Introduction

- Permafrost in Central Yakutia (Siberia):
  - Continuous and up to 500 meters thick
  - 50-90% ice rich
  - Permafrost stores organic carbon
- Increases in temperature are causing:
  - Landscape changes
  - Permafrost thaw and formation of thaw lakes
  - Release of greenhouse gases (GHGs) (CO$_2$ and CH$_4$) from permafrost

Hypothesis

There is significant heterogeneity in dissolved GHG concentrations and emissions between lake types and seasons.

Methods

Study Site

- Lake types:
  - Old alas (early Holocene)
  - Young alas (mid Holocene)
  - Recent thermokarst (last decades)

Basic Limnology

- YSI multi sensor limnological device
  - Conductivity
  - Dissolved oxygen
  - Temperature

Dissolved Greenhouse Gas Concentrations

- 2 L of lake water equilibrated with 20mL of ambient air
- Gaseous headspace analyzed by gas chromatography
- Dissolved GHG concentration at the surface (C$_{surf}$)
  \[ C_{surf} = K_{H} \cdot P_{gas} \]

where:
- $K_{H}$ Henry’s law constant (M/atm)
- $P_{gas}$ is the partial pressure of the gas (atm)
- $\text{Sink vs. source}$

aqueous gas concentration - atmospheric gas concentration

Results

- Fig. 1 Seasonal conductivity by lake type.
- Fig. 2 Seasonal dissolved oxygen (%) by lake type.
- Fig. 3 Winter temperature profile for each lake type.
- Fig. 4 Winter dissolved oxygen profile for each lake type.
- Fig. 5 Departure from saturation for dissolved CO$_2$ concentrations by lake type and season.
- Fig. 6 Departure from saturation for dissolved CH$_4$ concentrations by lake type and season.

Conclusions

- Heterogeneity in limnological characteristics and dissolved GHG concentrations:
  - Between lake types
  - Between seasons
  - Seasonal changes in limnology are contributing to seasonal differences in GHG concentrations

Future Work

- Incorporate GHG emissions from ebullition
- Integrate present day measurements with paleoenvironmental perspective
- Incorporate data retrieved from long term limnology sensors

References