Abstract View

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The Influence of Buoyancy Flux from Estuaries on Continental Shelf Circulation

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ABSTRACT

The release of freshwater from a midlatitude estuary to the continental shelf is modeled numerically as a Rossby adjustment problem using a primitive equation model. As the initial salinity front is relaxed, a first baroclinic-mode Kelvin wave propagates into the estuary, while along the continental shelf, the disturbance travels in the direction of coastally trapped waves but with a relatively slow propagation speed.

When a submarine canyon extends offshore from the estuary, the joint effect of baroclinicity and bottom relief provides forcing for barotropic flow. The disturbance now propagates along the shelf at the first coastally trapped wave-mode phase speed, and the shelf circulation is significantly more energetic and barotropic than in the case without the canyon.

For both the experiments with and without a canyon an anticyclonic circulation, generated by the surface outflow and deeper inflow over changing bottom topography, is formed off the mouth of the estuary. As the deeper inflow encounters shallower depth, the column of fluid is vertically compressed, thereby spinning up anticyclonically due to the conservation of potential vorticity. This feature is in qualitative agreement with the Tully eddy observed off Juan de Fuca Strait.

A study of the *reverse estuary* (where the estuarine water is denser than the oceanic water) shows that this configuration has more potential energy available for conversion to kinetic energy than the normal estuary. Brass Strait may be considered as a possible *reverse estuary* for generating coastally trapped waves.

The effects of a wider shelf and a wider estuary are examined by two more experiments. For the wider shelf, the resulting baroclinic flow is similar to that of the other runs, although the barotropic flow is weaker. The wide estuary model proves to be the most dynamic of all, with the intensified anticyclonic circulation now extending well into the estuary.

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