Geophysical Research Abstracts, Vol. 7, 05932, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05932

Formulation and implementation of a residual-mean ocean circulation model.

D. Ferreira (1) and J. Marshall (1)

(1) EAPS, Massachusetts Institute of Technology, Cambridge, MA.

A parametrization of mesoscale eddies in coarse-resolution ocean general circulation models (GCM) is formulated and implemented using the formalism of the 'Transformed Eulerian Mean'. In that framework, mean buoyancy is advected by the residual-mean velocity (the sum of the Eulerian and eddy-induced velocities) and modified by a residual flux which accounts for the diabatic effects of mesoscale eddies. The residual velocity is obtained by stepping forward a residual-mean momentum equation in which eddy stresses appear as forcing terms.

A closure is formulated for the eddy stresses and the residual flux. Taking advantage of the N^2-dependence of the horizontal eddy diffusivity suggested by Ferreira et al. (2005), the eddy stress is represented by a vertical viscosity proportional to f^2 (f Coriolis parameter). The residual flux is neglected in the ocean interior where mesoscale eddies are quasi-adiabatic, but is parameterized by a horizontal downgradient diffusivity near the surface where eddies develop a diabatic component as they stir properties horizontally across steep isopycnals.

The residual-mean model is implemented and tested in the MIT GCM. It is shown that the resulting model 1) has a climatology that is superior to that obtained using the Gent and McWilliams parametrization scheme and 2) allows one to significantly reduce the (spurious) horizontal viscosity used in coarse resolution GCMs.