Abstract View

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Frictional Response of Continental Shelf Water to Local Wind Forcing

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ABSTRACT

Because of relatively strong tidal currants and little notification, the response of continental shelf water to wired off South Carolina is predominantly frictional and barotropic. Currents measured at the 10, 30 and 40 m isobaths were highly coherent with wind and coastal sea level (CSL). Alongshelf current at 10 m responded rapidly to wind oscillations and led CSL by 6–12 hours at periods greater than 2 days. Coastal sea level led, or was in phase with, alongshelf currents at the 30 and 40 m isobaths.

A linear frictional barotropic model that assumes alongshelf homogeneity is used to explain the observed phase relationships. Cross-shelf variation in bottom friction due to the change in water depth and a fluctuating alongshelf pressure gradient at the shelf break which lags slightly behind the wind account for most of the observed features. Nearshore flow is dominated by frictional forces while inertial terms are important on the outer shelf. The boundary separating these two regions is the point at which alongshelf current is in phase with CSL.

Model results are summarized in a response diagram defining five nondimensional quantities: CSL amplitude and phase, width of the nearshore frictional strip, bottom friction coefficient, and alongshelf pressure gradient amplitude at the shelf break. Observations from South Carolina and other broad shelf regions are correlated in the diagram. Observations and model results provide a clear understanding of the frictionally controlled, wind-driven barotropic dynamics in shallow continental shelf regions.

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