Variations in Methane and Carbon Dioxide Production in Tundra Lakes in the Yukon-Kuskokwim Delta, AK

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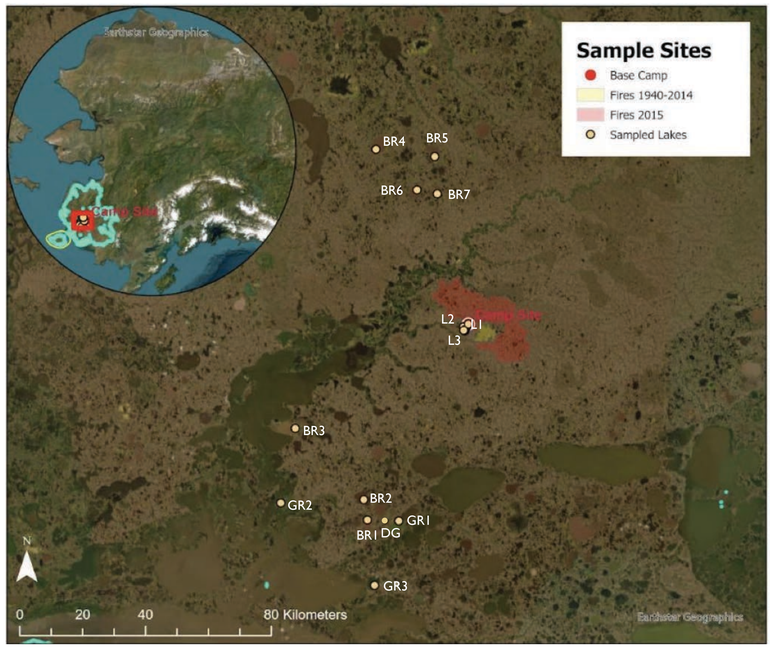
Introduction

Lakes are important components in carbon cycling, especially in the rapidly changing Arctic tundra. Most regional-scale models exclude or under-represent Arctic aquatic methane (CH_4) and carbon dioxide (CO_2) processes, in part, due to high variability of the drivers of aquatic fluxes. This project aims to quantify CO_2 and CH_4 dynamics in tundra lakes using lake-water chemistry, and sediment composition to understand more about the factors that affect CO_2 and CH_4 production within the Yukon-Kuskokwim Delta, AK.

Study Area



Methods

- 14 lakes sampled and named for color (Three GR: Green, Seven BR: Brown, One DG: dark gray) or proximity to basecamp (L1-3)
- Lake sediment grabs were taken, and hydrological characteristics (Temperature, pH, DO) were measured using a YSI.
- Lake water analyzed for DOC, CDOM, nutrients, dissolved CO_2 and CH_4.
- Sediments incubated under saturated conditions to measure CO_2 and CH_4 production using an Li-7810 trace gas analyzer.
- Loss-On-Ignition (LOI: wt. % organic matter, carbonate, terrigenous) from Standard Operating Procedure, 2013, LacCore, National Lacustrine Core Facility.

Results

Loss-On-Ignition

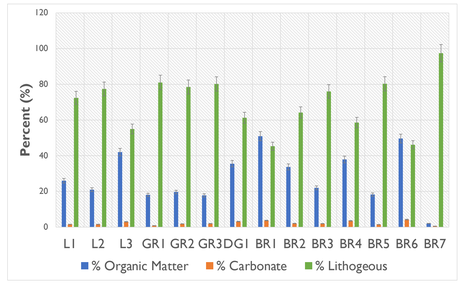


Figure 1. Percent organic mater, carbonate, and lithogenous material per lake.

Water Quality

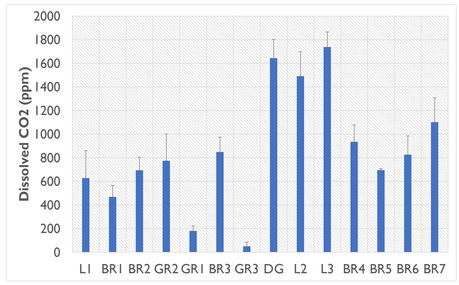


Figure 4. Dissolved CO_2 concentration by lake.

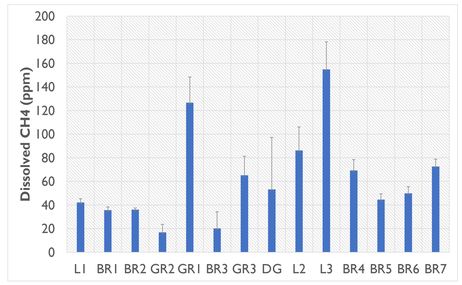


Figure 5. Dissolved CH4 concentration by lake.

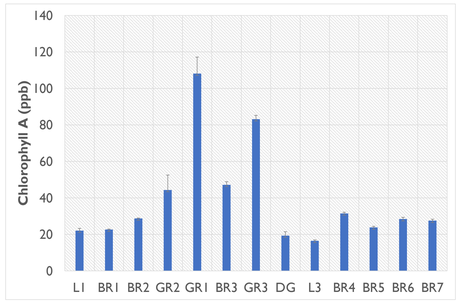


Figure 6. Chlorophyll-a concentration by lake. No chlorophyll data was collected at L2.

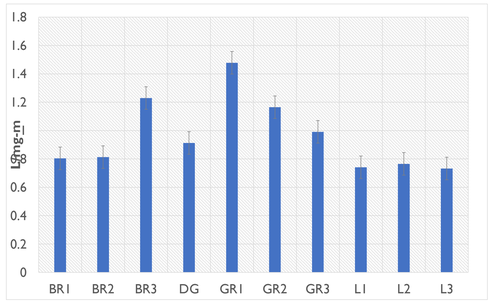


Figure 7. Specific UV Absorption (SUVA) for 10 of the lakes (Samples lost in transport.)

Sediment Incubations

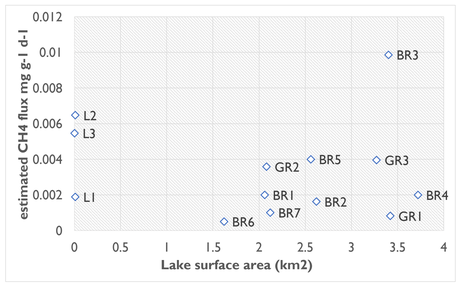


Figure 2. Estimated CH_4 flux by surface area of each lake.

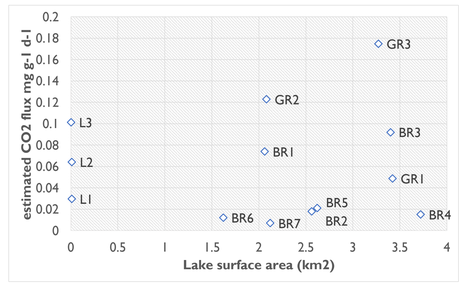
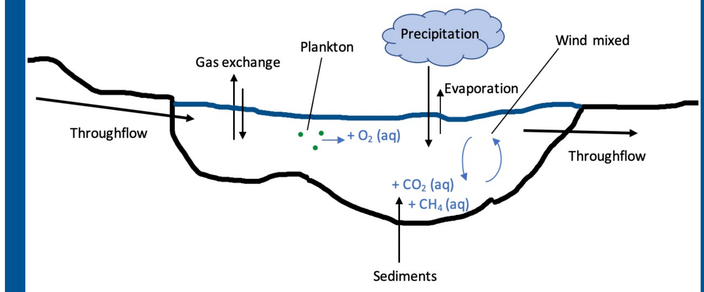


Figure 3. Estimated CO_2 flux by surface area of each lake.



Sandy sediment grab from BR7

Lake 2, MaryBridget (left) Heidi (right)

Results

- Lake sediments were predominately lithogenous except for BR6 and BR1 (organic matter) (Figure 1).
- BR3 sediment produced the most methane followed by L2 & L3 (Figure 2).
- GR3 sediment produced the most CO_2 followed by GR2 and L3 (Figure 3).
- L3,L2, and DG had the highest concentration of dissolved CO_2 (Figure 4)
- L3 and GR1 had the highest concentration of dissolved CH_4 (Figure 5).
- GR1 and GR3 had the highest chlorophyll-a concentrations (Figure 6).
- GR1, BR3, GR2 & GR3 had the highest SUVA, indicating more autochthonous inputs (Figure 7).

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Conclusions/Future Work

- Summertime lakes are most productive and are dominated by gas exchange with the atmosphere.
- No clear patterns of sediment controls on aquatic production of CH_4or CO_2

- Grain size and composition analysis
- Sediment microbe analysis

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