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Ocean Science Discussions

Interactive comment on "Impact of hydrographic data assimilation on the Atlantic meridional overturning circulation" *by* G. C. Smith et al.

Anonymous Referee #3

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This manuscript discusses the effects of the hydrographic data assimilation on the simulation of the Atlantic meridional overturning in a global numerical model of the oceanic circulation. The main conclusions in the paper are based on the comparison of the runs with and without data assimilation. The results thus help to understand the degree to which AMOC can be constrained with available observations of temperature and salinity, including the Argo data, in a given model. I fully agree with the authors that this issue is highly relevant to climate predictions. This manuscript should be published, after a major revision.

General comments:

Diapycnal diffusion, which tends to be too high in z-coordinate models, is usually one of the main causes of errors in the deep stratification. How large is the vertical diffusion

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in this model?

The analysis is constrained to the latitude of the RAPID/MOCHA array. It would be interesting to see the effects of the data assimilation on the global density structure. The authors can show, for example, the changes in the zonal-mean density in the entire Atlantic. Such a figure can help to interpret sensitivity of AMOC to data assimilation in this model and highlight remaining problems and needs for more data.

Figure 5c shows significant differences in the deep densities (below 2000m) between the RAPID and WOA data; these differences need to be discussed. Are they due to errors in WOA data? In that case, one can also wonder if CTL-IC and SYN-IC experiments are useful.

Figs. 5d and 6: The difference between the RAPID overturning and the one estimated from the WOA dataset using thermal wind relation should also be discussed. Are they due to errors in the WOA dataset, MOC variability, or the assumptions of the method based on the thermal-wind relation?

The paper is somewhat difficult to read and the authors should consider shortening some of the discussion and reducing the number of figures. In particular, I would replace some of the figures 7-13 with a short description in the text and significantly shorten Section 5. Given the fact that the total overturning is very similar between CTL and SYN experiments, it is not surprising to see that it is very little affected by tapering in coastal areas, so I did not find Fig.9 very useful.

Specific comments:

- p.2670, ll. 14-15: the importance of the MOC heat transport for the climate of the Northern Europe is still under debate and the divergence of oceanic heat transport in the northern North Atlantic tends to be very small.

- p.2672, l. 13: there seems to be some confusion in the text regarding the resolution of the ORCA model; is it 1/3 or 1/4 degrees?

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- p.2684, bottom: reporting variance of MOC variability for these runs may be helpful here.

- p.2692, ll. 10-14: I do not see how this study suggests that the RAPID/MOCHA array is not sufficient to monitor AMOC and that profiling of subpolar gyre can help. The effects of the assimilation of data at high latitudes are not isolated by this study.

Interactive comment on Ocean Sci. Discuss., 6, 2667, 2009.