Point-by-point replies to interactive reviewer comments of

Anonymous Referee #1, 12 Dec 2024

The authors report a novel dataset on hydrochemistry and CH4 regime in lakes from highly remote region, strongly understudied, which has high environmental importance.

This is consistent dataset for large number of variable lakes. It is a pity that CO2 concentrations were not assessed; however, the data are adequately interpreted and the available literature is well captured.

I can recommend moderate revision of this manuscript.

We are grateful for the positive feedback on our dataset. We agree that direct measurements of CO_2 concentrations would have enriched the study. Unfortunately, logistical and analytical constraints during sampling did not allow for any CO_2 assessment for our samples. Nevertheless, we aimed to provide robust interpretations using the available data.

Specific comments

L171 Reporting median E.C. for this dataset does not make sense – coastal lagoons and thermokarst lakes are incompatible categories

We thank the reviewer for pointing out the importance of distinguishing between water body types. We agree that combining such contrasting categories can be misleading. In the manuscript, we now changed the sentence to reflect the medians for each water body type (i.e., thermokarst lakes, ponds, and coastal lagoons) as follows:

"The median for lakes was 256 µS cm^{-1}, for ponds 129.1 µS cm^{-1}, for polygonal ponds 159.5 µS cm^{-1}, and for lagoons 10,340 µS cm^{-1} (Table 1, Fig. A1-A)."

L230 edit 'with elevation'

Thank you very much. We will edit the sentence as follows:

"For δD and δ18O we found significant negative correlations with elevation ($p < 0.05$, cor = -0.4) and distance to the coast ($p < 0.05$, cor = -0.5 and -0.4, respectively) as well as significant positive correlations with EC ($p < 0.05$; cor = 0.4 and 0.3, respectively)."

L249 for cations; L 250 for anions

Thank you very much. We will change the sentences as follows:

"For 20 lakes of our dataset, we measured aluminum (Al), barium (Ba), calcium (Ca), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), phosphorus (P), silicon (Si), and strontium (Sr) for cations. For 19 lakes of our dataset, we measured fluoride, chloride, sulfate, bromide, nitrate, and phosphate for anions."

L326-329 Note also that permafrost thaw an active layer deepening can liberate low molecular weight, potentially highly biodegradable OC from dispersed peat ice (i.e., https://doi.org/10.1016/j.geoderma.2022.116256; DOI: 10.1039/D1EM00547B; https://doi.org/10.1016/j.chemosphere.2020.128953)

We appreciate that the reviewer provided additional literature and notes. We will revise this paragraph as follows:

"High lability and biodegradability of permafrost and active layer DOC has been demonstrated by many studies such as from the organic rich active layer in the discontinuous permafrost zone of Central Alaska (Textor et al. (2019), permafrost peatlands of western Siberia (Lim et al. 2021; Kuzmina et al., 2023), or the continuous permafrost zone of the Yenisei River region (Kawahigashi et al., 2004). This high DOC biodegradability might lead to a rapid degradation of DOC supplied by shore erosion to larger lakes, and a lack of statistical correlation between DOC concentration with mean annual lake change rates."

L341-343 This is important result, that should be stated in the Abstract

Thank you for highlighting the importance of this result. We accordingly revise the abstract to explicitly include this finding, ensuring it is more visible to readers.

L379-381 Note that Zabelina et al (2021, doi: 10.1002/lno.11560) also reported a decrease in CH4 concentrations and emissions in large (>100,000 m^2) lakes compared to small thaw ponds and lakes (100-10,000 m^2).

Thank you for pointing out the broad study by Zabelina et al. (2021). Their findings generally support our conclusions. We see these results as complementary, highlighting the complexity of GHG dynamics in permafrost regions and the importance of integrating both local process-based and regional assessments. We now added this reference and revised the paragraph as follows:

"On the other hand, larger lakes would support a greater loss of CH_4 by increased water turbulence and subsequent increased diffusive flux out of the lake, as well as increased CH_4 oxidation rates by a better oxygenation of the water (Wik et al 2016; Zabelina et al., 2021; Manasypov et al., 2024)."

L394-395 This sentence is not necessary for Conclusions

We agree with the reviewer and will delete it.