Biogeosciences
Discussions

Interactive comment on "Modeling transient soil moisture limitations on microbial carbon respiration" *by* Yuchen Liu et al.

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Major concern 1: A significant problem with this (and other models expressly incorporating dormancy), is that measurements of the active vs. dormant. vs. dead biomass are very difficult to make. Traditional measurements of biomass tend to measure anything that can be extracted through chloroform fumigation (regardless of the taxonomic identity), and molecular measurements remain open to interpretation. However, given the likelihood of equifinality in interpretation of this modeled experiment (and the limited data set presented here), it would seem critical to be able to understand whether the model fit improved because of dormancy within the experimental conditions. What about comparisons to other datasets that examine variably respiration in variably saturated soils?

We thank the reviewer for their insight regarding the measurement of the active vs. dormant vs. dead biomass, and we wholeheartedly agree that this measurement is very difficult to make. In this study, we've shown that the DM model uniquely reproduces the transient 'Birch' behavior, and acquired a lower AIC value in simulating the shallow and intermediate soil samples, indicating this structure is the superior approach for further application. We argue that even if the measurement of different biomass pools is difficult, the improved performance is still worth the measurement. To address this concern, we are adding a new paragraph in section "5.4 Future directions" indicating that we will further examine the DM model under variable soil moistures using extended datasets which we are currently developing.

Major concern 2: Furthermore, I am find the manuscript quite difficult to follow. The unconventional layout is really quite confusing, and the discussion proceeds as an extended results section. The introduction is very good, but overall, I think a thorough reconsideration of the layout is in order.

We thank the reviewer for this observation and completely agree that there is a broad range of organizational approaches used in such model development papers. The reason we settled on this structure is that the development of the 4 models in increasing complexity is only justified when the datasets are already presented and used as a point of comparison to the simulations. Thus, we thought that splitting model development into an earlier section would leave readers with a poor understanding of why this hierarchical model framework is being developed. However, since all three anonymous referees have explicitly pointed out this problem, we've decided to change the structure to the more traditional model development within the earlier 'materials and methods' section and the model results within the latter 'results' section. The model description will be shortened, emphasizing the differences between the four models, and some of the currently detailed information will be moved into supplementary. In addition, the subtitles of the "Discussion" section will be modified to directly state the main take-home point of each subsection, focusing more on the big-picture questions. A new

paragraph will be added after line 377 as a summary containing the key points of the discussion section. Another paragraph will be added to section "5.4 Future direction" specifically about how we are going to upscale the reactive transport model with the application of the DM2 model, for improved simulation of hillslope to watershed scale carbon cycling.

Minor comments: 1) Ln 112: This is quite an irrelevant description of microbial communities. It's an operational definition used for ease of characterization an generally derived for higher organisms. Yet microorganisms tend to be metabolically flexible, and realistically fall across a continuum from r- to k-strategist, with little accumulation at either end.

The reviewer correctly points out that microorganisms tend to be metabolically flexible. To address this comment we have removed the terms r- and K- strategists in the paper, and the two kinds of microbes are instead described by their distinct response to soil moisture contents.

2) Ln 206: This is a pedantic point, but why write 'degrees celsius', as opposed to using symbols?

The symbol âĎČ is now used in line 206.

3) Ln 215: Why do the results appear here? Where is the model description?

The structure of the paper will be modified with the results reported in the "Results" section.

4) Ln 262: These aren't really communities right? Just two 'organisms' with differing kinetic values for Michaelis-Mentoin terms and growth rates?

The word "communities" has been changed to "organisms".

5) Ln 295: The comma after 'pathway' isn't required.

The comma has been deleted.

6) ln 297: Why use this value for CUE? It seems far lower than that measured for microorganisms in soil (which I think is about 0.3).

We use this number solely as an illustrative example. To address the reviewer's comment we have added a sentence at line 297 to specifically point out that different values should be used in different simulations.

7) Ln 328: should this be expressly?

The word 'expressly' is now used instead of 'express'.

8) Ln 377: A lot of this seems like results. There's very little discussion going on here.

The structure of the paper will be modified with these results reported in the "Results" section.

9) Ln 392-4: I'd recommend rewriting this sentence, very difficult to follow

This sentence has been changed to "With further time, the excess soluble carbon initially available is depleted, resulting in a decrease of the initially rapid rate of CO_2 production"

10) Ln 900: It seems like this table would be better presented as a figure?

The table has been converted to a figure.

11) Ln 992: Where are the references for the values in this, and the following table? It's important to understand where these came from, and how similar the environment was to the soil under consideration here.

Another column has been added to both Table 3 and 4 listing the references where those parameter values are used.