Reviewer #1

1. The abstract is quite confusing and should be revised that the content, methods and results of this study become more clear.

Thanks for your suggestion. We have revised the abstract, and now it reads "When the hydrometeor falls from the in-cloud saturated environment towards the ground, especially in the arid and semi-arid regions, the below-cloud processes could heavily alter the precipitation isotopic composition through equilibrium and non-equilibrium fractionations, and accounts for the misinterpretation of precipitation isotopic signal if these processes cannot be properly identified. To correctly understand the environmental information contained in the precipitation isotopes, qualitatively analyzing the below-cloud processes and quantitatively calculating the below-cloud evaporation effect are becoming very important. Here, based on a two-year synchronous observations of precipitation and water vapor isotopes in Xi'an, we compiled a set of effective methods to systematically evaluate the below-cloud evaporation effect on local precipitation isotopic composition. The ΔdΔδ-diagram shows the isotopic differences (δ^2H, d-excess) of the precipitation equilibrated vapor relative to the observed vapor, in which the equilibration and evaporation could lead to different pathways in the two-dimensional phase space. By using ΔdΔδ-diagram, our data show that evaporation is the major below-cloud process, while snowfall samples retain the initial cloud signal because of less isotopic exchange between vapor and solid phases. To quantitatively characterize the influence of below-cloud evaporation on precipitation isotopic composition, here, we chose two methods: one is based on the raindrop's mass change during its falling (hereafter referred to as method 1); another is to directly calculate the precipitation isotopic variations from the cloud base to the ground (hereafter referred to as method 2). By comparison, we found that there are no statistical differences between the two methods in evaluating the evaporation effect on δ^2H_p, except for snowfall events. The slope of evaporation proportion and difference in δ^2H ($F_i/\Delta\delta^2H$) is a little larger in method 1 (1.0 ‰/%) than in method 2 (0.9 ‰/%). Additionally, both methods indicate that the raindrops are weakly evaporated in autumn, and heavily evaporated in spring. Through the sensitivity test, relative humidity is the most sensitive parameter in both, while the variations of temperature show different effects on the two methods. Therefore, following our methods, the diagnosis of below-cloud processes and the understanding of their effects on the precipitation isotopic composition will be improved."

2. The introduction is with four pages too long and should be significantly shortened by 1-2 pages.

Thanks for your suggestion. We have shortened the introduction part to 3 pages.

3. It generally needs to be more clearly stated (abstract and introduction) which two methods are used and what the differences between these methods are (see specific comments below).

Thanks for your suggestion. We have followed your suggestion to revise the sentence. The sentence now reads "To quantitatively characterize the influence of below-cloud evaporation on precipitation isotopic composition, here, we chose two methods: one is based on the raindrop's mass change during its

falling (hereafter referred to as method 1); another is to directly calculate the precipitation isotopic variations from the cloud base to the ground (hereafter referred to as method 2). By comparison, we found that there are no statistical differences between the two methods in evaluating the evaporation effect on δ^2H_p, except for snowfall events. The slope of evaporation proportion and difference in δ^2H ($F_i/\Delta\delta^2H$) is a little larger in method 1 (1.0 ‰/%) than in method 2 (0.9 ‰/%).".

4. The method section is also somewhat lengthy and should be shortened. Some of the descriptions and information could be provided in an appendix.
Following your suggestion, we have shortened the method section, and moved some descriptions and information to the supplemental material as appendixes. Please see the revision.

5. Also the Result section is very lengthy and it becomes not clear where you actually compare the two methods and how you come to the conclusion that ones is overestimating the below-cloud processes while the other one is underestimating these.
Thanks for your suggestion. We have rewritten the result section, and deleted the redundant content. Now, according to your suggestion, we separated the methods into 1 and 2, and explicitly compared them in Section 3.3. In the revision, we just compared the two methods, pointed out flaws, and did not evaluate which one overestimates the results and which one underestimates the results.

6. A thorough language check should be made before re-submission of the manuscript. Much of the questions and comments arise due to a poor language.
We have seriously revised our manuscript following your suggestions. In addition, we have checked the English grammar and readability of the manuscript. Now, we believe it has reached the quality for publishing.

P2, L33-34: How does the below-cloud alter the isotopic composition? Why does this lead to a misinterpretation of the signal? This is not clear. If you want to start your abstract like this you have to be more precise and provide more explanations.
Thanks for your suggestion. We have rephrased the sentence to "When the hydrometeor falls from the in-cloud saturated environment towards the ground, especially in the arid and semi-arid regions, the below-cloud processes could heavily alter the precipitation isotopic composition through equilibrium and non-equilibrium fractionations, and accounts for the misinterpretation of precipitation isotopic signal if these processes cannot be properly identified."

P2, L42-44: Why is this important to be mentioned in the abstract? What information does one get from this value range? What does it mean?
Yes, you are right. After considering your question, we have deleted this sentence.

P2, L47: What relationship is considered here? You should explicitly state what this diagram is, i.e. that you use the relation between d-excess and the isotopes.

Thanks for your suggestion. Now the sentence reads “The ΔdΔδ-diagram shows the isotopic differences (δ^2H, d-excess) of the precipitation equilibrated vapor relative to the observed vapor, in which the equilibration and evaporation could lead to different pathways in the two-dimensional phase space. By using ΔdΔδ-diagram, our data show that evaporation is the major below-cloud process, while snowfall samples retain the initial cloud signal because of less isotopic exchange between vapor and solid phases.”

P2, L45 and L53: Here you mention the methods, but do not introduce them properly as method 1 and 2. Further, in the abstract it should be clearly stated, as it is done in the manuscript title, that you are comparing two methods. Furthermore, the characteristics of each method should be shortly described.
Thanks for your suggestion. We have followed your suggestion to revise the sentence. The sentence now reads “To quantitatively characterize the influence of below-cloud evaporation on precipitation isotopic composition, here, we chose two methods: one is based on the raindrop’s mass change during its falling (hereafter referred to as method 1); another is to directly calculate the precipitation isotopic variations from the cloud base to the ground (hereafter referred to as method 2). By comparison, we found that there are no statistical differences between the two methods in evaluating the evaporation effect on δ^2H_p, except for snowfall events. The slope of evaporation proportion and difference in δ^2H ($F_i/\Delta\delta^2H$) is a little larger in method 1 (1.0 ‰/%) than in method 2 (0.9 ‰/%).”

P2, L54: What is the “remaining fraction of raindrop mass” ? What does the reader learn from this parameter and the numbers given?
To make our expression more clear, we have revised the sentence to “Through the sensitivity test, relative humidity is the most sensitive parameter in both, while the variations of temperature show different effects on the two methods”, and deleted the numbers.

P2, L59: Which methods have been designed? Does that mean you have the methods developed yourself? Aren’t these established methods that are used and just compared?
Yes, you are right. Here, we just compiled the established methods to qualitatively analyze the below-cloud processes that the raindrops are experienced and quantitatively calculate the below-cloud evaporation ratio. Thus, we have rephrased the sentence to “Here, based on a two-year synchronous observations of precipitation and water vapor isotopes in Xi’an, we compiled a set of effective methods to systematically evaluate the below-cloud evaporation effect on local precipitation isotopic composition.”

P3, L69-70: Since this sentence at the beginning of the abstract is rather misleading I would suggest to move this sentence to L82 and start with “Thus, …….“. The original sentence starting in line 82 could then start directly with “However” (and skip “however” it in the middle of the sentence), thus that it reads “However, due to the ……..” then we first paragraph makes more sense and is more logical structured
Following your suggestion, we have revised this paragraph, and it reads “For the paleoenvironment, the isotopic signals of precipitation recorded in ice cores

(Thompson et al., 2000; Yao et al., 1996), tree rings (Liu et al., 2004; Liu et al., 2017b), speleothems (Cai et al., 2010; Tan et al., 2014), and leaf wax of loess-paleosol deposits (Wang et al., 2018b) and lake sediments (Liu et al., 2017a, 2019) could be used to reconstruct the information of temperature, precipitation, and hydrological regimes in geologic history, as it had participated into the formation or growth of these geological archives. For the modern environment, the isotopic ratios of precipitation could be used to quantitatively constraint the water vapor contribution from the end-members of advection (Peng et al., 2011), evaporation (Sun et al., 2020; Wang et al., 2016a), transpiration (Li et al., 2016a; Zhao et al., 2019), and even anthropogenic activities (Fiorella et al., 2018; Gorski et al., 2015; Xing et al., 2020), as itself is an important part of the hydrological cycle. Thus, the hydrogen and oxygen isotopes of precipitation are one of the most important tools to trace the hydrological cycle and climate change (Bowen et al., 2019; Gat, 1996). However, due to the limitations in sampling and isotopic fractionation theories, there remains large uncertainty (i.e., the remaining fraction of below-cloud evaporation, the moisture recycling ratio, water molecules exchange between the droplet and ambient air, etc.) in deciphering the information contained in precipitation by using hydrogen and oxygen isotope ratios (Bowen et al., 2019; Yao et al., 2013)".

P3, L93: The relation to climate change is not clear, especially in the frame of your study. You are using two years of data. With this set of data you can hardly derive any results on climate change. Thus, climate change should be deleted in this sentence.
Yes, you are right. We have deleted the sentence in the revision.

P95-96: I still do not get the point. All processes that isotopes are affected by are manifested somehow in the isotopic composition. To understand the isotopic composition the processes have to be disentangled and for this certain methods can be used. Isn't then the main purpose of this study to just quantify how large the contribution from below-cloud evaporation is on the isotopic composition?
Yes, you are right. The part of content looks a little redundant, we have deleted it in the revised manuscript.

P107-109: The relationship between isotopic composition (2H1H16O and 1H218O) and isotopic ratio (del2H and del18O) has not been made clear and you should carefully check your text when you refer to the isotopic composition and when to the isotopic ratio.
Thanks for your suggestion. We have checked our text, and revised our description. When the isotope without "δ", we used the isotope ratio to express; and when the isotope with "δ", we used isotopic composition to express.

P4, L111: Also here your statement is not entirely clear. You state that the non-equilibrium effect cause a decrease of d-excess, but how is it with the equilibrium effects? Do these cause and increase in d-excess? You actually write it two sentences later. For better readability this sentence should be moved higher up.
Thanks for your suggestion. We have revised the sentence, and now it reads "The equilibrium fractionation would not change the d-excess, while the non-

equilibrium diffusional process would result in a decrease of d-excess in rain (Fisher, 1991; Merlivat and Jouzel, 1979). Additionally, the slope of the local meteoric water line (LMWL) has also been widely used as a metric to infer the below-cloud evaporation effect according to the theory of water isotope equilibrium fractionation (Chakraborty et al., 2016; Putman et al., 2019b; Wang et al., 2018a). Generally, the LMWL's slope is approximately equal to 8.0 belonging to equilibrium fractionation and that is lower than 8.0 pointing to a non-equilibrium fractionation, such as the re-evaporation of raindrops."

P6, L174ff: This section is already too detailed on the methods and should thus be moved to the method section.
Thanks for your suggestion. We have deleted this section.

P6, L176 and L183: Which model? Before you stated you are using two methods, thus I think you mean here rather method.
We have deleted this sentence. And in the revision, we have changed "model" to "method".

P6, L190 and 192: Here again you speak about a model, but later and before these were methods and not models.
We have deleted this sentence. And in the revision, we have changed "model" to "method".

P6, L197: You still have not explained what the ∆d∆δ-diagram is and what it is used for.
We have explained the ∆d∆δ-diagram in the introduction, and it reads "Recently, Graf et al. (2019) provided a new interpretive framework to directly separate the convoluted influences on the stable isotopic composition of vapor and precipitation according to the theoretical fractionation processes, especially the influences of equilibration and below-cloud evaporation. The axes of the new diagram consist of the differences, $\Delta\delta^2H$ and Δd, between the isotopic composition of precipitation equilibrate vapor and near-surface vapor, namely ΔδΔd-diagram."

P8, L269: What do you mean with high-precision model? This is an instrument. You rather mean a high precision version of the instrument? Or do you mean measured with a high precision?
Yes, you are right. We have revised this sentence to "The precipitation samples were measured with a Picarro L2130-i (serial number HIDS 2104) wavelength-scanned cavity ring-down spectrometer at a high-precision mode."

P8, L277: What do you mean with "to the scale of two standard material VSMOW-GISP"? What is the abbreviation VSMWOW-GISP standing for? Do you mean with "two"? Two standard deviations, thus two sigma?
VSMOW and GISP are two international standards, and they are the abbreviations of Vienna Standard Mean Ocean Water and Greenland Ice Sheet Precipitation. To prevent misunderstanding, we have revised this sentence to "calibrated to the scale of two international standards VSMOW(Vienna Standard Mean Ocean Water)-GISP(Greenland Ice Sheet Precipitation)."

P10, L328: What is the fourth quadrant of the Δd-Δδ-diagram? What kind of separation can be made from this diagram can be made? This hasn't been explained.

Thanks for your suggestion, we have added the category of quadrant in Figure 4. Please refer to Figure 4 in the revision.

P11, L358: Why do you calibrate to VSMOW-GISP? Why do you need to do this?

Normally, the measured isotope compositions need to calibrate to a set of international standards. In this way, the researchers can compare their data with each other.

P14, L472: You still have nowhere clearly stated which two methods you are using. Using the term model always before causes even more confusion.

Many thanks. According to your suggestion, we have used method 1 and method 2 to represent our two methods, in addition, we have deleted the term "model" in the revised manuscript. Now, we believe our statement is more clear.

P15, L511: How do your derive this number? Is this derived from your study or known from other sources? In the former case more explanation is needed, in the latter case a reference should be added.

We derived this number based on the correlation coefficient in Fig. 3a, that is, the R^2 is equal to 0.70. Following your suggestion, we have revised the sentence to "As expected, they show a significant positive correlation (R^2=0.70, $p<0.01$), and thus the water vapor isotopic composition can explain 70% of the variation of precipitation isotopic composition."

P15, L513: How is this value for the cloud base justified? More information needs to be provided.

Here, we compared the precipitation-equilibrated water vapor isotopic composition at the ground level with the observed one. Therefore, we revised the sentence to "Further, we used the measured precipitation isotopic composition to deduce the water vapor isotopic composition at the ground level according to the liquid-vapor equilibrium isotope fractionation, and compared it with observed water vapor in Fig. 3b."

P19, Figure 5: Legend for which are the snow samples and which are the rain samples should be added (e.g. at the lower left corner of the plot or you make one for all suplots on the right bottom of the figure).

In the revised manuscript, we have deleted the Figure 5.

P20, L642: What are "intra-event" and "per-event" samples? This needs to be more explanations to understand that the differences between the Graf et al. and your data set are.

Thanks for your suggestion, we have revised our statement to "It should be noted that the slope of Graf's et al. (2019) is based on intra-event samples (from the start to the end of precipitation, each interval of 10 min to collect one sample), while ours is on per-event samples (only collect one sample in each precipitation event)."

P21, L661: Are you here comparing the two methods? If yes, what has exactly be done before. Does the title and the introduction then correctly describe what you are actually showing in this study? Generally: Due to the length of the manuscript and the large amount of figures (including supplement) I lost track of what the purpose of this study is. It seems not to be solely the comparison of the two methods used in this study.

Thanks for your suggestion. After reading the full text with many times, we have changed the title to "A set of methods to evaluate the below-cloud evaporation effect on local precipitation isotopic composition: a case study in Xi'an, China."

In fact, our manuscript consists of two parts: one is to use the ΔdΔδ-diagram to qualitatively identify the below-cloud processes in our site, and another is to compare two methods that are used to quantitatively evaluate the below-cloud effect on the local precipitation isotopic composition. In the revised manuscript, we have reorganized the structure. Now, I think the main topics of this study have become more clear.

P26, l828: Remove "climate change" since the connection to climate change does not become clear from your study.

Thanks for your suggestion, we have removed this statement in your revision.

P848: This is not a good last sentence for the paper. You should move this bullet point higher up, thus first summarize the results for Xi'an and the general results.

Thanks for your suggestion, we have moved this bullet to the first one.

P2, L42: Add "isotope" after precipitation and add "water vapour isotopes" before d^2H to be more clear.

Thanks, we have added "isotope" and "water vapor isotopes" at the proper positions.

P2, L61: signal → composition

Have done.

P2, L53: Check sentence. Is "while" correct here? If this latter part of the sentence is an explanation then it should rather read "since". Otherwise, the sentence in itself is not correct and needs to be rephrased.

Thanks for your suggestion. We have deleted this sentence in the revision.

P3, L69: Is "greatly" correct here? It should rather read "most"

Thanks for your suggestion. We have revised this word to "most".

P3, L82: Change sentence as follows "….itself is an important part of the hydrological cycle."

Following your suggestion, we have revised this sentence to "as itself is an important part of the hydrological cycle".

P3, L89: Add “The” → “The Chinese Loess Plateau……..”
Have done.

P3, L93: climate changes → changes in climates
Have done.

P3, L93: distorted → affected
Have done.

P4, L112: FISHER → Fisher
Have done.

P4, L114 and L123: Make a line break here and start a new paragraph.
Have done.

P4, L127: lose → lost
Have done.

P6, L164: Delete “As a creative work”.
Have done.

P6, L170: add “that” before experience and delete “effect”
Have done. Now it reads “Although the ΔδΔd-diagram gives us a new guideline to more accurately identify the below-cloud evaporation, Graf’s et al. (2019) work was only tested on a cold frontal rain event during a short time, and hence more works need to be done for validating the general applicability of their framework.”.

P5, L171: need to do → need to be done
Have done.

P6, L194: Here we have measured → Here we use measurements
Have done.

P6, L206: Meanwhile should rather be “Thus” or “Therefore”
Have done.

P7, L219: reported by many studies in → reported in many studies for
Have revised. Now it reads “The notable below-cloud evaporation effect has been reported in many studies for this area”.

P7, L242: add “site” after measurement
Have done.

P8, L268 and L280: by Picarro → with a Picarro

Have done.

P8, L281: instead of “model” you should write “version of the instrument”.
Thanks for your suggestion. We have revised this sentence to “The precipitation samples were measured with a Picarro L2130-i wavelength-scanned cavity ring-down spectrometer at a high-precision mode”.

P9, L299-300: Sentence not correct. Please check and rephrase
Thanks for your suggestion. Now, it reads “Thus, the missing data indicate that the instrument is used for measuring liquid samples or being maintained”.

P9, L307: China → Chinese
Have done.

P10, L334-337: Sentence not correct. Please check and rephrase.
Thanks for your suggestion. We have revised this sentence to “Since the water vapor concentration effect and isotopic composition dependency of the cavity ringdown spectrometer have been pointed out by many studies (e.g., Bastrikov et al., 2014; Benetti et al., 2014; Steen-Larsen et al., 2013; Weng et al., 2020), it is important to determine the isotopic composition-humidity correction response function.”

P10, L346-347: Sentence not correct. What do you mean with “were used to calculate the average to be recognized as the δ-value at the measured humidity”? Please rephrase.
Thanks for your suggestion. We have rephrased this sentence to “To eliminate the memory effect, the first five injections were discarded, while the last three of eight injections were used to calculate the average δ-value at the measured humidity”.

P11, L366: representative → representatives
Have done.

P11, L367: two-year study → two years of measurements
Have done.

P11, L368: Add “event” after rainfall
Have done.

P11, L373: add measurements, so that it reads “isotopic composition measurements”
Have done.

P11, L373-374: Second part of the sentence not clear. Please rephrase.
Thanks for your suggestion. We have separated it into two sentences, and it reads “In 2 years, a total of 514 days of water vapor isotopic composition measurements were carried out. For 141 precipitation samples, of which 100

precipitation samples have corresponding event-based water vapor isotopic results."

P11, L377: Move "in summer and autumn" at the begin of the sentence.
Have done.

P12, L396: The second d-excess should have the indice "gr-v"
Have done.

P12, L417: By isotope? Do you mean by the isotope method?
Yes, we have revised this sub-title to "Below-cloud evaporation calculated by isotope method".

P12, L418: Add "that" so that it reads "suggested that".
Have done.

P12, L419: Add "that" so that it reads "mass that remained".
Have done.

P13, L430: Model? It should rather be "method".
Thanks for your suggestion. We have revised the sub-title to "Below-cloud evaporation calculation: Method 1 ".

P13, L437: have → has
Have done.

P13, L443: reaching ground raindrop → raindrops reaching the ground-l
Have done.

P13, L450: model → method
Have done.

P14, L467: "respectively" obsolete and change "used" to "use"
Have done.

P15, L400: Add "value" after "range"
Have done.

P15, L409: Start a new sentence after "Figure 3a": "As expected……."
Have done.

P17, L548: Sentence incomplete. Unsaturated what? Conditions? Environment?
Thanks for your suggestion. We have changed it to "However, due to the CLP belonging to the semi-arid area, the raindrops are likely to experience evaporation in the unsaturated environment".

P18, L584-585: from through → by
Have done.

P18, L594: on Graf et al. ….→ on the by Graf et al. ….....
Have done.

P18, L600: by combined with → in combination with
Have done.

P19, L607: Add “one” so that it reads “use one single physical variable”.
Thanks for your suggestion. We have done.

P19, L619: Add “to be” so that it reads “to be distributed”.
Have done.

P20, L646: Here you write ΔdΔδ with a slash in between, but before it was written without a slash. This should be done one or the other way consequently throughout the manuscript.
Thanks for your suggestion. We have done.

P20, L658: to do → to be done
Have done.

P21, L664: Limited → limited
Have done.

P21, L668: used → use
Have done.

P21, L676: to do → to be done
Have done.

P21, L679: reaming → remaining
Have done.

P21, Figure 6, right panel, x-label: remaing → remaining
Have done.

P22, L694: in statistics → in the statistics
Have done.

P22, L705: pointed that → pointed out that
Have done.

P22, L710: Add what is shown in red and what in blue in the caption.
Have done.

P23, L715: Delete “computing”
Have done.

P23, L717: Add “that” so that it read “Our results showed that”.
Have done.

Reference list: Should be checked thoroughly so that the citation style is the same for all references and that chemical species names are printed correctly.
Thanks for your suggestion. We have done this work.

Reviewer #2

General comments:

1. The two methods used to calculate the below-cloud effect have to be better introduced: What assumptions are needed? How did you choose the unknown values? What are the differences between the methods? Why are you using the isotopic method as a benchmark and not the mass conservation method?

Thanks for your suggestion. In the revision, we used method 1 and method 2 to separately represent the two methods.

The assumption in method 1 is that the initial isotopic composition of the raindrop at the cloud base is in equilibrium with the surrounding water vapor. The assumption in method 2 is that the raindrop isotopic composition ($\delta_{cb\text{-}p}$) at the cloud base is in equilibrium with the surrounding water vapor, and the observed ground-level precipitation isotopic composition ($\delta_{gr\text{-}p}$) includes the processes of evaporation, growth, and isotopically equilibrium with the surrounding vapor. In addition, during the hydrometeors falling we assumed that there is no horizontal advection into or out of the column, and no updraft or downdraft.

For the unknown values, they are calculated according to the empirical equation. In addition, we have explicitly listed the calculation processes in supplemental materials. In the former edition, we assumed the cloud base is 1500m. Now, in the revision, we also used the empirical equation to define it:

$$Z=18400\left(1+\frac{T_{mean}}{273}\right)\lg\frac{S_0}{S_{LCL}}$$

The fundamental differences between the two methods are: method 1 makes use of the mass change of the falling raindrop to evaluate the below-cloud evaporation effect on isotopic composition, while method 2 evaluates its effect by directly measuring the variations of isotope composition.

In the revision, we did not take the isotopic method as a benchmark anymore. We just compared the two methods, and points out the flaws in each method.

After reading the full text with many times, we have changed the title to “A set of methods to evaluate the below-cloud evaporation effect on local precipitation isotopic composition: a case study in Xi’an, China.” In the revised manuscript, we have reorganized the structure. Now, I think the main topics of this study have become more clear.

2. Due to the large number of assumptions needed in the below-cloud evaporation models, the sensitivity analysis has to be more prominent. Further, the different model simulations have to be introduced better. Currently, it is difficult to understand the difference between the models and the different simulations.
Thanks for your suggestion.

In the sensitivity test, we analyzed the effects of each input physical parameter, and compared their differences.

In addition, we have revised our expression in the section of " 2.5 Analytical methods". Here, in order to clearly introduce the two methods, we used method 1 and method 2 to represent them.

3. The manuscript is often repetitive. References to the methods are repeated in many places and the introduction to the sections and paragraphs are too general without leading towards the main topics of the paragraphs.
Thanks for your suggestion. We have shortened the introduction part, and moved some descriptions and information to the supplemental material as appendixes.
In fact, our manuscript consists of two parts: one is to use the ΔdΔδ-diagram to qualitatively identify the below-cloud processes in our site, and another is to compare two methods that are used to quantitatively evaluate the below-cloud effect on the local precipitation isotopic composition. In the revised manuscript, we have reorganized the structure. Now, I think the main topics of this study have become more clear.

Specific comments:
4. Introduction: this section is very long, consider shortening it.
Thanks for your suggestion. We have shortened the introduction part to 3 pages.

5. line 269: model -> do you mean mode? (same on line 281)
Yes, you are right. We have revised our expression in the revision.

6. line 269-271: For how long did you measure each liquid injection? Did you apply a drift correction?
Here, we chose high-precision mode to measure the liquid sample, and thus each injection needs about 10 minutes.
Yes, we applied drift correction. We added the information in the revision, and it reads "To correct the instrument drift, the three laboratory standards were repeatedly measured after measuring every 8 samples."

7. Line 287: "measured by a CTC Analytics autosampler...", do mean that the samples were injected using the autosampler? I expect the measurements to be done by the laser spectrometer.
Thanks for your suggestion. We have revised this sentence to "The standards are injected into the evaporator with a CTC Analytics autosampler, PAL HTC-xt (Leap Technologies, Carrboro, NC, USA), and measured by the laser spectrometer."

8. Lines 311-331: This paragraph seems out of place as it discusses a method that hasn't been introduced yet.
Yes, you are right, we have deleted this section in the revised manuscript.

9. Lines 334-335: The first part of this sentence is difficult to understand, consider reformulating.
Following your suggestion, we revised this sentence to "Since the water vapor concentration effect and isotopic composition dependency of the cavity ringdown spectrometer have been pointed out by many studies (e.g., Bastrikov et al., 2014; Benetti et al., 2014; Steen-Larsen et al., 2013; Weng et al., 2020), it is important to determine the isotopic composition-humidity correction response function."

10. Lines 344-347: For how long did you measure each liquid injection? Did you apply a drift correction?
Here, we chose high-precision mode to measure the liquid sample, and thus each injection needs about 10 minutes.
Yes, we applied drift correction. We added the information in the revision, and it reads "To correct the instrument drift, the three laboratory standards were repeatedly measured after measuring every 8 samples."

11. Lines 349-350: The humidity-isotope dependency as shown in S1a and S1b shows a dependency on the isotopic composition of the standards as reported by Weng et al. (2020). For example in S1b, LS-1 shows a decrease in Δδ2H with decreasing humidity while LS-3 shows an increase with decreasing humidity. The linear calibration function of δ2H does not take this into account. Therefore, the humidity-isotope calibration functions (eq 1 and 2) should be reconsidered to include this isotope-dependency.
Thanks for your suggestion. You are right that both the humidity and isotopic composition effects exist in our data. Therefore, we referred to Weng's method to recorrect our data. We have added the discussions in the supplemental material Appendix A.
By using the different correction methods, they show some differences in the most positive and negative end-members. In the revision, we adopted Weng's method to correct our data.

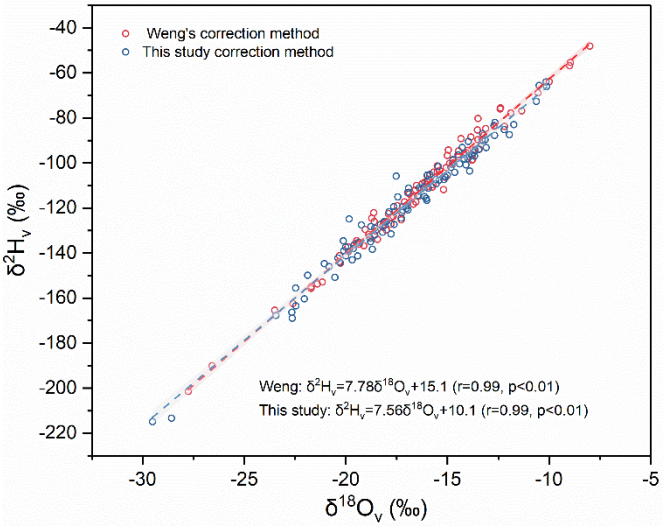


Figure 1 The relationships of $\delta^{18}O_v$ and $\delta^{2}H_v$ corrected by two different methods.

12. Line 355: “δhumidity calibration is the calibrated data for water vapor stable isotope” do you mean “... is the *humidity-dependency corrected* data..”?
Thanks for your suggestion, we have revised the expression to “where $\delta_{iso\text{-}hum\text{-}cor}$ is for isotopic composition-humidity dependency corrected water vapor isotopic composition at 20000 ppmv; δ_{meas} is the raw, measured isotopic composition at that humidity; h is the measured humidity; and a, b, and c are fitting coefficients for each water standard and isotope species. ”

13. Line 266: representative -> do you mean “representativeness”?
We have revised the subtitle to “The representativeness of the data”.

14. Line 373-374: “of which 100 precipitation samples have corresponding daily average water vapor isotopic results” Does this mean you compared the precipitation isotopes with daily average water vapour data? If yes, this would mean that you don’t always compare the same time periods with each other. To compare preciptiation and water vapour, the water vapour isotopic composition should be averaged over the time period of the preciptiation event.
Following your suggestion, we have recalculated the per-event water vapor isotopic composition on each precipitation day, and compared them with the per-event precipitation isotopic composition. We revised the sentence to “In 2 years, a total of 514 days of water vapor isotopic composition measurements were carried out. For 141 precipitation samples, of which 100 precipitation samples have corresponding event-based water vapor isotopic results.”

15. 388: “various” -> do you mean “different”?
The sentence has been revised to “Making use of stable water isotopes, Graf et al. (2019) introduced a ΔdΔδ-diagram to diagnose the below-cloud processes and their effects on vapor and precipitation isotopic composition, since equilibration and evaporation are two different processes and lead to different directions in the two-dimensional phase space of the ΔdΔδ-diagram.”

16. Lines 389-397: δpv-eq and d-excesspv-eq are defined twice in different ways. On lines 390-391, it says that these variables represent the equilibrium vapour from the precipitation samples, on lines 396-397, it says that they represent the water vapour composition at cloud base.
Thanks for your suggestion. We have unified our statement in the revision. Now it reads “Here, the differences in the isotopic composition of precipitation-equilibrated vapor relative to the observed ground-level vapor can be expressed as:

$$\Delta\delta_v=\delta_{pv\text{-}eq}-\delta_{gr\text{-}v} \quad \text{(eq. 2)}$$

$$\text{d-excess}_{pv\text{-}eq}-\text{d-excess}_{gr\text{-}v} \quad \text{(eq. 3)}$$

where $\delta_{pv\text{-}eq}$ and $\delta_{gr\text{-}v}$ are the $\delta^{2}H$ ($\delta^{18}O$) of equilibrium vapor from precipitation and observed vapor near the ground, respectively, and $\text{d-excess}_{pv\text{-}eq}$ and $\text{d-excess}_{gr\text{-}v}$ are d-excess values of equilibrium vapor from precipitation and observed vapor near the ground, respectively.”

17. Line 396: d-excesspv-eq and d-excess**pv-eq** -> d-excesspv-eq and d-excess**gr-v**

We have revised those expressions.

18. Sections 2.5.2 and 2.5.3: These two section introduce the two methods used to calculate the below-cloud effect. After reading these two section, I still didn't fully unterstand which assuptions were made. I think that part of the Appendix A has to be mentioned in 3.5.2 (e.g. how the isotopic composition of preciptiation at the cloud base is estimated). A conceptual schematic of the properties (and assumptions) between cloud base and ground and how they differ between the two methods might help to understand the two models better.
Following your suggestion, we have seriously revised the discussions in this part. We have clearly pointed out the differences between the two methods, that is, "method 1 makes use of the mass change of the falling raindrop to evaluate the below-cloud evaporation effect on isotopic composition, while method 2 evaluates its effect by directly measuring the variations of isotope composition."
Please refer to "2.5.2 Below-cloud evaporation calculation: Method 1; 2.5.3 Below-cloud evaporation calculation: Method 2; Appendix C; and Appendix D for the detailed revision.

19. Section 2.5.3 The first and last paragraph repeat a lot of information already mentioned earlier in the manuscript.
Thanks for your suggestion, we have shortened the content, and deleted the repeated information.

20. Line 508-509: "the corresponding day's water vapour isotopic composition" why do you not compare the perevent mean water vapour isotopic composition? The water vapour isotopic composition changes strongly pre-, intra- and post-event (e.g. Aemisegger et al. 2015). If you average over the full day instead of the precipitation period, the average water vapour isotopic composition can differ strongly.
Yes, you are right. Following your suggestion, we have recalculated the per-event water vapor isotopic composition on each precipitation day, and compared them with the per-event precipitation isotopic composition.
It expressed like this "As shown in Fig. 2, the LMWL is: $\delta^2H_p=7.0\times\delta^{18}O_p+3.0$ based on event precipitation isotopic composition, and the local water vapor line (LWVL) is: $\delta^2H_v=7.8\times\delta^{18}O_v+15.1$ based on per-precipitation-event water vapor isotopic composition."

21. Line 513: Is there any seasonal cycle in the mean cloud base at your measurement location?
In the former edition, we assumed the cloud base is 1500m. Now, in the revision, we also used the empirical equation to define it:

$$Z=18400\left(1+\frac{T_{mean}}{273}\right)\lg\frac{S_0}{S_{LCL}}$$

The calculated cloud base heights have large variations in each precipitation event (Fig. S5).

22. Line 525-526: "equilibrium prediction" -> do you mean "equilibrium water vapour from preciptiation"?

Yes, we have revised this sentence to “The reasonable agreement of observed and equilibrated water vapor isotopic composition has been reported by Jacob and Sonntag (1991), Welp et al. (2008), and Wen et al. (2010), however, they postulated the different relationships underlying the $\delta^{18}O_v$ and $\delta^{18}O_{pv\text{-}eq}$.”

23. Line 534: How is δ18Ov-eq(1500m) calculated?

Here, we revised our statement, and it reads “we used the measured precipitation isotopic composition to deduce the water vapor isotopic composition at the ground level according to the liquid-vapor equilibrium isotope fractionation ($\delta^{18}O_{pv\text{-}eq}$), and compared it with observed water vapor ($\delta^{18}O_v$) in Fig. 3b.”

For the $\delta^{18}O_v$ isotopic composition at the cloud base, please refer to supplemental material, Appendix D.

24. Lines 535-542: The sentence “our results indicate that it is possible to derive the isotope composition of atmospheric water vapor based on that of the precipitation in the semi-arid area.” seems to contradict “It is worth noting that we do not propose to extract the water vapor isotope time series from precipitation data.” What is your message here?

Thanks for your suggestion. We have rewritten the discussions, and now it reads “Although there is a good relationship between $\delta^{18}O_v$ and $\delta^{18}O_{pv\text{-}eq}$ in our data, the below-cloud evaporation has significant influence on the precipitation isotopic composition. Therefore, it should be cautious to derive the water vapor isotopic composition from the precipitation one.”

25. Line 555: d-excess is 0 ‰ during equilibrium fractionation only at temperatures around 20°C.

Thanks for your suggestion. The sentence has been revised to “Traditionally, to qualitatively assess the below-cloud evaporation of raindrops, the value of d-excess$_p$ is a benchmark. Due to the differences in diffusivities of the individual water molecules in non-equilibrium fractionation, therefore, it will cause d-excess$_p$ to deviate from 0‰, which is a theoretical value under vapor-liquid equilibrium fractionation at temperatures around 20°C (Gat, 1996).”

26. Lines 560-561: Kinetic/non-equilibrium fractionation should be introduced earlier, and used consistently.

Thanks for your suggestion. The sentence has been revised to “Traditionally, to qualitatively assess the below-cloud evaporation of raindrops, the value of d-excess$_p$ is a benchmark. Due to the differences in diffusivities of the individual water molecules in non-equilibrium fractionation, therefore, it will cause d-excess$_p$ to deviate from 0‰, which is a theoretical value under vapor-liquid equilibrium fractionation at temperatures around 20°C (Gat, 1996).”

In addition, the expression of non-equilibrium fractionation has been unified in the manuscript.

27. Line 562-563: ”Therefore, during the moisture transportation, the water vapor d-excess may be modified.” What do you mean with *moisture*

transportation? Diffusion or large-scale advection? It is important to specify the scale of the process.
Thanks for your suggestion, we have revised the expression to “In addition, in the water molecules diffusion process, the water vapor d-excess$_v$ may be modified, and this enhances the uncertainty to gauge the below-cloud evaporation process by solely using d-excess$_p$.”

28. Line 584-585: “...from through...” -> this is a repetition.
It has been revised to “However, as for snowfall event, it seems unreasonable to explain the strongly negative $\Delta\delta^2H_v$ by the raindrop size and rain rate (Fig. 4).”

29. Lines 591-593: Can you be more specific about what is the *new* learning from your results? Is has been known before, that snow does not interact strongly with sourrounding water vapour below the cloud base during its fall (e.g. Gedzelman and Arnold, 1994).
Thanks for your suggestion. The ΔdΔδ-diagram not only can be used to separate the below-cloud processes, but also to differ the precipitation types. Graf et al. (2019) only test the precipitation results on ΔdΔδ-diagram. Our snow sample supplements their data.
In order to specify our new learning, we revised the last sentence to “Our results suggest that in addition to raindrop size and rain rate, precipitation type is also an essential factor that influences the distribution of the data on the ΔdΔδ-diagram.”

30. Line 603: ∆2Hv -> do you mean ∆δ2Hv? This notation isn’t used consistently in the manuscript.
Yes, you are right. After checking the manuscript, the notations have been used consistently.

31. Line 603-621 and Fig.5: The discussed connection between meteorological conditions and the isotopic values is difficult to see in these figures. Boxplots instead of scatterplots might work better.
Thanks for your suggestion. We have deleted this part, instead, we discussed the meteorological controls in section 3.3.2: Meteorological controls on the two methods.

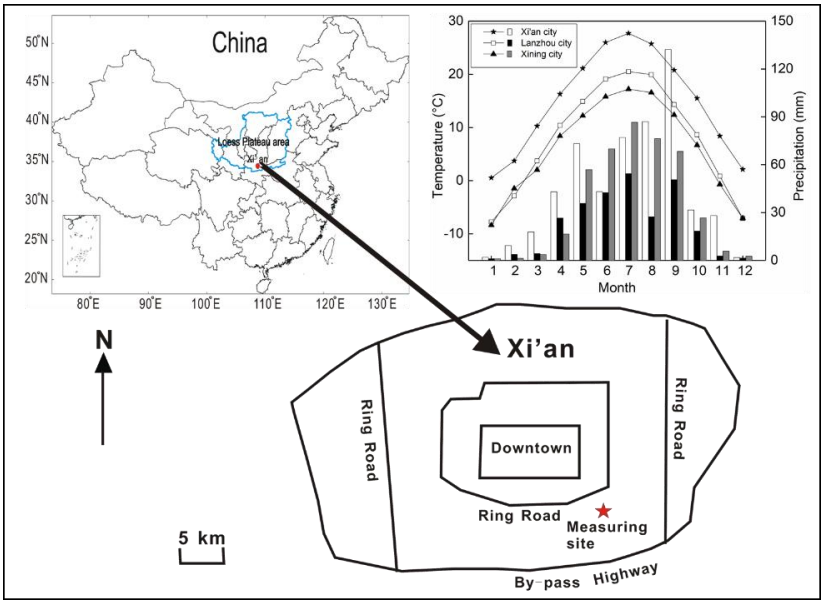
32. Line 615-617: I don’t understand this sentence. Are you referring to the temperature dependency of equilibrium fractionation?
We have deleted the discussions.

33. Line 670: “below-unsaturation” -> what does that mean?
We have deleted that sentence.

Figures:

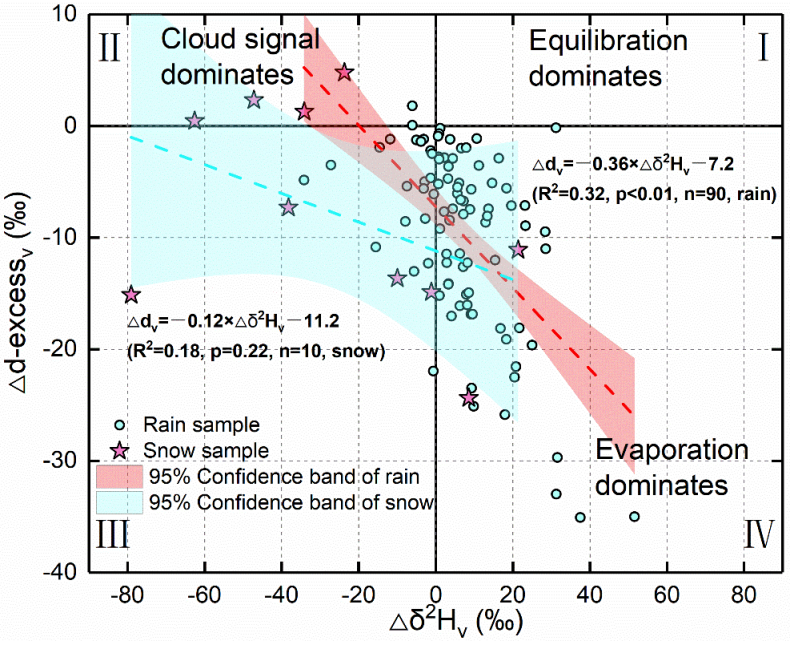
34. Fig. 1: The labels of the subfigures are very small

We have enlarged the labels of the subfigure in Figure 1.



35. Fig.4: The linear fit does not fit well to the data. Why do try to find a linear fit for snow and rain together? As these hydrometeors are influenced by different processes while falling, it is unlikely, that they lie on the same line in this diagram.

Following your suggestion, we have separately drawn the regression lines for snow and rain samples.



36. Fig.5: label text is very small. The dark red of very high values (e.g. temperature) is difficult to see.

We have deleted Figure 5.