Abstract View

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Circulation On the Continental Shelf of the Southeastern United States. Part I: Subtidal Response to Wind and Gulf Stream Forcing During Winter

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ABSTRACT

Subtidal current and sea level response to wind and Gulf Stream forcing are investigated for the South Atlantic Bight shelf during winter conditions. Low-frequency flow variability in the outer shelf results primarily from wavelike meanders and eddies in the Gulf Stream front that occur in a 2-day to 2-week period band. Current meter derived vertically integrated momentum balances indicated that these large amplitude flow events are in approximate geostrophic balance with baroclinic pressure gradients induced by northward propagating Gulf Stream disturbances.

Low-frequency flow at midshelf is primarily a local Ekman response to wind forcing. Cross-shelf momentum balance for the total water column is between the along-shelf geostrophic current and the cross-shelf barotropic pressure gradient resulting from wind induced sea level changes at the coast. This balance holds for both mean and fluctuating parts of the flow, with the along-shelf barotropic current lagging sea level by 6 to 12 hours and along-shelf wind by 12 to 24 hours. The along-shelf balance of momentum is between the Coriolis force, along-shelf pressure gradient and along-shelf wind stress for the mean flow, with additional contribution from the local along-shelf acceleration of the water column and along-shelf bottom stress for the fluctuating flow. Near the transition from midshelf to outer-shelf flow regimes, which occurs at about the 40 m isobath, there is a significant contribution to mean and fluctuating along-shelf momentum from the divergence of cross-shelf transport of along-shelf momentum. An along-shelf slope of Gulf Stream origin of order -10^{-7} appears to make a significant contribution to the observed mean northward flow over the shelf. Mean volume transports are approximately 20×10^4 m^3 s^{-1} northward, which indicates a shelf residence time of three months.

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