

Review on ACP Manuscript No. ACP-2022-576

Xing et al., A comparison of two methods to quantitatively evaluate the effect of below-cloud evaporation on the precipitation isotopic composition in the semi-arid region of the Chinese Loess Plateau

Xing et al. use measurement data for two years derived in the Chinese Loess Plateau and investigate the impact of below-cloud evaporation processes on the isotopic composition. Thereby, they compare two methods. Their comparison shows that the equilibrium method can be successfully used to predict the ground-level water isotopic composition from precipitation isotopes in semi-arid climates, especially in winter. On the other hand, the below-cloud evaporation calculated from the mass conservation equation would lead to an overestimation in semi-arid and arid regions.

Due to the poor language and the extreme length of the paper it is hard to follow what actually has been done and how. Also the purpose of the study is rather confusing. Title and abstract focus on a comparison of two methods and then in the result section much more is shown and the methods are somewhere compared without clearly stating this. Therefore, this manuscript needs major revisions before it can be published. I would strongly encourage the authors to considerably shorten their manuscript and focus on the essential results and clearly describe these.

General comments:

1. The abstract is quite confusing and should be revised that the content, methods and results of this study become more clear.
2. The introduction is with four pages too long and should be significantly shortened by 1-2 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).
4. The method section is also somewhat lengthy and should be shortened. Some of the descriptions and information could be provided in an appendix.
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.
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.

Specific comments:

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.

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?

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.

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.

P2, L54: What is the “remaining fraction of raindrop mass”? What does the reader learn from this parameter and the numbers given?

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?

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.

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.

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?

P107-109: The relationship between isotopic composition ($2\text{H}/1\text{H}$ and $18\text{O}/16\text{O}$) and isotopic ratio ($\delta^{2\text{H}}$ and $\delta^{18\text{O}}$) 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.

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.

P6, L174ff: This section is already too detailed on the methods and should thus be moved to the method section.

P6, L176 and L183: Which model? Before you stated you are using two methods, thus I think you mean here rather method.

P6, L190 and 192: Here again you speak about a model, but later and before these were methods and not models.

P6, L197: You still have not explained what the Δd -diagram is and what it is used for.

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?

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?

P10, L328: What is the fourth quadrant of the $\Delta d\Delta\delta$ -diagram? What kind of separation can be made from this diagram can be made? This hasn't been explained.

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

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

P15, L511: How do you 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.

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

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 subplots on the right bottom of the figure).

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.

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.

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

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 X'ian and the general results.

Technical comments:

P2, L42: Add “isotope” after precipitation and add “water vapour isotopes” before d2H to be more clear.

P2, L61: signal → composition

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.

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

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

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

P3, L93: climate changes → changes in climates

P3, L93: distorted → affected

P4, L112: FISHER → Fisher

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

P4, L127: lose → lost

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

P6, L170: add “that” before experience and delete “effect”

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

P6, L194: Here we have measured → Here we use measurements

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

P7, L219: reported by many studies in → reported in many studies for

P7, L242: add “site” after measurement

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

P8, L281: instead of “model” you should write “version of the instrument”.

P9, L299-300: Sentence not correct. Please check and rephrase.

P9, L307: China → Chinese

P10, L334-337: Sentence not correct. Please check and rephrase.

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.

P11, L366: representative → representatives

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

P11, L368: Add “event” after rainfall

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

P11, L373-374: Second part of the sentence not clear. Please rephrase.

P11, L377: Move “in summer and autumn” at the begin of the sentence.

P12, L396: The second d-excess should have the indice “gr-v”

P12, L417: By isotope? Do you mean by the isotope method?

P12, L418: Add “that” so that it reads “suggested that”.

P12, L419: Add “that” so that it reads “mass that remained”.

P13, L430: Model? It should rather be “method”.

P13, L437: have → has

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

P13, L450: model → method

P14, L467: “respectively” obsolete and change “used” to “use”

P15, L400: Add “value” after “range”

P15, L409: Start a new sentence after “Figure 3a”: “As expected.....”

P17, L548: Sentence incomplete. Unsaturated what? Conditions? Environment?

P18, L584-585: from through → by

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

P18, L600: by combined with → in combination with

P19, L607: Add “one” so that it reads “use one single physical variable”.

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

P20, L646: Here you write $\Delta d \Delta \delta$ 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.

P20, L658: to do → to be done

P21, L664: Limited → limited

P21, L668: used → use

P21, L676: to do → to be done

P21, L679: reaming → remaining

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

P22, L694: in statistics → in the statistics

P22, L705: pointed that → pointed out that

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

P23, L715: Delete “computing”

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

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.