Geoscientific
Model Development
Discussions

Interactive comment on "Jena Soil Model: a microbial soil organic carbon model integrated with nitrogen and phosphorus processes" *by* Lin Yu et al.

Lin Yu et al.

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A: authors' response

Yu et al reported the development and evaluation of the microbially-explicit SOM BGC model Jena Soil Model at a temperate beech forest stand. The model was found able to reasonably reproduce the measured profile of SOM stocks and radiocarbon. It also explained why microbial residue plays an important role in SOM cycling. Further, the nutrient dynamics resulting from plant-microbial interactions simulated by the model appeared reasonable, although important nitrification-denitrification dynamics are missing. Overall, I found the paper interesting and generally well written. I think the paper

will become a good read provided the authors address the following comments.

A: we thank the reviewer for the positive comment and recognition of our work

In section 2.3, subsection model protocol and calibration. I followed the authors without any problem on the model initialization, however, it is unclear how the 200 years are aligned with the time. Did the model pretend to start from 1850? Also the 14C of litter input in last 60 years was mentioned to match the observed 14CO2 atmospheric pulse, how was this done exactly ? Further, I think the inorganic P pool from Yang et al. (2013) is closer to contemporary (say year 2000) than 1850. Was this criterion appropriate? I have no answer to this last question myself, and we also struggled when doing the P cycle in our TBM. Nonetheless, I would like to know more about the authors' opinion on this.

A: we ran the model for 200 years and compare the simulated results with the present-day measurement; therefore the initialization should represent the condition of ca.1820, and the bomb pulse we mimicked occurred around 1960, which is ca. 60 years before the end of simulation. The pulse was fitted to the observed atmospheric peak , by simply modifying the 14C content of litter fall.

The inorganic P pool we used to initialize the model was the data set that Yang et al. published in 2014 (Yang X, Post WM, Thornton PE & Jain AK 2014: Global Gridded Soil Phosphorus Distribution Maps at 0.5-degree Resolution. ORNL Distributed Active Archive Center.), but we made a mistake in the reference and will revise it in the re-submission. The data set we used has no explicit temporal component, but data were nominally for the pre-industrial period ca. 1850 as recommended by the authors. So we don't think it is a problem to use it to represent the condition of 1820. As we stated in the discussion that the uncertainties in inorganic P cycling and initialization are very high. We have made some progress in reducing these uncertainties, and will hopefully publish the results in a separate study soon.

Another question is how the SOM 14C profile is initialized? It is not very clear from

current description.

A: We initialize the whole SOC profile with a 14C percent Modern value of 100% for all the carbon pools and then let the 14C values develop from there following COMISSION model (Ahrens et al. 2015). We will include the 14C initialization in the resubmission.

In the model formulation, I saw nitrate was part of the N dynamics. However, I did not see any description of other N related biogeochemistry. My impression is that the model does not have a nitrification-denitrification process. Is this why no abiotic ammonium adsorption is considered in the model?

A: Yes, the N dynamics in the current version is much simplified but will be implemented into the model in a later stage. In this paper, we mainly focus on the different roles of inorganic and organic nutrients in regulating the microbial/SOM dynamics and processes; therefore we think the simplified N processes won't alter the main conclusions of this study. However, we do realize this is an important point to mention and will clarify it in the summary section.

Further, the model predicted a number of interesting features, such as the importance of microbial residue, and that root input will result in different depolymerization dynamics. Given one purpose of modeling is to inform new empirical experiments, I think the authors can make the paper more interesting by explicitly asking what new experiments will help constrain their model .

A: Thanks for recognition of our work. We will include some implications for experiments in the resubmission. A few examples are: how the microbial carbon use efficiency will change when the nutrient availability changes? how the microbial enzyme production will respond to changes of litter input?

Finally, I think the English of the paper should be further improved. I collected some of these problems below, but I recommend the authors do a more thorough check.

A: Thanks for helping with the language. We will do a grammar check before resub-

mission.

Other comments:

P1 Line 3, remove the redundant "potential" from "predict potential future climate feedbacks".

A: Corrected

P1 Line 14, remove "of" from "ample of".

A: Corrected

P1 Line 17, replace "major nutrients" with "macronutrients".

A: Corrected

P1 Line 24, replace "reproduce the response" with "reproduce the ecosystem response".

A: Corrected

P2 Line 1, replace "their representation" with "their poor representation".

A: Corrected

P2 Line 2, please be specific about what "plant uptake".

A: Will be revised

P2, Line 5, remove "the" from "In these models, the nutrient".

A: Corrected

P2, Line 7, expand "the CENTURY approach" into "the sufficiency of the CENUTRY approach".

A: Corrected

P2, Line 8, remove "the representation of".

A: Corrected

P2, Line 10, "one other important limitation" is awkward, please consider revision. And replace "most of the current SOM" with "most current SOM".

A: Corrected

P2, Line 20, the sentence reads a little bit awkward, please consider revision.

A: Will be revised

P2, Line 30, remove "this" from "this competition". Also, the sentence seems incomplete, even though it is syntactically correct.

A: Will be revised

P2, Line 33, remove "for representing them".

A: Corrected

P3, Line 2. "kinetic" should be "kinetics".

A: Corrected

P3, line 6, replace "cycle process" with "cycling process".

A: Corrected

P3, line 13, remove "and was"

A: Corrected

P3, line 17, replace "a maximum" with "the maximum".

A: Corrected

P3, line 18, add "while" before "the mathematical".

A: Corrected

P3, line 19, replace "of the QUINCY" with "QUINCY".

A: Corrected

P3, Line 20, replace "can be" with "can either be".

A: Corrected

P4, line, 24, "a loam topsoil" should be "a loamy topsoil".

A: Corrected

P4, line 27, is the unit "g/kg" meaning "g C/kg soil"?

A: Yes. Corrected

P5, line 3, replace "the observations" with "observations".

A: Corrected

P5, line 19, replace "we assumed increased" with "we increased".

A: Corrected

P6, line 5, replace "the model experiments" with "model experiments".

A: Corrected

P6, line 18, Table S4 should be "S2".

A: Corrected

P7, line 10-11, the sentence is hard to understand due to unclear definition of organic P and stocks. Does this mean include all P from all organic SOM pools? Nor the definition of stocks is clear. Please define them clearly.

A: Will be clarified in the resubmission.

P7, line 14, perhaps Fig. 7 and Fig. 3 should be swapped, so the paper's logical flow is more continuous.

P8, line 24, remove "the fact"

A: Corrected

P8, line 27-34, I think "actual enzyme allocation" is not a proper name here because you don't know what is happening in reality. Perhaps a better name is needed.

A: Will be replaced with a less confusing name

P9, line 9, maybe "resistant" should be replaced with a more appropriate word.

A: Will be revised

P10, line 23, replace "The fact that" with "that".

A: Corrected

P11, line 13, perhaps "N&P" should be replaced with "N and P" for it to be consistent with the writing style of the paper. Similar changes should be made in other places.

A: Corrected. We will check the consistency of other terms in the resubmission

P11, line 13, "resulted" should be "resultant".

A: Corrected

Fig 5, some red annotation of depth overlapped with the y-stick label.

A: Will be revised

For all figures, some annotation text should use large font size, because they may become unreadable when included in the published version.

A: Will be revised