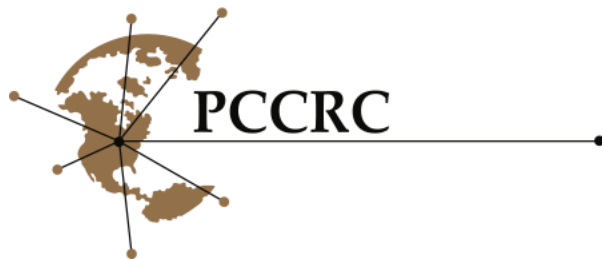


# The Climate Change Challenge

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**PURDUE**  
UNIVERSITY.

# PURDUE CLIMATE CHANGE RESEARCH CENTER



The **PCCRC** is a faculty-led, university-based research center with 65 active faculty representing 8 colleges and 17 departments across campus.

Our mission: *Increase scientific and public understanding of the causes and impacts of climate change through fundamental research and effective education and outreach.*

[www.purdue.edu/climate](http://www.purdue.edu/climate)

# WHAT DO WE STUDY?

- How will climate change impact our cities, agriculture, and energy systems?
- How can we engineer solutions to climate change into new and existing infrastructure?
- What can the past climate tell us about future climate?
- Can we provide the world with a global, spatially explicit, open-source database for analysis of climate change impacts?
- How do we design the most politically robust, cost-effective and socially equitable policy approaches for dealing with climate change?

# WHERE WE WORK



# FINDINGS FROM THE 5<sup>TH</sup> IPCC REPORT

## Global warming

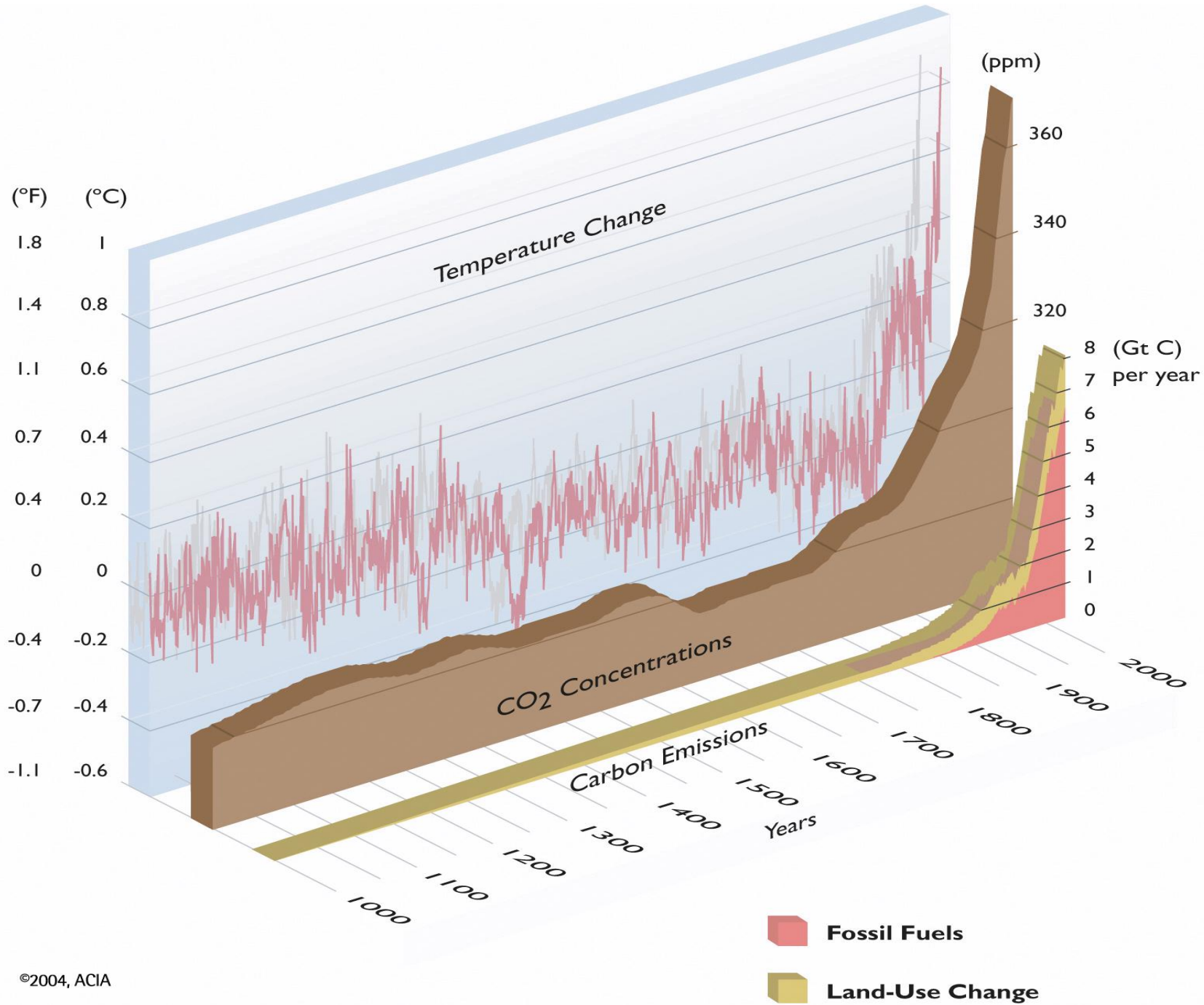
- More certain (> 95%) that **human influence has been the dominant cause** of the observed warming since the mid-20th century.

## Sea-level rise

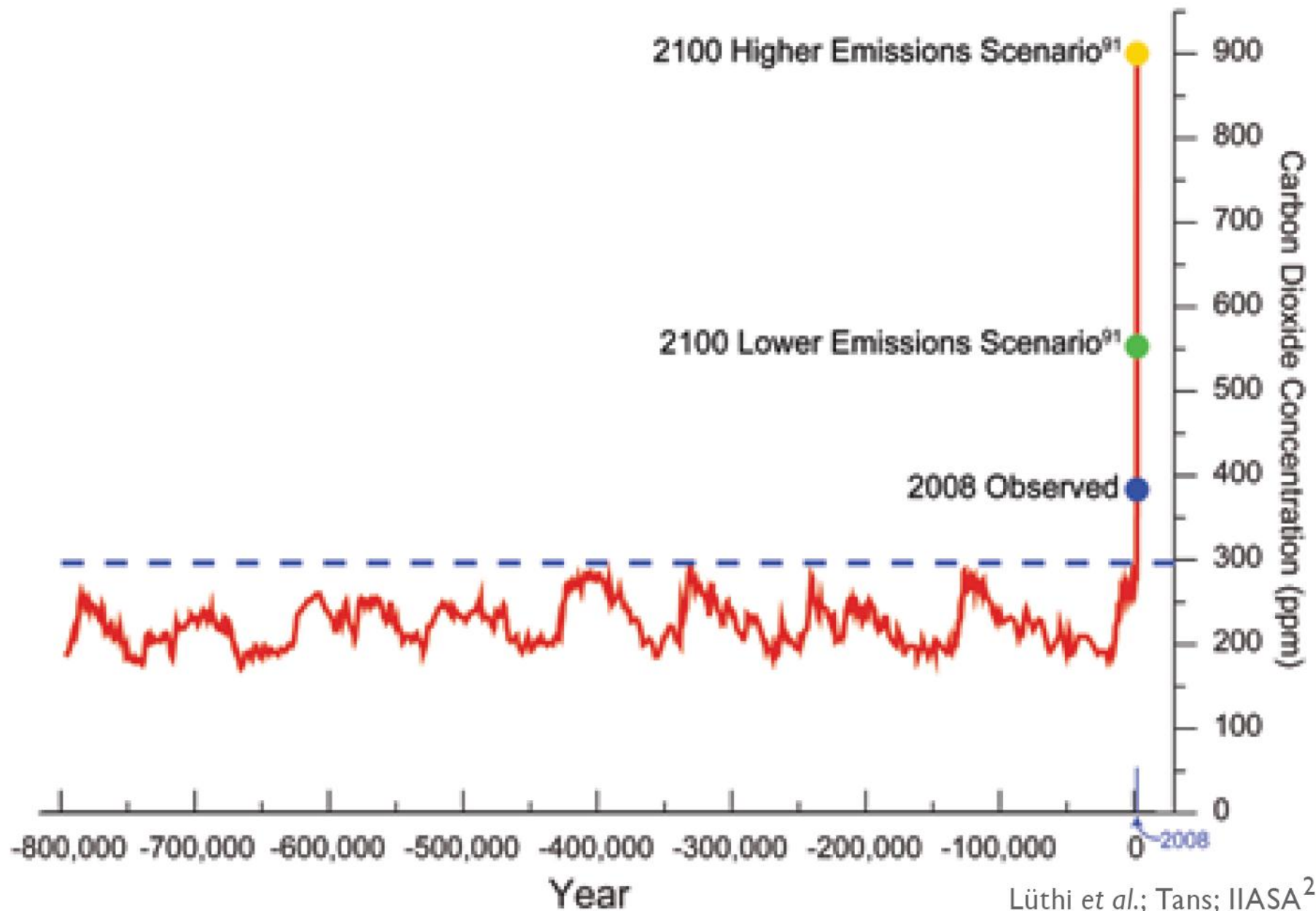
- A **much more rapid sea-level rise** is now projected (28-98 cm by 2100), and the rise will continue to accelerate – regardless of the emissions scenario, even with strong climate mitigation.
- It's **virtually certain** that the upper ocean has warmed from 1971 to 2010.

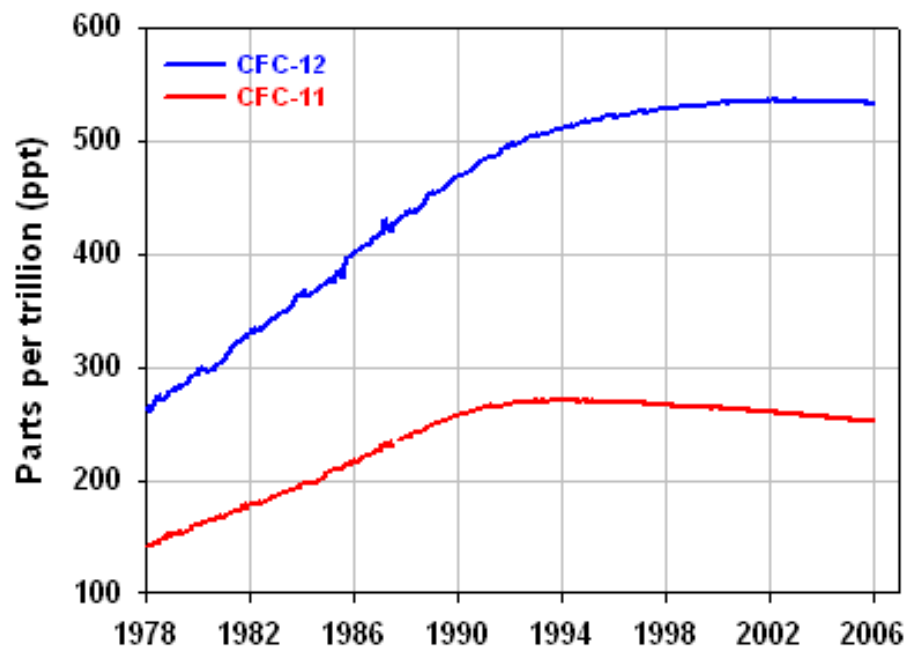
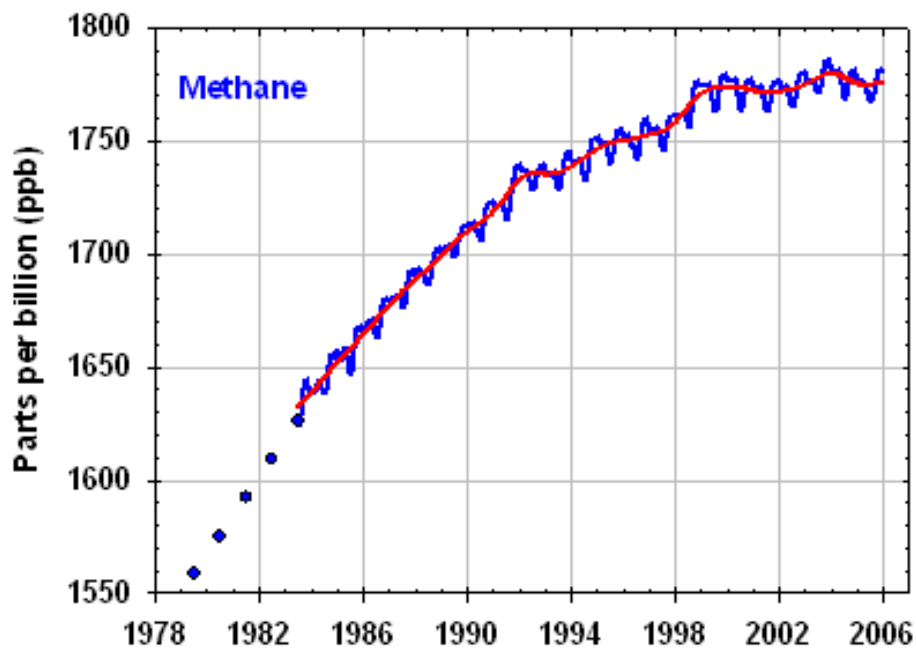
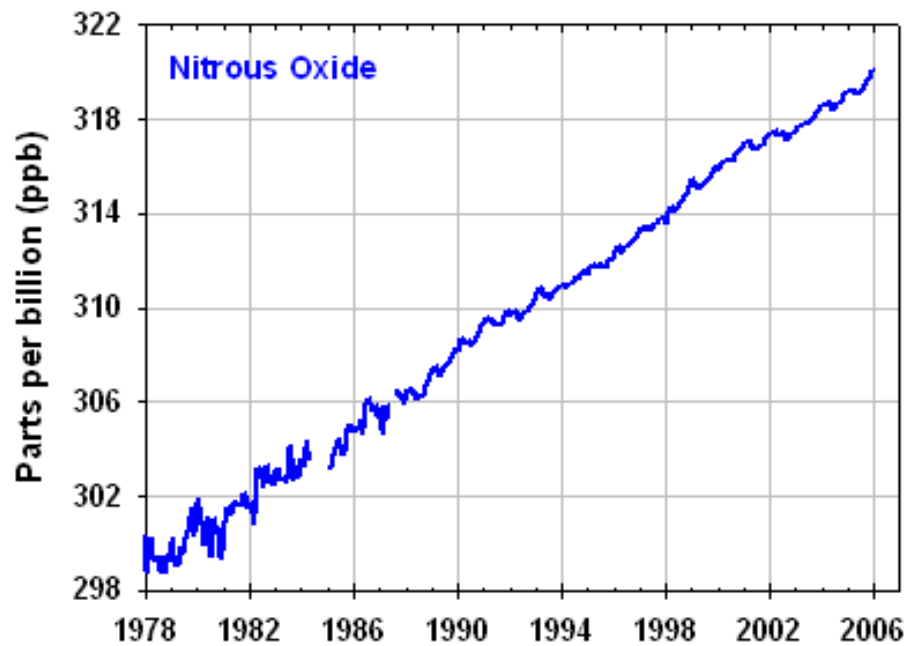
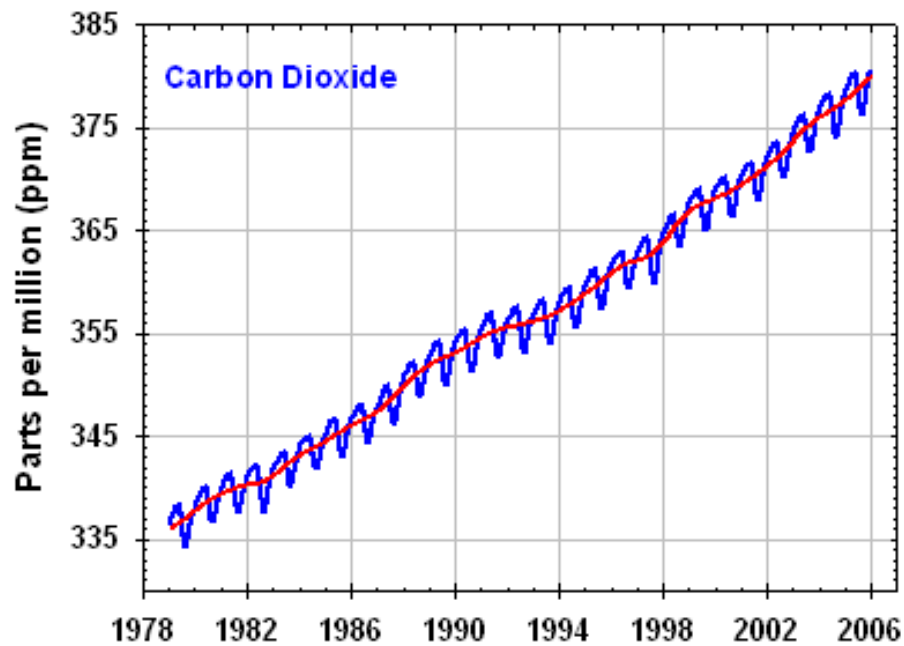
## Land and sea ice

- The Greenland and Antarctic ice sheets have been losing mass over the past two decades.
- The Arctic Ocean will likely become **virtually ice-free in summer** before the middle of the century.



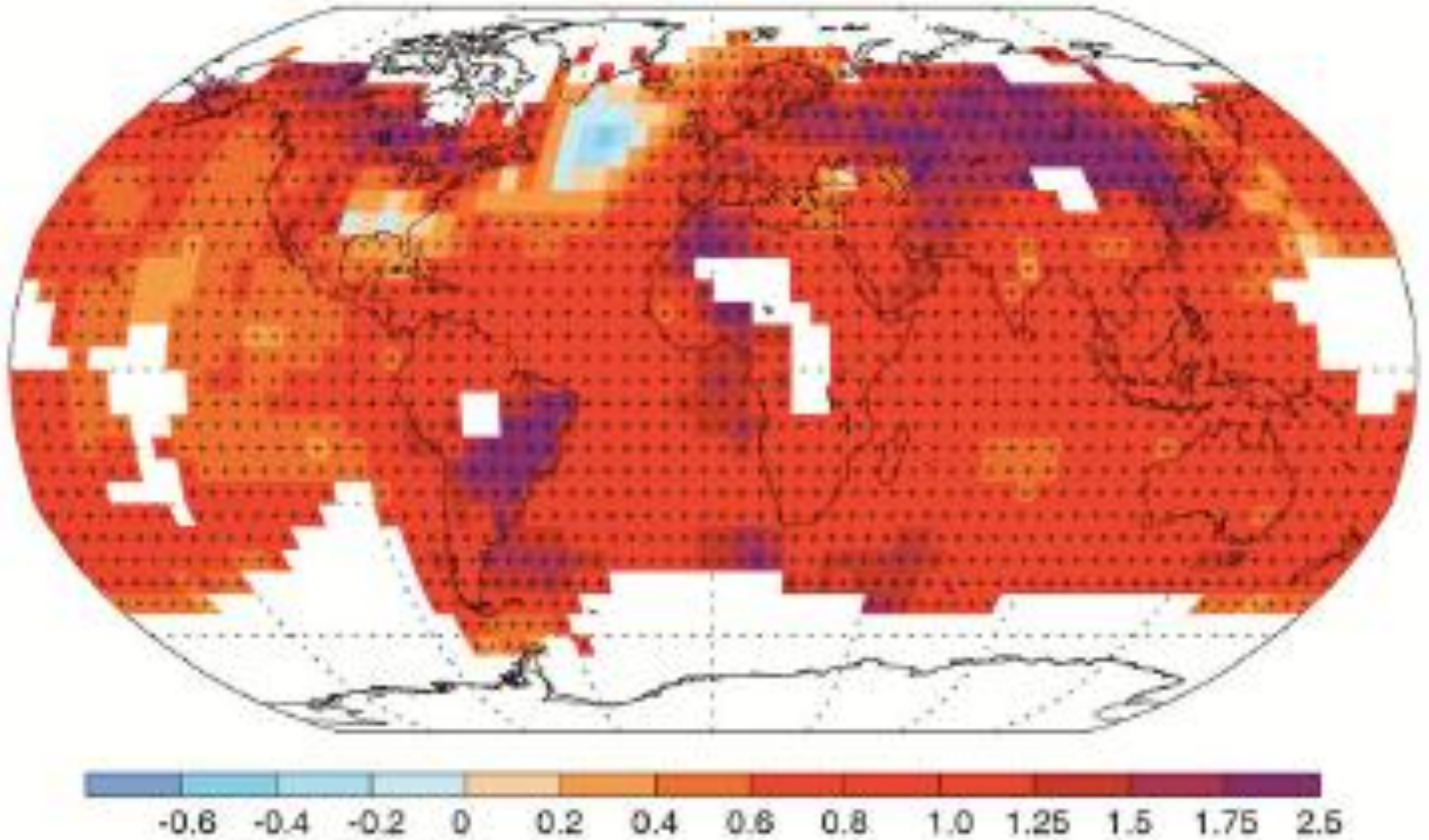
# 800,000 Year Record of Carbon Dioxide Concentration





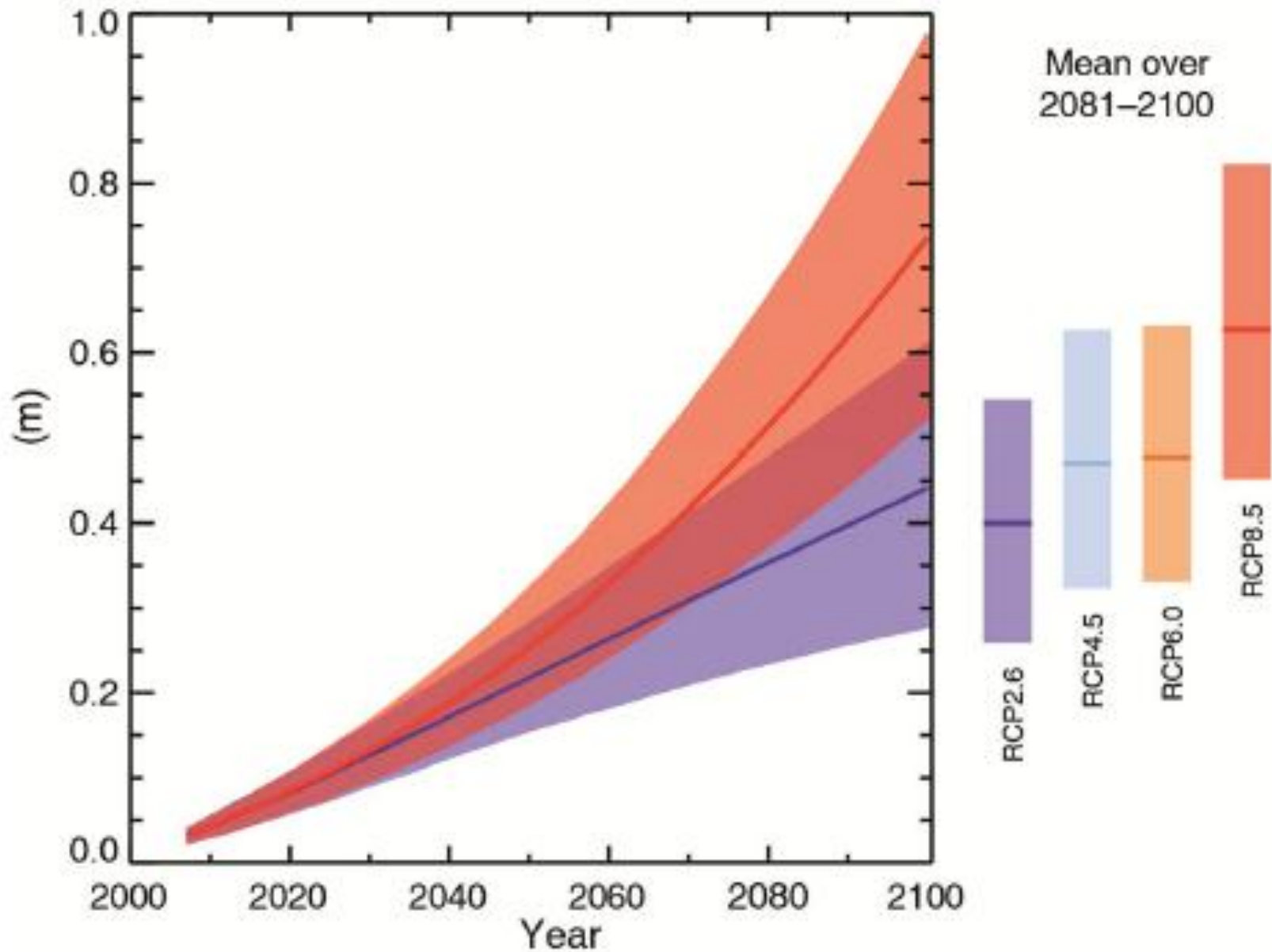


# Observed change in average surface temperature 1901-2012

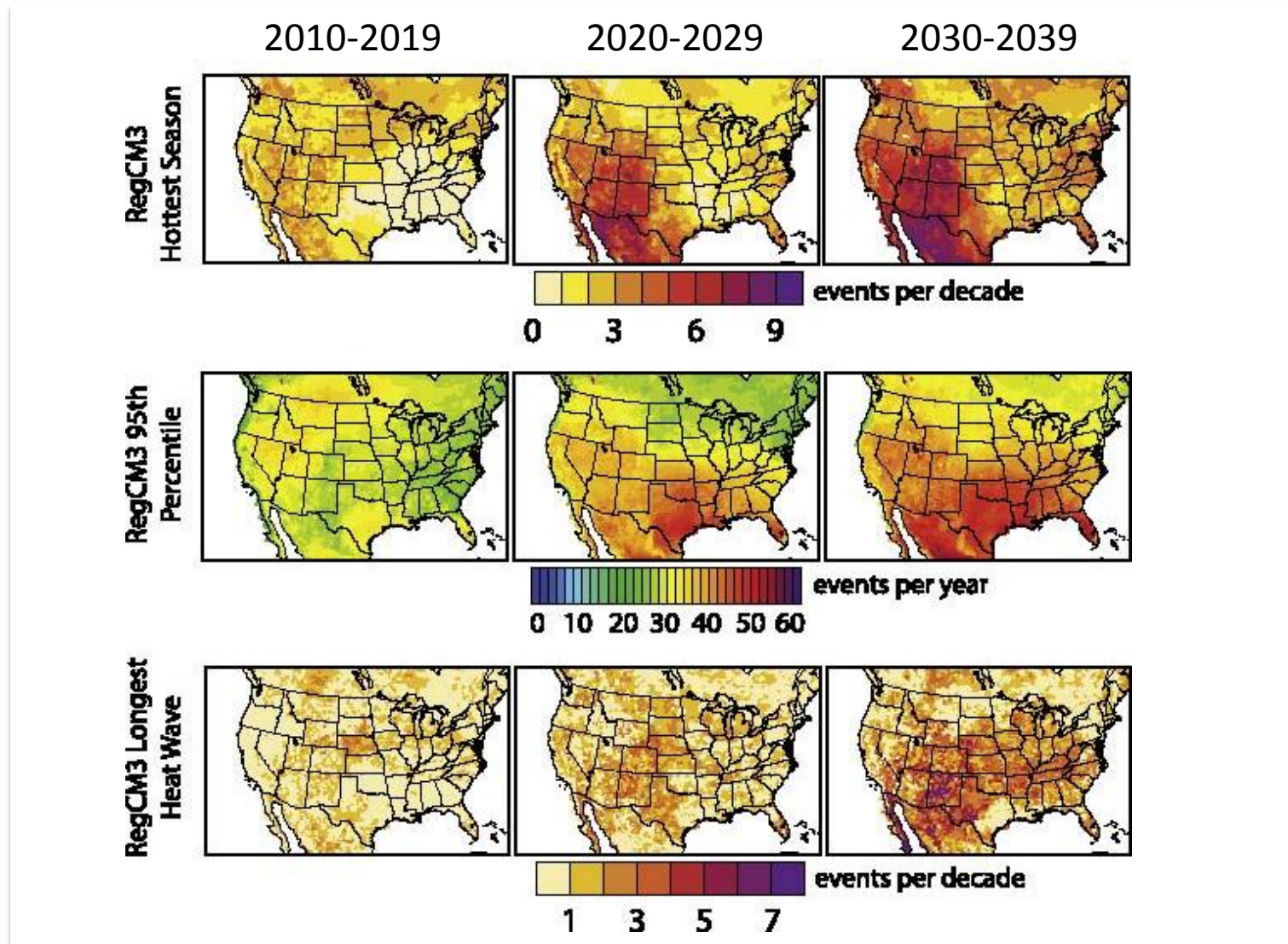


Trend °C over period

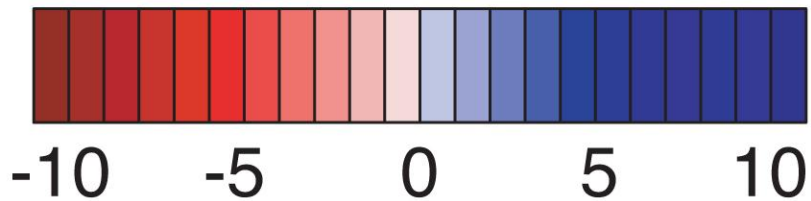
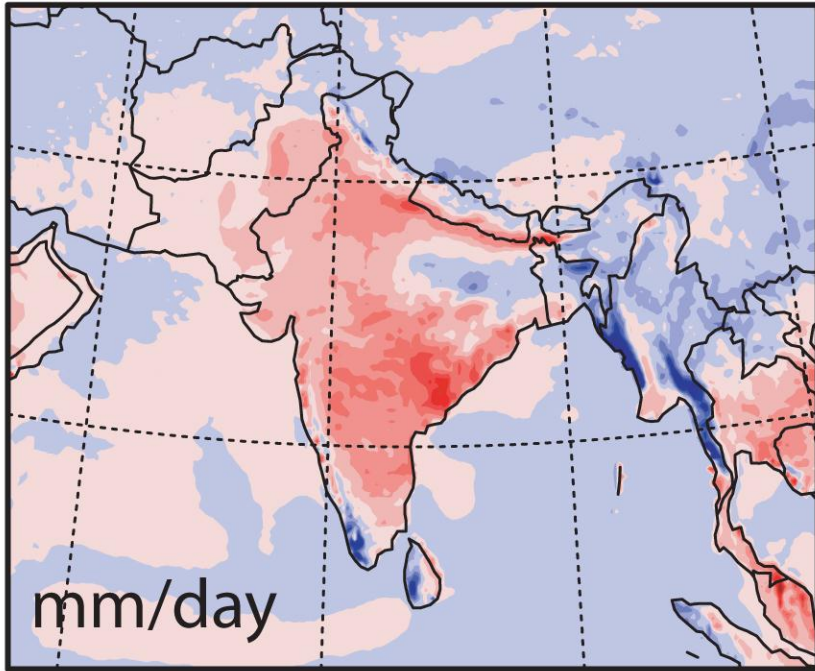
# Global Mean Sea Level Rise



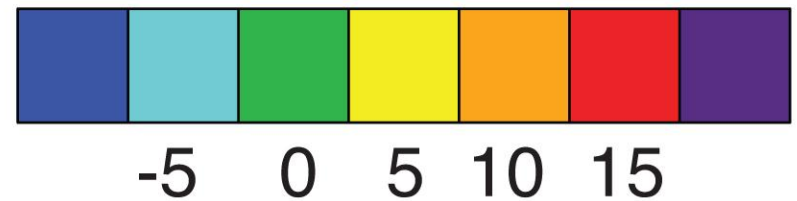
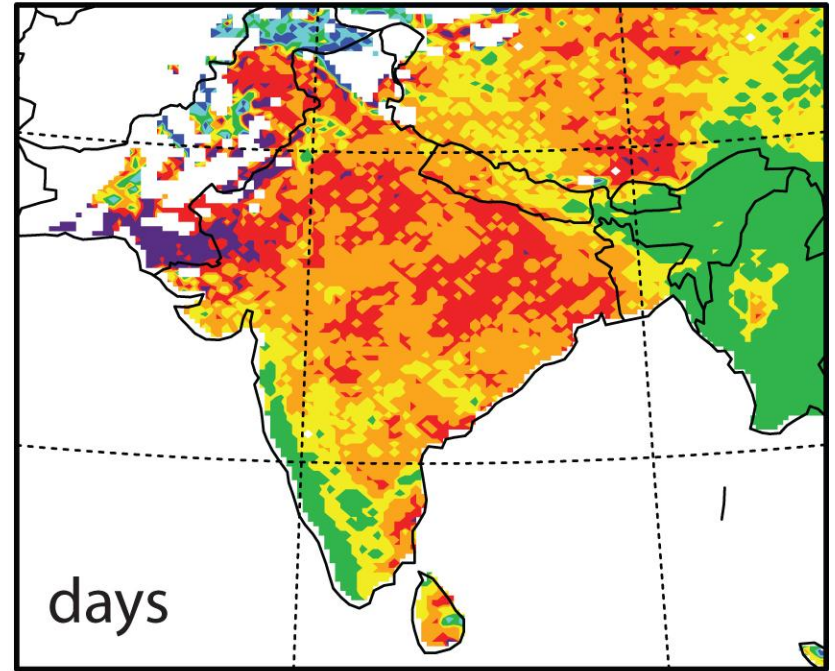
# Increased Frequency of Extreme Events



## Future Change in Summer Convective Precipitation



## Future Change in Monsoon Onset Date



# Climate change

## What we know

Increased amount of greenhouse gases (largely CO<sub>2</sub>) in the atmosphere are warming the planet.

Current warming is very likely due to human activity.

We already see the impacts of climate change.

## What we don't know

How high greenhouse gas levels will rise.

How much hotter the planet will get.

How things will change in each region.

How do aerosols and other “coolants” affect the climate system.

Climate “tipping points”.

# Observational evidence for climate change

## Global temperature rise

All three major global surface temperature reconstructions show that Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981 and with all 10 of the warmest years occurring in the past 12 years. Even though the 2000s witnessed a solar output decline resulting in an unusually deep solar minimum in 2007-2009, surface temperatures continue to increase

## Warming oceans

The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean showing warming of 0.302 degrees Fahrenheit since 1969

## Sea level rise

Global sea level rose about 17 centimeters (6.7 inches) in the last century. The rate in the last decade, however, is nearly double that of the last century.

# Observational evidence for climate change

## **Declining Arctic sea ice**

Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.

## **Extreme events**

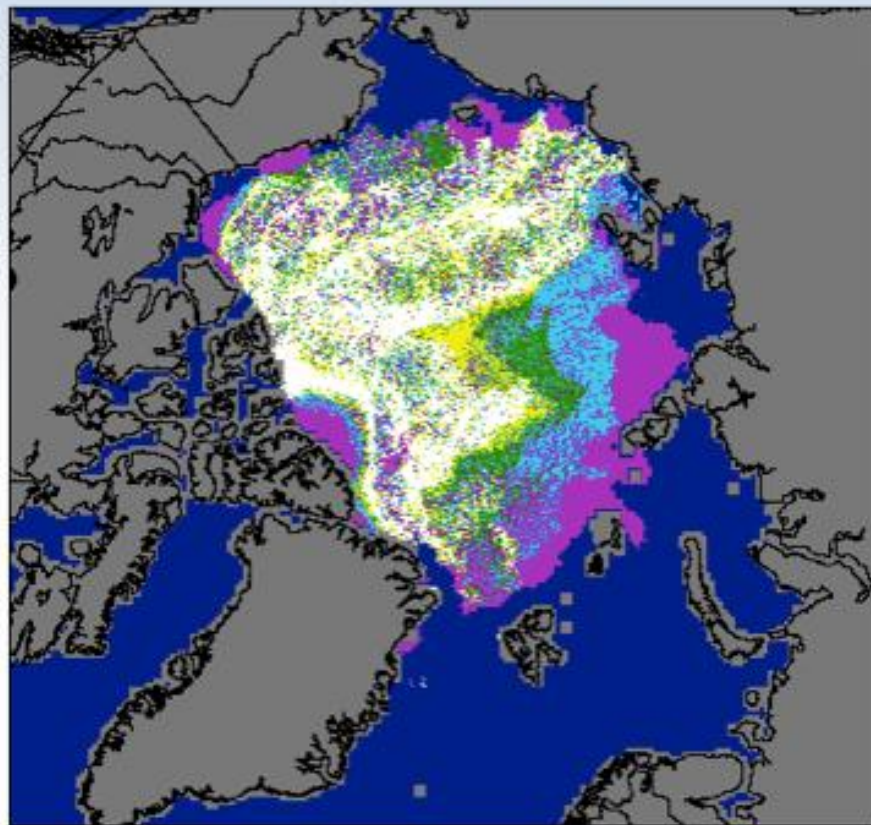
The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950

## **Ocean acidification**

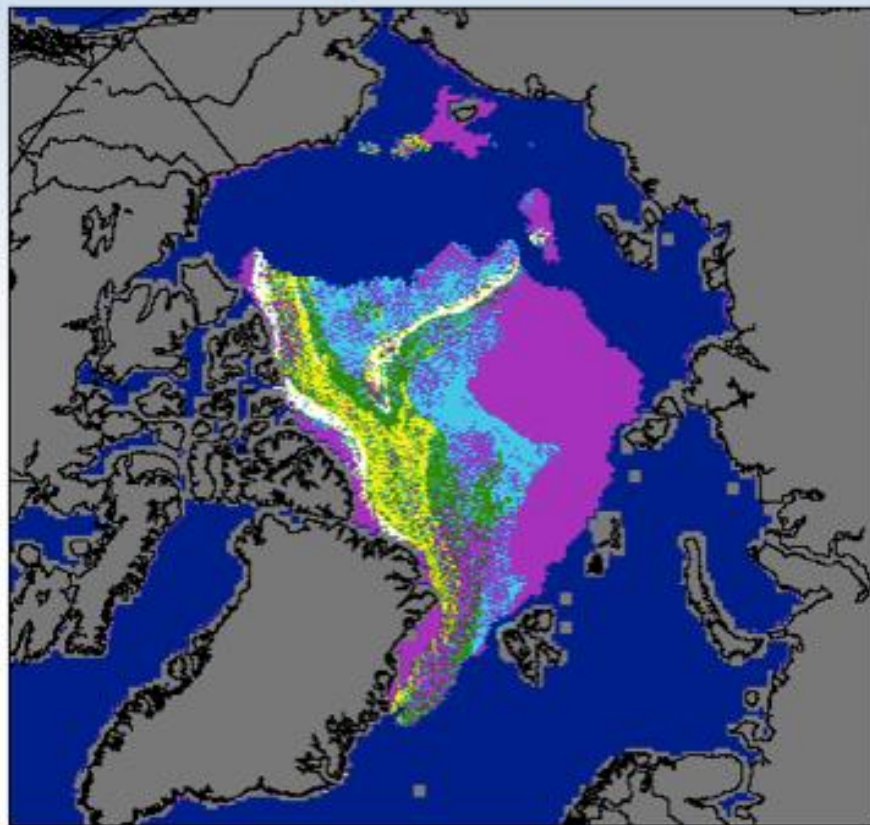
Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent


# Arctic Sea Ice is Younger, Thinner


August 1985




August 2012




 First-year ice  
(<1 year old)

 Second-year ice  
(1-2 years old)

 Third-year ice  
(2-3 years old)

 Fourth-year ice  
(3-4 years old)

 5+-year ice  
(5+ years old)





# Climate change & Agriculture

## Mitigation

- Agriculture as a carbon sink
- Land use impacts of agriculture
- As a renewable resource  
(biofuels)

# Climate change & Agriculture

## Adaptation – Critical Stress Points

- Heat
- Moisture
- Extreme Events

# Climate change & Agriculture

## Adaptation – Parameters to work with

Upper Midwest (versus fringe areas)

- Genetics
- Pests
- Institutions

# Climate change & Agriculture

## Adaptation – Corn in Indiana

- Length of season
- Timing of extreme heat
- Timing of rainfall
- Ultimate cropping system changes

# **World Food Production**

- **Fringe high-stress areas**
- **Same parameters**
- **Abandonment question**
- **Building resilient systems**



# Our Earth