Hydrology and Earth System Sciences Discussions

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Comment on hess-2021-285

Anonymous Referee #2

Referee comment on "Redistribution process of precipitation in ecological restoration activity of Pinus sylvestris var. mongolica in Mu Us Sandy Land, China" by Yiben Cheng et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-285-RC2, 2021

General comments:

In the manuscript "Redistribution process of precipitation in ecological restoration activity of Pinus sylvestris var. mongolica in Mu Us Sandy Land, China" the authors present a study on the distribution of precipitation to evapotranspiration, soil water storage, and ground water recharge of an afforested versus a bare site in semi-arid China. This is definitely an interesting and highly relevant topic. Also the main results which is the lack of ground water recharge in afforested sites, is important. Unfortunately, the manuscript is badly written, there are a lot of repetitions, lots of things are described far too long, while other essential ones are missing or mentioned too late (e.g. the amount of sap flow sensors or lysimeters installed). Also, even though not clearly described, the study design appears to be extremely minimalistic (only one sap flow sensor, only one lysimeter/soil moisture sensor profile per site) and does not allow any estimation of (spatial) variability. Therefore, I have to conclude that this manuscript is not suited for publication in HESS.

Specific comments

Abstract

Line 1: why "Precipitation was…" and not "Precipitation is…"? Is that not the case anymore? What has changed?

Line 3: Not sure what you mean with the term "land surface ecological system sustainability". Better to be more precise here. Would also rather use "afforested"

Line 7: To my knowledge, in (eco)hydrology the term "interception" is more used for water intercepted by the plant canopy (the opposite of throughfall) than in the soil, so I would use another term for water stored in the upper soil layer to avoid confusion (also in the following e.g. in line 14)

Line 12: I would avoid pseudo-accuracy, for instance "54% of precipitation" instead of "54.03%". Please check in the whole text (e.g "7.58 mm" in line 15 or "153.98 mm/yr" in line 17)

Line 13: Not sure about the effects of soil temperature on infiltration. It is quite straightforward that there should be differences in soil temperature between the afforested and the bare-soil plots due to shading etc. but how that might affect infiltration has to be explained…

Line 16/17: March to October is not really a one-year period but might be a growing season.

Line 19/20: A better reasoning for the final statement would be good, it is quite a big jump from the basic hydrological data presented before to this conclusion

Introduction

Line 31-33: A bit more information on these projects would be interesting, at least where they are situated.

Line 38-63: A lot of results on the hydrology of afforested (semi-) arid regions are presented, but a clear structure is missing here. Instead of writing some researcher found this and other researchers found something else it might be better to present a concise theory of the effects of afforestation on the local water cycle (e.g. more trees => more interception by the plant canopy/less throughfall => less infiltration + change of soil properties => higher water storage at top soil layer + higher transpiration by trees => less groundwater recharge) and add the corresponding references at the respective places.

Line 64-65: This rather general sentence would fit better at the beginning of the introduction

Line 64-78: I would merge this paragraph with the one before, it is basically a more general repetition of possible effects of afforestation on the water cycle

Line 78-90: This paragraph introduces Pinus sylvestris var. Mongolia and its degradation. The possible reasons for the later remain unclear, especially the question if precipitation actually decreases or increases. Could this be an effect of scale: large scale decrease of precipitation in the whole region but small-scale increases in the afforested stands due to higher air humidity caused by more evapotranspiration?

Line 91-108: The research questions are the most important part of this paragraph. The beginning and end of the paragraph should be shortened/streamlined.

Material and methods

Figure 1: The red and blue dots are hardly visible in the map, either make them bigger or zoom further in (or you make just one point as the 2 plots are really close).

Line 116: Not sure what you mean with "soil freeze-thaw period". Is this a period where the soil freezes during the night and thaws during the day (in addition to a period with frozen soil in winter and non-frozen soil in summer)? Or is this the winter period where soil might freeze but it does not happen every day?

Line 125: Any idea about potential evapo(transpi)ration on the forested site.

Line 138: Any idea about the (original) distance between trees within one belt

Line 149-193: There are two pages of description of the lysimeter and its installation which is just far too much, please condense it two maximum half a page. On the other site some important information is missing, e.g. what is the diameter of the lysimeters, how many lysimeters were installed, how many and which type of soil water content sensors (which producer) where installed, did you also measure soil water potential? This information could also be presented in a table. I also would not consider the idea of placing a lysimeter/seepage collector below the soil surface something completely new. What I was missing was a description of the lower boundary of the lysimeter, which could influence the amount of seepage measured.

Line 198-229: Again, the description of which trees were chosen for sap flow measurements is too long, but in the end it remains unclear how many trees where measured in the end (only one)?

Line 220/221: A reference for this equation should be given. In general, getting an exact amount of transpired water from sap flow is rather difficult (see e.g. Peters et al. (2018) New Pytologist doi: 10.1111/nph.15241 or Flo et al (2019) Aricultural and Forest Meteorology doi: 10.1016/j.agrformet.2019.03.012)

Line 231-247: The horizontal distribution of the roots was mentioned before. I would add the description of the soil moisture sensors and soil water storage (and also deep soil recharge) to the description of the lysimeter before and describe the sap flow sensors afterwards.

Line 249-269: Basically everything in this chapter (vapor flow has not been measured but is of minor importance, deep soil recharge is essential) has been mentioned before and should not be repeated.

Results

In general there is a lot of text here which belongs to the methods chapter (most of it repetitions but also some things mentioned for the first time) and also some other which belongs into the discussion (everything that goes beyond describing your results, for example interpretating them and comparing them with the literature).

Line 271: "ET" should be evapotranspiration, not precipitation.

Line 278-342: there is no need to repeat alle the information presented in the tables again in the text (and for example the deviation of precipitation from the long-term average could be added to table 1), better to summarize and point to important findings. Also be aware of pseudo-accuracy, I would not give two decimal places on annual sums, or 4-5 for an R^2.

Table 1: The abbreviations used in the table should be explained in the table caption, so that the table can be understand without reading the whole text (also important or figures). Also ET at BSL should be all E and not all T, as there is no vegetation.

Line 318-325: Did you correlate yearly sums of the different water balance components, or monthly sums, even daily sums would be possible and results may change with the time scale used.

Line 335-336: Why do you think reducing the density of PSM plantations would help it to cope with extreme drought? Inn general this is probably true, but more reasons and a clearer path to this conclusion should be given.

Line 346-355: Basically the whole paragraph belongs into the methods section and should not be repeated in the results (and if, with maximum one sentence).

Line 356-377 (including Figure 3): I think you confuse daily sap flow rates and annual sums of sap flow/transpiration in line 361. Table 1 shows that there is a large difference in the annual sum of transpiration at PSM between 2016 (323 mm) and the other years (max 198 mm). From Figure 3 one might think that there is hardly any difference in daily rates between the 4 years displayed, however the layout of figure 3 makes it hard to really compare between the years. Instead of using bar graphs, it would be better to use lines, then you could actually combine all 4 years in one graph and see immediately where there are differences. Also sap flow velocity is displayed in the figure while actual daily sums of sap flow/transpiration would be far better and allow a comparison with the annual sums in table 1. If you really think nighttime transpiration is important, you have to show daily courses of sap flow (of a selected period) where you can actually see it. The fact that sap flow was measured at only one tree (370-371) should be mentioned in the methods section and given the variability of sap flow measurements often observes and its dependence on correct installation casts a serios doubt on the overall validity of this study. In general, I would expect daily sap flow rates to be low when it rains, high when the sun is shining/temperatures are high/air humidity is low, but the soil is still wet, and then decreasing when the soil moisture starts to decline. If you cannot see that when plotting daily values, also weekly or monthly ums might help. To facilitate the interpretation, it would also help to combine sap flow data with precipitation and soil moisture data in one plot (also deep seepage could be added, all line graphs). Also, sap flow sensors are usually somewhat limited in their functionality when the air temperature is below 0 °C, so this should be considered when showing all year data.

Figure 4/5: Again line graphs would be much better here and would allow the combination of both years and maybe even both sites in one graph.

Line 393: More likely the amount of organic matter in the soil improves with reforestation rather than soil texture (i.e. the ration of sand/silt/clay) itself, but the studies showing that have to be properly referred to in any case (add citations). And then his should go to the discussion section.

Line 424: You should actually see if PSM has entered dormancy in your sap flow data.

Figure 6: Is there any reason why July is (c) but august is (b)?

Line 444-452: You actually do not show any concreate soil temperature data, therefore it is no possible to evaluate this conclusion. I would also be careful to draw such a general conclusion based on only two observations.

Discussion

Line 459-499: In general, in the discussion chapter, you should compare your results with other studies in the literature. You did that in some cases already in the results-chapter, those should be moved here. in the starting paragraphs of your actual discussion, you are describing very broadly topics of soil water transport, land degradation, and vegetation restoration, but without a connection to your actual study. So, this part could actually be a part of the introduction, but it is far to long here in the discussion.

Conclusions

Generally, the conclusions section should not be a summary of the manuscript so far, but

it should present conclusions from the study which go beyond its specific scope. In your case that could be for example (1) that tree density should be reduced in further plantations in the future (but provide specific, clear arguments for that), (2) what are the further consequences of reduced ground water recharge due to afforestation in the region, or (3) how the water balance is related to PSM vitality decline and mortality observed in dry years.