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Interactive Comment

Interactive comment on "Influence of numerical schemes on current-topography interactions in 1/4° global ocean simulations" *by* T. Penduff et al.

Anonymous Referee #2

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I have read the manuscript ‘‘Influence of numerical schemes on current-topography interactions in 1/4deg global ocean simulations” by Penduff, Le Sommer, Barnier, Treguier, Molines and Madec. The authors discuss several decadal-scale integrations with an eddy-permitting global model. The model versions differ in the numerical formulation of the momentum advection scheme, the representation of topography (full step vs. partial step) and side wall boundary conditions (no slip vs. free slip). It is shown qualitatively, that all such differences have comparable effects on the simulated circulation, i.e. demonstrate the sensitivity of the model simulation on dissipation. Although this result is not very surprising it might warrant publication in order to document it. My suggestion is, however, to focus the discussion in a revised manuscript and to add additional experiments.

EGU

Major remarks:

The scope of the manuscript appear rather engineer-like and I miss the physical motivation of the work. It is clear that the choice and numerical representation of the momentum scheme, topography representation and side-wall boundary condition affects the model simulation. Choosing the best one compared to observations amongst all simulation is the standard engineering approach (and common amongst modellers). However, as a scientist (writing a scientific paper) one has to ask what the principle dynamics are which might be at work (concerning dissipation near the bottom and side walls) and how one can represent or parameterise those dynamics in the model (eventually by choosing adequate numerical formulations).

I would advise the authors to try to reformulate their paper, by stating in the introduction what is known about the role and meaning of side-wall boundary conditions, dissipation and topography for the large-scale dynamics, meso-scale eddies and the energy cycle (including energy and enstrophy cascades in wavenumber space) in the ocean. Part of such a discussion is given in the last section of the manuscript, which should be extended and moved to the front. Further they should outline why they discuss the different model experiments and what insight can be expected into the fundamental dynamics. It would also be useful to discuss the impact of lateral friction and in particular the choice and amplitude of bottom friction in the model. Ideally one would like to see one or two additional model experiments in this respect, but it might also be that previous experiments with similar model versions can be utilised.

Furthermore, I would like to see a discussion of the meaning of enstrophy and energy conservation properties of the momentum scheme. What physical principles are implemented here and why? I guess the different numerical implementation yields different dissipation, so what kind of parameterisation for dissipation is inherent to these schemes? It should also be stressed that it is no good scientific style that those schemes are only detailed in a technical report (referred to as Madec, 2006) which is apparently not accessible to the public.

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Minor remarks:

Having read reviewer's A comments I cannot stop myself in asking the following: When the present z-level model becomes similar to sigma-coordinate models, does it also suffer from the problems of those models? That is, how large is the pressure gradient error due to the partial step formulation? Is it possible that the model sensitivity near boundaries are due to this error? Note that again the partial cell (and pressure gradient) formulation in the OPA code appears to be undocumented.

Interactive comment on Ocean Sci. Discuss., 4, 491, 2007.

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