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

Anonymous Referee #2

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This study addresses the temperature bias introduced by the assumption that proxy-based last interglacial (LIG) maximum temperatures are all peaking at the same time. The authors use transient model simulations from 9 different models to assess this bias. It is a neat idea, timely as well, and the results should be published. The study is well written, but lacks some information and discussion. Also including and discussing a few more analyses will largely enhance the impact of this study. Please find below the comments that I would like to see discussed before publication of the final CP paper.

GENERAL COMMENTS

1) Throughout the publication you sound unsure if the timing of peak warmth occurred

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simultaneously or not. There are now enough publications (and you mention several) showing that maximum temperature are not reached at the same time across the globe. Also, this assumption is the background for what you quantify in your study. Therefore, I suggest you change the wording of these sections. For example, page 741.27-30: "orbital forcing and its interaction with climate feedbacks cause seasonal differences in the timing of interglacial maximum warmth; e.g. the annual mean, summer or winter temperature maxima did not occur synchronously."

2) Similar comment on the sentence "ongoing debate whether proxy-based temperatures include a seasonal bias" (p743). This is quite accepted; only problem is that often it is not clear to which month/season the proxy is biased, especially as this also depends on geographical location.

3) Related to that: why do you only test annual mean and warmest month mean, and not a particular season or month? Proxy temperatures are seasonally biased, but not necessarily to the warmest month. Food availability and other factors (salinity, light, competition, . . .) also play a factor. It would really improve the manuscript to also include a computation based on a spring or summer season, or a particular month.

4) Also, information or preferably a figure indicating which months are the warmest months would improve the clarity of study.

6) Similarly, which 50 yrs time periods simulate the highest temperatures, and how do they differ over different regions (or preferable latitudes).

7) Why did you choose these regions (extratropics and tropics)? It might be nice to show other regional averages such as for example the Arctic, North-Atlantic, Europe, Southern Ocean, Monsoon regions, etc. Or at least discuss how the decision of your 3 regions affects the results.

8) Related to this: the different regions have very different number of proxy records from which averages are computed (see also the figures in Otto-Bliesner et al., 2013).

How does this non-uniform distribution affect the model to model-data comparison in your discussion? Also, mention the number (and possibly type) of proxy temperature values for each region used in your & Otto-Bliesners study.

9) You use atmospheric 2-meter temperatures for the entire comparison. Will your results change when you take simulated sea-surface temperatures (SST) and compare those to the proxy SSTs? Please discuss.

10) Great that you also assess the time averaging period that you choose (250 vs 50 yrs mean). However, most of the proxy records have a temporal resolution even lower, in the order of 1000-3000 yrs. Would it change your results if you did the averaging over such a (maybe more relevant?) period?

11) The data-model temperature offset found by Otto-Bliesner et al. (2013) you mention (0.67 degC) is based on annual mean surface temperature anomalies, right? In the discussion of your results (mostly page 747) you also compare your simulated warmest month values to Otto-Bliesners values. Maybe it would make more sense when you would use Otto-Bliesners warmest month or summer values (if this exists, otherwise it might be worth asking Otto-Bliesner for this information). Also, they compare simulated surface temperature anomalies, in contrast to your 2m air temperatures. Please discuss.

SPECIFIC AND TECHNICAL COMMENTS

Title, and also in the text: "thermal maximum temperatures", change to "thermal maximum" or "maximum temperatures"

(page.line) 740.13-15: rewrite, see also General comment 11)

740.18-22: change the order of the two arguments, second one is more important, and first argument could be disputable as the forcings in the LIG climate models are not the same as those for future climate scenarios.

741.22: include also Govin et al., 2012 (CP) and Langebroek and Nisancioglu, 2013

(CPD)

742.19-24: This is not easy to understand, and very essential. Please better explain the 2 different calculations. Do I understand well that for i) you first averaged the temperatures per region, and then search for the 50 yr period that has the highest temperatures; ii) you select the maximum 50 yr mean (?) temperature per grid cell, and then average over the region?

745.1-8: This could be an argument for the peak warmth not occurring simultaneously in all regions. Here it would be very interesting to see which months dominate the comparison, and which time periods dominate the compilation-warmest-period, and how they vary depending on latitude.

745.19: can you add the model resolution in Table 1?

746.24: "130 ka forcings", please briefly state which forcings (greenhouse gas, insolation, freshwater forcing?)

747.1: change to "0.98 and 0.31 degC annual mean temperature anomalies between 130 ka and pre-industrial" or equivalent

747.2: "this study" can refer to your study or Otto-Bliesners study. Please rewrite.

748.2-3: "model biases for present-day climate". Maybe you can assume that by taking anomalies the present-day biases are not a huge problem? Of course this is based on the assumption that the biases are time independent. . .

748.4-5: That is because the warming did not occur simultaneously.

748.19-20: Not clear, please rewrite.

Table 2: "present-day" is probably "pre-industrial"

Table 2: change to "found in the regionally averaged temperature evolution"

Fig 4: "Comparison of"

Fig 4: change "thermal maximum temperatures"

REFERENCES

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Otto-Bliesner, B. L., Rosenbloom, N., Stone, E. J., McKay, N. P., Lunt, D. J., Brady, E. C., and Overpeck, J. T.: How warm was the last interglacial?, New model – data comparisons, Philos. T. Roy. Soc. A, 371, 1–20, 2013.

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