

Interactive comment on “Low soil organic carbon storage in a subarctic alpine permafrost environment” by M. Fuchs et al.

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Reply on comments from Anonymous Referee #1

Thank you for your positive feedback and the comments on our discussion paper. We hope to address with this reply all your suggestions and questions. We follow the same order like you did in your comments.

Page 3497 lines 24-26: The samples were collected vertically by hammering down a steel pipe. Only the organic rich top soil layer was sampled from the pit dug. (This organic rich top soil layer was in average only 2.4 cm thick). In general, the whole vertical profile was sampled from top to the depth of 1 meter, if possible. In general, we collected the whole profile in 10cm increments, meaning that we got, in the best case,

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10 samples with a length of 10cm for each profile (plus the organic rich top soil layer). Therefore, we collected the whole profile and not only one sample per 5-10cm. The soil was mostly of uniform nature without any cryoturbation with a shallow O/A-horizon and a weak b-horizon. In general, the soils were very shallow so that we reached the bedrock in average already at c. 30cm depth of the profile.

Page 3498: The LCC was not based on another standard class scheme. These classes were established based on the field observations and was adapted to the land cover classes present in the study area. Of course, more detailed land cover classes could have been established but the generalization into nine main classes was suitable for establishing a LCC based on remotely sensed data.

Page 3499 lines 20-22: For the analysis we took a representative sub-sample of the whole sample (which was usually 10 cm long with a diameter of c. 4cm). This, which we applied for all the samples we collected, gave us a mean carbon value for every 10cm of the soil depth resulting in 5-10 carbon values for the profile, depending on the profile depth. We did not find any signs of cryoturbation in the samples. However, we did not dug whole pits, we had only the profile samples we collected by pipe. The presence of cryoturbation assessed visually and by examining the laboratory results. There was no positive outlier of OC with depth. We have neither visual nor laboratory results, which would indicate buried organic carbon through cryoturbation. We conclude that there is no indication of organically enriched (i.e. A or O horizons) soil horizons buried by cryoturbation in any core. We acknowledge that soil movements by cryoturbation likely occur in this area, but it seems that it mainly affects poorly developed soil horizons and rocks and thus does not cause significant burial of SOC down the soil profile.

We will mention cryoturbation earlier in the main body as you suggested at page 3498, line 2: “[. . .] full reference depth of 100cm. When collecting the soil samples no indication for buried organic carbon through cryoturbation could visually be detected. Furthermore, permafrost was never encountered during [. . .]”

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Page 3502, lines 6-8: Ok thank you for the advice, we will change this.

Page 3502, lines 21-22: As written on the following lines in the text, the variability of soil depth even within the same land cover class was an important factor that affected the organic carbon storage. We found large differences in profile depths when sampling. This is also shown in the high standard deviation in the soil depth of each LCC (Table 1). The high standard deviations of means of the SOC storage would maybe require a higher separation into sub-classes. This is however difficult to achieve in both the field and the land cover classification based on remotely sensed data. Another factor is the coarse fragment fraction which was also different from profile to profile site and not uniform for single LCCs.

Page 3504, lines 5-10: Thank you for this advice, the current limited selection of radio-carbon dates reflect the financial resources that were available for C14 dating.

Page 3507, line 17: Did you mean Page 3506, line 17? If so: In every land cover class there was a certain amount of stones present. Therefore, when we classified an area as “Patchy boulder moss” this meant that this area consists mostly of mosses on the ground but also of stones, which was in average 42% in the case of the class “Patchy boulder moss” (see Table S1, supplementary material). So, the abundant stone cover meant that there is a stone coverage in each class, even if it appears as vegetated in the LCC. For not overestimating the SOC stock in the different classes, we weighted the SOC stock of each LCC by the mean percentage of stones within a LCC as we considered that stones contain no organic carbon. The mean stone coverage in each LCC is presented in the supplementary material Table S1.

Page 3507, lines 19-21: We agree, shallow soils could indeed be carbon rich. Our statement is overgeneralized, but applies to Tarfala Valley where we did not find any evidence for peaty layers and in our study shallow soils have accumulated less organic carbon (in total) than deeper profiles. We will switch the statements as the lack of cryoturbation is probably a more important factor for low SOC storage.

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Figure 1: Thank you for the advice, we will change this.

Figure 2: Thank you for the advice, we will try out written text instead of the X for the percentage area coverage.

Supplement Fig 1: Ok, thank you for the advice. We will change it.

Table S1: We sampled with a steel pipe in 10cm increments but did not dig pit profiles. Therefore we unfortunately do not have subsurface pictures from the profile sites.

Interactive comment on The Cryosphere Discuss., 8, 3493, 2014.

TCD

8, C1886–C1889, 2014

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