

Interactive comment on “Methane oxidation potential of the arctic wetland soils of a taiga-tundra ecotone in northeastern Siberia” by Jun Murase et al.

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Response to RC1

The presentation of the results is not sufficient. It is not clear which measurements were done in which year, at exactly the same site? Also the purpose of the inhibitor experiments and its discussion is not clear and not easy to follow. Thus, I have made several detailed comments to the M&M section and the result section in the attached pdf-file. → Thank you very much for your valuable comments. We revised our manuscript to your comments as you may see in the supplement file (a revised ms).

C1

P5L19. after reading the MM section, I think a table would be helpful, explaining which experiments were done in which year and with set-up → A table that shows the summary of samples used and experimental set up was given.

P5L23. please specify: did you sample every year? → Yes, we did. The summary table was given.

P6L2-4. → Done.

P7L5. I do not understand what is meant here P7L6. please explain the experiment on temperature in a separate sentence and more detailed → We withdrew our discussion on the estimation of the threshold temperature according to the comment of Reviewer 2.

P7L21. there was only one chamber, no parallel? no comparison with a chamber without inhibitor addition? → We did have parallel to compare. It is already described in the text, but we revised it to make it clearer: “At least two chambers were set per site and methane flux measurement without the inhibitor was conducted in parallel to monitor the temporal shift of methane flux which could affect our interpretation of the effect of the inhibitor on methane flux.” (P9L1)

P7L23. the starting gas composition was determined in triplicate → We collected one gas sample for each of the three gas collections for the flux measurement. To clarify it, we give additional information: “Gas samples in the headspace were taken every 15 min into 20-ml pre-vacuumed vials for 3 times (0, 15, and 30 min).” (P8L15)

P8L1. why is there such a big difference between the 2 experiments? and incubation of 10 min versus 20 hours? → In the first experiment conducted in 2014, we followed the method of the original article where the methane flux was measured soon after injection of the inhibitor. As we did not find any influence of the inhibitor on the methane flux, we tried the prolonged exposure time of the inhibitor in 2015. We add more explanation: “Then, the second measurement of methane flux was done 10–15 min after injection of

C2

the inhibitor in 2014; as no influence of the inhibitor on the methane flux was observed, we extended the exposure time of the inhibitor to 18–19 hrs in 2015 in order to verify the result in 2014.” (P8L19)

P8L6. I do not understand what is meant here, please clarify → We mean here that parallel measurement was conducted without inhibitor injected. We revised the sentence as described above: “At least two chambers were set per site and methane flux measurement without the inhibitor was conducted in parallel to monitor the temporal shift of methane flux which could affect our interpretation of the effect of the inhibitor on methane flux.” (P9L1)

P9L8. it is not clear what is shown in which figure, please specify: a) moss in 2012 b) sedge in 2012 c) both in 2015? this should be separated as in a) and b) the symbols also should be consistent throughout.... → Figure 3 was redrawn.

P9L11. what do you want to stress here? that there is activity at/ near the frozen layer, or that this activity is lower than in the other horizons? please make 2 sentences of this, and for the latter state the actual rates ! → The phrase is removed.

P9L13. why is there now a mineral soil? was this also present in the other soils (moss and sedge in 2012) ? If not, I would separate this soil type and describe in a separate paragraph, only comparable settings should be compared → In the measurement of 2015, we collected the top part of the frozen layer from moss- and sedge-dominated sites. The organic layer of the sedge wetland was melted and thus the frozen part of mineral layer just below the organic layer was used to compare with the frozen sample from the organic layer of a moss-dominated site.

P9L15. This is a bit too short, please include the numbers of the rates in the text above → We rearranged the order of the sentences in the section.

P9L17. but the oxygen measurements were done in 2014, and the experiments in 2012 and 2015.... How can you assure that these profiles would have been valid for

C3

the soils for the experiments ?? → As shown in the newly added table, we actually did the experiments in 2013 and 2015 (2012 was incorrect). We omitted the description about the linkage of the methane oxidation rates in these years to the DO data in 2014. However, when we collected the samples in 2013 and 2015, the color of the soils collected from layers under the ground water level changed to dark brown after sample collection. This is most likely due to a browning reaction exposed to oxygen, which in turn indicates the soil was under anoxic conditions. We also measured DO in 2013 and found the similar results as 2014, though no precise vertical profiles were obtained in 2013. We added this information in discussion: “The color of the soils collected from layers under the ground water level darkened soon after sample collection in 2013 and 2015. This is most likely due to a browning reaction exposed to oxygen, which in turn indicates the soil below the ground water was under anoxic conditions. The vertical profile of DO verified the low oxygen concentration in the soil under the ground water, though the measurement was done in a different year (2014).” (P12L1)

P9L18. After reading the text and having a close look at the figures and tables I realized that there were different depth horizons sampled.... Thus I suggest to completely rearrange this section: I would plot the calculated rates versus depth, for each moss and sedge in 2012 and moss and sedge in 2015 (with broader columns, reaching from 0 - 10 cm) → Figure 3 was redrawn.

P10L1. I do not see the point in figure 4c.... I suggest to calculate the Q10 value ($1/\text{temp}(K)$ versus \ln rate) and give the Q10 values for better comparison with other studies. → We calculated Q10 values and made discussion on them.

P10L1. what do you mean by threshold temperature ?? Any references?? → We mean the lower threshold temperature for methane oxidation. As mentioned above, we withdrew our discussion on the estimation of the threshold temperature according to the comment of Reviewer 2.

P10L5. This section has to be completely re-written: Why did you add the inhibitor?

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What do you want to compare? Figure 5 is incomprehensible... please clarify the method, were there controls without inhibitor? where are they in the figure..... -> We compare the methane fluxes with and without the inhibitor to estimate the plant-associated methane oxidation. The data are also in the figure. We revised the parts related to this experiment.

P10L18. could you give your numbers and the literature numbers for comparison here -> The numbers were added: "The potential rates estimated in this study (54–496 nmol h⁻¹ g⁻¹) were at the higher end of the rates measured in other Arctic regions including Siberia using a similar headspace concentrations of methane (0–835 nmol h⁻¹ g⁻¹, Knoblauch et al., 2008; 50–66 nmol h⁻¹ g⁻¹, Christiansen et al., 2015)." (P11L18)

P11L12. throughout -> Corrected.

P12L11. I do not understand the explanation why the MOX inhibitor had no effect -> We described the principle of the method in more detail in the introduction part.

P13L4. I can not follow the discussion here -> We revised the discussion part.

Please also note the supplement to this comment:

<https://www.biogeosciences-discuss.net/bg-2019-98/bg-2019-98-AC1-supplement.pdf>

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2019-98>, 2019.

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Table 1. Summary of samples used and experimental setup

Year	Bottle incubation experiment		Methane flux with the inhibitor
	Soil layer (cm)	Effect of	
2012	0-10	Nutrients	-
2013	0-2, 4-6, 8-10	Depth (1)	-
2014	0-10	Temperature	Short exposure time
2015	0-10, 10-20, 30-40(moss), 37-46(sedge)	Depth (2)	Long exposure time

Fig. 1.

C6

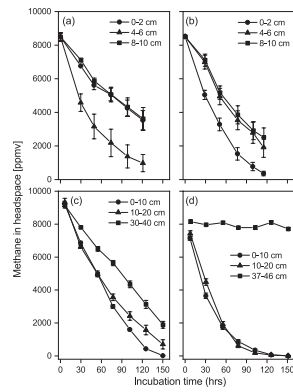


Figure 3. Methane oxidation by the different depth layers of moss (a, c) and sedge (b, d) dominated soils in 2013 (a, b) and 2015 (c, d). Bars indicate the standard error (n=3).

Fig. 2.

C7

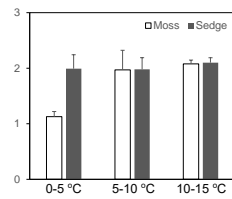


Fig. 6. Temperature coefficient (Q₁₀) of methane oxidation estimated between different temperature ranges .

Fig. 3.

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