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Reply

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ABSTRACT

No abstract available.

Broadhead (1999) has developed a numerical algorithm for the solution of the generalized Korteweg–de Vries equation that takes into account large values of the turbulent horizontal eddy viscosity (ν). In the study by Holloway et al. (1997) only small values of ν were considered. The stability analysis carried out by Broadhead of both numerical schemes, in the linearized approximation, has shown the scheme used by Holloway et al. to be unstable for large ν. The new numerical scheme is a useful extension of the numerical work and allows the effects of large ν to be investigated.

The correct description of the energy loss for the nonlinear internal waves, as discussed by Holloway et al., is a difficult problem. In their simulations of shoaling internal waves, Holloway et al. found the incorporation of dissipation was essential, as this prevented the formation of unphysically large nonlinear waves.

The modified Korteweg–de Vries equation incorporating the linear effect of weak molecular viscosity was produced by Grimshaw (1983) and Smyth (1988). For real oceanic conditions the effect of turbulent dissipation should be taken into account and its parametrization in the form of horizontal eddy viscosity produces smoothing of the short-length horizontal variations of the wave field. The empirical coefficient of the viscosity should be larger than the laminar value. For example, Liu et al. (1985) used ν = 10–30 $m^2\ s^{-1}$ for soliton modeling in the Sulu Sea and ν = 1 $m^2\ s^{-1}$ for internal waves in the New York Bight. Sandstrom and Oakey (1995) choose ν = 0.2 $m^2\ s^{-1}$ for the Scotian Shelf. The coefficients are likely to be functions of background conditions such as stratification, depth, and the vertical structure of the internal wave. It is also difficult to isolate the effects of horizontal viscosity from frictional dissipation near the seabed.

Dissipation in the bottom boundary layer for the internal tide (as for unsteady flow) can be parameterized in a linear (Brink 1988; Craig 1991) or quadratic (Holloway et al. 1997) form. From the theory of soliton damping (Grimshaw 1983), it can be shown that both quadratic bottom friction and horizontal eddy viscosity lead to the same form of dissipation of solitons and, as a result, can be modeled by a single mechanism. Although this may not be true for other waveforms, Holloway et al. modeled dissipation only through quadratic bottom friction. Broadhead, in his calculations, confirms that bottom friction is important and its effects are greater than those of the horizontal viscosity if $\nu < 1\ m^2\ s^{-1}$. When modeling the evolution of nonlinear waves, the appropriate values of bottom friction and horizontal viscosity when considered together poses an interesting problem.

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