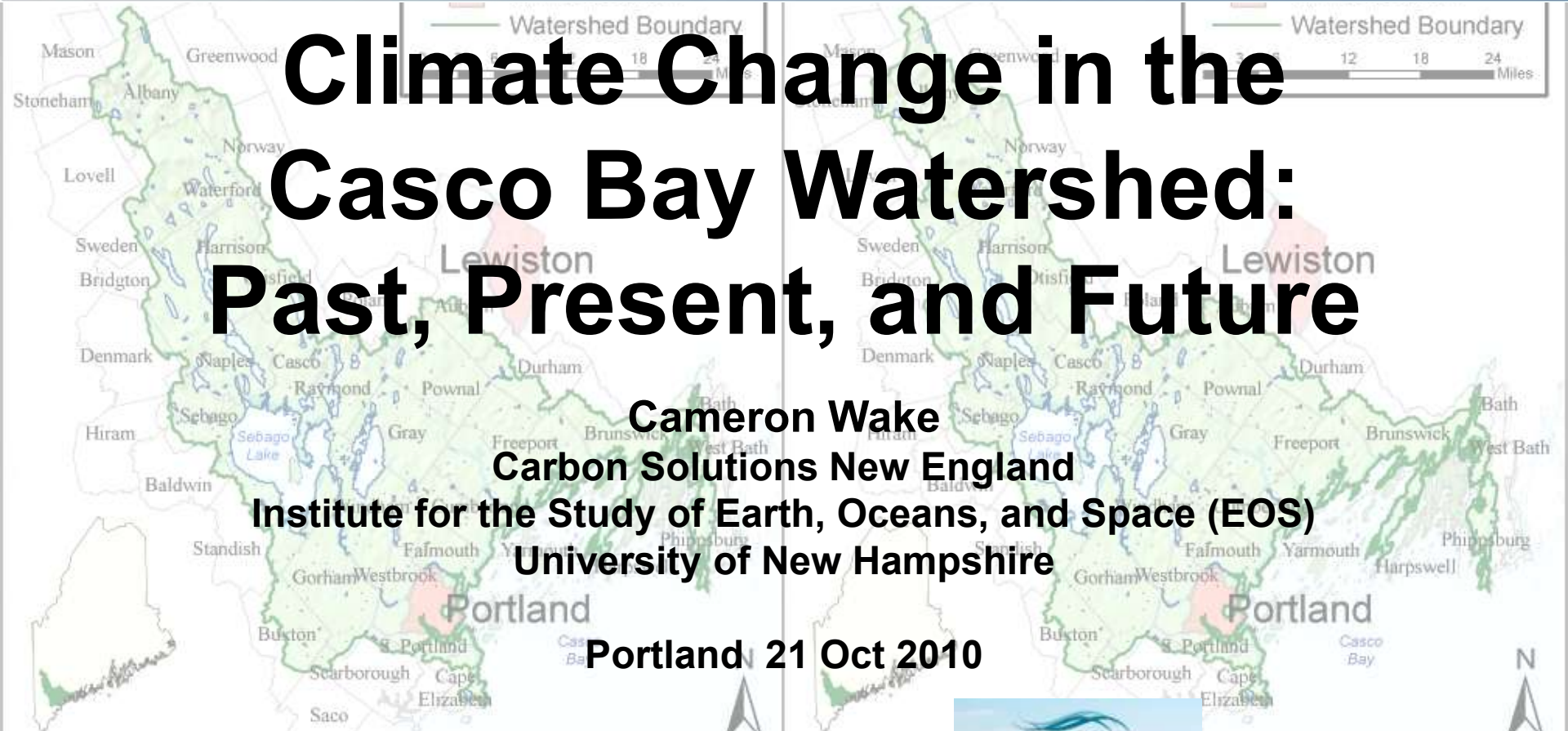




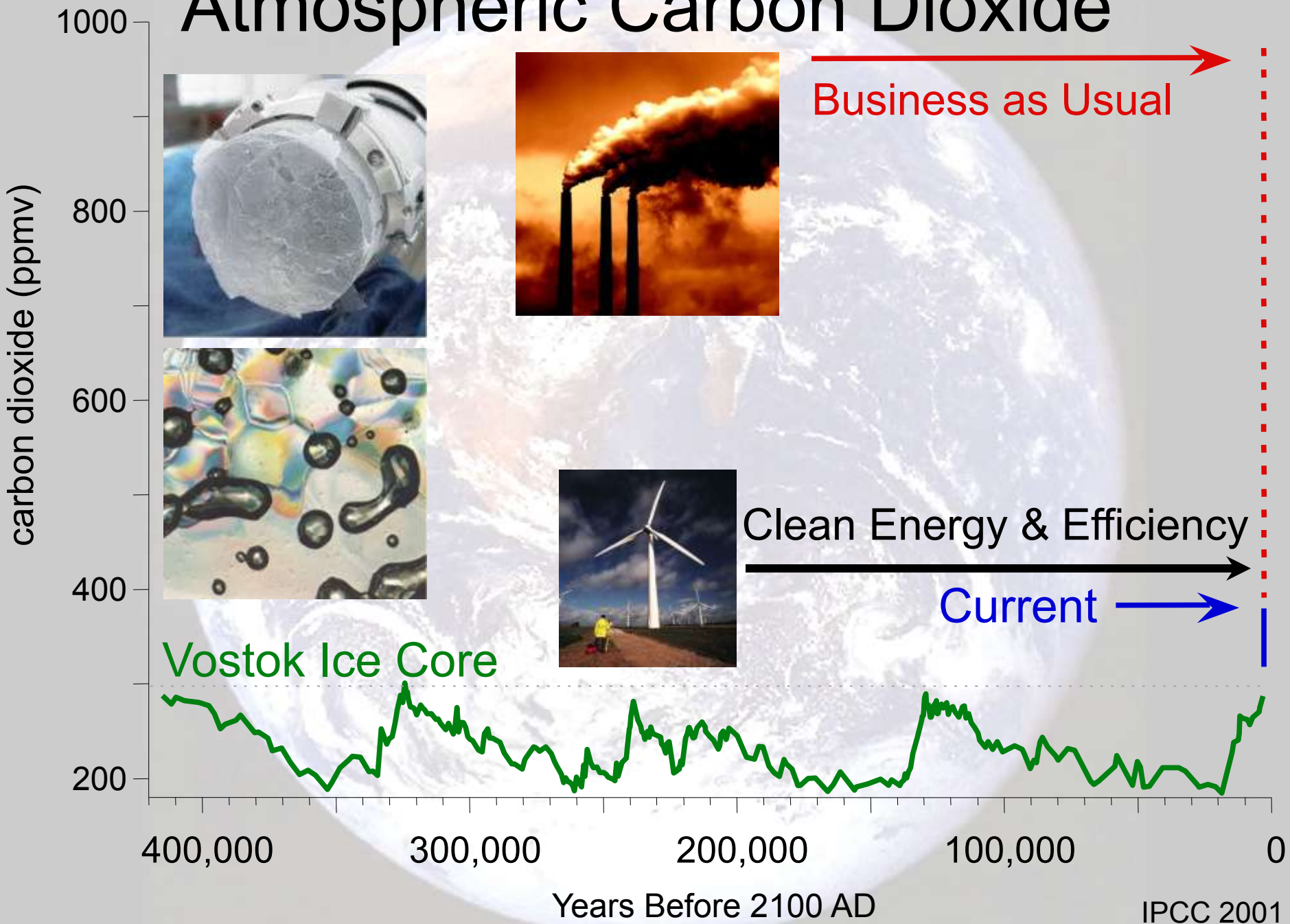
Climate Change in the Casco Bay Watershed: Past, Present, and Future

Cameron Wake
Carbon Solutions New England
Institute for the Study of Earth, Oceans, and Space (EOS)
University of New Hampshire

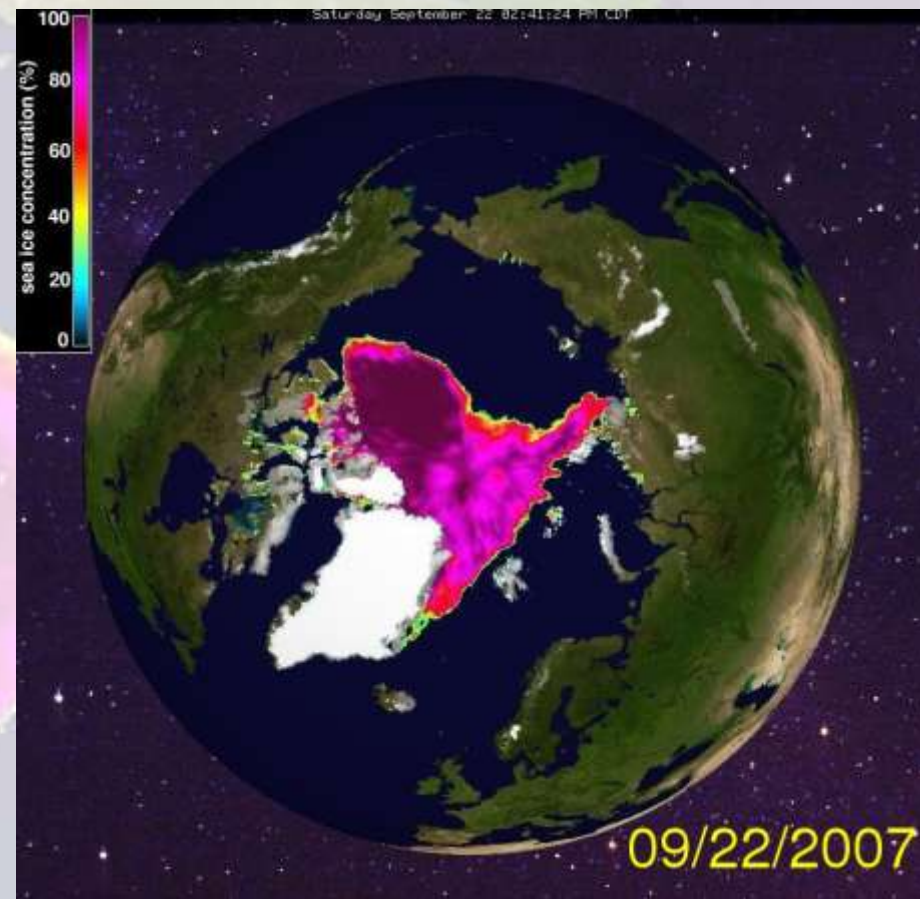
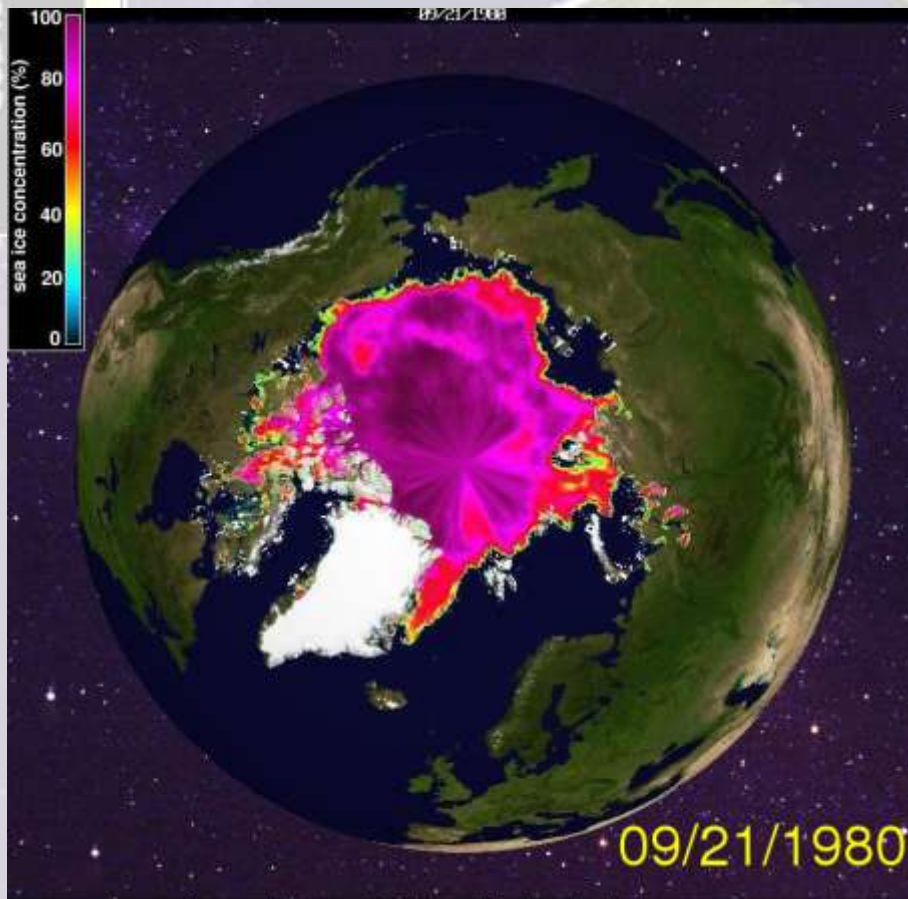
Portland 21 Oct 2010



Atmospheric Carbon Dioxide



Arctic Sea Ice: Sept 1980 vs Sept 2007

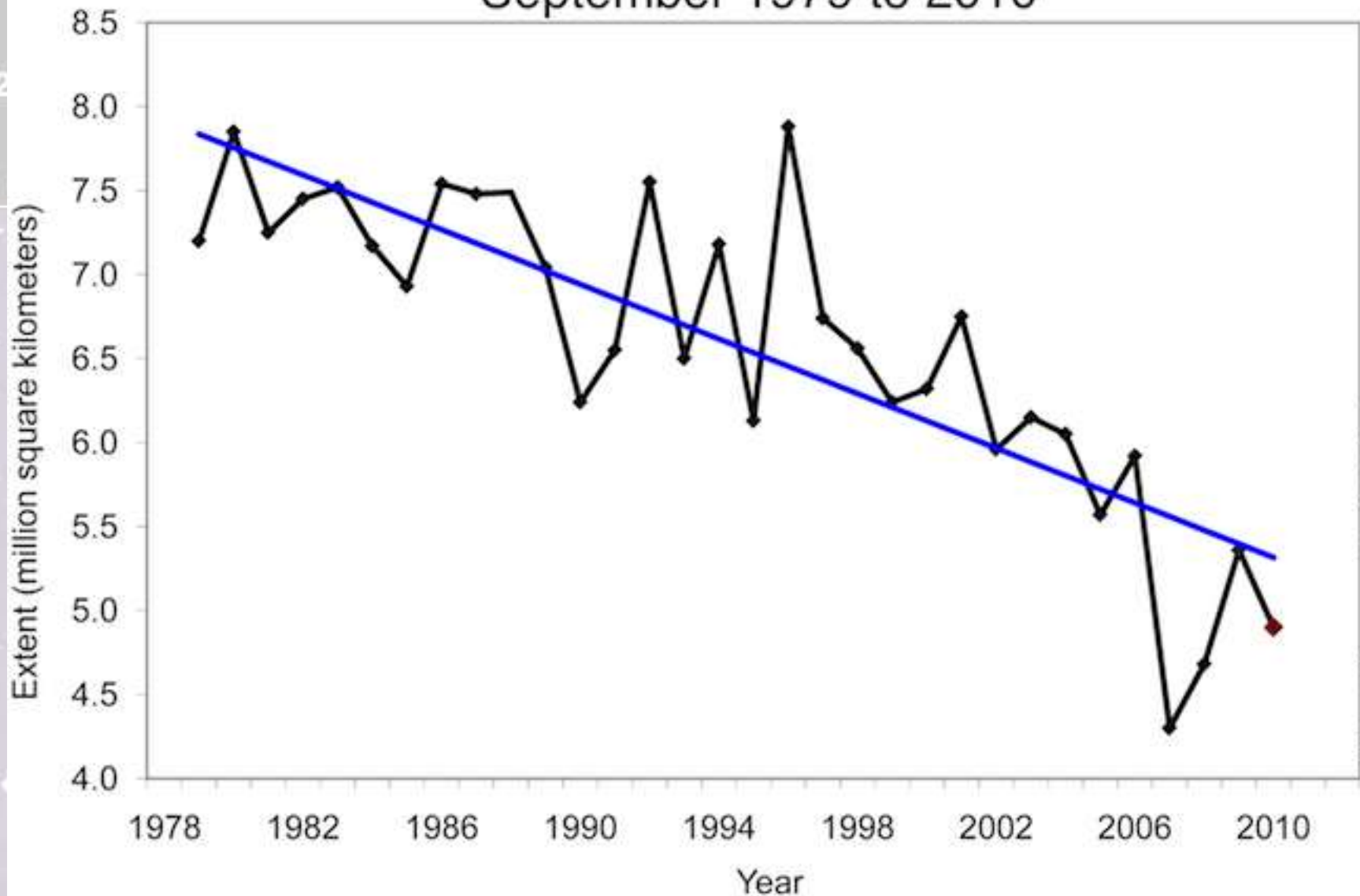


University of Illinois - The Cryosphere Today <http://arctic.atmos.uiuc.edu/cryosphere/>

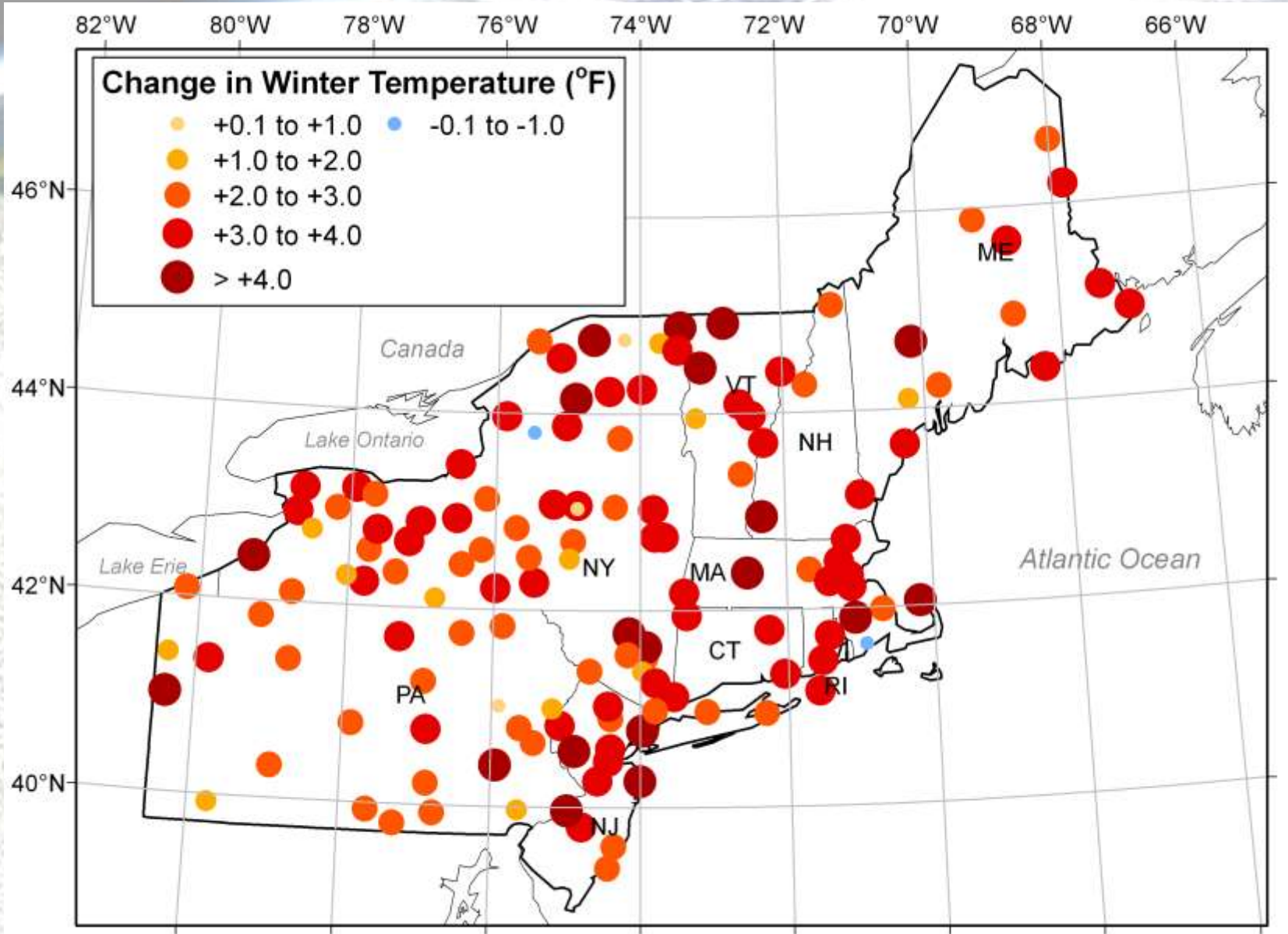
NSIDC Sea Ice Animation 1979-2008

http://nsidc.org/sotc/sea_ice_animation.html

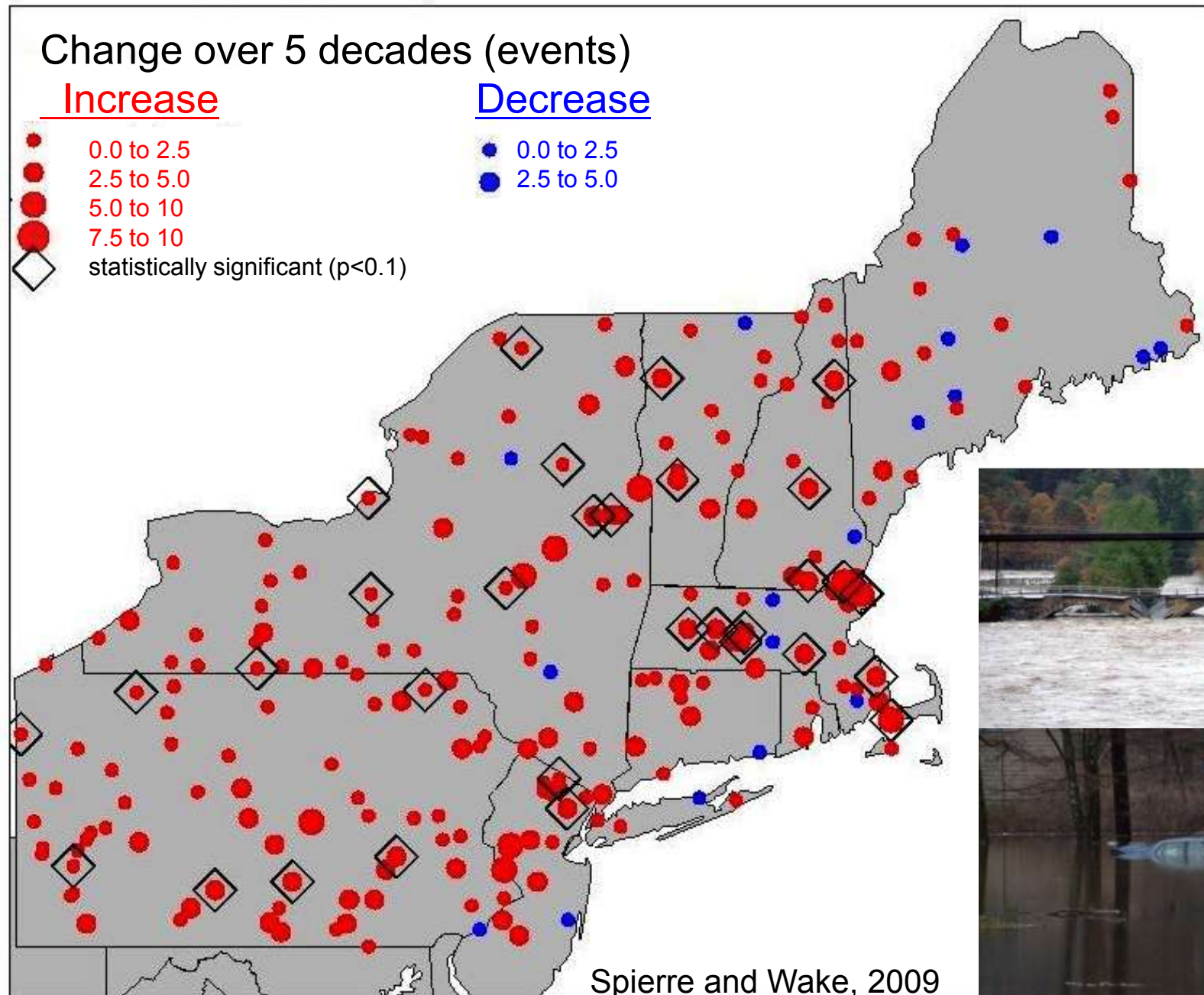
Average Monthly Arctic Sea Ice Extent September 1979 to 2010



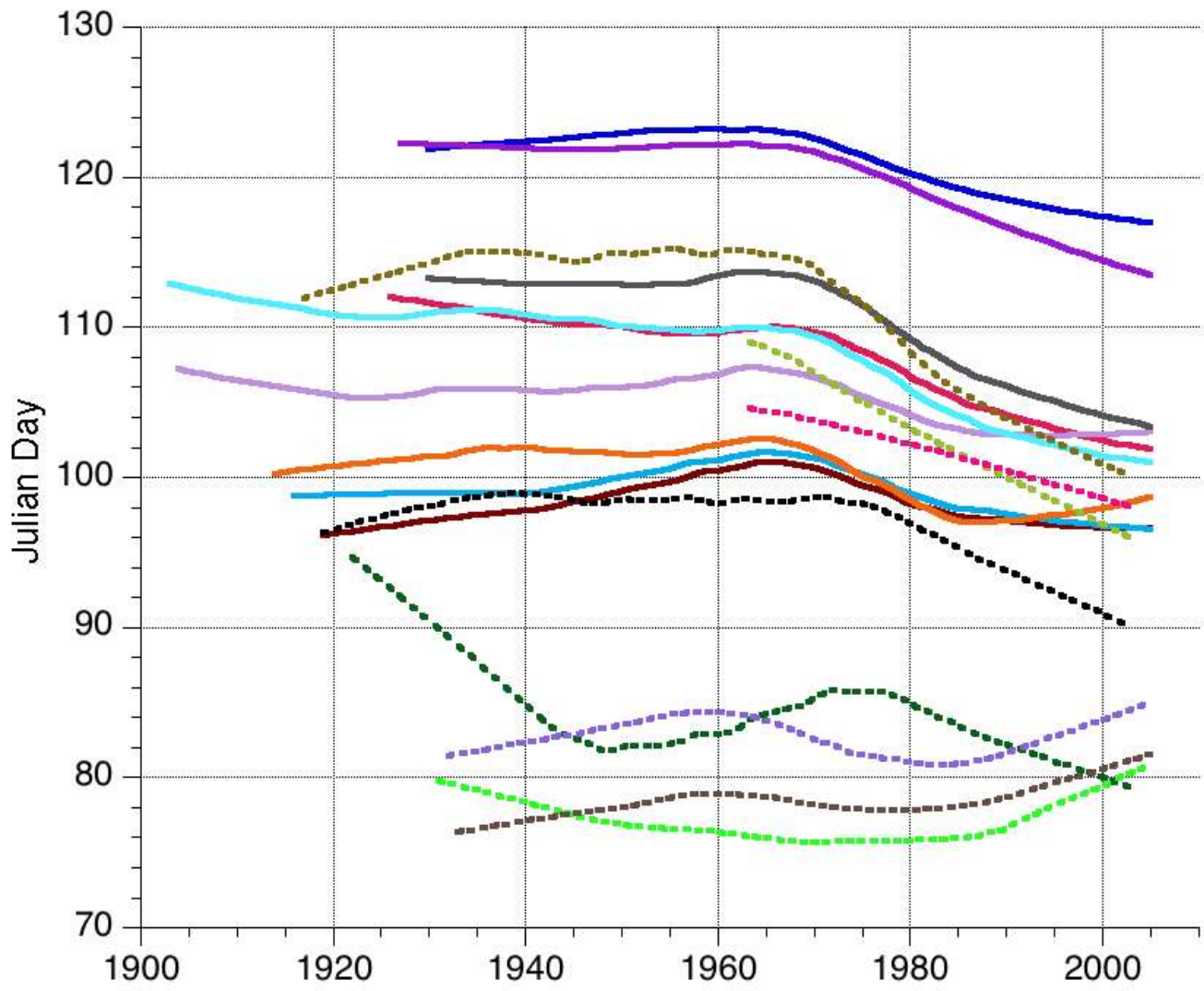
Northeast Winter Temperature Trends 1965-2005



Trends in One Inch Precipitation Events 1948-2007



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



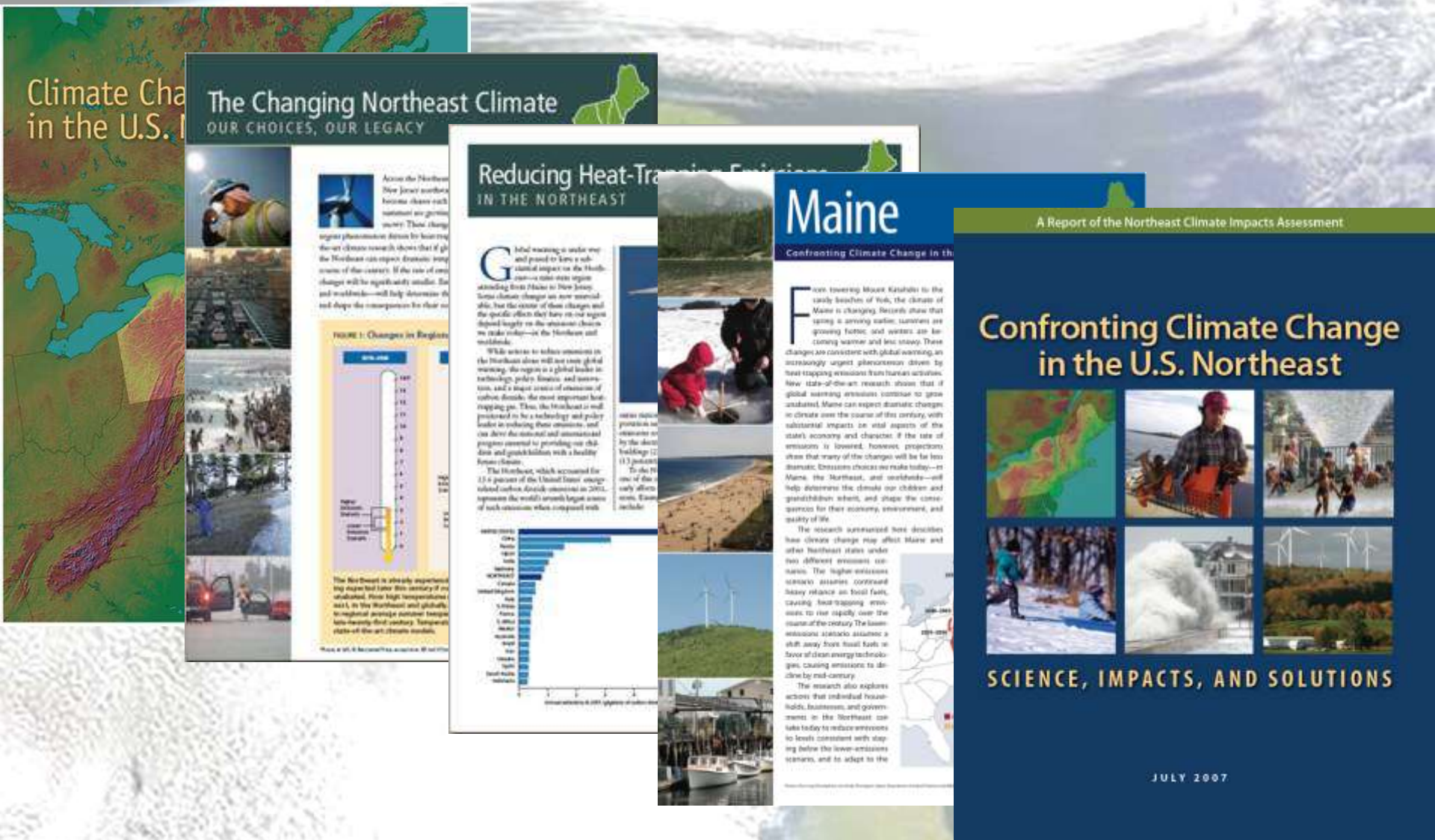
- Fish, ME
- St. John, ME
- Carrabassett, ME
- Smith, NH
- White, VT
- Pemigewasset, NH
- Little Androscoggin, ME
- Swift, ME
- Piscataquis, ME
- - - Lepreau, NB
- ... NE Margaree, NS
- ... Canaan, NB
- ... Beaverbank, NS
- ... SW Miramichi, NB
- ... Yantic, CT
- ... Pomperaug, CT
- ... Burlington, CT



All data from unregulated rivers; Hodgkins et al., 2003

Northeast Climate Impacts Assessment

Collaboration among Union of Concerned Scientists and 50 independent scientists



Climate Change in the Casco Bay Watershed: Past, Present, and Future

CAMERON WAKE AND ELIZABETH BURAKOWSKI

Carbon Solutions New England
Institute for the Study of Earth, Oceans and Space,
University of New Hampshire, Durham, NH

KATHARINE HAYHOE

ATMOS Research & Consulting, Lubbock, TX
Dept. of Geosciences, Texas Tech University

CHRIS WATSON AND ELLEN DOUGLAS

Environmental, Earth and Ocean Science Department,
University of Massachusetts, Boston, MA

JEFF VANDORN, VAISHALI NAIK, CLARE KEATING

ATMOS Research & Consulting

Casco Bay
Watershed

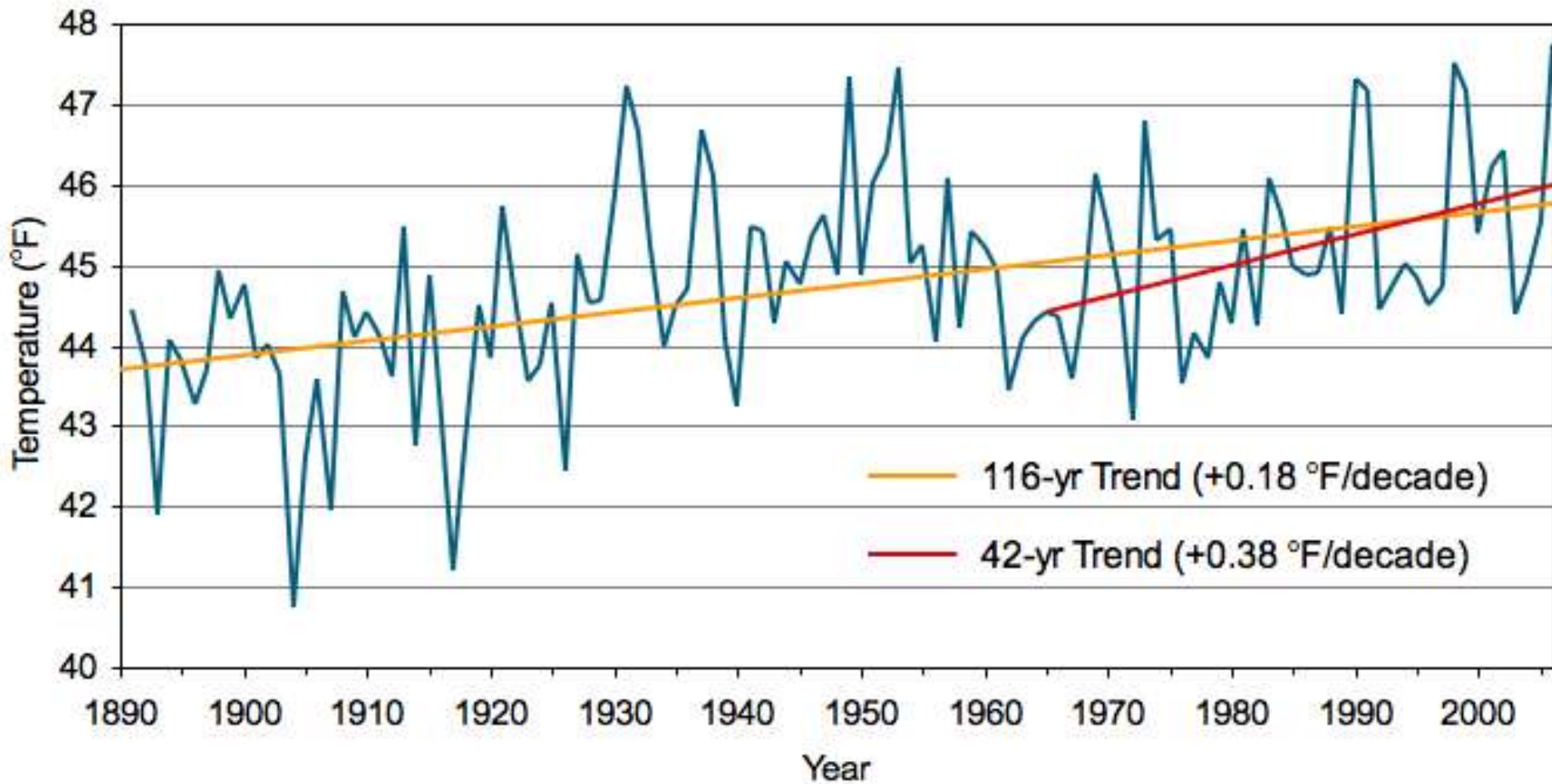
Climate Station
Watershed Boundary

12 18 24 Miles

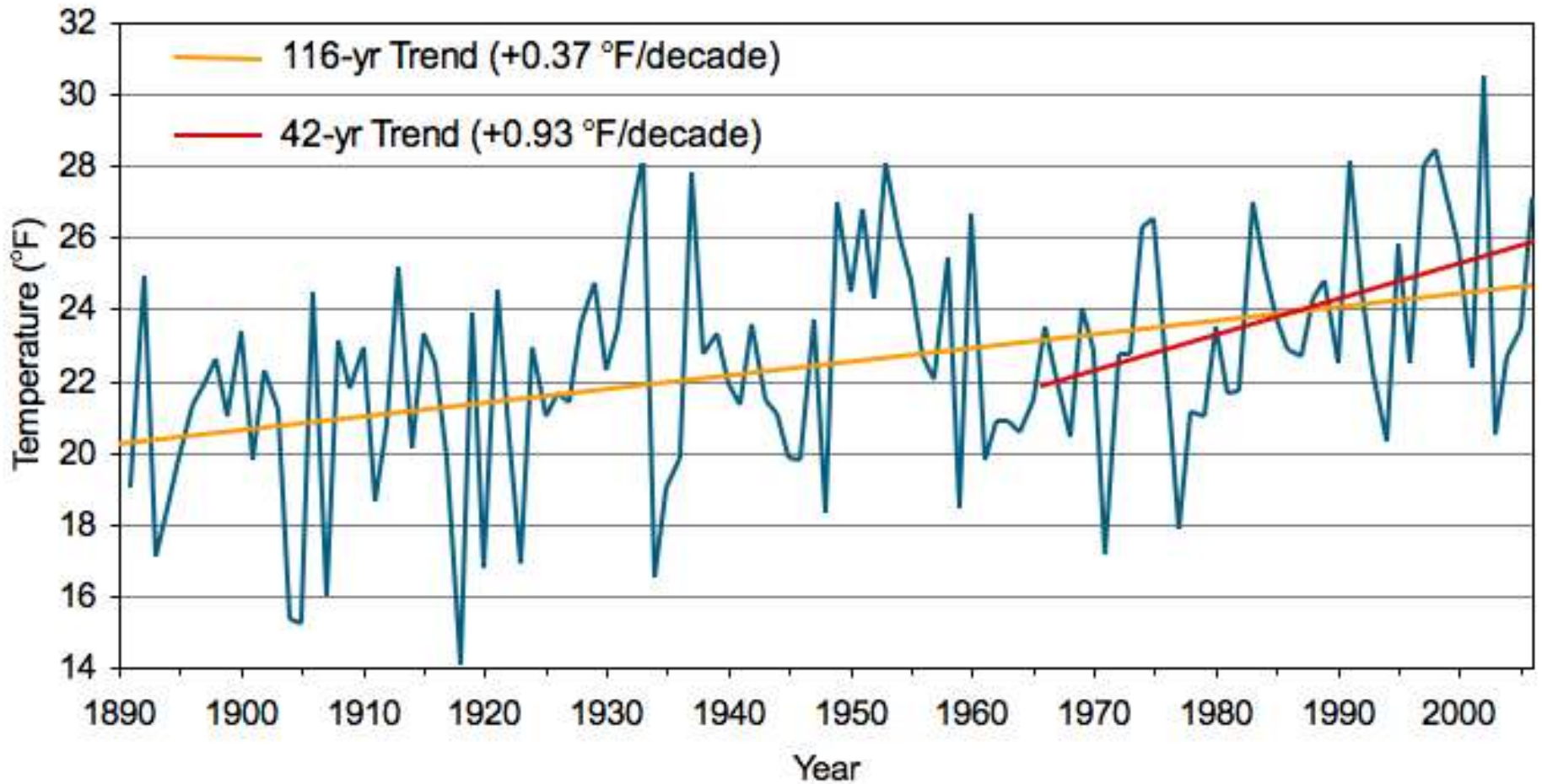




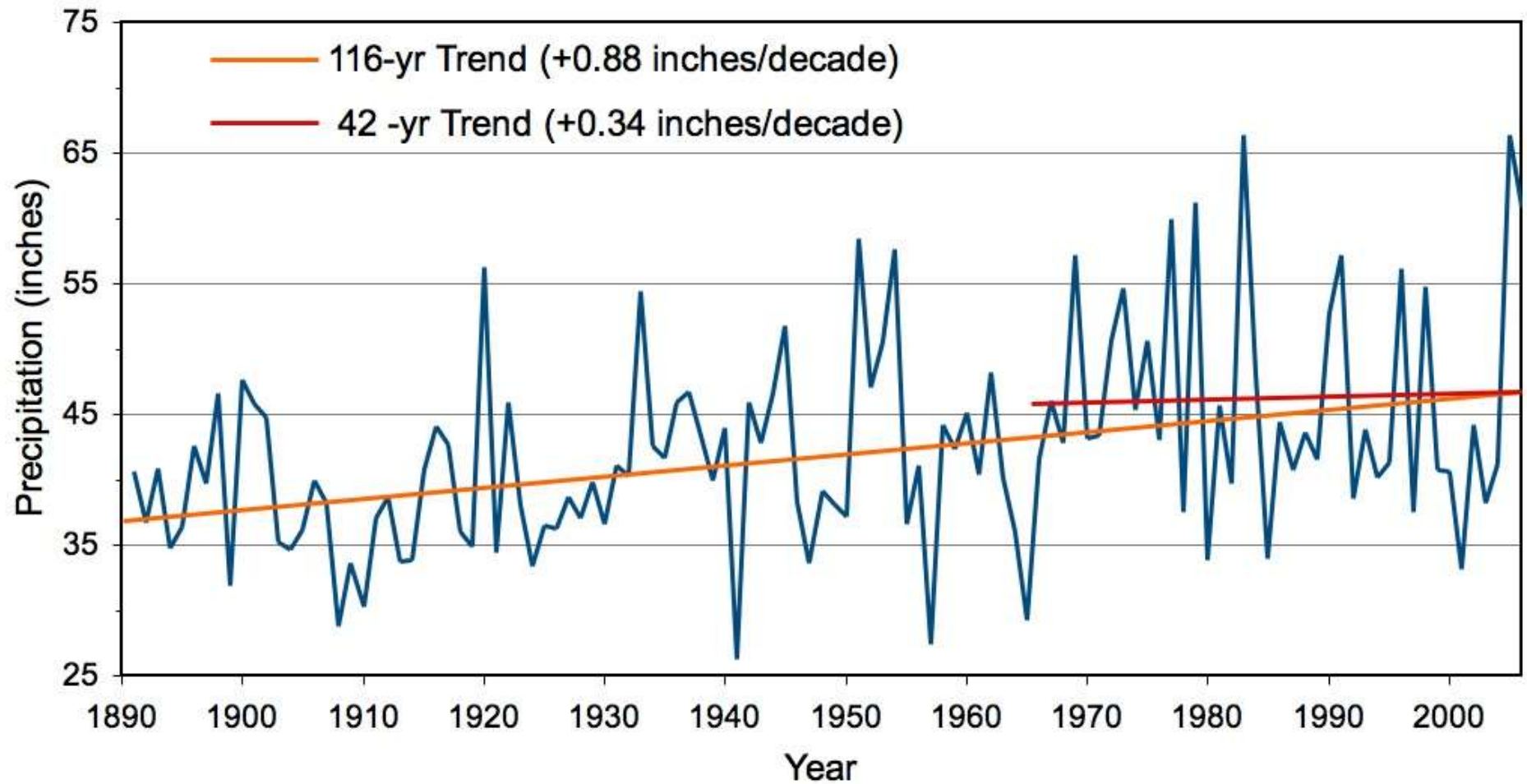
Portland Mean Annual Temperature: 1891-2006



Portland Winter Temperature: 1891-2006



Portland Annual Precipitation: 1891-2006

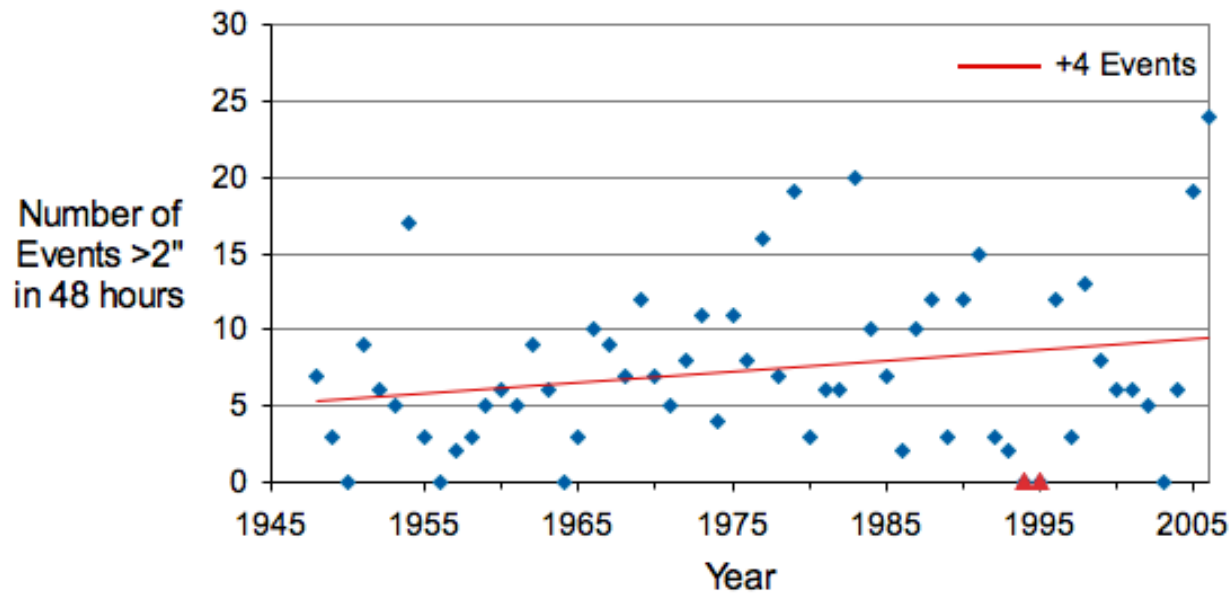
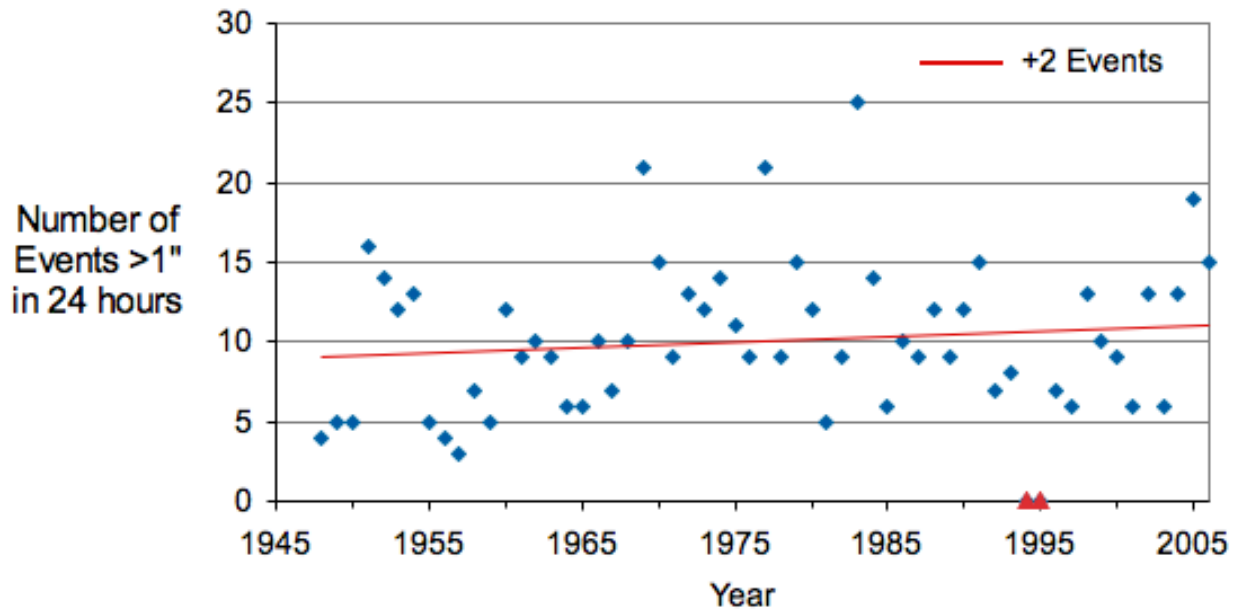


Climate Trends 1965-2006: Portland, Lewiston, Farmington

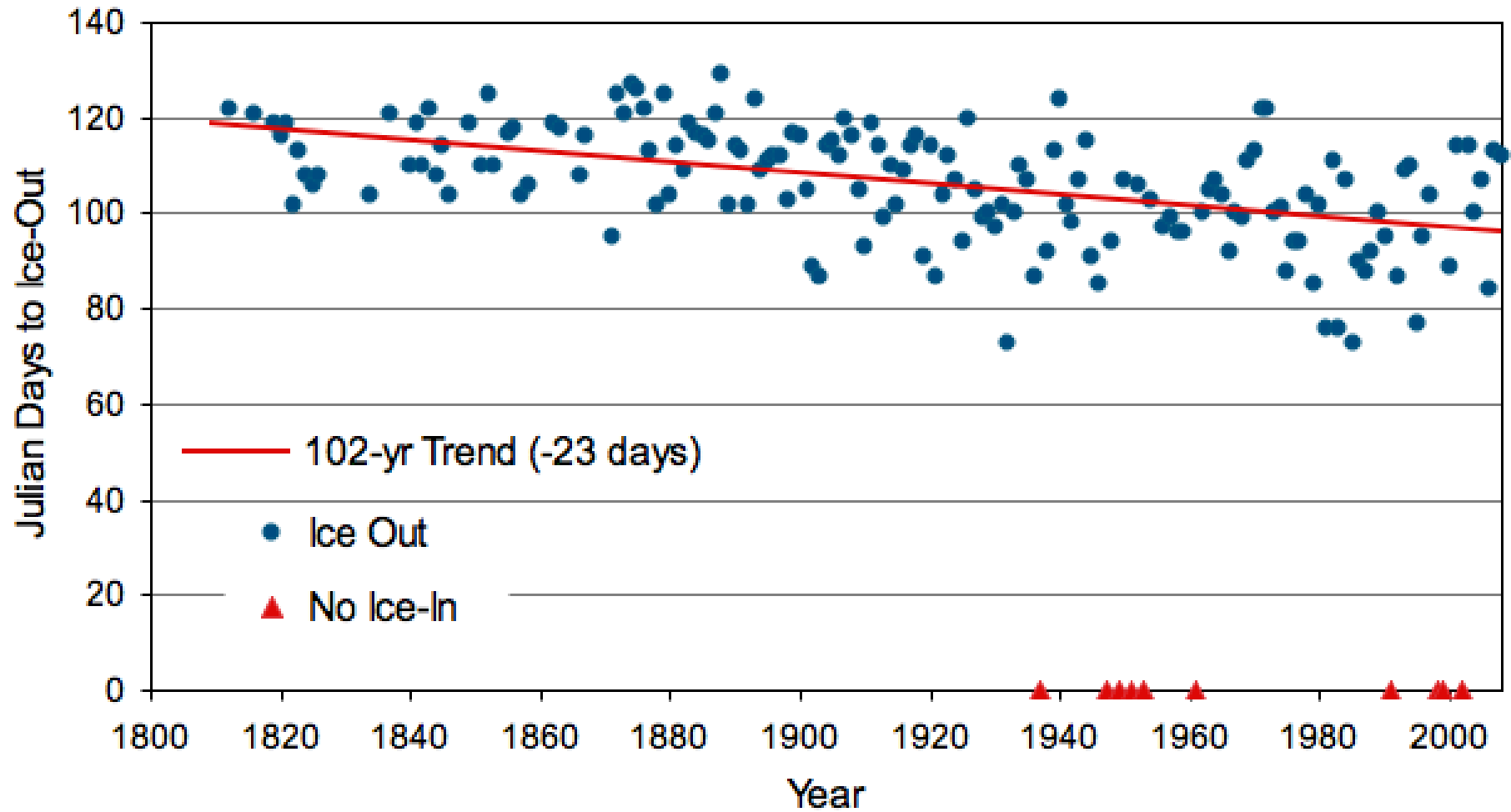
(**Bold** trends are statistically significant at $p < 0.01$; underlined trends significant at $p < 0.05$)

PORTLAND, ME	Winter	Spring	Summer	Fall	Annual
Precipitation (in/decade)	<u>-0.95</u>	+0.56	+0.13	+0.66	+0.34
Maximum Temp (°F/decade)	<u>+0.71</u>	+0.24	-0.05	+0.32	<u>+0.31</u>
Mean Temp (°F/decade)	+0.93	+0.33	-0.07	+0.26	+0.38
Minimum Temp (°F/decade)	+1.16	+0.43	-0.10	+0.02	<u>+0.39</u>
LEWISTON, ME					
Precipitation (in/decade)	<u>-1.03</u>	+0.26	-0.25	+0.50	-0.87
Maximum Temp (°F/decade)	+0.46	+0.24	+0.17	+0.24	<u>+0.29</u>
Mean Temp (°F/decade)	+0.54	+0.29	<u>+0.34</u>	+0.30	+0.39
Minimum Temp (°F/decade)	+0.65	+0.34	+0.52	<u>+0.35</u>	+0.48
FARMINGTON, ME					
Precipitation (in/decade)	-0.65	+0.74	0.0	+0.72	+0.77
Maximum Temp (°F/decade)	+0.81	<u>+0.60</u>	+0.15	+0.40	+0.51
Mean Temp (°F/decade)	+1.23	+0.74	<u>+0.42</u>	+0.56	+0.76
Minimum Temp (°F/decade)	+1.65	+0.88	+0.70	+0.70	+1.00

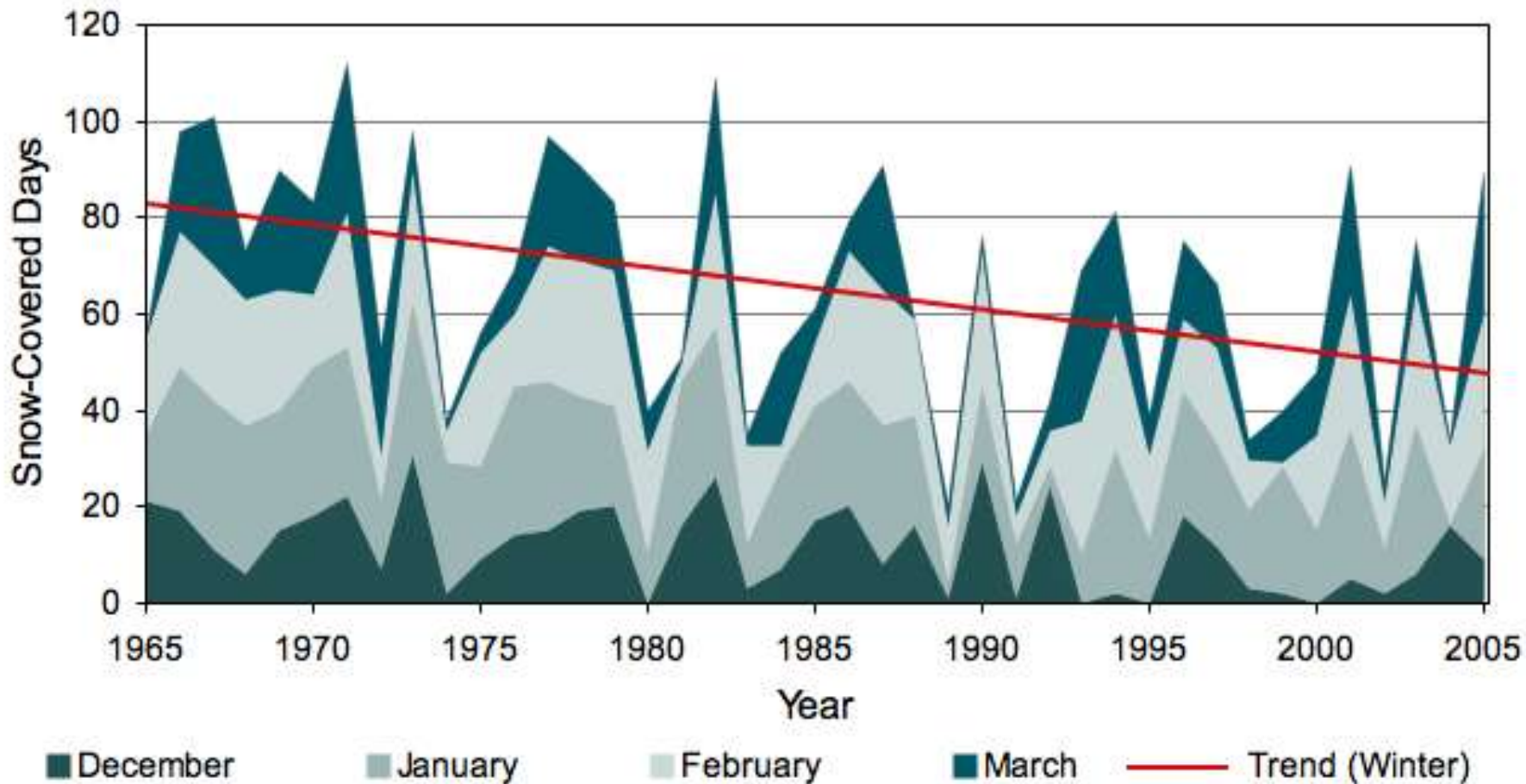
Extreme Precipitation Events - Portland



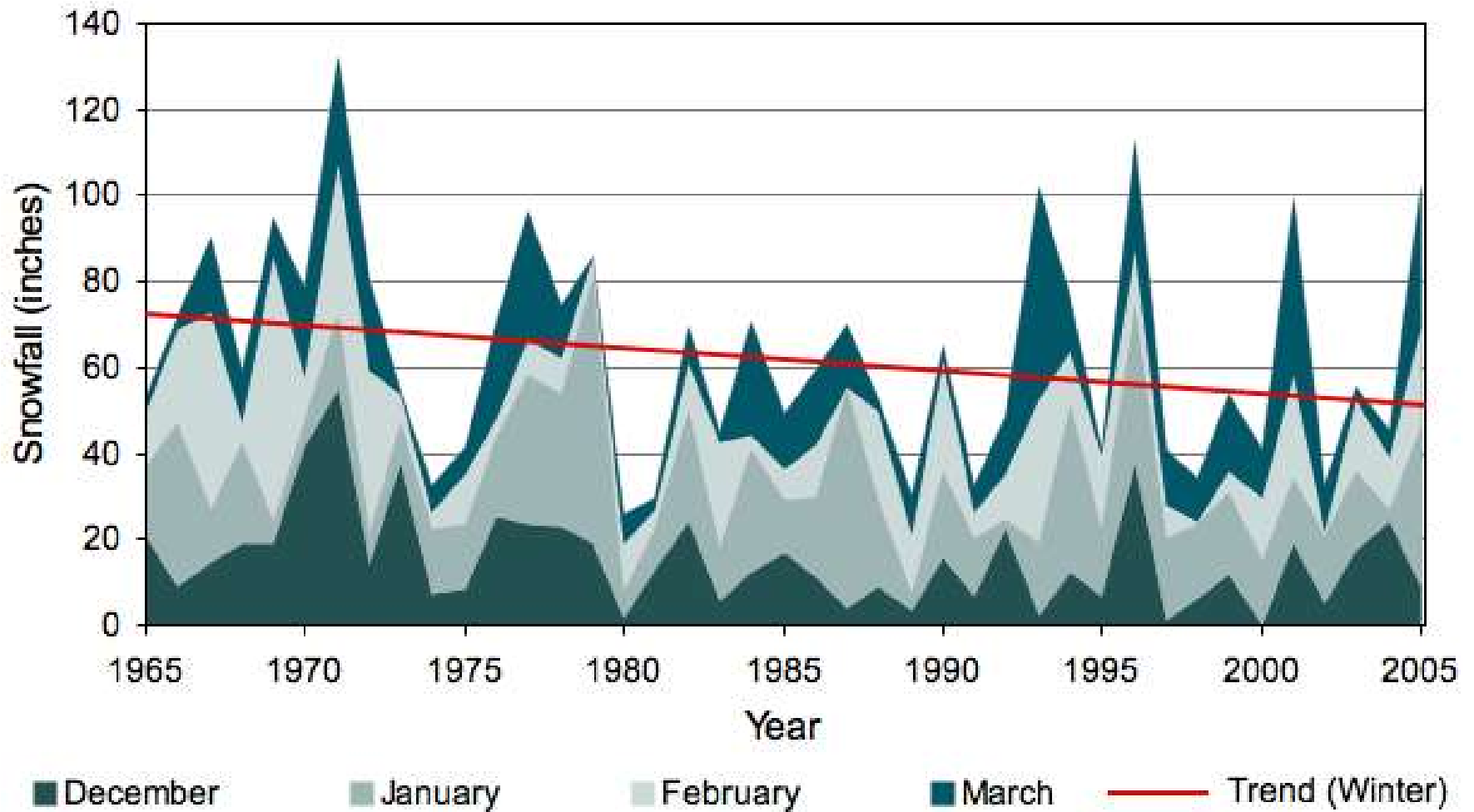
Ice Out Dates – Sebago Lake



Portland Covered Days: 1965-2006

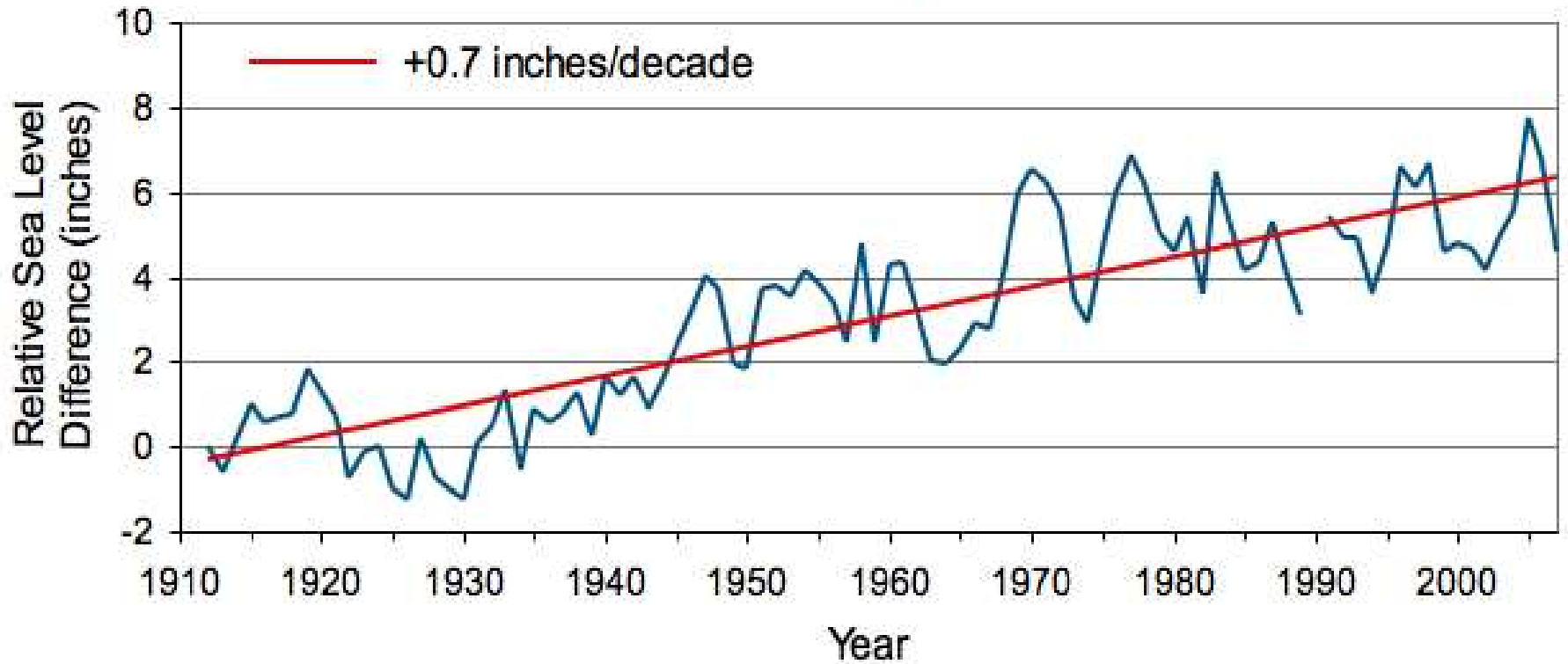


Portland Snowfall: 1965-2006

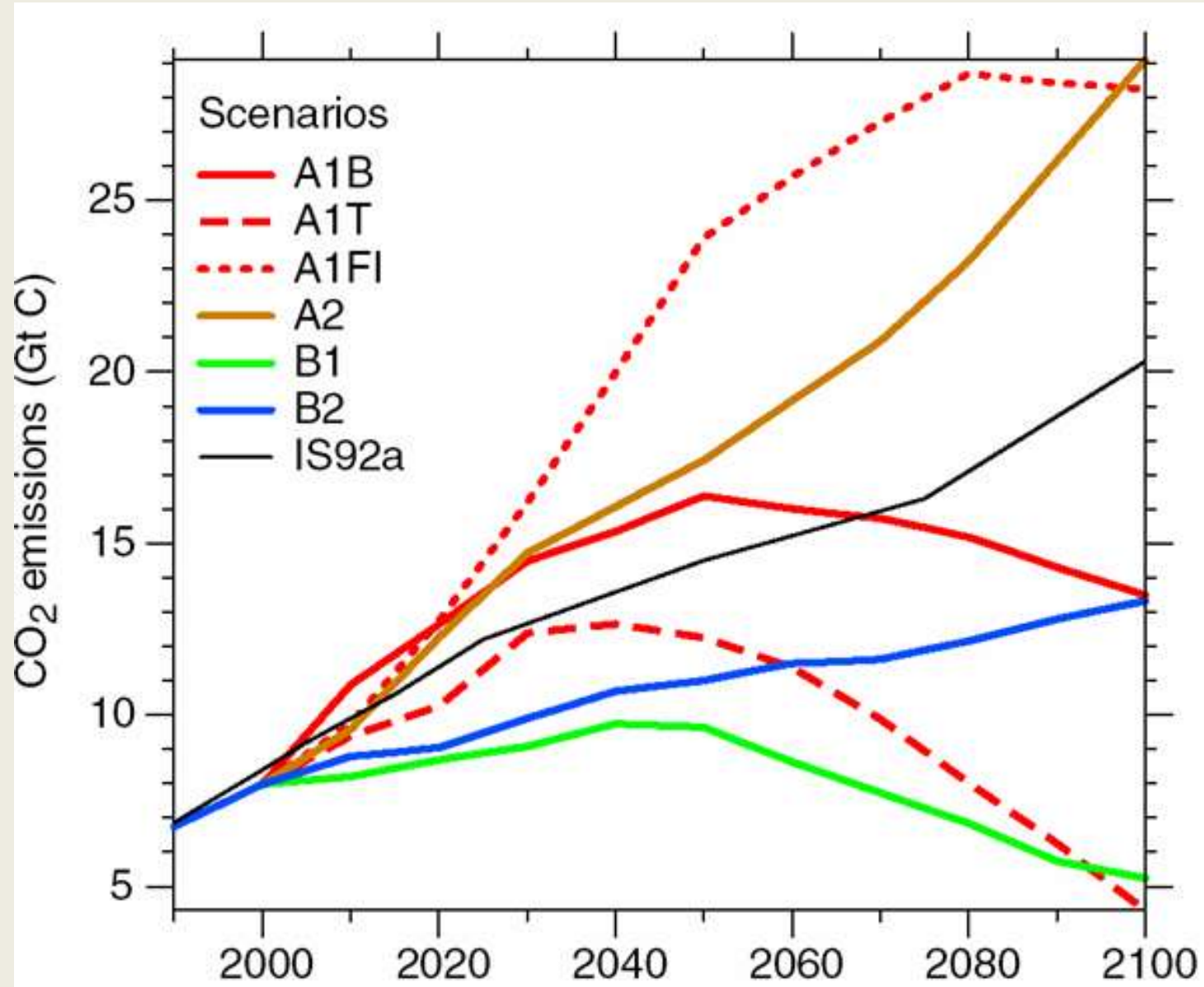


Relative Sea Level Rise – Portland

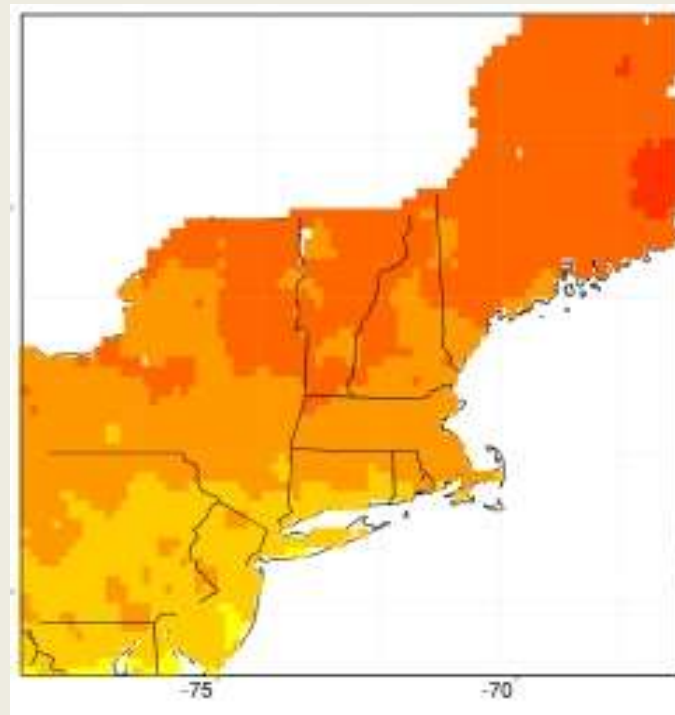
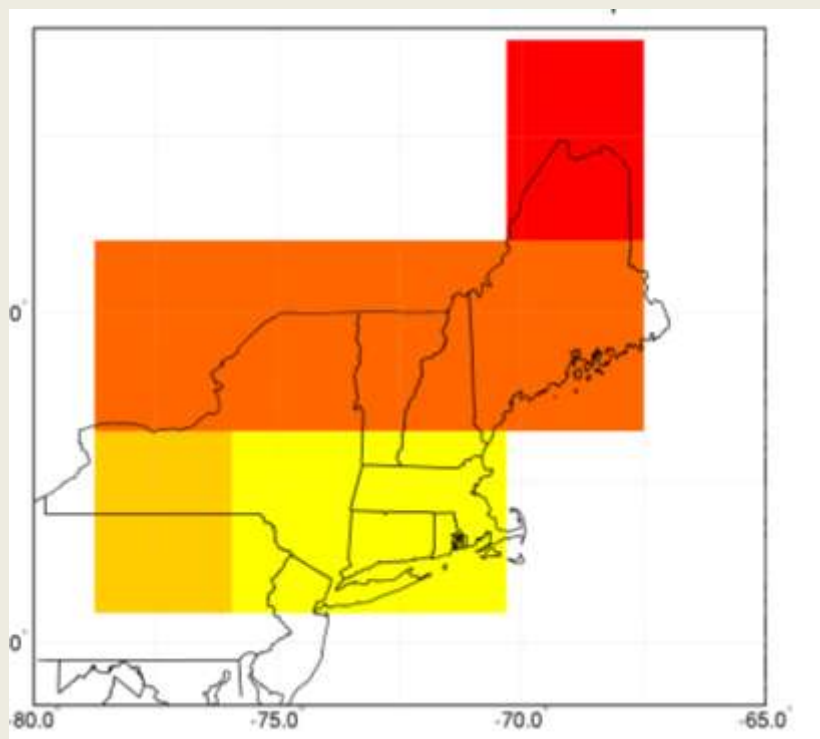
Relative Sea Level (inches) minus 1912 value
Portland, Maine



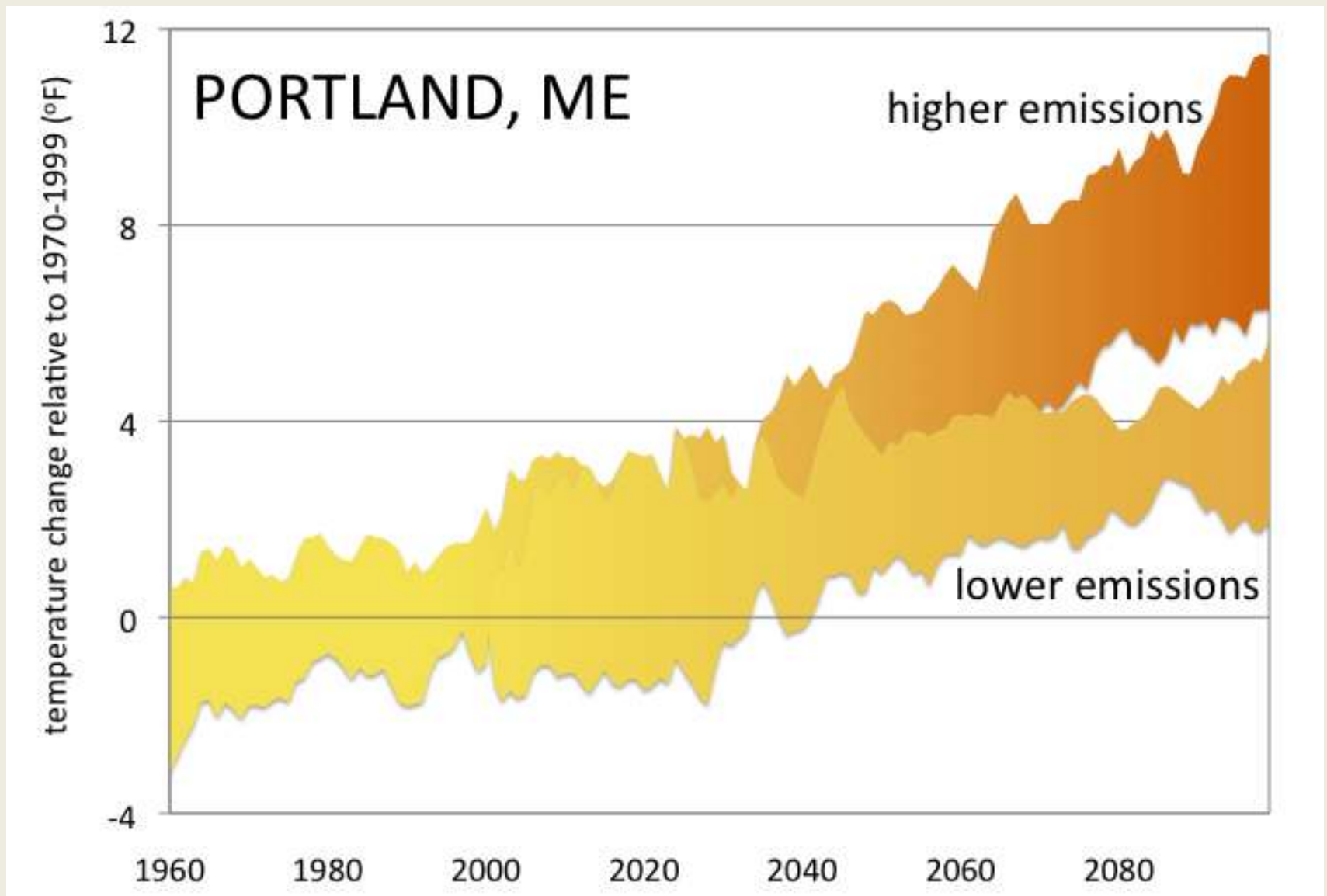
Greenhouse Gas Emission Scenarios



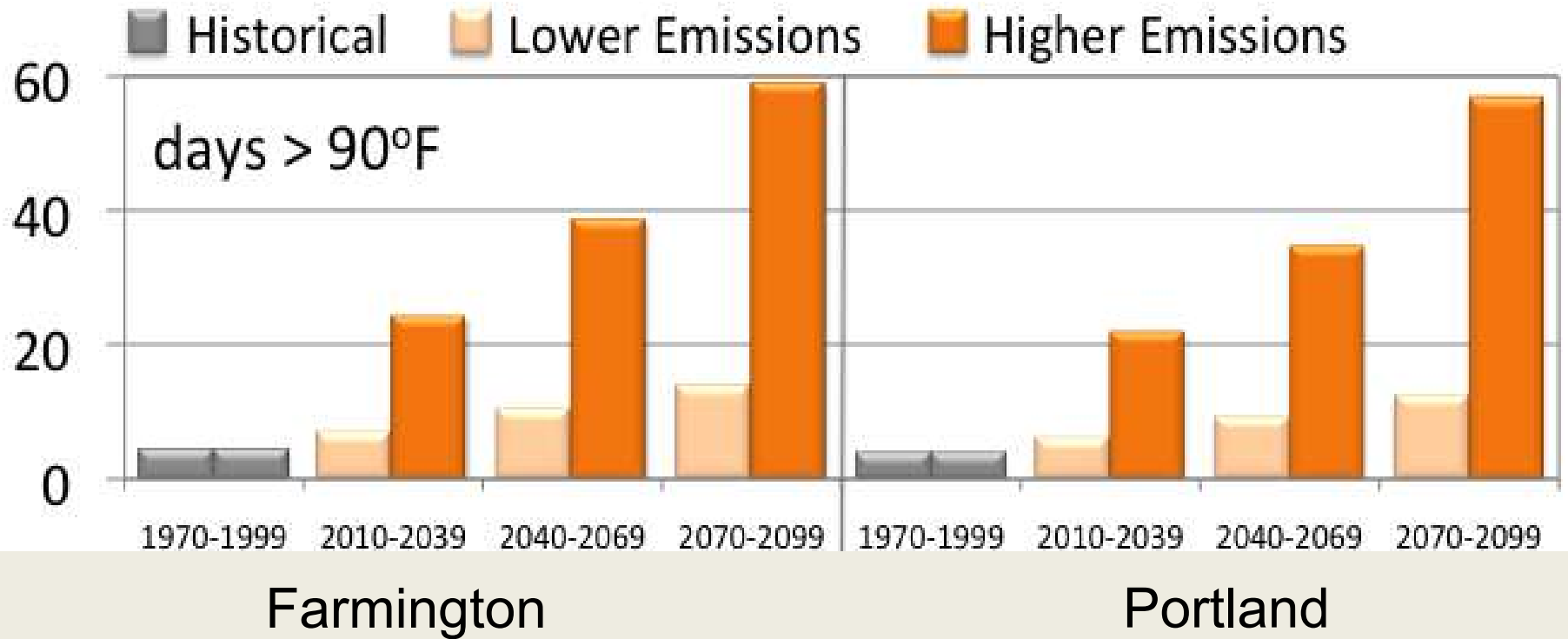
Projecting Future Climate Change for the Northeast: Downscale Global Projections to Regional Level



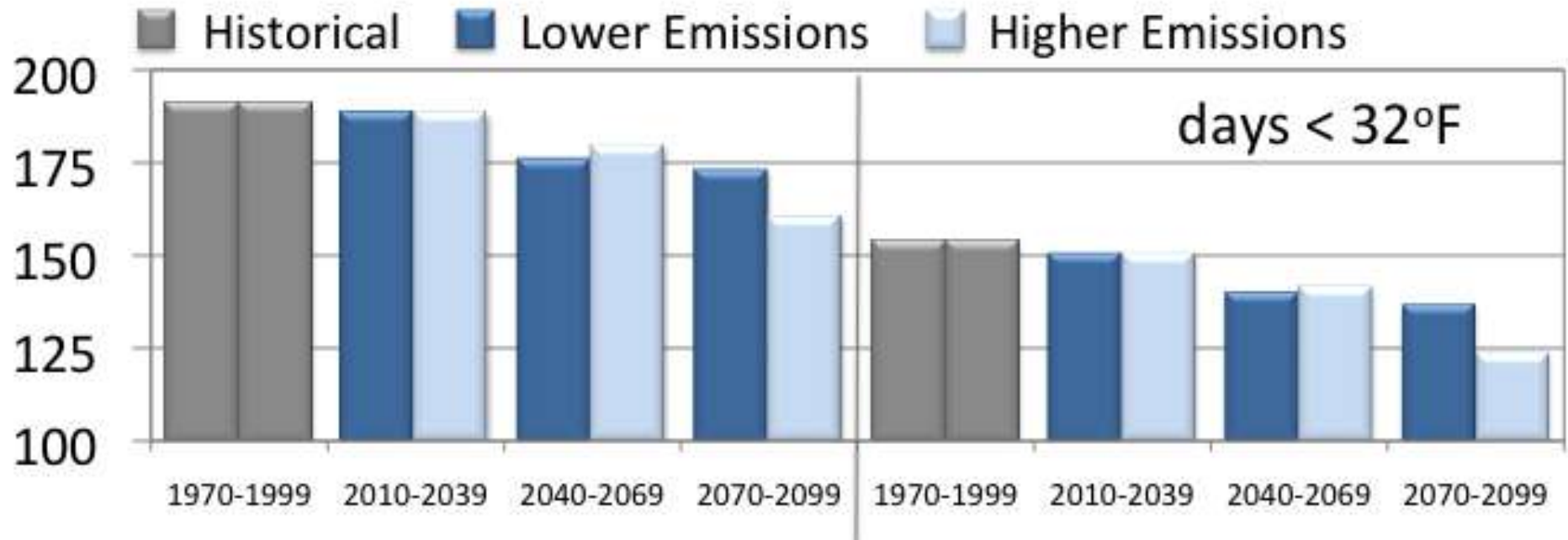
Rising Annual Temperatures



More Hot Days



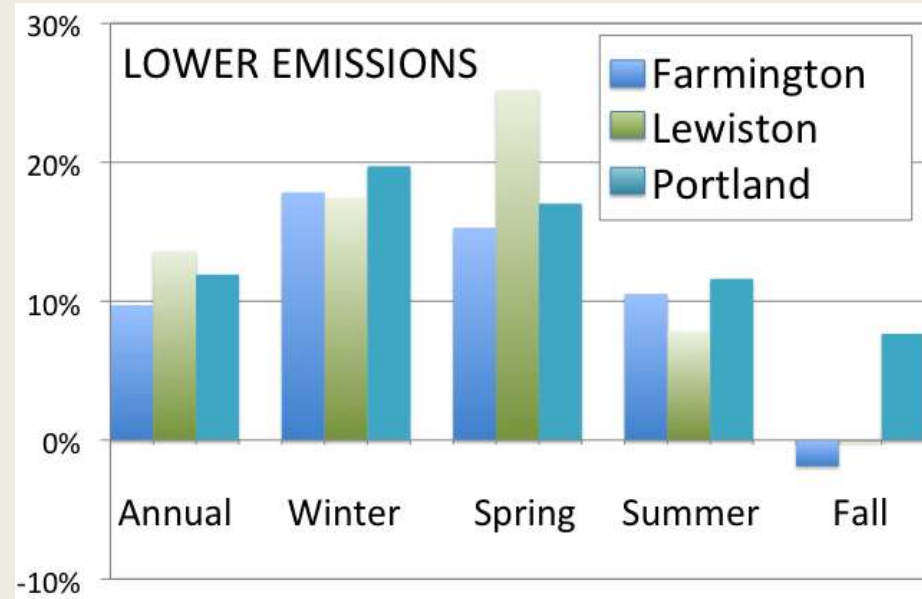
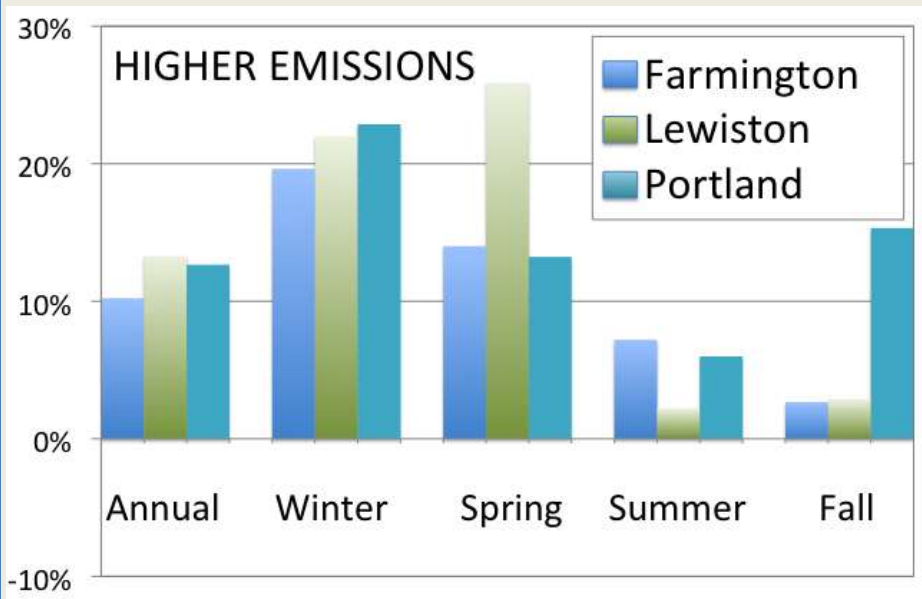
Fewer Cold Days



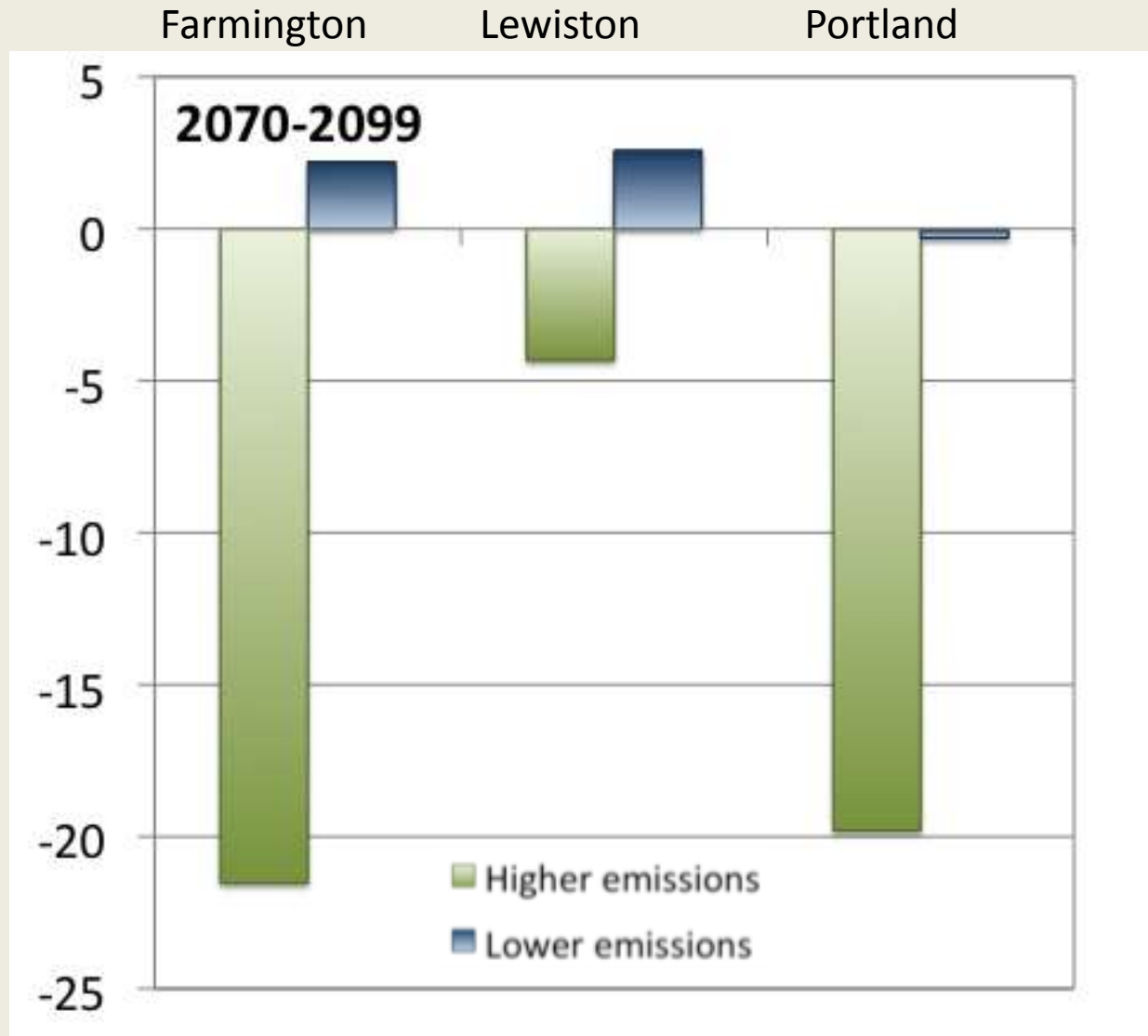
Farmington

Portland

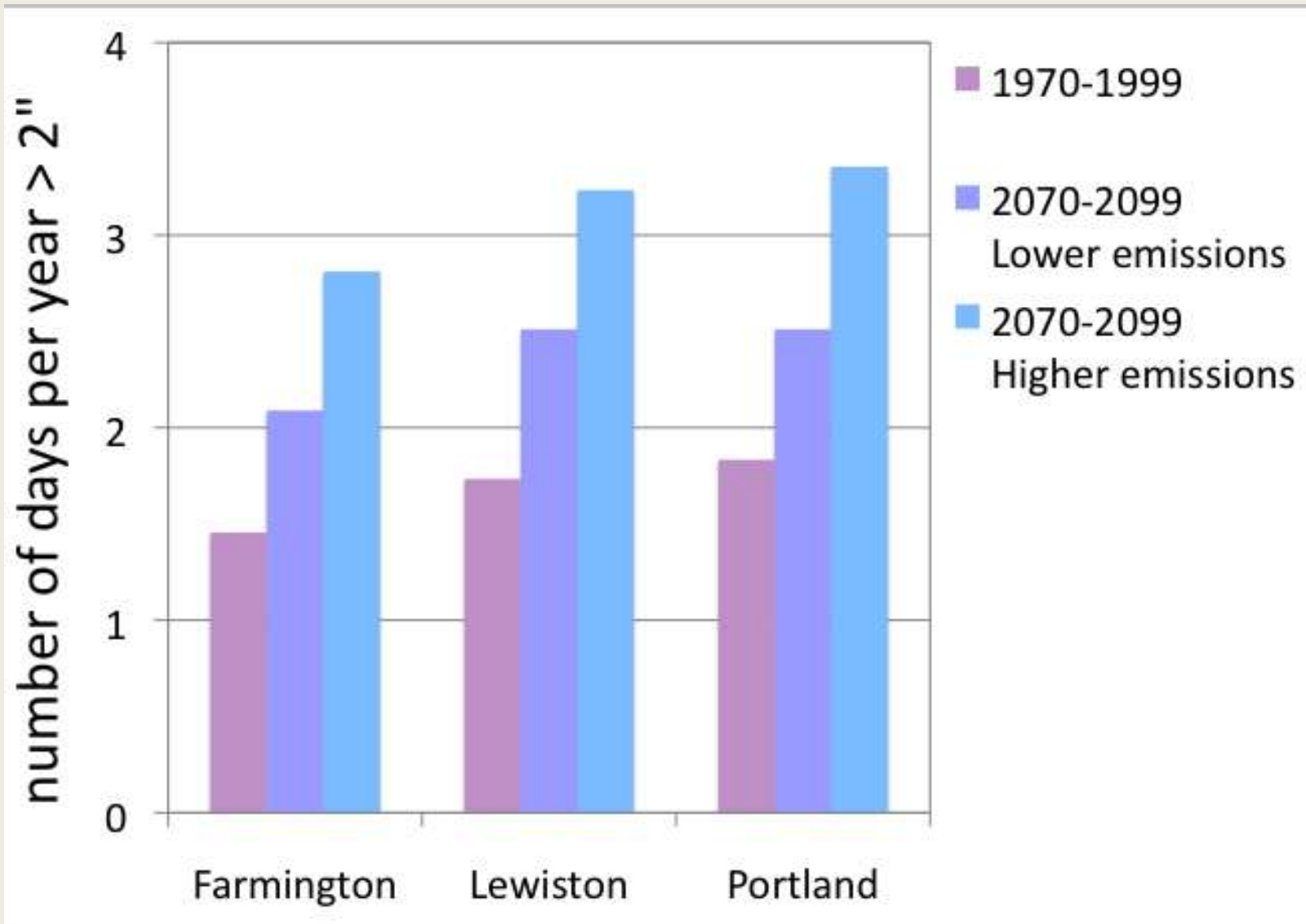
Increase in Precipitation in Winter & Spring Decrease in Summer



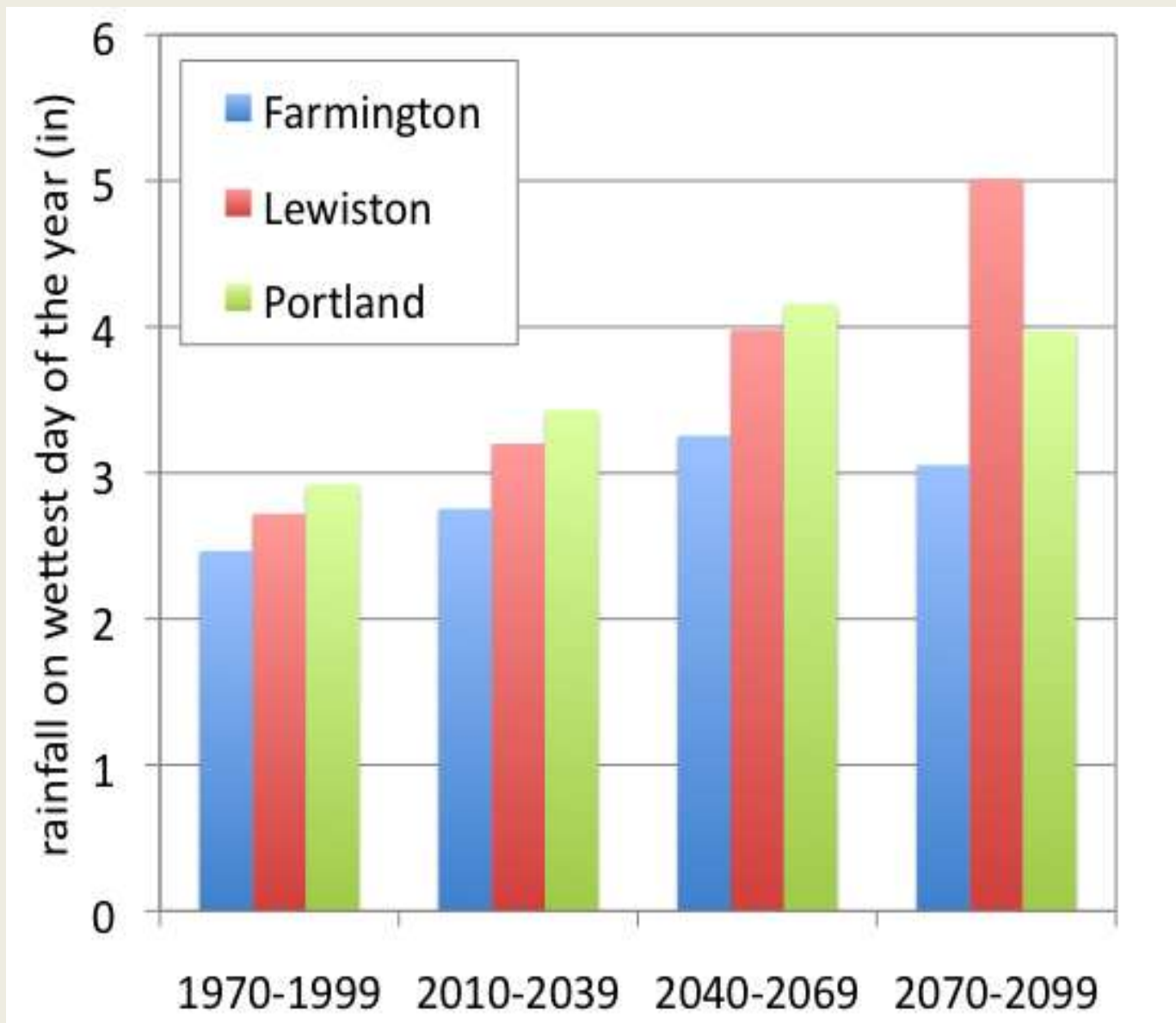
Snow Cover Days



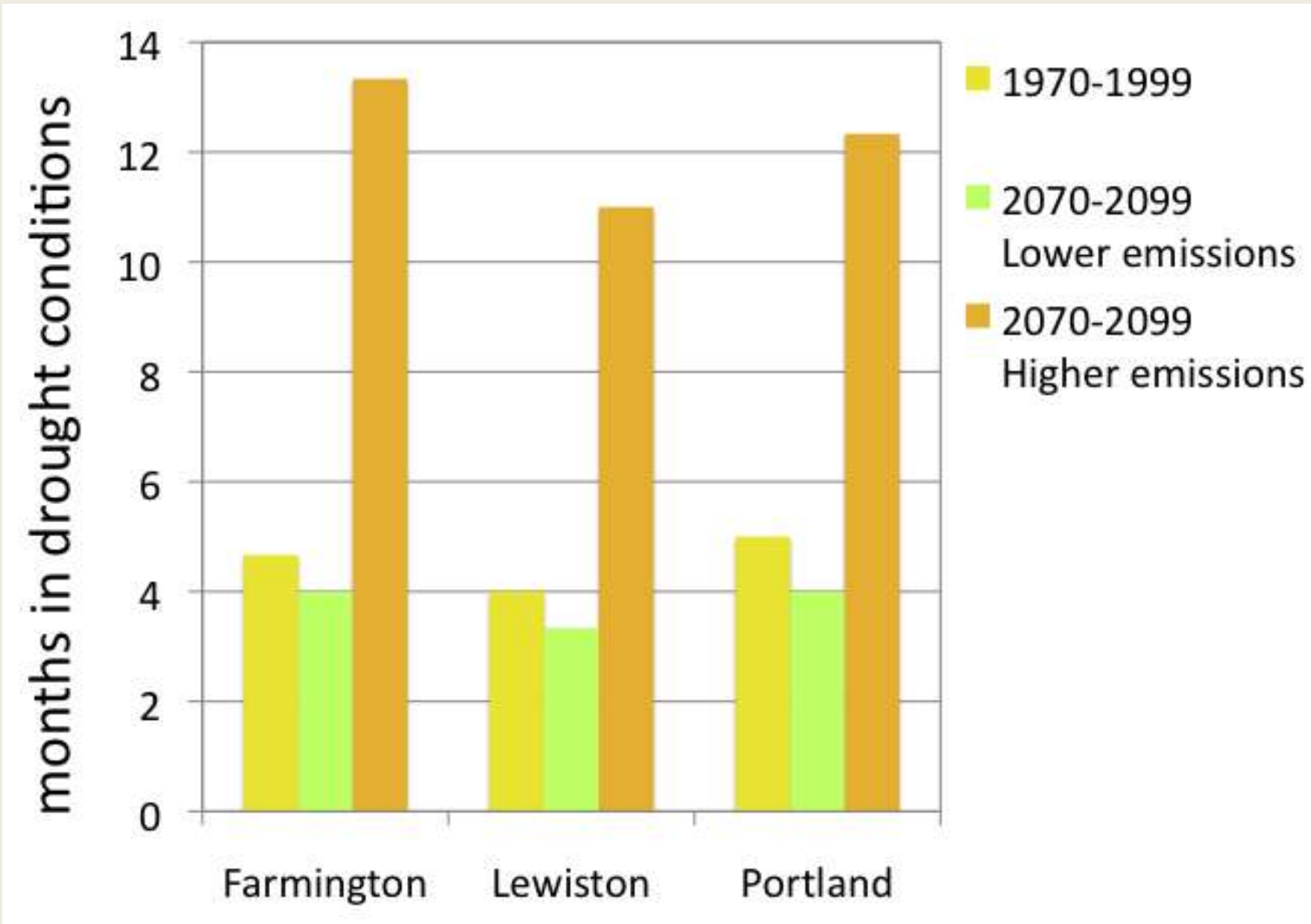
More Extreme Precipitation Events



More Precipitation During Wettest Day of the Year (higher emissions scenario)



Increase in Drought Conditions (20% below average ppt)



Change in Elevation of 100 Year Floods

Table 8
Preliminary Estimates of Future Stillwater Elevations
at the Portland Tide Gauge
Under Lower and Higher Emissions Scenarios
(feet relative to NAVD¹)

Scenario	Lower		Higher	
	2050	2100	2050	2100
FEMA 1998 Stillwater Elevation	8.9	8.9	8.9	8.9
Subsidence	0.024	0.043	0.024	0.043
Dynamic	NE	0.52	NE	0.79
Eustatic	0.66	1.6	1.4	4.6
Total Stillwater Elevation² (ft)	9.5	11.1	10.3	14.3

1 - NAVD: North American Vertical Datum of 1988

2 - Total Stillwater Elevation may not equal total of components due to rounding

NE - not estimated

Stillwater: The maximum coastal storm-induced water-surface elevation, primarily a combination of the normal astronomic tide and a storm surge

100 Year Storm Flooding in Portland Harbor in 2100 Under High Emissions Scenario (5.4 ft SLR)



100 Year Storm Flooding in Portland Harbor in 2100 Under High Emissions Scenario (5.4 ft SLR)

