Long-term Response of Sedge Meadows to High Arctic Climate Change

Alexandra Fiord, Ellesmere Island, Nunavut

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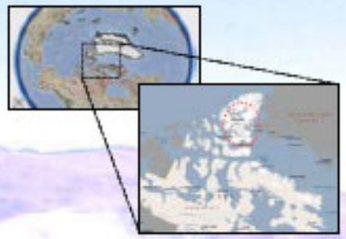
Location



Introduction

- The climate is changing
- Arctic ecosystems are sensitive
- NDVI & AVHRR from the 1980's &1990's shows increased tundra productivity (Myneni *et al.* 1997, Stow *et al.* 2004)
- Arial photos of the Western Arctic show increased shrubbiness (Sturm *et al.* 2001)
- Experimental control plots show species response to ambient climate change in the Western Arctic (Chapin *et al.* 1995)

Chapin FS, Shaver GR, Giblin AE, et al., 1995. Responses of Arctic Tundra to Experimental and Observed Changes in Climate. *Ecology* 76(3), 694-711.
Myneni RB, Keeling CD, Tucker CJ, et al., 1997. Increased plant growth in the northern high latitudes from 1981 to 1991. *Nature* 386(6626), 698-702.
Sturm M, Racine C, Tape K, 2001. Increasing shrub abundance in the Arctic. *Nature* 411(6837), 546-547.
Stow D, Hope A, McGuire D, et al., 2004. Remote sensing of vegetation and land-cover change in Arctic tundra ecosystems. *Remote Sensing of Environment* 89(3), 281-308.

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Objective

- To establish the longest-term study on Arctic ecosystem response to actual climate change in the Canadian High Arctic by replicating (in 2005) above and below ground peak standing crop measurements made in 1980-1983 in wet sedge meadows.

Methods

- 5 sites, 8 transects
- Biomass harvests
  - Peak above ground (0.1m² plots)
  - Below ground (0.03m² plots)
- Regional and local climate records

i:Alexandra Fiord Lowland, Ellesmere Is, NU. Site A, 4 transects, 24 plots, Sites B-E, 1 transect/site, 6 plots/site.

Statistics

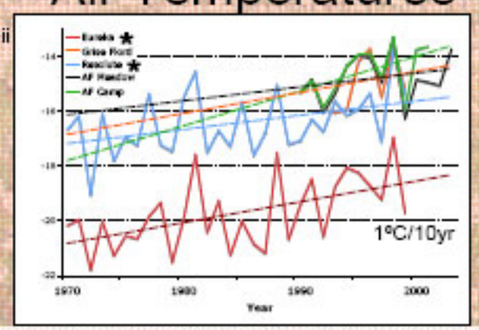
★= statistical significance based on univariate one way analysis of variance or non-parametric Wilcoxon rank test

★²=statistical significance based on multivariate MRPP group testing procedure (1980's *vs* 2005)

$\alpha = 0.05$

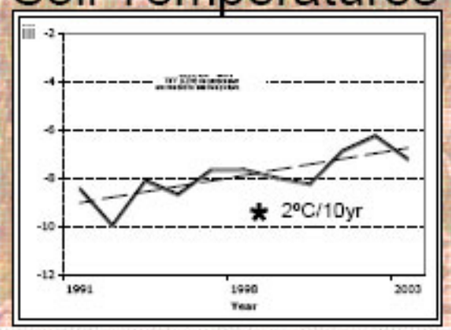
The Arctic is Warming

Air Temperatures



ii: Mean yearly air temperature (°C) at five High Arctic climate stations (solid lines) regressed against time (dashed lines). All slopes positive, >1°C/decade.

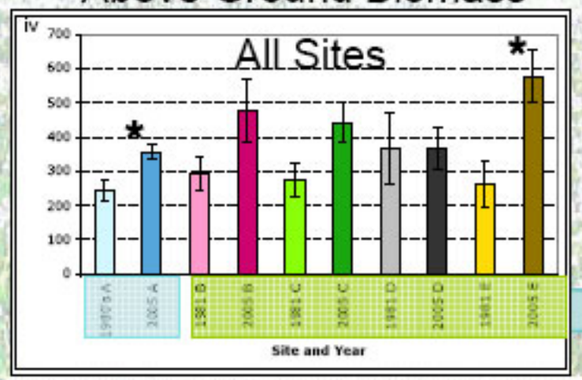
Soil Temperatures



iii: Mean yearly soil temperature (°C) at site B, AF Meadow and regression against time. Regression slope positive at 2°C/decade and significant, $p<0.05$.

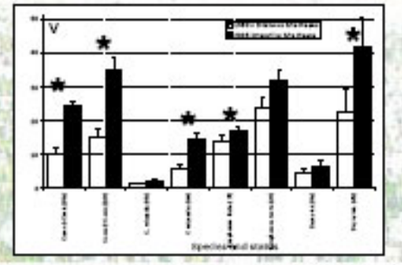
Sedge Meadow Species are Responding

Above Ground Biomass



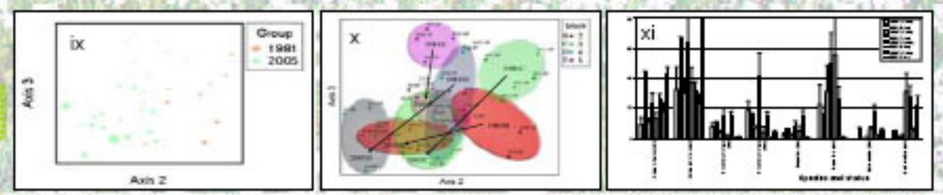
iv: Mean above ground biomass (g/m²) in Site A (1980-83[3], n=24, 2005, n=34) and sites B-E (1981, n=5, 2005, n=6) ★².

Site A



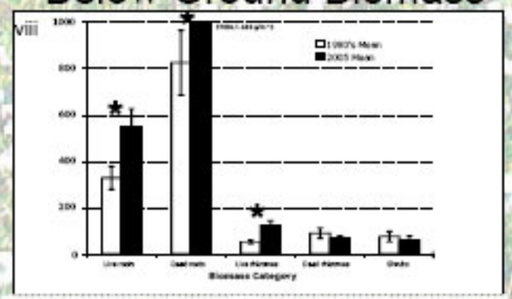
Mean above ground biomass (g/m²) in Site A in 1980-83 and 2005 for dominant (v) and minor (vi) species partitioned into green and attached parts and ground cover (vii) of moss and litter.

Sites B-E



NMS (MDS) ordinations (ix) of green above ground biomass plots in sites B-E in 1980 (red) and 2005 (green) and of sites (x) B-E with subjective spheres and arrows to show biomass response between years. Mean above ground biomass (xi) of dominant species in sites B-E between 1981 and 2005 ★².

Below Ground Biomass



vii: Mean below ground biomass, in Site A in 1980-83 (n=19) and 2005 (n=24), of 5 sorting categories ★².

3: insignificant inter-annual variability, ($p>0.05$)

Conclusions

- Sedge meadow species have responded to air and soil warming by increasing their above and below ground biomass
- This is the first recorded result of tundra species response to actual climate change in the circumpolar High Arctic