Abstract View

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The Influence of Wind Effects upon Internal Tides in Shelf Edge Regions

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ABSTRACT

The interaction of the internal tide with wind-induced currents in the shelf edge region off the west coast of Scotland is studied using a baroclinic shelf edge model. The model is used in cross-shelf form with a horizontal finite-difference grid of the order of 0.6 km and 50 sigma levels in the vertical to study the modification of the internal tide produced by upwelling and downwelling winds. Horizontal mixing in the model is parameterized using either the Laplacian form of the horizontal diffusion or the biharmonic form and the sensitivity of the solution to both forms is examined.

Coefficients for the vertical diffusion of momentum and density are determined using either an algebraic expression involving the Richardson number or from a two-equation turbulence energy submodel.

Calculations show that in the case of an upwelling-favorable wind the density gradient in the near-bed region is increased leading to a slight modification (compared to the tide only solution) of the internal tide at the fundamental frequency with significant increases in amplitude of the higher harmonics due to the increase in the nonlinear terms produced by the increase in the density gradient. With a downwelling-favorable wind the amplitude of the current and internal displacement of the internal tide at the fundamental frequency are significantly reduced due to the change in the density field in the region of internal tidal production. This also leads to a reduction in the amplitude of the higher tidal harmonics.

By using a fine grid in the horizontal, the coefficients in the horizontal diffusion terms were set at a minimum and no significant difference in solutions computed with the Laplacian or biharmonic diffusion terms was found. Similarly there are no differences in the major features of the flow field computed with the various parameterizations of the vertical diffusion, although there are some differences in the magnitude of the diffusion coefficients.

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