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Discussions

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Interactive comment on "Organic matter dynamics along a salinity gradient in Siberian steppe soils" by Norbert Bischoff et al.

Norbert Bischoff et al.

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Dear M.W.I Schmidt, Dear master students,

Thank you for taking your time to discuss our manuscript and give advices for improvements.

Short comment #1 (SC #1): *A note upfront from the submitting person: This review was prepared by two master students in geography or earth system science at the University of Zurich. The review was part of an exercise during a second semester master level seminar on "the biogeochemistry of plant-soil systems in a changing world", which I organize. We would like to highlight that the depth of scientific knowledge and technical understanding of these reviewers represents that of master students. We enjoyed

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discussing the manuscript in the seminar, and hope that our comments will be helpful for the authors.*

Rising temperature and anthropogenic influences are the main reason why salt affectedsoils become more frequent. This study aims to investigate the organic matter dynamicsof three different soil types (Kastanozem, non-sodic Solonchak, sodic Solonchak), along a salinity gradient in the South-Western Siberian Kulunda steppe. Soil samples and the aboveground plants and underground biomass have been characterized by avariety of methods. The results of this study were different from similar studies in the literature,and, and the authors had to reject their initial hypothesis. Surprisingly, organiccarbon stocks in the salt-affected were not smaller than in the non-salt-affected soils. Also the abundance and stability of the particulate organic matter was not influenced by salinity. The proportion and stability of mineral-bound organic matter was not reduced under high sodicity levels. Thus, salt-affected soils contribute significantly to the organic carbon storage in the examined region. Also most of the organic carbon was present in stable mineral-organic associations which implies a long-term sequestration. We liked the readability of the paper. The abstract, the introduction, the discussion and the conclusion are interesting to read. It is a very relevant topic that is important under future climate. However, we had problems to understand the experimental setup. Could the sampling and experimental set up be summarized in a figure or table?

Authors (A): Thank you for this evaluation of our manuscript.We are going to explain the experimental setup more clearly in the revised manuscript, particularly the part on p. 4 l. 31-39 will become changed. However, please note that we included already a figure explaining the experimental setup in the existing manuscript (Figure 1).

SC #1: Also, for the belowground plant samples we did not understand how they were taken.

A: To characterize the isotopic composition (d13C) and neutral sugars of plant samples,

we retrieved whole plants of the dominant plant species (see Table 1) from the soil. Subsequently, we split the plant into two parts: roots and shoots.

SC #1: Were they taken in the profile? Or in about 5 meter distance in every depth, or just once?

A: With respect to plant samples, we took three replicates in about 5m distance to the profile. This is explained on p. 4 l. 38 – p. 5. l.2 and also shown in Figure 1.

SC #1: As we are only in our second master semester the method section was too long forus. We understand that this section is important for replication. Would it be possible toshorten this section and/or move the details (set up, used instruments, packages, etc.) in the appendix? For non-experts it would help for faster understanding.

A: We agree that the method section is very long. But this is owed to the many methods we used to collect our data. Methods like density fractionation, neutral sugars analysis or PLFA have to be explained in such detail. Also other methods, as the determination of OC, TN, and d13C, are non-trivial and deserve a paragraph of explanation. However, we decided to move the part about soil mineralogical composition into the supplement of the revised MS as it does not contribute substantial data which is discussed later on.

SC #1:We also found many references to figures and tables in the supplement. We are wondering why they are referred to so often, sometimes more often than figures in the the normal text. Could it be, that some figures from the supplement should be Moved backto the main text?

A:The supplemental data (figures and tables) give additional information which contribute to the understanding of the manuscript but are not necessary for a deep discussion of the data. Hence, we would like to keep it as is and not move part of it into the main text of the MS.

SC #1:On page 6 in line 3 you the text says "Sample quantity allowed only for two treatments for qualitative analysis" Why are just two treatments for qualitative analysis

allowed. Where there not good enough or to less soil samples?

A: In XRD analysis there are usually four treatments used to distinguish the clay mineralogical composition of a soil sample: (i) Mg^{2+}-saturation, (ii) Mg^{2+} + ethylene glycol saturation, (iii) K^+-saturation and (iv) K^+-saturation + heating to 550K. We had not enough sample mass to conduct all four treatments, thus we had to decide for two of the treatments. As we were interested in the quantity of expandable (swelling) clay minerals such as smectite, we decided to use the "standard" treatment (Mg^{2+}-saturation) and the Mg^{2+} + ethylene glycol saturation, as the combination of both yields the necessary results.

SC #1:Also on page 11 & 12 in line 20 respectively 13 there was written "data not shown" but for us it was not clear why thereare not shown and why you have to state that. If the data are important could you putthe data in the supplement?

A: On p. 11 l. 20 we state the relative proportion of each neutral sugar on the entire data set. This is to give an overview to the data and not necessary to repeat in a table. Otherwise it would be a redundant presentation of data. On p. 12 l. 13 we write about fungi : bacteria ratios. We agree with you that it would be informative to the reader if we add the data to the supplements.

SC #1:Table 1: The last column shows "a" but we do not understand why.

A: As is noted in the heading of the table, these letters indicate whether there are significant differences between the samples or not.

SC #1:For table 2 & 3 aline between each soil type would help to read the table. It would also be nice to clarifyin the tables itself what the values in parenthesis mean (standard error).

A: We are going to add a line between soil types for better readability. We already clarified in the heading of the table the meaning of the value in parenthesis (standard error).

SC #1: The figure 1 was for us quite unclear. We could not make sense of the position in the plant sample dots. Does the position represent on which side they were taken? Why there are green dots in the Sodic Solonchaks could be stated in the text. However,for us it was not clear. As we wrote above, the experimental set up was mixed with therest of the text. Not all profiles have the same depth, but this different depth is notrepresented in the figure.

A: Yes, the dots represent the approximate position where the samples were taken. This is also indicated by the arrows which highlight the distance of the sampling locations to each other. As stated on p. 4 l. 32-36, four soil profiles were analyzed on the foot slope of the transect because of the larger site heterogeneity there. However, laboratory analyses afterwards revealed that one of the four soils was not sodic and had to be grouped together with the non-sodic Solonchaks. This exactly is shown in Figure 1. We also explained the meaning of the colors in Figure 1. The different depth of the groundwater table, which resulted in different depths of the soil profiles, is clearly shown in Figure 1.

SC #1: Also in the figure 3 it was for us not that clear why the depthis not the same as in the profiles.

A: 14C analyses are very costly and to measure all samples of a profile was therefore not possible for us. We therefore decided to measure all samples until the topmost C horizon of a profile, because the topmost horizons are those with the highest OC contents. Moreover, in the topmost horizons we observed the largest differences between the soils with respect to their OC stocks. Only in the Non-sodic Solonchak we had not enough LF material in the Cz horizon to analyze the 14C activity. We agree with you that we should mention this in the figure caption and the Material & Methods section. This is going to be included in the revised MS.

SC #1:In figure 5 a little mistake has slipped in. The y-axisshould be PC2 instead of PC1. There we also wondered why the grey dots are notconsidered as they are quite

a lot.

A: Thank you for this correction. We are going to change that in the revised MS. The grey dots are important in the analysis. We have explained this in the answer to Referee #2. This is our response to Referee #2: "The PCA on neutral sugars was applied on the entire data set, i.e. neutral sugar data of all three soil types and all three fractions was analyzed in one PCA. This resulted in the biplot shown in Figure 5. To highlight differences between the soils we split the biplot into three panels and indicated the fractions of each soil by different colors. The biplot shows all considered data (i.e. the entire data set); this includes the grey dots which do not belong to the particular soil type of a panel. We decided to apply the PCA on the entire data set and not on the samples of each soil type separately, as the sample size would be too small to conduct a robust PCA for each soil type. This is a common approach and was applied in many previous studies."

SC #1:In the conclusion we would also appreciate an outlook for future studies. What would be important to look at?

A: An important issue would be to determine the water potential of all soils as the sum of matric potential + osmotic potential. Determination of the matric potential can be done by collecting undisturbed samples and measuring a soil retention curve. A time-series of soil moisture measurements could then be related to the soil water retention curve to obtain the matric potential at the particular soil moisture over the year. The osmotic potential can be determined via measurements of the electrical conductivity of the soil solution. By that we could verify whether the water stress, as indicated by a low water potential, is similar between the soils. Another promising approach would be to relate our results to measurements of enzyme activities. By that we would be able to directly determine whether the microbial activity is inhibited by salt stress or not. In combination with incubation studies of the bulk soil we could compare soil OM decomposition rates between the salt-affected and non-salt-affected soils. In the incubation studies we could adapt the soil moisture to the values observed in the field

to simulate field conditions. In the revised manuscript we are going to give a brief overview on that future research prospects.

SC #1: Some minor comments: - Strange starting sentence of the introduction "... soils...important...." !why do they get more important. They will get more frequent and just to study them will get more important. Maybe "twice as" could be a nicer starting.

A: We agree with you and starting the sentence in the abstract with "Salt-affected soils will become more frequent in the next decades..." is a more precise statement. We are going to change that in the revised MS.

SC #1: Page 3/ line 42 !it is a german sentence; "Todate, these soils cover already an area..." do you need "already"?

A: "Already" indicates that the soils cover a considerable area worldwide.

SC #1: Page 6/ line 26 !units are at two lines

A: This manuscript is not yet text-edited. If published in Biogeosciences, text-editing will be done.

SC #1: Page 6/ line 33 !it is written Sect. 2.5, but chapters are notnumbered

A: The manuscript was written with a template offered by Copernicus Publications. This template does not include numbering of sections. But, if the manuscript gets published in Biogeosciences, numbering of sections will become necessary and thus we included the section number already.

SC #1: Page 9/ line 30 . . .very broad, peak broadening is related. . . ! you might make two sentences?

A: We agree with you and will correct this in the revised MS.

SC #1:Page 15/ line 19 This let's. . . ! informal english

A: In the revised MS we are going to change that to "This led us to the conclusion..."