Abstract View

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The Nantucket Shoals Flux Experiment (NSFE79). Part I: A Basic Description of the Current and Temperature Variability

Robert C. Beardsley, David C. Chapman, and Kenneth H. Brink

Woods Hole Oceanographic Institution, Woods Hole, MA 02543

Steven R. Ramp and Ronald Schlitz

National Marine Fisheries Service, Woods Hole, MA 02543

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ABSTRACT

The Nantucket Shoals Flux Experiment (NSFE79) was conducted across the continental shelf and upper slope south of Nantucket from March 1979 to April 1980 to study the flow of shelf water from the Georges Bank/Gulf of Maine region into the Middle Atlantic Bight. The experiment included a moored array of current meters and bottom instrumentation deployed at six locations across the shelf and upper slope spanning a depth range from 46 to 810 m, and supporting hydrographic observations. A basic description of the moored current and temperature data is given here with an emphasis on the low-frequency variability.

In the summer period (April–August) when the local vertical stratification reached a maximum due to increased surface heating and reduced wind mixing, the mean flow over the shelf at all instruments was primarily along 1ocal isobaths towards the west. The subtidal current fluctuations were coherent both horizontally and vertically over the shelf, but not with current fluctuations observed over the upper slope. The wind stress during summer was weak and only moderately correlated with the subtidal current fluctuations.

In the winter period (October–March), when the seasonal thermocline was destroyed and the shelf water locally homogenized by increased surface cooling and wind mixing, the mean currents observed over the shelf were also primarily alongshelf towards the west at speeds comparable to those measured in summer. However, the low-frequency current fluctuations over the shelf were much more energetic in winter. These subtidal current fluctuations were highly coherent horizontally and vertically over the shelf and with surface wind-stress fluctuations (which increased in magnitude by a factor of 5 over the summer period). The most energetic subtidal current events observed over the shelf also tended to extend into the upper slope region.

The subtidal currents observed over the upper slope in summer were dominated by three bursts of large eastward currents which correspond to the passage of anticyclonic Gulf Stream warm-core rings near or through the moored army. The effect of these rings on the current field does not appear to penetrate shoreward of the shelf break. In winter only two rings passed near the array and their influence on the observed upper slope currents was unclear owing, in part, to the increased subtidal current variability caused by the stronger synoptic wind forcing in winter.

Multiple regression analysis was used to identify possible annual variations in the NSFE79 moored current and temperature data. Significant annual variations were found in the temperature field over the shelf and upper slope and in the low-frequency current variability over the shelf. No significant annual variation was observed in the alongshelf current over the shelf, however, suggesting that there is, at least on time scales of one month and more, a continuous flow of shelf water into the Middle Atlantic Bight from the Georges Bank/Gulf of Maine region. The mean westward volume flux between the 40 and 120 m isobaths observed in NSFE79 was $38.3 \pm 6.9 \times 10^4$ m^3 s^{-1}.

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