

Interactive comment on “Continental-scale controls on soil organic carbon across sub-Saharan Africa” by Sophie F. von Fromm et al.

Anonymous Referee #1

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General comments

This very interesting paper tries to explain the heterogeneity of soil organic contents in tropical soils. Pedogenic, climatic and land cover properties were related to SOC contents to identify the main factors that control SOC. It mobilized numerous original data from a network of soil measurements through Africa. Two soil depths (0-20 cm and 20-50 cm) were considered. The paper is really worth a reading as the results were rich and surprising.

However, the work needs to be more explicit to be really compelling on some points (i.e. please give the main soil types studied: is there any andosols or young volcanic soils which could reinforce the role of Al, Fe extractable with oxalate in the SOC stabilization? It should be easy to dismiss that hypothesis).

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Discussion on the limit of your study and on the differences with the previous studies could deepen the significance of your results. The clay and fine silt contents seem to have poor impact on the soil organic content on the contrary of previous results. OK but previous results have related SOC to the clay+silt size fraction at 0-20 μm , you have related SOC to the clay+silt size fraction at 0-8 μm . Please discuss that point? The separation of the two-studied soil depths is not always clear in the Ms. Can it affect the results?

One of your main result is that land cover do not explain SOC content at continent scale, so in the world wide discussion on C sequestration to mitigate CO₂, what do you suggest? The final sentence on soil erosion is very OK but could be strengthened. Your remark on line 436 (“... on a regional scale”) is also OK. Please insist a little more on that point. You have also to be clear at the end of the Ms between predict SOC content (for instance to map SOC content or stock) and predict SOC dynamics (you have not studied SOC dynamic in your study): Ln. 437 to the end are not very clear. After your result on the lack of significance between soil clay and SOC contents, what do you think about using the soil carbon saturation deficit to quantitatively assess the soil carbon storage potential in tropical soils? Could you add one or two sentences on that point.

Specific comments

Abstract: The conclusion of the abstract is not clear/strong enough.

Ln. 62: “broader variables such as clay content. . . “ Ok but clay content implies SOC protection and association with minerals (L. 61). Please rephrase.

Ln. 64 “variety of processes” Please be more explicit (aggregation, organo mineral association. . .) Ln. 64 “differ” or their relative importance differ? (different hierarchisation). Please specify

End of the introduction: Please specify your hypothesis, you have not searched factors

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randomly. Please be more explicit. Your questions are too vague. Which soil properties you will focus on? What findings do you expect? You can base hypothesis on soil properties, climate properties and land cover. You have everything to make a more compelling introduction. Please explicitly justify the soil properties and the soil depth you will focus on in your study.

Ln. 105 “mid-infrared spectroscopy data” data or model? How have chosen the representative spectral data? Have you separate the two soil depth? Why have you finally chosen to study the lab measurements and not the predictions?

Ln. 120 why have you chosen this limit at $8 \mu\text{m}$? What arguments?

Ln. 133 It seemed that soil texture was performed without organic matter destruction? Is that really the case? Please specify.

Ln. 136-140 it was not really clear to me.

Ln. 145 “1,601 soil samples” is that on the 2,002 measured soil samples?

Statistical analysis: Note for the editor: A deep analysis of the statistics has to be done by a reviewer more competent than I am in statistics.

Table 1: Please specify in the title that it is a summary for the two soil depths (0-20, n= ? ,and 20-50 cm, n= ?)

Figure 2: Please prefer unit (g kg^{-1} soil) than

Ln. 250 could you give some essential data from the Table B2 in the Ms. It could be nice for the ones who do not go and see the supplement data.

Table 2: “Depth (Subsoil)” is not clear. It is clear when reading In 246-247, but it is not when reading the table alone. Table should explicit by itself.

Figure 3: I did not get the sentence “Note that the x-axis is truncated. . . .” At what Caex content value it should end? 76? Please specify.

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Ln. 286-287 and 301-302 Please make it clearer.

Ln. 304 yes we could already notice that point on Figure 3c according to the pH class (20 or 30 cmol+/kg)

Ln. 321-322 it is not very compelling. You have shown previously that there are slight differences between 0-20 and 20-50 cm (Ln 294, 253. . . .) Please be clearer.

Ln. 334 Please specify the size of the clay and fine silt fraction of the previously studies and yours. Discuss with these differences in mind.

Ln. 360-361 Yes it is OK, but please end the §by your results and not by the results of other scientists. Your result seemed to show that this mechanism seem to be stronger to explain SOC stabilization than straight organo-mineral association in quite different tropical environment. There is no words on particulate organic matter in your discussion. Have you any data to inform the role or the proportion of this organic matter pool in the total SOC content in your soil samples.

Here is some bibliography you could read in relation with your study. Perhaps that could help in the discussion : Barthès et al. (2008) in Geoderma (to discuss about Al, Fe oxides in tropical soils) ; Beare et al. (2014) in Biogeochemistry (to discuss about oxides and clay content) ; Fujisaki et al. (2018) in Geoderma and in AEE (to discuss about clay content, aridity index and SOC content and SOC storage in tropical soils specially) ; Wang et al. (2016) in Biogeoscience (to discuss about aridity index) ; Chenu and Plante (2006) in European Journal of Soil Science (to discuss about clay and fine silt content at 0-8 μm and 0-20 μm). Bibliography on the carbon saturation deficit.

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