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Climate of the Past Discussions

Interactive comment on "The global ocean circulation on a retrograde rotating earth" *by* V. Kamphuis et al.

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We thank the referee for the critical comments and useful suggestions; all points have been addressed in the revision of the manuscript.

Major Comments

To our opinion, we were already careful with our conclusions but have weakened them slightly based on the comments of the referee. We changed the sentence in the abstract, now saying "there is relatively weak but intermittently strong deep water formation in the North Atlantic." This is also the reason we need to keep figure 5 in the article, as it clearly shows the Atlantic MOC having a maximum strength of 13 Sv. This is about

the same as the OROSCALE=1 experiment in the recommended article of Schmittner et al. "Effects of Mountains and Ice Sheets on Global Ocean Circulation" (in press J. Climate, http://journals.ametsoc.org/doi/abs/10.1175/2010JCLI3982.1). Their results are very interesting, however, and show that many factors in the climate system play a role in setting the preference for Atlantic sinking and the paper is cited in the revised discussion.

The basin wide freshwater budgets are calculated for Atlantic (between 32°S and 80°N) and the Pacific (between 36°S and 70°N). The mean E-P flux in the Atlantic is 1.01 $kg\,m^{-2}\,day^{-1}$ for PRO and 0.71 $kg\,m^{-2}\,day^{-1}$ for RETRO. The mean E-P flux in the Pacific is -0.16 $kg\,m^{-2}\,day^{-1}$ for PRO and 0.07 $kg\,m^{-2}\,day^{-1}$ for RETRO. This is added in the text. What is important is that the Pacific becomes net evaporative.

The transport of salt from the Indian to the Atlantic ocean is not reversed in the sense that there is Agulhas leakage into the Indian Ocean, rather there is an inflow from the Indian to the Atlantic due to the reversed ACC. So this is more complicated than in Sijp and England (2009). These changes are a study in itself and a more detailed data analysis of these aspects are outside the scope of this paper.

The implicit model has its deficiencies, which are mentioned in the text and through references. However, the advantage of being able to directly calculate the bifurcation diagram outweighs these caveats. The fact that RETRO and RETRO2 have different MOCs is made more clear in the text.

Minor Comments

- Several additional references are provided.
- Agreed, E is indeed the most important factor setting the $E - P$ difference between Atlantic and Pacific as was already mentioned in the introduction.

- Suggestion followed.
- The North Pacific is truly saltier in RETRO than in PRO. Only the surface layer is not and this is because of the reversed Bering Straight transport. Just below the surface the water is much saltier. This cannot be seen clearly in Fig. 3 but has now been clarified in the text.
- The figures 4 and 5 have not been changed as otherwise compatibility with Fig. 9 is lost.
- The explanation about the sea ice extent is added to the text.
- We showed stable precipitation because it is not directly influenced by SST, and because the convective precipitation is not captured well by the model [Collins et al. : The Community Climate System Model Version 3 (CCSM3), J. Climate, 19, 2122–2143, 2006] .
- For reasons mentioned above, Fig. 5 was kept in the paper.

Interactive comment on Clim. Past Discuss., 6, 2455, 2010.