*Reply to comments*

Baseline characteristics of climate, permafrost, and land cover from a new permafrost observatory in the Lena River Delta, Siberia (1998–2011)

by J. Boike et al.

***Anonymous Referee #3***

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*General comments*

*The paper contributes field data from north Siberian tundra, a region that is poorly investigated, but of high importance for potential climate – soil carbon feedbacks. Although this description of baseline characteristics might not be appealing for a wide audience, I do think it is important to have such data published for comparisons with other research sites in Arctic tundra and for modeling purposes. I agree with the other referees that it should be more clear what the site is representing, for example in comparison with other Siberian sites. In terms of vegetation I am not so sure whether the polygonal tundra on Samoylov Island is representing Siberian lowland tundra. Very common tundra species, e.g. Eriophorum and Betula species seem to be missing, see for example De Klerk et al. 2011.*

We thank the reviewer for the valuable comments.

We agree with the reviewer and have clarified the representativeness of Samoylov with respect to other Arctic sites.

Please also refer to response to Reviewer #1.

Eriophorum species *(Eriophorum angustifolium, Eriophorum scheuchzeri, Eriophorum vaginatum)* are found in the relevés, but are too limited in presence and coverage to be listed as a key species in Table 1. *Betula nana* did not occur in the relevés (thus was not listed in the table), and is found rarely on the island. Further differences between Samoyloy Island and the lower Indigirka River area (Chorkurdakh, Yakutia) investigated by De Klerk et al. (2011) include a much smaller abundance of *Sphagnum* on Samoyloy Island compared to the Chorkurdakh site. According to the Köppen-Geiger classification, Chorkurdakh is also located in the "polar E" climate zone. Differences in vegetation between these two low-centered ice wedge polygon sites could potentially be explained by winter snow cover thickness and soil parent material, but both would require further analysis.

*Detailed comments*

*p.13629, l.4 You mean late Pleistocene river terraces?*

The sentence in the text is correct. "The landscape on Samoylov Island consists mainly of late Holocene river terraces with polygonal tundra, ponds and lakes, and an active floodplain."

*p.13633, l.13-28 Very good that you describe how the polygonal pattern is formed. How are the thermokarst lakes formed? On the next page you describe that the larger ponds represent transitional states, suggesting that ponds develop into thermokarst lakes. What is the mechanism behind this?*

We have added the following:

*The thermokarst process involves the thawing of ice-rich permafrost and subsidence of the ground surface. Thermokarst ponds are formed through water accumulating in the resulting depressions that potentially grow into larger thermokarst lakes (Jorgenson and Shur, 2007).*

*p.13635, l.3 You mention first terrace. Is there also a second terrace?*

We have added the following to Section **2** (**Site description and data collection facilities at the new Samoylov observatory**):

*Three main geomorphological units (river terraces) in the Lena River Delta were identified by Grigoriev (1993). Samoylov is located on the first terrace and is characterised by ice-wedge polygonal tundra, large thermokarst lakes, and active flood plains. This terrace formed during the Holocene and occupies most of the central and eastern parts of the delta.*

*The second terrace is characterised by sandy sediments with a low ice content and many large thermokarst lakes, and occurs in the north-western part of the delta; it was formed between the Late Pleistocene and early Holocene.*

*The third and oldest terrace is an erosional remnant of a Late Pleistocene plain consisting of fine-grained, organic-rich and ice-rich sediments, characterised by polygonal ground and thermokarst processes.*

*p.13642 I am surprised that there is so little difference in active layer thickness between dry and wet tundra. I thought that wetter places have larger thaw depths because of the heat conducting properties of water. Is there an explanation for the similarity of dry and wet tundra with respect to thawing depth?*

Figure 11 shows a statistical summary of thaw depth measurements covering a period of 9 years. The figure thus illustrates the temporal and spatial variabilities. There are indeed not many differences in temporal variability between wet and dry locations. A possible explanation is that the effect of greater heat conductivities at the wet locations is partly canceled out by the additional heat required to melt the larger ice content, as demonstrated by a “back of the envelope calculation” in which, assuming the same thermal gradient at both locations, a higher heat conductivity at the wet locations would potentially melt 20% more ground ice.

*6.1 Land cover classification, vegetation, and soils. This section does not contain a comparison of vegetation*

We have accepted the reviewer’s comment and omitted “vegetation” in the title.

*Table 1. The sum of percentages is much more than 100%. It is not clear that the percentages relate to polygonal tundra and flood plain respectively. Make this more clear, for example by indenting the subcategories.*

In our response to this comment we use the term "presence" to indicate the proportion of those mapped relevé areas with a specific habitat and vegetation-type that contain a particular species. A "presence" of 100% for *Hylocomium splendens*, for example, means that the *Hylocomium splendens* species is found in every mapped vegetation relevé of the *Hylocomium splendens /Dryas punctata* community. There are of course also other species in the relevés, which is why the total percentages of "presence" can exceed 100%.

To clarify Table 1 we have changed its headings. Instead of "Presence" we now use "Presence of key species in corresponding vegetation community [%]", and instead of "Cover" we now use "Proportion of corresponding vegetation community covered by key species [%]".

*Table 3. Guess porosity is in m3 m-3?*

The porosity of the two soil samples was determined by the ratio:

$$\varphi = 1 - V_s / V_t$$

with $\varphi$ being the porosity (a number between 0 and 1), $V_S$ the volume of the solid soil content (including the organic content), and $V_t$ the total volume of the sample.

Thus porosity can be expressed dimensionless or as $m^3\ m^{-3}$.

*Table 6. Mean ground temperature at 45/51 cm depth?*

The soil station was relocated in 2002 and thus the installation depths changed slightly. As detailed in the caption for Figure 9, the move occurred between the intervals 1998-2002 and 2002-2011.

We have now also added this information to the caption for Table 6, as follows:

*Record of mean monthly soil temperatures for active layer at polygon rim site on Samoylov Island: the readings for 1998–2002 are from sensor depths of 0.09 and 0.47 m, and for 2002–2011 from sensor depths of 0.06 and 0.51m.*

*Fig. 4. Is TOC in vol%?*

Correct.

The volumetric organic content $\theta_O$ is evaluated by

$$\theta_O = m_{ds}\ w_O / V_t\, \rho_O$$

with $m_{ds}$ being the dried mass of solid material in the sample, $w_O$ the proportion of organic material (by weight) and $\rho_O$ the density of organic material (1.3 g $cm^{-3}$; Farouki, 1981). The dry mass of the sample ($m_{ds}$) was measured after thawing the frozen block of soil and and then freeze-drying it. $V_t$ is then the total volume of the sample.

Farouki, O. T. 1981. Thermal properties of soils. Hanover (N.H.). Cold Regions Research and Engineering Laboratory, 136 p.

Additional literature that was added in the revised paper:

*Grigoriev, M. 1993. Cryomorphogenesis in the Lena Delta (in Russian). Permafrost Institute Press, Yakutsk, 176 pp.*