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Large amplitude long nonlinear internal gravity waves in stratified basins: models and dynamics

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The investigation of dynamics of large amplitude strongly nonlinear internal gravity waves in stratified fluid is proposed. The study is based, on the one hand, on generalized evolutionary models of Korteweg - de Vries and Boussinesq type, and on the other hand, on direct numerical modelling in the framework of hydrodynamic equations. Extension of Korteweg - de Vries equation for internal waves in two-layer fluid up to the third order accuracy is obtained using asymptotic expansions in small parameter characterizing internal wave amplitude and dispersion. Special case of almost equally-layered fluid (when degeneration of first-order nonlinearity appears) is considered in detail. In this situation rescaling is required in asymptotic procedure, and the modified expansion leads to extended Gardner equation, which shows new physical effects in wave dynamics. The comparison of evolution of localized initial disturbances and resulting wave dynamics is carried out for these different approaches, and quantitative range of applicability of evolutionary models is shown. Resonator effects are considered for internal waves in closed basins with external periodic forcing. Qualitatively different wave regimes are shown depending on the parameters of the boundary force. Boussinesq-like models of different order of accuracy are compared for the example of internal waves in two-layer fluid.