

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

### **Anonymous Referee #1**

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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.

Main comments:

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

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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.

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

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. Particularly, in fig 6, if I understood well you think that a cold bias is appearing at high northern latitudes

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due to mask issues. Maybe if you separate SST and T2M anomalies, the bias will be lessened... or it is a real bias of the model. An SST anomaly plot would actually be more than useful. If you really want to show IPCC models, you could take 4 of 8 models and show only anomalies.

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). I do not really see the use of figure 4 (specific humidity profile) In figure 15, there are 2 red contours over Antarctica... this might be a plotting error.

Minor comments:

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

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). Mentioning the mask of LSX could be also useful

Section 2.2: 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.

L.4, p 1704: “raging” ??

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.

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

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

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