

Interactive comment on “Building a field- and model-based climatology of local water and energy cycles in the cultivated Sahel – annual budgets and seasonality” by C. Velluet et al.

Anonymous Referee #1

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General comments:

Velleut et al. describes a mechanistic model that is parameterized using a 7 year hydroclimatic data set including energy fluxes from 2 study sites in the Sahel region. This kind of data and model analysis are very sparse from the Sahel region, and a 7 years' time series of field measured data of evapotranspiration and sensible heat flux, are, as far as I am aware of, none-existing. This makes this manuscript very interesting. Additionally the mechanistic model evaluated is applied for making reliable estimates of the climatological budgets. The budgets between the two sites are compared.

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However, for me it was quite unclear what the aim of this study was. After having read the abstract and the introduction, I thought that the focus of the paper would be the 7 years of field measured data, which are very interesting in it selves, as these data are so rare. And the model would only be used for filling the gaps to be able to produce reliable seasonal and annual budgets. However, later on in the text this was not the case. There are no results from the field measured data; these data are only used for the model evaluation and parameterization. This makes it kind of difficult; the field data set is very special and very interesting. These data have not been published elsewhere; therefore it would be nice with a focus on these data. On the other hand, the focus of the manuscript is, according the presented results, the parameterization, evaluation and output of the model. The manuscript is very long, and there are many parts that could easily being shorten substantially, or removed completely for a better focus around a specific aim of the study.

The manuscript thereby needs a better focus. This could be done either as a stronger focus on the model development in the introduction that could end in a clear aim in developing the model for estimating seasonal and annual budgets. Or a stronger focus on the field measured data in the results section, as there are no results from the field mentioned in the results section at all. Still the introduction needs to be better focused with a clear aim in the end to show the field data, and with a second aim of developing the model. I hope it is not completely impossible to combine a better description of the results of the field measured data, with a stronger focus in the introduction on the model development.

Parts of the text were rather difficult to understand and the text would benefit by being checked by a native English speaker.

It could be easier to follow the model description if some sort of overview diagram were shown. This is sometimes easier said than done though, but it would benefit the clarity of the manuscript. An overview diagram showing which are the input data, which are the physical processes modelled and which are the output data generated.

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Specific comments:

P4755 L12. What purpose do you mean?

P4755 L12, According the results , P4770 L20, it is only the simulated variables that are given. Then the model is not used for extrapolating to unobserved periods?

P4755 I do not understand the sentence "Furthermore. . .from physical laws."

P4756 L1-L6 In what way are the water cycle dynamics counterintuitive? Why do they challenge our ability to make projections? I think that you should place the references in the end of the sentence. The sentence is chopped apart by the references including in the middle; this make the it harder to read.

P4757 L29 Why in this region particularly?

P4758 Always write out acronyms the first time they are mentioned. What is AMMA-CATCh, SiSPAT, etc...

P4758 L28 What do you mean by population averages? I do not understand in what way the decadal non-stationarities could be an issue for this study?

P4759 L21 Rainfall is usually given in mm

P4761 L6 What practical reasons? Mention the reasons again.

P4761 L19-L29 How was the field survey conducted? By taking photographs, harvesting biomass? What vegetation phenology parameters were measured? What camera was used for the LAI images? How was the additional information on vegetation dynamics used to derive continuous LAI series?

P4762 L1-L8 These are results and should hence be moved to the results section.

P4762 L25-L27 According to the K-theory, fluxes are estimated by relating them to aerodynamical resistances as fluxes of energy and matter are proportional to the gradient of the parameter we are looking at. However, it has been shown that the K-theory

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is not applicable within the canopy (Denmead and Bradley 1987, Foken 2008, Kaimal and Finnigan 1994, Raupach 1989a, b). The transfer of matter does not behave as is required by using the analogy to aerodynamic resistances. There are many different sinks and sources of water and energy throughout the canopy, and this interfere with the transfer of matter, which makes these models incorrect for estimates of transfer of matter within the canopy. If the model is dependent on the aerodynamic resistance within the roughness sub-layer, the mechanistic representation of physical processes within the model is incorrect.

P4763 L6 How does the model know when a soil crust is formed and when there are none?

P4763 L10 Is H1 between 0.00-0.01, and H2 between 0.01-0.20? Be specific.

P4765 L8 Why is the lowest used for H1?

P4766 L4 What do you mean by understanding of the physics of the various processes? How was this understanding accomplished?

P4767 L15 If I understood table 2 correct, the parameters in table 2 are not results. They are parameters for the model. I think that you should include a section with results from the field measured data before the model calibration/validation section. Or restructure the manuscript so that more focus in the introduction is on the model development (see comment above).

P4769 L7 I do not understand the sentence: In addition, the half-hourly. . . Why is it a problem that it is at the scale of turbulence? Does the mode not estimate aerodynamical resistance? Then this should not be an issue.

What are the range in RMSE and NSE, is it for different years? In a model evaluation you should also report the slope and intercept of a linear regression between modelled and observed data (Willmott, 1982).

P4769 L9-L10 References to this sentence, which state-of-the-art model applications?

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There are no references to any figure in the model evaluation. But among the figures I assume that figure 4 and 5 should be for the model evaluation. A similar figure to figure 5 could be created for the LE, H and G variables. Preferably at 30 min temporal resolution.

P4771 L16 Be more specific about these components. Where did you get infrared radiation from? Infrared radiation is a part of the solar radiation. I do not remember any description of the model separating the solar irradiance into different wavelengths.

P4771 L19 _L23 This is not results, and should hence be moved to the discussion section.

P4772 Why are you interested in the mean value specifically? I do not see any benefit in this for our understanding of the system. I think that it would be much more interesting to show the full 7 year cycle, and in that way also see the variability between years. That gives broader information about the system we are studying and why it behaves the way it does.

P4773 L9 Again, comparing results with other studies should be moved to the discussion section.

As the manuscript is rather lengthy, I think the discussion section could be more focused on actual discussion of the results. For example the model-field data section could be shortened down to few sentences and placed in the introduction instead. The focus of the results section is completely on the results of the model, and the evaluation of the model. Instead of discussing drawbacks with the field measured data, focus should be on your results of the model evaluation and the outputs of the model applied. Which was the years used for model evaluation and why and how was these years specifically chosen?

P4780 L5-L10, where do these numbers come from? References please.

Figure 2a and b. I think that the true data would be much more interesting to see than

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the rainy day probability. Why don't you show the 7 years of true field measured data instead?

Figure 4 It looks like the model is doing a fantastic job...

Figure 7 is rather difficult to understand. Why are the bars for the dry and wet season different in a) and b)?

Figure 8- 10, see comment above. Why not showing the full time series...

References: Willmott CJ (1982) Some Comments on the Evaluation of Model Performance. *Bulletin of the American Meteorological Society*, 63, 1309-1313.

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Foken T, 2008. *Micrometeorology*. Berlin: Springer.

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