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Interactive comment on "Modelling dynamic interactions between soil structure and the storage and turnover of soil organic matter" *by* Katharina Hildegard Elisabeth Meurer et al.

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Meurer and colleagues describe a modiïňĄed version of the ICBM model which is intended to describe a feedback between SOC formation and decomposition and its effects on bulk density and pore size distribution. While the premise of the study is very interesting it falls short in proving that the feedback between micropore space and SOC decomposition is needed to describe SOC dynamics.

Authors′ response: We would like to thank the referee for his valuable feedback. The paper will be improved as a result.

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I would ask the authors to clarify and work on the following points: - Please do a more thorough literature research: Before Federer et al. (1993) a couple authors have used equations similar to the Federer one, maybe even your Equation 20 (Adams, 1973; Rawls, 1983). These are just two examples - probably you can work your way backwards from here. Tranter et al. (2007) provide a good overview of the literature and show how soil texture affect mineral soil bulk density.

Authors′ response: Thank you. Yes, Federer et al. were not the first to apply the model. We will this relevant literature in the text where currently we only mention Federer et al..

- It would be interesting for the reader to see how much of bulk density changes is due to the difference in density between minerals and soil organic matter (mass effect), and how much due to changes in porosity (difference in porosity between minerals and soil organic matter?).

Authors′ response: Yes, this is an interesting question. We interpret the second part of this sentence (“changes in porosity”) to mean the effects of aggregation. This question can be answered by analyzing equation 20. We will add a figure to the paper based on this equation showing how the relationship between bulk density and organic matter concentration varies with different values of fagg (the aggregation factor). We attach the proposed figure here. The curve for fagg=0 (i.e. no aggregation) shows that the different densities of organic and mineral matter have only a minor effect. Aggregation dominates the effects of organic matter on bulk density. We can mention here that that the simpler version of this bulk density model previously published does not allow for this kind of analysis, since it does not distinguish between these two effects.

- Figure 7 suggests that the microporosity effect is minimal and the increase/decrease in bulk density is solely driven by the decrease/increase in SOC.

Authors′ response: In this model application, all the parameters in equation 20 (for calculating bulk density) are considered as constants except for the organic matter

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content, so yes, the increase/decrease in bulk density is indeed solely driven by the decrease/increase in SOM.

- Please provide some numbers how important SOC changes are for changes in microporosity.

Authors′ response: Equation 25 shows how the time-varying SOC content and the (constant) soil textural pore space affect microporosity. The results of the sensitivity analysis suggest that the balance between microporosity and mesoporosity is most strongly determined by soil texture, which certainly agrees with past empirical experience. This was already discussed at lines 252 – 255.

- You set F_prot a priori based on literature values. I think you have to provide more background to the reader how they were derived. SOC is then decomposing at a speed of 10 percent in micropores. Is this well constrained by experiments?

Authors′ response: This value is based on a study published by Kravchenko et al. (2015) in which they used X-ray tomography to show that the decomposition rates of intra-aggregate particulate SOM were 3 – 15 times faster in the presence of connected networks of aerated soil pores > 13 μm in diameter than in the absence of such pores (see Introduction ll. 55 – 57). We chose the value for Fprot based on this range. This was mentioned in the text at lines 349 – 351 and also in Table 3. Clearly, more experiments of this kind will help to better constrain this parameter value in the future. We discussed this at lines 441 – 444.

- You use the term ‘warm-up’. Please correct to spin-up.

Authors′ response: We will change “warm-up” to “spin-up” in the revised version of the manuscript.

-Please provide a complete list with all symbols and abbreviations. The reader can get lost in the amount of equations otherwise.

Authors′ response: We will add a list with symbols and abbreviations.

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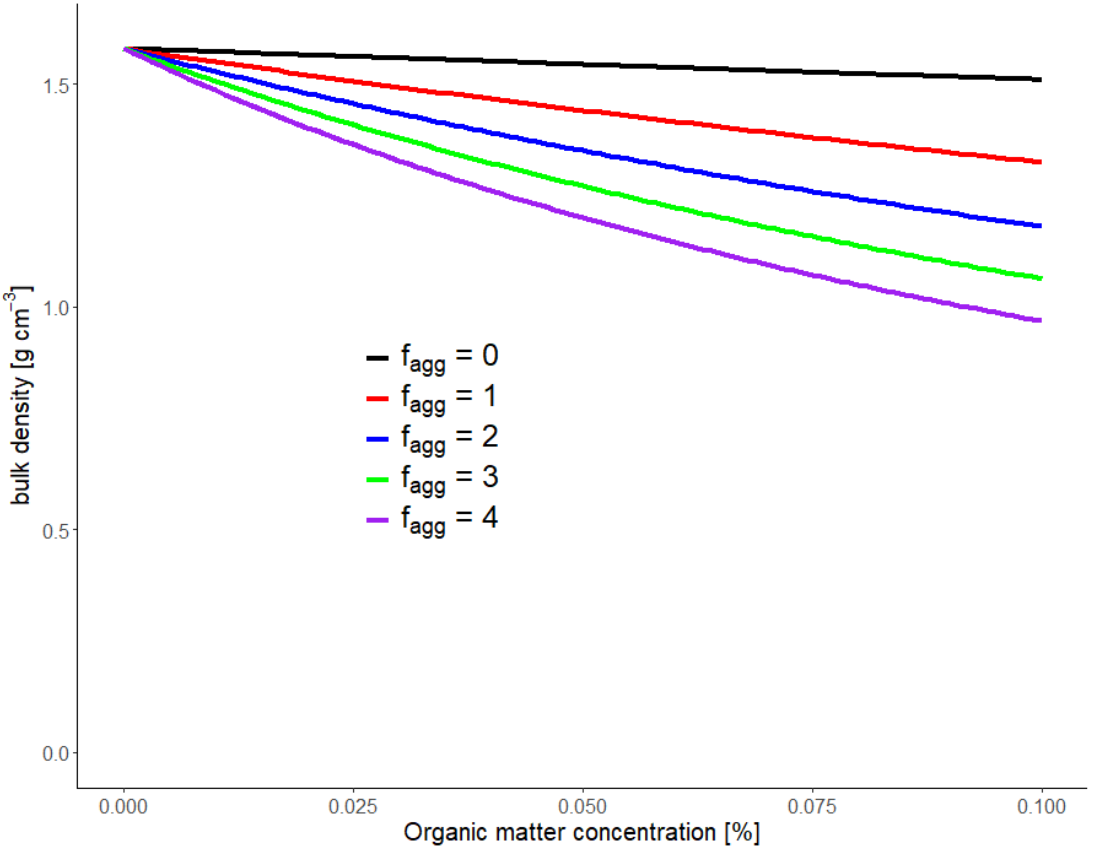

Fig. 1. Effect of fagg

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