Response to reviewer – RC1

We repeat the reviewer's comments here in black and our response is in blue.

The authors carried out downscaling simulation of the mid-Holocene Australian climate based on the WRF and compared it with the CESM simulation of the mid-Holocene Climate and obtained an added value. The study is certainly very interesting. Therefore, I suggest a minor revision.

1. I see that the authors have also given almost identical distribution of vegetation in the WRF for both the Holocene and control experiments. This is similar to the fact that most PMIP experiments still use the vegetation distribution of present day. Actually, the reconstruction results suggest that the vegetation distribution in the mid-Holocene may have been quite different from the present day and may have impacted on the regional climate (Thompson et al., 2022; Sun et al., 2023). For this reason, I suggest that authors might try to drive vegetation models (Such as Biome et al.) with CESM outputs and WRF outputs in order to examine the regional vegetation response to mid-Holocene climate change.

Thompson, A.J., Zhu, J., Poulsen, C.J., Tierney, J.E., & Skinner, C.B. (2022). Northern Hemisphere vegetation change drives a Holocene thermal maximum. Science Advances, 8.

Sun, Y., Wu, H., Ramstein, G. et al. Revisiting the physical mechanisms of East Asian summer monsoon precipitation changes during the mid-Holocene: a data–model comparison. Clim Dyn 60, 1009–1022 (2023). https://doi.org/10.1007/s00382-022-06359-1

We thank the review for this comment and bringing to our attention these two papers. We agree that vegetation changes between the mid-Holocene and pre-industrial should play a role in analysis of the regional climate. To account for this, the approach in the WRF simulations was to modify the land-use classification from the results of Allen et al. (2020). It transpired, as noted by the reviewer, that Allen et al. (2020)'s results presented a very similar vegetation distribution between the two periods as shown in Fig. 3. This is further corroborated, for example, by vegetation evidence from Rowe et al. (2019) that there has been little change in vegetation type over northern Australia between the mid-Holocene and present.

It could indeed be informative to use the results from our paper to drive an offline vegetation model, but we feel that would be outside the scope of the current manuscript.

2. Besides, in the introduction somewhere, previous progress in downscaling studies on other regions of the mid-Holocene should be reviewed.

Huo, Y., Peltier, W. R., and Chandan, D.: Mid-Holocene monsoons in South and Southeast Asia: dynamically downscaled simulations and the influence of the Green Sahara, Clim. Past, 17, 1645–1664, https://doi.org/10.5194/cp-17-1645-2021, 2021.

We appreciate the link to this article and will include this in the final manuscript.

References

Allen, J. R. M., Forrest, M., Hickler, T., Singarayer, J. S., Valdes, P. J., and Huntley, B.: Global vegetation patterns of the past 140,000 years, J. Biogeogr., 47, 2073–2090, https://doi.org/10.1111/jbi.13930, 2020.

Rowe, C., Brand, M., Hutley, L.B., Wurster, C., Zwart, C., Levchenko, V., Bird, M., 2019. Holocene savanna dynamics in the seasonal tropics of northern Australia. Rev. Palaeobot. Palynol. 267, 17–31. https://doi.org/10.1016/j.revpalbo.2019.05.004