

Biogeosciences Discuss., referee comment RC3
<https://doi.org/10.5194/bg-2021-275-RC3>, 2021
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Comment on bg-2021-275

Anonymous Referee #3

Referee 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-RC3>, 2021

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:

33 – are not is

42 – are not is

131 – space before the dash

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...”

355 – The last clause of this sentence is very awkward

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.

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.