

Modeling the Effects of Surface Sediments and Small Scale Bathymetry Upon High-Frequency Shallow Water Reverberation

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Abstract: Measured reverberation data from a high-frequency sonar were analyzed using the Comprehensive Acoustic Simulation System (CASS) with the Applied Physics Laboratory - University of Washington High Frequency EnVironmental Acoustic boundary models (HFEVA). Both are found in the Oceanographic and Atmospheric Master Library (OAML) at the Naval Oceanographic Office. The data were collected along a single track in the shallow waters off the coast of Panama City, FL. The ocean bottom displayed minor variations in bathymetry and surface sediment. Bathymetric variations took the form of sand waves, with a maximum relief of 5 meters or less and wavelengths of hundreds of meters with smaller-scale ripples imposed on these sand waves. Surface sediments repeatedly varied from fine- to medium- to coarse-grained sand along the track. A 10 knot wind was present. The sound speed profile contained a surface layer of significant depth, overlaying a weak thermocline.

Consistency in the measured reverberation was found to be a function of location along the track. Both the measured data and modeled results indicated ping-to-ping variation in reverberation levels proportional to change in bathymetry. Variation in reverberation level, up to a maximum of about 8 decibels, increased as the more significant changes in relief (e.g., sand wave crest to trough) were ensonified. Conversely, these variations did not exceed 3 decibels when only the up-current side of the sand waves was ensonified. Agreement between modeled results and measured data was improved by including the appropriate surface sediment. It is significant to note that multi-path propagation was important when modeling the reverberation, including scattering from relatively proximal ranges. Results indicate that diligent use of CASS, in association with the HFEVA boundary models can produce accurate high-frequency reverberation predictions in the littoral environment.