Abstract View

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Topographic Rectification of Tidal Currents on the Sides of Georges Bank

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ABSTRACT

The rectification of M_2 tidal currents on the sloping sides of Georges Bank is predicted to make an important year-round contribution to its observed mean clockwise circulation. A rectification mechanism involving continuity and Coriolis effects, but regulated by bottom friction (Huthnance, 1973), is operative. Huthnance's (1973) depth-averaged theory for the along-isobath mean Eulerian current associated with this mechanism and with a second, purely frictional, mechanism is extended to include mean current-tidal current interaction, spatially-varying bottom friction and rotary tidal currents. The ratio of cross-isobath tidal excursion L_e to topographic length scale L is found to be an important nondimensional parameter in determining the degree of nonlinearity of the Coriolis mechanism. A significant Stokes velocity is associated with both rectification processes, so that, for the Coriolis mechanism, the mean Lagrangian current is only about two-thirds of the mean Eulerian current.

On the sides of Georges Bank, L_e and L are of the same order, and the rectification is sufficiently non-linear that interaction of the mean current with the tidal current is important. The mean Eulerian and Lagrangian currents, and the cross-isobath mean sea surface slopes, are predicted for half-sinusoid representations of bottom topography on the northwestern, northern and open ocean sides of the Bank. The mean flow is clockwise and concentrated over the edge of the Bank, but smeared out onto the top of the Bank by the mean current-tidal current interaction. The predicted current speeds, which are greatest on the northwestern and northern sides, are of the same order as those observed.