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14. ABSTRACT
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Environmental Complexity and Stochastic Modeling of High Frequency Acoustic Scattering from the Seafloor

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LONG-TERM GOALS

The long-term goals of this work are to more fully understand high frequency scattering from complex and realistic seafloor environments. A more complete understanding will improve forward model predictions of seafloor scattering in realistic scenarios and enable the solutions to interesting inverse problems related to sediment biological, hydrodynamic, and geological processes.

OBJECTIVES

The short-term objectives are: 1) to address the applicability and accuracy of current methods of modeling scattering from the seafloor in environments where the sediments have complex heterogeneity; and 2) to apply stochastic methods of describing complex random structures in the sediment to improve models of seafloor scattering.

APPROACH

A combination of numerical modeling, stochastic process modeling, and field data analysis will be used. Numerical modeling and experiment data will be used to motivate and guide analytical modeling. Analytic modeling will focus on stochastic descriptions of the medium (sediment roughness and volume heterogeneity) and wave scattering solutions. Field and laboratory experiments will focus on measurements of spatial and temporal variability in sediment roughness.

WORK COMPLETED

Stochastic modeling has focused on describing variability in sediment roughness due to fish deposit feeding. This process was an important and unexpected mechanism of temporal variability in scattering during the SAX99 experiment. Initial laboratory experiments are being performed to provide time series measurements of roughness due to fish feeding (Figure 1, Time lapse measurements of sediment roughness due to fish deposit feeding). A stereo camera systems and tank experiment have been developed to make these measurement in the laboratory. Expanded stereo imaging methods are being developed of use in the SAX04 experiment.

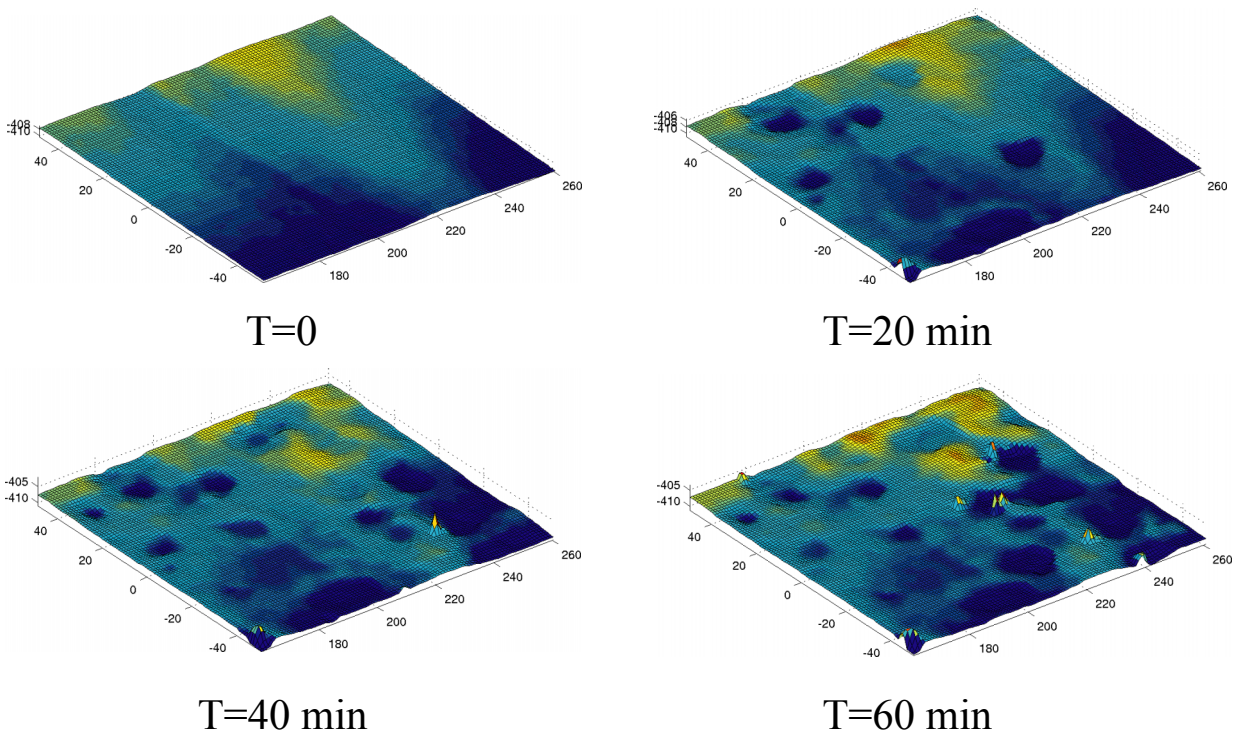

Figure 1, Time lapse measurements of sediment roughness due to fish deposit feeding

Numerical modeling of acoustic scattering has focused on time domain simulations of discrete multiple scattering using Foldy-Lax formulation, exact integral equation methods for volume scattering, and numerical perturbation methods for roughness and volume scattering.

RESULTS

No significant new results in the reported year. This work is in progress.

IMPACT/APPLICATIONS

Applications of this work include underwater acoustic imaging of the seafloor such as used for mine detect, search, and inspection. Understanding variability in scattering from the seafloor may lead to improved environmental inversion methods and seafloor remote sensing tools.

RELATED PROJECTS

This work overlaps efforts to apply time-reversal methods to underwater communications, imaging, and object detection. Time reversal relies upon complexity in the environment to enhance focusing and stability as the medium changes. The simulation and analysis methods used and developed in the reported project are also being used to study time-reversal acoustics.

PUBLICATIONS

No new publications for this project in the reported year.