Abstract View

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# Shoreward Intrusion of Upper Gulf Stream Water onto the U.S. Southeastern Continental Shelf

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ABSTRACT

In winter, cooling of the South Atlantic Bight continental shelf water results in higher density in the middle shelf region relative to the shelf-break region where the western flank of the Gulf Stream flows. Shoreward, estuarine-like intrusion of the upper Gulf Stream water in the presence of such a positive onshore density gradient is then possible through advective processes triggered either by the meander of the Stream or onshore Ekman transports by southward wind stresses. Repeated cross-shelf hydrographic transects were conducted from 10 January through 30 January 1986 to more closely study this intrusion process. These observations show many features predicted by a previous numerical model study. A semi-empirical model is proposed here wherein the state of stratification of water on the outer continental shelf region just inshore of the shelf break is used as an indicator of the intrusion process. Model analysis suggests correlating the observed time rate of change of potential energy of the water column with wind-induced cross-shelf Ekman transport. The correlation fit is good for at least half of the dataset, suggesting that wind-induced intrusion was significant during the observations. The analysis also suggests that it is possible to distinguish intrusion processes which are wind induced from those which are induced by Gulf Stream meanders.

Both observations and the previous numerical model study show transient shelf-break upwelling following a southward wind impulse. A simplified model suggests that the upwelling is a result of a cyclonic vortex, bounded at the shelf break, produced by interaction of wind stress and sloping bottom topography. Transient upwellings introduce Gulf Stream water from below the mixed layer to the sea surface, where it is transported onshore to the continental shelf by intrusion processes. This provides a mechanism by which nutrient-rich, deeper Gulf Stream water can replenish the water mass of the adjacent continental shelf.

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