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Mathematical properties of a higher-order model for nonlinear internal waves

Recent theoretical advances in connecting the wave-induced mean flow with the conserved pseudomomentum per unit mass has permitted the first rational derivation of a model that describes the weakly nonlinear propagation of internal gravity plane waves in a continuously stratified fluid. Depending on the particular parameter regime examined, the new model corresponds to an extended bright or dark derivative nonlinear Schrödinger equation or an extended complex-valued modified Korteweg-de Vries or Sasa-Satsuma equation. Here, we present the mass, momentum and energy conservation laws. A noncanonical and nonlocal infinite-dimensional Hamiltonian formulation of the model is introduced. The modulational stability characteristics associated with the Stokes wave solution of the model are described. The bright and dark solitary wave solutions of the model are given.