**Geoscientific
Model Development
Discussions**

Interactive comment on "Sensitivity analysis and calibration of a soil carbon model (SoilGen2) in two contrasting loess forest soils" *by* Y. Y. Yu et al.

Anonymous Referee #2

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The paper submitted by Yu et al. deals with the sensitivity analysis and calibration of the organic carbon dynamics in soils relative to the SoilGen2 model. This is a valuable contribution to the quantitative modeling of soil systems and should be considered for publication. However, I have two important remarks that should be addressed, regarding the initial conditions of the simulations, and the influence of bioturbation processes. These two remarks and a few others (including the quality of the English) should be addressed before the acceptance of the paper.

Initial conditions for simulations In the Model input data par (p. 1824), I think things should be clarified. I would intuitively understand from the objectives of the paper that OC dynamics would be modeled from incipient stages of soil formation up to today and this is not the case. Moreover, considering these input data, it seems there is a dis-

crepancy between the initial conditions for each study area. In the case of the Belgian pedon, initial conditions correspond to the current properties, simulated and validated after after 15000 years of soil evolution since the loess deposit. For the Chinese pedon however, and if I understand well, initial conditions seem to correspond to the measurements made in the parent material. This raises two questions: why consider initial conditions for the Chinese soil (parent material properties), and current simulated conditions for the Belgian pedon ? In the first case, OM dynamics is simulated on soils with current properties, while in the second case, OM dynamics is simulated from incipient stages of soil development over 1000 years, that do not correspond to the current soil properties. In the Chinese pedon case, it seems difficult to compare current OC contents with simulated OC contents that are the result of interactions with soil properties corresponding to the parent material, that are obviously not the same as the current ones in the soil (e.g. for example the scalfac parameter that is influenced by clay content, although the significance of scalfac remains unclear, see remark 6).

Bioturbation p. 1821 line 3: it is mentioned that the interaction between the OC cycle with other soil formation processes in SoilGen2 is occurring through the flow of CO_2. Is that the only interaction modeled? Indeed, p. 1821, lines 17 to 22, bioturbation (which contributes significantly to soil formation) is mentioned as a process that incorporates and mixes OC in soil. I would therefore mention this specific interaction. More importantly, Finke & Hutson (2008) mention that bioturbation can significantly influence the OC cycle in soils. Therefore, I do not understand why this process is not included in the sensitivity & parameterization analysis in this paper.

Other comments

1. While no being a native English speaker, I have found several spelling/expression mistakes. I think the paper should be thoroughly checked in that respect before publication.

2. In the abstract and introduction, the authors refer to the estimation of past terrestrial

carbon pools. While this is of course of major importance, recent developments in the quantitative modeling of soil genesis can provide as well a tool to estimate future carbon pools in the soils, and therefore future atmospheric CO2 concentration changes. I think this should be mentioned.

3. p. 1818, lines 4-14: I think this paragraph is very important and would request some clarification. It should be clearly mentioned that changes in soil organic carbon pools over long timescales have to account for changes in soil properties (e.g. particle size, pH,...) due to soil development. Therefore, existing soil carbon models have to include the modeling of soil formation over long timescales.

4. p.1819, line 13: References could be made to Kirkby (1977) and Salvador-Blanes et al (2007) as well.

5. p. 1820 lines 3-5: I would not mention this sentence at that stage of the paper.

6. p. 1820 lines 6-13: two particular soils developed on loess are selected. Does this mean that the calibration process has to be made for each soil type and each climate? This could be addressed in the discussion section. The first sentence is too long and should be split after 'SoilGen2'.

7. p. 1821, line 29: I did not understand what the scaling factor 'scalfac' is exactly corresponding to. I think it should be more detailed. What is the effect of clay on this parameter? Does this mean that scalfac is the only parameter varying explicitly in the model according to soil properties, and therefore with position in the soil profile?

8. p. 1822, line 19: try to give a reference.

9. p. 1822, study regions: as soil properties can influence OC dynamics, I think it would be interesting to add basic data on soil profiles in Table 1 (particle size, pH, carbonate content,...), in particular regarding the major comment made on the initial conditions. This would be a way, for the Chinese pedon, to check if the properties of the current soil are similar or not to the underlying parent material.

C753

10. p. 1823, line 3: reference should be made to Table 1.

11. p. 1823 : OC stocks are calculated according to bulk density estimations. As this is a key and potentially variable parameter, do we have any idea of the uncertainty of the measurement? Could it be possible to explain quickly how this parameter is modeled in SoilGen2?

12. p. 1823 : OC content are determined by two different analytical methods in both regions (weight loss-on-ignition in Belgium, potassium dichromate in China). Does this influence OC contents?

13. p. 1824, line 10 (and so p. 1825, line 15): what is a 'typical year' for climate? Please define what is meant here.

14. p. 1824, lines 16-17 and p. 1825, lines 22-24: a given rate of bioturbation is assumed. Please give some references here. These rates are very different in the two regions, and relate to very different soil thicknesses in each case. Again, I think it would have been interesting to test this parameter as well on the calibration of OC dynamics.

15. p. 1824, line 19: I think ref. to table 3 is incorrect.

16. p. 1825 lines 11-12: simplify mean temperature significant digits as for Belgium.

17. p. 1825, line 14: inverse distance interpolation is perhaps not the best interpolation method for climate data.

18. p. 1826, lines 3 to 6 : this sentence is not only valid for the Chinese pedon, but for both pedons. I would put it in the introductory part of the Model input data section.

19. p. 1827, line 7: I do not understand the expression between brackets after 'plausible parameter value range'. Please clarify it.

20. p. 1827, line 10: I did not understand the calculation 2x1/(8-1). What is the '2' corresponding to?

C754

21. p. 1830 line 9: Brackets seem to miss in the equation.

22. p. 1835, lines 1-8: I think this paragraph should be rewritten. The second sentence is very long and unclear, and I did not understand the explanation regarding leaching and bioturbation processes.

23. p. 1835, Comparison between two regions section: the litter composition as well as climate data are mentioned as factors explaining the differences in parameter values between the two sites. Could the specific properties of the two soils (e.g. particle size, pH, carbonate content,. . .) explain these differences to some extent as well?

24. p. 1835, line 18: Quideau et al. Is not in the references section.

25. p. 1836, Conclusions, lines 18-19: I think the sentence is not clear. A comparison is made between 'deeper soils' and 'surface soils' I think the terms are not correct. Is 'thick' and 'shallow' soils meant here? This aspect was not mentioned in the discussion section. This raises the question of the value of the parameters along the soil profile: could we imagine an implementation of the model where they could vary with depth (e.g. shielding effect of clay), or is this already accounted for in the scalfac parameter?

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