

Manuscript Review

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Title: Organic carbon and total nitrogen stocks in soils of the Lena River Delta

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General Comments

- 1) The authors present new data for soil organic carbon and total nitrogen stocks from the Lena River Delta, and provide estimates of C and N pools for the region. This represents an important dataset from a region of the northern circumpolar permafrost region that is not well represented in current estimates of the global permafrost C pool. Soil cores were collected from two geomorphic units (active floodplain and Holocene terrace) that represent a large percentage of the greater Lena River Delta.
- 2) I have made a number of editorial comments in an attempt to improve the clarity and concision of the text and the presentation of the data. See below.
- 3) The authors should include in-depth descriptions of the soil profiles that were sampled from these different geomorphic units. Soil cores were sub-sampled at various reference depths, but it's not clear why the authors chose those depths. C and N contents from sub-samples were then used to estimate stocks down to each reference depth, a calculation which assumes some degree of uniformity in soil properties along these vertical sequences. In my opinion, the selection of these reference depths and stock calculations deserves some justification based on soil descriptions.
- 4) I recommend adding some text to the Discussion section to better address sources of uncertainty in estimating C pools. Also, since prior estimates by Tarnocai et al. (2009) used just a few samples from alluvial deposits, how might this new dataset be used for refining estimates for all arctic river deltas? Are the data generalizable in that way, or should we be sampling directing sampling efforts to other major river deltas in Eurasia and North America?

Specific Comments

- 1) Page 17264, Line 15 – Important to note here that the estimate of 113 Tg is actually for permafrost at the depth increment 50-100 cm, and does not include the deep (> 1 m) alluvial deposits.
- 2) Page 17264, Lines 24-26 – Awkward wording here. Sentence needs to be reworded for concision and clarity. Also, statements would be strengthened by including some recent citations.
- 3) Page 17264, Line 26 – I recommend adding acronyms in parentheses here: soil organic carbon (SOC) and nitrogen (N). Replace full text with acronyms throughout manuscript.
- 4) Page 17265, Line 3 – Change text to state “north *of* 50°N”
- 5) Page 17265, Line 15-16 – Omit “progressive”
- 6) Page 17265, Lines 16-17 – Omit “turnover and mineralization” and replace with “decomposition”. Also, omit “climate-relevant” modify sentence to state “...release of greenhouse gases carbon dioxide and methane to the atmosphere.”
- 7) Page 17266, Line 8 – Omit “respectively”.

- 8) Page 17266, Line 22 – I would argue that the soil depths of 50-100 cm are not “rarely investigated”, but perhaps this is accurate for most regions in Siberia. In my opinion, it’s the measurements greater than 1 m that are truly rare. Also, I recommend replacing “permanently” with “perennially”
- 9) Page 17267 – The description of the study area is a little confusing as written. Start by stating clearly that in this study, you sampled soils from two geomorphic units: modern floodplain and Holocene terrace on Samoylov Island. Then state that the Lena River Delta as a whole contains additional terraces of pre-Holocene age that were not characterized by your sampling.
- 10) Page 17267, Lines 22-23 – Change micro-scale variability in “landscape” to “topography”.
- 11) Page 17268, Lines 6-8 – Omit “Average observed maximum depth of seasonally thaw.” and replace “mean active layer thickness” and add variance (standard deviation) to 50 cm average. Also omit “in summer” on line 8.
- 12) Page 17268, Lines 23-24 – Put “August” in parentheses.
- 13) Page 17268, Lines 26-29 – Sentence confusing as written. Modify to state -12.5 °C from 1998-2011 and...190 mm for years 1999-2011.”
- 14) Page 17269, Lines 7- 8 - Note that the SIPRE corer was designed originally by the Cold Region Research and Engineering Laboratory (CRREL).
- 15) Page 17269 – On line 9, the text states that core were of “1 m length”, and then on line 11, it states” sample should be “≥ 1 m”. Please correct this.
- 16) Page 17269 – I think you can omit the text regarding the soil cores that were not included in this study.
- 17) Page 17269, Lines 17-18 – Why did you choose these depth increments for sampling? This needs some explanation. It also gets at the need for more descriptions of soil horizons and composition (see general comment above).
- 18) Page 17269, Line 23 – Were all samples mineral soil only? If you collected organic-soil samples, then this temperature is too high and does not follow standard protocol (65 °C, I believe).
- 19) Page 17271, Lines 4-5 – I’m curious about the calculation of soil OC and N stocks based on the assumption that soil properties were vertically homogenous from sample depth increment down to the reference depth. Can you provide some more detailed information on the soil horizons and properties to justify these calculations?
- 20) Page 17271, Line 13 – Reword “high river bank dynamics” for clarity. Perhaps “dynamic geomorphic processes occurring along the river corridor” or something like that.
- 21) Page 17272, Line 8 – Is “mosaicking” a word? If so, is it spelled correctly?
- 22) Page 17272, Line 23 – Add “s” to “dataset”
- 23) Page 17273, Line 2 – I think this section on “supervised classification” needs more explanation for those readers not familiar with this technique. What is meant by “supervised”?
- 24) Page 17273, Lines 10-12 – I recommend omitting the different functions here (e.g. “function: Region Group”) – more detail than necessary.
- 25) Page 17274, Lines 5-6 – Can you describe in detail what you mean by “various accuracy parameters”?
- 26) Page 17274, Line 12 – Omit “bulk densities” and just use symbol.
- 27) Results section – In general, it is important to report standard deviations or standard errors with mean values. I recommend doing this throughout the results section so the reader can better evaluate uncertainties for each value.

- 28) Page 17247, Lines 23-24 – Why not report volumetric ice contents instead of or in addition to gravimetric values? Also, it's important to distinguish between ice contents for active layer and permafrost. Since, samples were collected in April and May, most active layer samples were probably frozen, but perhaps not surface samples? Please clarify.
- 29) Page 17275, Lines 4-6 – Should report P-values associated with R correlations.
- 30) Page 17275, Line 14 – ANOVA analyses were not mentioned in the Methods section. Please add text to the “Statistics” subsection and describe details of ANOVA (primary effect variable, post-hoc analyses?).
- 31) Page 17276, Line 4 – What does the number 42.0 kg m⁻² represent? The range is 6.5 – 48.6, is it the median?
- 32) Page 17276, Lines 16-17 – Omit sentence beginning “Pronounced differences...”
- 33) Page 17276, Lines 18-19 – This sentence needs to be clarified and elaborated upon: “This characteristic increased with increasing reference depth”. What figure are you referring to here? In Figure 5c and 5d, this increasing trend with depth is not apparent. In Figure 7, it does increase with depth, but that's not particularly interesting because each depth increase is a cumulative total, so of course they would increase with depth.
- 34) Page 17280, Line 14 – Report standard deviation with mean here.
- 35) Page 17281, Line 6 – Add standard deviation here too.
- 36) Page 17281, Lines 9-10 – I'm a little confused about the use of the terms “allochthonous” and “autochthonous” here. These terms are typically used for aquatic systems like lakes and rivers, not soils. However, I generally get what you are referring to. Perhaps reword to state “terrestrial organic matter” and “aquatic peat”?
- 37) Page 17282, Line 17 – What do you mean by “current of water of flat plains”?
- 38) Page 17283, Line 23 – Replace “seasonally thaw depth” with “active layer”
- 39) Page 17283, Line 28 – What do you mean by “recent” active layer?
- 40) Page 17284, Line 2 – I'm not sure that permafrost C is “inherently decomposable”. There's a high amount of uncertainty in biodegradability driven by differences in OM composition, microbial communities and activities, and physical protection and stabilization, not to mention sensitivity to temperature and moisture.
- 41) Page 17285, Lines 15-16 – Revise sentence to state “As a limiting nutrient for plant productivity...”
- 42) Page 17286, Line 1 – Replace “About” with “Approximately”
- 43) Page 17286, Line 15 – Revise to state, “Here we investigated...”
- 44) Page 17286, Line 16 – Omit “correspondent” or replace with “complimentary”
- 45) Table 1 – Wow, those standard deviations for bulk density are pretty big!
- 46) Table 4 and 5 – I think it would be clearer if the different sites/soil types were labeled directly in the table instead of labeling with A through E (Table 4) or A through H (Table 5).
- 47) Table 6 – What do these values represent? Are there units associated with these numbers? Define user's accuracy vs. producer's accuracy.
- 48) Table 7 – These are not really “depth distributions” as stated in the legend. You are basically reporting cumulative stocks with increasing reference depth. It'd be more accurate to state “C stocks for different depth increments. Also, I think it would be useful to show vertical distribution by reporting C density (kg m⁻³) vs. depth – see Harden et al. 2012 (GRL) Figure 2.

- 49) Table 8 – The columns for C stocks and N stocks (not mass or pools) are redundant with Figure 4 – I recommend omitting these from Table 8. Also, these values are reported with a different number of significant digits. Please be consistent and consider accuracy of C and N measurements.
- 50) Figure 2 – I recommend omitting this figure. It's okay just to report averages and trends in the study site description.
- 51) Figure 3 – Omit, unnecessary.
- 52) Figure 5 - I recommend omitting the legends for each figure and instead label the x-axes with appropriate depth increments. Also y-axes need labels and units. In legend, I recommend removing text stating “volumetric contents” – volumetric is C density in kg m^{-3} , stocks are areal in kg m^{-2} . In my opinion, a better way to report the variations with depth is to switch axes, with depth on the y-axis and % or stocks on the x axis.
- 53) Figure 6 – Label y-axis and add units.
- 54) Figure 7 - Label y-axis and add units.
- 55) Figure 8 – I recommend moving this figure up front with the other map of the study area.
- 56) Figure 9 – Label y-axis and add units. Abbreviations along x-axis need to be defined somewhere.