Eighteen years of ecological monitoring reveals multiple lines of evidence for tundra vegetation change

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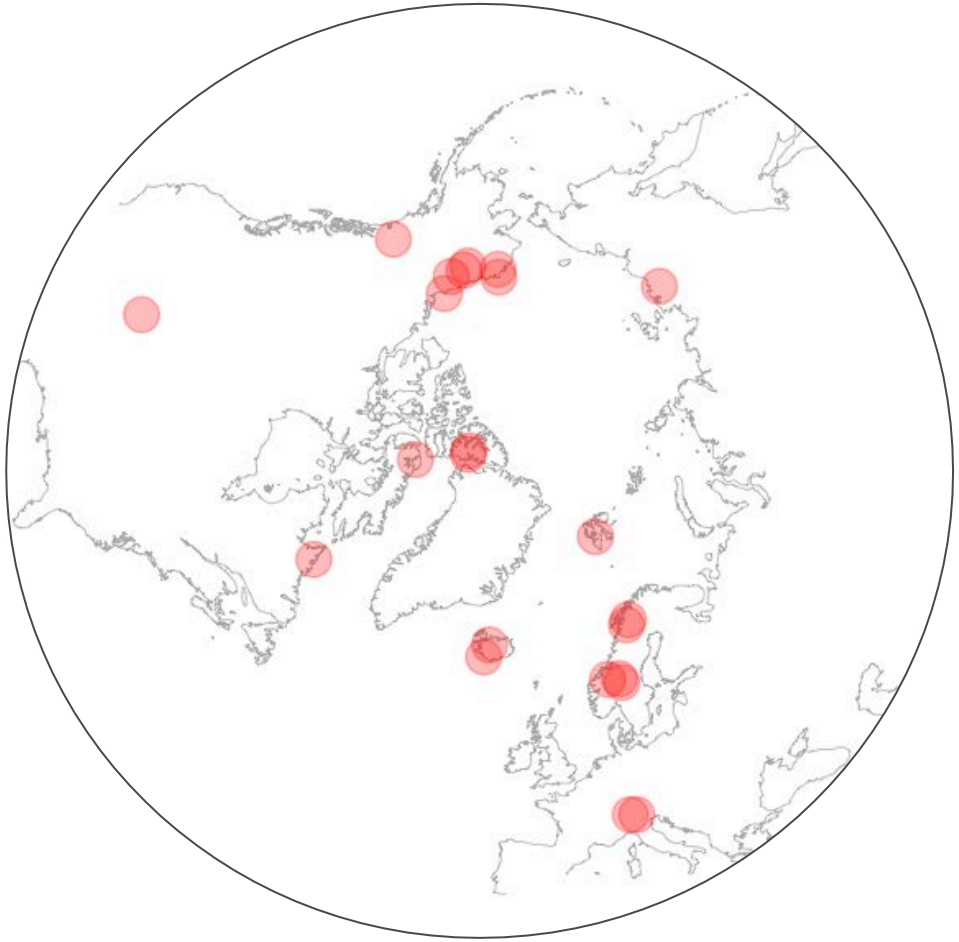
Research questions

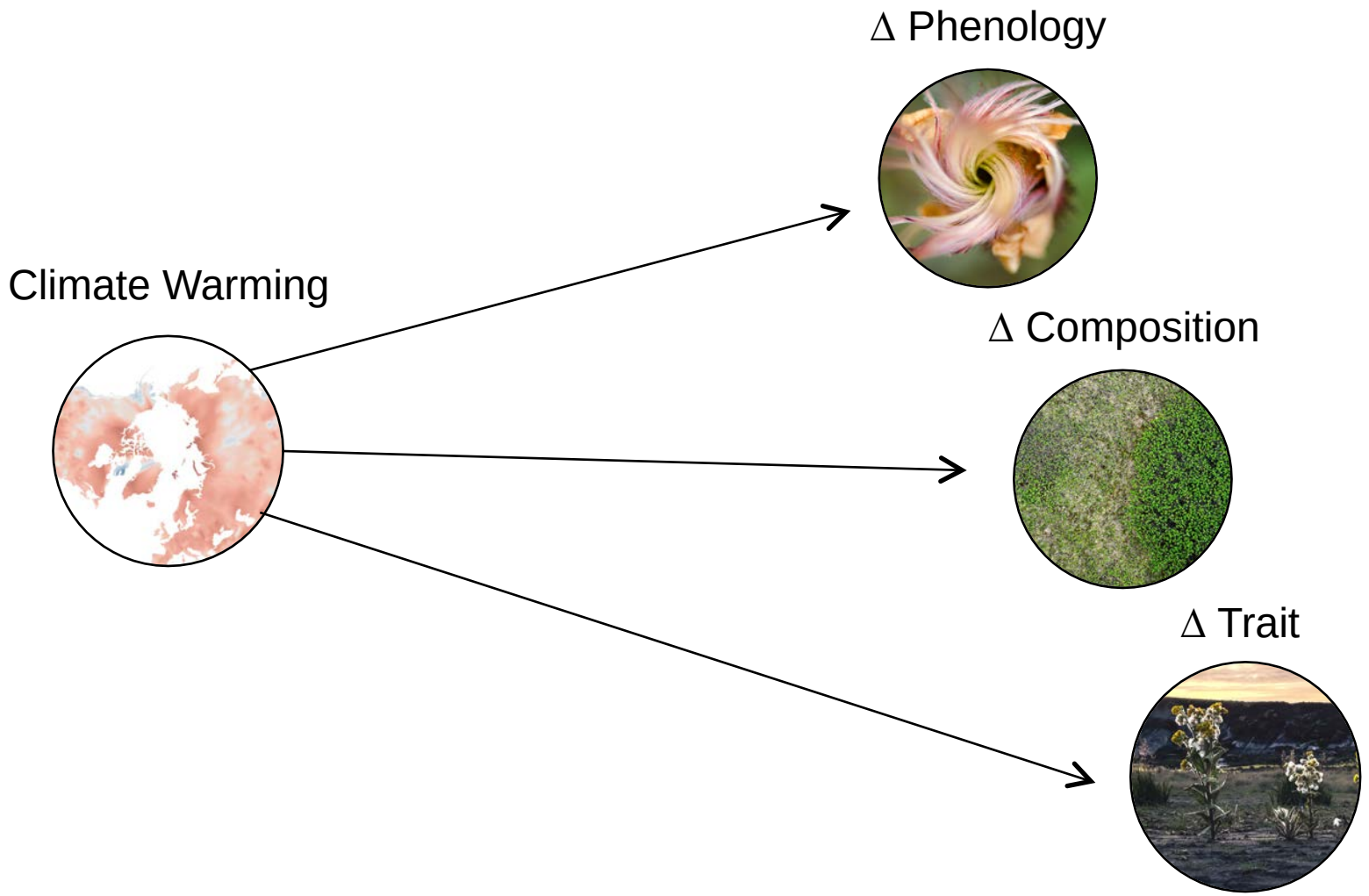
? How are tundra ecosystems changing?

? What are the drivers of tundra change?

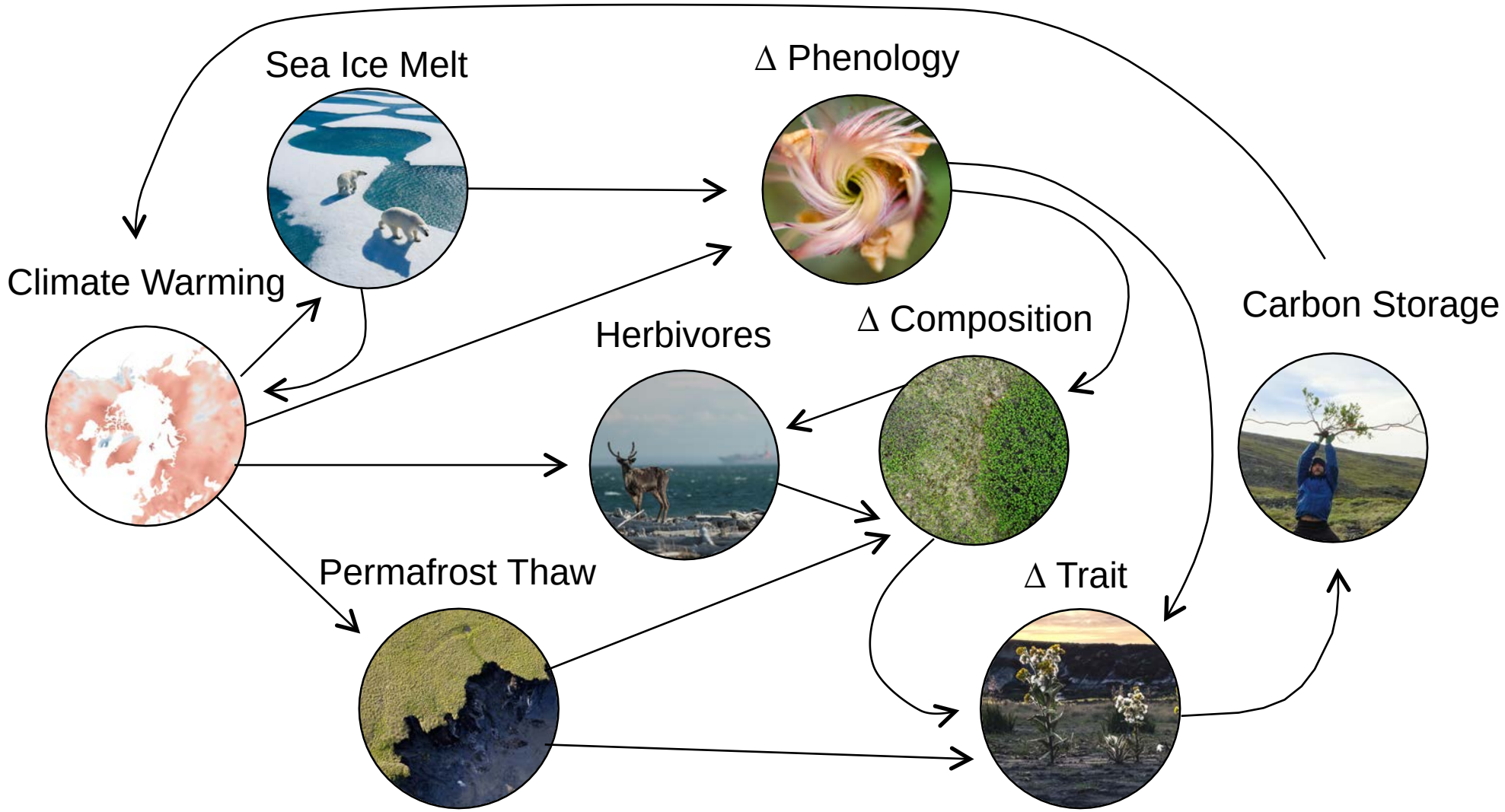
ITEX plant cover sites:



Simplicity: attribution of vegetation change to climate

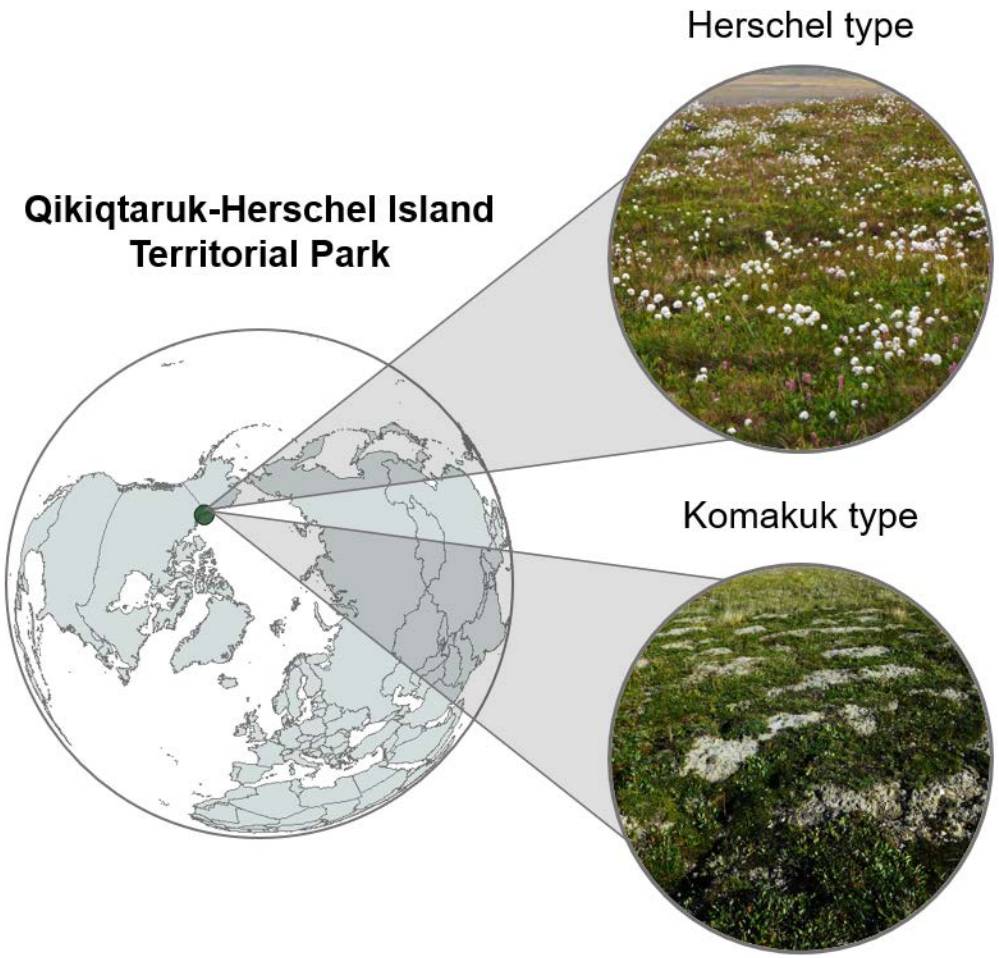


Complexity: direct versus indirect mechanisms



What is special about Qikiqtaruk-Herschel Island?

1999



Sandra Angers-Blondin

Indicators of change

SHRUB COVER

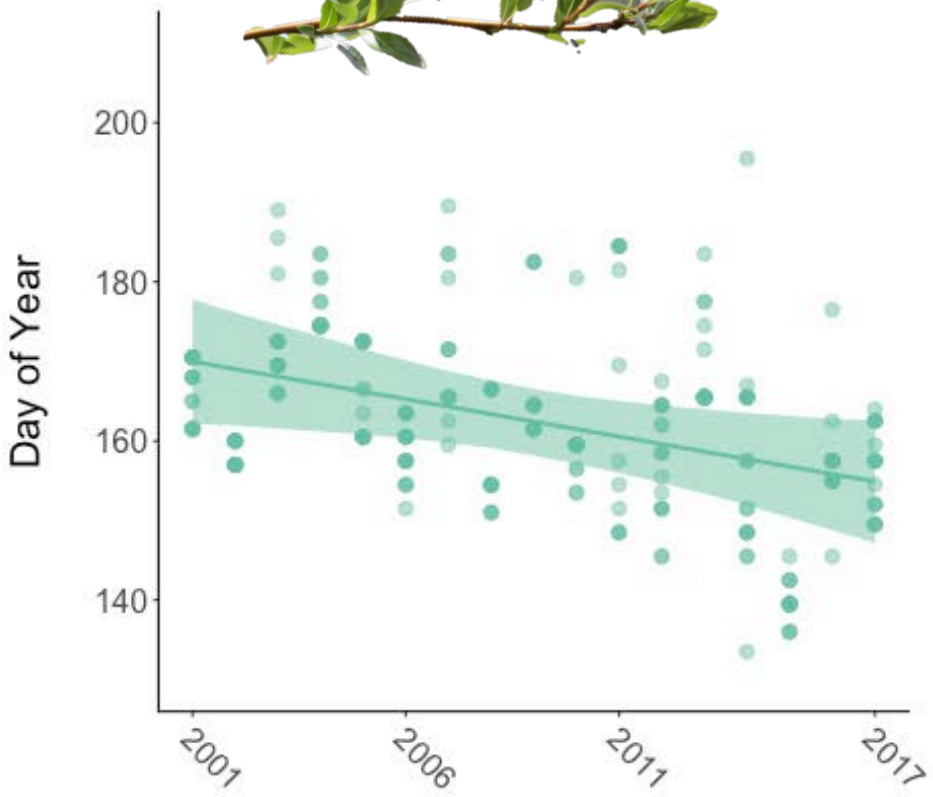
COMMUNITY COMPOSITION

PHENOLOGY

ACTIVE LAYER DEPTH

Elmendorf *et al.* 2012, Myers-Smith *et al.* 2015, Post *et al.* 2009, Burn and Zhang 2009

What have we found out so far?



Nine day per decade advance of *Salix arctica* leaf out

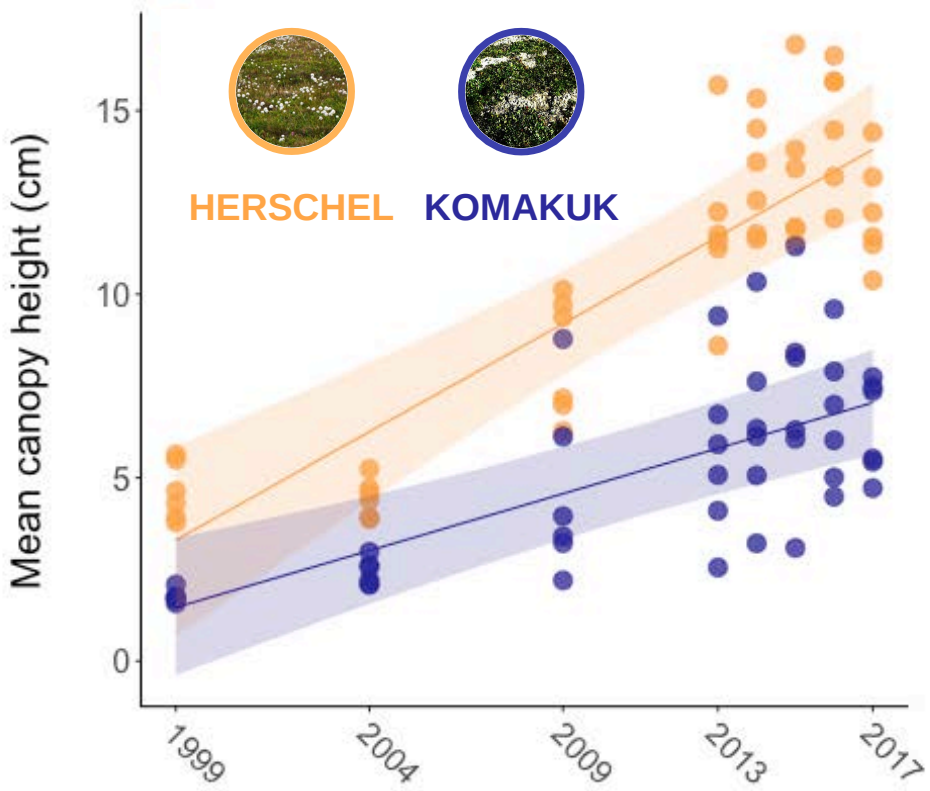
1987

2017

Myers-Smith *et al.*, submitted

What have we found out so far?

Mean canopy height



Myers-Smith *et al.*, submitted

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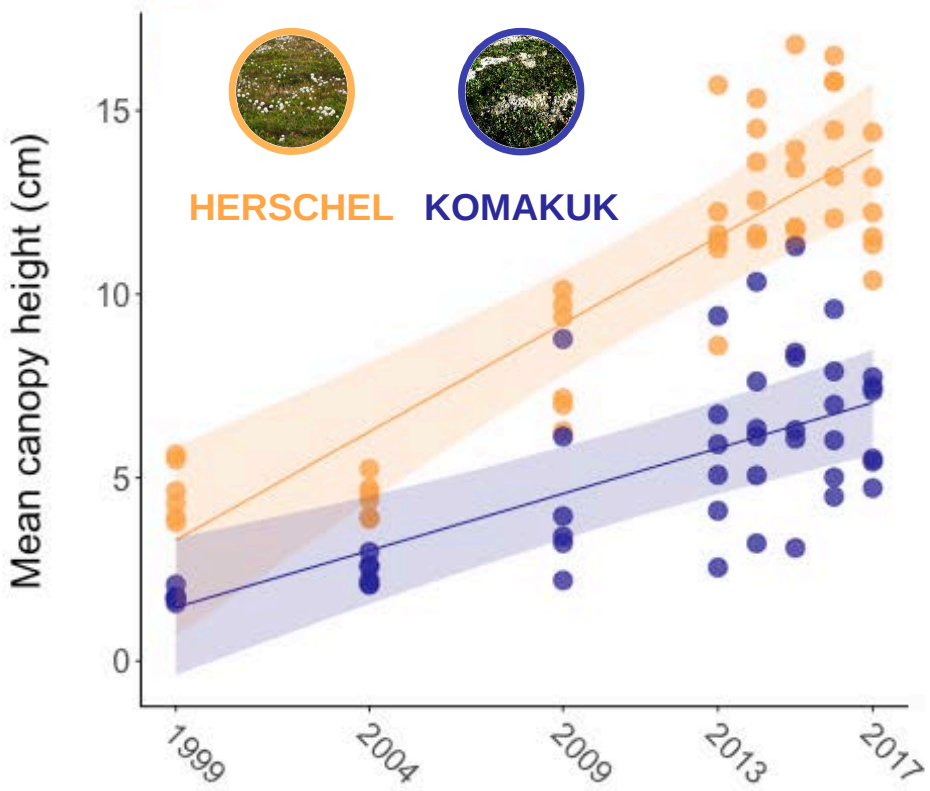
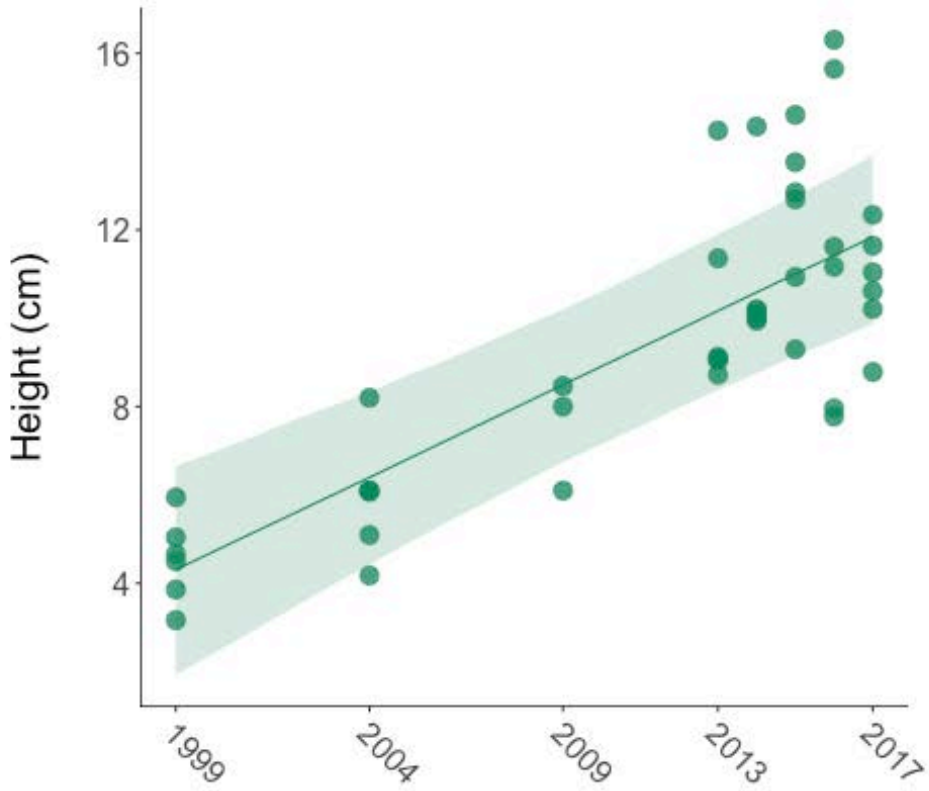


Salix pulchra canopy height



Myers-Smith *et al.*, submitted

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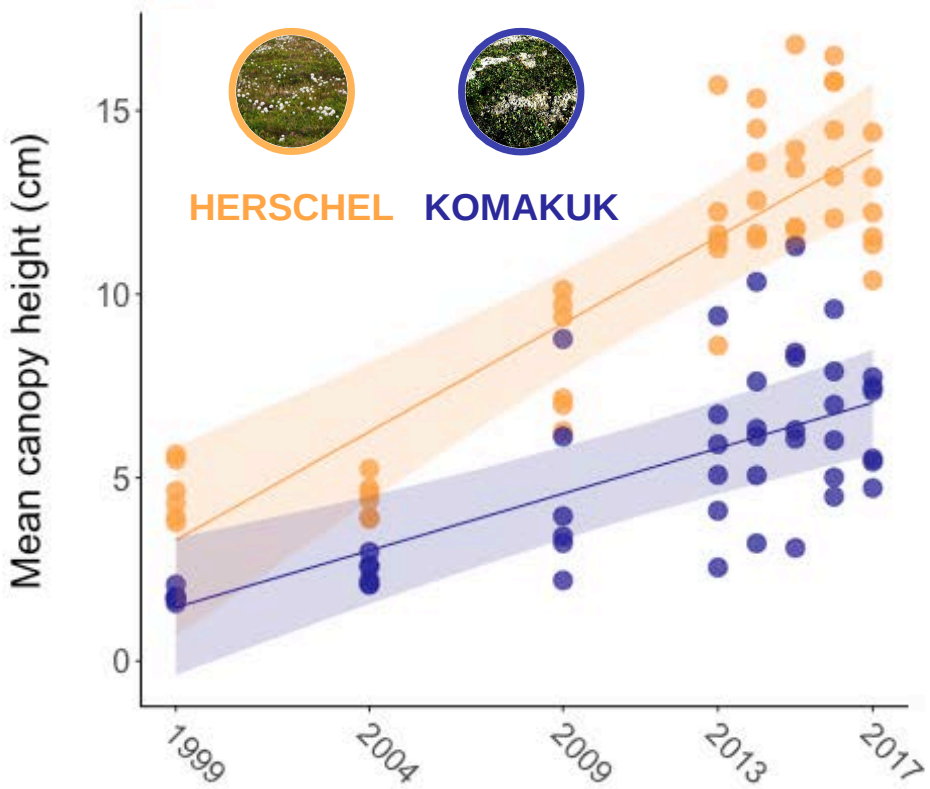
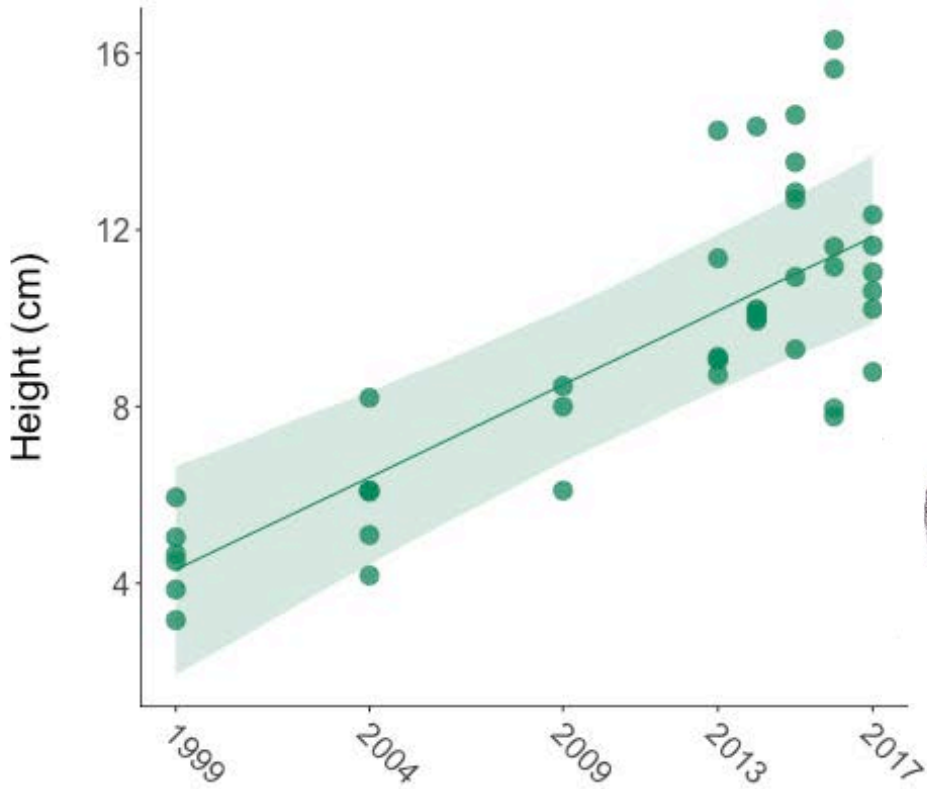


Salix pulchra canopy height



Myers-Smith *et al.*, submitted

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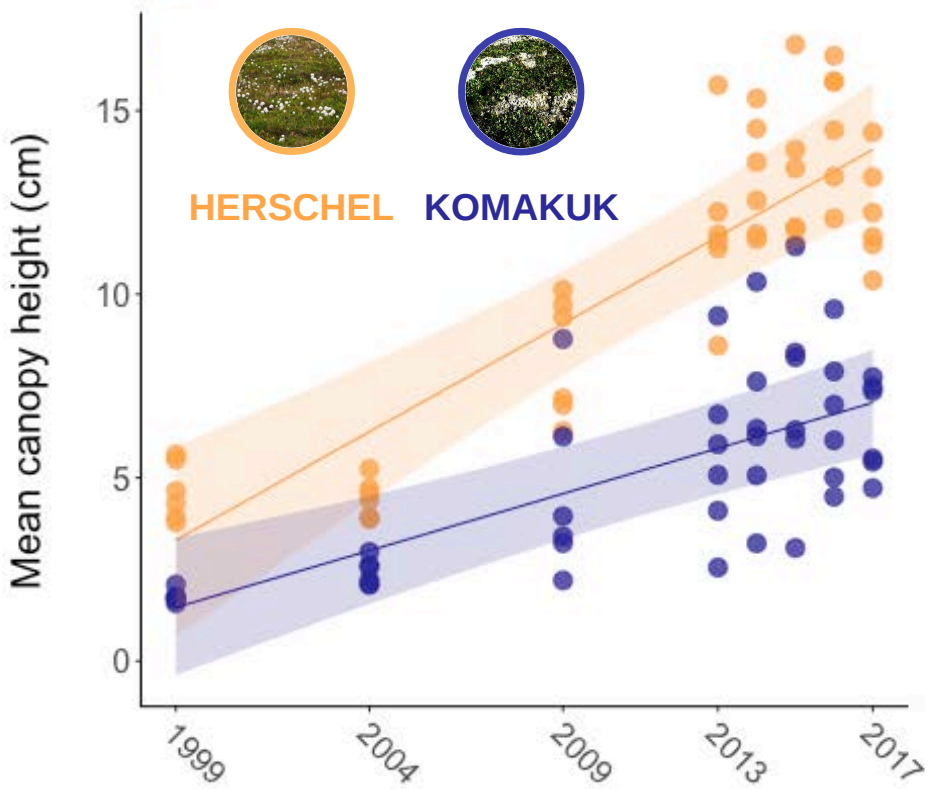
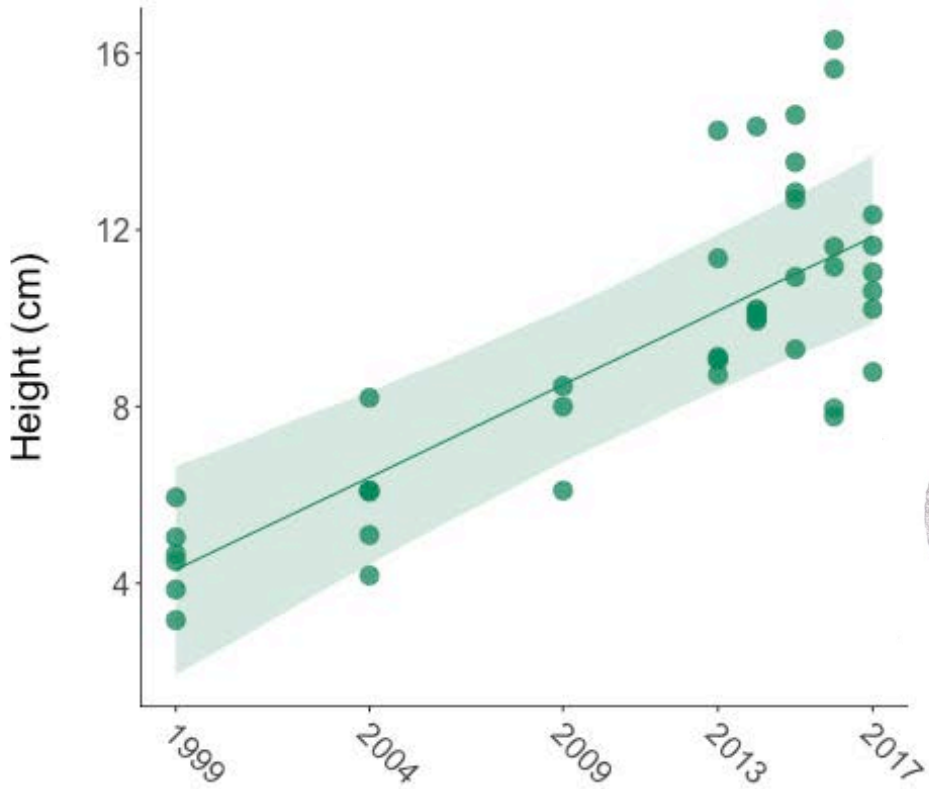


Salix pulchra canopy height



Myers-Smith *et al.*, submitted

What have we found out so far?

MONITORING

Local collaboration

ITEX protocols

VEGETATION CHANGE

Phenology advances

Increase in canopy height

Shifts in community composition

ATTRIBUTION

Growing season length

Active layer deepening

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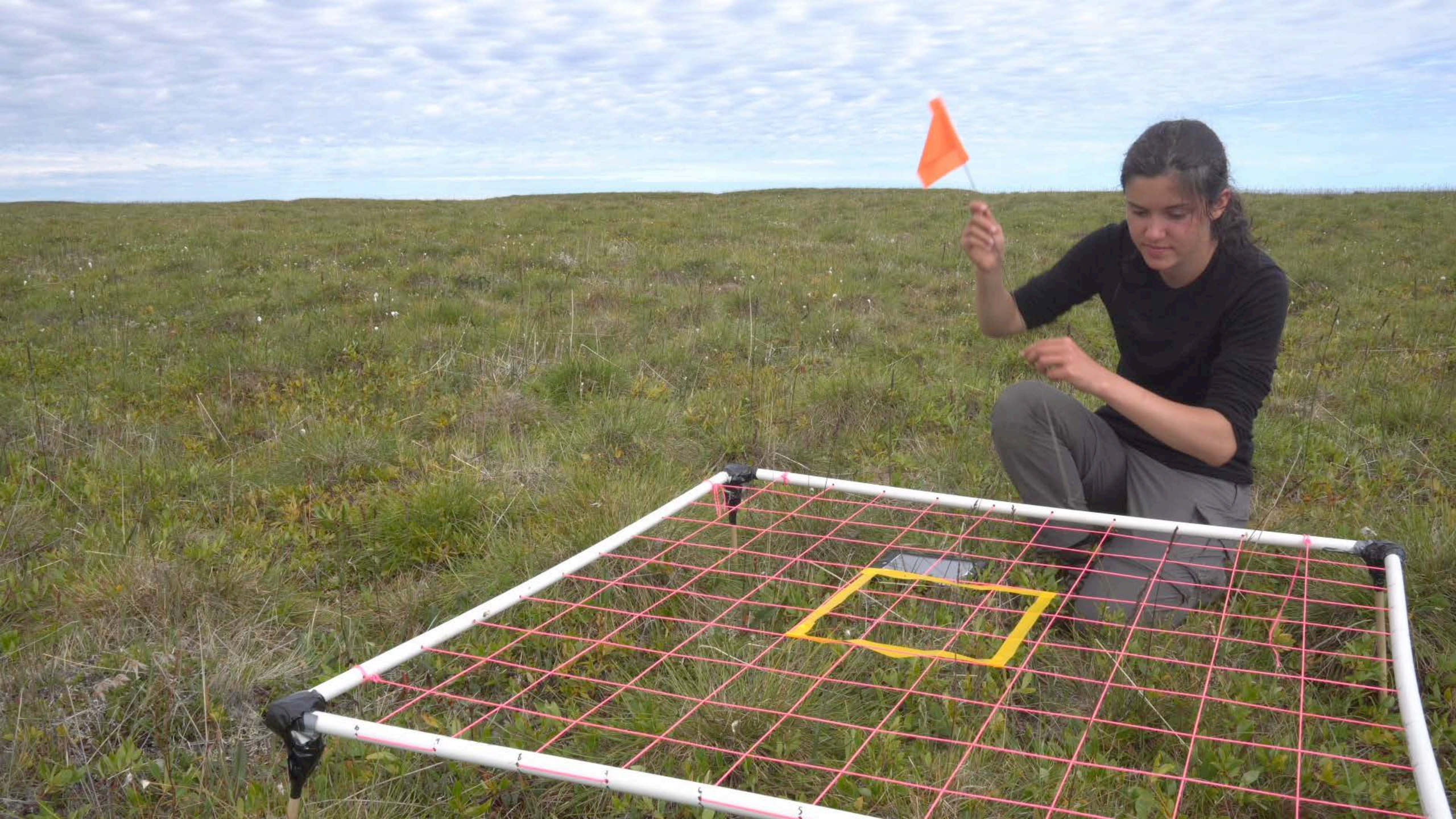
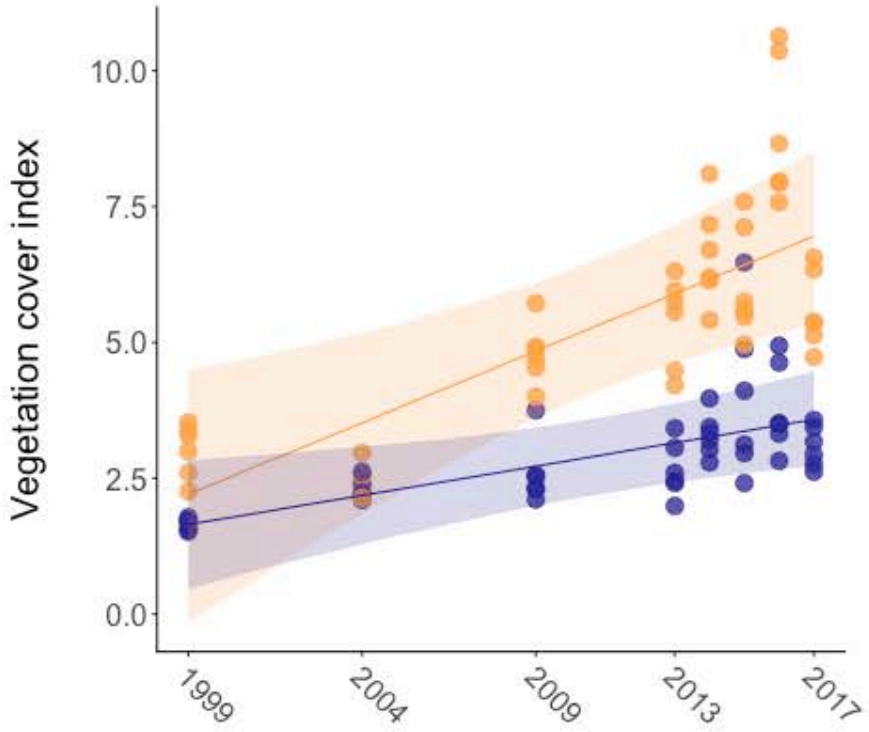


How is tundra vegetation changing?

Vegetation cover



HERSCHEL

KOMAKUK

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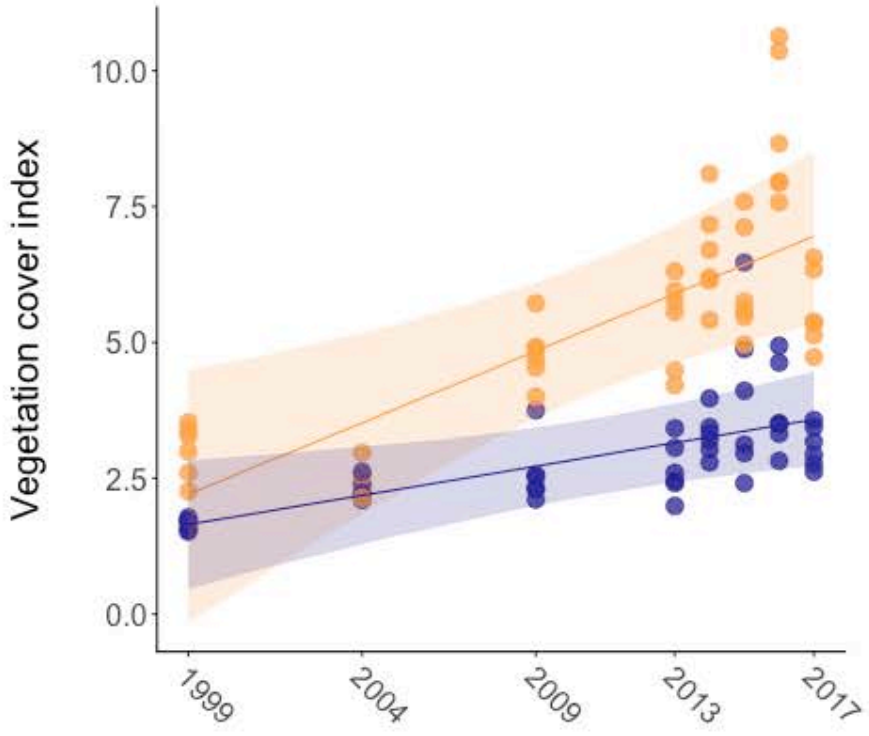
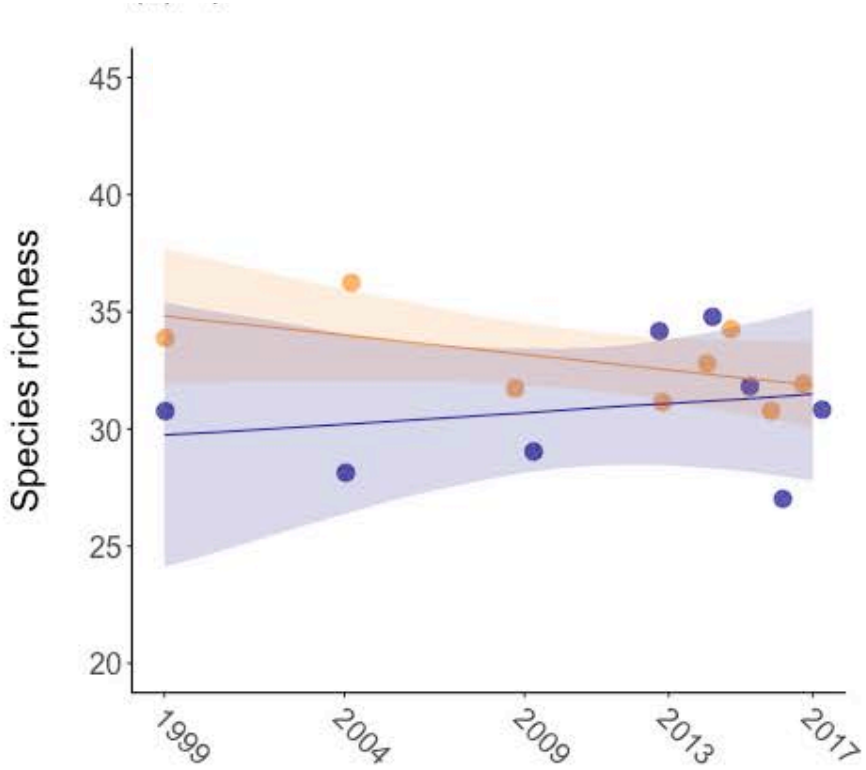


Species richness



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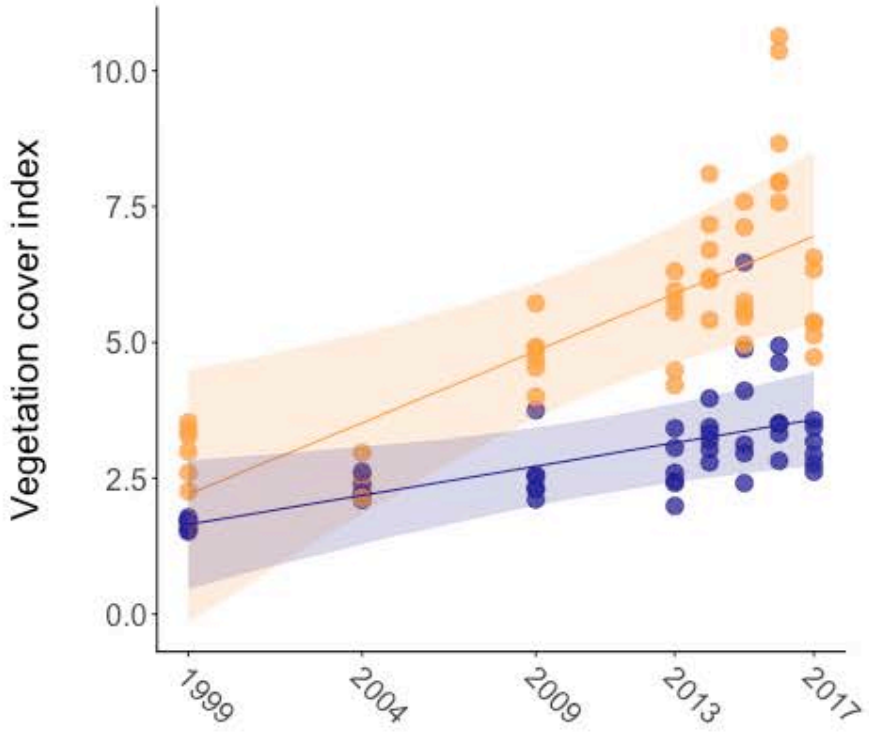

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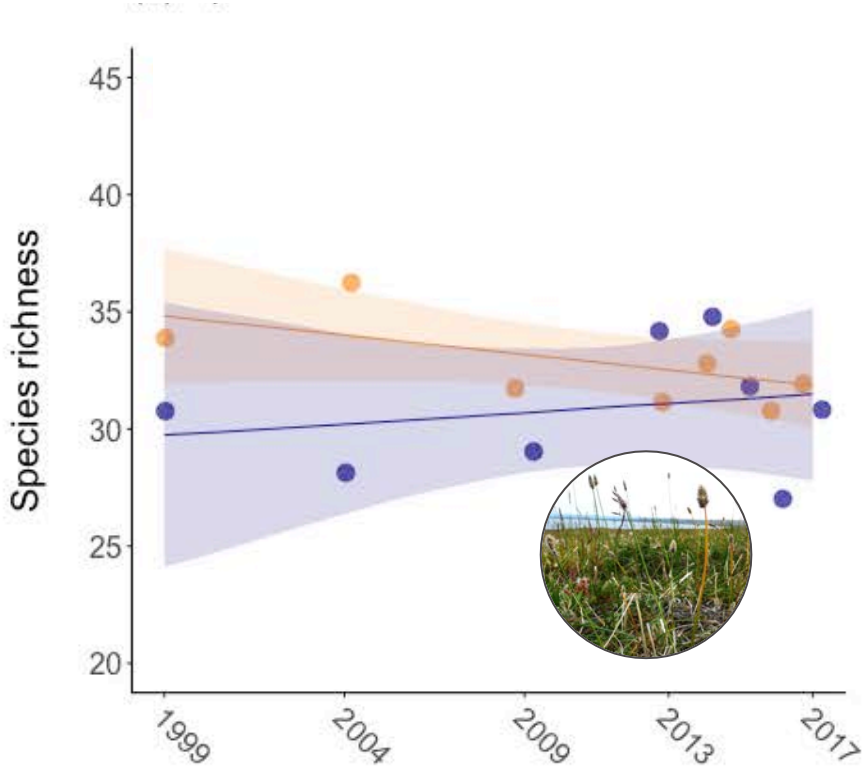

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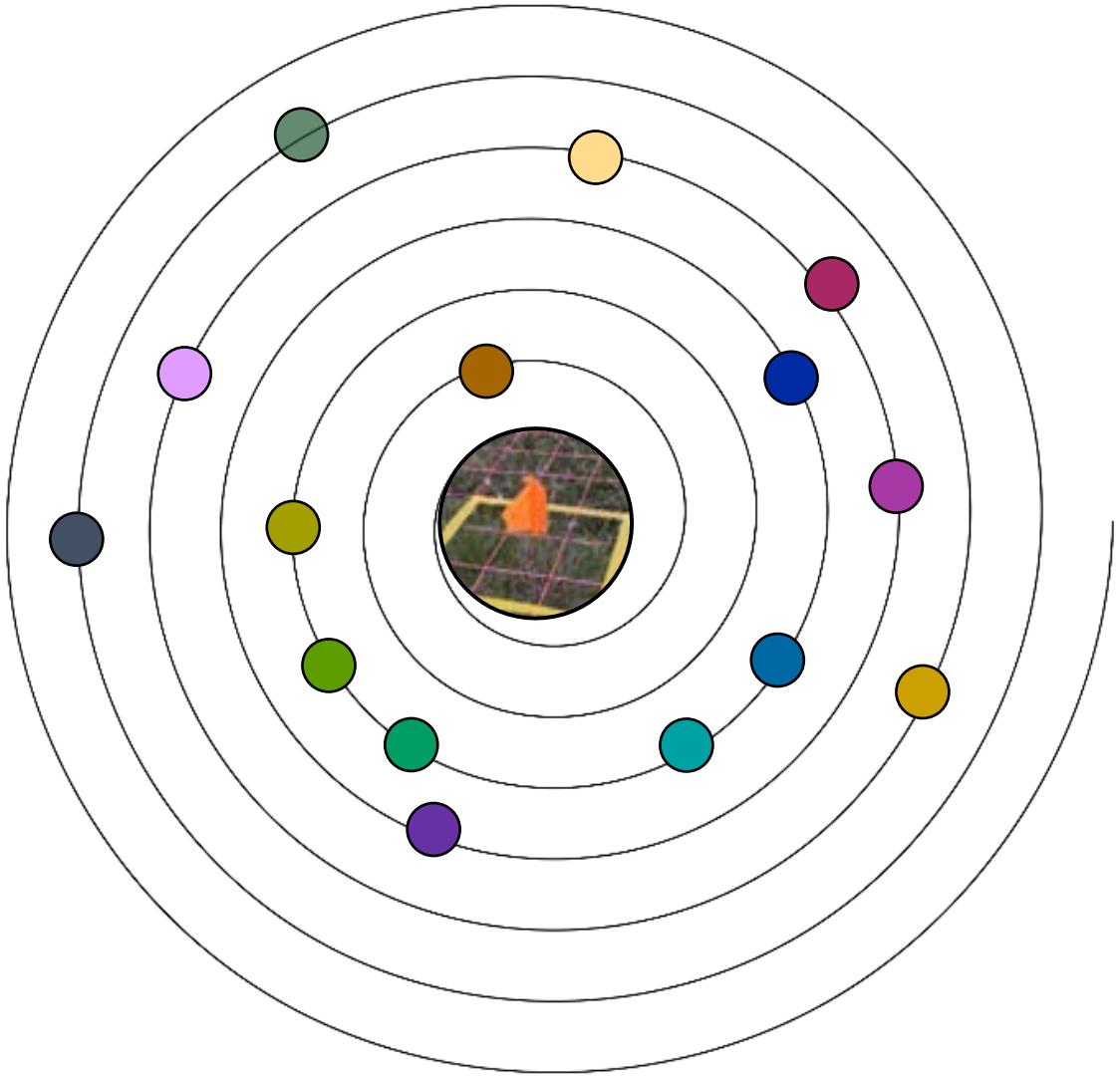
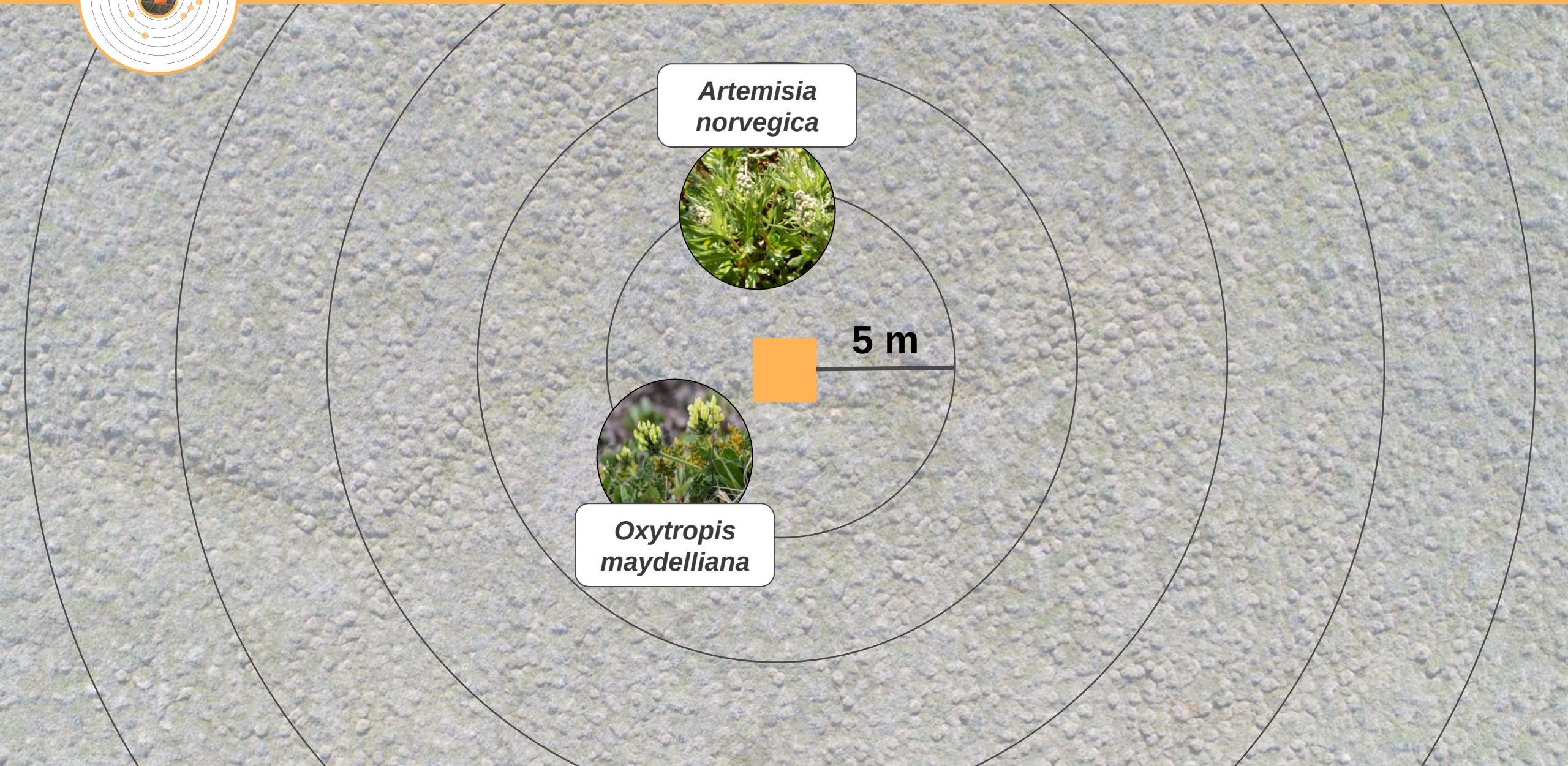
SPECIES POOL MONITORING



Saxifraga hirculus

Species pool – Herschel vegetation

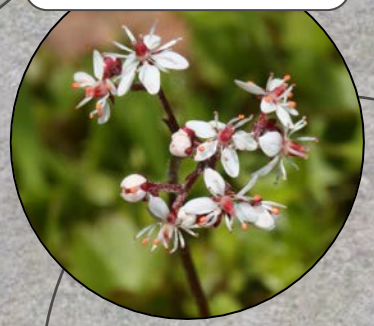
Species pool – Herschel vegetation



Species pool – Komakuk vegetation

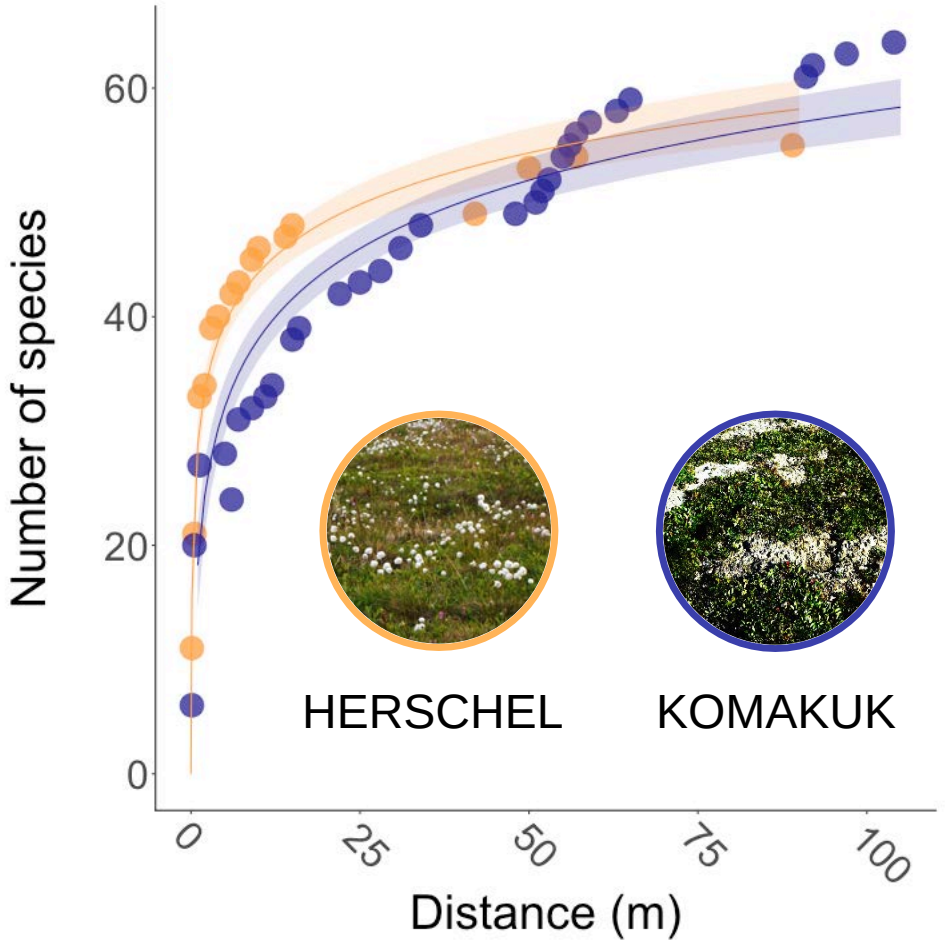
Species pool – Komakuk vegetation

Saxifraga nelsoniana



5 m

Parrya nudicaulis



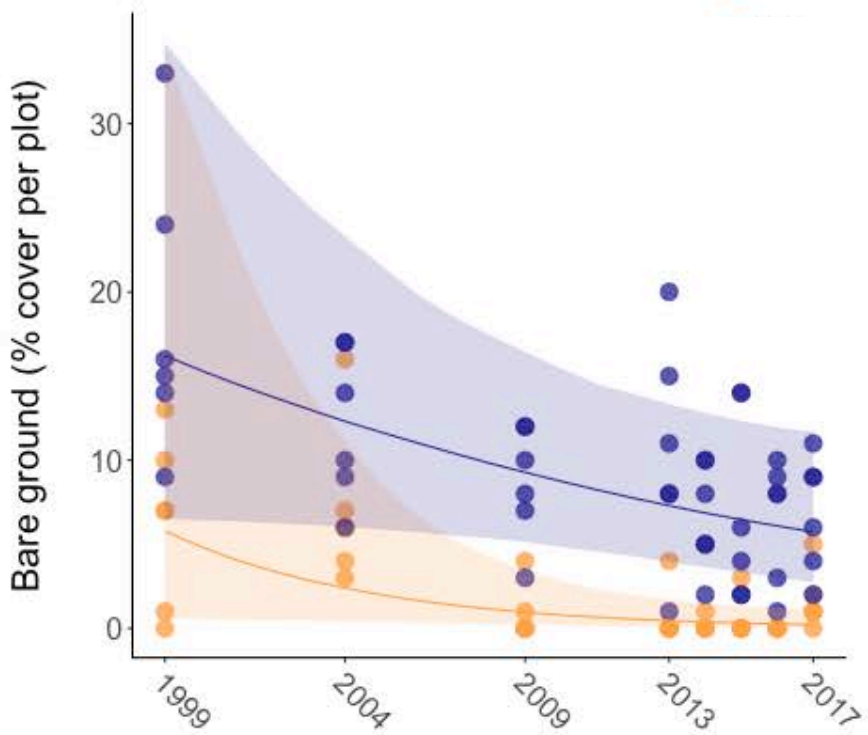
Species that have not yet been observed in the long-term monitoring plots:

13 WITHIN 100 M OF THE HERSCHEL PLOTS

26 WITHIN 100 M OF THE KOMAKUK PLOTS

How is the environment changing?

Bare ground

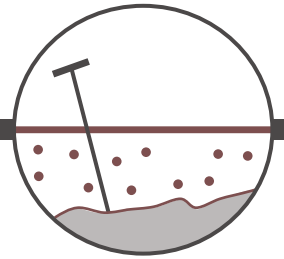


HERSCHEL

KOMAKUK

ACTIVE LAYER MONITORING

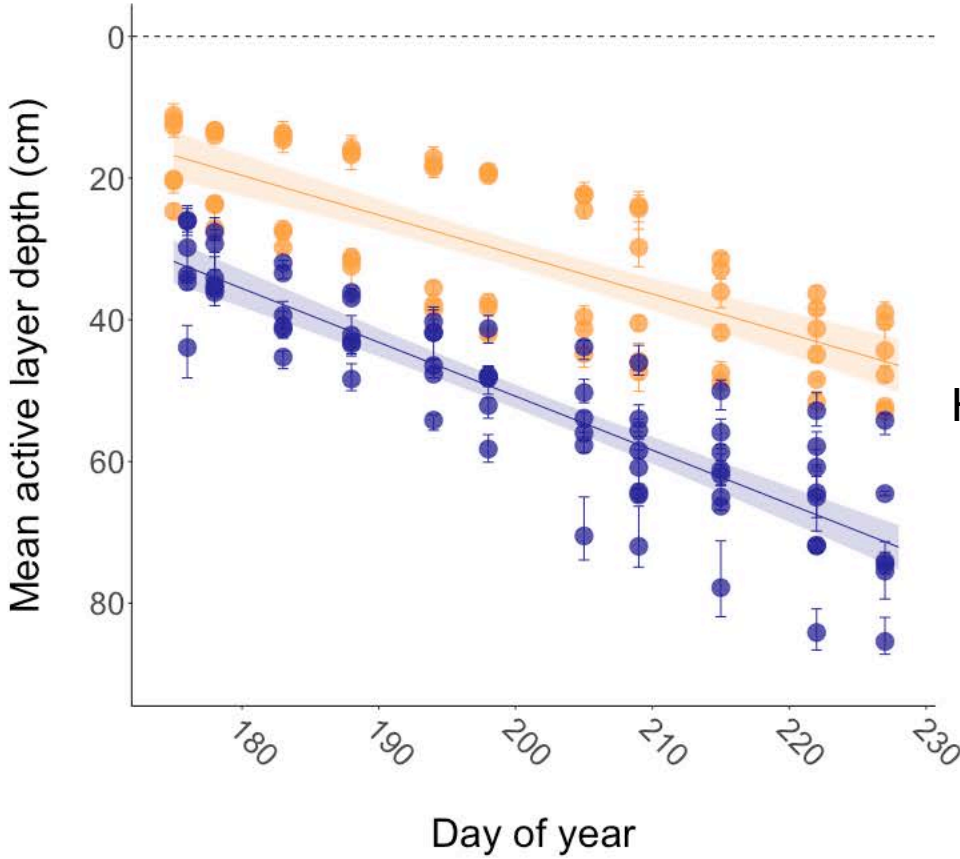
Jeff Kerby



Active layer depth across the 2017 season

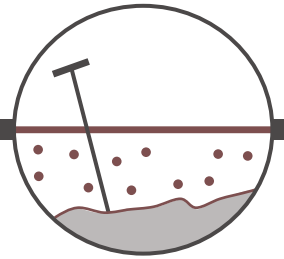
- **Herschel – max 58.5 cm**
- **Komakuk – max 87.2 cm**

Might need a longer probe soon!



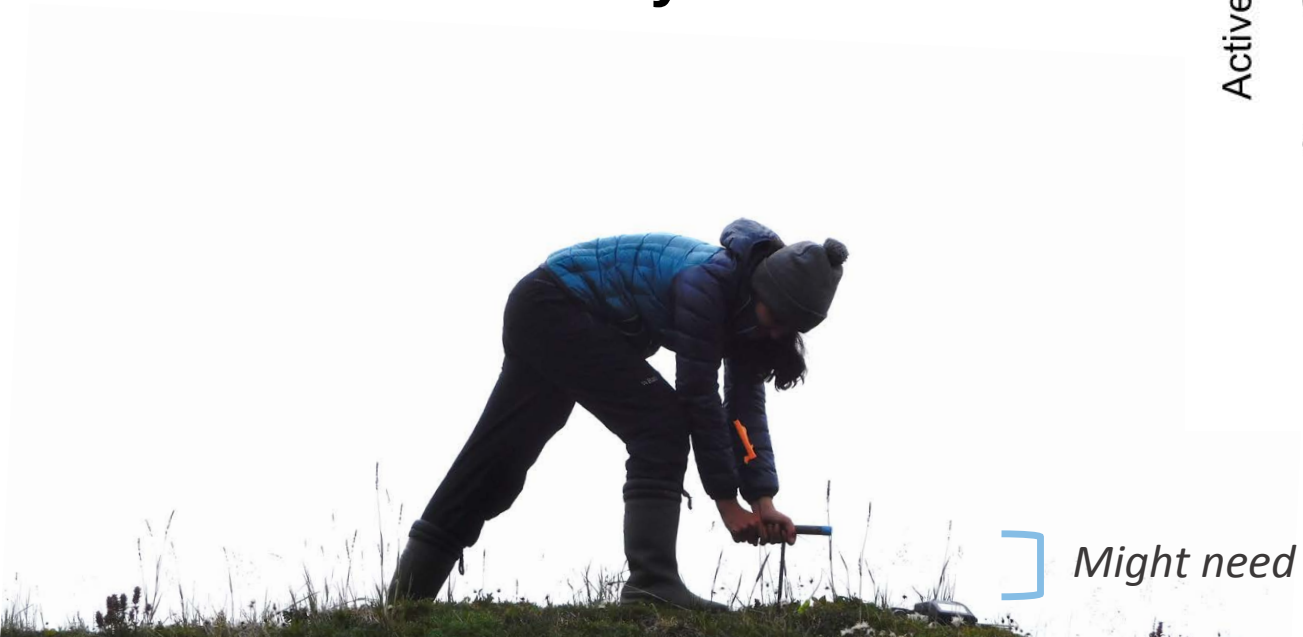
HERSCHEL

KOMAKUK



Active layer depth across years

Mean increase in active layer depth by as much as **20 cm over 20 years**



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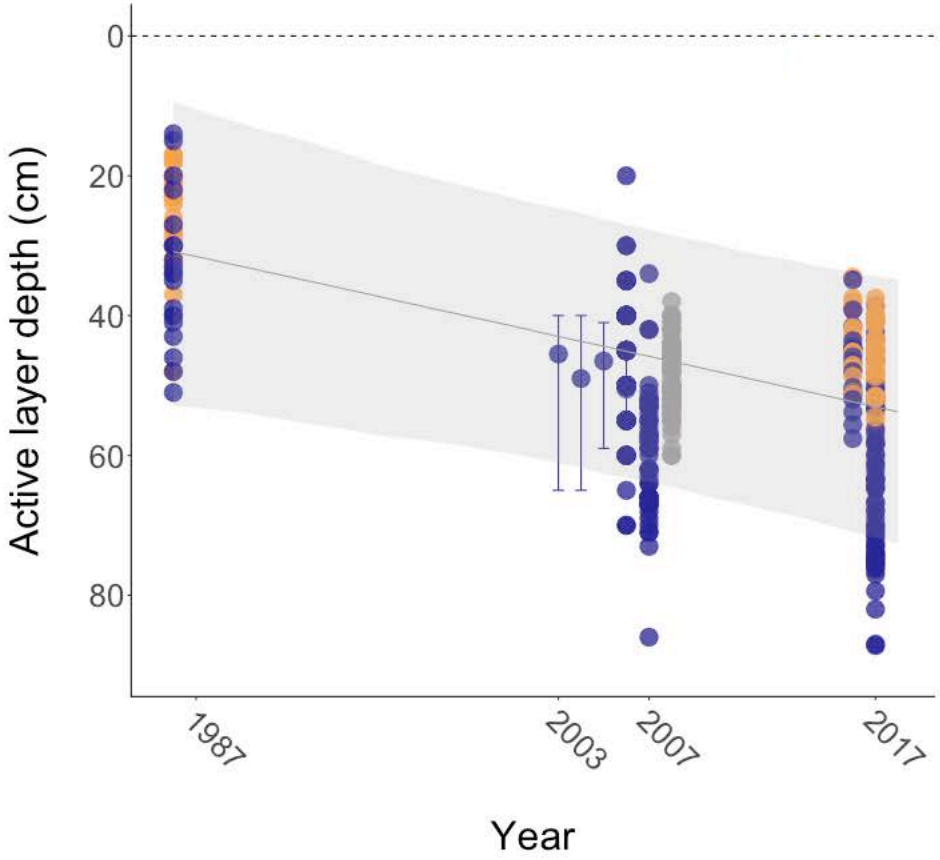


HERSCHEL

KOMAKUK

Smith et al. 1989, Burn and Zhang 2009, ArcticWOLVES project & Myers-Smith *et al.*, submitted

What’s next?

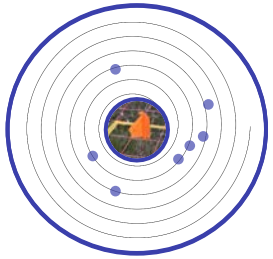
? Where are the potential sources of new species?

? How do diversity patterns vary across landscapes?

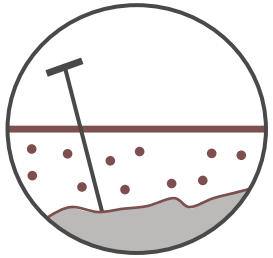
H Species-accumulation curves are steeper in more homogeneous landscapes.

SUMMARY

Advancing phenology, increases in shrub cover and canopy height



Species pool and future invasions might further alter biodiversity patterns



Almost doubling of the active layer depth in the last 20 years