The Response of the Alaska Boreal Forest to a Warming Climate

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Interior Alaska location of weather stations and study sites

A. Weather stations:
1. Fairbanks/UES
2. Big Delta
3. McGrath
4. Bettles

B. Map showing locations of weather stations.

Inset:
- Town or village
- Ring-width < 7 trees
- Ring-width > 7 trees
- Highway/road
- Latewood density
- $^{13}$C

C. Inset map focusing on Bonanza Creek LTER.
Responsiveness of tree-ring properties to Fairbanks mean monthly temperatures

A. ring-width

B. $^{13}$C

C. latewood density (MLwD)

month
Historic and reconstructed relationship between white spruce growth and summer temperature and climate scenarios in central Alaska

- temperature
- regional tree ring-width

- CCC scenario
- CSM scenario

- colder
- warmer

- probable zone of species elimination

- reconstructed temperature (isotope & density)

- period of instrument record

- period of climate model scenarios

- time slice #1
- time slice #2
- time slice #3

Fairbanks 2-yr. mean May-Aug temperature (oC)

White spruce radial growth (mm)
Climate sensitivity of radial growth in central Alaska birch

- Buffalo Lane (birch)
- Kaho (birch)
- Green Birch
- 2Red Fox Dr. (birch)
- Spinach Creek (birch)
- Live Birch

Correlation coefficient vs. month
Relationship of temperature indices to radial growth of negative responders in Alaska birch

ANNUAL VALUES

SMOOTHED (5-yr mean) VALUES

Spinach Creek 13

mean sample ring-width index (et/ev, units)

3-stand mean

year
Relationship of temperature indices to radial growth of positive responders in Alaska birch

**ANNUAL VALUES**

- Temperature
- Ring-width

**SMOOTHED (5-yr mean) VALUES**

- Live Birch

<table>
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<tr>
<th>Mean sample ring-width index (stdev. units)</th>
<th>Year</th>
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<th>Temperature (°C)</th>
<th>Year</th>
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Response of radial growth to temperature in black spruce on permafrost in central Alaska
Relationship of winter temperature index and relative growth of black spruce on permafrost, Fort Wainwright

- **Recorded temperature** (JanDec-1Jan-1Feb-1Dec)
- **Ring-width (FWD, n = 20)**

**ECHAM scenario**

**CSM scenario**

- Winter temperature (°C)
- Ring-width index (stdev)

Year range: 1900 to 2100.
Relationship of summer temperatures and relative growth of black spruce on permafrost, Toghotthele Corporation land, central Alaska

- Recorded temperature (mean of May, Jun, Jul, & Aug)
- Regional tree ring-width
- CCC scenario
- CSM scenario

Relative radial growth (stddev units)

Year: 1850 to 2100

Mean temperature (°C)

Colder and warmer zones are indicated.

Probable zone of species elimination.
Brooks Range

Mean ring-width (mm)

Decade ending

Conclusions

- Three major Alaskan boreal species have both positive and negative radial growth response to temperature
- We can expect to see landscape scale changes in species composition with increased warming and with increased disturbance as a result of changing climate (fire, insects, permafrost)
The End