Reply on RC1
Dóra Hidy

Community comment on "Soil-related developments of the Biome-BGCMuSo v6.2 terrestrial ecosystem model" by Dóra Hidy et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-389-CC3, 2022

Reply to the interactive comment
RC1: 'Comment on gmd-2021-389', Anonymous Referee #1, 05 Jan 2022

First of all, we thank Anonymous Referee #1 for reviewing the manuscript (gmd-2021-389). Thank you very much for the positive words. Here we answer the questions and issues raised by the Reviewer in detail. We also attached the manuscript (MS) and the supplementary material revised in the light of the comments received.

Note that the comments of Anonymous Referee #1 are shown below in italic. Our responses to the comments are presented below in normal font style.

*In Soil related developments of the Biome-BGCMuSo v6.2 terrestrial ecosystem model by integrating crop model components* the authors presents the latest implementations into the Biome-BGC model. The study is a good example of how to do a model description but maybe less so for model evaluation. The text and description (equations and simulation setup) are easy to read and follow.

Indeed, our intention was to present a detailed overview about the latest developments. Case studies are presented to highlight some features that might deserve attention by the community. It was not our intention to present detailed model evaluation here, partly because of length restrictions, partly because it was out of scope of the MS. Nevertheless, based on the suggestion and also according to the suggestion of Reviewer #2 we extended the MS with one additional case study focusing on soil N cycle and soil respiration. Forthcoming studies will provide further model evaluation.
I have two things that I think should be addressed: first the title, it mentions crops but the crop specific components are not that visible in the manuscript. This could be addressed by showing for instance the geography of cropland land management types in the data used. At the moment it's really hard to get from the results how the model are performing on different land covers. And maybe also showing the representative land cover classes on a map.

It is possible that this could be a misunderstanding. Croplands and other land use types are not specifically addressed in the study. We did not mention cropland specific investigation in the original manuscript with the exception of the case study of the lysimeter station (but this is a local scale simulation). The title referred to crop models since we took important features from crop models and implemented them in the Biome-BGCMuSo which is/was a general purpose biogeochemical model missing these options before. With the improvements, Biome-BGCMuSo can simulate almost all kinds of terrestrial ecosystems (forests, shrubs, grasslands and croplands). In the manuscript, we demonstrated that it is really useful to import features from crop models and use them in biogeochemical models. In the manuscript we mention the crop model elements explicitly (e.g. lines 271-273 and 334-337 in the revised MS).

In any case, as a response to the other issue raised by the Reviewer we present a land use map and a soil organic carbon (SOC) map in the end of the revised Supplementary Material.

This brings me on to the second part, although it is interesting to see how the updated parameters increased the overall model performance, but what are the simulated soil carbon stocks? I guess the evaluation of other components such as yields and aboveground biomass as well as fluxes will be presented in the following publication.

We have included the observation based SOC map in the revised Supplementary Material (see previous answer). The SOC map is derived from the DOSoReMI database (Pásztor et al., 2020). See reference in the Reference section of the MS. We started to work on a manuscript that will present the plant related developments of the model (this one focuses on the soil related developments). Validation of the model for eddy covariance based carbon fluxes and yield will be presented in that MS. Evaluation of soil N\textsubscript{2}O and CO\textsubscript{2} efflux simulations were included in the revised manuscript as a third case study based on observations.

Some specific comments on the text:

Line 105: the supplied reference for this statement is pretty old, LPJ-mL, LPJ-GUESS, Orchidee, etc. are all models that have implemented this after that publication.

We made a mistake during the MS editing, as originally we referred to a recent publication.
(Friedlingstein et al., 2020) but this was somehow modified to Friedlingstein et al. (2010) (which was in fact not in the References) which has no Table A1 at all. The Friedlingstein et al. (2020) paper contains the mentioned Table A1 which supports the statement. It is clear from the table that some DGVMs still miss some management options. Although the 2020 paper is quite recent we made a quick literature search to see the present situation. It is obvious that some models listed in Table A1 are still missing some management options (while e.g. ORCHIDEE was extended with grazing and irrigation options; grazing was added to LPJ-GUESS; CLM now has a fertilization module). Anyway, we have slightly modified our statement maintaining our original position on the matter. See lines 108-111 in the revised MS that reads the following:

"Additionally, human intervention representation (management) is still incomplete in some state-of-the-art BGMs, e.g. thinning, grass mowing, grazing, tillage or irrigation is missing in some models (see Table A1 in Friedlingstein et al., 2020)."

Line 175-178: This is not novel for Biome-BGC, this sounds very much like what is carried out in LPJ-GUESS.

What we meant here is that this is novel in the Biome-BGC ‘universe’. We extended the sentence to avoid this misunderstanding. In the revised MS (lines 178-181 in the revised MS) it reads:

"So-called transient simulation option (which is the extension of the spinup routine) is a novel feature in Biome-BGCMuSo v6.2 relative to the previous versions in order to ensure smooth transition between the spinup and normal phase (Hidy et al., 2021)."

Line 714: Wrong model version?

Corrected. Indeed, it should be 4.0.

Line 747-755: This whole paragraph is unfinished, especially which part is concerning grasslands and forests.

Thank you for finding this error. Indeed, the text was not entirely correct. Now we reformulated the paragraph (lines 839-848 in the revised MS):

“Grassland ecophysiological parameterization without management was used in the spinup phase to initialize SOC pools for croplands. For the transient phase cropland parameterization was used with fertilization, ploughing, planting and harvest settings. In case of grasslands, both during the spinup and transient phases grassland parameterization was used, and in the transient phase mowing was assumed once a year. In case of forests generic deciduous broadleaf forest parameterization was used for both
spinup and transient phases with thinning in the latter phase. For our parameterization presented in the MS the generic, plant functional type specific ecophysiological parameter sets published by White et al. (2000) served as starting points. These Biome-BGCMuSo specific parameter sets are available at the website of the model¹."

Please also note the supplement to this comment: https://gmd.copernicus.org/preprints/gmd-2021-389/gmd-2021-389-CC3-supplement.pdf