

Interactive comment on “Parametrization consequences of constraining soil organic matter models by total carbon and radiocarbon using long-term field data” by L. Menichetti et al.

Anonymous Referee #2

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Review of “Parameterization consequences of constraining soil organic matter models by total carbon and radiocarbon using longterm field data” by Menichetti et al.

This study used field experiment SOC and SO14C data to test/constrain five different soil decomposition model structures that explicated represented total SOC and 14C pools. Their main conclusions include 1) according to model, the treatment sites SOC were far from equilibrium. 2) model estimated mean MRT was sensitive to the consideration of 14C data. 3) estimated parameters were less sensitive to model structures. 4) The data were not sufficient to determine an optimal mechanistic SOC model structure.

I appreciate the authors effort in utilizing 14C data and the uncertainty analysis using different model structures. I do advocate the additional constraints imposed by 14C,

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which is crucial for getting the turnover time right.

General comments: The five models are difference models, I am wondering why do the authors not choose to solve a system of Ordinary Differential Equations, because difference equation systems can yield in notable differences from the ODEs.

The thickness of the soil that correspond to the SOC measurement was not mentioned in the text. How is the ^{14}C measurement, presumably from a mixtures of soil samples of both shallow and deep soil, differentiated and associated with the modeling pools.

The details of the ‘time series’ of SOC and ^{14}C data are not clear; it is also not clear what cost/target function were used in the optimization process. A graph showing the time evolving dynamics of the observations would help. Based on the text, it seems the measurement of SOC and ^{14}C were not vertically resolved, then it is very critical to report the depth to which SOC was sampled. If only total SOC and carbon-averaged ^{14}C is measured for one treatment, then the model seems to have too many parameters (minimum 4 parameters) than the observations (total SOC and ^{14}C , two values).

The MRT of the old pool obtained from the model is <100 years, while many studies reporting deep soil turnover of thousands of years (Schelesinger 2000), thus knowing the depth of the sampling is important to understand the magnitude of turnover time in this crop ecosystem.

Specific comments: Abstract: the reported MRT have too many significant digits, unless a range is able to be reported, otherwise please consider round to the units. Actually if the authors were running 4 MC chains for each calibration, then one should be able to calculate a variance for the MRT.

Abstract: where is there no uncertainty range on the estimated MRT?

P4 L23: change to “are currently under active development”

The exact time span and frequency of the SOC and ^{14}C measurements should be specified in section 2.2, currently it is not clear about this data information

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P8 L15: the notation ‘i’ was not defined in the text, seems it is inputs to the young pool. Then this model assumes no direct inputs to the old pool, but there are root exudates etc. that maybe directly input to the old pool. The current model structure may be fine, but some discussion on this potential caveat may be helpful. This is important because the 14C from root exudates are usually very young, thus maybe have a big impact on the 14C signature of the old pool.

Fig 1: consider relocate the legend to not interfere with the lines.

Fig 2: It is surprising to see the graph that shows the impact of different weights of SOC vs. 14C on the model optimization results. It is interesting to see that model structure has such a limited effect on the results, suggesting current dynamics in the models are not being well differentiated at all. One potential reason is that the limited 14C and SOC observations (not depth resolved and not really time series? Please see the general comment) are not sufficient to distinguish model structure, I would expect one to see stronger differentiation when vertically resolved SOC and 14C information was incorporated.

Fig 7: just by reading the caption, it is not clear what the different panels represent. Please clarify. Now I see what the observation look like. The high 14C in the observation makes me wonder that the 14C observation may not be sufficient to constrain the turnover of the old soil carbon, as the result shows, that the different model structures are not distinguishable. Maybe it is worth mentioning in the discussion the importance of vertically resolved SOC and 14C observations in model parameterization.

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