



The Southern Tier: Extreme Weather, Floods and Climate Change: Perspectives on the Past, Present, and Future

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NOAA's National Weather Service



Why is Climate Change Important?



- Affects where people can live.
- Affects where people can grow food.
- Affects food supply, water supply, energy, and commerce.
- Affects people's vulnerability to storms.



NYC: Today's 100-Year Flood Could Occur Every 10 Years under the Higher-Emissions Scenario

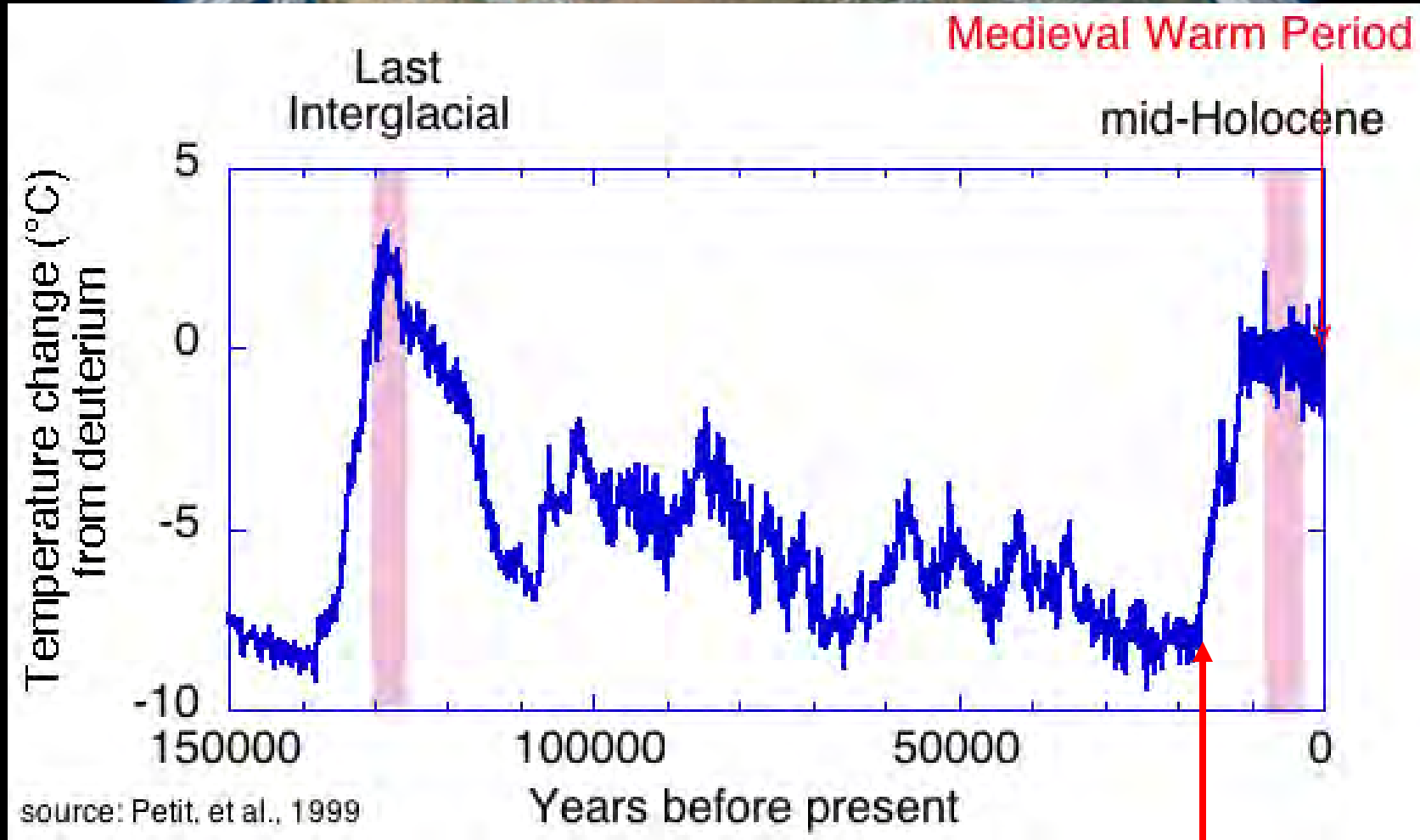


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The Last 150,000 years





18,000 Years Before Present

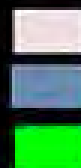
Northern Hemisphere

Modern Day

Ice Coverage
Summer

Legend

- Continental Ice
- Sea Ice
- Land Above Sea Level



[Ice sheet movie](#)

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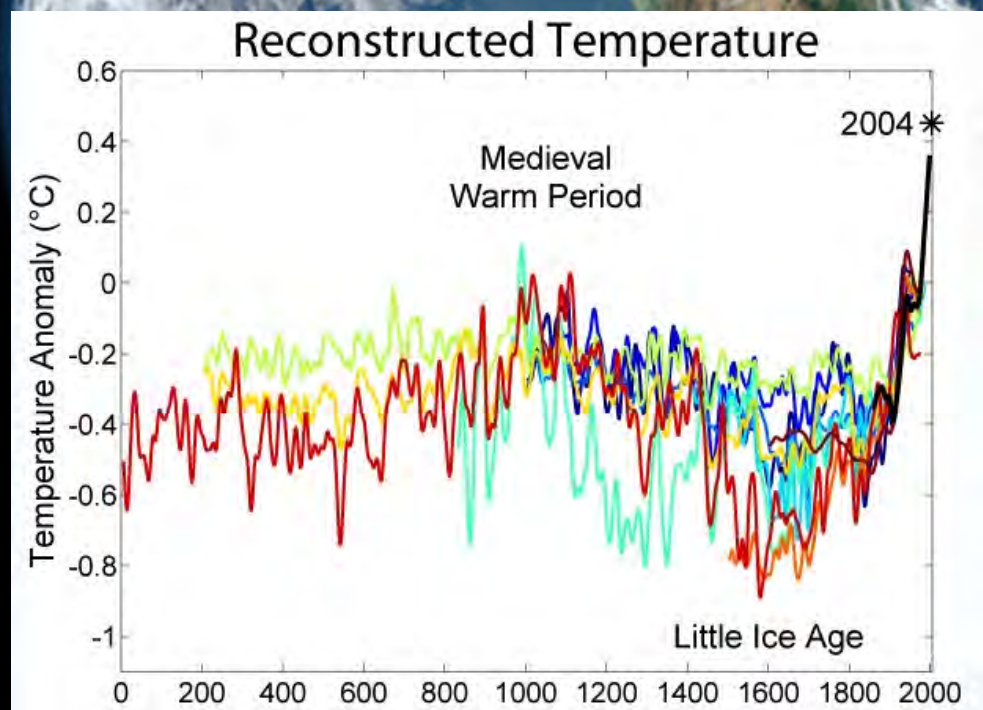
Binghamton, NY Summer 18,000 years ago



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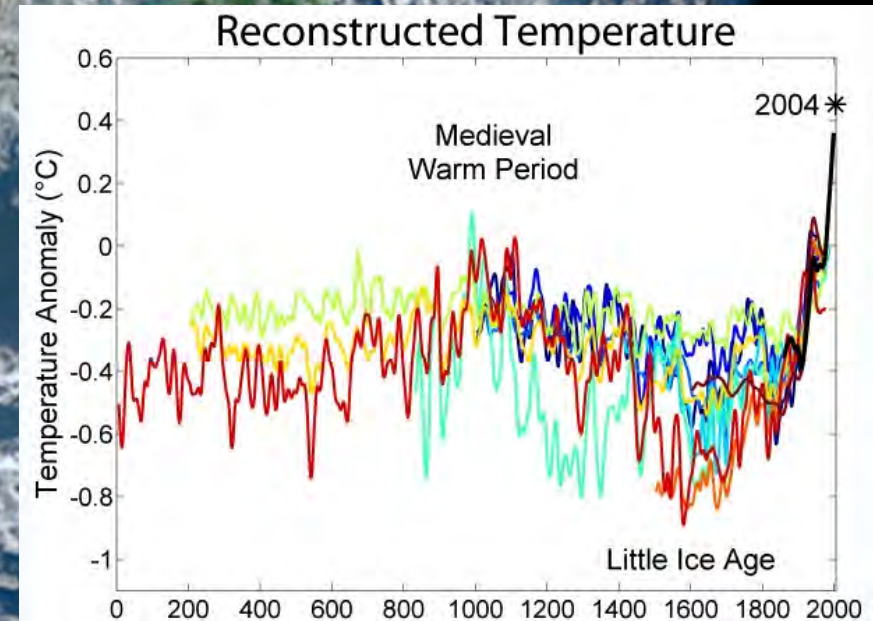
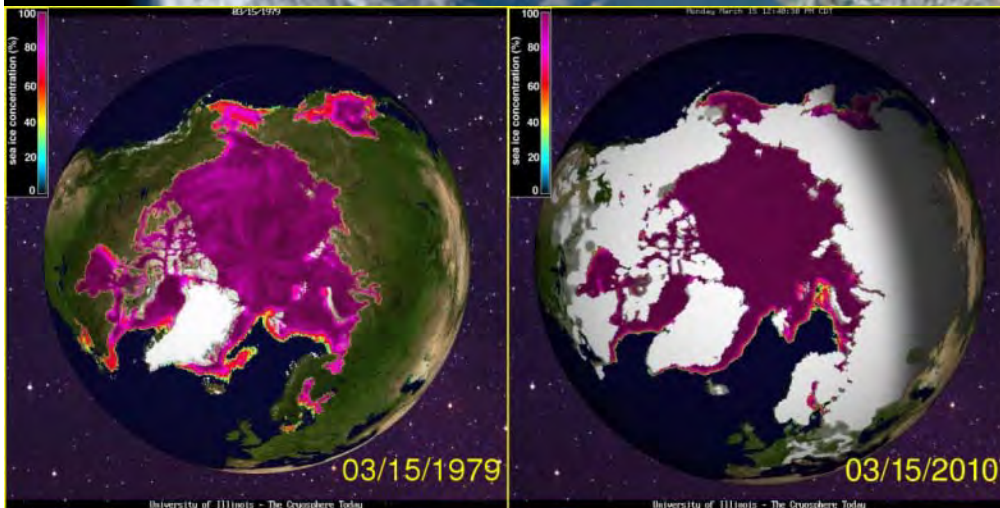
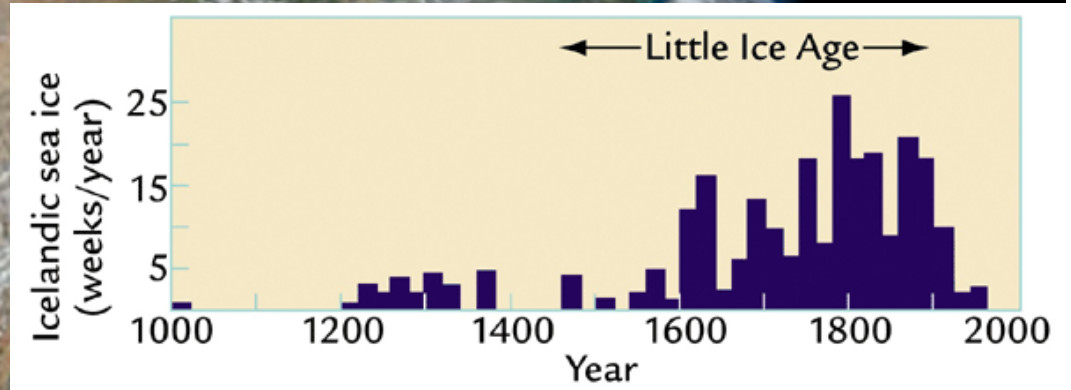


Medieval Warm Period





Little Ice Age

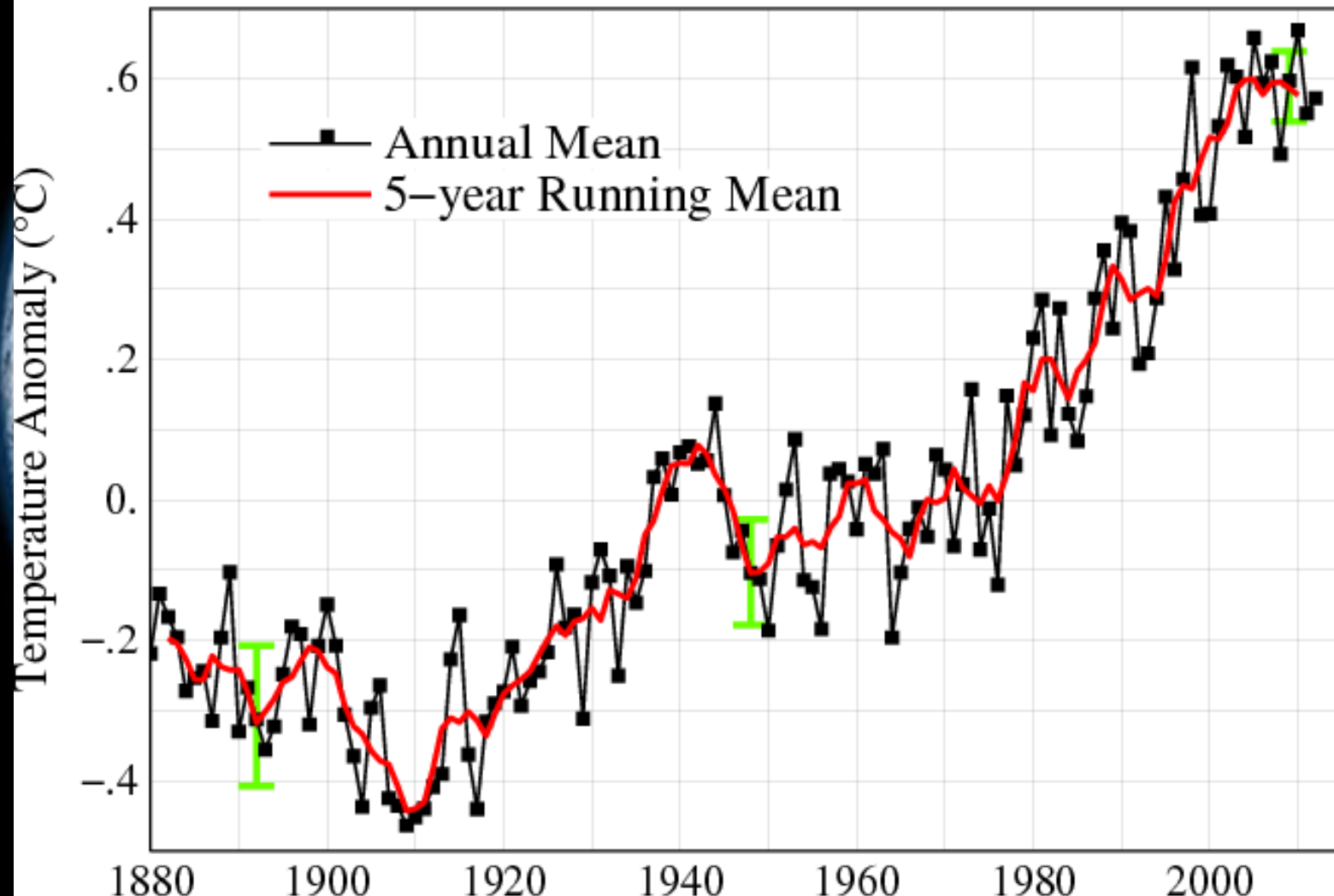




Surface Temperature Record



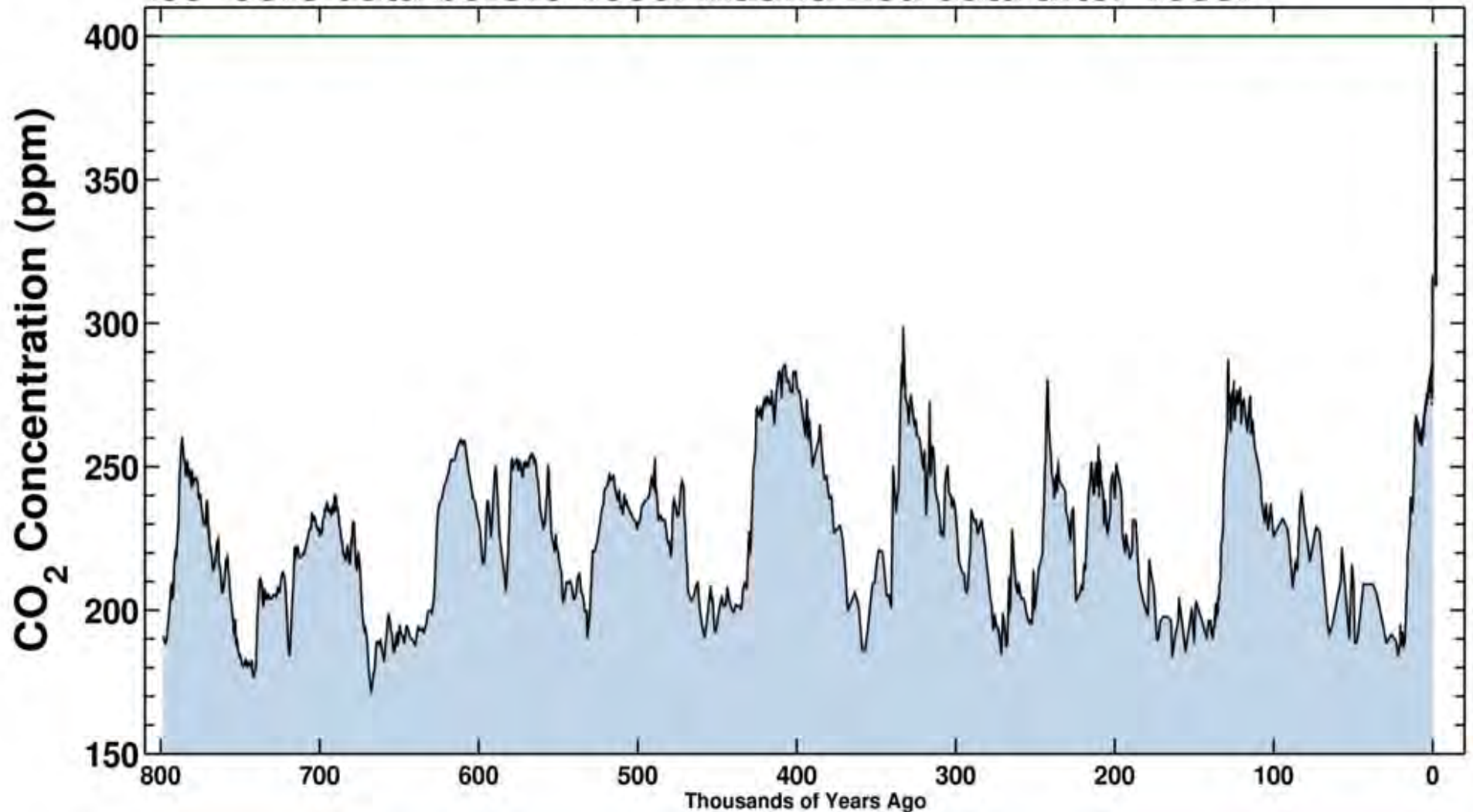
Global Land–Ocean Temperature Index





Greenhouse Gases Are Increasing

Ice-core data before 1958. Mauna Loa data after 1958.





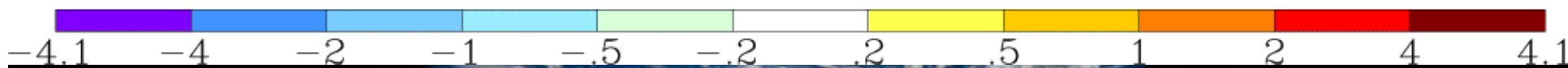
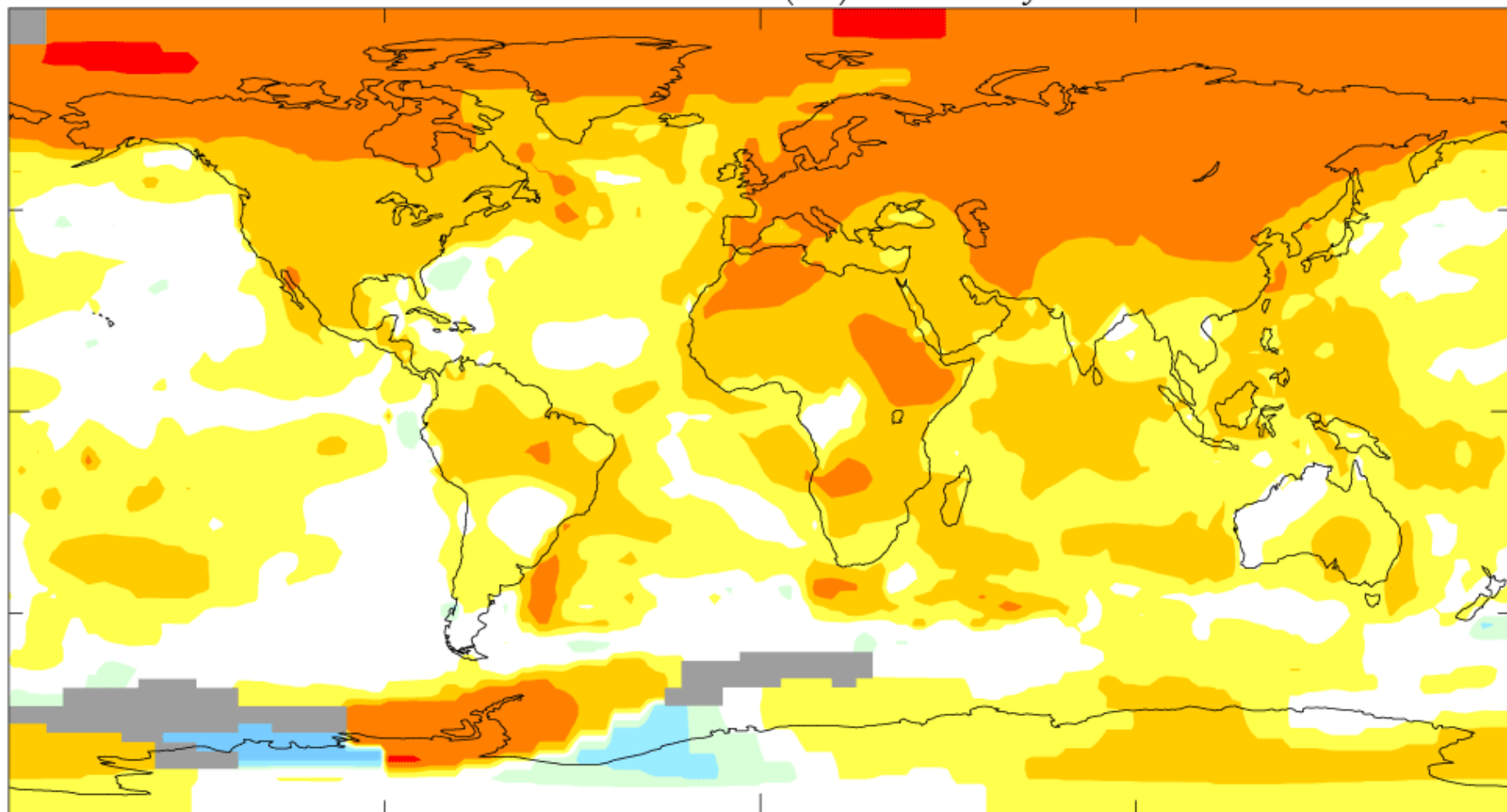
2000-2009 Decade Warmest On Record



Annual J-D 2000-2009

L-OTI(°C) Anomaly vs 1951-1980

.51



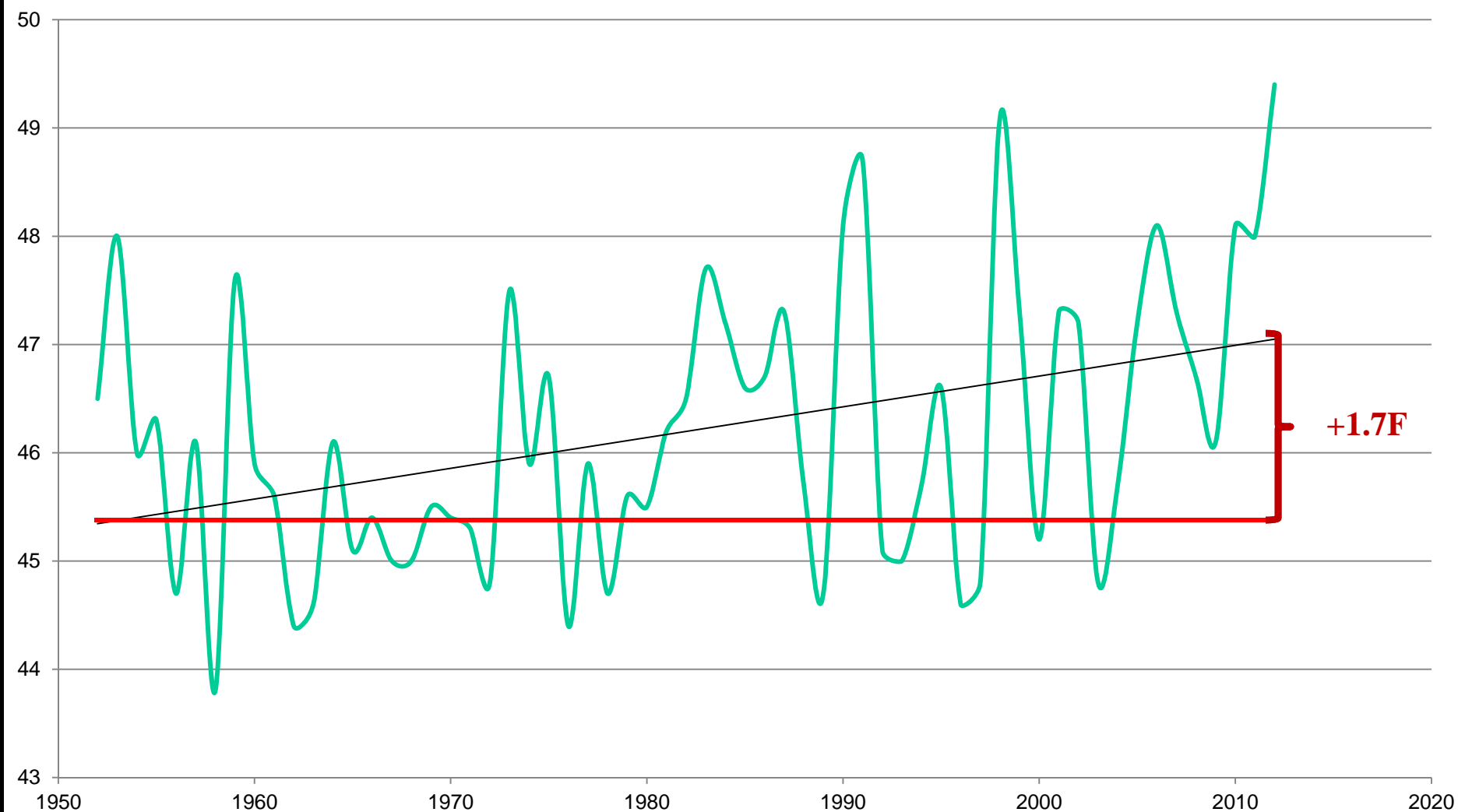
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What about Binghamton's Climate?

Average Annual Temperature (F)

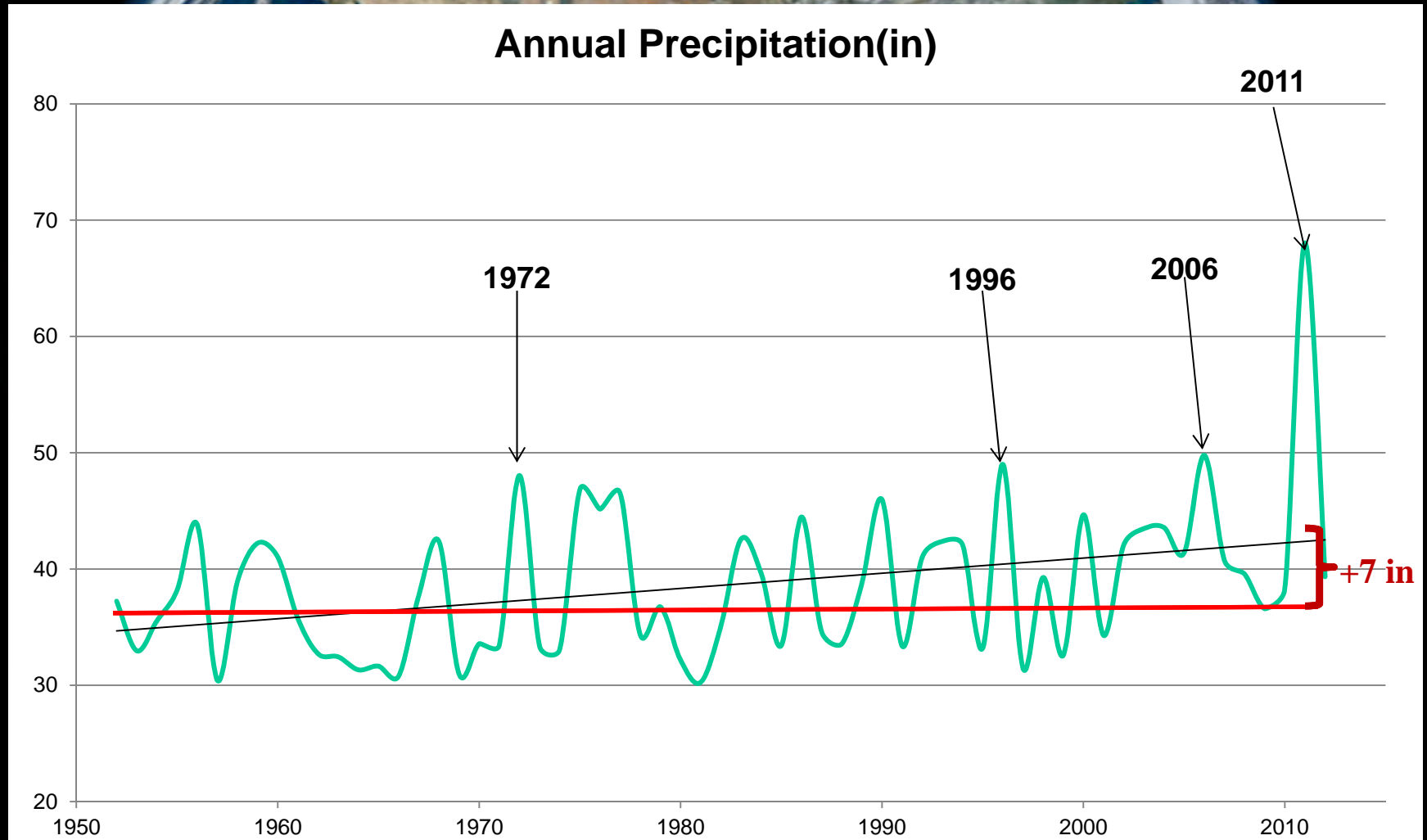
1952-2012



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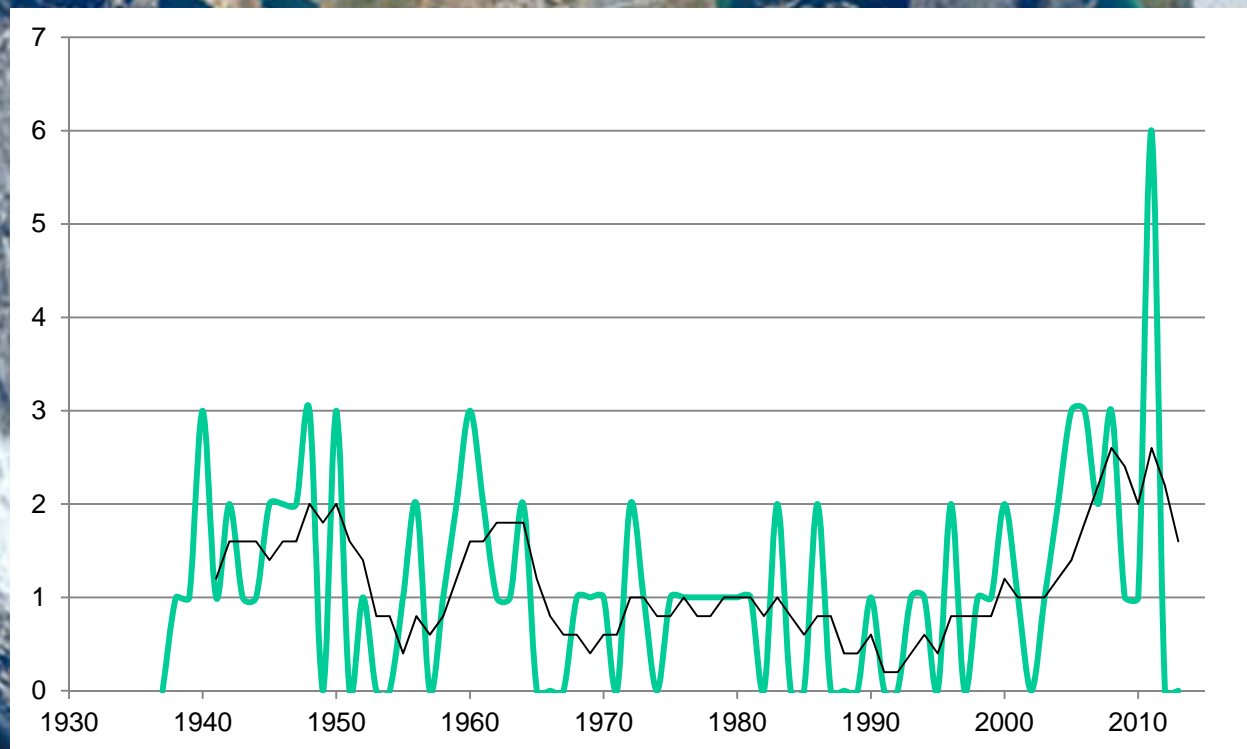
Binghamton NY Annual Rainfall (in)





Flood Frequency- Vestal, NY

Number of Times Flood Stage was exceeded at Vestal, NY 1937-present

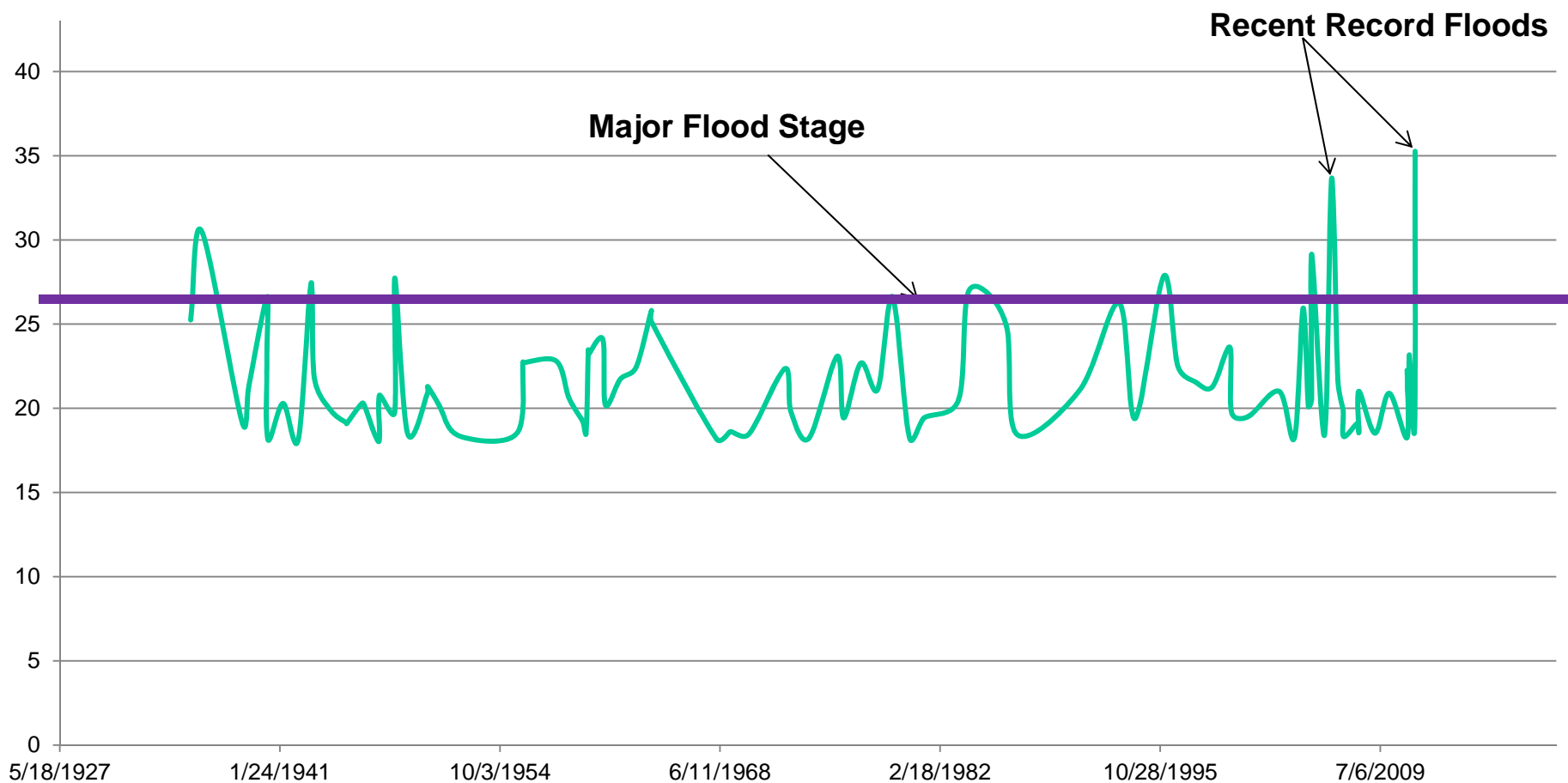




Vestal NY Maximum Stage



Maximum Crest(ft)



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Summary of Changes last 60 years

Warming- most pronounced winter and spring.

Growing season 1 week longer vs. 60 years ago.

Number of sub-zero days down 3 days per year.

Annual minimum temperatures up 4 degrees from -10F to -6F.

No changes in summer heat.

Precipitation up 6 inches which is 17%.

Snowfall has not changed.

Winter snow cover down by 11 days

More flooding??

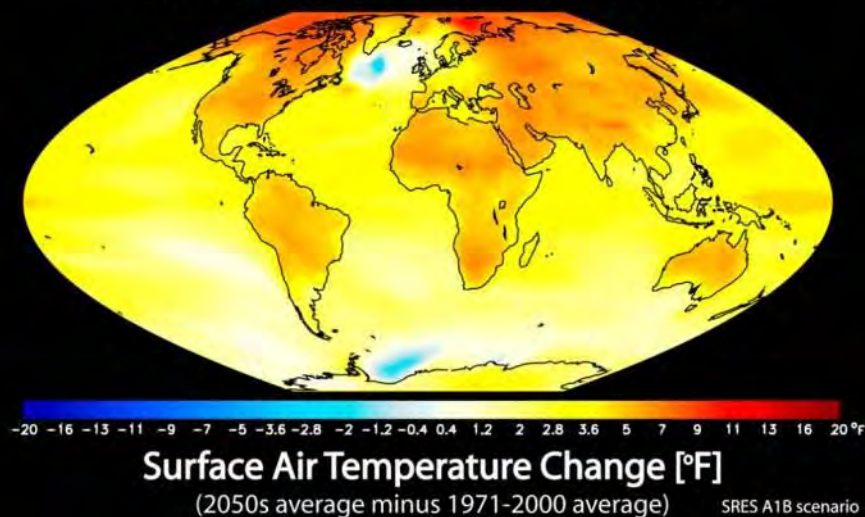
NOAA's National Weather Service



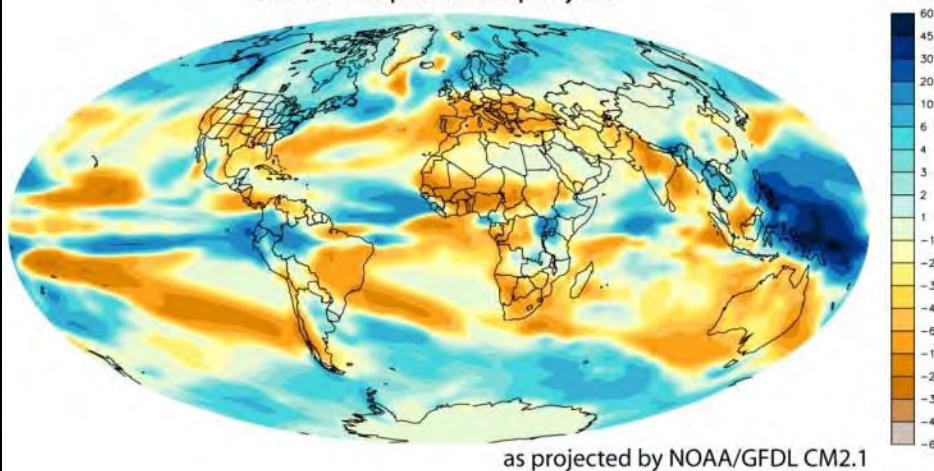
The Future: Climate Forecasts

- *Warmer world*
- *Enhanced hydrologic cycle*
- *Wet get wetter, dry get drier.*

NOAA GFDL CM2.1 Climate Model



CHANGE IN PRECIPITATION BY END OF 21st CENTURY
inches of liquid water per year





Adapting to Climate Change more challenging

- *Climate WILL change no matter what we do.*
- *Forecasts are for a warmer and wetter/drier world due to increasing greenhouse gasses.*
- *7 billion people on Earth now vs. approximately 5 million 10,000 years ago*
 - last time when rapid climate changes were taking place.
- *Society, the human race more vulnerable.*
- *Interdependence between societies very large.*
- *Our area is already very flood prone even without climate change!!!*



History of Flooding in the Susquehanna River Basin

The Susquehanna River Basin is one of the most flood-prone areas in the entire nation.

Major Devastating Floods In The Susquehanna River Basin

(flood records first kept 1810)

1810		1955	HURRICANES CONNIE and DIANE
1865		1964	
1889		1972	HURRICANE AGNES
1894		1975	HURRICANE ELOISE
1935		1996	JANUARY BASINWIDE FLASH FLOOD
1936	ST. PATRICK'S DAY	2004	Hurricane Ivan
1946		2005	April Snowmelt
		2006	June Heavy rain
		2011	Sept Tropical Storm Lee



Facts about the Susquehanna River Basin



Fast response time- 6 days for water to travel from Cooperstown to the Chesapeake Bay!

Shear number of streams creeks: 1000s

Many towns and cities in harm's way:

- Corning
- Elmira
- Athens
- Binghamton/Triple Cities area
- Wyalusing
- Meshoppen
- Scranton
- Wilkes-Barre
- Lock Haven
- Williamsport
- Harrisburg

Responsible for 10 percent of all flood insurance claims in the United States!!!!





Risks of A Tornado

In Northern Oklahoma, center of tornado alley,

- Risk of any tornado
1,585 per year.
- Risk of a deadly tornado (greater than 110 mph)
1 in 1,797 per year.

In Central NY,

- Risk of any tornado
1 in 4,410 per year.
- Risk of a deadly tornado (greater than 110 mph)
1 in 5,610 per year



Flood Risks

In the southern tier of NY,

- The 300 year flood, which was the flood of Sept 2011, has a **1 in 300** chance of occurring each year.
- By definition, the 100 year flood has a **1 in 100** chance of occurring each year!

Risks are about an order of magnitude higher for a major flood than for tornado occurrence, even if we were in tornado alley!!!



Probability of Reaching Major Flood Stage (years)

North Branch Susquehanna

Site	Stream	Major FS	Period Of Record	Years	Floods	1 Year	5 Years	10 Years	15 Years	20 Years
Bainbridge	North Branch Susquehanna River	22	6/29/2009-Present	4.17	1	19%	50%	100%	100%	100%
Binghamton	North Branch Susquehanna River	18	8/12/2010-Present	3.0	1	25%	50%	100%	100%	100%
Chenango Forks	Chenango River	20.3	8/3/1936-Present	77.8	1	1%	6%	13%	19%	25%
Conklin	North Branch Susquehanna River	20	10/4/1913-Present	99.92	4	4%	20%	40%	59%	79%
Cortland	Tioughnoiga River	12.5	10/1/1963-Present	49.92	3	6%	30%	59%	88%	100%
Owego	North Branch Susquehanna River	33	9/1/1998-Present	15.0	2	12%	50%	100%	100%	100%
Rockdale	Unadilla River	13	1/29/1937-Present	76.58	2	3%	13%	26%	39%	52%
Sherburne	Chenango River	10.6	6/29/2009-Present	4.17	2	39%	50%	100%	100%	100%
Unadilla	North Branch Susquehanna River	14.5	7/1/1938-Present	75.17	3	4%	20%	39%	59%	79%
Vestal	North Branch Susquehanna River	27	3/3/1937-Present	76.50	7	9%	45%	90%	100%	100%
Waverly	North Branch Susquehanna River	21.4	2/1/1937-Present	76.58	3	4%	20%	39%	58%	77%
Windsor	North Branch Susquehanna River	20.5	5/1/2009-Present	4.33	1	19%	50%	100%	100%	100%



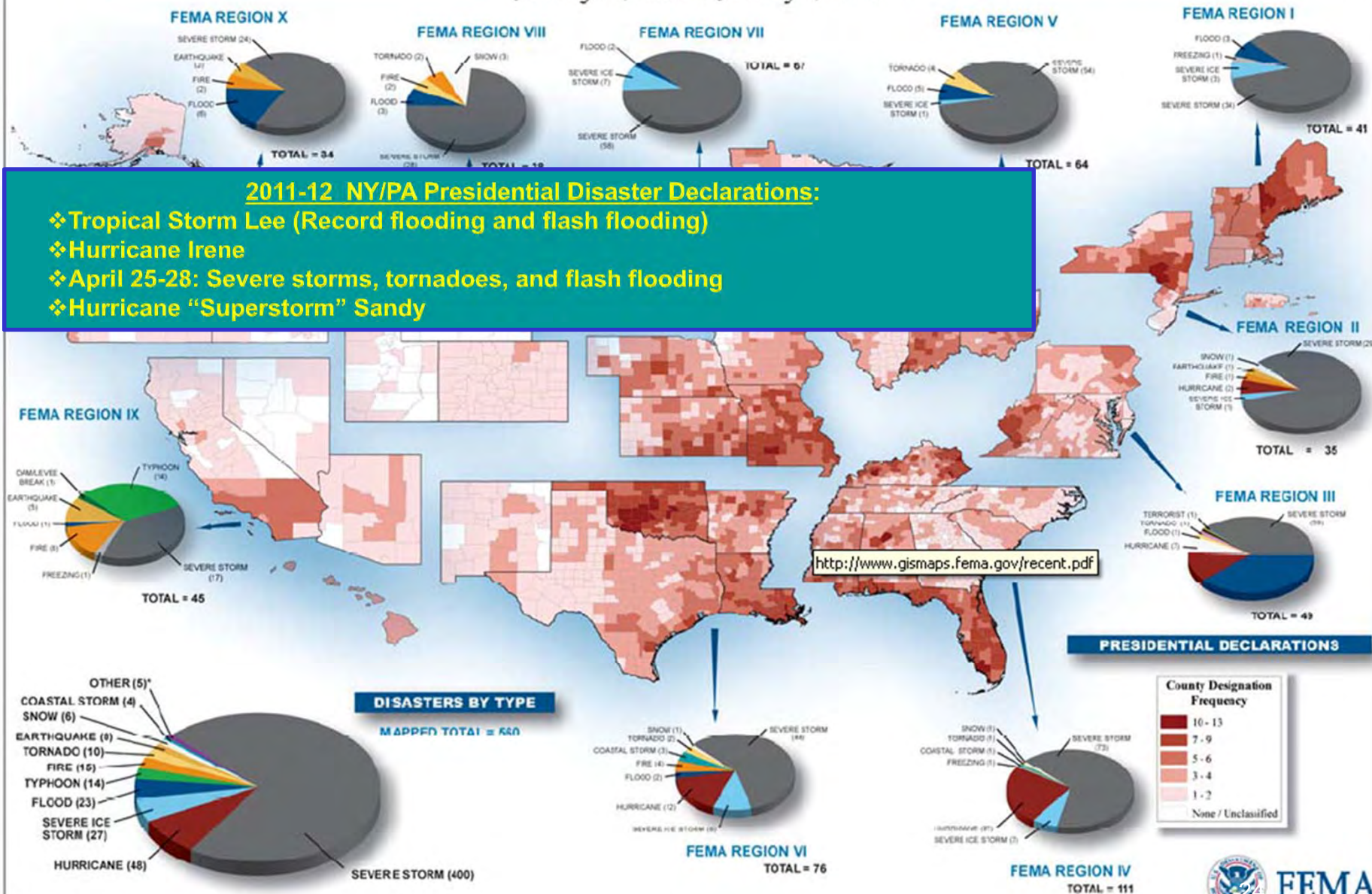
EXTREME WEATHER



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PRESIDENTIAL DISASTER DECLARATIONS

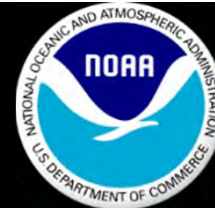
January 10, 2000 to January 1, 2010



* Other Includes Dam/Levee Break, Freezing, and Terrorist.



2011: A Year of Extremes



14 Weather and Climate Billion Dollar Disasters





2012 Severe Weather and Climate Events

Preliminary Significant U.S. Weather and Climate Events for 2012

SNOW PACK

3rd smallest winter snow cover extent. Below-average snowpack was observed for much of the West.

WARM

Warmest year on record for the nation. 19 states record warm. The 4th warmest winter, warmest spring, and second warmest summer contributed to 2012 having an average temperature 3.2°F above average and 1.0°F above the previous record warm year of 1996.

WILDFIRES

Over 9.2 million acres burned nationwide during 2012. CO experienced its most costly fire on record in June. The Whitewater-Baldy fire was the largest on record for NM.

DROUGHT

The 2012 drought peaked in July with over 60% (POSS) of the nation experiencing drought conditions, comparable to the drought episodes of the 1950s. Corn and soybean crops failed across a large portion of the Great Plains and Midwest. Water levels along the Mississippi approached record lows and slowed commercial shipping.

COLD

Coldest January on record in AK. The monthly average temperature in Bettles was -35.6°F. Brinnest winter in Anchorage with 34.5 inches.

FLOOD

Storms caused record flooding in and around Duluth, MN on June 20th with over 8 inches of rainfall observed in 24 hours. Rivers in the area reached their highest levels on record.

TORNADOES

An early season tornado outbreak on March 2-3 in IN, OH, WV, and KY resulted in 42 fatalities. This was the deadliest tornado outbreak of 2012.

HURRICANE ISAAC

Made landfall near the mouth of the Mississippi River in late August with winds of 80 mph. Significant storm surge and flooding rains along the Gulf Coast. 9 fatalities.

POST-TROPICAL CYCLONE SANDY

Made landfall near Atlantic City, NJ with sustained winds of 80 mph in late October. Record storm surge along NJ and NY coasts along with heavy rain and snow. Over 8 million people lost power. 131 fatalities.

STORMS

A straight-line wind storm called a derecho caused significant damage from IN to MD. Over 250,000 customers lost power, including the densely populated Washington, D.C. area.

WET

Florida had its wettest summer on record, partially due to Hurricane Isaac and Tropical Storm Debby. Seasonal precipitation was 140 percent of average.

STORMS

On March 8th a storm system brought severe weather to HI. A rare tornado hit Oahu. Largest hailstone on record for the state in Oahu.



NOAA's
National Climatic Data Center



Sandy



63 billion dollars in damages in U.S.

131 dead in the U.S

53 in NY state alone.



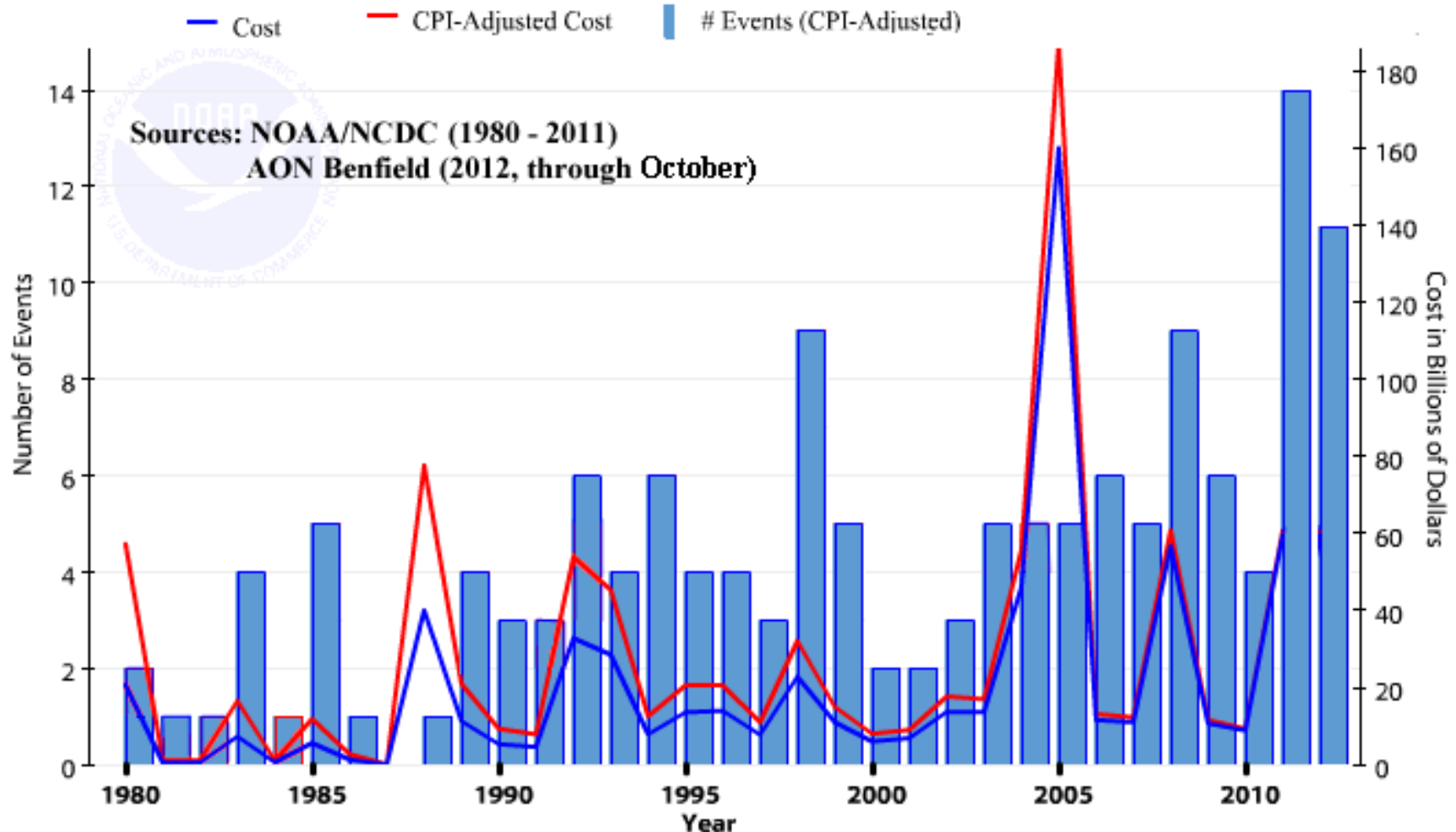
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U.S. Natural Disaster Trends

Increased Vulnerability to Extreme Events

Billion-Dollar U.S. Weather Disasters, 1980 - 2012

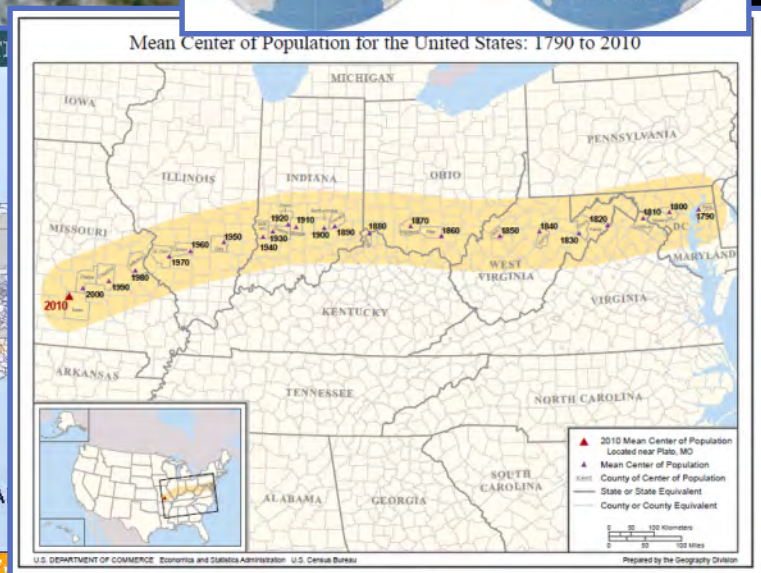
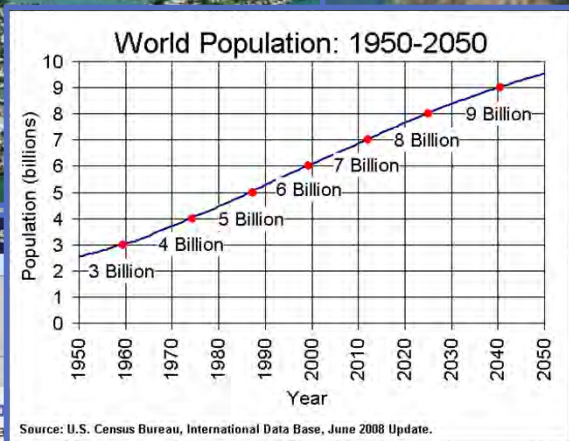
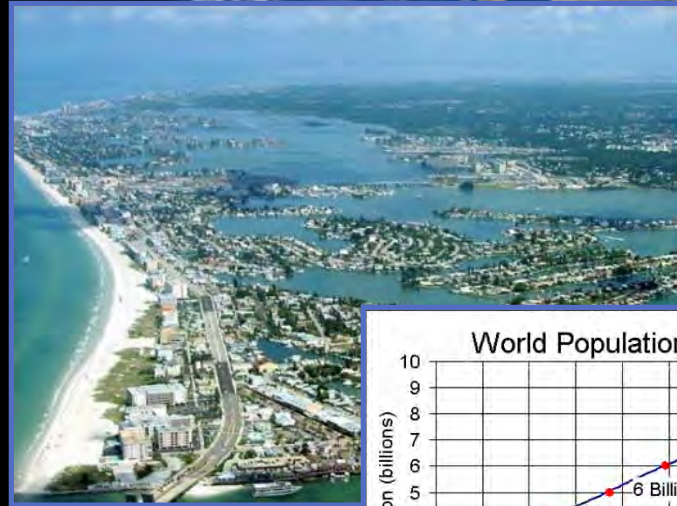


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Why is Society Increasingly Vulnerable?

Population Shifts, Technological Dependence





Weather Ready Nation

Lessons Learned



A Weather-Ready Nation is about learning from both success stories and failures of the past to build a vision and strategic plan to help our citizens and country prosper...to protect life and property from hazardous weather in the future.

It moves beyond weather forecasting to engage our partners and social scientists in the process

Endicott, NY: Flash flooding Sept. 7, 2011



National Guard assist Binghamton: Sept 2011



Passing out bottled water: Sept 2011



Binghamton University Event Center: Sept 2011





NWS's Operational Response

A Vision for Society and for NWS

Our Vision: A Weather-Ready Nation

- Society is Prepared for and Responds to Weather-Dependent Events (NWS Strategic Plan)

Impact-Based Decision Support:

- NWS Adapts Quickly to Improve Society's Weather-Dependent Decisions

Weather Ready Nation

Requires response from NWS and Society

Requires NWS to work hand-in-hand with our partners – Media, Emergency Management, DOT, USGS, and others



Weather-Ready Nation

National Oceanic and Atmospheric Administration



<http://weather.gov/com/weatherreadynation/>

Google “WeatherReady”

NOAA's National Weather Service



Thanks!!



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