

WINTER SOIL PROCESSES IN TRANSITION

What is the impact of climate change on soil health and water quality in Canadian cold regions?

Warmer winters are leading to a greater frequency of freeze-thaw events and colder soils due to the loss of the insulating snowpack. These factors are subsequently changing the movement of water, carbon and nutrients in soils during the winter. Common understanding is that frozen soils are dormant but our studies show that soils remain biogeochemically active during winter months, just differently from other seasons.

This study aims to uncover what is happening below the soil's surface during winter.

Our knowledge on the effects of changing winter conditions on soil biogeochemical processes and fluxes is limited: only 5% of warming studies have focused on this critical ecosystem's winter conditions. In particular, the processes governing carbon and nutrient transformations outside the growing season are largely unknown.

Transformations of carbon and nutrients

The timing and magnitude of carbon and nutrients exported from cold region landscapes is in part a function of winter soil processes. This can affect streamwater quality during spring snowmelt, which has significant implications for nutrient loading to water bodies and algal growth.

WE WILL:

- › enhance our ability to evaluate the impact of different potential climatic scenarios on carbon and nutrient export and speciation along the aquatic continuum.
- › predict the impact of below ground temperatures and snow cover on biogeochemical transformations of carbon and nutrients in winter soils.



Implications for soil health

Identifying biogeochemical drivers, such as energy and nutrient delivery, on winter microbial community composition, functions and dynamics, is critical to establishing a mechanistic understanding of winter biogeochemical cycles. This could affect the health of soils and their ability to support plant growth.

WE WILL:

- › examine the microbial activities during winter conditions to estimate the effect of repeated freeze-thaw cycles on microbial resilience and biological carbon and nutrient release.

New scientific discoveries

Little is known about the function of soil biogeochemical processes in cold region environments during the fall-winter and winter-spring transitions and during the non-growing season.

WE WILL:

- › develop novel experimental systems that allow us to simulate realistic soil conditions during freeze-thaw cycles.
- › improve our ability to predictively simulate subsurface microbial processes during winter conditions.
- › improve fundamental understanding of biogeochemical processes under freeze-thaw events during the winter to spring transition.

