

Interactive comment on “Could the Pliocene constrain the Equilibrium Climate Sensitivity?” by J. C. Hargreaves and J. D. Annan

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Thank you for the helpful review.

We will reconsider the wording in the abstract and the main text in order to ensure that readers don't get a misleading impression of our results. We certainly don't want the headline value to be taken as definitive.

As for the specific comments:

- 1 We will improve this aspect of the abstract.
- 2 Yes, we will emphasise this point (also relevant to rev1).
- 3 A good point and we will add the Dowsett reference.

C1

4 It is perhaps best to not over-interpret the term "constraint". However, if it can be argued that the Pliocene constraint is independent of others, it may still be useful even if weak (e.g. Annan and Hargreaves 2006).

5 We did look at this, but were not able to reach any firm conclusions. It is not easy to separate out internal variability (on long time scales) from drift, especially when looking regionally. So we can only mention it as a caveat and not provide a concrete answer.

6 It does matter. Reference will be added and section improved.

7 We have improved the discussion of the various inconsistencies in calculations of sensitivity. For the most part, however, it seems likely that these uncertainties are not large compared to the inter-model differences. It also appears that CMIP6 has given up on the calculation of equilibrium climate sensitivity via long equilibrium runs, preferring the related but distinct concept of effective sensitivity using regression following an abrupt change in forcing ("Gregory method"). PlioMIP may prefer to follow this approach.

8 This is an interesting point and one where we respectfully disagree with the reviewer. We do consider it strongly preferable to use averages over large areas, to maximise the relative importance of the large-scale forcing and minimise the influence of location errors. We do acknowledge your concerns about the reliability of the PRISM3 reconstruction and hope to see (and perhaps contribute to) more robust and traceable analyses in future iterations of the project. The main goal of this work was to see if such research is worth pursuing, and as such the numerical result itself (which we agree has limited credibility) is of secondary importance. Furthermore, dealing with individual data points would introduce the complication that we would have to make some additional assumptions regarding the covariance of errors across multiple sites. This would require a level of data analysis and interpretation well beyond the scope of this research.

9 We have re-done all the calculations with SST. This does clearly improve the agree-

C2

ment between models and data, due to the combination of slightly different anomalies, and some changes to the gridding and masking. However, there is still a substantial mean bias between models and data.

10 Note that this value is the uncertainty of the area mean, not that of the individual points. We can reasonably hope that the former will be considerably lower than the latter, though we are not yet in a position to evaluate this in detail.

11 Noted, and will be mentioned.

12 Noted and these forcings will be specifically mentioned. However, the issue is the other way around: according to our result, a model with zero (global) sensitivity will still warm in the tropics.

13 Noted.

14 Will do.

Technical comments

a,b Will do.

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