Abstract View

Volume 17, Issue 7 (July 1987)

Journal of Physical Oceanography
Article: pp. 970–985 | Abstract | PDF (1.12M)

Parameter Sensitivity of Primitive Equation Ocean General Circulation Models

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(Manuscript received May 28, 1986, in final form December 11, 1986)

DOI: 10.1175/1520-0485(1987)017<0970:PSOPEO>2.0.CO;2

ABSTRACT

Experiments with a low resolution, primitive equation ocean general circulation model with idealized basin geometry and surface forcing have been carried out in order to identify the processes controlling the climatically important aspects of the circulation. Emphasis was placed on the sensitivity of the model solutions to the magnitude of the vertical diffusivity. Scaling arguments suggest, and the numerical experiments confirm, that the solutions are most sensitive to the magnitudes of the wind stress curl and the vertical diffusivity. For small vertical diffusivity, wind forcing dominates the solution. The vertical scale of the thermocline is set by the strength of the Ekman pumping, and there is a multiple gyre circulation in the upper layers. For large vertical diffusivity, diabatic surface forcing dominates the solution. Vertical diffusion controls the vertical scale of the thermocline, and there is a single large anticyclonic gyre in the upper layers. Both the meridionally and zonally integrated overturning circulations are sensitive to the vertical diffusivity, though not to the same degree. The poleward heat transport is dominated by the zonally integrated meridional overturning circulation and, hence, also shows a sensitivity to the vertical diffusivity. The maximum poleward heat transport for the model used in this study varies by an order of magnitude as the vertical diffusivity is varied over a range comparable to that of estimates based on observations. The sensitivity to the prescription of the surface diabatic forcing and to other closure parameters is also described.