

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2021-246

Adrián Andriulo (Referee)

Referee comment on "A robust initialization method for accurate soil organic carbon simulations" by Eva Kanari et al., Biogeosciences Discuss.,
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The work aims to solve and reduce the main source of uncertainty of the AMG model, the Cs pool size estimation. This goal is greatly fulfilled without appealing both to the soil ¹³C abundance technique (when is possible to apply it) or adjusting other parameters at the same time. It is remarkable the possibility to work in non-equilibrium conditions at the initialization of the modeling, simplifying its use. Furthermore, the method could be easily adopted due to its relatively low cost.

Next, some things and questions are highlighted in order to improve the presentation of the manuscript:

1) Rock-Eval analysis of soil samples

- In the method description it is not explained what happens in the sites with CaCO₃ presence (Colmar, Grignon-Folleville, Auzeville) and its impact on total C released during the process.
- Pyrolyzed organic carbon (PC), line 149: If the pyrolysis was carried out under an inert N₂ atmosphere how CO and CO₂ could be released during this step?
- Should be detailed how is finally estimated the proportion Cs/C₀ with the PartySOC model.
- It is not clear how does the Cs pool size is finally estimated. Is the Cs obtained by the difference between TOC and the sum of all C released or is it an integrated prediction?
- Line 153: Please change mgHC•gTOC-1 by mgCH•gTOC-1.

2) AMG model results presentation:

- Supplementary Material - Table 1: Why a unique bulk density value is shown? Is it the initial mean value for each LTE? Please, describe in the Table.
- It is not shown if changes in bulk density were found in the treatments. If these changes happen should be convenient to express the results for an equal soil mass, affecting the considered soil depth. In these cases, is valid to use the same Cs concentration?
- Supposing that the soil arable layer is 0-30 cm, TOC and Cs concentrations are available. Now, 0-10, 10-20 and 20-30 cm Cs concentrations are required. Is valid to obtain them multiplying by the same proportion from 0-30 cm or is necessary to Rock-Eval analysis for each depth.

3) Other manuscript aspects:

- Lines 335-345: Results and Discussion are separated. However, in lines 335-345 the results are discussed.
- Supplementary Material - Figure 4: Discussion and Hypothesis are included in the figure legend.
- Please, change the expression t ha⁻¹ by Mg ha⁻¹ along with the manuscript.
- Line 165: change (Cécillon et al., 2021) by Cécillon et al. (2021).
- Line 391: change Coclusions by Conclusions.