EGUsphere, referee comment RC1
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# Comment on egusphere-2022-119

Anonymous Referee #1

Referee comment on "Probabilistic soil moisture dynamics of water- and energy-limited ecosystems" by Estefanía Muñoz et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-119-RC1, 2022

**Review of "Probabilistic soil moisture dynamics of water– and energy–limited**

**Ecosystems" by Muñoz et al.**

## Summary

The authors present an adaptation of the ecohydrological model for soil moisture dynamics at a point of Rodríguez-Iturbe et al. (1999) and Laio et al. (2001) that is currently restricted to water-limited conditions. The adaptation proposed is to limit Tmax in the Laio et al. model by available energy (PAR) using an empirical relationship between PAR en Tmax based on flux data and inspired by the Farquhar C3 assimilation and the Leuning model of stomatal conductance which both increase with PAR (the latter because it is an increasing function of assimilation).

## Major comments

- 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.

- By the way: do we really need Penman-Monteith? According to Penman Monteith, Figure 2 seems to show that Tmax increases linearly with radiation and does not saturate? This seems a contradiction. With the exponential function chosen.
- 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 Tmax(PAR) with flux data (Figure 4). Here the fluxnet dataset can be introduced.
    - Leading to the adaptation of the Lai et al model replacing Tmax with Tmax(PAR)
  - Sensitivity study (Figures 5,6)
  - Validation: (see remark hereafter).
  - Appendices A and B can be removed.
- 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.

**Minor comments**

- Abstract, line 8: sensibility -> sensitivity.
- Line 25: replace "there are seasonal environments .. fluctuates" with "There are areas where both regimes occur depending on the season.
- Lines 28-32: I do not understand this part. Why are is 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.
- Line 33: "from such complex processes". What complex processes are meant here?
- Line 62, start with: "The remaining part of this paper is organized as follows:"
- Line 92: tappers -> tapers
- 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