Point-by-point reply for Reyers et al.:
„On the importance of moisture conveyor belts from the tropical East Pacific for wetter conditions in the Atacama Desert during the Mid-Pliocene“

We thank all community members who provided comments on our manuscript for the appraisal of our manuscript. The comments helped us to further improve the presentation of the results in the manuscript. Our replies to the comments along with details on how we intend to revise the manuscript are printed in blue below the original comments in black. We also revise the color schemes in the figures for clarity.

Reply to CC1 by Arthur Oldeman

„Dear authors, You submitted a nice work to CP, advancing the science on the mid-Pliocene hydrological cycle. So well done! I do think that your work misses some key background information on the mid-Pliocene (Pacific) hydrological cycle, based on recent PlioMIP2 publications.

- The mid-Pliocene simulations of CESM2 you are using are further analysed in Feng et al 2020. They specifically also look at the tropical Pacific circulation changes, so Hadley & Walker circulation and equatorial Pacific SSTs. https://doi.org/10.1029/2019MS002033
- An evaluation of the large scale hydrological cycle response in PlioMIP2 (including the CESM2 simulations) is included in Han et al 2021. They find wetter conditions in the deep tropics, so Pacific ITCZ, and give an explanation for where this moisture is coming from. https://doi.org/10.5194/cp-17-2537-2021
- Pontes et al 2020 research PlioMIP1 and PlioMIP2 results and find a northward shift of the ITCZ and a weakened and poleward displaced South Pacific Convergence Zone (SPCZ). These results might again be relevant for where exactly the moisture in the atmosphere is coming from in your region of interest. https://doi.org/10.1038/s41598-020-68884-5
- Related but maybe less relevant is Gabriel Pontes' recent publication, relating the northward shift of the Pacific ITCZ to the reduced El Nino variability in the PlioMIP1 and 2. https://doi.org/10.1038/s41561-022-00999-y
- A very relevant study, using PlioMIP2 model CCSM4-UoT (so not CESM2) is Menemenlis et al 2021, where they study and attribute precipitation changes in the mid-Pliocene, a.o. focusing on the coastal area of Chile. They explain & attribute the precipitation changes to dynamical changes in atmospheric rivers. https://doi.org/10.1016/j.gloplacha.2021.103557

I saw you do include my 2021 paper on reduced El Nino variability in the PlioMIP2 ensemble (Oldeman et al). I think that most papers I refer to above are actually more relevant to your study than that article, since these focus more on atmospheric dynamics and the hydrological cycle rather than SST variability.
Your work is interesting but lacks - in my view - some relevant background knowledge on the hydrological cycle and atmospheric dynamics from modelling studies. I would recommend including some of the content of these publications either in the Introduction, or section 3.2 Potential drivers.
Technical comment: you consistently refer to "PlioMIP" in the Methods section. CESM2 was included in phase 2, so PlioMIP2. It would be good for findability to use PlioMIP2 (just as you are using CMIP6 and PMIP4 rather than CMIP or PMIP).
Much of luck with the research!
Best regards, Arthur Oldeman“

Dear Arthur Oldeman,

thank you very much for your interest in our manuscript. We appreciate your suggestions for further links to published works and include citations to articles that you suggest in our revised manuscript.

Specifically, we add in the introduction: “For the warmer mid-Pliocene climate, the multi-model mean of the PlioMIP2 models for instance indicate that the Hadley Cell was shifted northward and the Walker Circulation shifted westward (Han et al., 2021).”, and in Section 3.2: “Thermodynamic and dynamical changes in PlioMIP2 models lead to wetter tropics, particularly in the eastern tropical Pacific (Han et al., 2021). Furthermore, the subtropical anticyclones over the southern Pacific intensified and expanded further to the West in PlioMIP2 (Pontes et al., 2020). The change in the synoptic-scale circulation is a potential reason for the smaller frequency of troughs reaching the subtropical Pacific offshore the Atacama (Fig. 11a).”,

The studies with inter-comparison results are cited in the method section: “(…) the validation results of GCMs participating in PlioMIP2, assessed previously (e.g., Feng et al., 2020, Pontes et al., 2020, Han et al., 2021).”

We add in the conclusions: “Atmospheric rivers are not unlike MCBs and are more strongly changing in the Northern Pacific than in the Southern Pacific between the mid-Pliocene and the pre-industrial (Menemenlis et al., 2021), which suggests that a dynamical assessment with high-spatial resolutions for the mid-Pliocene would also be interesting in other regions.”

For consistency, we use the term PlioMIP2 instead of PlioMIP throughout the revised manuscript.