

***Interactive comment on* “The influence of atmospheric circulation on the mid-Holocene climate of Europe: a data-model comparison” by A. Mauri et al.**

Anonymous Referee #1

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General comments

This study provides an updated spatial reconstruction of the mid-Holocene temperature and precipitation over Europe both for winter and summer. The differences with present-day climate is shown and compared with simulations under present-day and mid-Holocene climatic conditions using HadCM3 model. The spatial structures are very different both in summer and winter in the model and in the reconstruction. While the model show mainly in the mid-Holocene a thermal response to the imposed radiative changes in insolation at the seasonal scale (i.e. warming in summer, cooling in winter),

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the reconstruction show strong latitudinal gradient with warming in Northern Europe and cooling in Southern Europe in both seasons. The authors then suggest that this pattern may be related to atmospheric circulation changes, since the signature of the modes positive NAO in winter and SCAND in summer strongly resembles the changes in mean state found for the mid-Holocene.

This paper is correctly presented and the methods are well presented. The hypothesis defended here is not totally new but the new evidences presented here are convincing. The use of a climate models is useful as well, although it will have been even better to consider a few more models available within the PMIP3 database in order to clearly demonstrate that all the models missed the spatial structure presented here. The authors do not propose any dynamical mechanisms to explain such a feature, which is a bit disappointing (even an hypothesis) but this is maybe far from the scope of the study. Moreover, the fact that the pattern response in the mid-Holocene is quite similar in summer and winter in the data, with a latitudinal gradient could indicate a mean state change that concerns the whole year, a jet stream shift for instance or an oceanic circulation changes. Maybe the authors can discuss this type of alternative hypotheses or explain why NAO and SCAND variability may have changed. I rather think this a question of mean state change. The fact that it resembles present-day signature of variability mode is not such a clear proof of a change in atmospheric circulation variability.

Nevertheless, I think the paper can be published almost as it stands and I only have a few suggestions and questions that could help to further improve and clarify this manuscript.

Specific comments

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- p. 5572 second paragraph: I think that the authors should be more specific here in their terminology. What they are discussing is differences in the mean state between mid-Holocene and present climate. These differences can be compared to signature of present-day mode of variability. Nevertheless, since the changes reconstructed concern the mean state, they should use the term “NAO+ like differences”. I think it is important to make the difference between mean state changes and modes of variability. For instance the authors could rather say l. 18-19: “Climate model simulations in contrast show little change in the mean state atmospheric circulation as well as in the NAO/AO variability for the mid-Holocene climatic conditions (Gladstone et al. 2005. . .)”
- p. 5575, top: Maybe here the authors can be considered to better depict what is the exact definition of each index used.
- P. 5577-5578: the section 4.2 (winter) starts with a description of the NAO, while it was not the case in section 4.1 for the SCAND. I suggest putting a whole description of what is known on NAO and SCAND (including a precise definition) somewhere, maybe in the Methods. Start of section 4.3 is also a repetition of the top of page 5572.
- P. 5579, l. 25: the authors only show one model here and should not use the plural for “climate model”

Technical corrections

- p. 5571, l. 2: replace “simulating” by “to simulate”
- p. 5571, l. 19: replace “aim to evaluate” by aim at evaluating”
- p. 5574, l. 27: replacing “although” by “since” seems to be more logical in this sentence, isn’t it?
- p. 5576, l. 20 replace “climate model sensitivity” by direct thermal response” and

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delete “thermal” in the next sentence. Indeed climate sensitivity has usually a very specific definition (warming for a doubling of CO₂)

- p. 5580, l. 24: replace “consistent with” by “similar to the signature of” and add “for present-day conditions” at the end of the sentence to be precise enough.

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