

Biogeosciences Discuss., author comment AC3
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Reply on RC3

Weilin Huang et al.

Author comment on "Implementation of mycorrhizal mechanisms into soil carbon model improves the prediction of long-term processes of plant litter decomposition" by Weilin Huang et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-275-AC3>, 2021

Response to Reviewer 3

R3.0. This study added mycorrhizal impacts on plant litter decomposition to the Yasso15 model, calibrated and validated the new Myco-Yasso model using 3 large-scale litter decomposition datasets, and explored the sensitivity, behavior, and broader implications of the new model.

In general, this paper was a thorough, thought-provoking, and enjoyable read. The paper was well-written and well-organized, making it easy to understand the approach the authors took to model development and testing. The sensitivity and model behavioral analyses were thorough and left me with very few of the "but what about..." questions that modeling papers usually give me. The role of AM and EM fungi in soil C cycling is an important factor that models have yet to address, and this paper is thus a timely and novel addition that will likely interest the readers of Biogeosciences. Although the authors' model addressed litter decomposition and not soil C cycling, litter decomposition is an important first step in both experiments and models of soil C cycling that has been rigorously documented by litter decomposition studies, and I think the authors did a successful job of placing their model in the broader context of soil C cycling without overstating the capabilities and implications of their model.

I agree with the comments made by other reviewers that mycorrhizal effects were represented within the model via the proxy variable of plant cover type, and that this limits the 'mechanistic' interpretation of the model somewhat. The new model did not incorporate microbial biomass or enzyme pools, and therefore cannot theoretically be validated using any measurements of actual microbial variables. As other reviewers have stated, plant cover type likely correlates strongly with both climate and litter chemical characteristics, which confounds the interpretation of the new model as purely representing mycorrhizal effects. I think the authors' approach to modeling mycorrhizal effects is still valid and interesting, but I think this limitation bears more discussion, especially when numerous other soil C models with explicit microbial impacts have been published recently (CORPSE, MIMICS, ORCHIMIC, the Millennial model, to name a few) and have demonstrated that microbes can be represented in models without relying on proxy variables.

I have a few additional language edits to suggest, and I imagine the journal's copy-editing service will catch a few more:

Re R3.0: Thank you for your careful reading and encouraging comments on our manuscript. Indeed, there are various concerns about the definition of so-called 'mechanistic' in this paper, and we will rephrase these parts to avoid more debates (Please see the rebuttal to R2.6 and R2.10 for details). And thanks for the recommended papers, we will include them in the discussion section.

R.3.1.

33 – are not is;

42 – are not is;

131 – space before the dash

Re R3.1: Thank you for your careful reading, we will modify the sentences accordingly: Line 33, '...are the most widespread symbiosis on Earth'; Line 42, 'The temporal dynamics of plant litter decomposition are underpinned by the dynamics of...'; Line 131, 'stage - contribute to the accumulation of mineral associated organic matter MAOM'

R3.2. 142 – “parameterize” is a modeling term that refers to the representation of a complex process as a simplified mathematical relationship between parameters and is not synonymous with “parameter selection” or “parameter tuning.” It would be more appropriate here to say “We selected parameters for our new model...”

Re R3.2: Thank you for pointing this out, the word should be 'calibrate'. We modified the sentence to 'We calibrated our new model using litter decomposition databases...'

R3.3. 355 – The last clause of this sentence is very awkward

Re R3.3: This refers to the sentence “The mycorrhizal impacts are likely less visible in the short-term (< 3 years), and detectable effects of the mycorrhizal environment of litter should be assessed over a longer period”. There are two typos in the last clause. It should be “and detectable effects of the mycorrhizal environment ON litter DECOMPOSITION should be assessed over a longer period.”

R3.4.

407 – quantitative not quantitatively

413 – The paper is careful elsewhere not to overstate the improvement in model performance generated by the new changes; I think the word “greatly” is not appropriate here.

Re R3.4: We modified the sentences in Line 407, 'Our modelling exercises provide mechanistic and quantitative examination...' and deleted the word 'greatly'.

R3.6. 421 – This paragraph doesn't flow as well as the rest of the paper and is somewhat difficult to get through; it could use another pass-through for sentence clarity and concision.

Re R3.6: Thank you for sharing your reading experience, we will polish the paragraph and the rest of the paper to give a better reading experience.