ACOUSTIC TOMOGRAPHY WITH NAVY SONARS

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LONG-TERM GOALS

The goal is to map the sound-speed and temperature fields of the oceans to increase the understanding of the ocean's circulation, the propagation of sound, and to increase surveillance capabilities. The maps are estimated using a Kalman filter based on data from acoustic tomography, hydrography, and satellites.

OBJECTIVES

Simulations with a validated ocean model show that the large-scale structures of the sound-speed and temperature fields may be accurately mapped with tomography when the navigational positions of the instruments have one-kilometer errors (Spiesberger *et al.*, 1997), when the transmission times of the sources have errors of minutes (Silivra *et al.*, 1997), and when the sources and receivers are mobile (Fabrikant *et al.*, 1998). We will show that it is possible to utilize passive and active Navy sonars to map the ocean.

APPROACH

We have obtained data from SOSUS, submarines, sonobuoys, and surface vessels. These data will be used to make tomographic maps of the sound speed and temperature fields.

Data from hydrographic surveys and satellites will be combined with the acoustic data using a Kalman filter. Interpretation of the temperature fields will be made with the aid of the outputs of the Naval Research Layered Ocean Model (Spiesberger *et al.*, 1998) in collaboration with Dr. Harley Hurlburt.

WORK COMPLETED

The U.S. Navy's data tapes from SOSUS stations can be processed to obtain signals from electronically generated sounds, such as those from ATOC's sources, and from other sounds from active Navy sonars.

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RESULTS

We have shown that it is possible to read U.S. Navy data tapes at SOSUS stations to detect and coherently process a variety of acoustic signals.

IMPACT/APPLICATIONS

An accurate in-situ observing system will help fulfil the need for more data of the large scale temperature field at temporal scales less than a century or so. Since acoustic thermometry data can estimate the large scale temperature fields with more accuracy than satellite altimeters (Spiesberger *et al.*, 1998), much will be learned about the ocean by comparing these observing techniques. The in-situ observing systems will benefit surveillance systems.

TRANSITIONS

This project is in a demonstration phase and no transitions have occurred.

RELATED PROJECTS

The ATOC program is designed to transmit electronically generated acoustic signals to vertical arrays and SOSUS stations to detect global warming.

The GAMOT program is designed to use electronically generated acoustic signals to map and climatic temperature variability with mobile receivers. This later program uses the NRL Layered Ocean model to interpret their results. The NOPP program at APL/U. Washington, NRL-Stennis, NOAA PMEL, and NASA is designed to use vertical arrays and SOSUS stations to understand climatic temperature variability in the Pacific.

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