

Interactive comment on “Synergy of the westerly winds and monsoons in lake evolution of global closed basins since the Last Glacial Maximum” by Yu Li and Yuxin Zhang

Anonymous Referee #2

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General Comments The study combines simulated water balance in closed lake basins and paleoclimate records to distinguish the influence and temporal evolution of monsoon and mid-latitude westerlies on moisture levels. This study is an interesting approach to the influence of both the westerly winds and monsoon on climate changes since the Last Glacial Maximum. While as a whole the study is of good quality and fits within the scope of the journal, there are a number of issues with the manuscript, that I think will need to be taken care of prior to publication. - The authors present the study as global, but mainly focus on Central and East Asia. - Some changes in the structure of the manuscript are needed, especially in the results and discussion sections. - More details on the method of selection of the paleorecords is needed. - I think

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the manuscript would greatly benefit from a thorough review of the English. While, the manuscript is comprehensible, there are many sentences that are not properly structured. The verb tense should be standardized, as they are sometimes changing even within a single sentence.

Specific comments Title I have issues with the title where the authors present the study as global, while in fact it is focusing on the Northern Hemisphere. The authors even provide the reasoning behind the focusing on the Northern Hemisphere in the last paragraph of the introduction. Actually, the study largely focuses on Central Asia and China (17/25 (68%) records from China). I think the title should be modified accordingly.

Introduction There is no clearly defined objective. Please clearly state the purpose of the study. What scientific question was this study intended to answer?

Time period partitioning What is the reasoning behind the selection of the PI period in the simulation? The authors mention that the selection of the time periods were subjective, was that 100 years period selected as a reference for the “modern/recent”? Why not choose a more climatically significant period like the Little Ice Age or the late Holocene, for which monsoon reconstruction clearly display a change? The authors mention that the division into those three periods was done to validate the water balance simulations and explore the evolution of the monsoons and westerly winds in the selected basins. Validating the water balance simulations for such a short period of time with records that are generally poorly constrained (see comment on section 2.2 below) for that period might be problematic. Furthermore, the PI period is absent from the discussion on the changes in monsoon and the westerlies.

Section 2.2: Please define what is considered a reliable chronology. . . Did the authors apply a minimum number of dates per thousand years? What about the temporal resolution for the selection of the various records? Did the authors apply a minimum number of the samples per time frame? For example, minimum one sample per 100 or 200 years? I cannot tell for other regions, but to me there are some Chinese high-

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resolution lake records missing from the list that would be of better quality than some of those included. On the top of my head, I would consider Gonghai lake (Chen et al., 2015 Sci Rep 5), Dali lake (Goldsmith et al., 2017 PNAS 114). They might not be within your simulated closed basins, but they are close enough and high-quality enough to be considered. Finally, for the PI period, as far as I know, many of the records in table 3 do not have any proper chronological control (210Pb or 14C bomb pulse) for the top section of the cores. The 1800-1900AD period can be difficult to narrow down chronologically as 14C is not very precise during this period and 210-Pb is at its limit.

In section 3.2, the authors state “Qinghai Lake, Hala Lake, Zhabuye Lake are typical lakes which are located in interactional transition zones between Asian monsoon and westerly winds, probably not following a single climate changing pattern”. I would argue that many of the selected lakes in China, which they consider as being in the monsoon zones (see Fig. 6), were influenced both by the westerlies and the East Asian summer monsoon. Especially since the boundary of the monsoon was not static over time.

Structure of the manuscript Some parts of the result section belong to the discussion. While I understand that the authors must show that the lake simulations are valid and that, to do so, some interpretation is needed. I think that sections 3.3 and 3.4 should at the very least be moved to the discussion as they are focusing on the mechanisms driving the changes in water balance. Actually, I think that, given the nature of the data, this manuscript is a case where it would be beneficial to do a results and discussion section rather than separating them.

Terminology Several times in the manuscript, the authors refer to the Asian monsoon. To me it seems that what they call Asian monsoon is actually the East Asian monsoon. Especially since most of the selected records at the eastern edge of the simulated closed basins in Asia are roughly located at the northern limit of the East Asian summer monsoon (EASM). I think some precision is needed.

Discussion - Westerlies-monsoon interactions While studies have shown that trends in

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moisture changes in Westerly dominated arid Central Asia generally differ from those in EASM regions, owing to the fact that EASM rainfall does not reach this region, the opposite is not necessarily true. Records well into the region that the authors would consider as the East Asian monsoon region suggest an influence of the westerlies on moisture levels. The authors briefly discuss the interactions between the westerlies and the East Asian monsoon. However, I think the discussion would benefit from a more in-depth discussion of the relationship between the Westerly Jet and the EASM. For example, there are increasing evidence for a control of the Westerly Jet on the northward extent and timing of the EASM rainfall in East Asia (see for example: Chiang et al., 2015 QSR 108: 11-129; Herzschuh et al., 2019 Nat Comm 10; Nagashima et al., 2013 (Geochem Geophys Geosys 14: 5041-5053).

- Speleothems The close similarity of the PCA1 time series with the speleothem records from Gongge and Hulu caves suggest it is a record of the East Asian summer monsoon. There is a long-standing debate about what the $\delta^{18}\text{O}$ speleothem records from China represents. One view interprets the oxygen isotopic record from Chinese cave deposits as reflecting real rainfall changes and hence reflecting changes in the EASM. The other main view suggests that these the oxygen records (depending where they are located) reflect changes in the moisture source (Indian monsoon vs EASM) and that they do not directly represent changes in EASM. What can the present study contribute to that debate? I think it could be an interesting addition to this manuscript.

Technical/minor comments Fig 3: Please provide letters to refer to each section of the figure both in the figure caption and the figure itself. I would also suggest putting both EOF figures on the left side and the PCA curves above the speleothem records. It would make the comparison of the curve easier. Fig 5: please provide letters the refer to each timeseries, especially since the font size is quite small. If possible, increase the font size of the time series. Section 3.3 and 3.4: EOF is not defined anywhere in the manuscript. Line 29: indicate rather than indicated. I would also remove monsoon after Australian and East African. Line 30: Remove the And at the start of the sentence.

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Lines 32-33. That sentence needs to be rephrased to something like “. . . the seasonal migration of the (ITCZ) profoundly influences the seasonality of the global monsoons.”
Line 36: Please define LGM. This is the first time you mention it in the main body of the manuscript. Line 36: . . . southern regions of THE North American continent. . .
Line 51: Please define MH. This is the first time you mention it in the main body of the manuscript. Line 51: remove one space between and and Pre-Industrial Line 51: remove and at the start of the sentence. Line 58: Capital letter for last Line 70: please define P-E. It is mentioned for the first time in the manuscript. Line 75: either remove And at the start of the sentence or combine with the previous one by for example writing: “(Peltier, 2004), while the vegetation. . .” Line 82: IN each grid cell not at Line 91: assumed rather than supposed Lines 135-136: However, there are exceptions that lakes. . . Replace that by where Lines 148-149: this sentence need to be rephrased, for example: “ Comparing the simulations with the records, most simulations coincide with the upward. . .” Line 135 “For better validating simulated results, reviewed and summarized the millennial-scale changing patterns in lake level of the closed basins since the LGM are particularly important.” Line 164: East Asian summer monsoon not East summer Asian. . . Line 173: suggested change to: “According to. . . basins in the Northern Hemisphere, affected both by low-latitude monsoon and mid-latitude westerly winds, are ideal region. . .” Line 179: “from A humid climate IN the early-mid Holocene to AN arid climate IN the late Holocene” not “from humid climate of the early-mid Holocene to arid climate of the late Holocene”. Line 185: “in THE early-mid Holocene” Lines 187-188: That sentence need to be rewritten. Lines 188-190: Do you still refer to Yu et al. (2000) there or to Fig. 5. This is not clear. Line 190: reaches A maximum not the Line 221: experienced not experiences Line 255-256: suggest edit: “Winter precipitations account for a large proportion of annual precipitations in these regions.”

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