Interactive comment on "The effect of rainfall amount and timing on annual transpiration in grazed savanna grassland" *by* Matti Räsänen et al.

Anonymous Referee #1

Dear Matti Räsänen and co-authors,

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 data-scarce 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.

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!

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.).

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.

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).

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?

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.

C3

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. Over all I think there is a conflict between this being a "site specific" paper and a "method" paper that you need to handle more directly.

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.

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??

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

C4

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

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.

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

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?

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

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,

C5

topography, etc.

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?

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

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

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

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 =)

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

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.

A figure comparing measured rainfall between station by event would be very helpful

C6

to interpret the accuracy of your measurement.

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

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

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

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.

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

Figure 5. Relationship !

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.

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

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

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

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. 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. 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.

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

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

L20 "farmers at the ranch" = ranchers