

Dear Chief editor and editors

Thanks for your careful revision of our manuscript. We have considered all the comments and suggestions from you carefully, and substantially revised our manuscript titled “First comprehensive stable isotope dataset of diverse water units in a permafrost-dominated catchment on the Qinghai–Tibet Plateau” (ID: essd-2024-54) point by point and marked by red words. The suggested revisions are all accepted. All the detailed responses are as follows:

### **Anonymous Referee #1**

In this manuscript, Yang et al. present an extensive isotope data set ( $d_{18}O$ ,  $dD$ ,  $d$ -excess) of samples taken over 6 years from different compartments associated to a permafrost environment (e.g. precipitation, thermokarst ponds, ground ice, etc).

These raw data are available via a link to a data repository. The data are distributed to five different Excel-sheets, clustered by compartments. On the one hand this is legit due to the high number of samples and necessity to include information about sampling sites. On the other hand it complicates the handling of the data.

Answer: Dear Reviewer, Thanks for your valuable comments and patient work on our manuscript. The dataset files will be improved before this manuscript is fully accepted and published online.

The study concept is sound and sampling, sample preparation and analysis have been conducted according to state-of-the-art methods. Specific care has been taken to prevent evaporative isotopic enrichment of the samples.

Answer: Thanks for your positive comments. Concerning the influence of evaporation on the isotopic enrichment, we have done a lot of work to prevent the evaporation of water samples during sampling processes and preservation. I.e., All the rainfall samples were immediately collected after the end of precipitation to minimize the effects of evaporation (Page 9 line 181-183). The sample bottles were filled up without bubbles and sealed with parafilm (page 15 line 235). All the samples were stored at 4°C (page 15 line 238). And in section 4.3.1, All these conducted procedures are needed to avoid the impact of evaporation on the original isotope signals of lake and stream water (page 16 line 264-265).

The manuscript includes a basic description of time-series and borehole data. Further, intercorrelations between different isotopes are shown, which is fundamental in isotope hydrology and justifiable to be presented in a data-description paper.

While there is a growing database of isotopes in precipitation and surface waters, data from permafrost environments are still scarce and limited to some study sites, mainly from Alaska and Siberia, plus a minor scale pilot study from the same study area as in this manuscript (all cited in the text). However, permafrost associated data are important to fully assess the potential of isotope applications within the hydrological cycle, specifically when this is influenced by melting of permafrost archives in course of global warming.

Therefore, I recommend the publication of this manuscript in ESSD after the completion of

minor revisions.

Answer: Dear Reviewer, Thank you for your caring and your assurance on my work. We will conduct this field monitor and sampling work, and the relevant dataset of stable isotopes will be continuously updated.

Comments:

Data: I miss a clear statement about analytical error / uncertainty of isotope data. There are no uncertainty values reported in the data files. Line 226ff gives values for analytical accuracy but it is not explained how this values have been calculated. Were samples measured in replicates? Clear and transparent information about analytical uncertainty and how it has been evaluated is essential for a data description paper.

Answer: Thanks. Here in line 226, we want to clarify the guaranteed precision of instrument (picaro L2130-i) that was stated in the factory settings, defined as the instrument precision. We have corrected this expression to “instrument precision” to avoid misunderstanding. (see the red words in page 15 line 253-254)

Thermokarst lake data: these are „mixed data“ so it is not possible to associate data from different seasons/sampling days to specific ponds. Probably those change a lot due to melting? If this is the case, add a sentence or two to the methods part, explaining this issue.

Answer: Yes, you are right. Here we give a detailed interpretation of the sampling processes: During the observation periods, the occurrence numbers of thermokarst lakes dynamically changed among different sampling years (Table 2) due to the interannual variations in the precipitation, active layer thickness, supra-permafrost water, as well as near-surface ground ice. Partial of sampled lakes disappeared in the next sampling year and additional new lakes emerged. Accordingly, we obtained as many as lake water samples to constrain the seasonal changes in the lake water hydrology and try to clarify the influence of permafrost and climate on the water balance of thermokarst lakes in this region. (see the red words in page 10 line 197-203).

Data organization: the distribution of the whole data set to five Excel files is legit. Nevertheless, I suggest to evaluate alternative versions of data management, with a more condensed organization in less or – in best case- only one single excel-spreadsheets.

Answer: Thanks. We have communicated with the data center. And we both agree that the dataset files will be improved before this manuscript is fully accepted and published online. All the data will be sorted and put into one single excel file and the data information will be updated.

I.17: not everybody is familiar with „Xizang“. Please note in brackets that it is Qinghai-Tibet-Plateau at least once in the beginning, which is a term better known to most researchers outside of China.

Answer: Thanks for your suggestions. I have changed “Qinghai-Xizang Plateau” into “Qinghai-Tibet Plateau” in the whole manuscript.

I.87: what precisely is „scarce“? The compartments (thermokast lakes, ponds, etc) or the data from those? Please rephrase for clarification

Answer: Thanks, I have improved it. Here we want to clarify that the stable isotope records of thermokarst lakes/ponds and ground ice are extremely scarce. (see the red words in page 5 line 97-99)

I.99/100: reference to Fig. 1 is needed here

Answer: I have added the Fig. 1.

I.110-120: short description/explanation of permafrost associated terms, such as thermokast active layer, etc, would be beneficent (later on the same accounts for „pore ice, „segregated ice“, etc). The latter here it is written as „active-layer“ while in other parts of the manuscript without dash „active layer“. Please correct.

Answer: Thanks, I have added short description/explanations of permafrost associated terms (see page 2).The active layer is used in the whole manuscript.

I.134: explain how the rain gauge in combination with the steel plate works. Which efforts were undertaken to prevent isotopic enrichment of the sampled water

Answer: Here, I have reorganized this sentence to make it clear. A rain gauge was installed to collect daily rain, and a steel plate was put on the roof to obtain as much as snow samples. (page 9 line 176-189).

About the methods done to prevent isotopic enrichment of the sampled water, we have given a detailed information in page 15 line 248-260.

I.142: how was this identified?

Answer: Thanks for your comments. For the groundwater observation, we selected two areas with substantial natural opening springs occurring, i.e., springs along the both sides of the observation stream (named as GSHQ) and spring in the source area of this stream (named as GSYTQ) (Fig. 1), (Fig.1; 2). Given the intermittent occurrence of these springs among different years and their unstable isotopic signals, we identified them as supra-permafrost water. (see red words in page 8 line 155-159)

I.145: again, provide more details, i.e. from which depths does the water of wells/springs come from, to classify them as sub or supra permafrost

Answer: You are right. I have given a detailed information of this spring. A drinking spring (CSQ) behind the BLH station (Fig. 1), with its aquifer depth (reaching 92 m) being deeper than the permafrost thickness (~50m) in the BLH, is selected to conduct continuous sampling work. In regards to the small fluctuations in water level all the year and little interannual differences in stable isotopes of spring, we identified it as the observation site of sub-permafrost water. (See the red words in page8 line 154-162).

I.179: clarify for which years the Covid-rules did apply

Answer: Thank you. Influenced by the Covid-19 and lockdown policies between June, 2022 to December, 2022 in China, only two months' sampling work was conducted in 2022. (see the red words in page 10 line 203-205)

Figure 2 caption: put the labels of panels before the respective phrase, i.e: (a) General

conditions... .., (b) typical feature ... .., etc.

Answer: I have done that.

Table 2 and 3: better write "number of samples". Sampling size is a bit confusing.

Answer: Thanks, I have revised it.

I.224: why actually not melting the permafrost samples directly in the field and further treat and process them the same way as liquid samples?

Answer: Because we didn't have good conditions (there was no sufficient power to support the run of refrigerator) to keep the meltwater samples of frozen soil and ground ice at in cold storage. In addition, the harsh climate conditions in the field was not beneficial for the treatment of samples.

I.255: describe which lab standards were used

Answer: The laboratory standards we used was provided by LICA United Technology Limited, Beijing, China.

Figure 4: the greyish and turquoise y-axes and labels are not good to read. Explain abbreviations GSHQ and GSYTQ in figure caption or refer to Fig. 2.

Answer: I have improved the figure 4 to make it clear, and give the explanation of abbreviations GSHQ and GSYTQ in the figure caption.

Figure 4: similar scales of y-axes would make data better comparable. I would also change order of the sub plots in a more logical way: move the most negative  $\delta^{18}\text{O}$  precipitation down (closer/above PP [mm]), then maybe streams and lakes above.

Answer: Thanks for your comments, I have improved this figure and changed orders of all sub plots according to your suggestions.

I.315ff / section 5.1.3: I assume there is no information / data about different ages of ground ice formation at this point?

Answer: Yes, the ages of ground ice is not concluded in this manuscript. In this study, we aimed to contrast on the variations in stable isotope ( $\delta^{18}\text{O}$ ,  $\delta\text{D}$ ) of different water components in permafrost regions. Due the little volumes of ground ice in permafrost on the QTP, the traditional dating method is hard to use in the ice dating, can are still work on it.

Figure 5: I suggest to decrease dot-size a bit

Answer: OK, I have improved this figure

Figure 6: again, explain all abbreviations (LEL, FL, AP, SP, WP, etc) in the figure caption, even if they are explained in the text.

Answer: Thanks, I have added all the explanations of the mentioned abbreviations.

I.395: there is something wrong with this sentence, please check

Answer: Sorry for my mistake. I have reorganized this sentence. (see the red words in page 24 line 428-433)

I.421: isotopic values, not contents

Answer: I have revised it.

## Anonymous Referee #2

This paper deals with an extensive dataset of stable isotope composition of water (precipitation, thermokarst ponds, ground ice, stream) in samples collected on a permafrost dominated area.

The raw data is available at <https://doi.org/10.5281/zenodo.10684110> in five Excel files organised in a logical way.

The concept of the study is good and ambitious, the applied sampling and analytical methods are adequate, although the description of the stable isotope measurements is not totally clear for me. How was the drift corrected and how were the raw data normalized to the SMOW-SLAP scale? Were all the five laboratory standards used in every measurement sequence? Please, make this part of the manuscript clear.

Answer: Dear reviewer, thanks for your valuable comments.

1. According to your suggestions, I have interpreted the drift treatments. If the measured precision and drift values were not passed the guaranteed values, the comprehensive inspection of the analyzer was conducted, i.e., the instrument analyzing system, the vaporizer module, as well as the quality of dry nitrogen. After completing all checking processes, we repeated the analysis of 14 distilled/tap water samples and calculated the drift values until they passed the guaranteed values. The results were normalized to the V-SMOW-SLAP scale by analyzing internal standards before and after each set of ten samples. Five laboratory standards (provided by LICA United Technology Limited, Beijing, China) for each group of 10 samples were used for instrument calibration. (see the red words in page 16 line 282-289)

The terms related to ground ice are not widely known, e.g. pore ice, pure ice layer, segregated ice, excess ice. Please, define these terms.

Answer: Thanks, I have defined these terms. (see the contents in page 2)

The dataset is very important and the manuscript is well written, therefore I recommend its publication after minor revision (see above and below).

Answer: Thanks for your appreciation and valuable comments, which helps us better improve our manuscript.

### Detailed comments

In the title I recommend to use Qinghai–Tibetan Plateau, because in the English literature it is much more known?

Answer: Thanks, I have changed the “Qinghai–Xizang Plateau” to “Qinghai–Tibet Plateau” in the whole manuscript.

### Page 3

Lines 49-50: You use the phrases “permafrost degradation” and “ground ice melting” side by side as two different ideas, but for me they are not so different. What is the difference between them?

Answer: Actually, there are some differences between them. The ground ice melting is caused by permafrost degradation. However, the permafrost degradation contains rise of ground

temperature, the increase in the active layer thickness, and sometimes the melting of ground ice which is not an inevitable outcome of permafrost degradation.

Line 58: "Immerzeel et al., 2010" is missing from the list of references.

Answer: I have added this reference in the list.

Line 68: "Liu et al., 2022)" – In the References there is Liu et al., 2022a and Liu et al., 2022b. Please, specify which one is intended here.

Answer: Thanks, it is Liu et al., 2022a, I have revised it.

## Page 5

Line 106: "between 2017 to 2020" – I recommend to write "between 2017 and 2020".

Answer: Thanks, I have revised it.

Lines 107-108: "393.71 mm", "555.99 mm". – There is no reason to give decimals here. Write 394 mm and 556 mm.

Answer: Thanks, I have revised it.

Line 111: "Lin et al., 2010" – In the list of references I could find Lin et al., 2020! Probably wrong year.

Answer: Thanks, this references is wrongly cited. I have deleted it.

Line 116: "melting water from permafrost and ground ice" – For me "melt water from permafrost" or "melt water from ground ice" are the same. Am I wrong? If I am wrong then please, make the difference clear in the manuscript!

Answer: Yes, you are right. I have revised it according to your suggestions.

## Page 7

Line 134: "to collected daily rain" – please, replace with "to collect daily rain"

Answer: I have revised it.

Line 135: "we select a typical" – better would be "we selected a typical"

Answer: I have revised it, thanks.

Line 144: "one drinking spring (CSQ)" – CSQ is not indicated on Figure 1. I think it is the "Sub-permafrost water" on the second map of Figure 1, but it is not indicated. If my supposition is true, then the legend should be modified as "Sub-permafrost water (CSQ)". Anyway, I have never met with the phrase "drinking spring". Why drinking? I think that in this case the word "drinking" should be omitted.

Answer: Thanks, you are right. I have revised it to "a perennial spring (CSQ; Fig. 1) for domestic water supply", and the figure 1 is also improved.

## Page 11

Line 195: "QXH" – What it stands for?

Answer: QXH denotes the Qinghai-Xizang Highway. I have defined it. Here according to your suggestions, I use Qinghai-Tibet rather than Qinghai-Xizang to make it clear and

understandable.

### Page 13

Lines 213-214: "All the treated raw frozen soil samples were immediately preserved in HDPE bottles." – How could you put the frozen soil samples into the bottles?

Answer: Thanks, during sampling work, the wide-mouth HDPE bottles were used with the diameter of 20cm. The raw frozen soil samples were cut in half and then put into the bottles.

Lines 226-227: "The analyzing accuracy was less than 0.02 ‰ for the  $\delta^{18}\text{O}$  value measurements and 0.05 ‰ for the  $\delta\text{D}$  value measurements" – I recommend to provide one standard deviation instead of accuracy, and please describe how you calculated the standard deviation.

Answer: You are right. Actually, the analyzing accuracy is not correct. I have revised it. The guaranteed instrument precision was 0.025 ‰ for the  $\delta^{18}\text{O}$  value measurements and 0.1 ‰ for the  $\delta\text{D}$  value measurements. (The red words in page 15 line 253). During the precision estimation, we have calculated the standard deviation. (red words in page 16 line 274-276). We calculated the standard deviation via the a function in the excel, and the standard deviation is 0.07‰ and 0.18‰ for  $\delta^{18}\text{O}$  and  $\delta\text{D}$ , respectively.

Lines 228-229: "IAEA standard Vienna Standard Ocean Water (VSMOW) standard" – The first "standard" should be deleted.

Answer: I have deleted it.

Line 230: " $\delta=(R_{sa}/R_{st}-VSMOW-1) \times 1000 \text{ ‰}$ " – I recommend to write " $\delta=(R_{sa}/R_{st}-1) \times 1000 \text{ ‰}$ ".

Answer: I have revised it.

### Page 14

Line 234: "events were occurred" – correctly "events occurred".

Answer: Thanks, I have revised it.

Line 236: "were mixed". – In which ratio? In amount-weighted ratio?

Answer: Thanks, because the precipitation amount of every single event was different. We collected event samples and mixed them in amount.

Line 255: "Five laboratory standards for each group of 10 samples". – Do you mean 10 unknown samples, or the 10 samples included the five lab-standards?

Answer: Thanks, five laboratory standards with given isotopic values were inserted before 10 samples, which were used for instrument calibration. (red words in page 17 line 289-293)

### Page 15

Line 277: "lakes/ponds more positive" – correctly "lakes/ponds are more positive".

Answer: I have revised it.

## Page 16

Line 284: “the isotopic contents of lakes/ponds are lower in” – The phrase “isotopic content” has no meaning. I recommend the following: “the heavy isotope contents of lakes/ponds are lower in”.

Answer: Thanks for your suggestions. I have revised it. ( see red words in page 18 line 321)

Lines 287-288: “isotopes of lakes/ponds are positive in May, June, July, and October (Fig. 4; Fig. S3) due to evaporation and isotopic-positive precipitation”. – Bad wording. The isotopes of lakes cannot be positive, only the delta values can be positive. And there is no “isotopic-positive precipitation”. But even the delta values of lakes are not always positive in May, June, July and October! Please, describe clearly what you mean.

Answer: I have revised it. In comparison, majority of isotope values of lakes/ponds are positive in May, June, July, and October (Fig. 4; Fig. S3) due to evaporation and recharge of isotopic-positive precipitation. (red words in page 18 line 324-326)

Line 291: “The mean values are equivalent to the average levels of precipitation”. – I recommend to change the word “levels” for “values”.

Answer: I have revised it.

Line 311: “isotopic-negative water” – I recommend to use “isotopically light water”.

Answer: I have revised it.

## Page 17

Figure 4. The legend and the figure caption do not explain every symbols used on the figure. E.g.  $\delta^{18}\text{O}$ precipitation diagram: I think that the grey dots denote event values, while the red dots denote the monthly average values, but this is not stated. It is interesting that the number of red dots of one year varies between 7 and 10. Wintertime there are months without red dots, but zooming into the precipitation amount diagram (PP at the bottom of the figure), we can see very low bars indicating small amount of precipitation (I think that event precipitation), but there is no data (grey dot) on the  $\delta^{18}\text{O}$  diagram. Why? Was the amount insufficient for performing analysis?

Answer: Thanks, I have stated all the symbols in this figure. About the data in wintertime, you are right, the very low bars indicate much smaller amount of snow, which were recorded by the instrument. However, the amounts were insufficient for performing analysis.

In few cases the red dots on the  $\delta^{18}\text{O}$  diagram stand without grey dots. E.g. the very first red dot. Why? Was there only one precipitation event in that month?

Answer: Yes, you are right. There only one precipitation event in that month

Lines 319-320: “isotopic points of ground ice are located in the left sides of the mean level of precipitation (Fig. 5), i.e., the ground ice represented more negative isotopes” – Bad wording again. “mean level”: please replace it with “mean value”; and provide this mean value in brackets ( $-10.94\text{‰}$ ). “negative isotope” – an isotope is not negative; it can be light or heavy. I recommend the following wording: “ $\delta^{18}\text{O}$  points of ground ice are located in the

left sides of the mean value of precipitation ( $-10.94\%$ ) on Figure 5, i.e., the ground ice is isotopically lighter than the precipitation”.

Answer: Thanks for your comments. I have revised this expression according to your suggestions. (see the red words in page 20)

### Page 18

Line 328: “past precipitation; et al)” – Please, delete “et al”.

Answer: I have deleted it.

Line 331: “(Fig. 4)” – correctly (Fig. 5).

Answer: It is revised.

Line 334: “more negative isotopes” – isotopically lighter.

Answer: I have revised this expression according to your suggestions. (see the red words in page 20)

“(Fig. 4; Table 4)” – correctly (Fig. 5; Table 4).

Answer: It is revised.

Line 337: “isotopic-positive pore ice” – the delta value can be positive.

Answer: It is revised.

### Page 19

I recommend to give the  $\delta D$  data with one decimal only.

Answer: I have revised it

### Page 20

Figure 5: There is a blue vertical line on every diagram. I suppose it indicates the mean  $\delta^{18}O$  value of precipitation. If this is true, then please, write it down in the figure caption.

Answer: Thanks, I have added it in the figure caption.

It would be interesting to check the relation between the  $\delta^{18}O$  values and the type of ice (segregated ice, pore ice, ...). May be it gives some clue for the interpretation of the wide variation.

Answer: This suggestion is wonderful. Thank you. Actually, the ice formation mechanisms vary among different types of ground ice. As I stated in this manuscript, the near-surface ground ice is closely related to the recent precipitation and active layer hydrology, however, the deep-layer ground ice exhibited complicated formation mechanism, including the various source water (meltwater from glacier, permafrost, and snow; lake water; past precipitation), climate conditions, and freeze histories. The pore ice is usually formed under in-situ quick freezing conditions, the isotopic signals of which reflected the original isotope information of its source water; however, the segregated ice grows under slow freezing, the source water of which suffered isotopic fractionation during water migration and water freeze. Given that the ESSD prefer to publish articles on original research data (sets), the detailed interpretation on original

data is will give in the future.

Lines 362-363: "The local meteoric water line (LMWL), determined by ordinary least square regression using the daily isotopic data during six years (2017-2022)," – This is only one way of determining the LMWL and not the most wide-spread one. It is widely accepted that the LMWL is calculated using monthly data. The LMWL based on daily data may differ significantly from that based on monthly data, see e.g. Barešić et al. 2006. Therefore, I recommend to determine the LMWL using monthly data. The most sophisticated way to determine the LMWL is using the amount-weighted multi-monthly mean isotopic values. See, e.g., Kern et al. 2016. I recommend to calculate the LMWL by all three ways.

Answer: Thanks for your suggestions. I have calculated the LMWL by all the ways you mentioned and referred the papers you suggested (Barešić et al. 2006; Kern et al., 2016), and put them on the figure.

The local meteoric water line (LMWL), determined by three different methods, i.e., ordinary least square regression using the daily isotopic data, the arithmetic mean isotopic values, and the amount-weighted multi-monthly mean isotopic values during six years (2017-2022). They are expressed as:  $LMWL_{event}: \delta D = 7.97\delta^{18}O + 15.26$  ( $r^2 = 0.96$ ),  $LMWL_{monthly}: \delta D = 8.06\delta^{18}O + 12.58$  ( $r^2 = 0.93$ ),  $LMWL_{PWA}: \delta D = 7.78\delta^{18}O + 8.78$  ( $r^2 = 0.92$ ). The slope is nearly identical to that of the global meteoric water line (GMWL; Craig, 1961). However, the intercepts are quietly different (Fig. 6) due to the influences of precipitation amounts and the exceptional meteorological conditions (Barešić et al., 2006; Hughes and Crawford, 2012; Kern et al., 2016). (see the red words in page 22 line 379-386)

Barešić, J., Horvatinčić, N., Krajcar Bronić, I., Obelić, B., & Vreča, P. 2006. Stable isotope composition of daily and monthly precipitation in Zagreb. *Isotopes in environmental and health studies*, 42(3), 239-249.

Kern, Z., Harmon, R. S., & Fórizs, I. 2016. Stable isotope signatures of seasonal precipitation on the Pacific coast of central Panama. *Isotopes in Environmental and Health Studies*, 52(1-2), 128-140.

Hughes, C. E., & Crawford, J. 2012. A new precipitation weighted method for determining the meteoric water line for hydrological applications demonstrated using Australian and global GNIP data. *Journal of Hydrology*, 464, 344-351.

## Page 21

Line 384: "Yang et al., 2017a" – Only Yang et al. 2017 exists in the list of references. If "Yang et al., 2017a" is intended to denote another paper than it is missing from the list.

Answer: Yes, it is Yang et al., 2017, I have revised it.

## Page 22

Figure 6: Please, insert to the figure caption what "Wt. avg. AP", "Wt. avg. SP" and "Wt. avg. WP" stand for.

Answer: I have added the detailed information. (see the red words in page 23 line 407-410)

Lines 396-397: "the d-excess values of ground ice are more negative than those of river water and more positive than the amount-weighted average value of annual/summer precipitation" – The mean d-excess values of ground ice are positive numbers except one

(BLH-L-6), see Table 4. I recommend the following sentence: “the d-excess values of ground ice are lower than those of river water and the amount-weighted average value of annual/summer precipitation”.

Answer: Thanks, I have revised it. (in page 24 line 431-433)

### Page 23

Lines 406-407: “All the stable isotope data that support the findings of this study The dataset provided in this paper can be obtained at <https://doi.org/10.5281/zenodo.10684110>” – Please, delete the text “The dataset provided in this paper”.

Answer: Sorry for my mistake. I have revised it.

### Page 24

The cited texts below are characterised by bad wording, see my comments above.

Answer: I have improved the contents.

Lines 420-421: “lower isotopic contents” – isotopically lighter.

Answer: I have revised it.

Line 422: “isotopic-positive precipitation”

Answer: I have revised it.

Lines 423-424: “The slopes of the three LELs are all lower than those of LMWL, indicating strong evaporation.” – The first part of the sentence is evident, otherwise we would not call it “evaporation line”. The meaning of “strong evaporation” is not clear. Actually the slope of the evaporation line is related to the relative air humidity, there is a positive correlation between them. See Figure 2-8 in the Clark & Fritz 1997. So, lower slope means lower relative humidity.

Answer: Thanks for your suggestions. I have revised it. (see the red words in page 23 line 391-393; page 26 line 459)

Line 426: “isotopic-negative water”.

Answer: I have revised it.

### Pages 26-30

The journal names should be written with capital initials, but in many cases it is not so. E.g. in reference [4] “Nature communications is written instead of “Nature Communications”. The same is true for references [25], [34], [52], [56], [59] and [67].

Answer: I have checked all the references and revised the patterns.

What is reference [5]? A book? Who is the publisher? It is an incomplete bibliography.

Answer: I have added the detailed information of this references.

Reference [42] is also incomplete, volume and page numbers are missing.

Answer: I have added the detailed information of this references.

## References

Clark, I., Fritz, P. (1997) Environmental Isotopes in Hydrogeology. Lewis Publishers, Boca Raton – New York

Barešić J, Horvatinčić N., Krajačar Bronić I., Obelić B., Vreča P. (2006) Stable isotope composition of daily and monthly precipitation in Zagreb. *Isotopes in Environmental and Health Studies* 42(3):239-249

Kern Z., R. S. Harmon, I. Fórizs (2016) Stable Isotope Signatures of Seasonal Precipitation on the Pacific Coast of Central Panama. *Isotopes in Environmental and Health Studies* 52(1-2):128-140

Answer: Thanks, I have refereed these papers for interpretation and make the explanation and contents clear.

### Anonymous Referee #3

Yang et al. offer to the benefit of the wider scientific community a dataset of stable isotope measurements in several components of the hydrological cycle in a typical permafrost area located in the Tibetan (Qinghai–Xizang) Plateau. The data is well-presented and the sampling strategy was designed to maximize the results. Except for a few minor technical comments, the manuscript is well organized and written and I recommend its publication in the journal, *ESSD*. One note, though: while the data is good, some of the interpretations are simplistic, they should either be improved, or left out entirely.

**Answer:** Thanks for your valuable comments. I have improved interpretation of the data to make them easily understandable.

#### Technical comments

Although the authors call the sampling area a “watershed” it is not clear which is its extent. It would help adding the outlines of the watershed on the map in Fig. 1b. If several watersheds are present (as I suspect), all should be mapped in Fig. 1b. Also, it would help adding the surface streams and all lakes, whether they were mapped or not. This would put the results in a better hydrological context.

**Answer:** Thanks, I have added the outlines of the watershed on the map in Fig. 1. And all the surface streams and all lakes are mapped.

It is not clear what is the source of water in the springs (lines 142-145) and which are the differences between these. As the authors only offer data and no interpretation (as per journal regulations), potential users of the data need this kind of information.

**Answer:** Thank you for the useful suggestion. In order to I have determined the recharge sources of supra-permafrost water and sub-permafrost water. (Red words in page 24 line 419-424) In addition, the differences between them are clarified (see the red words in page 8 line 154-162).

Lines 167-168: am not sure what contamination the authors refer to. Please clarify.

**Answer:** Thanks, I have revised it to make it clear. To avoid the contamination of water vapor from evaporation of shallow soil and surface water, and the mixing of windblown snow. (Red words in page 9 line 178-179)

L168-169: it is not clear whether the water was collected at 20.00 every day or at the end of precipitation, regardless of time, as implied in line 169. I suspect the former, but please clarify.

**Answer:** Here, in order to facilitate the analysis and calculation, we define one complete precipitation day beginning at 20:00 on one day, and ending at 20:00 in the next day. All data in this defined range is included in one complete day. Actually, all the rainfall samples were immediately collected after the end of precipitation.

L170-171 (and also line 134 above): how was sampling done during periods of freezing? Was ice scrapped from the plate, was the plate put at room temperature? And how was the plate constructed in order to minimize water loss during melting? A photo of the sampling device

would help.

Answer: Thanks. As I stated, all the rainfall samples were immediately collected after the end of precipitation to minimize the effects of evaporation (red words in page 9 line 182-183). No matter during freezing period or during thawing period, each liquid (rain) and solid (snow, hail) sample was collected immediately after the end of precipitation. Thus, every snow and hail sample collected via plate during freezing period was filled in pre-cleaned plastic bags. The excess air in plastic bags was exhausted to avoid the water vapor exchange. (see the red words in page 9 line 183-185)

L 171-172: I understand from here that rain water was collected on a plate? Is this correct? How was evaporation/exchange with moisture prevented? This is crucial for the integrity of the data.

Answer: May be the expression is not very correct. Most of the rain water samples were collected using a precipitation collector made according to International Atomic Energy Agency/Global Network of Isotopes in Precipitation (IAEA/GNIP) precipitation sampling guide (see the red words in Page 9 line 176-178). Only light rain and short-time rain/snow events were collected using a plate: In order to clarify the changes comprehensively and accurately in the precipitation isotopes in the BLH Basin, we tried to collect all samples during every precipitation event, including light rain and short-time events (usually with precipitation amount of less than 5 mm). Accordingly, a wide mouth stainless steel plate (400 mm×600 mm) was used to collect as much as samples of light rain and short-time rain/snow events for analysis. (See the red words in Page 9 line 185-189)

L173: which bottles? Was rainwater collected separately for washing? This entire section (4.1.1.) is unclear, at least to me and needs to be clarified.

Answer: Thanks, I have improved this expression. (see the red words in Page 9 line 190-191): Regarding preserving samples, 100 ml high-density polyethylene (HDPE) bottles were used. Before the sampling, the bottles were washed three times with rain water and then rapidly filled. In addition, I have reorganized this section (4.1.1) to make it easily understandable.

L177-180: while the implication is that lake water was collected for six months per year for six years, in line 180 it is said that water was sampled in 2 months, only. Please clarify. (Table 1 shows more than 2 months).

Answer: Yes, influenced by the Covid-19 and lockdown policies between August, 2022 to December, 2022 in China, only two months' sampling work (June and July) was conducted in 2022. (See the red words in Page 10 line 203-204)

L183: how was sub-permafrost and supra-permafrost water collected?

Answer: The supra-permafrost water and sub-permafrost water were randomly collected using a man-made water ladle at the location where the springs gushing out during each field work. The water ladle was washed using the spring water before sampling. (See the red words in page 10 line 207-209)

L201: please clarify the number of sample – perhaps[s separate the sentence in “boreholes”

and "profiles".

Answer: Thanks, I have revised it.

L233-245: this should go under "methods" rather QC

Answer: Thanks, during method I mainly introduced the sampling strategy and the distribution of sampling sites. Here I want to emphasize the normalization and the processes of sample preservation. I have improved this section. (Page 16 line 260-271)

L241: I don't see how this could be. Please clarify

Answer: I have improved it. During the sampling work of thermokarst lakes/ponds and streams, we do our best to control the sampling time at the same period during every month (controlling the sampling time within one week, i.e., between 17th and 22th in every month) to make sure that all the samples can represent the average level of the whole month. (Page 16 line 266-269)

L244-245: not sure this sentence applies here.

Answer: I have deleted this sentence.

L249: 12 injections of each of the 14 samples?

Answer: Yes, 12 injections of each of the 14 samples were done to adjust the status of the analyzer to the best.

L250-255: please specify the time of this analysis to better understand the drift.

Answer: In order to ensure the data quality, the "high precision" mode was employed during analysis. Under this mode, the analyzing time for each injection is about 8.75 minutes. (See the red words in page 16 line 276-278)

L255-257: please detail the "calibration of the instrument (?)"

Answer: I have added the details. The best-fit linear relationship between the five known calibration values and the analyzer's reported values was determined. The slope and intercept of the best-fit line through these points are used to calibrate the results of our samples. (See the red words in page 17 line 291-293)

L260-262: so, analysis was restarted every time the ppm dropped below 19000 or increased above 20000?? Or you just used the good/bad info from Picarro's GUI?

Answer: Yes, if the ppm dropped below 19000 or increased above 20000, the results of these samples were discarded and we stopped the analysis work. We then checked the instrument and wash the injectors, after this work, the analysis was restarted.

L268: "seasonal variability" is better than "trend"

Answer: I have revised it.

L273-274: on one hand, it is more complex than that, but on the other hand, the seasonal variability could be simply explained by temperature variability. "Transitions of moisture

sources" means "changes in moisture sources"?

Answer: Yes, I have revised it.

L282: again, "transitions of source waters and evaporation differences (?)" means nothing, either detail, or delete.

Answer: I have added details to make it clear. ...which is due to the changes in source waters (i.e., precipitation, meltwater of thawing permafrost/ground ice, groundwater) and alternations of evaporation degrees due to air temperature fluctuations. (See the red words in page 18 line 318-319)

L288: "isotopic-positive precipitation" is meaningless. Perhaps "2H and 18O-enriched precipitation water"? Generally, check the manuscripts for stable isotope jargon and correct. Sharp (2017), available here for free ([https://digitalrepository.unm.edu/unm\\_oer/1/](https://digitalrepository.unm.edu/unm_oer/1/)) offers good advice on stable isotope nomenclature (for instance, "isotope values" is ambiguous)

Answer: Thanks for your good suggestions. I have improved expressions related to isotopes.

L292: no contribution of winter precipitation (snow)? Also, "stable isotopes of streams" is incorrect/ambiguous

Answer: Yes, here we found that the mean values are equivalent to the average values of annual precipitation, which including the winter snow. In addition, I have revised it to " $\delta^{18}\text{O}$  values of stream water".

L293: please clarify how the short residence time results in less variability

Answer: Due to the short residence time of stream water, the evaporation of water is weak, which limited the enrichment of heavier isotopes.

L296-298: this contradicts the statement in L 293-295

Answer: Actually, in line 293-296, we want to compare the lakes with stream water. In contrast, the stream water exhibits much more stable isotope trend. However, in line 296-298, we take the isotopes of stream water separately for analysis. When the isotopic curve was amplified, the seasonal variability is shown.

L299: please explain the differences between the two

Answer: I have explained the differences. For the groundwater observation, we selected two areas with substantial natural opening springs occurring, i.e., springs along the both sides of the observation stream (named as GSHQ) and spring in the source area of this stream (named as GSYTQ) (Fig.1; 2). (See the red words in page 8 line 154-156)

L311: why during cold periods? I would expect sub-permafrost water to be release from the melting permafrost.

Answer: I have revised it. (See the red words in page 19 line 349-350)

L316: please (!) rephrase. Also rephrase the line below with the position of values left or right of the pp line. Describe the data variability, not the chart itself.

Answer: I have improved the expression and grammar.

L320: more negative isotopes. No such thing exists; see my comment above on nomenclature.

Answer: Thanks, I have revised it.

L324-338: slightly speculative, not sure it fits the scope of the journal, perhaps it should be simplified.

Answer: I have simplified this section.

L388: stream water exhibit a clear evaporative effect, they do not lie on the LMWL (and similar for the lake waters). Ground ice exhibits a clear freezing slope (Jouzel and Souchez, 1982, Souchez and Jouzel, 1984, Lacelle et al., 2011, Persoiu et al., 2011 etc).

Answer: Yes, good suggestions. I have improved the related expressions and interpretations.

Conclusions> please see the comments above on data interpretation and adjust the conclusions accordingly.

Answer: Thanks. I have improved the conclusion.

Fig. 1. Show the outlines of the watershed and the hydrological connectivity. What is the base map in fig. 1b?

Answer: Thank you, I have redrawn the figure 1 to make it clear.