Abstract View

Volume 19, Issue 11 (November 1989)

Journal of Physical Oceanography
Article: pp. 1669–1681 | Abstract | PDF (988K)

Potential Vorticity Balances and Horizontal Divergence along Particle Trajectories in Gulf Stream Meanders East of Cape Hatteras

Amy S. Bower

Graduate School of Oceanography, University of Rhode Island, Narragansett, Rhode Island

(Manuscript received July 18, 1988, in final form April 17, 1989)

DOI: 10.1175/1520-0485(1989)019<1669:PVBAHD>2.0.CO;2

ABSTRACT

Trajectories of 37 isopycnal RAFOS floats launched in the Gulf Stream off Cape Hatteras have been analyzed to examine the dynamics of meanders from a Lagrangian viewpoint. Using the float data in conjunction with information on the structure of horizontal velocity shear from the PEGASUS study (Halkin and Rossby), variations in planetary, curvature, and shear vorticity have been estimated along the float trajectories. Changes in fluid layer thickness were then inferred assuming potential vorticity is conserved following the floats.

This analysis shows that curvature vorticity changes are typically 10%–20% of f (planetary vorticity) as fluid parcels travel between meander troughs and crests. Lateral shear changes on the order of 20%–30% of f are common as parcels move laterally relative to the jet axis between meander extrema. Although changes in these two terms are usually of opposite sign and tend to compensate, significant layer thickness changes do occur, with some parcels exhibiting 30% changes in thickness over several days.

Sixty-one estimates of horizontal divergence were made from the average time rate of change of layer thickness between meander extrema. The magnitude of horizontal divergence [O(.01 f)] was found to be a strong function of temperature, clearly decreasing with decreasing temperature through the main thermocline.

Even more striking was the dependence of the sign of horizontal divergence on cross-stream position. On the anticyclonic side of the stream, divergence (convergence) was indicated downstream of a trough (crest). On the cyclonic side, convergence (divergence) was present downstream of a trough (crest). These results are discussed in relation to the free inertial jet model of the Gulf Stream developed by Robinson and Niiler. Implications for quasi-geostrophic theory are examined and it is found that this approximation may not be appropriate for use in the Gulf Stream.

top

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
Allen Press, Inc. assists in the online publication of *AMS* journals.