

Clim. Past Discuss., referee comment RC1
<https://doi.org/10.5194/cp-2022-52-RC1>, 2022
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Comment on cp-2022-52

Anonymous Referee #1

Referee comment on "Causes of the weak emergent constraint on climate sensitivity at the Last Glacial Maximum" by Martin Renoult et al., Clim. Past Discuss., <https://doi.org/10.5194/cp-2022-52-RC1>, 2022

This study investigates the usefulness of emergent constraints on ECS from palaeoclimate model ensembles. In particular, the authors look into different ensembles (PMIP generations) of the LGM and one of the mid-Pliocene, and explain why the emergent constraint works relatively poorly for the LGM, even though many more data are available than for the Pliocene.

This is a very decent and detailed study in terms of statistical analysis and physical feedbacks processes that contribute to the ECS and its uncertainty. As expected cloud and water vapour feedbacks turn out to be model- and state dependent, but difficult to quantify.

My only comment is concerned with the AMOC: While the authors do classify it as contributing both structural and state-dependent noise (in Table 7 and text), in the discussion the state-dependence becomes a bit vague. I agree that we don't know much, but I think it could be stressed a bit more that it is very likely that the AMOC contributes to state-dependent noise.

The AMOC does influence SSTs (and probably globally), but it is not the only factor, and the degree to which the AMOC influences SST can depend on the period of time. See for example the analysis in this preprint: <https://doi.org/10.5194/cp-2022-35> for the Pliocene, where an attempt is made to distinguish between AMOC-driven and 'gyre-driven' ocean heat transport. The statement the authors make in line 457-59 may hint towards the fact that for the LGM the amount to which the AMOC influences NH-SSTs is again different from present day and Pliocene.

Minor comments:

line 656: 'model' should be 'more'

line 676: capitalize 'ice sheet ...' it is the start of a new sentence.

Table 7, row 'Ocean': two brackets too much