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Climate of the Past Discussions

Interactive comment on "Large-scale features of Last Interglacial climate: Results from evaluating the *lig127k* simulations for CMIP6-PMIP4" *by* Bette Otto-Bliesner et al.

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We would like to thank you for your comments about our manuscript. We believe that the revisions we plan to implement should satisfactorily address your comments.

The first main set of comments in this review relates to the set of simulations included in the figures and analysis and included several queries.

1. Why not same set of simulations used in all figures and analyses? The submission of the paper was constrained by the IPCC AR6 deadline of the end of December 2019. Many modeling groups were in the process of publishing their data to the ESGF, but

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since only a few had completed that task, we relied primarily on data sent directly to us. The models included in the figures and analysis were dictated then by those that provided simulation results, which varied by climate variable, to the authors leading this paper. All figures now will include all 17 model simulations for the lig127k experiment published on the CMIP6 ESGF.

2. How was the set of 127k simulations determined? See answer #1 above. The set of simulations that will be included in the revised paper are those that have submitted their lig127k, as well as piControl, simulations to the CMIP6 ESGF. We include a new Table in the Supp Info that details the years analyzed and the DOI references. The CMIP6 database satisfies the publication requirements that all the model simulation data included in the paper is freely and publicly available. As many additional climate variables than those presented in our analyses are available in the CMIP6 database, subsequent, more in-depth topical papers will be possible. In addition, this database includes additional CMIP6 simulations by the modeling groups that could provide interesting past-to-future analyses. With regard to the models in the Scussolini et al. paper, those that are available in the CMIP6 database are now included in our figures and analyses (HadGEM3-GC3.1-LL, IPSL-CR-LR, MPI-ESM1.201p1-LR, NorESM1-f, NESM3).

3. The overlap of models that completed both the lig127 and midHolocene simulations is significant (14 of the 17 models with lig127k simulations also completed midHolocene simulations). We will clearly note where there is not an overlap in the applicable figure legends. Fig. 17 will include all the midHolocene simulations.

4. A related comment concerns comparison to previous last interglacial experiments. We do mention Lunt et al. in the Introduction and will include some additional text where relevant in the revised manuscript. The challenge is that the simulations in the Lunt et al. synthesis are an 'ensemble of opportunity' with different choices for time periods and forcings. PMIP3 and CMIP5 did not include a last interglacial simulation.

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The second main comment concerns the robustness of the results and intermodal spread. The standard deviations of ensemble changes in Figure 5 and 9 are intended to demonstrate the variation in the signal between the GCMs. They are the ensemble standard deviation in the temporal mean changes at each location – rather than the ensemble means of the temporal standard deviations. We will add to the multi-model ensemble-average panels stippling where most of the models do not agree on the sign of the change. For Figure 8, we will not only include the correlation coefficients but also a measure of their significance. Intermodel spread is already included in many of the other figures.

The third set of comments concerns the underlying mechanisms and effects of PI biases.

Figure 2 will be deleted in the revised manuscript since with the significant overlap of models with both midHolocene and lig127k simulations, it basically duplicates a similar figure and more extensive discussion in the midHolocene paper. Where relevant, we will refer to the midHolocene paper and include text in the lig127k paper. In place of Figure 2, we will replace the upper panel of Figure 3 with the MAT differences: PI minus observed to more clearly show the PI biases in surface air temperature.

More analyses like Figure 8 would greatly expand the scope of this paper and best left to current (e.g., Kageyama et al., lig127k Arctic sea ice paper) and subsequent (as happened in previous PMIPs) more-detailed, multi-model topical papers and single model papers (e.g. Williams et al., CPD, 2020; O'ishi et al. CPD, 2020). Discussion and references to previously published results will be added to relevant sections.

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