Response to Referee #2

The manuscript "The effect of rainfall amount and timing on annual transpiration in a grazed savanna grassland" looks at the ecohydrolocal 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 patters 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).

We thank the referee for their supportive comments. We will add comparison of the dry season ET partitioning results from all the partitioning methods based on the stage-2 soil evaporation theory (Hu and Lei, 2021). We will also show the daily and monthly results for all methods and point out clearly the differences between methods.

We tested the use of Scott and Biederman 2017 method but the multi-year monthly correlations between ET and GPP were not statistically significant so we could not apply this method at this site. Perez-Priego et al. 2018 method depends on the constant C (eq. 9) that is only available for C3 plants. Applying this method at this site would be inappropriate because the C_4 pump efficiency modifying the photosynthesis model requires another parameter to be calibrated and used vis-à-vis the C_3 photosynthesis. For the same reason, the Perez-Priego et al. 2018 method was not applied at maize field in the method intercomparison study by Hu, X. and Lei, H. 2021.

For example, one particular issue with the uWUE/Berlkelhammer methods is that the GPP*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*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 minGPP||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.

Testing the assumptions of the uWUE/Berkelhammer methods is beyond this study. However, we have compared the estimated E from each model during this period using the stage-2 soil evaporation theory. After a precipitation event at the end of wet season 2015, the soil is dry for stage-2 conditions. The soil desorption is the slope of the cumulative daily soil evaporation and day^(0.5). This relation is expected to be linear. The soil desorption values are 2.91, 1.92 and 1.08 mm/day^(0.5) for the Berkelhammer, uWUE and TEA method. The expected range for the soil desorption is from 3 to 6 mm /day^(0.5) for sandy soils (Brutsaert and Chen, 1995; Hu and Lei, 2021). This suggests that the Berkelhammer method produced the most plausible soil evaporation, but we will analyze this further by also looking at the LAI changes over this period.

The annual T and T/ET from Berkelhammer and uWUE methods is best predicted by the early season P frequency. This fact, that temporal distribution of P affects the productivity, is supported by other fieldwork from a similar site (Swemmer et al. 2007).

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.

Thank you for this comment. We will present all three methods in the revised results and clearly show the similarities and differences. We have also estimated the grass transpiration from soil profile measurements (Jackisch et al., 2020) and used stage-2 soil evaporation theory to compare the dry season ET partitioning results from all the partitioning method (Hu and Lei, 2021).

References (included for information)

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Brutsaert, W. and Chen, D.: Desorption and the two Stages of Drying of Natural Tallgrass Prairie, 31, 1305–1313, https://doi.org/10.1029/95WR00323, 1995.

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