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Internal solitary waves propagating through variable background hydrology and currents

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Abstract

Large amplitude, horizontally propagating internal wave trains are commonly observed in the coastal ocean. They are long nonlinear waves and hence can be modelled by equations of the Korteweg-de Vries type. However, typically they propagate through regions of variable background hydrology and currents, and over variable bottom topography. Hence a variable-coefficient Korteweg-de Vries equation is needed to model these waves. Although this equation is now well-known and heavily used, a term representing non-conservative effects, arising from forcing terms in the underlying basic state, has usually been omitted. In particular this term arises when the hydrology varies in the horizontal direction. Our purpose is to examine the possible significance of this term. This is achieved through analysis and numerical simulations, using both a two-layer fluid model, and actual density and current profiles from monthly averaged climatological data for some specific ocean cases of interest. We find that this "new" term can be significant, and while the overall structure of the dynamical wave evolution remains essentially the same, the effect of this "new" term is essentially to change the wave amplitude, depending on both the background stratification and background current for both summer and winter scenarios.