Climate change, a peat odyssey

Vegetation and carbon accumulation in a permafrost peatland affected by thaw in Nunavik, Northern Quebec, Canada

Édith Auclair-Fournier[1,2,3], Pascale Roy-Léveillée[1,2] and Michelle Garneau[2,3,4]

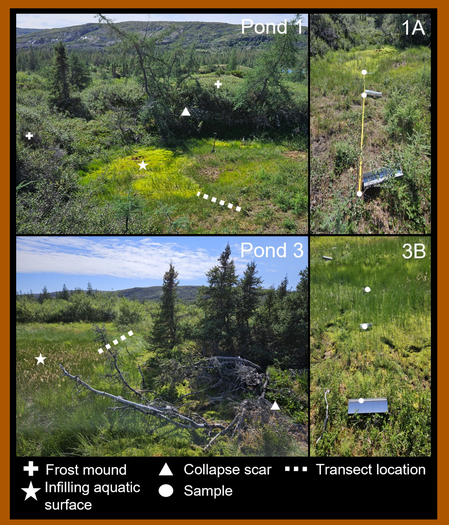
[1]Department of Geography, Université Laval; [2]Centre for Northern Studies; [3]Geotop Research Centre in Earth System Dynamics; [4]Department of Geography, Université du Québec à Montréal

A. Peat accumulation in a warming North

Permafrost peatlands are vulnerable to warming, yet the net effect of thaw-induced carbon (C) release vs accumulation due to increased primary productivity is still unclear. The scarcity of data on recent vegetation succession and plant productivity in thaw features contributes to this uncertainty. This project aims to **document the timing and trajectory of vegetation succession following permafrost thaw** in a degrading lithalsa field near Kangiqsualujjuaq, Nunavik, Canada.

B. Objectives

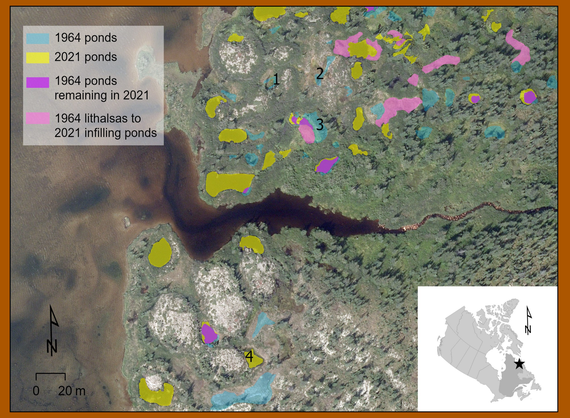
1. Reconstruct vegetation succession following permafrost thaw
2. Quantify peat and C accumulation since thaw using ^{14}C and ^{210}Pb chronologies
3. Assess site-scale variability



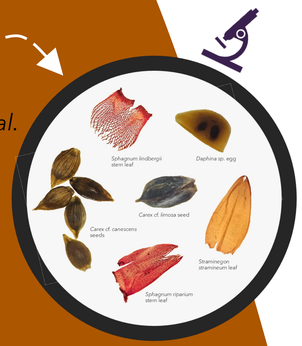
Sampled ponds and transects

C. A paleoecological approach

- Diachronic analyses of aerial photographs
- Peat-core collection (4 ponds x 2 transects, n = 23)
- Hydroseral succession reconstruction:
  ^{14}C & ^{210}Pb radiometric dating +
  Macrofossil analyses
- C quantification:
  Loss on ignition + Elemental analysis
- Age-depth modelling with *rplum* (Blaauw *et al.* 2023) and *rbacon* (Blaauw *et al.* 2023)



Site location and evolution of the thermokarst terrain. Kangiqsualujjuaq, Nunavik, Canada

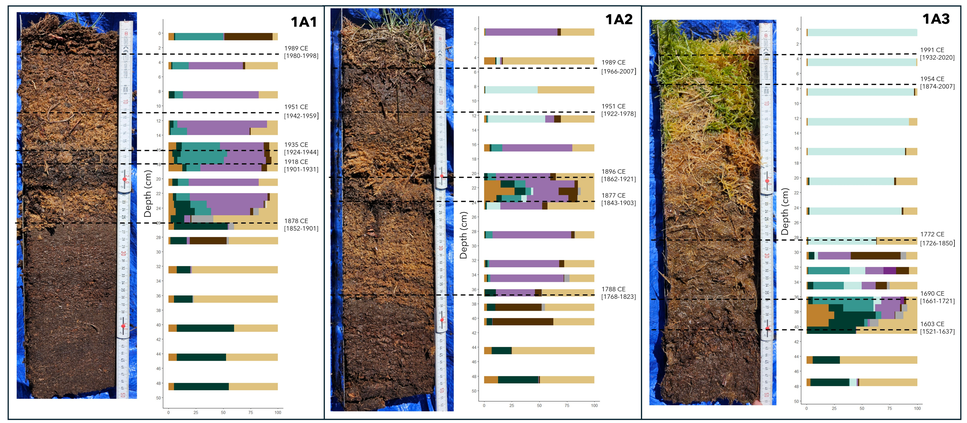


D. Preliminary results

- Numerous ponds have been drained and infilled with vegetation between 1964 and 2021, while new ones have formed within the past decades.
- Peat accumulation and composition vary according to sampling position within transect 1A but not in a outward-inward gradient pathway. ACAR is slightly slowing down for the 1990-2023 period VS 1950-1990 for cores 1A1 and 1A3 but is increasing for 1A2 while PAR is decreasing for core 1A1 but is increasing for the two others. This suggests a strong influence of local hydrology and microtopography on patterns of accumulation.
- **NEXT:** Use more **^{14}C** and **^{210}Pb dates** to compute C and peat accumulation rates for comparing results between ponds.

Recent (1950-2023) apparent carbon accumulation rate (ACAR, g m^{-2} yr^{-1}) and peat accumulation rate (PAR, mm yr^{-1}) for Transect 1A cores

Lower \ Higher	1A1	1A2	1A3
ACAR (ca. 1950-2023)	60,22	89,71	24,75
ACAR (ca. 1950-1990)	86,45	85,80	30,40
ACAR (ca. 1990-2023)	42,76	121,05	23,18
PAR (ca. 1950-2023)	1,65	1,74	1,18
PAR (ca. 1950-1990)	2,37	1,84	1,25
PAR (ca. 1990-2023)	1,15	1,94	1,30



Cores, peat composition and modeled dates using *rplum* (Blaauw *et al.* 2023) and *rbacon* (Blaauw *et al.* 2023) for transect 1A

E. Expected outcomes

An improved comprehension of C dynamics in permafrost peatlands will help to :

- Understand vegetation succession and its impact on C accumulation in the context of permafrost thaw under a warming climate
- Improve inputs in future climate models considering the increase in C accumulation
- Support northern communities in land-use planning and conservation decisions making

Nakurmiik, danke schön, merci, thank you! We thank the Community of Kangiqsualujjuaq for welcoming this project as well as the FRQNT and the Direction des Aires protégées of MELCCFP for their funding. Thank you also to Maxime Schaienks-Desrochers, Frédérique Turmel and Maxence Savard for their help with fieldwork and lab work.