

Ref: bg-2017-253

Title: Community specific hydraulic conductance potential of soil water decomposed for two Alpine grasslands by small-scale lysimetry

Dear Editor Paul Stoy, dear Natascha Töpfer!

Please find enclosed the revised version of 'Community specific hydraulic conductance potential of soil water decomposed for two Alpine grasslands by small-scale lysimetry' (bg-2017-253). Thank you very much for the detailed review and the constructive comments alongside which we thoroughly revised our manuscript. As you will see we considered all comments of both reviewers. We think the reviews really helped us to considerably improve the manuscript.

Reviewer 1:

R: Line 39: Very long chain of words.

A: The sentence was simplified in the manuscript.

R: Line 43: Very long chain of words. "drought adapted vegetation type" was written without hyphens, please be consistent, keep or remove the hyphens.

A: The sentence was simplified and we harmonized the term in the manuscript (always with hyphens).

R: Line 52: 'Earth' instead 'earth'

A: done

R: Line 64-64: 80% seems too high. Please check for follow up papers.

A: Thank you for this suggestion! We have incorporated the newer literature and changed the part accordingly: *'The water balance in terrestrial ecosystems is dominantly controlled by plant processes. It is suggested that up to 55% of the terrestrial water loss to the atmosphere is mediated through plant transpiration (Wang et al., 2014; Wei et al., 2017).'*

R: Line 67: Do the authors mean vegetation productivity? This should be specified.

A: Yes, we mean 'vegetation productivity'. We specified the term.

R: Line 79: 'are' instead 'is'

A: adopted

R: Line 81-82: unclear sentence, please rewrite

A: The sentence was rewritten.

R: Line 152-153: Here it is important to present which Alpine grassland communities have been studied.

A: Thank you for this suggestion! We specified here now the two grassland communities.

R: Line 173 (Table 1): are these average annual temperatures and precipitation?

A: Yes, we have changed to average annual temperature and precipitation

R: Line 224: Add space.

A: done

R: Line 564: Here, and elsewhere it should be clarified that these are plant communities.

A: adopted

R: Line 586-589: Difficult sentence to read.

A: The sentence was simplified in the manuscript.

R: Line 593-607: Please simplify this paragraph. It is very difficult to follow.

A: The paragraph was simplified.

R: Line 615: plant growth forms? and plant species composition?

A: Yes, we mean 'plant growth forms' and 'plant species composition'. We specified the terms.

R: Line 644-648: Cut, this sentence does not add more information.

A: done

R: Line 649: This whole last paragraph is mainly focusing on presenting the experimental limitations of the study. These limitations could be moved to the method section. Here I expect to see a broad discussion about the impact and meaning of the results of this interesting study.

A: The whole last paragraph was moved to the method section as suggested.

R: Line 652: change in '...should be considered as artefacts of sheltering'

A: done

R: Line 652-653: Unclear.

A: done

R: Line 663: change in 'in the context'

A: done

R: Line 705-707: This is a question. Add "?" at the end of the sentence. I do not understand this sentence. Re-write.

A: We changed to: 'To what extent play physiological and morphological changes of single plant species a role or is there an immediate shift to better adapted plant species?'

Reviewer2

R: Frenck and others measure water use and biomass gain by alpine plant communities from mesic and more xeric sites. Plants from the xeric sites exhibit a 'water savings' strategy. I found the technical aspects of the analysis to be interesting but the authors seem to have missed recent literature on isohydricity/anisohydricity (see e.g. <http://onlinelibrary.wiley.com/doi/10.1111/gcb.13389/full>). Opportunities to place observations in the context of surface and stomatal conductance were missed, and the results are therefore rather qualitative with respect to 'more water savings vs. more water spending'.

A: Many thanks for the valuable comments! We have taken all points into account in the revision. In this way we hope that we have now largely resolved these concerns.

The manuscript has interesting elements, but at a minimum the following comments must be integrated and the role of surface conductance and plant strategy discussed to place the manuscript into a more modern (with respect to the literature) context.

'merely understood' on line 35 doesn't make sense. Poorly understood? And if so, why?

A: The sentence was rewritten: 'For Alpine grasslands, community specific imprints on drought responses are poorly analysed so far due to the sufficient natural water supply.'

The abstract didn't contain a single number and was entirely qualitative. Please re-write to add quantitative vigor to the abstract.

A: We have slightly changed the abstract and have incorporated some important numbers.

On 65, the Jasechko et al. 2013 study has been roundly criticized by other studies. Basically it is incorrect. I recommend taking a look at the following references:

Coenders-Gerrits, A. M. J., Van der Ent, R. J., Bogaard, T. A., Wang-Erlandsson, L., Hrachowitz, M. and Savenije, H. H. G.: Uncertainties in transpiration estimates, *Nature*, 506(7487), E1–E2, 2014.

Fatichi, S. and Pappas, C.: Constrained variability of modeled T:ET ratio across biomes, *Geophys. Res. Lett.*, 2017GL074041, doi:10.1002/2017GL074041, 2017.

Schlaepfer, D. R., Ewers, B. E., Shuman, B. N., Williams, D. G., Frank, J. M., Massman, W. J. and Lauenroth, W. K.: Terrestrial water fluxes dominated by transpiration: Comment, *Ecosphere*, 5(5), 1–9, doi:10.1890/ES13-00391.1, 2014.

Schlesinger, W. H. and Jasechko, S.: Transpiration in the global water cycle, *Agric. For. Meteorol.*, 189, 115–117, 2014.

Wang, L., Good, S. P. and Caylor, K. K.: Global synthesis of vegetation control on evapotranspiration partitioning, *Geophys. Res. Lett.*, 41(19), 6753–6757, doi:10.1002/2014GL061439, 2014.

Wei, Z., Yoshimura, K., Wang, L., Miralles, D. G., Jasechko, S. and Lee, X.: Revisiting the contribution of transpiration to global terrestrial evapotranspiration, *Geophys. Res. Lett.*, 44(6), 2792–2801, doi:10.1002/2016GL072235, 2017.

A: Thank you for this suggestion! We have incorporated some newer literature (as suggested) and changed the part accordingly (see also R1).

On 108 please quantify what is meant by 'past' by van der Schrier et al., 2007. The past few millennia?

A: We mean 'past centuries'. We simplified this in the manuscript

Line 126-7 should be re-worded.

A: The sentence was simplified.

I agree with previous reviews with respect to the use of “common garden” in this case (line 150). It isn't strictly a common garden experiment.

A: This is correct! We changed now in: ‘In a transplant experiment we used a network of automated small scale lysimeters in a common garden to emerge plant community specific differences in the temporal dynamics of soil water depletion and evapotranspiration.’

On 160, the hypothesis is a straw man. This is how vegetation works by “spending” water when it is available and a “sudden decline” near the wilting point! The question is how (quantitatively) transpiration remains high amongst different vegetation types. That being said, does ‘continuous’ mean ‘monotonically decreasing’? There will be a point in the soil moisture continuum in which transpiration is insensitive to soil moisture.

A: Thank you for this suggestion! We have rewritten the hypothesis to be more consistent: ‘For this study we hypothesize that the vegetation adapted to local, humid conditions and characterized by high biomass has a water-spending strategy i.e. it will hardly reduce transpiration with decreasing soil water availability until close to the wilting point. In contrary, the water-saving strategy of the drought-adapted vegetation implies a tight regulation and consequently a continuous decrease of transpiration when soil moisture falls below field capacity. As a consequence the local vegetation produces more biomass at moderately dry but risks hydraulic failure at very dry conditions, while the drought-adapted vegetation reduces biomass production and water use earlier and is therefore better equipped to survive severe drought.’

The methods seem largely sound given the challenges of lysimeter measurements. The soil hydraulic parameter determination is exemplary, as are the uncertainty estimates. Points representing actual measurements in Fig. 4 would help the reader understand the trends and uncertainties (as in Fig. 5).

A: We have used a whole range of non-destructive biomass estimations to describe the development of biomass as well as possible. For each method, a separate regression is therefore obtained in which individual points are presented for each date. We have already tried to depict all the points together. However, this creates a data cloud that is difficult to interpret. That is why we would like to leave this figure as it is. In order to show the variation range, we have now provided an additional figure in the appendix (Appendix 1), which shows the biomass development for the individual lysimeters. The illustrated points depict the biomass values, which were modeled on the basis of the different methods.

Please don't use the comma on line 501 and elsewhere to denote the decimal point (see Fig. 6B).

A: done

The ‘component, which defines ecosystem water flux beyond the impact of variations in total biomass’ is stomatal regulation on line 573. I found it perhaps somewhat surprising that surface or canopy conductance variations along the soil moisture trajectories weren't estimated given its central role in plant and ecosystem physiology. Is this ‘water savings’ vs. ‘water spending’ strategy related to plant isohydricity/anisohydricity?

A: Thank you for this suggestion! We have incorporated some further information about the stomatal conductance measurements (Tasser et al., unpublished) and we changed the paragraph accordingly).

We sincerely hope that the revised version of this manuscript now fulfils all necessary criteria to be published in *Biogeosciences*.

We thank you very much for your time spent on our manuscript.

Sincerely yours,

Erich Tasser, on behalf of all Authors