



# Weather Gone Wild: Is Climate Change To Blame?

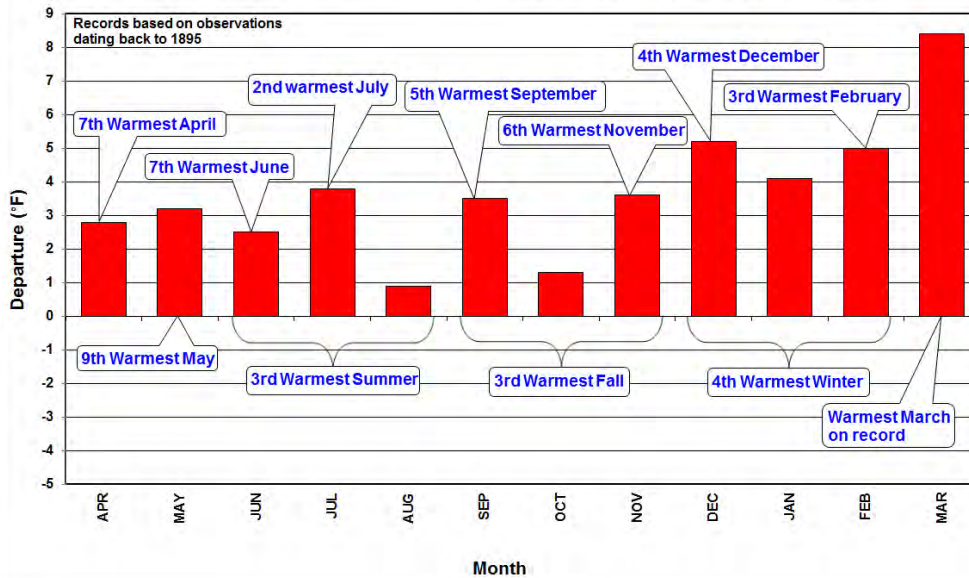
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Morristown, NJ  
April 10, 2012

## Climate Observations

### NJ Monthly Temperature Departures (April 2011 - March 2012)

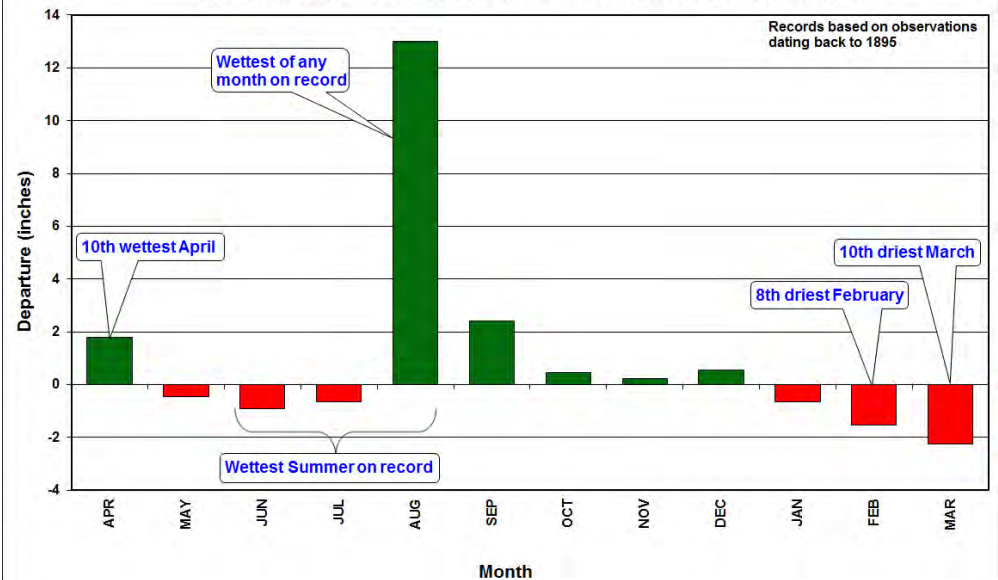
Departures calculated from differences between observed monthly temperatures and 1981-2010 monthly averages



Past 12 months of NJ's climate

### NJ Monthly Precipitation Departures (April 2011 - March 2012)

Departures calculated from differences between observed monthly precipitation and 1981-2010 monthly averages



## 2011 NJ Top 10 Weather/Climate Events

- 1) Wettest year for NJ (wettest station over a calendar year)
- 2) Tropical Storm Irene: August 27-28 (3rd wettest rainstorm, record flooding)
- 3) Wettest month on record for NJ: August (wettest two consecutive months: Aug-Sep)
- 4) Early-season snowstorm: October 29-30
- 5) Third warmest year for NJ (11 months above average; seven in the top ten for their month)
- 6) Second hottest month on record: July (including top ten hottest day: July 22)
- 7) Snowstorm: January 26-27
- 8) Snowiest January on record for NJ
- 9) Back-to-back rain storms March 6-7, 10-11 (major flooding)
- 10) Ice storm: February 1-2



Passaic  
Basin

March  
2011



## Climate Change 101: The Basics

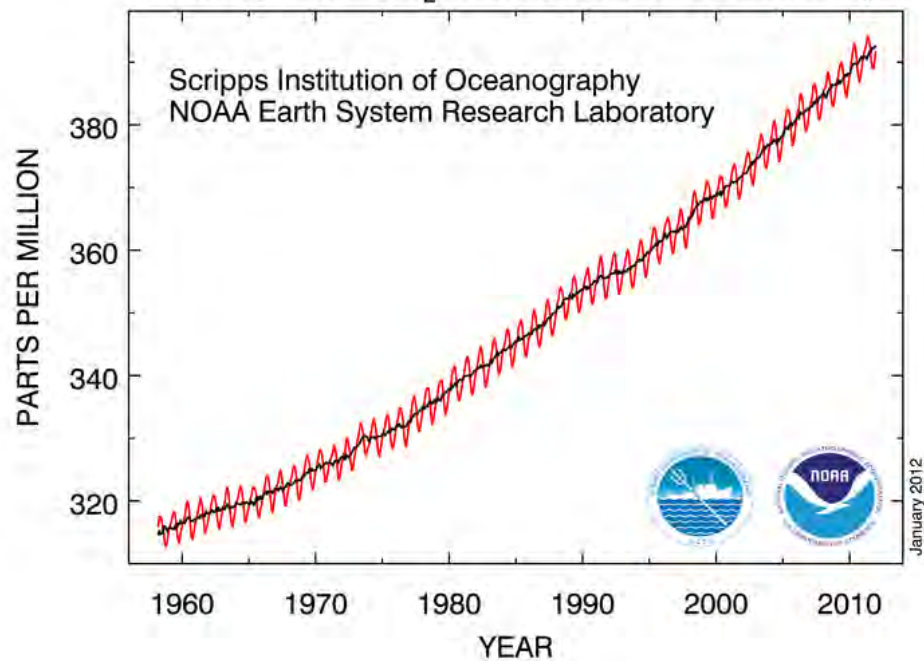
- Combustion of fossil fuels (coal, petroleum, natural gas) emits carbon dioxide into the atmosphere (currently about 9 billion tons of carbon per year)
- Roughly half of the carbon dioxide remains in the atmosphere; most of the remainder goes into the ocean (causing ocean acidification)
- Increasing carbon dioxide heats the earth; global temperatures have risen by 1-1.5°F during the past century.
- Increasing temperatures also cause other changes in climate and sea level.

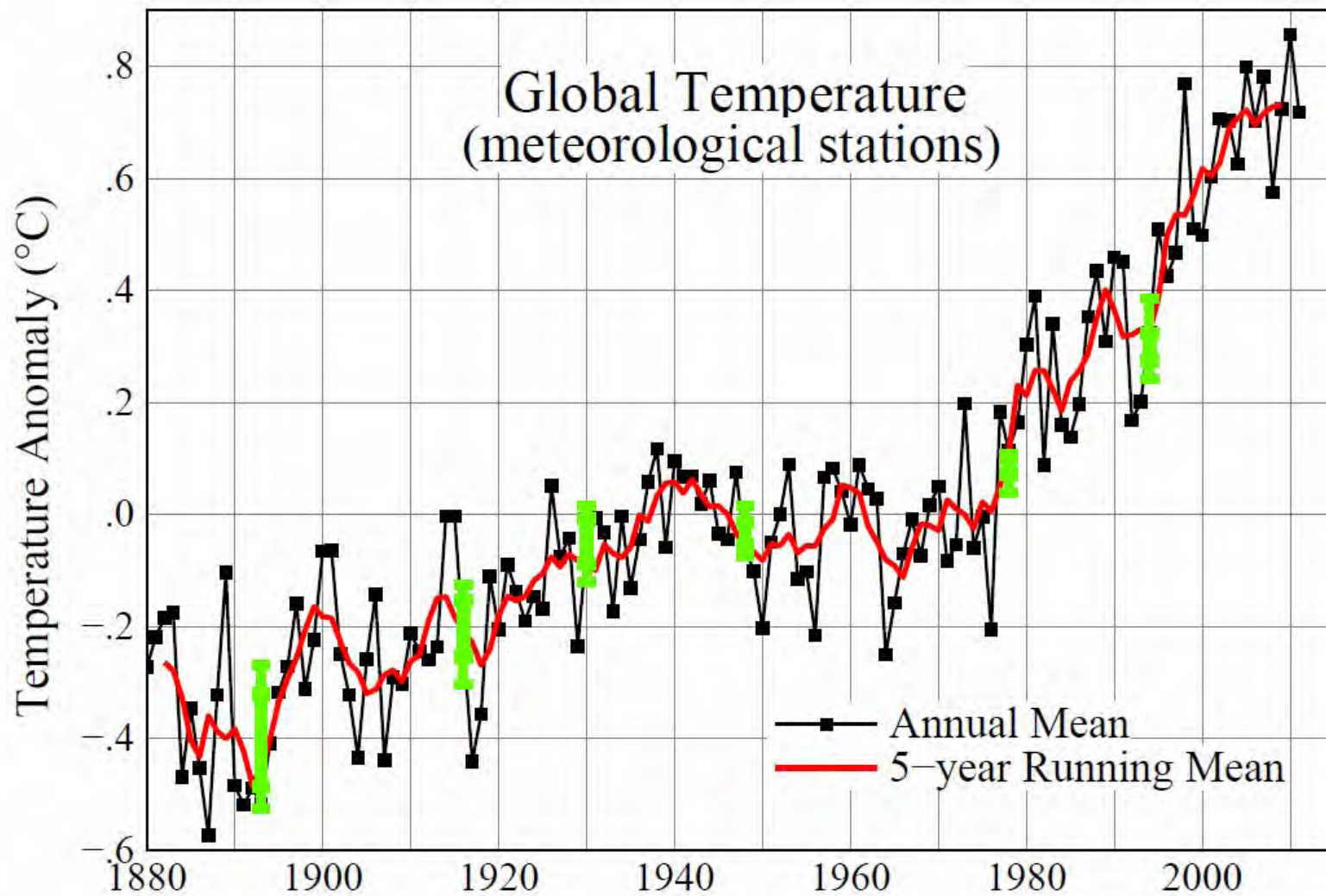
## Basic physics of CO<sub>2</sub> and climate

- If an object receives energy in the form of visible light, as the earth does from the sun, it warms up.
- The warmer an object is, the more energy it emits in the form of infrared light. This is the earth's cooling mechanism that balances the heating from the sun's visible light.
- CO<sub>2</sub> and water vapor are "greenhouse gases" that absorb infrared light, making it more difficult for energy to escape into space.
- Without greenhouse gases the earth would be much colder (i.e., its average temperature would be well below freezing).



Atmospheric CO<sub>2</sub> at Mauna Loa Observatory

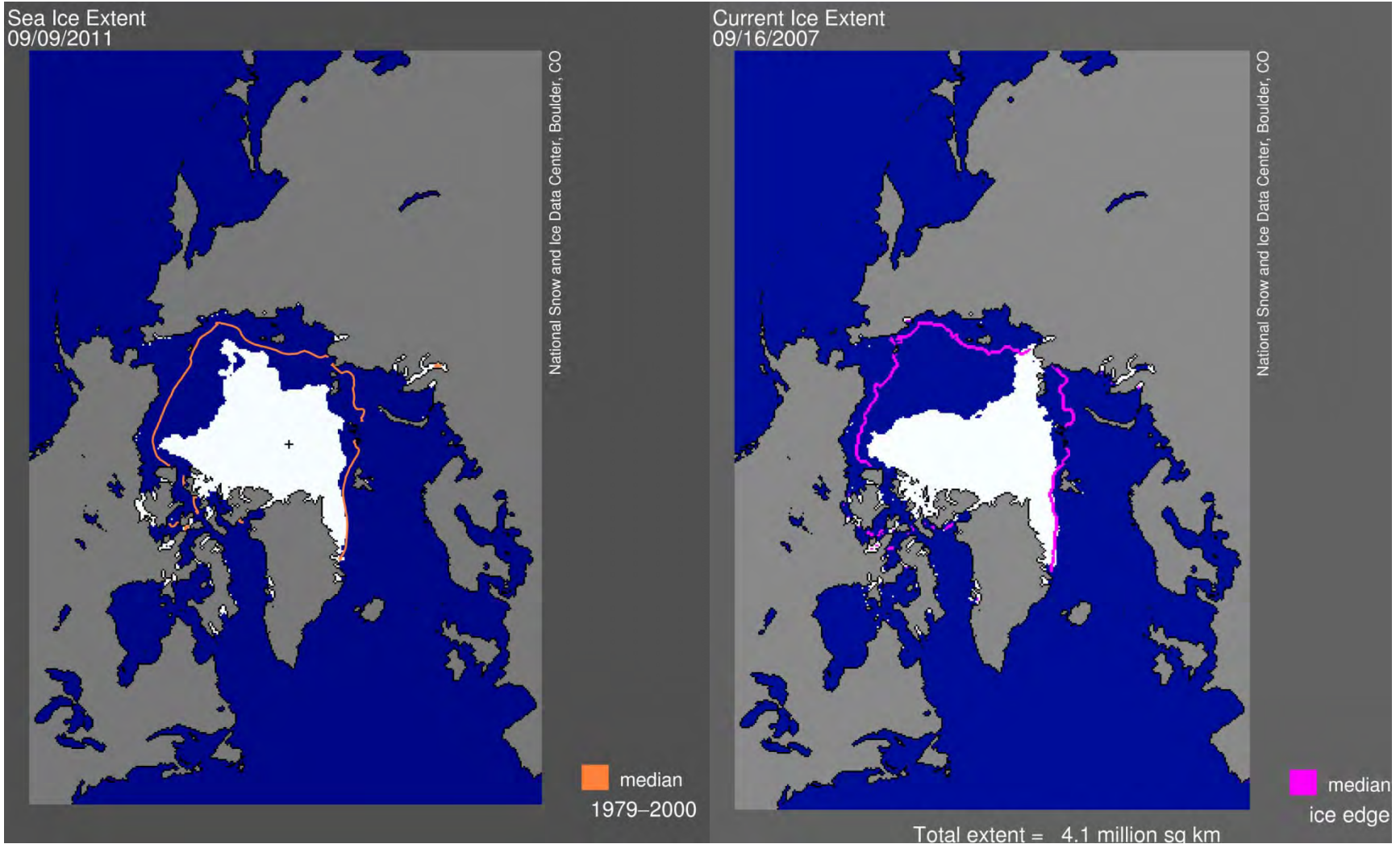




Source: NASA/Goddard Institute for Space Studies

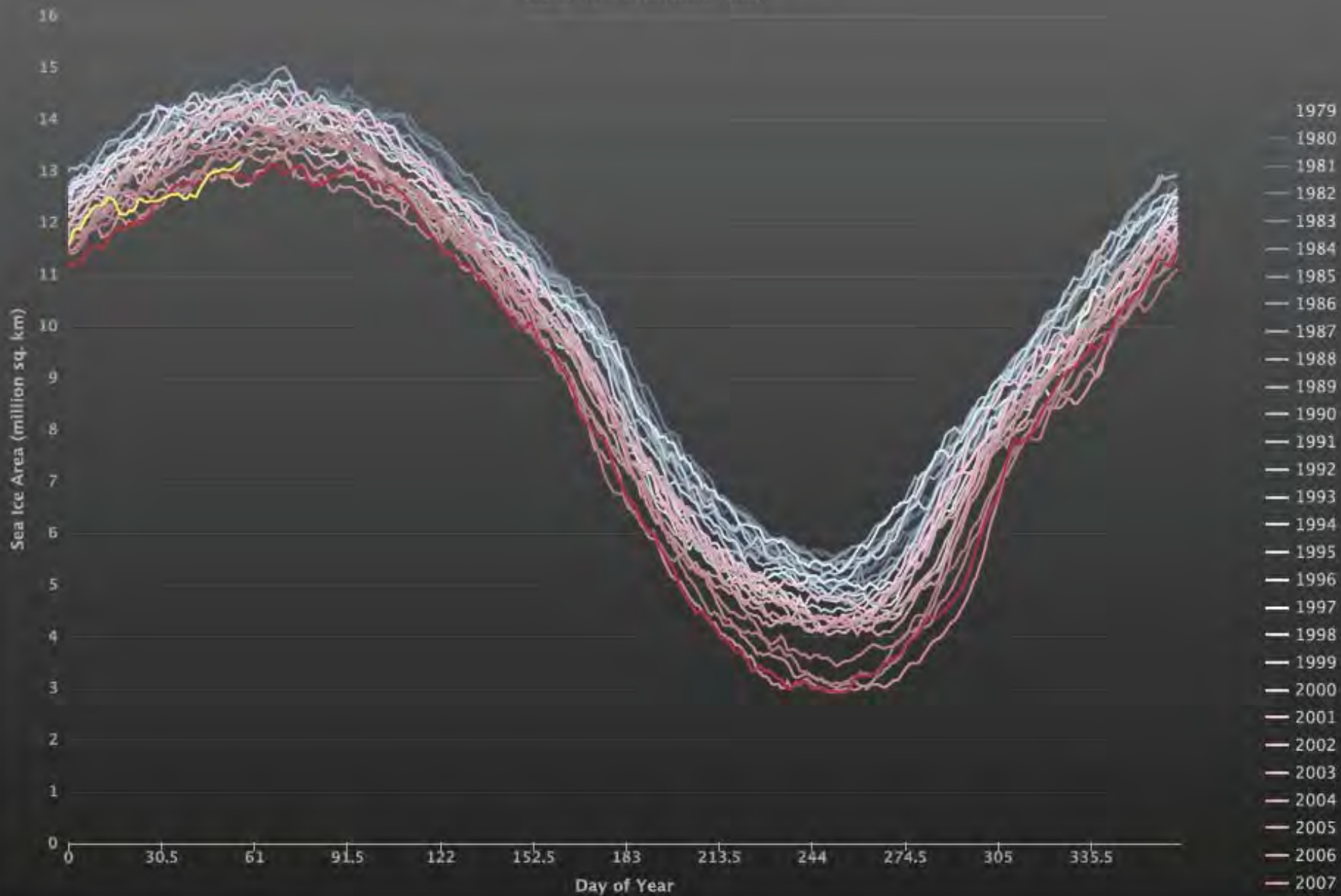


## Near-Record Low Arctic Sea Ice

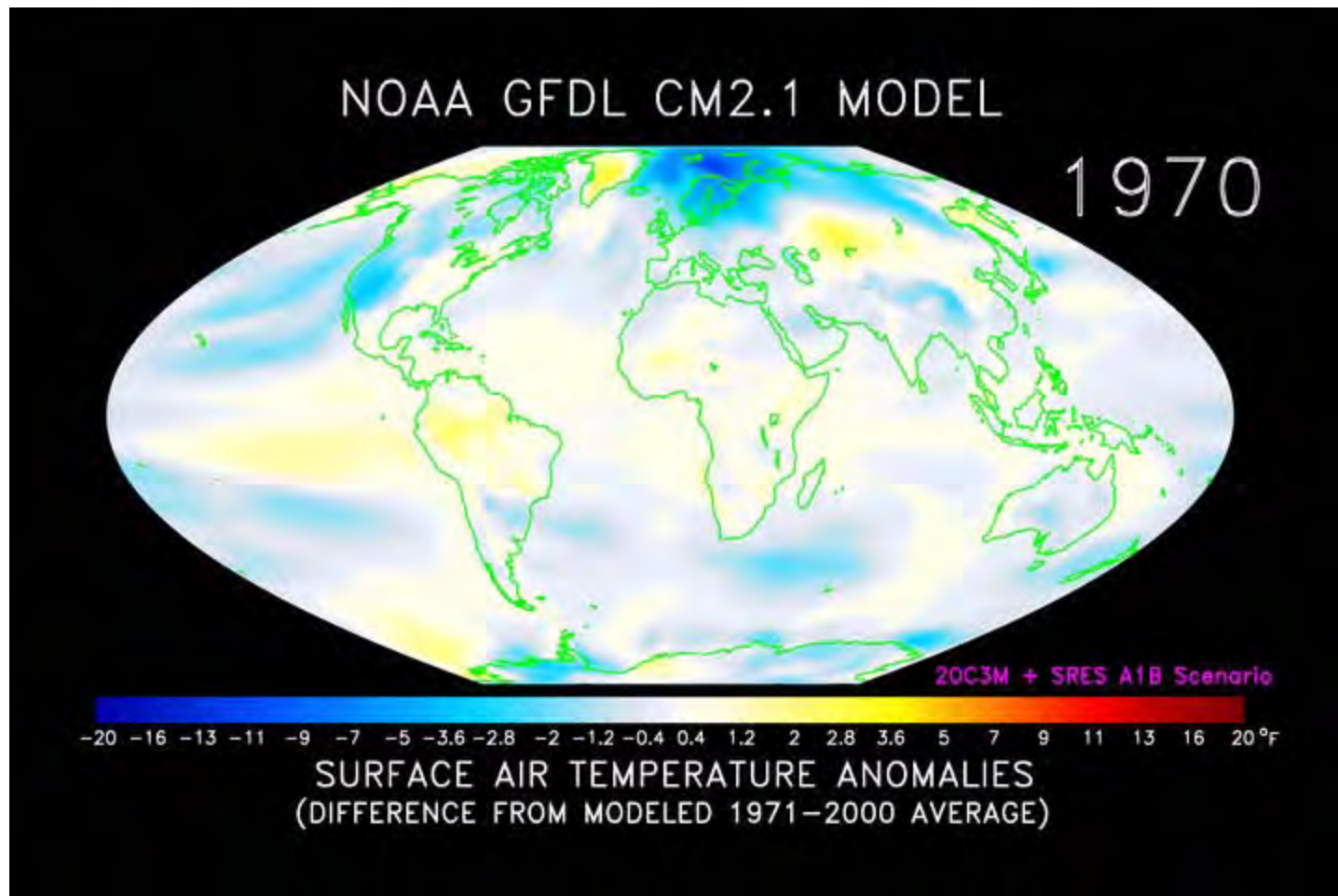


## Northern Hemisphere Sea Ice Area

Source: The Cryosphere Today



# Simulating Future Climate Change

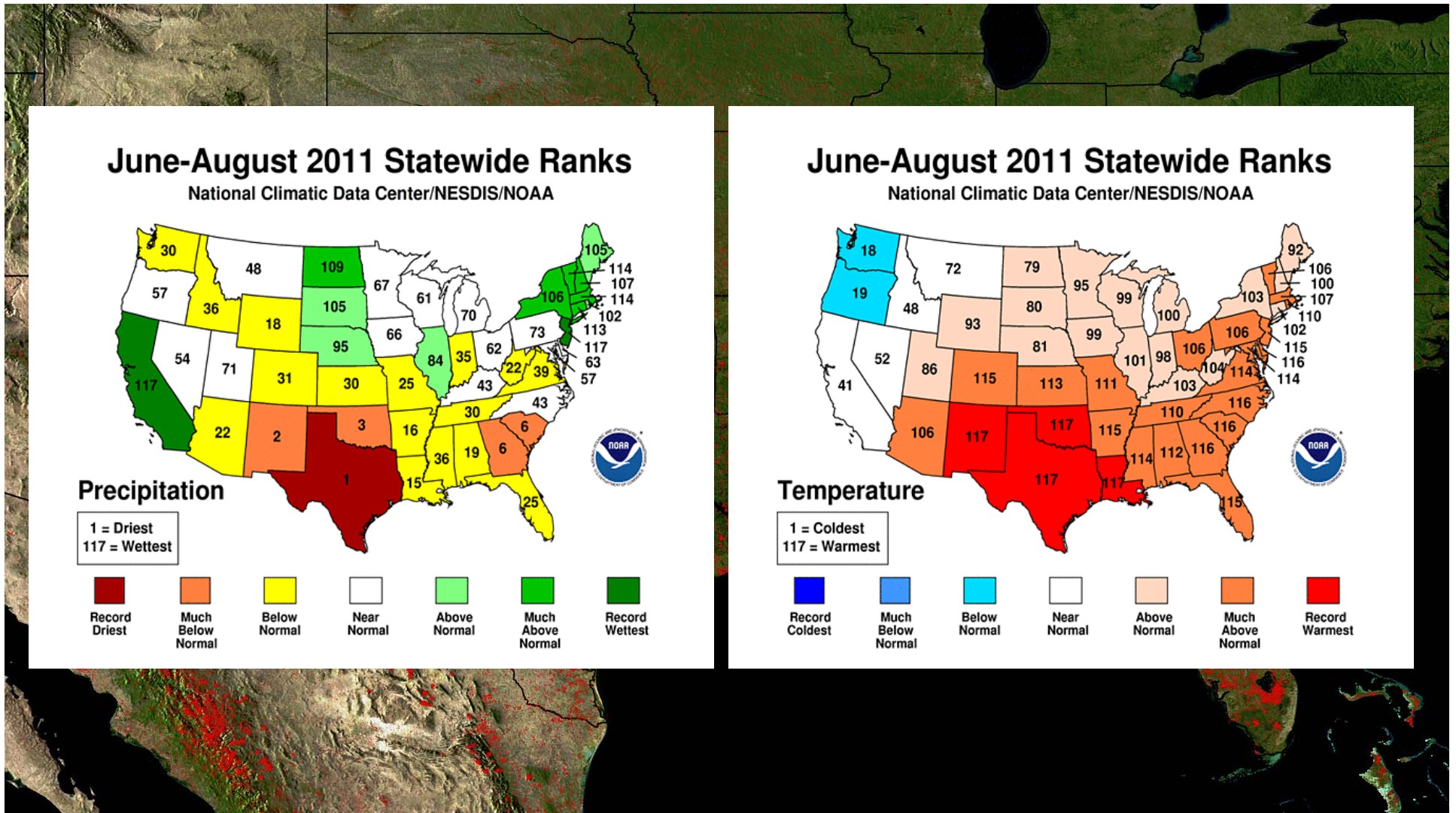


Source: NOAA Geophysical Fluid Dynamics Laboratory



The IPCC Special Report on Managing the Risks  
of Extreme Events and Disasters to Advance  
Climate Change Adaptation

# Southern Drought and Wildfires



## Heat and Drought

- Observations since 1950 show changes in some extreme events, particularly daily temperature extremes, and heat waves.
- It is virtually certain that increases in the frequency of warm daily temperature extremes will occur throughout the 21st century on a global scale. It is very likely—90-100% probability—that heat waves will increase in length, frequency, and/or intensity over most land areas.
- There is evidence, providing a basis for medium confidence, that droughts will intensify over the coming century in southern Europe and the Mediterranean region, central Europe, central North America, Central America and Mexico, northeast Brazil, and southern Africa.

## Historic Tornado Outbreaks



TwisterChasers.com



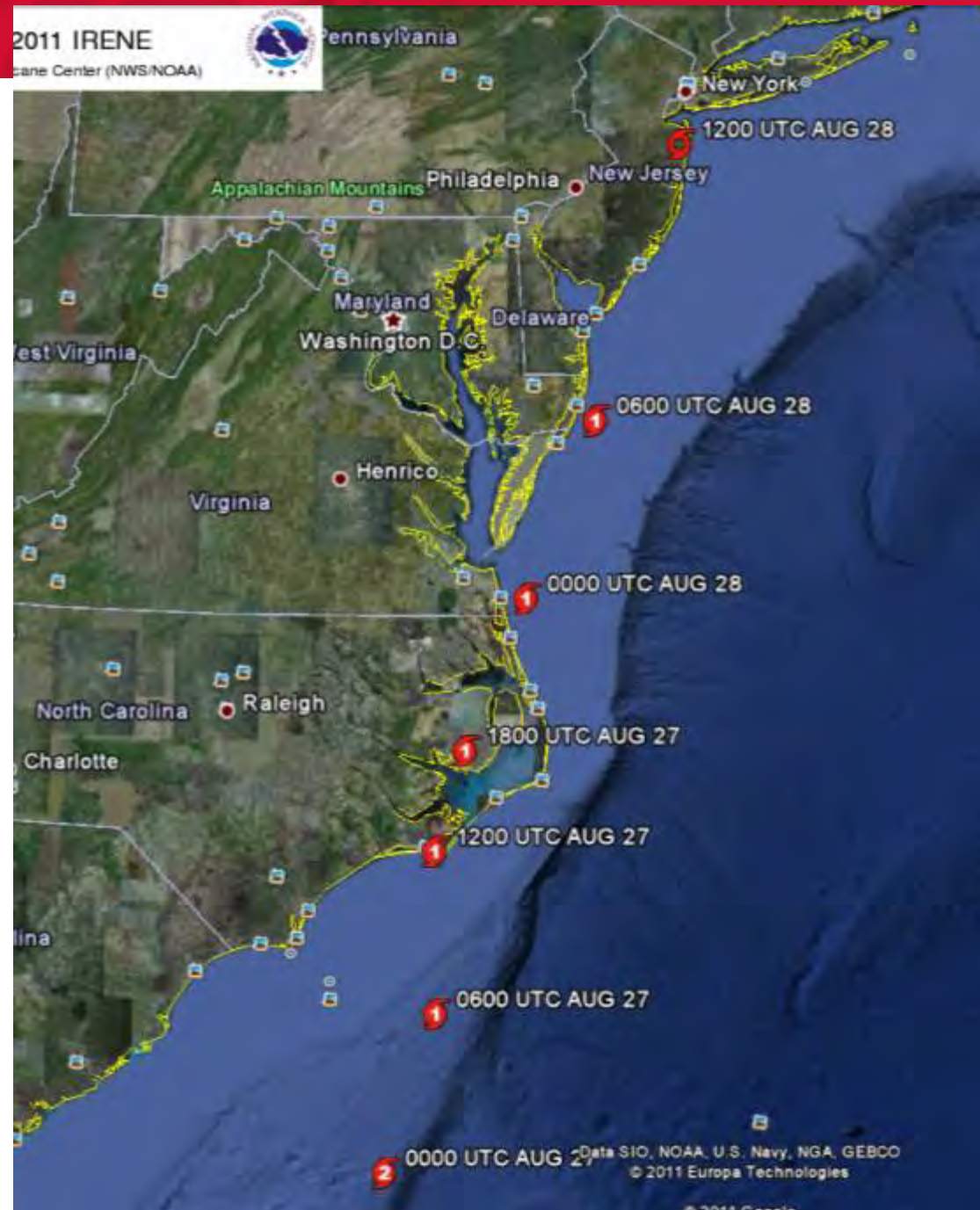
Joplin, MO

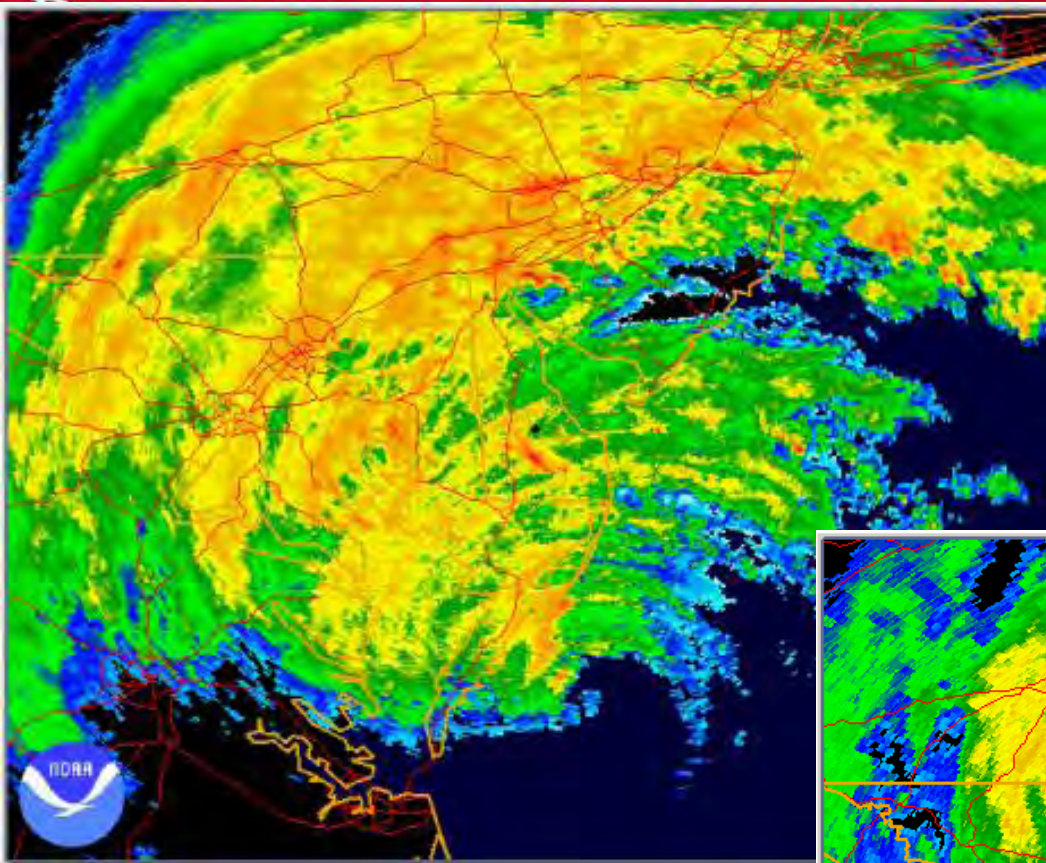
## Tornadoes/Severe Thunderstorms

- There is *low confidence in* observed trends in small spatial-scale phenomena such as tornadoes and hail because of data inhomogeneities and inadequacies in monitoring systems.
- Future trends are uncertain.

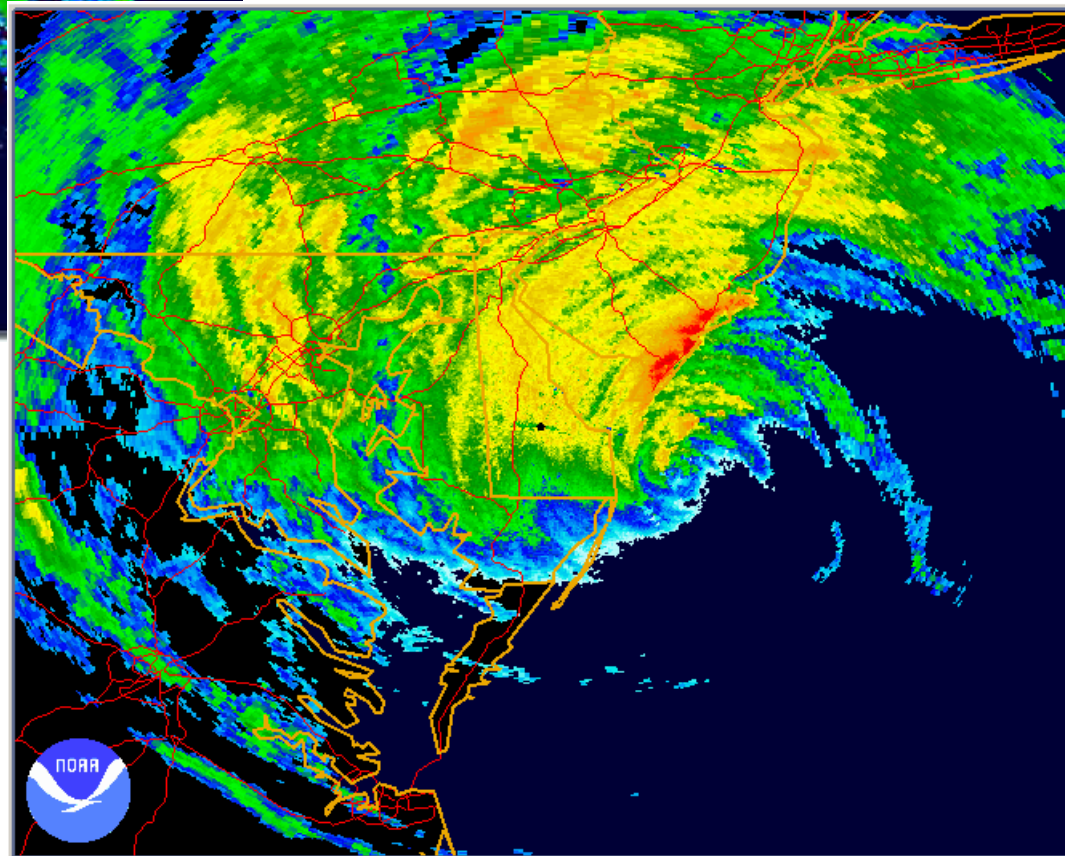


# Hurricane Irene





Aug. 27: 11:06PM EDT



Aug. 28: 3:10AM EDT

RUTGERS

# Irene At the Coast



Cape May, NJ



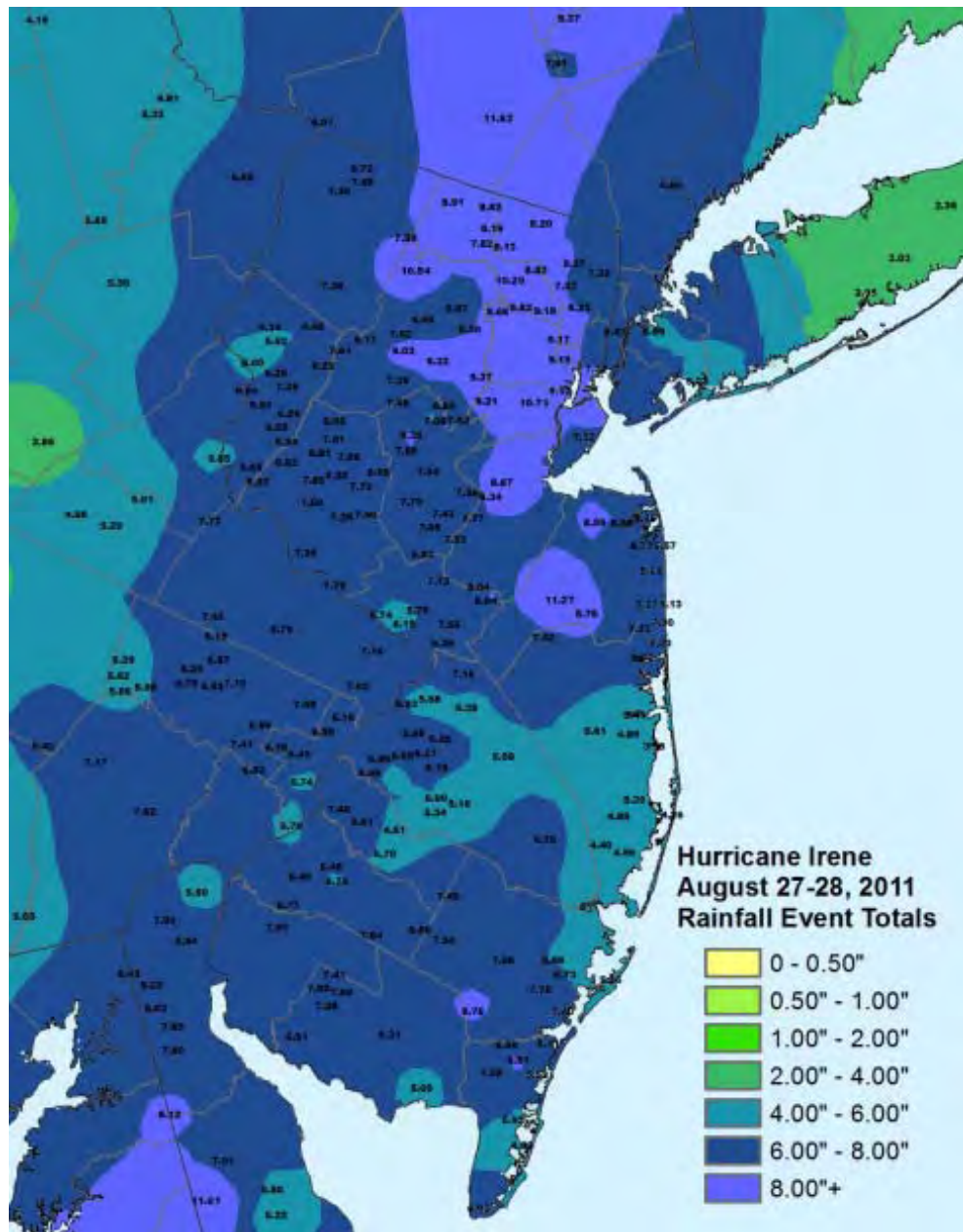
Asbury Park

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# Irene's wind:

Morris County





# Irene rainfall: station observations

New Brunswick, NJ





Manville, NJ





Millstone, NJ





Great Falls  
Paterson, NJ





Lincoln Park, NJ



Paterson, NJ



Fairfield, NJ



Kinnelon, NJ



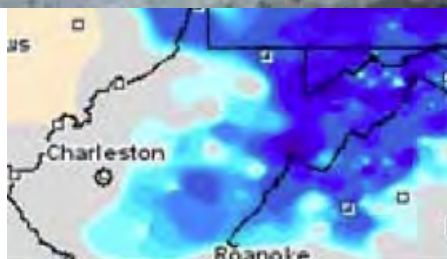
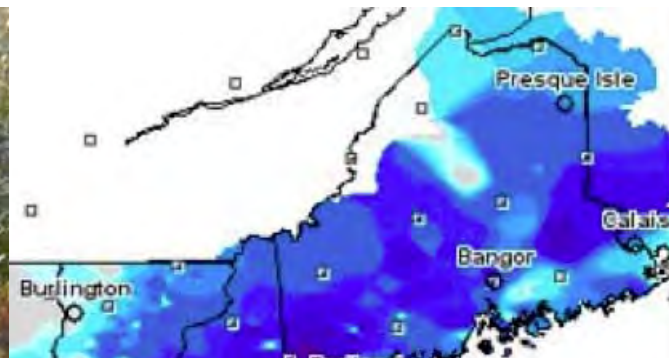
I 287: Boonton, NJ

## Tropical Cyclones and Heavy Rains

- There is low confidence in any observed long-term (i.e., 40 years or more) increases in tropical cyclone activity (i.e., intensity, frequency, duration), after accounting for past changes in observing capabilities.
- Average tropical cyclone maximum wind speed is likely to increase, although increases may not occur in all ocean basins. It is likely that the global frequency of tropical cyclones will either decrease or remain essentially unchanged.
- There have been statistically significant trends in the number of heavy precipitation events in some regions.
- It is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in the 21st century over many areas of the globe.
- There is limited to medium evidence available to assess climate-driven observed changes in the magnitude and frequency of floods at regional scales because the available instrumental records of floods at gauge stations are limited in space and time, and because of confounding effects of changes in land use and engineering.

Source: IPCC Special Report on Extremes (SREX)

# "Snowtober"

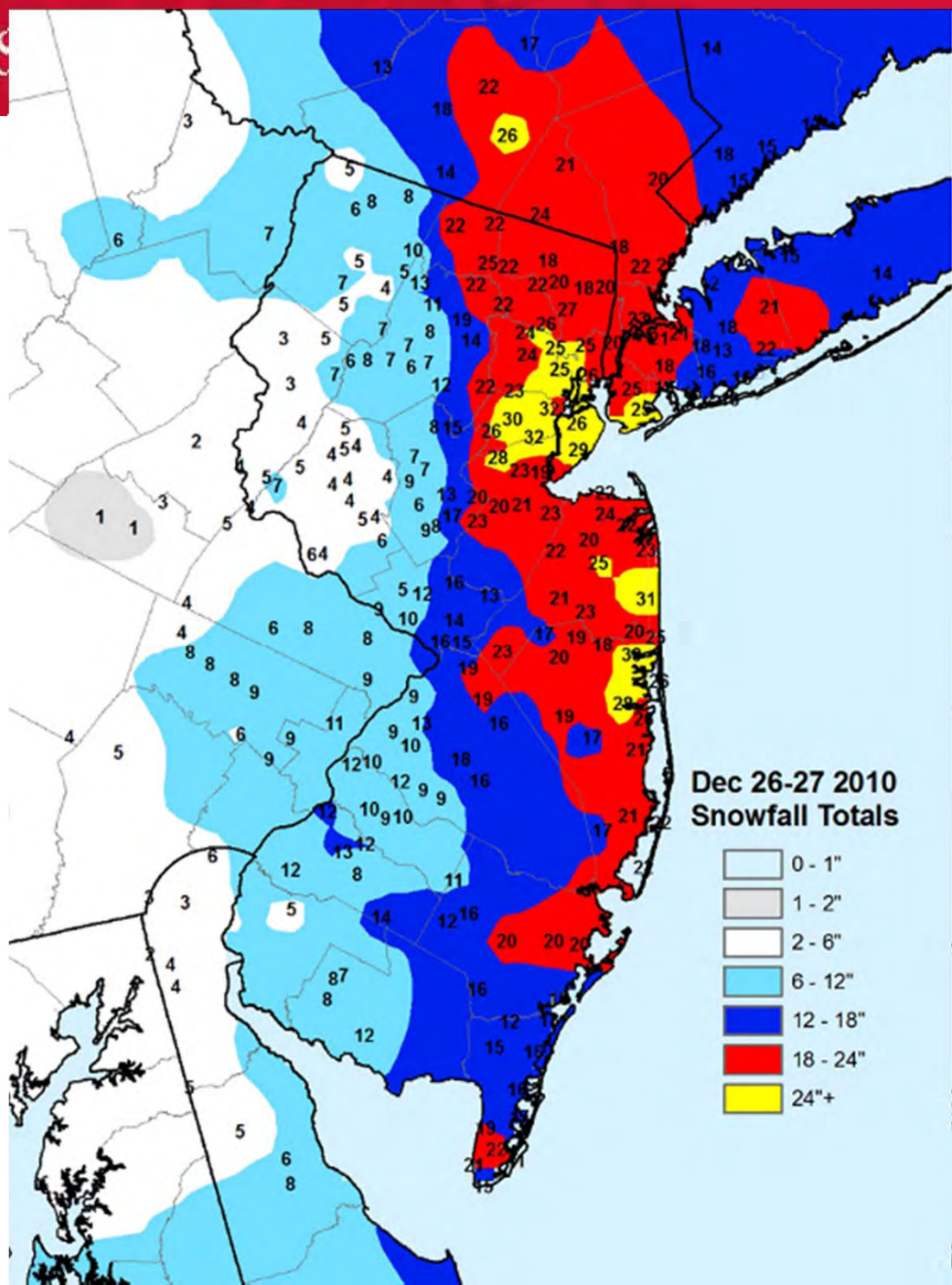






## December 2010 Blizzard





## Snowstorms

- Most snowstorms that occur outside of polar and mountainous regions result from a combination of abundant moisture and below-freezing temperatures. Their occurrence or absence is often a matter of timing.
- In most areas subject to snowfall, climate change will have potentially counteracting effects, with an increase in winter precipitation but a decrease in the fraction of precipitation falling as snow.
- Human-induced trends in snowfall will be slow to emerge from the “noise” of unforced climate variability.
- Beware the concept of “global weirding.”

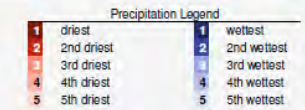
## New Jersey's Extreme Temperature and Precipitation Months

### Temperature - For each calendar month the 5 warmest and 5 coldest years in New Jersey



Observation: The warmest months tend to be after 1990. The coldest months tend to be before 1930.

### Precipitation - For each calendar month the 5 driest and 5 wettest years in New Jersey



Observation: There is no obvious trend in the distribution of wettest and driest months.

#### Explanation

- Each month has two sets of 1-5, one set in shades of red for warmest/driest and one set in shades of blue for coldest/wettest.
- Ties are indicated by the same number appearing twice for the same month.
- The period of record is January 1895 to December 2011.
- Monthly rankings are based on State-wide averages of monthly temperature and precipitation.
- All data are from the web page of the New Jersey State Climatologist.



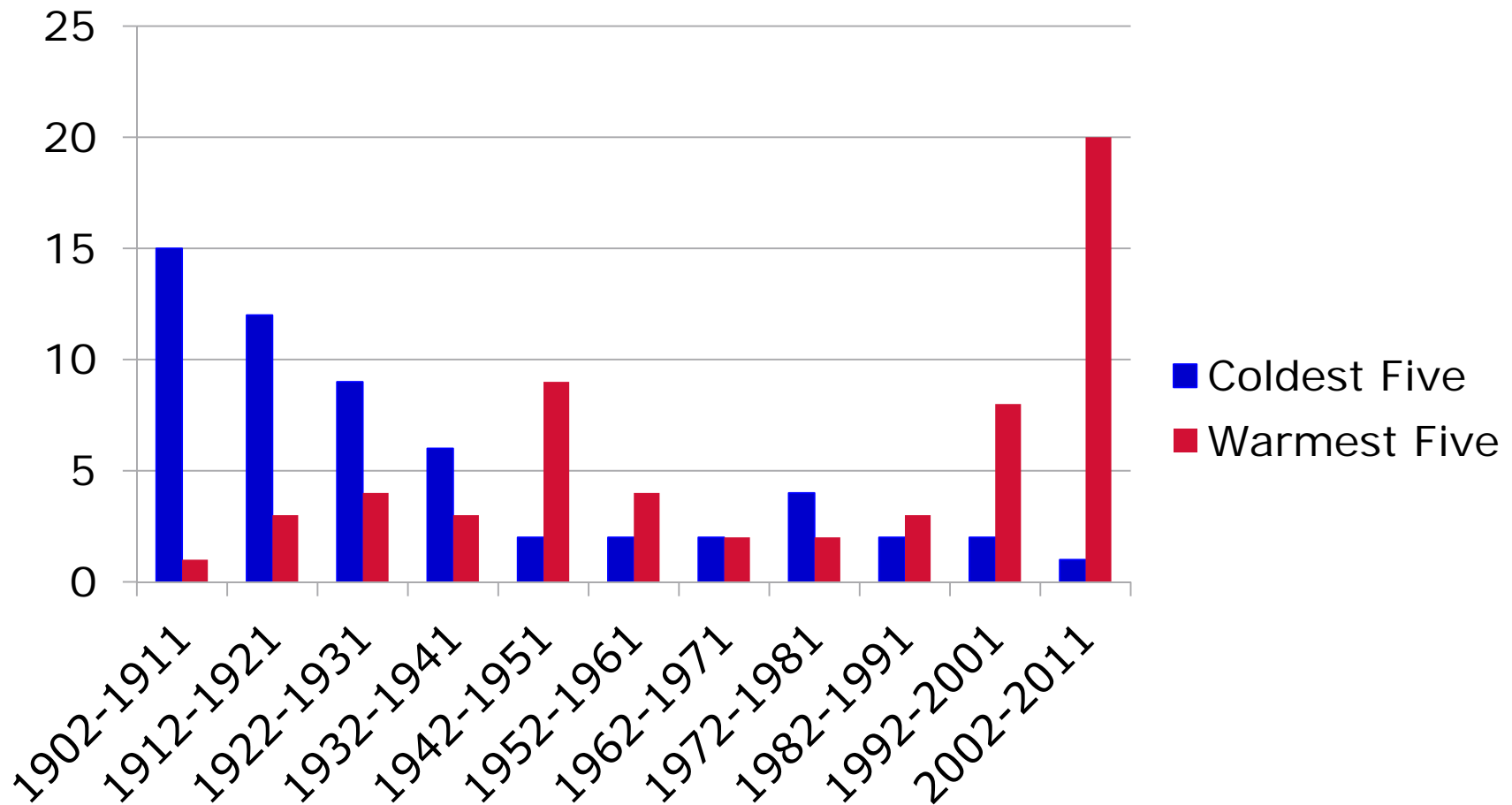
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# NJ Monthly Temperature Extremes



# NJ Monthly Precipitation Extremes

