

Interactive comment on “Changes to the tropical circulation in the mid-Pliocene and their implications for future climate” by Shawn Corvec and Christopher G. Fletcher

Anonymous Referee #2

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This is an interesting paper that provides quite a detailed analysis of changes in tropical circulation in response to Pliocene boundary conditions in climate models. The nature of atmospheric circulation in the tropics provided by models is not new (and the authors could do with referring to additional previous studies that have demonstrated similar behavior). However, to my knowledge this is the first study that examines these aspects of model responses across an internally consistent multi-model ensemble. To me this is where the novelty of the paper resides. The paper presents analyses using both prescribed SST and predicted SST simulations from PlioMIP Phase 1, which again have been presented before for individual models but never synthesized as an MME. Finally the paper draws some interesting comparisons between model responses in

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the Pliocene versus future climate change experiments, which I found very interesting and that directly face the Pliocene4Future agenda.

As a climate modeller I do not have any concerns with the methods used to analyse the model data and the approach towards the analysis of statistical robustness seems sensible to me. I think the conclusions drawn in the paper are well justified by the results presented and compliment previous work very nicely.

This paper makes an important and useful contribution to the PlioMIP project.

I recommend acceptance after only minor revisions. I formed my opinion before reading the comments of reviewer number 1 but on the whole support a number of his/her assertions regarding the lack of appropriate citation to previous mPWP studies.

Rather than analogue I would prefer the time period referenced as a unique opportunity to better understand climate dynamics and behavior in a warmer world. The implications of this are obvious without having to engage in any complex discussion on what constitutes an analogue or not.

I think in the introduction the authors should expand upon the aspects of tropical circulation response that models, when simulating future climate, are not consistent about.

Please use mPWP throughout and not mpWP.

I would also note that differences in orbital parameters in the mPWP overall were not "minor" from modern as the authors suggest. The Laskar orbital solution shows that across the ~300 Kyrs of the mPWP that there were very large changes in insolation at the TOA. Convention in previous model simulations for the mPWP was to use a modern orbit even those the evaluation data (SSTs and vegetation) would reflect a complex response to an amalgam of orbital forcing (due to its time average nature). This is why in PlioMIP Phase 2 they are focusing on a narrower time slice ~3.2 Ma where the orbital forcing represented by the SST responses, and given to the models themselves, is consistent.

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The authors should read the Haywood et al. 2016 review in Nature Communications to familiarize themselves with current uncertainties regarding tropical SST response. For those in the community who are in the know there is currently significant debate about stability of tropical SSTs during the Pliocene. Basically one would expect a model to increase tropical SSTs in response to a CO₂ increase (as indicated by CO₂ proxies). But the change derived from a ~ 120 ppmv CO₂ forcing is small and inherent uncertainties in the sensitivity of proxy detection and attribution remain - meaning quite simply the signal to noise ratio in this regard is unfavorable. So it is of no surprise that the PRES and CPLD results differ and the sensitivity of SSTs in the tropics during the mPWP is an area where current research is ongoing.

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