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Comment on hess-2021-292

Anonymous Referee #2

Referee comment on "The effect of rainfall amount and timing on annual transpiration in a grazed savanna grassland" by Matti Räsänen et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-292-RC2>, 2022

The manuscript "The effect of rainfall amount and timing on annual transpiration in a grazed savanna grassland" looks at the ecohydrological flux dynamics from a semiarid tree grass system. The study utilises a six year dataset of eddy covariance data which has obviously been well maintained, quality controlled, and is of high quality, as well as additional meteorological and remote sensing data. The study focuses on evapotranspiration (ET), as well as the partitioned plant transpiration, soil evaporation, and interception over the six year period, with one particularly dry year with significantly reduced ET and gross primary productivity (GPP).

I found study particularly interesting in the scientific set up, however, the comparison of ET partitioning methods and the conclusions drawn from the T/ET dynamics seemed to dismiss the discrepancies between the methods and instead assume that one particular method was most accurate without given much substantial evidence as to why. Given the high uncertainty in partitioning methods (Nelson et al. 2020, Scott et al. 2020), it would be more rigorous to apply multiple methods and base the conclusions on patterns which agree, or an independent evaluation as to why particular methods are likely to fail in certain situations. Given that the uWUE and Berkelhammer methods are methodologically very similar, a better analysis would be to use method with very different assumptions, such as one that avoids the T=ET assumption (e.g. Scott and Biederman 2017 or Perez-Priego et al. 2018).

For example, one particular issue with the uWUE/Berkelhammer methods is that the $GPP \cdot VPD^{(1/2)}$ to ET relationship is static throughout a year. In the case of a tree grass system, particularly when the grass is inactive for part of the year, the assumption that the ecosystem $GPP \cdot VPD^{(1/2)}$ to ET holds for the entire year may not be valid as the ecosystem fluxes shift from more tree to more grass dominated, which would then impact the inferred T/ET as the $\min(GPP || ET)$ could correspond to a period not consistent to the current state of the ecosystem. This is not to say the the uWUE or TEA estimates would be more correct either, but the low T/ET patterns seen in 2015 may also be underestimated by the Berkelhammer method. Indeed, the T/ET values from uWUE and Berkelhammer are significantly lower overall than the mean T/ET pattern from Wei et al. 2017 in Figure 6a

and would be on the low end of what is reported from site level studies in Schlesinger and Jasechko 2014.

While this paper does not set out to be an inter-comparison of ET partitioning methods from eddy covariance, I would recommend that at least all analyses utilise all three partitioning methods presented to determine if patterns are robust across methods, and possibly the addition of a fourth method which does not make the $T=ET$ assumption. This would make the conclusions more robust and make the work much more useful to the wider community.

Nelson, J.A. et al. (2020) 'Ecosystem transpiration and evaporation: Insights from three water flux partitioning methods across FLUXNET sites', *Global Change Biology*. doi:10.1111/gcb.15314.

Perez-Priego, O. et al. (2018) 'Partitioning Eddy Covariance Water Flux Components Using Physiological and Micrometeorological Approaches', *Journal of Geophysical Research: Biogeosciences*. doi:10.1029/2018JG004637.

Schlesinger, W.H. and Jasechko, S. (2014) 'Transpiration in the global water cycle', *Agricultural and Forest Meteorology*, 189–190, pp. 115–117. doi:10.1016/j.agrformet.2014.01.011.

Scott, R.L. et al. (2020) 'Water Availability Impacts on Evapotranspiration Partitioning', *Agricultural and Forest Meteorology*, p. 108251. doi:10.1016/j.agrformet.2020.108251.

Scott, R.L. and Biederman, J.A. (2017) 'Partitioning evapotranspiration using long-term carbon dioxide and water vapor fluxes: New Approach to ET Partitioning', *Geophysical Research Letters*. doi:10.1002/2017GL074324.