Clim. Past Discuss.,
https://doi.org/10.5194/cp-2018-138-AC1, 2019

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.

Haiwei Zhang et al.

zhanghaiwei@xjtu.edu.cn

Received and published: 7 February 2019

Anonymous Referee #2 Received and published: 27 December 2018

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 precip-

itation 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.

Thank you very much for your constructive comments and suggestions, we will revise the manuscript accordingly.

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.

Answer# Agree. The analyses of changes in d18O itself will be also added in order to quantify the effects of seasonal changes in precipitation d18O and precipitation amount on the d18Ow.

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.

Answer# Agree. We will use the similar decomposition method to analyze whether the precipitation seasonality causes the interannual changes in precipitation d18Ow.

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.

Answer# Agree. We will add these analyses.

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.

Answer# Agree. The same issue was also raised by the referee #1. Now we know how to run the moisture source trajectory considering the moisture content and how to perform the locations where the moistures are taken up. We will reanalyze the moisture source trajectory, then compare and discuss how the moisture source trajectories change during multiple El Nino/La Nina phases and their effects on the d18Ow.

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.

Answer# Tian and Yasunari (1998) and Wan and Wu (2007) suggest that the SPR

occurs mostly south of the middle and low reaches of the Yangtze River ($\sim$ 24°N to 30°N, 110°E to 120°) (line 39-40), we consider that GNIP station Changsha is located in the core area of the SPR region, but Guilin and Liuzhou GNIP stations are located at the edge of the SPR region. We think the data from Changsha station is the most representative. But we will also add the data from Guilin and Liuzhou GNIP stations in the revision in order to give more convincing evidences.

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.

Answer# This issue was also raised by the referee #1. Actually, we have compared the IsoGSM simulation data with the GNIP data, consistent variations in monthly precipitation amount and precipitation d18O can be found between them, but we did not show the results in the manuscript. We will evaluate the IsoGSM simulation data in the revision.

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".

Answer# In the revision, we will reanalyze the moisture source trajectory, and discuss the seasonal changes in moisture source during different phases of ENSO. The controlling mechanism on the variations in precipitation seasonality and d18Ow will also be discussed according to the new results of moisture source trajectory.

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.

Answer# This issue was also raised by referee #1. In the current manuscript, the temporal coverage of the NSM rainfall is from October to next April and the d18Opw is from January to December. There is a four-month overlapping (January-April) between 1-yr lag d18Opw, NSM rainfall and EASM/NSM ratio. Therefore, we also calculated the correlation coefficient between 1-yr lag d18Opw, NSM rainfall and EASM/NSM ratio. There is no physical sense between 1-yr lag d18Opw and EASM. Actually, we have calculated the contemporary correlations between d18Opw (Jan-Dec) and EASM rainfall (May-Sep), NSM rainfall (current Jan-April plus current Oct-Dec) and the corresponding EASM/NSM ratio, significant correlations can be also observed between them. But we did show the results in the manuscript. In the revision, we will recalculate the contemporary correlations and evaluate these results, the definition and the calculation will be clearly stated in the caption of Table 2 and in the manuscript.

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

Answer# We will make the definition of the temporal coverage of different periods clear and consistent in the revision.

Figures are hard to read. Please add essential legends to make figures more readable. L24: _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.

Answer# We will add essential legends for the figures and clarify the difference in the revision.

L26: simulated ! please specify

Answer# We will specify it.

L29: precipitation d18 ! amount-weight annual precipitation d18O?

Answer# Yes, we will correct it.

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

Answer# Yes, we mean the speleothem d18O inherits from precipitation d18O on interannual timescales. It will be clearly stated.

L72: d18Op!please define acronym before using; please examining similar problems at other places

Answer# Agree, we will define it and also check the whole manuscript.

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

Answer# Tian and Yasunari (1998) and Wan and Wu (2007) suggest that the SPR occurs mostly south of the middle and low reaches of the Yangtze River ($\sim$ 24°N to 30°N, 110°E to 120°) (line 39-40), we think that Changsha GNIP station is located in the core area of the SPR region, and Guilin and Liuzhou GNIP stations are located at the edge of the SPR region. We consider the data from Changsha station is the most representative, however, the data from Guilin and Liuzhou GNIP stations in the revision will also be added in order to give more convincing evidences.

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

Answer# Two references (Yoshimura et al., 2008; Yang et al., 2016) given in front of this sentence (line 116) should be mentioned here, we will reorganize this paragraph.

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

Answer# Yes, we will show them.

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

Answer# We consider that the mean value of the seasonal precipitation d18O should be used here. The mean value of the seasonal precipitation d18O and the mean value of the seasonal precipitation amount should be used for the calculation of d18Ow. We will evaluate it in the revision.

L250: rainfall amount ! rainfall seasonality?

Answer# The whole phrase is "……both rainfall amount and d18Op values during EASM and NSM season……", it means rainfall seasonality. We will reorganize this sentence and make it clear.

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

Answer# We think Changsha GNIP station is located in the core area of the SPR region, the data from Changsha GNIP station is the most representative comparing to those from Guilin and Liuzhou stations. We will also add the data from Guilin and Liuzhou GNIP stations in the revision.

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

Answer# The temporal coverage of the NSM rainfall is from October to next April and the d18Opw is from January to December. There is a four-month overlapping (January-April) between 1-yr lag d18Opw and EASM/NSM ratio. Therefore, we also calculated the correlation coefficient between 1-yr lag d18Opw and EASM/NSM ratio. But there is no physical sense between 1-yr lag d18Opw and EASM. Actually, we have calculated the contemporary correlations between d18Opw (Jan-Dec) and EASM rainfall (May-Sep), NSM rainfall (current Jan-April plus current Oct-Dec) and the corresponding EASM/NSM ratio, significant correlations can be also observed between them. But we did show these results in the manuscript. In the revision, we will recalculate the contemporary correlations, and the definition and the calculation will be clearly stated in the caption of Table 2 and in the manuscript.

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.

Answer# Agree, we will clearly state the temporal coverage of these meteorological parameters and recalculate the contemporary correlations.

L389: EASM/annual ! EASM?

Answer# Yes, it will be corrected.

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 _18O, 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 largescale atmospheric controls on Asian Monsoon precipitation water isotope ratios, Earth Planet. Sci. Lett., 503, 158-169, doi: 10.1016/j.epsl.2018.09.028.

Thank you for recommending these references.

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2018-138, 2018.