

Point-by-point response for:

gmd-2020-417: 'Modelling Gas Exchange and Biomass Production in West African Sahelian and Sudanian Ecological Zones'

General remarks

We are grateful for the general positive evaluation of the manuscript and have now addressed the remaining issues and questions that will certainly improve the comprehensiveness of the text.

Specific answers to the remarks (R: Repeated remark of the reviewer; A: Answer, **concrete changes in the text as indicated with bold letters**)

Reviewer 1

Comment to R1: The authors have considered FAO values, this is acceptable. The authors mentioned the sensitivity analysis in this reply, but without showing specific figures or tables. So, I suggest adding them (in the supplementary is also fine) to have a better understanding on the uncertainties.

A Reply to CR1: it is true that we have only indicated the parameter values and the FAO reference but do not report about the sensitivity analysis. Since we don't think to supply an extra table or figure on this or build a supplement file particular for this issue, we decided to supply this information within an additional paragraph added to table 3, with a reference link to the parameters (**L335ff**).

"Since there is a certain variability for this parameter (H2OREF_A) with respect to species and sites, we conducted an additional analysis to assess how sensitive biomass production of each crop species responds to this parameter. To do this, we varied H2OREF_A between 0.30 to 0.70 at each site and for each species. Results indicated that when applying the upper limit of 0.7, productivity are lower than the standard value for C3 (0.5) and C4 (0.45) crops by 6.4% for peanut, 3.9% for millet, 1.9% for cassava, 0.78% for sorghum, and 0.11% for maize. On the other hand, applying the lower limit of 0.3 increased productivity relative to the standard value by 3.8% for peanut, 1.5% for millet, 1.1% for cassava, 0.07% for sorghum, and 0.05% for maize. Thus, the overall sensitivity of biomass production to the RWC threshold value of photosynthesis decline was judged to be low."

Comment to R3: Thanks for adding the comparison of soil water content, is the simulation for 10 cm? please clarify the methods sections on the soil water content simulation. How about the average root depth for each vegetation/crop at each site, why choose 10-cm soil water content to compare?

I cannot totally agree with the authors that it is only minor deviations at the Nalohou and Agoufou site. It seems a serious underestimation especially at Nalohou site. I am wondering is it attributed to the overestimation of the evapotranspiration? I recommend more discussion for this relatively large bias.

Reply to CR3: The water content down to 10cm depth has been used because these data were available at all sites and showed the least gaps, enabling the best comparison of performances between sites. In addition, a depth close to the surface is more responsive to rainfall occurrences and is also most important ecologically since generally root abundance is higher than in deeper soil layers. We added an description and the limitation considerations into the methodology sector (**L176ff**).

Regarding the deviations between measured and simulated soil water content at the sites Nalohou and Agoufou, we tested some further model settings and concluded that they are mostly related to the soil parameterization, i.e. the field capacity and wilting point. For example, lowering the wilting point at Agoufou by

approximately 20 mm, would considerably improve the match with measured SWC compared to using the reported soil properties. This uncertainty in the initialization of soil properties that is difficult to derive with certainty in a heterogeneous footprint area is now discussed (**L388ff, L429ff**).

Comment to R7: How about the field management at each site? Is there no irrigation and fertilization as the simulation settings?

Reply to CR7: No, there is indeed no fertilization and irrigation officially reported for the sites, so we don't consider any in the simulations too (see also the documented input files in the data repository filed under <https://radar.kit.edu/radar/en/dataset/LpgXAmcqzUCGPdga?token=YbkhsPYRBKZklhsrxOdV>). This is now explicitly mentioned in the methodology sector (**L289**).

Minor comment: Line 259, please define the RWC at the first appearance here?

Reply to MC: It is true, the first appearance of RWC is at L259 (**now L264**), not L275. This has been corrected.