

Review of “Evaluating the large-scale hydrological cycle response within the Pliocene ensemble”

by Zixuan Han et al.

Manuscript No: CP-2021-72

Recommendation: Major revisions

General Comments: In this article the authors investigated the simulated changes in the mid-Pliocene Precipitation - Evaporation (P - E) pattern relative to the PI simulation. In addition, the authors also attempted to attribute these hydrological cycle changes to its dynamic and thermodynamic component, which is partially influenced by Seager et al. (2010). The results in this article could be useful for a detailed understanding of the mid-Pliocene hydro-climate but in its current form it is lacking some clarifications (listed below) that must be addressed before the publication.

Specific Comments

- Equation (1) only deals with the thermodynamic and mean circulation dynamics contribution. The transient eddy contribution and the surface quantities are included in the residual (R) term. It will be nice to see how different is the MMM PmE from the sum of TH and MCD component. This is since the poleward moistening is believed to be a result from the transient eddies and the difference might show this feature. I would also suggest to extend the meridional domain from 60° to 90°.
- Line 58: The wet-region-getting-wetter and dry-regions-getting drier phenomenon is primarily valid over the ocean. Over the landmass this characteristic is not always true. A study by Greve et al. (2014) reported that only 10.8% of the global land area shows dry gets drier and wet gets wetter pattern.
- Line 210-211: Did not understand properly the meaning of strengthened East Asian summer monsoon circulation (is it more rainfall or strong winds?) and how it affects the MMM PmE changes over Southeast Asia.
- Line 253-254: “mid-high latitudes” is a very broad region. You might specify the areas dominated by the climate mean horizontal circulation e.g. Western coast of South America, Southern tip of South Africa, a region extending from the Southern tip of South America to the Central tropical Pacific Ocean.
- Line 274: What does it mean by Southern part and Northern part of the deep tropics? Is it Southern and Northern hemispheric part of the deep tropics or something else?
- Line 275: It is not clear to me how one can infer from Fig. 4(f) that ITCZ has shifted northward.
- Line 277-278: Did not understand the meaning of the sentence starting with “There is a tendency...”.

- Line 327-328: Unable to agree with this statement. The changes in the MMM SST (Fig. 6a) and specific humidity (Fig. 6b) does not seemed to be in agreement. The MMM SST changes are largest over the higher latitudes and in contrary the largest changes in the specific humidity occurs over the tropics. Also you need to change the figure reference (it is not 5b, it should be 6b).

Technical comments

- Line 68: remove enhance or increase. Both have the same meaning.
- Line 214: I think the figure referencing is wrong here. It should be Fig. 6b.
- Line 220: It would be nice to add one more plot here which will represent the changes in the MMM PmE due to the combined TH and MCD component.
- Line 253: "... unaltered divergence of the mean zonal circulation.." puzzled a bit with the usage of "unaltered" and "mean". I believe you can remove the "unaltered".
- Line 269: "Overwhelming" is not the correct word in this context. Probably one can use "dominating".
- Line 317-318: In Figure 5 caption the orange band marking is wrong and I don't see any green band.
- Please make the contour intervals in such a way that it removes the zero contour lines. Applicable to all the figures. Often inclusion of the zero contours lead to misinterpretation of the results.
- I think stippling should be used on the non-significant regions so that we have a clear view of the significant results.

Reference

Greve, P., Orłowsky, B., Mueller, B., Sheffield, J., Reichstein, M., & Seneviratne, S. I. (2014). Global assessment of trends in wetting and drying over land. *Nature geoscience*, 7(10), 716-721.