Abstract View

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Low-Frequency Circulation at the Edge of the Scotian Shelf

Peter C. Smith and Brian D. Petrif

Atlantic Oceanographic Laboratory, Bedford Institute of Oceanography, Dartmouth, Nova Scotia 82Y 4A2, Canada

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ABSTRACT

Records of current, temperature and salinity from a two-year mooring program at the shelf break off Nova Scotia are examined to determine the low-frequency oceanic responses to the driving surface wind field and fluctuating offshore currents associated with the Gulf Stream. The seasonal mean and subtidal variance (at periods of 2–10 days) of the cross-shelf currents reflect the strong annual cycle in the wind field measured at Sable Island. The mean vertical shear suggests a simple Ekman response to winter increases in the longshore wind component, but this model fails quantitatively because 1) the inferred surface-layer (20 m) transport is much too large and 2) the deep (150 m) “return” flow shows no annual signal. The excessive offshore near-surface transport in winter must be reconciled with the relatively stationary position of the shelf/slope-water boundary (SSB) by invoking intense cross-frontal mixing and/or a seasonal mean alongshore pressure gradient. The seasonal mean longshore currents above the main thermocline appear to he more strongly influenced by energetic topographic Rossby waves than by wind.

Weekly sea-surface temperature analyses are used to monitor off-shore forcing reflected by fluctuations in the position of the SSB in the region from 60 to 65°W. The dominant empirical mode of its space-time variance represents a uniform on–offshore translation at very low frequencies. The longshore current variance in the ocean-forced spectral band (periods 10–90 days) is 1) correlated with the low-frequency onshore displacement of the SSB in the deep water on the continental rise and 2) comparable to that in the wind-driven band (periods 2–10 days) from 50 to 150 m at the shelf break.

On the shelf, the advective onshore transports of heat and salt exhibit annual cycles similar to those in the wind field, and generally exceed the vertically integrated eddy fluxes by factors of 2–4. However, the combination of observed moan and eddy transport supports excessive alongshore gradients of temperature and salinity in the context of a simple box model, and hence may not be representative of the entire shelf.

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Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
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