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Hamiltonian formulation and long wave models for internal waves

We derive a Hamiltonian formulation of the problem of a dynamic free interface (with rigid lid boundary conditions), and of a free interface coupled with a free surface, in view of modeling internal waves in oceans. Based on the linearized equations, we highlight the discrepancies between the cases of rigid lid and free-surface boundary conditions, which in some circumstances can be significant. We also derive systems of nonlinear dispersive long-wave equations in the large-amplitude regime, and numerically compute their solitary wave solutions. Comparisons with other weakly and fully nonlinear results show good agreement.