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Benchmarking of computational scattering models using underwater acoustic data from a corrugated wax slab

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Measured time series for underwater acoustic scattering from a 30 cm x 30 cm x 5 cm wax slab with a two-dimensional corrugated (rippled) surface are compared with simulation results. The experimental geometry and directionality of the sensors allowed for ensonification of the rippled surface and the appearance of shadowing effects at low grazing angles. The acoustic source transmitted impulses at 200-800 kHz (wavelengths between 0.75-0.19 cm). The height and spacing of the ripples were 0.3 cm and 3 cm, respectively, and the slab had negligible shear speed and a measured attenuation. We simulate the experiment with the following methods listed in increasing levels of physical accuracy and computational cost: Kirchhoff Approximation (KA), Second-order Small-Slope approximation (SSA2), the Wide-angle On-Surface Radiation Condition method (WOSRC), a Pseudo-differential Impedance Operator method (PIO), a 2-domain Integral Equation method (IE-2DOM), and an Elastodynamic Finite Integration Technique (EFIT). The range of techniques allowed us to examine effects such as reflections off the interior bottom or ends of the slab and the effectiveness of the asymptotic (KA/SSA2) and pseudo-differential (WOSRC/PIO) methods for cases that include shadowing. (Work sponsored by ONR and NURC.)