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Climate of the Past Discussions

Interactive comment on "Mid-pliocene Atlantic meridional overturning circulation not unlike modern?" *by* Z.-S. Zhang et al.

Anonymous Referee #2

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Zhang et al. make a comparison of eight different coupled climate models within the PlioMIP on investigating the differences in AMOC for the mid-Pliocene warm period (mPWP) in comparison with today. None of these models predicts a significantly stronger AMOC for the mPWP as has been suggested by proxy reconstructions. The only significant changes occur in the depth of the overturning cell/depth of formation of NADW. It is suggested that the main reason for the reduced gradients in benthic d13C based on proxy reconstructions are caused by changes in stratification in the Southern Ocean, eventually reducing the gradient instead of changes in AMOC.

The manuscript is well-written with a clear structure giving a straightforward overview of the model results. My major, and basically only, point of comment is the comparison to the existing proxy reconstructions which is currently mostly based on just one paper

by Hodell and Venz. There is a lot more published on the changes in Pliocene AMOC, arguing in both directions for the model results (see an example below), which is worth to include into the discussion. Below are points which require some more attention, as well as some minor comments at the end of this review.

Major comments: The comparison with proxy records is mainly based on the Hodell and Venz paper with short mentioning of Raymo et al. and Ravelo and Andreasen. I would add the records which were generated in the Caribbean (Sites 999 and 1000), Ceara Rise (Site 925) (and possibly NW-Africa (Site 659)) which show high-resolution reconstructions of benthic d13C (Haug and Tiedemann, 1998; Haug et al., 2001; Steph et al., 2010). These studies do not work with the d13C gradient over the Atlantic but rather look at the end-members of the southern and northern water masses, resp., as well as the interplay between upper- and lower-NADW. These studies do suggest a stronger AMOC too. Besides, the distinction between upper and lower NADW would be an interesting comparison with the data results suggesting the depth change in the overturning cell.

What are the errors associated with these experiments? Coming from a non-modeling background I wonder what the real impact is of a, for example, 4% change in the heat transport, especially when the results between different models seem to vary up to 100%. Is this the reason to suggest that no significant change in comparison with today occurred? Such variations in modeling experiments are definitely too small to reconstruct with proxy studies and might, as such, be overlooked in downcore records.

Minor comments: Title: "not unlike modern?" feels a bit awkward. I suggest changing this into something like "similar to the modern situation".

Page 1304, Lines 4-7: How is the warming in the North Atlantic explained then?

Page 1305, Line 20: add "the" before AMOC.

Page 1306, Line 5: add "modern" before NADW. Line 25: add "and" before in the.

Page 1308, Line 3: add “the” before other.

In conclusion, I recommend that this manuscript is well fitting within the framework of Climate of the Past and can be published after these mostly minor revisions have been made.

Interactive comment on Clim. Past Discuss., 9, 1297, 2013.