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Refractive Index Effects in the Marine Boundary Layer

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LONG-TERM GOALS

The long-term goals of the research are to measure the atmospheric mean and turbulence structures and statistics that are related to the propagation of laser and radar signals over the ocean. It has been hypothesized that waves have a large effect on propagation in certain wind speed ranges. Previous experiments from R/P *FLIP* have shown the effects of waves on the momentum flux and turbulence at wind-wave and swell scales. The problem now is to investigate the effects for the scalars that affect propagation -- temperature and water vapor.

OBJECTIVES

The objective is to first obtain accurate measurements of the mean temperature and humidity profiles over the ocean together with the surface fluxes of momentum, sensible heat and water vapor (latent heat). Fine-scale, fast response measurements of temperature, humidity and pressure fluctuations will also be obtained. These data will be taken in conjunction with propagation measurements and surface wave measurements.

APPROACH

The approach is to perform a surface-layer experiment from the R/P *FLIP* in conjunction with the SPAWAR in situ range propagation measurements to provide the necessary temperature and humidity data which determine the refractive index properties. The CIRPAS Twin Otter aircraft will also participate in RED and we will instrument it for turbulence and mean meteorological quantities as in the recent ONR-sponsored Sea of Japan/East Sea experiment.

WORK COMPLETED

Work has focussed on the design of the experiment and choice of sensors. With SPAWAR, sensors for mean and fluctuating humidity have been obtained. A humidity calibrator has been obtained and used to check the calibration of the chilled-mirror dew point units. An aspirated solar radiation shielded housing has been selected for 5 levels. Two GPS-inertial reference units were tested on R/P *FLIP* for measurement of *FLIP*'s residual motion. Precision thermistors were chosen for mean temperature profile measurements. Laboratory water bath checks indicate that some are accurate to better than 0.01C mean temperature difference. However, each probe has to be tested as some do not meet specifications. A data system has been assembled and programmed to record up to 96 analog channels

at 50 Hz, both filtered and non-filtered as well as 16 serial data instruments. It is expected that approximately 2 GB of data will be recorded per day.

The meteorological mast for deployment on R/P FLIP has been modified for 6 sonic anemometer/thermometers, 4 high-frequency humidity probes, 2 static pressure fluctuation probes, with a wave wire suspended beneath. Motion of the mast/boom on FLIP will be measured by both tilt sensors at the sonic anemometers, and a rate and inertial GPS unit mounted on the end of the boom.

For the CIRPAS Twin Otter aircraft, the turbulence system used in the ONR Japan/East Sea project has been tested. Extra Lyman-alpha humidity sensors were obtained for redundancy.

RESULTS

Results to date have been mainly in the areas of preparation and testing. RED is scheduled to take place from August 20-September 18 2001.

IMPACT/APPLICATIONS

The impacts of the research will be in the improvement of the basic understanding of temperature and humidity fluctuations and mean profiles in the atmospheric surface layer over the ocean. These directly affect the refractive index at optical and radar wavelengths. The basic results can then be incorporated into models. The data obtained will also further elucidate the basic physics of wind-wave interaction.

TRANSITIONS

We are working with the Navy Space and Warfare Systems Command, SPAWAR, on the preparation for the Rough Evaporation Duct experiment to be conducted on the Research Platform *FLIP* in fall 2001.

RELATED PROJECTS

This project is related to our overall work on air-sea interaction. The instrumentation and techniques we developed for the CIRPAS Twin Otter will be applied to RED.

PUBLICATIONS

Journal Papers:

None