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Discussions

Interactive comment on "Hydrochemical composition of thermokarst lake waters in the permafrost zone of western Siberia within the context of climate change" *by* R. M. Manasypov et al.

Anonymous Referee #2

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This paper presents a significant lake water chemistry dataset from study areas across a latitudinal permafrost gradient in NW Siberia. There is a paucity of published data on chemistry of tundra lakes from this very large and globally important permafrost region making the dataset valuable and of scientific interest. Investigating the variation of lake chemistry in the context of thermokarst lake development is also a very interesting idea. However, prior to publication of this manuscript, in my view the following items must be addressed. A) Organization and writing must be improved to increase the focus and clarity of the manuscript; B) the manuscript needs to be shortened - there

are too many figures and sections of the discussion are speculative; C) the patterns of variation in important chemical parameters or trends in the data should be tested statistically (it is not always clear in the text whether the reported differences or trends are significant); and D) the conclusions should be restricted to points that can be supported by statistical tests or models that describe the nature and significance of the variation in the dataset.

Some specific items which must be considered include: 1) The provision of additional context on the study areas; 2) provision of a clear explanation of the stages of thermokarst lake development and a justification for using lake size as a criteria for determining the stage of thermokarst lake development, as the latter is used to stratify the water chemistry data set; 3) the development of refined and concise objectives or hypotheses to focus how the lake dataset will be reported and analyzed, and to provide a framework to focus or constrain the discussion; 3) the greater use of statistical tests and reporting of test results to describe significant differences in the chemistry of different lake populations or the significance of trends; and 4) careful review of the text to eliminate editorial errors.

I also note that several of the figures require editorial attention and captions have inconsistencies and errors that require correction.

This manuscript has potential to provide new information on water quality conditions in NW Siberia and to provide insight on the geochemical conditions of thermokarst lakes across a continuum of lake size. I would strongly encourage the Authors to consider these recommendations and undertake the substantial revisions required to increase the rigor, coherence and impact of this manuscript.

I have provided several detailed comments for the Authors to consider.

Title – It would be useful to clarify in the title that the study evaluates lake conditions across a "permafrost gradient" or simply across "permafrost zones", those being continuous to discontinuous. This comment should also be considered with respect to the

running title. It is not clear why "in the context of climate change" is in the title. This can be omitted.

Introduction

I think the Authors should consider providing a few lines of additional context regarding peat thicknesses, nature of underlying mineral sediments, and possibly the mineralogical or geochemical composition of the substrate which characterizes the study region. Some additional description of the physical context, including regional physiography, ground ice conditions and nature and rates of thermokarst in the region would help to provide readers with a more clear understanding of the processes affecting these lakes. This would also assist in placing results of this study into a broader regional or global context.

P5335 L25: Additional text is required here to complete this sentence.

P5336 L5: Consider revising the term "permafrost lakes". Strictly speaking the term does not make sense. It would be more appropriate to state that the study was aimed at "extending lake sampling across different permafrost zones, or a permafrost gradient to..."

P5336 L10: It would be useful here to frame this work by stating the main hypotheses. This would help the reader understand how the study design tests ideas on the factors controlling lake chemistry. The hypotheses would help the reader understand what the Authors' believe the drivers of variation in lake chemistry to be at the front end of the paper.

P5337 15-20: Editorial modification – "Water objects" should be "Water bodies" - Some editorial attention is required on the section describing the nature and mechanisms of ground ice melt. - Last sentence of the paragraph also requires editorial attention. Are the Authors referring to thermokarst lakes in the region? If so the text may read "The largest thermokarst lakes that are located within the peat bog(s) are km-size (does this

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mean lakes are a km in diameter?) - Are all the lakes underlain by talik?

P5338 – A description of each stage of lake development would be very useful here since this scheme was used to stratify the dataset. Some information on the timescale of thermokarst lake evolution in the region would be helpful. Since thermokarst lake evolution is likely a continuum, a clear justification for why lake size was used as the criteria to group lakes into a "stage of development" should be provided.

Figure 1. It would be useful to indicate the approximate location of the transition zone between continuous and discontinuous permafrost on the inset map on Figure 1, and also to include a scale bar so that size of this study area can be better appreciated by the readers.

It would recommend commenting on the size catchment area relative to lake area. What is the relationship between catchment and lake area for the study lakes?

P5340 15: A few additional words are required in this first sentence to create proper context.

P5340 20-25: It is useful to clarify whether the Authors' believe these are subpermafrost groundwaters contributing to the lake water, or simply that water flow is through a deeper, mineral rich active layer.

Figure 2: Spelling corrections are required for "continental, rectangles, triangles and circles". Clarify why the sample population was grouped by the stage of lake development for the southern part of the study region but not for the north.

Table 2 – What are the correlations between the different chemical parameters? Establishing the water quality parameters that are highly correlated may help to determine which are most important to report, and which figures and discussion may be omitted.

P5342 – I think it is important to emphasize the nature of surficial deposits, particularly the organic characteristics in this region. What is the peat thickness in the study region?

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P5342 – 1-5 – This section requires some clarification. I assume that the Authors' mean that lake circumference increases linearly with thermokarst expansion, whereas area increases exponentially. Consequently a lower amount of thawed materials relative to lake water volume are contributed as a thermokarst lake grows in size. I see that this is better explained on Page 5343, but this preceding section remains difficult to decipher.

P5342 L24 – Change "objects" to "bodies". The correct terminology should be "water bodies".

P5343 – L26-30; Suggested editorial adjustment to clarify that reference to DOC variation relates to work by Vincent and Pienitz, 1996 "The difference in DOC amongst coastal lakes of varying size is comparable to the northward decrease in DOC across the treeline tundra transition reported by Vincent and Pienitz (1996)."

P5344 – L10-18: This section requires editorial attention to improve clarity of ideas.

Figure 7. Caption requires attention. Element concentration is plotted against lake diameter.

P5345 L4-20; P5346 L16-18 Line 16-18 indicates that "other" chemical elements are not statistically different across the different stages of lake development. This implies that some of, or all of the parameters discussed earlier are significantly different across the different stages of lake development. It should be clear which differences are significant.

Table 3. Which of these correlations are significant?

P5347 L22-24: When I inspect the supporting figures and the summary table I am not convinced that Rb, Sr, B and U all increase with lake diameter to the 4th stage as stated in the text. Is there a statistical basis for making such a statement? The text throughout is a mix of results and discussion (5346-49); I cannot comment on all of the interpretation of geochemical patterns made here by the Authors, however in my view the discussion would greatly benefit from being more focused.

P5350 L10-11: This sentence requires clarification, in particular with reference to "recommendation of a world average"

P5351 L9: Please add the reference to support the statement.

P5352 – The Authors should provide a statistical summary of the reported patterns. From figure 12a it would be useful to understand if there are significant differences for a particular analyte, for a given lake size class across the latitudinal gradient.

Figure 12. Remove "the evolution of" The figure reports "lake water pH, DOC, Ca and K concentrations....."

P5353 L6-21: This section requires editorial attention to improve clarity.

P5355 L15 Please clarify the meaning of "watershed divide of the discontinuous permafrost zone".

P5355 L25: Clarify the meaning of this sentence. "based on the current state of permafrost rocks in the north of western Siberia..."

I caution the Authors about being too speculative in their Conclusions.

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