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Predicting Acoustic Backscatter from Bioturbation and Vice Versa: Scale-Dependent Modeling

Peter A. Jumars

Darling Marine Center
University of Maine
193 Clark's Cove Road
Walpole, ME 04573-3307
phone: (207) 573-3307, x.242 fax: (207) 563-3119 e-mail: jumars@maine.edu
Darrell R. Jackson
Applied Physics Laboratory
University of Washington
Campus Box 355640
Seattle, WA 98195-5640
phone: (206) 543-1359; e-mail: drj@apl.washington.edu
Bernard P. Boudreau
Department of Oceanography
Dalhousie University
Halifax, Nova Scotia, Canada B3H 4J1
phone: (902) 494-8895 fax: (902) 494-3877 e-mail: bpboudre@is.dal.ca

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http://www.ume.maine.edu/~marine/jumars.htm

LONG-TERM GOALS

Our long-term goals are to help understand — to an extent that allows quantitative prediction — important interactions among acoustic propagation, marine organisms, particles (including sediments), solutes and moving fluids. The reason for this goal is to permit solution of interesting forward and inverse problems in the marine environment (although this group of PIs may not always agree on which are the forward and which are the inverse problems).

OBJECTIVES

Our present objectives are to attempt to work toward being able to relate rate of change of acoustic backscatter from the seabed with bioturbation rates.

APPROACH

Our approach is to work toward a middle ground starting from two endpoints. One comprises acoustic records of backscatter taken at 40 and 300 kHz from bottom-landing sonars (BAMS and XBAMS developed at the Applied Physics Laboratory, University of Washington). This endpoint is the start for Pete Jumars and Darrell Jackson. The other endpoint is complete mechanistic description of local details of sediment change through automata models, undertaken by Bernie Boudreau. These automata models move sediment parcels and can be used to calculate local density and sound speed and local relief at the interface. The ideal result would be verified automata models of local organisms that could predict the temporal and spatial autocorrelation of sound speed.

WORK COMPLETED

We analyzed 300-kHz records from the Strataform program first because of their high spatial and temporal resolution and the extensive ancillary information at Strataform. We correlated these records with the upward-looking 300-kHz records from the ADCP at the 60-m Strataform mooring. Working from the other direction, the computational scheme has been implemented by Bernie Boudreau, and some automata models have been run to simulate effects of burrowing by a single individual.

RESULTS

Strataform records from the 300-kHz bottom-landing sonar (XBAMS) correlated very well with the near-bottom backscatter and showed a diel pattern in intensity, suggesting that a substantial component of the 300-kHz record may be due to volume reverberation from near-seabed plankton. The methods that we used to subtract the non-seabed components of the 40-kHz signal in the past (with BAMS, Jumars *et al*. 1996) apparently did not remove the intervening reverberation or leave a clear benthic signal.

IMPACT/APPLICATIONS

The implication is that for 300-kHz backscatter volume reverberation may present a serious impediment to gaining information on benthic or sub-seabed processes, organisms and objects.

RELATED PROJECTS

Bernie Boudreau is PI on the sister program; we are working closely with him to overcome the problem of insufficient constraints on in situ behaviors of real animals. We are attempting to combine what is known about functional morphology and feeding to put some limits on behavioral ruled for the automata models. Because of the interpretation problems with 300-kHz data so far, with Chris Jones of the Applied Physics Laboratory of the University of Washington, we have been pursuing a more direct means (with a TAPS-6 instrument built by TRACOR) to measure statistical characteristics of near-seabed plankton. We hope to be able to use this information to develop an improved algorithm for extracting the benthic components of low-angle, 300-kHZ backscatter signals.

REFERENCE

Jumars, P.A., Jackson, D.R. Gross, T.F. and Sherwood, C. 1996: Acoustic remote sensing of benthic activity: A statistical approach. *Limnology and Oceanography*, **41,** 1220-1241.