Geosci. Model Dev. Discuss., 3, C702–C708, 2011
www.geosci-model-dev-discuss.net/3/C702/2011/

**Geoscientific
Model Development
Discussions**

Interactive comment on "Evaluation of a present-day climate simulation with a new coupled atmosphere-ocean model GENMOM" *by* J. R. Alder et al.

J. R. Alder et al.

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Received and published: 20 January 2011

General Revisions:

We have used both the spirit of the reviewer's comments and our own critical review to revise the manuscript as a whole so that it flows better and reads a bit more logically. The overarching recommendations from both reviewers are to reduce the number of figures and to focus more on evaluation of GENMOM and less on comparison with other AOGCMs. We agree with these recommendations and we have accommodated them by: 1) including only one figure in which we compare GENMOM surface temperature and precipitation with NCEP and three other AOGCMs (as opposed to eight).

Based on the recommendation of Reviewer 1, we now plot only the anomalies for each model. This has eliminated three figures without diminishing the information we feel is needed. 2) We have added to the discussion of GENMOM and minimized the comparison of GENMOM with the other AOGCMs to a sentence in the discussion of surface temperature (p. 8, line 13) and precipitation (p. 9, line 6), ocean temperature (p.9, line 19) , salinity (p., 10, line 12) and parenthetically in the overturning (p. 11, line 1). We feel it is essential to keep some comparison in the paper because it is valuable and necessary to benchmark our model against other models.

Reviewer #1

The manuscript describes the performances of a new coupled atmosphere-ocean model: GENMOM. It presents the main characteristics of the model, compares present-day climate with observations and states the main flaws of the model. I recommend publication of the manuscript in GMD but have a few comments that the author should consider.

Reviewer #1 Main comments:

Reviewer #1 1) The authors acknowledge that the strength of the AMOC is quite weak. They further suggest that this weak AMOC leads to a series of bias in the model (temperature and sea ice in the North Atlantic ....). The overturning as well as salinity section in the Atlantic do show an issue with an AMOC too weak and too shallow. The model GENMOM is non flux corrected. Some models routinely add freshwater and/or heat correction to a model to improve the performances. It might be worthwhile to see if the biases disappear when boosting the AMOC. Anyway , the strength of the AMOC is such an important player in the climate system and for paleo studies (what the model will be used for?) that it might be interesting to add a negative freshwater flux in the North Atlantic and see the impact on the climate. It will also make a much more fun paper to read.

Response: Improving the AMOC in the model is one of our top priorities as it is a key

component of the paleoclimate simulations we are doing in general and for the upcoming PMIP model comparison. We will be doing freshwater flux sensitivity experiments, but as a separate study. [No change to text]

Reviewer #1 2) Another concern is the very weak Southern hemisphere westerlies. The weak westerlies also lead to a weak southern ocean overturning and a significant warm bias over the Southern ocean. Other models (GFDL and CCSM3) simulate such a strong warm bias. I do not know if it is also due to the weaker westerlies. It might be interesting to discuss it. The authors attribute the weak westerlies to the coarse resolution of the model (L.15, p 1709), which I'll be surprised if it is the case.

Response: The work of Schmittner et al (2011, Journal of Climate, accepted) and others (Held and Phillipps, 1993; Tibaldi et al., 1990) indicate weak SH wind stress can in part be explained by low meridional resolution and the resulting coarse model orography. Schmittner et al (2011) show that convergence of the southern hemisphere wind stress occurs at T42 resolution while failing at T21. SH wind stress in GENMOM at T31 could be suffering from the same problem. We have included short discussions of this potential mechanism in the paper.

Biases are attributed a little bit too quickly to the model resolution in general in the paper.

Response: We agree with this comment and throughout the paper we have attempted to offer additional explanations for the underlying reasons causing the biases.

The Gent & Mc Williams parametrization was not used in this study. Would the use of the GM parametrization give a better representation of high southern latitude climate? For both the AMOC and the westerlies, if the authors cannot/do not want to correct the discrepancies, maybe more discussion should be included as to what limitation this will bring when using the model.

Response: The use of Gent-McWilliams may produce a better simulation in the SH by

adding cooling and more sea-ice and should be tested in the future. Testing of the G-M scheme is part of the work we will be doing for our paleoclimate simulations. We now address the issue of the G-M scheme two places in the paper: p 9. Line 25 p13, line 3

Reviewer #1 3) Figures There are many figures in this paper.

I do not really like figures 5,6, 8 and 9. There are way too many panels to look into details and I wonder why the authors need to compare the performances of their model to 8 IPCC models. I guess you put these figures to show that GENMOM is not much worse than other IPCC models. I think it is enough to discuss the changes in the text. People who will read your paper are most likely familiar with IPCC models and their flaws. You do not have to show them all. Instead you could focus on your model compared to observations.

Response: See General Revisions

If you really want to show IPCC models, you could take 4 of 8 models and show only anomalies.

Response: See General Revisions.

Particularly, in fig 6, if I understood well you think that a cold bias is appearing at high northern latitudes due to mask issues. Maybe if you separate SST and T2M anomalies, the bias will be lessen... or it is a real bias of the model. An SST anomaly plot would actually be more than useful.

Response: The mask issue was a plotting error that was corrected in the new figure (now figure 4). The error was resolved by only comparing air temperature in the case when the land/sea mask do not line up between model and observed grids.

On the other hand, an Atlantic section of ocean temperature might be very informative, much more than the global one (I would take that one out).

Response: We decided to continue to use the global plot as we reference the AR4

figures in the supplementary material of chapter 8. Our plot is intended to be comparable to the AR4 ocean temperature plots, hence global data with the same colors and breaks.

I do not really see the use of figure 4 (specific humidity profile)

Response: Figure was removed, all figure numbers above 4 were reduced [text change, figure removed]

In figure 15, there are 2 red contours over Antarctica... this might be a plotting error.

Response: This was a plotting issue as there is 0 sea ice over land, hence the double contour. The plot has been updated for Antarctica but unmodified in NH. [Figure updated]

Reviewer #1 Minor comments:

Reviewer #1 L6 p 1699 : “to improvements” maybe the authors mean “two” or there is something wrong with the sentence.

Response: Corrected to “additional” in updated manuscript. [text changed]

Reviewer #1 L.21 - . About the LSX model, you mention “trees and grass” can be specified at each grid point, you might also want to mention that “desert” can also be simulated (if that is the case).

Response: LSX represents desert landuse. Detailed information on vegetation cover is found in the LSX and GENESIS references. [No text change]

Mentioning the mask of LSX could be also useful Section 2.2:

Response: We are not sure what this suggestion is referring to. The land-ocean mask is consistent between GENESIS and MOM. [No text change]

It might be nice to state the performances of the model: the modeled years during one day. The speed of a model is an important fact.

Response: We added the suggested text (p. 5, line 8).

Reviewer #1 L.4, p 1704: “raging” ??

Response: Corrected to “ranging” in updated manuscript. [text changed]

L.12, p 1706: I am quite confused by this paragraph. The authors attribute surface temperature anomalies over a large part of high northern latitudes to a mismatch between ICE4G land mask and NOAA SST V2 mask...please make sure that is correct. Also if it is just a graphical issue (i.e. anomaly arise when plotting it) then you should be able to correct it. See main comments on figures.

Response: This was indeed a plotting error that has been corrected. Where mask mismatches occur, anomalies are created from air temperature only rather than mixing air temperature and SST (hence larger anomalies).

The following text was removed from L.12, p 1706: “We note that the high latitude temperature anomalies (Fig. 6) are partially attributed to a mismatch between the ICE4G derived land mask and that of NOAA OI SST V2 interpolated to T31. Where a mismatch occurs, large anomalies are created due to comparing an SST grid cell to a 2 m air temperature grid cell.” [text removed]

The following text was removed: “Similar to Fig. 6, grid cells where the land-ocean distribution does not match have large seasonal cycle amplitude anomalies.” [text removed]

The caption on figure 4 notes: “All data are bi-linearly interpolated to a 5° x 5°grid.” No additional info is given on interpolation process or that TS2 is compared along the coastlines (ie mismatches).

Reviewer #1 L.27, p 1206: I do not really like this paragraph: “Our simulation GENMOM has many features in common with the IPCC AR4 models: 1) a cold bias.....” Putting all the IPCC models into one bag is a little strange. I would suggest you describe the flaws of your model and eventually say: a 4degC warm bias over the Southern Ocean

is also identified in CCSM3 and GFDL. . .. a cold bias....

Response: See General Revisions.

Interactive comment on Geosci. Model Dev. Discuss., 3, 1697, 2010.