Abstract View

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Some Two-Layer Models of the Shelf-Slope Front: Geostrophic Adjustment and its Maintenance

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ABSTRACT

Two conceptual models of a two-layered frontal system are presented to study the wintertime shelf-slope front. The first model examines the geostrophic adjustment over a step topography after the fall overturning and applies only over short time scale before the nonconservative processes become important. The second model, on the other hand, examines the thermodynamic balance over longer time scales when some dissipative and mixing effects are included.

From the geostrophic-adjustment model, it is found that the flat-bottom solution of a less-dense shelf water with respect to the slope water is little modified by the presence of a step. But in the case of denser shelf water, the solution shows the detachment of the spillage when the depth ratio across the step is greater than two, resembling some regional observations.

In the frictional model, the wind generated entrainment is demonstrated to provide a virtual momentum source to maintain the along-front current against friction and thus can account for the persistence of the front through the winter season. The entrainment also decreases the buoyancy of the exported shelf water, the distribution of which however, varies greatly with the external parameters. For parameter values applicable to the Middle Atlantic Bight, an inflection point, corresponding to a weakened lateral buoyancy gradient, is predicted above the front, consistent with observation.