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Ocean Science Discussions

Interactive comment on "Mixed layer sub-mesoscale parameterization – Part 2: Results for coarse resolution OGCMs" *by* V. M. Canuto and M. S. Dubovikov

Anonymous Referee #1

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Review of: Mixed layer sub-mesoscale parameterization - Part 2: Results for coarse resolution OGCMs.

This paper presents a parameterization for the vertical scalar flux owing to O(1km) sub-mesoscales in OGCMs that do not resolve either mesoscales or sub-mesoscales. The authors rely very heavily on parameterizations for the sub-mesoscale and mesoscale scalar fluxes that they presented in two previous papers. This paper starts with the sub-mesoscale parameterization, applies a multi-scale expansion, and then attempts to use the mesoscale parameterization to write the sub-mesoscale flux in terms of large scale quantities that are explicitly resolved in OGCMs. Despite the title, the authors do not

present any results from using the parameterization in OGCMs, nor do they attempt to validate the results based on high resolution models or observations. Due to the limited scope of the paper, unjustified assumptions, and the lack of clarity, I do not believe that the paper will be useful to the ocean modeling community and I do not recommend it for publication.

There are several important steps in the derivation that are not explained. Although it is never stated explicitly, Eq. (A1) appears to assume that the mixed layer stratification and the mixed layer depth, N and h, do not vary over unresolved scales by OGCMs. Since the authors assume that mesoscale eddies are unresolved in OGCMs, this assumption seems very dubious. Second, in stating Eq. (A2), the authors assume that tracer gradients are aligned with buoyancy gradients. The only explanation given is that mesoscale eddies tend to be axisymmetric which is far from satisfactory. Finally, the parameterization equations do not appear to be closed since the tracer slope, s in Eqns. (9e,f), depends on the mesoscale buoyancy gradient.

The notation that the authors use is nearly impenetrable and makes reading the manuscript very difficult. There are more than ten different symbols used to modify variables, and their selection is unclear and sometimes inconsistent. For example, double prime and subscript M denote mesoscale quantites, while sub-mesoscale quantities are variously denoted by a single prime, subscript SM, subscript s, or superscript s. Tau is also a curious choice to denote a generic scalar since it is common practice to use this symbol to denote stress.

Interactive comment on Ocean Sci. Discuss., 7, 1289, 2010.