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Effects of solitons on acoustic energy flow in three dimensions

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The impact of a train of non-linear solitons on the propagation of acoustic energy in shallow water is examined. The soliton perturbations are based on an analytic formulation that produces a train of five soliton waves. Each wave front is parallel and has infinite extent in the horizontal direction. The acoustic field is modeled using a three-dimensional (3-D) split-step Fourier parabolic equation (SSF/PE) approach defined in Cartesian coordinates. The standard PE approximation is employed in both depth and cross-range directions. Both pressure and particle velocity fields are computed in a self-consistent manner, allowing a full description of the 3-D acoustic intensity field which describes the flow of energy in the presence of the solitons. Individual, low-order modes are extracted from the propagating field so that the impact on specific modes may be examined. The analysis is performed at various frequencies and for various source-receiver geometries relative to the soliton train. Emphasis is placed on the focusing and defocusing of acoustic energy between the various soliton waves. The impact of such soliton perturbations on signal variability and bearing resolution at the receiver will be quantified. [Work supported by ONR 321OA.]