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Geoscientific Model Development Discussions

Interactive comment on "Impact of model resolution on Holocene climate simulations of the Northern Hemisphere" *by* Axel Wagner et al.

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Review of "Impact of model resolution on Holocene climate simulation of the Northern Hemisphere" by Axel Wagner, Gerrit Lohmann, Matthias Prange.

This work analyses the impact of resolution on Holocene Northern Hemisphere temperature and atmospheric circulation in ECHAM5 model. Authors found that winter temperature differences among sensitivity experiments are mainly due to changes in the orography and resolution, both affecting the pattern of stationary waves and transient eddies. On the other hand, summer temperature differences are attributable to difference in the cloud cover due to different subgrid parametrization between low and high resolution sensitivities.

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Discussion paper

General comments: The paper is overall well written and addresses very well the problem of the resolution impact on past temperature with a dedicated set of sensitivity experiments well designed. I think however that in order to be published, further investigation is needed, especially on the dynamical influence on DJF temperatures.

AW: As recommended by the reviewer, a discussion on the dynamical influence on DJF temperatures, particularly stationary wave patterns, has been integrated in the introduction, results and discussion section of the updated version of the manuscript.

Specific comments: Ln 111: why PMIP2 boundary conditions and not PMIP3? AW: Model simulations have been performed with PMIP2 boundary conditions. PMIP3 boundary conditions are equal to PMIP2. Thus, as recommended by the reviewer, we will substitute the PMIP2 reference by PMIP3. See also table PMIP2 – 4 comparison of experimental design. PMIP4 boundary conditions of the pre-industrial period show small changes (see table). For the mid-Holocene, CO2 and N2O are comparable to PMIP2 and PMIP3. According to PMIP4, our CH4 estimation is overestimated by 8,9 %. References: https://pmip2.lsce.ipsl.fr, https://pmip3.lsce.ipsl.fr, https://pmip4.lsce.ipsl.fr/doku.php

Action: We will insert a sentence about PMIP4 into the new version of the manuscript.

Ln 306-311: Adding another section specifically on how stationary waves influenced temperature patterns in the past would be a valuable contribution for understanding regional discrepancies between simulation and proxy reconstructions. Furthermore, the discussion section is too long and sometimes seems just a list of previous work findings (seems an extension of the introduction): in my opinion, it can be shorten, focusing only on the discussion of the results.

AW: The discussion section has been shortened, reorganized, more focus on the discussion of own results, and a paragraph about stationary wave patterns and atmospheric blocking has been added in the new version. Parts of the discussion section has been moved to the introduction. Changed will be presented in the revised

manuscript.

Ln 314: Which differences are you talking about? You must be more precise. Adding a comparison with proxy reconstructions would be very useful. Reporting previous findings on the discrepancies itself in the discussions is not enough in order to “solve the problem” in this specific contest. You should be able to quantify those discrepancies between simulations and proxy reconstructions and being able to address to which extent, increasing the resolution would help reducing them. In fact, many other reasons can be imputable to the disagreement between simulations and reconstructions: e. g. dust concentration, vegetation cover ... not only clouds ...

AW: The discussion section has been extended by a paragraph about proxy-model comparisons. Furthermore, large-scale improvements/deteriorations of high resolution simulations are discussed in the framework of proxy-results. Changed will be presented in the revised manuscript.

Technical comments: Ln 113: “present-day” ... in order to avoid ambiguities you should write “pre-industrial”. AW: Changed. Ln 114: You should specify LR_oro before - around AW: Changed. Ln 108 - 113. Ln 153: “ ... between” ... is the space a typo? AW: Changed. Ln 220: Erase “The” at the beginning of the sentence. AW: Changed.

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