We thank the reviewers for the positive reception of the manuscript, as well as all their comments and helpful suggestions. We have explicitly reported the nighttime ET results and discussed its influence on ET uncertainty. The language and structure were also revised in accordance with their suggestions.

Anonymous Reviewer #1

Thank you for the article about the effect of rainfall amount and timing on annual transpiration in the grazed savanna grassland.

This is an extremely interesting paper on a very important subject in an overall datascarce region. I believe that overall the methods and scientific work is sound, however I do think that the paper would benefit from some editing and streamlining. Often sentences are long and cumbersome and the presentation seems redundant and not distinct. Thus most of my feedback is on presentation quality and not scientific quality or significance. I believe it does present a substantial contribution to scientific progress within the scope of Hydrology and Earth System Sciences in terms new concepts, ideas, methods, and data. I believe the scientific approach and applied methods to be valid. I believe that the results are discussed in an appropriate and balanced way.

They consider some related work but have some pretty large omissions. They only invoke one other, non-directly-related, study using eddy-covariance in Africa. This study was in Benin, in a very different climate zone. Meanwhile, if you include the whole African continent, there are have been other studies using eddy-covariance, many in more similar climatic areas. It would be interesting to compare your results with those of more similar studies, for example see the work of Marc Parlange's group in Burkina Faso, or group by the French CIRAD organization and associated researchers throughout francophone west Africa, or Kelly Caylor's work in East Africa, or some older studies in Niger and Nigeria.

Thank you for this suggestion. The focus of the analysis is on the transpiration and we now discuss transpiration estimates from different studies. In addition, we have now added comparison to the Ramier et al (2009) annual ET measurements.

One very minor, but very significant change in presentation would be to format paragraphs as distinct. I found it very hard to read because the appearance is of one single continual paragraph. Perhaps this is the flaw with the HESS template, but a compromise should be found!

We are using the HESS template. We now divide paragraphs into shorter ones.

Additionally, although the information that I would want from a picture of the site and a map is present (geographical coordinates, density of trees), I think it would be a tremendous boost to the ability of the reader to visualize if at least one figure was added including a map, a picture of the measurement station, a picture of the land cover (topography) around the station, and perhaps a sketch (to scale) of the different components of evapotranspiration (i.e. from C3 grasses, C4 grasses, woody-vegetation, ground water depth, soil layers, and any surface water etc.).

We have overlaid a 2D footprint analysis on the site map so as to indicate the tree and land cover in proximity of the site together with a picture of the station as requested (Fig. 1).

I rate this paper Good (2) because I don't think the results and conclusions are currently presented in a clear, concise, and well-structured way. Some figures could be integrated with each other and of higher quality. The English is correct, though I think some editing (fewer words) would make it more readable.

We restructured and streamlined the discussion of several sections, including the soil physics evaporation check. This is now included as supplementary material because it offers an indirect (but independent) check on evaporation estimates. Figure 5 and 7 were combined, and only Table 1 remains in the results. Others figures are integrated with existing ones or moved to supplementary material.

The paper addresses (scientific questions):

Objective: to partition measured ET Quantify effect of seasonality on grass activity (this is very vague, and it is not clear why this is important).

Transpiration relates to productivity of these ecosystems as well as grazing. We have added the following sentence:
"These longer time scales are of interest to valuation of ecosystem productivity and their services when assessing climatic shifts (Godde et al. 2020)."

How ET and its components vary according to mean annual P and vegetation change in a grazed savanna grassland ecosystem 3 study objectives: 1) quantifying the variation in P, ET, and estimated T based on met measurements at this new long term monitoring site 2) identifying the main drivers of the annual, seasonal, and monthly variation in the water balance components 3) identifying remote sensing variables that explain variations in T/ET and transpiration.

Later the goal is to select the method most applicable to water limited ecosystems.

I think the paper would be strengthened if they adhered more to these goals and used them to structure the results, discussion, and even conclusions. I will try to reproduce the calculation with a similar data set, and I currently believe that you present ample information even if I have not yet tried. The title clearly placed annual transpiration as the goal. It does not invoke the three methods. The title is acceptable but you could make it more exciting or intriguing. Overall, I think they should write out abbreviations and equations more often in full text. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

Thank you for this suggestion. We streamlined the manuscript by moving the soil physics check to the supplement. The beginning of the results section introduces the blue-print of how the results addresses the goals of the study.

I found some sentences to be repeated more or less word for word in multiple parts of the text. This is completely unacceptable. Please respect your reader who reads all the way through and reword. Each sentence should bring new information. i.e. the first sentence of the introduction is the same as the short summary. For the short summary, I recommend saying some unknown problem and generalizing more. In general, sentences are jargon-y & convoluted. Some frames that could be said differently are repeated. I.e. partitioning? You could alternate it with divided, split, etc and talk about it more concretely. There are places where the article is missing. There are numerous places where a superlative or comparison is used without a clear expression of the direction or magnitude. I recommend articulating everything as concretely as possible.

We revised the language and vary the expression appropriately in different sections. The comparisons have been adjusted.

I think they could lay out management goals and uncertainties and problems in the introduction so that it isn't such a shock in the conclusion. Discuss the management practices more in depth earlier on. And in the site description, you need to clearly describe the land cover as that is the most important part of this analysis. Overall I think there is a conflict between this being a "site specific" paper and a "method" paper that you need to handle more directly.

Thank you for this suggestion. We view the analysis here as 'necessary but not sufficient' for constructing and implementing best management practices. Specific recommendations about management practices of these type of grasslands is beyond the scope of this study. However, we do now state that the site is under heavy grazing each year that limits the grass height to 10 cm or less. The uncertainty in water balance is now presented in both – the results and discussion sections. The site description is now more detailed and includes a map of the land and tree cover.

Specific Comments Note: I did not perform a detailed proof reading. But there are numerous syntax and tense problems that should be controlled. I'll put some here that stood out. For most of these, you do not need to reply to this line by line. Undoubtedly there are more or other ways that sentences could be reconfigured to solve the problem.

Thanks, the syntax and tenses have been checked.

Page 1 L20 - no comma L22 - one mm is enough L24 - highly (also first sentence of discussion). What do you mean by this? Well constrained? What not just delete this word. L27 altered, complicated L28 remained L29 was L30 of rainfall L31 levels of water stress "Effectively use pulsed rainfall" => unclear perhaps you mean efficiently used sporadic rainfall??

Corrected. Removed highly. Changed to sporadic rainfall.

Page 2 L2-4: These sentences seem identical to those in conclusions, can you say this more generally to launch paper? This whole first paragraph should really situate the research in the global problematic at the largest scale whereas here I feel shoved into a fairly narrow location, site, and quantitative description that seems drawn from a site description and conclusions. Perhaps frame it into the management needs of this ecosystem and why knowledge of transpiration would improve management? L1 an -> the (reference this first sentence?, not to prove your point but to guide the interested reader) Delete " in the form" add: grazing "land & fodder" in South Africa L2 change second half of sentence to ... is reevaporated in the form of .... Transpiration [what does it mean to consume precipitation, really?] L3: magnitudes The T component evaporates from leaf stomata of a ... L5 > 1 week = maybe for both extended and short (a few lines lower) just say periods lasting more than a week / sub-daily time scales

Added reference and revised the first paragraph.

L12 is there a weird font of your references? L14 at time scales ranging between daily and seasonal L15 partition (delete -ing) L16 can you delete "display" ? L17 don't you talk about another species later? Also, this is a bit early to mention the study site. Please organize better. A species list would really help and some analysis of the relevant patch area. L22 in an hot and open ... but what do you

mean by open here? Be more precise L 24 C4 draws uses soil water intensively and quickly However, to to their low water storage capacity, severe ..their LAD L25 Our objective is therefor... L26 environmental variables??? What are you referring to specifically and why? Do you mean environmental seasonality as measured by the following variables : It seems like your objective is more to compare methods than to partition. L27 to partition ET L26-28 this isn't so clear. Can you write about pros and cons / assumptions

Corrected. Here the old name (Acacia) was mistakenly used. It is the same species. We have clarified the role of the method comparison.

Page 3 L2 - write equation in words followed by equation. It is really hard to read like that. Same for other places i.e. all the E(=ET-T) in line 5 and the whole following paragraph. L7 In this paper, three different methods that establish the relationship between ... L9 you talk about bins a lot. I'm not sure what you mean. Can you clearly define bin somewhere ? However some of this paragraph seems very technical for the intro. I would move some to methods. L13 I think you can remove "based on a recent review", the reference is enough L15-18 - this is too specific for the intro.

This section was moved to methods and the sentences were revised.

L29 1300 +/- 300 head of cattle according to year.

Corrected

Site Description - how was station positioned in relation to farm? Protected land? Was the area around the station protected? A map and picture would help? What is the footprint of station?

The housing is 300 m away from the measurement station located on a large commercial farm. The measurement station is inside a fence. We added a picture of the measurement site and a satellite map of the area with a 2D flux footprint estimated from daytime data (Fig. 1).

PAge 4 L1 - specify the soil texture according to depth. L2 - change"water table depth" to not repeat - say water at 30 m below surface

Soil texture represents surface soil but there are no changes in texture at least up to a depth of 1 m.

L9 Introduce variables with something like In addition to other variables.... And then just focus on the one you use., be more precise "meteorological variables", at what time step, how many points, how chosen and organized in relation to land surface, topography, etc.

All the variables are measured inside or next to the measurement station. The nearest patch of trees is about 15 m away from measurements. The meteorological measurements were sampled every minute and 15 min averages were recorded.

L12 what direction does your EC station point? How does that compare with the dominate rain. L17 how do you convert 2 way radiation to PAR? What's the foot print and the land cover of its field of vision?

The EC sensors are pointing towards the north. The mean wind direction during rainfall was 124°. The PAR is separately measured by Kipp & Zonen PAR-lite sensors. All radiation sensors are positioned at 3 m above the ground with field of view at the grass field near the measurement station (this is added in the revised manuscript).

L20 two separate profiles L21 a single average soil moisture. This paragraph : where in relation to other measurements - this would be good on a map L27 you say "measurement" three times in one sentence - there must be a better way

Corrected and revised the sentence.

IN GENERAL: how did you determine soil texture? Calibrate measurements? Validate measurements?

The detailed soil sampling results are reported in a previous publication cited here (Räsänen et al., 2017). Also, all the details about the calibration of the eddy covariance system are provided in that publication. The soil moisture sensors were calibrated for the soil according to the manufacturer manual.

The gas analyser was calibrated every month with a high-accuracy CO2 span gas (378 ppm verified by the Cape Point GAW station), and Afrox instrument grade synthetic air with CO2 < 0.5 ppm was continuously used as a reference gas.

Page 6 Section 2.5 - deja vu from intro - it makes sense to present it in detail here, maybe you can talk about it more generally in intro . Page 7 First 5 lines - remember to put goals in the intro and methods here. Also, in the intro you could compare the methods in a more symbolic way and then here in the methods in a more technical way. For example, a table that shows the variables they require, the output, some examples of how and where they've been used (references), would really help the reader conceptualize these 3 methods. L8 - "in the fitting" replace with "the process or step of fitting the .... " for example

The method details in the introduction were moved to Section 2.5. We added a table that shows input variables, references and an explanation how monthly T/ET is calculated for each method.

L21 sampled => selected L22 searched => identified L23 in 5 hydro years, there were ... .(comma and tense) L24 - write out CV and say what it means i.e. April has the most variation of __ (cv =)

Corrected

Page 8 Do you use mean storm frequency? Limit methods to things you use.

Yes, it is presented in table 2 and now added to the figure 1.

Page 9 Line 7 - the variation => that Table 1 legend. - it is plural stations? do you present these stations ? That could go on a map What is in parenthesis and what is the +/- ? And why not put the SD (last line) in the box with the mean like the others. ? This table might be able to present graphically more succinctly.

The table caption was revised as follows:

Table 1. Annual sum of water balance components for each hydrological year (September to August). The annual P at the measurement site is followed by the annual P at the SAWS Potchefstroom station in parentheses for comparison. The total uncertainty (Eq. 3) is indicated for ET after ± sign. ET_N is the annual nighttime evapotranspiration. The PET, determined from Eq. 1 is also shown. The transpiration and evaporation are calculated from monthly T/ET estimates. The EBC-slope stands for the slope of the energy balance closure with ordinate defined by measured R_n-G and abscissa defined by the sum of the measured latent and sensible heat fluxes.

A figure comparing measured rainfall between station by event would be very helpful to interpret the accuracy of your measurement.

The annual rainfall between the measurement site and SAWS station is not significantly correlated and thus the event scale analysis is not possible. The SAWS data has many gaps in 2010 but not during the other years. The fact that the SAWS rainfall is 139 mm yr^{-1} higher than the measurement site rainfall in 2011 and it is lower than the site rainfall during all the other years supports the fact that the rainfall at the site may have been underestimated in 2011.

Table 2 - this could also be a figure i.e. with little creativity, tables 1 and 2 could be put on figure 1. "Having a late start" => starting late. This figure just looks so simple and unappealing, I really think you could make it more interesting and sophisticated with a little creativity

Table 1 was kept in the results and annual nighttime ET was added to the table. The precipitation statistics were added to Figure 1 and Table 2, which was moved to the supplement.

Fig 2 - make the 2011 dashed if you aren't considering it.

The year 2011 is indicated with a star and not considered in the linear regression due to uncertain precipitation.

Page 13 - Figure 3 - my version is blurry. L6 - Define bin better somewhere!

The figure resolution was changed and the bins were defined also here in the caption.

m3m-3 ? Is that really the best way to write units? I think you should come up with another name for the T=ET line.

According to HESS guidelines units should be written exponentially. The T=ET line is a slightly awkward expression, but it emphasizes the method assumption.

Figure 4. Relationship ! Should 2015 be included in the regression ?

Corrected. The fit line was slightly extended to indicate that 2015 is included in the fit.

Figure 5. Relationship !

Corrected

Figure 6. It seems like this figure should come second, as it has to do with how you figured out T. It also could use some colors and creativity.

Figure 6 is positioned at the comparison.

A scatter plot of the different methods would help highlight your comparison.

We prefer the time series plots that reveal the strong seasonality at the site and support the method check. A scatter plot would add statistical measures of the differences, which are not the focus here.

Tables 3 and 4 could be integrated into the other tables.

The tables were moved to the supplement.

In general I think the figures could be streamlined a bit. Based on the objectives, I would say, present a) an over view of the data highlighting the seasonality, what was measured vs. what was calculated b) a plot with both magnitudes of evaporation and transpiration, comparing calculation methods, perhaps dry vs wet season +> P, E, T c) a large matrix of plots comparing environmental seasonality indicators (that you define as) with WB components d) remote sensing indicators compared with above

Figure 5 and 7 were combined. Table 2 precipitation statistics were added to Figure 1. The text in hydrological years section was streamlined. The structure of the results is briefly explained at the beginning and it corresponds to the aim of the study.

Figures that are really just to help understand methods can go in supplement.

Page 22 Line 3 - "highly" ??? Well? L5 - "aided" ? Augmented? L8 - this is a different tree than you previously said was important. Is this really the place for this deep discussion? I really like the examination of specific trees and species but I think more work has to be done to tie it into this paper.

It is the same tree species. The old name is Acacia. The dry season transpiration, as well as increase of early season T/ET with tree green-up are all results related to this specific dominant tree at the site.

L15 - choose slash or parenthesis P23 L25 add "a" before cultivated L29 - Beninese is the adjective, but is this really the only relevant research? This is a very different climate-vegetation zone from yours. It is not an open savanna. There is other research out there.

There are definitely more studies on ET and we have added the Ramier et al. (2009) study from a similar climate to the ET comparison. If there are other studies reporting measured annual ET from savannas with deep rooted trees, we can add a comparison. However, the analysis is focused on transpiration that is compared to other studies. We agree that the Beninese site is not similar but our comparison focuses on the dry season when sites are more similar.

P25 - L19-20 "Mediterranean" is it capital? I think this example (as with the previous comment) could be better integrated. If you compare climate zones, you need to articulate what you expect between these two climate zones. It is hard to make these comparisons.

In this comparison we have pointed out the important difference in soils that is the most likely reason for the difference in T/ET. We have not found any other relevant study reporting monthly T/ET results.

L25 - what do you mean by conservative? L26 - are you clear about density and crops ?

Changed to “nearly constant”. The 15 % tree cover means “few trees”.

P26L2 - do you mean consistent instead of conservative? L3 - conservative again? L6 - limitation - shortages?

Nearly constant. Corrected.

L20 "farmers at the ranch" = ranchers

Corrected

References

Ramier, D., Boulain, N., Cappelaere, B., Timouk, F., Rabanit, M., Lloyd, C. R., Boubkraoui, S., Métayer, F., Descroix, L. and Wawrzyniak, V.: Towards an understanding of coupled physical and biological processes in the cultivated Sahel – 1. Energy and water, Journal of Hydrology, 375(1–2), 204–216, doi:10.1016/j.jhydrol.2008.12.002, 2009

Räsänen, M., Aurela, M., Vakkari, V., Beukes, J. P., Tuovinen, J.-P., Van Zyl, P. G., Josipovic, M., Venter, A. D., Jaars, K., Siebert, S. J., Laurila, T., Rinne, J. and Laakso, L.: Carbon balance of a grazed savanna grassland ecosystem in South Africa, Biogeosciences, 14(5), 1039–1054, doi:10.5194/bg-14-1039-2017, 2017.