

## ***Interactive comment on “Anticyclonic atmospheric circulation as an analogue for the warm and dry mid-Holocene summer climate in central Scandinavia” by K. Antonsson et al.***

**K. Antonsson et al.**

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Here is our response to the reviewer’s comments on the Antonsson et al. paper “Anticyclonic atmospheric circulation as an analogue for the warm and dry mid-Holocene summer climate in central Scandinavia”.

We thank the two referees for detailed and constructive comments. Here we detail the changes we have made following the referees’ comments.

First, we note that both reviewers acknowledge that the basic argument regarding the potential role of anticyclonic circulation is solid and provides a reasonable basis for the paper. We also note that both reviewers focus on the parts that deal with model simulation and data-simulation comparison. This is understandable and acceptable, but the

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main aim of the paper was to analyze circulation patterns that can lead to the warm and dry summer climate, as reconstructed for the mid-Holocene. More thorough discussion about the data-model comparisons is out of the focus of this paper. However, we have amended those parts of text where the model simulation is mentioned.

Both reviewers argue that the difference between the Holocene climate simulations and palaeoclimate records, as shown in Figure 2 and discussed in the text, is too pronouncedly expressed in the paper. Our aim is not to argue that there is a major data-model discrepancy. We rather think that the simulation and reconstruction outputs are generally consistent, especially in terms of temperature trend during the last 7000 years and this trend is consistent with the summer insolation trend. In order to make this point clear we have modified text on page 10 where we now write that “*Hence, during the early Holocene the simulated summer temperature trend deviates from the observed pattern in central Scandinavia. . . After 7000 cal yr BP the simulation and reconstruction are more consistent, although the simulation shows a steadier fall of the temperature whereas the reconstructions show a longer period of higher mid-summer temperatures and markedly dry climatic conditions*”.

Further, in response to the suggestions to clarify the interpretation of the data-model comparison, we have modified the abstract of the paper. The original text saying “*the model, which is predominantly driven by insolation patterns, fails to produce the reconstructed mid-Holocene dry and warm period in Scandinavia. As an alternative explanation for the reconstructed climate, we hypothesize. . .*” reads now “*the model, which is predominantly driven by insolation patterns, suggests less prominent mid-Holocene dry and warm period in Scandinavia than the reconstructions. As an additional explanation for the reconstructed climate, we argue. . .*”. We have therefore deleted the term “alternative”, as suggested by both reviewers.

Both referees also stress that the output of a transient simulation based on a model of intermediate complexity was used for comparison in Figure 2 and that this simulation does not account for the dynamics of the early-Holocene ice sheets. It is true

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that the model of intermediate complexity with prescribed ice sheet configuration has deficiencies especially regarding the early Holocene and that there are more complete modeling outputs for specific time windows such as 6 ka. We have now added references to some of these model simulations to our paper (Masson et al. 1999; Braconnot et al., 2007). However, for comparison in our Figure 2 an output of a transient model is needed because the reconstruction results are presented as time-series data. Related to this, we have also modified the text on page 10 where now write that “*the deviation between the model simulations and the climate reconstruction may be interpreted as deficiency of this particular model in simulating at least one of these processes*”. We hope that this indicates that we acknowledge that this feature is typical to this particular model and that we do not generalize this deficiency to all model simulations (this is also response to referee 1 minor comment 9).

### More specific comments for referee 1

Comment 1. Amended - see above

Comment 2. We have replaced the term “*hypothesis*” by “*argument*” and write that “*The argument is tested. . .*”

Comment 4. We have added the longitude, latitude and altitude of the Falun meteorological station (60.37 N, 15.37E, 160 m)

Comment 5. We now write that “*As in Chen (2000) for years 1850-2003, SLP data from 16 grid points were used.*”

Comment 7. Amended by adding text “*Tilia, most likely Tilia cordata, the most common Tilia species in Scandinavia. . .*”

Comment 8. Done

Comment 9. This has been amended, as explained earlier.

Comment 10. This is a reasonable suggestion. We have added a reference to the

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paper by Seppä and Birks (2001) where two such synoptic maps are shown, demonstrating the anticyclonic and western directional (cyclonic) circulation patterns.

Comment 11. We have amended this and write now write that “*Warm and dry summers occur together and from the viewpoint of. . .*” (We have changed this part in the abstract as well.)

Comment 12. This is an interesting question, but slightly out of focus of our paper. Any direct suggestion at this point would be hypothetical or even speculative.

Comment 13. This error has now been amended.

Comment 14. We think that this would be out of the focus of our paper and would deserve a separate study.

### **More specific response to referee 2 (Andrey Ganopolski)**

The responses to the first two main comments have been already explained.

The third part of referee’s main comments - We fully agree with the referee that the higher temperature is an important factor that partly explains the low mid-Holocene lake-levels and the inferred general drought. To emphasize this we have added the following sentence to the introduction (page 4) “... the high summer temperatures were associated with low lake-levels and generally dry conditions, *probably predominantly due to the higher summer evaporation*”.

Minor comments by referee 2

Comment 1. The term “solar insolation” has been modified to “insolation” throughout the paper.

Comment 2. The “effective humidity” has been replaced by a more commonly used term “effective precipitation”.

Comment 3. We now write that “*major changes in summertime climate took place with*

*increasing mid-summer temperatures and markedly dry climatic conditions.”*

Comment 4. As explained earlier, we have modified the relevant parts of the text, stressing that now say that “*this particular model*”.

Comment 5. We have modified the text and write now that “*because there is no evidence for millennial-scale solar output anomaly during the mid-Holocene*”.

Comment 6. We use the term “millennial” to refer to patterns that occur on scale of several millennia.

We hope that these amendments serve to make our arguments more clear and hope that the paper can now be accepted for publication in *Climate of the Past*.

Sincerely,

Heikki Seppä, Karin Antonsson, Deliang Chen

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Interactive comment on *Clim. Past Discuss.*, 4, 585, 2008.

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4, S391–S395, 2008

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