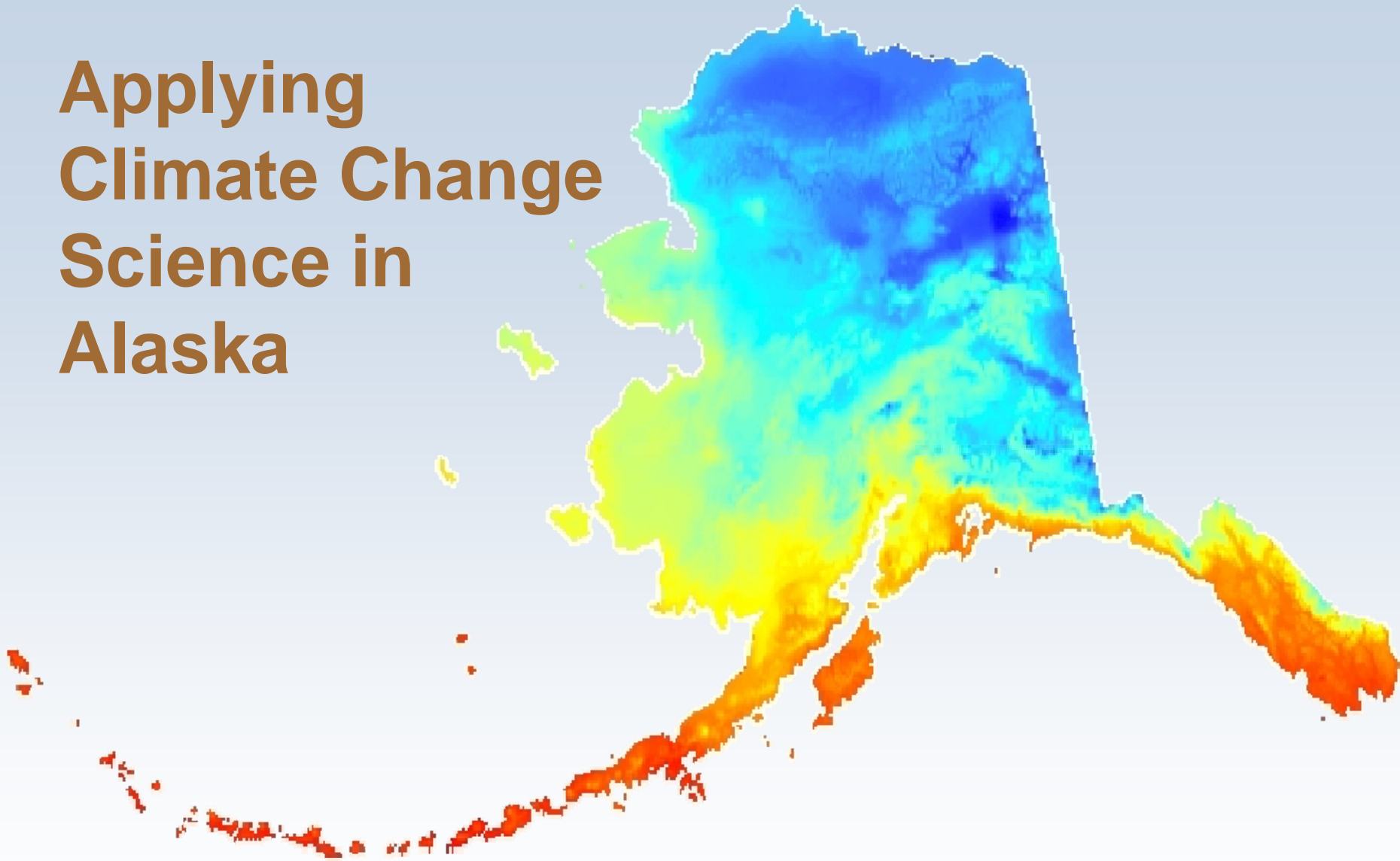


Applying Climate Change Science in Alaska



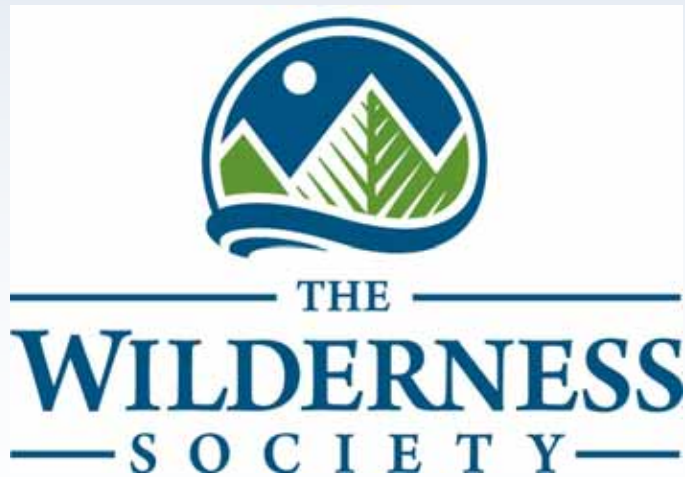
Wendy M. Loya
The Wilderness Society

Co-Authors

Anna Springsteen (SNAP UAF)

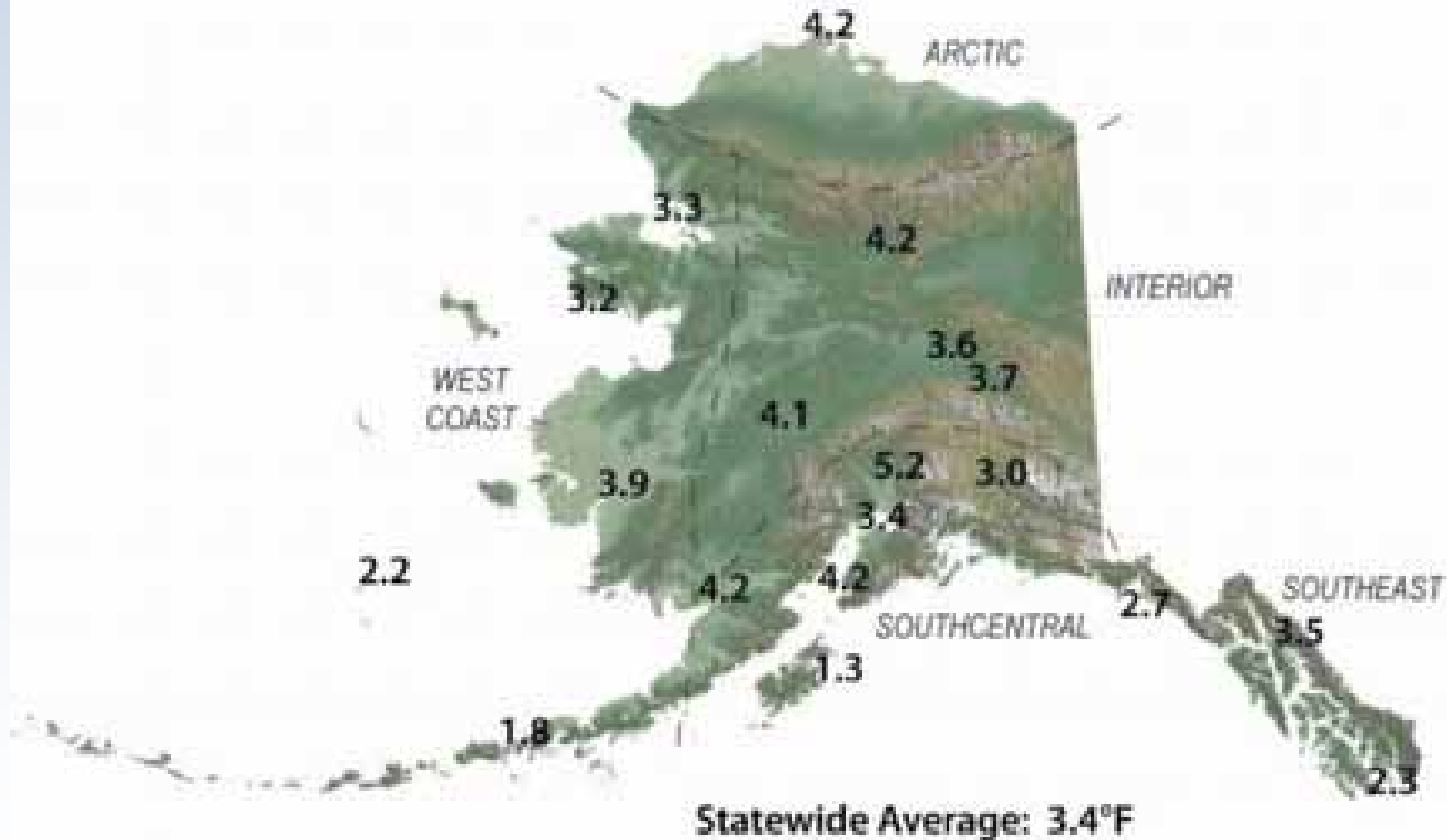
Brendan O'Brien (The Wilderness Society)

Dr. Scott Rupp (SNAP UAF)



Climate Change in Alaska

Total Change in Mean Annual Temperature (°F), 1949 - 2007



How will climate change affect species and ecosystems in Alaska?

What can biologists and refuge managers do today to address the effects of climate change?



Climate Change Science Tools for Conservation in Alaska



Dr. Alfred Brooks

Long-term monitoring

Experimental Studies

Downscaled climate models

Spatially directed ecosystem
x climate modeling





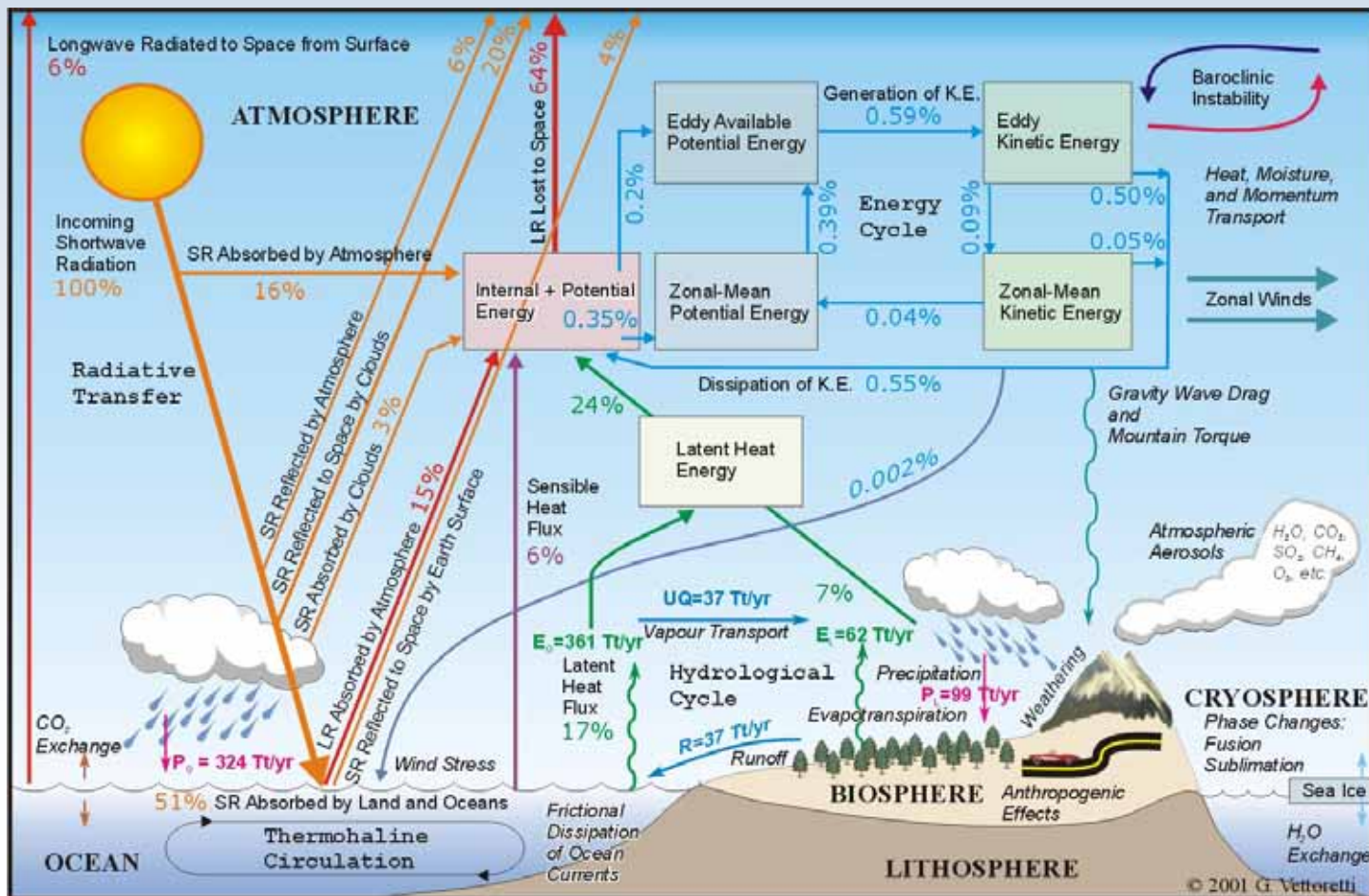
Downscaled Climate Models

Global Circulation Models (GCMs):
Project future Temperature & Precipitation, & other climate variables

5 Models

- Echam5
- Gfdl2.1
- Miroc3.2MR
- HadCM3
- CGCM3.1

Composite
(average) of all 5

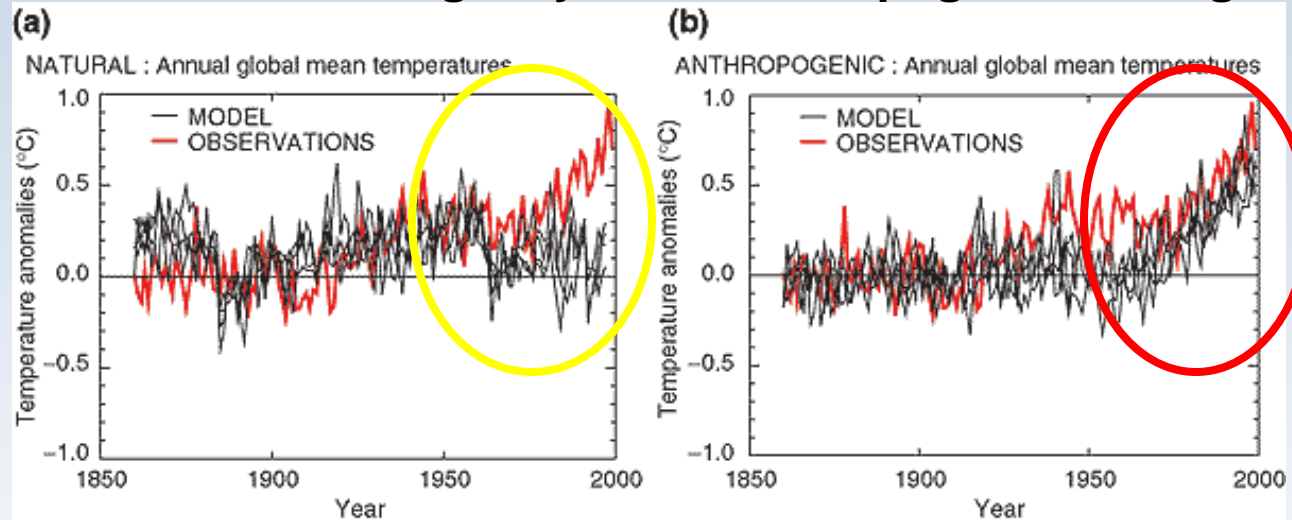


GCMs:

Despite uncertainty, they do a pretty good job...

Natural forcing only

Anthropogenic forcing only

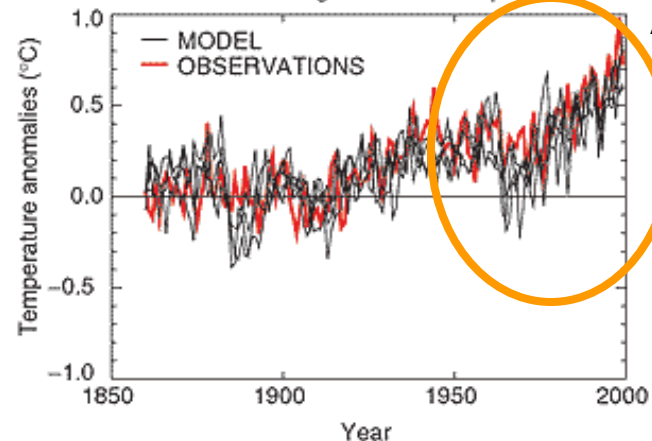


Evaluation of the Change in Annual Global Temperature

Temperature anomalies = change in temperature relative to 1880-1920

(c)

ALL FORCINGS : Annual global mean temperatures

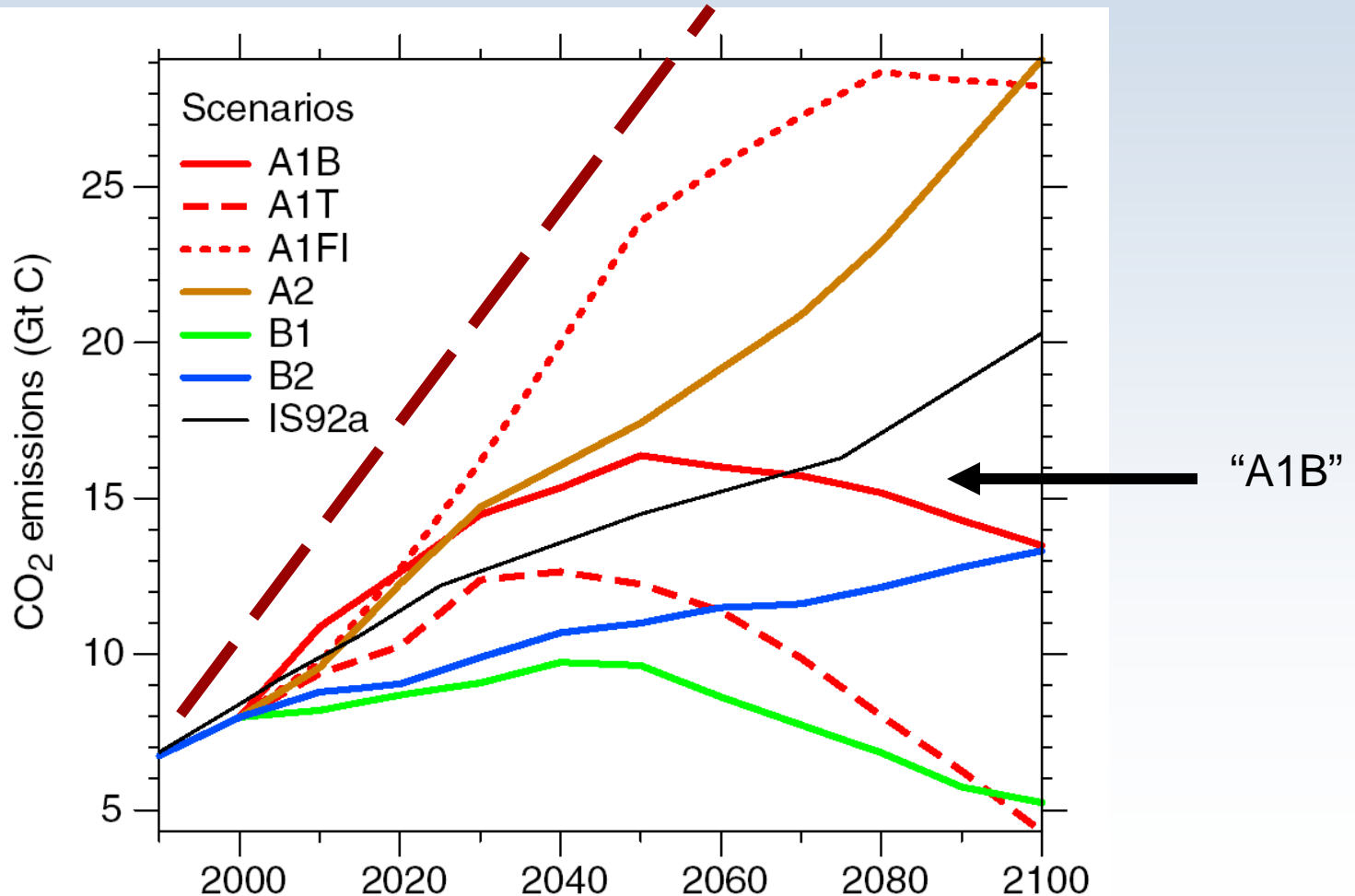


All forcings

Greenhouse gas emissions:

Which path will we take?

Our current trajectory is worse than the worst case scenario!



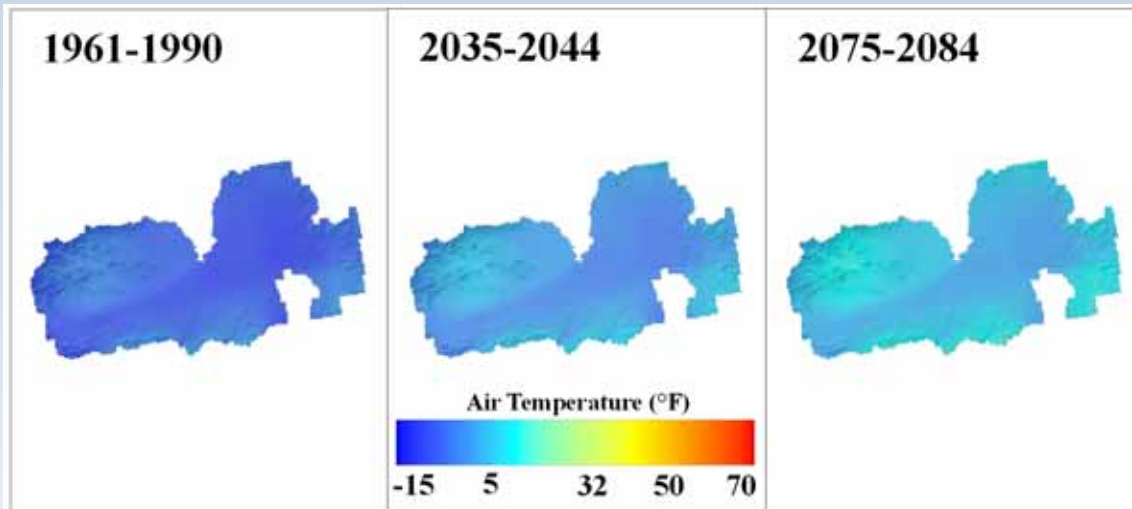
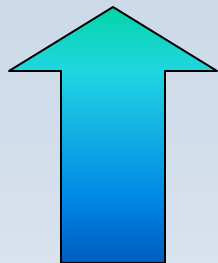
How will climate change affect species and ecosystems in Alaska?

- Direct and indirect impacts of climate change
- Extreme weather events
- Changes in the timings of seasonal events
- Shifts or losses of habitat
- Cumulative Effects of Impacts

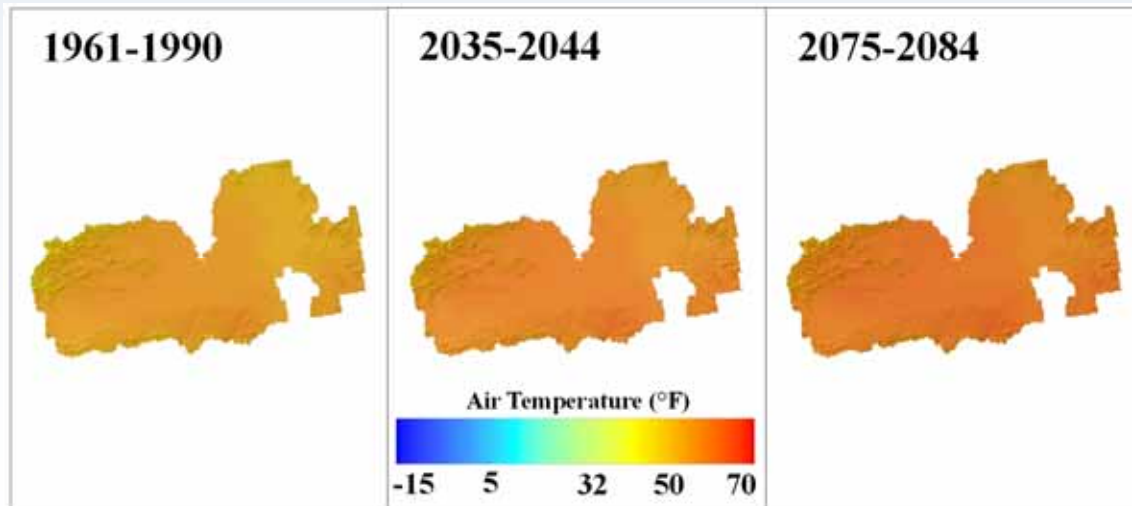
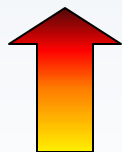


Temperature Change in Yukon Flats NWR

Winter
+12°F

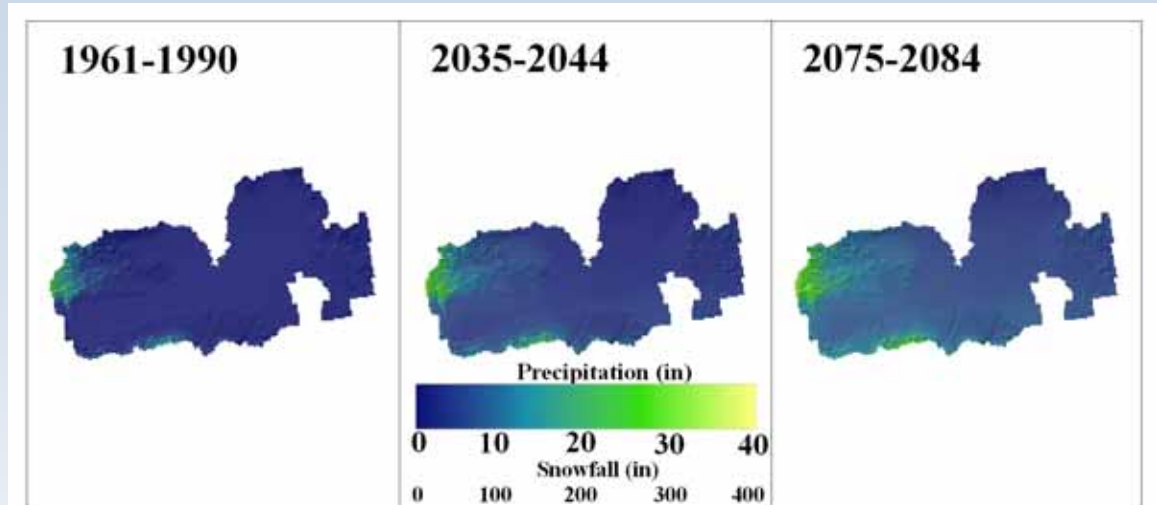
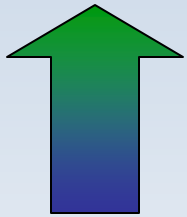


Summer
+6°F

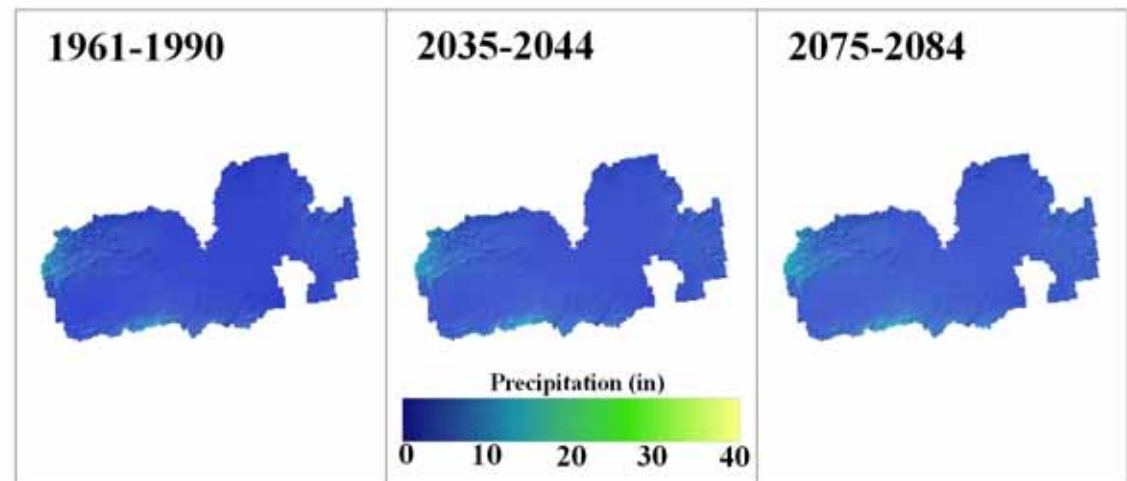


Precipitation Change in Yukon Flats NWR

Winter +66%



Summer +33%



How will climate change affect species and ecosystems in Alaska?

- Models predict continued increases in Temperature
- Precipitation is projected to increase

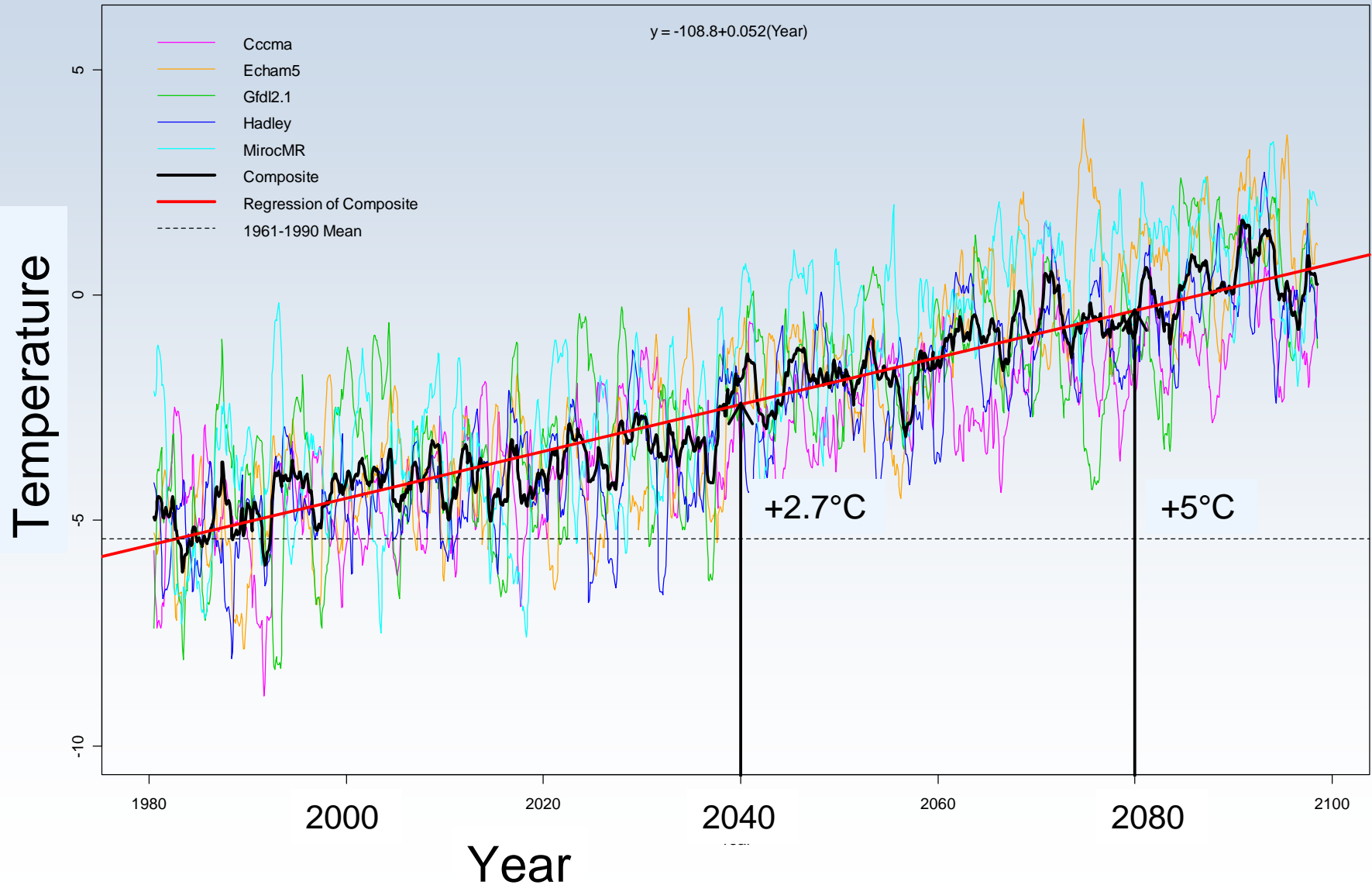
Hypothesis: Species and ecosystems will move northward and higher in elevation as the climate warms.

How do we test or verify these predictions?

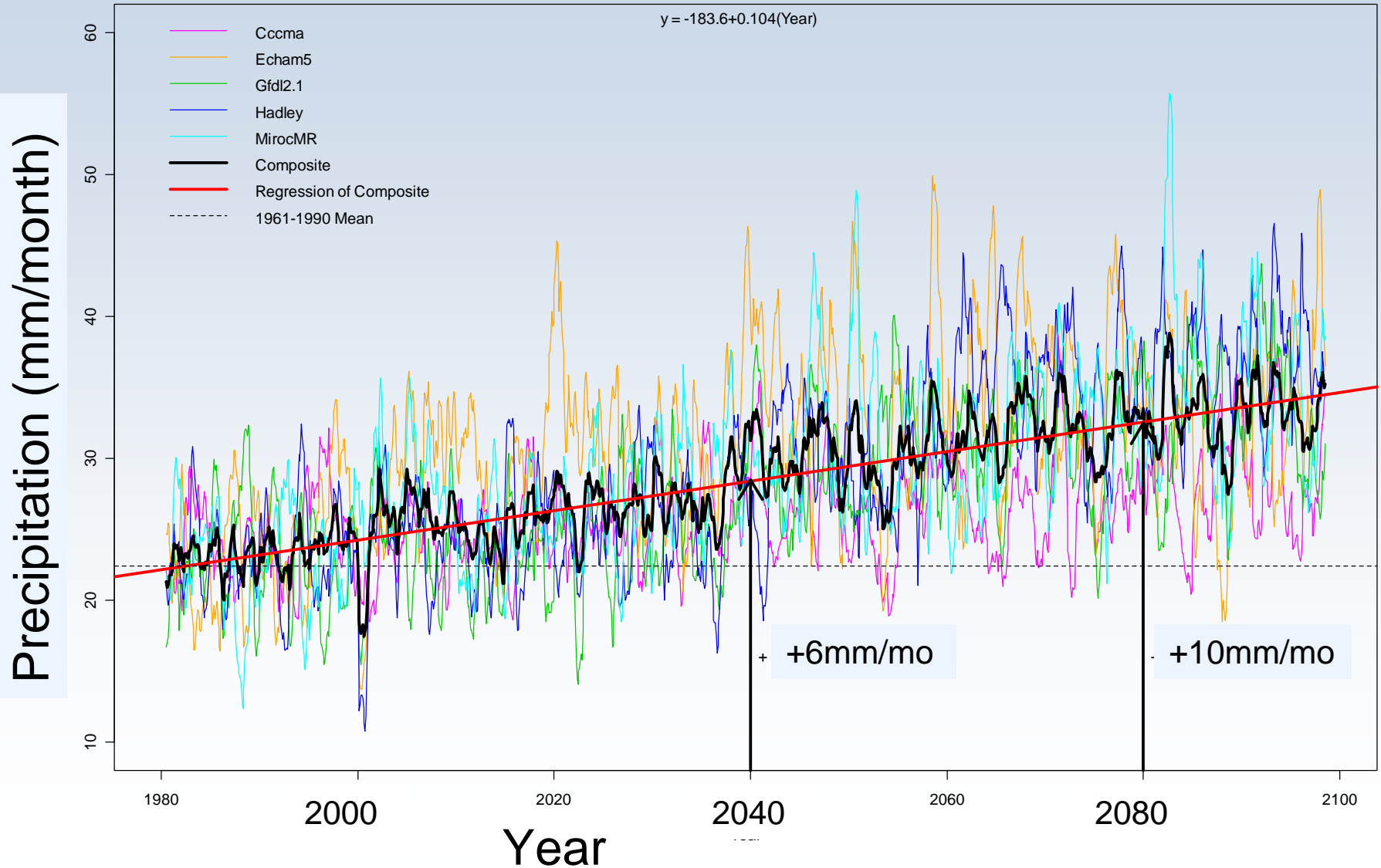
- Long Term Monitoring of Climate
- Inventory & Monitor Species to understand Habitat Requirements



Impacts of Extreme Events: Temperature in Yukon Flats NWR



Impacts of Extreme Events: Precipitation in Yukon Flats NWR



How will climate change affect species and ecosystems in Alaska?

The impacts of extreme weather events & variation

- Temperatures > Current Maximum Temps by 2040
- Variation among models and years results in high variation, especially for precipitation

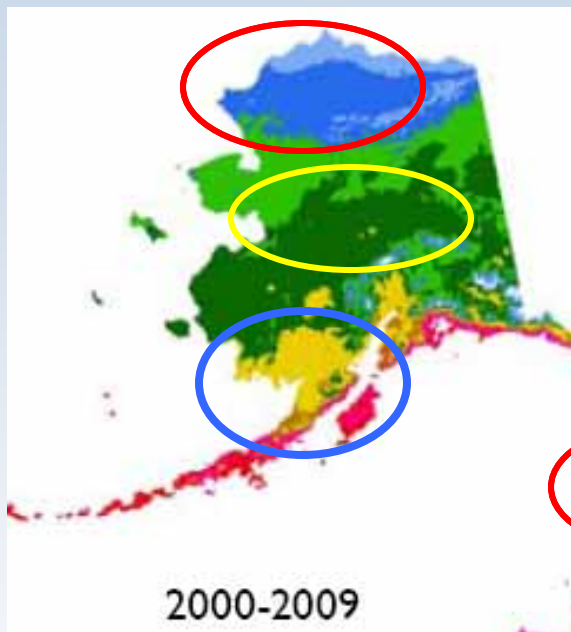


Hypothesis: Species will be pushed to their limits of survival during future extreme weather events

How do we test or verify these predictions?

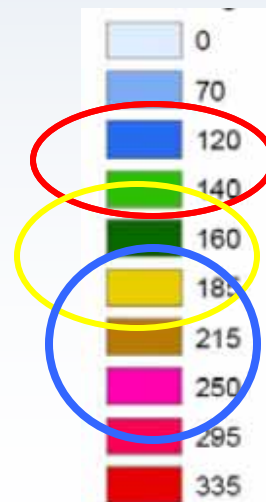
- Long Term Monitoring of Climate
- Long Term Monitoring of Populations & Health
- Experimental Studies to understand critical thresholds

Changes in the timing of seasonal events: Growing Season Length



Frost-Free Season:
~20 days longer
~25 days longer
~65 days longer

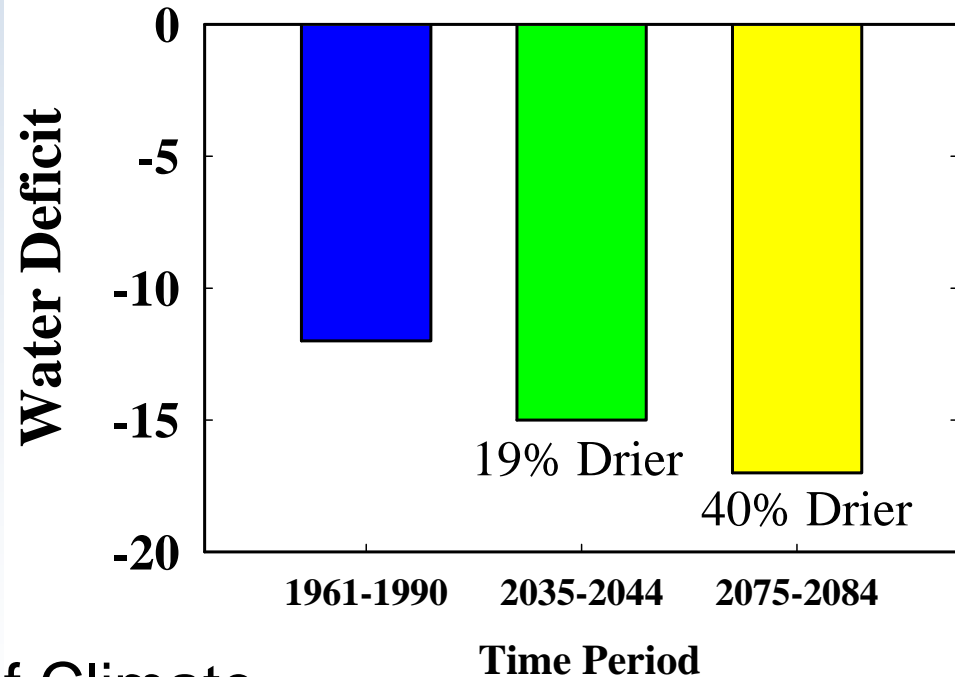
Season Length
(Days)



Changes in Water Availability In Yukon Flats NWR

Hypothesis: Despite increases in Precipitation, conditions predicted to become drier due to warmer temperatures and a longer growing season.

Water Deficit is the difference between the amount of Precipitation and Potential Evapotranspiration (P-PET)



Verify through:

- Long Term Monitoring of Climate
- Hydrologic monitoring

How will climate change affect species and ecosystems in Alaska?

Climate



Weather

Disturbance

Human activities
Industry
Fire Insects
Thermokarst

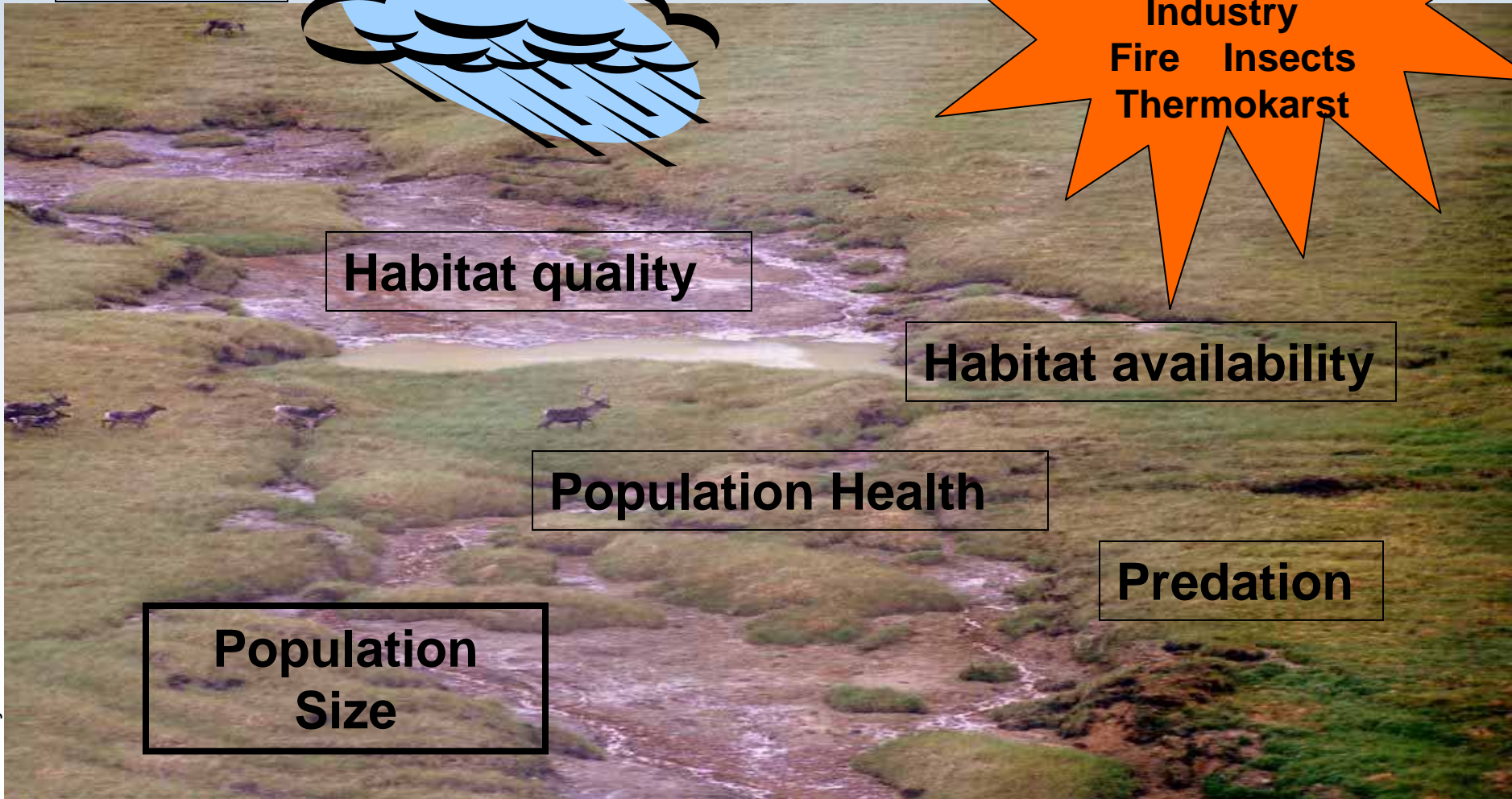
Habitat quality

Habitat availability

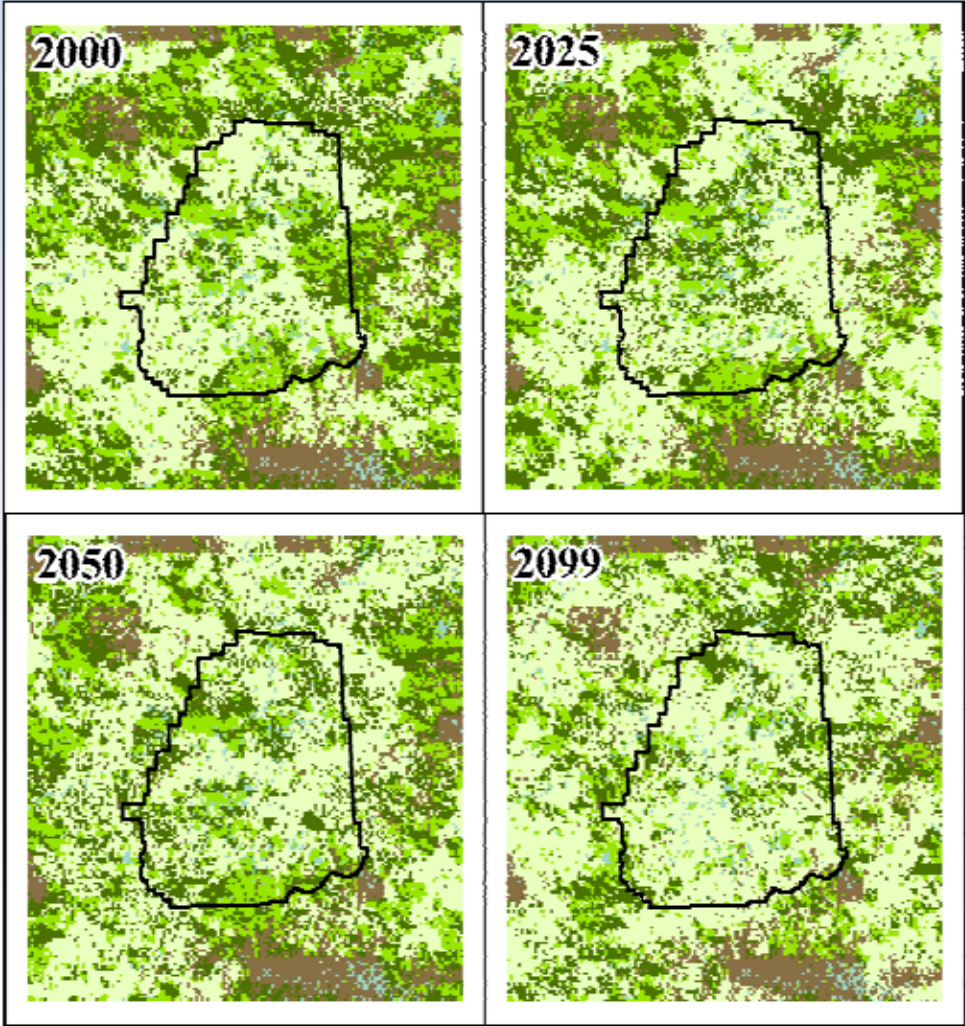
Population Health

Predation

**Population
Size**

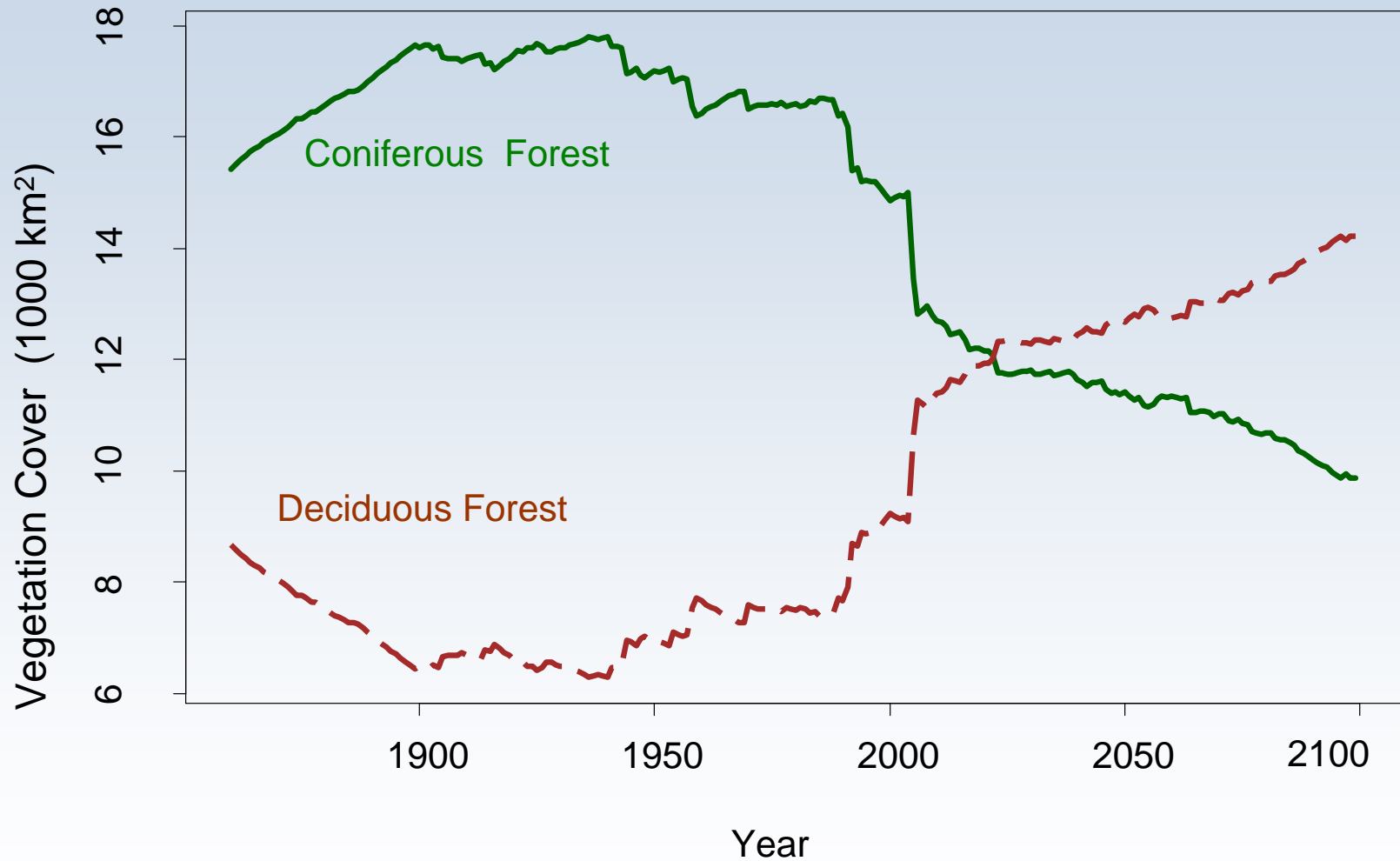


Climate x Ecosystem x Fire Modeling In Kanuti NWR



- No Vegetation
- Tundra
- Black Spruce
- White Spruce
- Deciduous

Climate x Ecosystem x Fire Modeling



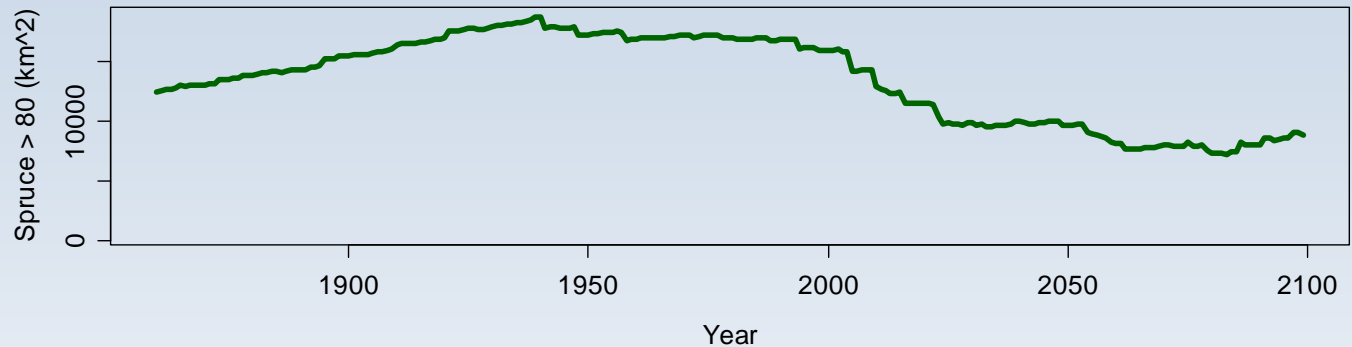
*Time series for the Composite climate scenario 1860-2099 based on the mean of replicates (n=500).
Data from Rupp & Springsteen, SNAP.*

Climate x Ecosystem x Fire Modeling

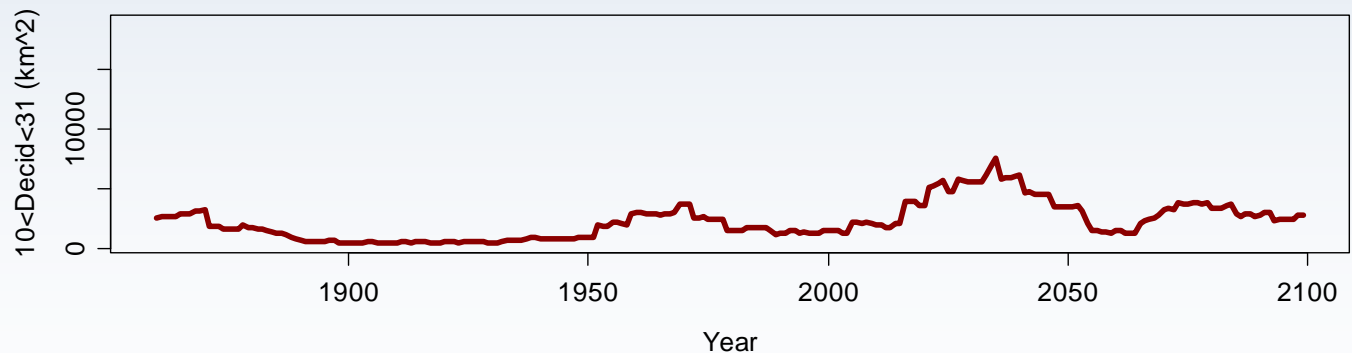
Wildlife Habitat Availability in Kanuti NWR



Caribou Winter Habitat



Moose Habitat

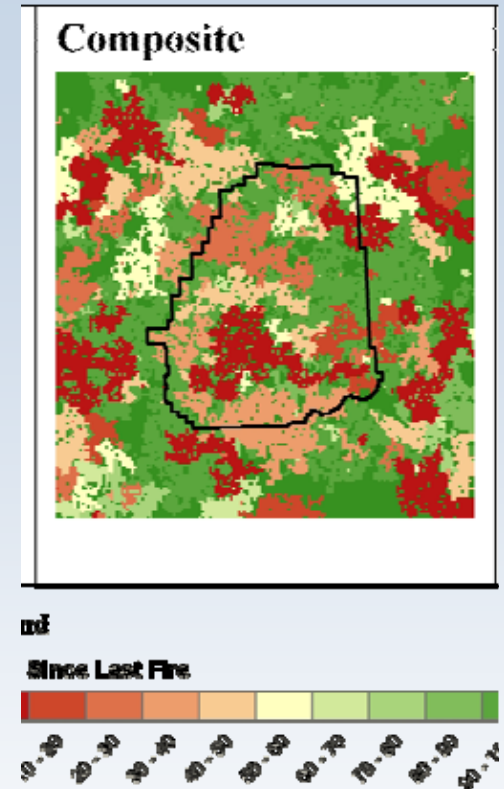


Habitat graphs showing how habitat is projected to change with the simulated fire activity in the Composite climate scenario. Data from Rupp & Springsteen, SNAP.

How will climate change affect species and ecosystems in Alaska?

- Warmer, drier conditions predicted to result in increased fire frequency and severity

Hypothesis: Habitat quality and availability for Moose will increase while Caribou winter habitat will decrease.



How do we test or verify these predictions?

- Long Term Monitoring of Climate
- Monitor habitat use by moose & caribou
- Long Term Monitoring of populations & health
- Map landcover and future fires

Summary

Down-scaled Climate Models provide scenarios to guide monitoring and assessment

- Arctic Alaska is projected to warm more in the next 40 years than it has in the last 50
- With only modest increases in summer precipitation, conditions may become significantly drier

Emissions reductions under A1B scenario don't reverse the course of change within the 21st century

- Long-term monitoring, Experimental Studies and Continually improving Models will help improve our ability to understand and manage for climate change

For More Information:

Climate Change Summaries
Available at:

The Wilderness Society Website
www.wilderness.org

Scenarios Network for Alaska
Planning Website:
<http://www.snap.uaf.edu/>

For more information:
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