

Replies to the fourth-round's reviews:

Replies to Reviewer #1:

Overall, I consider this revised version to be much improved. The addition of the new transient simulations definitely increases the novelty and robustness of the work. I would not be disappointed to see the manuscript published as is, but there are few things that I feel could be improved a little if there was an opportunity.

The mid-Holocene experiment in previous version of PMIP (particularly PMIP3) involved solely altering the orbital configuration. The manuscript currently does not describe that adequately, that all analysis of these simulations has effectively isolated the ORB component. The solar constant in PMIP3 was specified to be same value used for each model's preindustrial simulation, although that itself was not a single number across all the models. This is highlighted in Otto-Bliesner et al (2017), as it means that the local insolation changes can vary slightly in magnitude between the various PMIP3 experiments.

Responses: Thank you very much for your comments and suggestions, we have added a sentence around line 91: “By tightly controlling the external forcings in the different experiments, our simulations effectively isolate the external forcing component compared to PMIP3, not just the ORB.”

I still feel that the issue of internal variability could be more explicitly addressed in the manuscript. However, the inclusion of the new simulations make me confident now that internal variability is not the explanation for the changes seen in the MH experiments. This could be achieved by, for example, adding a sentence or two, including error bars on Fig. 7, or stippling on Fig. 6 with a significance test (based on low frequency variability).

Responses: Thank you very much for this comment, we have redrawn figure 6 with a significance test and added the sentence around line 205: “Some scholars have suggested that the change of AMOC in Exp MH may come from internal variability (Williams et al., 2020), but it is clear from our simulations that changes in response to external forcings are the main reason for the variations that occur in Exp MH (Fig. 6).”

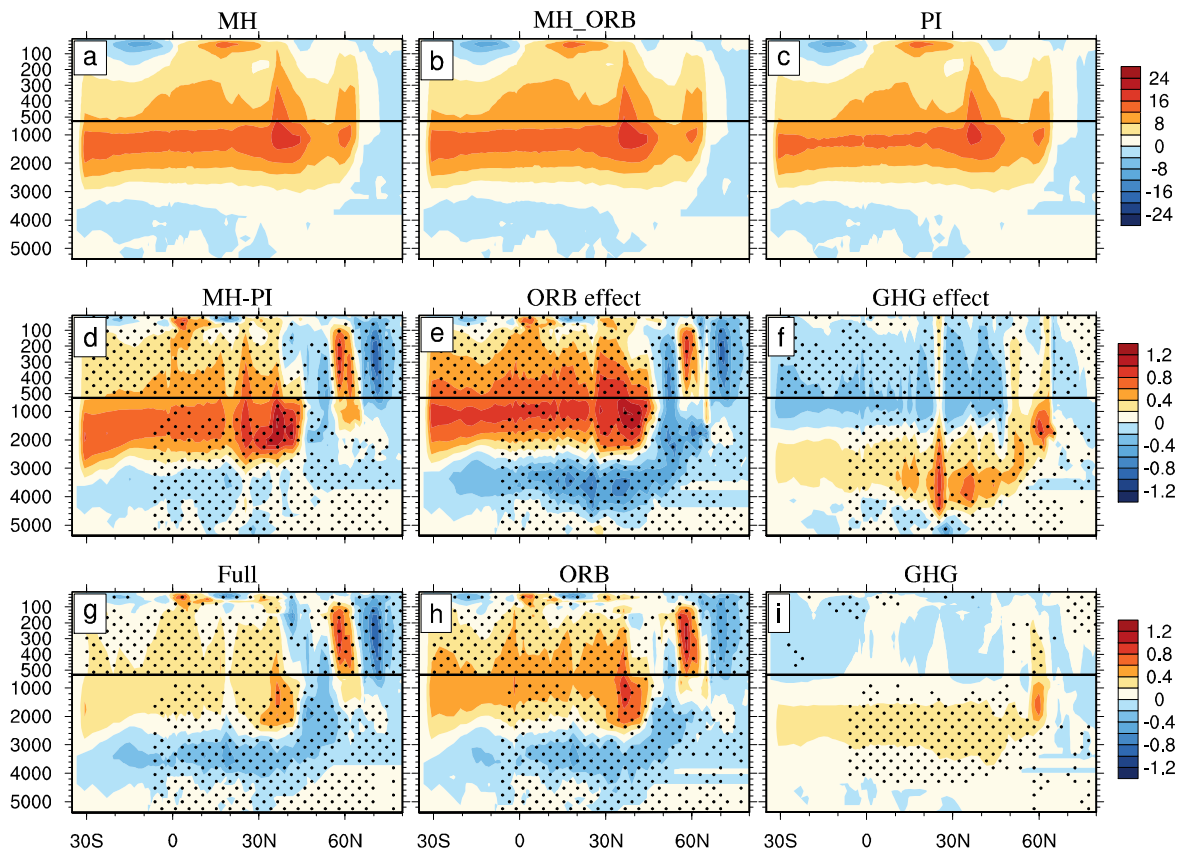


Figure 6 Patterns of mean AMOC in (a) Exp MH, (b) Exp MH_ORB, and (c) Exp PI; and (d) AMOC change in Exp MH, with respect to Exp PI. (e) and (f) show AMOC changes due to the ORB effect and GHG effect, respectively. g, h, i represent the AMOC changes between the two stages (Stage1-Stage2) in Exps Full, ORB, and GHG, respectively. The AMOC index is defined as the maximum streamfunction in the range of 0–2000 m of 20°–70°N in the North Atlantic. Stippling shows significance over the 90% level calculated by Student t-test. Units: Sv.

Technical corrections:

1. L15: ‘*remarkedly*’ should be ‘*markedly*’ Revised.
2. L79: *your space is in the wrong place (before T31 rather than 26)* Revised.
3. L105: *The sentence starting “Each transient...” would be better placed earlier in the paragraph.* Revised.
4. *Around L240, you could mention comparison with the patterns seen in this experiment, and the ‘warming hole’ seen in observations.*

Response: Thank you very much for this suggestion, we have added the sentence around line 244: “This is in contrast to the warming hole shown by observations, which are dominated by the cooling of the North Atlantic in the context of global warming.”

5. *L278. I do not understand what is meant by [no “-“]. I can see no dashes on Fig 10.*

Responses: Thank you very much for this suggestion, we have fixed the error.

6. *L314. A space is missing before ‘In’* Revised.

7. *L353. Add space into “studyfocuses”* Revised.

8. *L357. I believe that the Larrosoana referencies would be better evidencing the statement that N Africa was wetter in the MH period.* Revised.