Experimental Alteration of Plant Canopy and the Effects on Cryoturbation Regime

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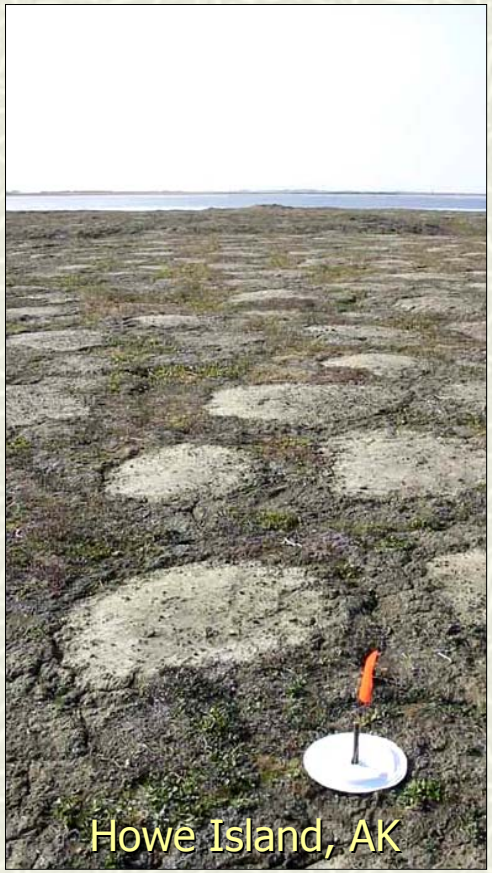
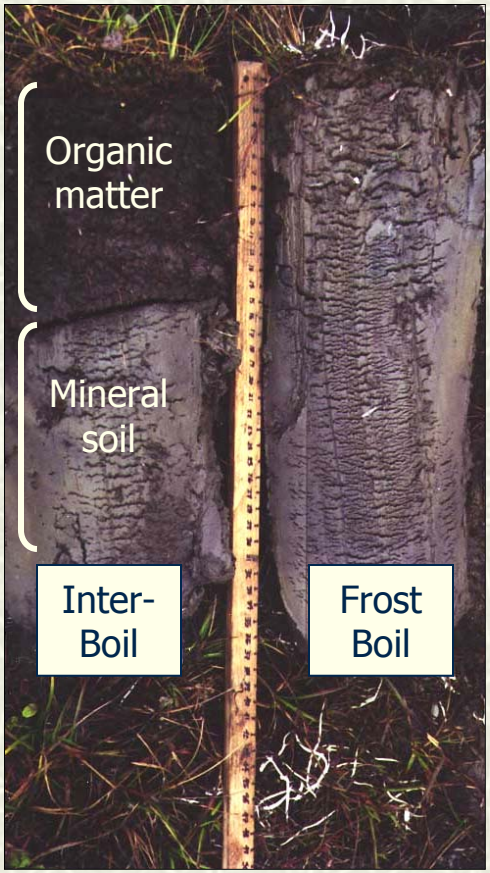
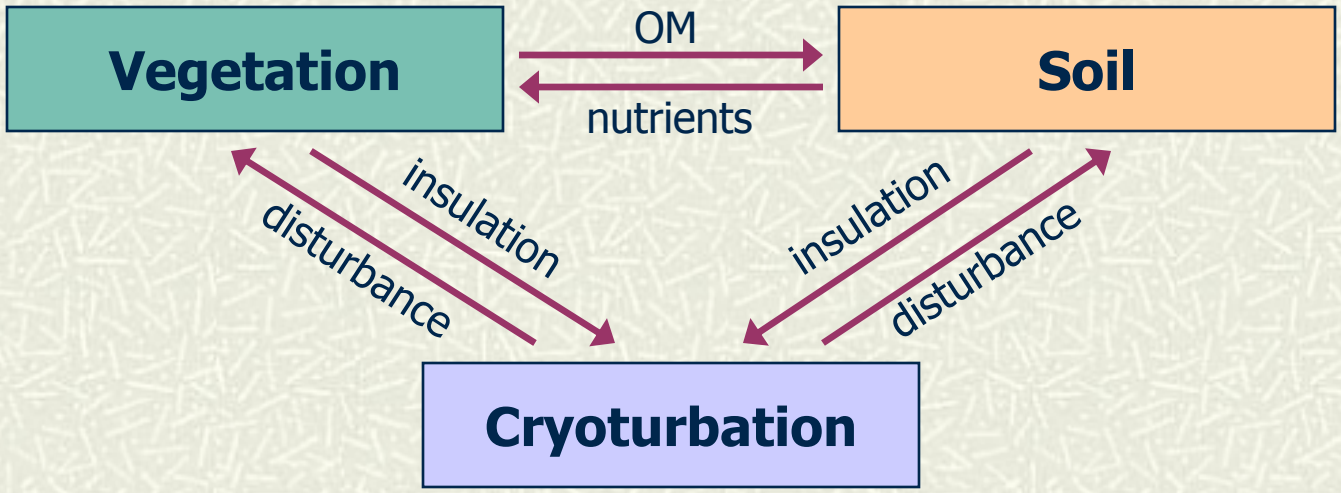
Frost Boils in Alaskan Arctic Tundra



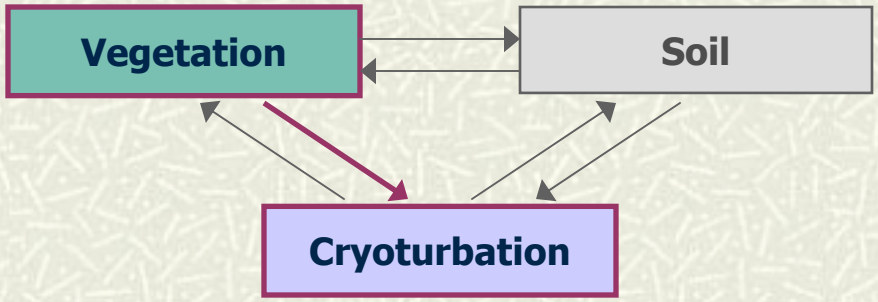
- Patterned, circular landforms of northern tundra areas
  - Non-sorted circles in loess landscapes of northern Alaska
  - Sorted circles in areas with coarser material
- 1-3 m in diameter
- Caused by differential frost heave
  - High content of ice lenses
- Minimal vegetation cover
- Great thaw depth



Frost-Boil Ecosystem

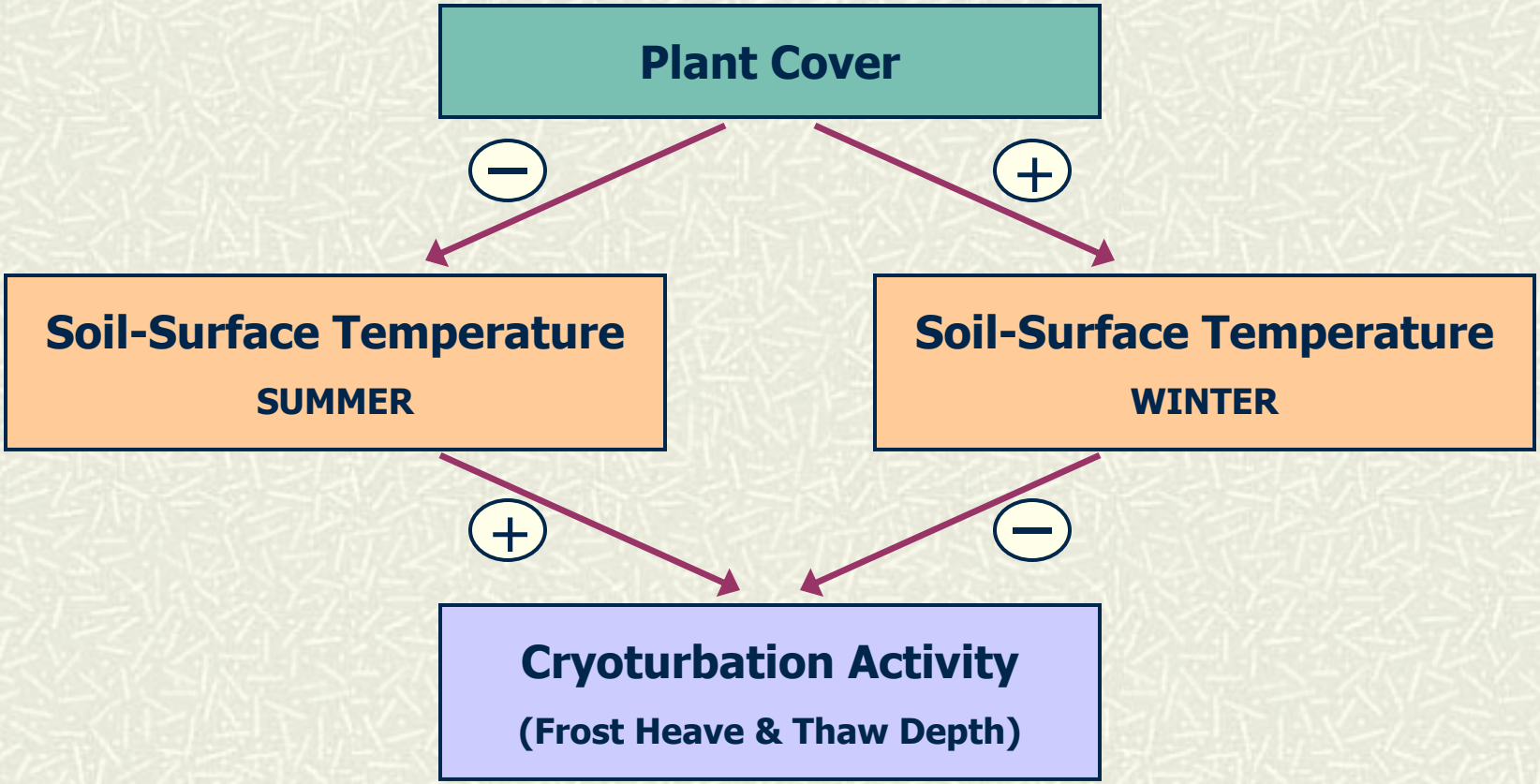


Objective

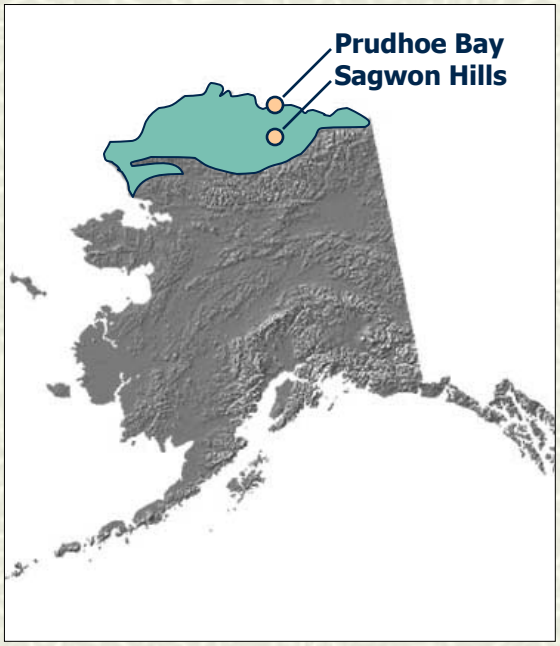


To study the influence of the plant canopy and different plant functional types on cryoturbation regime.

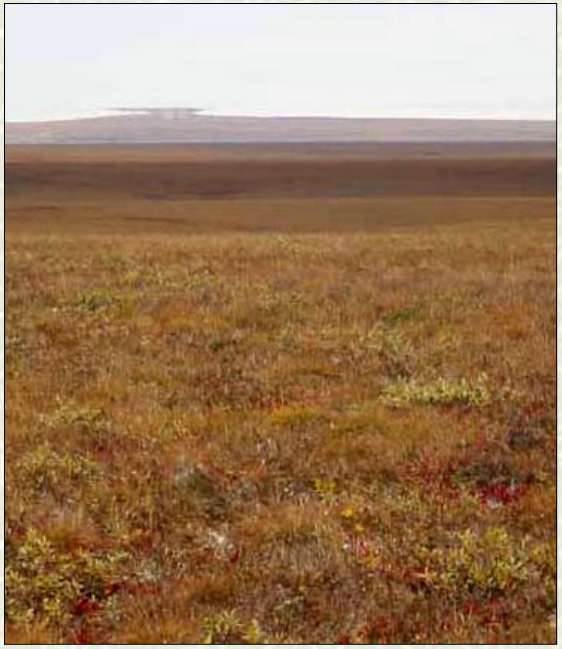
Hypotheses


Plant Cover
−
+
Soil-Surface Temperature
SUMMER
Soil-Surface Temperature
WINTER
+
−
Cryoturbation Activity
(Frost Heave & Thaw Depth)

Study Area



- North Slope, Alaska
- Sagwon Hills (60 miles south of Prudhoe Bay)
- Mean July Temp.: 7ºC
- Erect dwarf-shrub bioclimatic subzone
- Frost-boil vegetation: small mosses, fruticose lichens, forbs



Frost-Boil Treatments

- Vegetation removal

  What influence does the lack of plant canopy have on thermal insulation and cryoturbation parameters of frost boils?

- Vegetation removal & transplanting sedge seedling

  How do vascular plants with an extensive root system *(Eriophorum vaginatum)* affect cryoturbation activity?

- Vegetation removal & transplanting "moss carpet"

  What effect does an insulating moss carpet have on cryoturbation activity?

- Control

Methods: Vegetation Removal

- Stripping off vegetation mat
- Exposing mineral soil

Methods: Graminoid Transplants

- Collecting *Eriophorum vaginatum* seedlings
- Transplanting seedlings at 10 cm intervals

Methods: Moss Carpet

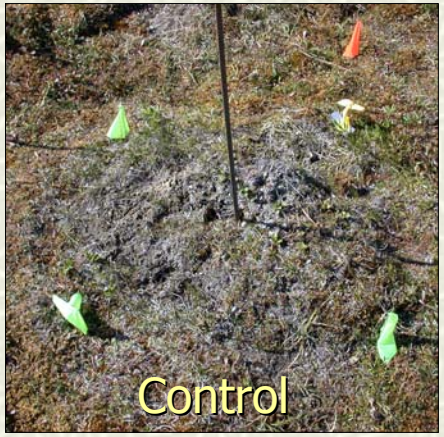
- Collection of moss slabs from surrounding area
- Transplanting 10-15 cm thick moss slabs

Methods: Rebar and Toothpicks…

… to measure frost heave

… and to monitor soil-surface stability

Finished Plots

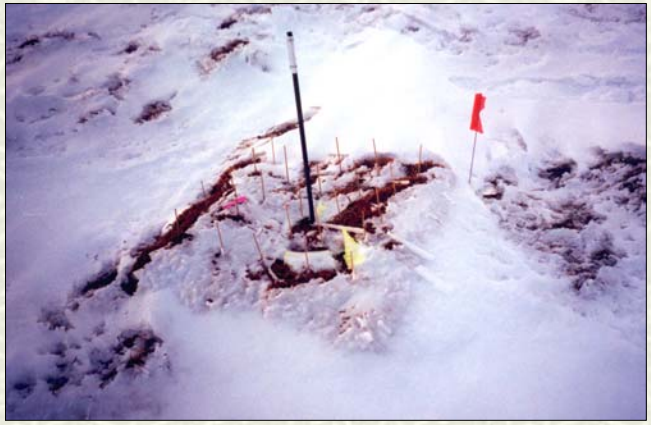


Response Variables

- Frost heave
  - Movement of ground around rebar
- Thaw depth
  - Insertion of probe through active layer
- Soil moisture
  - Spot measurements of upper 6 cm of soil with Theta probe
- Soil temperature
  - In situ measurements with data loggers at 2 cm depth in the soil and at 2 cm above soil surface
- Soil-surface stability
  - Percentage of tilted or expelled toothpicks
- Snow depth

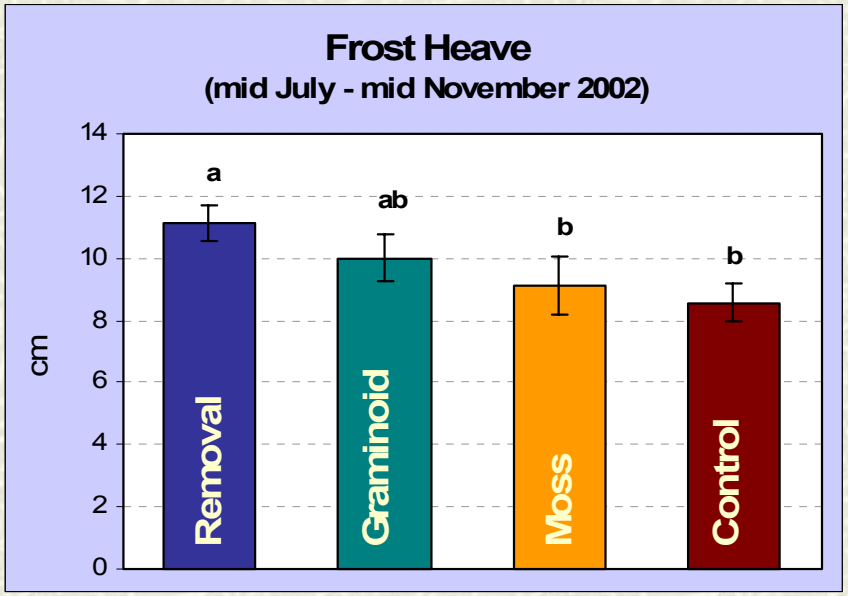
Winter in Sagwon…

November 2002

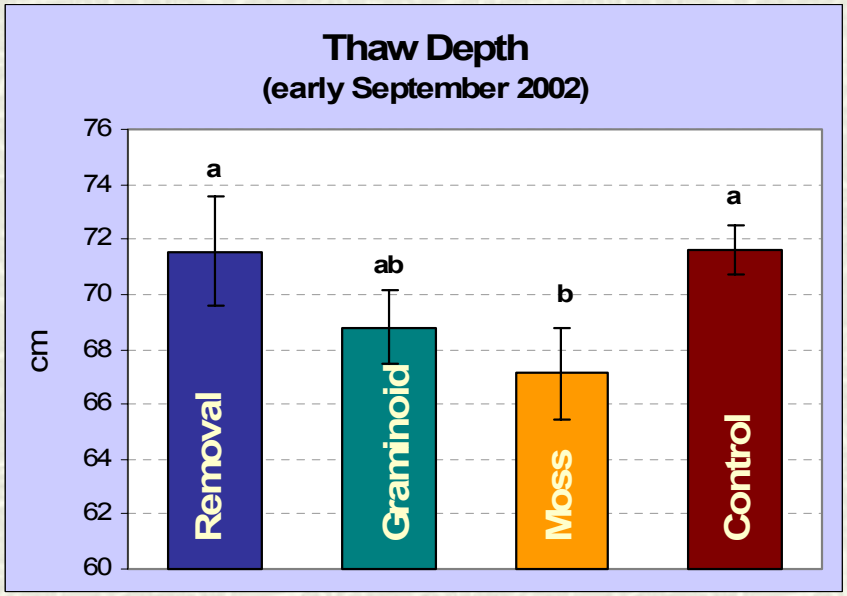


April 2003

Preliminary Results

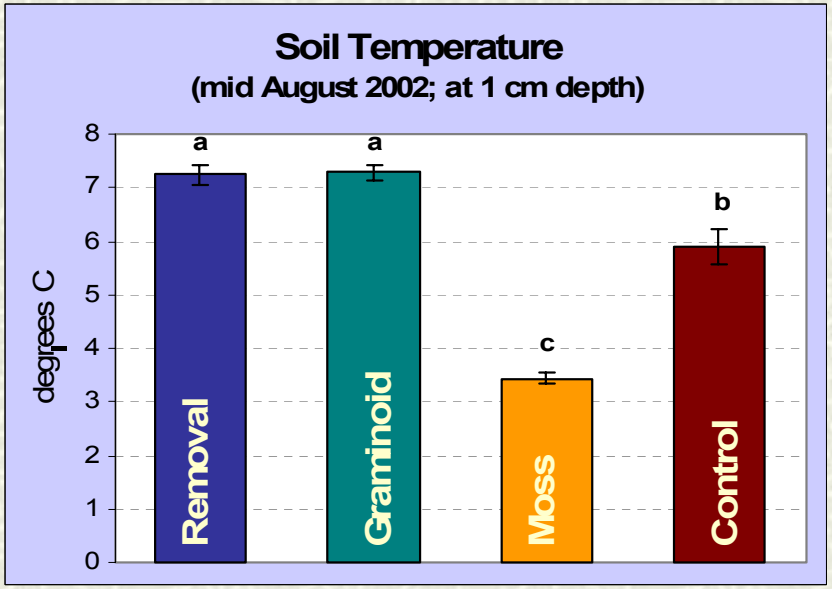


Frost heave

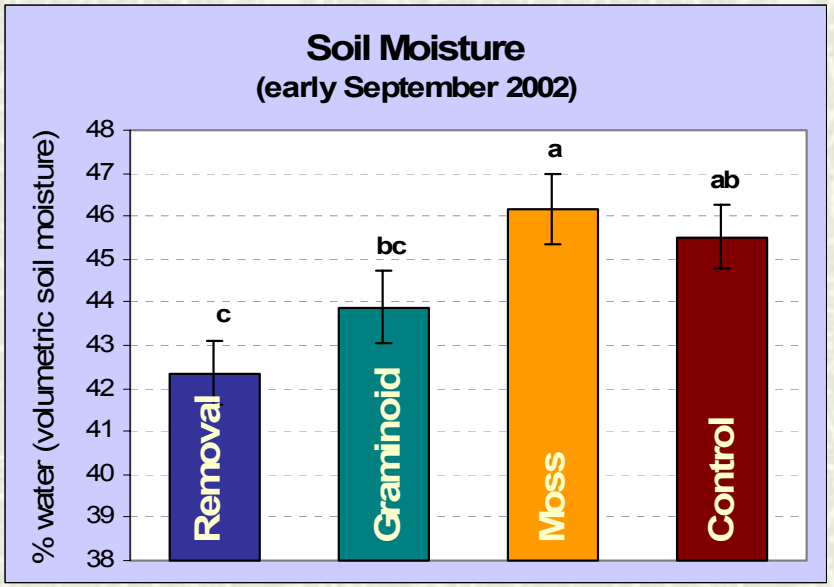


Thaw depth

Preliminary Results



Soil temperature



Soil moisture

Preliminary Results

- Cryoturbation parameters:
  - Frost heave was increased by vegetation removal.
  - Thaw depth was decreased by moss carpet.
- Soil parameters:
  - Summer soil-temperature was increased by vegetation removal and graminoid treatment. It was decreased by moss carpets.
  - Soil moisture was decreased by vegetation removal.

Discussion and Conclusion

- Cryoturbation activity seems to be closely linked to insulation through plant canopy.
- Why was thaw depth not affected by vegetation removal, and why did frost heave show no response to the moss carpet?
- Frost boils seem to have an imprint on their cryoturbation regime and "remember" their past – more time might be required to alter all cryoturbation variables experimentally.