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Climate of the Past Discussions

Interactive comment on "Effect of precipitation seasonality on annual oxygen isotopic composition in the area of spring persistent rain in southeastern China and its palaeoclimatic implication" *by* Haiwei Zhang et al.

Anonymous Referee #2

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This manuscript by Zhang et al. investigates precipitation seasonality in the monsoonal region of China and its potential influence on weighted mean annual precipitation d18O. Consistent with previous findings, they found that the precipitation in southeastern China is characterized by a pronounced portion of precipitation in spring. With this significant precipitation amount in spring, they found that weighted mean annual precipitation d18O at Changsha correlates with the ratio between summer monsoon season rainfall and non-monsoon season rainfall as well as ENSO events. Then they concluded that, in southeastern China, the precipitation seasonality which is associated

with ENSO, drives interannual variations in weighted mean annual precipitation d18O. In general, the manuscript discusses an important aspect of paleoclimatic significance of precipitation d18O in monsoonal China and is within the scope of Climate of the Past. However, the manuscript needs substantial revisions or improvements to make the conclusion more convincing.

From the mathematical definition of weighted mean annual precipitation d18O, it contains composite signal of precipitation seasonality and changes in d18O itself. Thus, it is not surprising that precipitation seasonality could leave fingerprints on weighted mean d18O (d18Ow). Current analysis in the manuscript largely ignores changes in d18O itself and only emphases the role of precipitation seasonality but without a quantitate assessment besides correlation analysis. However, the problem is how to decompose these two signal sources rather than simply using correlation analysis. For example, Cai and Tian 2016 used a simple decomposition method to analysis whether precipitation seasonality caused interannual variation in Hong Kong precipitation d18Ow during ENSO years. However, their results indicate that changes in annual d18Ow at Hong Kong during ENSO events are mainly associated with changes in d18O itself rather than precipitation seasonality. Similar decomposition method can be applied in this manuscript to make the question more clearly addressed. In addition, a parallel analysis on the interannual variations in EASM season d18Ow and NSM season d18Ow or SPR season d18Ow should be performed to reveal the variation of d18O component in specific seasons and its association with interannual d18Ow variation.

A potential but fatal risk of the air mass back trajectory analysis in the manuscript is that the analysis only considers air mass movement without considering moisture content. Thus, the analysis result should not be treated as equal to moisture source nor its movement. But when the authors interpreting their back trajectory results, they treated these back trajectories as moisture source trajectories. Further, no information is given on where these air masses picked up or lost water vapor. With this said, the true moisture sources could be totally different from the authors' interpretation in the

manuscript. For instance, the C3 ends in the Indian Ocean, but it also travels through the western Pacific region (e.g. the South China Sea). From current results, it is hard to conclude that C3 represents Indian Ocean moisture source.

There are several other GNIP stations located within the SPR region and some of them have longer records than Changsha. I am wondering why the authors only used data from Changsha to address the influence of precipitation seasonality.

The use of IsoGSM outputs is too imprudent. In the manuscript, there is no evaluation on the performance of the IsoGSM simulation and no citation of relevant previous evaluations! Does the IsoGSM faithfully re-produce the SPR? Does it correctly simulate the seasonal and interannual precipitation d18O variations in the analyzed region? At least, these questions should be evaluated either from the authors' own analysis or from literature. Otherwise, the results are not solid.

Overall, the manuscript tends to be descriptive and lacks an in-depth understanding of the controlling mechanism. For example, the interpretation of seasonal precipitation d18O variations as moisture source changes in section 3.2 does not agree with the citation from Baker et al. 2015 in section 4.1 that "the moisture uptake area does not differ significantly between summer and winter".

Why use 1yr-lag correlation? By definition, the d18Ow is not calculated from precipitation amount from the previous or the following year! Thus, the 1yr-lag analysis does not make sense making the analyses and results related to this analysis not scientifically sound.

The definition of the temporal coverage of seasons or different periods in the manuscript is messy. For example, the authors defined the SPR season for El Nino years as March-to-May between L165-170, but the authors refer to "SPR in March-April during El Nino years (1991-1992)" at L302. Between L165-170, the authors defined SPR and EASM seasons for El Nino years, but what about other years? When the authors analysis "El Nino years (1991-1992)" and "La Nino years (1988-1989)", do

you mean Jan 1991 to Dec 1992 for "El Nino years (1991-1992)" and Jan 1988 to Dec 1989 for "La Nino years (1988-1989)"? But both events did not start from Jan or end at Dec. At L345, the MEI is calculated for October-June. Please make all the seasons and periods clear and examine whether the acronyms have a consistent meaning

Figures are hard to read. Please add essential legends to make figures more readable.

L24: $\sim$50% annual precipitation amount? Similar ambiguity in the main text of the manuscript. Please clarify the difference between the contribution to annual precipitation amount (the weight for calculating annual d18O) and the contribution to annual d18Ow.

L26: simulated $\rightarrow$ please specify

L29: precipitation d18 $\rightarrow$ amount-weight annual precipitation d18O?

L30: Do you mean speleothem d18O records precipitation d18O on the annual scale?

L72: d18Op $\rightarrow$ please define acronym before using; please examining similar problems at other places

L110-111: But Cai et al. 2018 showed that at least Guilin and Liuzhou is also characterized as significant spring rainfall.

L117-118: please provide reference and data to support this conclusion

L154-156: Please show the results for NSM/annual or indicate that NSM/annual equals 1 – EASM/annual.

L248: why not using the weighted mean value of EASM and NSM precipitation d18O?

L250: rainfall amount $\rightarrow$ rainfall seasonality?

L305: Why not considering data from other stations? Such as Guilin even has a record longer than that at Changsha.

Figure 6: Plotting the 1 yr lag time series does not make sense.

L345: EASM precipitation amount and NSM precipitation amount: during the following year or the previous year? The MEI is for October-June, but EASM for JJAS and NSM for Oct-May? Why not calculating the contemporary correlation? Even though there is a lead-lag relationship between ENSO and precipitation amount in east Asia, but this is not the scientific question in this manuscript. L385-390: Annual precipitation is mainly from summer monsoon season does not necessarily mean d18Ow should correlates with precipitation amount. There is no causal relationship between them; one is precipitation seasonality, the other is associated with the "amount effect" on long term scales.

L389: EASM/annual → EASM?

References:

Baker, A. J., H. Sodemann, J. U. L. Baldini, S. F. M. Breitenbach, K. R. Johnson, J. van Hunen, and Z. Pingzhong (2015), Seasonality of westerly moisture transport in the East Asian Summer Monsoon and its implications for interpreting precipitation δ18O, J. Geophys. Res., 120(12), 5850-5862, doi:10.1002/2014JD022919.

Cai, Z., and L. Tian (2016), Atmospheric controls on seasonal and interannual variations in the precipitation isotope in the East Asian Monsoon region, J. Climate, 29(4), 1339-1352, doi:10.1175/JCLI-D-15-0363.1.

Cai, Z., L. Tian, and G. J. Bowen (2018), Spatial-seasonal patterns reveal large-scale atmospheric controls on Asian Monsoon precipitation water isotope ratios, Earth Planet. Sci. Lett., 503, 158-169, doi: 10.1016/j.epsl.2018.09.028.

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