

Interactive comment on “Variability in methane emissions from West Siberia’s shallow boreal lakes” by Aleksandr F. Sabrekov et al.

Anonymous Referee #1

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General comments

This manuscript presents spatio-temporal variation in summertime methane fluxes from small lakes within the West Siberian middle and south taiga zones. Pronounced flux variability was found between individual lakes and between zones. The methane data together with 25 environmental controls was used to develop a new dynamic process-based model. The model showed good performance with emission rates from the south taiga lakes and poor performance for individual lakes in the middle taiga region suggesting that besides the well-known controls such as temperature, pH and lake depth, there are significant variations in the maximal methane production potential between these climatic zones.

I think this manuscript is an important addition to the understanding of the methane dy-

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namics and sources globally, because small lakes are one important methane source. Small lakes are numerous in the vast Siberian taiga, and little is known about their methane emissions. A good model predicting the methane emissions will be a powerful tool to extrapolate the predictions to the larger areas. The manuscript requires some revisions and technical corrections to make it easier to read and understand.

The paper addresses relevant scientific questions and presents tools (a model) to evaluate the methane release from the West Siberian lakes. The results are an important step towards the exhaustive model of the methane release from lakes, which would greatly improve the possibilities to create global scenarios of the methane release from the aquatic systems. The scientific methods and experiments are valid and mainly clearly outlined, but the authors could improve the presentation of the methods in the manuscript in order to make it easier to read and understand. The description of the calculations concerning the model are complete and precise. In the paper, the authors refer properly to the earlier methane studies. The title reflects the contents of the paper and the abstract provides a concise and complete summary of the work. The overall presentation needs a few specifications and maybe some structural changes. I also recommend the language check by the native English speaker. The usage of abbreviations needs to be checked and revised. The supplementary material is appropriate and useful and gives support to the findings in the manuscript.

Specific comments

Methods - Page 3, row 117: “Day time emissions” could be expressed more specifically. In the previous sentence you say that total field measurement time varied from 4 to 10 hours. It is not totally clear, did you visit each lake ones, and spent in average 6 hours there? More useful would be to know what is “daytime measurement” 10-16 (6 hours)? 12-18 (six hours)? You could say e.g. all measurement were carried out between 9am and 6 pm. Or did you visit the same lake several times? - Page 3, row 117: I would put CH₄ first, it is bit confusing that you mention CO₂ before CH₄, the whole manuscript is anyway about methane. You could also write here that

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CO₂ was measured as a background information. - Page 4, row 149: The whole idea of comparing West Siberia lakes with lakes in South Eastern Australia seems rather strange. Same "West Siberian climate is more similar to the Australian autumn." Do you mean West Siberian summers resemble Australian autumns? - Page 4, row 159: Do you mean 10 cm above sediment? - Page 4, rows 159-160: Please add here all the abbreviations you use later in the text. - Page 5, row 170: You could specify trace metals, the correlation between CH₄ and Cu comes out of the blue for the reader later in the Results section, because Cu has not been mentioned previously. - Page 5, row 190: You could shortly explain here which are the "well-known controls". E.g. the first two sentences from Appendix A (Page 15, row 558-561) could be here instead of being in the Appendix. - Page 6, row 226: I would put this paragraph first or at least somewhere in the beginning of the section. Now there are lengthy explanations before you actually say the main point of the chapter.

Results - Page 6, row 243-244: You have not explained the abbreviations EC or Eh previously. - Page 7, row 266-267: I would delete the last sentence. I don't think it is necessary to tell where you are going to discuss the results. - Page 7, row 268: This is rather surprising considering that there are significant relationships in the simple regression analysis. I'm not familiar with Statistica, but in the software I have used, multiple regression gives the similar result as the single one. If only one variable shows significant relationship, the multiple regression procedure includes only that variable. I think you could explain the multiple regression method in more detail.

Discussion - Page 8, row 321: According to the Table 2 there are considerable pH differences between MT and ST lake populations, with significantly higher pH in ST lakes. In the Figure B1 you present the optimum pH for the methane production. Although you say in the appendix that you have observed high methane production rates in the very low pH, the reader anyhow sees the Figure and the pH difference between lake populations. I think you should discuss the influence of pH differences between the lake populations in this section. - Page 8, row 330: add: Net primary production (NPP)

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- Page 9, row 348: I'm wondering, if the both wetlands are acidic, why are there considerable pH differences between MT and ST lakes? - Page 10, row 379: This could be explained in more detail, since Cu was the only element correlating with CH₄ in your data. I think you could already in the Introduction tell a little about what is known about controls and inhibitors of methanotrophy and methanogenesis. - Page 12, row 497: What do you mean CO₂ and CH₄ fluxes almost the same? Methane fluxes are about 100 times higher according to Table 4? I think you mean that there is very little variation between MT lakes in both CO₂ and CH₄ fluxes?

- Table 2 does not include all the water quality variables that you measured. It would be nice to know how e.g. Cu varies, because it correlates with CH₄.

- Table 6: There are empty rows in the first "Reference" column. What are the numbers presented in the next columns?

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