

Geosci. Model Dev. Discuss., author comment AC4
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Reply on RC2

Jaber Rahimi et al.

Author comment on "Modeling gas exchange and biomass production in West African Sahelian and Sudanian ecological zones" by Jaber Rahimi et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-417-AC4>, 2021

General remarks

We are grateful for the remarks and suggestion that we happily used to improve the manuscript as described in detail below. In particular, we added a new figure that evaluates satellite derived LAI information (Fig.2), complemented Figure 1 and Table 1 with additional site information, improved the model description including new parameter indications, and added information into Figures 3, 5, and 7 for a better evaluate the representation of water balance simulations. Along the revision, a couple of minor corrections have been made regarding language or logical problems. As far as these led to additions to the text, they are all indicated in track-change mode as are the changes that had been done in response to the specific remarks.

Specific answers to the remarks of reviewer 2 (R: Repeated remark of the reviewer; A: Answer, **concrete changes in the text as indicated with bold letters**)

R1: Lines 203-207: Does the author validate the MODIS LAI data with field measure LAI in the studied sites?

A1: This is a bit tricky since field observations of LAI were only occasionally done within the period from when the MODIS data were derived. Nevertheless, it is an interesting task and thus **we added a comparison using only maximum LAI values at a site per year (new Figure 2). Generally, the observations match the MODIS data but are higher at higher LAI levels. We add a brief description, possible explanations and additional discussions (including literature references, L211ff).**

R2: Lines 209: I would put some key functions, such as the calculation of water stress factor, in this section.

A2: After some consideration, we have decided against this suggestion, since it is difficult to supply the most important equations in a rather complex model, in particular since the importance might be rather different for different vegetation types. However, **we went through the description and clarified potentially difficult issues such as the calculation of evapotranspiration (L253ff) which also led to the indication of new**

parameters in tables 2 and 3.

R3: Some results were not fully discussed. For example, in Figure 1(A), the LAI was overestimated in 2007 and the NEE was overestimated at the very beginning of the growing season.

A3: Thank you for the remark. Indeed, the local measurements of LAI and NEE were not always well represented. Several reasons might be considered but the most important issue relates to uncertainties in the vegetation initialization (e.g. at Niakhar trees were likely considered in the MODIS pixel leading to an overestimation of LAI; or at Wankama, bushes are widespread in the region but not considered in the modelled grassland type).

We have now improved the discussion and included the specific points mentioned to the text (L360ff, L431ff, L500ff).

R4: Although this manuscript focus' on evaluating the ability of LandscapeDNDC in simulating gas exchange and biomass production simulation, the simulation of soil moisture is very important especially in some arid or semi-arid sites (such as Agoufou, Dahara, and Wankama). Do you have the field measured soil moisture? If you have, I suggest the author validate the simulation of soil moisture of LandscapeDNDC.

A4: Thank you for this suggestion. The performance of the model to represent water fluxes above grassland and some crop sites has been evaluated for Bontoli in a previous publication (Grote et al. 2009). However, **we have now provided additional soil water content measurements for all sites in Fig. 3 and 5 for additional evaluation.**

R5: For the validation of NEE, I would like to partition NEE into gross primary productivity and ecosystem respiration. After that, the gas exchange part can be in-depth discussed.

A5: This is true and in fact, simulated NEE is a composite from the model outputs of gross primary production and respiration. Similar comparisons have been done e.g. in Lindauer et al. and Molina-Herrera et al. before. However, the paper is already quite long and a discussion that would need to include the uncertainties related to the gas partitioning processes of the LDNDC model as well as the empirical algorithm used to separate NEE into two fluxes would substantially increase the extent of the manuscript. We also think that the net flux which is the only one directly measured is also the most important and is corroborated by the parallel development of biomass.

References mentioned:

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Molina-Herrera, S., Grote, R., Santabárbara-Ruiz, I., Kraus, D., Klatt, S., Haas, E., Kiese, R., and Butterbach-Bahl, K.: Simulation of CO₂ fluxes at European forest ecosystems with the coupled soil-vegetation process model "LandscapeDNDC", *Forests*, 6, 1779-1809, 10.3390/f6061779, 2015.