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Climate of the Past Discussions

Interactive comment on "Large-scale features of Pliocene climate: results from the Pliocene Model Intercomparison Project" *by* A. M. Haywood et al.

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This is a very important paper that will influence the philosophy of Pliocene climate modelling studies for many years to come. It details the results of the Pliocene Modelling Intercomparison Project and makes some clear and systematic conclusions for improving the veracity of the models and the proxy data with which they are compared. I have the following comments.

Title of section 1.1

Although the 'mid-Pliocene warm Period' is very clearly defined here (and widely used in the literature), the recent redefinition of the base of the Pleistocene to include the Gelasian, means that a better term is 'mid-Piacenzian warm period'. I would suggest

this latter form is used here, but making it clear that this is synonymous with the older use of 'mid-Pliocene warm period'.

Section 1.1

There cannot be a 'mid-Pliocene warm Period'. The Pliocene is an Epoch (chronostratigraphic equivalent 'Series') and the use of the capitalised 'Period' here suggests a chronological unit of higher rank than an epoch. This should be changed to 'period'. Also, I would rewrite the sentence as 'It sits within the Piacenzian Age of the Late Pliocene. . . .' If you use 'Piacenzian Stage' with 'Late' you are mixing chronostratigraphy and chronology (sorry, pedantic stratigrapher).

Section 6.1 and the PMIP triangle

I take the point that using a time-averaged proxy dataset is difficult for climate models where other parameters will clearly vary over a 240Kyr time interval. Not least, as a palaeontologist, I know that some organisms may have encompassed environmental drift in their own biology through such a time interval, so that the end may not compare with the beginning. However, there is much in the PRISM3D dataset that will be of considerable value in constraining the efficacy of different proxies, and the data is not only of use to time slices. For example, how do we know that a particular proxy in a particular time slice is truly representing the full range of ambient environmental conditions at that time/place? We need to test these proxies to the 'nth degree', and we can do that best where we have an existing large database. Yes, if a range of proxies repeated at many sites can be assigned to a single time slice that will be great. But if you can get one proxy dataset from that time slice site, but have corroborating data from other sites (of other Pliocene ages) that quantify proxy uncertainty, well that's also good (please see my comments under conclusion too).

Section 6.2

The identification of a time slice (at 3.205Ma) with a near modern orbital configuration

represents a massive step forward (massive), and may lead to the golden chalice of a very useful 'analogue' (notwithstanding all of the nuances that surround that word in deep time palaeoclimate studies) for a late 21^{st} century world. The challenge now is to find sufficient proxy data that can be correlated to such a narrow time slice with a voracious stratigraphy: and to correlate the marine and terrestrial data.

Conclusions

Much is made in the conclusions about inconsistencies between models and proxy data, not least where the proxy data spans a much greater (1 million year time interval) than the 'mid Piacenzian warm period'. And this is good. The time slice approach will surely improve on this, though it will narrow the dataset. But there is a deeper point to be made here too, about the proxy data. Proxy workers know that their proxies have limitations. Some proxies record seasonality – but perhaps not the full range of seasonality at a particular site. Some proxies may amplify peak summer temperatures. Some proxies may be subject to overprinting or alteration, or may not yet be fully quantified. Uncertainties in the models, proxies, and model-proxy comparisons can only be made by a dual approach. One that narrows the time slice and therefore constrains the analysis to a single orbital cycle, but one that also seeks to improve the veracity of proxy estimates of climate state, perhaps by a proxy inter-comparison project, taking its lead from the climate modellers. Such an approach does not need to constrain the proxy data analysis only to a single time slice, but rather should seek to establish the variability and uncertainty of a particular proxy (or proxies) through a much wider dataset and across a range of different environmental settings. Then it can be applied with veracity to a single time slice.

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