NPC 150822: Responses of Permafrost Microbial Communities to Climate-Driven Thaw

Close

Proposal Status: Conformity Determination Issued

Overview Documents

Project Overview

Type of application: New

Proponent name:

Eric Bottos

Proponent company:

Thompson Rivers University

Project Description:

In our warming climate, the rate of permafrost thaw (ground that remains frozen for at least two consecutive years) is accelerating in the Canadian Arctic. Permafrost stores vast amounts of carbon, which, upon thaw, is released as carbon dioxide and methane into the atmosphere, significantly contributing to rising global temperatures. The microbial communities (groups of microorganisms living together in an environment) within permafrost play a central role in this process, becoming more active as the ground thaws and accelerating the release of carbon. Interestingly, permafrost microbial communities are not all uniform. They can vary across Arctic landscapes, as shaped by local environmental conditions and the characteristics of the overlying soil layers. As permafrost thaws, it mixes with the microorganisms and nutrients from this overlying soil, which can dramatically alter microbial community composition and, in turn, influence how much carbon is released. Despite their importance, the composition of permafrost microbial communities and its overlying soils across Arctic landscapes, as well as how these layers interact during thaw, remain largely understudied. The goal of this research is to study these factors, which could help us better predict the effects of permafrost thaw on future carbon emissions and global climate, as well as help support climate resilience planning and advocacy for northern communities. This August, Gwen Freeze, a member of Dr. Eric Bottos' lab at Thompson Rivers University, will join Adventure Canada on their Baffin Island and Greenland and Into the Northwest Passage trips, travelling by ship throughout northern Nunavut. In coordination with scheduled passenger landings, Gwen will go ashore to collect permafrost cores and overlying soil samples representing a range of Arctic environments. The proposed research will specifically investigate the following questions: 1) How do permafrost microbial communities and overlying soil characteristics vary across different Arctic landscapes? and 2) How do interactions between permafrost and its overlying soil influence microbial community responses to warming? At the proposed sampling sites (see attached map), soil and permafrost samples will be collected within 3 × 3 meter plots. A small quantity of overlying soil will be collected at 10 cm below the soil surface using a spade and shovel, while 30 cm permafrost cores will be collected using a portable gas-powered auger. Samples will be stored at -20 °C onboard until transported to Thompson Rivers

University in Kamloops, BC, with Gwen Freeze. DNA sequencing technologies will be used to characterize microbial community compositions, and simulated thaw experiments will be carried out in lab to assess how overlying soils influence permafrost microbial communities during warming events. Environmental, wildlife, and community impacts will be kept to a minimum. Sensitive vegetation and wildlife habitats will be avoided during sampling. Any soil and vegetation disturbance will be carefully restored to its original condition, with soil layers kept separate during excavation and replaced in the correct order post-sampling. Prior to sampling, consultations with local communities will be conducted to ensure the procedures align with and respect community knowledge and priorities, including input on appropriate sampling site selection. Research plans will remain flexible and be adjusted as needed in response to community feedback and contextual considerations. While ashore, the research will not require transportation, infrastructure, or water use, nor will it create waste. All data generated will be securely stored and managed on institutional servers at Thompson Rivers University. Relevant datasets will be made publicly available, and findings published in open-access and peer-reviewed journals. Prior to fieldwork, and in collaboration with Adventure Canada, Nunavut residents in proposed sampling locations will be consulted about the research plans and invited to participate in sampling activities, for which they will be compensated. Within one year of sample collection, results are to be shared with participating communities, territorial organizations, and the Nunavut Research Institute, both as plain-language summaries and a technical report. Throughout the project, we are dedicated to ongoing collaboration with communities and organizations, and for their input to guide how data and findings are best managed and shared. Our goal is to ensure the most accessible and inclusive approach for all Nunavut residents, and we hope this research can benefit northern communities by informing future climate knowledge.

Project Schedule

Start Date:

2025-08-05

End Date:

2025-09-01

Project Map

List of project geometries:

Id

Geometry

Location Name

17210

point

Monumental Island

17211

point

Lady Franklin Island

17212

point

Panniqtuuq

17213

point

Hoare Bay

17214

point

Cape Dyer

17215

point

Dundas Harbour

17216

point

Powell Inlet

17217

point

Port Leopold

17218

point

Beechey Island

17219

point

Prescott Island

17220

point

Pasley Bay

17221

point

Port Epworth

NPC Planning regions:

No Approved Plan

North Baffin

Project Land Use and Authorizations

Project Land Use:

Scientific Research

Licensing Agencies:

Nunavut Impact Review Board

Nunavut Research Institute

Kitikmeot Inuit Association

Qikiqtani Inuit Association

Government of Canada - Crown-Indigenous Relations and Northern Affairs Canada

Material Use

Equipment:

Type

Quantity

Type

Use

Spade

1

20 x 100 cm

The spade will be used for digging to collect soil (overlying the permafrost).

Shovel

1

25 x 150 cm

The shovel will be used for digging to collect soil (overlying the permafrost).

Portable 2-stroke engine auger

1

9 cm x 1 meter

The auger will be used to drill permafrost cores where conditions and circumstances allow. The SIPRE core barrel has a diameter of 9 cm and a height of 1 meter. The auger's overall dimensions will be slightly larger to accommodate the engine and frame. Permafrost depth is expected to range from 1 to 2 meters below the surface, with permafrost cores approximately 30 cm in length extracted from each site.

Fuel Use:

Type

Container

Capacity

Use

Gasoline

1

10

Gasoline will be used to power the auger. No more than 10 L will be required total for the research.

Hazardous Material and Chemical Use:

Type

Container

Capacity

Use

No data found

Water Consumption:

Daily Amount (m^2)

Retrieval Method

Retrieval Location

0

Waste and Impacts

Environmental Impacts:

Environmental impacts will be kept to a minimum through careful planning and execution. Sensitive vegetation and wildlife habitats will be avoided during sampling, and any soil or vegetation disturbance will be carefully restored. Soil layers and plant material will be kept separate during excavation and returned to their original positions post-sampling to ensure proper restoration. Additionally, any equipment used will be cleaned between each sampling site to prevent the introduction of non-native species or pathogens into new environments. We will also work closely with local communities to ensure traditional ecological knowledge and conservation priorities are respected. By adhering to these measures we aim to ensure minimal disruption to local ecosystems.

Waste Management:

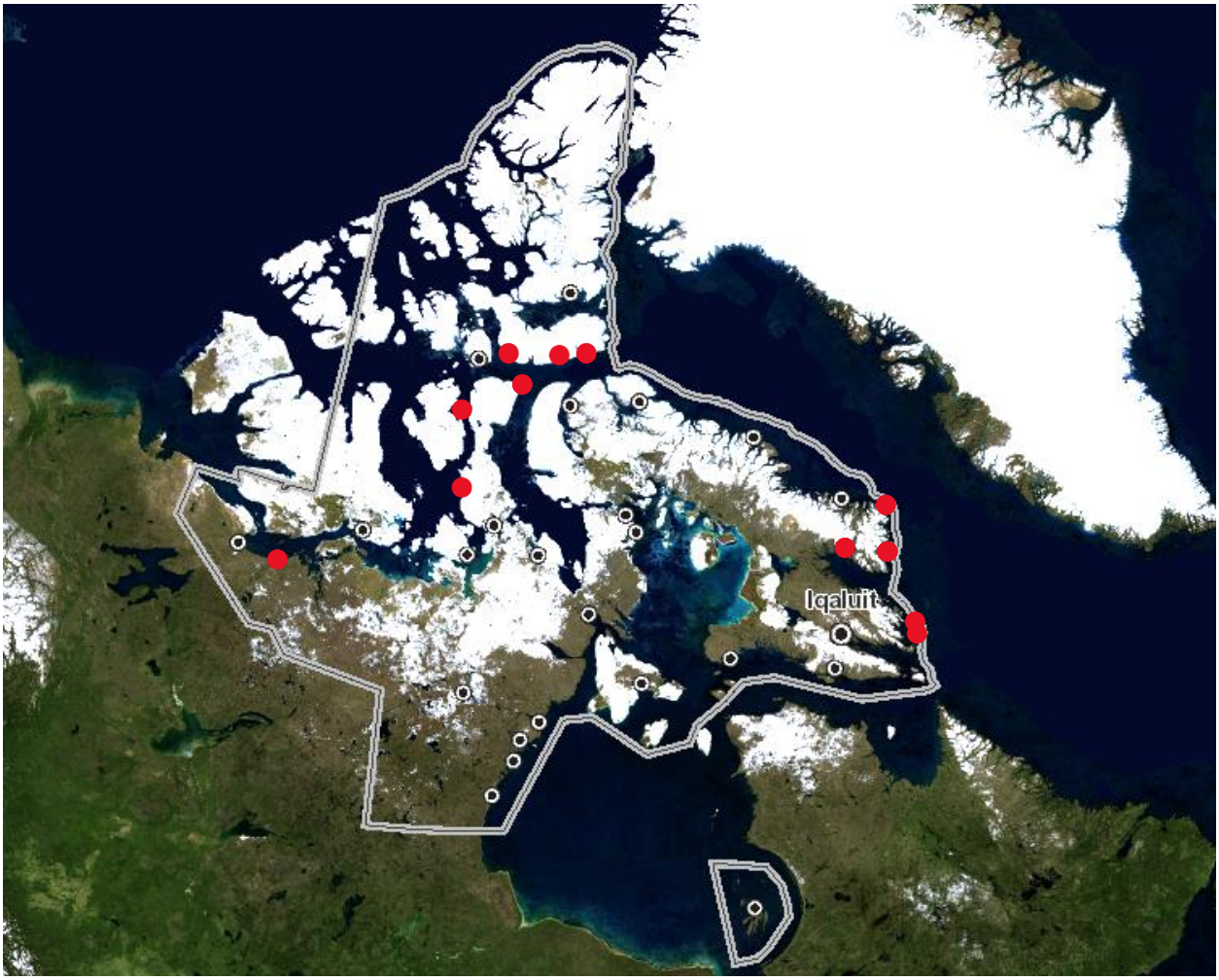
Waste Type

Quantity Generated

Treatement Method

Disposal Method

No data found



+Zoom In

−Zoom Out