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 #2:

This manuscript presents an analysis of seasonally varying moisture transport paths that influence the water isotopic composition of 1668 days' worth of precipitation samples collected in the Dongting Lake Basin area of China. Transport paths are estimated using a "vector interpolation method" that is applied to vertically integrated moisture fluxes within IsoGSM, a General Circulation Model equipped with water isotopic tracers. The results largely follow expectation. Given that the moisture flux is a function of both wind field and moisture supply, water vapor transport paths do not always align strictly with dominant wind flows. Transport from higher latitudes tends to advect more isotopically depleted water than transport from lower latitudes. And precipitation processes en route to Dongting Lake Basin also influence precipitation isotope ratios. The manuscript is fairly easy to read but lengthy.

Response: We appreciate the comments from the reviewer. We respond to the reviewer's comments as follows:

For the comments "Transport paths are estimated using a "vector interpolation method" that is applied to vertically integrated moisture fluxes within IsoGSM, a General Circulation Model equipped with water isotopic tracers", we utilize the ERA5 reanalysis data to compute the vertical integral of water vapor flux (Q), using parameters such as V (vector wind speed), including the latitudinal wind speed (v) and

meridional wind (u), q (specific humidity), g (acceleration due to gravity), p_s (lower boundary pressure), and p_t (upper boundary pressure), while the ERA5 reanalysis data used in this study include "surface pressure (p_s, hPa), the potential height of 500 hPa (H_{500}, meter), and specific humidity (q, kg·kg^{-1}), latitudinal wind (m/s), and meridional wind (m/s) at 1000/850/700/600/500/400/300 hPa" (Lines 234-236). Moreover, we have delineated the pathways of water vapor transport based on the Q field, which represents the water vapor field—that is, as demonstrated in the main text: "In the Q field (Fig. 3a), regarding the Dongting Lake Basin as the endpoint, the vector cluster of the vertical integral of water vapor flux (i.e. the Q) directed towards the Dongting Lake Basin delineates the path of water vapor transport in January (black arrow lines in Fig. 3). The water vapor transport path was determined by 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. The source regions of water vapor were determined based on the conditions for the formation of air masses, which need to form on a uniform underlying surface and possess stably in terms of isotopic, thermodynamic, and dynamic properties as well as circulation condition, typically located over vast land and ocean regions (Smirnov and Moore, 1999)" (Lines 394-404). Besides, we have analyzed the variations of various factors along the water vapor transport path, drawing data from the isoGSM2 simulations and the ERA5 reanalysis dataset—that is, as demonstrated in the main text "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 scatter points. Besides, the factors at the grid points along the water vapor transport path exhibit, in spatial terms, as average characteristics of conditions over multiple years,

and, in temporal terms, as sequential characteristics of these factors along the water vapor transport path" (Lines 414-420).

Overall, the purpose of our study is to analyze the influences of water vapor sources and transport on the isotopic composition of precipitation in the Dongting Lake Basin. Before our research, no studies had addressed these specific aspects of water vapor origin and isotopic composition, while previous studies' explanations for the variations in precipitation isotopes did not align with the facts of water vapor transport. Although our methodology is fundamental, our interpretation of isotopes is reasonable, and the narrative is clear and coherent. As the comment given by the reviewer "The manuscript is fairly easy to read", primarily because it follows a logical structure throughout.

I have three overarching comments:

First, the study focuses almost entirely on seasonal climatological output from IsoGSM, which feels a bit disappointing given the incredibly large number of daily precipitation samples collected in the Dongting Lake Basin. None of the major findings require the precipitation isotope data, and the paper does not clearly link the IsoGSM interpretation back to the collected samples.

Response: We appreciate the constructive comments from the reviewer. This article primarily focuses on the fundamental seasonal isotopic variations in the Dongting Lake Basin, by comparing actual monitoring data with model simulation data, for instance, precipitation $\delta^{18}O$ ($\delta^{18}O_p$), precipitation deuterium excess (Ex_d_p), and precipitation amount (P) measured at the Changsha station and simulated by

isoGSM2 or driven from the ERA5 reanalysis dataset. We found that the isoGSM2 simulated data and ERA5 reanalysis data closely match the actual measurements from the Changsha station, thus confirming the models and reanalysis data to be used in our study. This decision was primarily made because actual monitoring data could not fulfill the spatial and temporal analysis of water vapor transport required for this paper. Additionally, due to space constraints, some research content could not be included in the same article, and it is also impractical for a single paper to encompass too much research material.

Second, the study is largely descriptive in nature. Seasonal maps of moisture, wind, and isotopic output are shown, but the reader is required to eyeball small spatial variations in otherwise large latitudinal gradients. One way to address this might be to plot composite differences (e.g. mapping one season as an anomaly from the annual mean, or plotting the difference between one season and another). Differences between the representative source regions could also be tested statistically, and transport paths could be shown on a single plot—again, to facilitate the reader's ability to compare. The text states that isotopic variations along transport paths are consistent with Rayleigh distillation; however, it does not appear that this was ever tested, which would be quite easy to do in a quantitative manner.

Response: We appreciate the constructive comments from the reviewer. We respond to the reviewer's comments as follows:

Firstly, for the comments "the study is largely descriptive in nature. Seasonal maps of

moisture, wind, and isotopic output are shown, but the reader is required to eyeball small spatial variations in otherwise large latitudinal gradients", we indeed described the results obtained through extensive statistical work, but these data were based on quantitative analysis, as seen in Figs. 4, 6, 8, and 10. For instance, the subtle spatial variations within the otherwise significant latitudinal gradients were captured and displayed in Figs. 3, 5, 7, and 9, while the isotopic variations along the transport paths were included and reflected in Figures 4, 6, 8, and 10.

Secondly, for the comment "One way to address this might be to plot composite differences (e.g. mapping one season as an anomaly from the annual mean, or plotting the difference between one season and another)", our primary focus is on analyzing the factors variations across the four seasons, rather than comparing factors between seasons. However, the comments from the reviewer provided us with an excellent line of thought and represent an innovative aspect for future work. Consequently, we have included this in the main text about the future research "A potential direction for future research could be to investigate the intra-seasonal variations in composite differences across various factors, rather than focusing on inter-seasonal comparisons" (Lines 875-878).

Thirdly, for the comment "and transport paths could be shown on a single plot", given the numerous figures and subplots already presented, we have chosen not to create additional graphs to display this particular element. However, readers can still glean information by comparing the water vapor transport paths depicted in Figs. 3, 5, 7, and 9.

Fourthly, for the comments “The text states that isotopic variations along transport paths are consistent with Rayleigh distillation; however, it does not appear that this was ever tested, which would be quite easy to do in a quantitative manner”, we believe that the isotopic variations along the water vapor transport paths encompassed the effects of Rayleigh distillation (i.e. the rainout effect) and water mass balance and isotopic equilibrium. Isolated Rayleigh distillation cannot fully account for the changes in water vapor isotopes and precipitation isotopes along these paths. Therefore, we have added the relevant statement to the main text “In these four months that represent different seasons, variations in the $\delta^{18}O$ and Ex_d of precipitation and water vapor along these water vapor transport paths adhered to principles of Rayleigh fractionation and water balance principles, underscoring the complex transport paths and processes that influence isotopic variations in precipitation in the Dongting Lake Basin” (Lines 860-864). Furthermore, the factors along the water vapor transport paths include both static spatial averages (i.e. the point averages) and the temporal sequence along the paths, and we have also made relevant statements in the main text regarding this aspect “the factors at the grid points along the water vapor transport path exhibit, in spatial terms, as average characteristics of conditions over multiple years, and, in temporal terms, as sequential characteristics of these factors along the water vapor transport path” (Lines 417-420).

Third, it is not clear to me what new information about water cycle processes (including transport) this study provides, other than to provide a thorough description

of seasonal mean wind flows, moisture transport paths, and vapor and precipitation isotope ratios around a single location. It motivates me to ask: was the Dongting Lake Basin chosen for a particular reason as a scientifically important location? Or was this a study of opportunity based on the large number of event-based precipitation samples?

Response: We appreciate the constructive comments from the reviewer. We respond to the reviewer's comments as follows:

For the comment "it is not clear to me what new information about water cycle processes (including transport) this study provides, other than to provide a thorough description of seasonal mean wind flows, moisture transport paths, and vapor and precipitation isotope ratios around a single location", our study deliberately emphasized not the water cycle itself, but rather the transport of water vapor and its influence on the isotopic composition of precipitation.

For the comment "It motivates me to ask: was the Dongting Lake Basin chosen for a particular reason as a scientifically important location?", we believe that the Dongting Lake Basin, situated in the East Asian monsoon climate zone, offers a rather typical representation for research purposes. A significant amount of work has already been conducted within this basin, including sampling and observation of various water bodies, and analysis of the stable isotopes in stalagmites, lake sediments, and peat. This study is part of a series of research efforts in the Dongting Lake Basin.

For the comment "Or was this a study of opportunity based on the large number of event-based precipitation samples?", However, from a philosophical perspective, we

believe that universality is embodied within particularity. By examining the seasonal variations in water vapor transport and their influences on precipitation isotopes in the Dongting Lake Basin, we can gain a broader spatial understanding of the scientific issues surrounding water vapor transport. Therefore, we added the relevant statement in the main text "Focusing on the Dongting Lake Basin within the East Asian monsoon area, and drawing upon fundamental theories of meteorology, water vapor diagnostics, and water vapor calculations, a broader spatial understanding of the scientific issues surrounding water vapor transport can be achieved" (Lines 153-156)

I feel that this study would benefit from some additional context for why this work was conducted, how the IsoGSM output guides us in understanding the precipitation data, and the inclusion of quantitative analyses.

Response: We appreciate the constructive comments from the reviewer. As demonstrated in our previous responses, the data we employed comprises the isoGSM2 simulated data and ERA5 reanalysis data. The variations in Q, P, and isotopes in water vapor and precipitation along the transport paths can be regarded as quantitative changes and subject to quantitative analysis.

I also have two additional comments specific to methodology:

First, the study needs to provide more information about the "vector interpolation method." The introduction criticizes other moisture transport evaluation approaches, such as those based on Langrangian back trajectory techniques, because these cannot

definitively determine what moisture becomes rain. However, it is not clear to me how interpreting vertically integrated moisture flux fields in IsoGSM would allow one to do this either. In fact, there is a possibility that the vertically integrated transport could be quite distinct from the transport vectors of moist layers that generate precipitation (e.g. if free tropospheric moisture convergence is more critical than low-level moisture convergence for producing rain).

Response: We appreciate the constructive comments from the reviewer. For the comments "the study needs to provide more information about the "vector interpolation method", the method we employ is a fundamental approach in meteorological plotting: using the center of the Dongting Lake Basin as the endpoint and aligning parallel to the systematic transport of the *Q* vector cluster, which can be described as following the direction of the water vapor streamline. Therefore, in the main text, we introduce this concept as follows: "In the Q field (Fig. 3a), regarding the Dongting Lake Basin as the endpoint, the vector cluster of the vertical integral of water vapor flux (i.e., the Q) directed towards the Dongting Lake Basin delineates the path of water vapor transport in January (black arrow lines in Fig. 3)" (Lines 394-397).

For the comment "The introduction criticizes other moisture transport evaluation approaches…….convergence for producing rain", HYSPLIT is capable of depicting water vapor transport paths at various levels, yet this does not necessarily correspond to the water vapor responsible for precipitation. This finding has been explicitly stated in the referenced literature. In our results and analysis, the variations of *Q* and *P* along the transport pathways, as well as isotopic changes, can be considered quantitative

alterations. Moreover, the ratio of *P* (precipitation amount) to *PW* (precipitable water) can represent both the rate of precipitation generation and the level of rainout, which has been reflected in the paper previously published by our research group. In this study, we focused on specific precipitation days and analyzed the impact of different precipitation forms, such as convective and advective precipitation, on the isotopic composition of precipitation in the study area. However, due to space limitations, not all content could be presented in this submitted manuscript. The reference is as follows:

Xiao, Z., Zhang, X., Xiao, X., Chang, X., & He, X. (2024). The Effect of Convective/Advective Precipitation Partitions on the Precipitation Isotopes in the Monsoon Regions of China: A Case Study of Changsha. Journal of Hydrometeorology, 25(4), 581-590.

Second, it appears that the paper weights all days equally in its analysis, regardless of whether rain occurred or not. Thus it is hard to draw conclusions about whether the descriptive analysis accurately describes the conditions in which precipitation samples were collected.

Response: We appreciate the constructive comments from the reviewer. In fact, our analysis represents the average results over multiple years from January 1979 to December 2017, totaling 468 months, including monthly precipitation amount (*P*, mm), stable isotopes (δ^2H and $\delta^{18}O$) in the precipitation and vertical integral of water vapor (δ^2H_p, $\delta^{18}O_p$, δ^2H_v, and $\delta^{18}O_v$), and the calculated deuterium excess in water

vapor and precipitation (Ex_d_v and Ex_d_p). Therefore, our analysis is based on the multi-year averages of these factors to characterize the long-term conditions for four representative months, and we examine the impact of water vapor transport paths on the isotopic composition of precipitation in the Dongting Lake Basin. Furthermore, addressing the author's concerns, the relevant content has been demonstrated in previously published papers by our research group. In that study, we focused on specific precipitation days, analyzing the effects of different precipitation forms—convective and advective precipitation—on the isotopic composition of rainfall. The reference is as follows:

Xiao, Z., Zhang, X., Xiao, X., Chang, X., & He, X. (2024). The Effect of Convective/Advective Precipitation Partitions on the Precipitation Isotopes in the Monsoon Regions of China: A Case Study of Changsha. Journal of Hydrometeorology, 25(4), 581-590.

Other line-by-line comments:

Line 53 - This mention of isotope paleoclimate applications seems out of context. Could more information be provided or this sentence eliminated?

Response: We followed comments from the reviewer and eliminated this sentence.

Line 89 - Here and in all other instances, I believe "southwesterly" is meant, rather than southwestward.

Response: We appreciate the constructive comments from the reviewer. However, our

use of “southwesterly” is intended to indicate that the wind originates from the southwest, not that it is blowing towards the southwest. In other words, “wind from the northwest direction” and “northwesterly winds” convey the same meaning. To revise this would contradict our original intent.

Line 94 - I do not understand what this concluding sentence is trying to say.

Response: We apologize for the unclear statement and revised this sentence to “Despite the presence of water vapor input from the northwest direction, we observe no correlation between the transport of water vapor from this direction and the regional water vapor budget or precipitation amount. In some instances, an inverse relationship is even apparent. These relationships imply that northwesterly winds do not exert a direct influence on the precipitation generation in the region” (Lines 90-94).

Line 116 - Rain forms from water vapor that condenses, so I’m not sure how water vapor source regions are not relevant for or the same as precipitation source regions, unless the source regions are being defined climatologically (irrespective of whether there is rain). Clarification is needed.

Response: We appreciate the constructive comments from the reviewer. For the determination of the source regions, we demonstrated that “The source regions of water vapor were determined based on the conditions for the formation of air masses, which need to form on a uniform underlying surface and possess stably in terms of

isotopic, thermodynamic, and dynamic properties as well as circulation condition, typically located over vast land and ocean regions (Smirnov and Moore, 1999)" (Lines 401-403). What we intend to convey is that the source regions of water vapor may not be the primary factor directly affecting the precipitation in the Dongting Lake Basin, rather than suggesting that "water vapor source regions are not relevant for or the same as precipitation source regions". Therefore, we have demonstrated that "With emphasis, for the water vapor source of precipitation in the Dongting Lake Basin, the oceanic representative regions located at low latitudes may not necessarily be the initial water vapor source regions, and the relationship between upstream and downstream regions may not entirely be point-to-point, as there were continuous water recycling and rainout processes along the water vapor transport path (Pokam et al., 2012; Risi et al., 2013; Christner et al., 2018)" (Lines 726-731) and "In the process of seasonal changes, as air masses move out of their source regions, their physical and weather characteristics also change with the variations in underlying surface properties and large-scale vertical motion conditions" (Lines 773-776).

Line 129 - I'm not sure what is meant by "by simple deduction." What follows is not obvious to me.

Response: We apologize for the unclear statement. What we intend to convey is that the water vapor transport during the summer monsoon aligns with the spatial distribution of precipitation isotopes under the influence of latitudinal and continental effects and is consistent with the Rayleigh distillation principle for water stable

isotopes, however, water vapor transport during the winter monsoon does not follow the above spatial distribution and Rayleigh distillation principle. Therefore, we have demonstrated that "Typically, during the summer monsoon, prevailing southeast or southwest winds dominate the East Asian monsoon region, with water vapor for precipitation originating from low-latitude oceans (Barker, et al., 2015; Wu et al., 2015; Tang et al., 2015), while precipitation isotopes are significantly depleted influenced by intense rainout effects along the water vapor transport paths during this period (Zhou et al., 2019; Wu et al., 2022). Conversely, during the winter monsoon, northwest or northeast winds prevail in the East Asian monsoon region, the precipitation isotopes should be more enriched if water vapor for precipitation is carried by westerlies or originates from the evaporation of inland regions (e.g., Liu et al., 2011; Wu et al., 2015; Shi et al., 2021). However, both actual observations from the Global Network of Isotopes in Precipitation (GNIP) and simulations from isotope-enabled General Circulation Models (isoGCMs) consistently demonstrate that, whether during the summer or winter monsoon, the spatial distribution of precipitation isotopes in the East Asian monsoon region exhibits significant latitudinal and continental effects—that is, the precipitation isotopes become more depleted with the increases of latitude or distance from the ocean (Feng et al., 2009; Zhang et al., 2012; Zhang et al., 2016)." (Lines 127-142).

Line 139 - This seems to be the problem statement for the paper: what the analysis will address. This should appear sooner in the introduction, and the analyses should

test these ideas (e.g. test consistency with Rayleigh distillation).

Response: We appreciate the constructive comments from the reviewer and added the relevant introduces in the head of this paragraph "Verifying whether the stable isotopic composition of water vapor undergoes changes consistent with Rayleigh distillation during transport, and assessing the impact of this transport on the isotopic composition of regional precipitation, constitute significant research objectives" (Lines 120-123).

Line 155 - Sub "influence" for "influencing."

Response: We followed the comment from the reviewer and revised this sentence to "reveal the mechanisms by which water vapor sources and transport paths in the monsoon region influence precipitation amounts and isotopes" (Lines 159-161).

Line 223 - I'm not sure what is meant by the "fractionation process…cannot be directly observed." We cannot observe individual molecules evaporating and condensing, but we do observe the partitioning of isotopes between distinct water phases.

Response: We apologize for the unclear statement and revised this sentence to "Since the direct observation of the isotopic fractionation process in the atmosphere is extremely challenging, analyzing the variations of atmospheric stable isotopes requires the application of stable isotopes fractionation theory along with the fundamental principles and methods of meteorology" (Lines 240-243).

Line 243 - What are “the driving factors” referring to?

Response: We apologize for the unclear statement and revised this sentence to “The driving data include sea surface temperature, sea ice, and temperature and horizontal wind fields in 28 vertical layers” (Lines 250-252).

Line 285 - Here and elsewhere, variables should be defined. Deuterium excess is never explicitly defined in the paper, and the notation is irregular. Typically, we would write d for deuterium excess.

Response: We apologize for the mistake and explicitly defined Deuterium excess in the paper when it first occurred—that is, “The water stable isotope simulation data used in this study are from isoGSM2 (January 1979 to December 2017, totaling 468 months), including monthly precipitation amount (P, mm), stable isotopes (δ^2H and $\delta^{18}O$) in the precipitation and vertical integral of water vapor (δ^2H_p, $\delta^{18}O_p$, δ^2H_v, and $\delta^{18}O_v$), and the calculated deuterium excess in water vapor and precipitation (Ex_d_v and Ex_d_p)” (Lines 263-267).

Figure 2 Caption is missing an “E” before “RA5.”

Response: We apologize for the mistake and replace “RA4” with “ERA5” (Line 310).

Line 359 - “Lied” is not the correct word.

Response: We apologize for the mistake and revised this sentence to “Unlike most

regions of the East Asian continent, the Dongting Lake Basin was situated on a wet tongue, benefiting from the Southwest Vortex in the eastern Tibetan Plateau" (Lines 364-366).

Line 360 - it would help to point the vortex out if it is significant for the interpretation.

Response: We followed the comment from the reviewer and added more relevant descriptions about the Southwest Vortex "This Southwest Vortex is a cyclonic bypass flow of westerlies from the southern branch of the Tibetan Plateau, as this vortex moves eastward with the westerly belt, it brings precipitation to the downstream areas" (Lines 366-369).

Line 381 - It is a bit misleading to state that deuterium excess is generally affected by condensation. It is often conserved when condensation occurs under thermodynamic equilibrium (at saturation). It is not when condensation occurs under supersaturation. There is also a dependence on temperature conditions, but this is more detail than required for this sentence.

Response: We appreciate the constructive comments from the reviewer and revised this sentence to "Typically, the Ex_d_p largely depended on the Ex_d_v, but processes such as condensation and super-saturation in ice-water mixed clouds, secondary evaporation below clouds, evaporation from underlying surfaces, and the exchange and diffusion of water vapor isotopes could cause precipitation isotopes to deviate to

varying degrees from atmospheric water vapor isotopes (Zhang et al., 2016)" (Lines 388-393).

Line 393 - It is very hard to see the January wind vectors to verify this statement.

Response: We apologize for the unclear statement and added the relevant descriptions as "It can be seen that this water vapor transport path was not consistent with the prevailing wind direction in January as shown in Fig. 1a, which was represented by the black arrows with northwesterly winds prevailing in the Dongting Lake Basin as shown by the average wind field at the 850 hPa" (Lines 407-411).

Line 401 - here and elsewhere, "relatively positive" is misleading, since these values are always negative. "Less negative" or "higher" could work instead.

Response: We appreciate the comments from the reviewer and revised "relatively positive" to "higher" (Lines 425).

Figure 5 - It should be made more clear here and in the text that there are two dominant transport paths for this particular month. At first, I thought the January path was being copied over from the preceding plots. This leads me also to ask: how are two dominant paths selected? How does the method permit the identification of more than one average path?

Response: We appreciate the comments from the reviewer. We determined the dominant transport paths based on the flow of water vapor in the water vapor field (i.e.

the *Q* field), which can be described as the "water vapor rivers" indicated by the vector lengths and directions of *Q* in Fig. 5a. Based on this analysis, we identified two distinct dominant transport paths in April.

Line 440 - I'm not sure one can make such a broad conclusion based solely on the fact that there are similar deuterium excess values between the lake basin and the ocean. Also, does the large bin size on the color scale of the maps hide small-scale spatial variability?

Response: We appreciate the comments from the reviewer. However, we have roughly deduced the relationship between the water vapor sources and the Dongting Lake Basin by comparing the deuterium excess and stable isotopic values between the basin and the ocean. This is a relatively coarse and broad estimation method, yet it is widely utilized in related isotopic hydrometeorological studies.

Line 487 - What is the "variation rule?" I am unfamiliar with this concept. A brief description would help.

Response: We apologize for the unclear statement and revised this sentence to "following the variation rule of deuterium excess during water vapor transport—that is, as the rainout effect progressed, the heavier isotopes preferentially left the air parcel or cloud during the water vapor transport processes and generated precipitation, thus resulted in subsequent precipitation having increasingly higher deuterium excess values (Vasil'chuk, 2014)" (Lines 510-514).

Line 557 - I'm not sure I agree without knowing more. Similar advective paths is one reason deuterium excess may be similar between sites. They could also be influenced by similar degrees of sub-cloud evaporation or other processes that produce similar signals.

Response: We appreciate the constructive comments from the reviewer and added the relevant statement in the manuscript: "However, there were no significant changes in both the Ex_d_v and Ex_d_p (Figs. 8e and 8f), the reasons may be due to the continuous water vapor supply from low-latitude oceans, similar advective paths between the grid points, and the similar degrees of sub-cloud evaporation" (Lines 582-586).

Line 638 - Should the representative regions be interpreted as the vapor source regions? This is not clear to me.

Response: These regions are located over the ocean, essentially forming the water vapor source areas. We have revised this statement following the reviewer's comments: "the water vapor regions corresponding to the Arabian Peninsula (40°E~56°E, 16°N~28°N), the Arabian Sea (56°E~74°E, 10°N~20°N), the Bay of Bengal (80°E~98°E, 8°N~18°N), and the western Pacific Ocean (120°E~160°E, 6°N~20°N), along with the inland regions of Dongting Lake Basin (110°E~114°E, 25°N~30°N) and East Asia monsoon region (110°E~135°E, 42°N~55°N) were labeled as Regions I, II, III, IV, V, and VI, respectively (Fig. 11)" (Lines 665-671).

Line 654 - I don't think "seasonal differences" is the right term. I believe the text is describing the difference between the max and min values for each season, not differences between seasons, which is what the former implies. Perhaps "seasonal range?" It's also not clear to me why this particular metric is chosen.

Response: We appreciate the constructive comments from the reviewer and revised "seasonal differences" to "seasonal range" (Lines 683, 686,689, and 690).

Table 1 - I think some of the Discussion length could be cut down by removing parts of the text that simply repeat what is already in Table 1.

Response: We followed the comment and removed these sentences from the text: "According to the statistics in Table 1, in January, the average $\delta^{18}O_v$ and Ex_d_v were −19.04‰ and 18.45‰, respectively, in Region I under the latitudinal water vapor transport, while −18.82‰ and 15.21‰, respectively, in Region V with their differences only 0.22‰ and 3.24‰, respectively; In April, the average $\delta^{18}O_v$ and Ex_d_v were −16.22‰ and 16.93‰, respectively, in Region I also under the latitudinal water vapor transport, while −17.94‰ and 13.91‰, respectively, in Region IV under the meridional water vapor transport, and −14.91‰ and 13.55‰, respectively, in Region V; In June, the average $\delta^{18}O_v$ were −14.45‰ and −18.10‰, respectively, the average Ex_d_v values were 13.09‰ and 13.98‰, respectively, in Regions II and III, all under the meridional water vapor transport, while the average $\delta^{18}O_v$ and average Ex_d_v were −20.77‰ and 15.03‰, respectively, in Region V after experiencing intense rainout processes; In October, the average $\delta^{18}O_v$ and Ex_d_v were −22.30‰

and 17.72‰, respectively, in Region IV under the weakened meridional water vapor transport, showing non-significantly differences from the values of −22.09‰ and 17.14‰, respectively, in Region V (Table 1)".

Line 683 - Sub "Furthermore" for "Furtherly"

Response: We followed the comment and replaced "Furtherly" with "Furthermore" (Line 707).

Line 744 - I'm not sure what a "modificatory" air mass is or why it should become more negative. Condensation and precipitation cause air masses to lose heavy isotopes, as does mixing.

Response: We apologize for the unclear statement and added the relevant descriptions about the modificatory air mass "In the process of seasonal changes, as air masses move out of their source regions, their physical and weather characteristics also change with the variations in underlying surface properties and large-scale vertical motion conditions. East Asia is primarily controlled by modificatory air masses, which were commonly used to describe air masses that have changed as they move through different regions (Ding, 1990; Chang et al., 2012)" (Lines 773-778). The modificatory air mass becomes more depleted in heavier isotopes than the original air mass, a phenomenon that can be explained as "following the variation rule of deuterium excess during water vapor transport—that is, as the rainout effect progressed, the heavier isotopes preferentially left the air parcel or cloud during the

water vapor transport processes and generated precipitation, thus resulted in subsequent precipitation having increasingly higher deuterium excess values (Vasil'chuk, 2014)" (Lines 510-514). Therefore, we revised the relevant statements to "Whether cold and dry air masses moving southward or warm and moist air masses moving northward, the isotopic composition of water vapor in the modificatory air mass continues to become more negative, while the deuterium excess of water vapor continues to become more positive than the original air mass, following the variation rule of stable isotope and deuterium excess during water vapor transport (Vasil'chuk, 2014; Zhou et al., 2019; Xu et al., 2019; Jackisch et al., 2022)" (Lines 778-784).

Line 749 - That air masses are distinct in various ways can be taken for granted. Hopefully we can conclude more than this from this original work? A more specific conclusion sentence would be welcome.

Response: We followed the comment and made more specific conclusion sentences "In summary, based on the comparison of stable isotopes of water vapor and precipitation in different seasons and representative regions presented in this study, it can be observed that, as an integral component of the climate system, air masses in various regions not only exhibit differences in thermodynamic, dynamic, hydrous, and static properties, but are also influenced by interactions between air masses, the underlying surface, and the intensity of convection, among others" (Lines 786-792).

Line 783 - Point B in the schematic is where mixing between cold and warm advected

air masses should occur, and yet mixing is not discussed in the paper as a possible process shaping the water vapor and precipitation isotope ratios. Some discussion of the contribution of mixing might be a worthwhile addition depending on what a revised, more quantitative analysis yields.

Response: We appreciate the constructive comments from the reviewer and added more detailed descriptions about Point B: "However, at point B located within the front zone, the wind direction and speed are uncertain (Fig. 12b). Specifically, this front zone marked the transition from a warm air mass to a cold one, or vice versa, where meteorological factors have undergone rapid changes. Mixing between cold and warm advected air could occur within this zone, manifesting as a shear zone in wind fields, or as alternating southerly and northerly winds" (Lines 824-829).