Abstract View

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Time-Dependent Temperature and Vorticity Balances in the Atlantic North Equatorial Current

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ABSTRACT

The nature of the temperature and vorticity balances of the Atlantic North Equatorial Current is examined at three different depths and four different frequency bands using the POLYMODE Array III, Cluster C data set. A balance of the type described by Bryden (1976) between horizontal advection of temperature and local change of temperature, was found only in the mid-thermocline (300–500 m) and in the 30–64 day frequency band. However, horizontal advection is still an important term in this frequency band at other depths and is important everywhere at lower frequencies. Vertial advection, consistent with wind forcing, is found to balance temperature changes in the 4–28 day band.

A Reynolds' decomposition of the individual terms in the temperature conservation equation is performed to allow a closer look at the nature of the motions. Remarkably, north–south motions of the mean northward temperature gradient ($v'\bar{T}_y$ in the thermocline do not correlate with changes of temperature. This implies that within the *y*-*z* plane the motion is more along-isotherm. By contrast, mean westward advection of distorted isotherms ($U\bar{T}_x$) is found to be highly coherent with changes of temperature. This is shown to be consistent with the presence of a critical layer at 200–300 m.

Relative vorticity changes are found to be balanced by advection of planetary vorticity (β*v*) in the 81–324 day band, within the estimated errors. Advection of vorticity is found to be important in the 30–64 day band, stretching at higher (4–28 days) frequencies. The dominance of β in the low-frequency band is shown to be due to the larger scales in that band, allowing the fluid to “feel” the planetary gradients of potential vorticity (β) rather than local variations.

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