

Dear Reviewer,

We would like to thank you for taking the time to assess our manuscript and for your valuable comments and suggestions. We agree that the manuscript could be restructured to make it easier to follow and that some points should be better explained to avoid confusion. We have analyzed the comments carefully and the detailed responses are presented as follows.

Sincerely,

Estefanía Muñoz
Andrés Ochoa
Germán Poveda

Major comments

1. This is a relatively limited extension of an existing model, but interesting enough to warrant a publication in HESS. However, for such a limited innovation, the paper is much too long winding. It can be reduced considerably. Why are so many equations related to the Farquhar model (in the main text and the appendix) provided, while in the end no assimilation is calculated: only soil moisture and water balance components. These could be left out or only the equations presented that are needed to support the arguments.

Authors' response: Thank you for your comment. We agree with you that the manuscript is too long and we can significantly shorten it. Since Farquhar's model is widely known and published, it is not necessary to rewrite the equations but only cite the original work. Regarding assimilation, to calculate the relationship between the transpiration rate and PAR shown in Fig. 4, we coupled models of assimilation, transpiration and stomatal conductance. We noted that this point is not clear enough in the manuscript, so in the restructuring of the manuscript, we will better organize the methodology, explicitly explaining this point.

2. By the way: do we really need Penman-Monteith? According to Penman Monteith, Figure 2 seems to show that T_{max} increases linearly with radiation

and does not saturate? This seems a contradiction. With the exponential function chosen.

Authors' response: You make a valid point that the paper should focus more on explaining the transpiration mechanisms considered. When it is assumed that the other variables considered in the Penman-Monteith equation do not depend on radiation, this equation indicates a linear increase in transpiration rate with radiation (Eq. 2). Penman-Monteith assumes that plants are not damaged by excess energy and that there is no light saturation point, so photosynthesis, and thus, transpiration, will increase when radiation does. To avoid this, we calculated the relationship between transpiration and PAR by coupling the assimilation, transpiration and stomatal conductance models and measurements from the FLUXNET database. This calculation allows us to consider how radiation affects transpiration when multiple factors are involved, such as the physiological capacity of plants to transpire.

3. While the paper is too long, it should also be heavily restructured, A much simpler setup would be the following:
 - Introduction
 - Short recap of the Laio et al model (only Eqs 7, 8, 9, 10, 12)
 - Short review of transpiration under both water and energy limited conditions.
 - Describe Figure 1. Also describe why the T-R or T-PAR relationship is a saturating curve? Is this based on Leunings stomatal conductance model and C3 Farquhar assimilation and Penman monteith? Please explain.
 - Support the chosen form of $T_{max}(PAR)$ with flux data (Figure 4). Here the fluxnet dataset can be introduced.
 - Leading to the adaptation of the Lai et al model replacing T_{max} with $T_{max}(PAR)$
 - Sensitivity study (Figures 5,6)
 - Validation: (see remark hereafter).
 - Appendices A and B can be removed.

Authors' response: Thank you for your specific and detailed suggestion to make our manuscript simpler and easier to understand. We believe that your proposed structure will make the paper easier to follow and the message

clearer. We will update the structure of the manuscript and explain in detail the points you noted here and in the previous comments.

4. To show the importance of the addition an additional validation step is needed. Since you are looking at fluxnet data, at least qualitatively you should be able to show that the pdfs of soil moisture (or at least evapotranspiration) obtained from your adaption are closer to the observed values at the flux sites than the original ones obtained from Laio et al (all other parameters being equal). I realize that the assumption of stationarity does not hold for the German site due to seasonality, but you could focus on one summer month (July) and one early spring month (April) separately to have a water limited and an energy limited example.

Authors' response: We agree that this could add significant value to our proposed extension. We will assess the availability and quality of soil moisture data at the sites we analyzed from the FLUXNET database and compute histograms for comparison with the pdfs calculated using Laio's model and the extension proposed here.

Minor comments

1. Abstract, line 8: sensibility -> sensitivity.

Authors' response: We will fix the error.

2. Line 25: replace "there are seasonal environments .. fluctuates" with "There are areas where both regimes occur depending on the season."

Authors' response: We will replace the phrase as you suggested as it better explains the idea.

3. Lines 28-32: I do not understand this part. Why are in situ and remote sensing data and numerical simulations presented as three categories. The type of data used and the way equations are solved are two separate issues.

Authors' response: Thank you for letting us notice it. We will split the comparison according to the type of data and the ways to solve the equations.

4. Line 33: "from such complex processes". What complex processes are meant here?

Authors' response: We meant the complex processes involved in the soil moisture dynamics, such as water and energy fluxes among the

atmosphere-soil-vegetation system, anthropic effects, etc. Thanks for pointing out that the current phrase in the manuscript is incomplete and unclear. We will fix it.

5. Line 62, start with: "The remaining part of this paper is organized as follows:"

Authors' response: We will modify the paragraph that describes the structure of the article starting with this sentence you suggest.

6. Line 92: tappers -> tapers

Authors' response: We will correct the typo.

7. Lines 260-262: groundwater can have a major impact on the pdf of soil moisture and evaporation. See e.g.:

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2005WR004696>

<https://www.sciencedirect.com/science/article/pii/S0304380010001079>

Authors' response: We will complete the implications of this simplification taking into consideration the papers you mentioned and others.