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Interactive comment on "Strong warming of subarctic forest soil deteriorated soil structure via carbon loss – Indications from organic matter fractionation" *by* Christopher Poeplau et al.

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Dear Christopher, Páll and Bjarni

It was a pleasure to me to find a manuscript which deals with a very similar fractionation approach and which presents an Icelandic study. Hence, it is very similar to my research which I did in Iceland some years ago. My memories from the southern part of Iceland came back... Therefore, I read the manuscript of your study and would like to give you my comments.

1) It is ingenious to use a natural heat source and the resulting warming gradient to

study ecosystem changes. This is likely possible on a volcanic island like Iceland. But on volcanic islands, soil properties differ from other soil types of non-volcanic regions in the boreal ecosystem. How much are your results applicable to the rest of the boreal ecosystem? What could be the limitations?

2) You mentioned that the worst scenario in the IPCC report predicts a temperature increase of 11 °C for the region North of 60°N. Your temperature sequence ends at +17.5°C. Can you link your results to the different IPCC scenarios with regards to the maximum predicted temperature increases in the IPCC report? Can you make any assumption, how the SOC change would look like at +11°C (IPCC report) based on your temperature sequence (..., 5.8°C, 17.5°C). By the way, does the referenced temperature increase (+11°C) corresponds to the air temperature? In this case, how do you link the increase of air temperature to the increase of soil temperature? Does soil temperature increase in the same way and with the same slope gradient in the future and therefore does your soil warming gradient corresponds to the assumed soil temperature increase in the future for boreal ecosystems? Please clarify this in the introduction part.

3) Based on Comment 2, could you make any statements about the impact of temperature increase on SOC regarding the different IPCC scenarios (e.g. SOC change according to the smallest temperature increase).

4) In your study the temperature increased within 10 years. The modelled increase of air temperature will however change within several decades. What would you think, is the different time scale irrelevant concerning the change of SOC and the soil processes which control the SOC?

5) Is the vegetation (grassland or forest ecosystem) also changing during the warming within these 10 years? If there is also a change in the vegetation composition or the supply of OM to the soil phases, might these changes also be responsible for the changes in your SOC results? In this case, the increase of the temperature is not the

only independent parameter that changes.

6) Discussing the change of soil structure and SOC content (within SOC fraction), you might also need to have a look at the soil mineralogy. Did you analyse the volcanic clay minerals? Volcanic clay minerals and the abundance or change of metal-humus complexes, allophane content, ferrihydrite content can also explain the changes within more resistant SOC fractions.

7) What do you suggest to use as a further analysis technique to characterize the stable SOC fraction (rSOC) or the <63 microns fraction? I ask you, because I used the same fractionation technique and later, however, read that the wet oxidation step is questioned. Spontaneously, I would measure the SOC and the volcanic clay minerals in the <63 microns fraction to get an idea about the characteristics between the SOC and the soil mineralogy. Do you have any further ideas which approaches can be used when the SOC of volcanic soils is fractioned and characterized?

Statistics 8) How many replicates do you have per category (e.g. Fig. 4)? Is it n=5? Can you mention the number of samples per category and the number of samples within the two ecosystem datasets in section 2? It might be also useful to mention it in the capture of Table 1.

9) Mention also p-values in the text when giving the regression values (e.g. page 6 line 31, Figure 6). I remember the reviews of my manuscript. . .

10) In Figure 4 and Figure 5, what does the intervals along the regression lines indicate? Is it the 95% range of the regression value or the 95% range of the modelled value?

11) Changes of ecosystem processes are not always linear. Figure 4 and Figure 5 show distributions of values which could be modelled more accurate with a non-linear function. For example, the patterns of the contents of bulk SOC, SA, POM or rSOC show different slopes along the temperature gradient and asymptotic properties. Did

you tested other types of functions to explain the patterns of SOC changes? There might be also a non-linear correlation in Figure 6 D.

12) In the case of a non-linear pattern, is it useful to show only one absolute change value (g C kg-1 fraction °C-1)?

13) In the case of a non-linear pattern, when do you expect the highest rates of change? Is this in the beginning of the warming or at the end? What does this mean for the change of the boreal ecosystem and at what time do you expect the highest changes (in the next 10-20 years or in 80-100 years)?

14) I offer you to read the reviews of my manuscript. The study deals also about SOC fractions in volcanic soils in Iceland and some comments might be also useful for the revision of your manuscript. https://www.soil-journal.net/5/223/2019/soil-5-223-2019-discussion.html

15) In this journal, square brackets are not used to note any units (e.g. [°C]). It uses parenthesis (°C).

16) I guess that Figure 5 shows the scatterplots for the SOC contents in the subsoil (20-30 cm). Please change the title in the Y-axis.

Basel, 25th August 2019 Matthias Hunziker

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