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Geoscientific Model Development Discussions

Interactive comment on "Long residence times of rapidly decomposable soil organic matter: application of a multi-phase, multi-component, and vertically-resolved model (TOUGHREACTv1) to soil carbon dynamics" *by* W. J. Riley et al.

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We thank both reviewers for their time and effort to review our paper. Below we address each of the reviewer concerns separately, with their text in italics and our responses in normal font.

Reviewer 1 (B. Guenet) We thank the reviewer for the positive comments on our manuscript. Regarding the few minor comments:

1. *The evaluation made by the authors is quite qualitative because of the difficulty to*

find sites where all the processes represented are measured but I would appreciate a better justification for that (even if I understood why it has been done this way).

We agree with the reviewer, and therefore have discussed this issue in several places in the manuscript: page 838, lines 17-25; page 840, lines 12-28; page 841 lines 1-4.

2. *I appreciate the discussion but I believe that some lines are missing to discuss about the risk to use this kind of models, with several parameters, in ESMs. Indeed, tuning or optimization possibilities are quite high with an increasing number of parameters and I believe that a particular attention must be paid to ensure that parameters values make sense even after tuning and/or optimization. It is a personal opinion but I would prefer a model that does not perfectly fit the data but with parameters measured or at least in the range of the parameters measured instead of a perfect fit with totally stupid values for parameters.*

We agree with the reviewer's sentiment that care must be taken when choosing parameters for complex models. Such an approach is necessary for ensuring reasonable model predictions, particularly in situations outside of where the model has been tuned. We discussed this point on page 878, lines 17-25.

3. *P824 l5: I did not fully understood what the authors mean with 'unfolding capability'*

This term is only applied to peptides/proteins (Table 2), which under certain conditions can change their structure and therefore have different mineral surface interactions.

4. *P825 l14: 'we did not include the effects of pH', do you mean that g(pH) is fixed to 1 in equation (2)? Please clarify*

Yes, we have clarified this restriction in the text.

5. *P826 equation (4), (5) and (6), why there is some minus after the '=' sign?*

As substrate is consumed (i.e., dCi/dt < 0), CO2 production increases (dCO2/dt > 0).

6. *P827 l10: BA is expressed in mgC-wet-biomass L-1 but litre of what soil, or soil*

solution?

We have clarified the answer to this question in the text (i.e., soil solution).

7. P833 l7: There is no Fig 3a is the figures section please modify

This reference should just be to Figure 3; the problem has been fixed.

8. P834; Section 3.2, there is no words about interaction effects between parameters, are all the effects only additive? The figures suggest that interaction effects may exist. Please present these as a result and add few words in the discussion.

Yes, interactive effects exist, and that is why we performed concurrent manipulations of both the mineral interaction constants and microbial growth rates (p 834, Line 25-38). The interaction effects are also described in the Discussion section.

9. P835 l10: This sentence suggests that comparison with 14C data will be done and no data are represented in the corresponding figure. It is a bit confusing, please clarify.

We have changed this first sentence to clarify this confusion. The text in that paragraph indicates that the simulations are qualitatively consistent with several measurements that are cited in the paper (Trumbore et al. 1995; Baisden and Parfitt 2007).

10. Fig 4a. The legend is not clear, it represents microbial biomass but why there is lignin etc?

That is an error in the figure caption; the legend is correct. We have corrected the figure caption.

Interactive comment on Geosci. Model Dev. Discuss., 7, 815, 2014.