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Interactive comment on “Storage and transformation of organic matter fractions in cryoturbated permafrost soils across the Siberian Arctic” by N. Gentsch et al.

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Received and published: 11 May 2015

Comments on Referee #4

We thank the reviewer for thoughtful comments which help to improve the manuscript quality. We have reworked our manuscript accordingly, wherever possible. In the following, the referee comments are given in bold, followed by our response as plain text.

How well do current stock estimates account for cryoturbation? How should the community better sample to account for the findings in this manuscript? I agree with Reviewer 3 that greater discussion on the use of a longitudinal transect

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would help here – how do these results likely scale across the great continental region they span? A conceptual diagram at the end of the results or within the discussion may help here.

Indeed, the current C stock estimates did not consider a separate quantification of SOM in cryoturbated horizons. The latest SOC update for permafrost soils (Hugelius et al., 2014) gives estimates for the main types of permafrost-affected soils (Turbels, Histels, and Orthels). Therein, cryoturbation is a diagnostic level to characterize the Turbel soil order. However, no details of how much cryoturbated horizons contribute to the ecosystem C storage were reported so far. Only few studies have addressed the importance of cryoturbation, such as Bockheim (2007) and most recently (Palmtag et al. 2015, and Palmtag et al. submitted). Based on the reports in Hugelius et al. (2014), we give a rough estimate on the contribution of cryogenic processes to OC sequestration on page 2716 (line 6-20). As mentioned in the response to reviewer # 3, the mapping of cryogenic features was the main goal of our study. The small scale heterogeneity of OC stocks within and between the soil profiles based primarily on the abundance (and frequency) of cryogenic features. The more cracks, pockets involutions or tongues were present in the profile the larger was the OC storage. These features are overwhelming effects in OC stocks between the different types of tundra. Significant differences only occur between the geographic regions. The western Siberian sites clearly show least disturbance and the differences in OC stocks compared to the eastern sites were significant. As suggested, a schematic map (Fig 1, below) is now included in order to visualize the data. The schematic map illustrates the distribution of OC stocks across the sampling sites and all investigated soil profiles. The bubbles give the total OC stocks (kg m⁻² to one meter soil depth) by size, while the bar charts give the proportion of the OM fractions (in different colors) with respect to the total OC stocks in mineral soil horizons.

Abstract – has too much detail, particularly for the methods, and could be significantly shortened. p. 2700, line 8 – “most important” OM fraction – but is largest OM fraction the most important? I would tend to think of the most labile

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as the most important, and the largest fraction as the greatest contributor to C stock.

We agree that some methodic details can be removed and reworked the abstract accordingly. We changed “most important” to “dominant” and re-worked the sentence.

p.2701, line 10, soils to soil

Done.

p. 2701, line 17 add “an” before “Ecosystem”

Done.

p. 2703, In 13 remove “the” before “transport”

Done.

p. 2703, In14 “triplicate” not “triplicates”; line 20 “given by” not “described by”?

Changed.

p. 2707 line 7 “so-called” in English means “erroneously called”. I think you can say just “referred to as the transient layer

Changed.

p. 2711, line 19, “relatively contained” is confusing – maybe rewrite without “relatively”? I can’t follow the logic here.

Re-written.

p. 2713, line 22, add “a” before “response”

Done.

p. 2714, line 12 needs a date for Palmtag paper; line 14 add “the” before “Results”, line 26, “constant” seems too strong since I don’t think it’s a truly continuous process – maybe just remove this word?

We changed constant to continuous. We wanted to pay attention that cryoturbation of OM rich pockets is a faster process, wrapping OM involutions to the subsoil probably by the course of few events. Cryohomogenization, on the other hand, is a process acting slowly and continuous over the whole formation period of the solum.

p. 2716, line 3, change “precipitating” to “precipitation”, line 19-20 remove either “in” or “within”

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Done.

p. 2717, line 13 “LF fraction” is redundant – just say “LF”, line 21 change “the” to “a” and clarify the writing so that it doesn’t appear that lichens are plants

We changed the sentence.

p. 2723, line 5 remove s on “causes”; line 4 add “an” before “object” Fig 3 caption change “occur” to “occurred”

Changed.

Fig 5 it is very difficult to read the scale bar on these microscope images, please adjust

The scale bars was adjusted.

Fig S3: capitalize “Siberian” and remove “ing” from “showing” both times

Done.

References

Bockheim, J. G.: Importance of Cryoturbation in Redistributing Organic Carbon in Permafrost-Affected Soils, *Soil Sci Soc Am J*, 71(4), 1335–1342, 2007.

Hugelius, G., Strauss, J., Zubrzycki, S., Harden, J. W., Schuur, E. A. G., Ping, C.-L., Schirrmeister, L., Grosse, G., Michaelson, G. J., Koven, C. D., O'Donnell, J. A., Elberling, B., Mishra, U., Camill, P., Yu, Z., Palmtag, J. and Kuhry, P.: Estimated stocks of circumpolar permafrost carbon with quantified uncertainty ranges and identified data gaps, *Biogeosciences*, 11(23), 6573–6593, doi:10.5194/bg-11-6573-2014, 2014.

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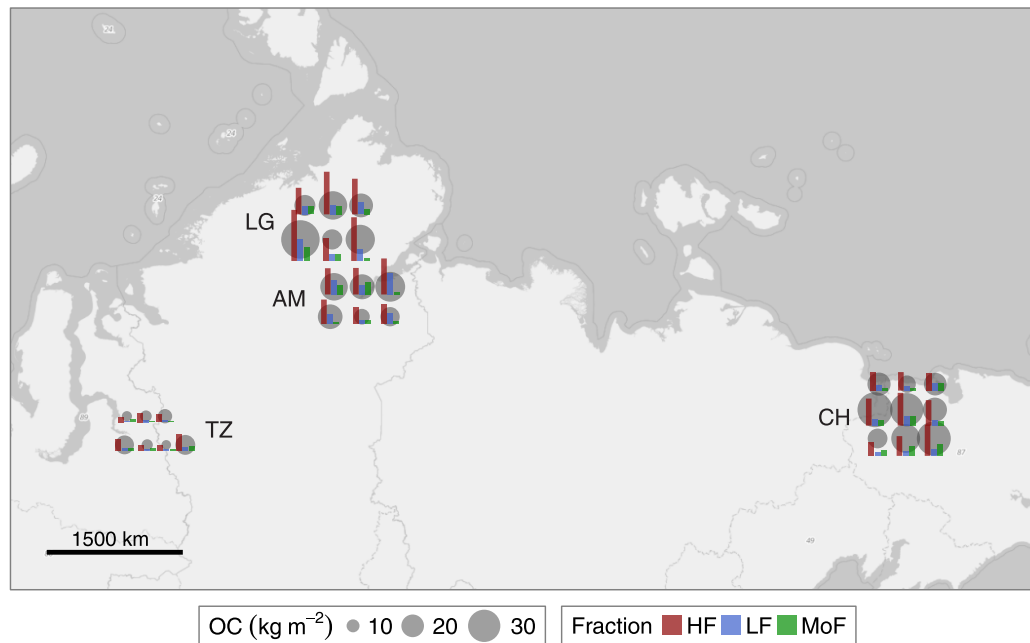


Fig. 1. The schematic map illustrates the distribution of OC stocks across the sampling sites and all investigated soil profiles.

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