Ocean Sci. Discuss., 7, C399–C401, 2010
www.ocean-sci-discuss.net/7/C399/2010/

Ocean Science
Discussions

Interactive comment on "Mixed layer mesoscales: a parameterization for OGCMs" *by* V. M. Canuto et al.

V. M. Canuto et al.

VCANUTO@GISS.NASA.GOV

Received and published: 8 September 2010

V.M. Canuto[1,2] and M.S.Dubovikov[3]

[1]NASA, Goddard Institute for Space Studies, 2880 Broadway, New York, NY, 10025

[2]Dept. Applied of Phys. and Math., Columbia University, New York, NY, 10027

[3]Center for Climate Systems Research, Columbia Univ., New York, NY, 10025

The Editor's decision stopped a scientific discussion on an important scientific issue:

Mixed Layer mesoscale parameterization for use in OGCMs

It therefore hindered scientific progress which is what our work represents, as the points below make clear.

The mesoscale parameterizations available today are valid for an **adiabatic ocean** and cannot describe the mixed layer which is **diabatic** and is thus governed by different physical processes.

The practice thus far has been to adopt **tapering schemes** which however "produce sea surface temperature differences as large as a few degrees in regions where the models have strong heat exchange with the atmosphere (e.g., western boundary currents and the Atlantic Circumpolar Current)" (Ferrari et al., 2008).

To bypass these problems, it must be recognized that ML and deep ocean are governed by different physics and must be treated differently. In accordance with that spirit, we developed and presented a parameterization that is not an extension-adaptation via tapering schemes of the mesoscale model we presented earlier in CD5,6 for the adiabatic ocean. As far as we know, our work is the only one that exhibits the following features:

a) in recognition of the different physics in the ML**,** the new parameterization is obtained using the solutions of new mesoscale dynamic equations which are different from those in CD5,6 used to derive a mesoscale model for the adiabatic deep ocean,

b) the parameterization is not based on heuristic arguments, neither is it constructed using data from numerical simulation data. Rather, the latter are used to validate the parameterization.

c) the parameterization is for an *arbitrary tracer*. A model for buoyancy (*active tracer*) is insufficient since it cannot describe CO2 (*passive tracer*) whose dynamics is of primary importance in climate studies.

d) the vertical mesoscale flux automatically vanishes at the ocean surface.

e) thus, our model does not need any tapering mechanism

f) the second z-derivative of the buoyancy vertical mesoscale flux is negative thus entailing mixed layer re-stratification, in agreement with results of eddy resolving simu-

lations.

g) the vertical buoyancy mesoscale flux is of the same order of magnitude but opposite sign of the vertical flux due to small scale turbulence. This leads to a significant cancellation that leaves behind a more stratified mixed layer which absorbs less heat and CO2, two features with important climatic implications

h) the z-profile of the eddy kinetic energy K(z) compares well with WOCE data in several locations

i) the surface eddy kinetic energy K_s compares well with the Topex-Poseidon-Jason-1 data

j) the z-profile and the magnitude of the vertical mesoscale flux is assessed against eddy resolving simulation data.

Given the above points, the referee never suggested to "reject" the paper.

Reference

Ferrari, R., J.McWilliams, V.M.Canuto and M.S. Dubovikov, 2008, *Journal of Climate*, **21**, 2770-2789,

---

Interactive comment on Ocean Sci. Discuss., 7, 873, 2010.