Geosci. Model Dev. Discuss., 8, C391–C396, 2015
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Geoscientific Model Development Discussions
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# *Interactive comment on* "Representing life in the Earth system with soil microbial functional traits in the MIMICS model" *by* W. R. Wieder et al.

**Anonymous Referee #3**

Received and published: 7 April 2015

## General comments

Wieder et al. (2015) expand previous work on the MIMICS model (Wieder et al., 2014) and another simpler model (Wieder et al., 2013) by comparing a restructured version of MIMICS with various observations: leaf litterbags, site-level SOC stocks, data from an N-enrichment meta-analysis and the top 1 m SOC stocks from the Harmonized World Soil Database. The authors aim to highlight the importance of representing microbial functional groups in MIMICS. The MIMICS model also includes the protection of SOC on clay minerals. Overall, I find the ideas and concepts embedded in the MIMICS model quite innovative and comprehensive. Some aspects of the MIMICS model and especially its comparison to the various observations, however, are insufficiently



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described and hard to follow. The adjustment of different model parameters to fit the various observations seem a little bit ad hoc, and need to be better described and motivated.

**Specific comments**

- P2015,L5-6: I think you misrepresent the results of Sulman et al. (2014) a little bit. Their CORPSE model also includes different litter qualities and protection on soil minerals. MIMICS obviously also includes different microbial functional groups (copiotrophs and oligotrophs), but Sulman et al. (2014) distinguish into rhizosphere and non-rhizosphere soil which could be interpreted as the preferred habitat for copiotrophs (rhizosphere soil) or oligotrophs (non-rhizosphere soil).
- P2015,L12: With the term "soil biogeochemical model" you imply that you model more than SOC dynamics (e.g. nutrients or weathering). SOC turnover model or SOC decomposition model might be more fitting.
- P2016,L17: You state that "microbes only assimilate C from the available SOM pool", but according to your model structure microbes also directly assimilate metabolic and structural litter.
- It might be worth to discuss how fungi fit into your framework of copiotrophs and oligotrophs.

Structure of the paper

- I think a flow chart is needed to illustrate how the various comparisons against observations are linked: For example, is the calibration to leaf litterbags informative for the comparison with site-level SOC stock?



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Model structure

- Your definition of the “chemically protected pool” deviates from the conventional use of this term in SOM research. To my knowledge “chemical protection” is usually used to describe stabilization on iron or aluminium oxides or the edges of clay minerals via ligand exchange or anion exchange (Six et al., 2002; Conant et al., 2011). The more appropriate term would be “chemical recalcitrance” or “selective preservation”. Within your model framework the “chemically protected pool” could be called “structural microbial residues”.
- You state that you normalize the microbial turnover rate with site-level NPP (P2018,L6-8). What is the mechanistic justification for this? Is this normalization the reason for the strong correlation of the global microbial biomass with NPP (P2023,L14)?
- For the decomposition of $SOM_c$ to $SOM_a$ you introduce the parameter $KO$ (Eq. A10). Could you elaborate what this parameter represents and why microbes have a harder time decomposing $SOM_c$ compared to $Lit_s$. In other words: Why is $V_{max}$ the same for $SOM_c$ and $Lit_s$, but more microbes are needed to reach this $V_{max}$ for the decomposition of $SOM_c$ compared to $Lit_s$?

Model-data comparison

- You compare the MIMICS model with the LIDET leaf litterbag data. It is unclear to me why the clay content of the different LIDET sites should be considered. To my knowledge the LIDET leaf litterbags were not in contact with the mineral matrix. Adair et al. (2008) state “leaf litterbags were placed on the ground surface”. Hence, the protected pool should be zero when modelling leaf litterbags.



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- It might be a good idea to use both litter types of LIDET - the root litterbag and leaf litterbag data. This would make it possible to evaluate the effect of physical protection (leaf litterbag VS root litterbag).
- You keep the microbial biomass constant during your modelled litterbag experiment (P2017,L22-23). What is the mechanistic reasoning for this approach? Does this mean that microbes outside of the litterbag decompose litter inside the litterbag? I would guess that microbial biomass and the ratio of oligotrophs to copiotrophs changes during a litterbag experiment according to how much of the metabolic litter is remaining. Please clarify why the ratio of oligotrophs to copiotrophs should not change during a litterbag experiment.
- For the comparison against site-level SOC stocks you modify "the microbial turnover and growth efficiency parameters" (P2018,L13-14) because surface and subsurface dynamics are not explicitly modelled in MIMICS (P2018,L12-13). In my opinion surface and subsurface dynamics are included in MIMICS: For the litterbags (surface dynamics) SOC cannot be stabilized on clay minerals (there is no clay in the leaf litterbags), while for the comparison with site-level SOC stocks (subsurface dynamics) the influence of the soil matrix comes into play.
- For the comparison against data from the N-enrichment meta-analysis you force MIMICS with an increased aboveground NPP. What about belowground NPP? Did the meta-analysis discuss if plants might invest less into roots because the uptake of mineral N was easy?
- For the global simulations I do not understand why you have to adjust $\tau$, $f_{met}$ and $P_{scalar}$ (P2019,L18). Has this to do with the influence of the mineral matrix which is absent in the leaf litterbags?



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Model parameterization

- You state that you "parameterized MIMICS with leaf litter decomposition simulations" (P2016,L24). How did the parametrization work? You should clearly state which parameters are literature-derived or from previous studies, and which parameters were calibrated to the leaf litterbag data.
- What is a "Tuning coefficient" (Table B1). How was this coefficient determined?
- Why is $V_{mod-K} = \{3, 3, 2\}$ and $V_{mod-r} = \{10, 2, 10\}$ (Table B1)? Or in other words why do the r-strategists decompose the structural pool slower than the available SOM pool, while K-strategists decompose the structural pool faster than the available SOM pool?

**Technical corrections**

- P2020,L23: I think you wanted to refer to Table 1 not Table B1
- P2021,L18,L20: MIMCS

**References**

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Interactive comment on Geosci. Model Dev. Discuss., 8, 2011, 2015.