

# ***Interactive comment on “Comparing the spatial patterns of climate change in the 9<sup>th</sup> and 5<sup>th</sup> millennia B.P. from TRACE-21 model simulations” by Liang Ning et al.***

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Reviewer #2 In this manuscript, the authors compared the spatial patterns of global temperature, precipitation, and SST during two centennial-scale droughts during the Holocene based on model simulation. The similarities and differences between these two drought events, which are believed to be caused by different reasons, are examined in details. The authors also hypothesized that the drought during the 5th millennium B.P. is caused by a reduction in the AMOC due to the long-term changes in insolation related to precessional forcing, which passed a threshold around 4.5 ka B.P. This manuscript covers two important topics: one topic is the detailed spatial patterns during

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the 4.2 ka BP event, which could be used for comparison with proxy reconstructions, and the other topic is mechanisms behind the 4.2 ka B.P., which are interesting to the whole paleoclimate community. So, I believe this manuscript should be interesting to a wide audience of Climate of the Past. Some interesting results and meaningful conclusions are shown in this manuscript, and the analyses are straightforward and clear, however, I still have some comments regarding the manuscript listed below. Therefore, I would recommend that the present manuscript may be accepted for publication after some minor revisions.

We really appreciate the valuable comments and suggestions from the reviewer. We have carefully addressed all these concerns, and we hope that the reviewer finds this revision satisfactory.

1. The numbering of the manuscript needs to be re-arranged, for example “Results” should be Section 3 rather than Section 2.1.

The numbering of the manuscript has been re-arranged. The “Results” is now Section 3, and the “Discussion and Conclusions” is now Section 4.

2. More details of the TRACE-21 experiments should be provided for the readers, such as the external forcing used in the experiments.

Following the reviewer’s suggestion, we added the following information “The orbital forcing is based on transient variations of orbital configuration (Berger, 1978). The concentrations of greenhouse gases were adopted from study of Joos and Spahni (2008). The ice sheet data were modified from the reconstruction of Peltier (2004). The meltwater scheme was adopted from study of Liu et al. (2009)” in to the second paragraph of Section 2.

3. The authors claim that the 4.2 ka BP event was one of the several late Holocene centennial-scale fluctuations, have they compared the timing of these fluctuations with the Bond events? Do they have some similarities?

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Both of them have similar centennial-scale variability but the timing of “Bond events” does not match the fluctuations seen in the model simulations.

4. Line 198, considering the 5th millennium BP event as the start of the Neoglacial is a really interesting topic, which should be strengthened with more discussion.

Following the reviewer’s suggestion, we now added more discussion into the manuscript. We also added a new Fig. 7 to show that the AMOC has been decreasing since 4.5 ka BP, especially in the orbital forcing only simulation (new Fig. 7b).

5. In Fig. 1, the dash lines are the means, right? The authors should add this information into the caption.

The reviewer is correct & we have added “The black dash lines show the averages of the time series” to the caption.

6. In the figure captions, the time “4500 ka BP” should be “4.5 ka BP”, and also other similar timings.

The figure captions have been changed to “Year” to be consistent with the x-axis ranges.

7. In the caption of Fig. 7, the phase “shown in dark blue” is obscure, and should be revised.

The caption has been revised as “the area of the North Atlantic with significant negative SST differences between the the 5th millennium BP and 9th millennium BP periods (40-60 °N, 7.5-60 °W)” to be clearer.

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