**Biogeosciences
Discussions**

Interactive comment on "Information content of incubation experiments for inverse estimation of pools sizes in the Rothamsted carbon model: a Bayesian approach" *by* B. Scharnagl et al.

Anonymous Referee #1

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In this manuscript, the authors used a well validated soil carbon model, ROTHC model, generated a set of data (mineralization rates) with given initial pool sizes and parameter values. And then they used different parts of these data to inverse the initial values of ROTHC carbon pools with the same set of parameter values and found that the longer data series lead to better estimates of initial pool sizes. Bases on these results, they claimed that long-term incubation data provided more information on the carbon pools.

It is a very interesting topic that how to get the information on soil carbon components from incubation data. However, the authors used the same model (ROTHC) with the same parameter values (Table 1, in the manuscript) to generate "incubation data" and

to inverse the quantity of the initial carbon pools. This method contains two very important assumptions: 1) The classification of carbon pools is known. The authors used the same pools in generating data and inversion. 2) All the key parameters controlling SOC decomposition, e.g., decomposition rates and temperature sensitivities are known. The authors used the same parameters in generating and inversion.

Therefore, their estimates of the initial pool sizes are conditioned on the known carbon components (carbon pools) and known SOC decomposition processes (decomposition rates, partitioning coefficients, temperature sensitivities, and other parameters). However, in incubation experiments, we don't know how the carbon components change with time. And, their decomposition rates and temperature sensitivities are just what we want to know. Therefore, these two assumptions made their results have no meaning to current incubation experiments.

The authors may try another model (e.g., a two carbon pool model, labile and recalcitrant carbon, with unknown decomposition rates and temperature sensitivities) in inversion to check what they can get, or, use the real incubation data sets and ROTHC model to check if they can constrain those carbon pools and other parameters in their table 1.

Using a model to generate a set of data and then using these data to inverse the parameters in the same model can only test the reliability of the model and the inversion approach.

I have some minor concerns: 1. In abstract (Lines 11∼12, Page 9332), "this methodology has not yet been tested for assessing carbon pools in multi-compartment SOC models." Actually, inversion approaches have been often used by the community. Xu et al. (2006) estimated turnover rates of litter and SOC based on data collected from Duke Forest FACE by MCMC approach. Fox et al. (2009) compared seven inversion methods with a model including litter and SOC pools.

Xu, T., L. White, D. Hui, and Y. Luo (2006), Probabilistic inversion of a terrestrial ecosys-

tem model: Analysis of uncertainty in parameter estimation and model prediction, Global Biogeochem. Cycles, 20, GB2007, doi:10.1029/2005GB002468.

Fox A, et al. 2009. The REFLEX project: Comparing different algorithms and implementations for the inversion of a terrestrial ecosystem model against eddy covariance data. Agricultural and Forest Meteorology 149: 1597–1615

2. Lines 20, Page 9336: "2.2 Incubation experiment". This part tells us how to generate synthetic data, rather than an incubation experiment".

3. Lines 24∼26, Page 9336: It should be stated as "In simulations, the temperature was set to 20C . . .".

4. The manuscript should have a figure showing their data of mineralization rates derived from ROTHC model. The readers may want to know what the data look like.

5. Page 9351: Table 1. I'm wondering if all parameters were inversed, could they still constrain the three initial carbon pool values?

6. Lines 16, Page 934, ∼ Line 24, Page 9344: "informative prior for the microbial biomass pool" just means one more parameter is known, let's inverse the other three.

7. Page 9346: Conclusions: I don't think these results have shown that the mineralization rate data (or, incubation data) have enough information to estimate the carbon pools. The authors should keep it in mind that their estimates of the initial carbon pool values are conditioned on known parameters (decomposition rates, partitioning coefficients, and temperature/soil moisture/ sensitivities. However, they are unknown for real data.

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