Abstract View

Volume 27, Issue 3 (March 1997)

Journal of Physical Oceanography
Article: pp. 403–418 | Full Text | PDF (984K)

Seasonal Transport Variations of the Kuroshio: An OGCM Simulation

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(Manuscript received September 20, 1995, in final form July 18, 1996)

DOI: 10.1175/1520-0485(1997)027<0403:STVOTK>2.0.CO;2

ABSTRACT

Numerical simulation is performed using a high-resolution ocean general circulation model to investigate seasonal variations of the Kuroshio transport. The simulated velocity profiles of the Kuroshio agree surprisingly well with ADCP observations and dynamic calculations. The annual mean of the model Kuroshio transport relative to 700 m across the PN line near the Nansei (Ryukyu) Islands is about 25 Sv (Sv $\equiv 10^6$ m^3 s^{-1}), which is almost the same with the estimate based on the long-term hydrographic observations. The model transport variations across the PN line are also almost the same as the observation; the transport shows a weak maximum in summer and a weak minimum in winter. Although the Sverdrup balance is valid in the broad interior of the basin, it fails to predict the variations as well as the transport of the Kuroshio south of Japan due to existence of the Kuroshio recirculation.

The above discrepancy between the Sverdrup theory and the model (observations, as well) is studied in detail by analyzing the torque balance. In winter the Kuroshio transport across the PN line is much smaller than expected from the Sverdrup theory because the topographic control prevents the western boundary current from intruding west of the continental slope near the Nansei Islands. The current over the slope region changes its direction from winter to summer due to anticyclonic eddy activity related to the joint effect of baroclinicity and bottom topography. The deep northeastward current over the slope in winter is canceled in summer by the eddy activity so that the interaction between the continental slope and the current is much reduced. Since the same eddy activity intensifies the Kuroshio recirculation, the Kuroshio transport across the PN line in the East China Sea is increased in summer.

The present study demonstrates that comparing model results with observations requires a model resolution suitable enough to resolve locations of observations as well as essential dynamics related to the interaction between baroclinic ocean currents and bottom topography.

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