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Acoustic mode beam effects of nonlinear internal gravity waves in shallow water

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Ducting of sound between short-wavelength nonlinear internal gravity waves in coastal environments has been demonstrated by substantial evidence. The ducting takes a unique form for each of the acoustic normal modes. Some consequences of this are examined here using three-dimensional parabolic equation modeling and theory. For a pair of waves having a broadband 200-Hz source placed between (i.e. in the duct), strong interference patterns within the duct are developed for each mode after a few kilometers. Some of the energy escapes at high angle with respect to the duct direction. Termination of the internal wave duct, an observed feature, results in beams of energy unique to each mode to radiate outward. Specific cases having water depths of order 80 m and propagation distances of 20 to 30 km are examined. Situations where one or more modes are completely absent at selected positions are compared with similar events observed in the field.