

Interactive comment on “Last Interglacial model-data mismatch of thermal maximum temperatures partially explained” by P. Bakker and H. Renssen

Anonymous Referee #1

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General comments:

Due to current limitations in establishing a coherent temporal framework between paleoclimatic records covering the Last Interglacial (LIG), published data compilations for this time period have focused on the maximum temperature assuming that the maximum warmth occurs simultaneously across the globe. In the present paper, P. Bakker and H. Renssen assess the impact of such assumption from a model-based perspective. Although such a study needs to be taken with care since the tools (e.g. climate models) used to investigate the LIG model-data mismatch are not perfect, the proposed exercise is interesting. The outcomes of this study are helpful in understanding the potential origin of the differences observed currently between reconstructed and

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simulated LIG temperature. Still, major revisions need to be performed on the current manuscript before its publication in *Climate of the Past*. In particular, while on one hand I appreciate the concise style of the authors, on the other hand this has the disadvantage on several occasions that some concepts/results miss of a clear explanation/ description. I recommend the authors to better describe their results, carefully explain their interpretations and also to propose a more in depth-discussion section. In particular, the discussion based on the comparison with the results of Otto-Bliesner et al. (2013) requires to be clarified. In the following, I report the sections that should be revised in particular, some more specific comments and some technical corrections that need to be taken into account in the revised version.

Specific comments:

-p740: Abstract: The wording of the beginning of the abstract has to be changed (at least the two first sentences) since it does not reflect exactly the “state of the art” knowledge about the timing in temperature peaks during the LIG across the globe. Indeed, there is not yet a precise “global” sequence of events at the start of the LIG from the available paleoclimatic records but there are still various evidences that the Southern Hemisphere started to warm and reached maximum warmth during the LIG before the Northern Hemisphere (e.g. Govin et al. 2012). Thus the first sentence should be changed into a sentence such as “the exact timing of the LIG thermal maximum across the globe remains to be precisely assessed” or similar. Moreover, the authors should not write that the current compilations are based on the assumption that maximum warmth occurred synchronously across the globe in the LIG because of these uncertainties on the event timing. The main reason why available compilations so far are offering only one single “snapshot” of the climate during the LIG is due to the difficulty of establishing a common temporal framework between records from different paleoclimatic archives retrieved in various places around the globe. This is actually something that the authors mentioned in the introduction. The limitations of these compilations are actually mentioned by the authors who published these studies (such as in Turney

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and Jones's paper). Thus the second sentence in the abstract should be also changed accordingly.

-p741, line 4: Similar comment as for the abstract, the sentence "As a consequence..." should be reformulated. It should be mentioned the fact that up to now one single compilation does not allow taking into account for potential asynchronous temperature changes across the globe during the LIG, leading to the fact that it limits to perform robust model-data comparison since such a unique time slice leads to the underlying interpretation that the maximum temperature peaks are synchronous.

-p741, line 17: In addition to present the evidence from the models' side that the temperature peaks are likely to not be synchronous everywhere across the globe, the authors should mention the growing evidences in the data too. For instance the authors should refer to the work by Govin et al. published in CP in 2012 and references therein.

-p743, line 22:" Determining the temporal resolution...." should be rephrased. The temporal resolution for each record contained in the compilation is known. To me, the issue that should be highlighted is that the records covering the LIG cover a large range of temporal resolution which could make it difficult to identify when the maximum temperature warmth occurs. Also, the test on the impact of the temporal resolution of the records that the authors propose is not realistic in the context of the LIG. Not many records have a temporal resolution better than 200 years and most of them have a pluri-millennial temporal resolution. The authors need to consider performing tests that reflect better the range of the characteristic temporal resolutions encountered during the LIG. The authors could keep the test with a 250 year-resolution but should also provide a test with a temporal resolution of 2000 years for instance.

-p744, line 5: "for smaller geographical regions...", this statement is not correct for the NH extratropics ($0.5 \pm 0.4^{\circ}\text{C}$). This sentence needs to be reformulated and the discussion on this point more developed.

-p745, line 20: "firstly models with reduced resolution...": Please, give more explanation

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/or reformulate your sentence so it is clearer why this argument could explain why the calculated overestimation of LIG maximum warmth is smaller in low resolution models.

-p746, line 3: the paragraph starting with “to access” should be included in the discussion section rather than in the results section. For instance, the first paragraph of the discussion section should begin with an evaluation of the robustness of the presented results by looking at the impact of the two arbitrary choices (the considered time interval and the temporal resolution).

-p746: line 9: “Not unexpectedly” should be removed and the authors need to better explain why such a result should be expected.

-p746, line 23: “....when the comparison is solely for the locations from which the proxy-records are derived...” : this sentence is unclear, the authors should add one/two sentences to better explain what has been done in Otto-Bliesner et al. (2013).

-p747: line 16: “In the NH extratropics...”. It seems to me that this statement does not stand with the results shown on the figure. Please, can you check this sentence?

-p747: line 12-line 25. The authors wrote that a comparison between the CCSM3 simulations and the transient simulations are not easy to interpret, still they do present such a comparison, thus, they should provide a more in depth discussion, or at least, they should list the implications of what they observed/ the future work needed to progress since, in the current manuscript they only provide a description of the results they obtain in comparison to Otto Bliesner et al. (2013) for each geographical region.

-p749, conclusions: The authors need to develop more the implications of their work, the perspectives and future work (both on the model side and data side) that should be performed to be able to progress.

Technical corrections:

-p740, line 23: “in such an evaluation” should be modified into “in the evaluation”

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-p740, lines 25-26: Two references for LIG compilations should be added.

Kaspar et al. 2005. A model-data comparison of European temperatures in the Eemian interglacial GRL, 32, L11703, doi:10.1029/2005GL022456

Clark and Huybers, 2009. Global change: Interglacial and future sea level Nature 462, 856-857 (doi:10.1038/462856a)

-p741, line 2: “ABSOLUTE chronological uncertainties...”

-p747, line 20: remove “even”

-p747, line 21: “in the CCSM3 model, the model used by...”: replace by “in the CCSM3 model used by ...”

-p747, line 23: unclear, the sentence should be reformulated

-p748, line 18: replace “the final and possibly most important point of critique is the fact that” by “an important limitation of our study is linked to the fact that”

-p757, Fig 1: replace “based on annual mean temperatures” by “taking into account simulated annual mean temperatures”

-758, Fig 2: replace “based on warmest month temperatures” by “taking into account simulated warmest month temperatures”

-760, Fig 4: please, precise in this caption that the calculated MMM overestimation of the LIG thermal maximum temperature is illustrated by the differences between the compilation-warmest-periods and the warmest-single-period method

-Reference list: It is probably an editing issue that the authors are certainly not responsible for, however, note that at the end of each reference, a number/several numbers is/are added while it/they should not be present.

References:

Clark and Huybers, 2009. Global change: Interglacial and future sea level Nature 462, C351

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856-857 (doi:10.1038/462856a).

Govin et al. 2012, Persistent influence of ice sheet melting on high northern latitude climate during the early Last Interglacial, *Clim. Past*, 8, 483-507.

Otto-Bliesner et al. 2013. How warm was the Last Interglacial ? New model-data comparison, *Philos. T. Roy. Soc. A*, 371, 1-20.

Kaspar et al. 2005. A model-data comparison of European temperatures in the Eemian interglacial *GRL*, 32, L11703, doi:10.1029/2005GL022456

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