The authors have made substantial revisions to the initial manuscript. I recommend some minor and technical changes before publication.

We thank the reviewer for the positive evaluation of the revised manuscript and for the helpful suggestions. All minor and technical comments have been addressed as detailed below.

Minor comments

The title is much better than before. Authors should capitalize Compared and Modern-Day

We have revised the title accordingly and capitalized "Compared" and "Modern-Day" as suggested.

Intro Paragraph lines 34-42. This is a heavy modeling study, the authors should incorporate knowledge from prior modeling studies about the Middle Miocene and MCO. Plenty of modeling work has been done on the Climate and hydrological cycle for this period. See papers in MioMIP archive and those cited in them. See publications like Goldner, Herold, and Huber 2014; Burls et al. 2021; Frigola, Prange, and Schulz 2021; Acosta et al. 2023.

We have added those references in the introduction and discussed them throughout the manuscript.

Line 88. Since your TOA imbalance is still relatively high, I assume the ocean response to the warming is not fully expressed. I would add a text "We note that our MCO runs have not fully reached quasi-equilibrium, however, for the purpose of our work, we primarily focus on the atmospheric and surface ocean response. A full analysis of the ocean circulation is substantial, thus we reserve a companion paper focused specifically on Miocene ocean–atmosphere dynamics for future studies."

Thanks for this suggestion. We have added clarification in Section 2.1 (Lines: 125-126). It now reads: "We note that the MCO runs have not fully reached quasi-equilibrium. However, as this study focuses primarily on the atmospheric and upper-ocean response, the remaining drift does not affect the interpretation of the results.".

In Section 3.1, we also note that "a detailed analysis of the ocean circulation response will be presented in a separate study focusing on Miocene ocean–atmosphere dynamics" (Lines: 169-170)

Line 169 Utescher et al., 2009 is for late Miocene and should not be used in this context. Unless the authors are saying the Miocene as a whole has a weaker seasonality.

We agree, as this study focuses on the MCO. We have accordingly removed this reference.

Line 170 Reichgelt et al., 2023 explicitly says "Reconstructed Miocene rainfall seasonality was predominantly higher than modern, regardless of latitude, indicating greater variability in intra-annual moisture transport." The authors should be specific and say Miocene temperature seasonality. This apply this change throughout the entire text.

We have addressed this by rephrasing the sentence from the meridional gradient perspective. It now reads: "a reduced meridional temperature gradient in North America (Reichgelt et al., 2023).". in lines 172-172 and lines 222-223.

Line 237-240. Instead of mid-Holocene Green Sahara why not include work specifically on the intensified hydrological cycle over the Mediterranean and North African region? See Zhang et al. 2014; Acosta et al. 2024.

We have replaced this discussion with reference for Miocene hydrological cycle. It now reads: "These findings are in line with proxy evidence for intensified Miocene hydrological cycle and increased precipitation over the Mediterranean and North African region (Hoelzmann et al., 2001;

Liu et al., 2024; Acosta et al., 2024; Zhang et al., 2014)". Lines 239-241.

Line 240 Using the word driven is bit confusing "support the interpretation that MCONSImax cooling is driven by hydrological intensification" Applying orb max is a forcing, and the hydrological cycle intensification is a response.

We have revised the sentence to:" supporting the interpretation that the cooling in MCONSImax is associated with enhanced hydrological feedbacks." in line 241-242.

Line 170 and 250 The authors should change all the text that says the "Miocene" to MCO or Middle Miocene to be more explicit.
We have fixe this issue by clarifying them in their sub-titles, it now reads:"3.2.1 Reduced High-latitude Orbital Response in the MCO, 3.2.3 Disrupted Southern Ocean warming in the MCONSImin, 3.2.2 Enhanced tropical North Africa cooling in the MCONSImax".

Lines 255-256 should note that land-ice is a prescribed feature in the model, and full assessment of this will require an ice-sheet model. See Halberstadt et al., 2021.
We have added a sentence to clarify this. It reads: "It is worth noting that land ice-sheet is prescribed in the model and therefore exerts a one-way influence on the climate system; associated feedback would like amply the response. A full assessment of this effect, however, would require coupling with an interactive ice-sheet model (Halberstadt et al., 2021).": (lines: 253-256).

Line 278 land-atmosphere*
We have revised it into:" Mid-latitude Eurasia and North America exhibit higher variability in the PI simulation, which is further amplified in both PINSImin and PINSImax, reflecting enhanced ice-albedo interactions.".

Line 279-281 panama seaway citation?
We have added ref of Lunt 2008, who found damped variability after opening the gateway.

We thank the reviewer again for the constructive comments, which have improved the clarity and precision of the manuscript.