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Interactive comment on "Integrating microbial physiology and physiochemical principles in soils with the MIcrobial-MIneral Carbon Stabilization (MIMICS) model" *by* W. R. Wieder et al.

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This manuscript presents a new model of soil carbon based on principles of microbial community dynamics and their differing effects on soil organic matter quantity and structure. These effects are missing in "traditional" soil carbon models used in land-surface schemes and climate models that are used to address issues of global carbon balance and its future projections.

I find myself not qualified to review the model details regarding microbial physiology, but rather I review this paper in the context of what it means for large scale / long-term simulations of the global carbon balance. The C4MIP study and analysis of more recent

CMIP5 models have found a large and important role for terrestrial cabron storage in influencing the future land carbon sink and hence atmospheric CO2 concentration. Soil carbon is the largest terrestrial pool in these models and plays a significant role in the spread between models. This model spread has not reduced over nearly a decade of multi-model intercomparisons.

In this context I found this paper fascinating and it represents a really important step in taking a crucial component of the Earth System beyond the very simplistic models that are used to date. As such I have no specific comments about the work presented in the paper, but I would ask that the authors could give more details about the implications of this modelling for global models.

specifically - a lot of the manuscript deals with how carbon is allocated differently to different MIC and SOM pools depending on quality rather than quantity. But what I missed was how this might change simulations of changes in soil carbon under different future environmental conditions. E.g. if global soils were circa 2-4 degrees warmer how would this affect soil carbon storage? from the look of equations 2 and 3 there is still a temperature dependence on the decomposition - so would this model give a fundamentally different sensitivity to warming from "traditional" models? Perhaps the zero-order question that global models are used for is to see how the global carbon sink will change in future - knowing what this new modelling approach means for that question is where this manuscript would become really interesting for me.

related - would the main differences from this model be in the steady-state following a perturbation, or in the transient response to changes? (e.g. Jones et al 2005 discuss that the multi-pool vs single pool approach has most impact on the timescales of the transient response without necessarily affecting the steady-state response).

the structure of this model (in terms of number of pools and number of equations) does not look to be so different from traditional models, so what, if anything, prevents this model being implemented and run globally in CLM? or is that a planned next step?

Even if you can't quantitatively answer these questions, I think it would be useful to hypothesise and maybe try to give some clue as to where this model would behave differently (or the same) as others. (e.g. if this model took part in CMIP5 would it completely stand out of the pack for some reason in its behaviour?)

so overall I really like this study, and recommend publication. But I was left frustrated (partly from my own ignorance perhaps) that I couldn't figure out how important it might be (or even if it would increase or decrease the sensitivity to changes, let alone the magnitude).

Chris Jones

some minor specific queries:

- you say litter quantity affects MIC rather than SOM size. Can you give an indication of the comparable magnitude of these two pools (is SOM orders of magnitude bigger than MIC?)

- why does this model seemingly not include soil moisture as a driver? (or did I miss it?). Is this not seen as an important issue?

- are you suggesting that all such models should include this level of microbial process detail? or rather would you use this more detailed model to improve parametrisations of simpler models? (e.g. maybe in the same way that cloud-resolving models can be used to help parametrise cloud processes in GCMs)

Interactive comment on Biogeosciences Discuss., 11, 1147, 2014.