Strongly Nonlinear Long Wave Model for Internal Waves

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Abstract

For internal waves in the ocean, there are various weakly nonlinear models have been proposed under the assumption of small wave amplitude. However, there have been an increasing number of observation of large amplitude internal solitary waves for which the classical weakly nonlinear assumption is no longer valid. The strongly nonlinear model has been derived under long wave assumption in a simple two-layer system in order to describe the evolution of large amplitude long internal waves. While the steady model has been demonstrated to capture correctly the characteristics of large amplitude internal solitary waves, a local stability analysis shows that the time dependent inviscid model suffers from the Kelvin-Helmholtz type instability due to a tangential veolicity discontinuity across the interface accompanied by the interfacial deformation. To suppress this undesiable short wave instability, an attempt is made to stabilize the strongly nonlinear long wave model numerically and regularize the model by modifying the short wave behavior of the dispersion relation.