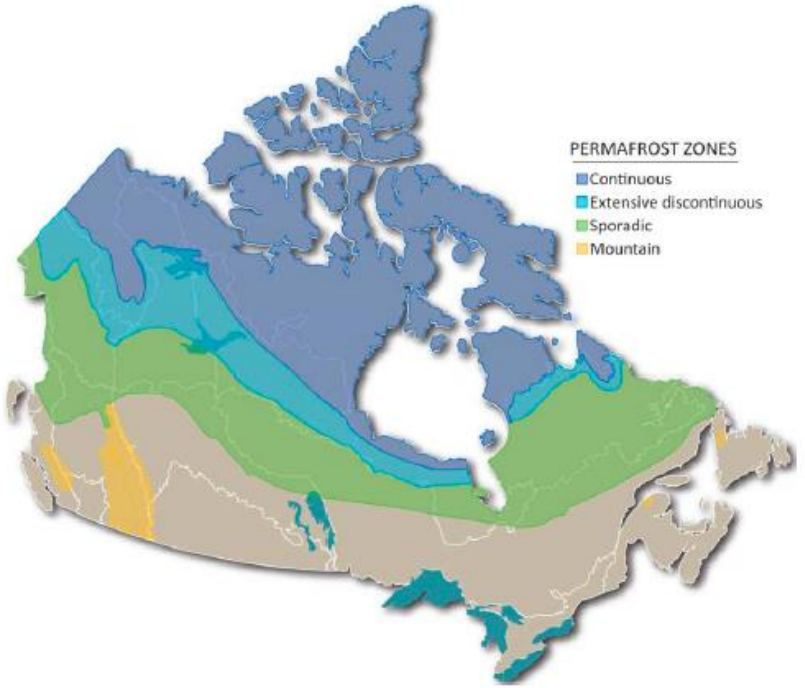
Effects of permafrost thaw on food, water, and carbon security

Merritt R. Turetsky

mrt@uoguelph.ca

@queenofpeat

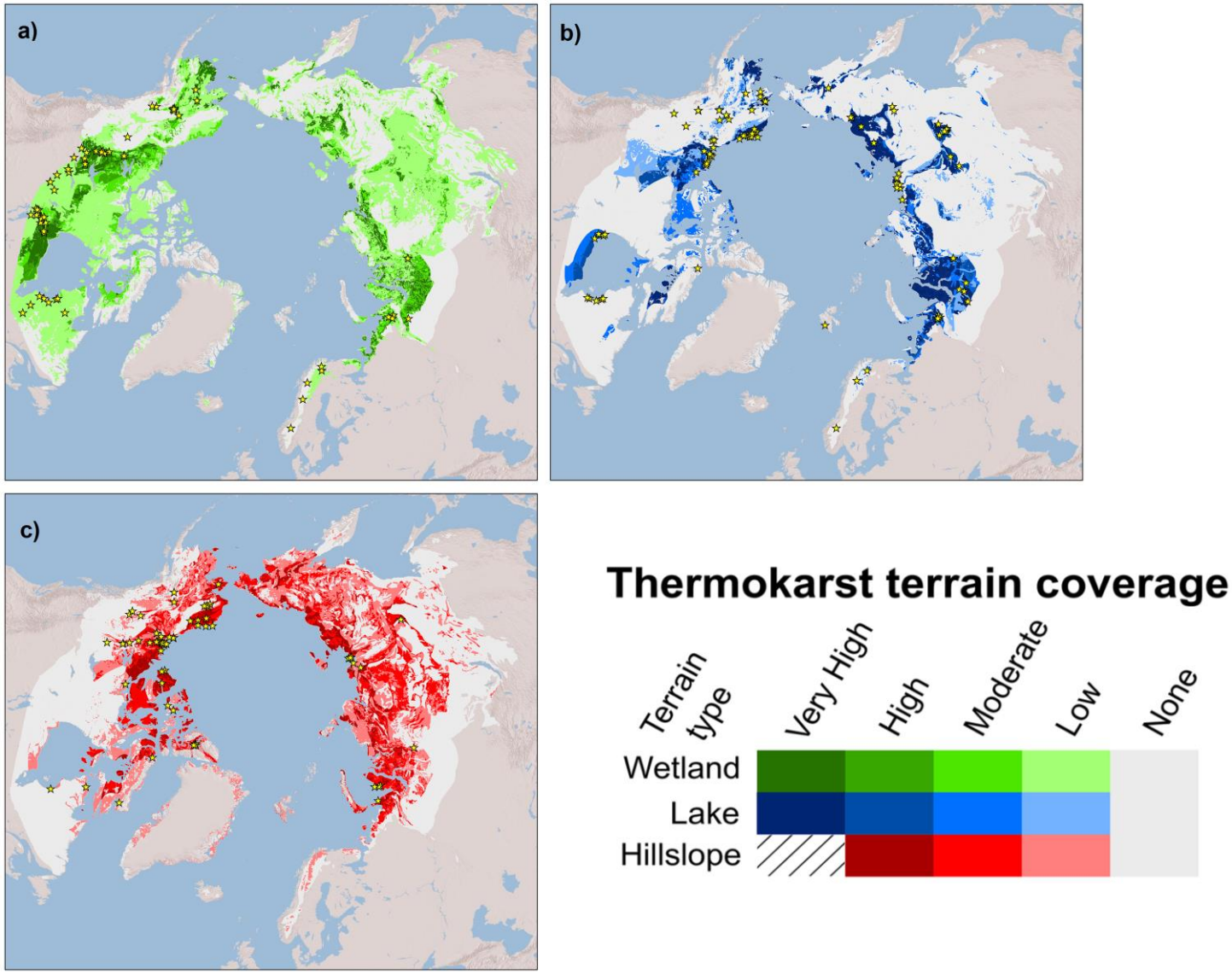
What is a key defining feature of Canada?



#PermafrostNation

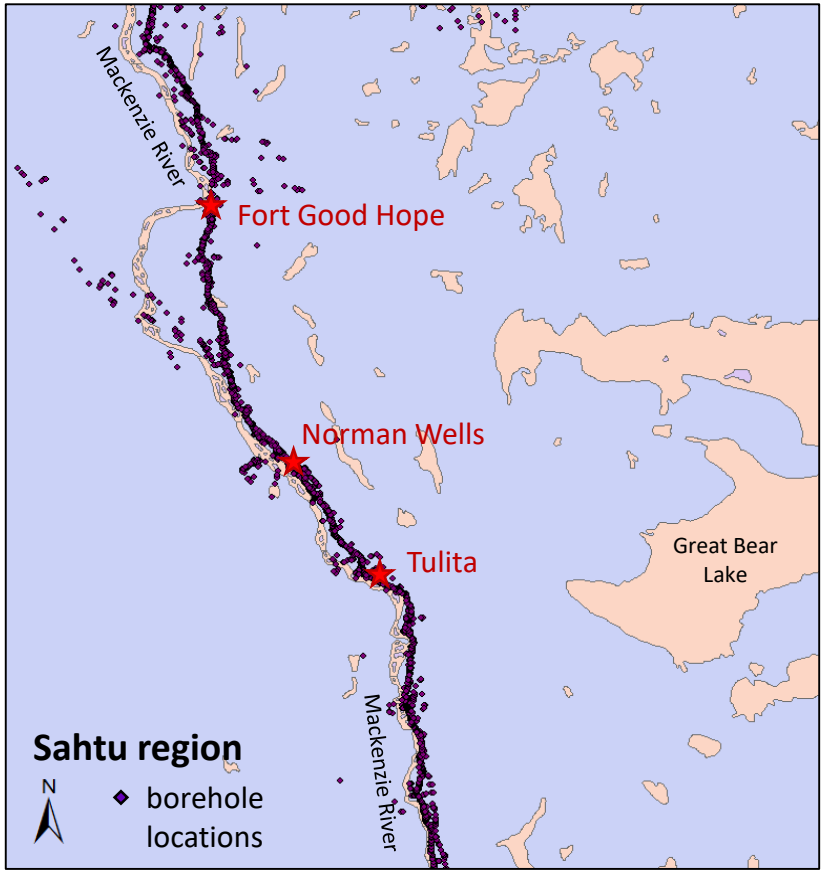
Models do not account for abrupt thaw processes (thermokarst, thermo-erosion)

Abrupt thaw spatial mapping

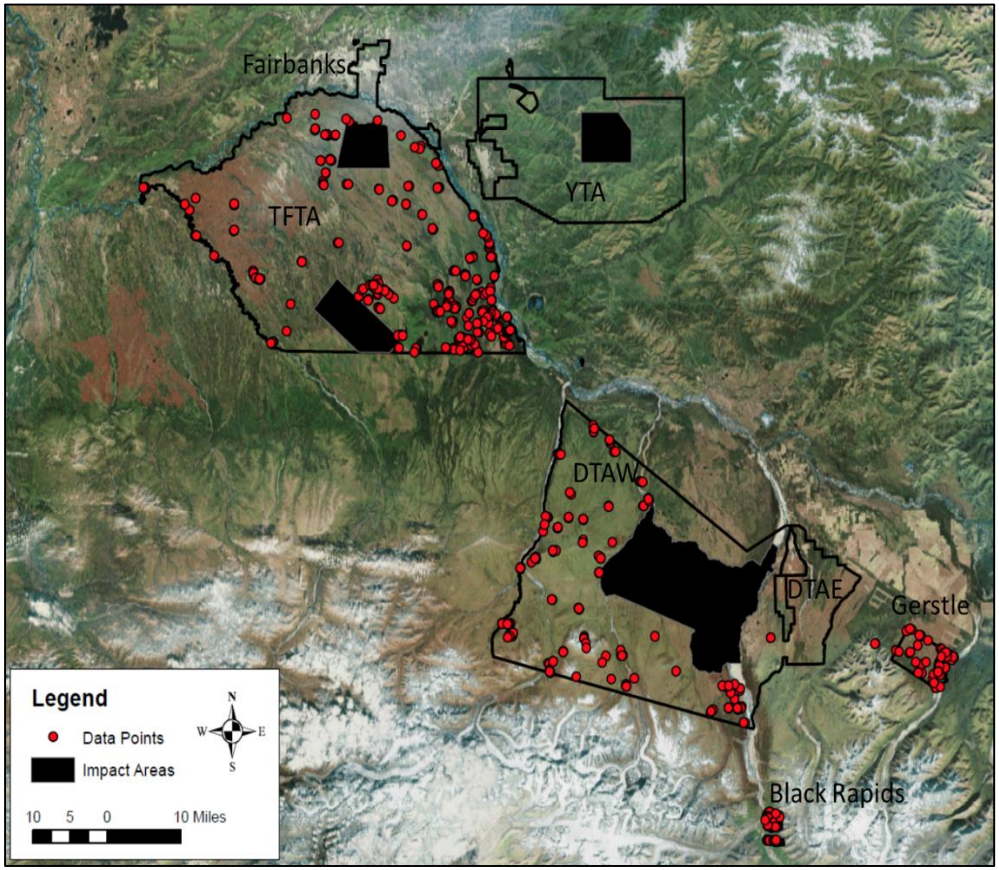


Olefeldt et al. 2016 Nature Comm

Improving abrupt thaw maps:
Ground ice data rescue!

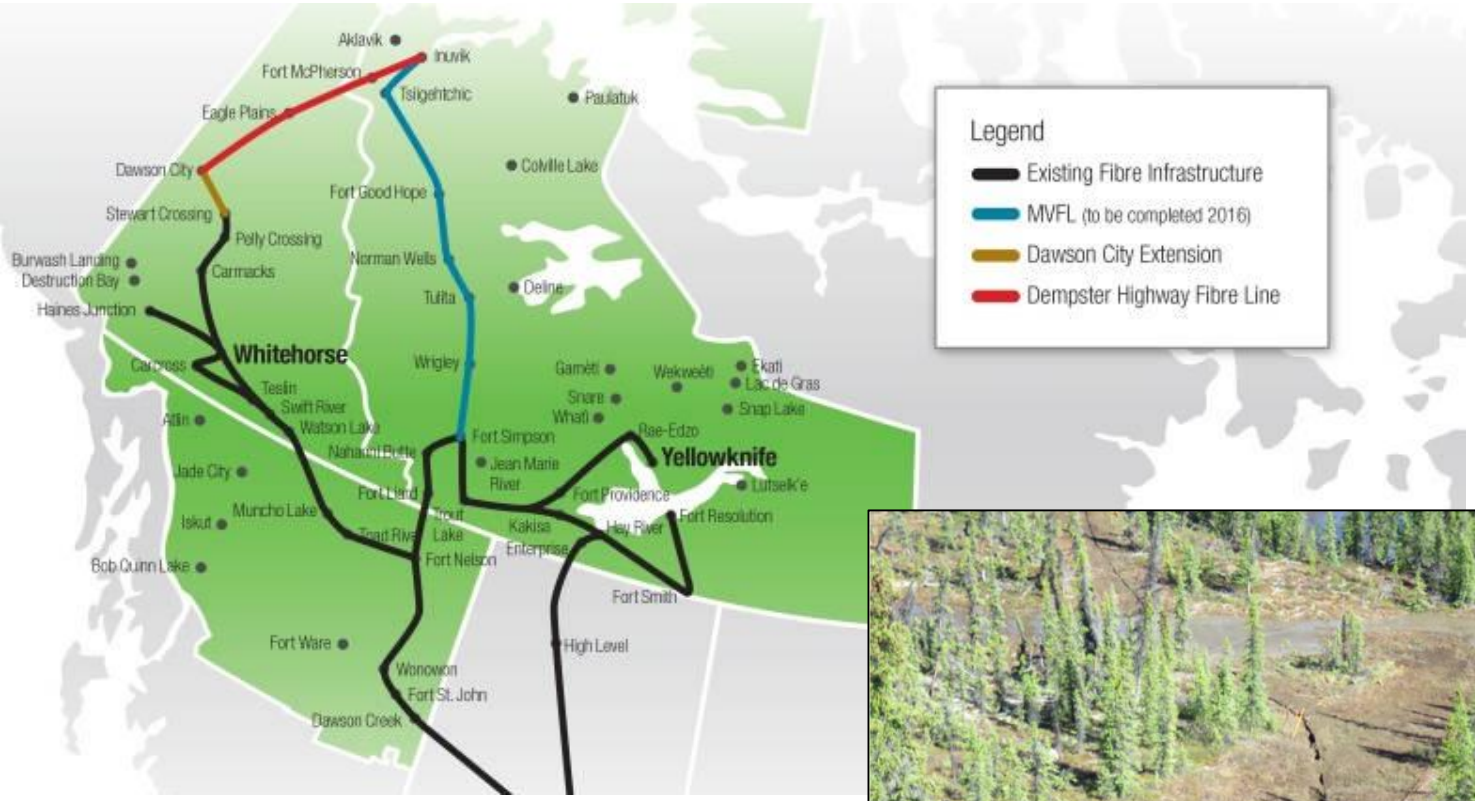


Data from >7000 boreholes drilled by Geological Survey of Canada or industry

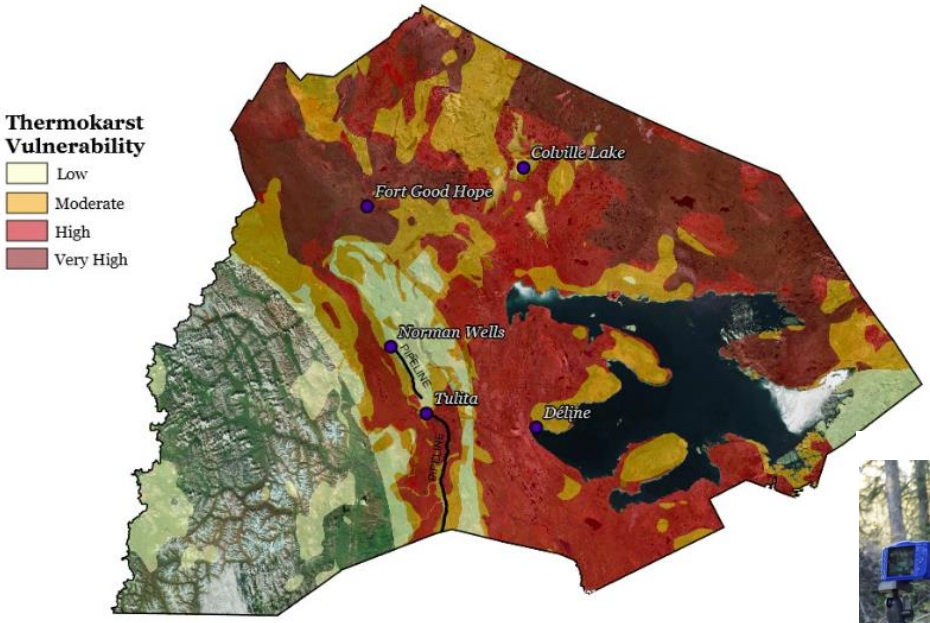


Permafrost and ground ice data on military lands in interior Alaska (NRCS)

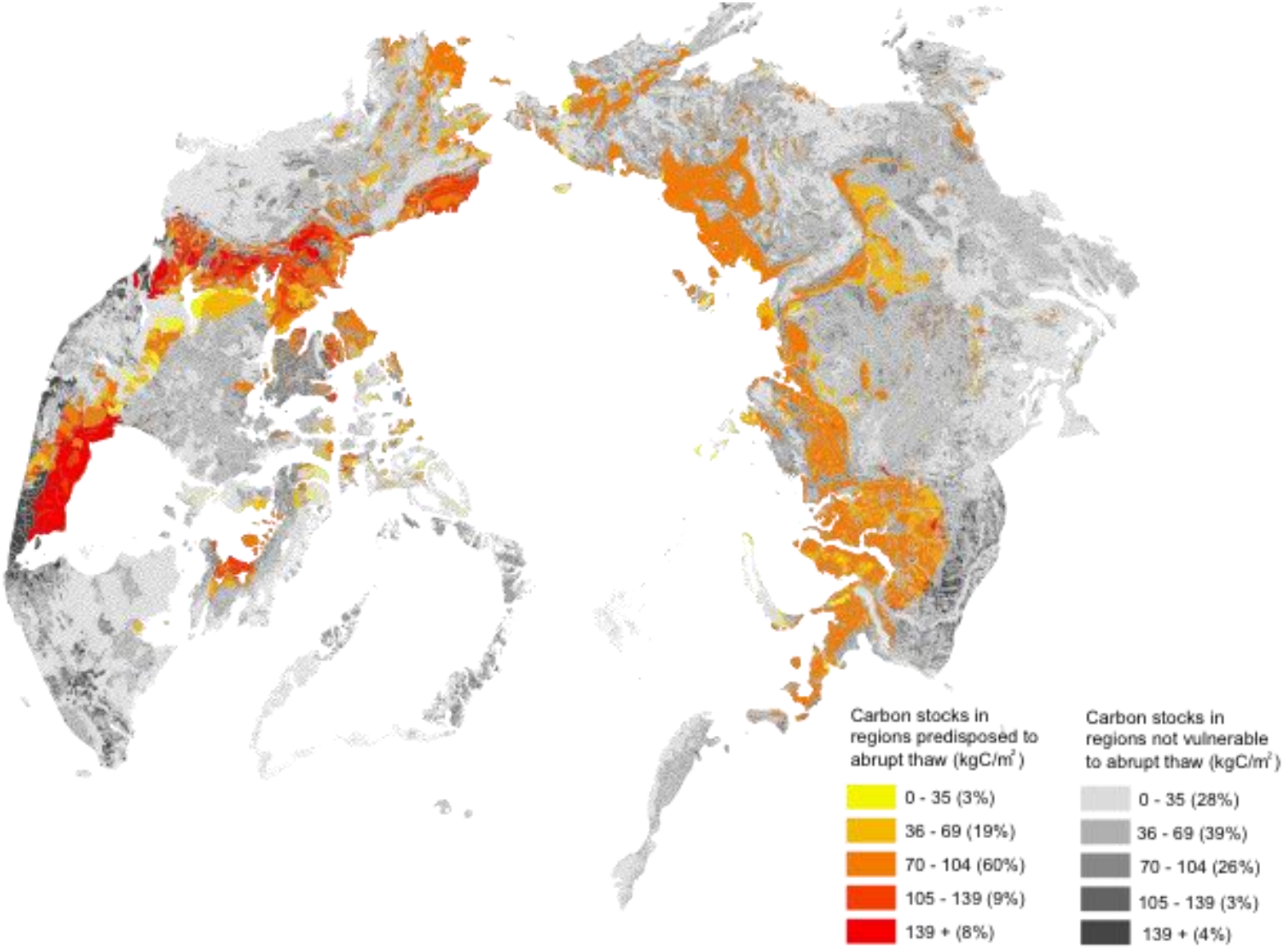
Improving abrupt thaw maps:
Infrastructure failure as "test cases"



Improving abrupt thaw maps:
Local knowledge, community participatory work

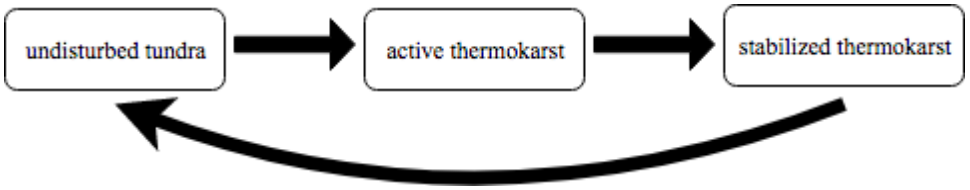


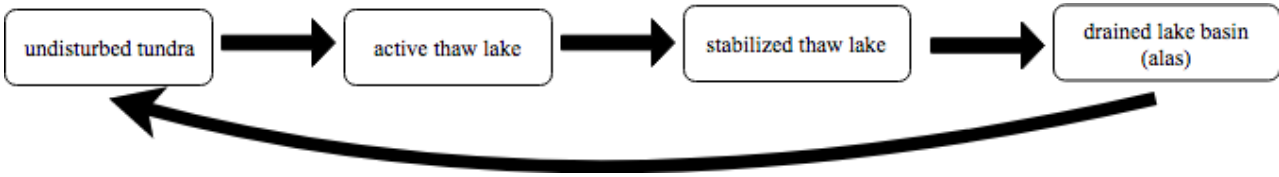
Abrupt thaw affects the most C-rich soils

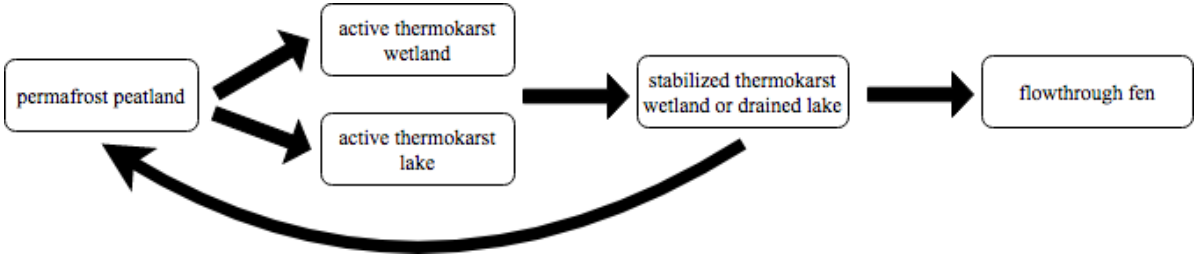


Turetsky et al. 2019 Nature

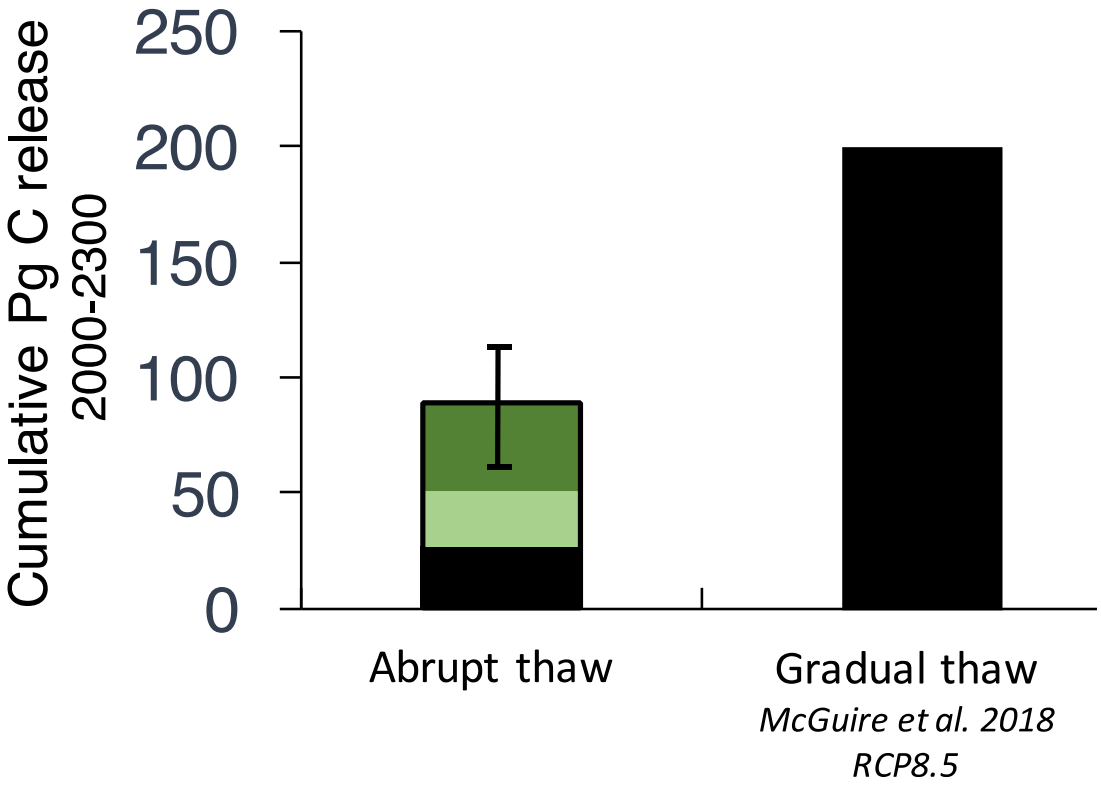
Conceptual models of change





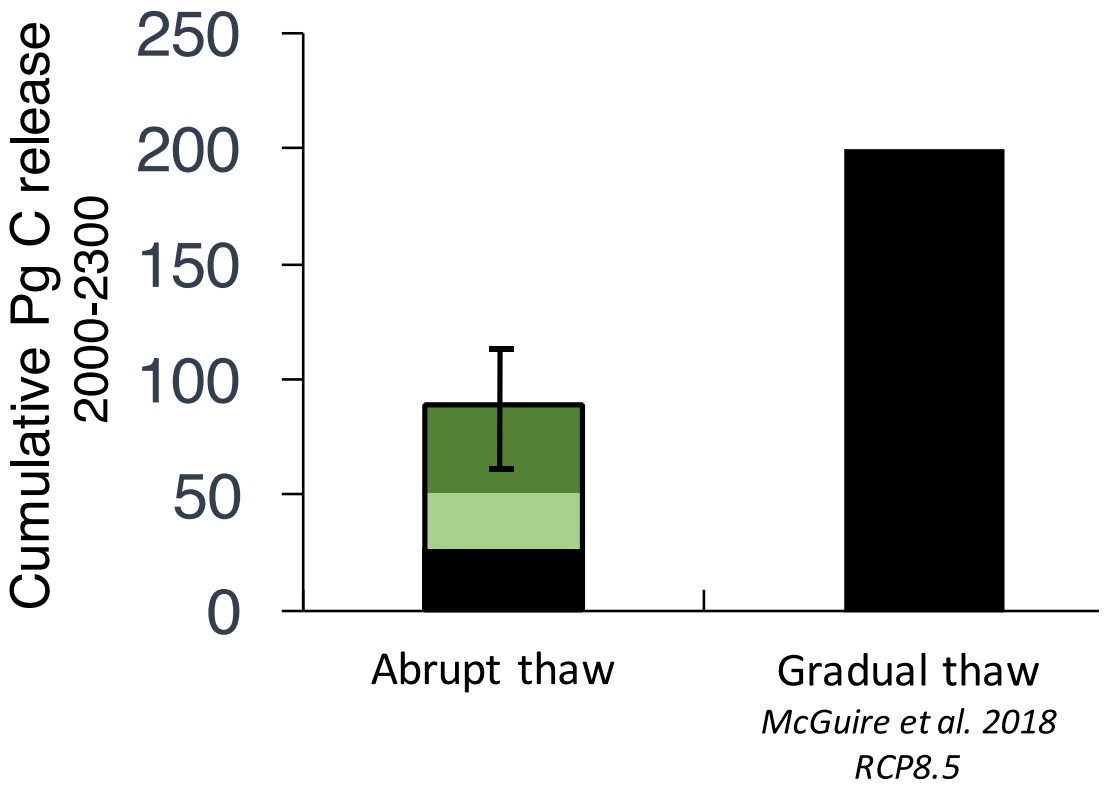


How does abrupt thaw compare to gradual thaw?



- By 2300, abrupt thaw could cover 2.5 million km^2 or ~15% of the permafrost region.
- Abrupt thaw emissions increase estimates of permafrost carbon release by ~50%.

How does abrupt thaw compare to gradual thaw?



- By 2300, abrupt thaw could cover 2.5 million km^2 or ~15% of the permafrost region.
- Abrupt thaw emissions increase estimates of permafrost carbon release by ~50%.
- Due to large CH_4 emissions, abrupt thaw could provide a similar climate feedback as gradual thaw emissions

Meta-analysis of permafrost ecosystem services

Carolyn Gibson, ongoing PhD

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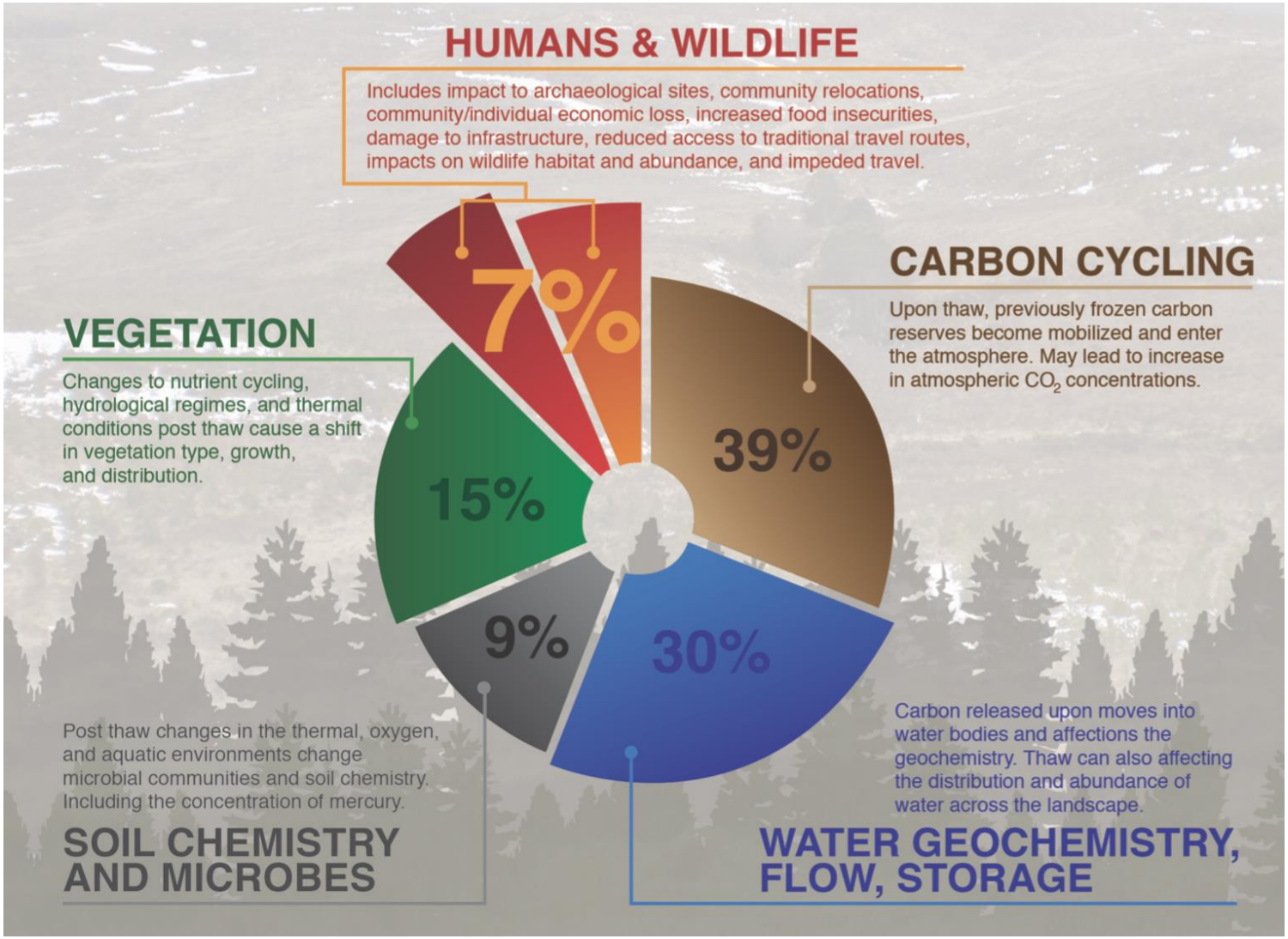


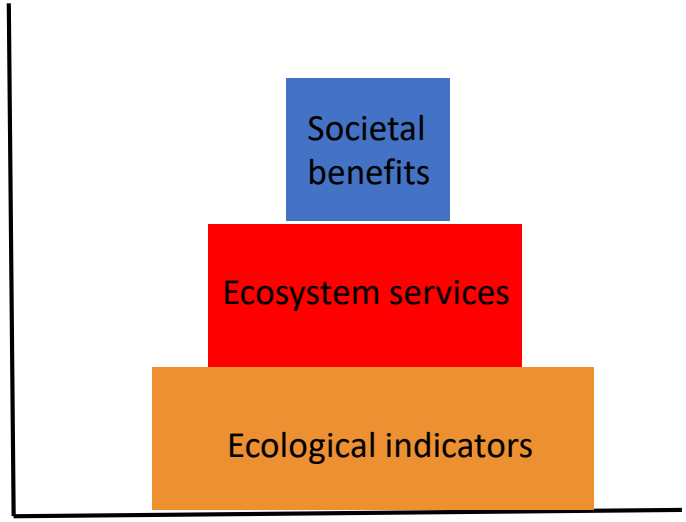
Meta-analysis of thaw causal networks/chains

Carolyn Gibson, ongoing PhD

△ Mobile carbon availability → △ DOC concentrations → △ Oxygen concentrations → △ Fish populations → △ Fish availability → △ Fish harvesting → △ Food security/cultural identity

Thaw-related causal chains are being developed for impacts on:

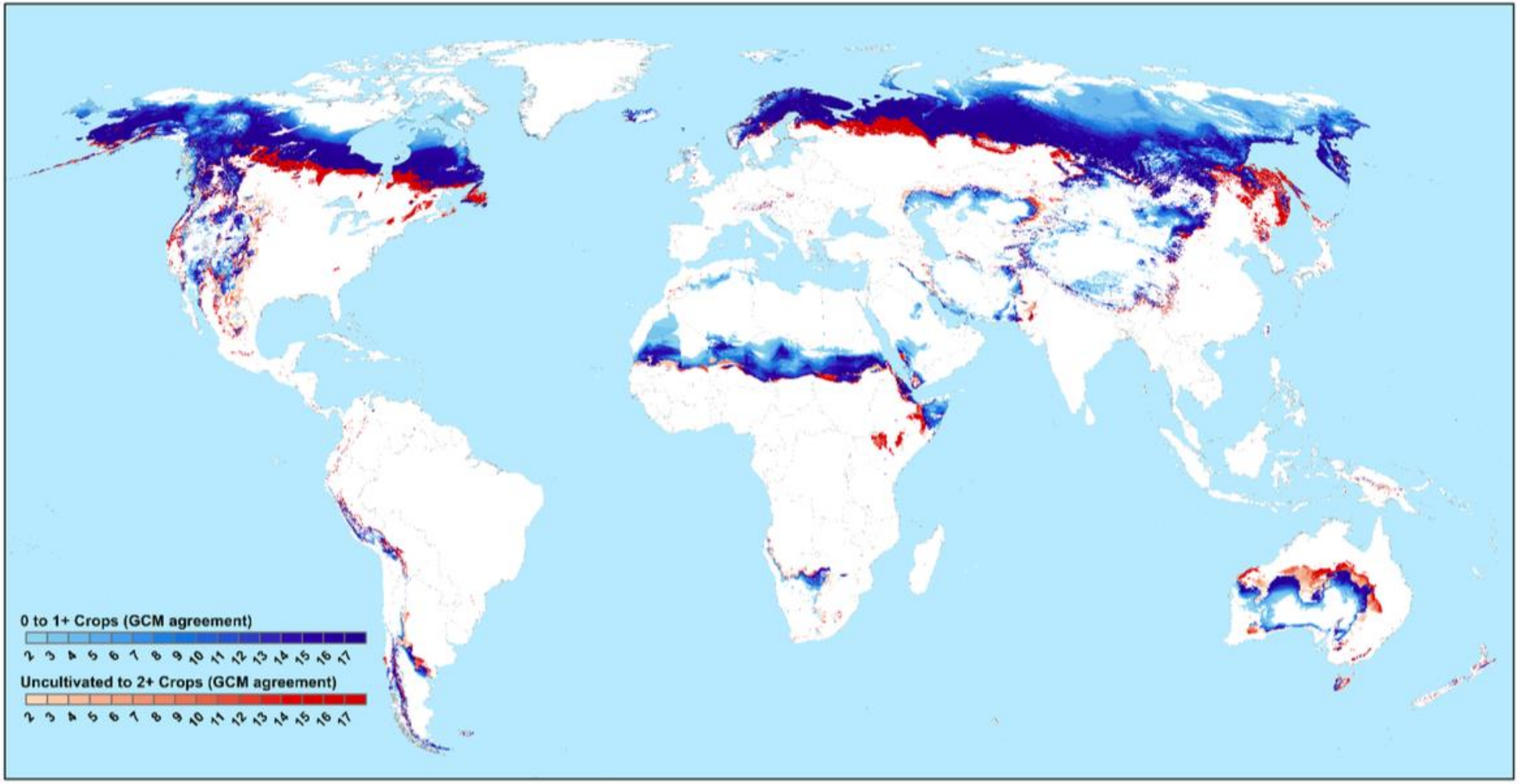
- Caribou populations (provisioning service)
- Carbon storage (regulating service)
- Land access and land travel (cultural service)



# of publications

Current food system in northern Canada

There is both a **need** and an **opportunity** to grow more food in the north

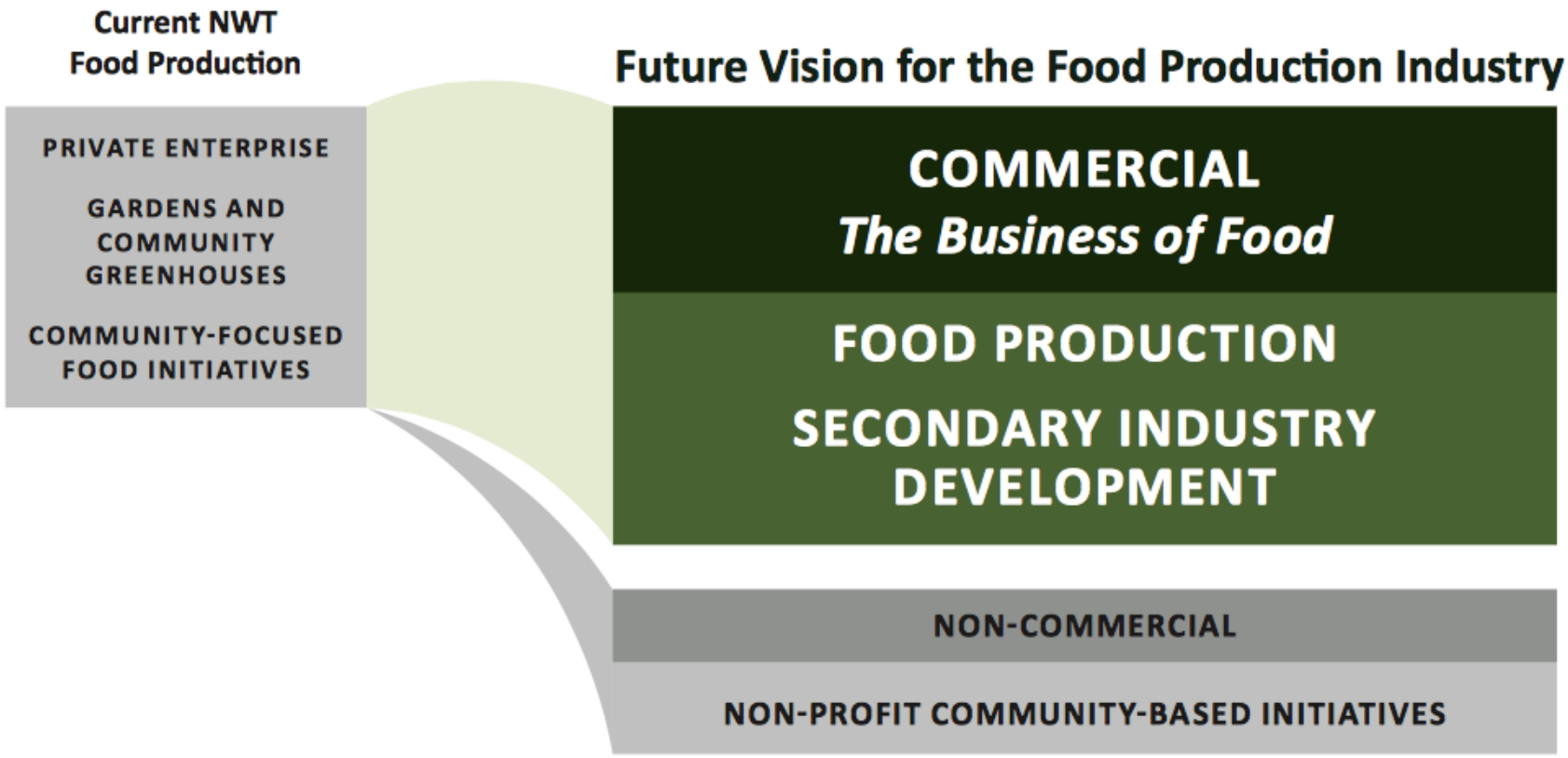


Hannah et al. in press

NORTHWEST TERRITORIES AGRICULTURE STRATEGY

The Business of Food: A Food Production Plan

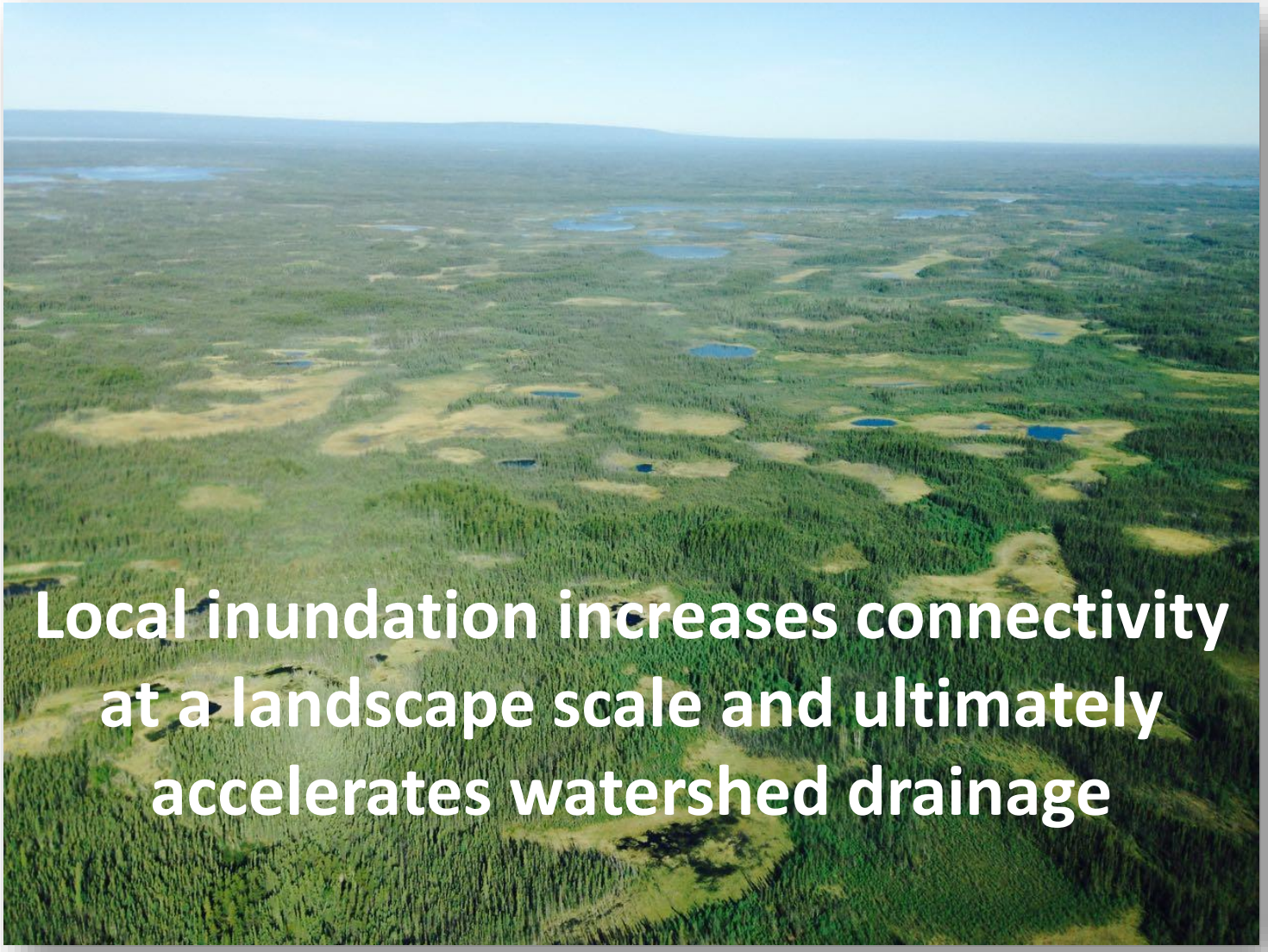
2017 – 2022



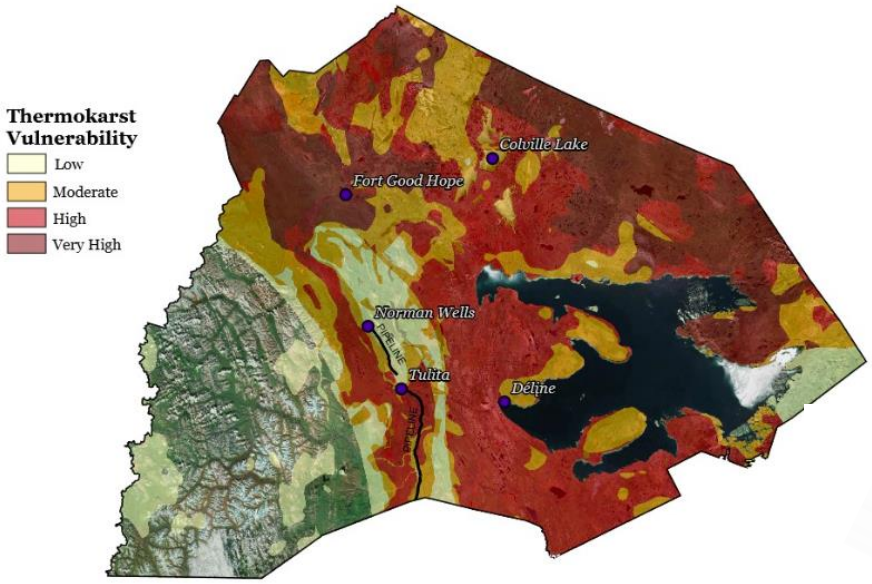
Northern agricultural futures

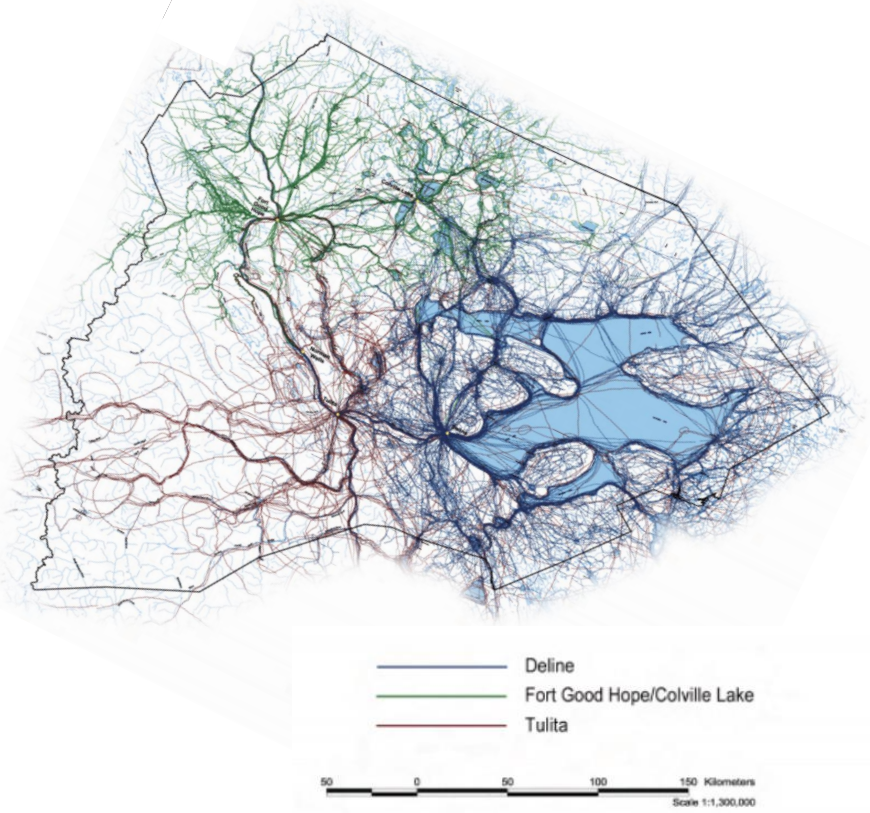
- How is northern soil fertility affected by warming, fire, & thaw?
- How does cultivation affect soil C, nutrients, & water storage?
- Can we best balance food production with boreal forest health?

How does this work inform LTER research & understanding of cross-scale feedbacks?



Regions with ice-rich permafrost historically was preferred for infrastructure and travel circuits. Now at high risk from thaw but also likely accelerates thaw.





Dene Mapping Project –Travel Routes

Thank you

NSF

NSERC CRSNG

NASA

Bonanza Creek LTER
Bonanza Creek
Long-Term Ecological Research

@queenofpeat mrt@uoguelph.ca

Sila

We are all connected through our environment, including our shared atmosphere.

Sedna © Antony Galbraith