Biogeosciences

Discussions

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Interactive comment on "Impacts of the seasonal distribution of rainfall on vegetation productivity across the Sahel" *by* Wenmin Zhang et al.

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M. Marshall Referee 1 Received and published: 29 September 2017

The manuscript titled, "Impacts of the seasonal distribution of rainfall on vegetation productivity across the Sahel" uses gridded climate and vegetation data to determine the impact of seasonal rainfall metrics (typically ignored over large areas) on NPP. The analysis is performed over the Sahel where NPP estimates are used extensively for food security analysis and other important areas of drylands research. The manuscript is generally well written and organized. The analysis is thorough and sufficiently addresses the objectives of the manuscript. The discussion and summary adequately capture the major findings. I believe the manuscript should be accepted by Biogeo-

sciences after the authors address the few questions/comments below

We would like to thank Dr. Marshall for the supportive comments on the manuscript. We have implemented all of the suggestions and we believe that the revised version is now substantially improved. Below we respond to each of the comment individually.

1) Regarding grammar: the sentences in the introduction and discussion tend to be long-winded, omit commas, and confuse "that" and "which." Sections, subsections, etc. should be numbered 1., 1.1, 1.1.1. throughout the manuscript. Use past tense for tasks performed and present tense for general statements. There are other minor grammatical and spelling errors that should be addressed.

R1: Thanks. We have edited the introduction and have rephrased some overly convoluted sentences. We have carefully gone through the manuscript to remove additional minor errors and the subsections have been numbered as suggested.

2) The methods section would flow better if rainfall and NDVI were detailed in their own data subsection.

R2: In the revised version we have chosen to present the CHIRPS rainfall data in a separate subsection 2.2 (L91), whereas the use of the MODIS NDVI is now included as a part of the section describing the TIMESAT seasonal integration approach "2.4 Estimation of growing season ANPP" (L123).

3) RFE-2.0 is no longer a "state of the art" dataset and is not appropriate for daily rainfall estimation. RFE-2.0 is primarily used at 10-day intervals. The developers caution against using the daily product, because the estimates are statistically disaggregated from the 10-day data and therefore may or may not represent the physical reality. Why was the RFE successor CHIRPS not used for the analysis? It is higher resolution and I would suspect provides more realistic daily rainfall estimates: : :Why was daily data necessary if it was compared alongside 8-day MODIS?

R3: Thank you for suggesting the use of the CHIRPS data. We fully agree and the

CHIRPS data was used to replace RFE in the revised MS.

4) Regarding MOD09Q1: : :the 8-day composites are quite noisy over the Sahel due to persistent cloud cover. Was any filtering done prior to S-G? Was the optimized MODIS S-G used? If so, please provide citation. Otherwise, how did you determine the smoothing terms? Certainly not a requirement for this manuscript, but the authors should consider using eMODIS in the future, since it is a 10-day product intended to be analyzed alongside RFE-2.0 or CHIRPS for food security applications.

R4: We thank the reviewer for this good suggestion. Here, we applied a Savitsky-Golay filter on the 8-day MODIS composites. On the one hand, Savitsky-Golay filtering has been reported to be robust against noise and missing data, while preventing over-smoothing. On the other hand, as the presence of clouds is one major error sources of EO data in the Sahel region during the rainy season, we routinely checked the quality of MODIS time series via TIMESAT GUI, where one can test how does Gaussian/ Double Logistic/ Savitsky-Golay filter smooth the data and cope with noise removal. For this study (and some other studies published recently), the Savitskey-Golay filter was chosen since it can filter out the noise and capture the temporal features for the time series, whereas the other two filters generally over-smooth the temporal curve. As described in the revised version of the MS, we have set a window size of 4 and seasonal parameter of 0.5 to fit one season per year, number of iterations for upper envelope adaptation of 2, and strength of the envelope adaptation of 2. The eMODIS is indeed a product identified more cloud observations in some regions such as Canada and US. It will definitely be considered in the future analysis along also with initial tests that we have conducted based on the MODIS MAIAC processing chain.

We added in the text as: "For this study, we applied the Savitzky-Golay filter implemented in TIMESAT with the following settings: A window size of 4 was applied and a seasonal parameter of 0.5 to fit one season per year. Both the number of iterations for upper envelope adaptation and strength of the envelope adaptation were set to 2 and the start and end of season were determined as 20

5) The relationships in Figure 5 are non-linear. Why were they not fit with an exponential curve? How do you take into account the non-linearity of NDVI in highly productive grid cells?

R5: Yes, thanks - they are not exactly linear relationships for the most variables. We used exponential regression in the revised version to better represent the statistical relationship between variables.

Minor Ln 54-57: Sentence beginning with "Recent studies: : :" is difficult to understand and should be reworded.

R6: Thanks, we have rephrased the sentence. (L55)

Ln 100: Typo "(R. Fensholt and Rasmussen, 2011)"

R7: Sorry for this. This part in this new version is deleted and other similar problems were checked throughout the manuscript.

Ln 117-130: Consider using a different nomenclature for climatological and dynamic rainfall anomalies.

R8: In order to keep consistent with the work by Liebmann et al., we have adopted their nomenclature. Liebmann, B., Bladé, I., Kiladis, G. N., Carvalho, L. M. V, Senay, G. B., Allured, D., . . . Funk, C. (2012). Seasonality of African precipitation from 1996 to 2009. Journal of Climate, 25(12), 4304–4322. https://doi.org/10.1175/JCLI-D-11-00157.1 Font sizes in the figures are too small. R9: Thanks, we have enlarged font size for the figures.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-331/bg-2017-331-AC1-supplement.pdf

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