

Interactive comment on “Soil organic carbon stocks are systematically overestimated by misuse of the parameters bulk density and stone content” by Christopher Poeplau et al.

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The manuscript is clear and well-written. It addresses the bias in SOC stocks that could result from the correction for rock fragment content. This is an important topic and the paper could be well-cited. I am pleased to see that a detailed comment was already posted and that the authors replied to this comment as well as to the comments of reviewer 1. Thus, the majority of the minor errors and issues that were not clear are already dealt with. This short paper is valuable in correcting estimation of SOC stocks and even allows a correction of available data bases. I have one major remark (see below line 159). I agree with the proposed use of FSSi (eq. 6), but I would not be surprised if many/some studies (out of the 36) using M3 already implicitly use this approach by

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C1 calculating the mass fraction of stones (see explanation below). Minor comments: Line 28, 31 and throughout the manuscript: I agree with the comments posted on terminology of gravel and stone content. Already in the 1990's Poesen and Lavee (1994, Catena 23, 1-28) published a special volume on stony soils. I am not suggesting that you cite these authors. However, their use of the term 'rock fragments' avoids discussion on the size fraction of mineral particles > 2 mm, and I would recommend to use it. Nevertheless, the use of 'stony' as an adjective is fine for me.

Response: We changed stone content into rock fragments content in the entire manuscript.

Line 47 See previous comment: 'coarse soil' is creating confusion, as commonly we think of the fine earth as soil. Could not you say 'the fraction > 2 mm'

Response: We changed this into "fragments >2 mm".

Line 70 Please reformulate in order to avoid using 'identified' twice in one sentence.

Response: The second "identified" was deleted.

Lines 81-82 I am not sure that I understand 'inadequate representation'. Method M1 overestimates SOC stocks as it does not correct for a volume of SOC free soil fraction i.e. the stones. Is this correct?

Response: Yes. We changed the sentence as follows: "This method does not account for rock fragments at all". The introduced bias is discussed later and does not have to be mentioned here. Lines 96 and 101 I assume that the stone fraction is a volume fraction and not a mass fraction. Could you please specify this in the text? Response: Yes, that is correct. We now added [Vol. % /100] in the text.

Line 159: I would argue that M3 gives correct results if used with the mass fraction of stones instead of the volume fraction of stones. Writing the units of the SOC stock equation will hopefully convince you (not taking into account '%' for the concentration):

$$\text{Stock} = g \text{ C/g fine earth} * g \text{ (fine + coarse)} / \text{cm}^3 \text{ (fine + coarse)} * \text{cm} * g \text{ fine}$$

/ g (fine + coarse) Simplifying this equation gives: $\rho C / \rho_{cm3}$ (fine + coarse) which is the stock. I believe that this approach is also frequently used in the literature, and maybe unfairly accounted for in your 36 studies in line 127. If I am not mistaken, the benefit of this equation is that you do not need the density of the stones. This approach is similar to your equation 6. After all, you also correct for the mass of the stones only.

Response: After reconstructing the suggested equation, we agree that M3 is only wrong in the case that volumetric rock fragments fraction is used. We have now added the following sentence in the M&M section: "It has to be noted, that when the term rock fragments fraction in Eq. 5 corresponds to the mass fraction of rock fragments and not to the volume fraction, M3 resembles M4." Also we have revisited the 36 publications using M3 and changed the section as follows: "The literature review revealed that M1, M2, M3 and M4 were used by 52, 5, 30, and 13 studies respectively. In 19 out of 30 studies using M3, it was unclear if the correction term (1- rock fragments fraction) referred to the volumetric or gravimetric rock fragments fraction. Thus, in 68-87% of all studies reviewed, SOC stocks were systematically overestimated assuming a rock fragments fraction >0."

In addition, we also included the following: "For the probe method, the equation to calculate FSS_i can be further simplified to: $FSS_i = \text{mass_finesoil} / \text{Surface_sample}$ (Eq. 8), where Surface_sample is the surface area [cm²] of the sampling device. This might be of special interest for studies conducting sampling by fixed soil mass and not by fixed depth."

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