

Interactive comment on “Towards a representation of priming on soil carbon decomposition in the global land biosphere model ORCHIDEE (version 1.9.5.2)” by B. Guenet et al.

Anonymous Referee #2

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General comments: The MS by Guenet et al., “Towards a representation of priming on soil carbon decomposition in the global land biosphere model ORCHIDEE (version 1.9.5.2)” describes the attempt to model priming effect at ecosystem scale using the CENTURY-type ORCHIDEE model with new features (and three additional parameters). I admit that SOM matter turnover models should be developed in this direction and I welcome this attempt. This work is also in general trend of microbial-driven model application for global SOM simulation (e.g. Li et al., 2014, Wieder et al., 2014, 2015). The strong side of the work is a thorough model calibration and validation against independent datasets including both laboratory incubation experiments and field observations. All mathematical and statistical procedures as well as experimental data taken

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from literature are carefully described. My main concern is that authors try to improve the SOM model from previous generation (CENTURY-type, based on first order kinetics) keeping the original cumbersome and complex structure. Including the interactions between pools could help to simplify the model structure, but this was not done. Therefore, the results are not very impressive: authors show that ORCHIDEE-PRIM hardly improve the prediction of CO₂ production in litter amendment experiments and addition of new parameters increase Bayesian Information Criterion in many cases, when original model is compared with modified one, i.e. PRIM model is overparameterized. Authors have to describe better the advantages of their approach, which is based on well-tested and broadly used ORCHIDEE model. The capability to describe priming effect is an important improvement, but this can be done explicitly with a help of a simple models and this kind of models already was applied for global scale (see review by Wieder et al, 2015). If direct comparison of new generation model with explicit description of microbial biomass turnover is not possible, you should at least mention alternative approaches and discuss pro and contra of their application in relation to your approach.

Some further specific and technical comments are below:

Discussion section: I find it reasonable to discuss the levels of complexity allowing to present priming effect in the models, similar to way as it was done in paper by Wutzler and Reichstein (2013). PRIM model according to their classification can be described as microbial steady-state model, also according to you description at P9199L23.

P9195 L21 - reference Luo et al is absent in the list.

P9196 L3-4. Interestingly, that you cite paper by Kemmit et al., 2008 in support of your claim that soil decomposers are the main actors of SOC decomposition. In fact, in the cited paper authors try to prove the idea that microbial biomass size, composition or specific activity do not influence the decomposition - i.e. opinion completely opposite to your statement.

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P9197 L16: Expression is not clear "several of parameters" what do you mean with this?

P9198 L24 ..the same as..

P9201 L9-12: What was a basic underlying principle for the selection of data for model calibration? You sometimes take one treatment or incubation or variant among several published datasets.

P9202 L6 correct misprint.

P9203 L10: Please, describe how these two fraction of respiration flux were separated. Was root respiration the same for litter amendment and litter exclusion variants?

Figure 2 and 3: Please indicate (as in text) that Figure 2 present result of model calibration (dataset 2.2.1) and Fig. 3 present the result of model evaluation on independent dataset (2.2.2).

References:

Li J, Wang G, Allison S, Mayes M, Luo Y. 2014. Soil carbon sensitivity to temperature and carbon use efficiency compared across microbial-ecosystem models of varying complexity. *Biogeochemistry* 119 (1-3):67-84.

Wieder WR, Allison SD, Davidson EA, Georgiou K, Hararuk O, He Y, Hopkins F, Luo Y, Smith MJ, Sulman B et al. . 2015. Explicitly representing soil microbial processes in Earth system models. *Global Biogeochemical Cycles*: DOI: 10.1002/2015GB005188

Wieder WR, Bonan GB, Allison SD. 2013. Global soil carbon projections are improved by modelling microbial processes. *Nature Clim. Change* 3 (10):909-912.

Wutzler T, Reichstein M. 2013. Priming and substrate quality interactions in soil organic matter models. *Biogeosciences* 10(3):2089-2103.

Interactive comment on Geosci. Model Dev. Discuss., 8, 9193, 2015.

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