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AIRBORNE MEASUREMENT OF THE SPACE/TIME PROPERTIES OF WAVES IN THE COASTAL ZONE

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LONG-TERM GOAL

Our long-term goal in this project is to utilize a newly-developed airborne microwave technique to monitor the propagation of waves from the deep ocean into the coastal zone.

SCIENTIFIC OBJECTIVES

Our scientific objectives are to investigate the generation of forced waves produced by quadratic nonlinearities, the refraction of swell in shallow water, the possibility of determining bottom topography from refraction, and the effects of bottom topography and composition on the reflection and attenuation of swell propagating shoreward.

APPROACH

Our approach is to fly a coherent real aperture radar (CORAR) on a NOAA Twin Otter aircraft in order to make images in a sidelooking mode of the waves propagating toward shore and to measure their directional spectra and the accompanying wind speed utilizing a simultaneous rotating mode. By obtaining wave spectra from both the imaging and rotating modes, we will obtain the dispersion behavior of any spectral peaks and thus determine the order of the interaction that produced them. We will also attempt to extract currents from CORARís rotating mode and compare them with currents simultaneously measured by a shore-based CODAR. We will fly along with two NOAA radiometers that will measure air/water temperature as well as wind speed and direction.

WORK COMPLETED

Since this project was funded in March 1997, work has focussed on modifying the existing hardware and software to allow CORAR to operate at the speeds of the Twin Otter and to operate in both the rotating and imaging modes simultaneously. We are also modifying the software to allow quasi-real time processing of the data collected.

All of the necessary hardware has now been ordered using funding under a DURIP grant and most of it in presently in hand. The major exceptions to this statement are the microwave power module, which has been ordered but has a delivery time of several months, and the antennas, which also have long delivery times. We have purchased two new ADSP boards to use with the two modes of CORAR and one of them has yet to be received. We have possession of two new, dual-processor Pentium computers that will be utilized for the simultaneous data collection and processing. The antenna mount for the rotating antennas has been constructed and is in testing. Flight on an airplane rather than an airship has necessitated the construction of a new, stepped,

local oscillator system that can adjust its frequency to the pointing direction of the antenna. Construction of this system is in progress.

Major software modifications are underway. We have decided to use Windows NT as an operating system and have reprogrammed the display to accommodate this choice. The two new ADSP boards are very different from those previously used and will allow much faster operation; testing of these boards is in process. Our decision to attempt to do quasi-real time data analysis is presently being implemented on the dual processors. We will collect the data using a C++ program and will analyze the data shortly after it has been collected using Matlab programs which have been developed during analysis of our previous airship data.

RESULTS

We are in the process of analyzing two sets of data from previous operations of CORAR on an airship. In both of these data sets, images of surface waves were obtained with CORARís antenna pointing alternately into and perpendicular to the wind. The images were obtained in both cases immediately after CORAR had been operated in its rotating mode. Utilizing the output from these two modes has clearly shown that surface waves are present which do not conform to the first-order dispersion relationship. In one set of data, it appears that these waves do satisfy the second-order relationship. In the other set of data, however, this assessment is more problematic and is still under analysis.

The first flights of the modified CORAR system are planned for November of 1998 in a pilot experiment also involving the buoys being developed by the University of Miami. The main experiment of the Shoaling Wave Project will occur in October and November of 1999.

IMPACT/APPLICATION

This project will shed new light on the interactions that occur when long ocean waves propagate onto continental shelves. In addition to this scientifically-interesting impact, the results will also allow an assessment of the feasibility of determining ocean conditions near denied coastlines by means of coherent radars mounted on remotely piloted vehicles.

TRANSITIONS

CORAR has not yet been transitioned.

RELATED PROJECTS

This work is a direct outgrowth of research funded under the core program of the Space and Remote Sensing Program.