Strongly nonlinear internal wave model in a three-layer fluid system

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Abstract

Many observations of large amplitude internal waves in the ocean are recently reported due to advanced science and technology. Large amplitude waves are common phenomena for internal waves, but early theoretical works are based on KdV-type equation from weakly nonlinear assumption, which is, in general, not valid for describing large amplitude waves. A strongly nonlinear model in a two-layer fluid system, called MCC model, is suggested for studying large amplitude internal waves. It turns out that the model has excellent agreements with Euler equations and laboratory experiments. For real application of the model, a continuous density profile needs to convert to two constant densities. Even with proper parameters, the model set-up cannot explain recent observation of the second mode baroclinic internal waves. Thus, we investigate three-layer MCC model, which is the simplest set-up for understanding second baroclinic internal modes. We describe the formulation of three-layer model and identify mode-1 and mode-2 baroclinic internal waves from the model PDE. We also discuss some numerical result and its stability issues which come from the governing equations, coupled Euler equations.

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