

Coastal Variability Analysis, Measurement, and Prediction (COVAMP)

Dr. Juergen H. Richter
Space and Naval Warfare Systems Center San Diego D88
53570 Silvergate Ave Rm 2505
San Diego, CA 92152-5230
ph: 619-553-3053
fax: 619-553-3058
E-mail: richter@spawar.navy.mil

Dr. Douglas Jensen
SPAWARSYSCEN San Diego D883
49170 Propagation Path
San Diego, CA 92152-7385
ph: 619-553-1415
fax: 619-553-1417
E-mail: djensen@spawar.navy.mil

Kenneth D. Anderson
SPAWARSYSCEN San Diego D883
49170 Propagation Path
San Diego, CA 92152-7385
ph: 619-553-1420
fax: 619-553-1417
E-mail: kenn@spawar.navy.mil

Dr. Kenneth L. Davidson
Naval Postgraduate School
Department of Meteorology Code MR/Ds
589 Dyer Road, Room 254
Monterey, CA 93943-5114
ph: 831-656-2309/2563
fax: 831-656-3061
E-mail: davidson@nps.navy.mil

Dr. Earl E. Gossard
CIRES
Campus Box 449 R/E/ET4
University of Colorado/NOAA
Boulder, CO 80309
ph: 303-497-7017
fax: 303-497-6978
email: egossard@etl.noaa.gov

Jay Rosenthal
Geophysics Branch (521400E)
Naval Air Warfare Center Weapons Division
Point Mugu, CA 93042-5001
ph: 805-989-7893
fax: 805-989-4817
e-mail: rosentj@mugu.navy.mil

Dr. C. Russell Philbrick
315 Elec Engr East
Penn State University
University Park, PA 16802
ph: 814-865-2975
fax: 814-863-8457
email: crp3@psu.edu

N0001498WX30075
<http://sunspot.spawar.navy.mil>

LONG TERM GOALS

The long-term goal is to provide representative three-dimensional, time-varying refractivity and optical property inputs for propagation models.

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OBJECTIVES

The objectives are to provide a testbed to develop and evaluate urgently needed state-of-the-art measurement capabilities and accurate now- and forecasting techniques.

APPROACH

No one instrument or model is currently available with the capability to characterize propagation conditions on the necessary spatial and temporal scales thought to be typical of the coastal regions. Therefore, sensing information from a variety of sources/instruments are to be combined with high-resolution meteorological mesoscale models to provide a better description of the propagation environment than either sensing or models alone. COVAMP is divided into 2 tasks: (1) Electrooptical Propagation Assessment in Coastal Environments (EOPACE), and (2) Remote Sensing.

WORK COMPLETED

EOPACE

FY98 is the fourth year of EOPACE. An EOPACE home page on the Internet contains all the EOPACE information, updated as necessary. The EOPACE effort for FY98 was conducted as per the EOPACE Work Plan. The surf aerosol generation/transport effort at Duck, N.C. was completed (16-27 February 1998). This was a cooperative effort between NRL, TNO and SSC-SD. The data have been reduced into the standard EOPACE format and readied for distribution to all participants. SSC-SD and TNO are addressing the aerosol transport issues.

An EOPACE session was scheduled in the NATO Sensors and Electronics Technology Panel Symposium on EO Propagation, Signature and Systems Performance Under Adverse Meteorological Conditions, Considering Out-of-Area Operations, held in Naples Italy, 16-19 March 1998. In this session, chaired by Dr. J. H. Richter and Dr. D. R. Jensen, a total of 12 papers were presented and will be published in the proceedings. At the Annual SPIE Symposium on "Propagation and Imaging through the Atmosphere II," San Diego, CA, July 1998, an EOPACE session was held. Twelve papers were presented in this session and are published in the SPIE proceedings

The EOPACE data analysis workshop and scientific committee meetings were held at SSC-SD, 27-29 July 1998. Each EOPACE participant presented an overview of the work that they had accomplished and made recommendations for future work to accomplish the EOPACE objectives. The EOPACE scientific committee reviewed the research/publication outline previously made for coordinating the planned effort by the EOPACE participants. Topic coordinators were assigned to coordinate each research/publications effort.

NPS conducted buoy-based near-surface and sea-surface measurements during the IOPs in November 96 and August 97 and reduced and distributed the data. During the March IOP, NPS conducted shipboard surface layer and rawinsonde measurements from R/V Point Sur. Optical depths were computed in real-time from NOAA AVHRR satellite passes and enhanced GOES-9 imagery was used during the experiment to direct ship and aircraft.

REMOTE SENSING

In the GPS Sounder project, GPS ALERT and GPS Tide Gauge were prepared to support NSWCCD's Wallops '98 experiment. Unique antenna mounts were designed and built; one set of two mounts for port and starboard antenna placement on NSWCCD's boat 'Sealion'. Data from ALERT and Tide Gauge, combined with concurrent vertical refractivity profiles measured by in situ radiosondes and

rocketsondes, will be used to test the GPS Sounder refractivity inversion technique. Three weeks of GPS ALERT and Tide Gauge measurements were completed during NSWCCD's Wallops '98 experiment.

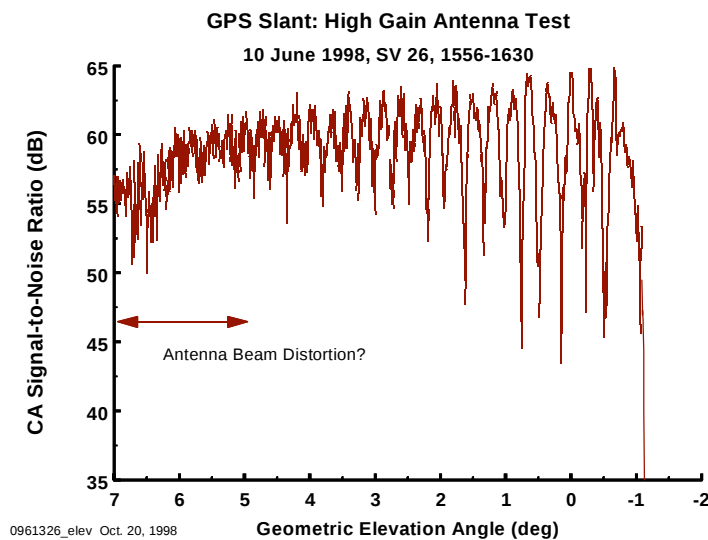


Figure 1. Received GPS signal vs. elevation angle.

Figure 1 shows one of the datasets in which signal reception was maintained in the nulls. Previously, signal would often be lost in the nulls at angles below approximately 2 degrees, breaking receiver lock-on and resulting in lost data.

Under the Lidar Atmospheric Profiling task, the current work involves developing a physical description of the optical characteristics of the plumes with the goal of preparing a predictive capability for describing the optical propagation. The optical extinction measurements obtained with the PSU lidar instruments have been used to investigate the capabilities for the Raman scatter technique to provide the description of optical propagation. This is the last year of this task.

In the Remote Boundary Layer Sensing task, a large body of data was collected at Vandenberg AFB for evaluating the feasibility of using radar wind profilers for collecting height profiles of radio refractive index and profiles of turbulence intensity. These data were accompanied by turbulence data collection with a helicopter-borne pod of micro-meteorological sensors built and owned by the University of Hannover in Germany. The reduction of this data set and the data set collected during the Air Resources Laboratory's "Model Verification Experiment" is well under way. The data collected by the HELIPOD, provided by AERODATA and the University of Hannover, seems to have yielded the best in-situ data on the micro-structure of refractive index ever collected within sub-tropical subsidence inversions.

RESULTS

EOPACE

As a result of the limited Duck, N.C. surf aerosol generation/transport effort (16-27 February 1998), it was shown (SSC-SD, TNO, and NRL) that aerosols generated on a surf line can be a significant factor on EO systems performance at large distances from the coastline due to aerosol transport.

REMOTE SENSING

Results from the GPS Sounder test during Wallops '98 show that the standard error in tide height measurements is less than 8.2 cm, which is excellent. ALERT correctly identified all refractive conditions as standard (there were no non-standard cases) and also demonstrated the inadequacies of a dual non-coupled GPS receiver system. The ideal receiver system for ALERT is one receiver and four antennas, one antenna covering each quadrant. A new technique has been developed to automatically extract the antenna height from low-angle GPS observations. Results from one set of measurements with a co-located tide gauge (at Scripps Pier) are excellent. The Wallops Island data will be re-processed using this technique. It is anticipated that this technique will be the central algorithm for profile inversion.

Results from the PSU lidar measurements have shown that the Raman signals at visible and ultraviolet wavelengths can be used to obtain profiles of optical extinction. An analysis approach for the extinction profiles has been developed and an initial version of an analysis program is now available for testing of the real time profiles from the PSU lidars.

IMPACT/APPLICATIONS

The spatial and temporal data collected under this project are used to validate system performance models and provide variability statistics to EM/EO system designers. The EOPACE results are quantifying the effects of aerosols in the variable coastal regime and, in particular, the effects of surf-generated aerosol on IR transmission across a coastline. EOPACE results are impacting the scientific community through EOPACE sessions in the NATO Sensors and Electronics Technology Panel Symposia and SPIE Symposia on "Propagation and Imaging Through the Atmosphere". The patents resulting from the GPS Sounder effort have generated interest in NOAA/ETL, NASA, and NRL for extending the techniques to further characterize the sea surface.

TRANSITIONS

The GPS ALERT technique transitioned to the METOC Systems Program Office with FY99 funding for demonstration and validation (PE 0604218N). The progress in Remote Boundary Layer Sensing of refractivity is providing data and techniques being applied by others for sensing of meteorological parameters (Stankov 1998).

RELATED PROJECTS

This project is closely related to the synoptic and mesoscale numerical analysis and prediction projects pursued by NRL Monterey, the EM Propagation and EO Propagation projects, the Remote Refractivity

Sensing project under ONR 321SI, and the EO-IR Sensor Diagnostics project under ONR 313. Tri- service coordination is conducted under the Technology Area Review and Assessment.

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