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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.

Anonymous Referee #2

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Summary

The authors provide an overview of the lig127k simulations prepared for CMIP6 and PMIP4. They show the main global features of an ensemble of 17 coupled climate models, including the temperature, precipitation and sea-ice response. The article will provide an important reference for the CMIP process and a starting point for further more detailed lig127k analysis. Having said that, the present text could in my opinion better convey what has been learned about the Last Interglacial climate and/or about these climate models. Therefore, I recommend publication once these messages have been brought out, either through more detailed discussion or with further analyses.

Main comments

Several questions feel unanswered at the end of this manuscript, e.g. why might models be getting the incorrect pattern of change in some regions (e.g. is it really all down to missing freshwater or dynamic vegetation)? What factors might contribute to the relatively large spread in simulated responses? How robust are the seasonal versus annual reconstructions and which one of these tells us most about the model deficiencies? Why does the sea-ice loss scale with ECS? How do models with interactive vegetation or LAI differ from the fixed vegetation models?

Whilst I realise that a full treatment of each of these questions could generate a paper by itself, more discussion would be extremely valuable, especially given that the author list brings together a list of experts for each model and in the palaeoclimate archives.

Other comments

If I understand correctly, you are showing that models with higher ECS also show stronger Arctic sea-ice loss in LIG simulations. This despite lower GHG levels in the lig127k simulations. I think this is interesting, but requires more analysis.

It feels incomplete to omit HadGEM3 from the sea-ice ECS comparison, especially as this model has the largest polar warming in the ensemble. Please can you include this in the analysis?

Lines 595-604: I don't really agree with the main point here. None of the dynamic vegetation models in PMIP2 or CMIP5 showed an adequate precipitation response in North Africa, so why should this differ for the last interglacial?

Table 2: The details of the models included needs to be completed before publication. What is the HadGEM3 ECS and how were vegetation and aerosols treated in FGOALS, GISS-E2-1-G and NESM3 and CNRM?

Fig. 11-13: I think some assessment of the model uncertainty and paleo reconstruction uncertainty is required. It's not clear from these figures whether the multi-model mean

is good but the individual models are biased etc.

Technical corrections

Line 550: "though with significant differences among the models". Line 552: "but with substantial differences among the ensemble" Line 555: "though again with a large spread across 555 the model ensemble" Line 562: "The spread across the multi-model ensemble is particularly large for the North African monsoon" Line 585: "However, the model spread is large"

Please quantify these.

Line 583: "The most consistent picture from the temperature proxies representing annual conditions is warmer LIG temperatures over Greenland and Antarctica" What do you mean here? Consistent between model simulations and reconstructions, or consistent within the reconstructions?

Line 627: "There appears to be a clear relationship between the ECS of each model and its simulation of August-September lig127k minimum Arctic sea ice extent"

I'm not sure this is accurate. The comparison in the first panel of figure 8 (which needs to be properly labelled) is moderate at best, but perhaps I have misunderstood the plots as the labels are inconsistent with the caption. The r2 would be useful here.

Figures

Fig. 3: a) I can see why you have offset the models and observations in the latitudinal direction, but this could lead to confusion. Would this plot not work better as anomalies? Mostly what we see here is that the models capture the latitudinal temperature gradient. Additionally what is the uncertainty on the observations?

b) Please can you join the circles in the lower plot with lines, so that we can see the integrated latitudinal change in each model separately. For example, this might show that a model is the warmest at high-latitudes but is in the middle of the ensemble

elsewhere?

Fig. 8: the y-axes are incorrectly labelled in all but the first panel. There are also grey lines between some of the panels.

Fig. 16: ACCESS-ESM appears to show close to no change in these figure panels - can you double check this?

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