Climate Change and Forest Systems

MINNESOTA FOREST RESOURCES COUNCIL
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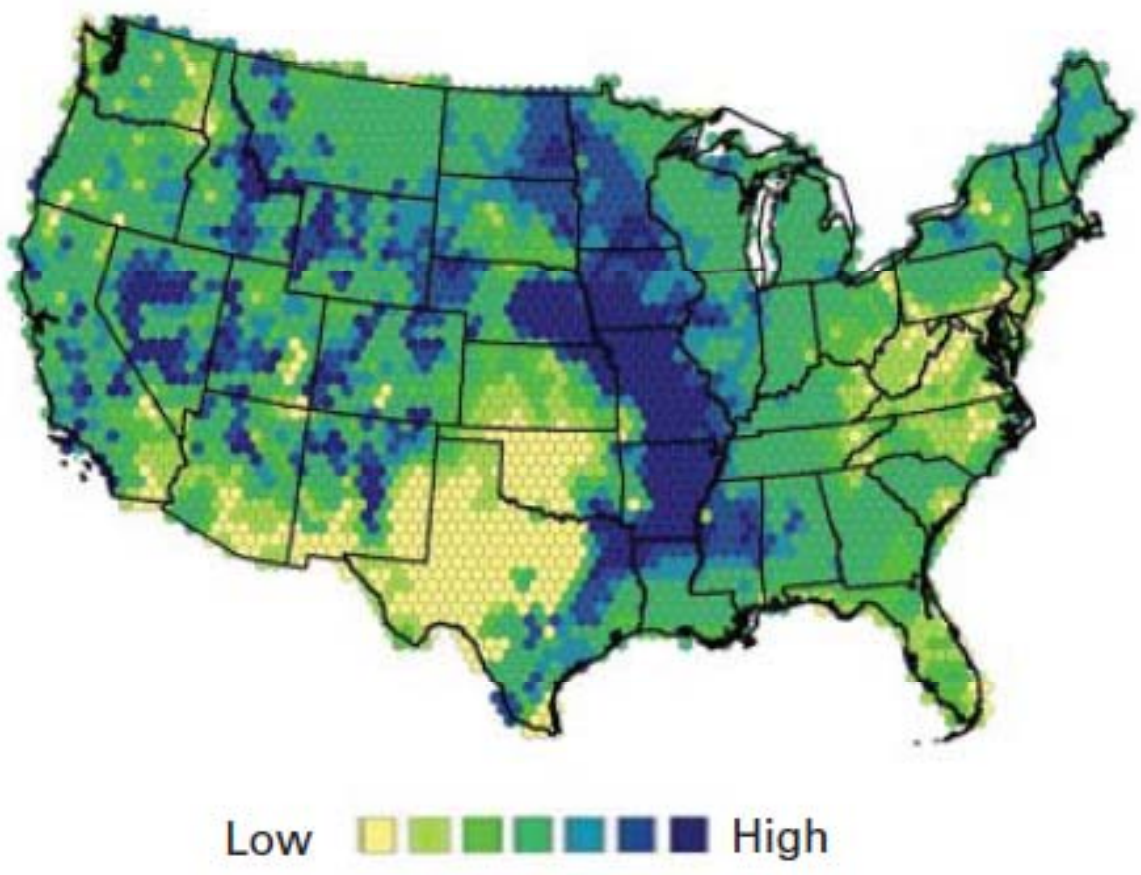
ANN PIERCE
MN DNR

Minnesota forest in a climate context

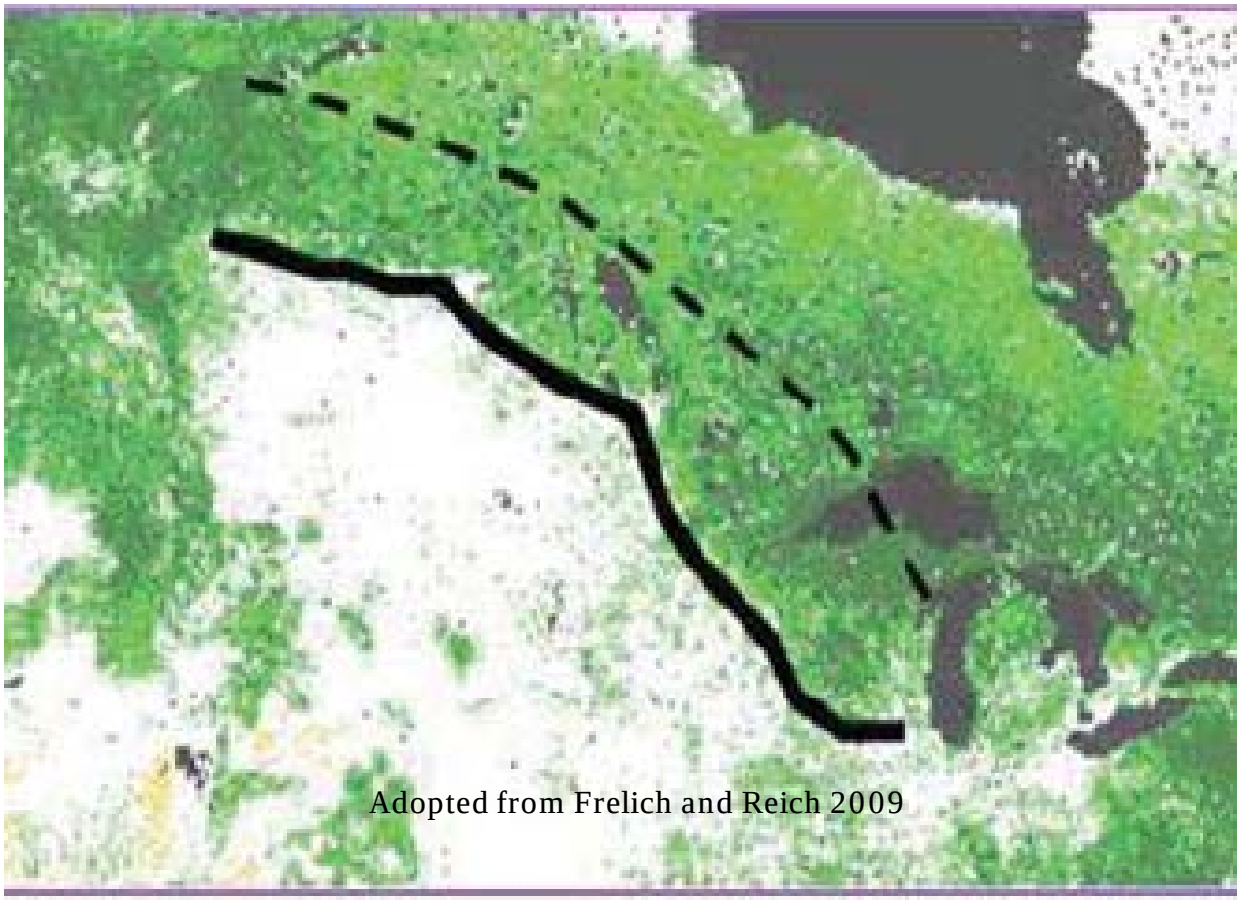
- Historically forest occurred wherever there was adequate moisture and protected from frequent fires.
- The prairie-forest border is a visible climatic signatures and is sensitive to change.
- There are 107 different forest and woodland native plant communities in Minnesota.
  - Climate
  - Physiography
  - Nutrient levels
  - Disturbance

In general forest systems are expected to be vulnerable to climate change. Minnesota is particularly vulnerable as it sits in the center of a continent and crosses a climatic transition zone.



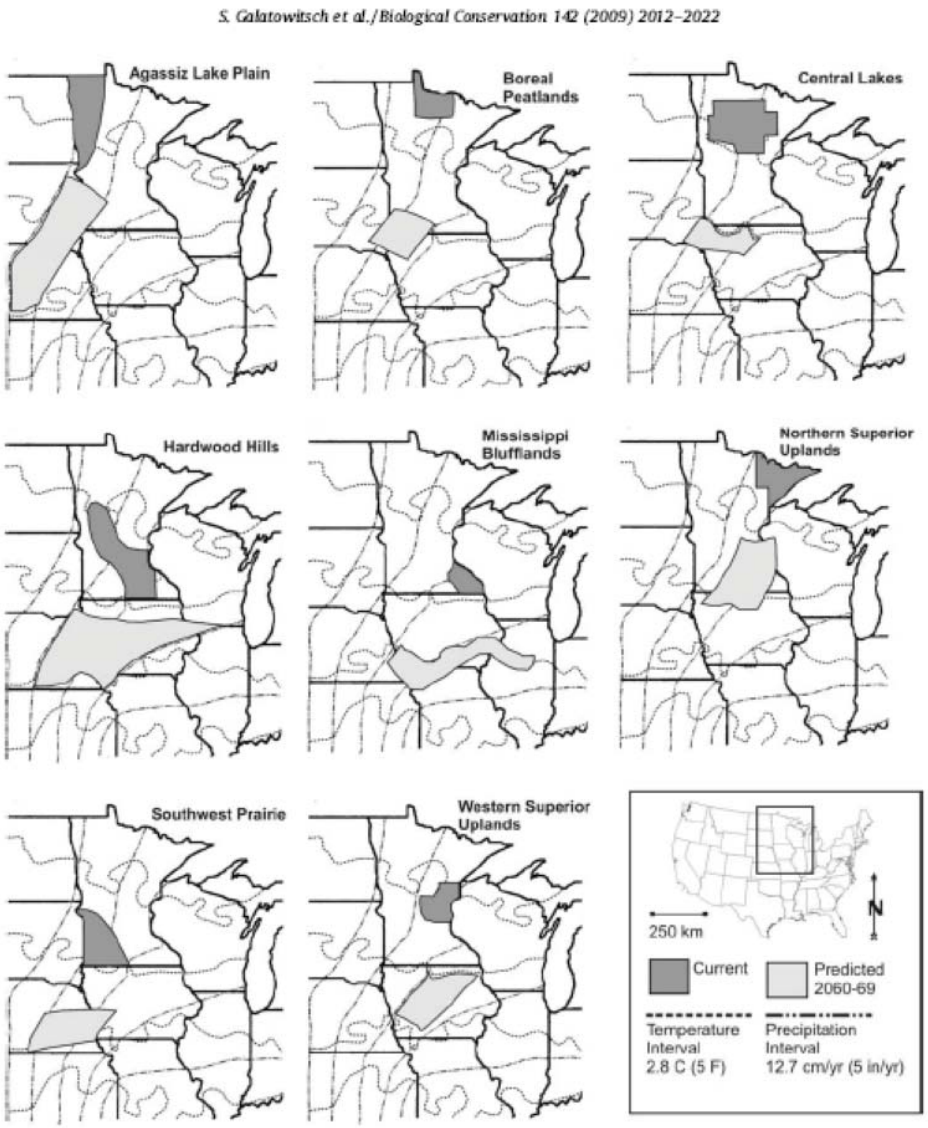
Terrestrial Climate Stress Index: Joyce et al. 2008

Warmer temperatures combined with reduced precipitation (or moisture availability) would shift the current location of the prairie-forest border to the northeast.



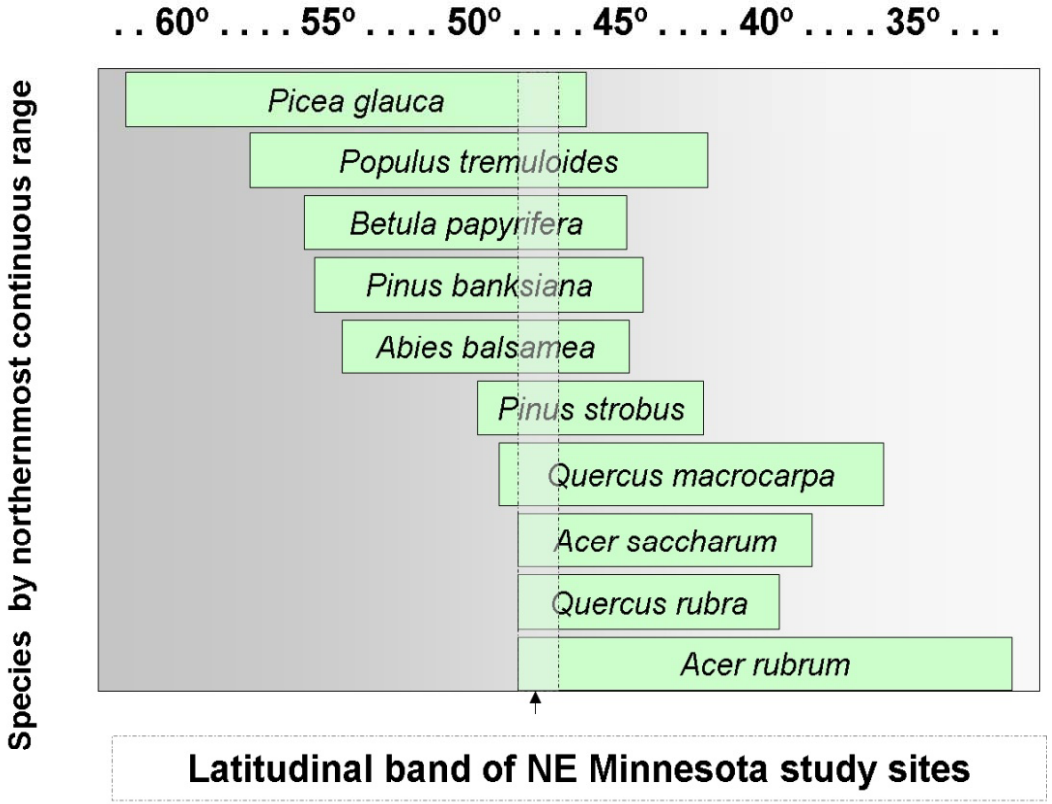
Prairie Forest boarder shift 300 miles

Climate envelopes for each Minnesota landscape based on projections for 2060-2069 on a base map of mean annual precipitation and temperature (1961-1990). Adopted from Galatowitsch et al. 2009



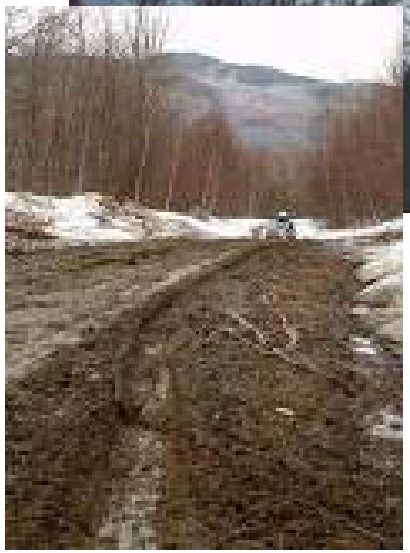
Future climate conditions may result in the extirpation of some common boreal species. Adopted from Boreal Forest Warming at an Ecotone in Danger (Reich).

Increasing oak-maple dominance in our forest communities under a warmer future would represent a shift from our boreal heritage. However, both the northern and temperate tree species may perform poorly under warmer conditions. If so, neither our current forest trees nor their potential replacements may be well suited to our future climate.



What are we already seeing

- Many northern tree species in eastern and central U.S. migrating north (6miles/year).
- Since the 1960's, 84% of resident forest birds in U.S. have shifted their winter range an average of 75 miles.
- Eastern Larch beetle has caused increased mortality in Tamarack trees and is likely increased because of warmer winters.
- Shorter winters are reducing the available time for winter logging operations.



Accelerated climate change will affect both the nature and extent of MN forests

- More frequent droughts and floods.

➢More frequent natural disturbance events.

  - Forest fires
  - Blow-downs
  - Ice storms

➢All coupled with increased insect outbreaks.

➢Increased tree mortality

Changes on Leopold's Farm

- Analysis of trends over 61- years.
- Resent Trends:
  - Cardinals sing 22 days earlier
  - Forest phlox blooms 15 days earlier
  - Butterfly weed blooms 18 days earlier.

System level changes

- Phenological Responses
  - Vary among species
  - Phenological mismatches
  - Timing of migration
  - Breeding
  - Flowering

- Food supply of pied flycatcher nestlings now peaks before the flycatchers arrive.

Inter play of existing threats and climate change

With increased disturbance and drought, invasive species are expected to disrupt existing species assemblages, potentially becoming dominant species in some areas.

Invasive species

Many insects will respond rapidly to climate change, allowing them to expand into forests that have been outside their range. Warmer winters in Western Canada has already resulted in range expansion of mountain pine beetle (loss of 120 million cords)

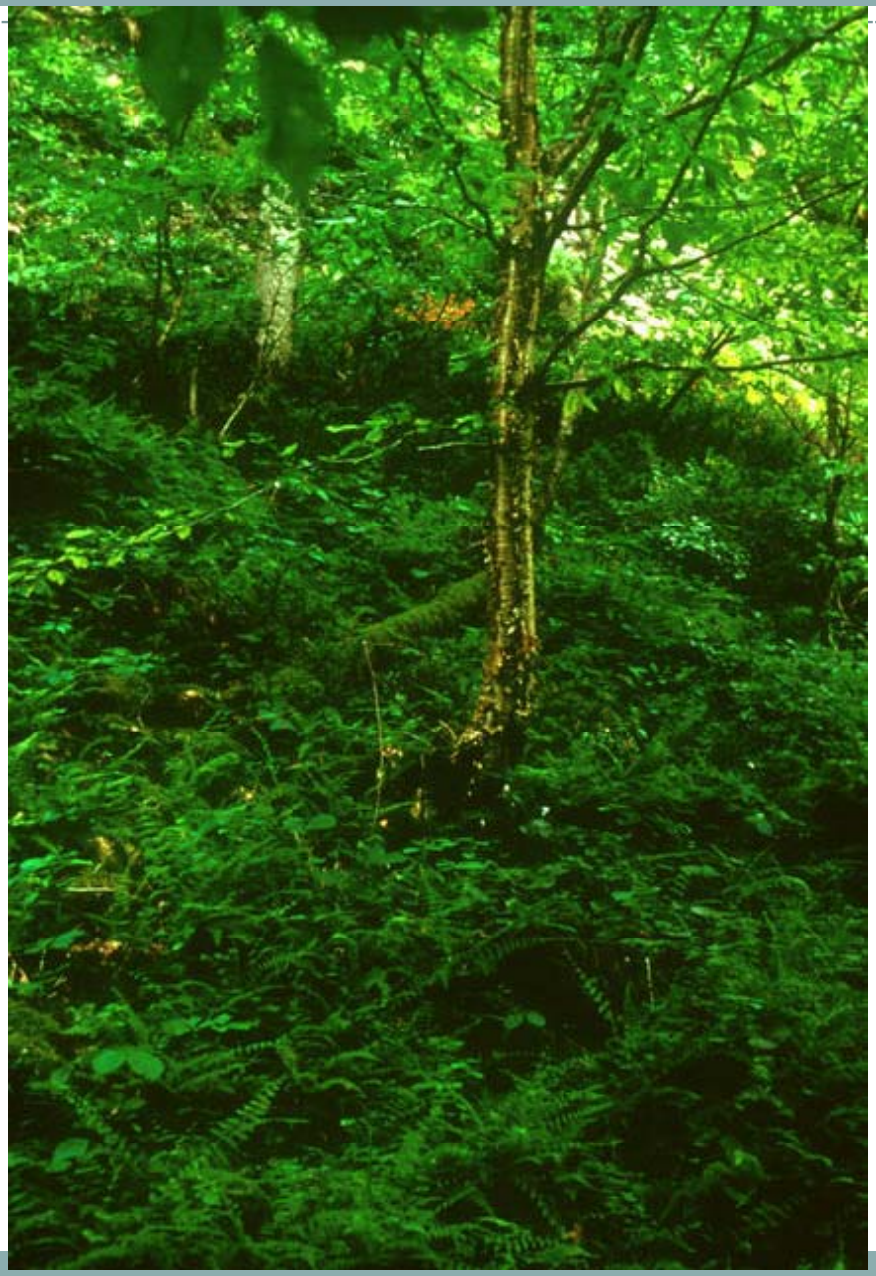
Insects and disease

Forest systems are fragmented due to agriculture, development, and some forest management practices, reducing ecological connectivity. Such fragmentation is most pronounced in southern portions of the state.

Connectivity

Net effects

- Warming will cause shifts in species ranges
  - Reductions in current economic species
- Warming combined with precipitations could shift the location of prairie – forest border.
  - Ecosystem disruptions
  - Recreational changes
  - Changes in timber industry



Challenge for Resource Managers:

How to intervene in dynamically unfolding and uncertain system

Questions?