Editorial: Special Issue on the 2006 Shallow Water Experiment

To improve our basic understanding of ocean acoustics, physical oceanography, and marine geology on continental shelves and slopes, the U.S. Office of Naval Research (ONR) sponsored a large, multidisciplinary, multi-institution, multinational experiment off the coast of New Jersey in summer 2006, designated "Shallow Water Experiment (SW06)."

SW06 was a very large scale effort which entailed, over its two month (mid-July to mid-September) duration: seven ships; 62 moorings, aircraft overflights, and satellite coverage; a fleet of oceanographic gliders; data assimilating numerical modeling; real-time data communication from a number of shipboard experiments; and dozens of principal investigators tending to their parts of a tightly coordinated effort.

The papers collected in this Special Issue represent a portion of the research that has been carried out under the umbrella of SW06, and deal with geoacoustic inversions and the acoustic effects of internal waves and internal tides, both of which were major foci of the experiment. A second collection of papers from SW06 is being prepared for a forthcoming issue.

I. Internal Wave Papers

Two papers are presented here, which deal with two aspects of the internal wavefield and their effects on acoustic propagation. The first paper, entitled "The effect of the internal tide on acoustic transmission at mid-frequencies" by Yang *et al.*, deals with the effects of the internal tidal displacement of the mixed layer and thermocline upon acoustics in the 1–10-kHz band. In this work, oceanographic input from moored sensors is combined with an ocean model of the internal tide to provide input to ray theory models of the resolved acoustic arrivals. The variations in the ray arrival structure data are seen to be well described by this approach, giving one confidence that midfrequency acoustic fluctuations due to internal tides are predictable overall. The second paper, "Acoustic ducting, reflection, refraction, and dispersion by curved nonlinear internal waves in shallow water" by Lynch *et al.*, uses a combination of theory, numerical models, and data to describe what the effects of wavefront curvature in nonlinear waves are upon low-frequency (below 1 kHz) acoustics. Numerous "physical optics" effects are possibly present when sound interacts with such highly structured and coherent ocean structures, and this paper describes a number of them, along with the conditions under which they may or may not be seen.

II. Geoacoustic Characterization Papers

The geoacoustic characterization experiments were focused at two main sites where extensive ground-truth information was collected before and during SW06. One site was in a region of outer shelf sands and silty clays, and the other was on a ridge with a sand layer over the outer shelf clays. The papers here describe inversions that are related to the two sites, using various approaches and data that span a broad frequency band from $\sim$50 Hz to several kilohertz.

The papers by Ballard *et al.* and Rajan and Becker both apply a linearized perturbative approach to invert modal properties for low-frequency ($<$200 Hz) data. The Ballard *et al.* paper, "Geoacoustic inversion for the New Jersey Shelf: 3-D sediment model," combines a modal wave number inversion with previous chirp sonar survey data that provides information about the depths to the sub-bottom interfaces to estimate high-fidelity geoacoustic models over a region that spans both of the main focus sites of the experiment. Their results are very similar to the geoacoustic models derived by Rajan and Becker ("Inversion for range-dependent sediment compressional-wave-speed profiles from modal dispersion data") using an inversion of modal dispersion data. In each case, the models are shown to provide close agreement with measured transmission loss. The papers by Jiang *et al.* and Jiang and Chapman use higher frequency chirp data (1.5–4.5 kHz) from a short range experiment designed to characterize the bottom near one of the main sites. The former paper, "Estimation of marine sediment properties using a hybrid differential evolution method," describes an inversion of travel-time data from sub-bottom reflections to estimate the sediment layer model parameters, and the latter paper, "Measurement of low-frequency sound attenuation in marine sediment," extends the analysis of the sub-bottom signal to estimate the sound attenuation in the sediment. These results provide new information about the frequency dependence of sediment attenuation. The paper by Stotts *et al.*, "Geoacoustic inversions of horizontal and vertical line array acoustic data from a surface ship of opportunity," uses low-frequency noise from a passing ship that was collected on a bottom moored line array at the sand ridge site to simultaneously estimate the geoacoustic model and track the ship. Their approach was based on matched-field processing. Overall, the geoacoustic models derived from the various inversion approaches show remarkable consistency in the predicted sediment structure.

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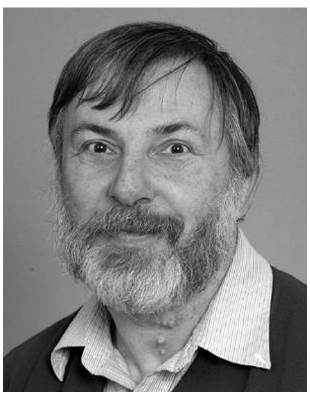

James F. Lynch (M'96–SM'02–F'05) was born in Jersey City, NJ, on June 3, 1950. He received the B.S. degree in physics from Stevens Institute of Technology, Hoboken, NJ, in 1972 and the Ph.D. degree in physics from the University of Texas at Austin, Austin, in 1978.

He then worked for three years at the Applied Research Laboratories, University of Texas at Austin (ARL/UT) from 1978 to 1981, after which he joined the scientific staff at the Woods Hole Oceanographic Institution (WHOI), Woods Hole, MA. He has worked at WHOI since then, and currently holds the position of Senior Scientist in the Applied Ocean Physics and Engineering Department. His research specialty areas are ocean acoustics and acoustical oceanography, but he also greatly enjoys occasional forays into physical oceanography, marine geology, and marine biology.

Dr. Lynch is a Fellow of the Acoustical Society of America, the former Editor-in-Chief of the IEEE JOURNAL OF OCEANIC ENGINEERING and recent chairman of the Applied Ocean Physics and Engineering Department at WHOI.