Instrumentation for Upper Ocean Dynamics, Turbulence and Gas Transfer Research

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LONG-TERM GOAL

To understand the physics of upper ocean dynamics, turbulence and gas transfer.

SCIENTIFIC OBJECTIVES

Using new technological advances in instrumentation to measure accurately the wavenumber-directional spectrum and its spatial and temporal variation; the velocity components over the full range of scales from large eddies on down to Kolmogorov micro-scale motions for turbulent kinetic energy properties in air and water; the eddy-correlation mass transfer velocities for gas transfer studies; the radiative fluxes and turbulent flux-gradient relationships in air-sea interaction; and to gain further insight in the backscatter measurement of HF Doppler radars.

APPROACH

We have acquired new instrumentation for use in air-sea interaction, ocean turbulence, gas transfer and radar backscatter studies. Specifically, the new instrumentation will be used on the ONR-funded air-sea interaction spar (ASIS) buoys, on the Canadian SWATH ship "Frederick Creed" and in the DoD-funded air-sea interaction saltwater wind-wave tank (ASIST) which is currently being built at the Rosenstiel School of Marine and Atmospheric Science.

WORK COMPLETED

The following instrumentation has been acquired:

Report Documentation Page

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1. Six laser ranging devices from Riegl USA, Inc.
2. Hot films brdige/amplifiers (4) from TSI, Inc.
3. Twenty pressure transducers for pitot tubes and Elliot pressure probes from MKS Instruments, Inc.
4. Ten acoustic Doppler velocimeters (ADVs) from Sontek, Inc.
5. One gyrocube system from Systron-Donner, Inc.
6. Twenty Elliot pressure probes from Strike Industries.
7. One custom-designed calibration wind tunnel from National Water Research Institute.
8. Miscellaneous data recording devices.

RESULTS

The laser ranging sensors have been installed at the end of a custom-designed boom and successfully used in a recent pilot testing phase (October 1998) on the SWATH ship "Creed" in and outside of Halifax, Nova Scotia harbor. Similarly we have also instrumented a special spar with four levels of pitot tubes, Elliot pressure probes and hot film anemometers, which was mounted on the boom of SWATH ship. All instrumentation, sensors and systems worked flawlessly and a high-quality data set was acquired. This sensor and system test was performed for the Shoaling Waves Experiment (SHOWEX) scheduled in fall/winter 1999. The acoustic Doppler velocimeters (ADVs) were laboratory tested and will be deployed on the ASIS buoys in the upcoming field experiment in the Gulf of Mexico in February 1999.

IMPACT/APPLICATION

The use of non-invasive ranging devices to measure sea surface elevation will permit higher quality estimates of the directional wave spectrum from floating platforms such as the ASIS buoy and the SWATH ship. The measurement of accurate directional wave spectra over scales ranging from the small Bragg waves to long ocean swell will be an important component in the interpretation of microwave remote sensing data, improving numerical wave prediction and establishing the influence of surface roughness in air-sea interaction and surface scattering at acoustic, radio and microwave frequencies.

The deployment of acoustic Doppler velocimeters from the ASIS buoy will provide near surface oceanic turbulence measurements which are difficult to make from any other floating platform. ASIS is a low-disturbance, stable platform designed to make high-resolution flux and turbulence measurements in autonomous moored or drifting modes. Thus the potential for acquiring voluminous data sets for good statistics is now at hand.

The use of pitot tubes, Elliot pressure probes and hot film anemometers will provide crucial data on the momentum and energy input from the wind into the waves. Using the combination of the laser ranging sensors and the pressure probes will enable us to make direct measurements of the work done by the wind on the waves. With these measurements we will be able to establish the functional form of the wind-wave growth function.

TRANSITIONS

No transitions.

RELATED PROJECTS

The instrumentation acquired under this project will directly benefit the Shoaling Waves Experiment (SHOWEX) as well as future experiments dealing with upper ocean dynamics and air sea interaction research.