***Replies to Interactive comment on "Effects of changes in moisture source and the upstream rainout on stable isotopes in summer precipitation – a case study in Nanjing, East China" by* Y. Tang et al.**

**Anonymous Referee #2**

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**Note: The reviewer's comments are in black, our replies in blue, and the changes in the text are marked in red.**

Tang et al. examined the isotopic variations in summer precipitation in Nanjing, East China and aimed to attribute those variations to the effects of atmospheric circulation, changes in moisture source, and the upstream rainout by exploring HYSPLIT model with NCEP reanalysis and the OLR (outgoing longwave radiation) composition analysis. This study, including the literatures reviewed in this manuscript, questioned the isotopic "amount effect" for those oxygen isotopes from Chinese speleothems to inferring changes in the amount of Asian monsoon rainfall. In general, it is an important study, and the manuscript is generally well written. I recommend publication but further improvements in several aspects are needed.

There are two major comments that I have:

1) This paper concluded that changes in moisture source location and upstream rainout effect which should be taken into account when interpreting the stable isotopic composition of speleothems in the Asian monsoon region. This is the main

contribution of this research. However, only variations of summer precipitation in monsoon were analyzed. The author stated that the proportion of summer monsoon precipitation (June–September) at Nanjing accounts for 54.8 percentage of its annual precipitation. It is hard to believe the annual variations of precipitation also have same rules. Besides, it is a pity that d-excess and deltaD results are missing. The d-excess is very useful tools to detect the moisture source. For example Xie et al., (2011).

We focused our analysis on summer because the “amount effect” is most prominent with summer precipitation in the monsoon region because of the relatively high intensity of summer precipitation events, often involving strong convective processes. In addition, precipitation concentrates in summer in monsoon region. According to long term monthly means of Nanjing precipitation for the years 1981-2010 from the China Meteorological Data Sharing Service System (http://cdc.nmic.cn/home.do), summer precipitation (June-September) accounts for 54.8% of its annual precipitation. Therefore, in order to determine whether the “amount effect” is the predominant mechanism for the isotopic variations of precipitation in the Asian monsoon region, it is important to examine summer precipitation in details. Such results will be of great value to paleohydroclimate reconstructions using speleothem isotopic records as they are often interpreted as a proxy for monsoon intensity as indicated by monsoon season (summer) precipitation amount. The isotopic variations of precipitation in winter/non-monsoonal season (October-May) are controlled by different processes, and its contribution to the annual precipitation-weighted mean isotopic composition has not been fully assessed when interpreting isotopic records in speleothems in the

Asian monsoon regions. These are important issues that will be addressed in a follow-up study, hence are not discussed in this paper.

We agree with the reviewer that the d-excess is a very useful tools to detect the moisture source. Our d-excess data exhibits significant seasonal variations, with low values in summer monsoon season (June-September) and high values in winter/non-monsoonal season (October-May) (Fig. S1), reflecting shifts in the atmospheric circulation between the summer and winter monsoon. In general, the d-excess in precipitation is controlled by both the relative humidity and sea surface temperature (SST) of the moisture source region. However, the variations of relative humidity and SST in the moisture source regions for this study were not significant during the summer season (Fig. S2 and Fig. S3). Thus, we didn't discuss the d-excess in this paper.

2) The conclusions mainly result from OLR and water vapor transport data analysis which make progress comparing with previous studies. Therefore, that information needs to be emphases in results section clearly and the whole paper needs to be reorganized accordingly. In discussion part, there should have included possible uncertainty analysis for the current conclusion. Such as, How about NCEP reanalysis and the OLR composition analysis? Are those methods robust? How about water vapor from local evapotranspiration? Is it negligible? How about the impact of water vapor- precipitation isotopic exchange?

We didn't include the results of the OLR and vapor transport in the results section because we thought it was better to focus on the results of precipitation stable isotopes in the results section.

We agree with the reviewer that possible uncertainty analysis for the current conclusion should be included in the discussion part. We believe the method of NCEP reanalysis and the OLR composition analysis was robust because the isotopic variations of precipitation in summers of 2012-2014 could be well explained by the composition analysis.

The local evapotranspiration is likely to be considerable in the Asian monsoon region because of high vegetation cover under the humid monsoon climate. However how the local evapotranspiration affects the summer precipitation $\delta^{18}O$ was unclear and required further study. We added a brief discussion about the evapotranspiration in the discussion section. In addition, it is possible that the amount affect could still play an important role during some periods in the past as suggested by another anonymous reviewer. We also added the discussion about the possible role of the amount effect in the revision.

We have not examined the impact of water vapor-precipitation isotopic exchange on the isotopic composition of precipitation over the monsoon region. Additional observations are needed to assess this impact.

Minor comments:

1) P3923, L6 : The author cite the (Gu and Zhang, 2002), but it is not find in reference list.

The reference (Gu, G. J., and Zhang, C. D.: Cloud components of the Intertropical Convergence Zone, J. Geophys. Res., 107(D21), 4565, doi:10.1029/2002JD002089, 2002) was added to the reference list.

2) P3923, L12: The daily OLR data was a very important indicator for interpreting variations of isotope composition in precipitation. Thus, there should be explanation for data source and details.

A more detailed description (including data source and other details) of the OLR Data was added here.

3) P3926, L8-10: Was any calibration on the water isotope measurement conducted? Two standards or three standards?

Three internal water standards were used for calibration. Clarification about this was added accordingly in the revision.

4) P3931, L10: Please show the evidence more.

In Fig. 5c, h and Fig. 6c, h, one could clearly see the shift of ITCZ location northward and eastward and the shorter distance of water vapor transport for stage 3 of 2012 and 2013. The corresponding figures were cited here in the revision.

5) P3939 for Figure 2: Is it possible to show the backward trajectory result for each stage as showed in Figure 5 and 6?

The backward trajectories for each stage are displayed in Fig. S4. In general, most results of the backward trajectory were consistent with our conclusions. For example, the short distance of water vapor transport during stage 3 (corresponding to the shift of ITCZ location northward and eastward) (Fig. S4c, h, m), the distal water vapor transport from the Bay of Bengal during stage 4 (Fig. S4d, i, n), and the water vapor transport from the northern inland areas and the adjacent seas in the northeast during stage 5 (Fig. S4e, j, o) could be clearly identified. However, there were some discrepancies between the result of back trajectory and our result during stage 1. Our result suggests that water vapor transport during stage 1 was from both the Bay of Bengal and the South China Sea, but the trajectory indicates little or no water vapor transport from the Bay of Bengal (Fig. 4a, f, k) during stage 1. The back trajectories of air masses at a location identified using the HYSPLIT model could be sensitive to the choice in height of moisture transport and back time, which may explain the difference between the results of back trajectories (Fig. 4S) and our results. We didn't add the results of the back trajectory in the revision due to the potential uncertainty of the HYSPLIT model.

6) P3944, Figure 7: How to acquire the spatial distribution of daily-18O in precipitation?

We did not quite understand this comment.

Correlation fields between the preceding (prior to n days) daily NCEP OLR and the daily $\delta^{18}O$ in precipitation recorded at a single location in Nanjing were calculated and the strongest correlation fields were displayed in Figure 7.

## Supplementary Figures

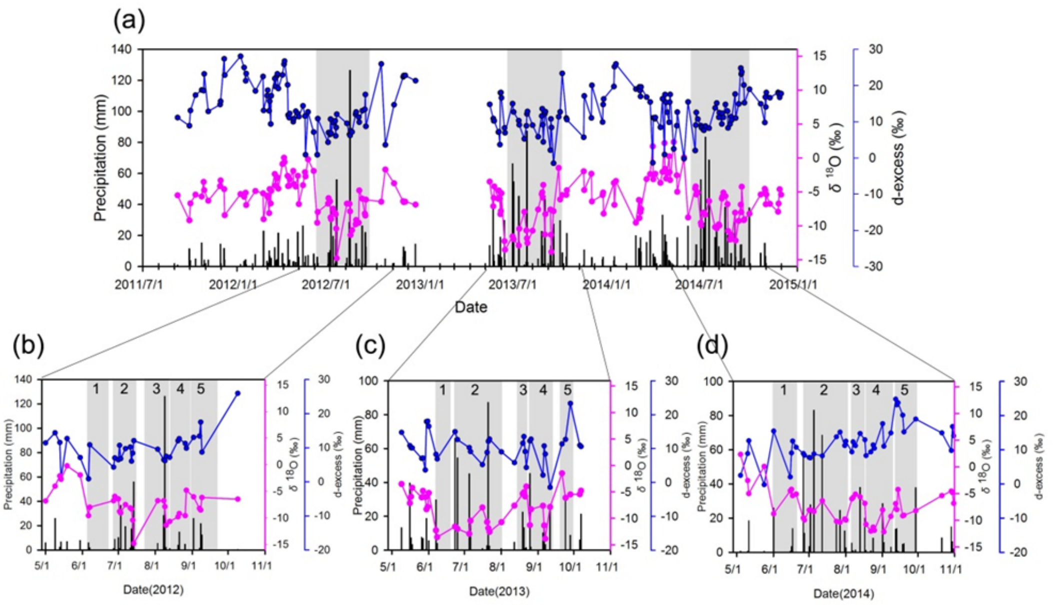


Fig. S1. Similar to Fig. 3 in the revision, but the d-excess data (the blue dot-line) were added in this figure.

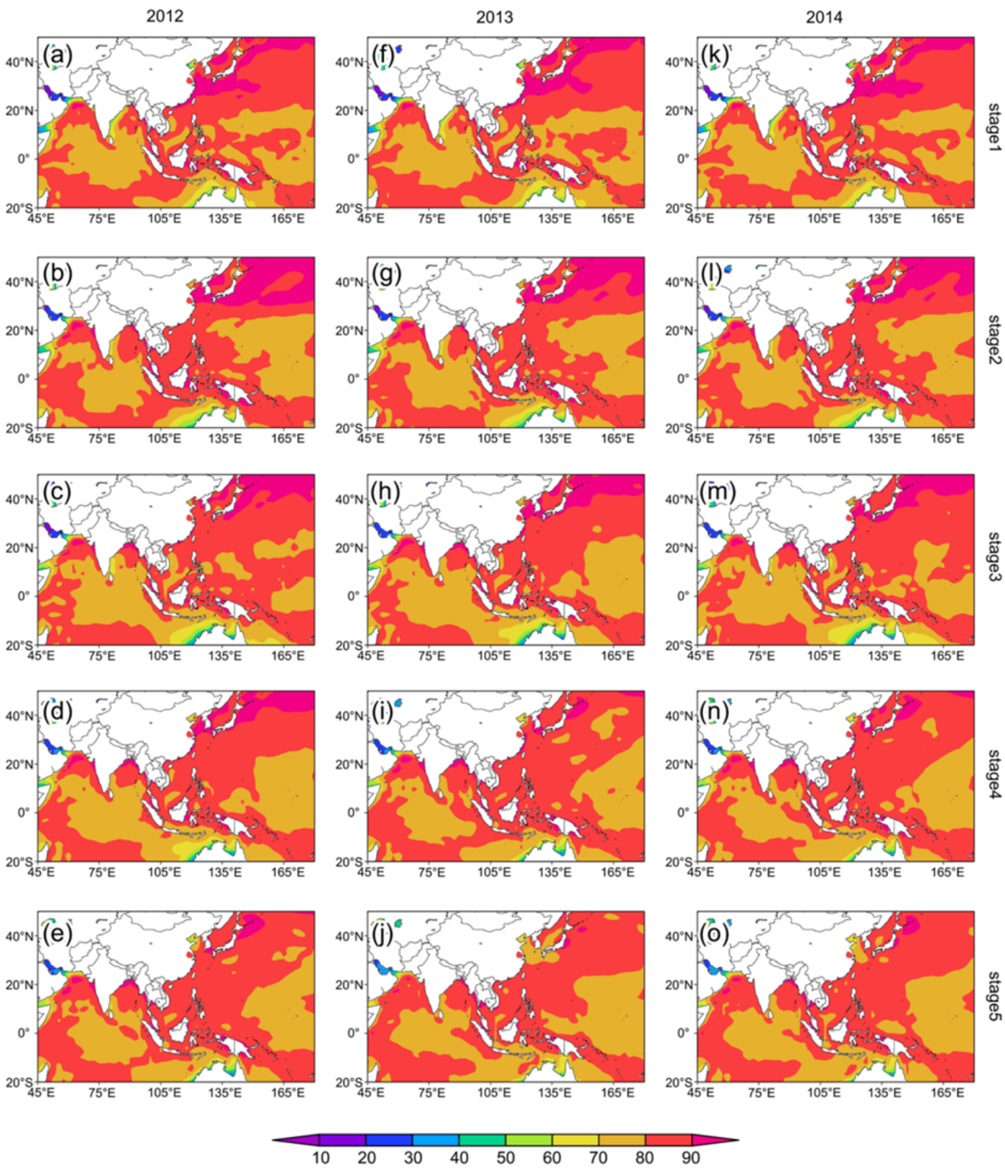


Fig. S2. Similar to Fig. 5 or Fig. 6 in the revision, but for the relative humidity (%) at surface in the moisture source regions.

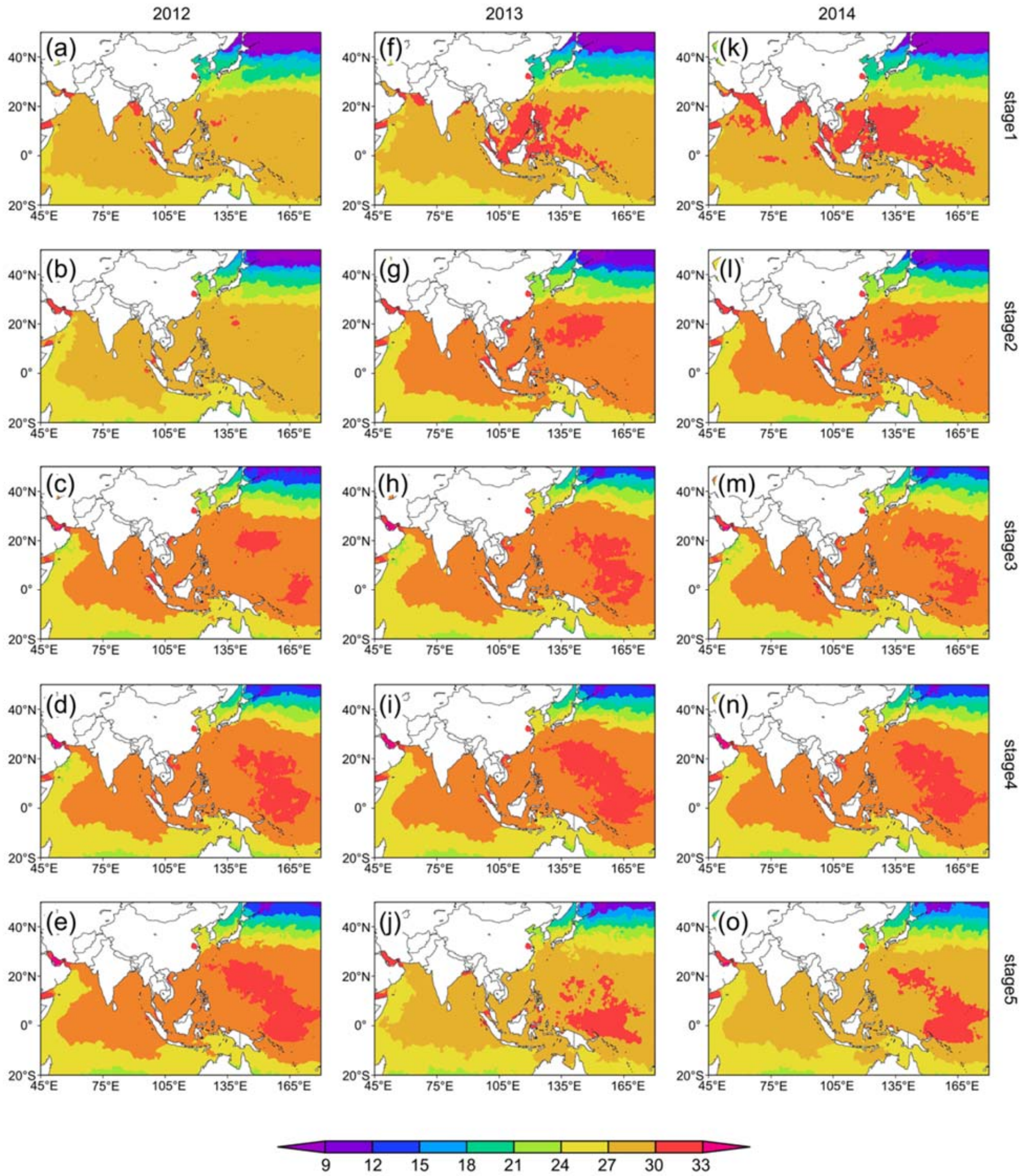


Fig. S3. Similar to Fig. 5 or Fig. 6 in the revision, but for the sea surface temperature (℃) in the moisture source regions.

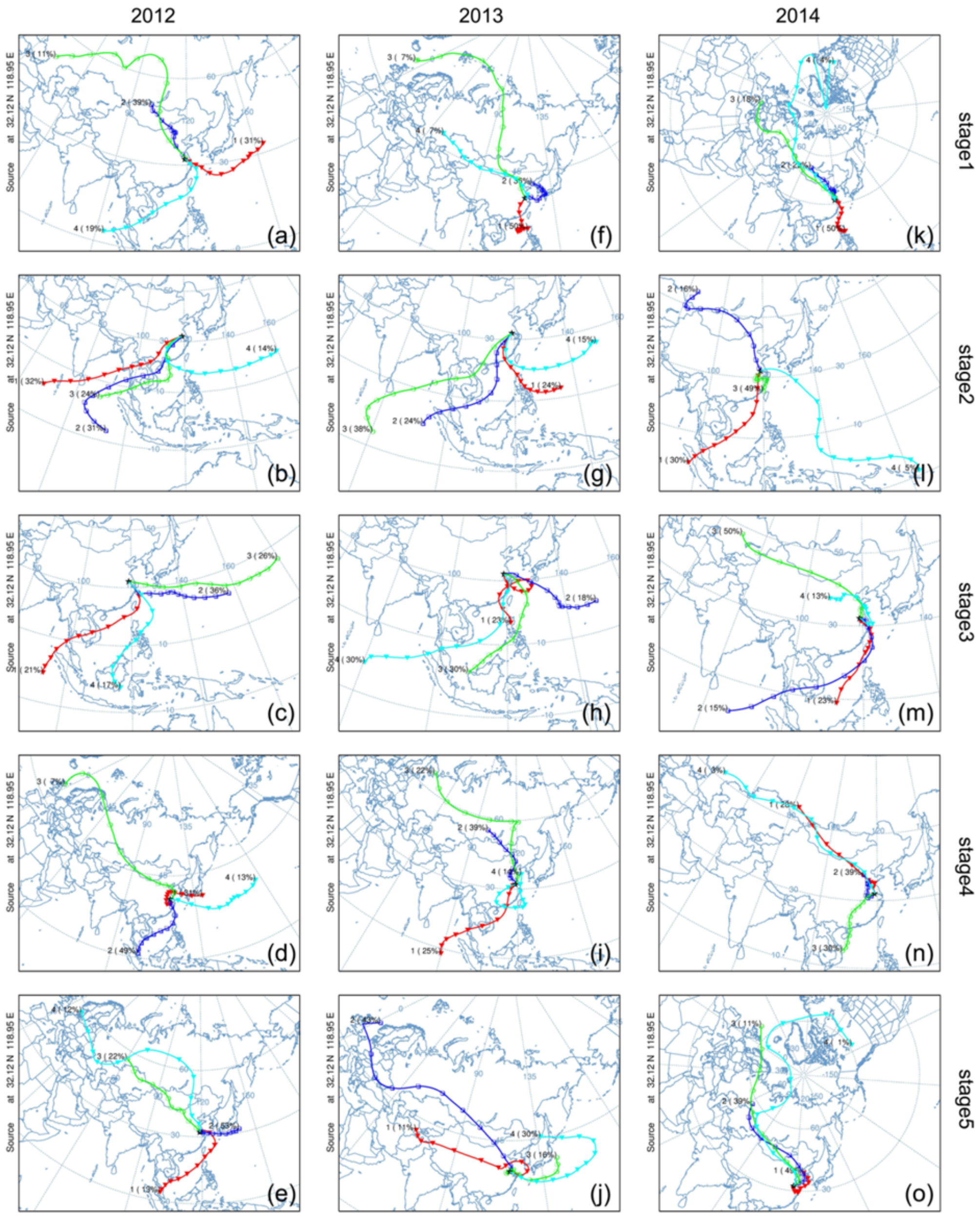


Fig. S4: Similar to Fig. 2b in the revision, with backward trajectory results shown for each stage as in Figures 5 and 6 in the revision.