

# **Analysis of Results from ASIAEX East China Sea: Mid to High Frequency Bottom Loss**

Peter H. Dahl

phone: (206) 543-2667 fax: (206) 543-6785 email: [dahl@apl.washington.edu](mailto:dahl@apl.washington.edu)

Jeewoong Choi

phone: (206) 616-8597 fax: (206) 543-6785 email: [choijw@apl.washington.edu](mailto:choijw@apl.washington.edu)

Applied Physics Laboratory  
College of Ocean and Fisheries Sciences  
University of Washington  
Seattle, Washington 98105

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## **LONG-TERM GOALS**

Bottom loss at mid to high frequencies [  $O(1 - 10)$  kHz] can be highly sensitive to the meter-scale layering in near surface sediments. This project seeks to improve our understanding of bottom loss, and to help fill the void in our data base of bottom loss measurements, at mid to high frequencies in littoral regions.

## **OBJECTIVES**

Analyze and model  $O(1 - 10)$  kHz bottom loss measurements made during the Asian Seas International Acoustics Experiment (ASIAEX) conducted in the East China Sea (May-June 2001).

## **APPROACH**

The bottom loss measurements are interpreted as estimates of the modulus of the plane wave reflection coefficient, and data are compared to predicted values using a reflection coefficient model, based on a two-layered sediment for which the sound speed in the surficial sediment layer is allowed to vary as a linear  $k^2$  profile, where  $k$  is acoustic wavenumber. The region below this layer is modeled as a half space with constant density and sound speed. Geoacoustic parameters for the reflection coefficient model are estimated from the data by minimizing the weighted squared error between the data and the model predictions. Variances for these parameter estimates are derived using the Bootstrap method.

## **WORK COMPLETED**

*Data analysis and reporting:* The paper, "Mid to High Frequency Bottom Loss in the East China Sea" [1] has been submitted to the, *IEEE J. Oceanic Eng.* special issue on Asian Marginal Seas. The PI has also been involved in the works [2-6] concerning various experimental aspects of ASIAEX East China Sea.

# Report Documentation Page

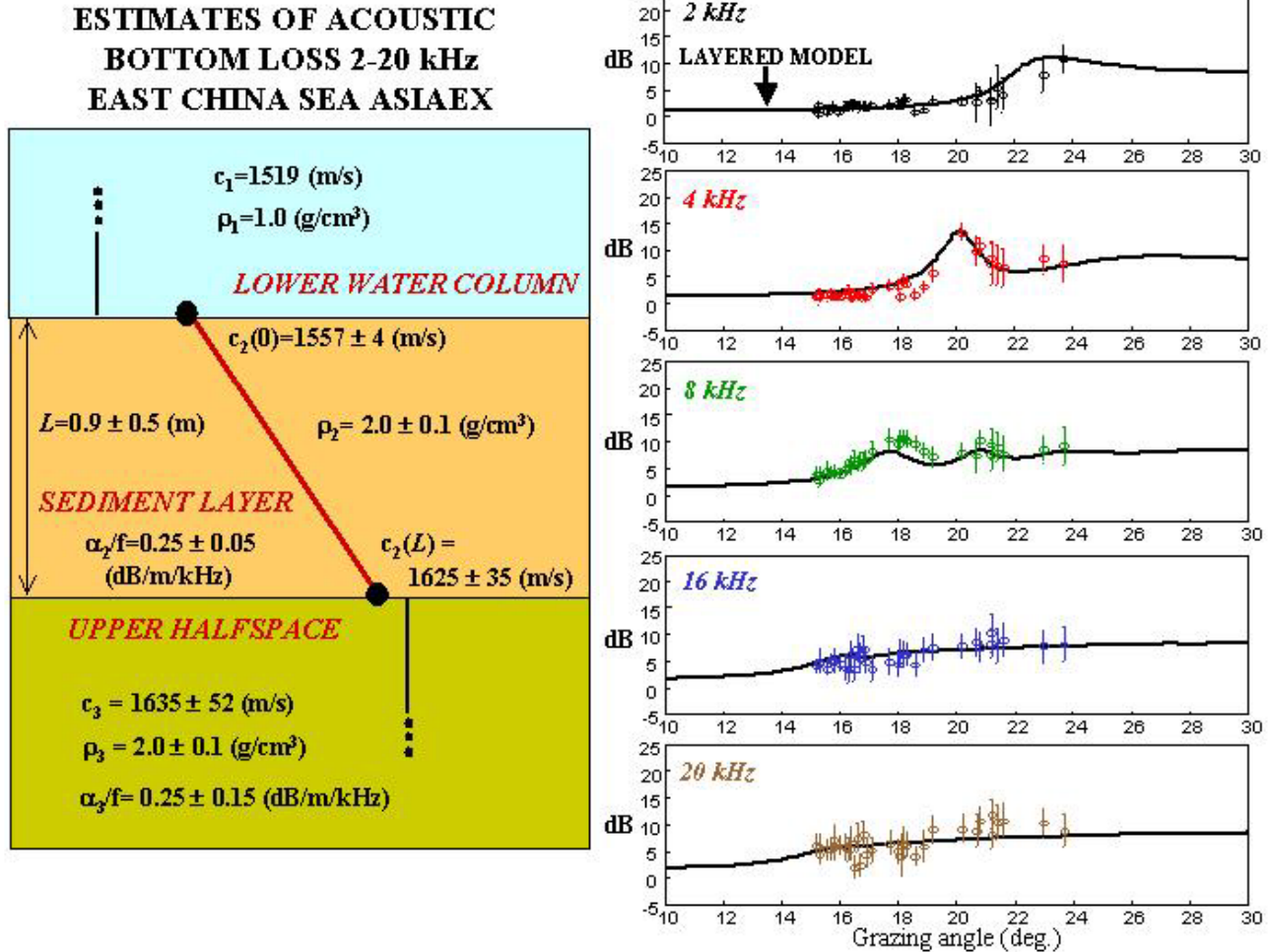
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## RESULTS

Model curves based on the geoacoustic model (Fig. 1) agree reasonably well with the observations of bottom loss over the entire frequency range, and the parameter estimates are consistent with the range of independently measured geoacoustic variables (Miller *et al.* 2003). Since this mid to high frequency data set does not provide detailed information about the sediment structure for depths beyond about 3 m, the geoacoustic parameter set is more properly viewed as description of *near-surface* sediments.



**Figure 1.** Right: Estimates of bottom loss for the East China Sea as a function of frequency (2 kHz to 20 kHz) and grazing angle. Solid curves are model based on the geoacoustic parameters shown in the left panel.

For deeper sediments, results obtained at lower frequencies from same experiment (e.g., Miller *et al.* 2003) should be blended with the results shown in here, for a self-consistent geoacoustic model for the East China Sea, applicable over a broad frequency range.

## IMPACT/APPLICATIONS

The Geophysical-Acoustic Bottom Interaction Model (GABIN) is currently being evaluated by the OMAL software review board, and the Naval Oceanographic Office. The mid-to-high frequency bottom loss data base originating from this research has been made available for exploitation by this effort, as well as by other modeling and simulation efforts involving mid frequency systems such as the AN/SQS 53 (A-D) series.

## RELATED PROJECTS

This research is integrated together with several projects within the ASIAEX field program (James Miller (URI), D. J. Tang (APL-UW), Jixun Zhou (Georgia Institute of Tech), and Zhaohui Peng (Institute of Acoustics, Beijing), with focus on propagation, and surface scattering and reflection, bottom reflection, and volume scattering effects in the East China Sea.

## REFERENCES

J. H. Miller, L. R. Bartek, G. R. Potty, Dajun Tang, Jungyul Na and Yiquan Qi, "Sediments in the East China Sea", accepted to *IEEE J. Oceanic Eng.*, 2003.

## PUBLICATIONS

[1] Jeewoong Choi and Peter H. Dahl, "Mid to High Frequency Bottom Loss in the East China Sea", *IEEE J. Oceanic Eng.* [submitted, refereed]

[2] Dajun Tang, S. R. Ramp, P. H. Dahl, James Lynch, Jixun Zhou, Renhe Zhang, Ching-Sang Chiu, R.C. Spindel, and J. Simmen, Proceedings, The Asian Seas International Acoustics Experiment (ASIAEX) International Symposium, Chengdu, China, October 14-18, 2002, APL-UW TR 0201, December 2002. [published]

[3] Dahl, P. H., "Forward Scattering from the Sea Surface and the van Cittert-Zernike Theorem", *J. Acoust. Soc. Am.* [in press, refereed]

[4] Zhaohui Peng, Ji-xun Zhou, Peter H. Dahl, and Renhe Zhang, "Seabottom acoustic parameters from dispersion analysis and transmission loss in the East China Sea", *IEEE J. Oceanic Eng.* [submitted, refereed]

[5] Ji-Xun Zhou, Xue-Zhen Zhang, Peter H. Rogers, Jeffery A. Simmen, Peter H. Dahl, Guoliang Jin and Zhaohui Peng, Reverberation Vertical Coherence and Seabottom Geoacoustic Inversion in Shallow Water *IEEE J. Oceanic Eng.* [submitted, refereed]

[6] S. R. Ramp, J. F. Lynch, P. H. Dahl, C-S. Chiu, and J. A. Simmen, "Program Fosters Advances in Shallow-water Acoustics in Southeastern Asia", *EOS Transactions American Physical Society*, Vol. 84, No. 37, September 2003. [published, refereed]

## HONORS/AWARDS/PRIZES

Name and Institution: Peter H. Dahl, Applied Physics Laboratory, University of Washington  
Award: Fellow, Acoustical Society of America