Internal Wavepacket Propagation: Nonlinearity and Tunnelling

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Abstract

Horizontally periodic, vertically localized internal gravity wavepackets induce a horizontal mean flow in a manner analogous to the Stokes drift for surface waves. Unlike the the Stokes drift, however, the wave-induced mean flow of nonhydrostatic internal waves non-negligibly interacts with the waves themselves if they are moderately large amplitude: that is, if their maximum vertical displacement is larger than approximately one percent of the horizontal wavelength. Their consequent evolution, at least over few buoyancy periods, is well described by a nonlinear Schroedinger equation. The results are used to interpret the results of fully nonlinear simulations that examine the partial transmission of waves across weakly stratified regions in the Boussinesq approximation and extensions to anelastically growing waves are discussed.