

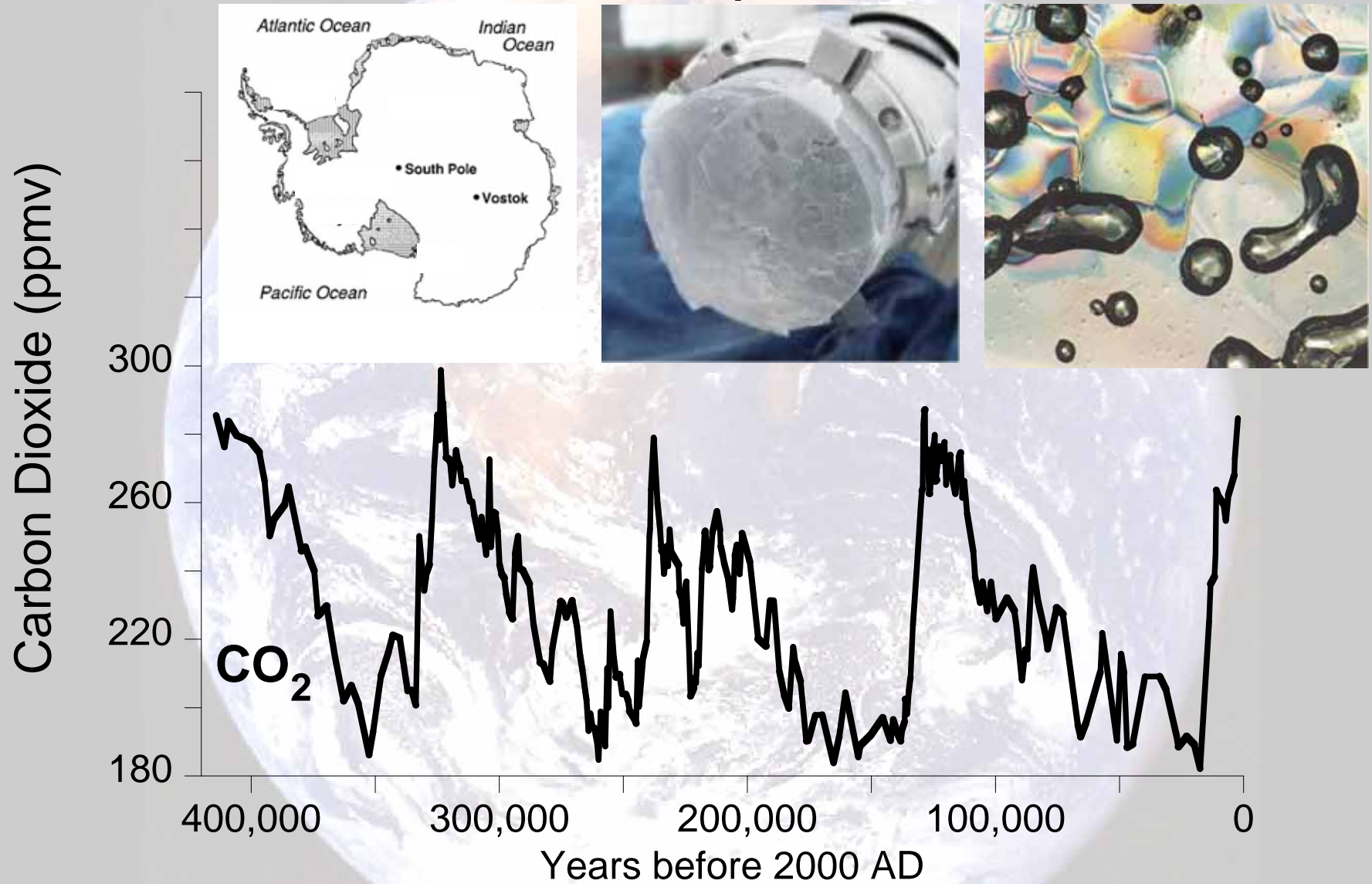
A satellite image of Earth showing a large hurricane over the Atlantic Ocean. The hurricane is a large, circular cloud system with a clear eye. The surrounding clouds are white and dense. The landmasses of North America and South America are visible in shades of green and brown. The ocean is a deep blue. The text is overlaid on the image.

Climate Change in the Northeast: Past, Present, and Future

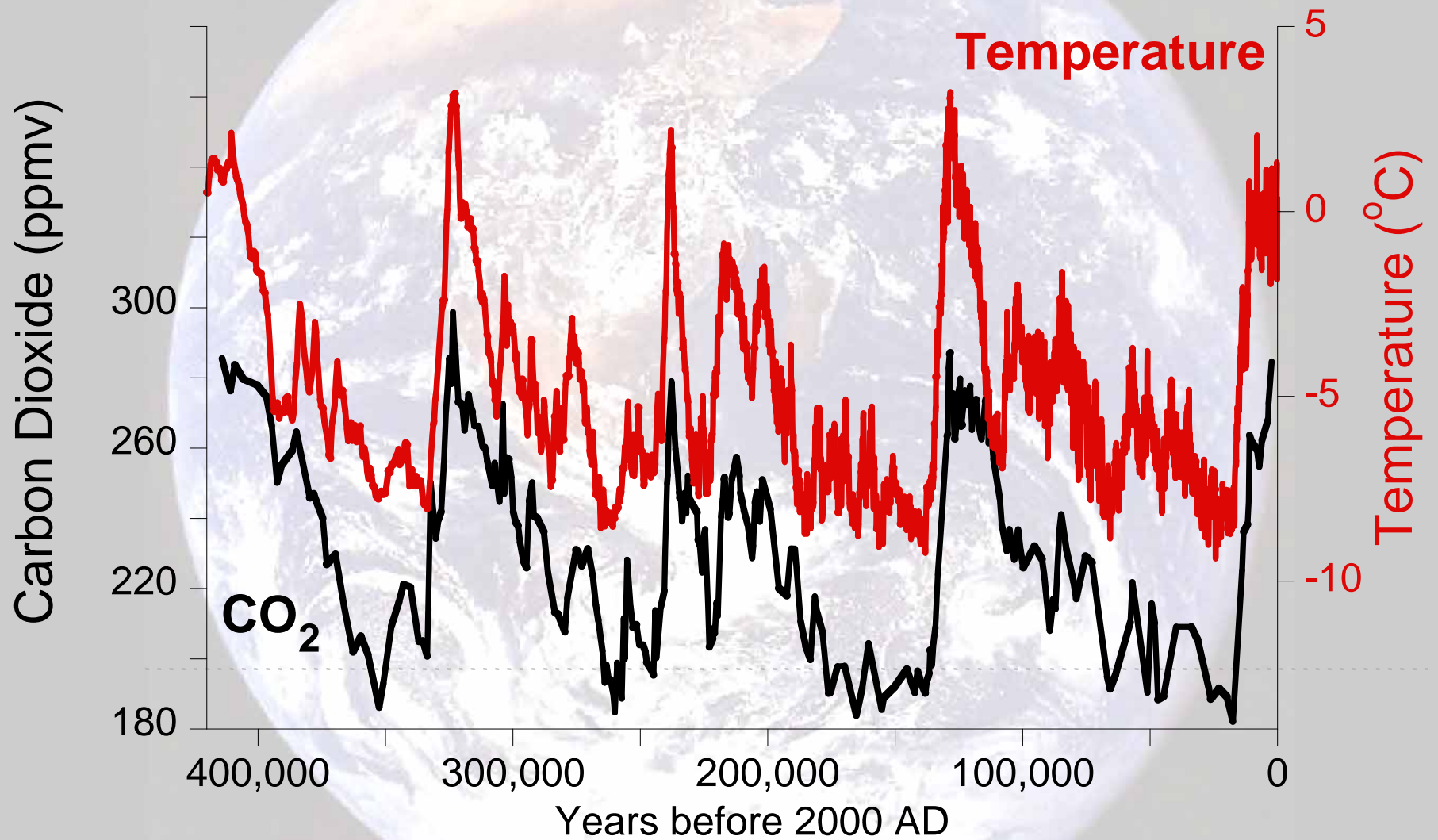
Dr. Cameron Wake
Institute for the Study of Earth, Oceans, and Space (EOS)
University of New Hampshire

62nd Annual Meeting of the
Northeastern Weed Science Society
Philadelphia, PA 8 Jan 2008

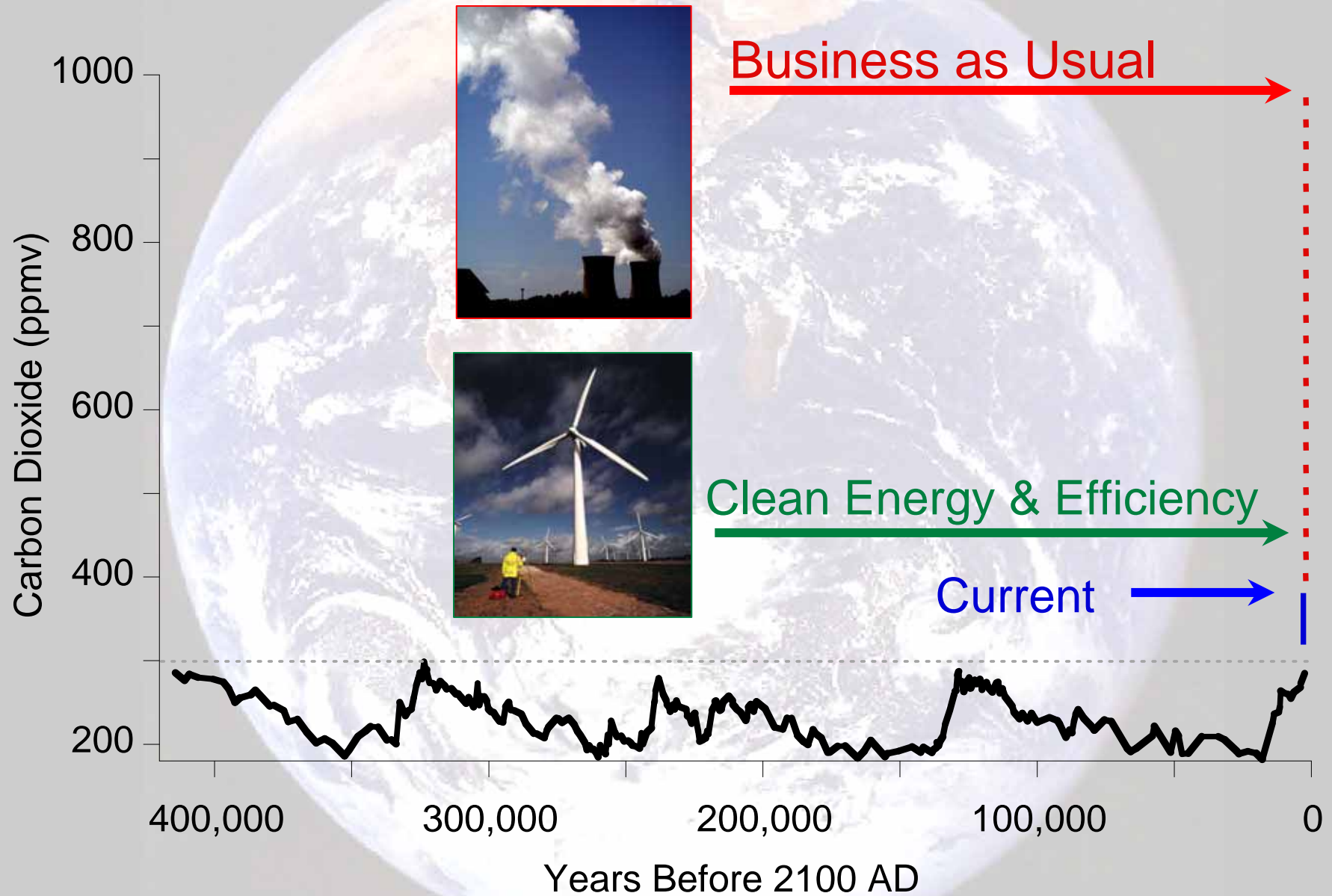
Vostok Ice Core - Atmospheric Carbon Dioxide



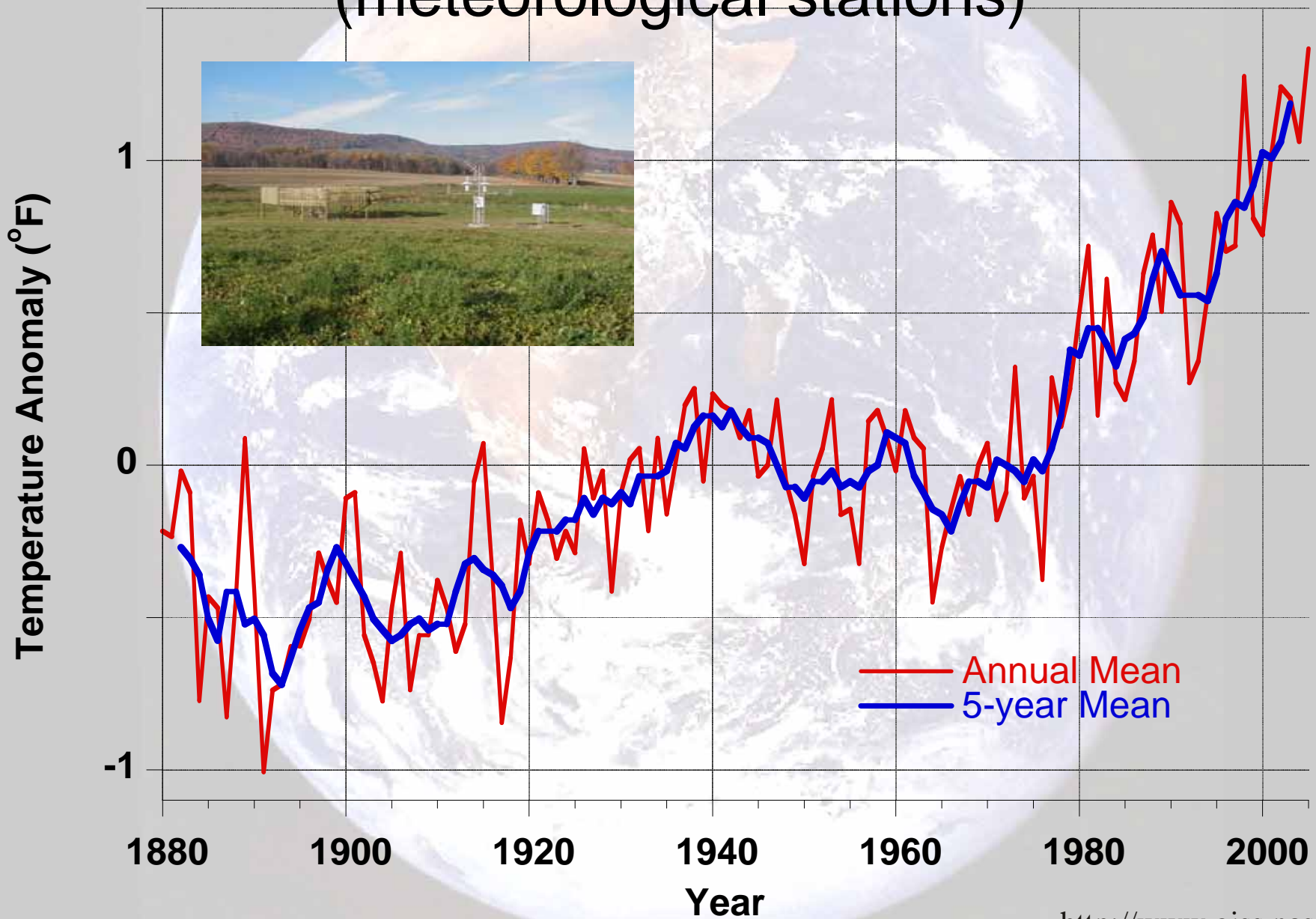
Vostok Ice Core - Carbon Dioxide & Temperature



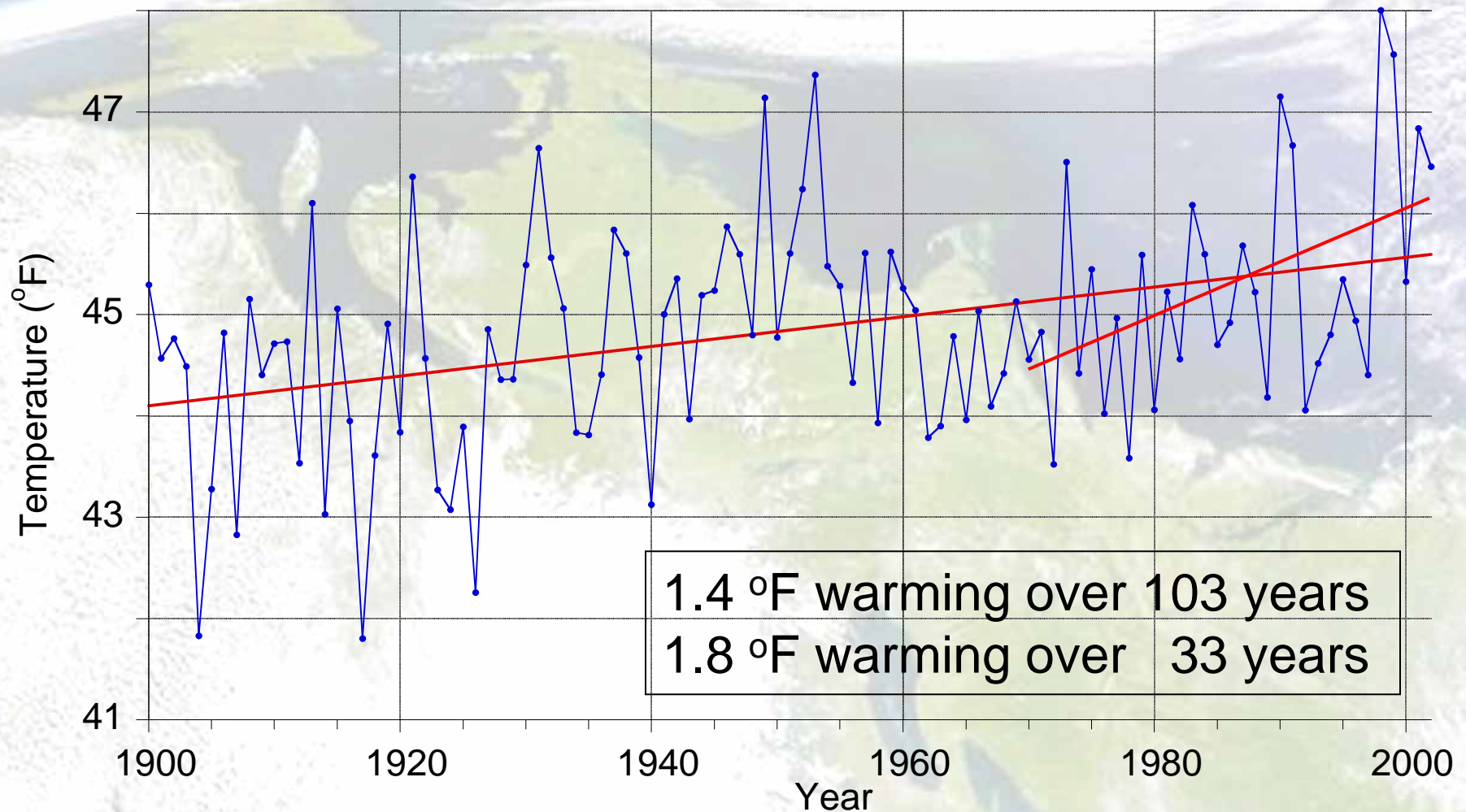
Vostok Ice Core - Atmospheric Carbon Dioxide



Global Temperature 1880-2005 (meteorological stations)

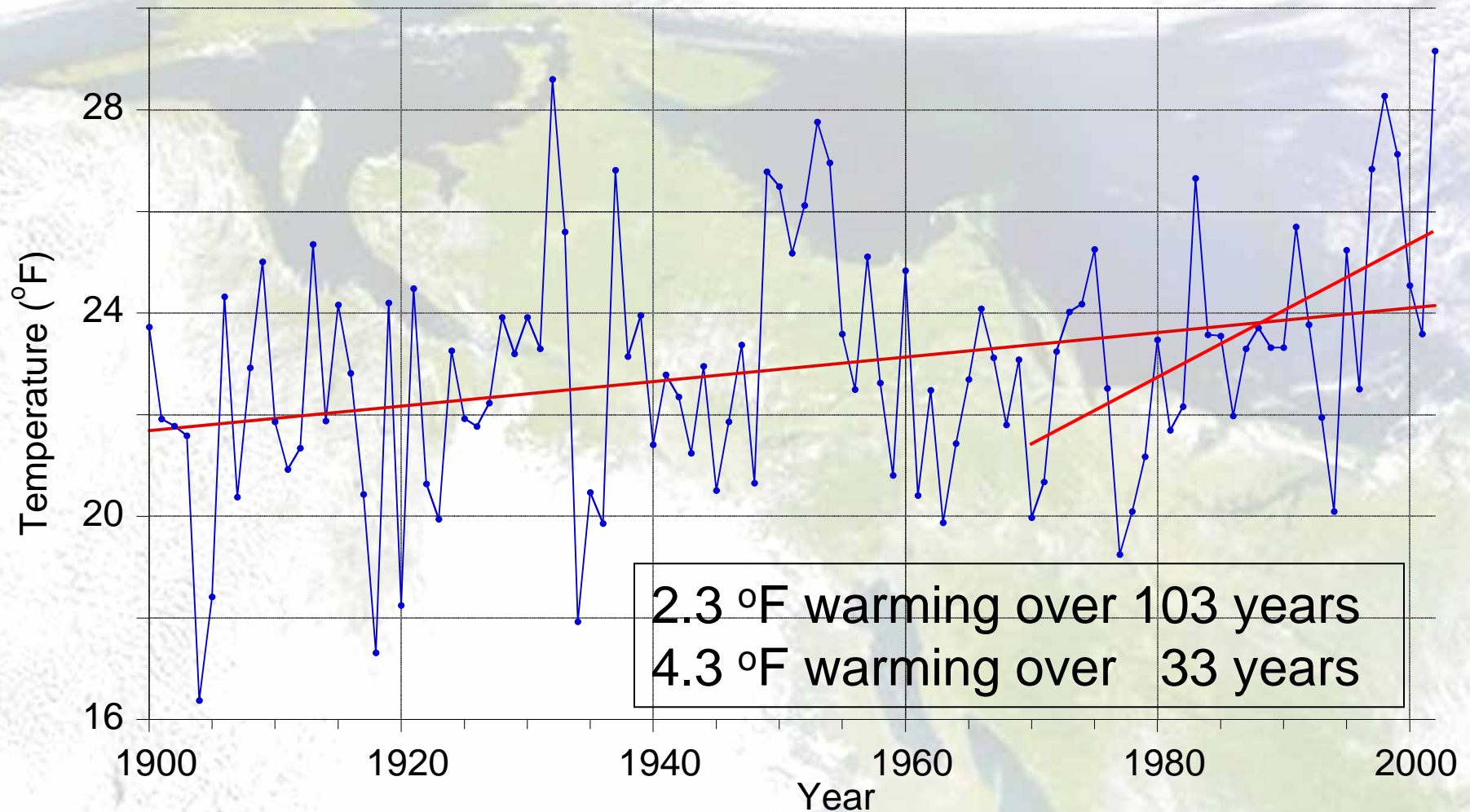


Annual Temperature in Northeast US & Canadian Maritimes: 1900-2002



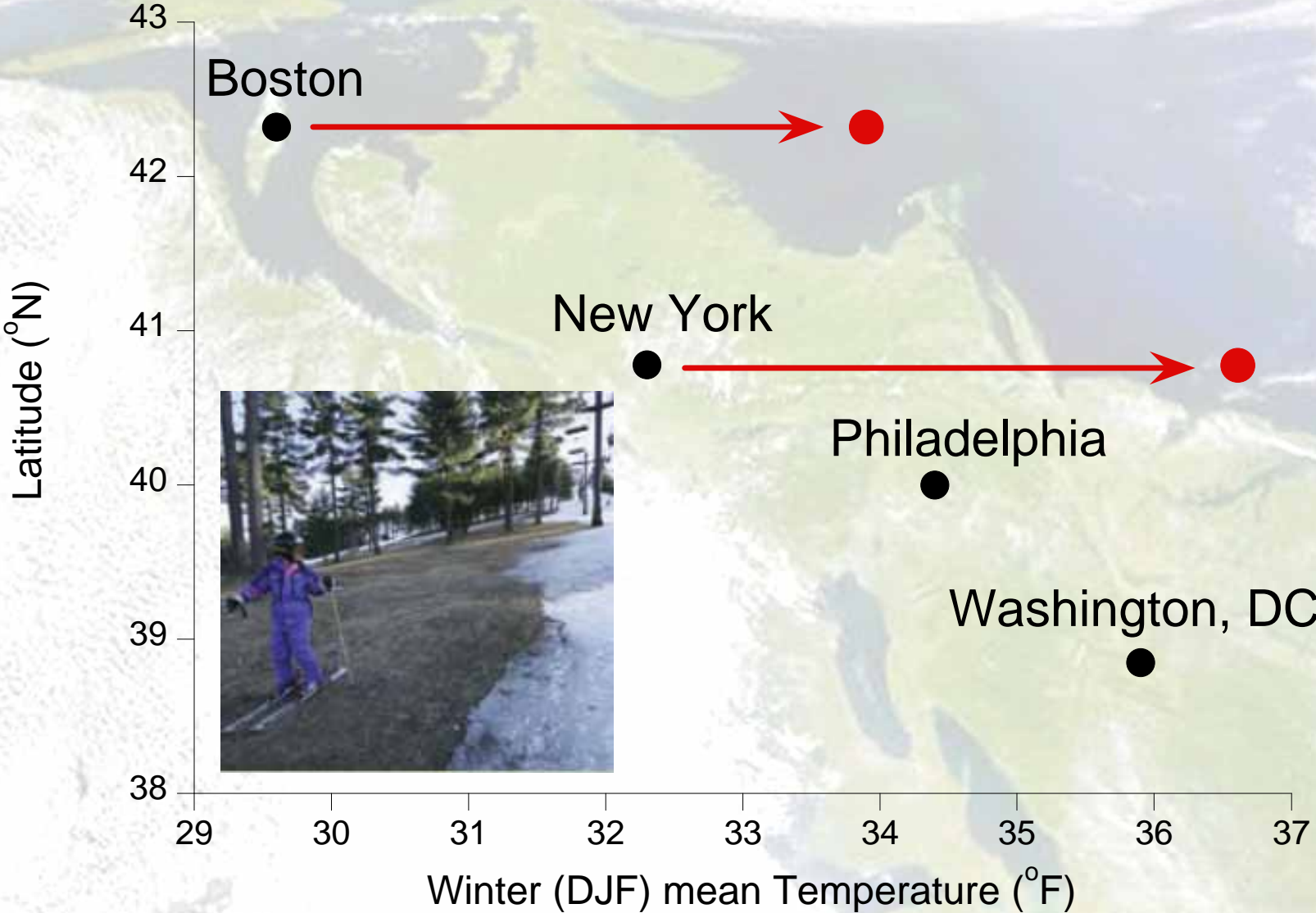
Time-series represents an aerielly weighted average of data from 136 stations.
Data from the NOAA-NCDC and Environment Canada

Winter Temperature in Northeast US & Canadian Maritimes: 1900-2002

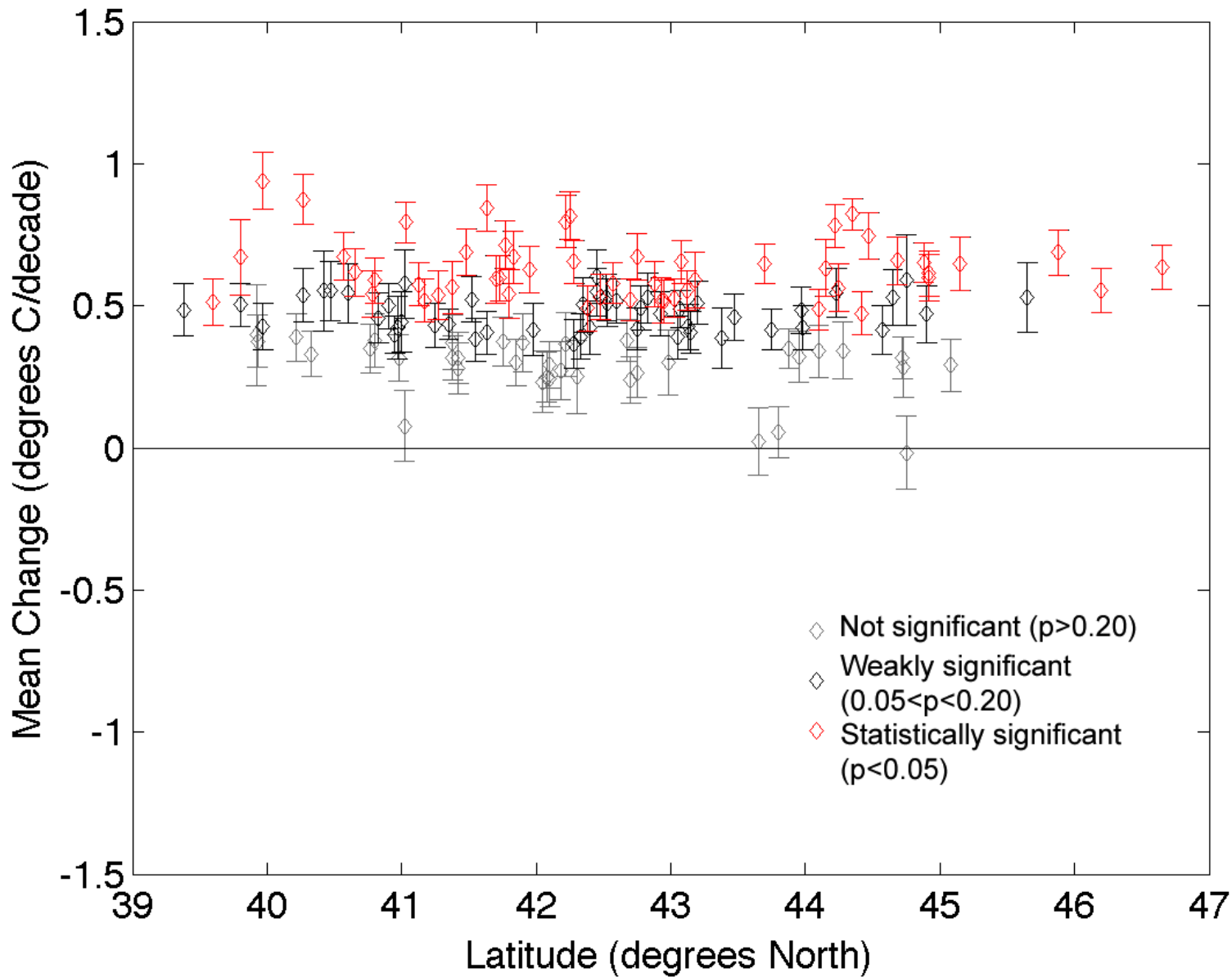


Time-series represents an aerielly weighted average of data from 136 stations.
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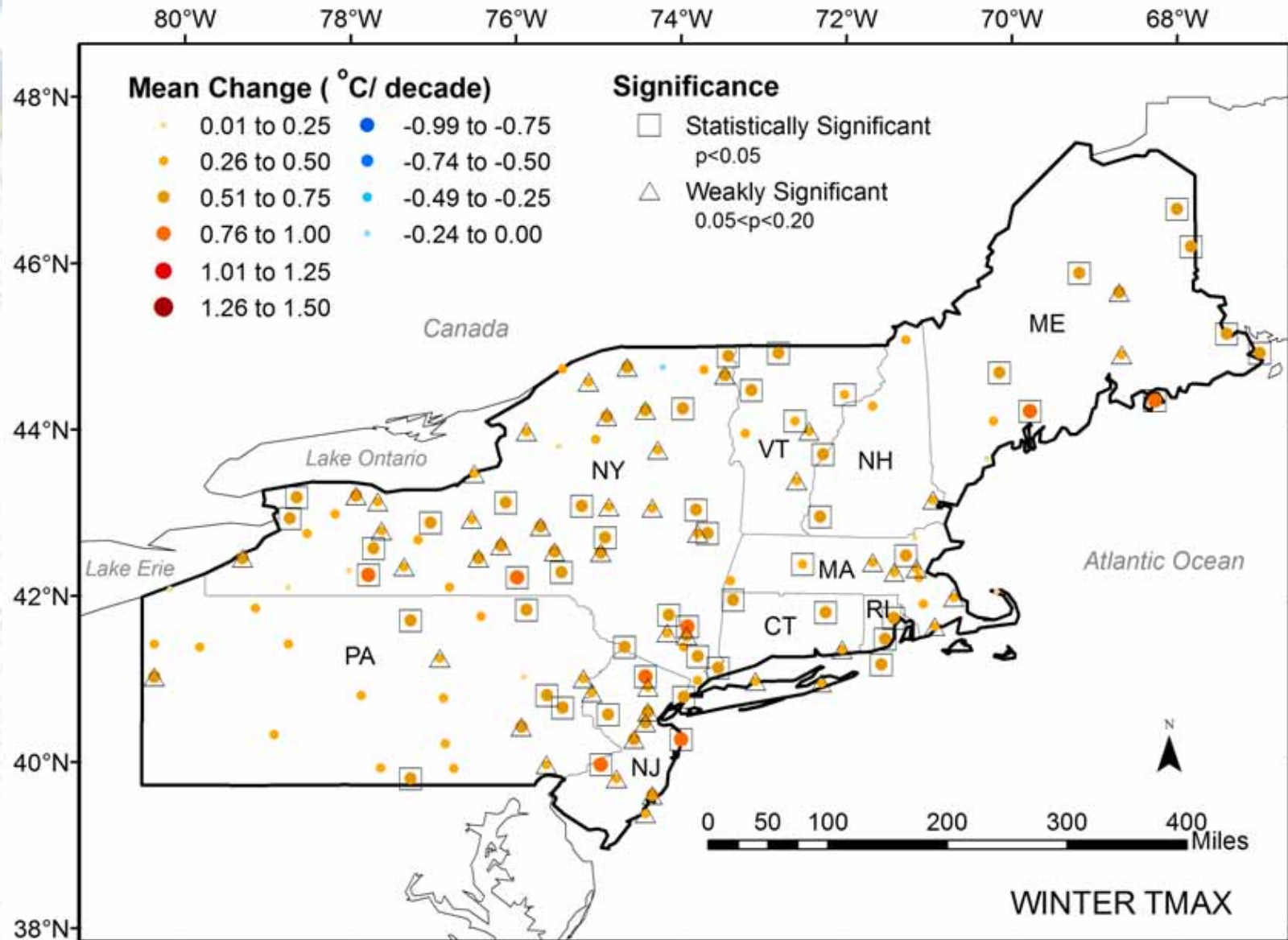
4.3°F Winter Temperature Increase



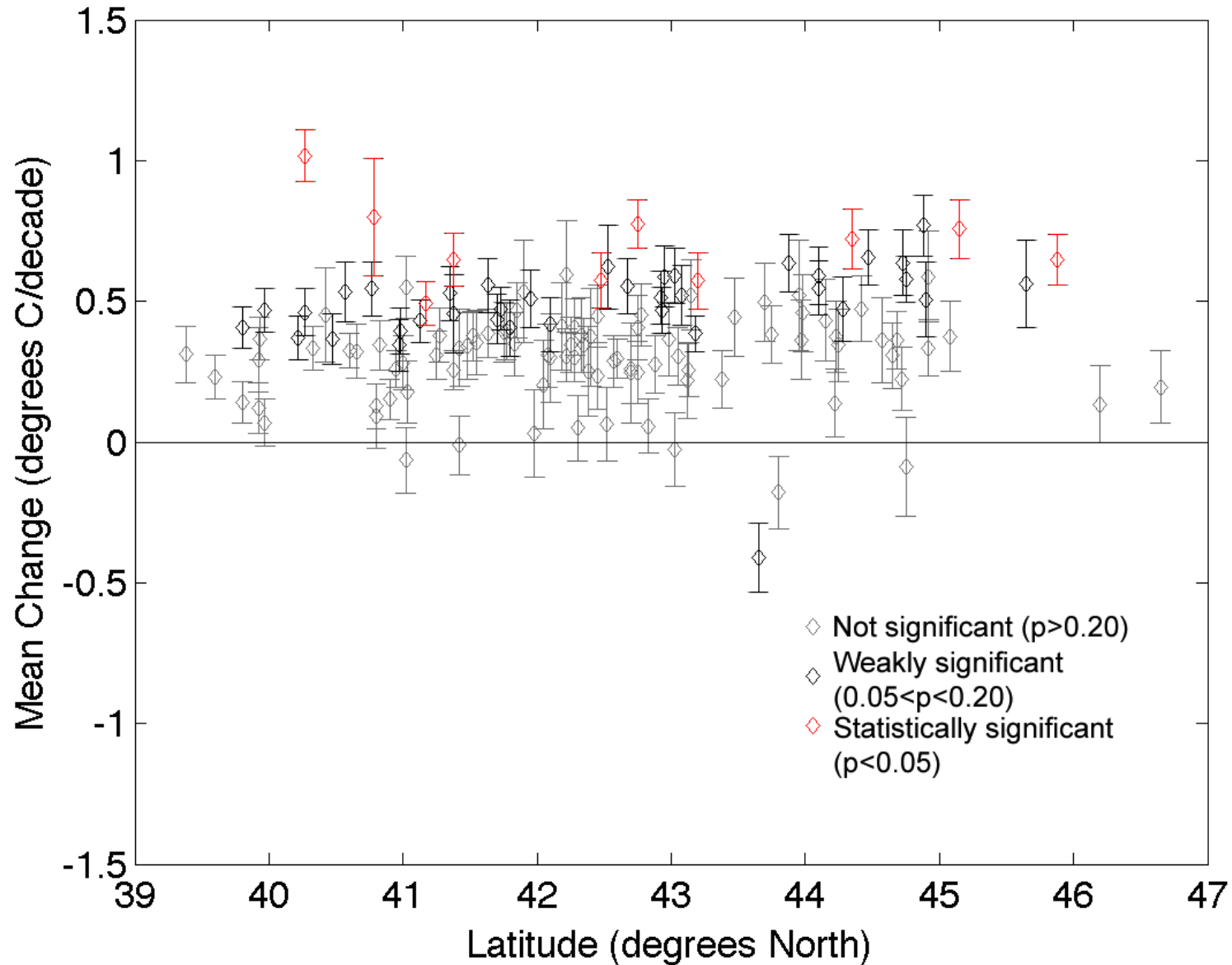
Trends in Mean Winter Temperature ($^{\circ}\text{C}/\text{decade}$)



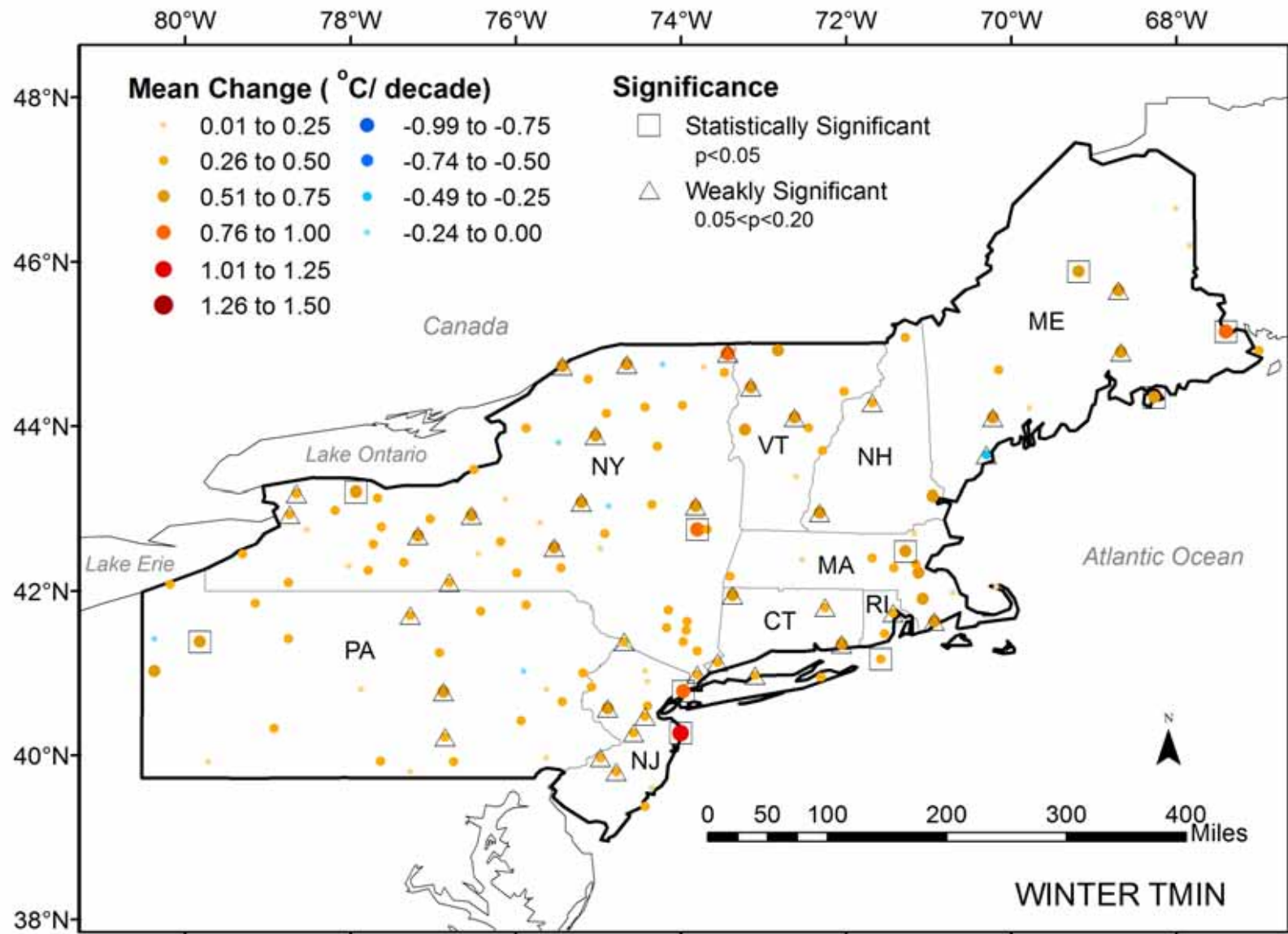
Trends in Mean Winter Temperature ($^{\circ}\text{C}/\text{decade}$)



Trends in Minimum Winter Temperature (°C/decade)



Trends in Minimum Winter Temperature ($^{\circ}\text{C}/\text{decade}$)



Trends in Minimum Winter Temperature

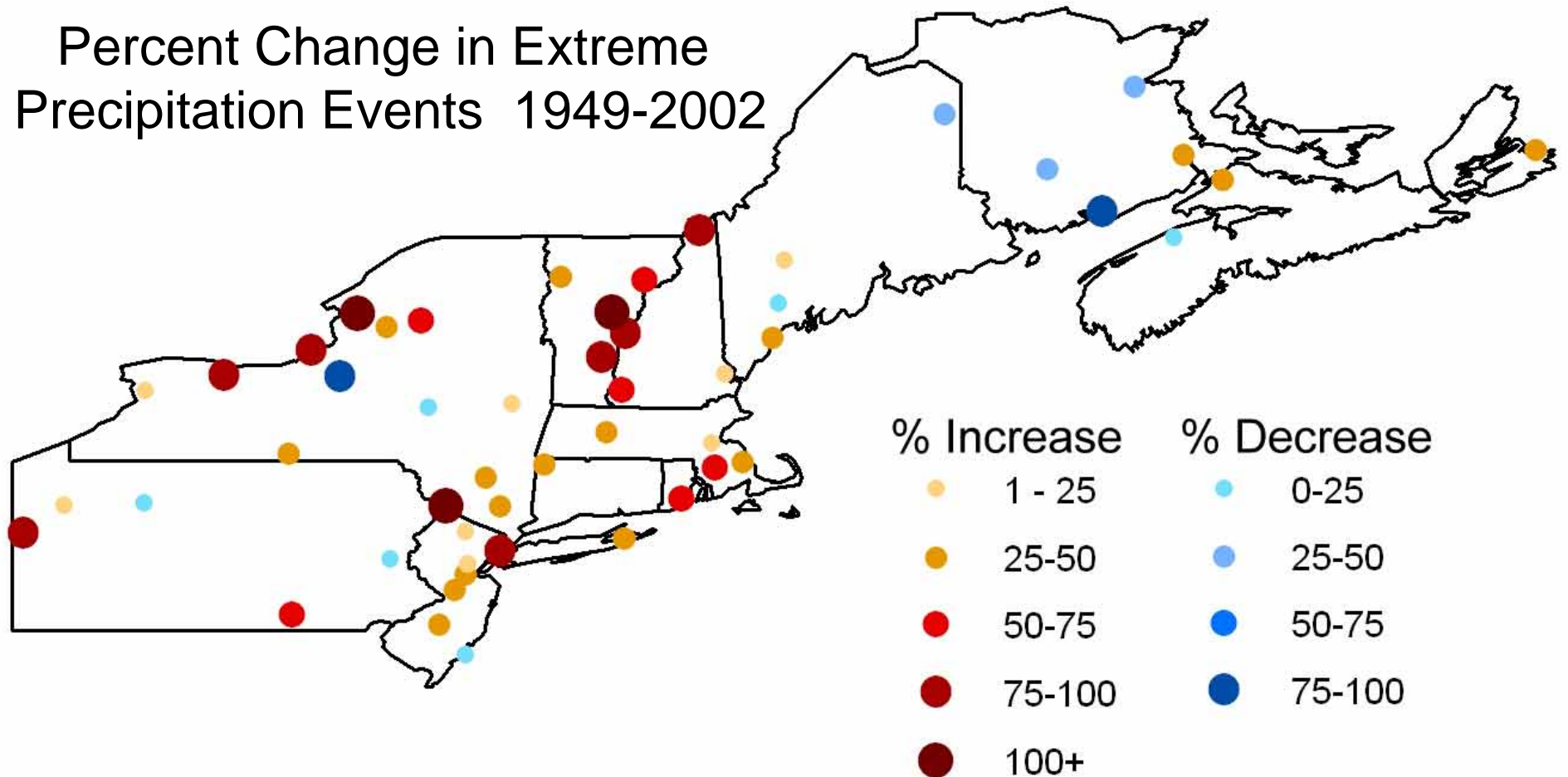
(°C/decade)

December	+ 0.18 \pm 0.15
January	+ 0.62 \pm 0.12
February	+ 0.60 \pm 0.17
March	+ 0.08 \pm 0.08

Winter	+ 0.37 \pm 0.10
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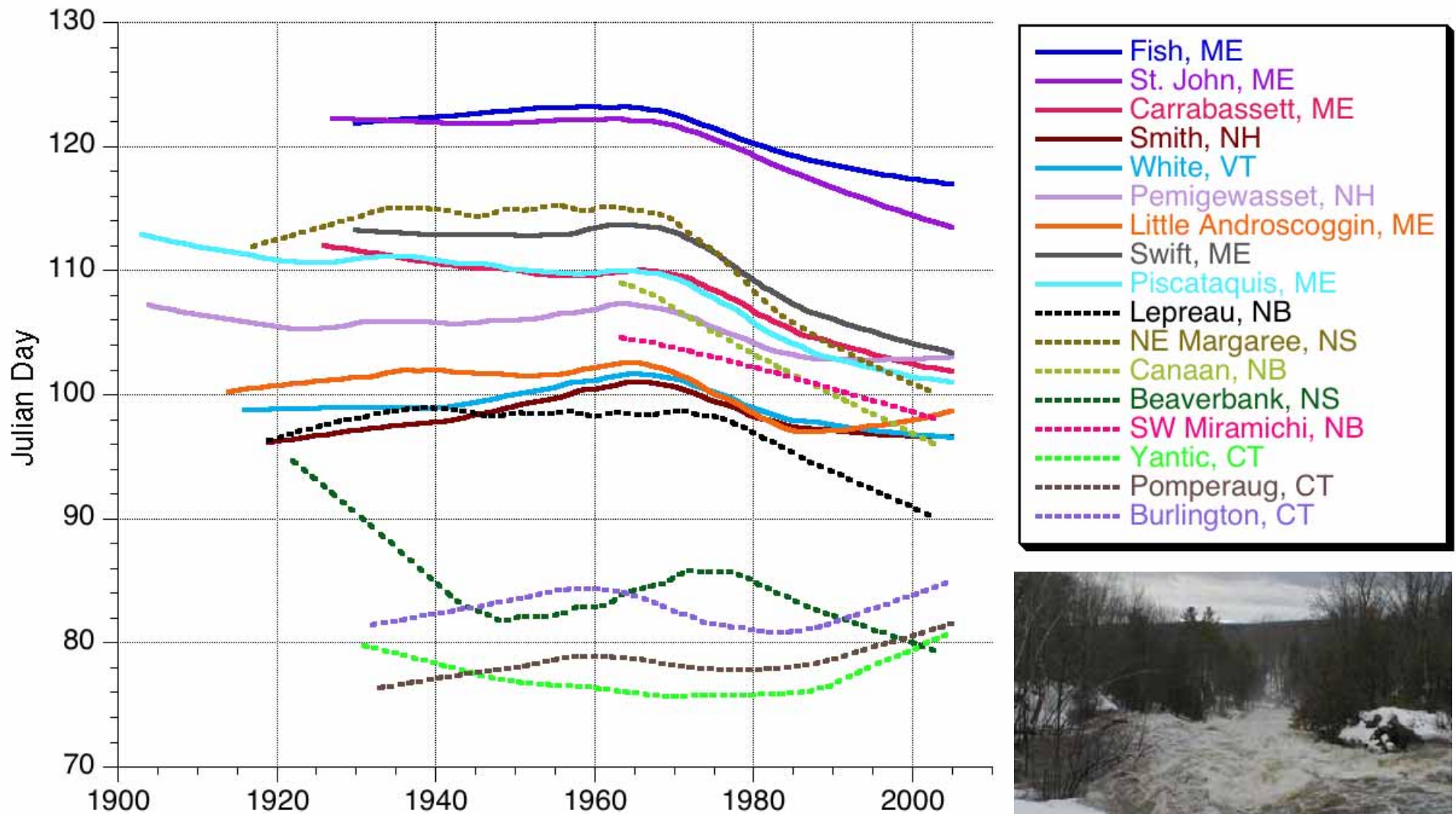
Spatial Variation of Extreme Precipitation Trends: 1970-2002

Percent Change in Extreme Precipitation Events 1949-2002



The extreme precipitation trend was calculated from a linear regression of number of

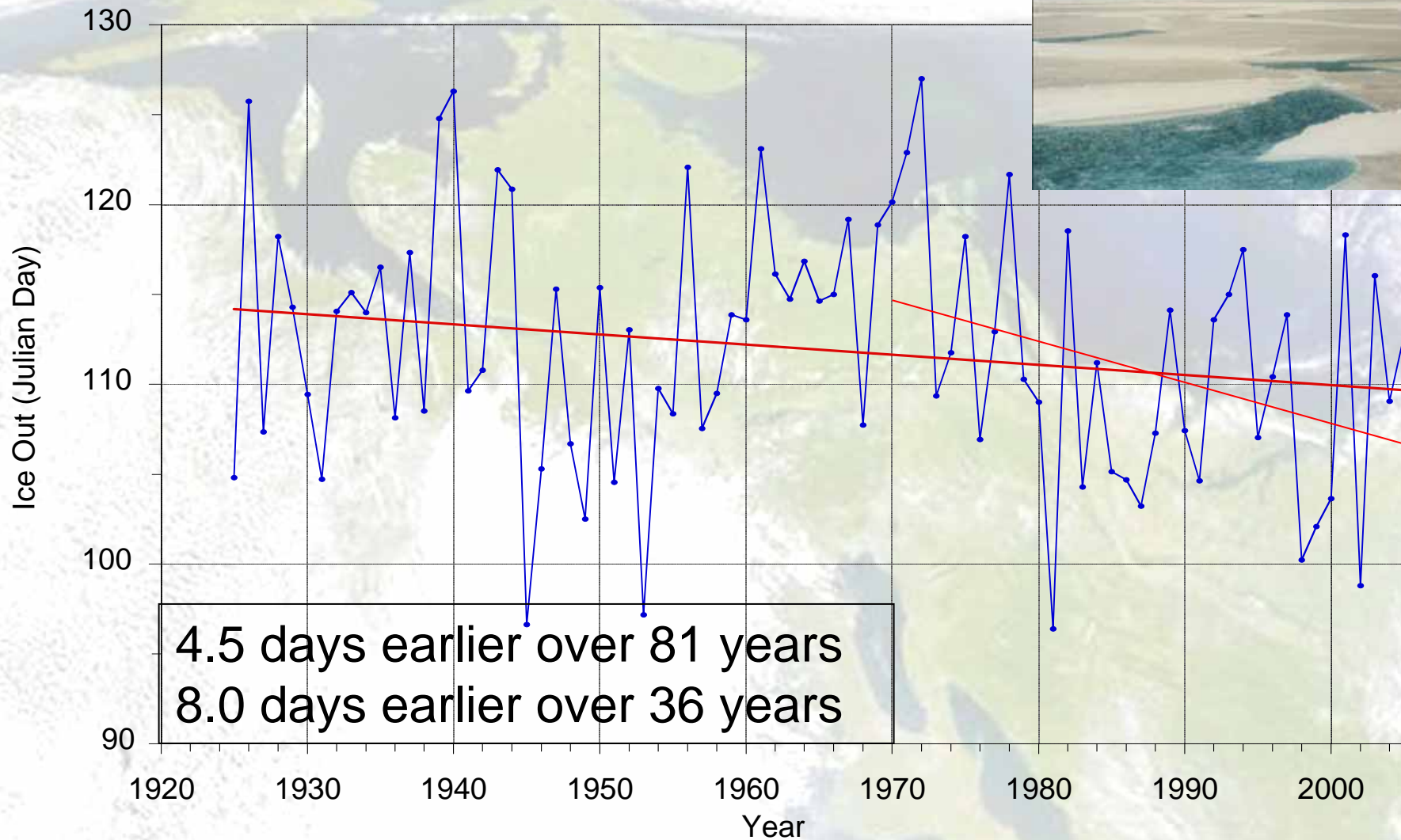
Winter/Spring (1 Jan - 31 May) Center-of-Volume Dates



All data from unregulated rivers; Hodgkins et al.,

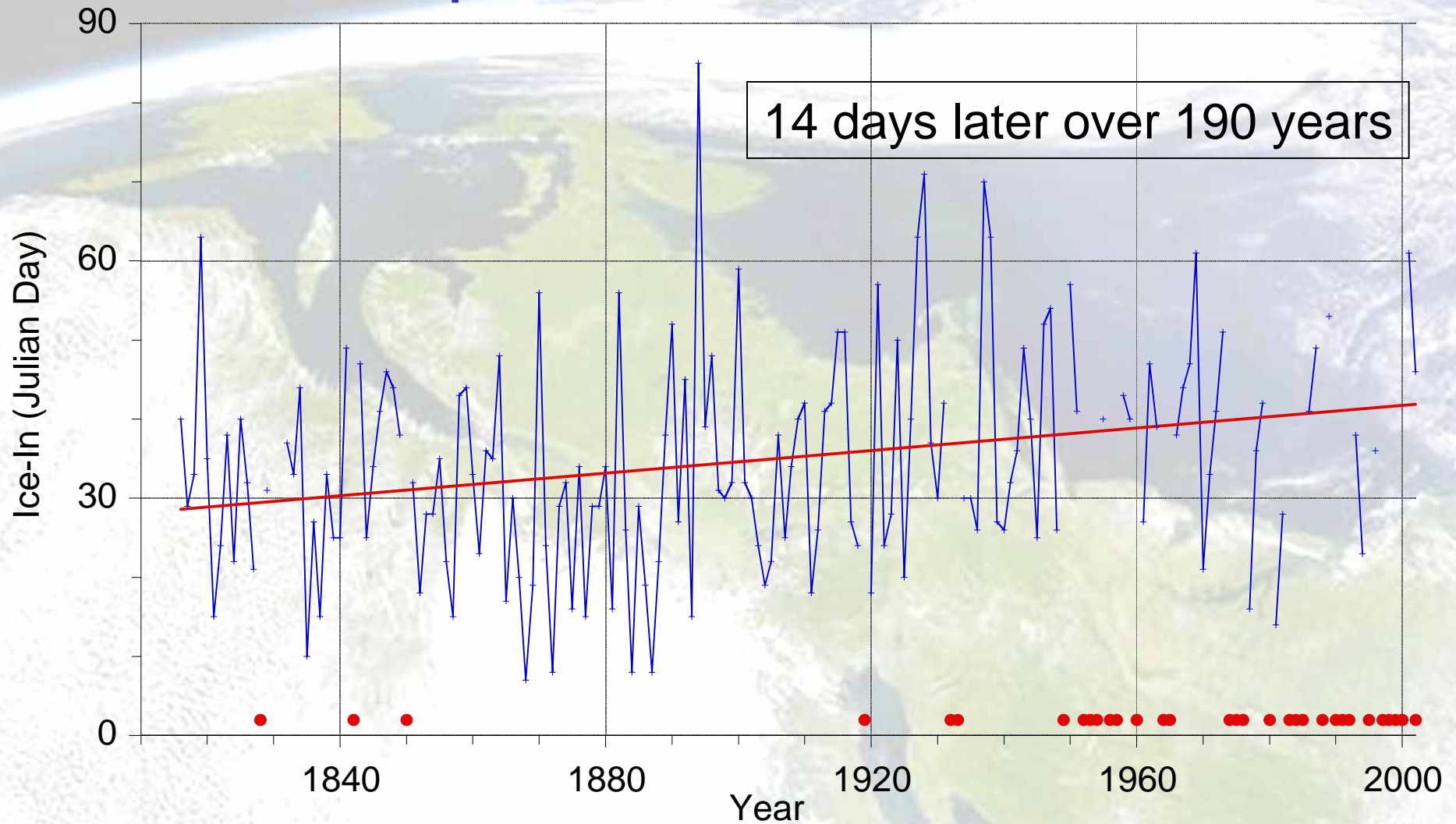


Average Ice Out Day Trend 1925-2005 (27 Lakes)



Ice Out data from Hodgkins et al., 2002 and at: <http://me.water.usgs.gov/iceout.html>

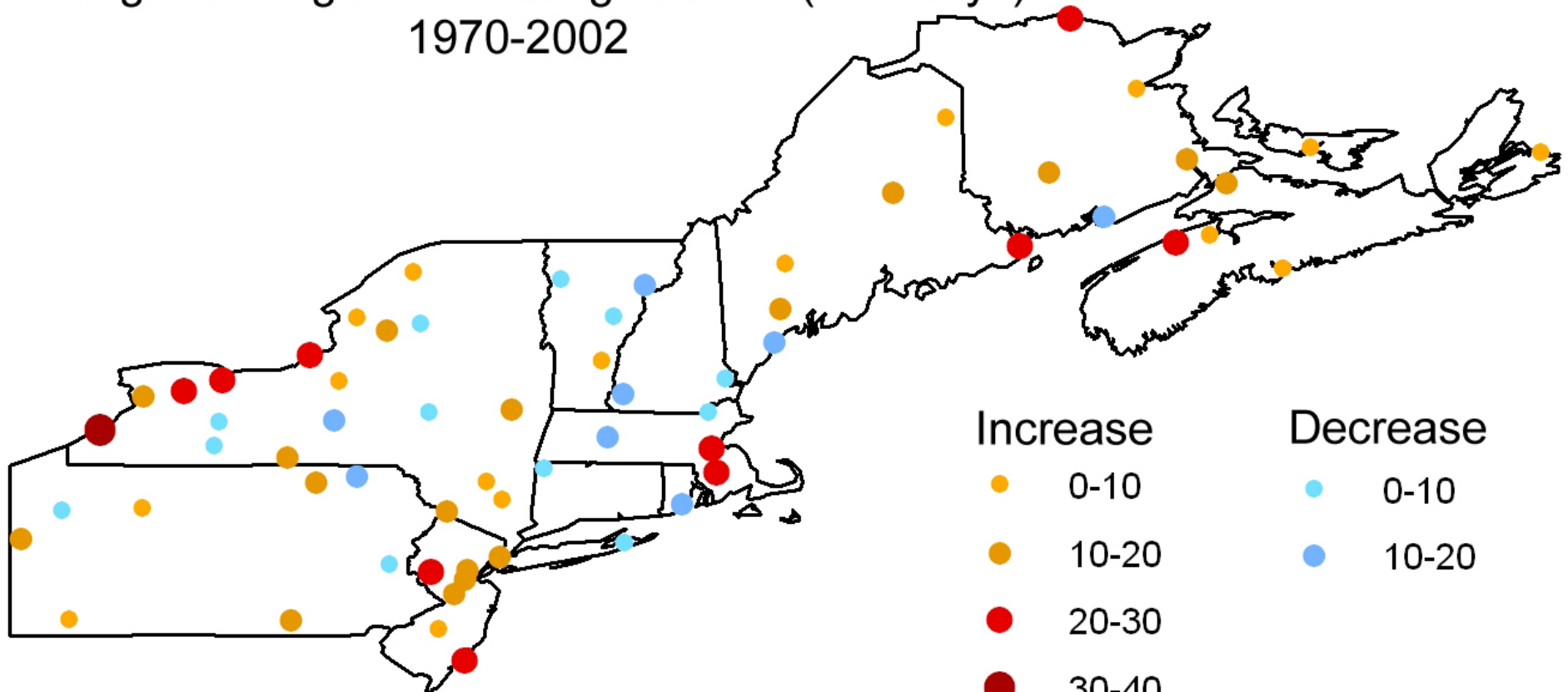
Lake Champlain Ice-In Dates: 1816-2005



33 times lake has not frozen over (●)
78% since 1950; 54% since 1970

Spatial Variation of Growing Season (28°F) Trends 1970-2000

Change in Length of Growing Season (# of Days)
1970-2002



70% stations - longer growing season
20% stations - 20 days longer

The growing season trend was calculated from a linear regression of annual average

Northeast Climate Impacts Assessment

A Report of the Northeast Climate Impacts Assessment

Confronting Climate Change in the U.S. Northeast



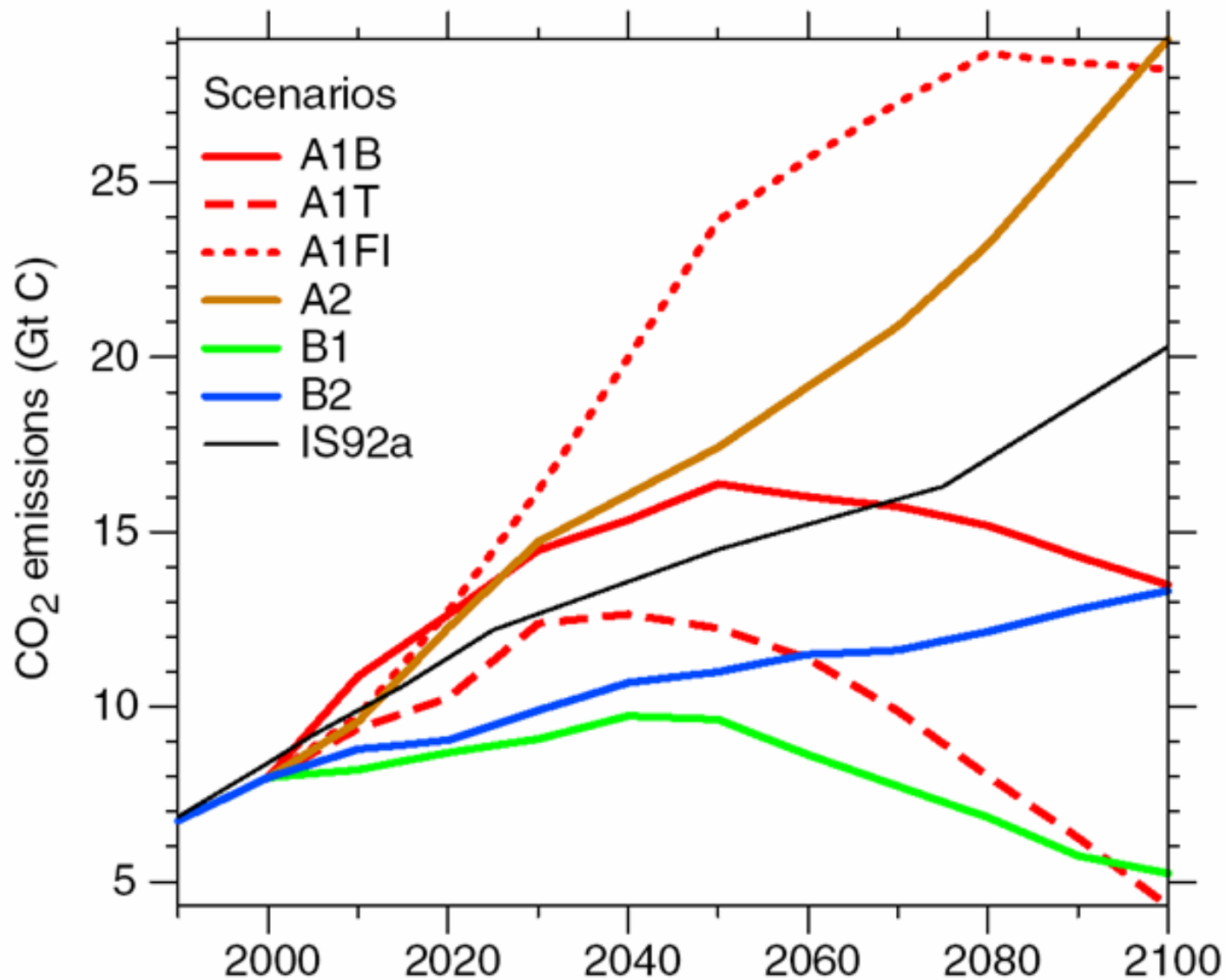
SCIENCE, IMPACTS, AND SOLUTIONS

JULY 2007

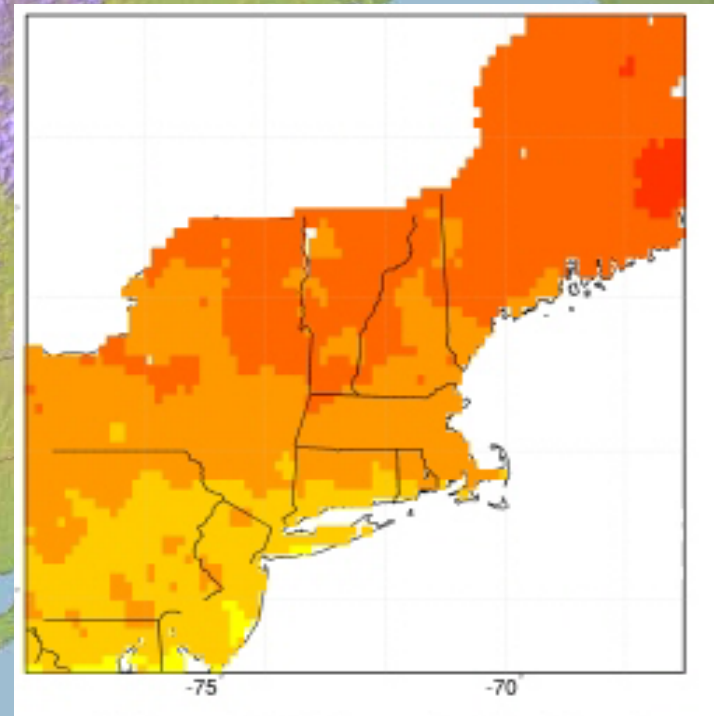
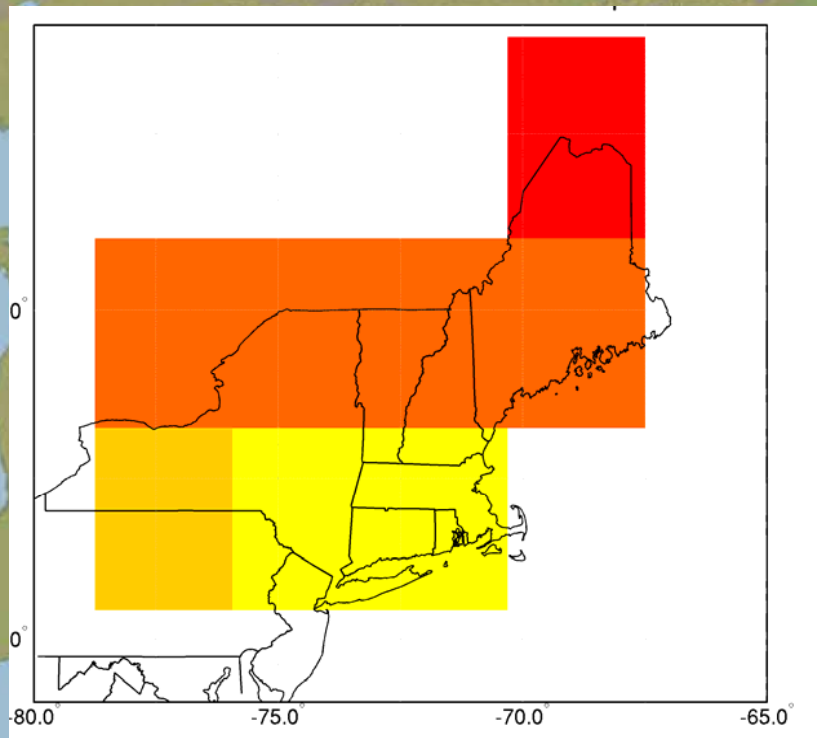
www.climatechoices.org

- Collaboration between Union of Concerned Scientists and 50 independent scientists
- **Geographic Scope**
Nine Northeast states, from Maine to Pennsylvania
- **Peer Review**
Climate Dynamics, 2007
14 papers in *Adaptation and Mitigation of Climate Change*, 2008

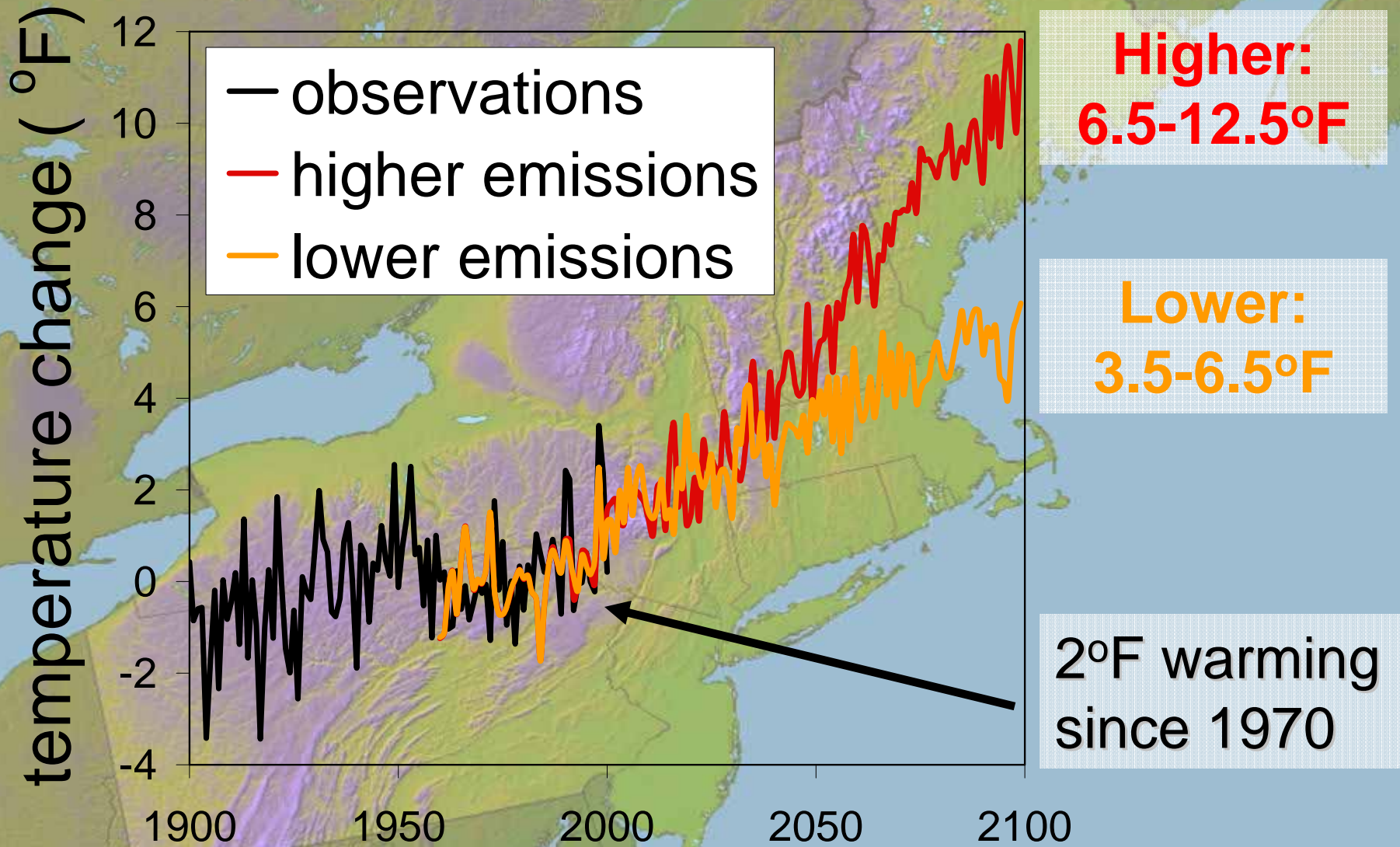
Projecting Future Climate Change for the Northeast: Greenhouse Gas Emission Scenarios



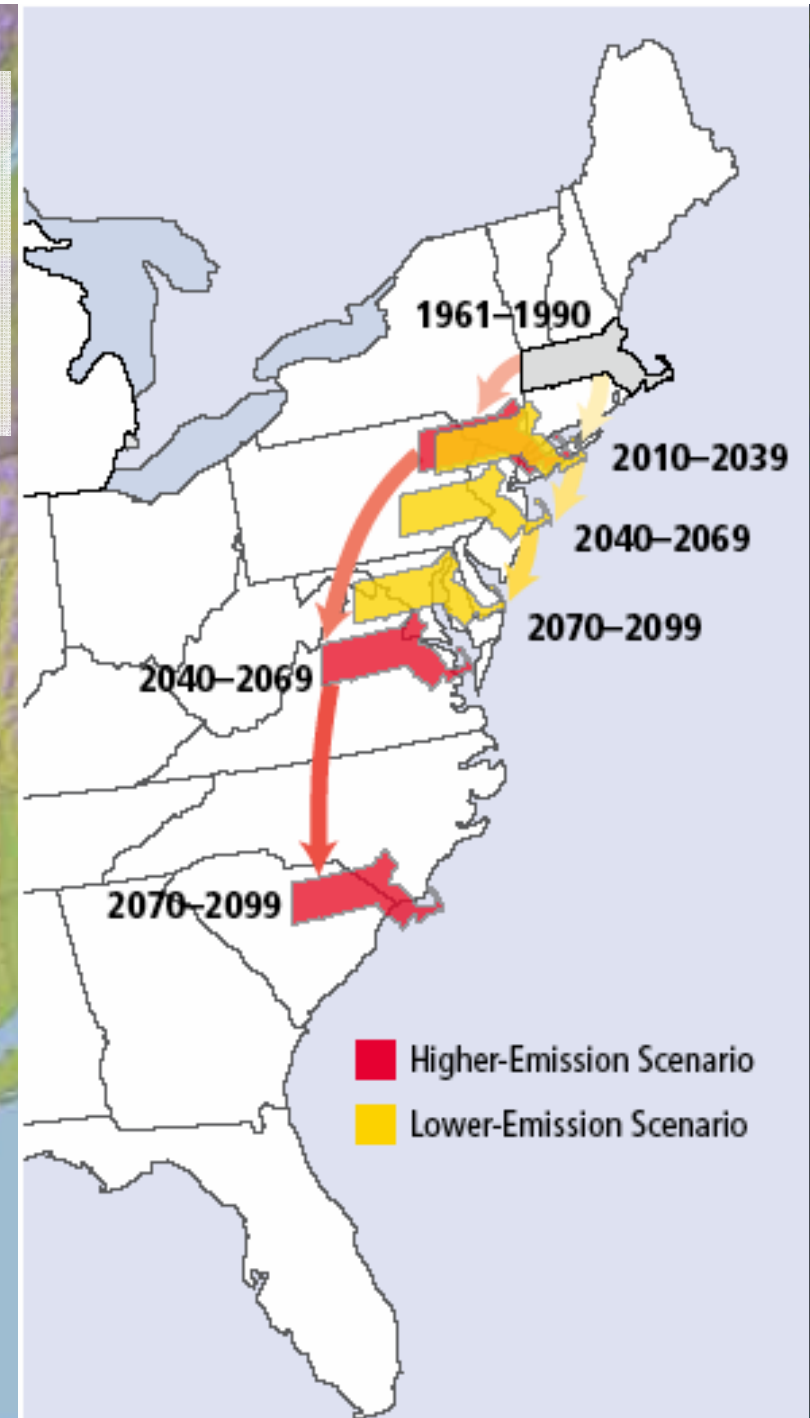
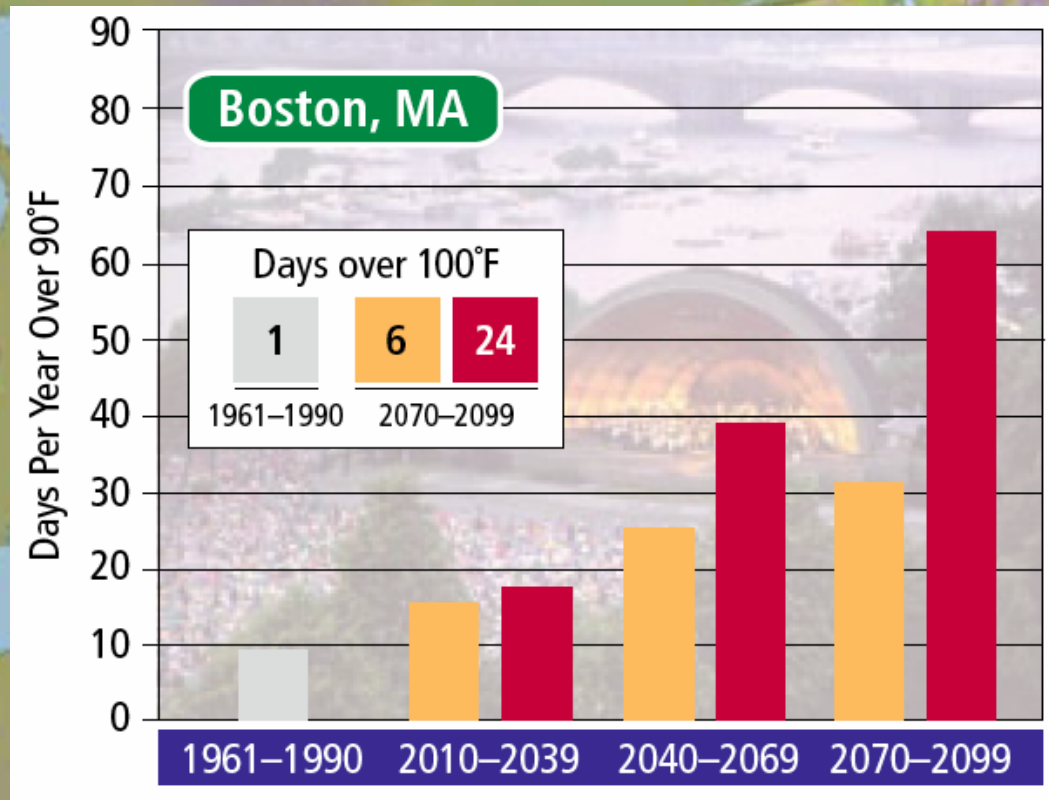
Projecting Future Climate Change for the Northeast: Downscale Global Projections to Regional Level



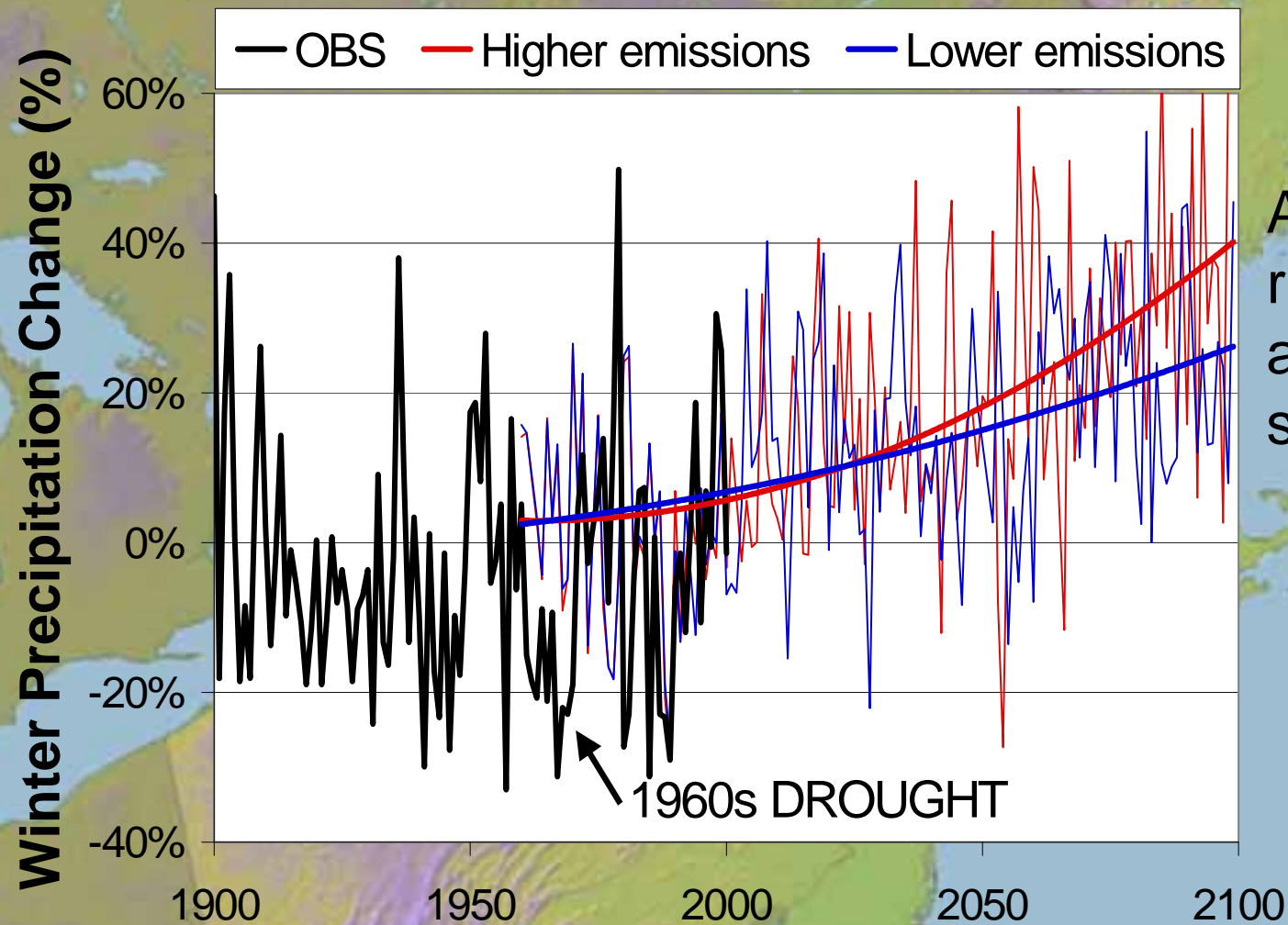
Projecting Future Climate Change for the Northeast: Rising Annual Temperatures



Summer heat index: *How hot summers will “feel” in Massachusetts*



Increasing winter precipitation



As temperatures rise, more falling as rain, less as snow

Extreme Precipitation Events Increase

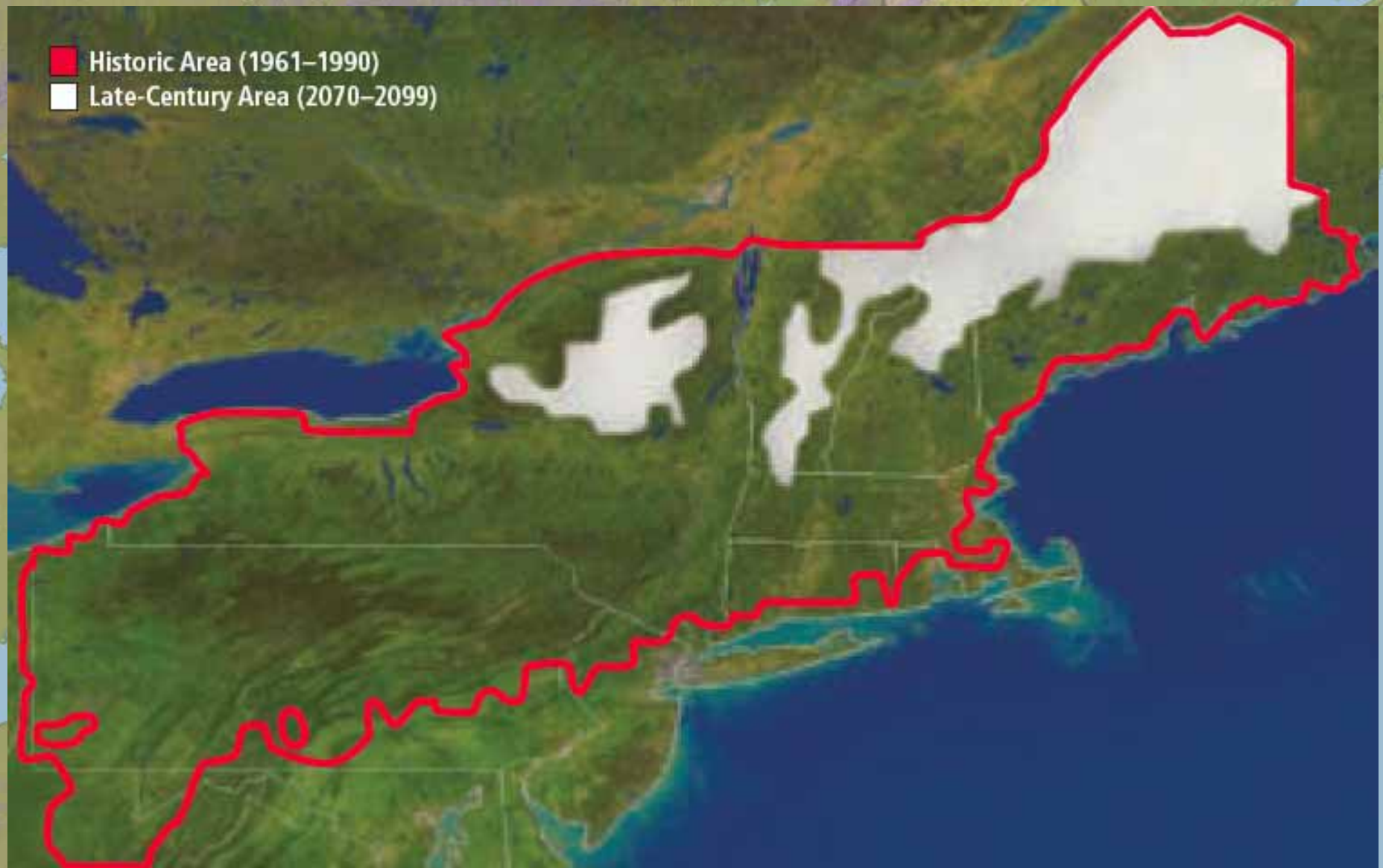
- Heavy rainfall events are becoming more frequent across the Northeast
- Under both emissions scenarios
 - rainfall is expected to become more intense
 - periods of heavy rainfall are expected to become more frequent



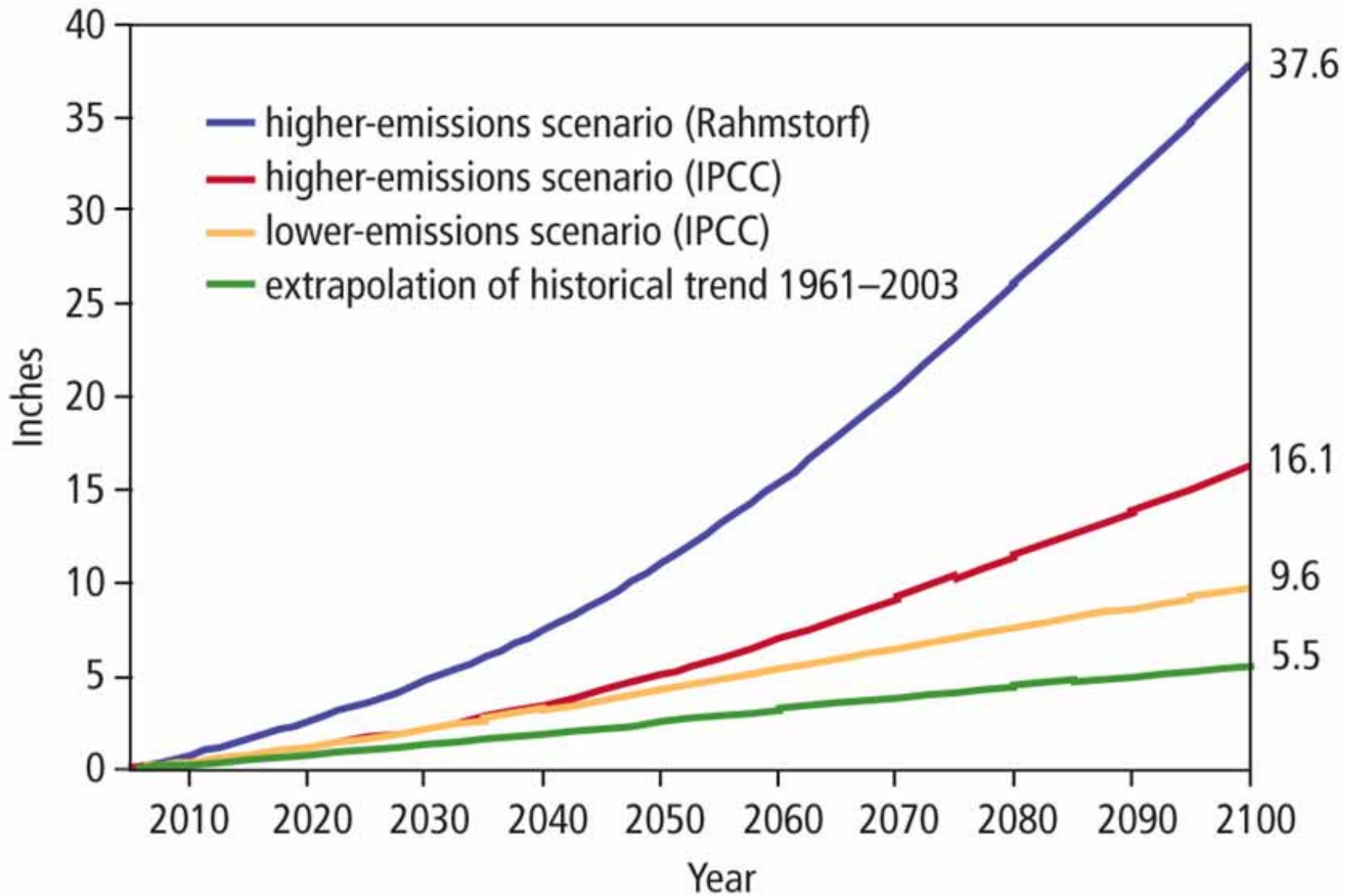
Bridge over Axe Handle Brook, Rochester, NH
May 2006.

credit: Associated Press

Reduced Snow on Ground Days

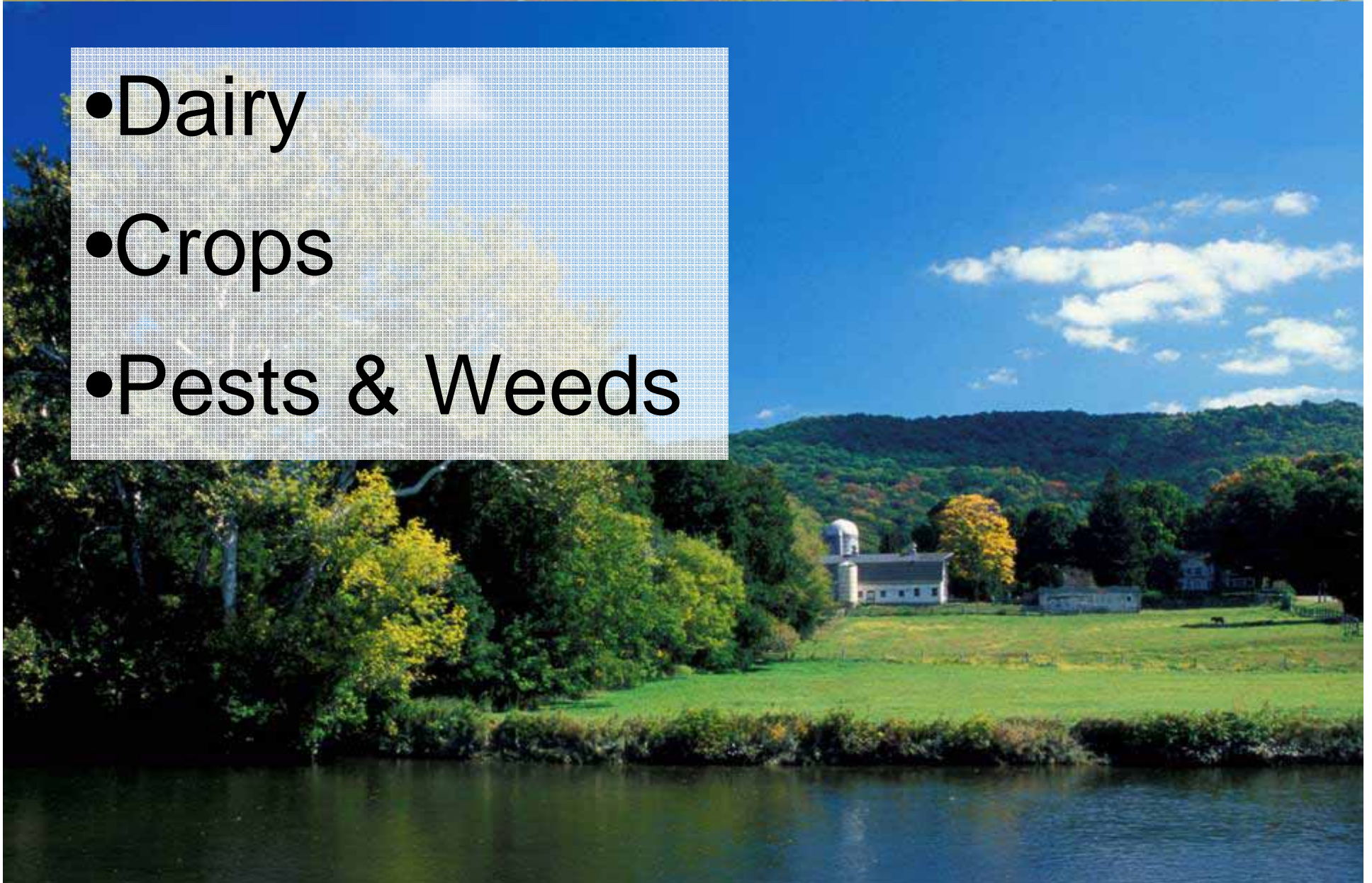


Projected Rise in Global Sea Level



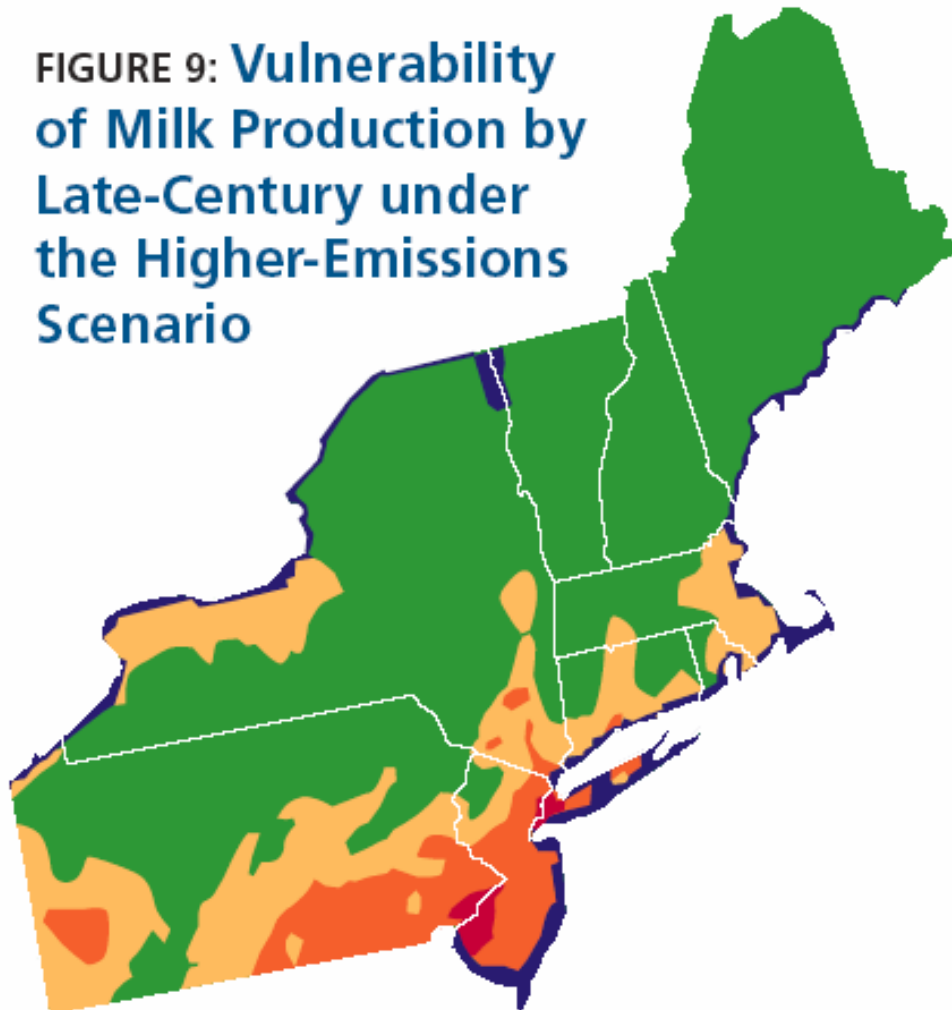
Impacts on Agriculture

- Dairy
- Crops
- Pests & Weeds



Impacts on Agriculture: Dairy

FIGURE 9: Vulnerability of Milk Production by Late-Century under the Higher-Emissions Scenario



■ 0–10% decline ■ 10%–15% decline
■ 15%–20% decline ■ >20% decline
■ no data



Higher Temperatures Depress Milk Production

Impacts on Agriculture: Crops

Traditional Fruit
Crops May Suffer in
a Warmer Climate



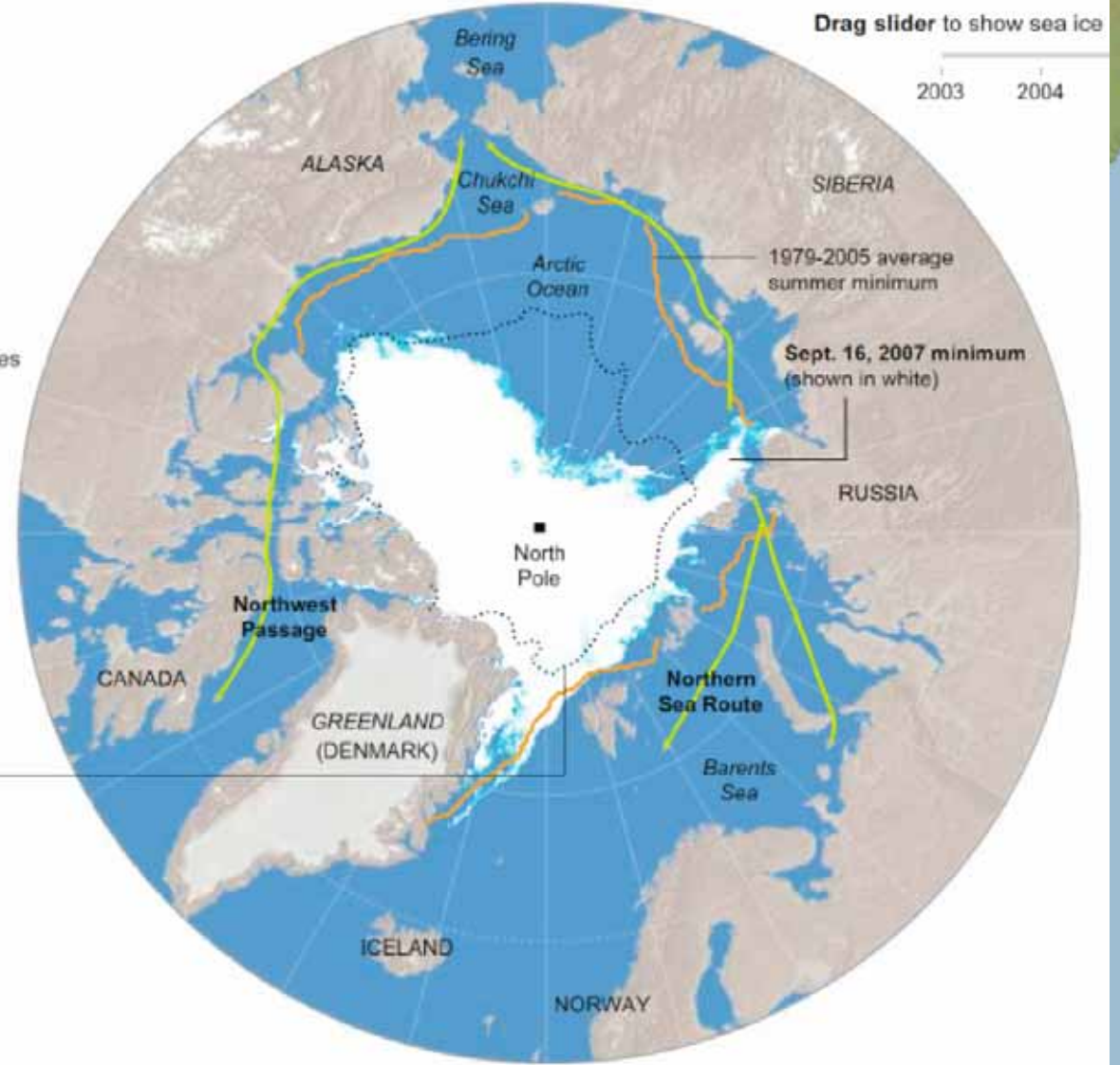
Impacts on Agriculture: Weeds & Pests

A Longer Growing Season Comes with a Price . .



Tipping Points?

Greenland Ice Sheet Melting?



What path will we take to the future?



Two roads diverged in a wood, and I -
I took the one less traveled by,
And that has made all the difference.

Robert Frost



TABLE 3: Top Agricultural Commodities of the Northeast

State	Dairy	Hay	Grains	Vegetables	Fruit	Nursery
Maine	88	15	8	126	34	37
New Hampshire	51	8	1	9	9	53
Connecticut	57	7	1	19	15	246
New Jersey	29	12	30	168	87	366
New York	1,556	108	156	323	179	334
Pennsylvania	1,394	103	203	126	109	733
Rhode Island	4	1	0	6	2	38
Vermont	342	24	3	10	9	23
Massachusetts	57	11	1	38	56	154

Economic value (in millions of dollars) based on 2002 U.S. Department of Agriculture data.⁵ Total value of the commodities listed here exceeded \$7.5 billion.⁶

