**Biogeosciences
Discussions**

Interactive
Comment

Interactive comment on "Colimitation of decomposition by substrate and decomposers – a comparison of model formulations" *by* T. Wutzler and M. Reichstein

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General comments

Some recent results on the priming effect have shown that the decomposition of recalcitrant soil C is not only limited by the size of soil C pool, but also by the size and probably the functional diversity of decomposer populations. In this context, Wutzler and Reichstein's work attempts to understand how including this substrate-decomposer colimitation in models explicitly could affect their predictions on C storage in soils. The mathematical form of this co-limitation has never been determined experimentally and several equations exist. Therefore, Wutzler and Reichstein present a review of these

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different mathematical equations, and then test these equations in a simple model of soil C dynamics they have built for the occasion. They show with success that the different mathematical representations of the co-limitation result in qualitatively different long-term behaviour. For example, the capacity of soils to accumulate soil C can be either limited or non-limited depending on the type of equation. This important work with others demonstrate that, as long as there is no fundamental understanding of the processes involved in the decomposition of soil C, our ability to predict the future capacity of soils to accumulate carbon, or to become a source of C as a result of the global warming, is extremely limited. The example presented in the part "challenging models with experimental data" is not very convincing: differences between formalisms seem to be very small and it is not clear why the isotopic ratio of respired CO_2 is a variable that can discriminate the formalisms presented in the article. Some sentences are not clear and I found several typing errors (see comments below).

Specific comments

In the following P=page L=line

Introduction You should explain why the classical equation $dC/dt=-kC$ can apply to the decomposition of fresh C and not the decomposition of recalcitrant soil C. P164 L23-24 Change "a decomposer community" by "soil decomposer communities". P165 L12 Insert citations to support your sentence "...at daily resolution at plot-scale" P166 L18-21 The 2-3 objectives presented here deserve two sentences.

Methods P167 L22 Replace "an" by "a". P167 L5 If I understand what you mean, I think that you should replace "was" by "could". P168 L2-3 This idea has already been presented before. P168 L9 Replace "booth" by "both". P168 l14 This precision is not essential.

Results The equations should be close to the text which describes these equations. For example, insert equation (3) after the first paragraph. P171 L8 The introduction of the reverse equation of Monod proposed by Schimel is not clear, explain the rational of this

equation. L9 the term "eventually" is not clear. P171 I don't understand the eq (11): if A=0, that is, there is no microbe breaking the soil C, the model should predict that ds=0. Moreover, if A tends to infinity, decomposition flux goes to 0. P172 L14-15 Rephrase or delete this sentence. P172 Eqn (17) and (18) be careful, the symbol which represents the fraction of soil C that is assimilated by decomposers has changed compared to the Eq (1). Use the same symbol throughout the manuscript. P173 L5 Precise that some models do not predict steady state for the soil C pool. P173 L6 Correct the word "unlimited". P173 L9 Precise your prediction: when $s>ek$. P173 L26-27 Insert citation in order to support this statement.

Discussion P174 L8 Correct the word "colimitation". P175 L2-4 Please pool the equations 4, 5, 7, 8, 9 in your description of results since these equations have the same behaviour. P175 L6 Insert "between different microbial functional groups" after the word nitrogen. P175 L16 Insert a sentence of conclusion at the end of the paragraph. P175 L18 Please precise the type of model in question: non-explicit representation of what? P177 L5-11 Your sentences are not clear. It seems that soil C decomposition linear group of formulation do not depend on the availability of fresh C, which is false. P177 L13 Your conclusion should be clarified or shortened. From P178 L11 to the end of the text, replace Fig. 5 by Fig. 3. Finally, I agree that we need initiatives and experimental designs that can distinguish between the decomposition modelling formalisms. However, the example presented here is not very convincing: differences between formalisms seem to be very small and it is not clear why the isotopic ratio of respired CO_2 is a variable that can discriminate the formalisms presented in the article. P180 L3 Change "witch of the competing" by "which of the competing".

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