on Carbon Dioxide and Methane Emissions in the Yukon-Kuskokwim Delta, Alaska

The Impact of Fire, Landscape Position, and Nitrogen Availability Mia Arvizu, Susan Natali, John Schade, and Sarah Ludwig

Introduction

Warming temperatures in the Arctic tundra have resulted in increased permafrost thaw and more frequent and severe fires. Both of these issues have the potential to increase nitrogen availability in this region, which may have important implications for microbial decomposition and greenhouse gas (GHG) emissions. However, microbial activity and GHG emissions also depend on soil moisture. Thus, we explored the relationships between GHG emissions and nitrogen availability, fire, and soil moisture in a tundra ecosystem recently impacted by fire.

Hypotheses

Nitrogen may stimulate microbial activity, increasing CO_2 and CH_4 production. However, if NO₃ is present in high enough concentrations it may inhibit CH₄ production.

Increased soil moisture may increase the extent of soil anoxia, reducing microbial metabolism and CO₂ emission, while increasing anaerobic metabolism, which increases CH₄ emission.

Methods

•Carbon dioxide (CO₂) and methane (CH₄) fluxes measured using a dark chamber and a Los Gatos Research Ultraportable Greenhouse Gas Analyzer(LGR). •Fluxes measured in burned and unburned areas that included peat plateau tundra, saturated soil in fens ('wetlands'), and surface water in fens ('water'). •Soils sampled to 30 cm and analyzed for percent nitrogen (%N) and carbon (%C) using a LECO Elemental Analyzer and for KCI-extractable ammonium and nitrate on an Astoria Analyzer.







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Summary and Conclusions

Wetland regions have higher CH_4 and CO_2 gas emissions than both upland peat plateaus and open water.

and higher organic carbon availability

• Total Nitrogen and NH₄⁺ pools have higher concentrations in lowland environments.

as runoff.

 CH_4 and CO_2 gas emissions significantly correlated with soil NH_4^+ pools.





- Possible Explanation: Partially anoxic environment, warmer, deeper thaw depth,
- Possible Explanation: Nitrogen from plateaus are being transported to wetlands
- Possible Explanation: Nitrogen, which is a limiting nutrient in tundra ecosystems, is stimulating microbial activity.

Log Total NH₄+ mg/m²

Further Work

- Examine total and extractable N in permafrost cores to determine potential inputs as a result of permafrost thaw in burned and unburned areas.
- Analyze the role of N and soil oxygen availability on CH₄ and CO_2 production using a lab experiment with anaerobic and aerobic conditions and N additions using soils from upland and lowland regions.