

Interactive comment on “Weak Southern Hemispheric monsoons during the Last Interglacial period” by Nicholas K. H. Yeung et al.

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In this manuscript, the authors, Yeung et al., provide an analysis of weakening monsoons in the Southern Hemisphere at the Last Interglacial in the ACCESS-ESM1.5 lig127k and piControl simulations. The manuscript is well written and I would like to suggest this manuscript to be accepted with some minor revision.

My minor comments regarding the text and analysis are following:

1. Section 3: This section includes more results than monsoons in the Southern Hemisphere. Please modify, or change your title.
2. Figure 2d: Remove the red vertical lines around 100degW and 80degW in high latitudes.

C1

3. Figure S1 and sea ice extent in text: The numbers of sea ice extent plotted in Figure S1 are similar to the sea ice areas (not extent) plotted in Figure 4 in Otto-Bliesner et al. (2020). I'm a co-author of that LIG paper, and we may have made an error in our calculation as our numbers are different from yours. My apologies. Following the SIMIP community, we've gone for area not extent in the LIG paper. The SIMIP papers appear to ditched "sea ice extent" (area of grid boxes with >15% coverage) in favour of "sea ice area" (grid box area * fractional coverage). This decision is motivated by sea ice area being better constrained by the observations. You might want to consider this.

4. Line 128-129: Could you give a potential explanation to the mismatch? Meltwater from ice sheets, in line 292-295, could be one.

5. The structure of section 3.2.2 is confusing. Figures and text mix up analysis of DJF precipitation and NDJFM precipitation, in my view.

6. Line 105-108 and Section 3.2.2: If I understand correctly, adjusted monthly precipitation data are used in analysing monsoon variables. Brierley et al (2020) (I'm also a co-author, my apologies) estimated the size of the interpolation error from the PaleoCalAdjust routine on monsoon domain. The calendar adjustment brings a dry bias in monsoon variables and its magnitude is larger than the wet bias in directly using monthly data. Otto-Bliesner et al (2020) and Brierley et al (2020) therefore not applied the calendar adjustment in monsoon analysis in the lig127k and midHolocene simulations. I attach our LIG monsoon numbers used in Otto-Bliesner et al (2020) that have been calculated from your simulations in the supplement. I can't say which one is correct.

7. Line 205-209: The definition of monsoon domain of Wang et al (2011) includes two parts: first, summer rainfall minus winter rainfall is at least 2.5 mm/day; second, at least 55% of the annual rainfall falls in the summer season. Could you justify why only the first part has been used?

8. Figure 6: Remove the white bands at the Greenwich Meridian.

C2

9. Figure 7: The right-hand axes should be in red, so that it is clear that they are only associated with the tas bars.

10. You might want to refer to the description of SH monsoon in D'Agostino et al (2020) to help with the mechanisms in discussion.

Refs: Brierley, C. M., Zhao, A., Harrison, S. P., Braconnot, P., Williams, C. J. R., Thornalley, D. J. R., Shi, X., Peterschmitt, J.-Y., Ohgaito, R., Kaufman, D. S., Kageyama, M., Hargreaves, J. C., Erb, M. P., Emile-Geay, J., D'Agostino, R., Chandan, D., Carré, M., Bartlein, P. J., Zheng, W., Zhang, Z., Zhang, Q., Yang, H., Volodin, E. M., Tomas, R. A., Routson, C., Peltier, W. R., Otto-Bliesner, B., Morozova, P. A., McKay, N. P., Lohmann, G., Legrande, A. N., Guo, C., Cao, J., Brady, E., Annan, J. D., and Abe-Ouchi, A.: Large-scale features and evaluation of the PMIP4-CMIP6 midHolocene simulations, *Clim. Past*, 16, 1847–1872, <https://doi.org/10.5194/cp-16-1847-2020>, 2020.

D'Agostino, R., Brown, J. R., Moise, A., Nguyen, H., Silva Dias, P. L., & Jungclaus, J. : Contrasting Southern Hemisphere Monsoon Response: MidHolocene Orbital Forcing versus Future Greenhouse Gas–Induced Global Warming, *Journal of Climate*, 33(22), 9595-9613, 2020.

Please also note the supplement to this comment:

<https://cp.copernicus.org/preprints/cp-2020-149/cp-2020-149-RC2-supplement.pdf>

Interactive comment on *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2020-149>, 2020.