORAP will review and forward the ocean observation plan documents to the NORLC for approval.
- SOSUS Data Plan
 - The IWG, under Navy lead, will develop a process for handling this request on behalf of the Chair of the NORLC.
 - This plan will be included in the 1 March 1999 NOPP Report to Congress.
- NSF/OSB Report
 - NSF will report to the NORLC at the Spring 1999 meeting on its plan to address this request.

Appendix 4. - NOPP Ocean Research Advisory Panel

MEETING REPORT AND SUMMARY

9 September 1998

Introduction

The first meeting of the Ocean Research Advisory Panel (ORAP) of the National Oceanographic Partnership Program (NOPP) was held 9 September 1998 in Washington, DC. A list of Panel Members and their biographies is attached. The meeting was moderated by Dr. Robert Frosch and assistance was provided by the Department of the Navy point-of-contact for the Panel (Dr. Steven Ramberg). The meeting included a general session which was open to the public, and an executive session which was closed. A summary of activities and recommendations follows.

General Session - Synopsis

The ORAP was briefed on the Partnership Program, its background, goals, and current funding status, including existing research and education projects as well as operational ocean surveys using academic fleet vessels. The Panel discussed a wide range of issues associated with programmatic and process, and made the following general observations and recommendations. Background materials will be retained at the NOPP Program Office for ORAP and public access.

NOPP PROGRAM PHILOSOPHY

- There are two characteristics of the NOPP that make it a unique and significant program in oceanography. One is the emphasis on successful development of broad partnerships among funding agencies and among performers in government, academia, and industry: fostering a culture of partnership. In this regard, the ORAP feels that in just the first year of its operations NOPP has supported unique new approaches to ocean research which, as a coherent group, would not have been supported within the traditional mechanisms of funding. The second aspect is the blend of technical and policy issues which are addressed by the program.
- The ORAP discussed its role with respect to responsibilities beyond the immediate domain of the National Oceanographic Partnership Program. The ORAP feels that NOPP is more than just a funding program. It is a program which not only identifies and funds crucial technical research and education in oceanography but also exists to guide and coordinate national federal policy on oceanographic research and education. As such, NOPP can serve a leading role in aiding decisions about the direction for ocean research and education. The ORAP feels its responsibilities for advising NOPP fall into three contexts: activities requiring immediate actions (such as responding to the Saxton/Weldon letter, as identified below), long-term visionary guidance for the program, and, continuing activities.

NOPP PROGRAM PRACTICES AND STRUCTURE

- The role of education in the research projects supported by NOPP must be addressed specifically. The ORAP feels that the integration of education into research must be advocated in NOPP and not treated as a separate endeavor.
- There is a need to address the funding of projects for periods longer than the one or two years currently covered by NOPP. The responsibility for sustaining important research and educational efforts must be balanced with the objective of NOPP to serve as an incubator for new partnerships, all within available resources.
- There is a need to develop stronger public outreach for NOPP in order to foster public support of integrated ocean policy, research, and education. Enhanced visibility, especially for the early successes of the program, is important during the first years of the program. There is also a need to attract and foster a more diverse community interested in the oceans and ocean research.
- NOPP should try to encourage increased participation in the program by industry, state and local governments, and non-profit, non-government entities, particularly in the area of data acquisition (see Observations and Data sections below). This would enable the program to better study regional and local problems as part of the effort to build an overall understanding of the oceans. This would also enable the program to develop more “grass roots” support.

OCEAN OBSERVATIONS

- One of the most pressing concerns in oceanography is the need for integrated ocean observation systems. There is no coherent federal policy on these systems, which has resulted in an inability of the research community to commit to existing, proposed observation system plans or to react to initiatives by the other nations to develop such systems.
- An area where NOPP could play a significant role is in providing guidance, coordination (national and international), and funding for ocean observation systems, management of data from those systems, and assimilation of those data into ocean-atmosphere models.

The ORAP was also briefed on a letter sent to the Chair and Vice-Chair of the National Ocean Research Leadership Council (NORLC) of the NOPP (respectively, the Secretary of the Navy and the Administrator of NOAA). This letter was sent by Congressmen Jim Saxton and Curt Weldon of the House Subcommittee on Fisheries Conservation, Wildlife, and Oceans and the Subcommittee on Military Research and Development, respectively. This letter requested the NORLC to provide them with a plan “to achieve a truly integrated ocean observing system.” The ORAP was asked to render an opinion on the response which should be developed by the NORLC.

- The ORAP agreed that a single, overall plan for an ocean observation system is required but that this would be a large and difficult effort. There are a number of existing global and coastal efforts which should be used as the basis for developing the larger plan and the overall plan would be best developed as a series of smaller pieces which integrate the existing efforts. Issues addressed by the plan should include the identification of data users, providers, and developers as discussed below.

DATA

- Ocean data issues should be addressed in terms of the identification of data users (or consumers) and their needs, the identification of data providers and their needs, and the identification of system developers to serve both. Important questions include how and where data are collected and by whom, why they are collected, how data quality is handled, and how data accessibility is ensured. Recognizing the extent to which these issues are being addressed by a range of disciplines, the ORAP feels that connectivity between NOPP and efforts such as the National Science Foundation Knowledge and Distributed Intelligence initiative (KDI) would be a fruitful endeavor.
- The ORAP noted that outreach to marine industry and improved access to data required by all levels of government regulation might be rewarding activities to pursue.

Executive Session - Synopsis

In closed session, the ORAP discussed a number of issues, including panel procedures and the NOPP FY99 Broad Agency Announcement/ Request for Proposals.

Members of the ORAP selected a Chair and Vice Chair. The Chair will be Dr. John Knauss and the Vice-Chair will be Dr. Robert Frosch. The ORAP agreed to meet twice a year with meetings in the fall and spring prior to the semi-annual meetings of the NORLC. The ORAP expressed interest in hearing reports from NOPP principal investigators and participants from all the partnering sectors (academia, government, industry) at future ORAP meetings in order to assess the impact of the partnering.

The ORAP was also addressed by the President's Science Advisor, Dr. Neal Lane. Dr. Lane provided background on the President's request at the Ocean's Conference for recommendations from the Cabinet on ocean policy. Dr. Lane invited NOPP and the ORAP to provide input on the importance of science and technology in such a policy, and to provide specific advice on the science and technology needs in world ocean policy.

Recommendations for the Next Meeting

The ORAP discussed the next meeting which will be held in spring 1999, some time prior to the spring meeting of the NORLC. At some point before the meeting, input will be

solicited from the ORAP members for items to be discussed. A draft agenda will also be provided for comments and revision by the Panel. In the meantime, the ORAP agreed that it would like to see presentations at the next meeting by funded NOPP investigators, preferably several partners from one project so that they may hear how well a project is working. The NOPP IWG and Program Office will work with the NOPP investigators to select appropriate individuals for such presentations.

ORAP Short Biographies

Dr. Bruce Alberts: Born in Chicago, Dr. Bruce Alberts graduated from Harvard College in 1965 with a degree in biochemical sciences and from Harvard University in 1965 with a doctorate. In 1966 he joined the faculty of Princeton University, ten years later he was appointed professor and vice chair of the department of biochemistry and biophysics at the University of California, San Francisco (UCSF). He was awarded an American Cancer Society Lifetime Research Professorship in 1980. UCSF named him chair of the department of biochemistry and biophysics and Faculty Research Lecturer. He has chaired the National Research Council's Commission on Life Sciences and was principal author of *The Molecular Biology of the Cell*. Currently, he is the President of the National Academy of Sciences.

Dr. Vera Alexander: Born in Budapest, Hungary, Dr. Vera Alexander graduated with a bachelor of arts degree and master of science degree from the University of Wisconsin, and in 1965 she graduated from the University of Alaska with a doctorate. From 1965 through 1974 she was an Assistant, then an Associate Professor at the University of Alaska Fairbanks. From 1974 to present, Dr. Alexander has been a Professor of Marine Science at the University of Alaska Fairbanks. Other accomplishments while at the University of Alaska Fairbanks include: Dean of the College of Environmental Sciences, 1984-1984; Director of the Institute of Marine Science, 1980-1993; Dean, School of Fisheries and Ocean Sciences, 1989-present. She is currently involved in a variety of activities, some of which include Commissioner of the United States Marine Mammal Commission; Member, Science Advisory Board to NOAA; and U.S. Delegate to North Pacific Marine Science Organization.

Dr. Richard A. Anthes: Born in St. Louis, Dr. Richard Anthes graduated from the University of Wisconsin-Madison with a bachelor degree, a masters in 1967, and a doctorate in 1970. In 1971, he began teaching at Pennsylvania State University, and attained full professorship in 1978. During this time he also conducted research and taught at the Naval Postgraduate School in Monterey, CA. In 1981 he became the director of the National Center for Atmospheric Research (NCAR) Atmospheric Analysis and Prediction Division and, in 1986, he became director of NCAR. The University Corporation for Atmospheric Research (UCAR) selected him to become president in 1988, and he remains in that position today. Dr. Anthes has received the AMS awards: Clarence L. Meisinger Award and Jule G. Charney Award, and was elected as an American Meteorological Society Fellow in 1979.

Dr. Alfred Beeton: Born in Denver, Dr. Alfred Beeton enrolled in the University of Michigan where he received a bachelors of science in 1952, a master of science in 1954, and a doctoral degree in 1958. He received an Honorary doctoral degree in science from the University of

Wisconsin-Milwaukee in 1996. Dr. Beeton held numerous positions at the University of Michigan from 1976 to 1986, including Director, Great Lakes Marine Waters Center; Professor of Natural Resources; Professor of Atmospheric and Oceanic Science; and Director, Michigan Sea Grant College Program. He has also taught at Wayne State University and the University of Wisconsin-Milwaukee where he helped establish the Center for Great Lakes Studies and served as Associate Dean of the Graduate School. From 1986 through 1996, he was Director of the Great Lakes Environmental Research Laboratory. In 1996 he then became Acting Chief Scientist of the National Oceanic and Atmospheric Administration. Since retiring from his position at NOAA, Dr. Beeton is currently associated with the University of Michigan, Department of Environmental and Industrial Health, School of Public Health, as an adjunct professor. He has served on Boards and Committees of NAS/NRC and the International Joint Commission, and is presently Chair of the Science Advisory Board of NOAA.

Dr. Otis Brown: Dr. Otis Brown graduated from North Carolina State University with a bachelor of science degree in 1966. He continued his education at the University of Miami, receiving a masters of science degree in 1968 and a doctorate in 1973. From 1970 through 1983 he was a Research Assistant, Research Associate, Research Assistant Professor, Research Associate Professor, and an Associate Professor at the University of Miami. He was Acting Chairman, Meteorology and Physical Oceanography Division (MPO), from 1984 to 1985, and Chairman, MPO, from 1985 through 1989. He became a full Professor in 1987; Associate Dean for Research, Rosenstiel School of Marine and Atmospheric Science (RSMAS) in 1989; and Dean, RSMAS, in 1995. He was the recipient of NASA's Public Service Group Achievement Award (1985); AGU Editor's Citation for Excellence in Refereeing, Journal of Geophysical Research - Oceans (1990); and the American Association for the Advancement of Science Fellowship (1995).

Dr. John Dane, III: Dr. John Dane graduated with a bachelor of science degree and doctoral degree in civil engineering from Tulane University. He began his career with Halter Marine, Inc. in 1974 as a program manager, and in 1980 formed his own shipyard - Moss Point Marine. That yard was later purchased by Halter Marine Group's predecessor, Trinity Industries, and he was named president of Trinity Marine Group in 1987. Dr. Dane is currently president and Chief Executive Officer of Halter Marine Group, Inc.

Dr. Robert Frosch: Dr. Robert Frosch received an A.B. degree from Columbia College in 1947, and a doctoral degree from Columbia University in 1952. From 1951 to 1963 he was employed at Hudson Laboratories of Columbia University as a research scientist and then Director. In 1963 he became Director for nuclear test detection in the Advanced Research Projects Agency (ARPA) of the Department of Defense, and Deputy Director of ARPA in 1965. In 1966 he was appointed Assistant Secretary of the Navy for Research and Development and served in this position until 1973 when he became Assistant Executive Director of the United Nations Environment Programme (UNEP). In 1975 he became Associate Director for Applied Oceanography at the Woods Hole Oceanographic Institution (WHOI). From 1977 to 1981, he served as Administrator of the National Aeronautics and Space Administration (NASA). From 1981-1982, he served as President of the American Association of Engineering Societies. In 1982, he became Vice President of General Motors Corporation in charge of research laboratories. Dr. Frosch retired from General Motors as Vice President in charge of the North

American Operations R&D Center in 1993. Currently he is a Senior Research Fellow and Lecturer at the John F. Kennedy School of Government, Harvard University and a Senior Fellow at the National Academy of Engineering.

Dr. Robert Gagosian: A Massachusetts native, Dr. Robert Gagosian graduated with a bachelor degree in chemistry from the Massachusetts Institute of Technology in 1966. In 1970 he received his doctorate from Columbia University. From 1970 to 1972, he was a National Institutes of Health Postdoctoral Fellow at the University of California, Berkeley. In 1972, he became an Assistant Scientist at Woods Hole Oceanographic Institution (WHOI). Dr. Gagosian was appointed as Director of WHOI in 1994, after serving six years as Director of Research and two years as Senior Associate Director. He has served on a wide variety of visiting committees and research panels for the National Science Foundation, the Office of Naval Research, and universities and research organizations in the U.S. and internationally.

Mr. David Keeley: Mr. David Keeley graduated from the University of New Hampshire with a bachelor degree in 1976 and from Arizona State University in 1978 with a masters degree. He joined the Maine State Planning office in 1980 after previously working at the local and county levels in Maine, New Hampshire, Arizona, and consulting in the Pacific and Australia. For ten years, Mr. Keeley directed the Coastal Zone Management Program in Maine and has served as the Chairman of the Coastal States Organization. He currently chairs two local committees, volunteers with youth groups, and is vice-president of a non-profit foundation.

Dr. John Knauss: Native of Detroit, Michigan, Dr. John Knauss received a bachelor of science degree from Massachusetts Institute of Technology in 1946, a master of science degree from University of Michigan in 1949, and a doctoral degree from University of California, Scripps Institution of Oceanography in 1959. He served in the U.S. Navy from 1943 through 1946 and 1953 through 1954. His professional career at the University of Rhode Island includes Professor of Oceanography, 1962-1990; Dean, Graduate School of Oceanography, 1962-1987; Provost for Marine Affairs, 1969-1982; Vice-President, Marine Programs, 1982-1987; Dean and Professor Emeritus, 1990-present. He served as Under Secretary of Commerce for Oceans and Atmosphere, and Administrator of the National Oceanic and Atmospheric Administration from 1989 through 1993. He was the U.S. Commissioner to the International Whaling Commission from 1991 through 1993. Since 1994, Dr. Knauss has also been a Research Associate at Scripps Institution of Oceanography. He is currently President of the American Geophysical Union.

Dr. Margaret Leinen: Born in Chicago, Dr. Margaret Leinen graduated from the University of Illinois with a bachelor of science degree in 1969, a master of science degree from Oregon State University in 1975, and a doctoral degree from the University of Rhode Island in 1980. From 1979 through 1989, she held the positions of Research Associate, Marine Scientist, Assistant Research Professor, Associate Research Professor, and Professor of Oceanography at the University of Rhode Island. She became Vice-Provost for Marine Programs and Dean of the Graduate School of Oceanography in 1991, after serving as Associate Dean, Graduate School of Oceanography, and Acting Dean, College of Resource Development. She has received a number of awards and honors throughout her career, including the WLNE Channel 6 Freedom Torch Award (1993) and the Distinguished Lecturer, US Science Advisory Committee to the

Ocean Drilling Program (1992). She has served as President of The Oceanography Society and on numerous national and international committees.

Dr. Shirley Malcom: Dr. Shirley Malcom received her doctorate in ecology from The Pennsylvania State University; masters degree from the University of California, Los Angeles; and bachelor degree from the University of Washington. In addition, she holds seven honorary degrees. Currently, Dr. Malcom is Head of the Directorate for Education and Human Resources Programs of the American Association for the Advancement of Science (AAAS). Prior to this, she was head of the AAAS Office of Opportunities in Science from 1979 to 1989. Between 1977 and 1979, she served as program officer in the Science Education Directorate of the National Science Foundation (NSF). She has also held the position of assistant professor of biology at the University of North Carolina, Wilmington and taught high school science for two years. Dr. Malcom was appointed by President Clinton and confirmed by the Senate as a member of the National Science Board, where she served until May, 1998. She is a member of the President's Committee of Advisors on Science and Technology.

Mr. Joel Reynolds: Mr. Joel Reynolds has practiced public interest law for eighteen years, with the Center for Law in the Public Interest, the Western Center on Law on Poverty, and, currently, as Senior Attorney with the Natural Resource Defense Council's (NRDC) Los Angeles office and Co-Director of NRDC's Urban Program. He graduated from Columbia Law School in 1978 and clerked for U.S. District Judge John Bartels (E.D.N.Y.) until 1980. Since 1980, Mr. Reynolds has specialized in complex law reform litigation and has argued cases on behalf of environmental and community organizations at all levels of the federal courts, including the U.S. Supreme Court. Mr. Reynolds heads NRDC's Coastal Ecosystem and Marine Mammal Protection projects and has spearheaded NRDC's efforts to obtain or preserve legal protection for California's wildlife and its habitat. For four years, he was Endangered Species Editor for the Land Use and Environment Forum, published by the California State Bar; in 1994, a member of the U.S. delegation to the Third International Conference on Environmental Enforcement; and, from 1994 to 1997, a member of the State of California Blue Ribbon Commission on Unified Environmental Statute. From 1986 through 1990, he served as an Adjunct Professor at the University of Southern California Law Center.

Dr. Patrick Sullivan: Dr. Patrick Sullivan received a bachelor of science from the University of Colorado, and a masters and doctoral degree from the University of Hawaii. He has served as an adjunct professor with the Department of Ocean Engineering at the University of Hawaii at Manoa. He has also served as the Vice-Chairperson of Hawaii's High Technology Development Corporation (HTDC). Dr. Sullivan founded Oceanit Laboratories, Inc. (Oceanit) in 1985, of which he is currently president.

Appendix 5. - The Fiscal Year 1999 National Oceanographic Partnership Program Research Solicitation [Office of Naval Research Broad Agency Announcement (BAA)]

(As published in Commerce Business Daily, November 16, 1998)

PART: U.S. GOVERNMENT PROCUREMENTS SUBPART: SERVICES CLASSCOD: A-- Research and Development OFFADD: Office of Naval Research, 800 North Quincy St., Arlington, VA 22217-5660 SUBJECT: A--NATIONAL OCEAN PARTNERSHIP PROGRAM SOL 99-003 DUE 020999 POC **Brian Glance** ONR 252, (703) 696-2596 DESC: **BAA 99-003** On behalf of the National Ocean Partnership Program (NOPP) The Office of Naval Research (ONR) solicits proposals addressing a variety of Partnership Programs as outlined in Title II, subtitle E, of Public Law 104-201 of September, 1997, the National Oceanographic Partnership Program.

Up to \$14M may be available for this announcement which is subject to final approval by the National Ocean Research Leadership Council. Proposals are due February 9, 1999. Team efforts among academia, industry, and government participants: cost sharing and proposals augmenting ongoing joint efforts are very strongly encouraged.

Proposals are sought in the following major topic areas which are also described at http://www.onr.navy.mil/sci_tech/ocean under "Additional Points of Interest:"

Topic A - DATA ASSIMILATION AND MODELING INITIATIVE Partnership efforts are sought to begin a community-wide effort of building a linked system of resources and collaborations for ocean modeling and data assimilation leading to new scientific insight and synthesis of new results with broad utility to the ocean community. The genesis for this initiative is a series of workshops in 1997 and 1998 which illuminated the need for an Ocean Research Synthesis and Modeling Program (ORSMP) formed under a new structural paradigm. Background on the workshops can be found in Nowlin (1997) and Powell (1998) available through the ONR and CORE/NOPP websites.

From Powell et al (1998) NOPP finds that arguments to begin a substantial enhancement of modeling and data assimilation capabilities in all sub-disciplines of the ocean sciences are compelling. The most critical of these reasons involve: existing and new satellites and the data they are collecting; voluminous data sets assembled by World Ocean Circulation Experiment (WOCE), Joint Global Ocean Flux Study (JGOFS), Global Ocean Ecosystems Dynamics (GLOBEC), etc.; the need for greater coordination and integration among ocean modelers, and between modelers and observationalists; as well as the requirement for improved access to greater, yet more diverse, computing capabilities.

To address these needs new infrastructure and partnerships are required that span the ocean community. A concept has been developed to address these needs and evolve in a phased manner. The concept involves a central "hub facility" supporting a number of "scientific nodes." The hub facility will provide computational and data assimilation capabilities, high-level analyses, technical assistance, code and analysis software, benchmark solutions, documentation, and other services. The "hub facility" may itself be a distributed (virtual) entity depending on

further study. Nodes are envisioned as small to large teams (5-15 scientists) collaborating on model/data synthesis projects requiring regional- to global-scale computational capability. The rationale is that such groups are needed to advance our capability in the simulation and understanding of the physical, chemical, biological and biogeochemical behavior of the ocean, estimations of the state of the ocean, and the identification of essential new ocean observing capabilities.

Four initial nodes, or scientific teams, were discussed by Powell (1998). In no particular order, these are in the areas of: (1) the coastal ocean, (2) coupled physical-biological models, (3) marine biogeochemistry, and 4) ocean general circulation/climate. Specific examples within these general areas are also cited in the report. New partnerships in these areas capable of serving as "scientific nodes" in the new structure are sought in this announcement. At this stage NOPP intends to support the development of the ORSMP by funding one or more multi-disciplinary science teams in each of the proposed science areas listed above. Once selected, these teams will assist NOPP in establishing the requirements for the "hub" facility to support them and other "nodes" to be established by NOPP in the future.

Under this topic of the announcement, NOPP will consider two types of proposals:

- (A1) planning activities ("Phase A studies") up to \$250K for one year, or
- (A2) implementation activities ("Phase B studies") on the part of teams that have already developed a mature work plan.

The purpose of the one-year planning award will be to develop a detailed rationale, justification and plan of action for five or more years of follow-on work as a node in the chosen area. Teams funded for Phase A studies will be expected to submit Phase B proposals at the completion of the one-year planning activity. Phase B activities would be in the range of \$500K to \$1M per year for 5 years.

A working group, representative of the selected nodal activities plus other experts, will be formed to advise the NOPP on the form and requirements of the future hub facility. This working group will be called upon to suggest the essential characteristics of the hub facility to support team activities for the next decade. All participants selected under this topic are expected to establish strong collaborative interactions between the various teams and be willing to participate in the concept development of a central "facility" capable of serving the teams. To foster these collaborations, all investigators selected for awards may be expected to participate in periodic workshops starting shortly after award to identify the specific needs and considerations of individual teams and the necessary hub infrastructure to support ORSMP. It is expected that NOPP will call for proposals for a central "hub" as early as fall 1999 along with the next set of "node" proposals.

The challenges for proposers in this topic area are two-fold. The first objective is to develop the partnerships and rationale for a scientific study and products of wide community interest. The second objective is to develop concepts that maximize flexibility and utility of the hub-node system for future teams. The goal is to simultaneously produce scientific results in challenging areas and develop new infrastructural resource arrangements. The scientific problems to be addressed by this structure will evolve and will be of such a nature to warrant resources invested in the hub and normally unavailable to a single investigator. By providing the necessary infrastructure, this program will promote the development of community models and

modeling capabilities, efficient and effective data assimilation and data management systems, and provide ongoing rationale for the most informative and useful ocean observations. We plan to make this widely and readily available to a growing set of users.

Topic B - OCEAN OBSERVATION CAPABILITIES Partnership efforts are sought to develop and/or demonstrate ocean observational capabilities to establish the means for continuous, high resolution measurements of oceanic processes. Collaborative proposals are sought for development and application of new sampling, analytical, and interpretive techniques to improve the characterization of distributions, mechanisms, and rates of processes involving chemical and biological variables together with physical variables in the ocean. The challenge is to develop rapid analytical techniques and "smart" sampling tools based on real-time measurements. Fundamental progress will require coordinated efforts involving improvements in sampling and measurement strategies on process-relevant time and space scales, implementation and/or development of new analytical methodologies, and processing/storage/transmittal that closely link observations to models, sufficiently to develop a predictive capability. Such efforts should embrace networking and broad accessibility to all derived data in near or real time.

Autonomous and/or long-term and/or distributed approaches that provide a new observational capability for the ocean community are particularly encouraged. Innovative sensors and measurement techniques are solicited to obtain oceanographic variables (e.g., chemical, optical, or biological) in 3-D space and time to augment physical variables. The emphasis should be placed on:

- novel approaches and concepts for measuring a particular parameter coherently in 4-D;
- observations which can be conducted as autonomously as possible (i.e. for independent operation on Remotely Operated Vehicles (ROV's), Autonomous Underwater Vehicles (AUV's), buoys, or with expendable instruments);
- providing a significant reduction in instrument weight and volume without reducing fidelity or resolution as compared to current state-of-the-art devices;
- and developing the next generation of low cost instrumentation usable by the ocean research community.

Proposals should clearly specify: what the new technology will do; how it improves existing technology; why it is important and relevant to the needs of specific ocean studies; whether a prototype has been tested or when one will become available to the larger community as a result of funding provided by NOPP. Since future renewal funding from NOPP for the selected efforts under this Topic will be rare, plans for follow-on support, if any, and/or deployments and availability of the products should be addressed in the proposal.

- (B1) Approximately \$6M is available to support 4 to 6 large projects in the range of \$750K to \$1.5M per year for up to 3 years.
- (B2) In addition, focused partnership efforts to develop sensors and instrumentation packages compatible with future systems described above are solicited. Two to three awards of this nature in the range of up to \$250K per year for up to 2 years for these smaller projects are anticipated.

Interested offerors are required to submit a notice of intent to propose by December 21, 1998 to the address listed below. A short letter (1-2 pages) should be submitted that gives the intended

title with a description of the subject and a list of the potential partners (by name and affiliation). The information submitted in this notice of intent should be in sufficient detail to aid the government in the identification of potential peer reviewers who possess appropriate technical expertise and are without conflicts of interests, in advance of full proposal submissions. All proposals will be subject to peer scientific review, which may include non-governmental reviewers. All reviewers will adhere to confidentiality and conflict of interest standards. E-mail or fax submissions are strongly discouraged.

Twenty copies of the proposals are due not later than 4:00PM EST on Tuesday, February 9, 1999 to NOPP BAA/ONR 32, Room 407-8, Office of Naval Research, 800 N. Quincy Street, Arlington, VA 22217-5660. Proposals received at ONR after this date and time will not be considered. All proposals must indicate BAA number above and which subtopic area is being addressed (e.g. Topic A1, A2, B1 or B2) on the cover page. Separate proposals must be submitted for each subtopic area. E-mail and facsimile materials are not acceptable. No request for proposal (RFP), solicitation, or other announcement of this opportunity will be made. Historically Black Colleges and Universities and Minority Institutions, as determined by the Secretary of Education to meet requirements of 34 CFR Section 608.2 and 10 U.S.C. Paragraph 2323(a)(1)(C), are particularly encouraged to participate. Evaluations of the proposals will use the following selection criteria:

- (1) relevance of the proposed research to Partnership objectives, including
 - a) support of critical research objectives or operational goals such as data accessibility, education and communication,
 - b) broad participation within the oceanographic community,
 - c) partners with a long-term commitment to the proposed objectives,
 - d) resources are shared among partners, and
 - e) the degree of cost-sharing by partners with the requested Partnership funding,
- (2) overall scientific and technical merits of the proposal,
- (3) the offeror's capabilities, related experience, and facilities or unique combinations of these that are critical to the proposal objectives,
- (4) the qualifications and experience of the proposed principal investigator and key personnel,
- (5) degree of significant partnering among at least two of the following parties, academia, industry or government,
- (6) socio-economic merits of the proposal,
- (7) realism of proposed costs.

A synopsis of the NOPP review process can be found at

<http://core.cast.msstate.edu/NOPPpg103.html>.

A component of education and/or public outreach is strongly encouraged for each NOPP effort. The level and type(s) of effort are left to the proposers but linkages/collaborations with ongoing NOPP or other similar education/outreach efforts are particularly encouraged (see <http://core.cast.msstate.edu/NOPPpg102.html>). Activities of this nature that are meritorious and require significant levels of support can request additional NOPP support (up to 10%) beyond the amounts listed in the Topic areas. NOPP wishes to foster education and public outreach as an integral part of its research programs wherever feasible.

The final distribution of awards among topics will depend on quality of proposals and availability of funds as determined by the NOPP Council. Funding estimates for any ship-time

must be specifically included in the proposal and the budget should clearly specify the size and type of vessels proposed for use. Ships of opportunity are encouraged. Proposers should include shiptime requests on either the former NSF Form 831 (Shiptime Request Form) or preferably the UNOLS on-line request form available at: <http://www.gso.uri.edu/unols/ship/shiptime.html>

For awards made as contracts, the socio-economic merits of each proposal will be evaluated based on the commitment to provide meaningful subcontracting opportunities for small business, small disadvantaged business, women-owned small business concerns, historically black colleges and universities, and minority institutions. The standard industrial classification code is 8731 with the small business size standard of 500. In addition, contract proposals that exceed \$500,000 submitted by all but small businesses, must be accompanied by a Small, Disadvantaged and Women-Owned Small Business Subcontracting Plan in accordance with FAR 52,219-9.

Additional Information is available on the World Wide Web at: "http://www.onr.navy.mil/sci_tech/ocean" under "Additional Points of Interest". This notice constitutes an ONR Broad Agency Announcement (BAA) as contemplated by FAR 6.102(d)(2). Questions regarding business and legal matters relating to this BAA should be directed to: Office of Naval Research, Attention Mr. Brian Glance (Code 252), Ballston Towers One, 800 N. Quincy St., Arlington, VA 22217-5660, (703) 696-2596. Technical and programmatic questions may be submitted by E-mail to "NOPPBAA@ONR.NAVY.MIL" or by fax to "NOPP BAA" (703) 696-2007 if necessary.

Appendix 6. - The Sound Surveillance System [SOSUS] Data Assessment.

USE OF DATA FROM THE SOUND SURVEILLANCE SYSTEM (SOSUS) FOR RESEARCH AND EDUCATION

Background. This responds to a request contained in Conference Report H.R. 105-736 for an assessment of four issues related to the use of SOSUS data for research and education.

The overall question of how to leverage the nation's investment in SOSUS for other than its original purpose has been addressed several times since the end of the Cold War and documented in reports such as "Dual Use of IUSS" (Joint Oceanographic Institutions, 1994). The potential research and educational uses of SOSUS data have not changed significantly during this time. The problematic issue has always been how to accommodate such applications without compromising legitimate national security interests. Recent developments demonstrate progress in addressing that issue. For several years, researchers with security clearances have been using classified data from operational stations for various applications with support from the Strategic Environmental Research and Development Program. More recently the Ocean Acoustic Observatory Federation has begun collecting classified SOSUS data from reactivated stations (decommissioned by Navy but authorized for civil uses) in the Pacific with support from the National Ocean Partnership Program (NOPP). In June 1998, a Cooperative Research and Development Agreement (CRADA) signed by the Space and Naval Warfare Systems Center (SPAWARSYSCEN) and the Scientific Environmental Research Foundation (SERF) established for the first time a vehicle by which SOSUS data from reactivated stations could be made available at the unclassified level.

Issue 1: [Assess] the value of SOSUS data to meet the requirements of appropriate private and public institutions and agencies with ocean research and education programs.

Previous reviews have described the potential of SOSUS data to support research into a variety of areas including marine mammal movement patterns, mid-ocean ridge geophysics, and studies of regional seismology. Some of those research efforts are in progress today using classified data from both operational and reactivated stations. However, these efforts are conducted by individuals who are not only experts in specific fields but who also have security clearances and prior knowledge of the SOSUS system.

A more complete assessment of the value of SOSUS data to users outside the Anti-Submarine Warfare community will only be possible after a representative long-term data set is made available at the unclassified level. Subsequently, potential users would have the opportunity to develop proposals focused on their own research or other activities.

Issue 2: [Assess] the cost of making SOSUS data available for such purposes in comparison to the cost of deploying alternative data-gathering systems.

Every site offers opportunities for one or more applications, but each site has its own geographic and system-health limitations. The cost of reactivating the first decommissioned site in the Pacific was less than \$100,000 and operating costs are approximately \$40,000 per year. The cost to archive the classified data from this first site is about \$4,000 per year, and will grow as the data accumulate. Startup and operational costs at other sites should be roughly

comparable, but will vary based on each station's present condition. Declassification of one years' data from the three Pacific stations operated by the NOPP sponsored Ocean Acoustic Observatory Federation, using the procedures envisioned in SERF's CRADA with Navy, is estimated to cost \$500,000. Recurring costs, and the incremental cost associated with additional data sources, can be better estimated after the declassification procedures have been tested. To the extent the data satisfy the needs of many users, these costs may be small when compared with the cost for each user to deploy and recover their own alternative data gathering system.

A pilot project to determine the costs of creating and providing access to declassified data is an important component of developing a cost/benefit analysis for the use of these data for research and other purposes. By relying on NOPP and SERDP investments to meet collection and dissemination costs, the pilot project could cost no more than about \$550,000. An outreach effort might also be considered, to ensure the broad community of potential users is made aware of the pilot project; depending on the approach chosen the cost should in no case exceed \$250,000 and could be considerably less.

The number of users and their alternative data collection costs will not be known until the community of potential users has the opportunity to develop proposals to utilize SOSUS data for specific research and other purposes. The unclassified data set described in the response to Issue 1 is an essential precursor to the development of focused proposals, which in turn are needed to support meaningful cost comparisons.

Issue 3: [Recommend] options for making such data available to civilian and defense research and education institutions and agencies.

A small number of investigators is making use of classified SOSUS data for research and associated graduate education, but such uses are limited to scientists with appropriate security clearances. The attendant security requirements represent a manageable but real burden, which slows the dissemination of results and can discourage all but the most dedicated. Additionally, while these investigations are important in their own right and demonstrate the value of continued access to classified data for scientific purposes, they do not constitute the full range of research or other uses for SOSUS data. To realize the greatest possible return on the national investment in SOSUS, data must be available at the unclassified level to any funded user.

Before committing the resources necessary to routinely collect and declassify data from all reactivated sites, a Pilot Project of the kind envisioned in SERF's CRADA with Navy should be considered. Providing a year-long unclassified data set from one or more of the NOPP Ocean Acoustic Observatory Federation sites would permit declassification and dissemination procedures to be tested, would provide improved cost estimates, and would enable a much broader community of scientists and other potential users to evaluate the importance of such data for their individual efforts. Data from such a Pilot Project could also be used to evaluate the usefulness of SOSUS as a possible element of a national Ocean Observation System.

Issue 4: [Provide] recommendations on effective ways to foster cooperation among agencies that would benefit from SOSUS data, including the potential for cost-sharing among the agencies and institutions that would participate in the program.

The National Ocean Research Leadership Council together with its supporting bodies includes representation from most of the institutions and agencies which might benefit from SOSUS data, and is well-suited to foster cooperation among them. The NORLC will consider support for cost-sharing an appropriate SOSUS Pilot Project at its next meeting. The goal is to determine the feasibility of providing routine access to declassified SOSUS data in such a way that it does not adversely impact national security activities.

SOSUS Task Team Members

James M. McDonald, Ocean, Atmosphere and Space Department, Office of Naval Research

Robert C. Spindel, Applied Physics Laboratory/University of Washington

John A. Orcutt, Institute for Geophysics and Planetary Physics, University of California,
San Diego

David L. Evans, Office of Oceanic and Atmospheric Research/National Oceanic and
Atmospheric Administration

David E. Epp, Division of Ocean Sciences/National Science Foundation

Duane A. Cox, Scientific and Environmental Research Foundation

Joseph C. Johnson, Undersea Surveillance Branch, [N874], Office of the Chief of Naval
Operations

Linda K. Glover, Office of the Oceanographer of the Navy, [N096], Office of the Chief of
Naval

Operations

Richard W. Spinrad, Director, Consortium for Oceanographic Research and Education

Edward D. McWethy, Intelligence Advisor, Office of Naval Research

Kenneth W. Turgeon, Minerals Management Service

Captain John P. Quinn, USN, Office of the Navy Judge Advocate General

Appendix 7. - The Year of the Ocean [YOTO] NOPP Ocean Data Buoy Program

Sarah Schoedinger
National Oceanographic Partnership Program Office
1755 Massachusetts Ave., N.W., Suite 800
Washington, D.C. 20036
phone: (202) 232-3900 fax: (202) 986-5072 email: sschoedinger@brook.edu

Mark Swenson
Atlantic Meteorological and Oceanographic Laboratory
4301 Rickenbacker Causeway
Miami, FL 33149
phone: (305) 361-4363 fax: (305) 361-4582 email: swenson@aoml.noaa.gov

Sharon Walker
University of Southern Mississippi
Institute of Marine Sciences
J.L. Scott Marine Education Center and Aquarium
P.O. Box 7000
Ocean Springs, MS 39566-7000
phone: (228) 374-5550 fax: (228) 374-5559 email: shwalker@seahorse.ims.usm.edu

LONG-TERM GOAL

Our long-term goal is to provide a mechanism for translating current oceanographic research to a broad audience and enhance science and math instruction at the K-12 level. NOPP funding will be used to deploy drifting buoys whose telemetered data will be available to researchers, educators, and the general public.

OBJECTIVES

Specific objectives for this project include providing K-12 educators and their students real data in a useful format while at the same time helping oceanographers to study ocean currents, transport of heat, sediment, larvae, and pollutants, as well as to provide ground-truthing of remotely sensed optical data.

APPROACH

A multi-agency meeting that included representatives of the educational community was held to develop the research and educational goals of the project for FY 1998. It was decided that standard Lagrangian drifters were to be purchased to augment the current distribution of buoys already afloat. The areas of deployment would be the Caribbean Sea and Tropical Atlantic Ocean. In addition, 10 drifters equipped with optical sensors were to be purchased for ground-truthing remotely sensed ocean color data. Personnel at the GLOBE program at NASA and the Department of Energy's Oak Ridge National Laboratory were to provide expertise in developing the web site so that it is visually interesting to the public at-large and can be used by students and teachers to learn more about research using drifters.

The web site offers activities for classroom including:

- An explanation for reasons for the research
- Activities for the classroom provided at no-cost to K-12 teachers and students
- Links to other ocean drifter databases
- Links to other drifter programs
- An “Ask-an Oceanographer” feature
- “Drifter News” feature
- A map for tracking drifters in the Caribbean and Tropical Atlantic.

WORK COMPLETED

The web site has been developed (<http://doe.drifters.gov>) and is maintained by personnel at the Department of Energy’s Oak Ridge National Laboratory. Two of the educational activities involving tracking drifters and making drifters are already available. Other relevant educational activities are in development under the guidance of Dr. Sharon Walker and include on-line classroom activities and displays for 22 aquaria around the United States. The USGS has developed a map of the Caribbean and Tropical Atlantic Ocean for students and teachers to track drifters. The map is available to the public for free. The Atlantic Meteorological and Oceanographic Laboratory (AOML) personnel provide updates of the drifter positions and SST in 3-day segments. They also handle the procurement of the drifters. The GLOBE Program at NASA is continuing to provide visualizations of these data for web site. Five of the 10 optical drifters and about 75 of the 140 standard Lagrangian drifters that were purchased for this project have been deployed. Deployments of the remaining drifters will occur as ships of opportunities arise in early 1999.

RESULTS

Web site usage has grown steadily and will continue to do so once the remainder of the educational activities are available on-line and the displays are in public aquaria. Researchers have been using the data primarily for studying currents and SST. For some specific examples of results look at [<http://drifters.doe.gov/results/>](http://drifters.doe.gov/results/).

IMPACT/APPLICATION

This project will provide researchers with new information about the Caribbean and Tropical Atlantic waters and these data will augment the historical database of Sea Surface Temperature (SST). Ground-truthing of remotely sensed ocean color (e.g., with SeaWiFS) will also be possible.

The web site allows the K-12 community to study the oceans with timely data that researchers are also using by providing “hands-on” classroom activities for students and teachers. By being able to incorporate real data into their classroom activities, students and their teachers are able to see first-hand the dynamic and, often, unpredictable nature of observational research.

**Appendix 8. - The Fiscal Year 1998 National Oceanographic Partnership
Program Annual Report [w/o Appendices]**

National Oceanographic Partnership Program

NAVY/ NOAA/ NSF/ NASA/ DoE/ DARPA/ OMB/ EPA/ OSTP/ USCG/ DoI/USGS/ DoI/MMS

**Report to the U.S. Congress
on the
National Oceanographic Partnership Program
(Fiscal Year 1998)**

on behalf of the

***National Ocean Research Leadership Council
(NORLC)***

The Honorable John Dalton
Secretary of the Navy
Chair of the NORLC

The Honorable D. James Baker
Under Secretary of Commerce for
Oceans and Atmosphere
Vice-Chair of the NORLC

1 March 1998

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 - 5. NORLC Terms of Reference
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 - 7. FY 1998 Agency funding for the National Oceanographic Partnership Program
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I. INTRODUCTION

The Secretary of the Navy is charged in Subtitle E of title II, Division A, Public Law 104-201 to establish a National Oceanographic Partnership Program to:

- 1) promote the national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean; and
- 2) to coordinate and strengthen oceanographic efforts in support of those goals by -
 - a) identifying and carrying out partnerships among Federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication, and
 - b) reporting annually to Congress on the Program.

This report of the FY 1998 Partnership Program meets that statutory requirement.

II. SUMMARY

As the National Oceanographic Partnership Program [NOPP] moves into its second year; FY 1998, Program activities to date are summarized below:

- The successful FY 1997 Partnership Program continues and consists of eleven major research projects, 397 academic ocean survey ship days, and support to the MEDEA Ocean Panel;
- Curative legislation for appointments to the NOPP oversight body, the National Ocean Research Leadership Council [NORLC] and the Ocean Research Advisory Panel [ORAP], is contained in Public Law 105-85, the FY 1998 Defense Authorization Act. As stipulated, the NORLC will be made up of exclusively Federal representatives and the ORAP representation will be from the private sector;
- A Broad Agency Announcement seeking FY 1998 Partnership Program Research Proposals was issued November 14, 1997;
- The National Ocean Research Leadership Council met again on November 24, 1997;
- The ORAP Charter was signed January 20, 1998 and the Federal Advisory Committee Act [FACA] process has been initiated for sixteen Advisory Panel candidates;

- Ongoing interagency activities continue, including Year of the Ocean [YOTO] actions and liaison with other established Federal coordination groups, such as MEDEA Ocean Panel, the Federal Oceanographic Fleet Coordination Council, the ad hoc Ocean Principals Group and the NSTC Committee on the Environment and Natural Resources;
- The FY 1998 Partnership Program Awards are expected to be in place by May 1998 following Council approval.

III. FISCAL YEAR 1997 ACTIVITIES

The Office of Naval Research provided a Program Status report to members of Congress on February 26, 1997. The Chief of Naval Research and the NOAA Chief Scientist briefed NOPP status and projected plans to key Congressional Staff on June 30, 1997.

Merit based competitive procedures were employed to select eleven research projects involving over seventy researchers in nineteen states. The University-National Oceanographic Laboratory System [UNOLS], working with the Naval Oceanographic Office, developed a comprehensive oceanographic ship survey program that encumbered 397 ship survey days funded at \$7.5M to address validated Navy operational requirements. These efforts are described in greater detail in the FY 1997 NOPP Annual Report [Appendix 1].

The Consortium for Oceanographic Research and Education [CORE] was selected through a competitive process to operate the Partnership Program Office.

A NOPP Interagency Working Group [IWG] was established and chartered as the “Operating Arm” of the NORLC. The membership of the IWG mirrors the Leadership Council and is Chaired by a Navy representative with a NOAA official as Co-Chair. The IWG meets regularly to initiate and oversee necessary programmatic actions attendant to Partnership Program operations with the support of the Program Office.

The Interagency Working Group represents the NOPP in related Federal interagency activities. For example, via the ad-hoc interagency Ocean Principals Group, the NOPP is charged as the ocean science and technology focal point for United States efforts in the 1998 Year of the Ocean [YOTO].

IV. FISCAL YEAR 1998 ACTIVITIES

The FY 1998 National Oceanographic Partnership Program contains the following elements:

- \$7.5M for oceanographic ship survey operations. A schedule has been developed by the University-National Oceanographic Laboratory System [UNOLS] and the Naval Oceanographic Office using academic research vessels to address validated Navy requirements. That survey schedule is at Appendix 2:
- \$17M for science and technology partnership efforts as follows:
 - MEDEA Ocean Panel - Continue ocean-related declassification for national needs;
 - Databasing and Networking - Foster conventions and protocols for national distributed, virtual data system;
 - Observations of ocean processes - New Start solicited in the FY 1998 Broad Agency Announcement;
 - General Partnership Projects, including Regional Scale and Open Ocean Prediction - New Start solicited in the FY 1998 Broad Agency Announcement;
 - Education, Training and Outreach - This will be a continuation of FY 1997 projects;
 - Program Office - Continuation of current contract.

The NOPP FY 1998 Broad Agency Announcement [Appendix 3] was released November 14, 1997. Seventy-two proposals were received and a comprehensive peer-review process is currently [Feb-Mar 1998] underway. Upon approval by the National Ocean Research Leadership Council, the NOPP Awards for FY 1998 are expected to be in place by May 1998.

The NOPP oversight body, the National Ocean Research Leadership Council, met for the second time on November 24, 1997. The Minutes of that meeting are at Appendix 4. The Council approved the following:

- The NORLC Terms of Reference [Appendix 5];
- The ORAP Charter [Appendix 6]; and
- The NOPP Interagency Working Group [the NOPP Operating Arm] Charter.

The cooperative scientific project, Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) supported by NOAA, ONR, EPA, NSF, NASA, and USDA will be coordinated under the NOPP.

The Partnership Program has initiated plans for a New Start project utilizing ocean drifter buoys as part of United States activities for the 1998 Year of the Ocean [YOTO] to serve both research and education goals. Subsequently, a YOTO Drifter Project Workshop was convened 7 January 1998 with representation from NOPP agencies as well as experts from academia and industry with experience in drifting buoy systems and K-12 education. A special session at the AGU-ASLO Ocean Sciences meeting was held in early February 1998 to seek comments and support from the larger research community.

The House National Security Committee Report 105-132 directed the Secretary of Defense to report Federal Agency funding for the FY 1998 NOPP by February 28, 1998. That letter report is at appendix 7.

V. FISCAL YEAR 1999 ACTIVITIES

The President's FY 1999 budget request includes the following NOPP-related requests:

Navy/ONR - \$10,000,000;

NOAA - \$2,000,000;

NSF - \$5,500,000 for "basic research in partnership programs such as NOPP";

The remaining NOPP agencies continue to provide program funding and "in-kind" support to a variety of NOPP projects such as the YOTO Drifter Project.

The Ocean Research Advisory Panel [ORAP] is primarily responsible for advising the Council on outyear plans for the National Oceanographic Partnership Program. That charge is contained in the Charter of that Panel. The NOPP Interagency Working Group has developed an initial working paper for review and comment by the ORAP. That draft document, NOPP 2000, is at Appendix 8.