

SOIL Discuss., referee comment RC2
<https://doi.org/10.5194/soil-2021-81-RC2>, 2021
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Comment on soil-2021-81

Anonymous Referee #2

Referee comment on "Content of soil organic carbon and labile fractions depend on local combinations of mineral-phase characteristics" by Malte Ortner et al., SOIL Discuss., <https://doi.org/10.5194/soil-2021-81-RC2>, 2021

Comments on manuscript SOIL-2021-81

This manuscript presents the distribution of SOC and its labile fractions predicted using parent material, land use and soil properties in Southwest Germany. The results indicated that soil properties were clustered by parent materials and soil texture rather than land use. In general, mixed-effect model gave better predictions than bivariate regression. They compared "global model" with "local model" to show that the application of global model on local dataset introduced poorer predictions. Also, the explained variance generally decreased from bulk SOC to its labile fractions.

In general, the objectives were clear and relevant while the scientific value is sufficient. The large sample size contributes to a robust prediction. However, there are several concerns to be addressed.

One concern is the distribution of the sampling points. As mentioned in L47-48, soil formation is also controlled by climate and topography. The clustered locations of the four parent materials are likely to introduce differences in topographical and climate conditions. As climate and topography factors were not included in the models, their effects might be recognized as the effects of parent materials, texture or land use in the predictive models. (Details in comments for Fig. 1)

Another concern is that the usage of "global/local scale", "global/local model", "global/local cluster" and "global/local/entire dataset" may confuse readers because they were used without necessary explanations. In addition, the words "global" vs. "local" give the impression that the study aimed to compare SOC distribution on global vs. local scale, but no investigation on global scale was given in this study.

In addition, in some parts of the manuscript, R^2 was used to estimate whether models are well-fitted, which is not proper. Also, the Results and Discussion can be improved by splitting them into sub-sections and better re-organizing. Finally, the readability of the manuscript can be improved by revising long-complexed sentences and vague expressions.

Title: (1) Although "soil organic matter" is used in the title, the main part of this manuscript is mostly talking about "soil organic carbon". Please be consistent in using them because soil organic matter contains not only organic carbon but also other elements such as nitrogen.

(2) It is advised to add restrictions on the area/location because the study was performed in western Germany and will not be necessarily applicable in other places.

L14, L18 and L21: It is confusing to mention "local scale", "global/local cluster" and "global/local dataset" in abstract without further explanation. The usage of "local" vs. "global" gives me a feeling that this study compares SOC distribution on local vs. global scales. Apparently, the distribution of the sampling sites represents a local or sub-regional scale. It is suggested to either give them definitions when they are mentioned for the first time or replace them with more suitable words.

L21: As only regressions were performed in this study, it is recommended not to use both correlation and regression in the text.

L21-23: It is difficult to understand this sentence. It is not clear between which factors the correlations are significant. What does "partially low" mean? Splitting this sentence into simple ones may help.

L66: In general, organo-mineral associations are considered contributing to the formation of stabilized fractions (not labile fractions) and therefore the accumulation of SOC.

L72: ...leading to SOC sequestration...

L85: Please check if surnames and given names are misplaced in this reference.

L90: "Local vs. global models" are confusing. Do they mean models on local vs. global scales?

L102: Is the "entire dataset" equivalent to the "global dataset"?

Materials and Methods

L104: It is recommended to add more information about the study area. In general, most studies show readers climate factors (e.g. annual precipitation and average temperature), soil type/classification and composition of vegetation/crops.

L119: Please explain why soil samples were stored either at -20 °C or air-dried. For different analyses?

L139: More information of the incubation is appreciated. How long the samples were incubated before sampling? What was the temperature? Did you sample for only once or multiple times?

L146: Please give more information of linear regressions. For example, indicate that they only have one predictor. Did you check the normality of residues?

L147: and after: What are the reasons for performing mixed-effect models? Why parent materials, texture group and land use are selected as random effect variables? In general, random effects are used when samples are only a small subset of the group or when limited groups are included. Does it aim to make predictors on a larger scale using the limited dataset?

L162-163: Why was response variable transformed but not predictors?

Result

Overall: The readability can be improved by dividing this section into a few subsections due to a large content in this section.

L170: What are "soils and topsoil properties"? Consider revising.

L177-178: Are they significantly different or different by looking at means/ranges?

L190: "Somewhat different" is vague.

L205: and after: This paragraph is comprised of isolated points, which makes it difficult to follow. A suggestion is to describe Table 3 in a well-organized way to shorten this paragraph. For example, you can follow the order of entire dataset --> land use --> parent materials --> texture, or you can introduce them by the types of predictors. Also, focusing on your key findings helps.

L207-208: The items "global cluster" and "local cluster" are explained here but they appear in previous parts (e.g. L18 and L193). Please give explanations when they appear for the first time.

L208 and L94: Please be consistent for "parent material" or "parent rock material".

L224: What is "a sufficient extent"? Please specify.

L237 -242: Please indicate that they are from Table 3.

L240: How to know "weight of samples" is equal? Why does it act as global cluster?

L250: It is not clear how to compare R^2 between bivariate regression and mixed-linear model. By the means of each cluster?

L257-258: DCS sites look different from LBS and DLS.

L279-286: Please indicate related Tables and Figures. It is hard to follow.

L282 & L287-288: This gives me a feeling that you are estimating whether the models were well-fitted. If this is true, comparing R^2 does not make sense. Large R^2 means more variation is explained by predictors. Instead, you have to look at the distribution of residue using e.g. root mean square error (RMSE).

Discussion

L304-305: "for the in total very sandy soils ...of LBS". Try to revise this sentence.

L309: "...SOC in soil" --> "in soil"

L314-315: "ECEC, Ca and Mg are suitable predictors for SOC in this study"; L317-318: "The minor ability of ECEC (Ca+Mg) to explain SOC.." They look like contradictory. Also, I missed a point that whether you are talking about entire dataset or specified cluster. Table 3 showed that the predictions using ECEC and (Ca+Mg) are largely dependent on parent materials and texture cluster. A possible explanation is that DCS soils had more sands and lower pH, so that Ca and Mg do not contribute to SOC stabilization, whereas DLS and PSS soils had higher pH, so that Ca and Mg bridging play a role in SOC stabilization (see your cited paper). Please consider re-organizing this part.

L328-333; Grassland had higher SOC contents than arable land, but the PCA showed that they were largely overlapping. This is a good point for discussion. Some explanations will be appreciated.

L334-336: "Several studies with..." has only one citation?

L351-352: Previous explanations are good reasons for using multiple parameter models. However, the reasons for using mixed-effect linear model are not well mentioned. For example, why not multiple fixed-effect model or partial least square regression? My recommendation is to stay in a safe way.

L373-374: To be prudent, I would say models of parent materials explained more

variation of SOC because we don't if the model-fitting was better than others (see comments on L282). The same for L374-375.

L379 and after: A major finding of this study is that the overall explained variance decreased in the order SOC>HWEC>MBC. Some explanations for this would be appreciated.

L395: Please be consistent with "mixed effect model" and "mixed parameter model".

Figures and Tables:

Fig. 1 The clustered locations of the four parent materials are likely to introduce differences in topographical and climate conditions. For example, DCS and LBS sites are mostly located on the top of the mountain/hill, whereas PSS sites are located in a flatter area. The difference may affect soil formation and SOC accumulation. Also, the different altitudes between DCS and PSS sites may cause differences in climate conditions. Therefore, it is possible that the variation caused by climate and topography factors was explained by parent material or land use in this study. I just wonder whether something has been performed in experimental design, statistics or anything else to deal with this problem.

Table 1: What does the unit for respiration mean? As suggested for L146, more information of the incubation is needed.

A suggestion for Fig. 2: Why not combining Fig. 2 and Fig. S1 if you want to show the readers that parent material and soil texture make good separations while land use make an insufficient separation?

Fig. 2 and 5: The shape of the font might be improved as some of them are narrow but others are wide.

Fig. 3 It looks like that the residue of MBC is less normally distributed compared to SOC and HWEC. Particularly, MBC in grassland soils is underestimated. Also, HWEC has a similar but less obvious trend. My questions are: (1) Is the model prediction of MBC less reliable than others due to the skewed distribution of residue? (2) Are there any reasons for the underestimation of MBC in grassland soils?

Fig. 4 What do "dataset", "DCS", "sand" and "arable" on the left mean?

Table 5: Does the "model" before "global model to local cluster" mean local model?

Fig. 6: Is it a part of Table 5? Is there any reason to make it a new Figure? Maybe try to combine Table 5, Table S3 and Fig. 6 into a good shape, or move unnecessary information to supplementary.