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SURFACE SCATTERING AT HIGH FREQUENCIES: DATA ANALYSIS AND MODELING

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LONG-TERM GOALS

The long-term goal of this project is to improve on our capability to model sea surface backscattering at high frequencies (i.e., > 10 kHz range).

OBJECTIVES

There are three objectives: (1) to investigate transitions between rough surface, or Bragg, and bubble scattering modalities that occur at low wind speeds, (2) to incorporate the small slope approximation of Voronovich [1] and discussed in Thorsos and Broschat [2], in a generalized bistatic scattering model, and (3) to incorporate improved surface wave vector models into scattering calculations and test results against data.

APPROACH

First, two experiments in surface scattering in the $O(10)$ kHz range were conducted at a shallow water site off south Florida in 1995, (1) on low-grazing angle backscattering (over a 24-hr period), and (2) on bistatic forward scattering. Directional wave measurements and other key air-sea parameterizations accompanied each experiment. These data have now been analyzed, with the next phase, modeling, is nearly complete. The modeling effort includes work by Dr. Bill Plant of APL-UW, towards improving on his sea surface vector wave model [3], the results of which we shall use for the high wavenumber components. For the low wavenumber components we use the measured directional wave spectrum in conjunction with a directional spreading models [4]. Effects of scattering from near-surface bubbles are also included.

WORK COMPLETED

A computer code to compute bistatic scattering has been developed and results compared with from the above two experiments. The model uses the Kirchhoff integral expression, which includes a correction factor to conform with the small slope approximation.

RESULTS

Data in the form of horizontal spatial coherence, which is an *integrated measure* of bistatic scattering have been compared with the above model with excellent agreement [5]; results are also part of a manuscript in progress.

IMPACT / APPLICATIONS

The work relates directly to programs pertaining to shallow water acoustics, such as the ONR DRI entitled "High Frequency Sound Interaction with the Sea Floor," as these environments, interaction with the sea surface is difficult to avoid.

TRANSITIONS

This work relates directly to other ONR programs (both 6.1 and 6.2) that involve frequencies in the > 10 kHz range, and scattering from the surface and near-surface bubble layer. The results will be particularly useful for scattering models used in Torpedo and MCM system performance predictions.

RELATED PROJECTS

Basic research programs in scattering theory, such as the work on the small slope approximation by Thorsos and Broschat.

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