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Climate of the Past Discussions

Interactive comment on "PMIP4/CMIP6 Last Interglacial simulations using different versions of MIROC, with and without vegetation feedback" *by* Ryouta O'ishi et al.

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R. O'ishi and co-authors presented results of the CMIP6/PMIP4 lig127k simulation with three different versions of MIROC. They assessed large scale features of surface temperature, precipitation, and sea ice distributions in the simulated LIG climate, with extensive comparison to proxy dataset available. In addition, they addressed the importance of including vegetation feedbacks in getting Arctic warming at the northern high latitude, as indicated by proxy data.

I am overall positive about the manuscript. It fits the scope of the journal and the targeted special issue, and would serve as a useful reference for the audience interested

in this topic. However, I do have a number of comments on the manuscript as listed below (most of them are relatively minor), and hope the authors could address them before the manuscript can be considered for potential publication in Climate of the Past.

> The title is a bit misleading, e.g. ", with and without vegetation feedback" can read as sensitivity experiments for each version of the model. I do understand that the authors would like to address the importance of vegetation feedback, however, the authors could consider to drop this, as the majority of the paper is focused on the large scale features. In addition, it would be useful to highlight "using three different versions of MIROC" in the title.

> L8: It should be three LIG experiments; please rephrase.

> L12-13: too many commas in the sentence; suggest to change to, for example, "... vegetation distribution, shows annual mean warming signals at northern high latitudes, as indicated by proxy data."

> L27: For context please give a number/range of the estimated sea level rise for the LIG from the literature – Dutton et al. (2015) for example. Dutton et al., 2015, Sea-level rise due to polar ice-sheet mass loss during past warm periods, Science 349, aaa4019

> L21-29: I don't think the authors have presented sufficient background introduction for the LIG period. Such information might be obvious to certain experts but not so to the general audience. Could the authors further elaborate on the characteristics of the LIG climate, for example, on the sea level (see previous comment) and surface temperature? Especially, the authors have discussed extensively in the main text on the proxy-reconstructed temperature from different dataset, and some introduction here would be beneficial. In addition, a recent paper on the LIG precipitation (Scussolini et al., 2019) would also be helpful for the introduction here.

Scussolini et al., 2019, Agreement between reconstructed and modeled boreal precip-

itation of the Last Interglacial, Science Advances.

> L31; the three Braconnot papers should be combined into, e.g. Braconnot et al. (2000, 2007, 2012). The most recent PMIP4 overarching paper by Kageyama et al. (2018) should also be cited here.

> after L36: please expand with how the manuscript is structured.

> L40: "The AOGCM MIROC4m, is based on. . ."?

> L49: here and elsewhere; is there any reference for the sea ice model?

> L49: "These models are used . . ."; you mean MIROC4m, or the different components of it?

> L64: The model resolutions of (?) are the same as those of MIROC4m.

> L67-68: The reference of Hajima et al. appears in GMDD and should be updated here.

> L83: Otto-Bliesner et al. (2017)

> L83: piControl should be italic here.

> L85-86: ". . . using MIROC-ES2L to MIROC-ES2L." is strange. Please rephrase.

> L91: Figure 2 is not properly referred to in the text; I think it should come early in Section 2.1.

> L93: Although information can be found in Table 2, the authors should state the length of their simulations here – which is impressive by the way, and could be useful for the audience who are potentially interested in studies of equilibration and variability (multi-decadal/centennial) during the LIG.

> L98: please address that ">6 K" is only a regional feature.

> L104: please give global mean values of LIG annual mean temperature anomalies

relative to PI. This is important information for comparing with other model simulations, and should also be highlighted in the abstract.

> L112-114: It is up to the authors to decide, but I don't see the added value for including this paragraph here. Also, why MJJA is used here (rather than JJA)?

> L116: To my (very limited) knowledge on paleoclimate proxy dataset, the Turney and Jones (2010) dataset gives geographically asynchronous warming information, e.g. the compilation presents peak warmth information during the LIG rather than a time slice; see discussions by Capron et al. (2014, 2017). I therefore wonder the meaning and validity of making such a model-data comparison. The authors should take this into account, and at least make clear of the limit of the dataset and hence the comparison in the text.

> Figs 6&7: please consider merging these two figures. I understand that the core locations could be overlapping each other for the two datasets, but this could be avoided by, for example, putting them side to side and mention it in the figure caption.

> L120: "+1 K"; please make consistent of Celsius or Kelvin throughout the text.

> L126: ". . .at low latitudes"; you mean southern latitudes?

> L131, 133: ". . .warming in the northern Atlantic Ocean"; I guess the authors refer to comparison with that one single site in the Irminger Sea? If yes I don't think the comparison should be generalized to the "northern Atlantic Ocean".

> Section 3.2.1: The description on the LIG precipitation is inadequate. Please add more details on the main features/changes. The work by Scussolini et al. (2019) could be referred for comparison here. In addition, I wonder if it is more conventional to have an anomaly map (LIG minus PI) rather than the ratio map? I am not an expert on this, and it is up to the authors to decide.

> L149: "MIROC4m-LPJ" and "MIROC4m" should be swapped in this line?

> L154: “Figure 13”

> L168: It would be useful to overlie the observed sea ice extent in the figure.

> Figure 13: 1) please consider presenting the sea ice thickness in meters rather than centimeters (this also applies to other sea ice figures); 2) please change the colormap, as the current one is quite saturated with high values, and it is difficult to see the intervals (this may also apply to the other sea ice figures); 3) please consider overlying the observed (in the PI panels) and modeled (in the PI and 127k panels) 15% contour of sea ice extent (this also applies to the other sea ice figures). The field of sea ice thickness only is insufficient in presenting the sea ice distribution; this is especially the case for the SH sea ice extent.

> Figures 15&16: please change the range of the plotted sea ice thickness (and perhaps also colormap; see previous comment), e.g. it does not need to be the same with that of the NH.

> L172: “as well as” -> “, similar to”?

> L175: “seasons”

> L190: move “by +3K” to later in the sentence (after “North America”)?

> L197: I would say “similar” rather than “basically the same”.

> L209: “and in future”; I would say that such results have implications for future simulations.

> L210-211: I don’t see the direct connection with climate sensitivity here. The LIG climate change relative to present day is related to differences in the orbital forcing rather than CO2.

> L215: is there really a “warm bias” in MIROC4m-LPJ, or is it just warmer in this model version compared to the other two? If it is the former case, then this should be brought up earlier in the main text.

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