Abstract View

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Wind-Driven Motion near a Shelf-Slope Front

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ABSTRACT

A two-dimensional, two-layered frontal system is used to examine the wind-driven motion near a shelf-slope front. In the linear regime, the along-frontal current is characterized by barotropic perturbations. The front is dynamically passive and displaced according to purely kinematic constraints. The nonlinear solution shows that, even for a relatively small Rossby number, the frontal response to the oppositely directed along-frontal winds is highly asymmetric. When the wind is such that it forces surface water offshore, the model predicts ridging of the frontal interface, resembling some hydrographic observations. The model results suggest that the topographic shoaling of the deep onshore flow causes the generation of a cyclonic shear which, in a nonlinear regime, produces the observed ridging through geostrophic balance. It is reasoned that the increased entrainment above the pycnocline ridge could cut off the offshore shelf water and result in its export to the slope water regime. On the other hand, the apparent rigidity of the front as the surface water moves shoreward suggests a relative ineffectiveness for the surface slope water to penetrate through the frontal zone and contribute to mass or property balances on the shelf.