

Climate Change in New York

Recent Trends and Future Projections

Art DeGaetano

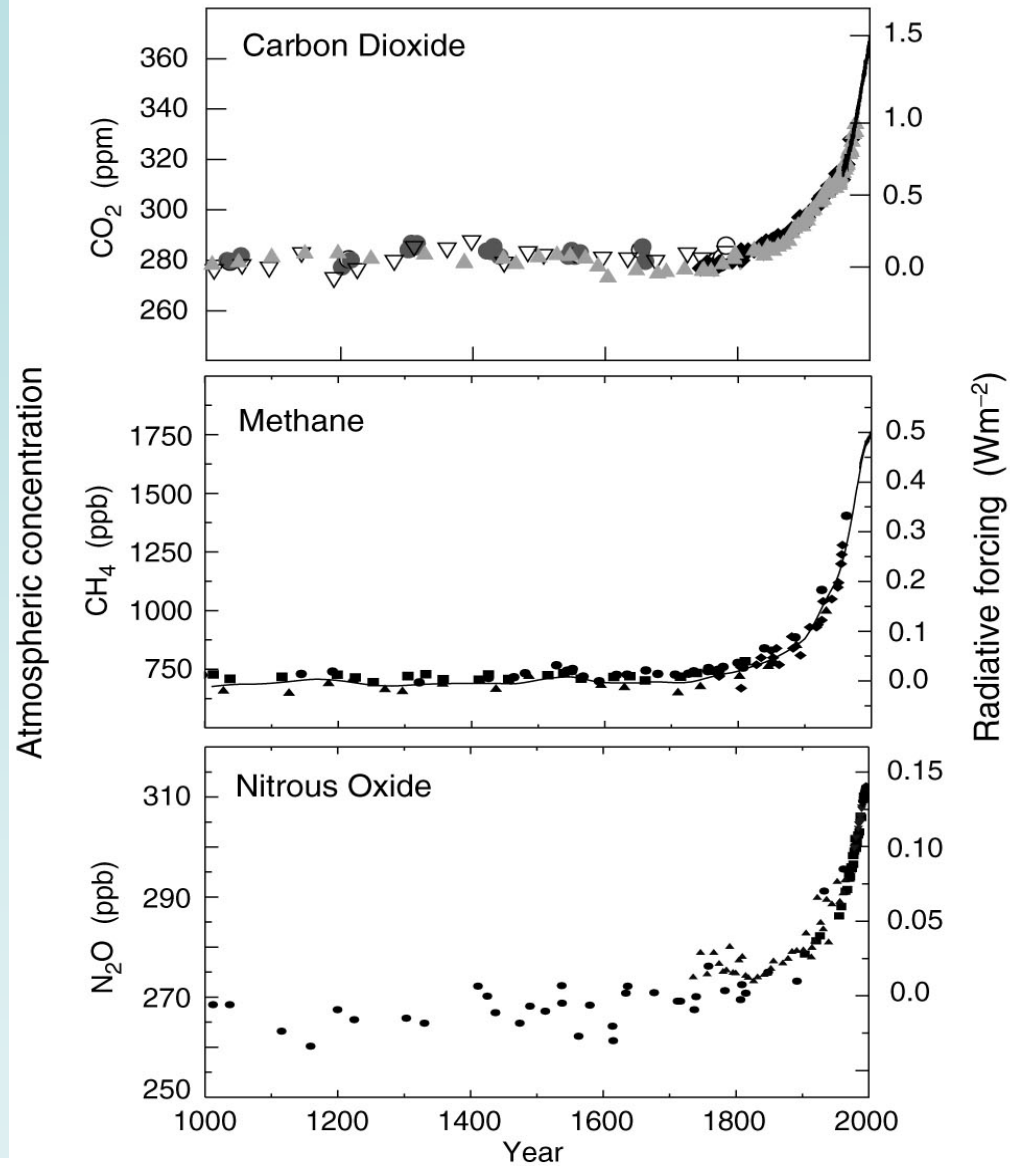
Professor and Assoc. Chair

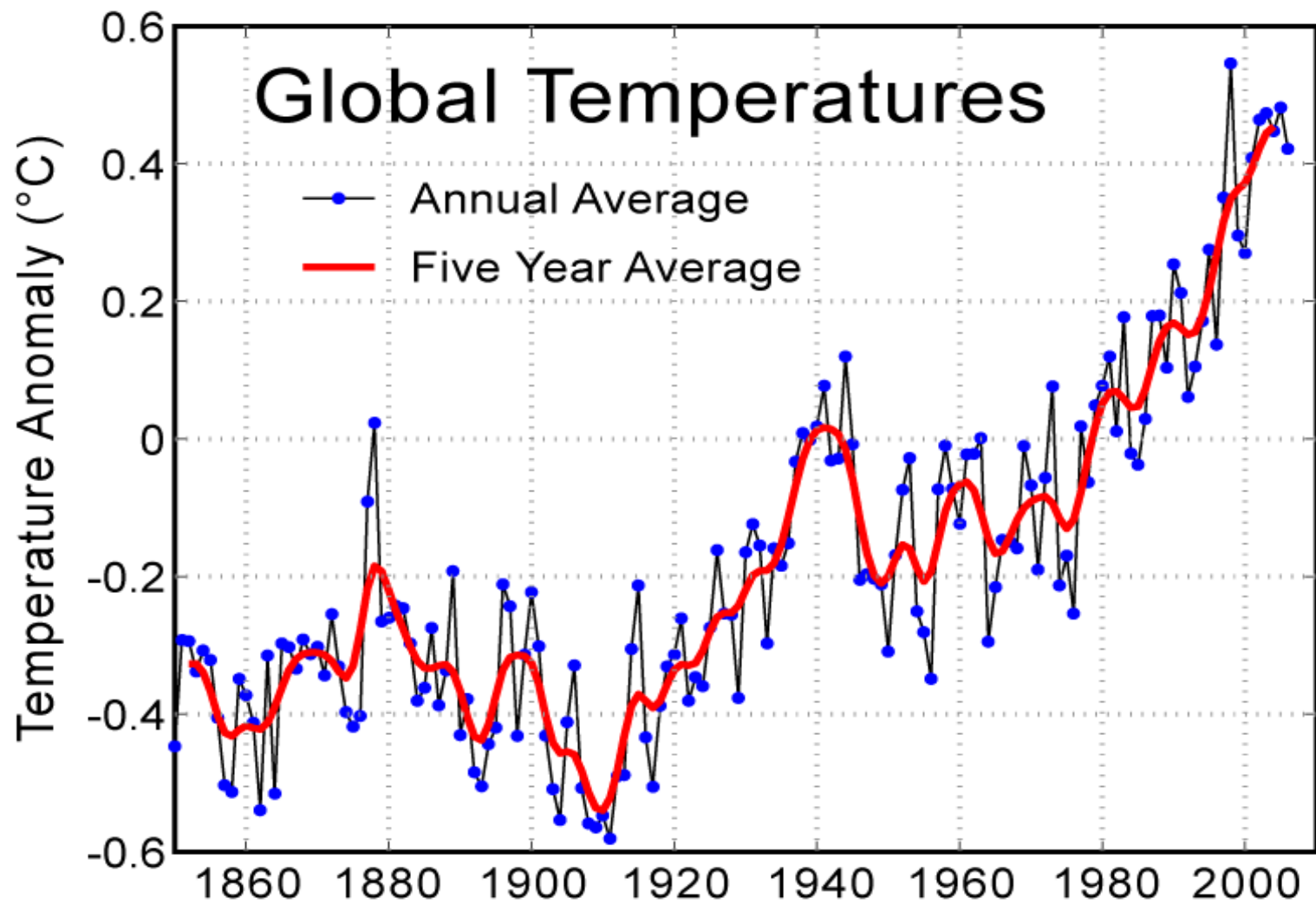
Dept. of Earth and Atmospheric Science,
Director Northeast Regional Climate Center



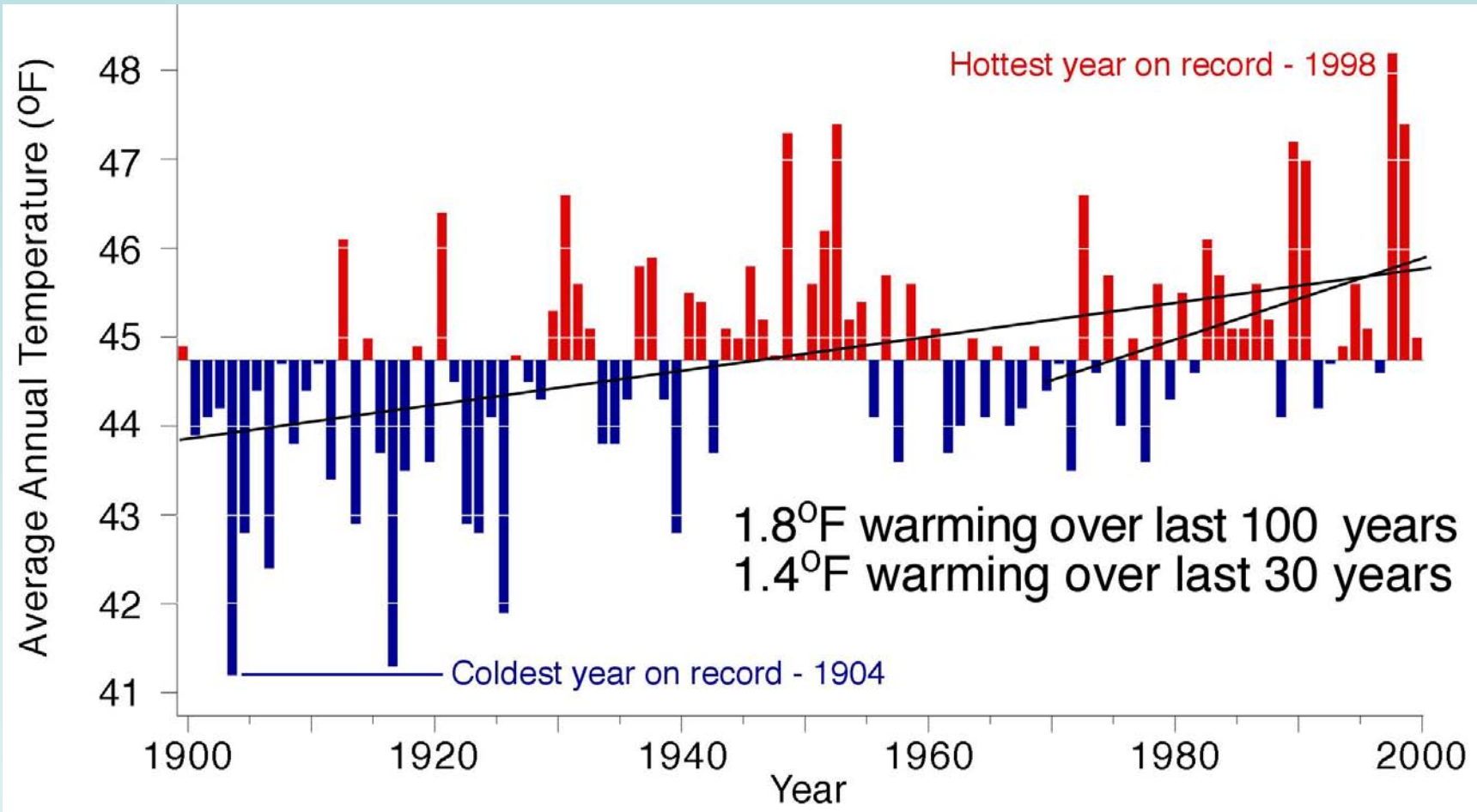
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(a) Global atmospheric concentrations of three well mixed greenhouse gases





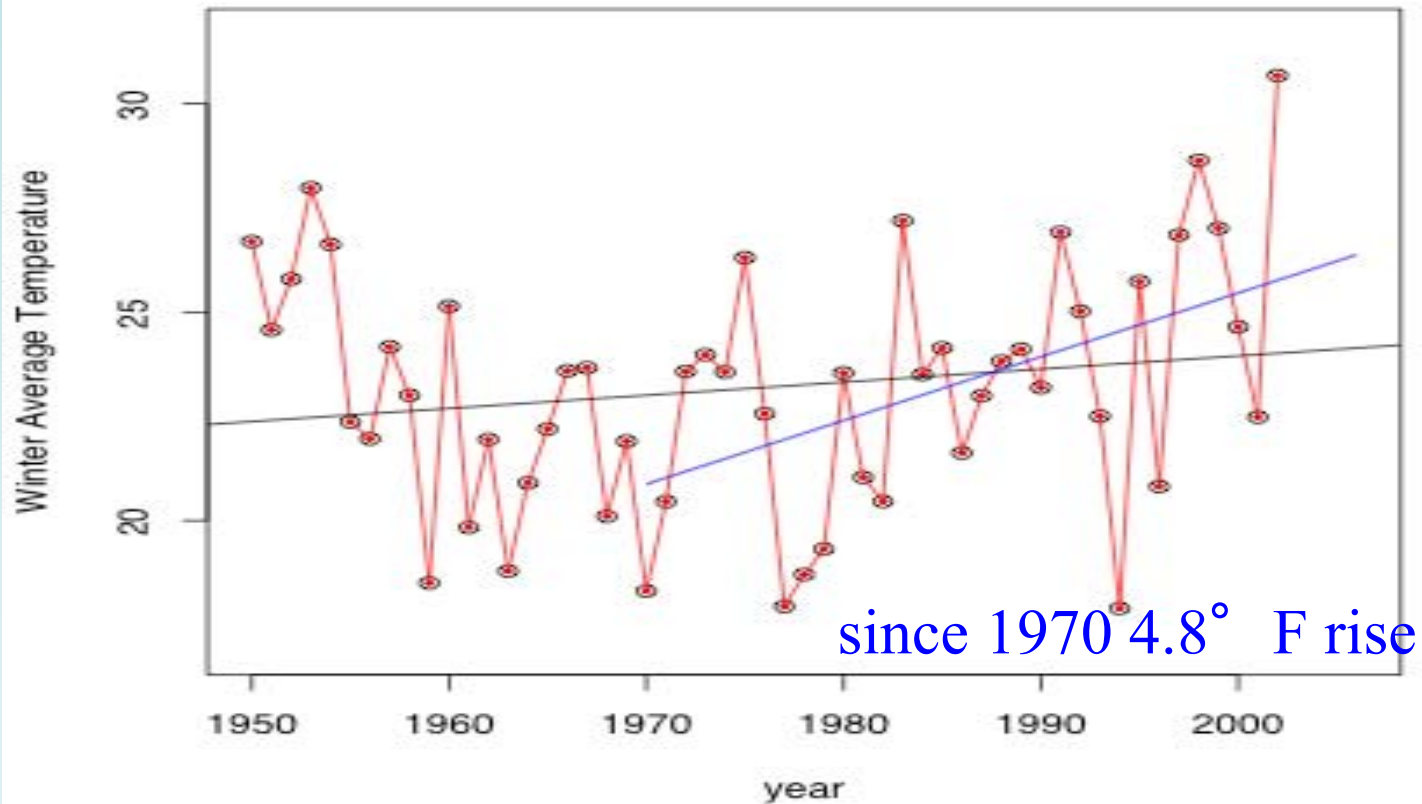
The Northeast Annual Temperature



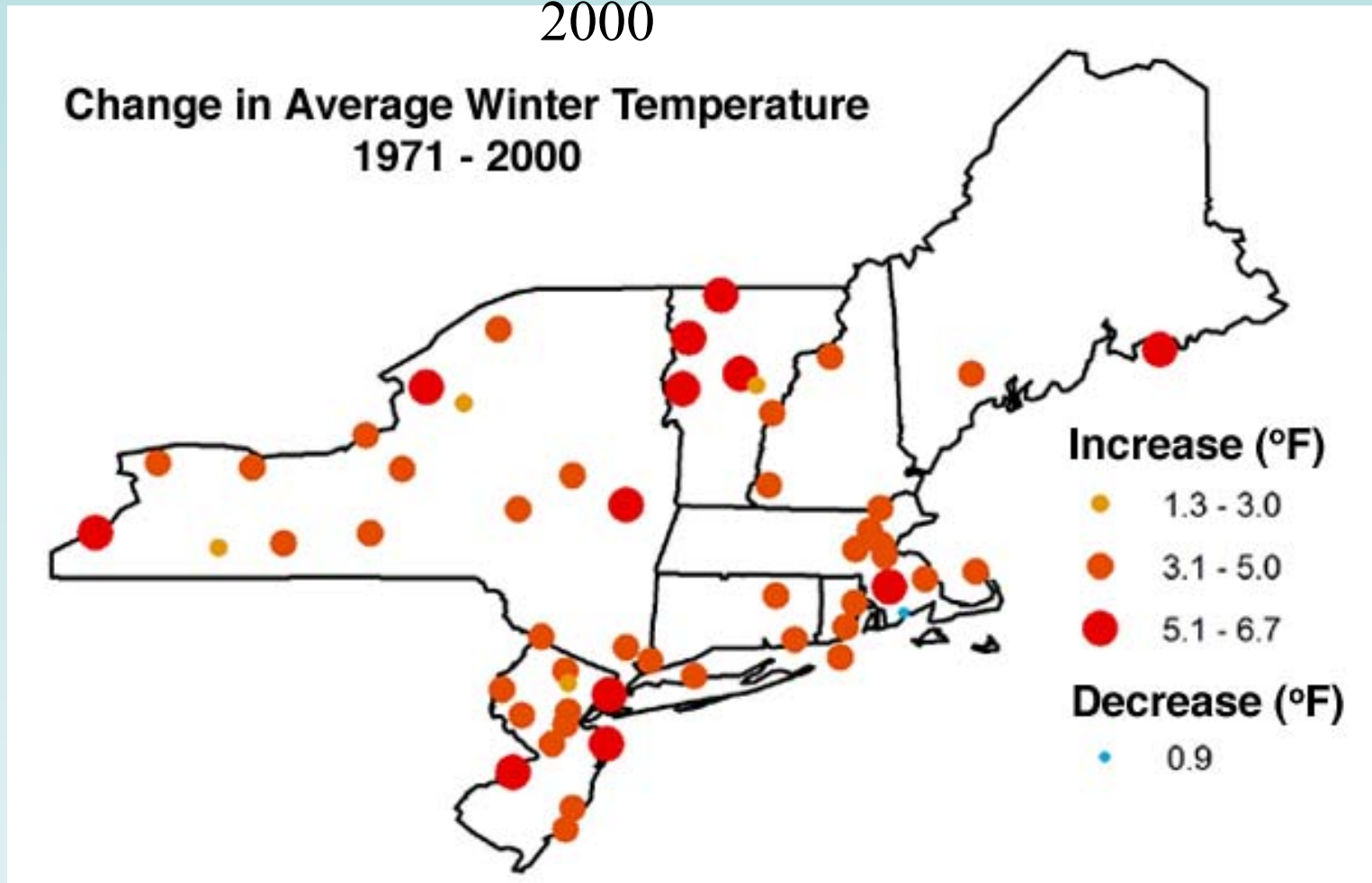
New York Winter Trends

December, January February Temperature

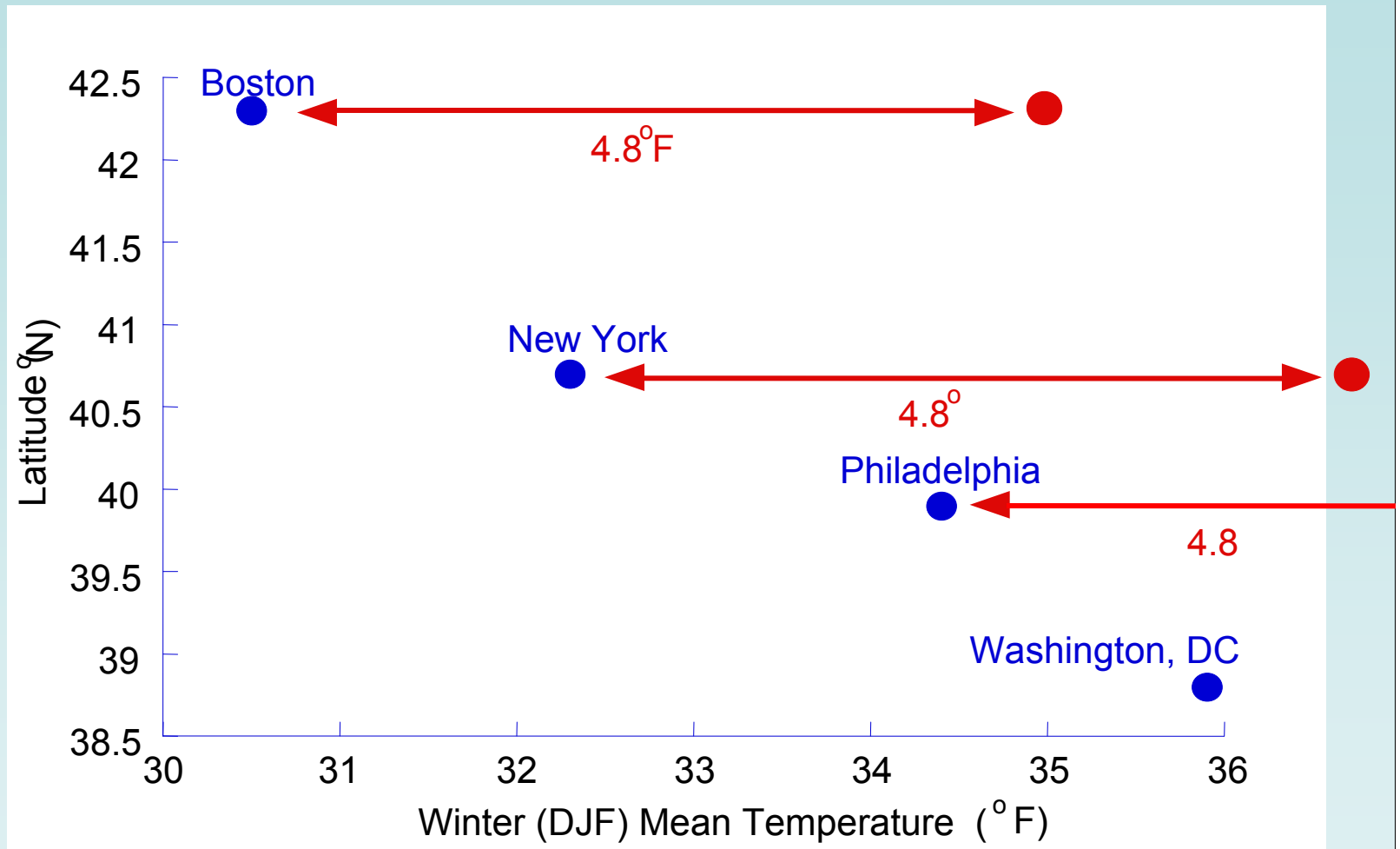
since 1950 1.56° F rise



Spatial Variation Winter Linear Temperature Trend 1970-2000



Significant Change in Winter Climate!



Timing of Seasons

By 2070-2099:

- **Spring** will be arriving earlier by 1-2 weeks (lower) or almost 3 weeks (higher)
- The **growing season** is projected to be extended by 4 weeks (lower) and up to 6 weeks (higher)
- **Summer** is expected to arrive earlier by 1-1.5 weeks (lower) or 3 weeks (higher) and stay longer by 2 weeks (lower) or 3 weeks (higher)

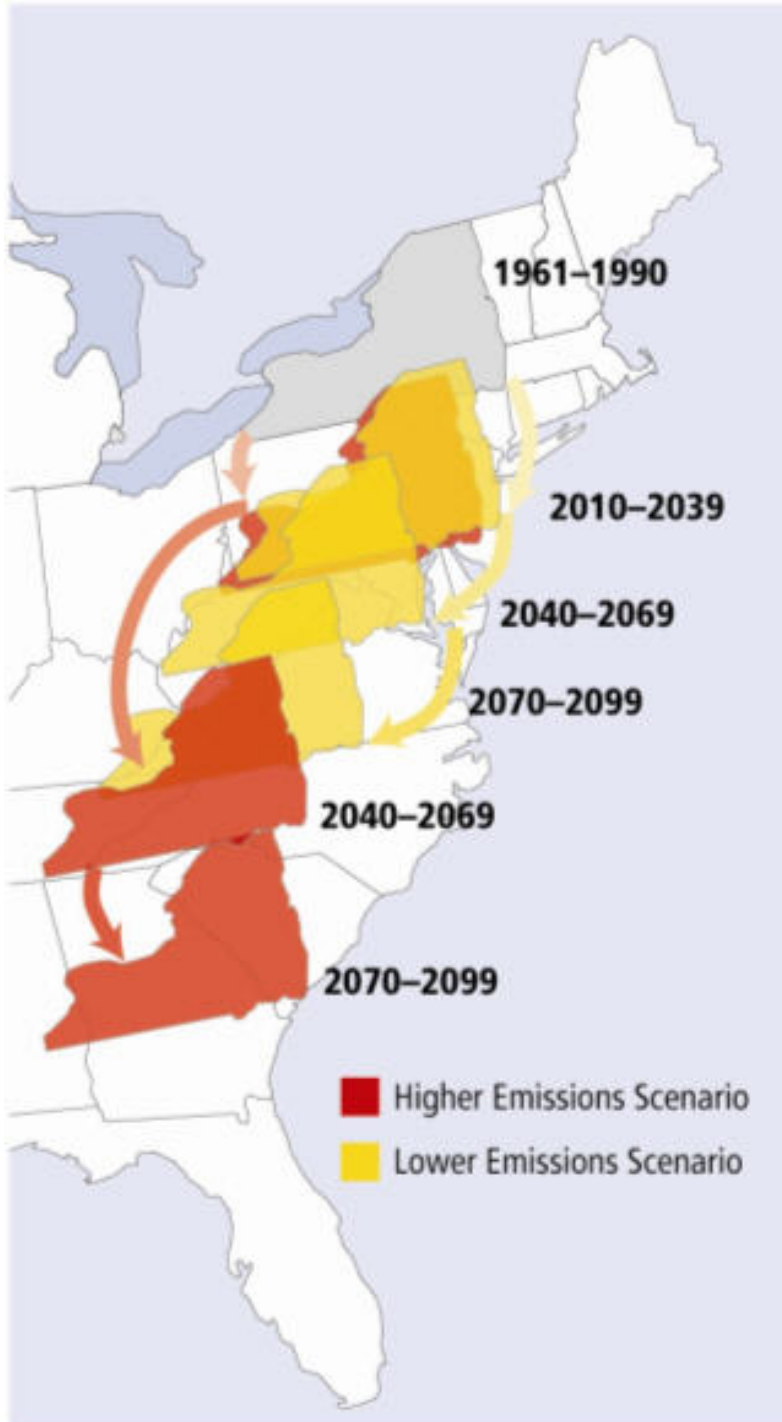


→ **Lilacs: 4 days earlier**
→ **Apples: 9 days earlier**
→ **Grapes: 6 days earlier**

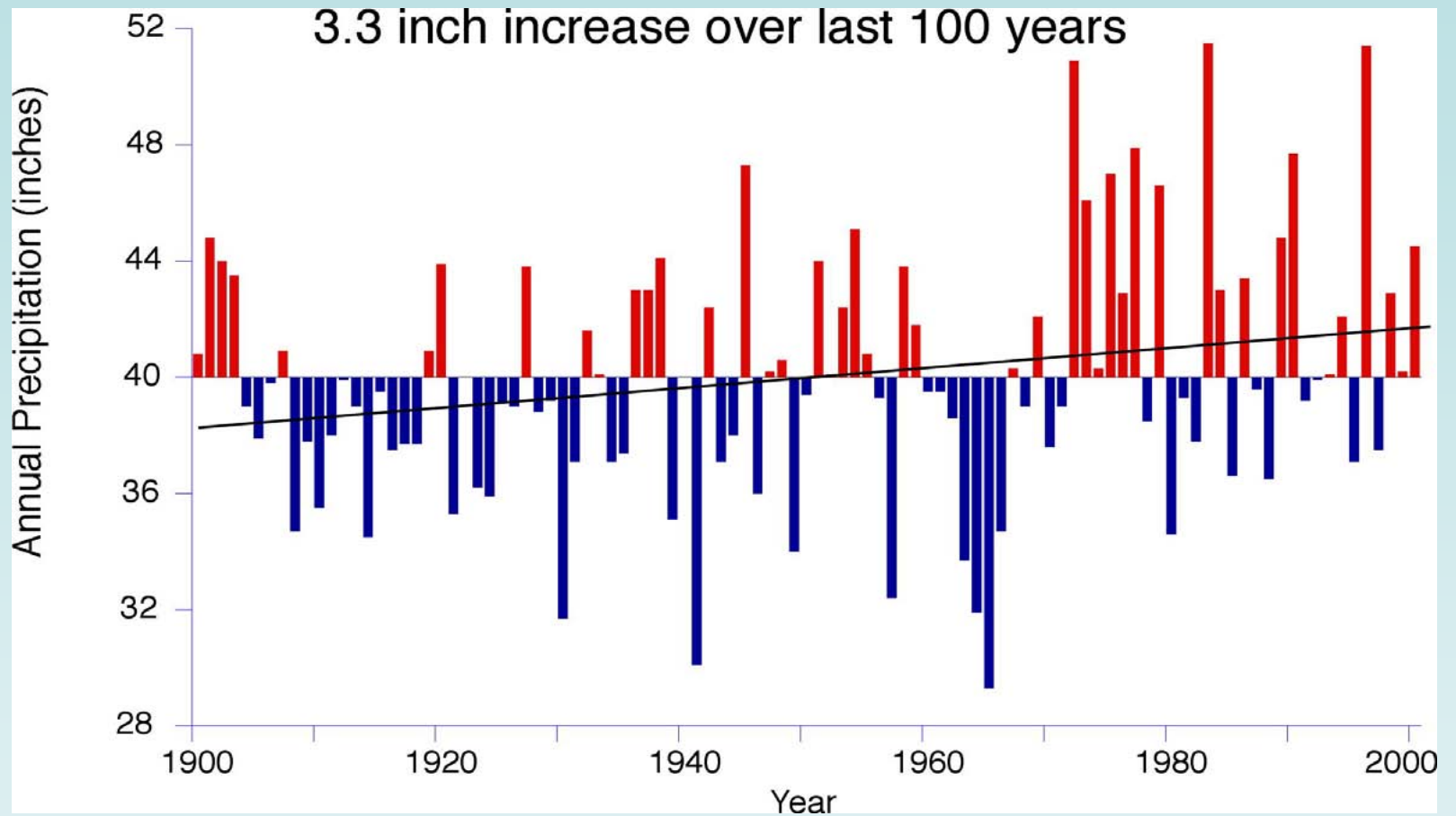


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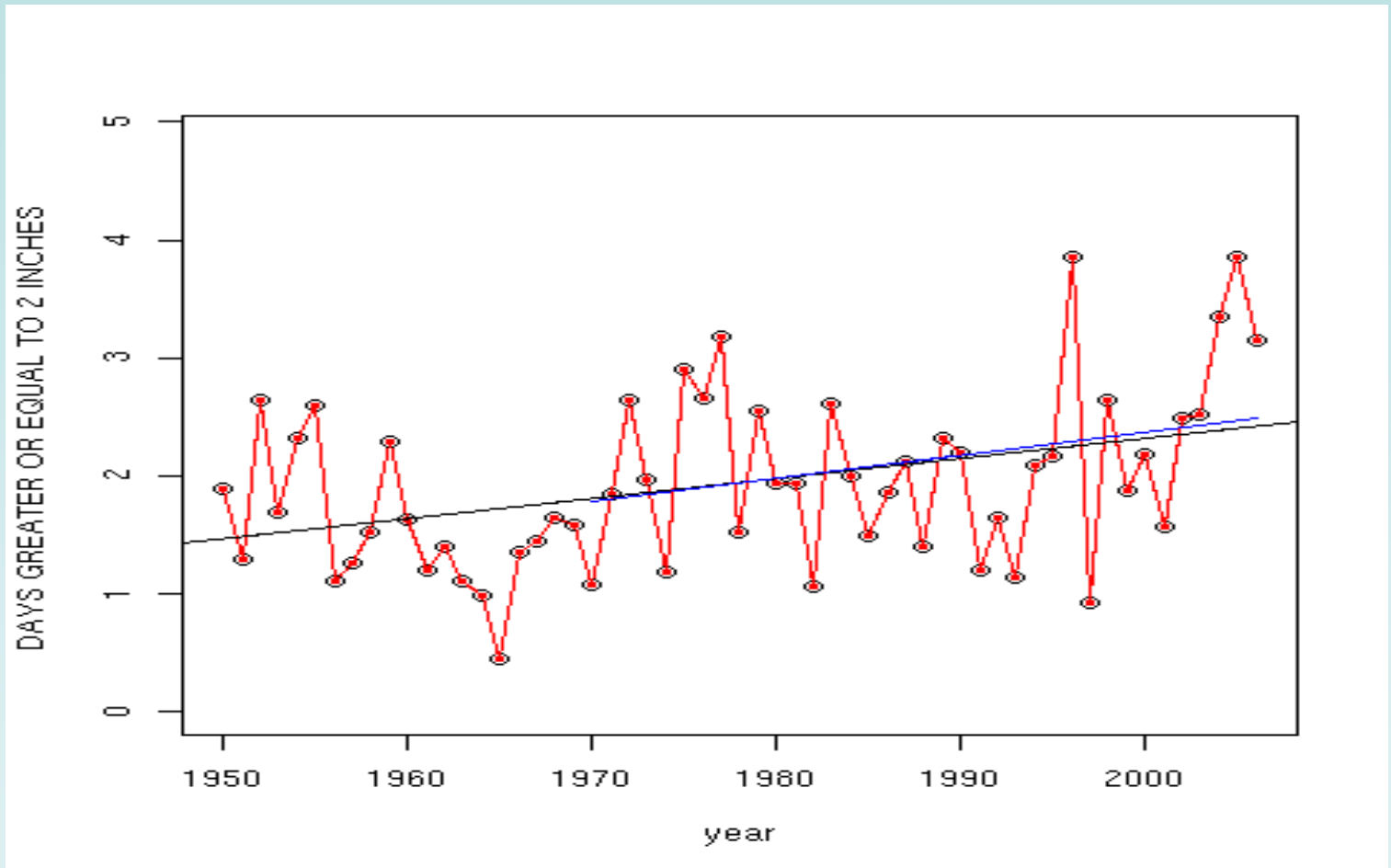
Summer Heat Index



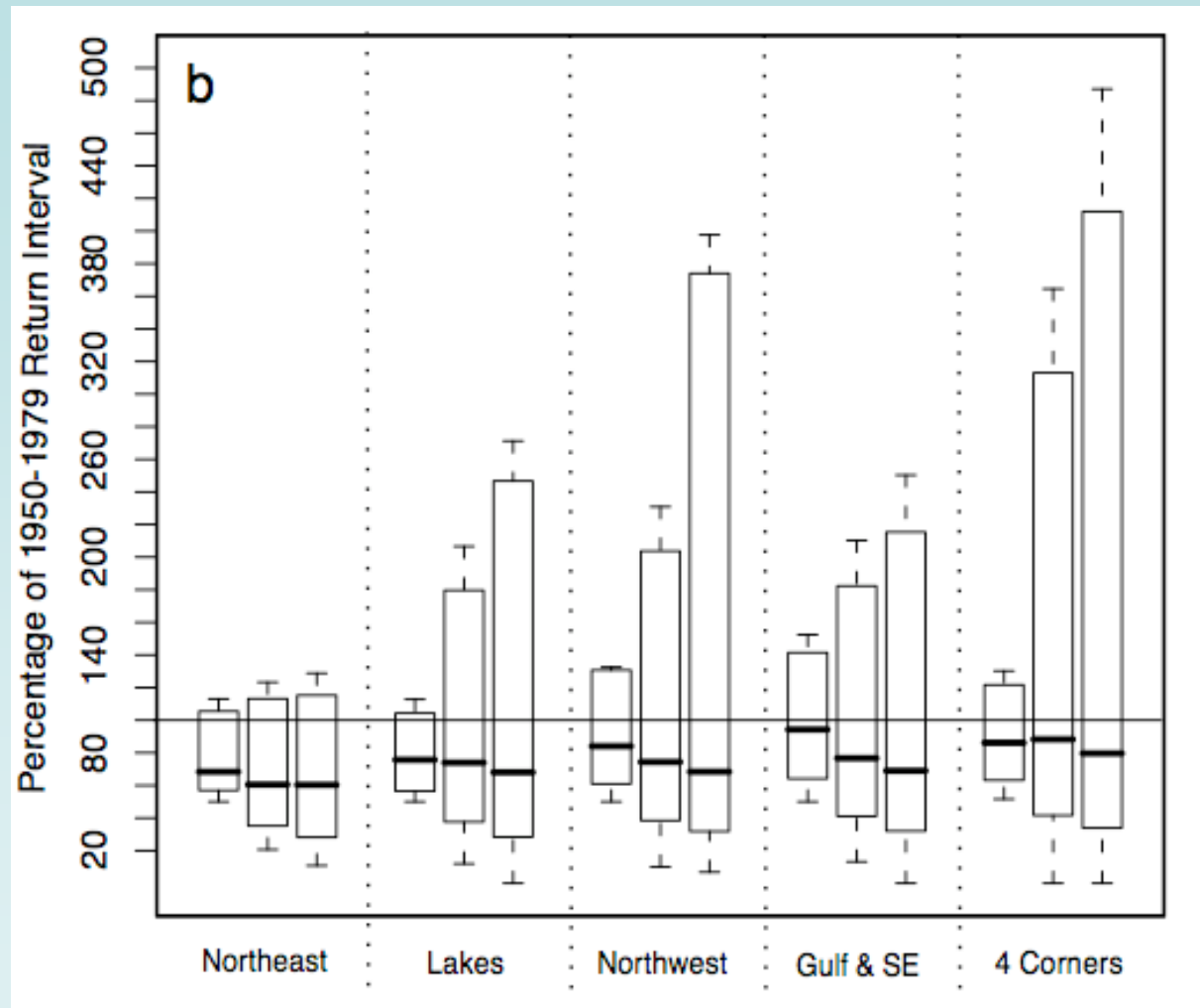
Average Annual Precipitation in the Northeast



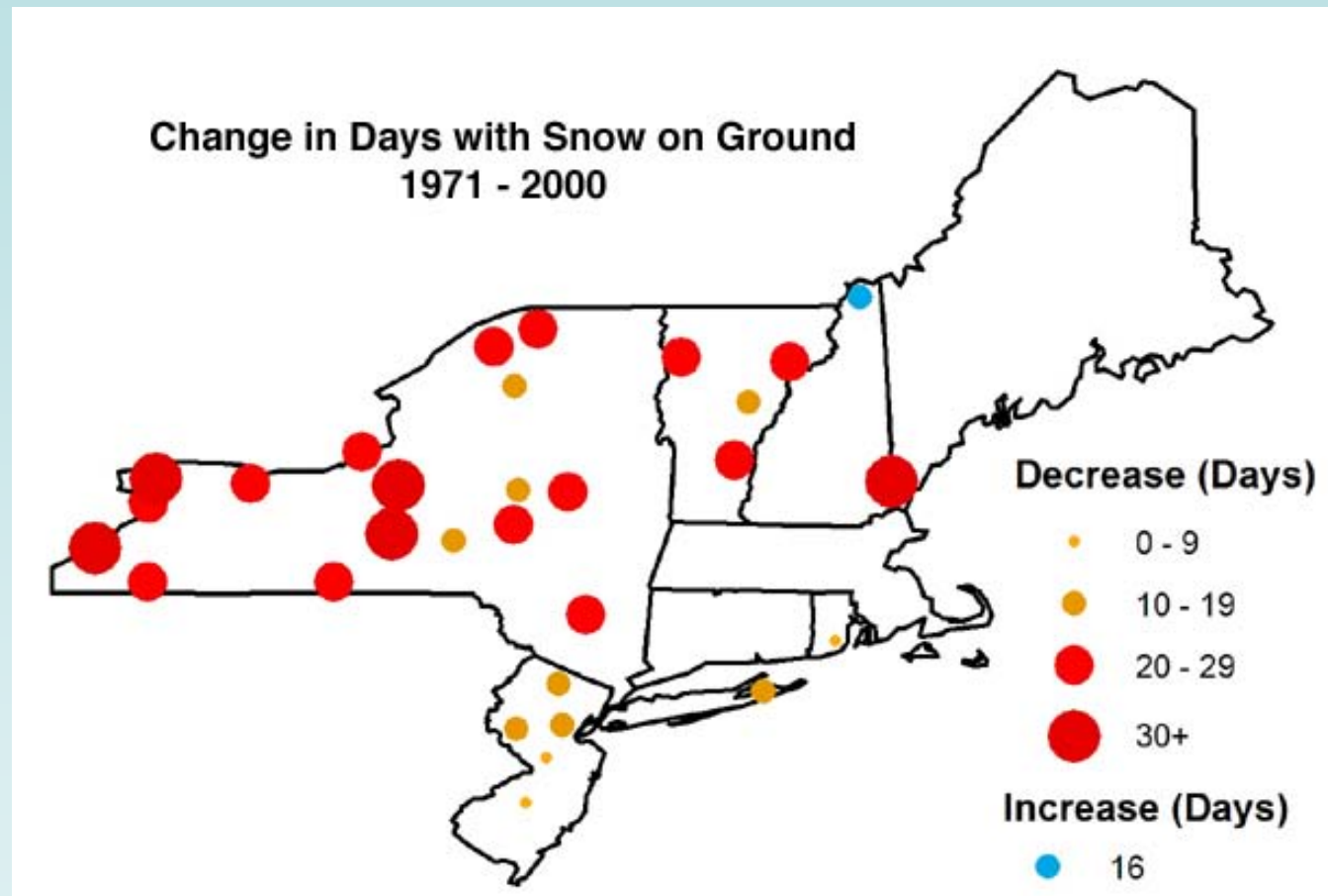
New York Extreme Precipitation Events (>2 inches in 48 hrs)



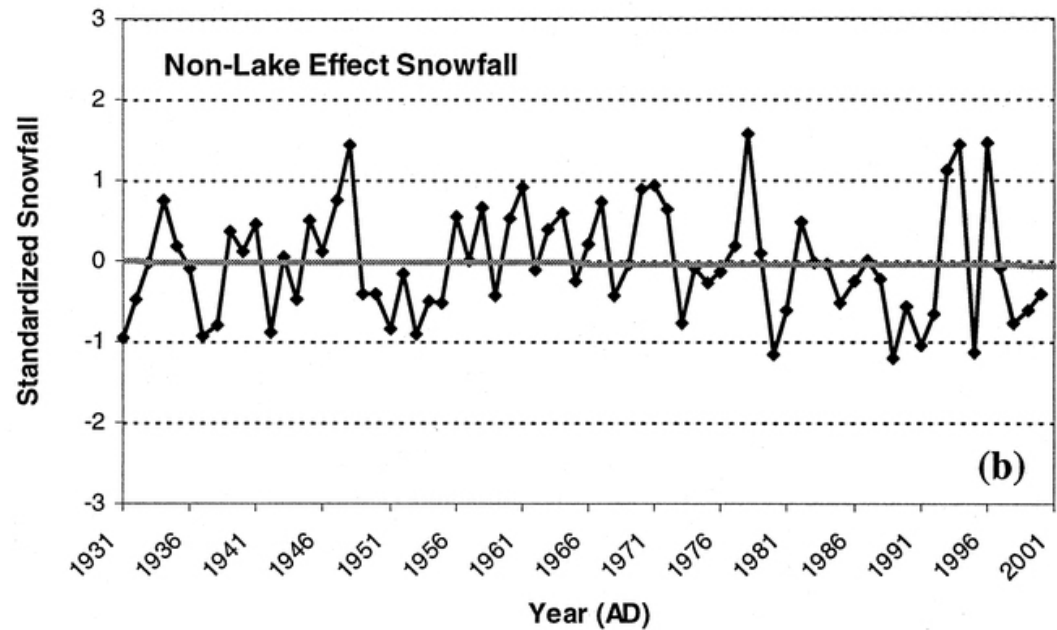
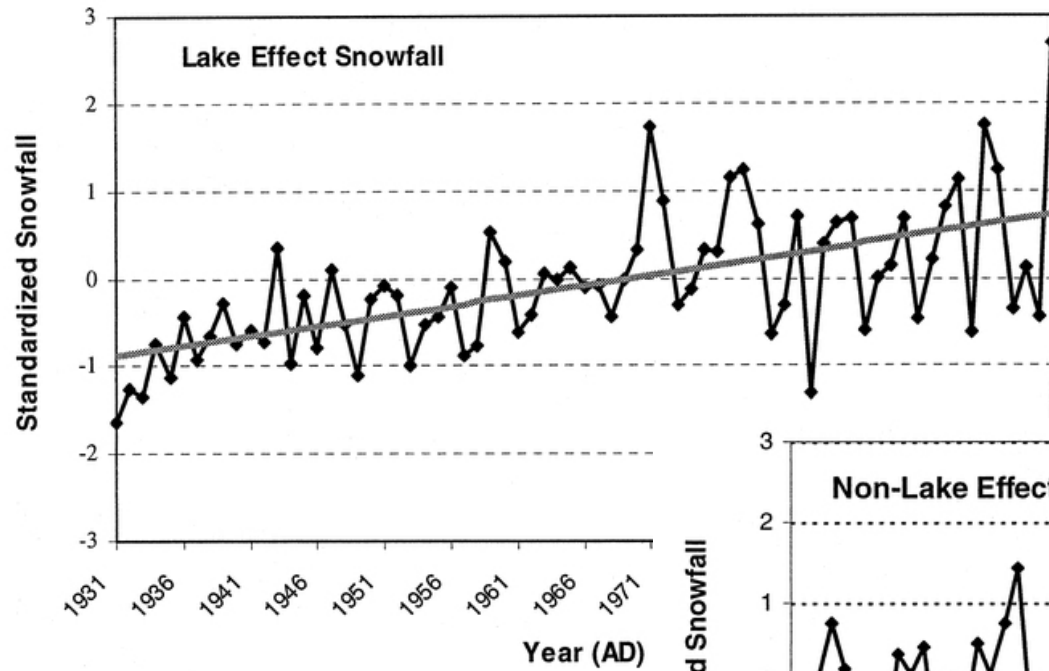
Extreme Event Frequency



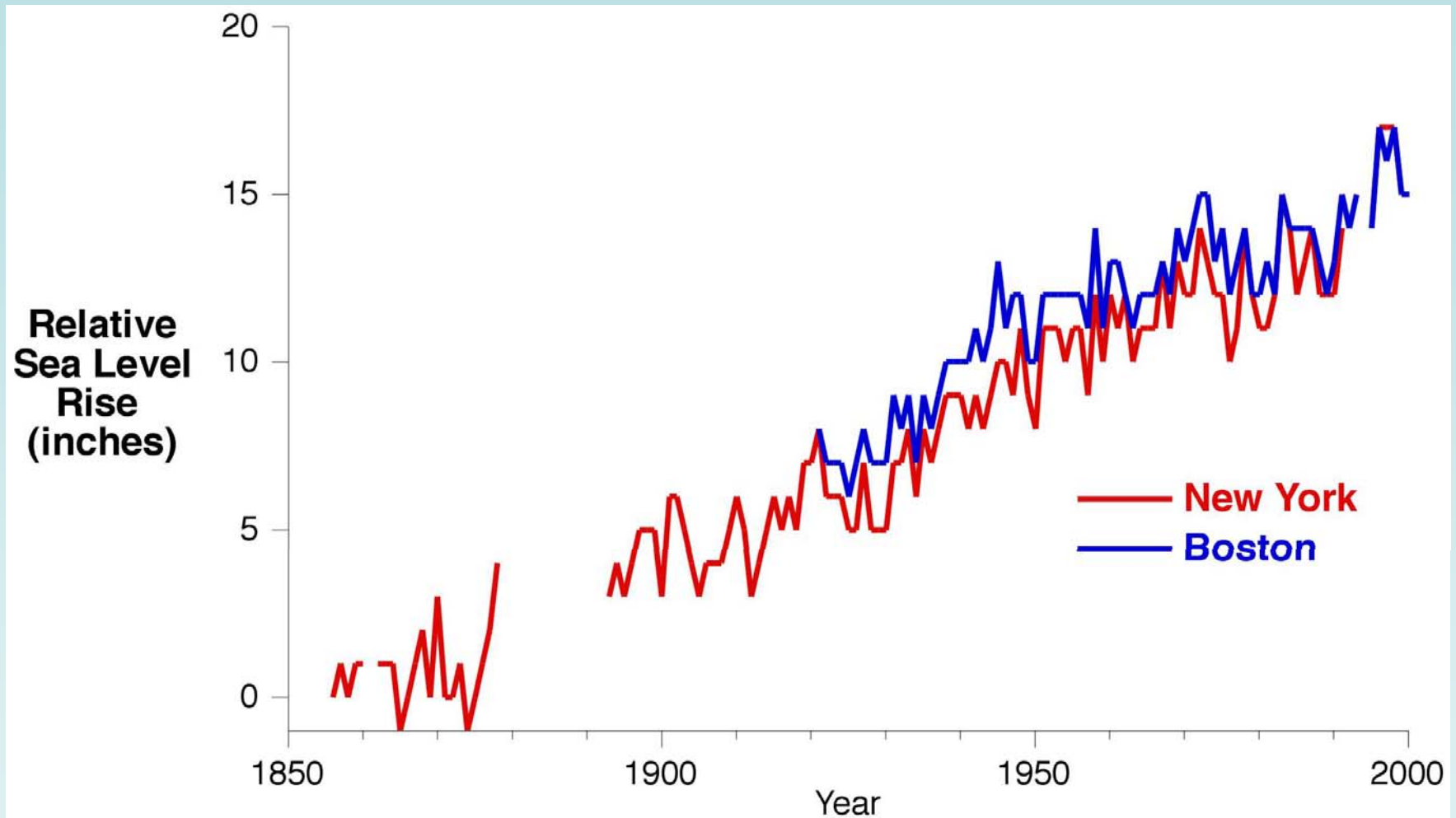
Spatial Variation of Days with Snow on Ground 1970-2000



Lake Effect



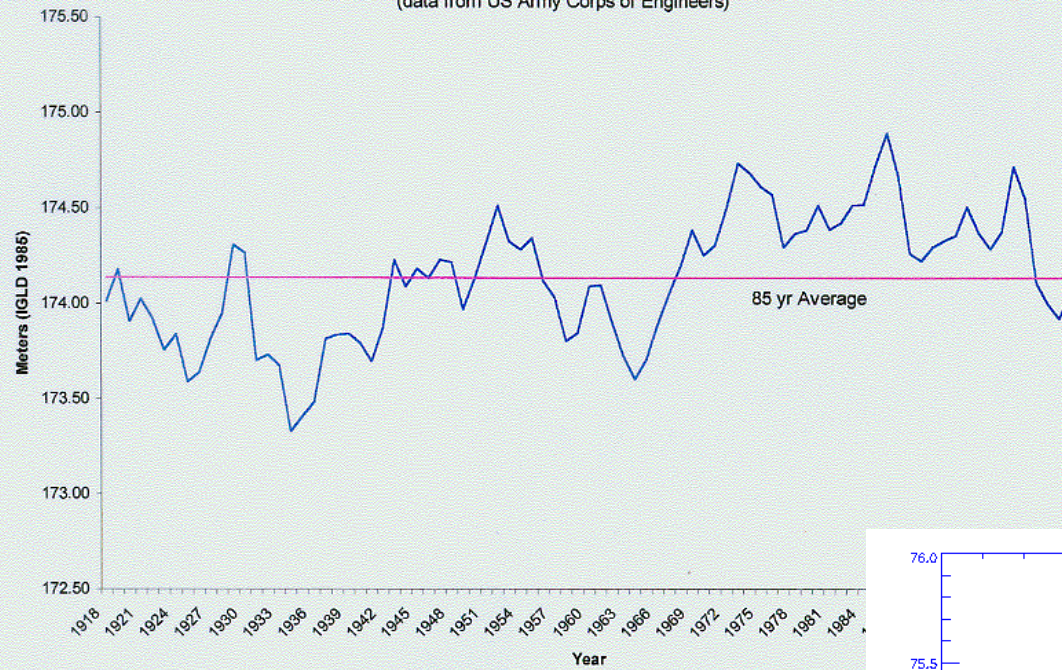
Sea Level



Lake Levels

Lake Erie Water Levels 1918-2002

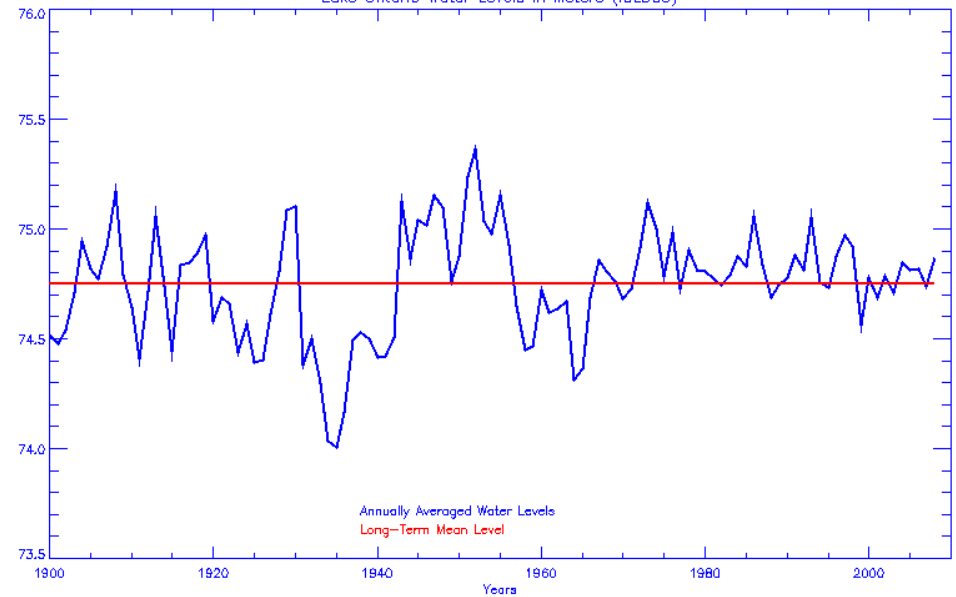
(data from US Army Corps of Engineers)



Erie

Ontario

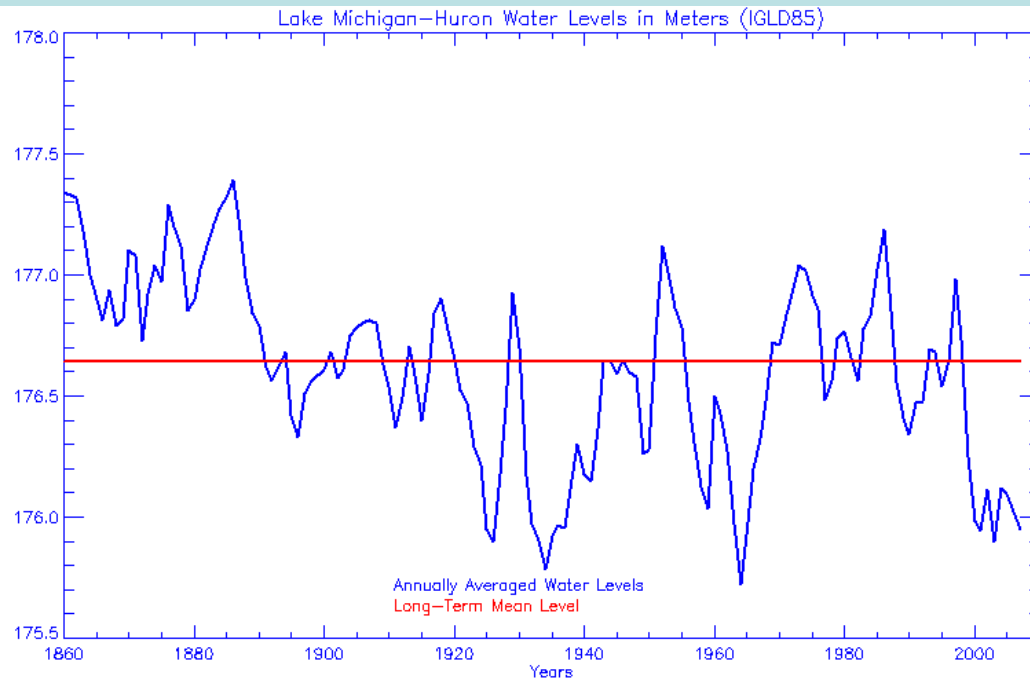
Lake Ontario Water Levels in Meters (IGLD85)



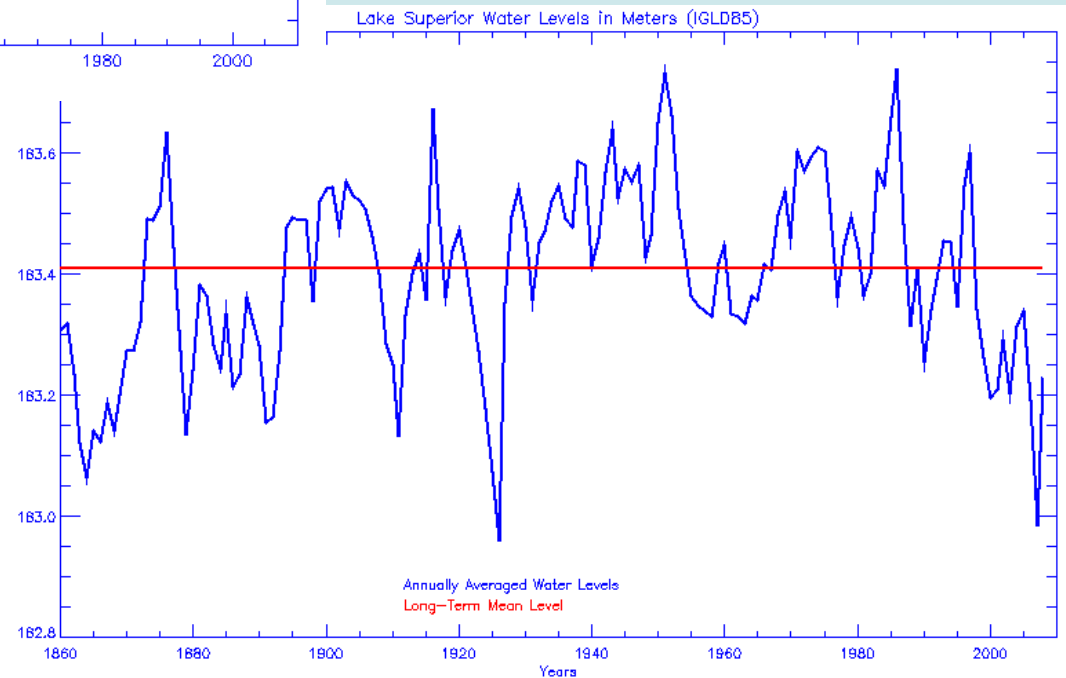
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Lake Levels

Michigan-Huron

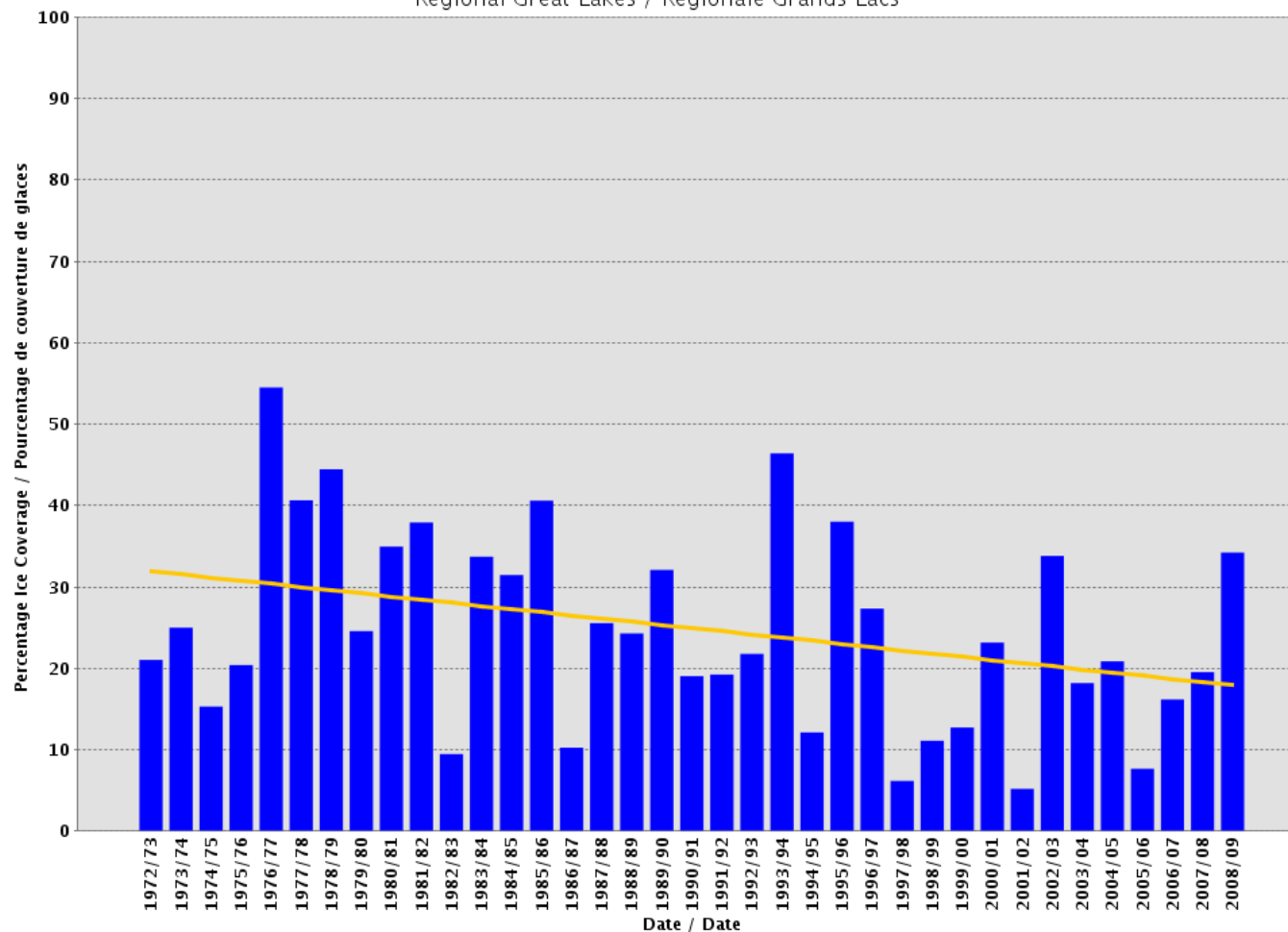


Superior

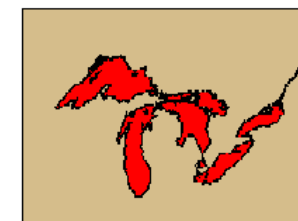


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Historical Total Accumulated Ice Coverage 1204-0319 **Total accumulé de la couverture des glaces historique 1204-0319** Regional Great Lakes / Régionale Grands Lacs




 Environment
Canada
 
 Environnement
Canada



Canada

 Ice Coverage / couverture des glaces
 Trend / tendance (-0.39% S= 11.30%)

by the Canadian Ice Service - Environment Canada / par le Service canadien des glaces - Environnement Canada



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The Climate of New York is Already Changing

- Annual temperatures across New York have warmed almost 2° F since 1970
- Winter temperatures have warmed by nearly 5° F since 1970
- More extremes in rainfall
- Most places are less snowy except LES
- The growing season as enlongated



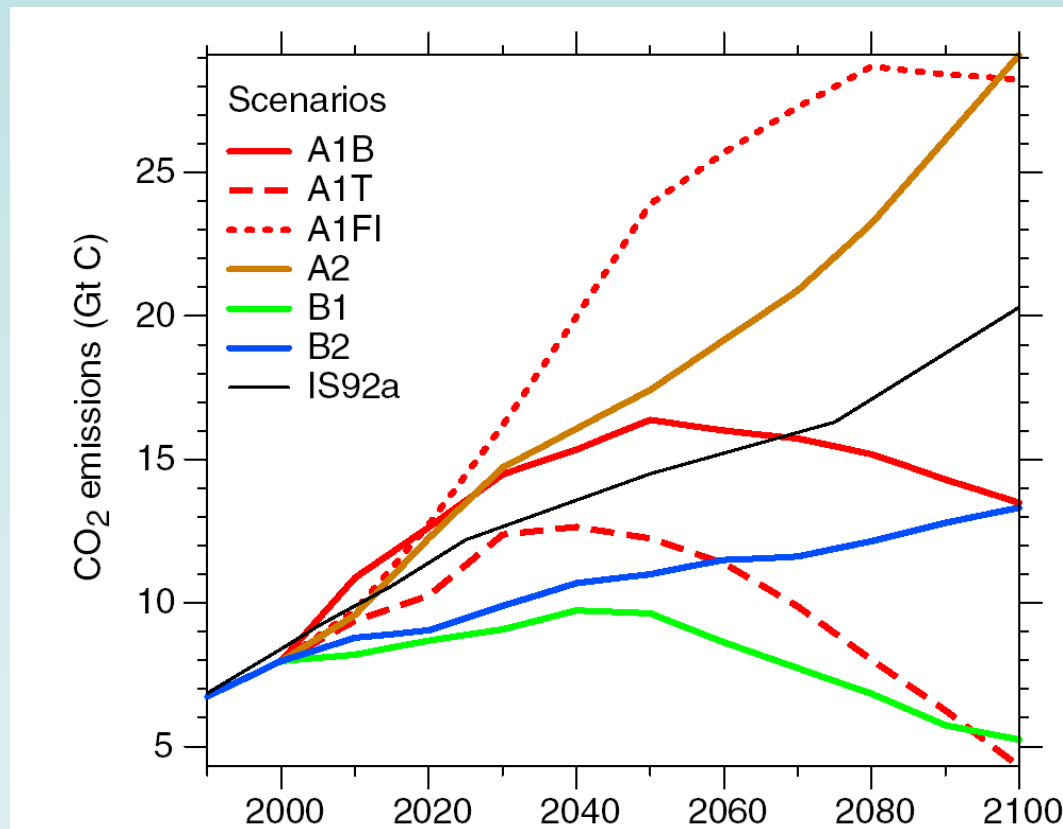
Looking to the Future

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



STEP ONE:

Future Emissions from Human Activities



A1fi (higher)

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

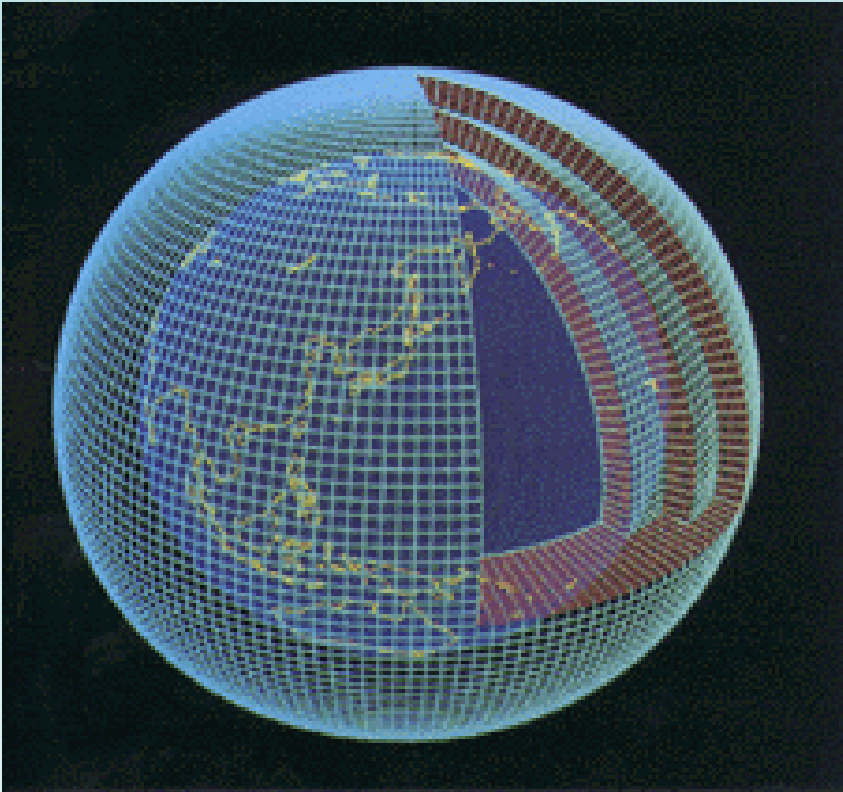
B1 (lower)

← shift to alternative energy sources with service & information-focused economy
~550ppm at 2100



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.

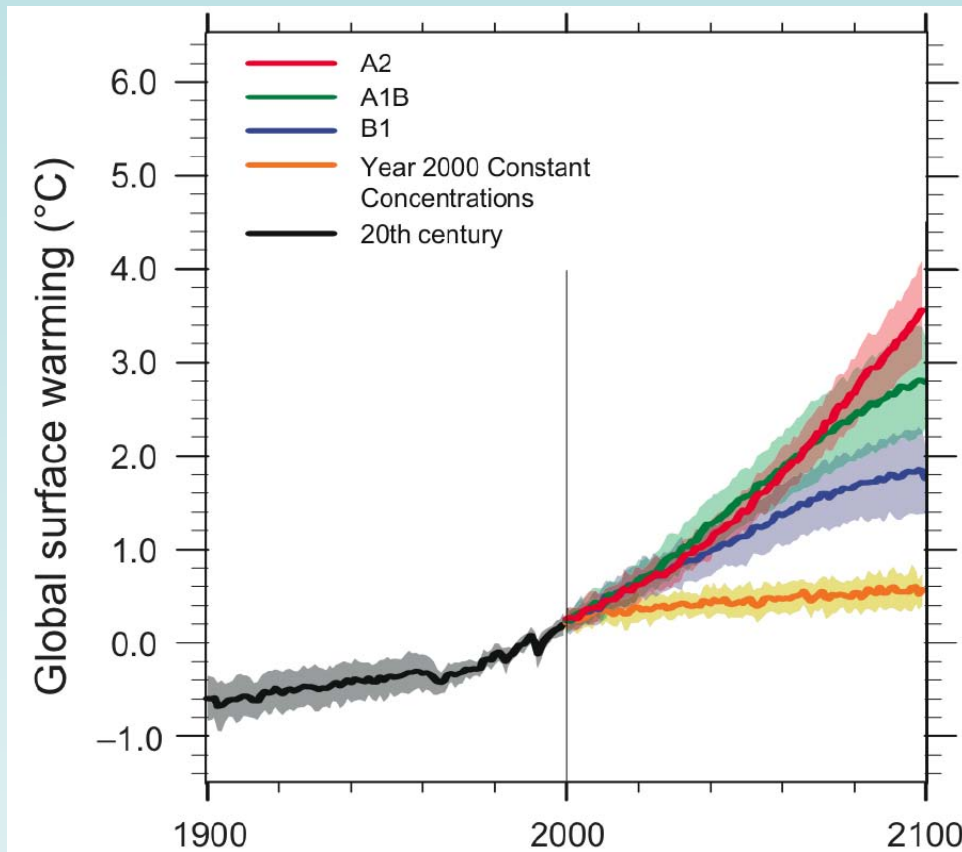


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3 different climate models

STEP 3:

Global Temperature Change

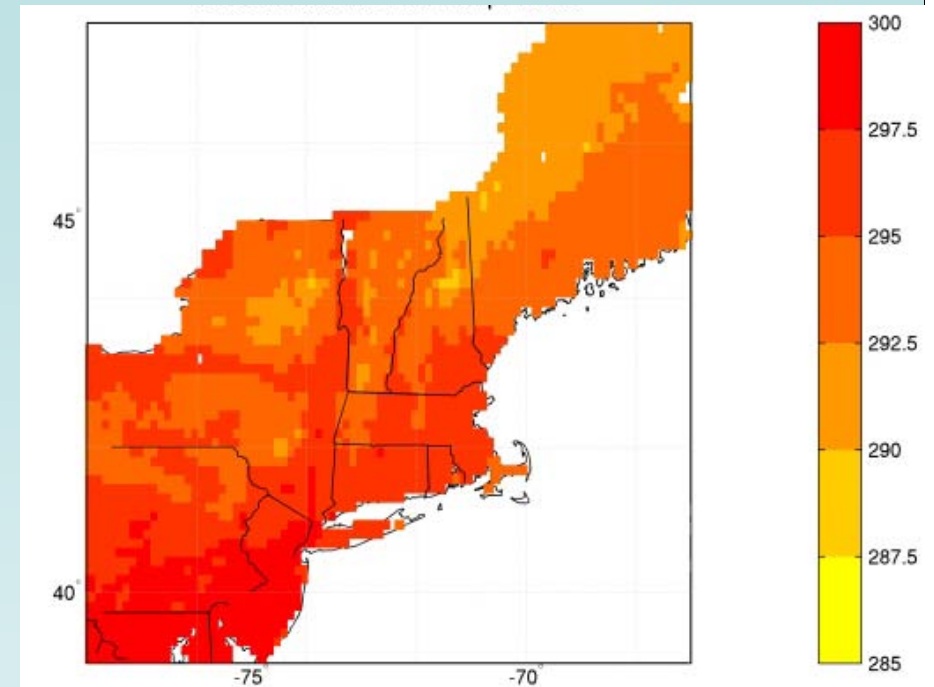
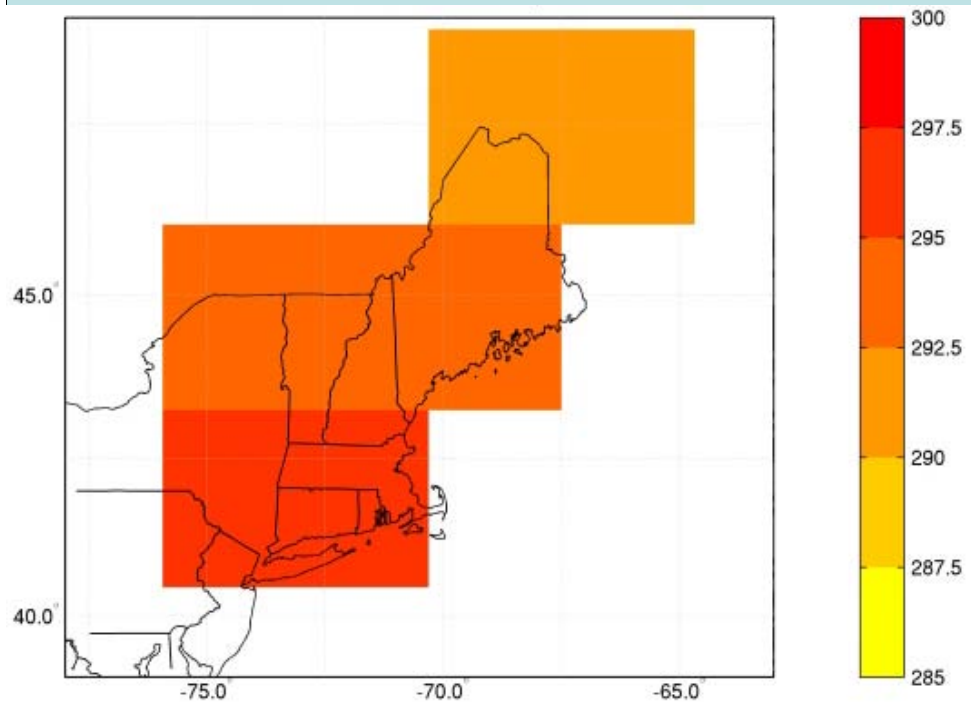


Likely range:
1.1°C to 6.4°C
2°F to 11.5°F



STEP 4:

High-resolution regional climate projections



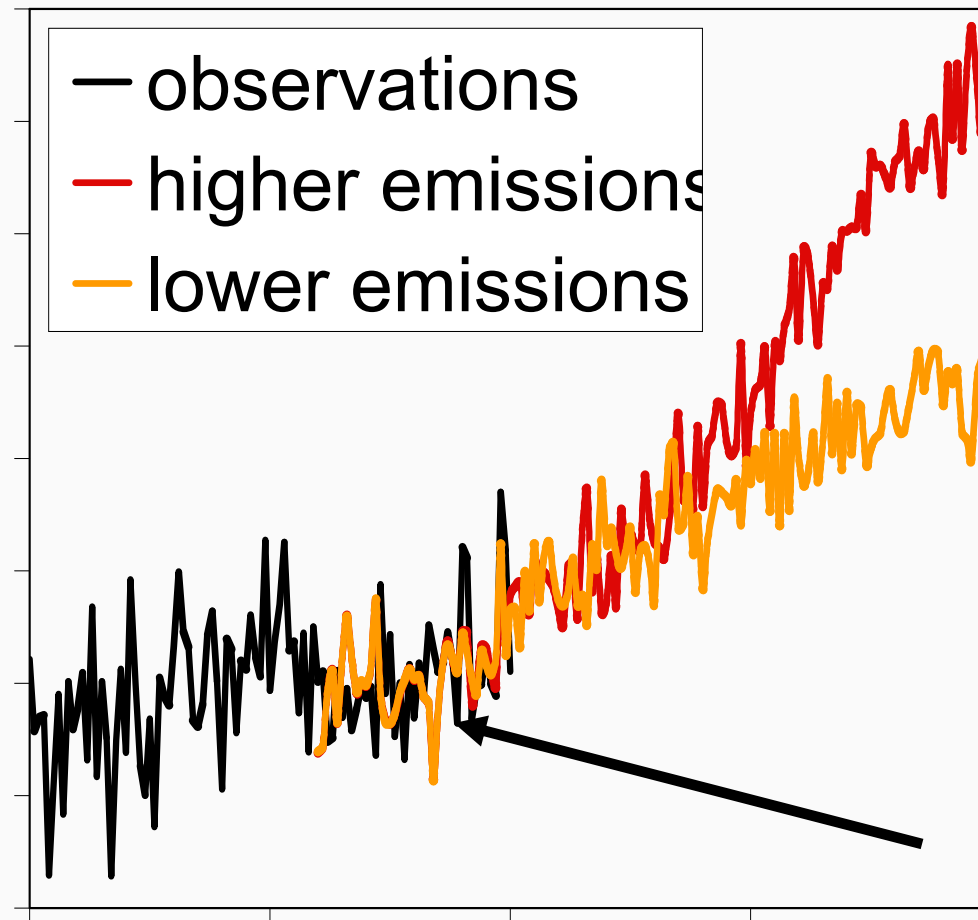
Temp from global climate model

Temperature from downscaling



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Projecting Future Climate Change for the Northeast: Rising Annual Temperatures



Higher:
6.5-12.5°F

Lower:
3.5-6.5°F

Since 1970
2°F

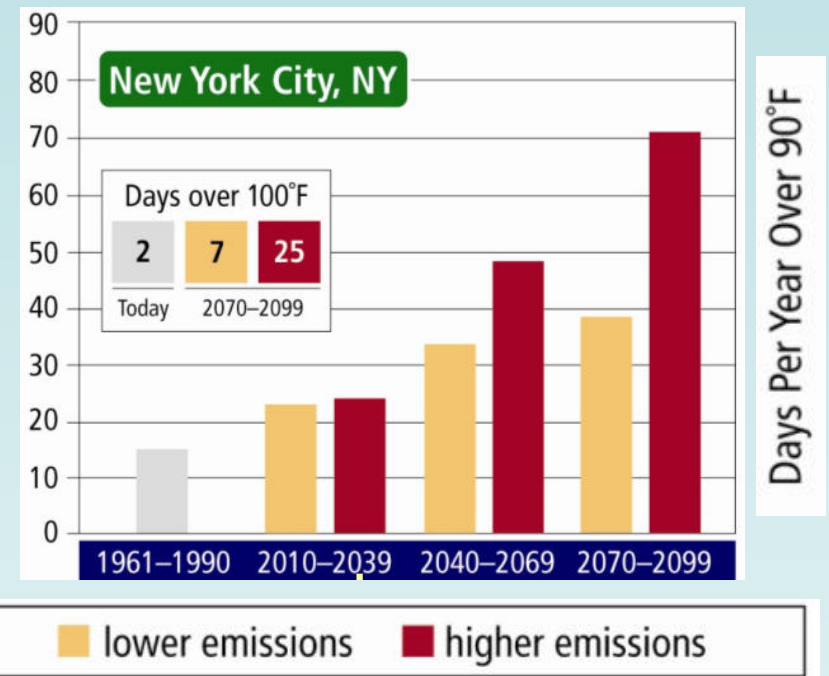


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Heatwaves and Temperature Extremes: *New York City*

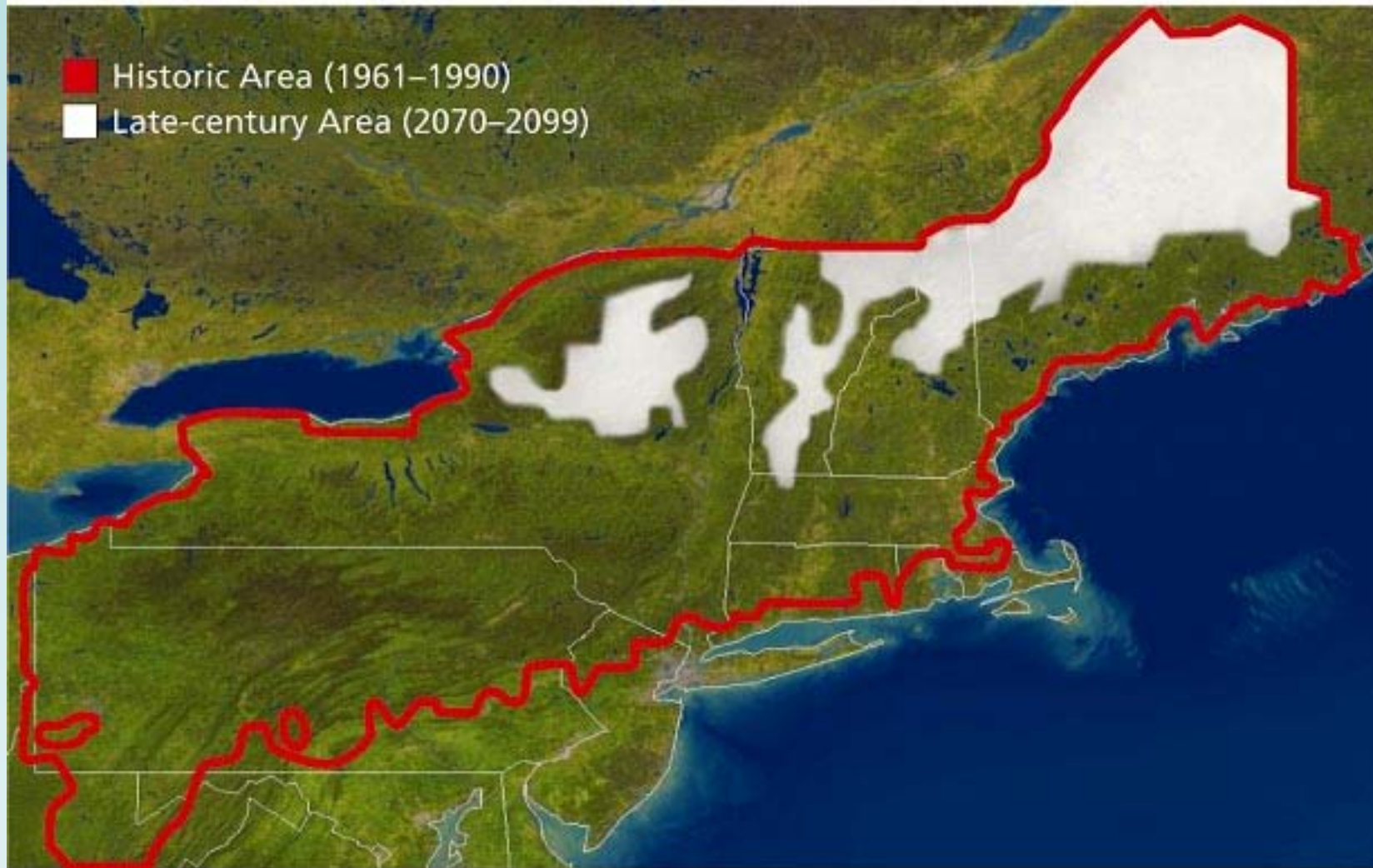


Photo credit: Associated Press



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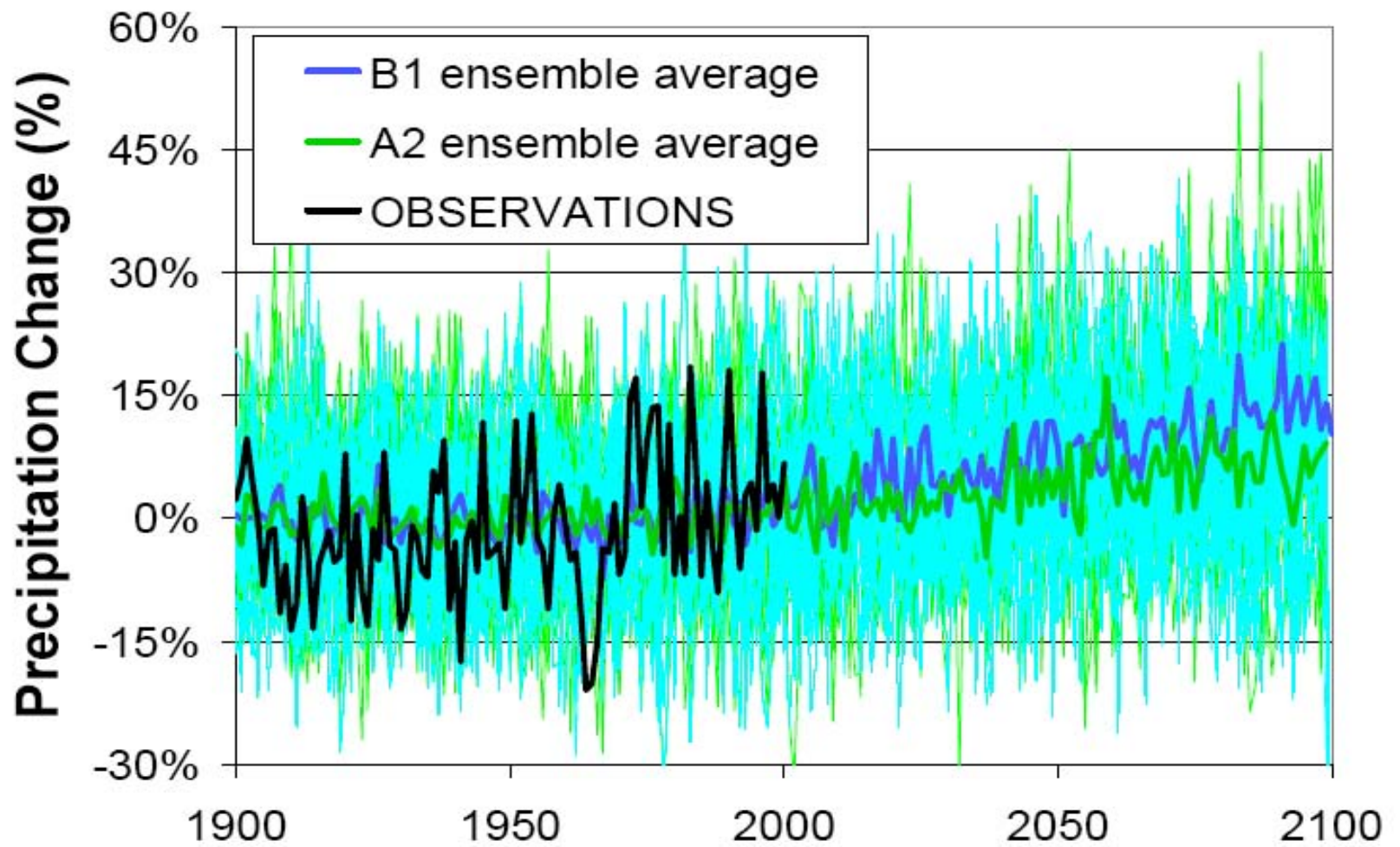
The Changing Face of Winter



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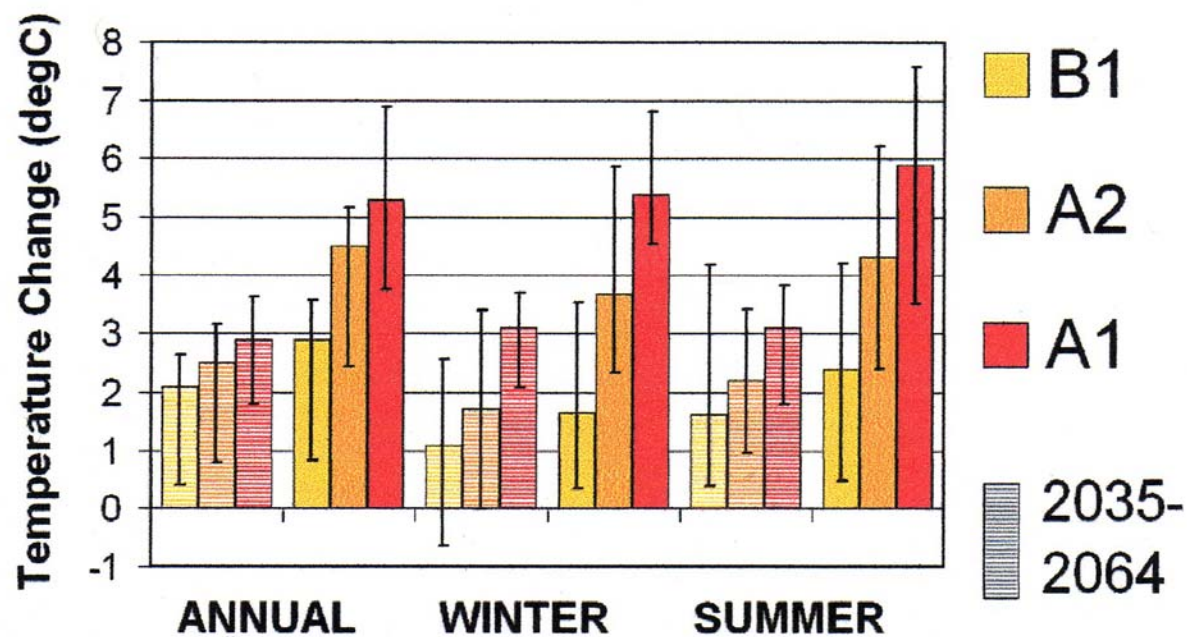
Intraresearch, d.b.a. MapMart

Annual Precipitation

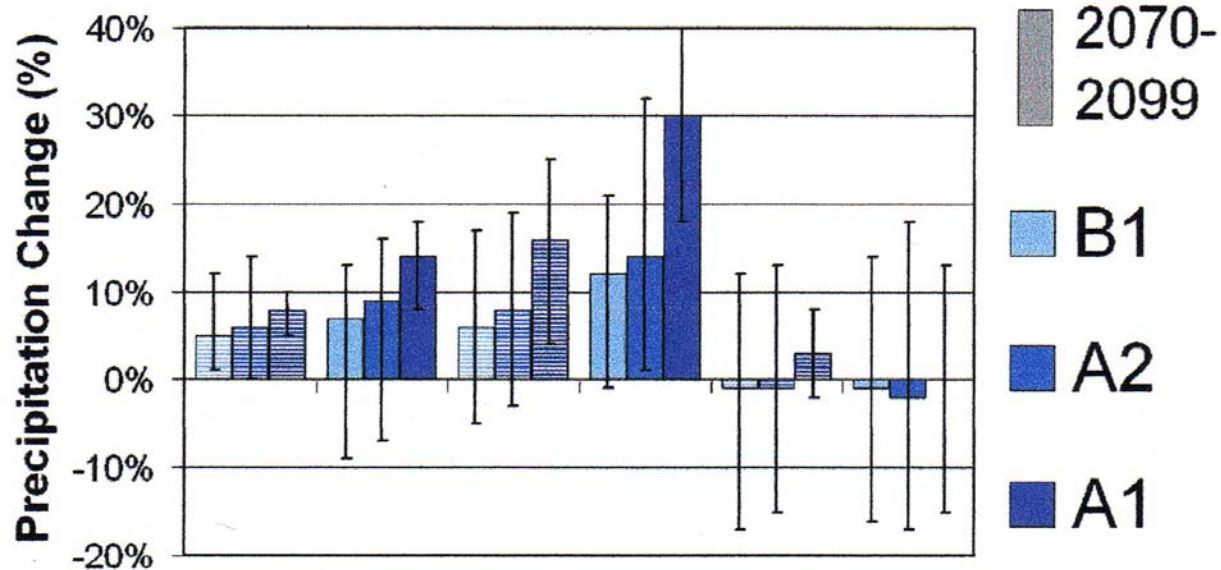


Seasonal Projections

Temperature



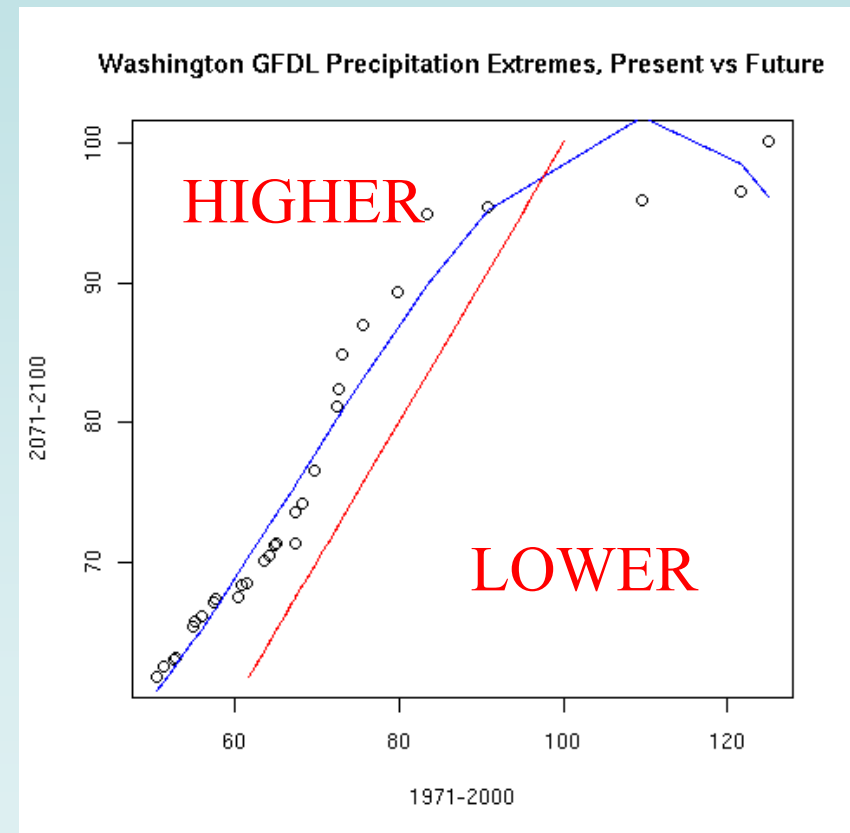
Precipitation



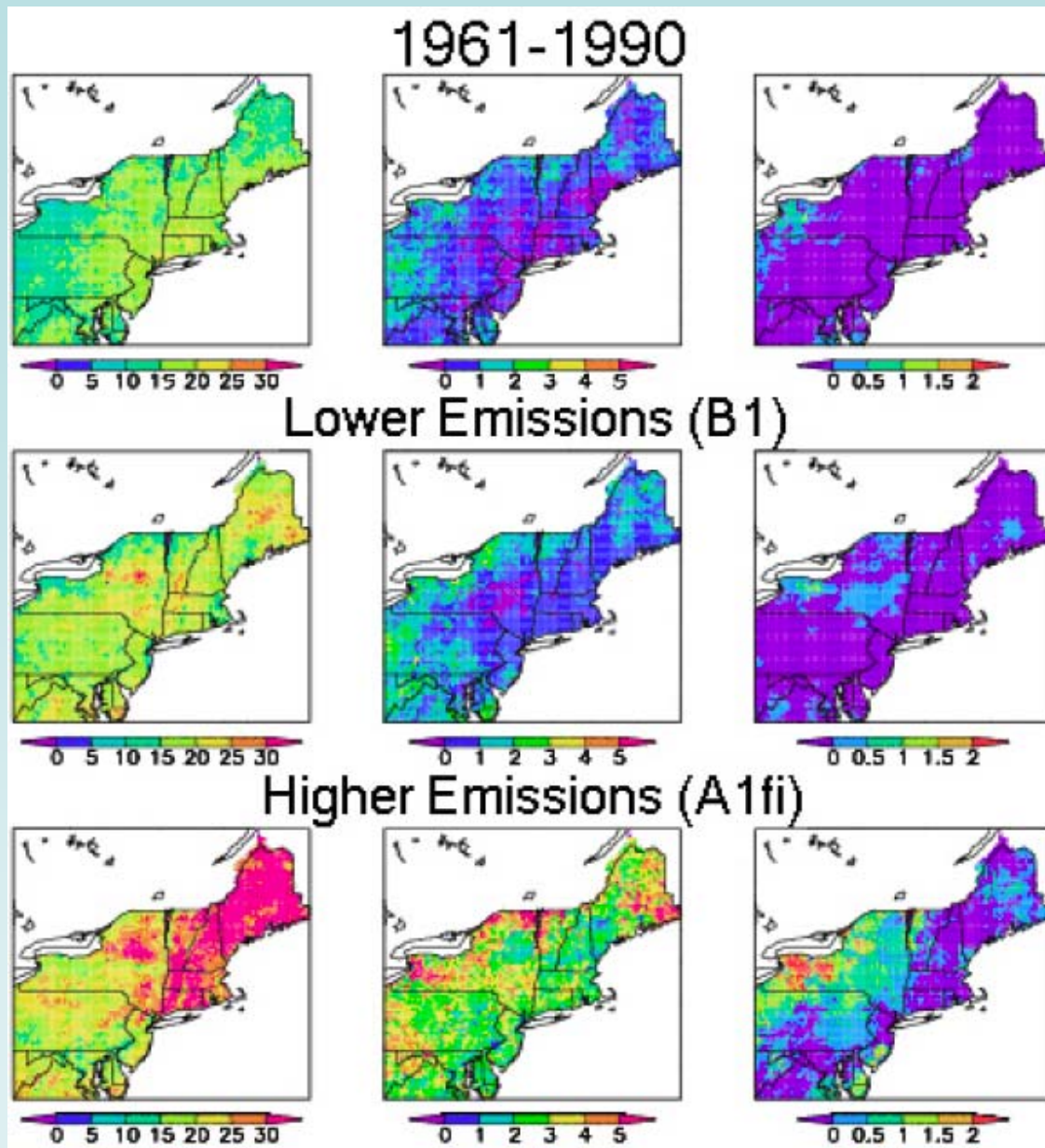
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Extreme Precipitation

- 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.



Drought



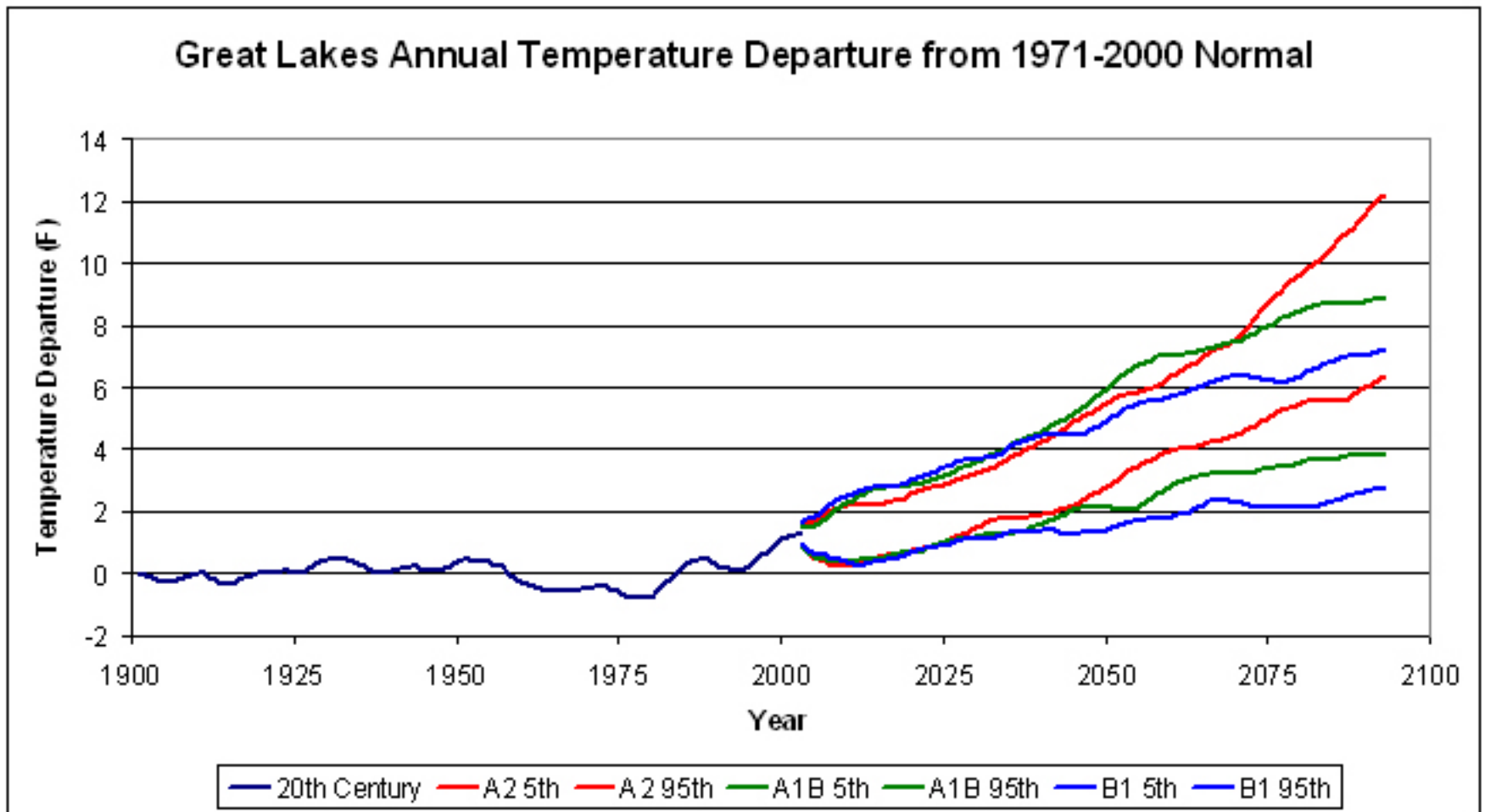
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SHORT

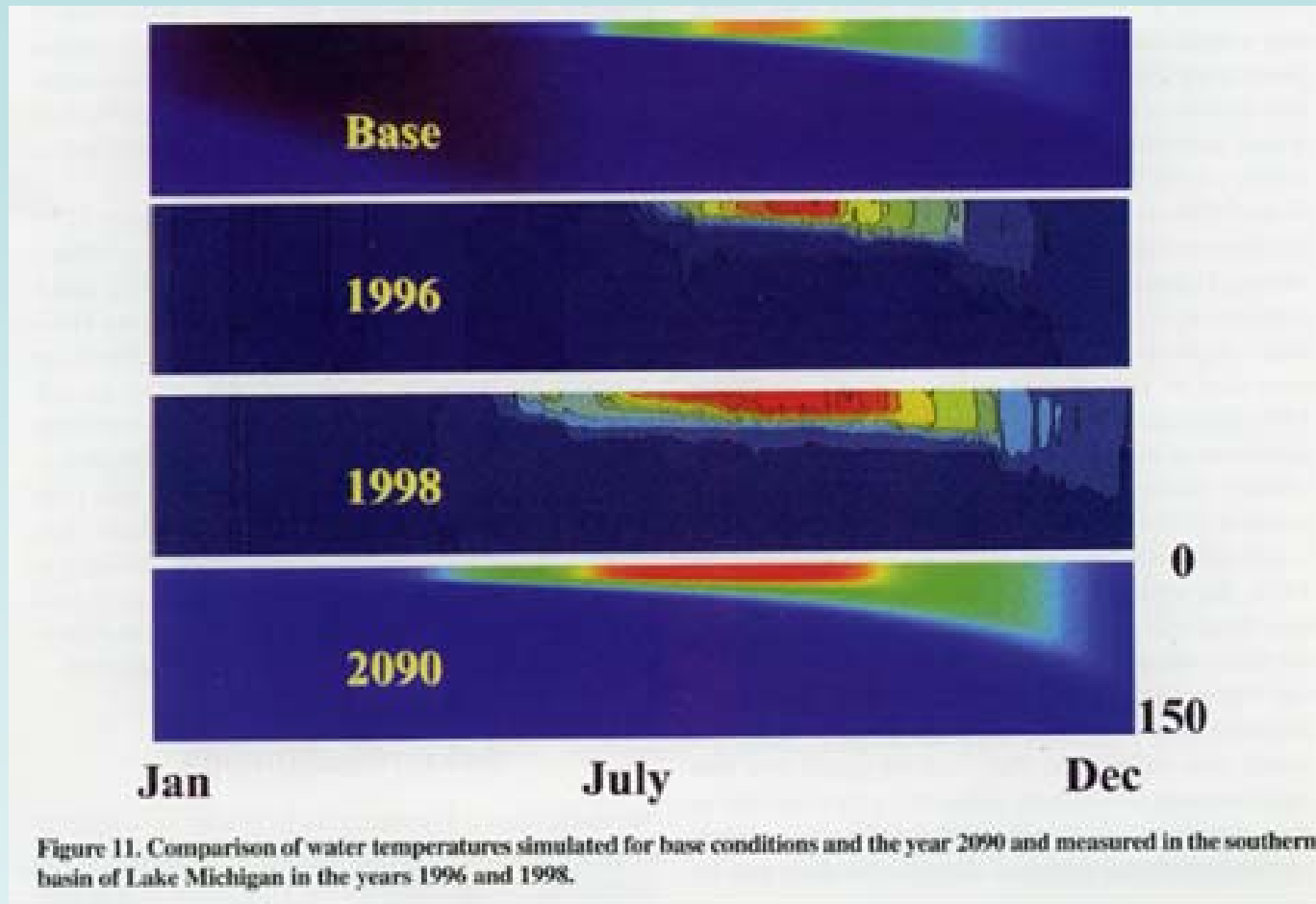
MEDIUM

LONG

Lake Temperatures



Vertical Lake Michigan Profile

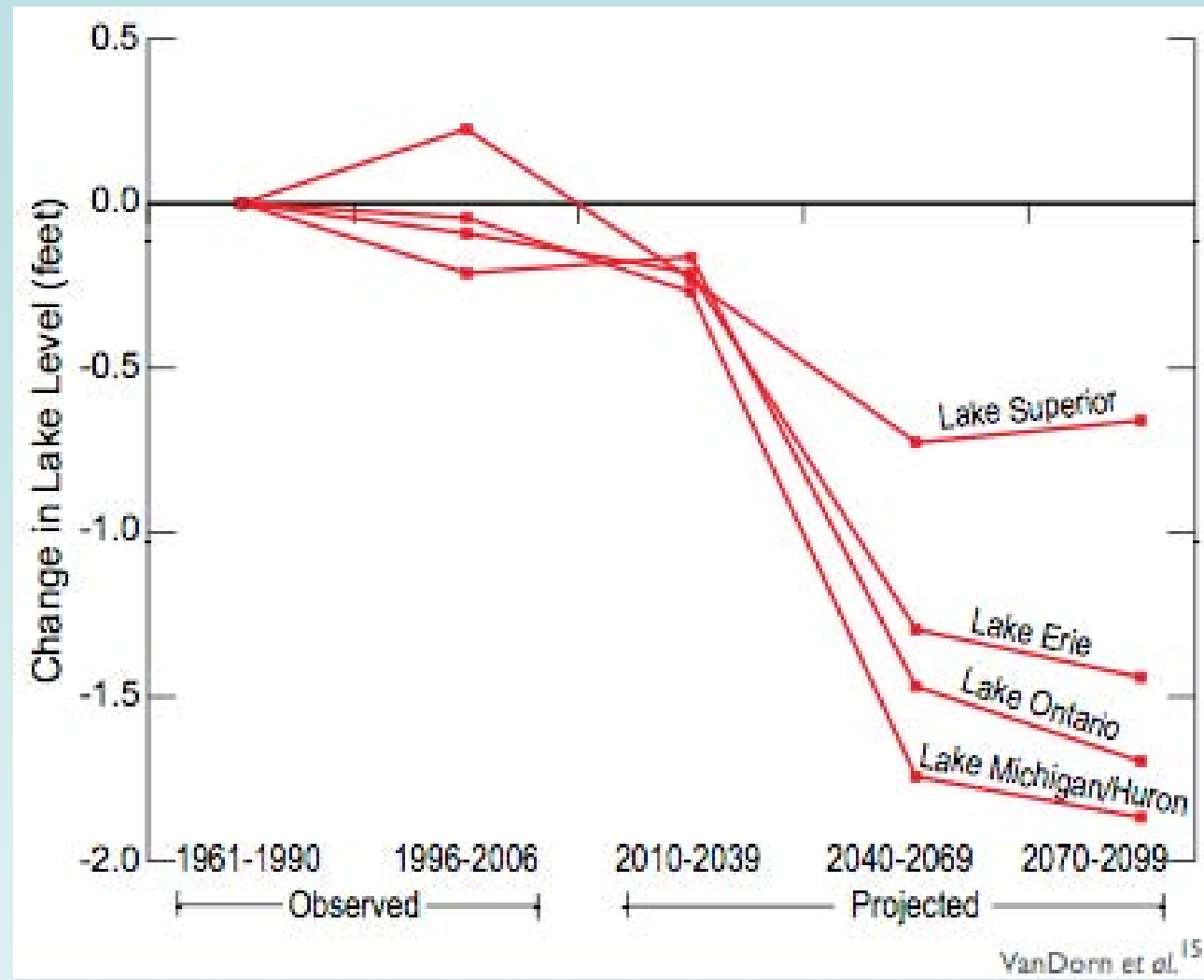


Brandt, S.B, Mason, D.M., McCormick, M.J., Lofgren, B. and T.S. Hunter, 2002, Climate Change: Implications for Fish Growth Performance in the Great Lakes. American Fisheries Society Symposium 32:61-76



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Lake level projections



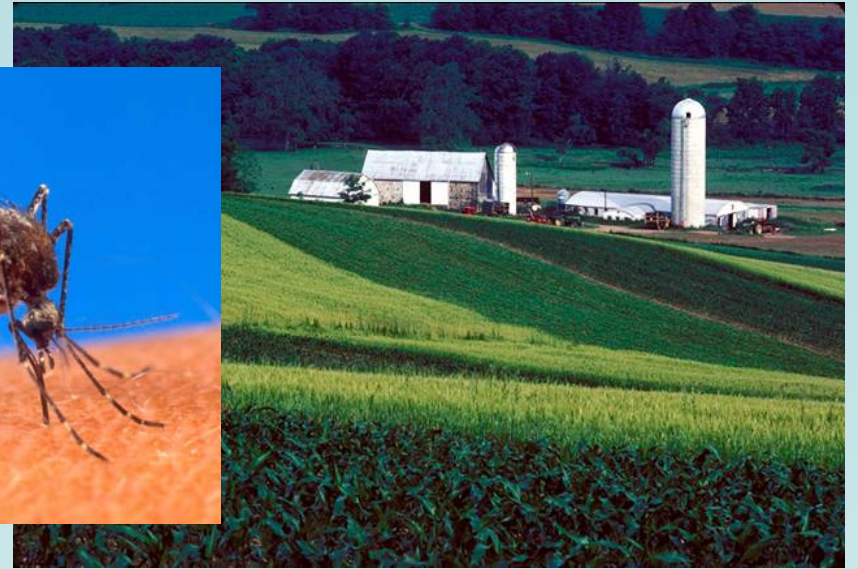
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VanDorn, J., T. Croley, K. Hayhoe, and D. Wuebbles, 2008: Projected 21st century transient changes in Great Lake levels under higher and lower emission scenarios. *Journal of Great Lakes Research*, submitted.

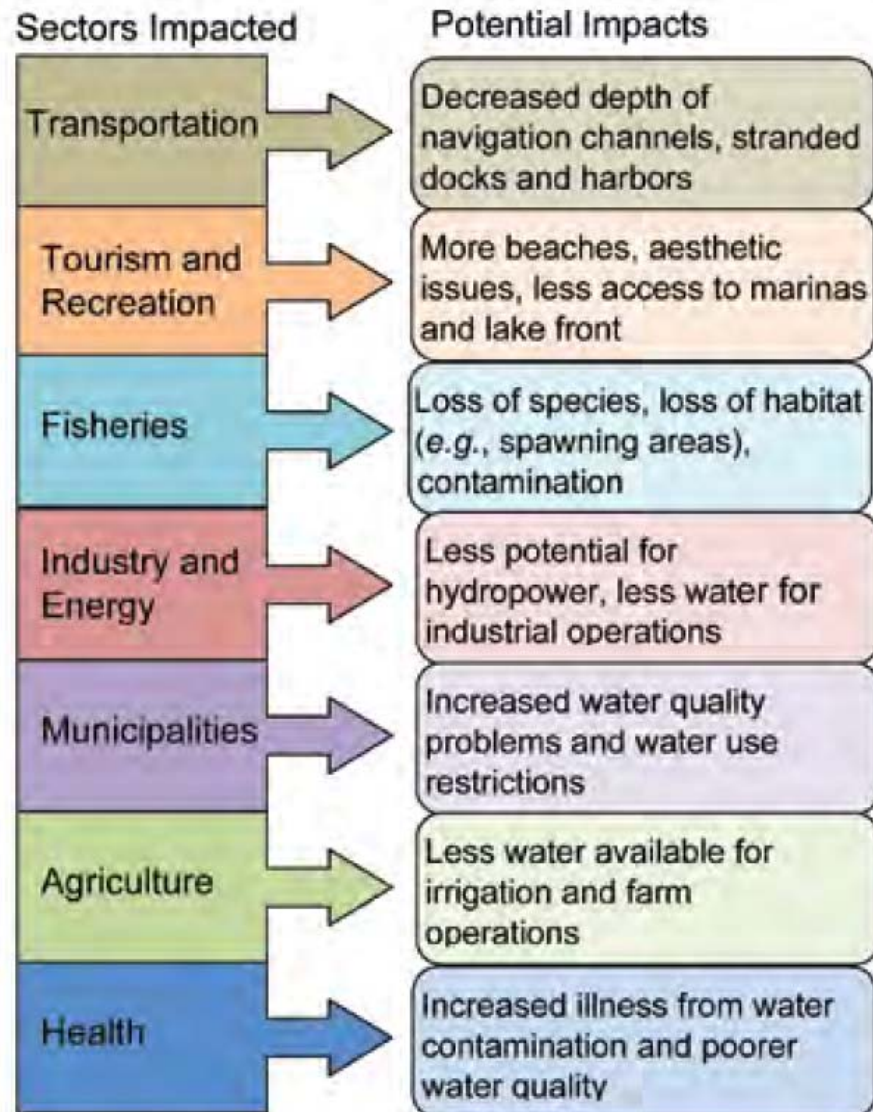
Key Climate and Impacts Findings

- Changes consistent with global warming are **already evident** across New York
- Over **next few decades**, changes similar under both emissions scenarios
- By **mid-century**, most changes are greater under the higher scenario
- By **late-century**, under the higher scenario many changes almost twice those seen with lower emissions





Lower Water Levels in the Great Lakes



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Field, C.B., L.D. Mortsch, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running, and M.J. Scott, 2007: North America. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, UK, and New York, pp. 617-652.

Questions?

