

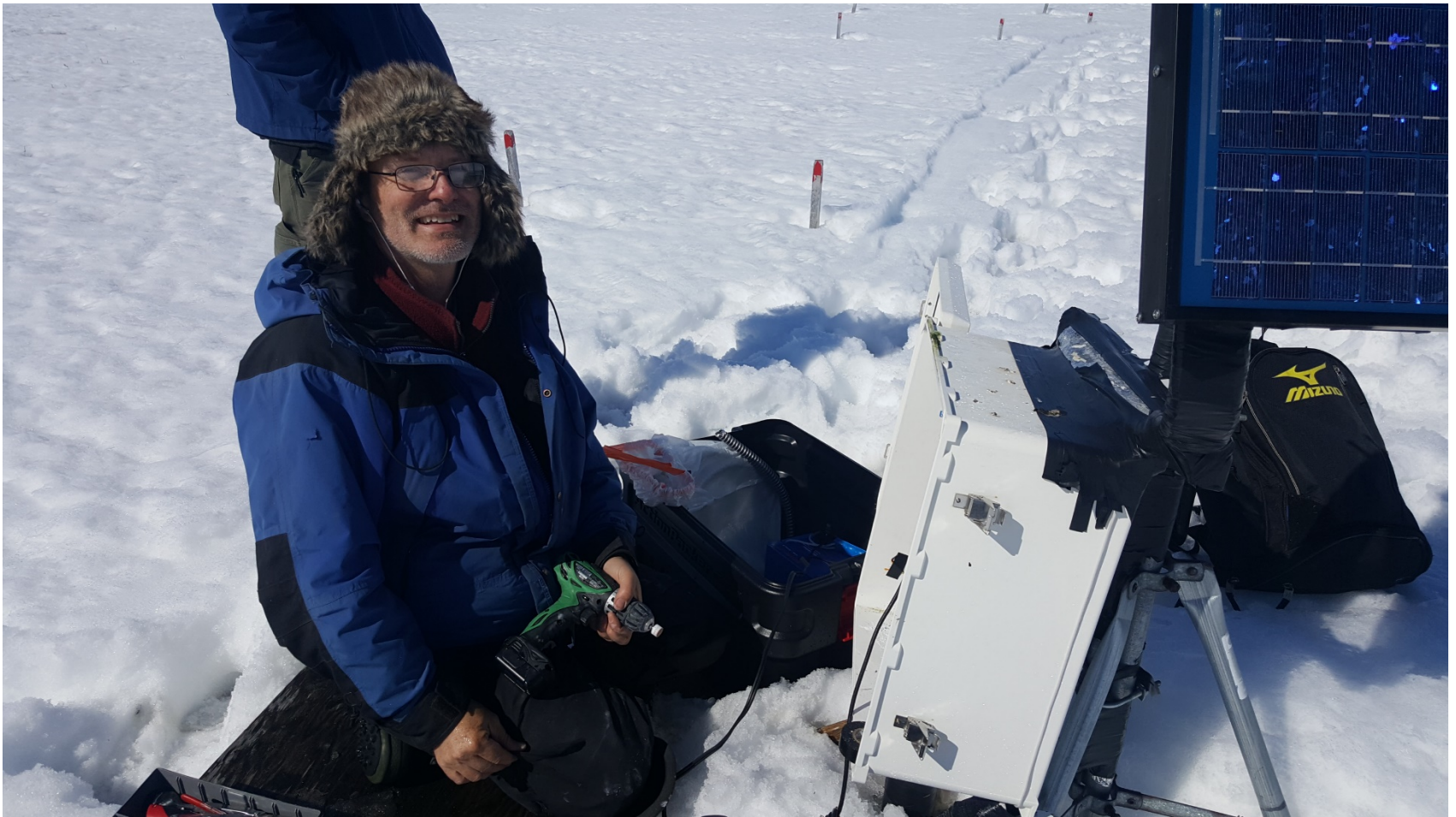
The International Tundra Experiment (ITEX)

Arctic Ecology Program
Grand Valley State
University

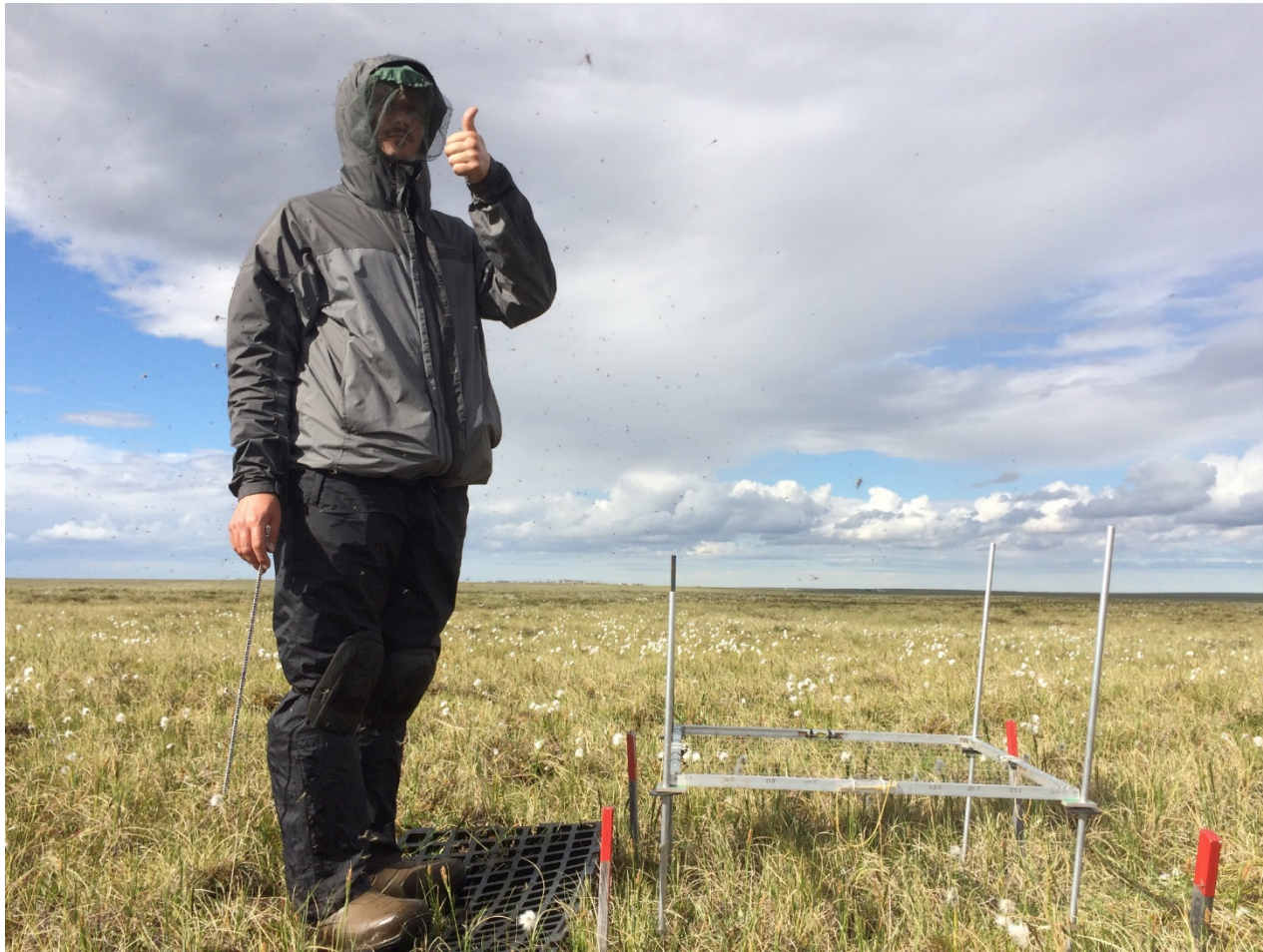


Grand Valley Researchers

Bob Hollister, PhD: Principle Investigator



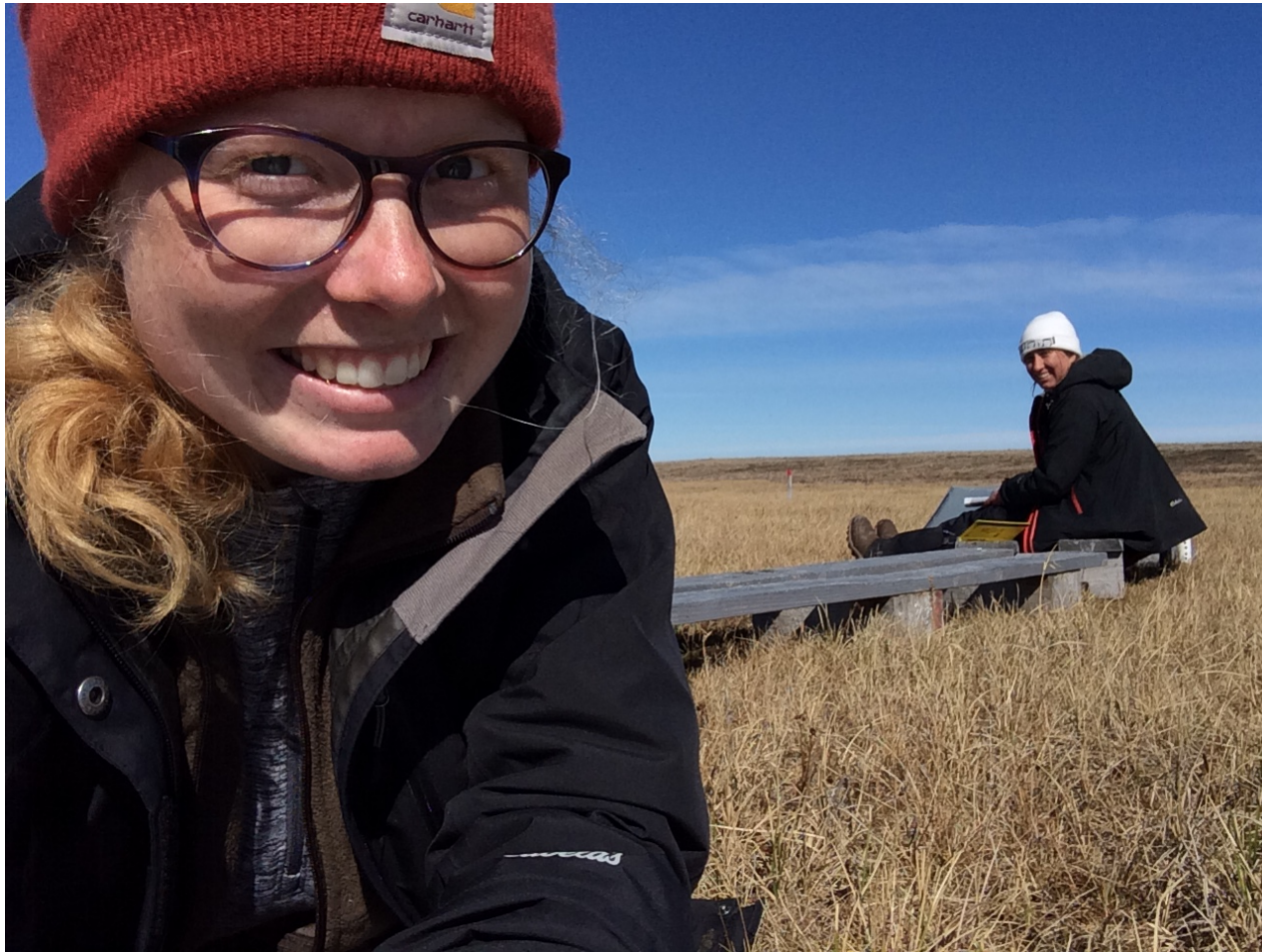
Jacob Harris: graduate student



Katlyn Betway: Undergraduate Researcher



Hana Christoffersen: Undergraduate Researcher



Kailey Keenan-Whittemore: Undergraduate Researcher



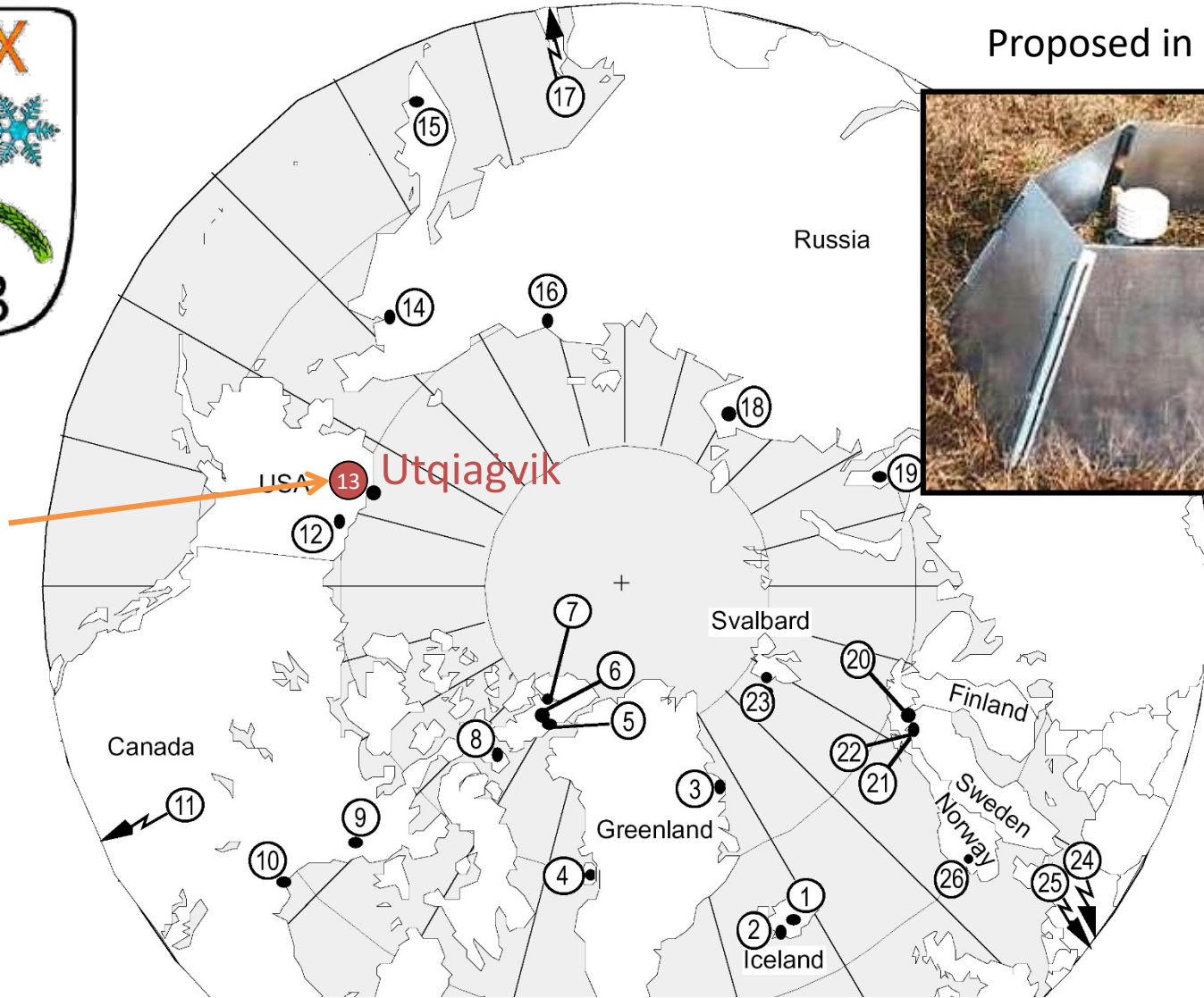
Brief Project History



Proposed in 1990



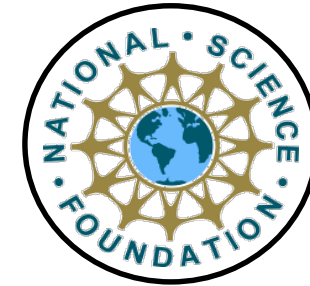
1994
2007



The original **I**nternational **T**undra **E**xperiment sites
*agreed on a common warming manipulation
to simulate climate change*

Part of the

Beginning in 2009



Arctic Observatory Network

Collaborative Research: Sustaining and amplifying the ITEX AON through automation and increased interdisciplinarity of observations

Funding: National Science Foundation

Collaborators: FIU, Florida International University
UTEP, University of Texas at El Paso
UAA, University of Alaska at Anchorage

Research Sites



Dry Heath



Wet Meadow

Atqasuk

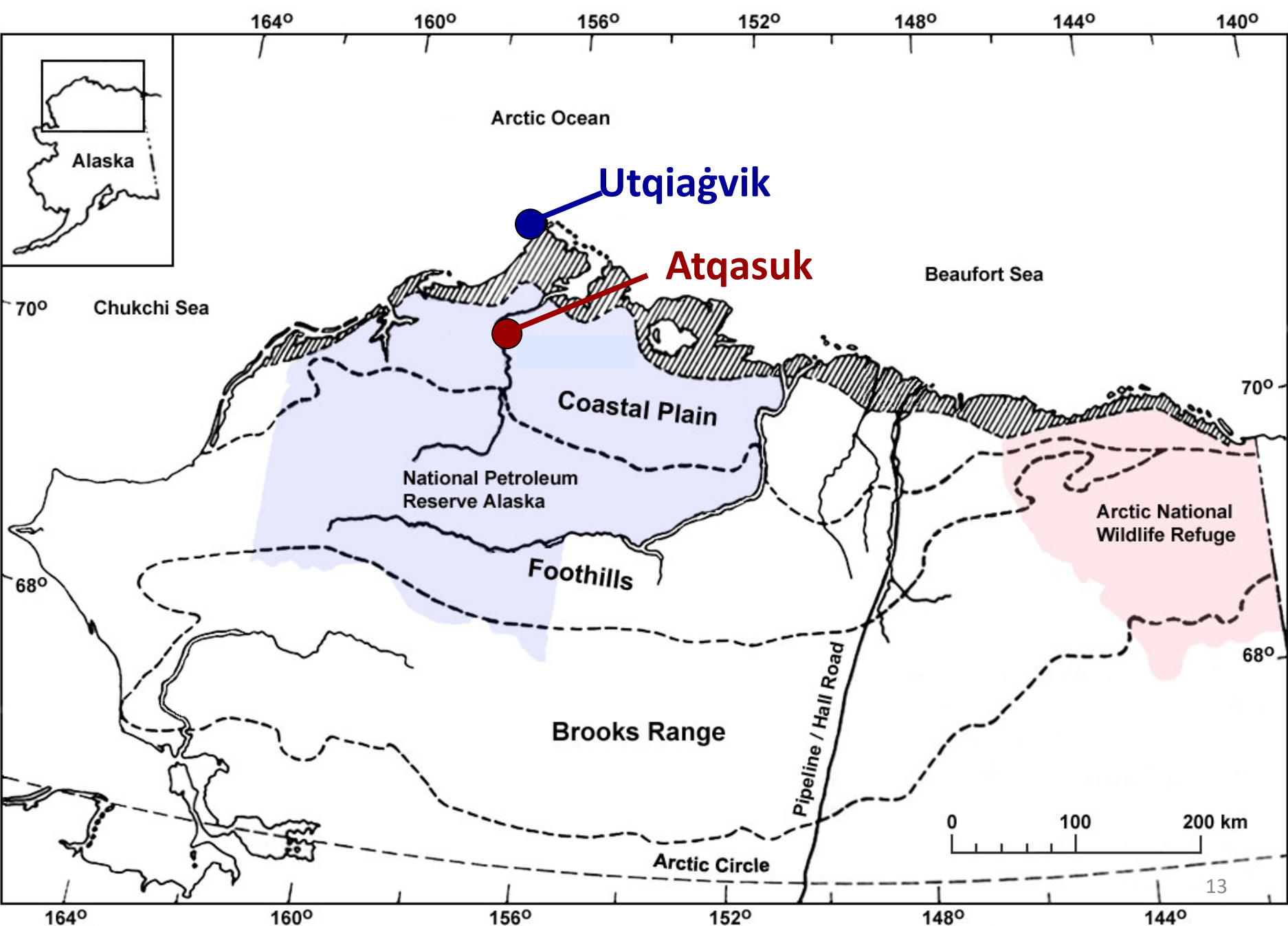


Dry Heath



Wet Meadow

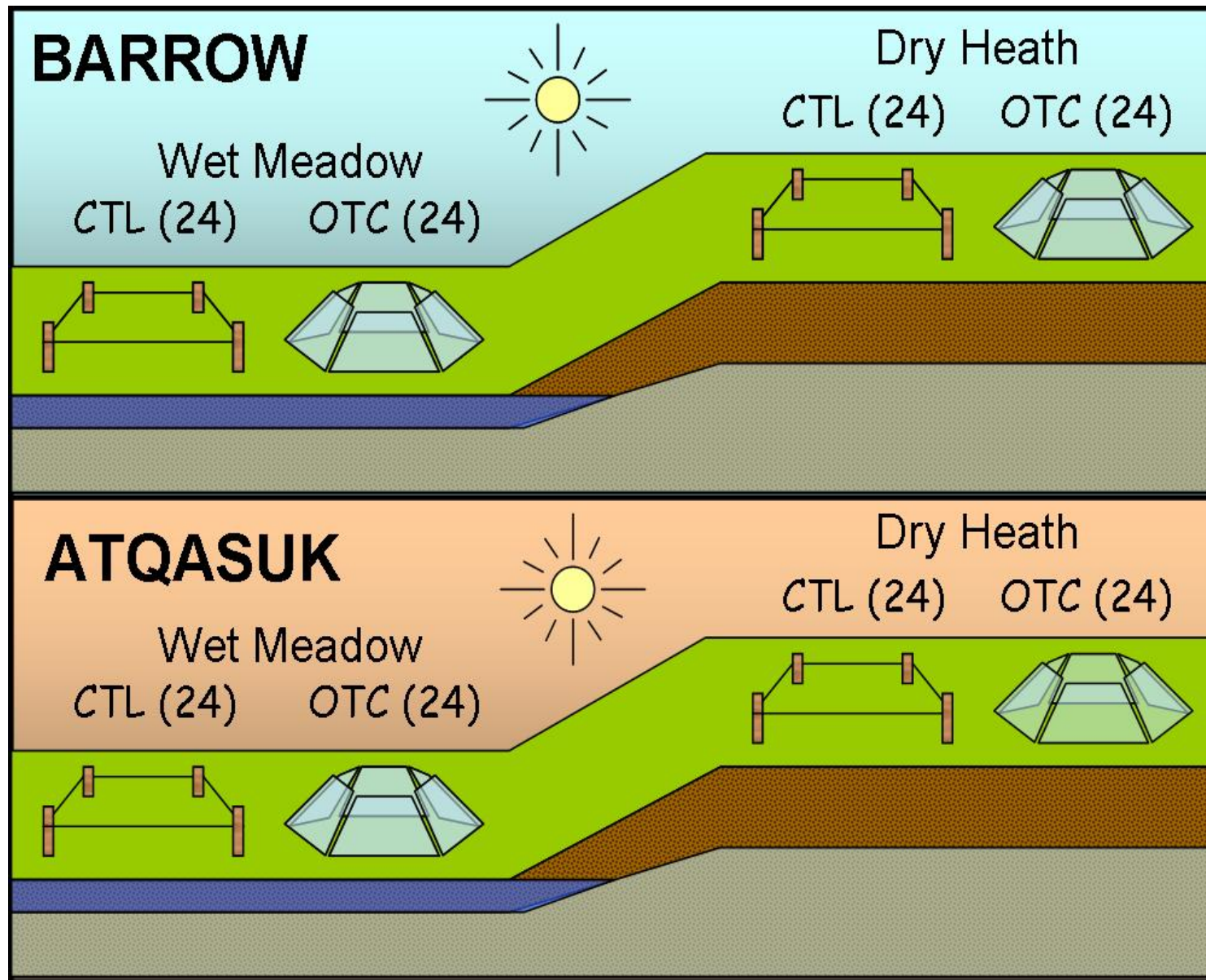
Utqiagvik



Open Top Chambers (OTC's) effectively warm by $\sim 2^{\circ}\text{C}$

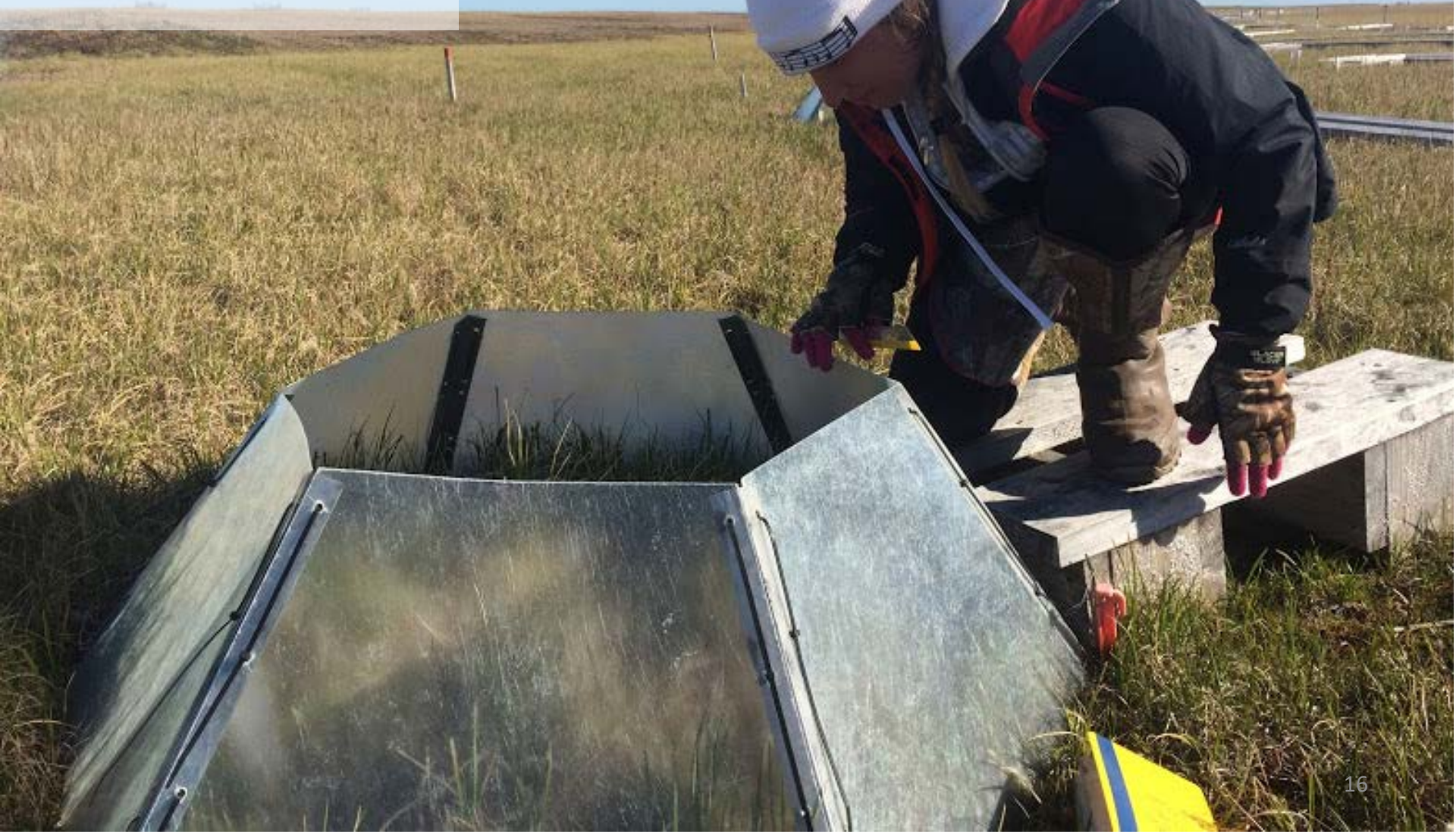


Experimental Design



Plant traits

- Plant phenology
- Plant growth
- Plant reproduction



Community composition

- Plant cover
- Canopy height
- Species diversity



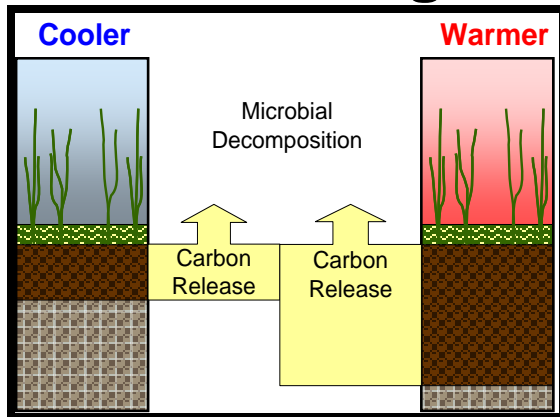
Why Plants are important



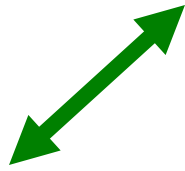
Why Plants are important



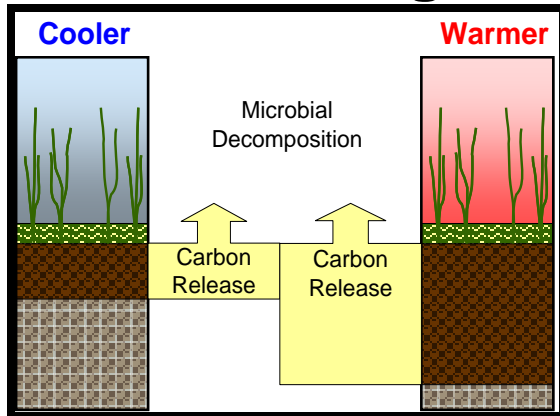
Carbon Budget



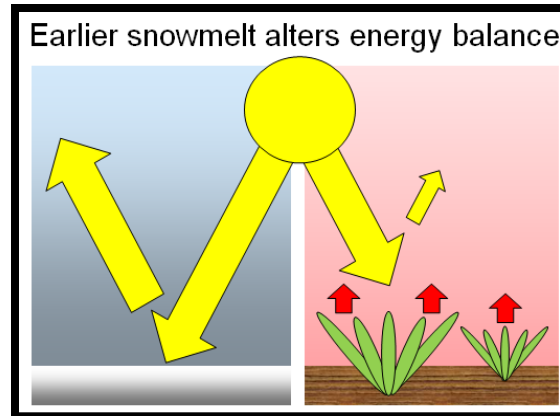
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Carbon Budget



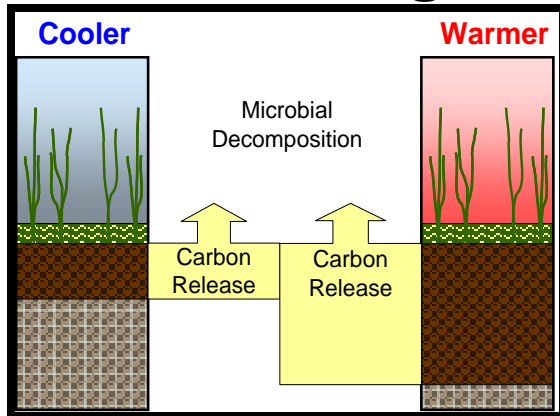
Energy Balance



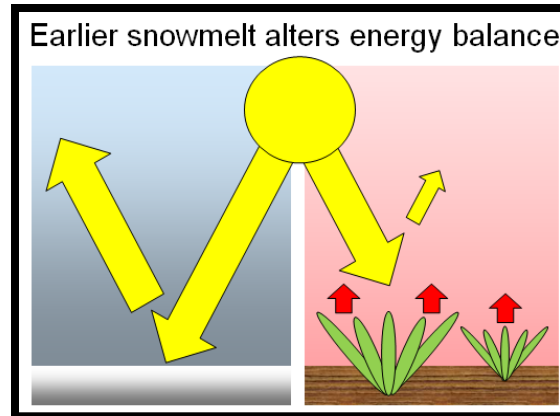
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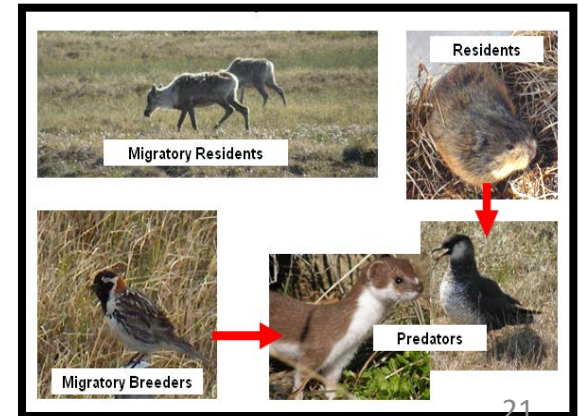
Carbon Budget



Energy Balance



Trophic Interactions



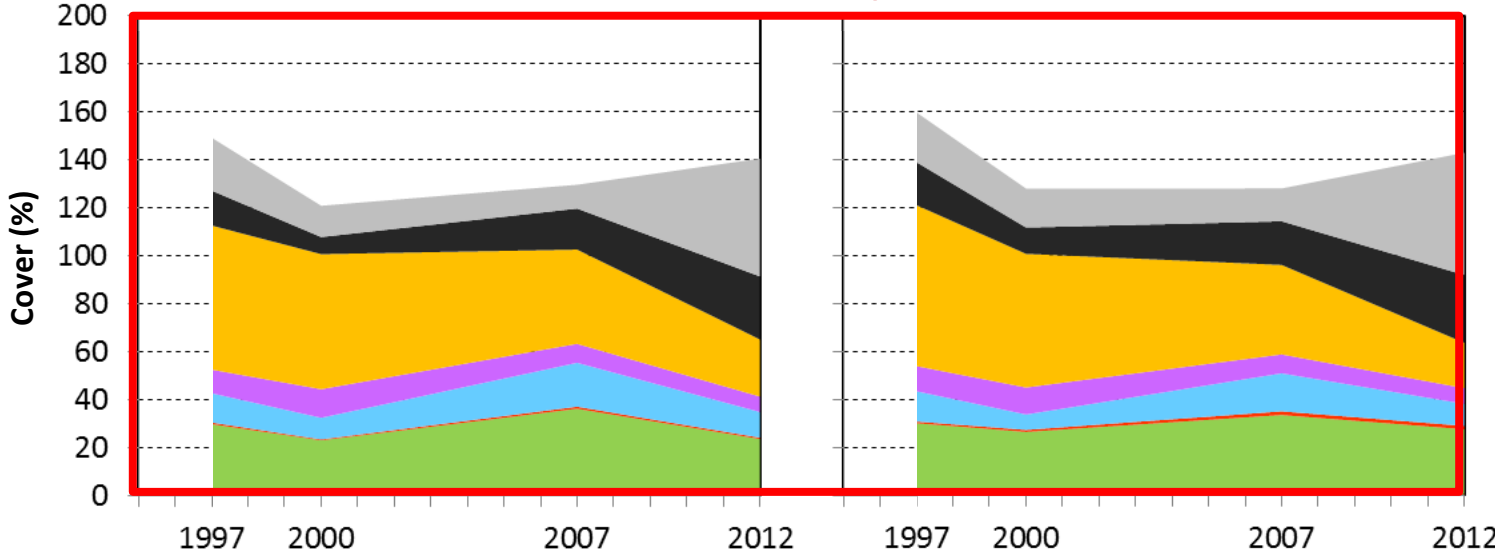
Recent Findings

Plant Species Composition Changes

Control

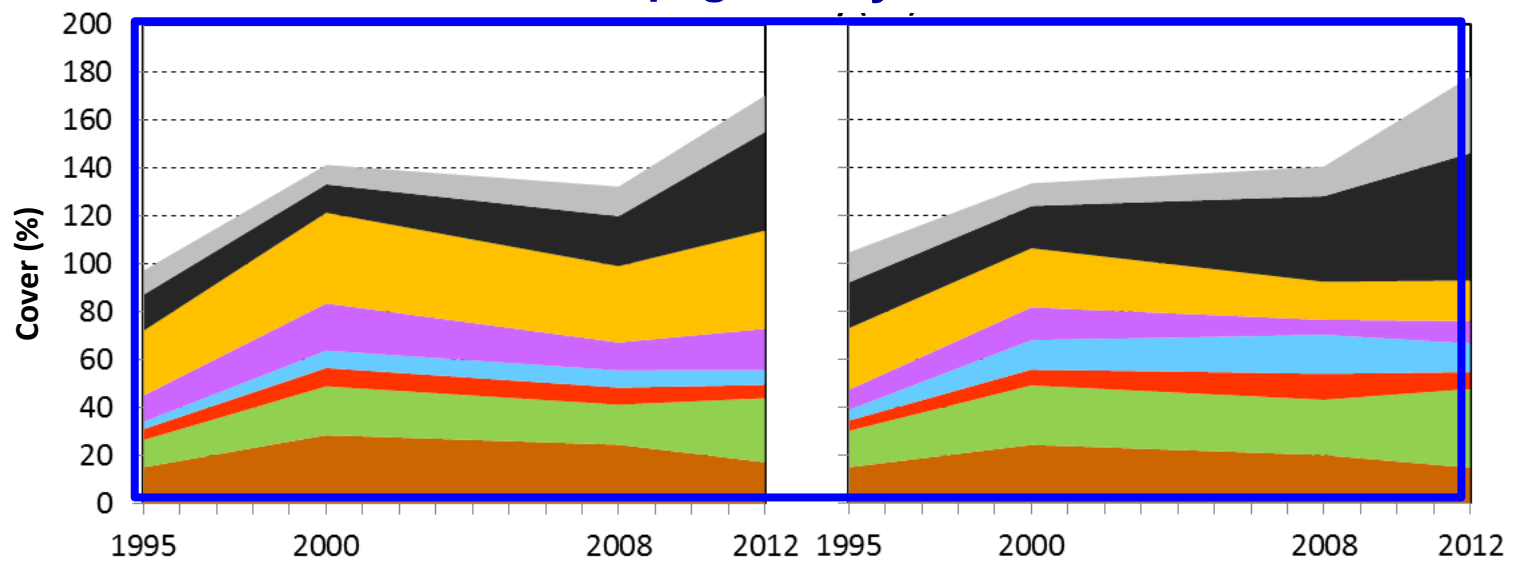
Warmed

Atqasuk Dry Site



- Litter
- Standing Dead
- Lichen
- Bryophyte(moss)
- Graminoid
- Forb
- Evergreen Shrub
- Deciduous Shrub

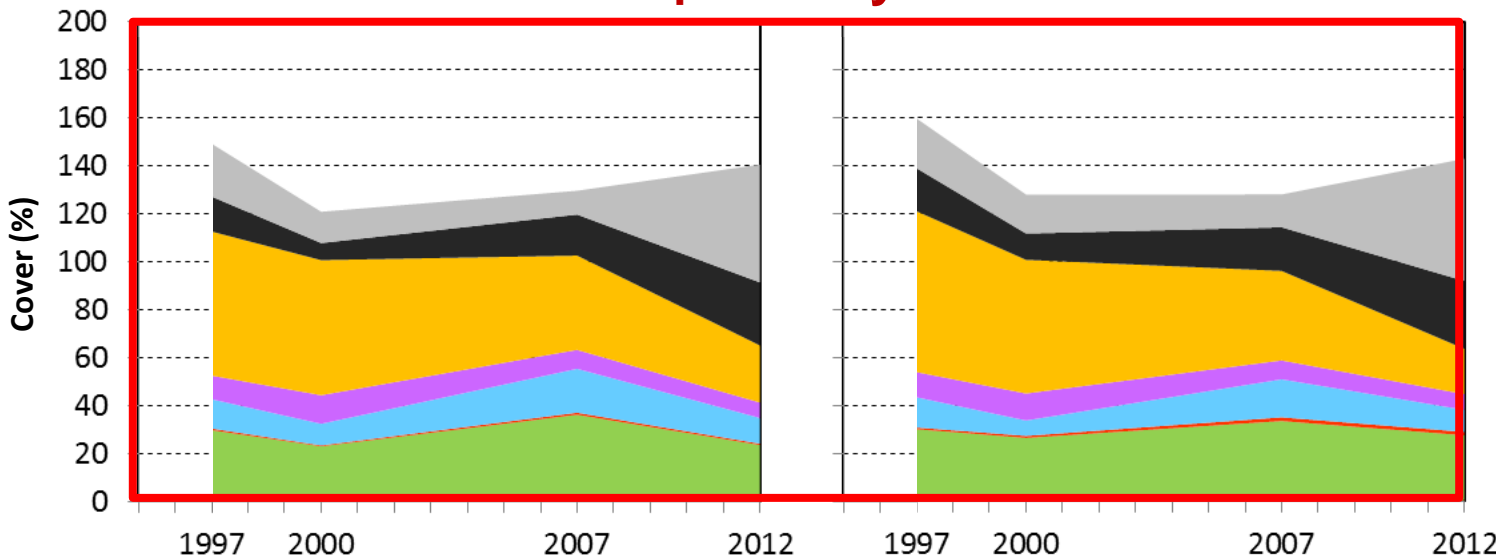
Utqiagvik Dry Site



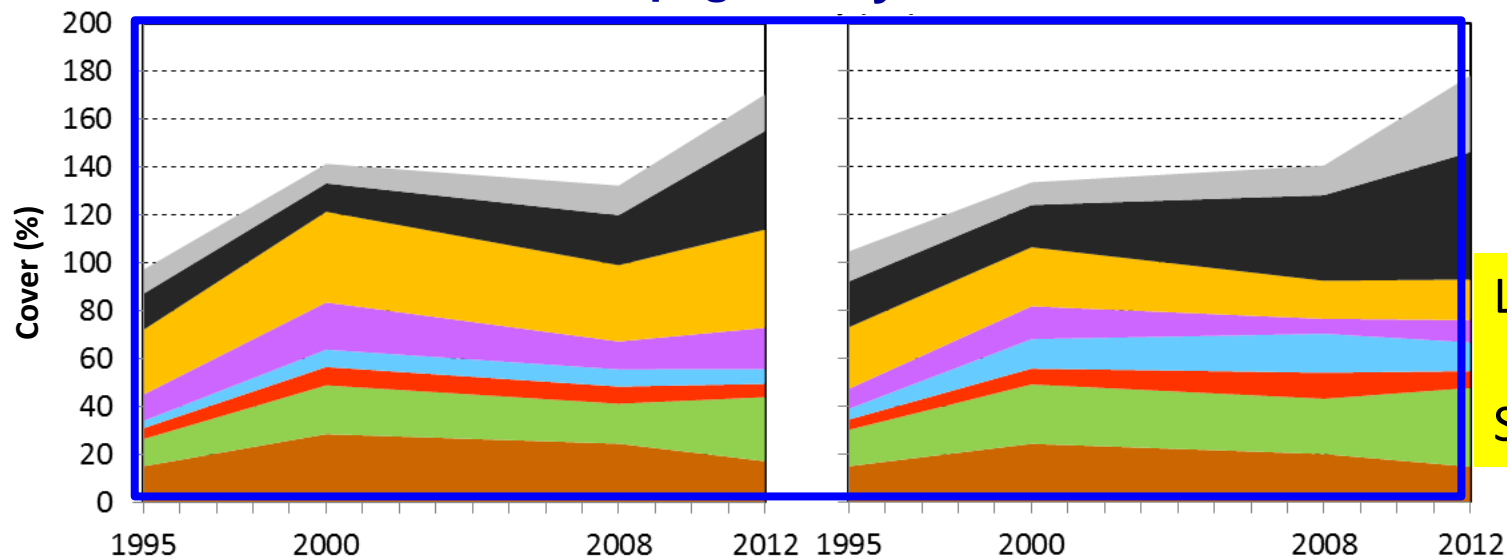
Control

Warmed

Atqasuk Dry Site



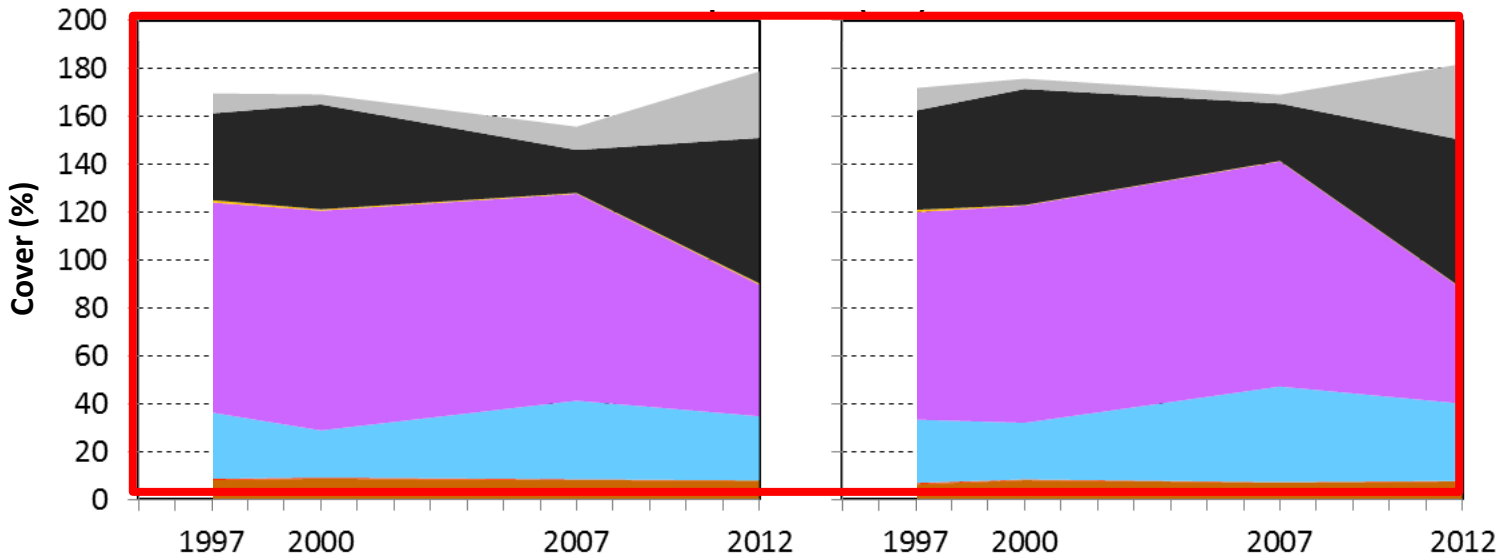
Utqiaġvik Dry Site



Control

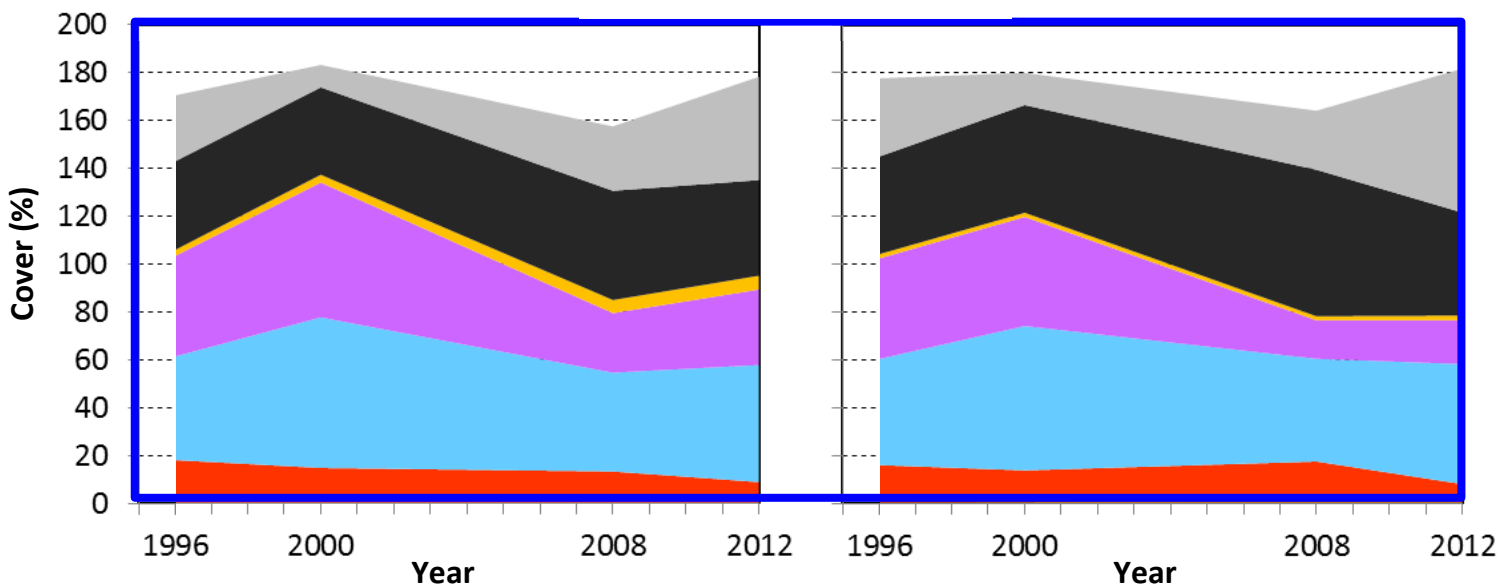
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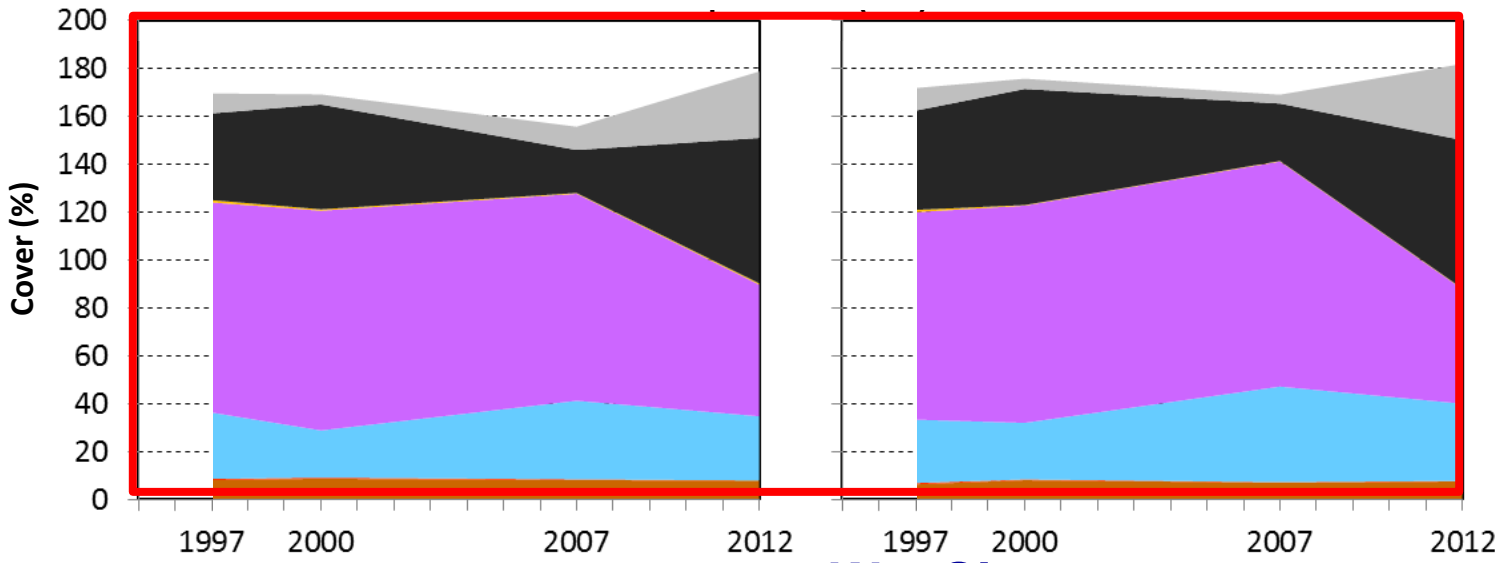


Control

Warmed

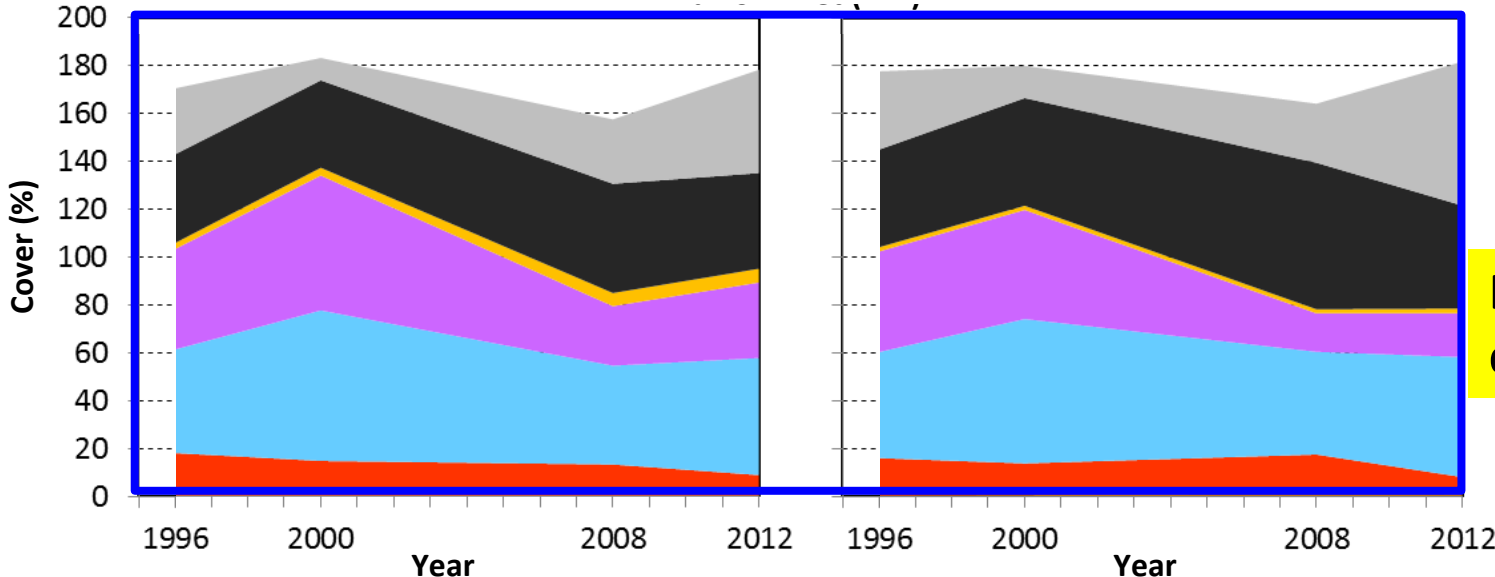
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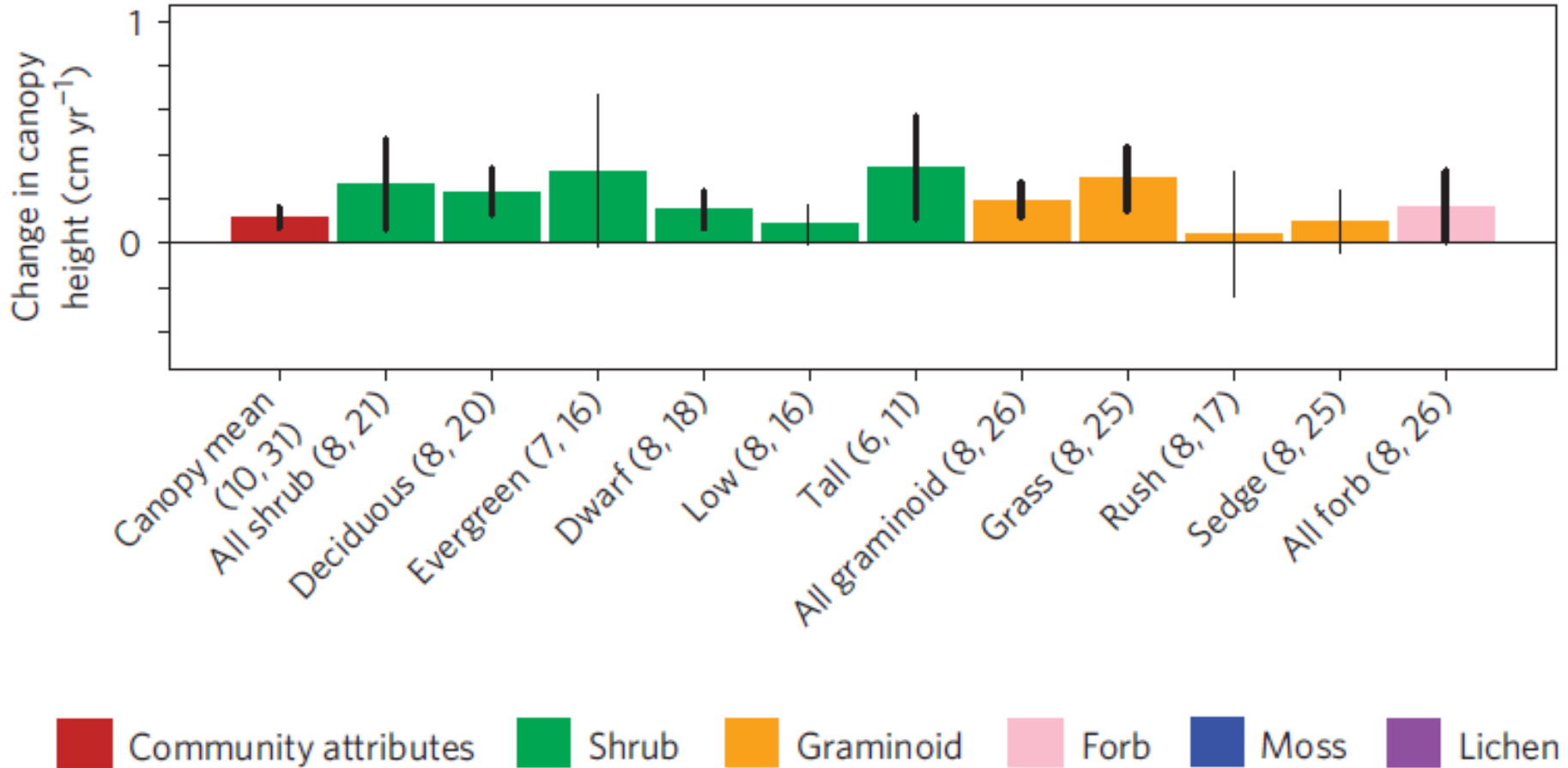
Bryophyte (moss) decrease



Recent Findings

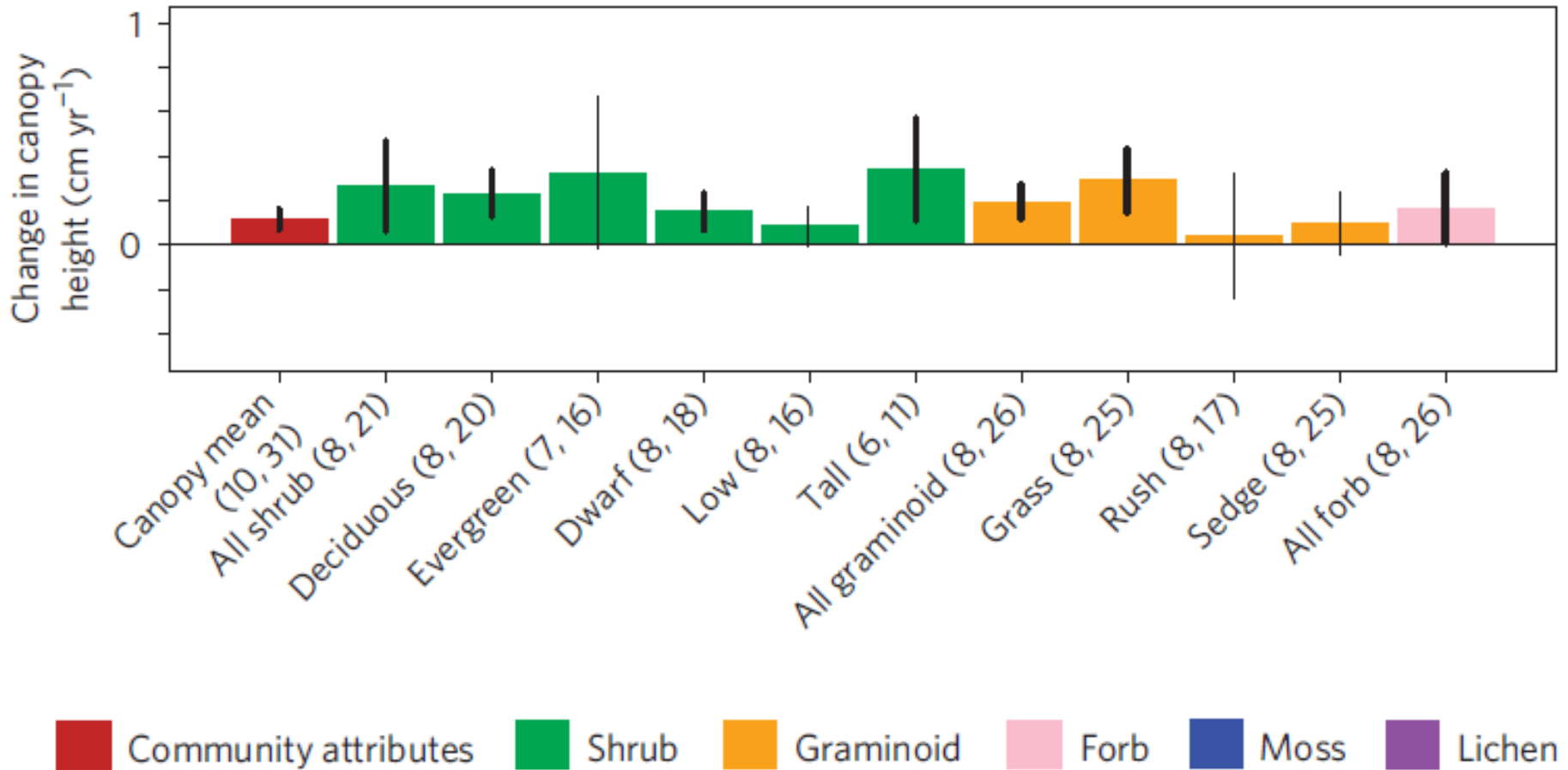
Plants Grow Taller

Change in height over time



plants got taller

Change in height over time



Relation to Climate Change Mechanisms

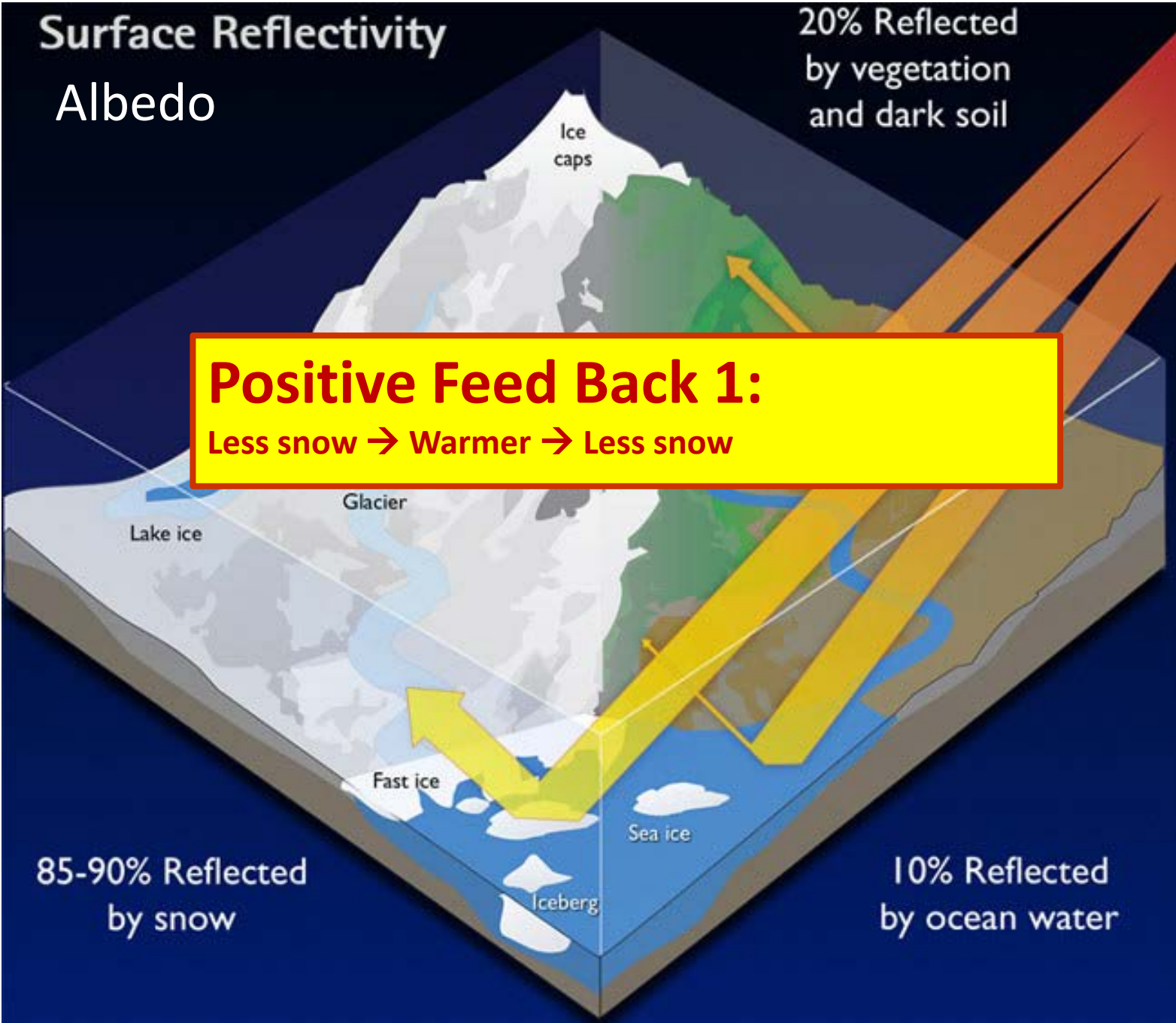
Surface Reflectivity Albedo

20% Reflected
by vegetation
and dark soil

Positive Feed Back 1:
Less snow → Warmer → Less snow

85-90% Reflected
by snow

10% Reflected
by ocean water



No warming

Solar radiation

High albedo

Low atmospheric heating



Warming with snow and vegetation feedback

Positive Feed Back 2:

Taller plants → Warmer → Taller plants

Solar radiation

Low albedo

Higher atmospheric heating

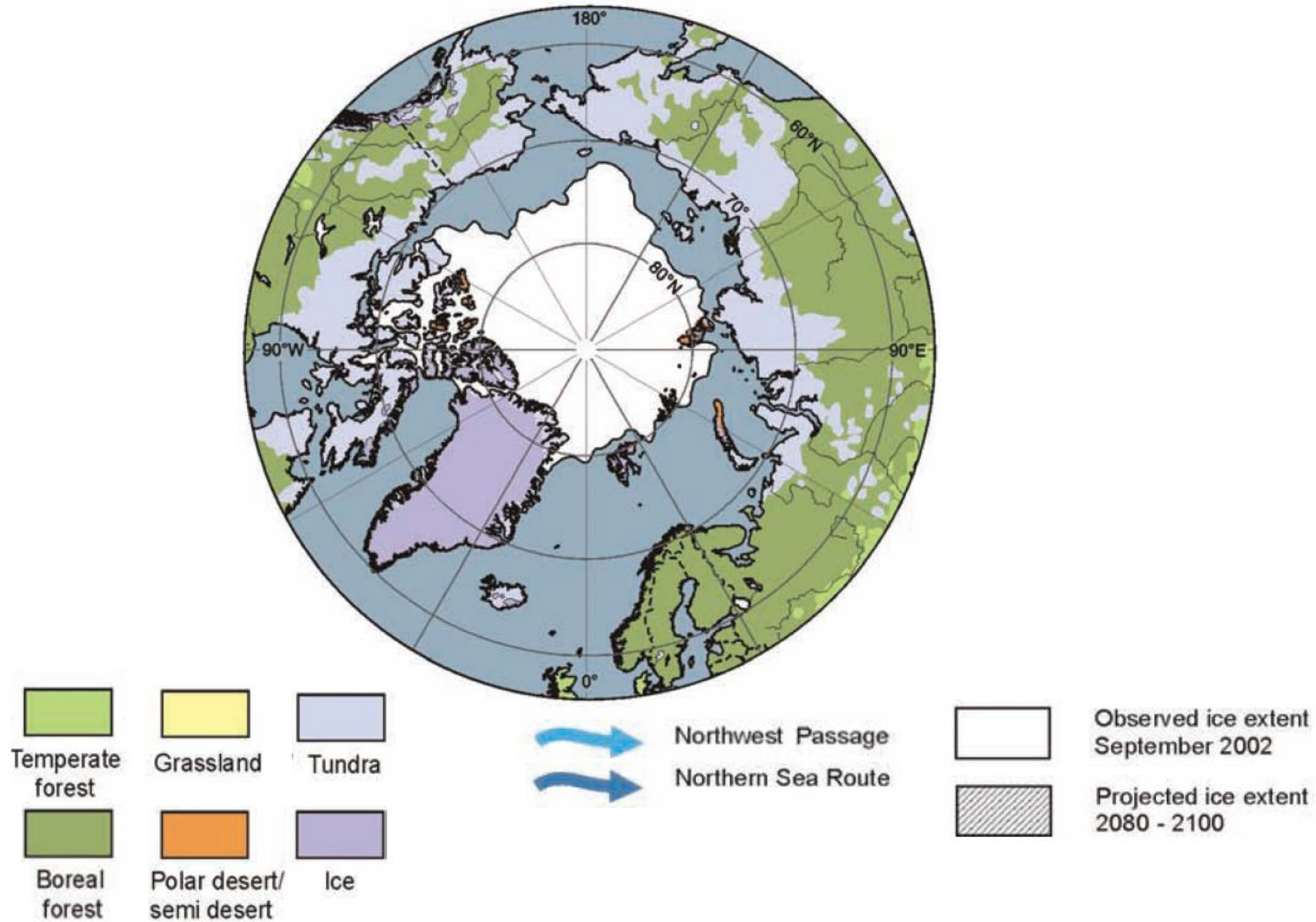


Carbon Release

Positive Feed Back 3:

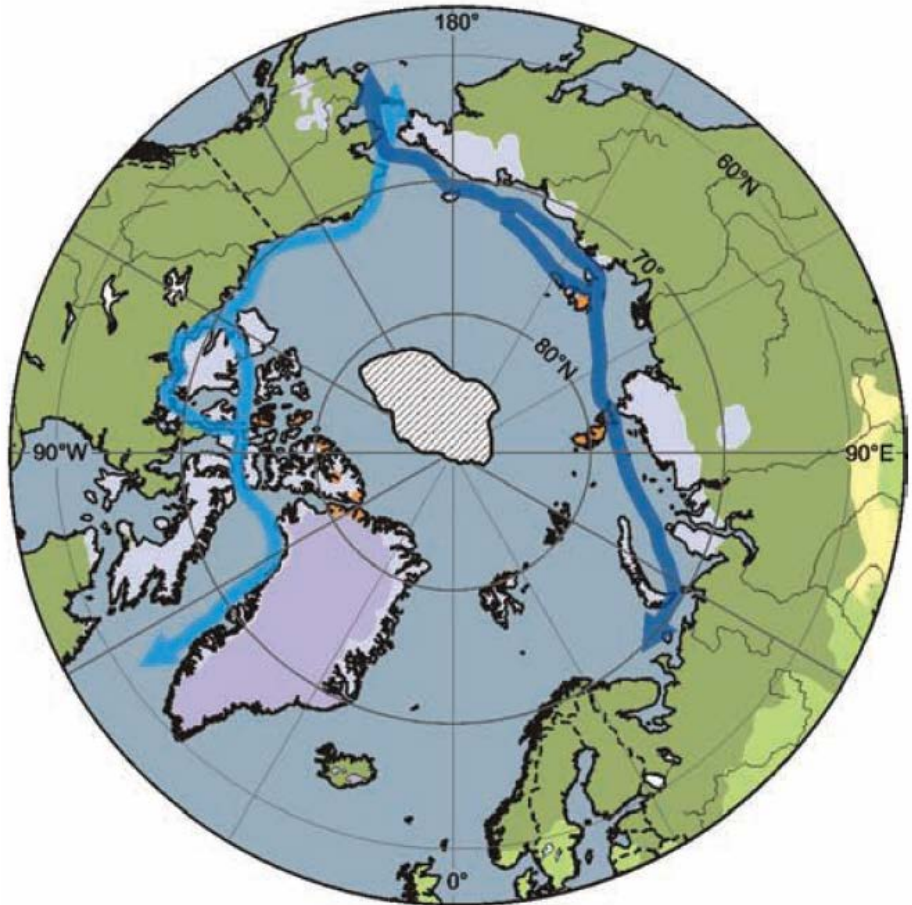
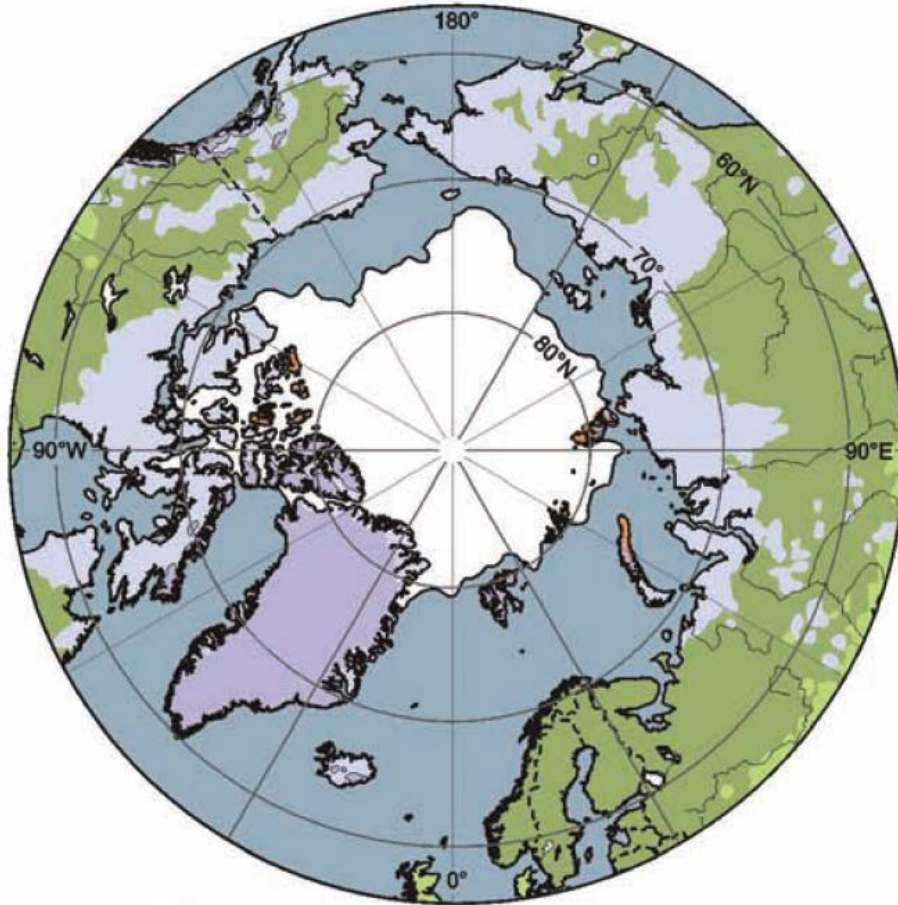
Carbon release → Warmer → Carbon release

Current



Current

Projected



Northwest Passage
Northern Sea Route

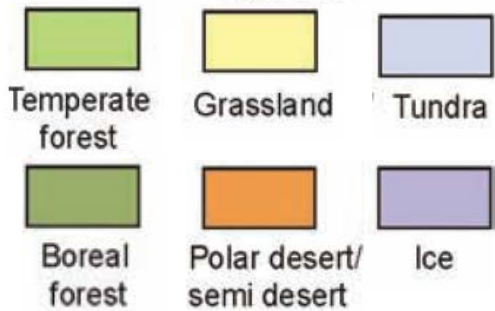
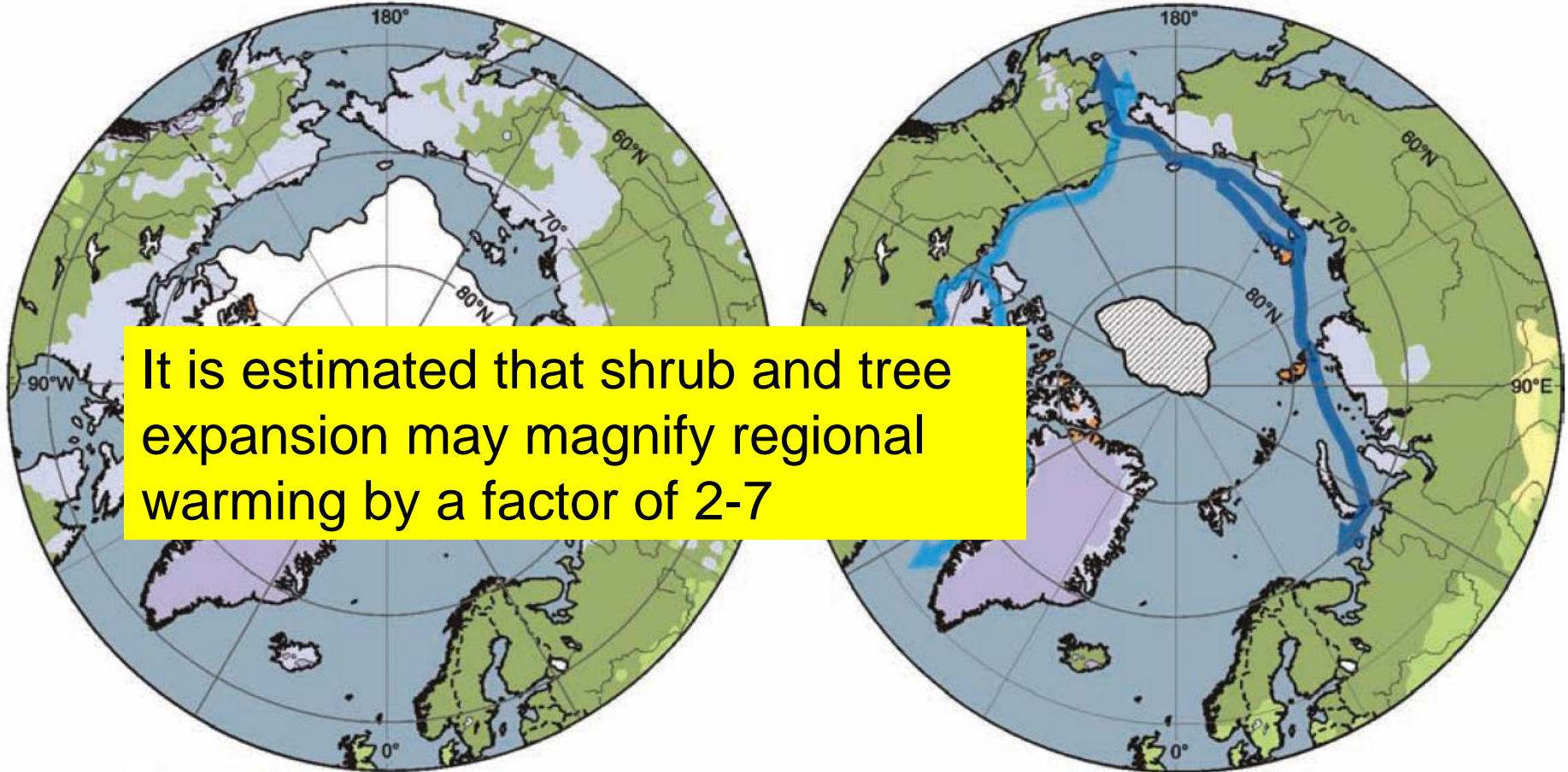


Observed ice extent
September 2002
Projected ice extent
2080 - 2100

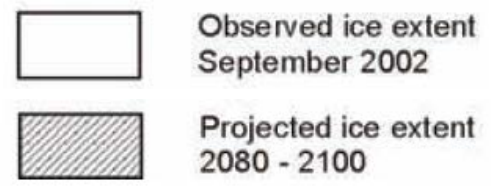
Current

Projected

It is estimated that shrub and tree expansion may magnify regional warming by a factor of 2-7



Northwest Passage
Northern Sea Route



Summary:

Impacts of climate change on the Arctic

- Melting snow & ice (less white)

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Increase in shrubs (especially tall shrubs at warmer sites)

Potential to magnify regional warming by 2-7 X

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Further increases in shrubs

Decreases in lichen and moss

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Possible Local effects

Changes in forage for local animals: More Geese, Less Caribou? Long term changes influence food for game animals



Thank you for all the support over the years!

Any Questions?

