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Interactive comment

Interactive comment on "A model based on Rock-Eval thermal analysis to quantify the size of the centennially persistent organic carbon pool in temperate soils" *by* Lauric Cécillon et al.

Anonymous Referee #1

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This manuscript presents an analysis of thermal properties of soil organic matter (SOM) and how they relate to the concept of persistence. The analysis is performed on a range of long-term bare follow experiments, which are of special significance to understand long-term carbon dynamics in soils. The manuscript is well written and most of the information is well presented. I only have two major conceptual issues, but overall no technical comments.

1 Major comments

One important source of confusion in this manuscript is the use of the concept *residence time*. Notice that in soils one must distinguish between the concepts of age and transit(residence) time (Bruun et al., 2004; Manzoni et al., 2009; Derrien and Amelung, 2011). What the authors are trying to estimate here is an indication of the *age* of the SOM, not the residence time. These should be more clearly treated in the introduction and the discussion. Currently, the use of these terms is ambiguous.

The other important issue in this manuscript is also conceptual. The model presented in equ. 1 and used to compute the centennially persistent pool is, in my opinion, inappropriate. It assumes that an amount of 'inert' carbon c is sitting there doing nothing and it will never decompose. This is highly unlikely, because there's always some small probability that carbon that is stabilized either by mineral association or protection in aggregates, would get consumed by microorganisms and respired as CO_2.

One possibility to deal with this issue is to modify the model of equation 1 to account for this small probability of decay of the centennial pool. This can be achieved by simply adding a second decay term so,

$$\gamma(t) = ae^{-b_1 t} + ce^{-b_2 t} \tag{1}$$

However, this equation adds an additional parameter to estimate. To solve this problem, notice that at time $t = 0$, $\gamma(t = 0) = a + c = \gamma_0$. So, we can modify this equation as

$$\gamma(t) = \gamma_0 \alpha e^{-b_1 t} + \gamma_0 (1 - \alpha) e^{-b_2 t} \tag{2}$$

Now we have an equation with the same number of parameters to estimate as the original one, but with the ability to conceptually add a probability of the carbon in the persistent pool to be decomposed over time. The size of this persistent pool would be simply $(1-\alpha)$, expressed as a proportion of the initial amount of carbon at the beginning of the experiment.

References

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