Climate Change and Water in the Northeast

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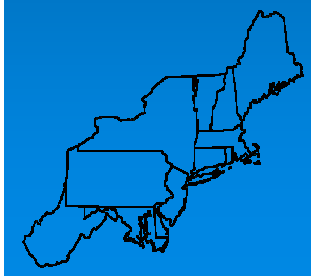
Director, Northeast Regional Climate Center



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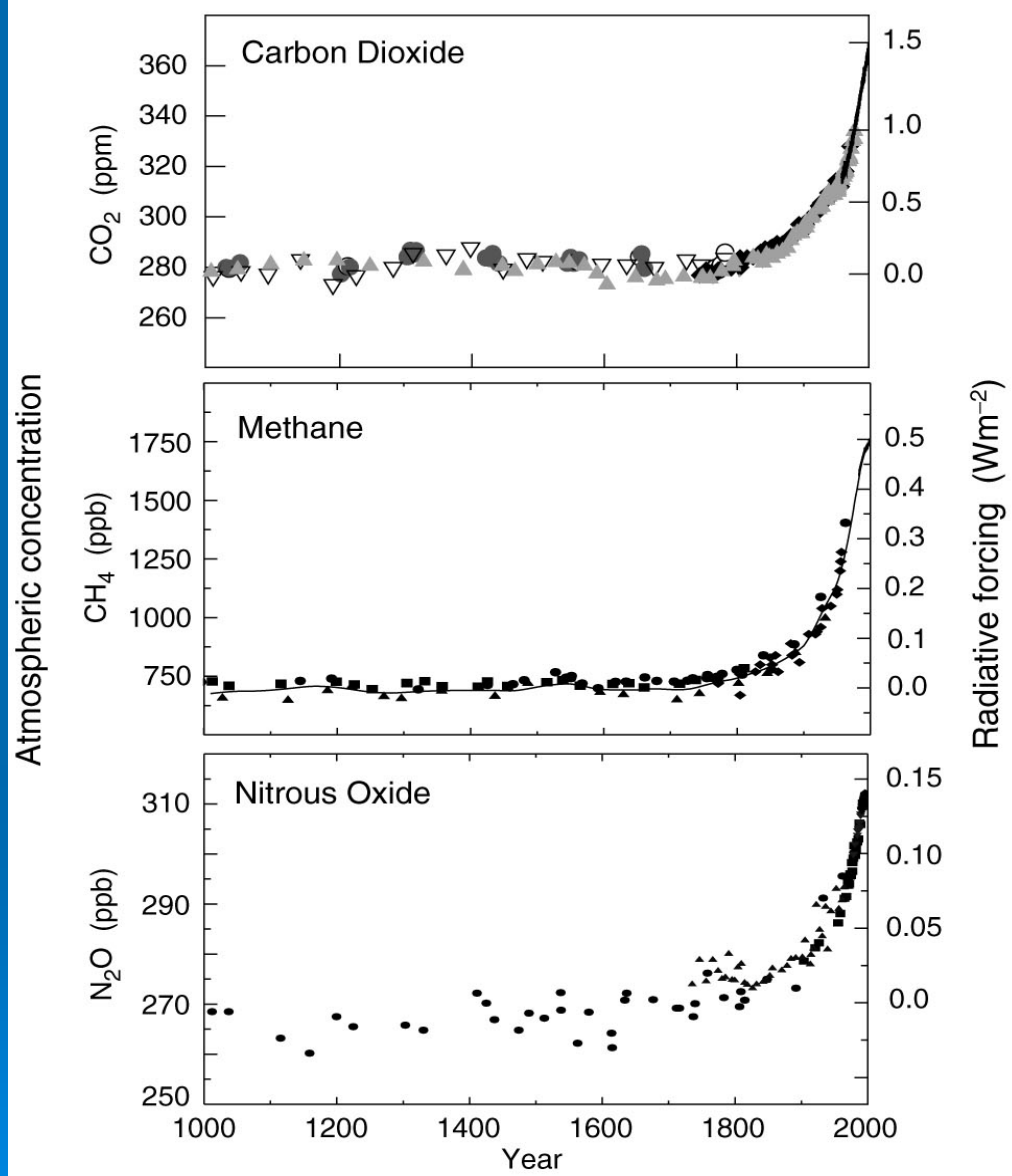
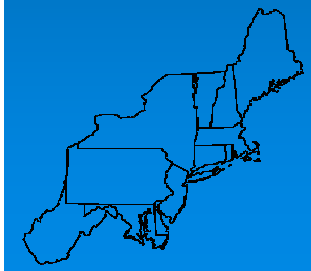
(a) Global atmospheric concentrations of three well mixed greenhouse gases





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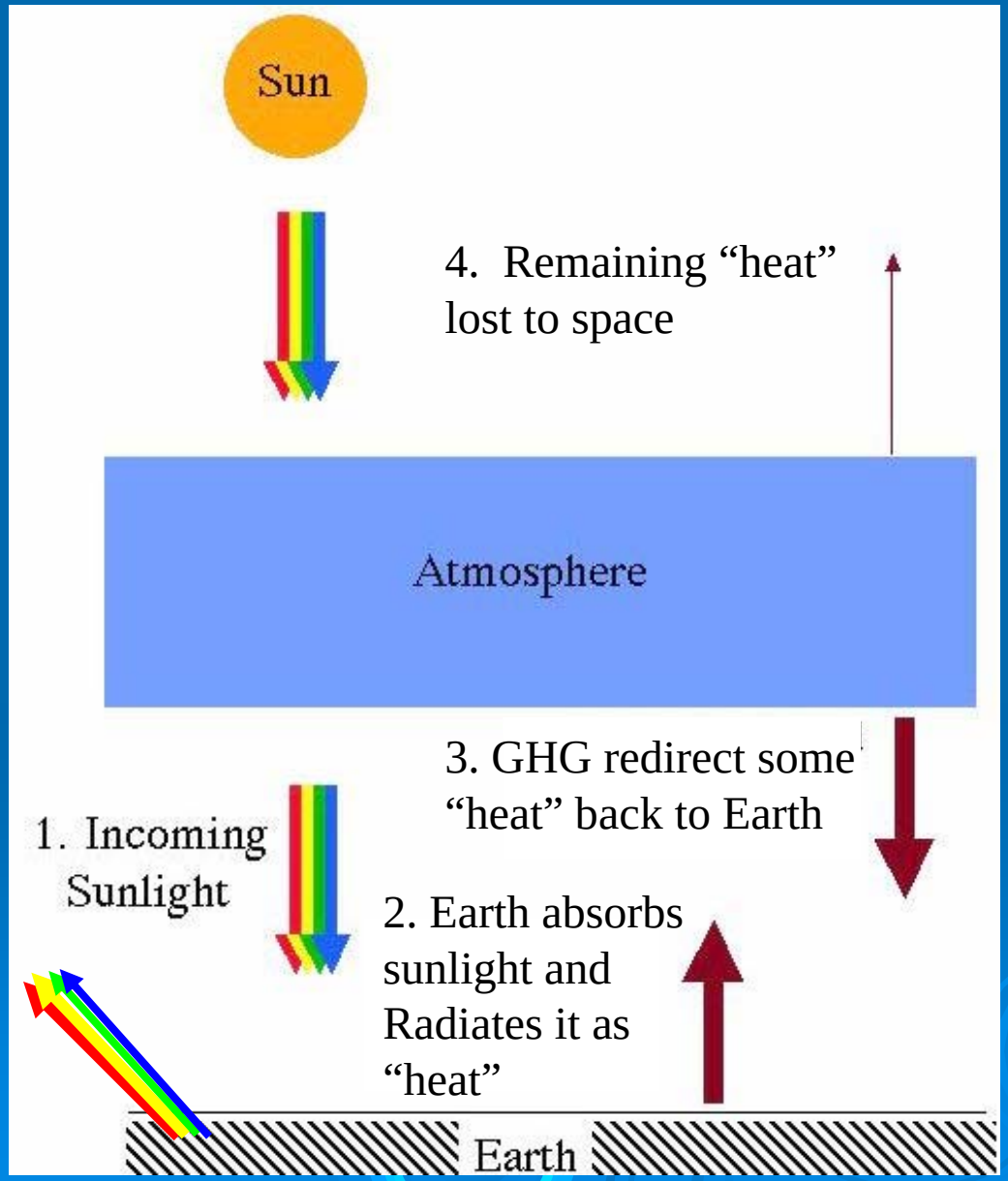
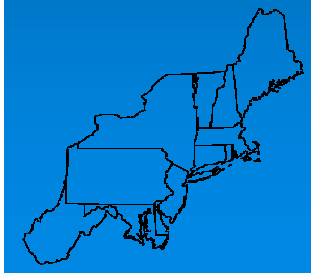
Alone GHG act as a Blanket





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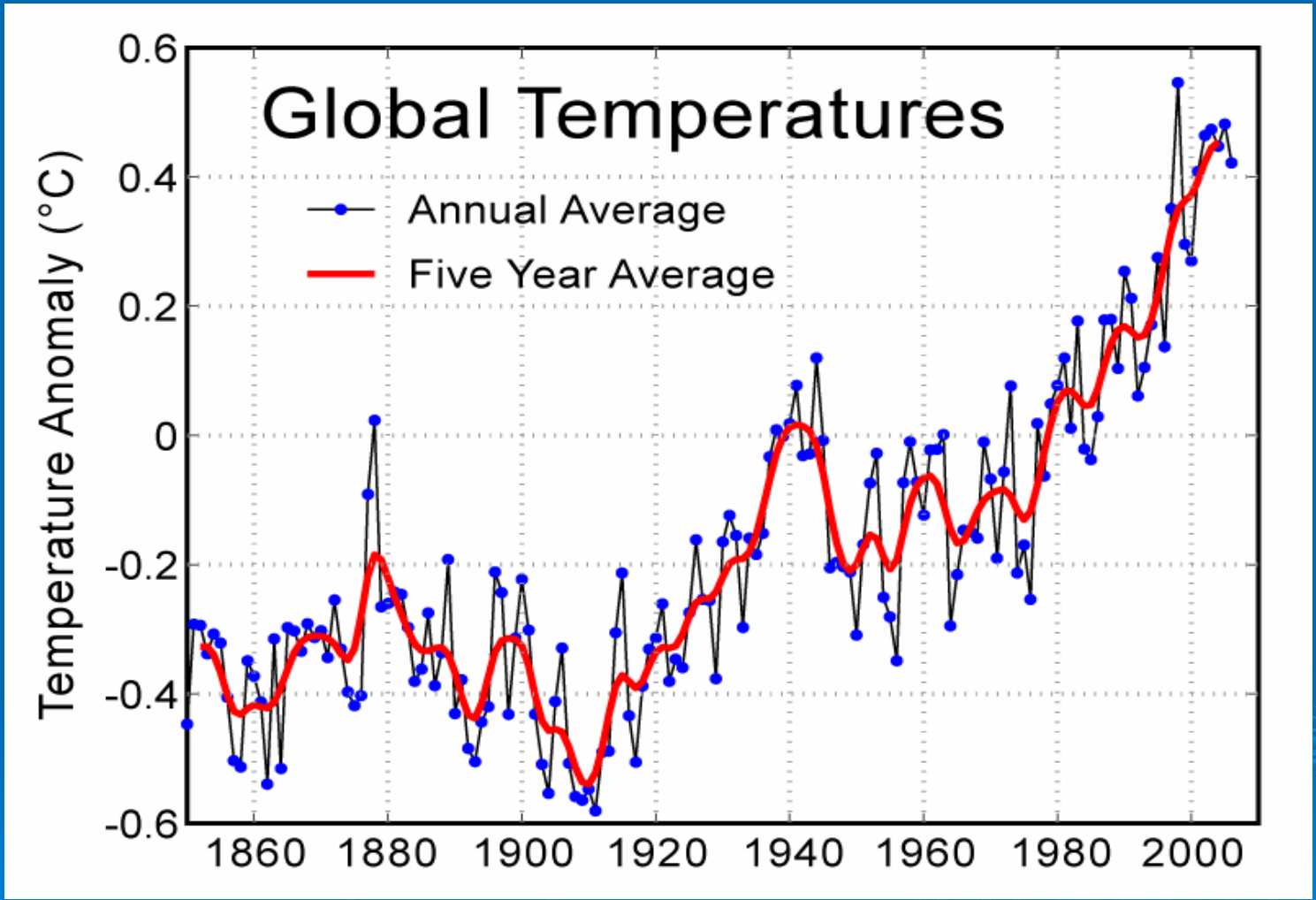
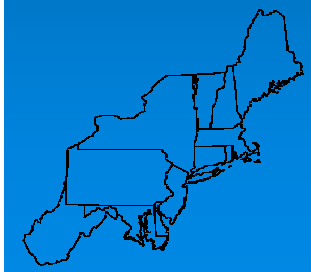
On the Ground





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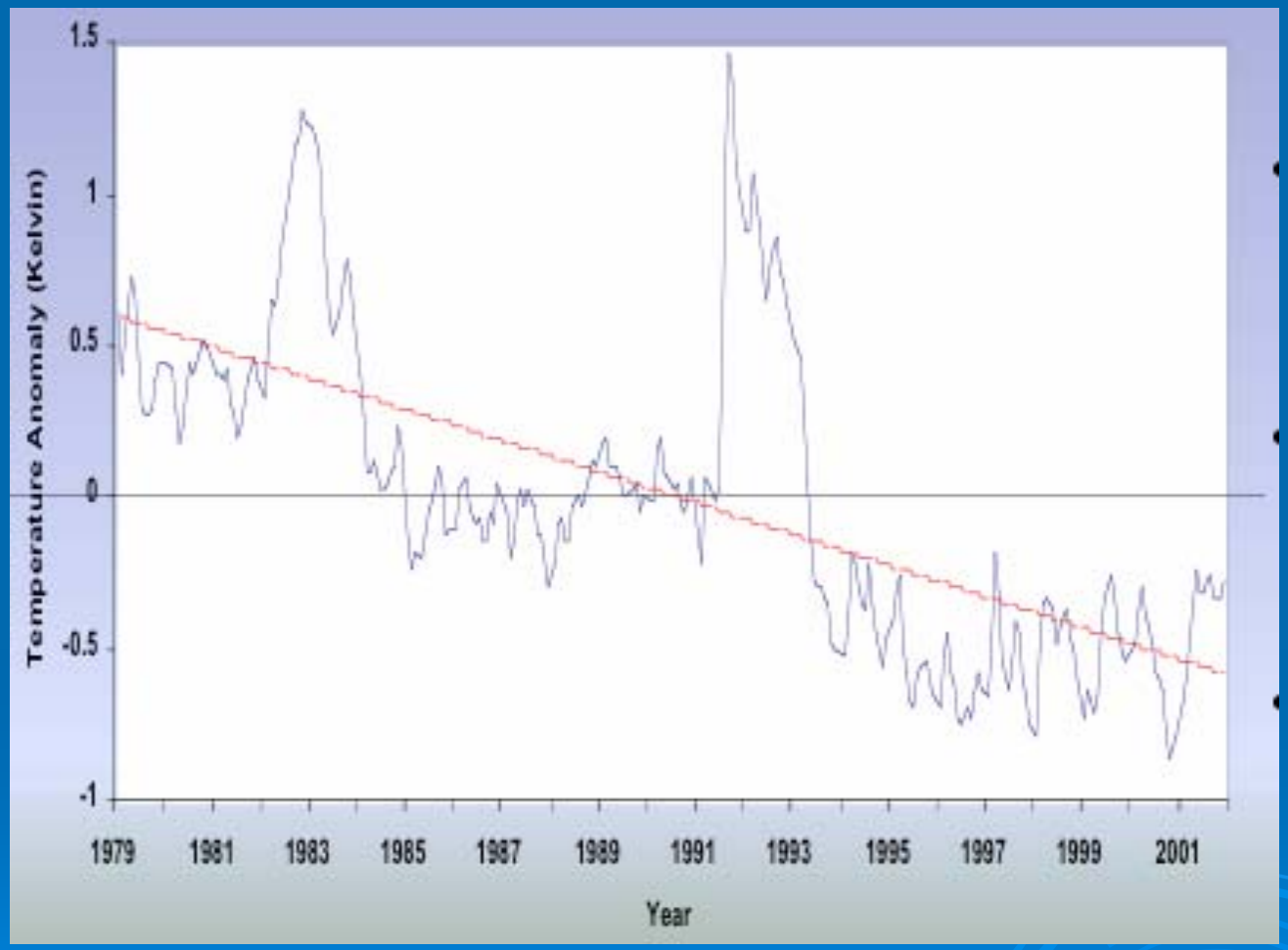
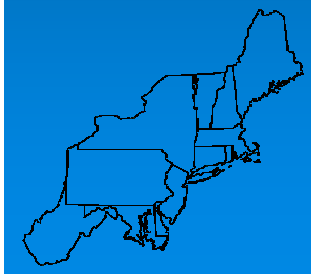
Aloft





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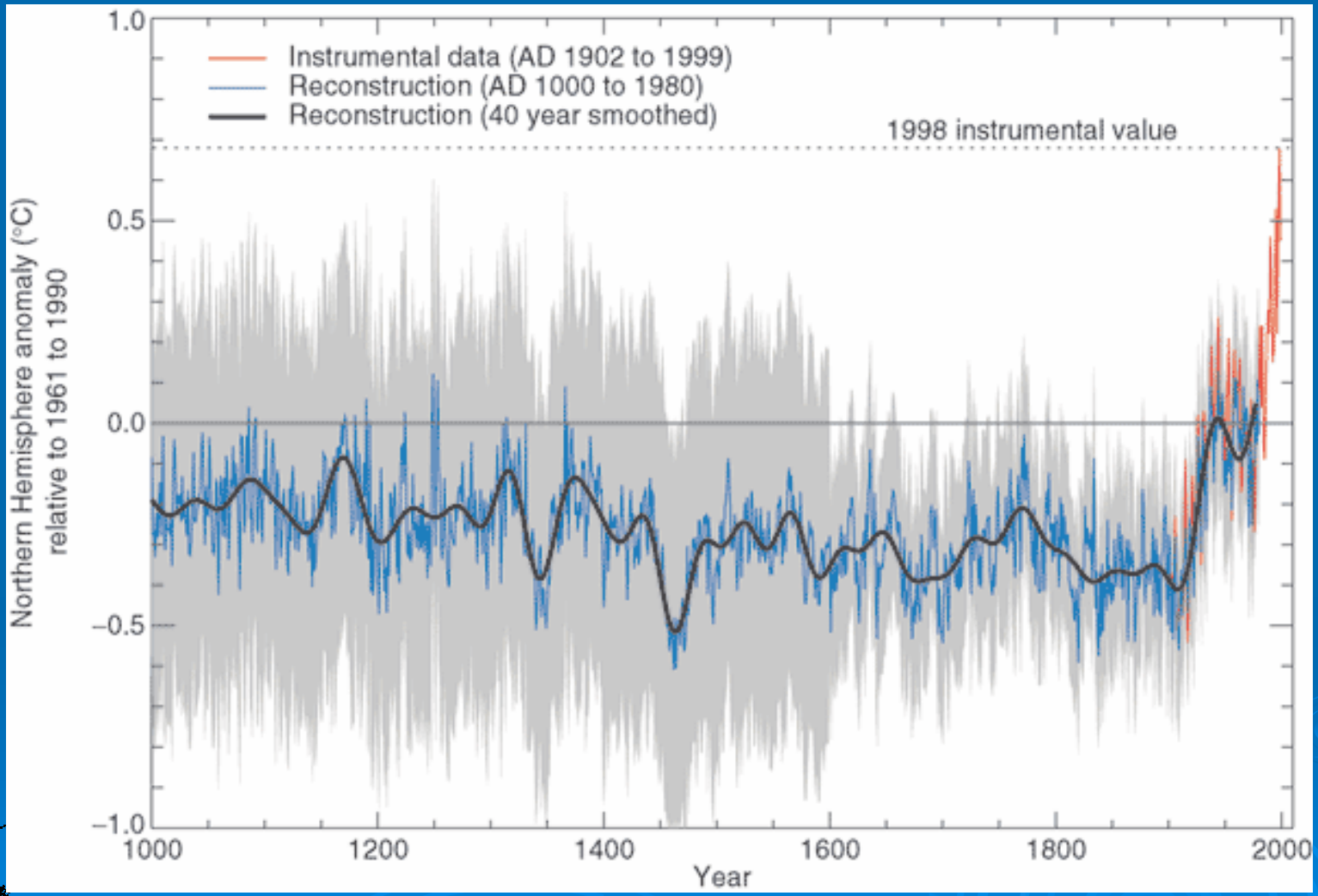
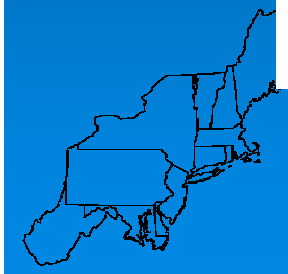
The “Hockey Stick”





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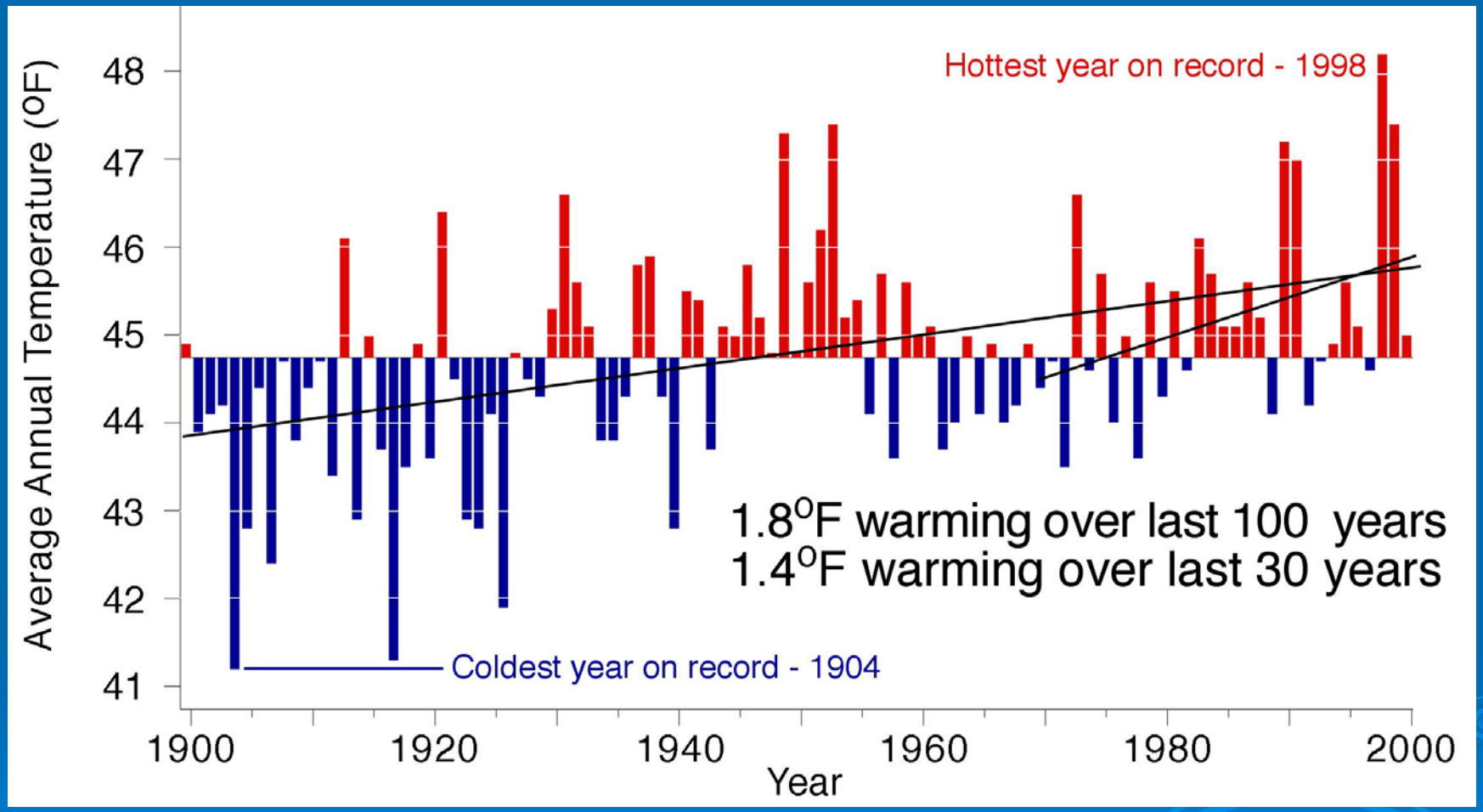
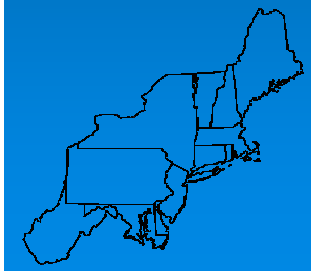
Average Annual Temperature in the Northeast





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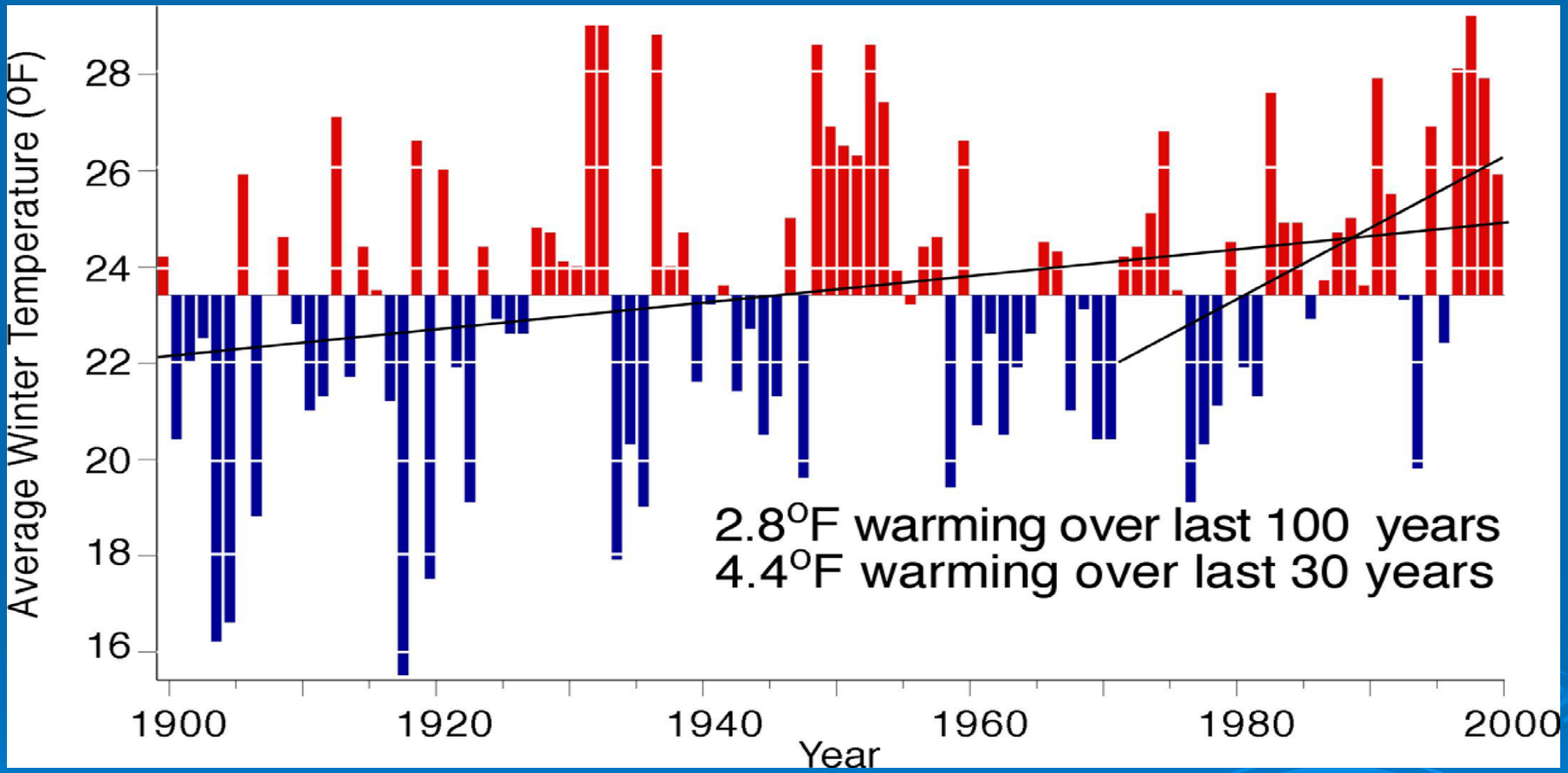
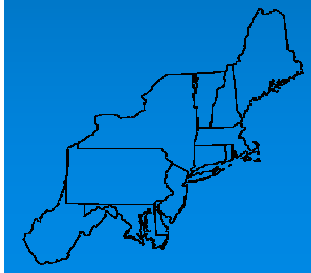
Average Winter Temperature in the Northeast





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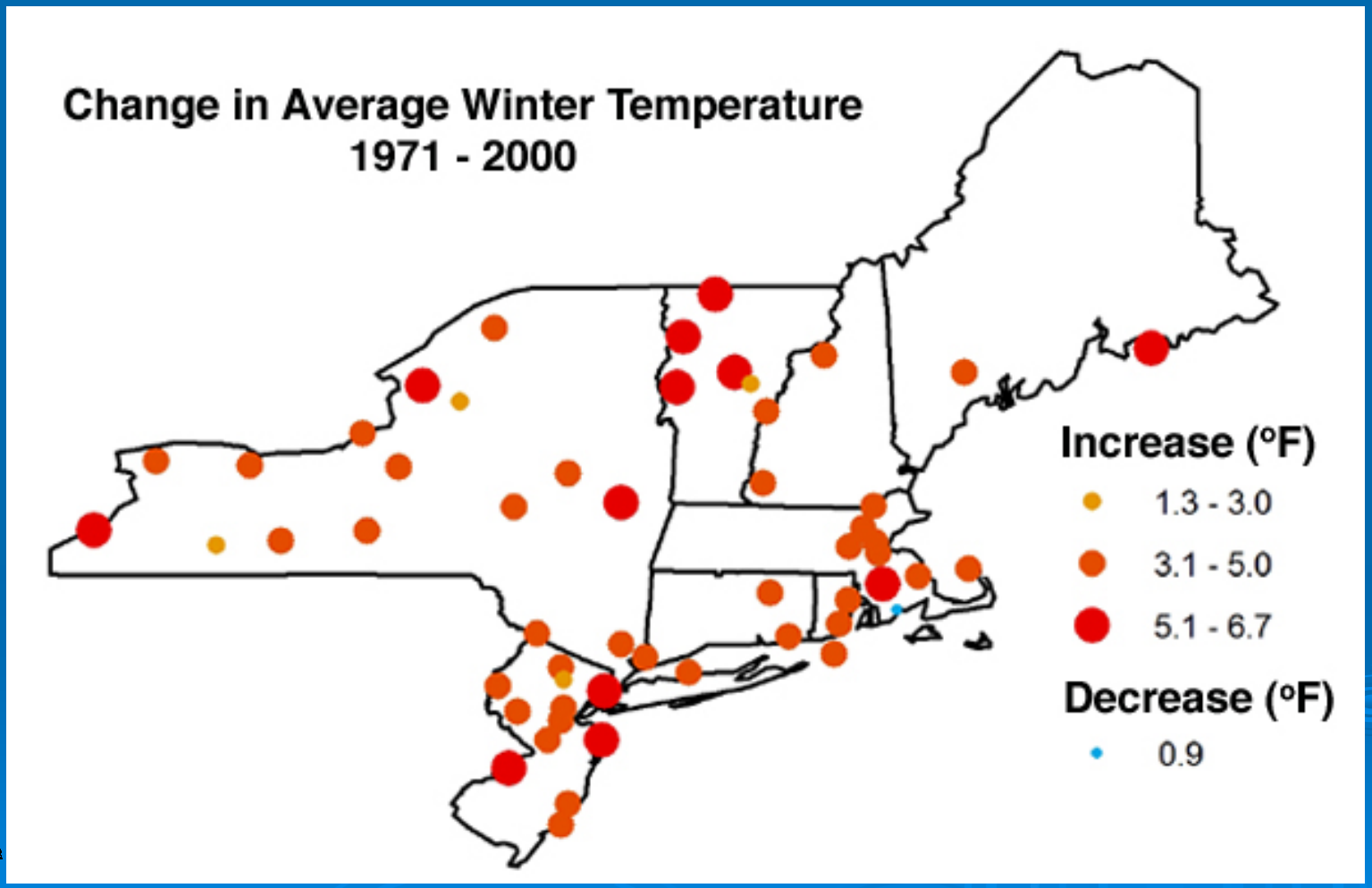
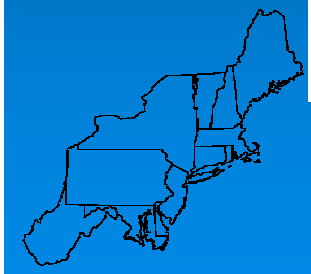
Spatial Variation Winter Linear Temperature Trend 1970-2000





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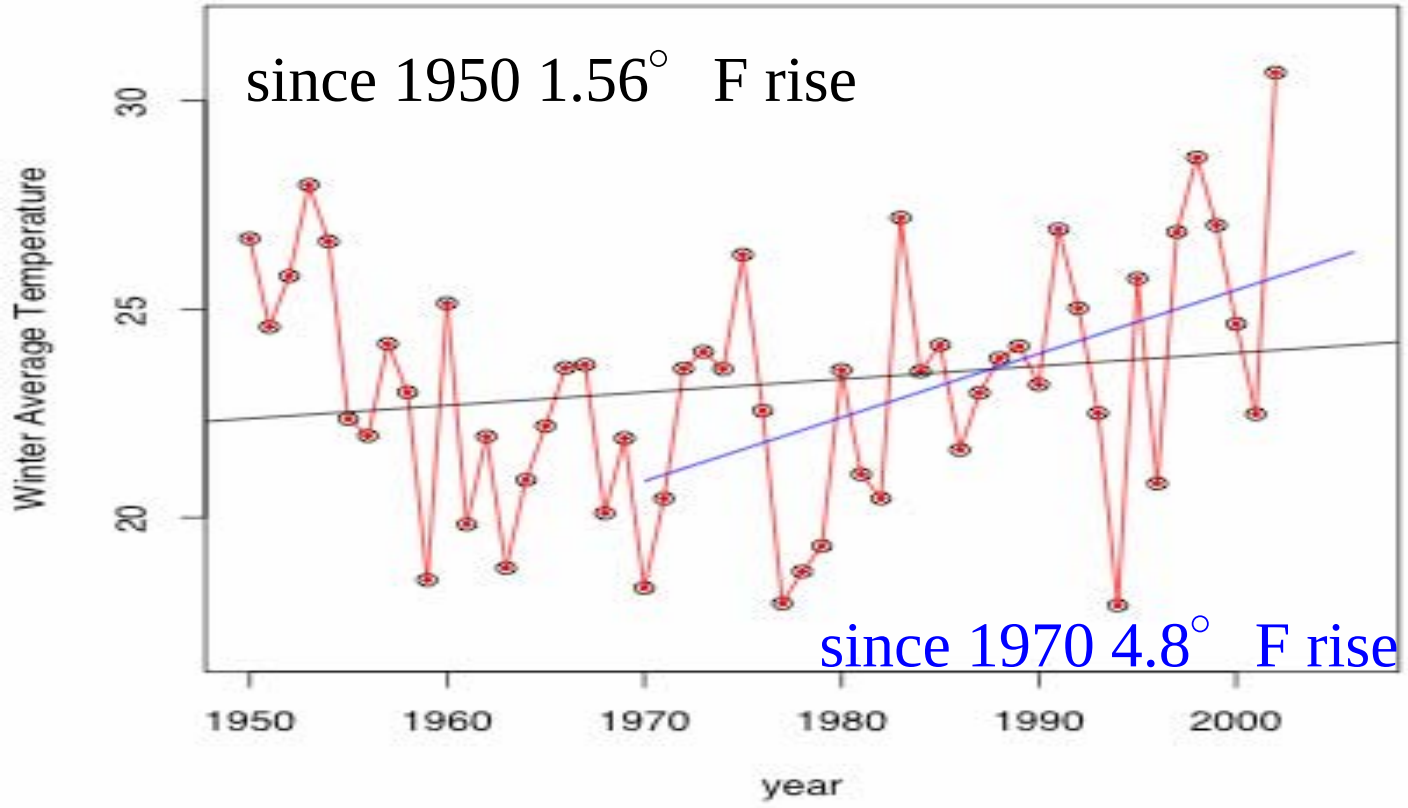
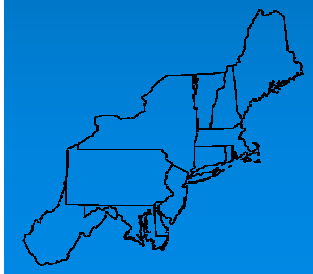
New York Winter Trends

December, January February Temperature





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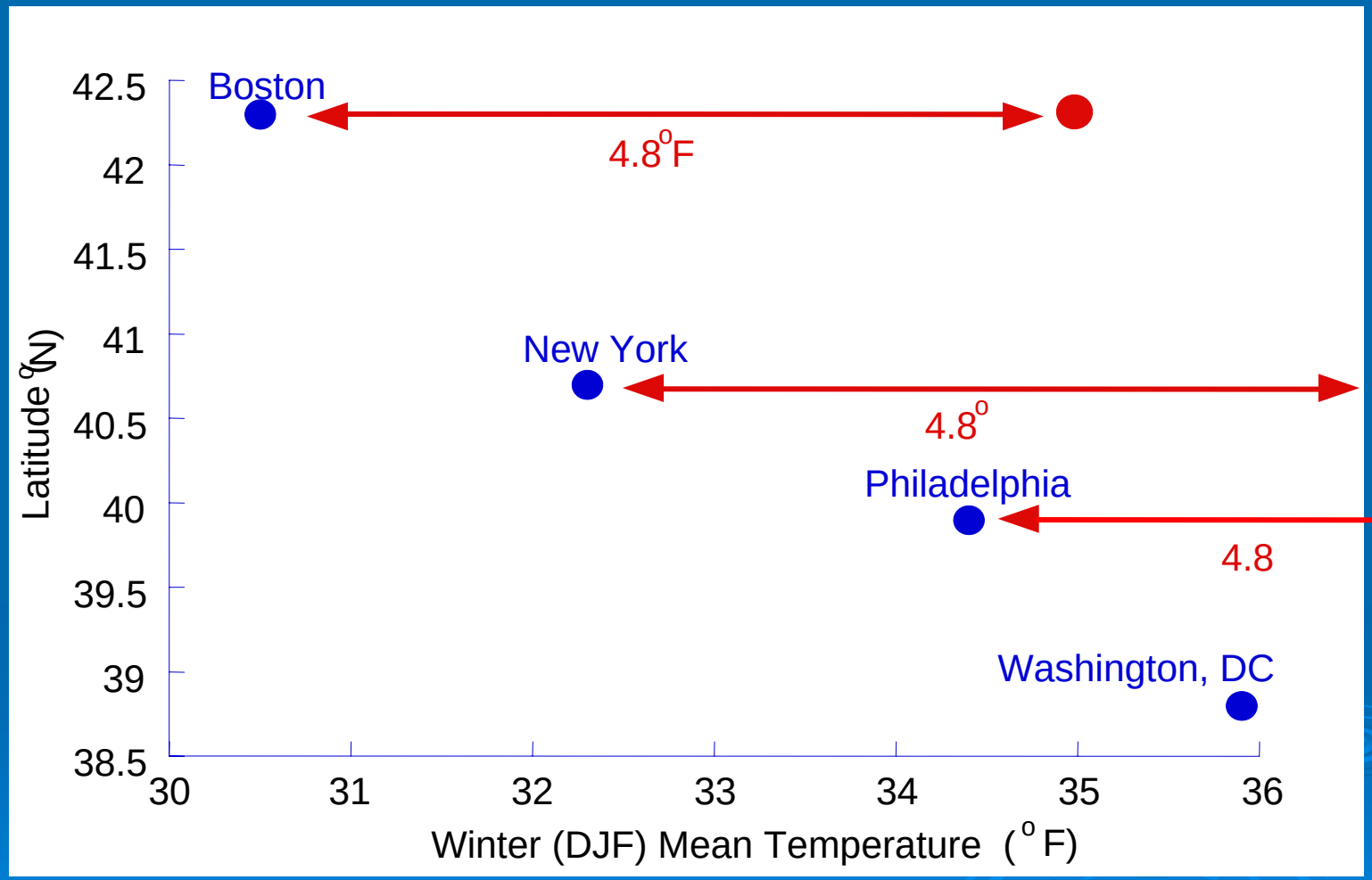
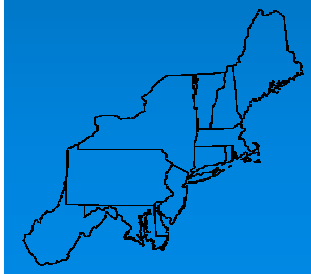
Significant Change in Winter Climate!





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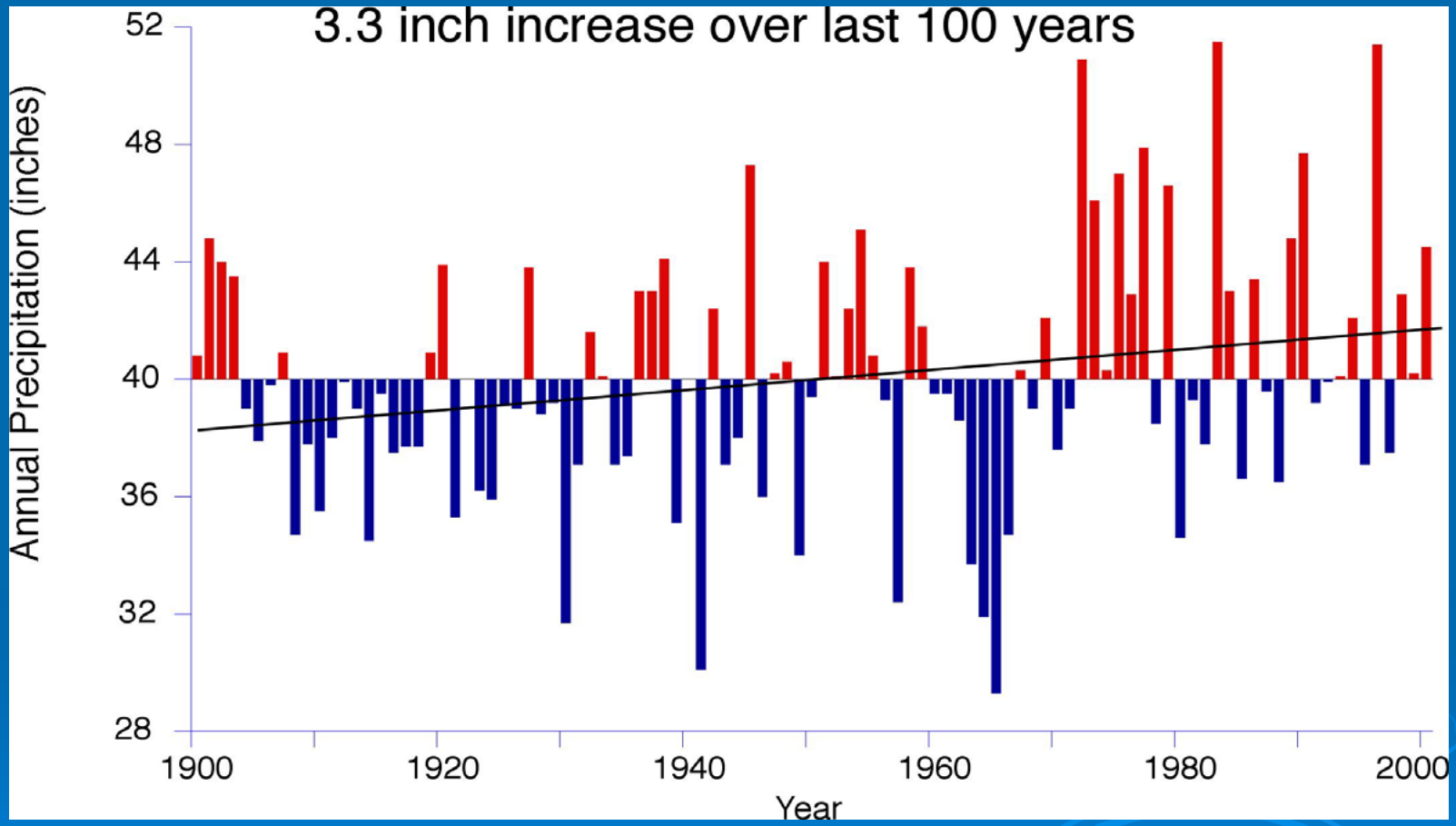
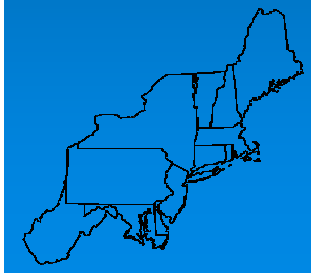
Average Annual Precipitation in the Northeast





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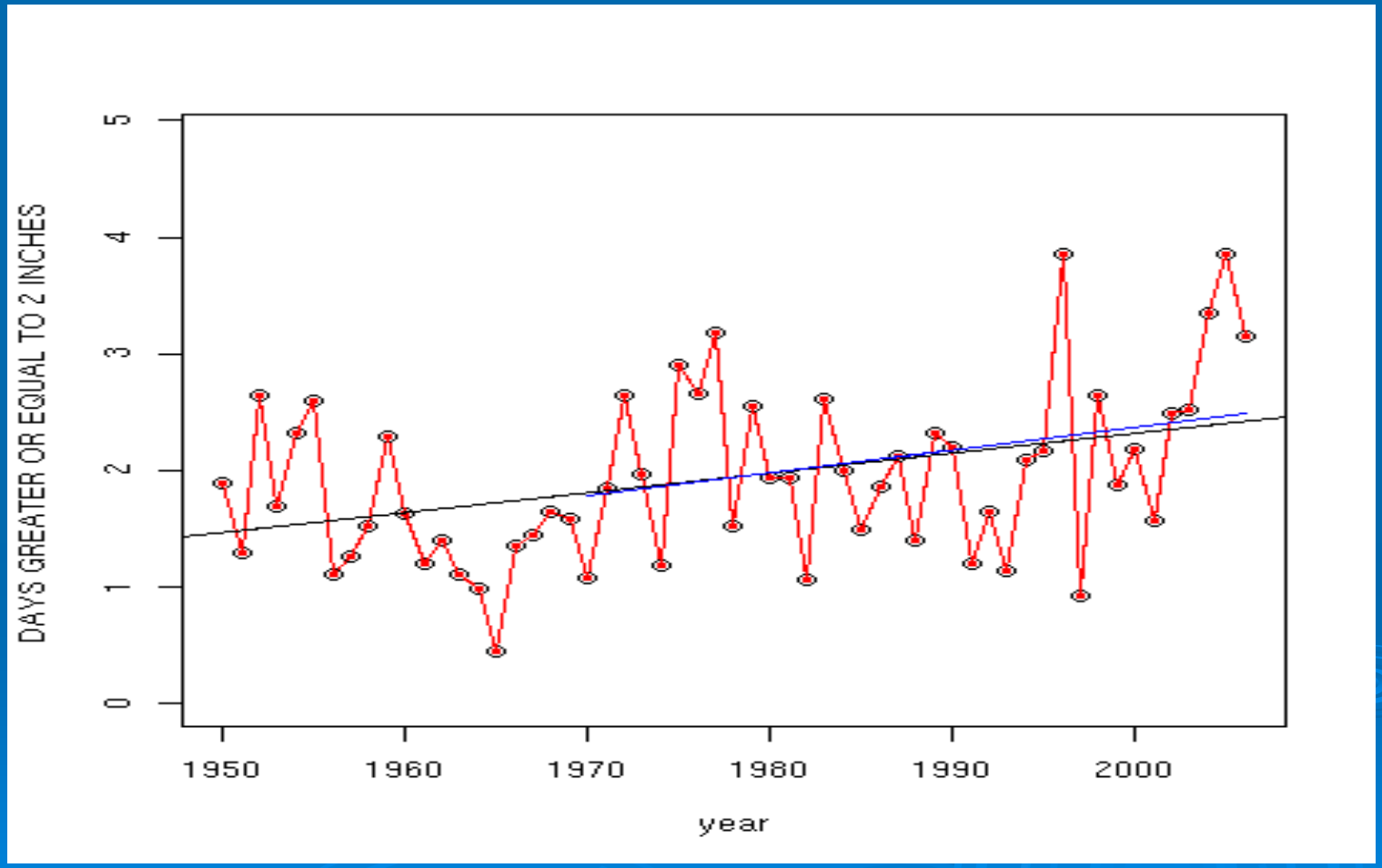
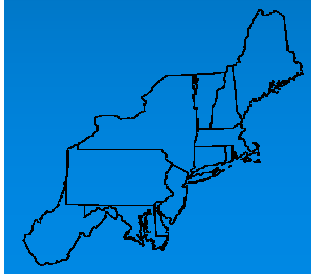
New York Extreme Precipitation Events (>2 inches in 48 hrs)





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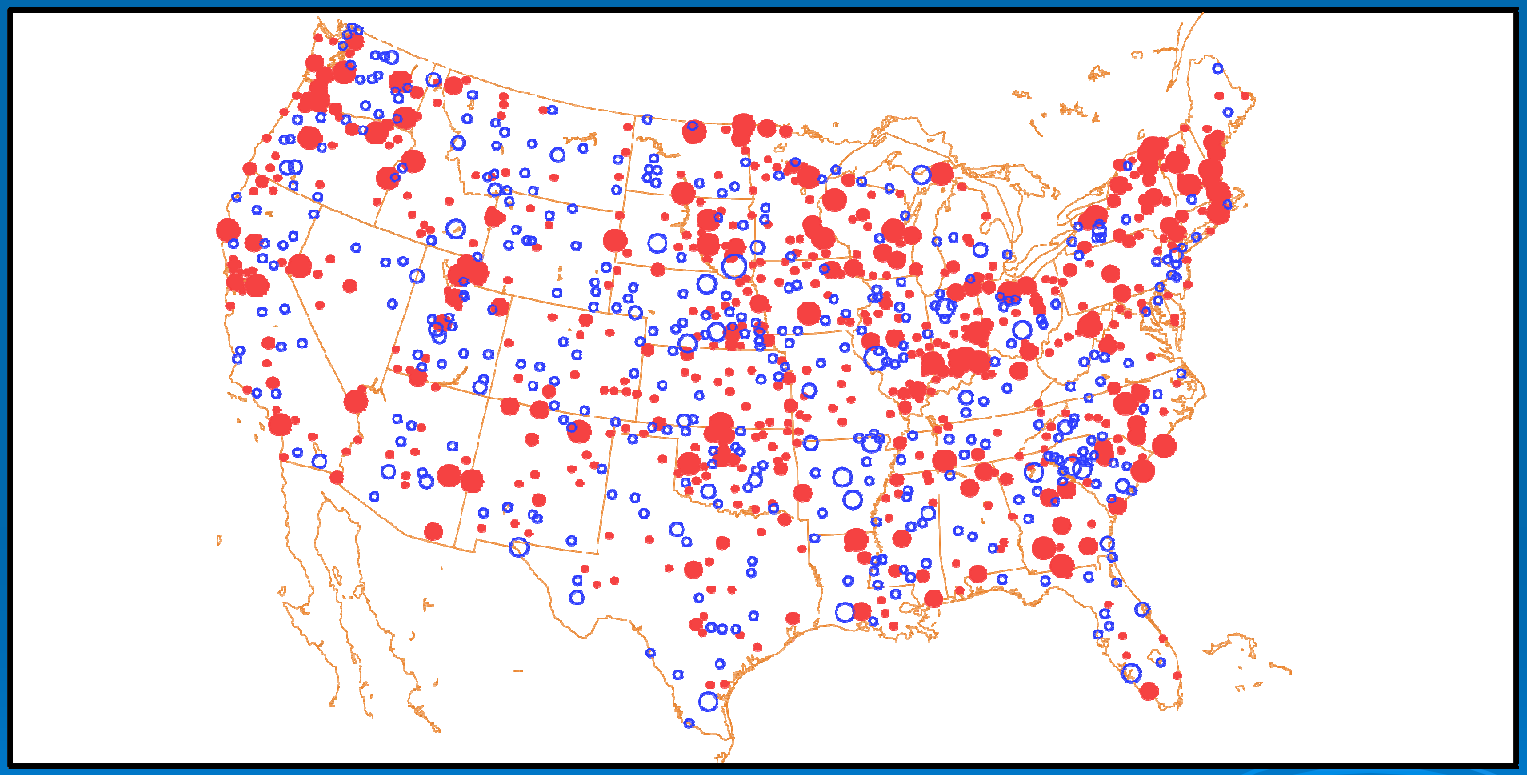
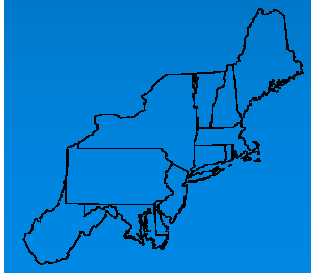
Trend in 2 year Return Period





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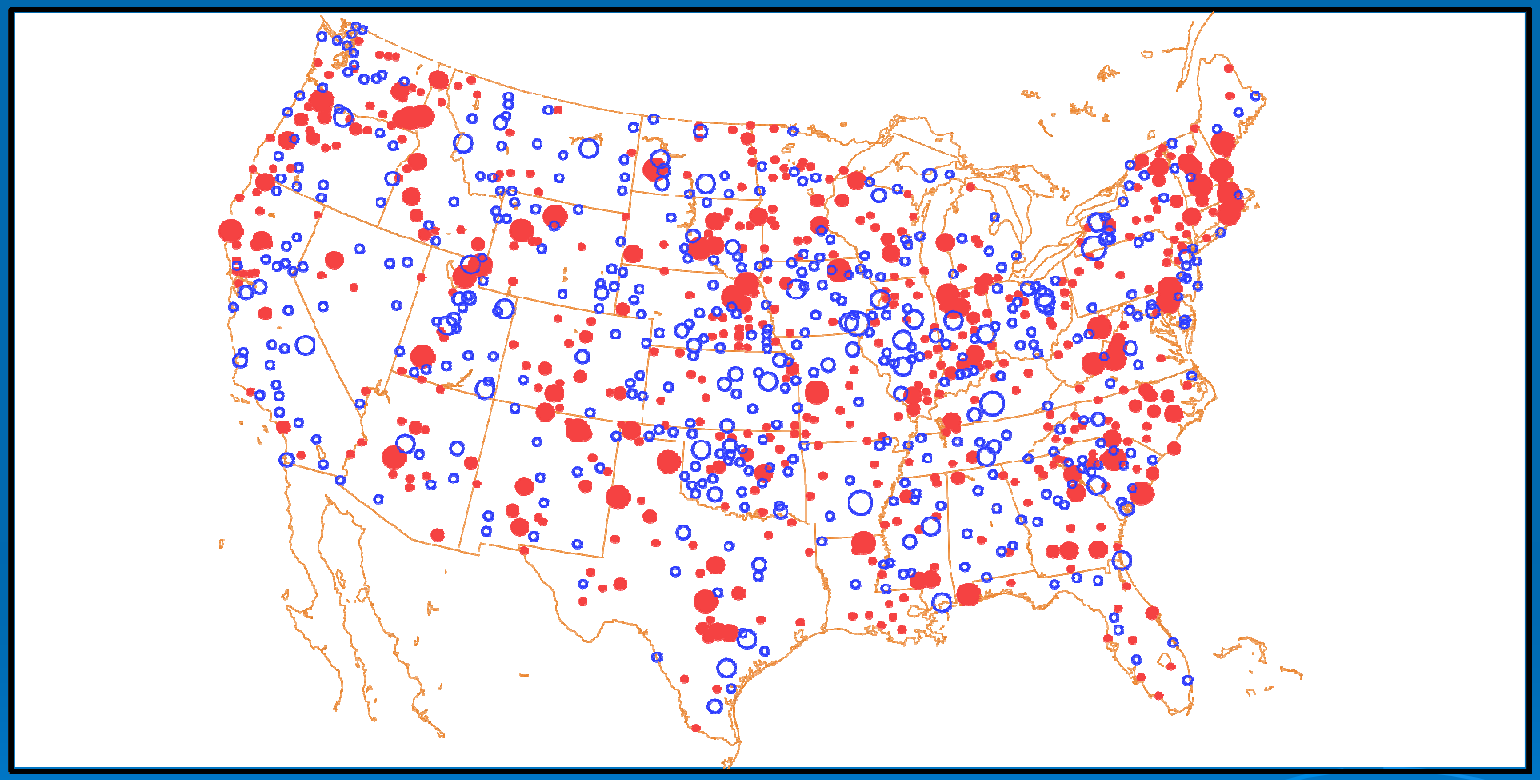
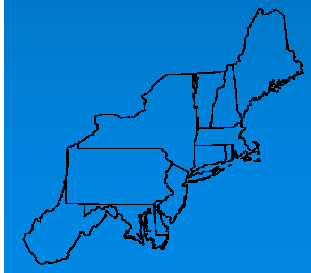
25 year Return Period





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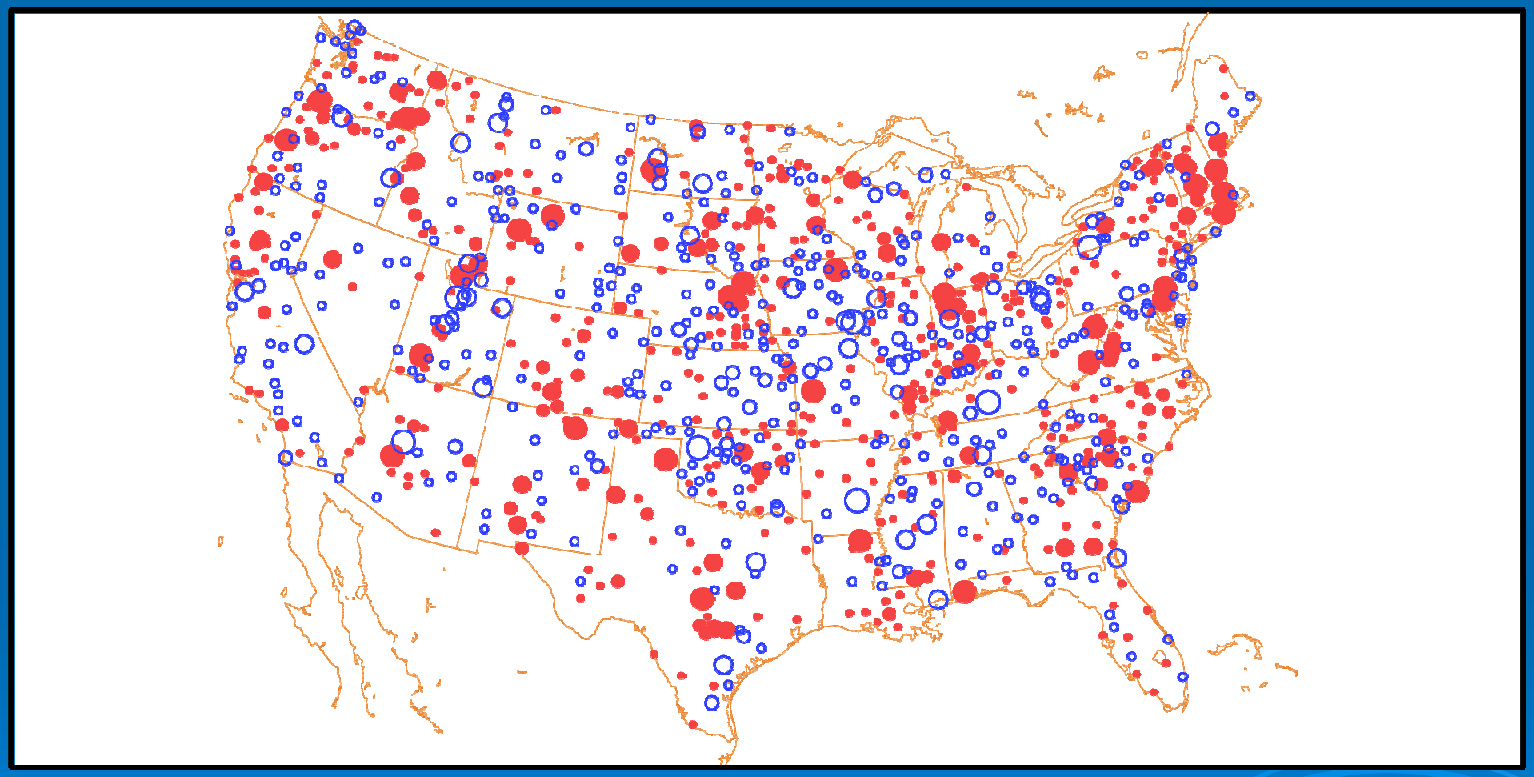
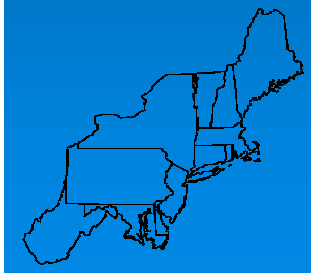
50 year Return Period





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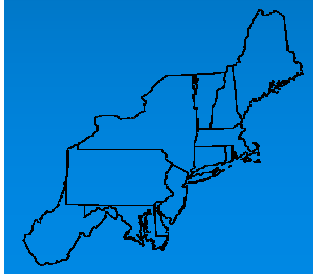
50 year Return Period

	1940 – 1960	1960-2007
Ithaca		
2-yr	2.43	2.40
50-yr	4.46	4.75
100-yr	5.08	5.72
York Haven		
2-yr	2.50	2.89
50-yr	3.93	6.49
100-yr	4.45	8.10



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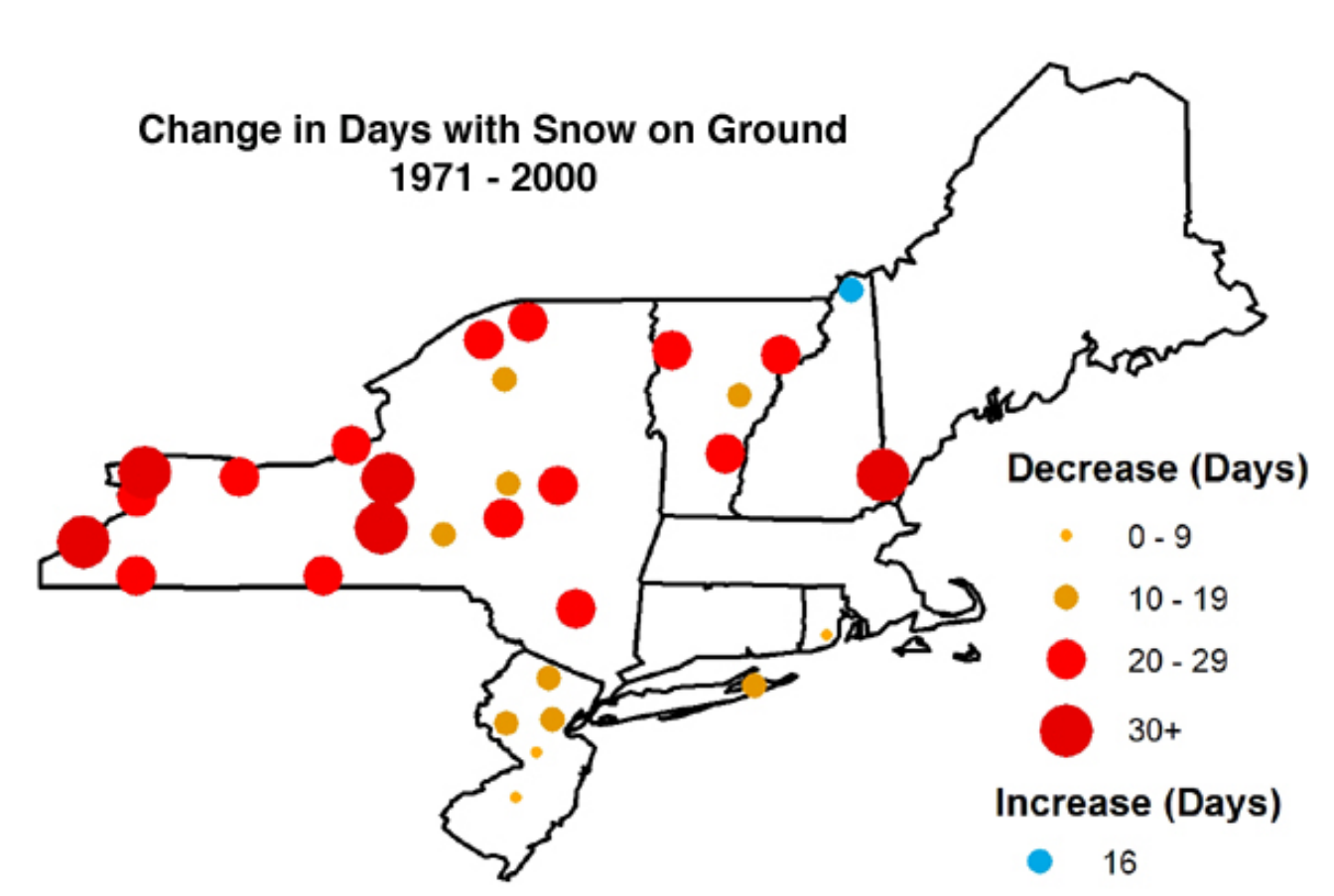
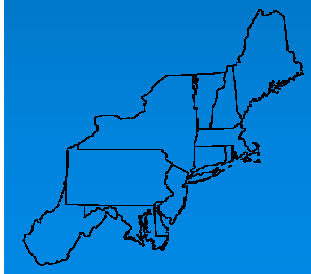
Spatial Variation of Days with Snow on Ground 1970-2000





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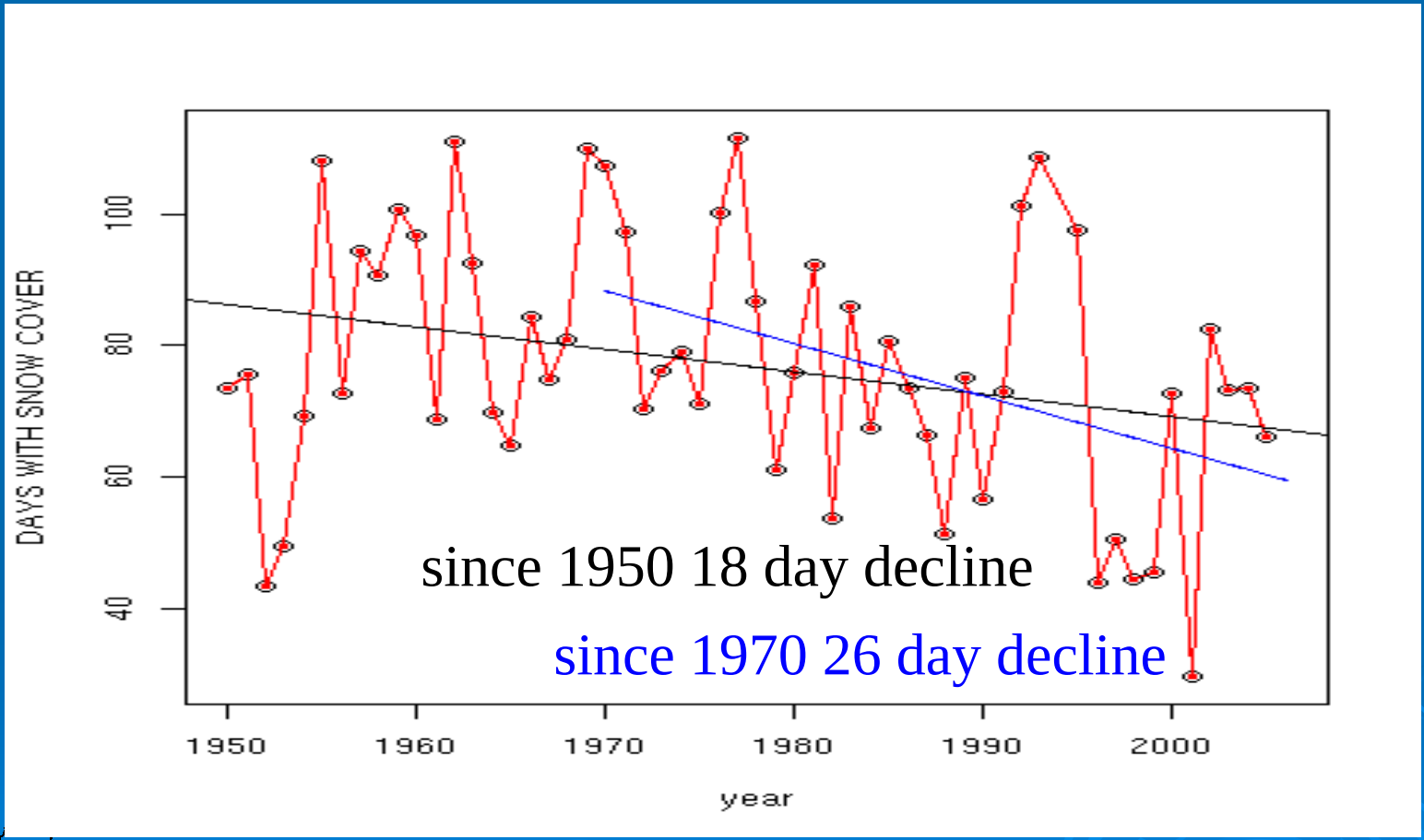
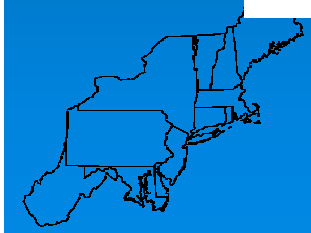
Central Lakes Snow Cover





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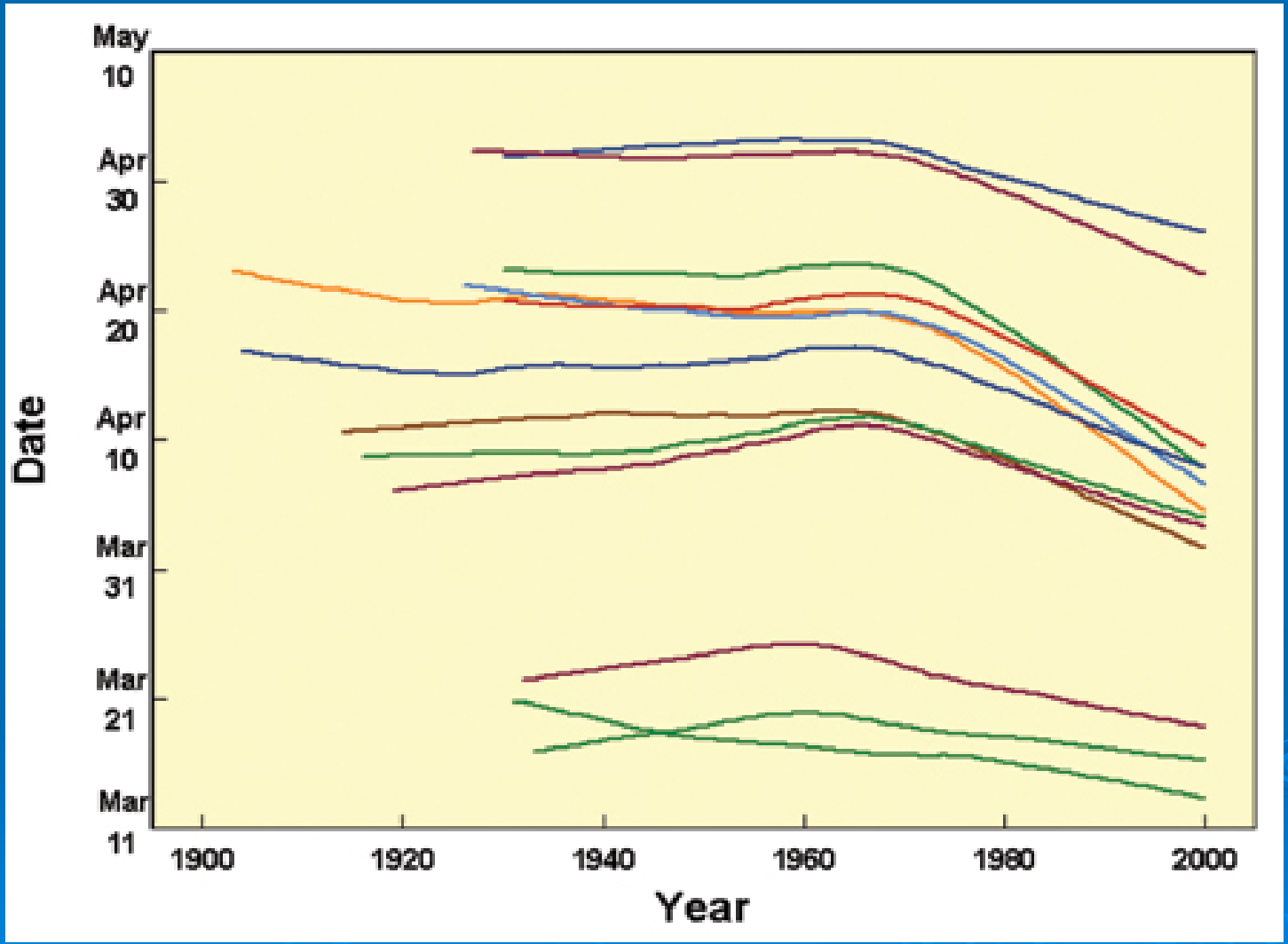
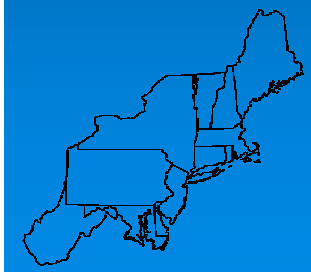
Dates of Center-of-Volume River Flow





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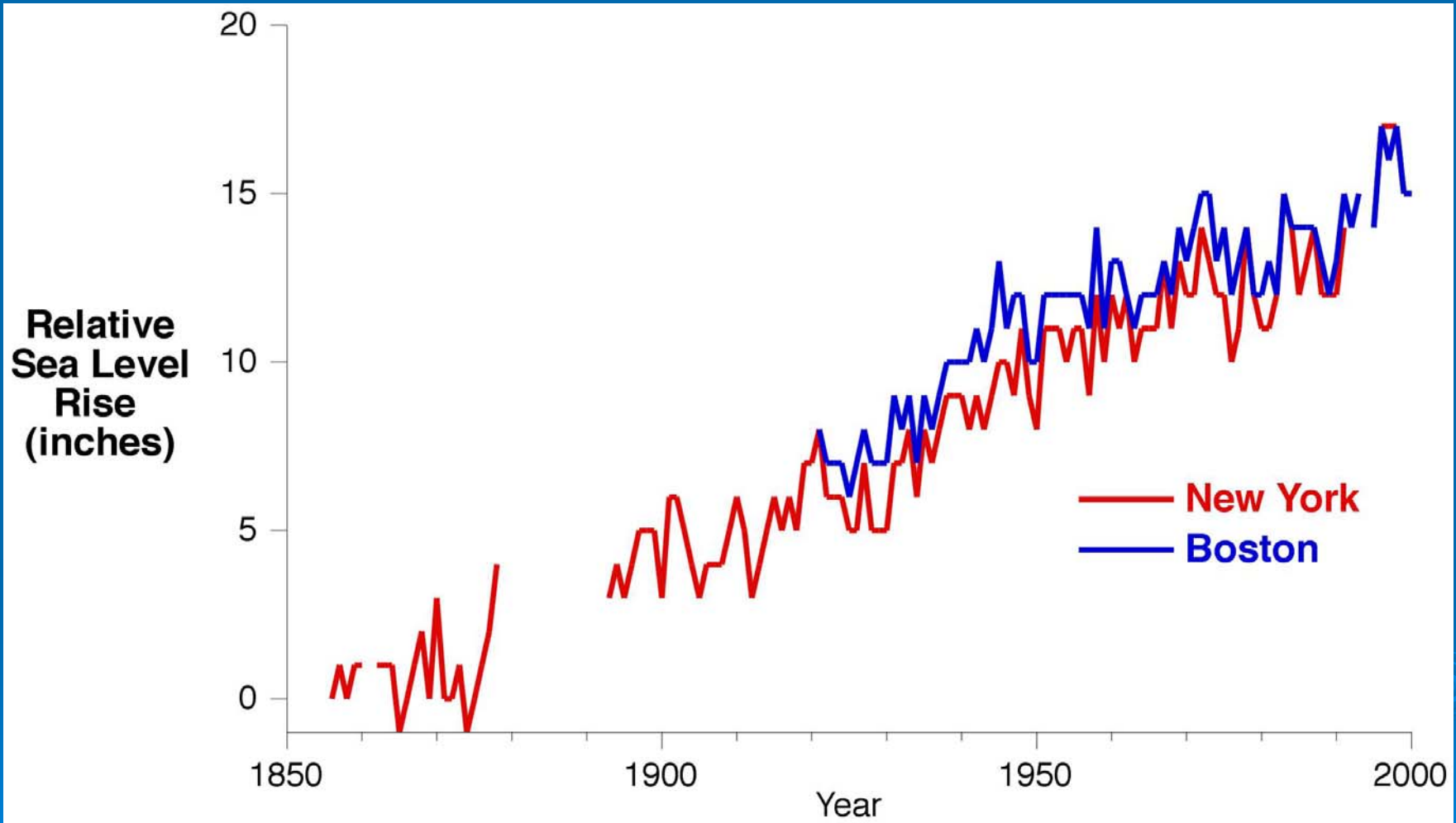
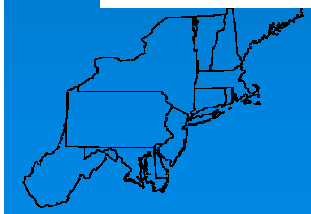
Sea Level Rise





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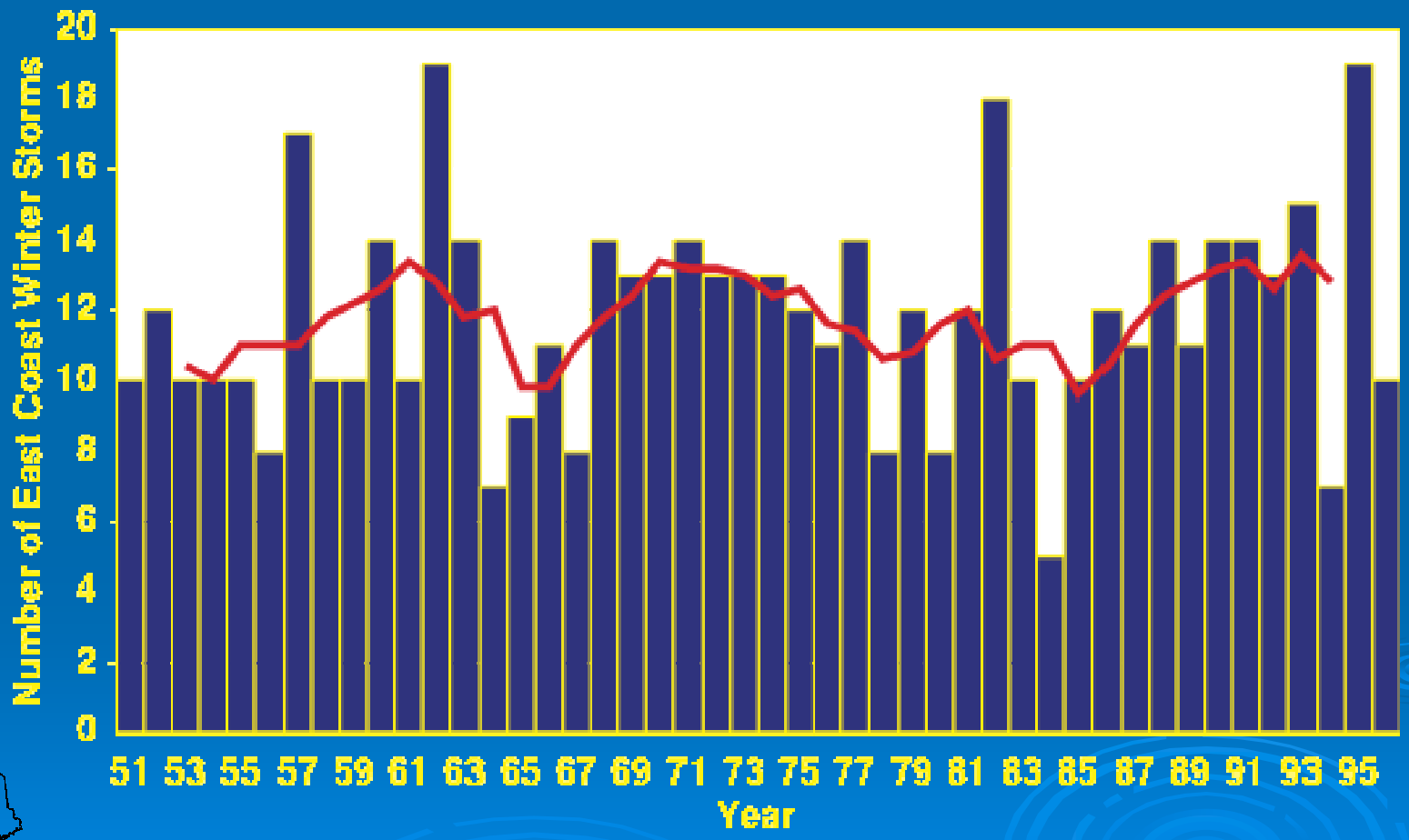
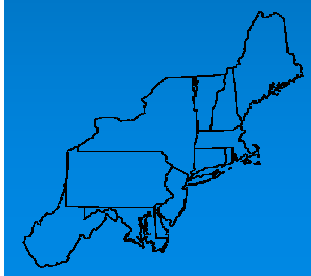
Storms





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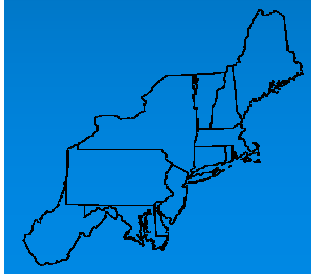
Looking to the Future

- What will happen to concentrations of climate altering gases such as carbon dioxide?
- What will happen to regional temperature and precipitation?



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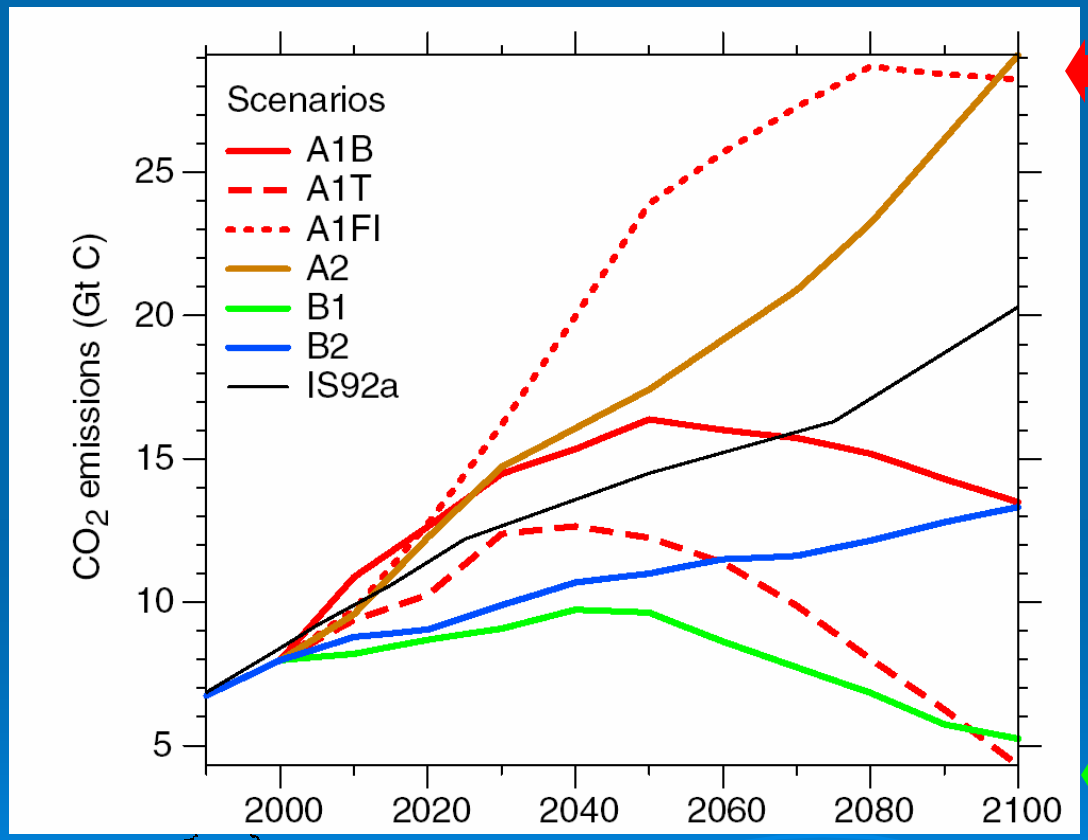
STEP ONE:
Future Emissions from Human Activities



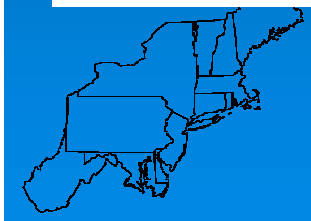
A1fi (higher)

continued dependence on fossil fuels with material-intensive economy, ~970ppm by 2100

B1 (lower)

shift to alternative energy sources with service & information-focused economy

~550ppm at 2100



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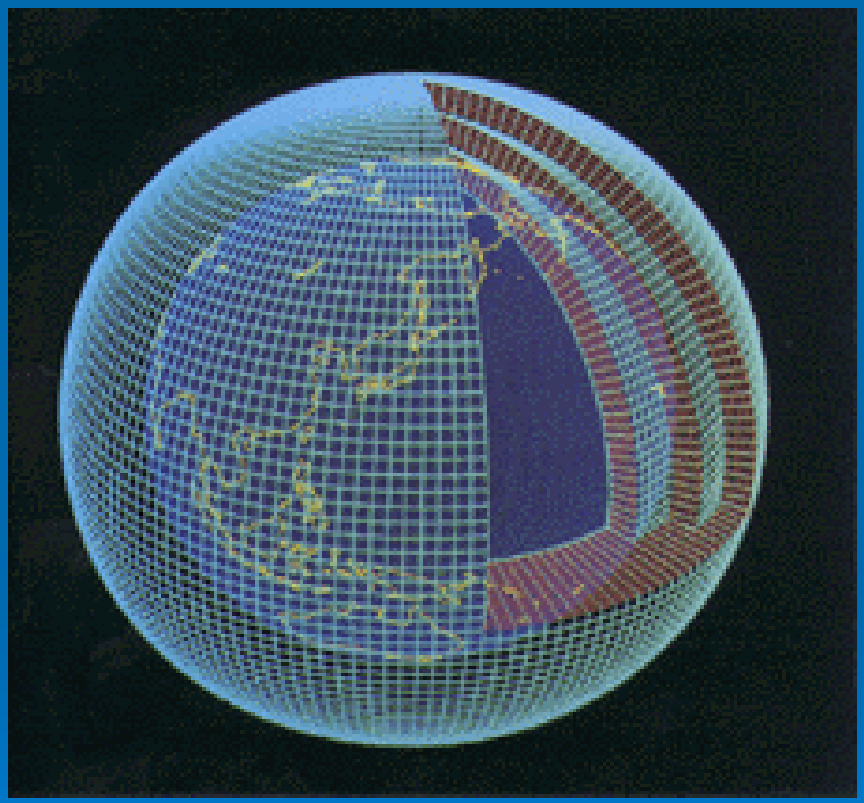
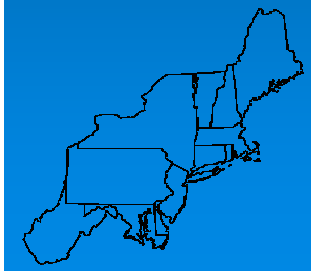
STEP TWO:
Global Climate Modeling



"Backcast" to compare historical simulations with observed climate.

"Forecast" to develop future projections of changes in temperature, precipitation, extreme events, etc.



3 different climate models

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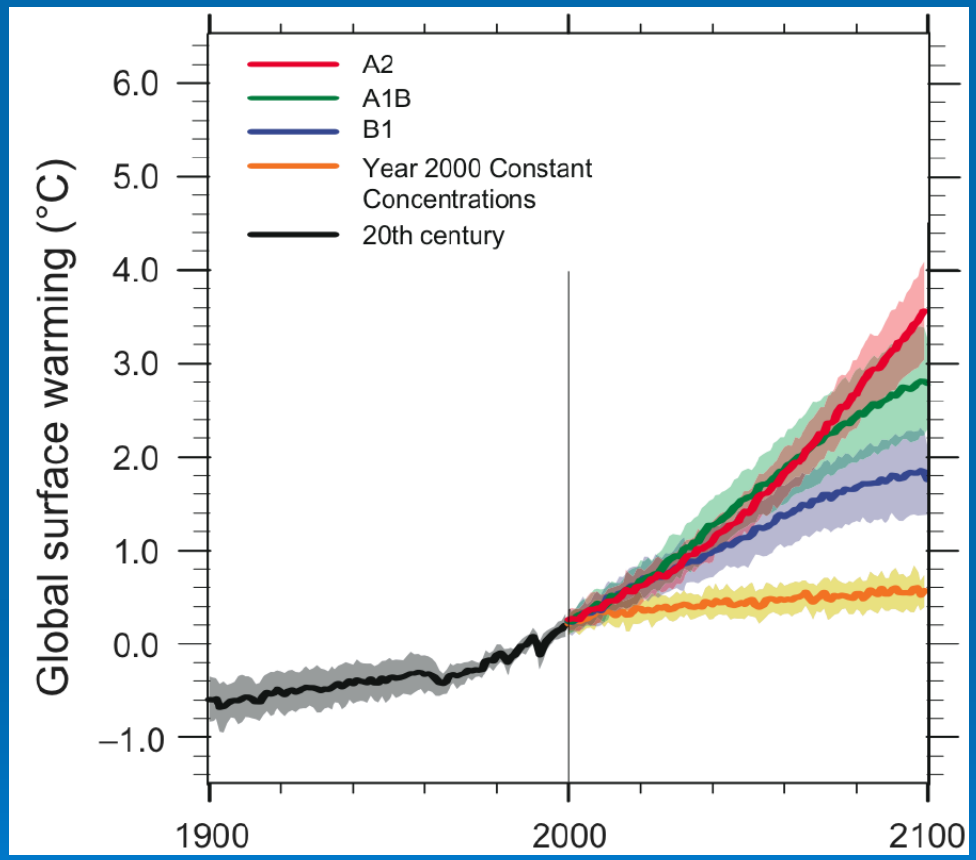
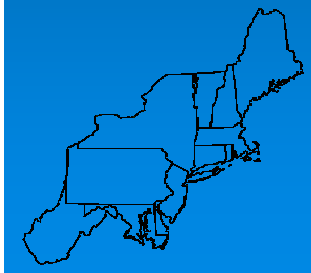
STEP 3:
Global Temperature Change



Likely range:

1.1ºC to 6.4ºC

2ºF to 11.5ºF



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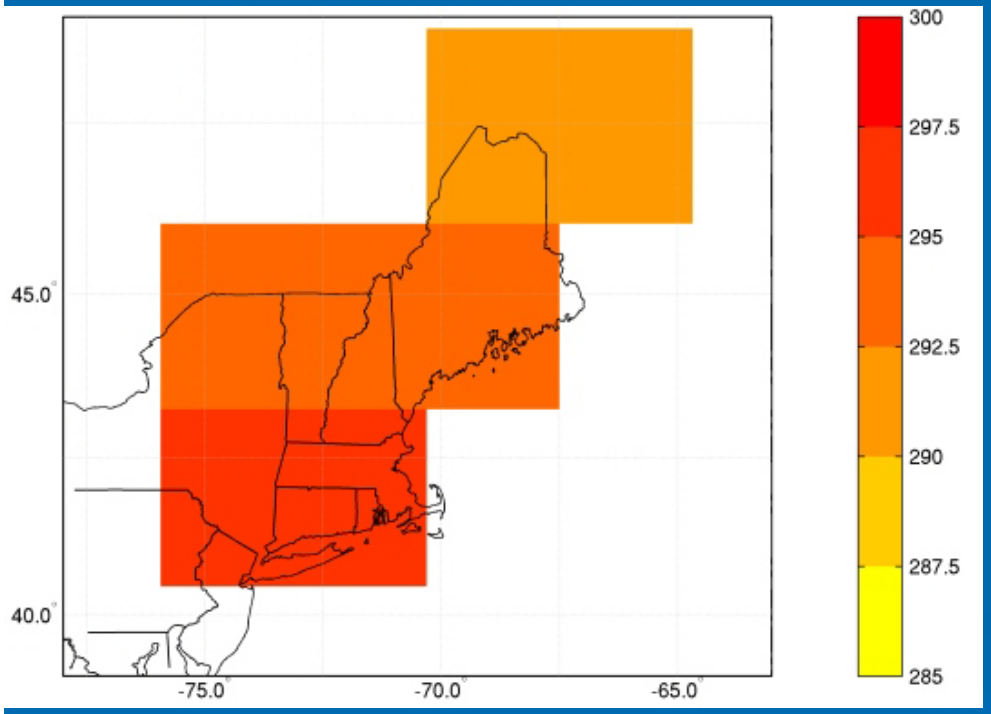
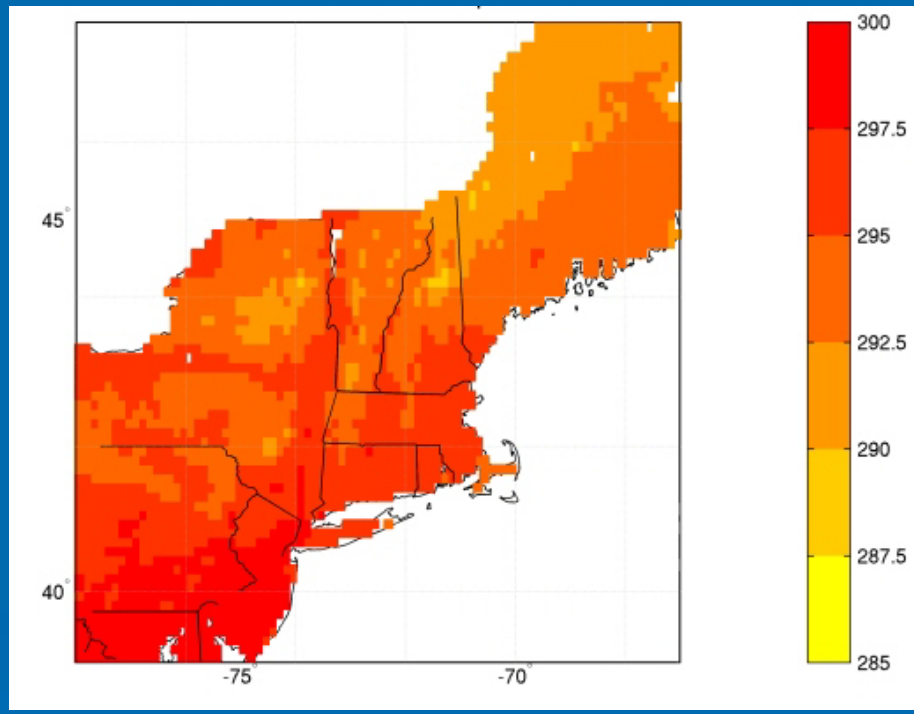
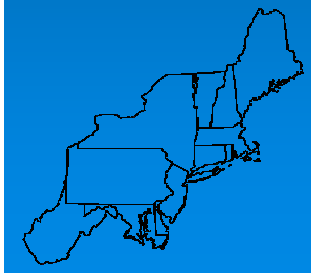
STEP 4:
High-resolution regional climate projections



Temp from global climate model



Temperature from downscaling



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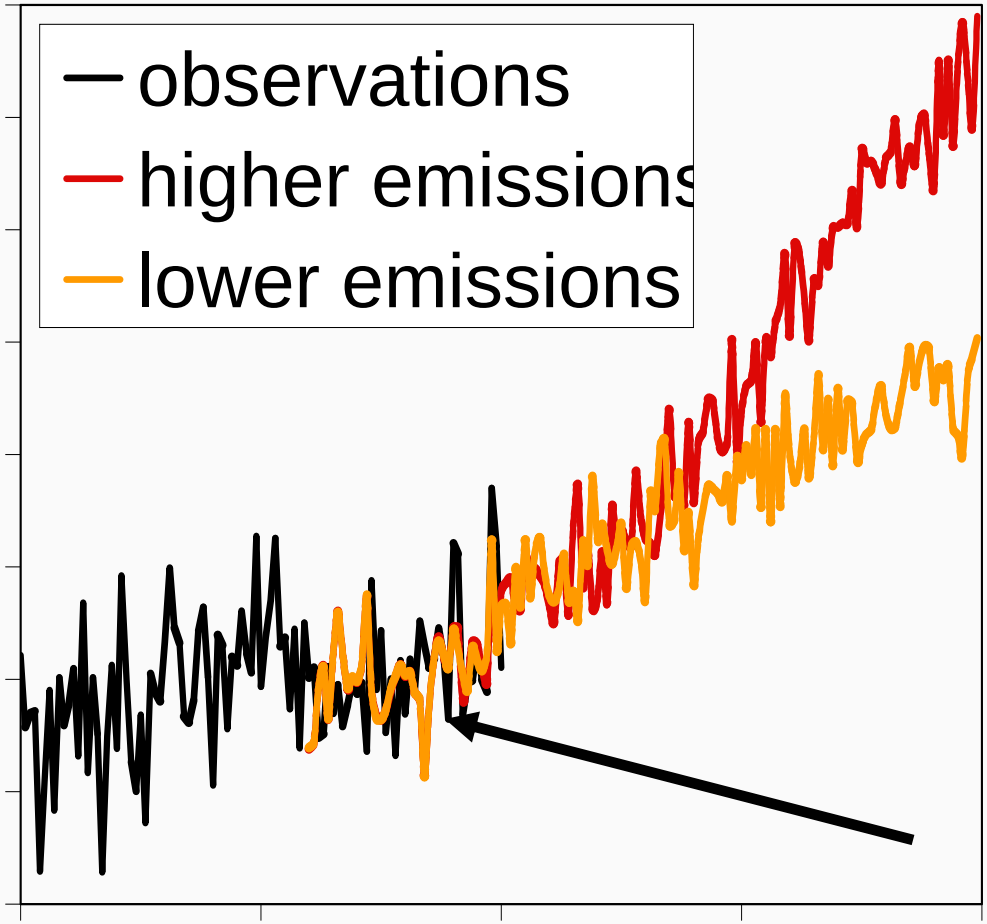
Projecting Future Climate Change for the Northeast: Rising Annual Temperatures

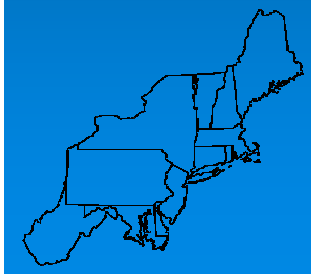


Higher: 6.5-12.5ºF

Lower: 3.5-6.5ºF

Since 1970

2ºF



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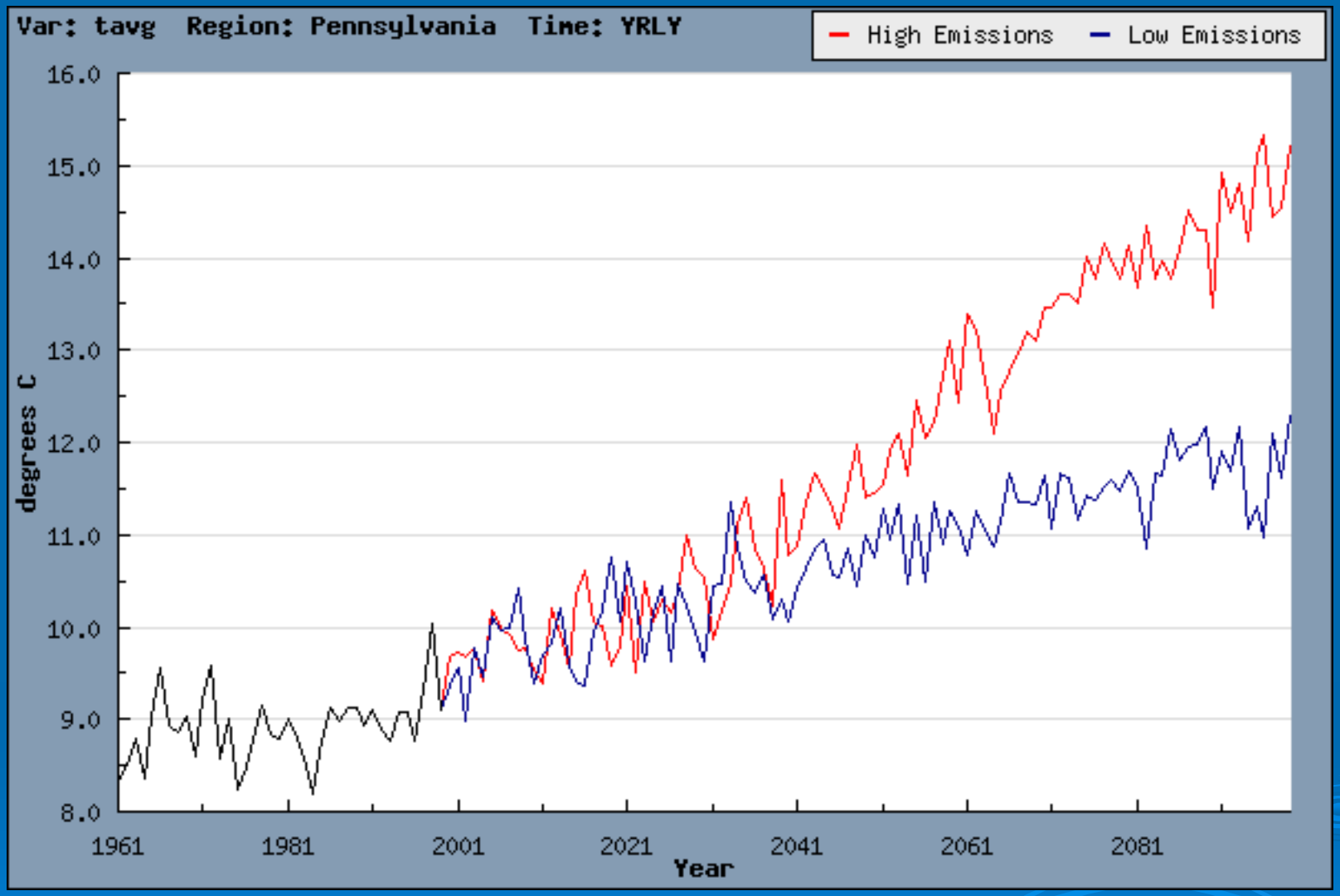

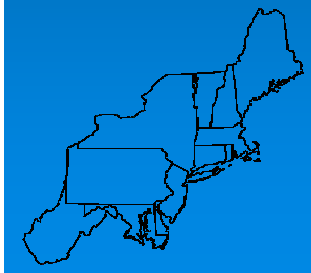

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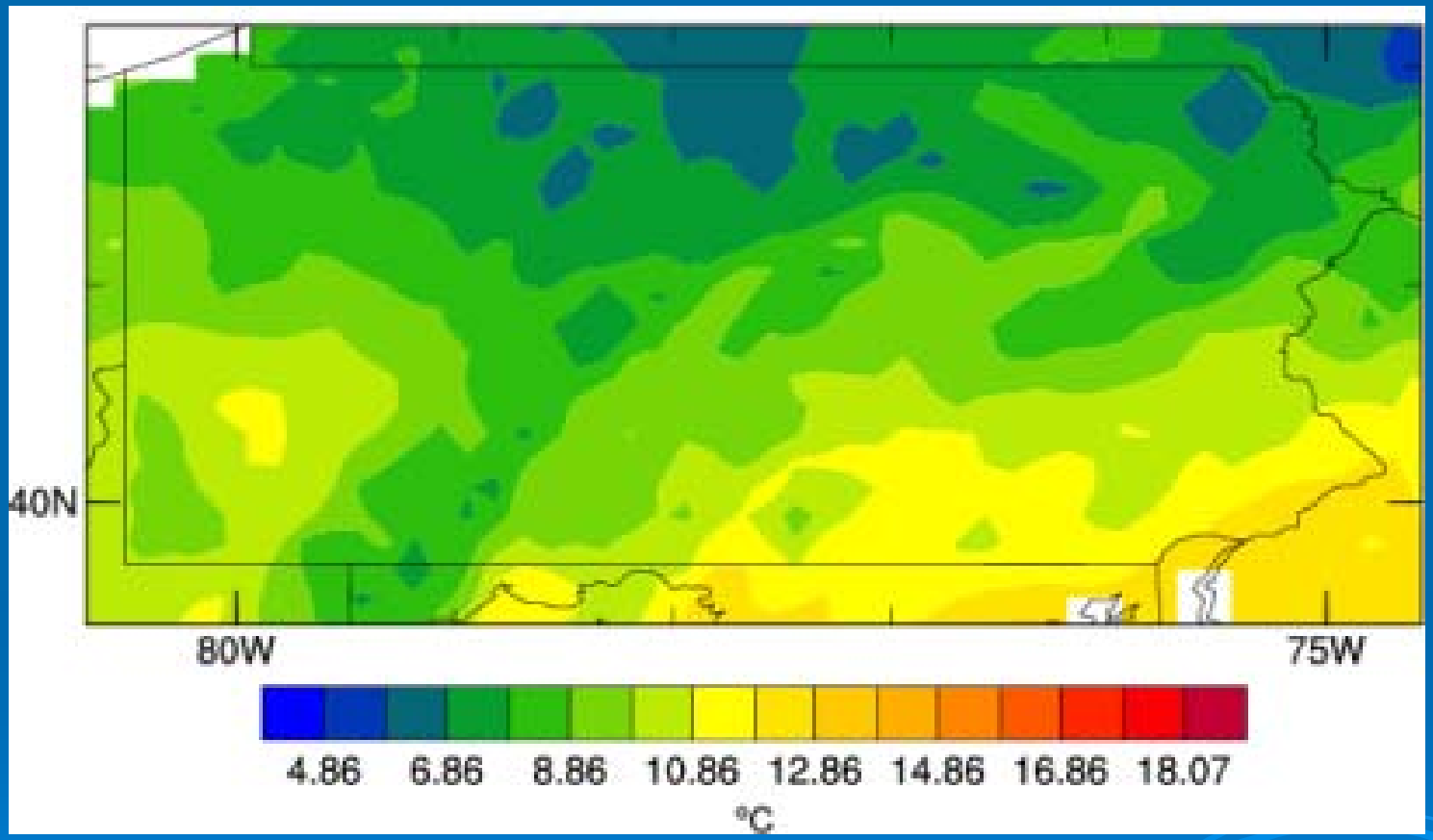
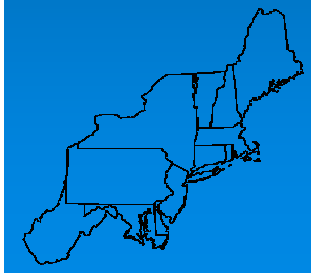
Annual Temperature 1961-1990





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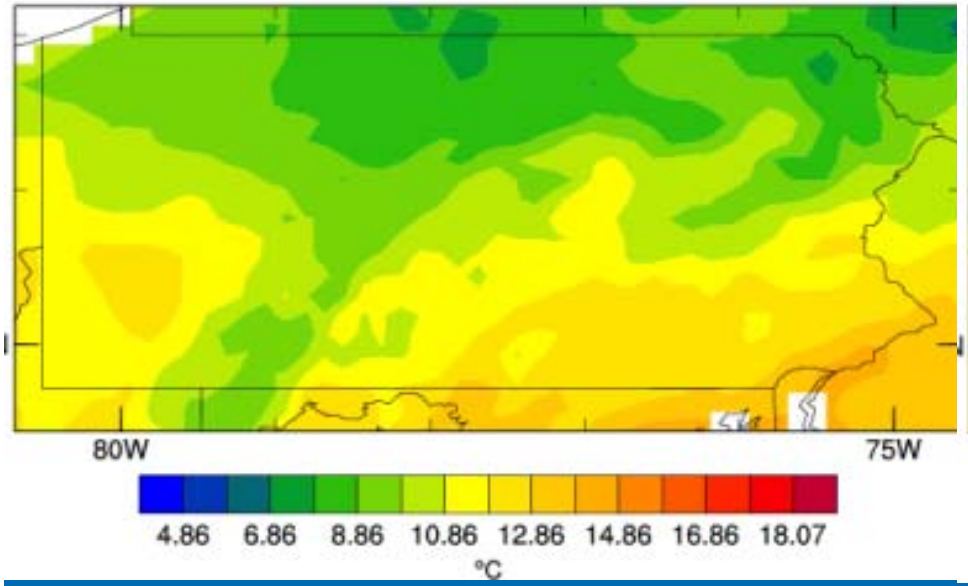
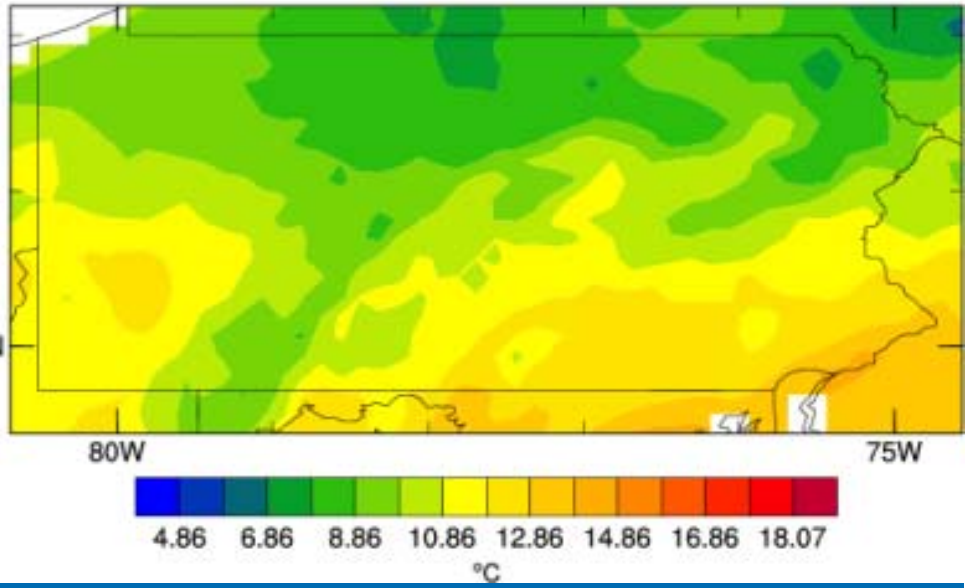
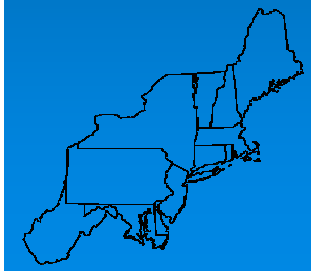
Annual Temperature 2010-2039





Higher emissions

Lower emissions



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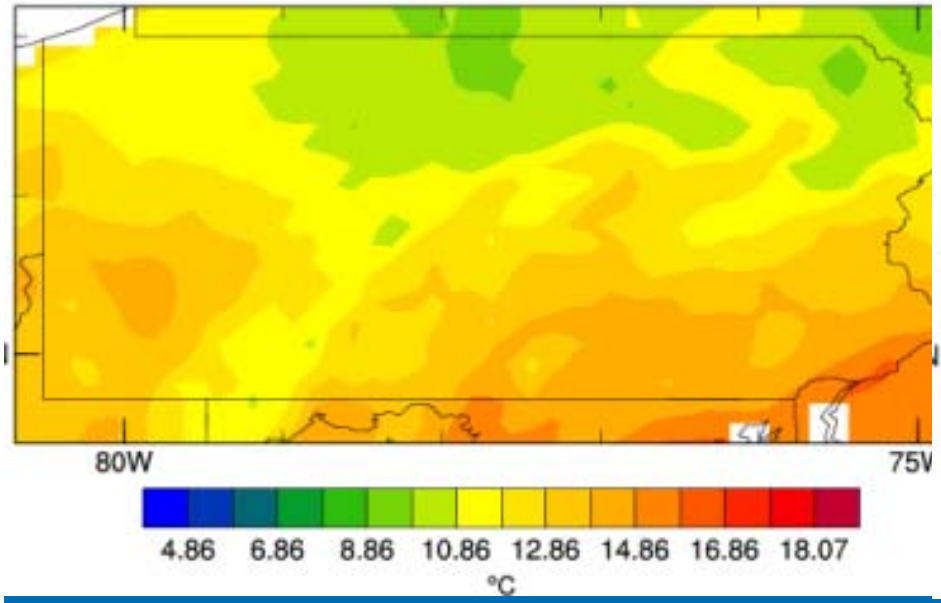
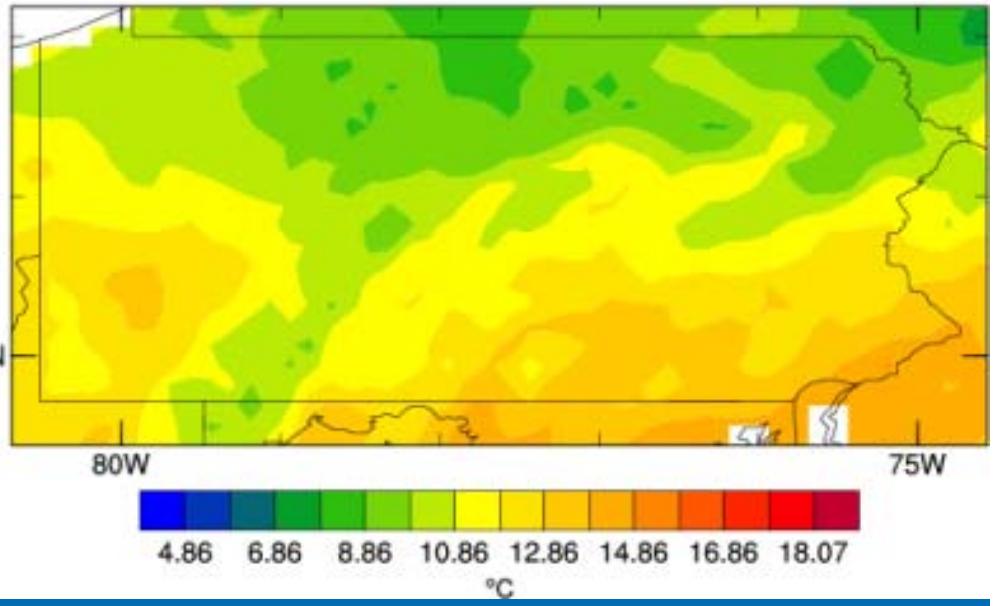
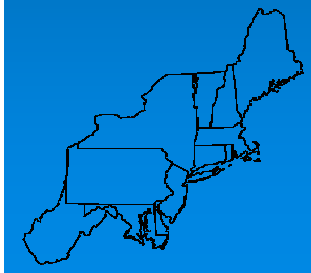
Annual Temperature 2040-2069





Higher emissions

Lower emissions



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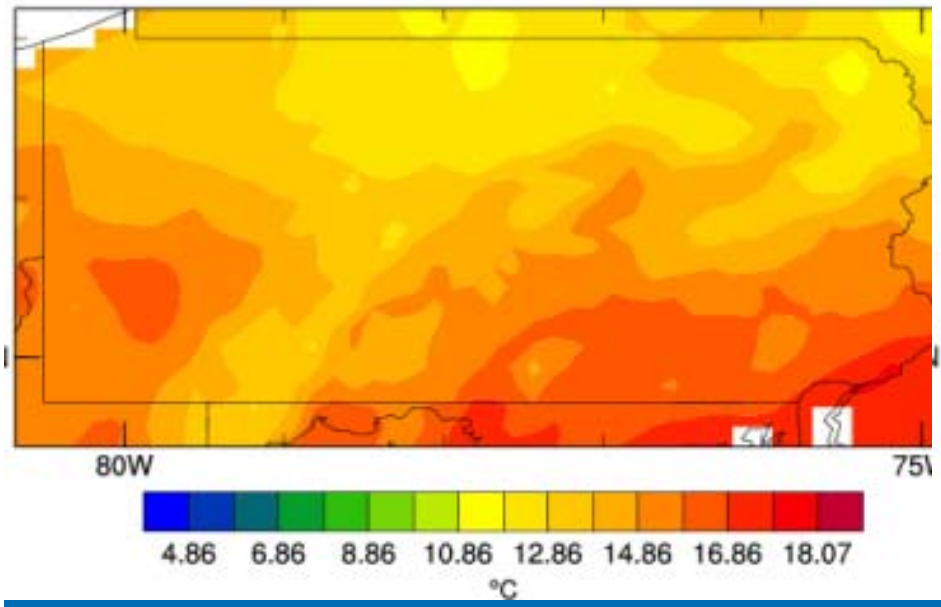
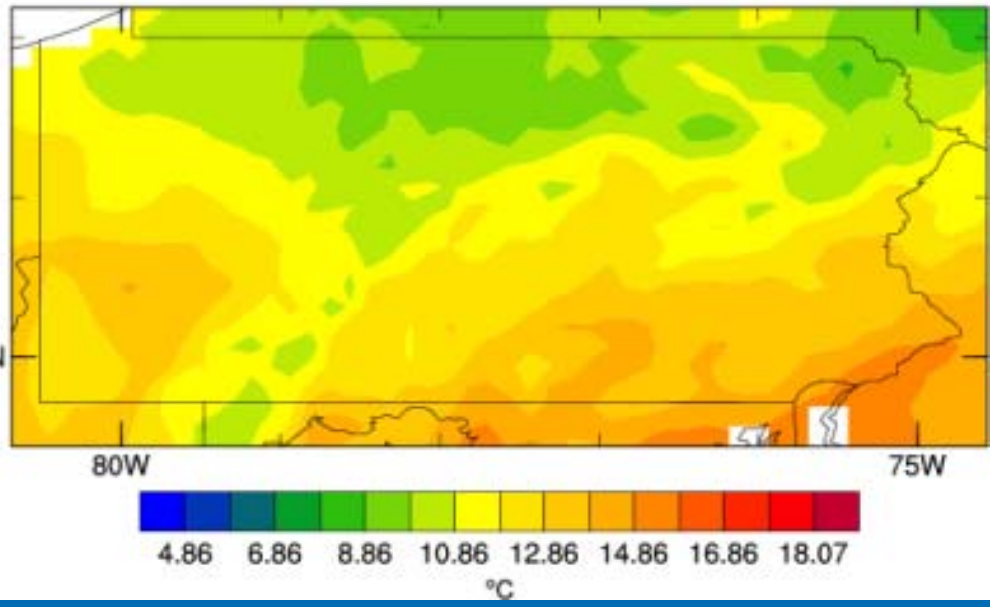
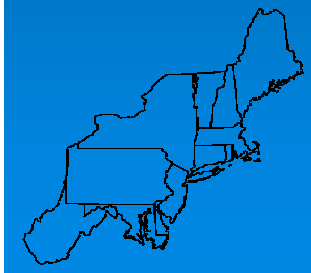
Annual Temperature 2070-2100





Higher emissions

Lower emissions



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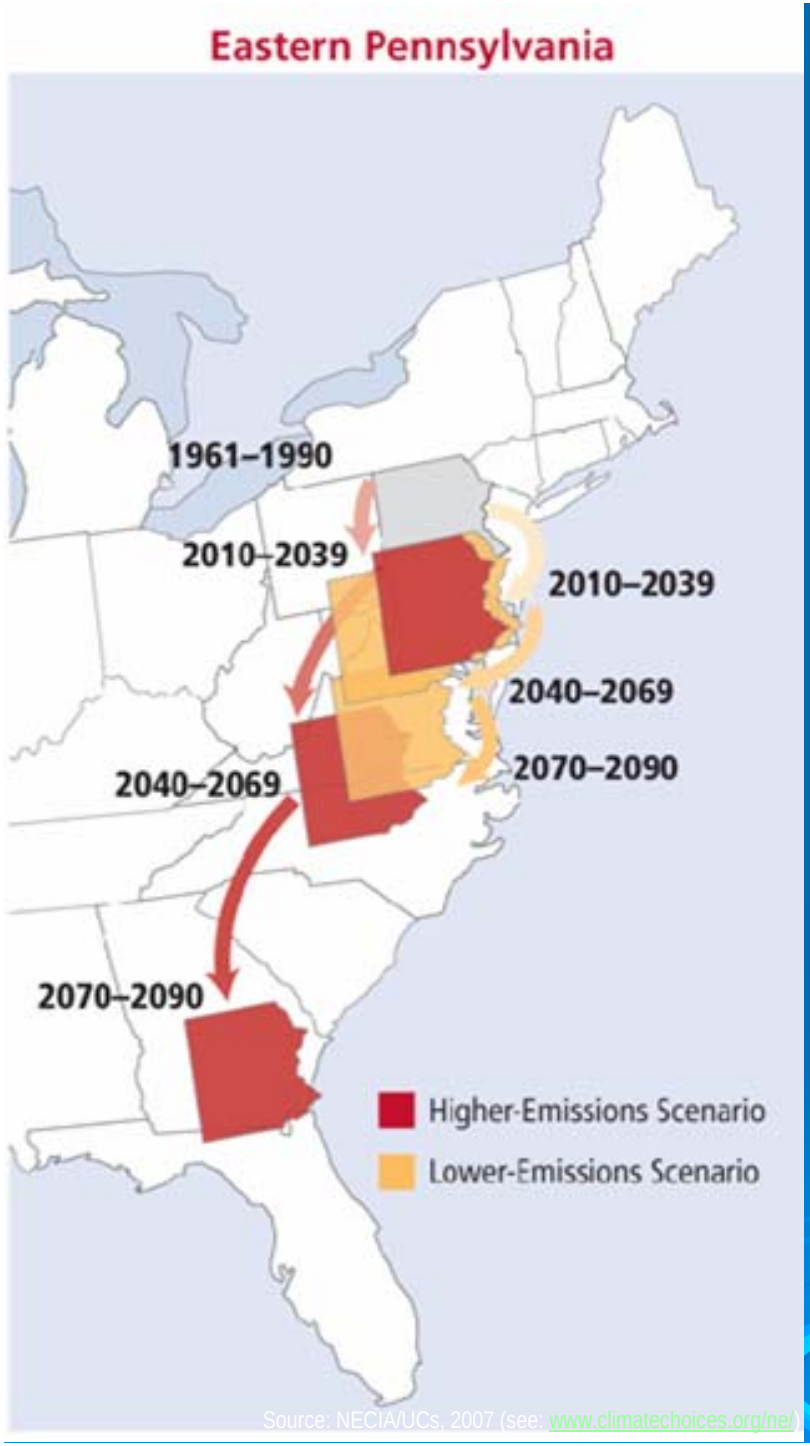

Source: NECIA/UCs, 2007 (see: www.climatechoices.org/ne/)

Summer Heat Index

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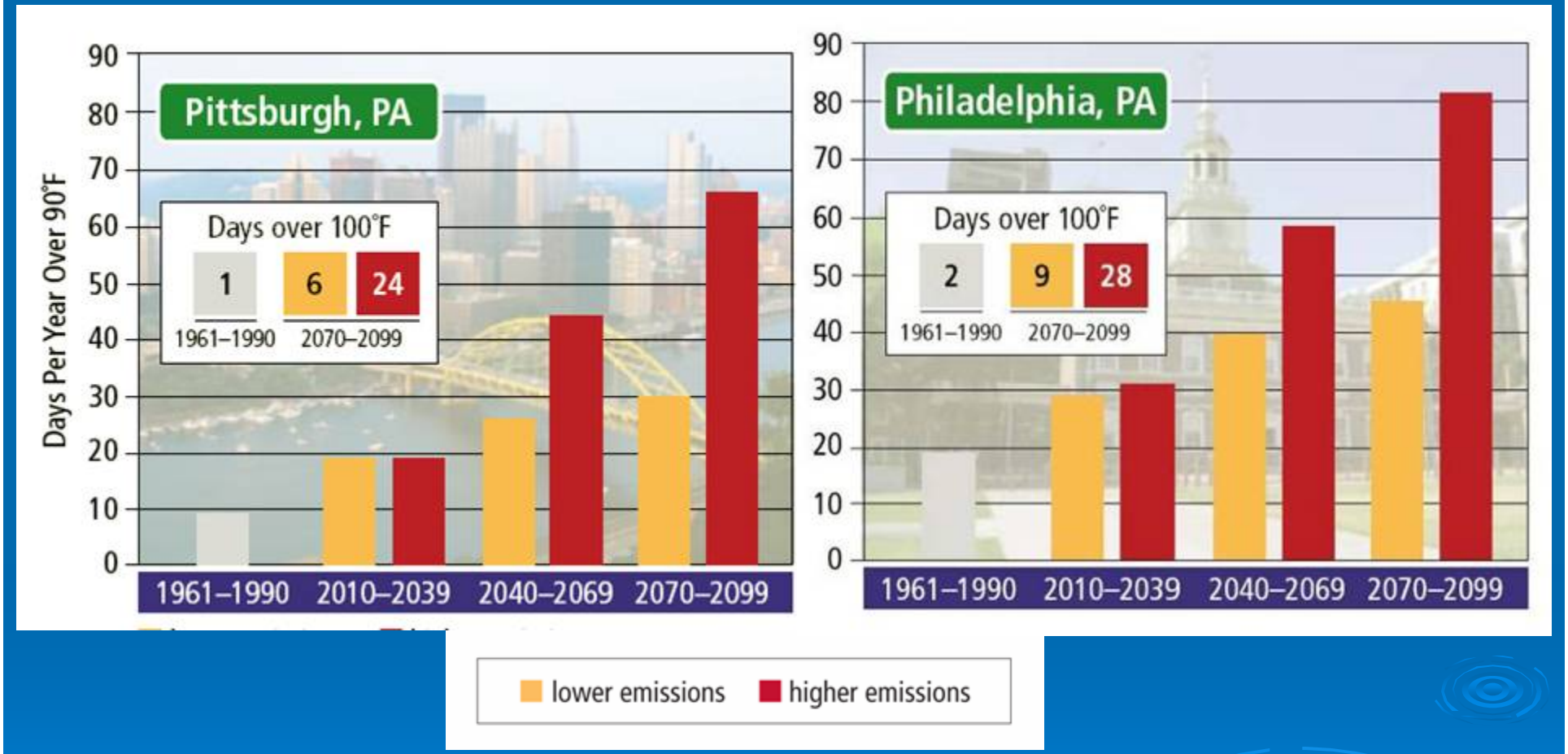
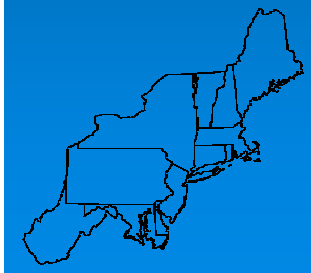
Increases in Extreme Heat



Source: NECIA/UCS, 2007 (see: www.climatechoices.org/ne/)



Potential implications for water demand

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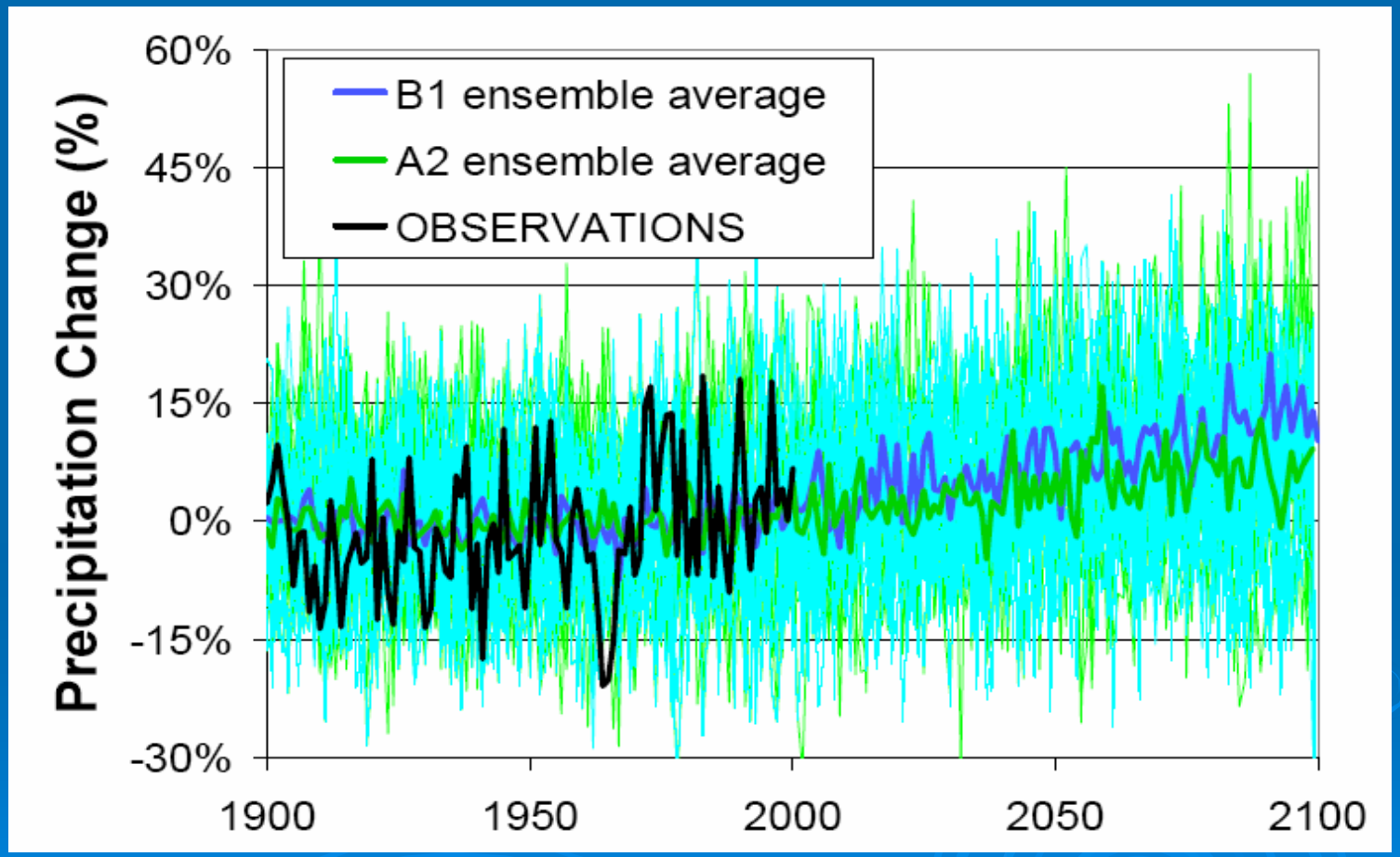
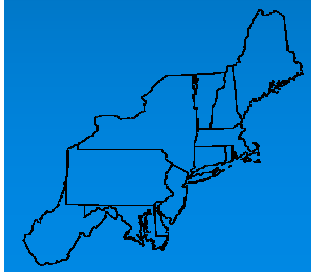
Annual Precipitation





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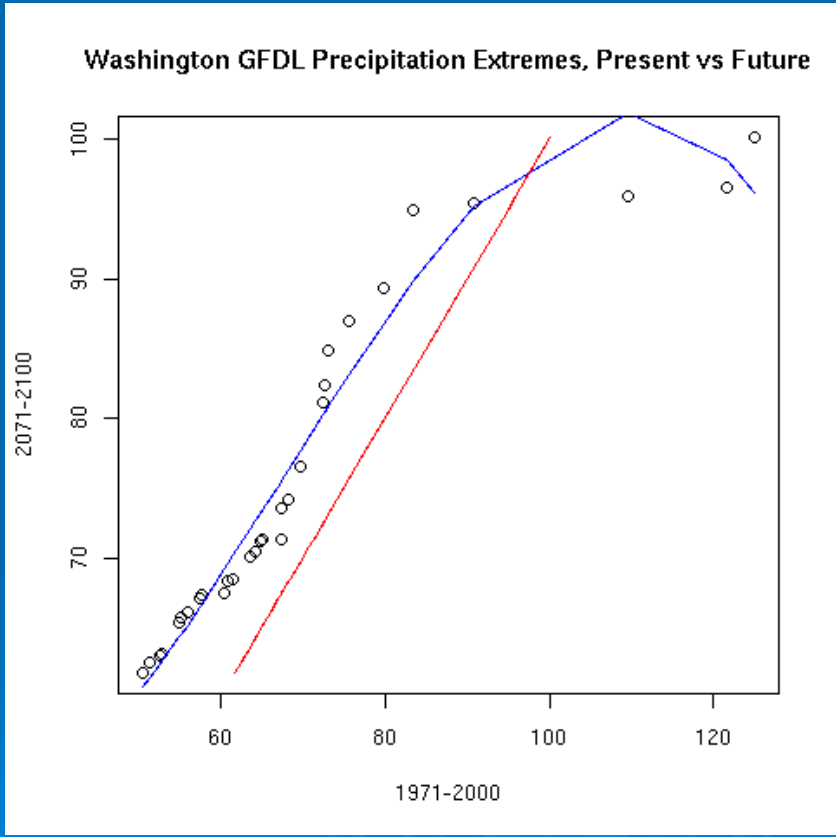
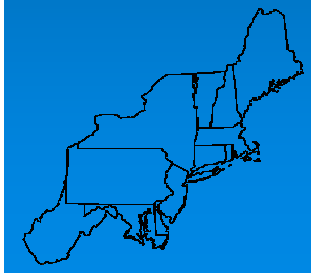
Extreme Precipitation

- Heavy rainfall events are becoming more frequent across the Northeast
- Under both emissions scenarios
  - rainfall expected to become more intense
  - periods of heavy rainfall are expected to become more frequent.





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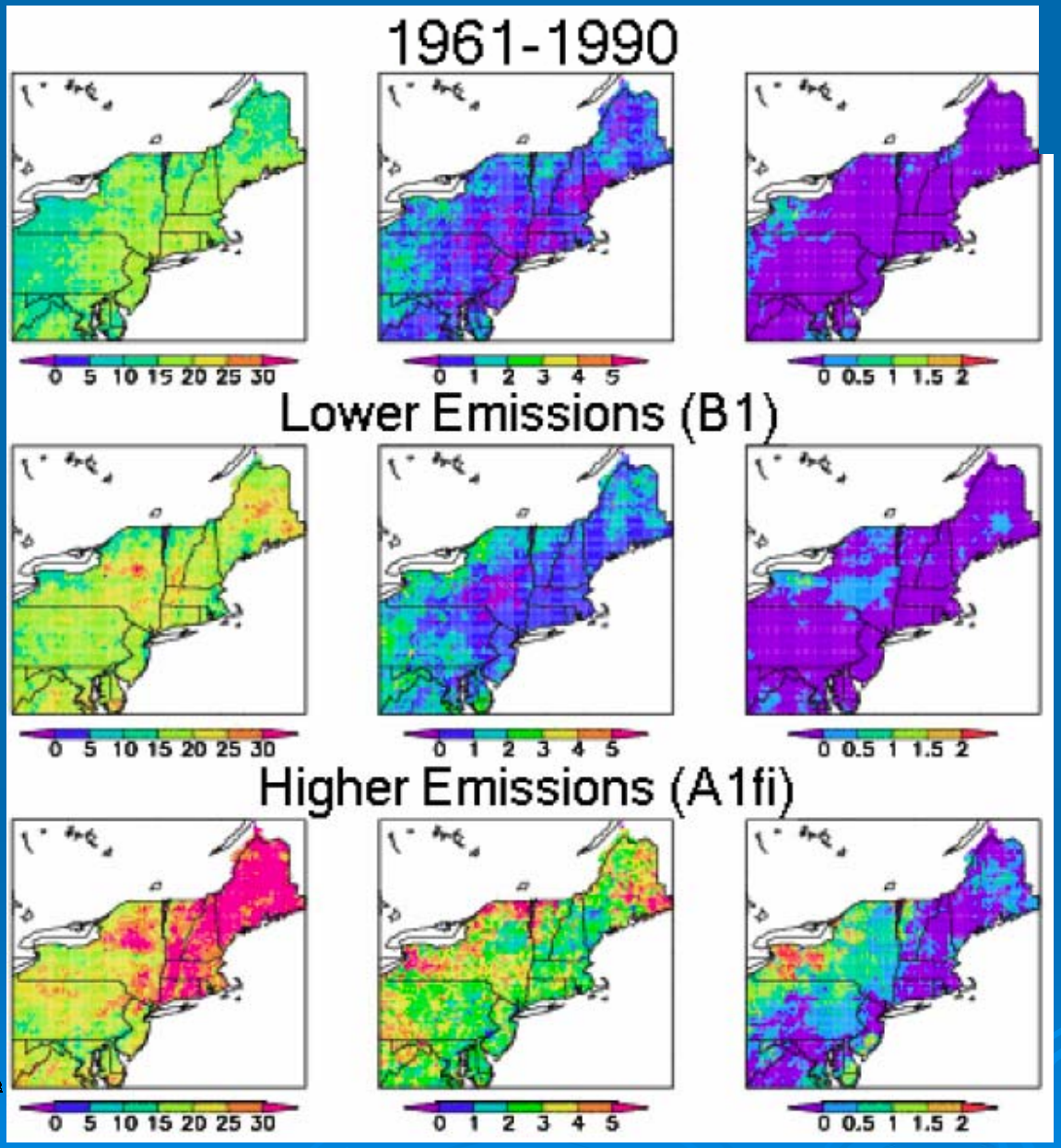
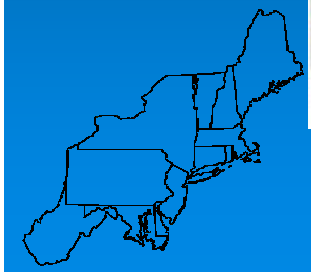
Drought





SHORT MEDIUM LONG

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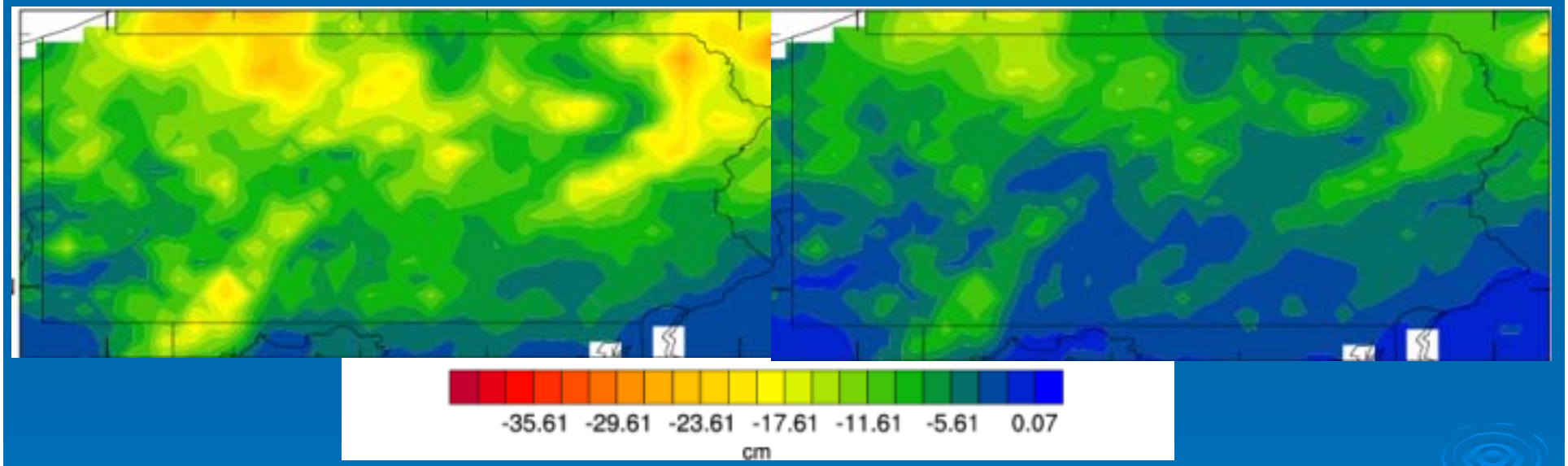
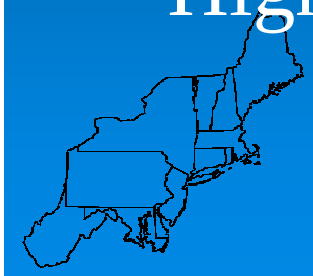
Decreases in Snow Depth

Change by 2070-2099 relative to 1961-1990



Higher emissions

Lower emissions



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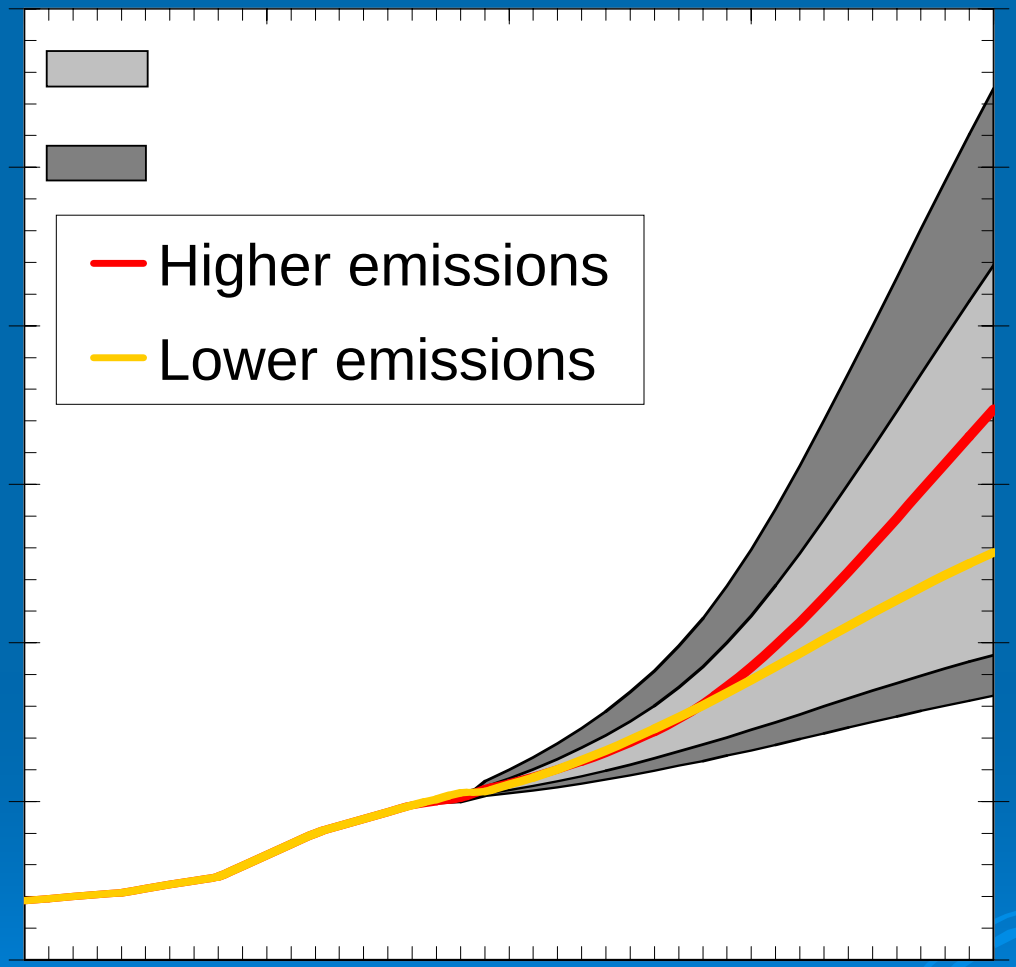
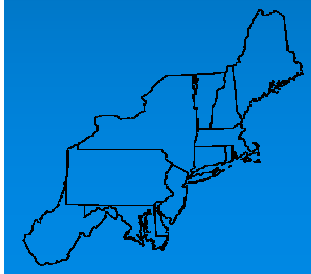
Sea Level Rise



Higher: 8-33 in.

Lower: 4-21 in.



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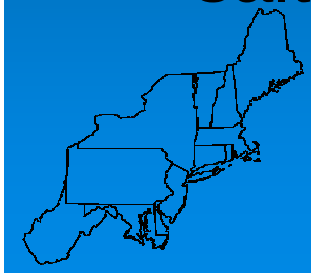
Summary of Impacts

- Heavy precipitation events very likely
  - Flood risk
  - Adverse quality of surface/groundwater
  - Contamination of water supplies
- Water supply in snow cover will decline
- Coastal communities stressed by interactions of climate, development and pollution
- Increases in evap, water demand, algal blooms, salt water intrusion



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Questions?