Abstract View

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An Eddy Resolving Numerical Model of the Ventilated Thermocline

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ABSTRACT

A three-dimensional, primitive equation numerical model is used to study the effects of mesoscale eddies within the subtropical thermocline. Solutions are obtained for an ocean bounded by idealized topography are driven by simple wind and buoyancy forcing at the surface. Results using an eddy-resolving, fine grid are compared to those using a noneddy-resolving, coarser grid. Relatively little difference is realized in the basic, mean flow patterns of the two solutions. However, more significant differences are seen in the distributions of a passive tracer and the potential vorticity. Mixing by eddies in the westward flowing sector of the subtropical gyre is quite effective in homogenizing these quantities on isopycnals.

Whereas previous theory has predicted homogenization of potential vorticity on long time scales within recirculating gyres the present model demonstrates homogenization on a much shorter time scale, across recirculating/ventilating flow boundaries. Anomalous potential vorticity that it advected into the thermocline from isopycnal outcrops by ventilated flow causes changes in sign of the meridional gradient of local potential vorticity, which in turn gives rise to baroclinic instability. The resulting eddies serve to homogenize the anomalous potential vorticity with its environment.

Net poleward heat transport is quite similar in the two solutions. Equatorward heat transport by time variant flow due to eddies is compensated by an additional contribution of the eddies to the mean meridional circulation, producing a net heat transport nearly the same as that of the noneddy-resolving solution.

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