Responses to editor comments:

We have now received the comments of the two referees and the responses from the authors. After my own assessment of the manuscript and looking at the reviewer comments, I agree that the manuscript presents valuable information from an experimental study on the hydrologic effects of biocrusts in in the Qinghai-Tibet Plateau region. However, as identified in the referee comments, there are several aspects that need to be carefully addressed before considering publication.

Response: *First of all, we would like to express our great appreciation to the editor and two anonymous reviewers for their valuable suggestions and comments on the previous version of the manuscript. The revised manuscript has been significantly improved as a result of your constructive advices. Our responses to the editor's and two reviewers' comments and modifications made are detailed in following pages. We hope that the revised version is satisfactory to your journal.*

1. Both reviewers have identified some aspects that need to be clarified including the following key aspects:

1) Discussion of the potential limitations of the results (i.e., due to site-specific aspects) and possible generalization or transferability of the results/conclusions to other sites. Both reviewers agree that this point needs to be captured in the conclusions.

Response: *Thank you for your positive comment, we have added the potential limitations of the results in our discussion, such as "Nevertheless, our study results were only obtained by conducting in site scale, which may not sufficiently to extrapolate the whole QTP owing to its high spatial heterogeneity. Thus, a larger scale or more study sites is necessary to have a generalizability conclusion regarding the effects of biocrust on hydrological processes in alpine meadow of QTP (Lines: 286-289)".*

2) Justification of study site selection.

Response: *Thank you for your positive comment, we have added the justification of study site selection in our revised MS, such as "to reduce the differences caused by spatial heterogeneity, the BM was selected adjacent to the NM to ensure the soil type and topographic condition was same (Lines: 100-102).*

3) Clearer explanation of the biocrust characteristics at the study site.

In addition to these main points, both reviews include very useful feedback and several other comments that are extremely valuable (including some clarifying comments on figure captions, etc.). I appreciate the authors' detailed and positive responses to all comments, which is very important as after resubmission the paper will be returned to the reviewers for further assessment.

Response: *Thank you for your positive comment, we have carefully revised our MS based on two reviewers comment.*

Responses to Reviewer #1 comments:

1. *This manuscript explores how the biocrust influence the hydrological features in meadow ecosystems in the Qinghai-Tibet Plateau, and the authors found that the presence of a biocrust community is a signal of degradation of the meadow ecosystems due to reducing the soil water retention and soil infiltration compared to typical Kobresia meadow. The finding is vital empirical evidence for making management policies for maintaining the sustainability of meadow ecosystems in the long run, especially under dramatic climate changes during the anthropocene. However, some minor errors still need to be improved before a formal publication.*

   Response: *Thank you for your positive comment. We would like to express our great appreciation to the anonymous reviewers for their valuable suggestions and comments on the previous version of the manuscript. We have revised manuscript substantially based on reviewer's constructive advices. Our responses to the reviewers' comments and modifications made are detailed in following pages. We hope that the revised version is satisfactory to your journal.*

2. *After going through the whole ms, the "which" at line 29 refers to biocrust but not infiltration. So, this sentence needs to be rewritten.*

   Response: *Thank you for your remind, we have revised these sentences.*

3. *At the beginning of the introduction, the ms only depict the imperative functions of biocrust. However, a clear definition of biocrust may make the ms more general to large audiences.*

   Response: *Thank you for your good comment, we have added the clear definition*

of biocrust in revised MS, such as "Biocrusts are composed of living non-vascular plants (mosses,lichen and green algae) and microorganisms (such as cyanobacteria, fungi and bacteria) associated with their bonding soil particles that occur in the uppermost few millimeters or even centimeters of surface soil"

4. *Line 42, please explain why arid and semi-arid ecosystems differ from meadow ecosystems.*
   Response: *Thank you for your comment, we have explain the rid and semi-arid ecosystems differ from meadow ecosystems, such as "most previous studies were conducted in arid and semi-arid ecosystems, such as the Tengger Desert, Negev Deserts, and Loess Plateau hydrological processes where plant are limited by soil moisture. Very few studies have focused on the role of biocrust on hydrological processes (i.e., soil water content, soil water retention, and soil infiltration) in alpine ecosystems where plant are limited by soil temperature.*
5. *Line 43, What "display a positive effect on soil hydrological properties"? Consider splitting the sentence from 40-44, " However,.... hydrological properties." into two sentences.*
   Response: *Thank you for your comment, we have revised.*
6. *As the alpine already contains information about high altitude, there is no need to use the expression of "high-altitude alpine ecosystem." For instance, in line 45.*
   Response: *Thank you for your comment, we have deleted the high-altitude.*
7. *Try to unify the expressions between "hydrological processes" and "hydrological properties.".*
   Response: *we have made it consistent.*
8. *Line 48, same grammar error as in the abstract, the "which" refers to the alpine meadow, not QTP.*
   Response: *Thank you for your comment, the "which" refers to the alpine meadow in our meaning.*
9. *Line 61, the first half of the sentence, is unrelated to this ms; the second half repeats the meaning at line 41.*
   Response: *Thank you for your comment, we have deleted this unrelated sentence and repeat sentence.*
10. *A typo between lines 103 to 105..*

Response: *revised.*

11. *Line 67, compared to what "biocrust could increase soil water infiltration.....". Similarly, there are expressions like this; the author needs to clarify the reference object when comparing biocrust and other reference objects.*
    Response: *good comment, we have added the reference object.*
12. *Please explain the meaning of "disturbed" and "undisturbed" in lines 103 and 109.*
    Response: *Thank you for your comment, we have added the meaning of "disturbed" and "undisturbed" in our revised MS, such as "We obtained the disturbed soil samples (i.e. non-ring knife soil sample) in NM and BM" and Undisturbed cylindrical ring samples (i.e. ring knife soil sample) were also obtained in each treatment.*
13. *he abbreviation "CMC" stands for soil capillary water capacity, but there is no letter "M" within this terminology.*
    Response: *Thank you for your carful check, we have revised the CMC into CWC (capillary water capacity).*
14. *. Line 142, to keep consistency with the first sentence of the paragraph, replace "crust and NM" with "BM and NM."*
    Response: *Thank you for your comment, we have revised.*
15. *Because there are many types of biocrust, mainly composed of different kingdoms of organisms, hence biocrust is a very broad concept. Therefore, I suggest the authors clarify the type of biocrust when mentioning it in the discussion. Moreover, the same issue mentioned in comment-8, the author needs to make the reference object clear when comparing biocrust and other reference objects.*
    Response: *Thank you for your comment, we have clarified the type of biocrust when mentioning it in the discussion, such as "In this study, however, we found that the presence of cyanobacteria crust could improve topsoil texture compared with normal meadow, but not that of deep soil....." .*
16. *Line 238, the conclusion is just speculation by authors but not proved by the data of this study. Hence, the word "conclude" is too strong.*
    Response: *Thank you for your comment, we have revised our conclusion just*

based on our data results.

17. *Line 449 lacks a legend of "(b)" in correspondence with the right panel of Fig. 6..*
    Response: *Thank you for your comment, we have revised.*

18. *In Fig. 8, the arrows are overlaid with the numbers.*
    Response: *Thank you for your comment, we have revised.*

19. *The authors need to upload Table 1.*
    Response: *Thank you for your remind, we have upload Table 1.*

20. *For Fig. 7, did the authors generate this figure using the combination of the NM and BM datasets? This needs to be clarified.*
    Response: *Thank you for your good comment, the figure by both the datasets of NM and BM, we have clarified in revised Figure caption such as "Pearson correlation between soil water retention and soil properties (a) among two surface soil types, and the relative influence of soil properties on soil water retention (b)"*

21. *Line 455 lacks a legend of "(b)" in correspondence with the right panel of Fig. 7..*
    Response: *Thank you for your remind, we have revised*

22. *For Fig. 8, the same issue as Fig. 7, did the authors generate the figure by both the datasets of NM and BM?*
    Response: *Thank you for your remind, the figure by both the datasets of NM and BM, we have clarified in revised Figure caption such as "Structural equation modeling of the direct and indirect effects of soil properties on soil water retention capacity (SWRC) among two surface soil types"*

Responses to Reviewer #2 comments:

1. *This manuscript reported an experimental study on the hydrologic effects of biocrusts in the Qinghai-Tibet Plateau. On the paired study sites, i.e., crust and normal meadows, field sampling, lab measurements, and statistical analyses were performed to examine the hydrologic properties of soil samples in comparison between the crust and normal meadows. It was concluded that biocrusts may have negative hydrologic effects by reducing soil infiltration and water retention*

capacities. This study is valuable in the context of providing empirical data and some insights on biocrusts in high-latitude regions, which are much less studied than those in arid or semi-arid regions. It is potentially publishable contingent upon addressing the following comments:

Response: *Thank you for your positive comment. We would like to express our great appreciation for your valuable suggestions and comments on the previous version of the manuscript. We have revised manuscript substantially based on your constructive advices.*

2. *The conclusions can be more carefully drawn with more careful discussion. The role of biocrusts can be affected by numerous factors, including but not limited to, human influences such as landuse and managements, soil properties such as composition, climate conditions such as precipitation, radiation and temperature, vegetation characteristics, etc. Considering all these complexities, how site-specific are the conclusions and how exactly transferrable are they?*

   Response: *Thank you for your good comment, we have revised our conclusion based on your advice, to make our conclusion* not *too strong. We are full agree with your comment that the role of biocrusts can be affected by numerous factors, we are just want to explore the effect of biocrust on soil hydrologic properties from sites scale, and try to control other environment variables (such as climate condition and human influences) as the same between normal Kobresia meadow and biocrust meadow, thank you for your understanding.*

3. *More justifications on the site selection should be provided, i.e., are the climate conditions and spatial scales sufficiently representative of the whole Qinghai-Tibet Plateau and/or other high-latitude regions? If not sufficiently representative, it is fine, but such limitations should be clearly noted, at least in the discussions. This part will directly affect the generalizability of the findings drawn here.*

   Response: *Thank you for your good comment, we had stated the limitation in our discussion section, such as "Nevertheless, our study results were only obtained by conducting in site scale, which may not sufficiently to extrapolate the whole QTP owing to its high spatial heterogeneity. Thus, a larger scale or more study sites is*

necessary to have a generalizability conclusion regarding the effects of biocrust on hydrological processes in alpine meadow of QTP"

4. *A question to the authors that is mainly out of my own curiosity (maybe other readers as well): can the authors offer somehow unified explanations for the seemingly contrasting effects of biocrusts in arid regions versus the Qinghai-Tibet Plateau? In arid regions, biocrusts lead to increased vegetation coverage (as compared to bare soils). In the Qinghai-Tibet Plateau (not sure about the other high-latitude regions), biocrusts are formed due to grazing, i.e., decreased vegetation coverage. If (and only if) this is correct, can we infer that whether biocrusts lead to positive or negative hydrologic effects depend on whether they have lead to increased or decreased vegetation cover?*

   Response: *good comment, we are agreed with your views. Indeed, the effect of biocrust on hydrologic effects could part depend on vegetation cover, i.e. positive hydrologic effects could favor the vegetation growth, and the biocrust in turn could reflect by the vegetation cover. Therefore, it is correct, we can infer that whether biocrusts lead to positive or negative hydrologic effects depend on whether they have lead to increased or decreased vegetation cover.*

5. *Scientific presentation can be significantly improved. There are many overly long sentences, and they should be split into shorter ones, such as Lines 40-44, as also pointed out by Reviewer #1. Also, many sentences do not read well either due to grammar issues or lack of scientific rigor. These should be rephrased. Here I only provide three examples:*

   Response: *Thank you for your comment, we have checked the whole MS to revised these sentences may have grammar issues or lack of scientific rigor.*

6. *Line 14-16. This sentence is not clear. "role" can imply many things, including "effects and mechanisms". Line 36-40: sentence too long. Please split it into two or more sentences..*

   Response: *Thank you for your comment, we have revised the role into impacts.*

7. *Line 40-44. The second half does not make good sense. Who "display a positive effect"?*

   Response: *Thank you for your comment, we have deleted the second half sentence.*

8. *Line 426. The caption is misleading. What the figure shows is soil texture, not particle size distribution?*

   Response: *Thank you for your comment, we have revised.*

Thank you for your detailed comments. Please see our PDF revised MS in supplement files.