Responses to the Comments by the Reviewer

We thank Editor Nadia Ursino and an anonymous reviewer for their constructive comments. Based on your comment and request, we have made extensive modification on the original manuscript. Here, we attached revised manuscript in the formats of both PDF and MS word, for your approval. A document answering every question from the referees is also included. The manuscript has been significantly improved by addressing the comments. The following are our point-to-point responses to their comments.

(The manuscript presents analysis of precipitation distribution in a Mu Us Sandy Land plot planted with Pinus sylvestris var. mongolica (PSM), over a period of four years. Total precipitation, soil water content, deep soil recharge and sap flow were directly measured, and other parameters (soil water storage, evapotranspiration) were calculated based on the measurements. The analysis of precipitation distribution in the PSM plot was compared to an adjacent bare sand plot to evaluate the effect of the PSM on the precipitation distribution. Overall, I find this manuscript valuable to the understanding of hydrological cycles in areas where vegetation restoration is implemented for desertification control. Hence, in my opinion the manuscript is worthy of publication.

However, in the current form of the report, the quality of the scientific work done by the authors cannot be fairly evaluated. The text contains multiple structure, coherence and grammar issues / mistakes and currently does not meet the quality standard for publication in HESS.

Some of the major issues that should be corrected in the revised version are related to the following:

Correct construction of paragraphs including an emphasis on the flow of the text (i.e., connection to the next paragraph).

Response: We have revised the full manuscript and adjusted the research methods to avoid repetitive and unnecessary descriptions. Adjustments were made to the conclusions of the experiment and the vague parts of the discussion, including grammar and paragraph structure.

Attention to the length and clarity of sentences.

Response: We revised the long sentences and vague descriptions and used short sentences as much as possible to describe the experiments and conclusions clearly.

Definition of acronyms at their first mention and consistent use of the acronym after it has been defined.

Response: We have annotated the acronyms that appear for the first time in the abstract and the main manuscript to ensure that readers can clearly understand.

Captions of the figures and tables should describe in more detail what is shown in each panel / what are the parameters presented in the table.

Response: We have revised captions of the figures and tables in Figure 1, Figure 3, Figure 4, and all tables, and described the parameters in the main manuscript.

Correct use of grammar.

Response: We have verified and revised the grammar of the manuscript, and sorted out the full manuscript with the assistance of a native English speaker.

Below are some specific examples. The authors should note that these are merely examples, and the revision should include the entire text.)

1. **Abstract, line 1:** "Precipitation was the most important water resource in semi-arid regions of China". **The sentence communicates that precipitation is no longer the most important water resource in the semi-arid regions of China. I believe that the authors meant to convey that precipitation is the most important water resource in those areas (and therefore the paper focuses on the analysis of its distribution).**

Response: This is a grammatical error. This sentence is rewritten as "Precipitation is the most important water resource in semi-arid regions of China". Please see line 1.

2. **General: pay attention to the excessive use of 'we' / 'we need to' / 'we decide' / 'we can select' / 'we set up' etc.**

Response: Implemented.

3. **Introduction, general: please refrain from excessive use of 'some researchers'. Note that when you state that 'many researches' have shown something you are expected to cite more than one paper.**

Response: Implemented. We have added more relevant references when many researchers are mentioned, and we have limited the use of "some researchers".

4. **Introduction, line 46: "**Large-scale afforestation can affect water cycle like consuming vast majority soil water and regulating water redistribution process (Zhou et al., 2019;Zhang et al., 2018)." **Here and elsewhere, the use of the word 'like' in this context is incorrect.**

Response: Implemented. The word "like" is replaced with "such as".

5. **Introduction, line 65:** "Most of the forests in the 3NSP are rain-fed forest(Cheng et al., 2021b), thus whether the precipitation can supply the survival of reconstructed PSM and the precipitation redistribution in shallow soil layer is important in this rain-fed forest ecosystems, which affect the water balance of forest land and the biochemical cycle of this region". **This is an example of a very long and unclear sentence. Note the missing space before the cited papers (here and elsewhere).**

Response: Implemented. This sentence was rewritten as: "Most of the forests in 3NSP are rain-fed forests and their survival is directly related to precipitation (Cheng et al., 2021b). The shallow soil layer is an important zone for storing precipitation in semi-arid areas, thus it

is a key zone for studying hydrological cycles of rain-fed forests". All references formats in the article have been adjusted and a space before the cited papers has been added. Please see line 85.

6. **Introduction, line 67: the term PSM is used but it was not defined before.**

Response: Implemented. We have provided the full name of PSM (Pinus Sylvestris var.Mongolica) when it is mentioned the first time in the abstract and text. Please see line 93.

7. **Introduction, line 96-106: this part of the introduction, describing the main goal of the study, the research questions and the expected contribution should be especially clear to the reader. Since there are several research questions, I'd suggest to number them and refrain from phrasing them as questions. The use of 'find out' (**'The purpose of this study is to find out the effect of…'**) is not appropriate here. The use of 'try' in the context of the aims of the study (**'We will try to understand'**) is also not appropriate. In line 105 the word 'exam' (**'We will also try to exam'**) should be changed to 'examine'.**

Response: Implemented. This part is rewritten as: "the purpose of this study is to observe and assess the effect of rain-fed PSM on precipitation redistribution in MUSL through in-situ observation experiments. We try to answer the following three questions in this investigation: 1) Can precipitation recharge groundwater after PSM restoration? 2) What are the proportions of evapotranspiration, SWS and groundwater on precipitation? 3) Can rain-fed PSM survive under existing annual precipitation conditions? To answer these questions, we have designed a comprehensive experiment system through continuous observation of precipitation redistribution process in the PSM forest land and the bare sandy land (BSL) in the northeastern MUSL. We try to uncover the precipitation redistribution mechanism of PSM replantation and provide a theoretical basis for managing sand-fixation plantation in MUSL. This study will also try to examine whether the incapability of PSM reproduction is caused by water shortage or not."

8. **M&M, general comment: overall the M&M section is very long and poorly organized.**

Response: Implemented. M&M section is adjusted the order and rewritten.

9. **M&M, line 112:** "…a large area of vegetation restoration has been carried out since 1978." **In its current form, the sentence suggests that a large area has been carried out (which makes no sense grammatically).**

Response: Implemented. This sentence is changed to the past perfect tense, "The study area was located in Taigemiao (39°10′13.62″ N, 109°31′51.59″ E) on the northeastern of MUSL. MUSL was one of the severe desertification areas in China, thus massive vegetation restoration had been carried out in MUSL since 1978."

10. **M&M, Figure 1: the different panels should be marked with letters (A, B, C, D) and the caption should be improved.**

Response: Implemented. All the panels have been marked with letters (A, B, C), and the figure caption is rewritten as: Figure 1 Overview of the research area: A) the location of the research area in China, northern arid-semi-arid areas; B) the characteristics of the PSM forest field in the research area, the strip-shape PSM restoration zone: C) the in-situ experimental observation instrument.
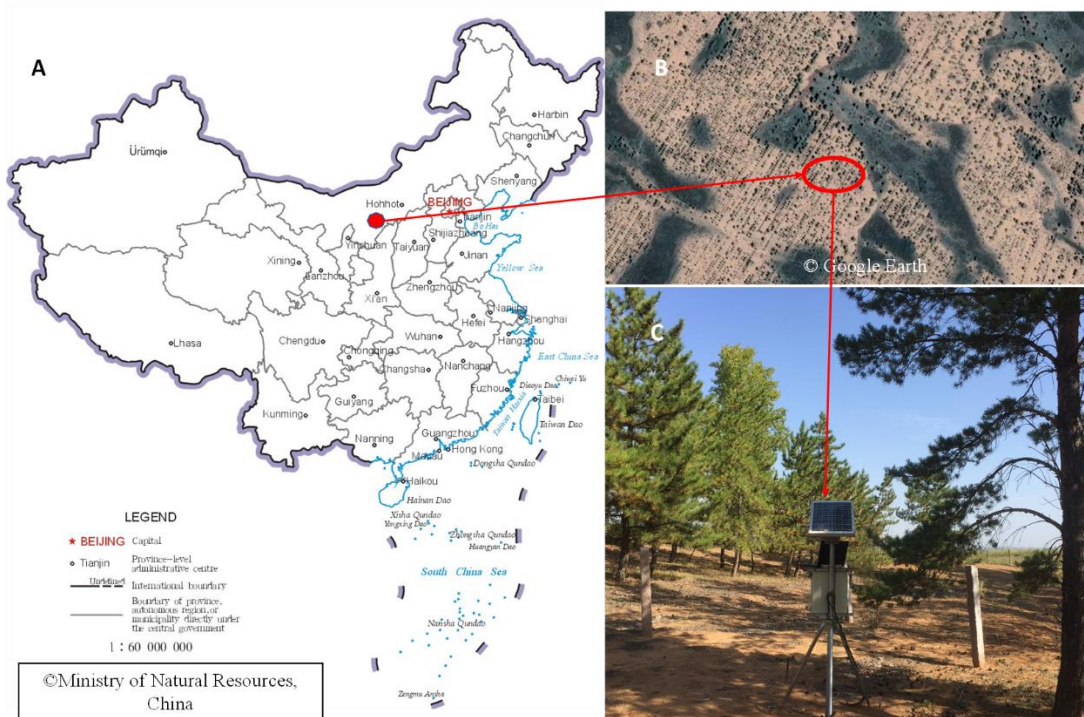
Figure 1 Overview of the research area: A) the location of the research area in China, northern arid-semi-arid areas; B) the characteristics of the PSM forest field in the research area, the strip-shape PSM restoration zone: C) the in-situ experimental observation instrument.

11. **M&M, line 125: the term BSL was already defined in line 103.**

Response: Implemented.

12. **M&M, line 144: the term DSR was not defined.**

Response: Implemented.

13. **M&M, line 144:** 'Since 2015, the experimental field has been established'. **This sentence is grammatically incorrect.**

Response: Implemented. The sentence is changed to "The in-situ experimental observation plot was established in 2015."

14. **M&M, line 190:** "It takes a certain time for the soil to settle down, so we need to install the instrument six months to one year in advance for the soil profile to settle down to its pre-

excavation stage". **This is an example of a badly phrased sentence. The use of 'settle down' and 'a certain time' in this context makes the sentence unclear.**

Response: Implemented. The sentence is changed to "In-situ experiments required the excavation of soil at the site, installation of DSR instruments and backfill of the excavated site. These procedures inevitably altered the native soil condition. Therefore, it is recommended to wait six months to a year for the backfilled soil to settle and return to its pre-excavation state".

15. **M&M, line 199:** "The planting years of PSM in this region are the same, but the growth is not the same". **Unclear sentence.**

Response: Implemented. "The PSM plants in this area were all replanted at the same year in 1978, but the growth status of individual PSM can be different from each other due to various reasons". Please see line 258.

16. **Results, line 272:** "ET was calculated by the water balance equation.". **I think that this should be explained in the M&M.**

Response: Implemented. Please see line 301-310.

17. **Results, Table 1: the parameters T and E were not defined before but are used in the table. The caption should describe all the parameters that are presented in the table (the use of 'etc.' is not appropriate here).**

Response: Implemented. Please see line 338-340.

18. **Results, line 350: this equation should have been presented in the M&M.**

Response: Implemented. Please see line 301-310.

19. **Results, line 360-361: the phrasing of this sentence as a question is not appropriate here.**

Response: Implemented. "This suggested that the sap flow rate during a specific precipitation event might be suppressed by that event, but overall, there was no significant change in the annual sap flow regardless of wet year (like 2016) or dry year (like 2019). Recent studies have shown that rising temperatures caused by increasingly strong solar radiation can allow plants to transpire water back to the atmosphere even at night time (Panwar et al., 2020) and the annual sap flow was more closely related to the annual net radiation, rather than the annual precipitation. "

Please see line 420-425.

Although a full evaluation of the quality of the manuscript is currently very difficult, below are some content-related comments that should be addressed or clarified:

1. **Line 198:** "The sap flow flux equal to the transpiration of PSM". **Is this always true or is this true under a steady state assumption?**

Response: Very nice comment. Since Garnier (1987) invented the TDP method to measure vegetation sap flow, the view of sap flow equaling to the transpiration has been gradually accepted by many investigators. However, some other studies argued that the sap flow was less than the transpiration because the growth of vegetation would retain part of the sap flow, which did not actually flow up to become transpiration. Because of this concern, such studies stated that the sap flow could equal to 95% of the vegetation's transpiration. If the growth of vegetation becomes very slow, then the sap flow could be close to 100% of the vegetation's transpiration. PSM investigated in this study was 40-year-old, and the growth rate of PSM at this age was very slow, so we assumed that the sap flow was approximately equal to the transpiration in this research. Please see line 254-268.

Granier, A. (1987). Evaluation of transpiration in a Douglas-fir stand by means of sap flow measurements. *Tree physiology*, *3*(4), 309-320.

2. **Table 1: the sum of SWS, DSR and ET adds up to < 100%. Please include a statement (or mass balance %) somewhere in the text.**

Response: Implemented. ET=Pr-SWS-DSR, Pr was precipitation, SWS was soil water storage, DSR was deep soil recharge, ET was Evapotranspiration. We kept four decimal places when calculating, which caused the result to add up to not equal to 100%. Please see line 340.

3. **Line 338-342: a correlation coefficient of ~0.27 is presented for precipitation and evaporation in BSL and a correlation coefficient of ~0.99 is presented for precipitation and evaporation in PSM. Considering this, your conclusion in line 340 is not clear to me.**

Response: Thank you for your careful review and very important suggestions. The BSL plot only has evaporation (E) but no transpiration (T). The PSM plot has evapotranspiration (ET). In this study, surface evaporation and vegetation transpiration were calculated separately. The conclusion here has been rewritten as: "The correlation between precipitation and evaporation was not significant (with a Pearson coefficient of 0.27416) in BSL plot, but in PSM plot, ET and E were closely correlated with Precipitation with a Pearson coefficient of 0.95364, 0.99706, respectively. This finding showed that: without vegetation, precipitation was highly correlated with DSR, and most of the precipitation was converted into DSR; when vegetation was restored, precipitation was highly correlated with ET and T and precipitation was mainly converted into ET and T."

4. **Line 368: the sentence implies that solar radiation is presented somewhere in Figure 3. Since it is not – please rephrase this sentence.**

Response: Very nice comment. We have no solar radiation meter under in-situ conditions, our judgment is based on subjectively felt changes in the intensity of solar radiation and we decided to delete this sentence.

5. **Line 374:** "Thus, there was no difference in sap flow rates among dominant trees". **This is not a fact or a finding. It's an assumption based on the distribution of trees in the plot.**

Response: Implemented. We deleted this reasoning.

Thanks again to the anonymous reviewers for their careful and meticulous review. We believe that the current manuscript has reached the requirements of HESS.