Reply to reviewer 1:

We like to thank the reviewer for the constructive comments on our manuscript. The review helped to enhance the quality and improve the comprehensibility of our study. We carefully considered all comments of the reviewer. The answers are highlighted in bold and changes done in the manuscript are marked in italic.

In the abstract, lines 28-34 are a statement that advanced (degradation) state ponds show higher production rates of methane than from the "tundra landscape" at the study site. It's difficult to tell precisely what the authors mean by this. Do the authors mean that the CH4 production in the lakes during freeze-up is faster/greater than from the same lakes in the summer/ice-free period, or do they mean that the CH4 production in the lakes during freeze-up is faster/greater than the CH4 emission from the entire local landscape (lakes + tundra). Or only the tundra? Are the authors trying to say that the lakes are a larger local source than the tundra? I think the authors mean the entire local landscape, as a similar but clearer statement is made in the conclusions (line 698).

We agree with the reviewer that our statement in the abstract is not clearly formulated. Indeed we mean the CH4 emissions of the entire local landscape (lakes + tundra). Thus, we changed the statement in the abstract to:
The early winter net CH4 production rate per square meter of ponds with signs of erosion exceeded the per square meter emission rate of the average tundra landscape which was measured at the study site during summer. Our results therefore indicate…

Most of the units shown are those preferred by modelers rather than experimentalists; it would be helpful to provide the important flux values in units such as mg CH4 / m2/ day, at least occasionally, such as in the results. This aids in comparison with other papers in the literature.

Changed. The revised manuscript now includes additional units as suggested by the reviewer.

I am most concerned with the extrapolations (explicit and implied), given the sampling method (13 sample ice blocks from 8 ponds and 1 lake, line 247). Previous work has shown high spatial variability of ebullition over single, similar lakes. Especially as the CH4 emission rates calculated for the study lakes was found to be so variable, the low number of samples is troubling. I wonder if we are seeing a sampling bias here? I understand well the difficulty of obtaining these samples. However, I think the authors should address, probably in the methods section, how they believe their sampling distribution is adequate for characterizing these ponds.

We agree with the reviewer that it would be very desirable to have more samples from the frozen ice. As the reviewer points out, the number of sampled water bodies is limited by the laborious procedure of ice sample extraction. However, we believe that the sampled waterbodies provide a good cross section through the different types of pond and lakes at the study site. The following statement was added to Sect. 3.3:

Despite the limited number of samples, the eight waterbodies provide a good cross section through the different types of ponds and lakes at the study site.

Line 720-724: The first sentence is true, but the second sentence does not logically follow from the first. Ponds make a significant contribution to the budget of methane in the atmosphere regardless of the freeze-thaw cycle. I suggest deleting the second sentence ("Ponds therefore make...").

Done.

Line 737: I am not sure that the final statement in the conclusions that warmer winters may prolong the CH4 production period in ponds is well supported. Other studies (in different lakes) have shown that CH4 production and ebullition effectively shuts down well before lake freeze-up due to low, but above freezing, sediment temperatures. For example: Wik et al., JGR 2013, doi: 10.1002/jgrg.20103 Of course not all lakes are the same, but the statement seems too general as currently written.

We agree with the reviewer and have deleted the final statement.

Finally, because the lake/pond water and lake sediment during freeze-up period is cooler than in the ice-free summer period, the CH4 production in sediment is almost certainly lower during freeze-up, regardless of the lake-edge degradation state explored in this manuscript. It appears from the manuscript that this decrease in CH4 production is not observed in the study lakes, correct? This seems surprising to me, and this difference should be noted in the manuscript. One would expect that the methane trapped in ice during freeze-up and released at ice-out in the spring is likely being produced at lower rates than in the summer season. If possible, explain this surprising result. (To be specific, this is surprising because colder sediments produce less methane; e.g. Zeikus, J. G. and M. R. Winfrey (1976), Temperature limitation of methanogenesis in aquatic sediments.)

We agree with the reviewer that lower CH4 production rates should be expected during the freezing period than during the summer period. During the freezing period, the sediment temperatures are close 0°C while during summer much warmer sediment temperatures up to 15°C can be expected. Though we are not able to directly compare summer and winter CH4 production rates of the waterbodies within this study, we can compare production rates during the freezing period of the ponds in relation to the average per square meter CH4 emissions rate measured for the entire tundra landscape during summer. Even though it is likely that these ponds have higher CH4 production rates during summer, their production rates during the freezing period are still higher than the landscape average during summer. In order to clarify the limitation of the performed comparison we modified the paragraph at the end of Sect. 5.2 as follows:
The maximum summertime CH4 emission rates per square meter from the average tundra landscape on Samoylov Island are of the order of 5×10−8 mol m−2 s−1 (60 mgCH4 m−2 d−1) (Sachs et al., 2008; Wille et al., 2008). Using this emission rate as a reference, the early winter net CH4 production rates per square meter from ASPs are half an order of magnitude larger. This stresses the importance of ponds and the freezing period to the local carbon cycle. Even during the freezing period small waterbodies must therefore be considered hotspots of CH4 production in a tundra landscape.

Section 5.1, should be broken up into paragraphs. Suggested break spots: line 577 “However, this study has demonstrated...” line 581: “Detailed investigations of the surface energy balance..” line 599: “The survey of waterbodies also revealed...”

Done.

Line 22: “then inferred” should be “were then inferred”

Corrected.

Line 62: “the Lena River Delta more than” should be “the Lena River Delta, more than”

Done.

Figure 5: Could the authors draw figure 5 without black circles around the data points? This would make the color points appear less cluttered and make them easier to see.

We have tried to plot Fig. 5 without the black circles. We found that it was even more difficult to distinguish individual data points. Therefore, we would like to keep the original version of Fig. 5.

Line 464: “are show in” should be “are shown in”

Corrected.