

A detailed, point-by-point response to the review comments is given below. Each review comment is repeated followed with [our action to modify the manuscript](#). All Page and Line numbers correspond to locations in the revised manuscript.

Comments from Reviewer Luke He:

The manuscript entitled “Water Vapor Transport and its Influence on Water Stable Isotope in Dongting Lake Basin” by Xiao et al. presents a comprehensive study on the sources and transport pathways of water vapor and their influence on the isotopic composition of precipitation in the Dongting Lake Basin. This region provides an excellent case study for understanding the intricate links between atmospheric circulation, water vapor dynamics, and isotopic signatures in precipitation. The research is particularly significant in the context of climate change, where such insights can aid in predicting shifts in precipitation patterns and their isotopic composition, which are vital for water resource management and paleoclimatic interpretations. The authors have employed a multi-faceted approach, utilizing both observational data and model simulations, to trace the origins and pathways of water vapor contributing to precipitation in the study area. The use of reanalysis data and isotopic simulations adds depth to the analysis, allowing for a robust examination of the seasonal variations in water vapor transport and their isotopic implications. Overall, this manuscript could make a nice contribution and be of interest to many different groups ranging from hydrologists to meteorologists, and could be acceptable for publication in the ACP. However, to further strengthen the manuscript and enhance its impact, several areas require the authors’ attention.

Response: We appreciate the positive comments from the reviewer and have revised the manuscript accordingly, the details can be found in the responses to the specific concerns.

My major comments are:

Line 33-42: the Significance Statement, I suggest the following logical structure for the presentation: Starting from the sources of precipitation water vapor (which characterize the influence of atmospheric circulation), that is, the origins of water vapor (initial conditions), to the changes in water stable isotopes along the water vapor transport pathways (stable isotope fractionation and water vapor exchange), and finally to the changes in precipitation isotopes at the point of deposition (outcomes). This approach will reflect a comprehensive understanding of the cycle and fractionation of water stable isotopes within the context of atmospheric circulation.

Response: We appreciate the reviewer's constructive comments and have revised the structure of the Significance Statement: "This research explored how water vapor transports influenced the precipitation isotopes in the Dongting Lake Basin in representative months of different seasons. By tracking water vapor from its source regions, we revealed the influence of large-scale atmospheric circulation on the transportation of water vapor to the Dongting Lake Basin. The changes in water stable isotopes along the water vapor transport paths highlighted the isotopic fractionation and water vapor exchange that occurred along these paths, while the isotopic changes in the precipitation reflect the cumulative influences of water vapor transport on the

local precipitation. These comprehensive insights have clarified the influences of atmospheric circulation on water vapor transport and precipitation isotopes, and thus essential for predicting regional precipitation patterns” (Line 33-42).

Line 385-406 and the relevant descriptions: How are the water vapor pathways determined? How are the source regions of water vapor identified? And how are the scatter points along the water vapor transport pathways established?

Response: We appreciate the reviewer’s constructive comments. For the comment “How are the water vapor pathways determined?”, we added the relevant description in the manuscript as “The water vapor transport path was determined by the the rules to find the systematic vapor currents in the Q field, which need to have the same directionality and draw the path along the central axis of the vapor currents” (Line 388-390); For the comment “How are the source regions of water vapor identified?”, we added the relevant description in the manuscript as “The source regions of water vapor was determined based on the conditions for the formation of air masses, which need to have uniformity in the properties of the air mass and isotopes, and have a stable circulation field” (Line 390-393); For the comment “how are the scatter points along the water vapor transport pathways established?”, we added the relevant description in the manuscript as “Moreover, the grid points along the water vapor transport path were identified on the central axis of the path and based on the principle of uniform distribution of the scatter points, and the factors at the grid points were obtained from these the scatter points” (Line 402-405).

Line 451~467: In April, there are two distinct pathways for water vapor transport. One is predominantly the transport of continental water vapor, and the other is maritime water vapor. A detailed comparison of the characteristic elements of these two pathways should be conducted. The water vapors from these two paths converge in the Dongting Lake Basin; which of these has a relatively more significant impact on the isotopic composition of precipitation in the Dongting Lake Basin region?

Response: We appreciate the reviewer's constructive comments. In April, we evaluate the impact of two water vapor transport paths on the isotopic composition of precipitation in the Dongting Lake Basin, considering the path with the air mass isotopic composition most similar to the precipitation isotopes in the basin, before its entry, as having the greater influence. According to this principle, we found that the input of oceanic air parcel with low deuterium excess had a stronger impact on the isotopic composition of precipitation in the Dongting Lake Basin. Referring to Table 1, we observed that in April, the $\delta^{18}\text{O}_v$ and Ex_d values of water vapor in the Dongting Lake Basin (i.e. Region V) were -14.9‰ and 13.6‰ , respectively. Meanwhile, before entering the Dongting Lake Basin, the $\delta^{18}\text{O}_v$ and Ex_d values of air parcel on the first water vapor transport path—that is, Path I, were -14.9‰ and 14.3‰ , respectively. For the second transport path—that is, Path II, these values were -14.9‰ and 13.5‰ , respectively. We can find that the oceanic air mass with low deuterium excess had a relatively more significant impact on the isotopic composition of precipitation in the

Dongting Lake Basin region. Therefore, we demonstrated these findings in the manuscript “For instance, two distinct water vapor transport paths were identified in April (Fig. 5), thus it is crucial to assess which path exerted a more significant influence on the isotopic composition of precipitation in the Dongting Lake Basin, with priority given to the path whose air parcel isotopic signature closely matches the precipitation isotopes in the basin before entry. According to this principle and referring to Table 1, we observed that in April, the average $\delta^{18}\text{O}_v$ and Ex_d values of the Dongting Lake Basin (i.e. the Region V) were -14.9‰ and 13.6‰ , respectively. Moreover, before entering the Dongting Lake Basin, the $\delta^{18}\text{O}_v$ and Ex_d values of air parcel on the first water vapor transport path—that is, Path I, were -14.9‰ and 14.3‰ , respectively (Figs. 6c and 6e). For the second transport path—that is, Path II, these values were -14.9‰ and 13.5‰ , respectively (Figs. 6c and 6e). Clearly, the oceanic air mass with low deuterium excess had a relatively more significant impact on the precipitation isotopes in April in the Dongting Lake Basin region” (Line 732-744).

My minor comments are:

Line 21: “Dongting precipitation sourced from,”, should it perhaps read “vapor sourced from,”?

Response: We followed the comment and have revised “Dongting precipitation sourced from,” to “vapor sourced from the northern branch of the South Indian Ocean subtropical high” (Line 21).

Line 107: “air dehydration”, is this the correct term as used in the manuscript?

Response: We appreciate the reviewer’s question and have revisited the description in the reference literature, and indeed it is described as “controlled by the intensity of the air dehydration” in Risi et al. (2010).

Line 115: “are”, should this be in the present tense?

Response: We appreciate the reviewer’s comments and have revised “are” to “were” (Line 115).

Line 224: “altitude” might be better replaced with “level” for clarity.

Response: We appreciate the reviewer’s comments and have revised “altitude” to “level” (Line 225).

Line 226: “data release”, is this the appropriate term to use?

Response: We appreciate the reviewer’s comments and have revised “data release” to “the release delay days of ERA5” (Line227).

Line 229: It should be noted that the use of “potential height” is preferred, as well as the terms “latitudinal wind” and “meridional wind”.

Response: We appreciate the reviewer’s comments and have revised the relevant descriptions to “The reanalysis data used in this study include surface pressure (p_s ,

hPa), potential height of 500 hPa (H_{500} , meter), and specific humidity (q , $\text{kg}\cdot\text{kg}^{-1}$), latitudinal wind (m/s), and meridional wind (m/s) at 1000/850/700/600/500/400/300 hPa” (Line 228-231). Moreover, we revised “altitudinal wind” to “latitudinal wind” (Line 230) and have also reviewed the entire manuscript to ensure that the terms “latitudinal wind” and “meridional wind” were used correctly.

Line 259: The order of “ $\delta^2\text{H}_v$, $\delta^{18}\text{O}_v$, $\delta^2\text{H}_p$, and $\delta^{18}\text{O}_p$ ” should be adjusted to match the sequence in the text.

Response: We appreciate the reviewer’s comments and have revised “ $\delta^2\text{H}_v$, $\delta^{18}\text{O}_v$, $\delta^2\text{H}_p$, and $\delta^{18}\text{O}_p$ ” to “ $\delta^2\text{H}_p$, $\delta^{18}\text{O}_p$, $\delta^2\text{H}_v$, and $\delta^{18}\text{O}_v$ ” (Line 261) to match the sequence in the text, i.e. “in the precipitation and vertical integral of water vapor ($\delta^2\text{H}_p$, $\delta^{18}\text{O}_p$, $\delta^2\text{H}_v$, and $\delta^{18}\text{O}_v$)”.

Line 804: Or wherever it may appear, “Dongting precipitation” should be “precipitation in the Dongting Lake Basin”.

Response: We appreciate the reviewer’s comments and have revised “Dongting precipitation” to “precipitation in the Dongting Lake Basin” (Line 837).