Investigation of CH_4, CO_2, and N_2O Emissions from a Thawing Permafrost Wetland in Northern Sweden

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Introduction

- Northern permafrost ecosystems store vast amounts of carbon that is released as temperatures warm and permafrost thaws.
- As permafrost thaws, previously dry ecosystems are converted into saturated wetlands, altering greenhouse gas (GHG) dynamics.
- Permafrost thaw can lead to higher methane (CH_4) and carbon dioxide (CO_2) emissions, but the fate of nitrous oxide (N_2O) is less constrained and is rarely measured at the same time as CO_2 and CH_4.
- **Goal: To understand how CH_4, CO_2, and N_2O dynamics will change with permafrost thaw.**

Figure 1: Flux sampling using Licor and Aeris gas analyzers.

Figure 2: Flux sampling, respiration measurements.

Study Site/Methods

- Stordalen Mire is a permafrost wetland complex in Northern Sweden (coordinates) that is rapidly experiencing permafrost thaw.
- Three ecosystem type

Palsa

Bog

Fen

- LICOR for CO_2, CH_4, H_2O
- Measurements done between June and July, 2023.
- Measurements are continuous at second intervals
- Aeris for N_2O
- Soil moisture probes, temperature gauges, PAR sensor

Results

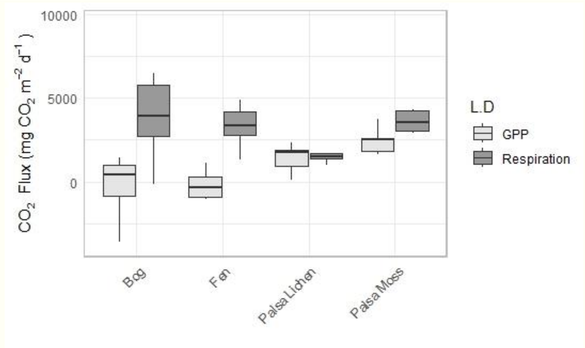

Figure 3: Gross Primary Production and soil respiration across different location types.

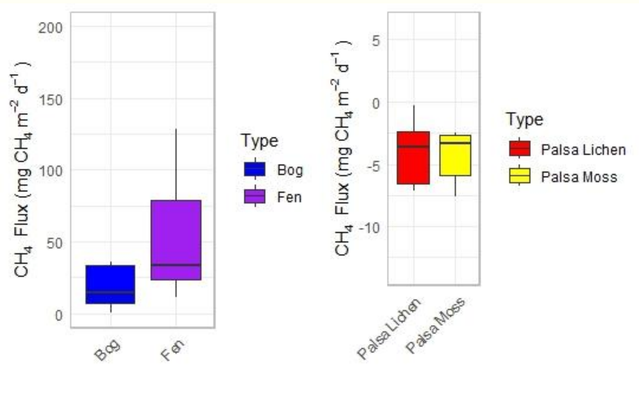

Figure 4: Methane emissions across different location types.

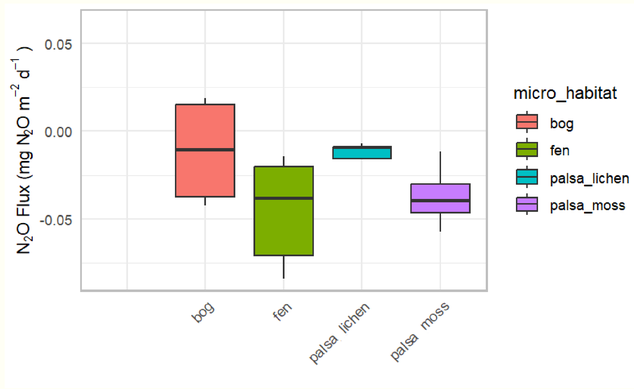

Figure 5: N_2O emissions across different location types

Figure 6: Palsa moss site in Stordalen Mire.

Figure 7: Bog site in Stordalen Mire, overhead view before flux measurement.

Conclusion

The implication of more methane seen at bog and fen sites means that collapsing palsa ecosystems could result in higher methane emissions from the mire as permafrost continues to thaw. Respiration was the same across all sites except for palsa lichen, which was lower. While flux magnitude was low, all of the ecosystem types were small N_2O sinks. Overall, continuing to measure CH_4 and CO_2 emissions simultaneously is important to better understand the impacts of thawing permafrost GHG dynamics across northern ecosystems.

Future research

- Measurements of GHG year round
- More N_2O measurements to better understand if ecosystem is truly a sink.

Figure 8: Bog site in Stordalen Mire, overhead view.

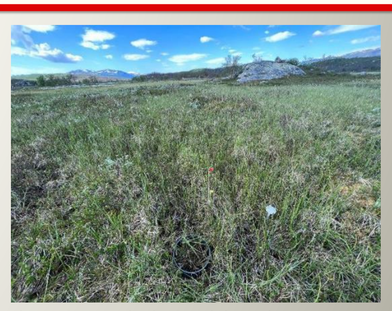

Figure 9: Fen site in Stordalen Mire.

Acknowledgements

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