Our assumptions about climate

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PINEMAP

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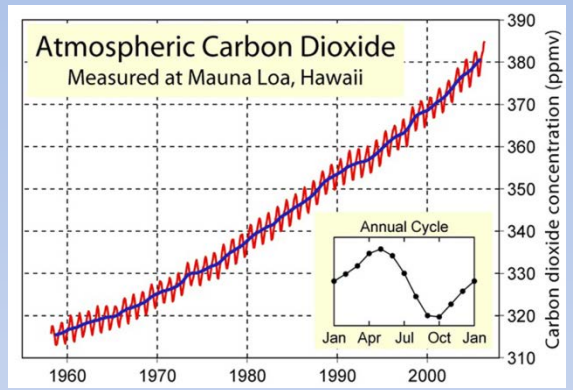
Florida Climate Institute

LEEF http://leef-florida.org/

It is possible that Climate Change is not your typical science topic.

- Complex, uncertain, high stakes, global implications
- Emotional reaction from many
- Confusion and misconceptions
- Yet 75% of Americans want schools to cover it

Understand the science



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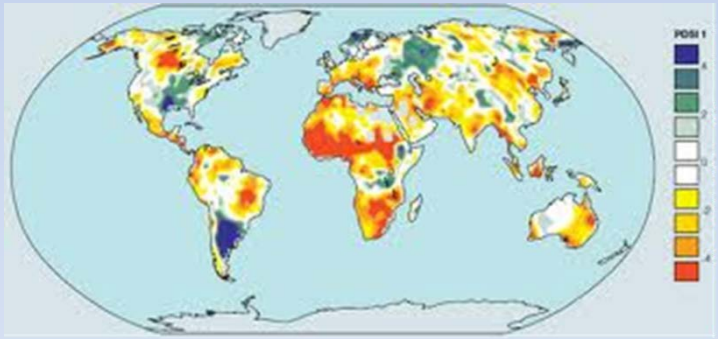


Phenology

Carbon dioxide makes a Warm Blanket

OR

Carbon dioxide creates a Greenhouse

Analogies

Labs

Apply Pedagogical Content Knowledge

Science Standards

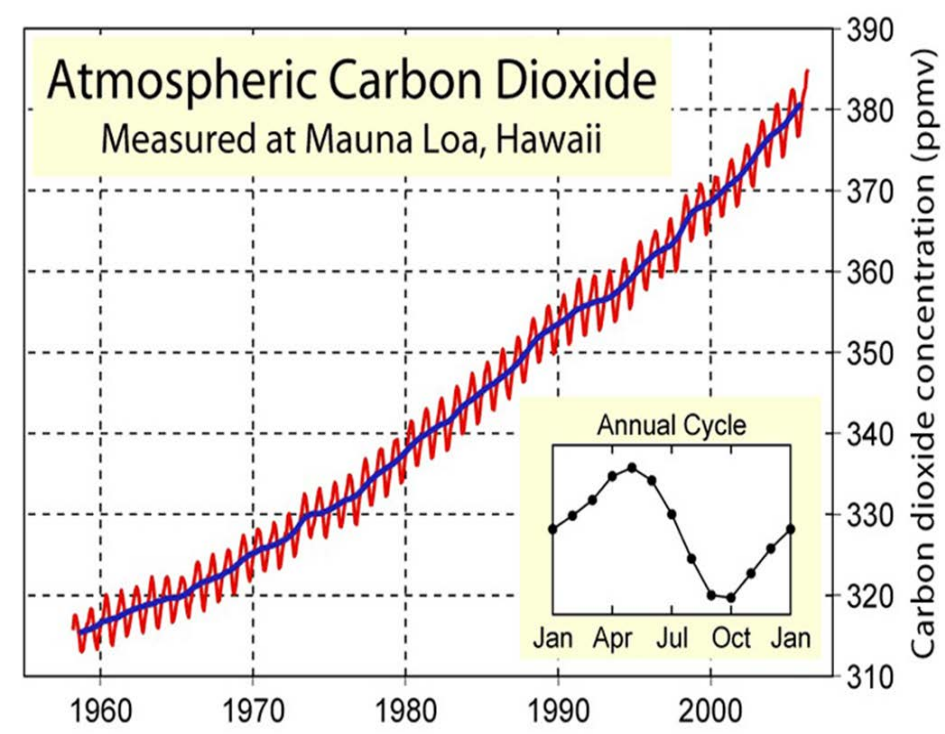
- Florida Next Generation Biology
- Describe changes in ecosystems resulting from… climate change…
- Recognize the consequences of the losses of biodiversity due to… climate changes...

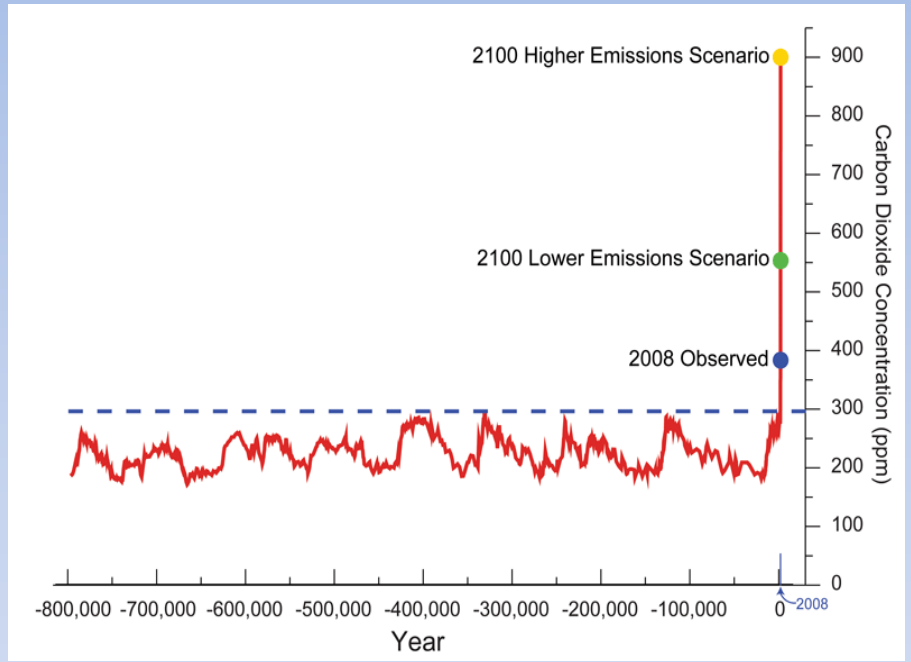
- National Next Generation Science
- Explicit in earth/space science
- Crosscutting concepts: Systems, patterns, relationships, causation
- Biology: feedback and systems; interdependence; changing and resilient ecosystems

Following NCSE…

- The science does not have multiple perspective or two sides.
  - It can be complicated
  - There are uncertainties
- The implications of the science for policy and behaviors can be explored, compared, and debated.

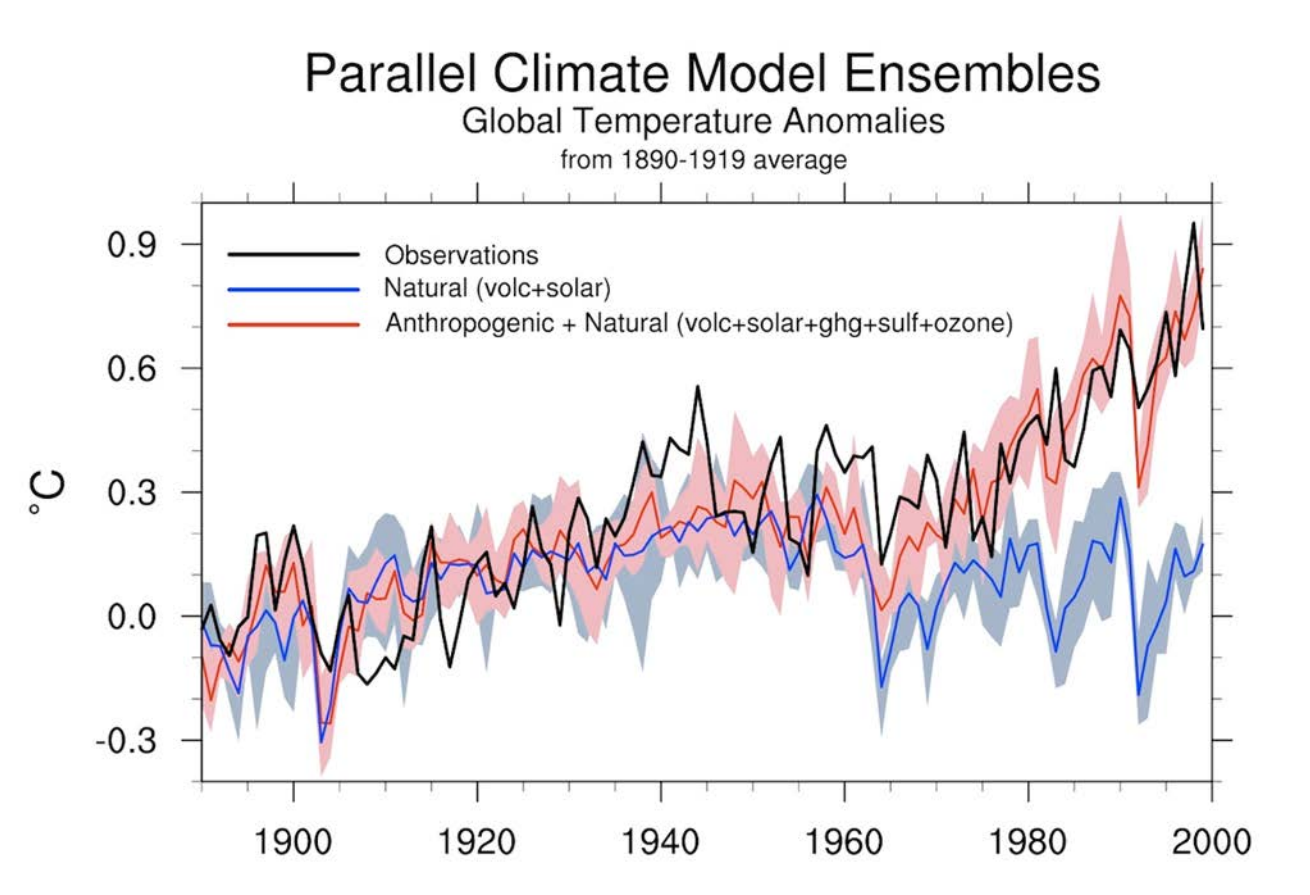
Rise in Atmospheric Carbon





due to human and natural factors

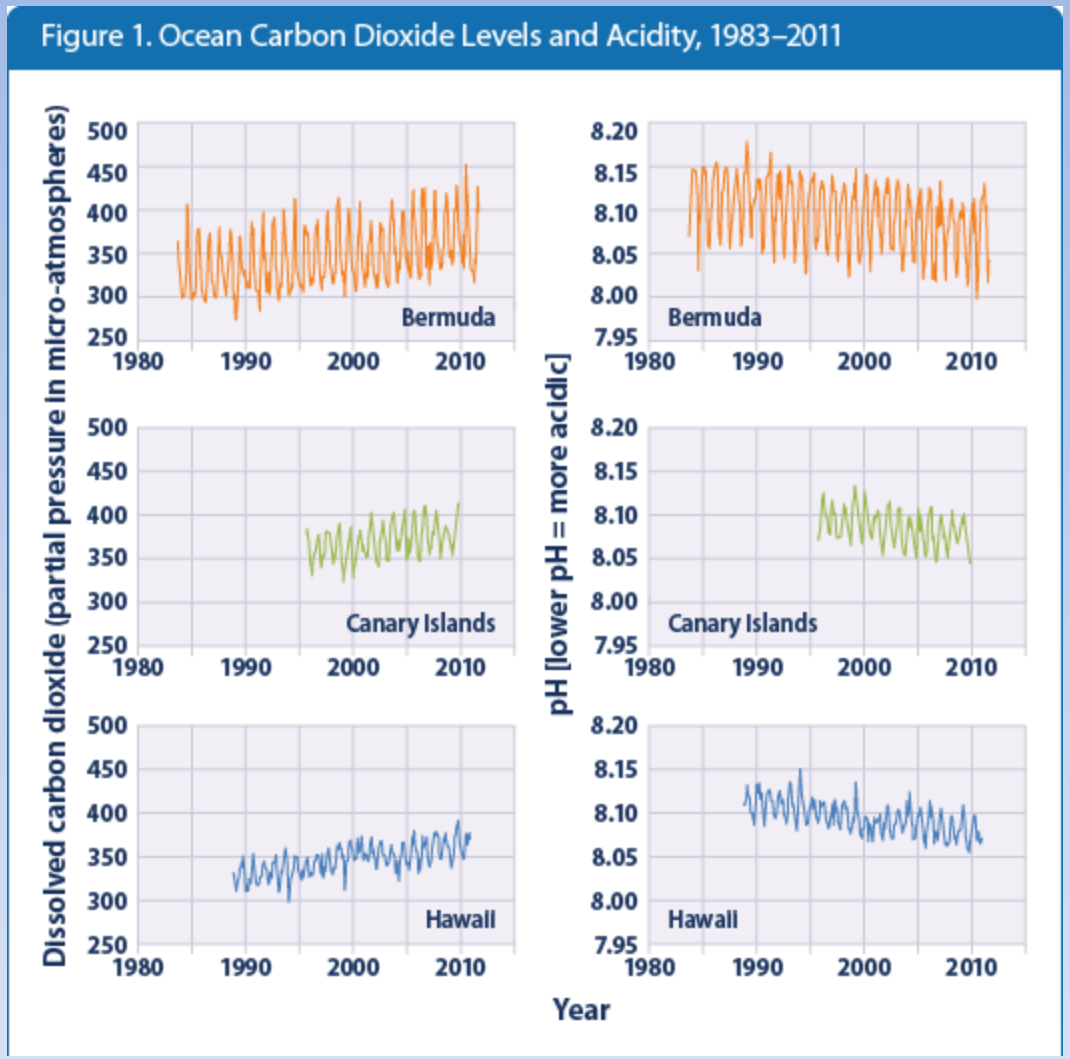
We mostly hear about the impact on surface temperature, 4° to 8° C



Models can be used to separate out the effects of individual factors to see what effect each factor has on the temperature trend.

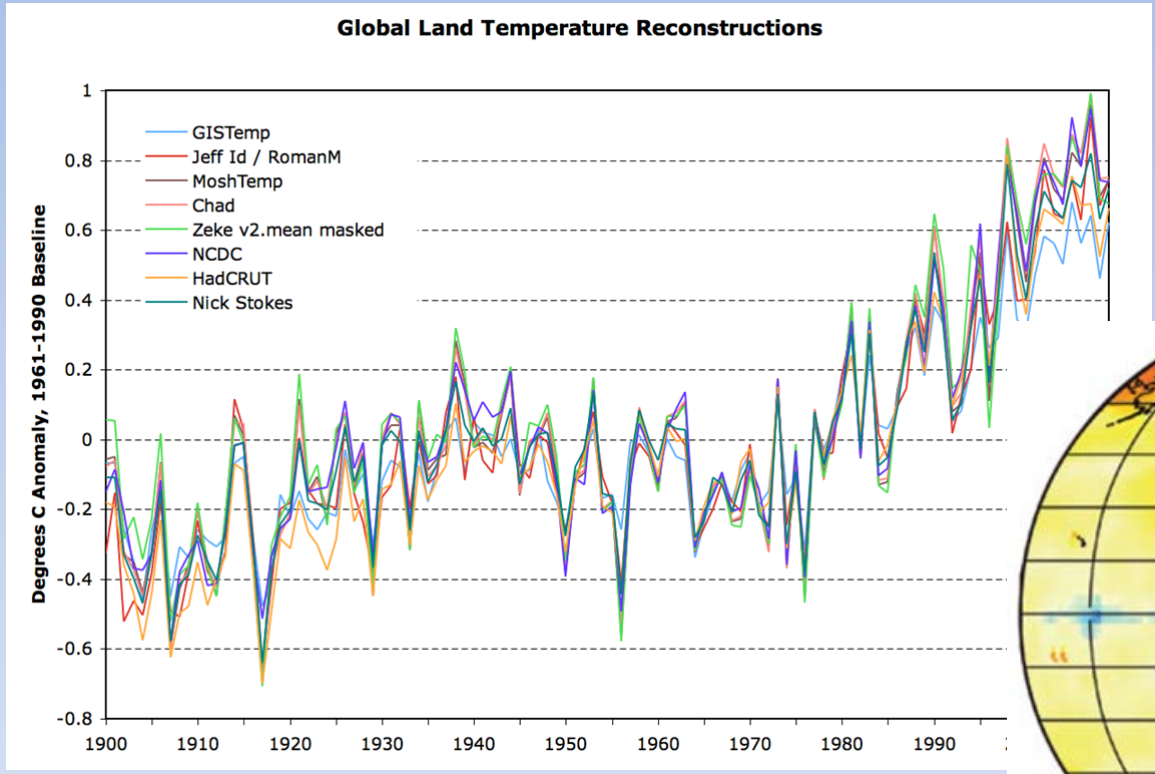
CO_2 in Oceans

- Increase in CO_2 has increased acidity = decreased pH
- Change of 30% from pre-industrial period

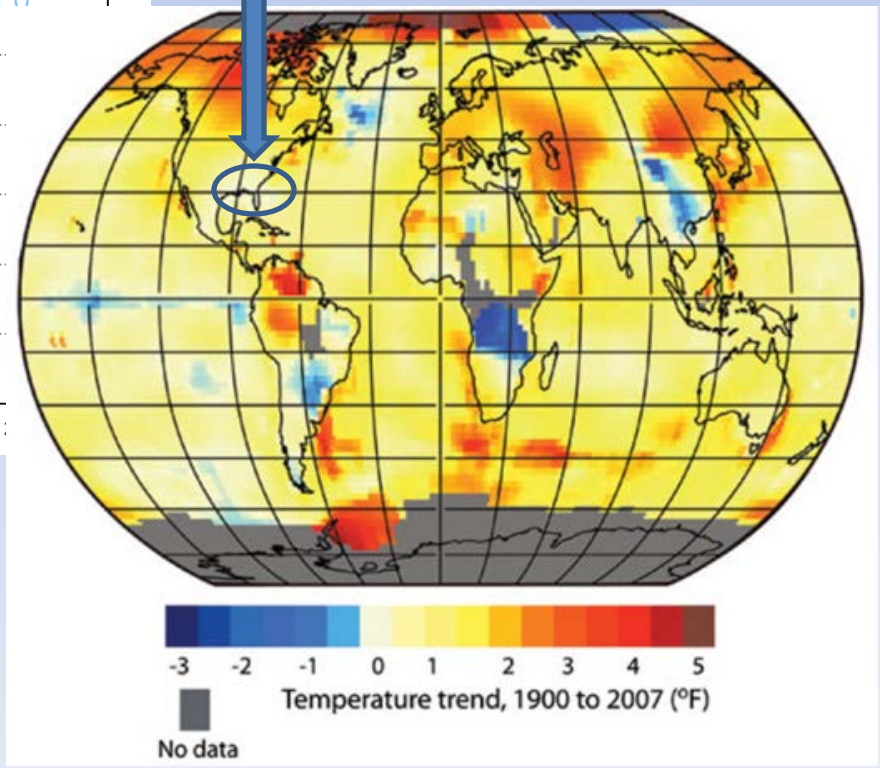


Review of Present Climate Trends:

Global Temperature

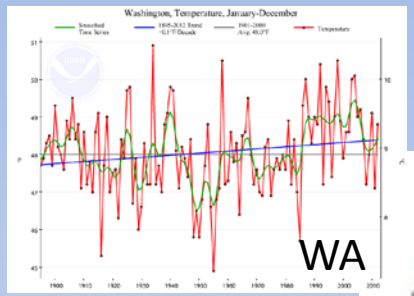


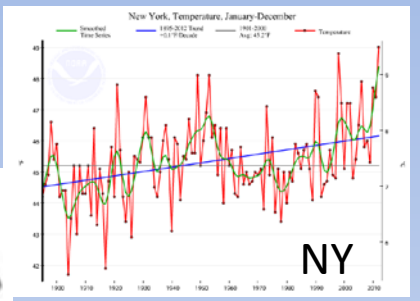
And the Southeast US?

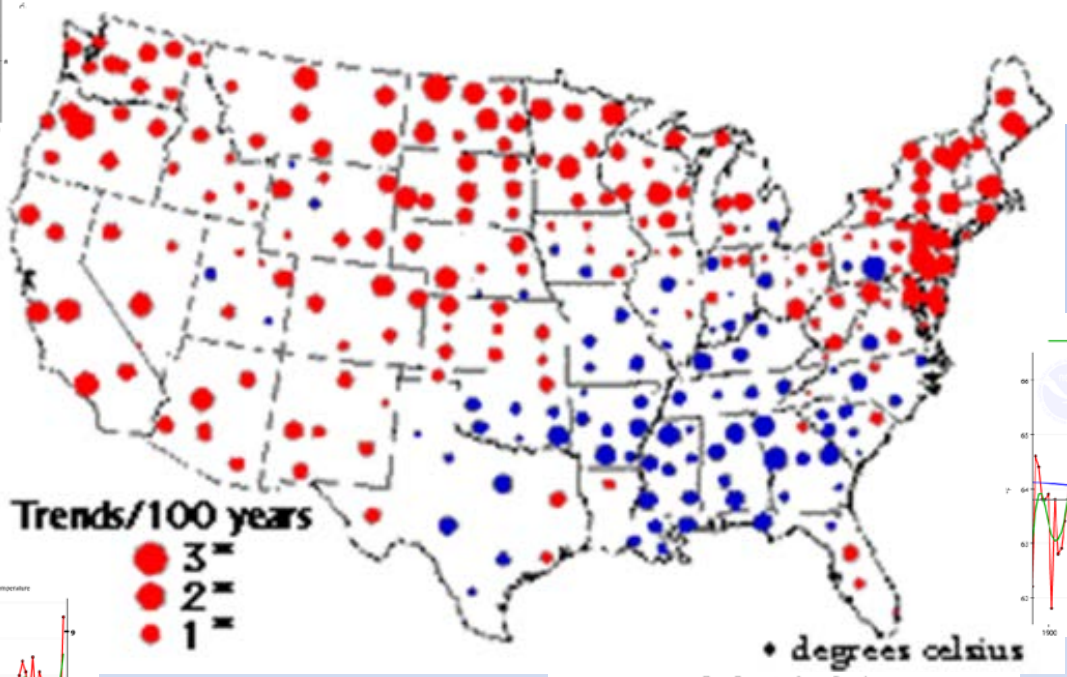


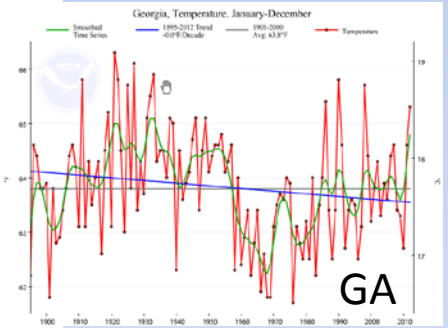
Review of Present Climate Trends:

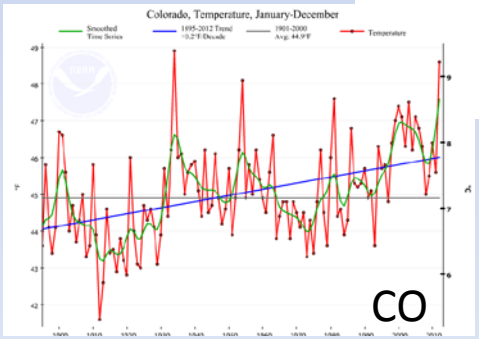
US Temperature





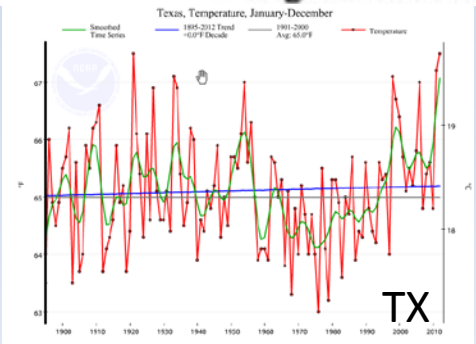






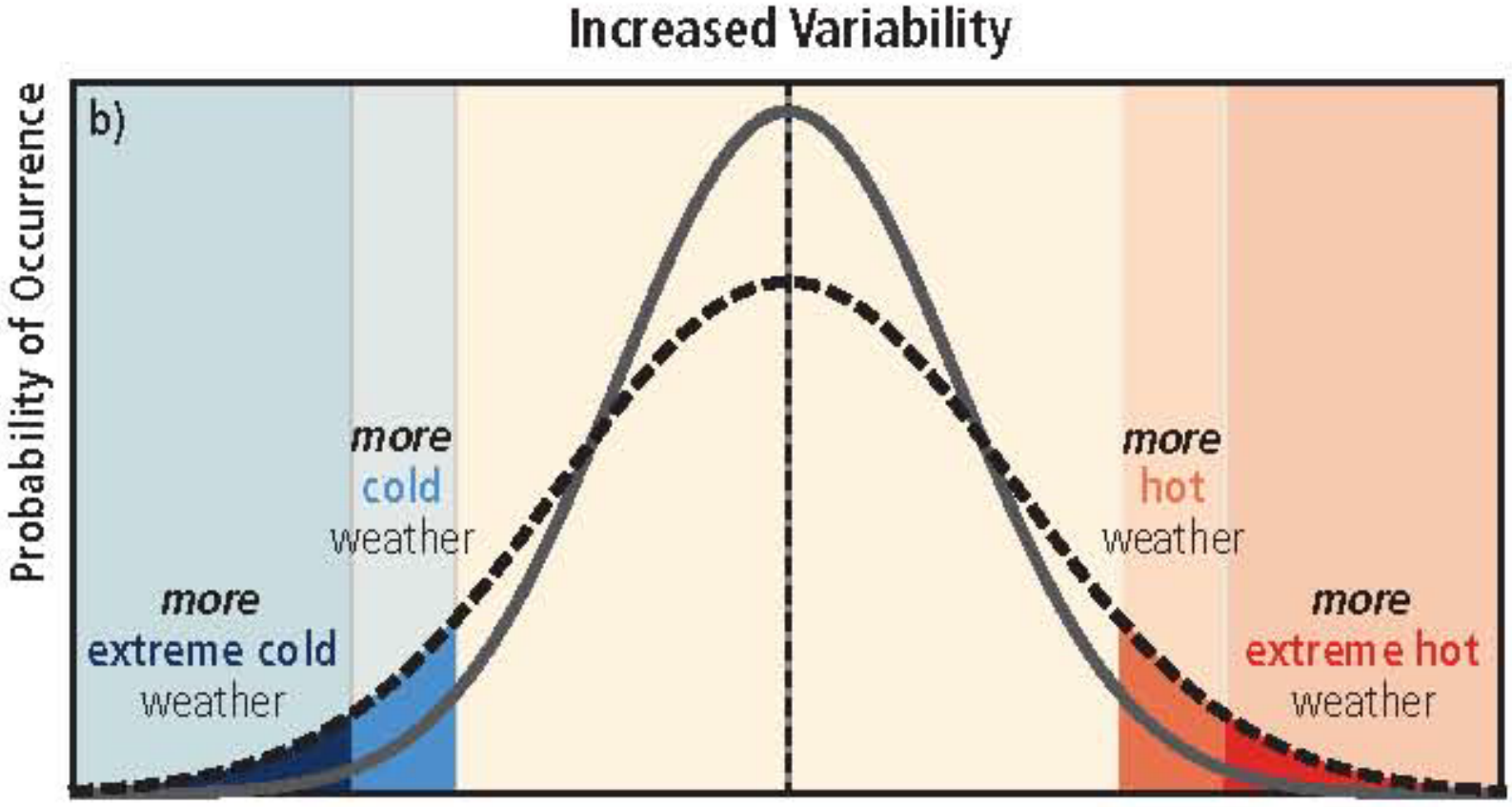
Higher temperature

Lower temperature



http://www.ncdc.noaa.gov/cag/time-series/us

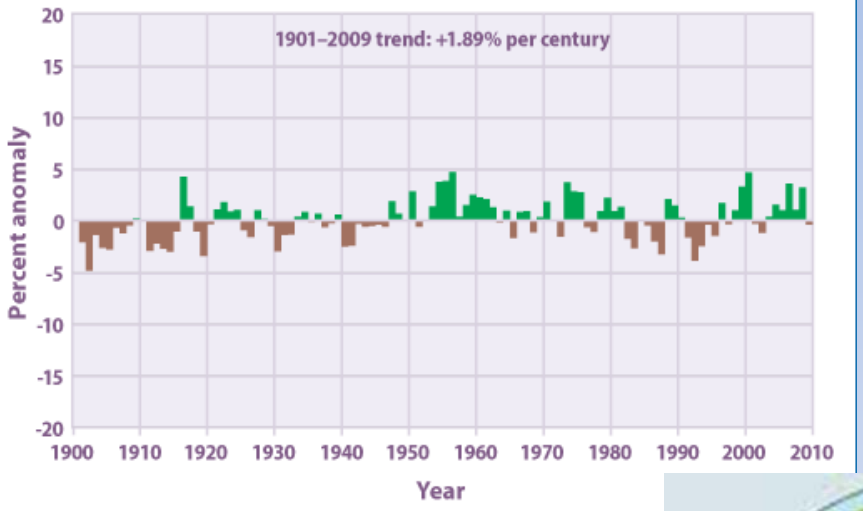
Extremes can occur and still show no change in average temperature

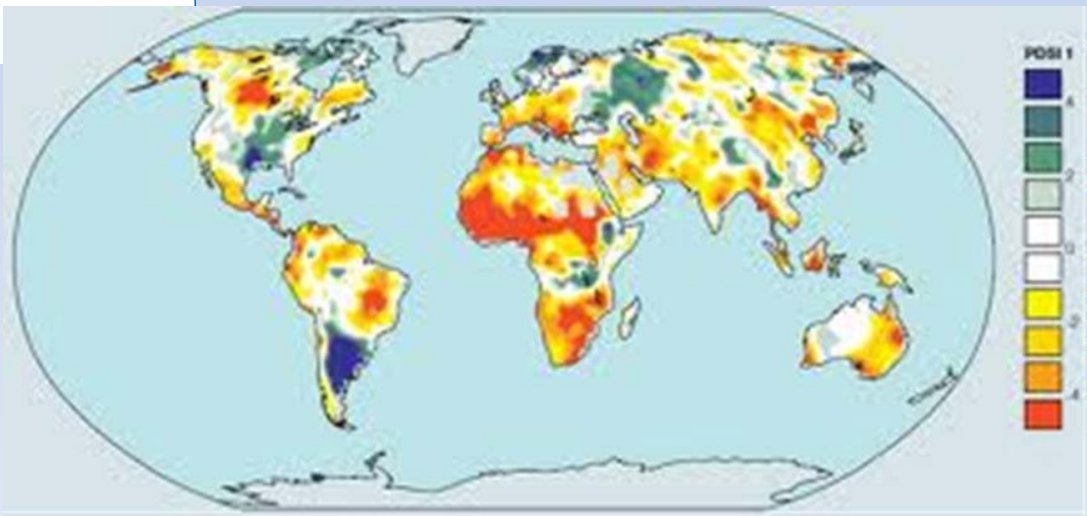


Source: 2012 IPCC Special Report

Same with Global Precipitation

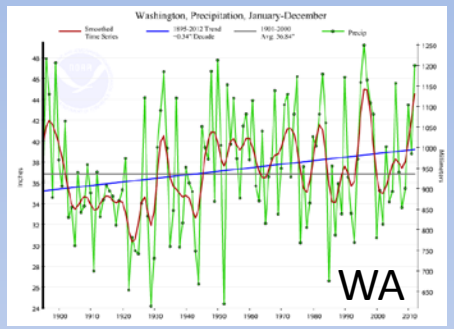
Figure 2. Precipitation Worldwide, 1901–2009

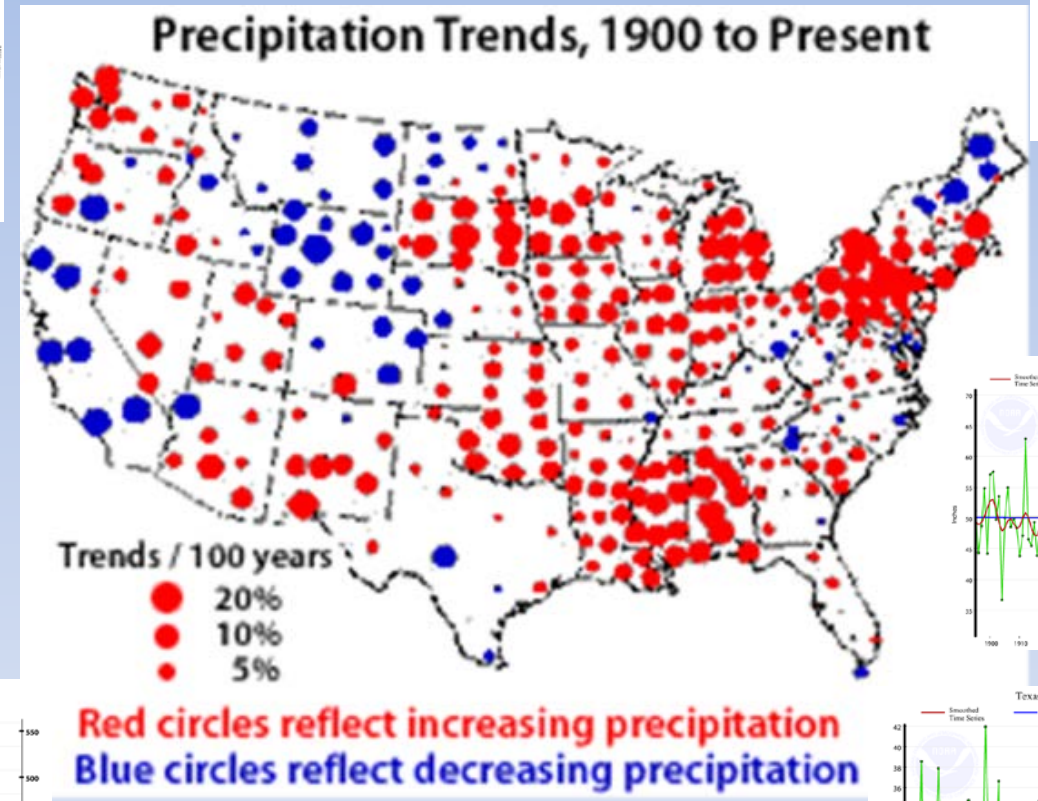


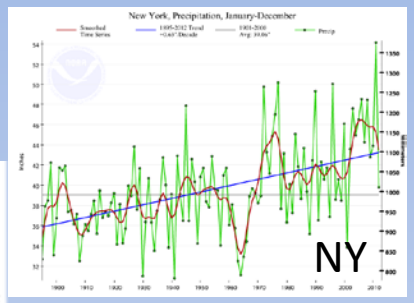


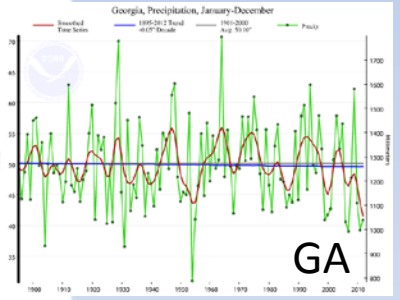
Review of Present Climate Trends:

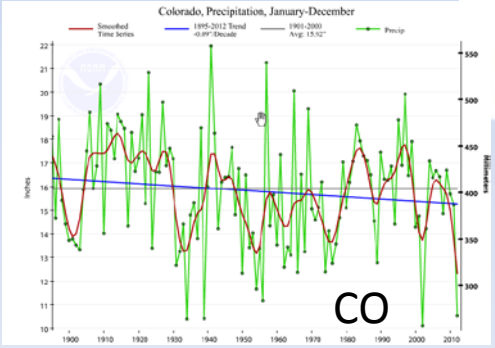
Precipitation

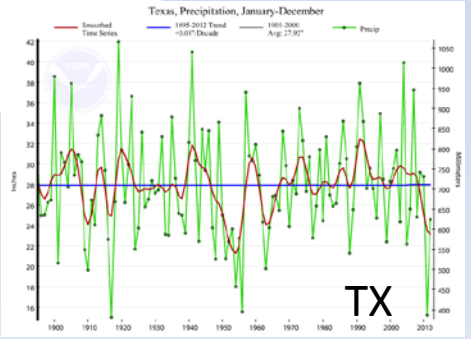




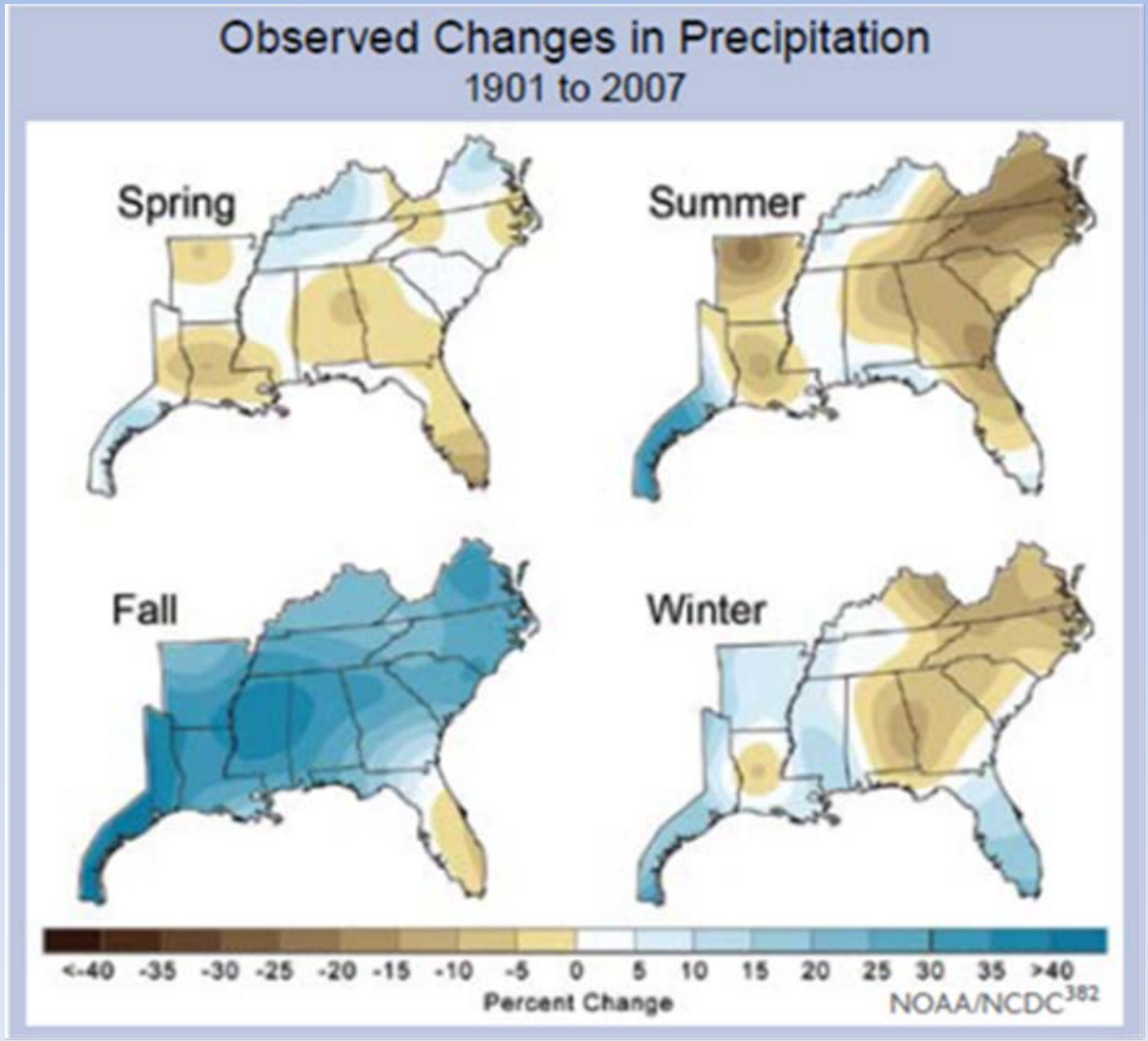








Seasonal Precipitation Trends



Today's Presentations

- Impacts to ecosystems, existing and projected, of changes in CO2, temperature, precipitation
- Strategies to reduce those impacts
  - **Mitigation**
- Strategies to tolerate or thrive despite those impacts
  - **Adaptation**
- Strategies to help you in the classroom

Why bother?

- Fisheries = $6B/yr
- Agriculture = $85B/yr
- Forestry = $15B/yr

Our Assessment, Spring 2012

- 746 educators responded to online survey, likely those who are interested. Not random sample.

Currently, 77% of respondents teach about climate change

Time spent	Courses
Informal discussions	Agriculture, chemistry, and physical science
Planned lessons < 1 week	Biology (regular and AP), earth science, integrated science, marine science
Planned lessons > 1 week	Environmental science (regular and AP), ecology, environmental issues

What do they need in lessons or materials?

It is very or somewhat important to the largest percentage of respondents for the module to help them meet the following goals:	
Connecting science to students' everyday lives	98%
Emphasizing critical thinking	98%
Developing data analysis skills	94%
Emphasizing choices that affect sustainability	92%
Emphasizing systems thinking	92%
Conveying life cycle analysis	85%

How do they teach about climate?

Over 85% believe it is appropriate or very appropriate to:

- Explain scientific uncertainty
- Present rationale for how people interpret climate change differently
- Discuss advantages and disadvantages of climate related policies
- Discuss the history of climate change science

More variation for "Presenting all perspectives as valid, even those that most scientists disagree with"

- 36% inappropriate or very inappropriate
- 41% appropriate or very appropriate

Address the science behind multiple perspectives

"It is also very important for students to learn about and ANALYZE different perspectives. This allows them to interpret and separate media hype from sound science."

Can be tricky

Adding climate change to course material

- Could increase student interest by connecting carbon to real world issue that is in the news

- Could decrease student interest if they do not believe climate change has anthropogenic causes, and even generate negative reactions

So we set up an experiment with Science Quest students through CPET last summer…

Two sessions on Carbon, with and without Climate

Week 1 (n=23)

- Pretest on carbon and climate change knowledge
- Activities
  - Carbon cycle + human
  - Measuring carbon in the forest, state's sequestration rate compared to emissions rate; how to mitigate
- Posttest
- Interviews

Week 2 (n=24)

- Pretest on carbon knowledge
- Activities
  - Carbon cycle
  - Measuring carbon in forest
- Posttest
- Human changes to carbon cycle, state's sequestration rate compared to emissions rate

Interviews

Results

	SQ 1 (n=23)	SQ 2 (n=24)	P Value	Standard Error
Mean Pretest Score	3.48 carbon 1.43 climate change	3.83 carbon	0.2247 carbon	0.2784 carbon
Mean Posttest Score	4.13 carbon 1.96 climate change	3.96 carbon 1.29 climate change	0.2951 carbon 0.0002* climate change	0.1622 carbon 0.1595 climate change
P Value	0.0102* carbon 0.0004* climate change	0.5430 carbon		
Standard Error	0.2319 carbon 0.1238 climate change	0.2025 carbon		

Week 1 increased carbon knowledge; week 2 did not.

Week 1 also learned more about climate change than week 2.

Interviewed students

44/47 students indicated they felt knowing carbon is an important part of climate change made the activities more interesting because

It made the activities more **important**
It made the activities more **relevant**
Climate change is **controversial**
It gave them a better **understanding** of carbon concepts and climate change

How you convey this information is important!

Comments or questions?