Response to Reviewer#2

Anonymous Referee #2

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The paper of Li et al. "Hydrological and Runoff Formation Processes Based on Isotope Tracing During Ablation Period in the Third Polar Region" investigates the hydrological and runoff formation processes of river water in the source regions of the Yangtze river during different ablation episodes in 2016 and the ablation period from 2016 to 2018. In particular, the authors discuss the temporal and spatial variations of isotopes in different tributary rivers under the background of climate warming and their influencing factors by using the methods of field observation, experimental testing, stable isotope tracing, and analytical modeling of end-element mixed runoff. In general, I like the idea of understanding the hydrological and runoff formation processes of river water during different ablation period. Also, I think that the data obtained with this study have highpotential interest for the scientific community. Therefore it is worth publishing this article in HESS after revising the following minor revisions.

Thank you very much for your comments.

1. In the abstract precise in the method used.

Thank you very much for your comments. The abstract section has been revised as: "This study focused on the hydrological and runoff formation processes of river water by using stable isotope tracing in the source regions of the Yangtze river during different ablation episodes in 2016 and the ablation period from 2016 to 2018. The

effects of altitude on stable isotope characteristics for the river in the glacier permafrost area were greater than for the mainstream and the permafrost area during the total ablation period in 2016. There was a significant negative correlation (at the 0.01 level) between precipitation and $\delta^{18}O$, while a significant positive correlation was evident between precipitation and d-excess. More interestingly, significant negative correlations appeared between $\delta^{18}O$ and temperature, relative humidity, and evaporation. A mixed segmentation model for end-members was used to determine the proportion of the contributions of different water sources to the target water body. The proportions of precipitation, supra-permafrost water, and glacier and snow meltwater for the mainstream were 41.70%, 40.88%, and 17.42%, respectively. The proportions of precipitation, supra-permafrost water, and glacier and snow meltwater were 33.63%, 42.21%, and 24.16% for the river in the glacier permafrost area and 20.79%, 69.54%, and 9.67%, respectively, for that in the permafrost area. The supra-permafrost water was relatively stable during the different ablation periods, becoming the main source of runoff in the alpine region, except for precipitation, during the total ablation period."

2. The aim of the study should be exhibited in the introduction section.

Thank you very much for your comments. The aim of the study has been added as: "Based on the conversion signals of stable isotopes in each link of the runoff process, at first, this study further explores the hydraulic relations, recharge-drainage relations and their transformation paths, and the processes of each water body. Furthermore, this study determines the composition of runoff, quantifies the contribution of each

runoff component to different types of tributaries. Finally, this study analyzes the hydrological effects of the temporal and spatial variation of runoff components. ”

3. Line 59-61. "The runoff system in the source area of the Yangtze River consists of alpine glaciers, snow, frozen soil, and liquid precipitation. ". Delete this

Thank you very much for your comments. I have deleted it.

4. Line 64-68. "Therefore, studying changes in the composition of runoff and its hydrological effect in cold areas can not only consolidate theories on runoff research, prediction, and adaptation, but also have important practical significance for construction, industry, and agriculture in cold regions" - please rephrase it.

Thank you very much for your comments. It has been revised as: “Therefore, the study on the composition change of runoff and its hydrological effect in cold areas can not only consolidate theories on runoff research, prediction, and adaptation, but also have important practical significance for construction, industry, and agriculture in cold regions ”

5. Line 109-110. The ground temperature of the permafrost increases, causing it to melt significantly. - rewrite this statement

Thank you very much for your comments. It has been revised as: “

6. Line 227. EMMA is a section name - required full name not abbreviation.

Thank you very much for your comments. It has been revised as: “ **2.3 End-Member Mixing Analysis**”

7. Please change “final ablation” into “end ablation”, and change “total ablation” into “ablation”.

Thank you very much for your comments. I have changed it.

8. Line 274-276. Sentence is badly written, please rephrase.

Thank you very much for your comments. It has been revised as: “As shown in Fig. 2, Stable isotope characteristics of $\delta^{18}O$ and d-excess was different during different ablation for the different types of runoff. ”

9. Line 349. " However, all regions exhibited high ablation, especially in the Tanggula Mountains," please rephrase.

Thank you very much for your comments. It has been revised as: “However, all regions except for areas in the eastern region where the ablation was low during the ablation period in 2017 exhibited high ablation especially Tanggula Mountains.”

10. The conclusion section is too long, please rewrite.

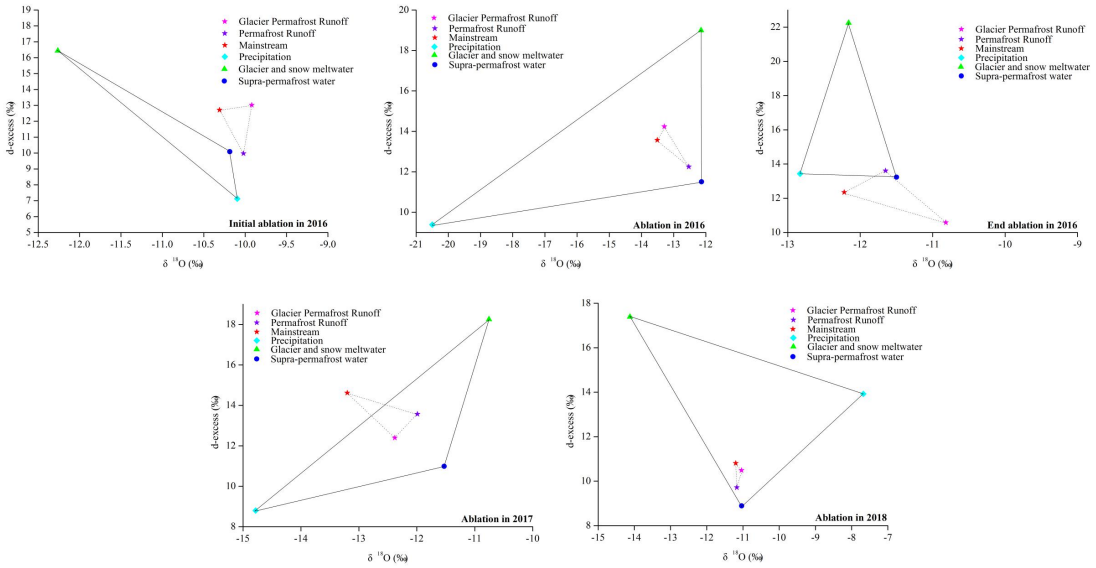
Thank you very much for your comments. The conclusion section has been revised as: “Through systematically analysis of the characteristics of $\delta^{18}O$, δD, and d-excess of river water in the different ablation periods in 2016 and the ablation periods from 2016 to 2018, the results were as follows.

The temporal and spatial characteristics of stable isotopes of river water were significant in the study area. The $\delta^{18}O$ in mainstream was more negative than that in the glacier permafrost area river and permafrost area river. The influence of evaporation on isotope and d-excess is only prevalent in some places, such as the central and northern parts of the study area in the initial ablation and total ablation periods. However, the influence of evaporation on isotope and d-excess is prevalent in most places except the southeastern part of the study area. Meanwhile, this results

also indicated that there may be a hysteresis for the influence of meteorological factors on isotopes and d-excess. The altitude effect is only present during the ablation periods in 2016 and 2018, and the altitude effect was −0.16‰/100 m ($p < 0.05$) and −0.14‰/100 m ($p < 0.05$). The slope of LEL for river water showed an increasing trend from initial ablation to final ablation in 2016. Meanwhile, the intercept of LEL for river water also increased from the initial ablation to the final ablation period. Moreover, the mixed segmentation model of the end-member is used to determine the contribution proportion of different water sources to the target water. The results showed that the supra-permafrost water was the major recharge source for the permafrost area river in the study area. Meanwhile, the glacier and snow meltwater contributed little to the permafrost area river in the initial and final ablation periods. For the mainstream, the proportion was 35.93% in initial and final ablation periods, and 45.55% in the total ablation period. However, the proportion was 47.49% in the initial and final ablation periods, and 36.47% in the total ablation period. The proportion of glacier and snow meltwater for the mainstream (16.59%) was higher than that for the permafrost area river (3.25%) but was lower than that for the glacier permafrost area river (19.44%) in the initial and final ablation periods. Meanwhile, the proportion of glacier and snow meltwater for the mainstream (17.98%) was higher than that for the permafrost area river (13.95%) but was lower than that for the glacier permafrost area river (27.30%) in the total ablation period. ”.

11. Fig. 8.Small plot inside is unreadable.

Thank you very much for your comments. It has been revised as:


Glacier Permafrost Runoff
Permafrost Runoff
Mainstream
Precipitation
Glacier and snow meltwater
Supra-permafrost water
d-excess (‰)
δ 18O (‰)
Initial ablation in 2016
Ablation in 2016
End ablation in 2016
Ablation in 2017
Ablation in 2018