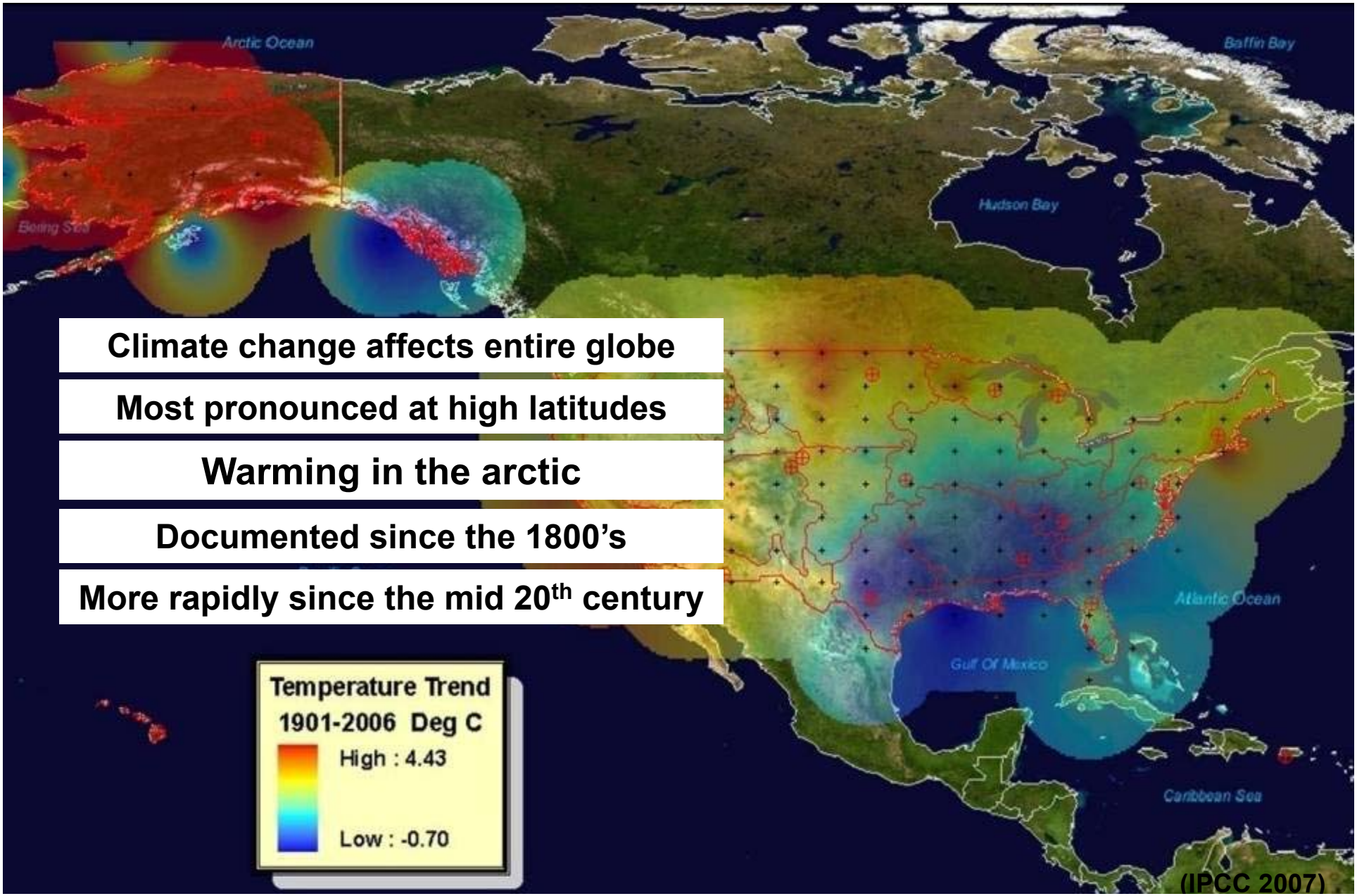
# Vegetation community response to long term experimental warming in Northern Alaska

**Jeremy May and Robert Hollister**

# Why study the Arctic?




Climate change affects entire globe

Most pronounced at high latitudes

Warming in the arctic

Documented since the 1800's

More rapidly since the mid 20th century

(IPCC 2007)

# Effects of Warming on Tundra Plants

**Even small variations in the environment effect community composition and water/nutrient cycling**

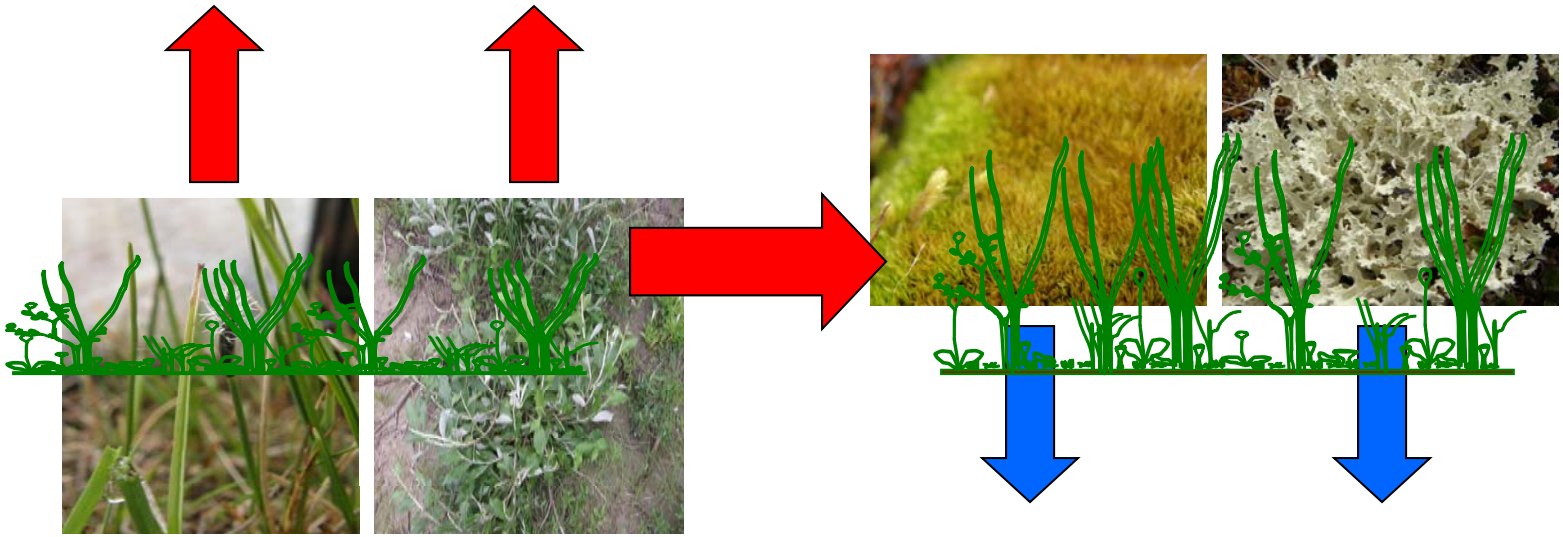
**(Chapin and Shaver, 1985)**

**Warming shifts community control from facilitation to competition**

**Graminoids and Shrubs often increase in response to warming, while bryophytes and lichens decrease**

**(Arft et al, 1999; Hobie and Chapin, 1998)**

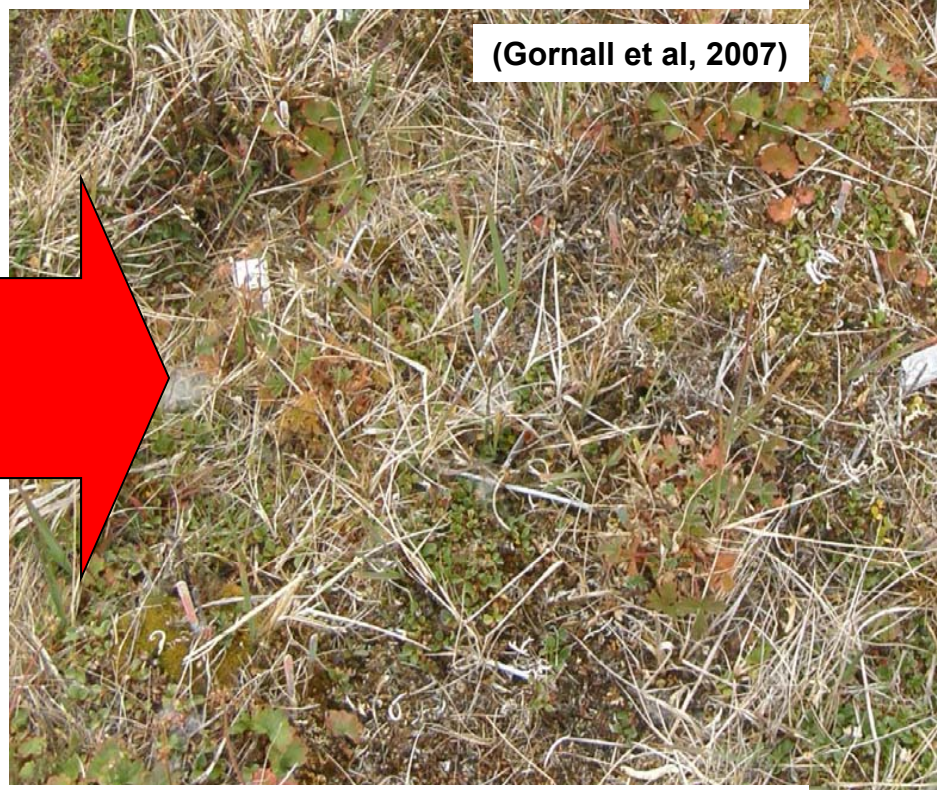
**Increases in tall and decreases in short plants should increase canopy height and cause canopy to fill in**



# So why do we care about changes in the canopy?

**Plant canopies influence other cycles in tundra ecosystems**

**Changes can alter nutrient and water cycling**



**(Gornall et al, 2007)**

**Plant communities make up the base of Arctic food webs**

**Changes can alter forage quality for caribou herds and other animals**

**(Larter and Nagy, 2001; Lenart et al, 2002)**

**We investigated:**

1. **Temperature trend in our two regions**
2. **Canopy height change in response to experimental warming and over 12 years**
3. **Whether canopies became more closed or open**
4. **What plant growth forms contribute most to changes**

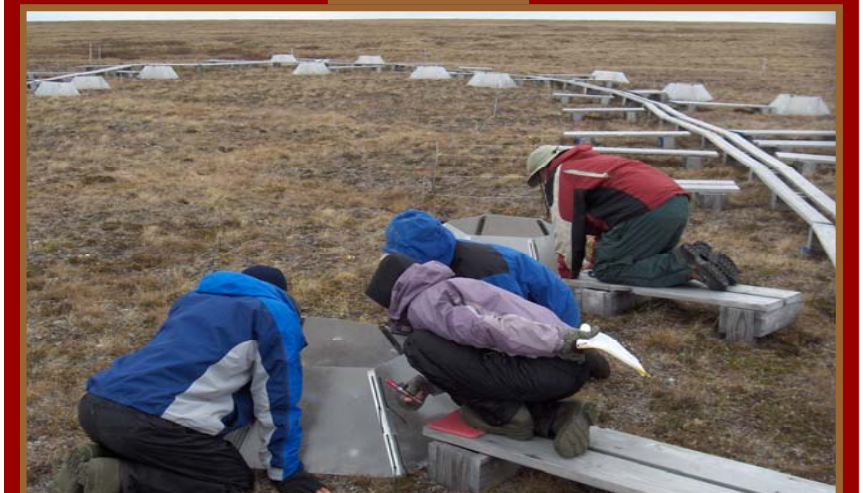
# Site Locations


## Barrow

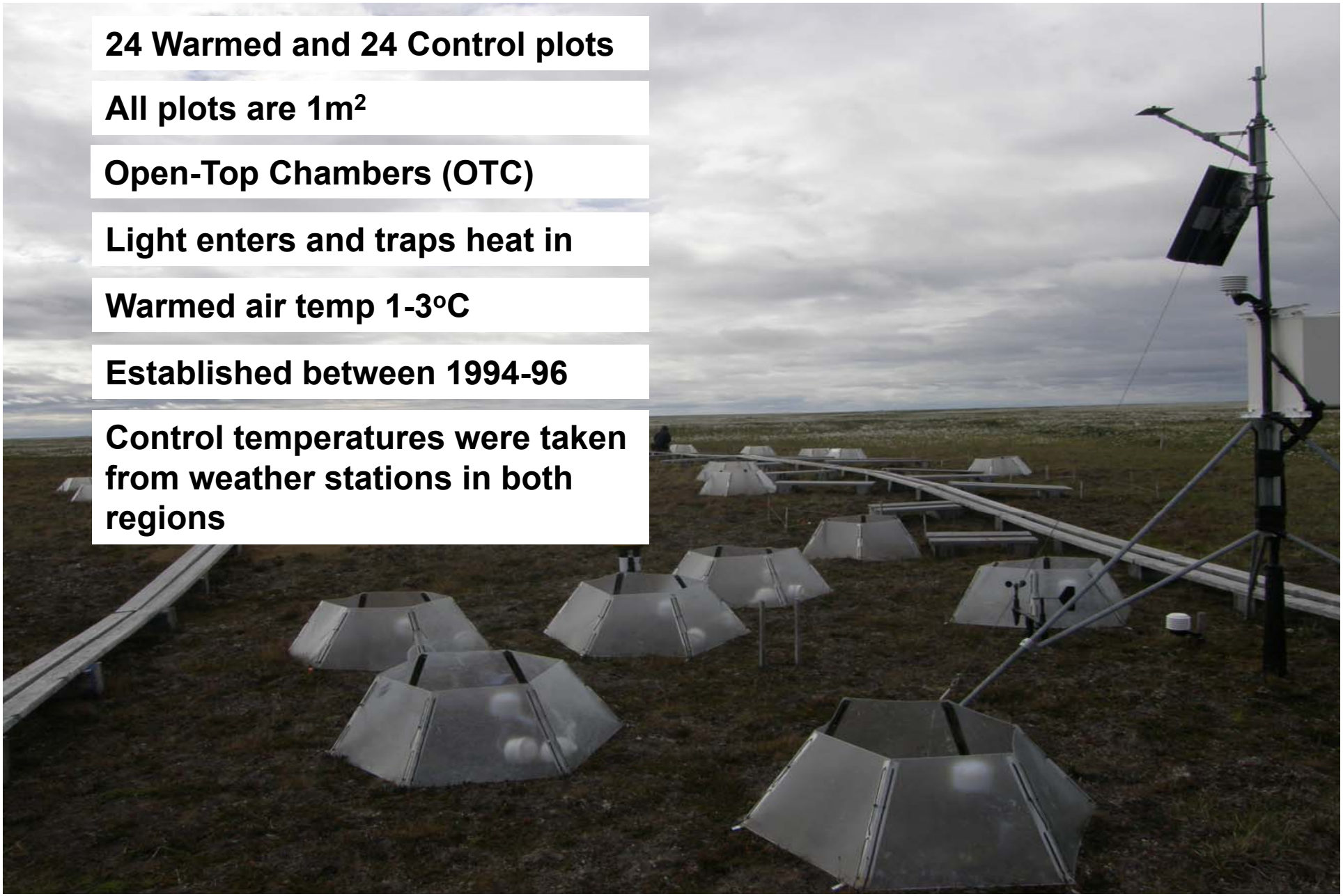
DRY

WET

## Atqasuk



# Site Setup and Warming



- 24 Warmed and 24 Control plots
- All plots are $1m^2$
- Open-Top Chambers (OTC)
- Light enters and traps heat in
- Warmed air temp 1-3$^oC$
- Established between 1994-96
- Control temperatures were taken from weather stations in both regions

# Point Frame Method

3 Samplings

Summers of 1995-96,
2000, and 2007-08

Same 2 weeks each year

Point Frame Grid
-75cm by 75cm
-100 points

Measurements

-At each point

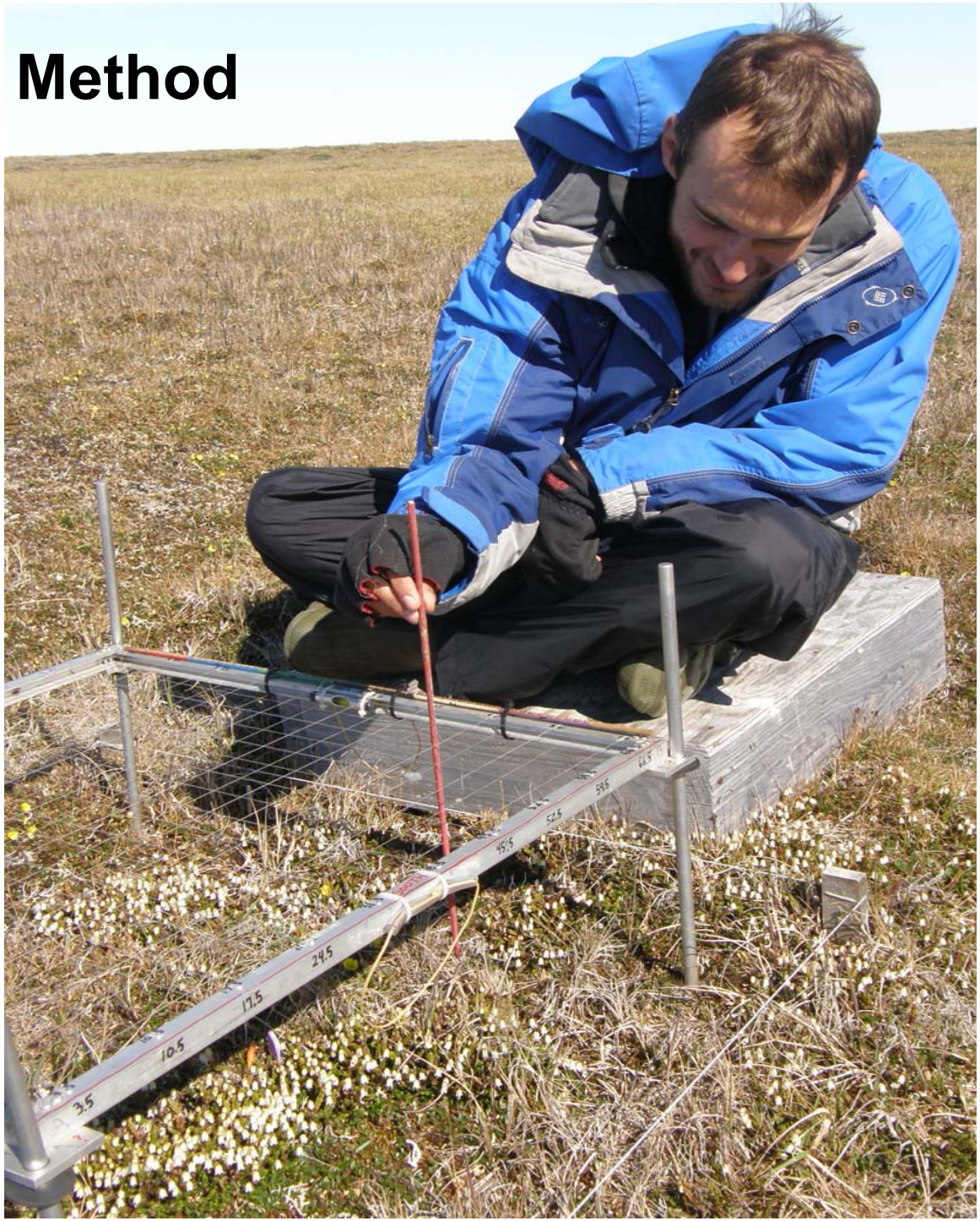
Top and Bottom contact

Species

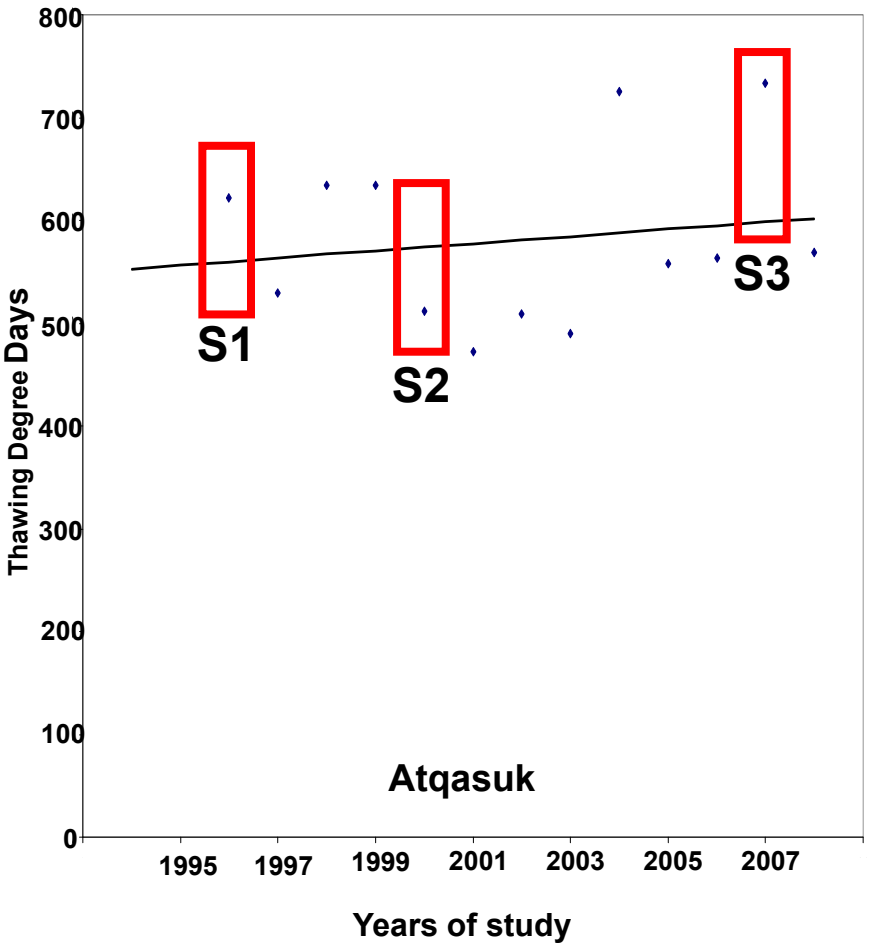
Live/Dead Status

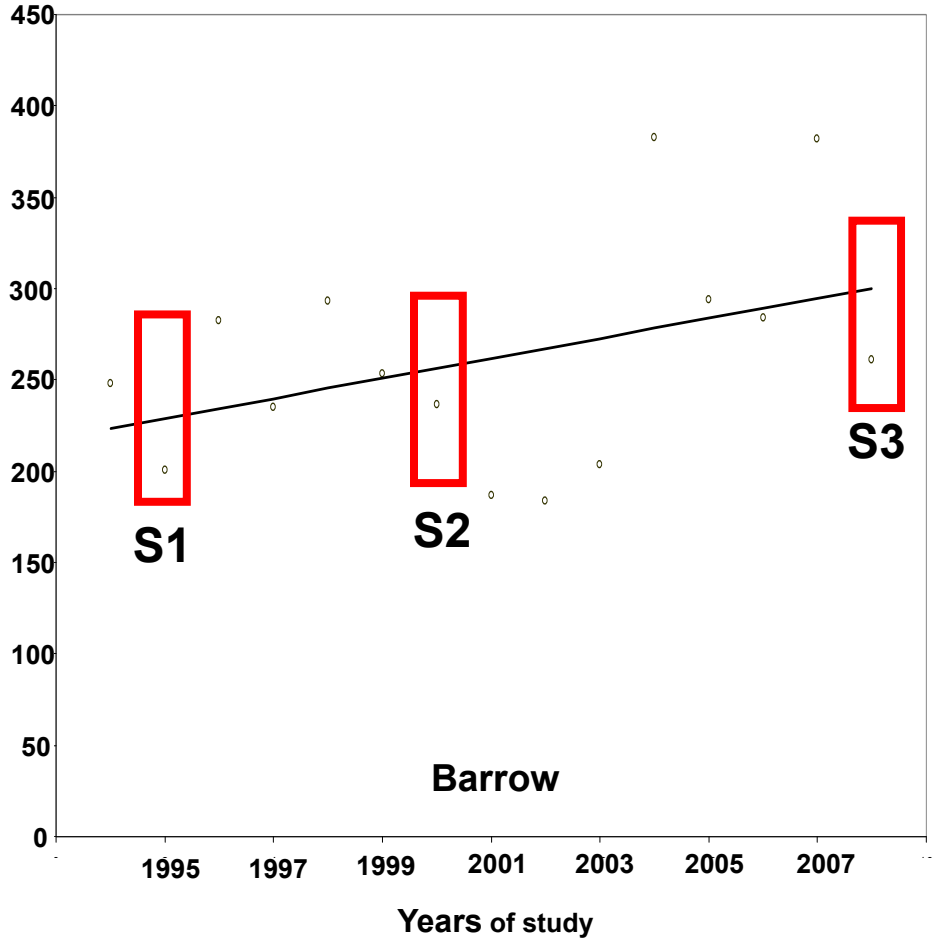
Height

(Hollister et al, 2005)



# Control temperatures

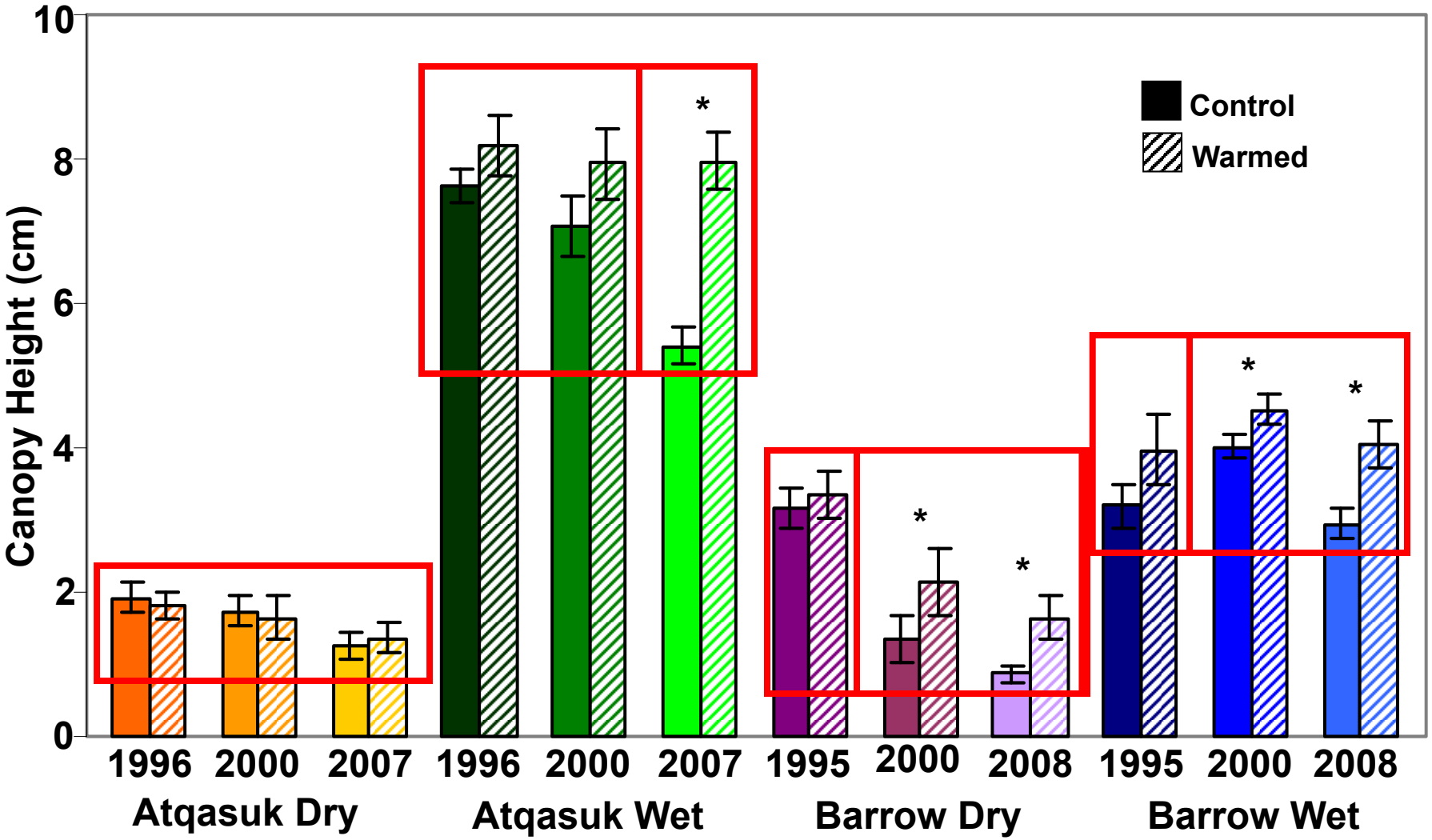



**Both regions show increasing trends in temperature**

**Temperatures at each sampling did not fit the overall trend well**

# Canopy Height Change



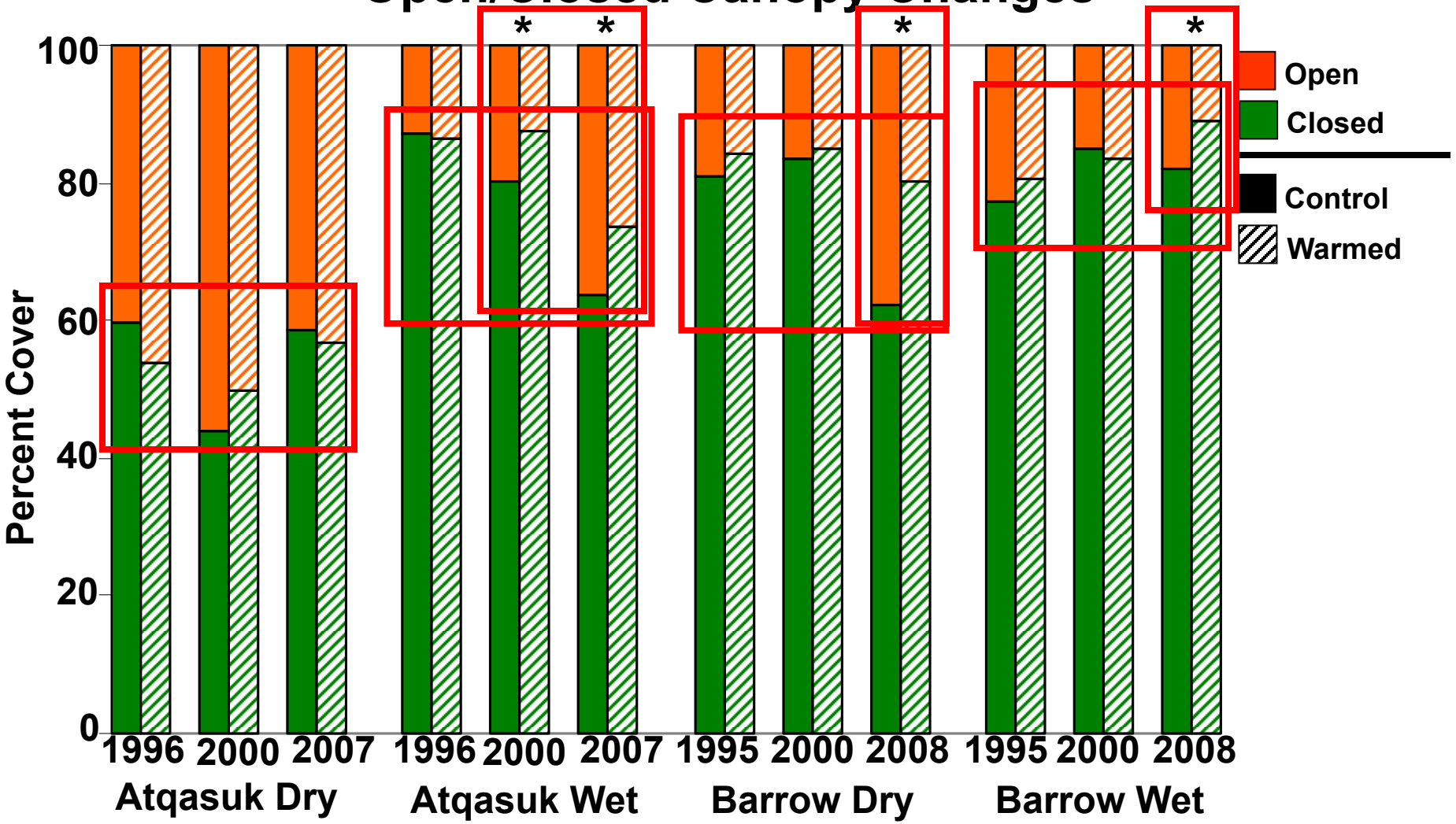

Wet sites have higher canopy heights due to more graminoids and shrubs

Canopy Height decreased in control plots in most sites over time

Canopy Height increased with warming in all sites, except Atqasuk Dry

Warming had an increased influence in later years

# Open/Closed Canopy Changes



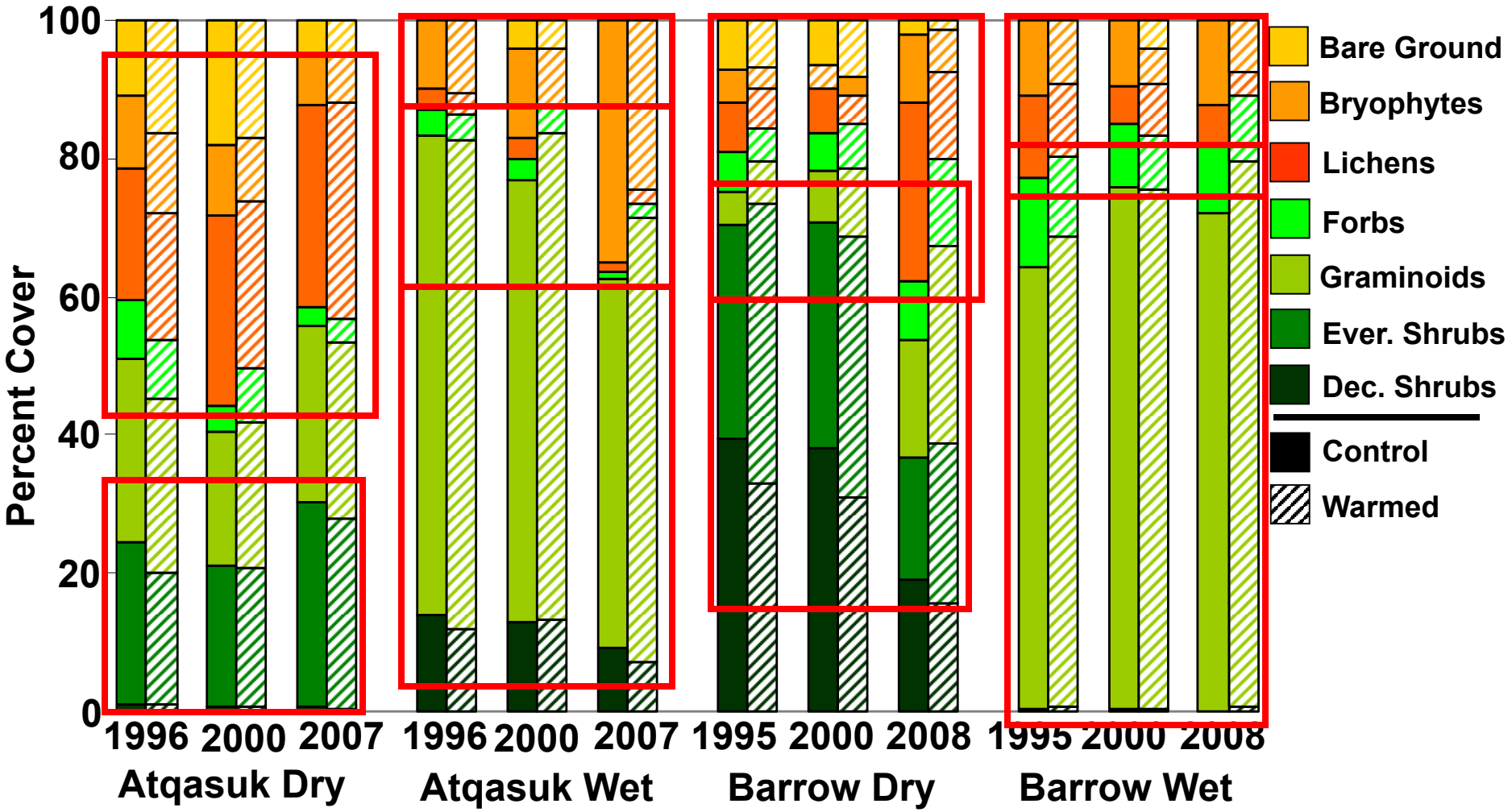

Controls often show contrasting changes between samplings

Warming led to a more closed canopy in sites

Most dramatic changes were in later years

But what is driving these changes?

# Growth Forms Driving Canopy Change




Canopy opening in response to warming is driven by a loss of Evergreen Shrubs in the Atqasuk Dry site

Canopy closing in all other sites driven by Graminoids or Evergreen Shrubs

Species loss occurred in all sites and was mostly in nonvascular plants

# Conclusions

**Warming responses were often different than over time changes**

**Over time changes frequently were in contrasting directions**

**These trends are likely due to factors in addition to temperature playing a role**

**Trends:**

**1. Temperatures increased over time in all sites, but with large year to year fluctuations**

**2. Canopy height increased in response to increased temperature**

**3. Canopies shifted to being more closed overall and all sites lost species richness in response to warming and over time**

**4. Canopy changes were most often driven by evergreen shrub or graminoid shifts**

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Questions?