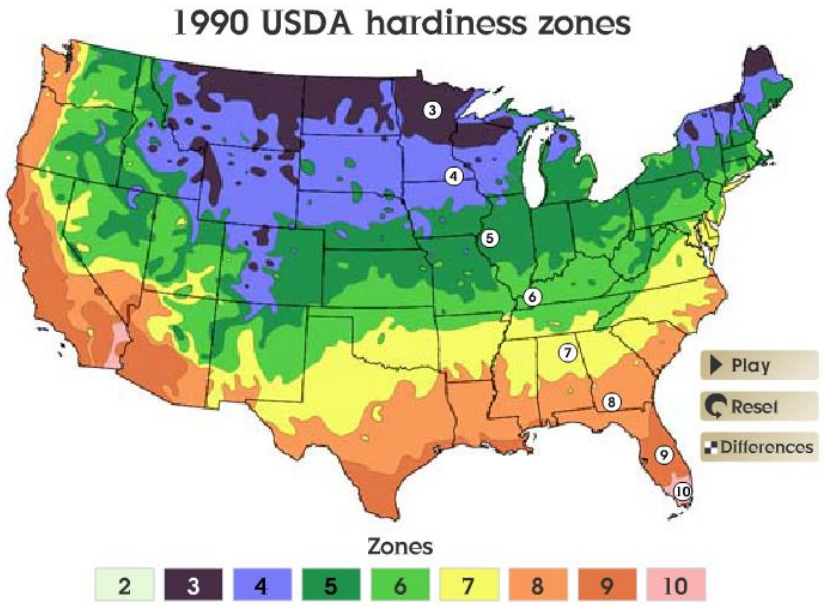
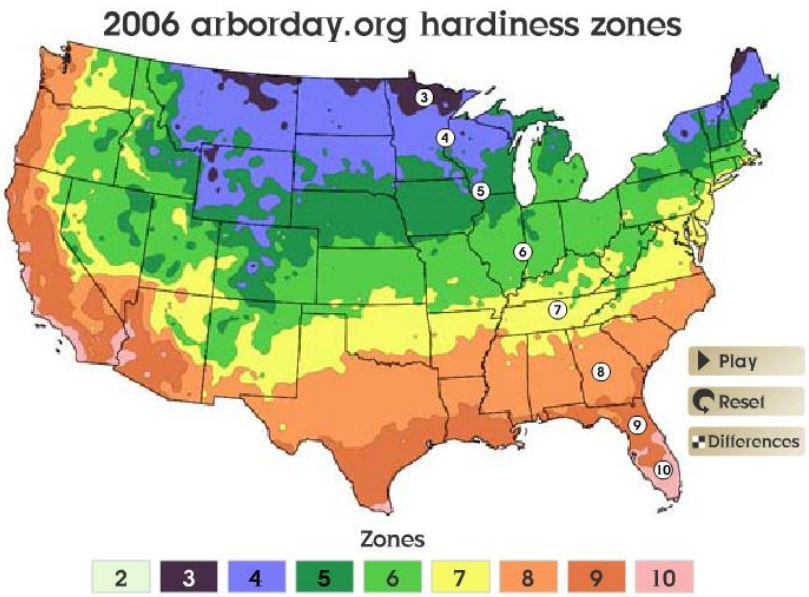
What is “Climate Change”?

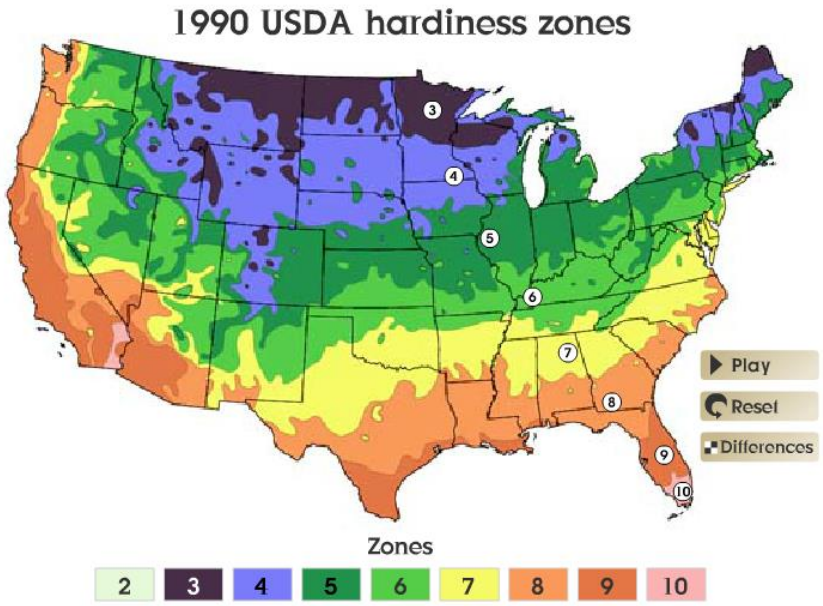
Have you or someone you know been affected by climate change?

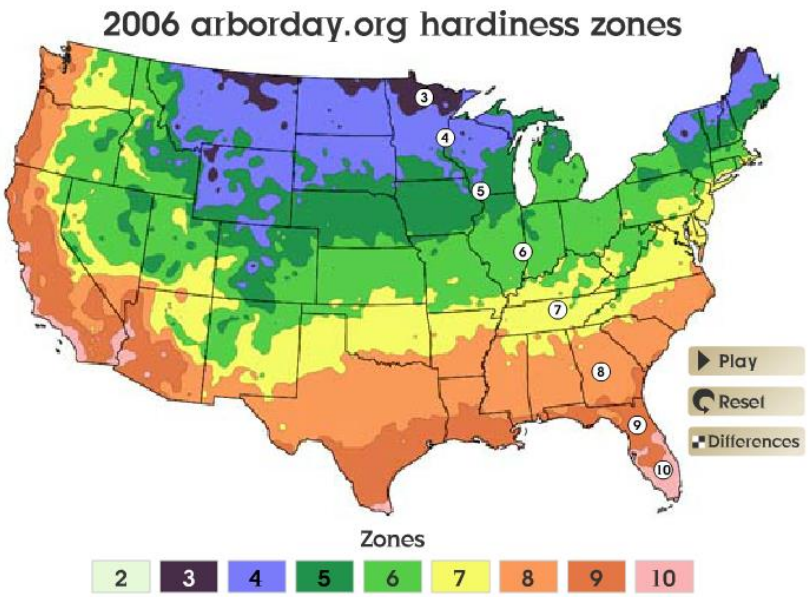




Has the climate always been the same?

How do you know?





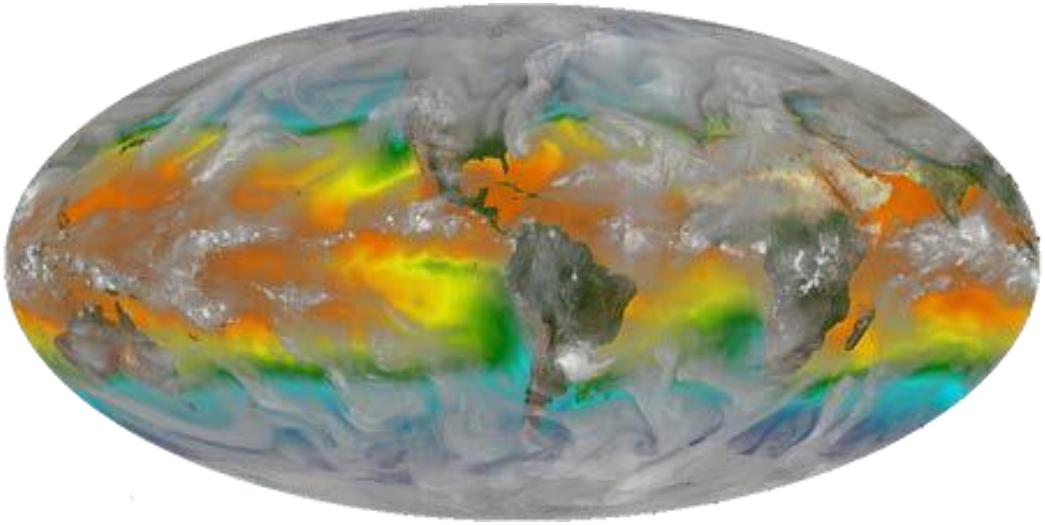
Climate Change Summary
What we know and how we know it

Margaret Mooney

Cooperative Institute for Meteorological Satellite Studies (CIMSS)

a presentation in conjunction with the

CIMSS Climate Literacy Ambassadors project



What we know

1882

2005

Warming of the climate system is unequivocal

Since the 1950s, many of the observed changes are **unprecedented** over decades to millennia.

The atmosphere and ocean have warmed,
the amounts of snow and ice have diminished,
sea level has risen,
and concentrations of greenhouse gases have increased.

What has caused the climate to change?

What we know

Human influence on the climate system is clear.

This is evident from

increasing atmospheric greenhouse gas concentrations
positive radiative forcing,
observed warming,
and understanding of the climate system.

IPCC 2013 Summary for Policy Makers

What we know

Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system.

Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

IPCC 2013 Summary for Policy Makers

What evidence shows that the climate has changed?

How we know it

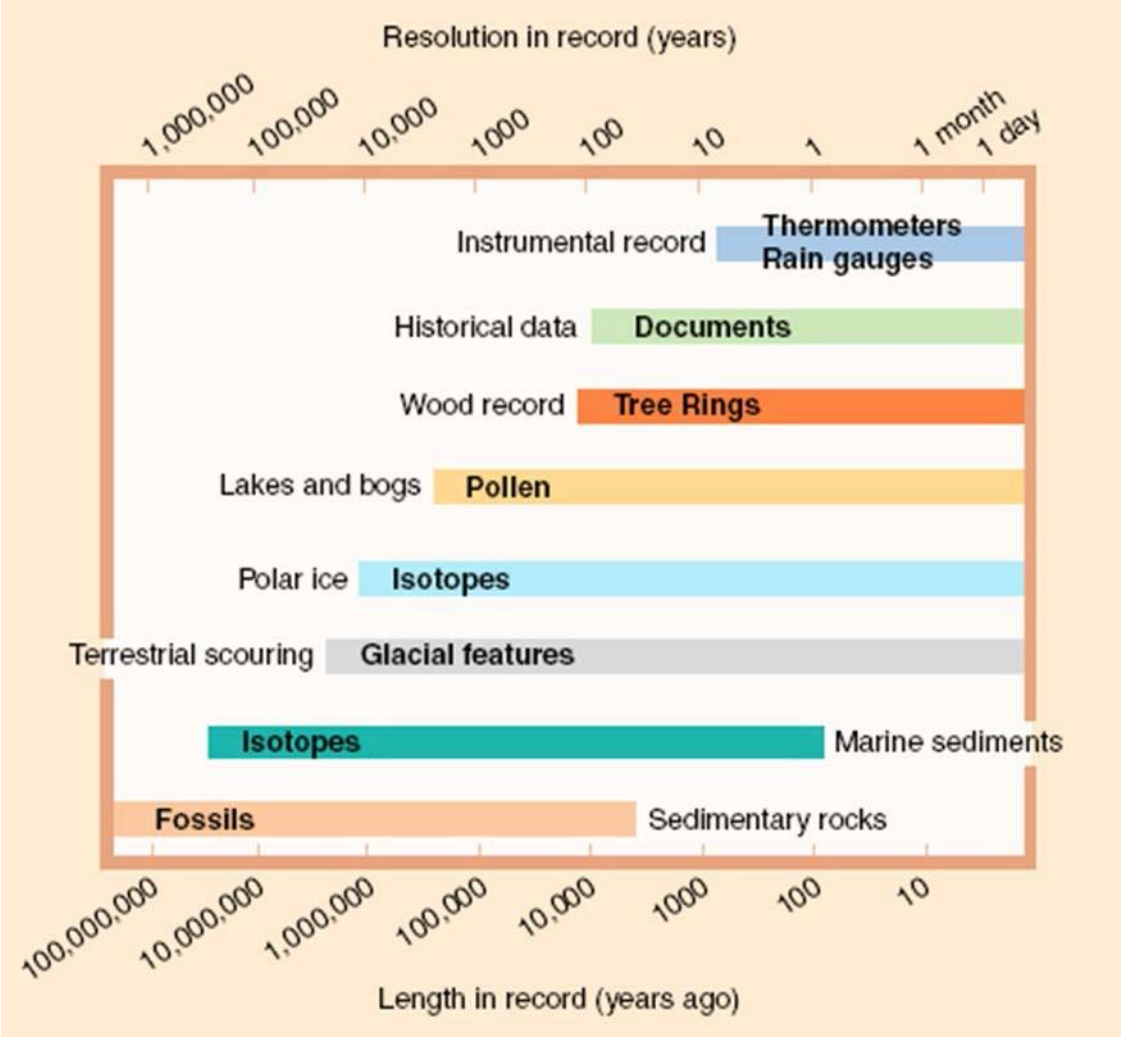
Proxy Data

Data from natural recorders of climate variability such as tree rings, ice cores, fossils, pollen, or ocean sediments. Paleoclimatologists use “proxy” clues to infer past climates.

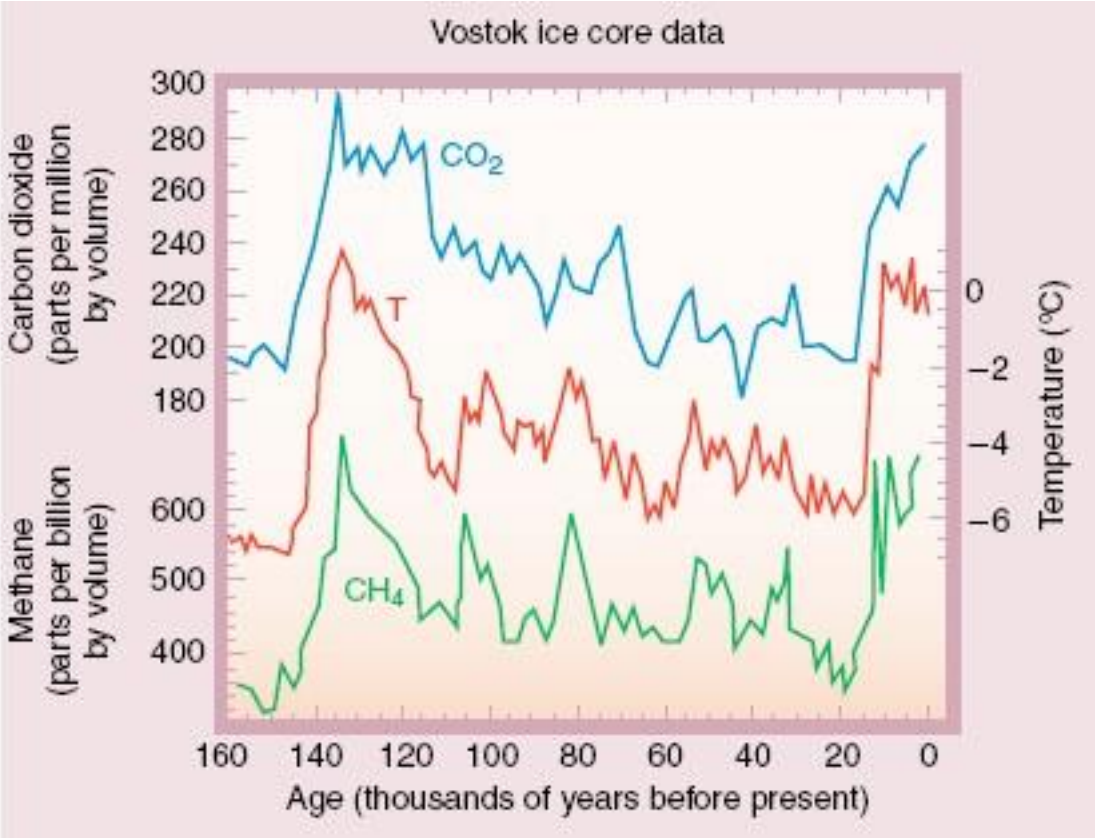
Direct Observations

Data obtained from instruments like thermometers, altimeters, tidal gauges or rain gauges -
or remotely via satellite observations.

Proxy Data – prior to ~150 years ago

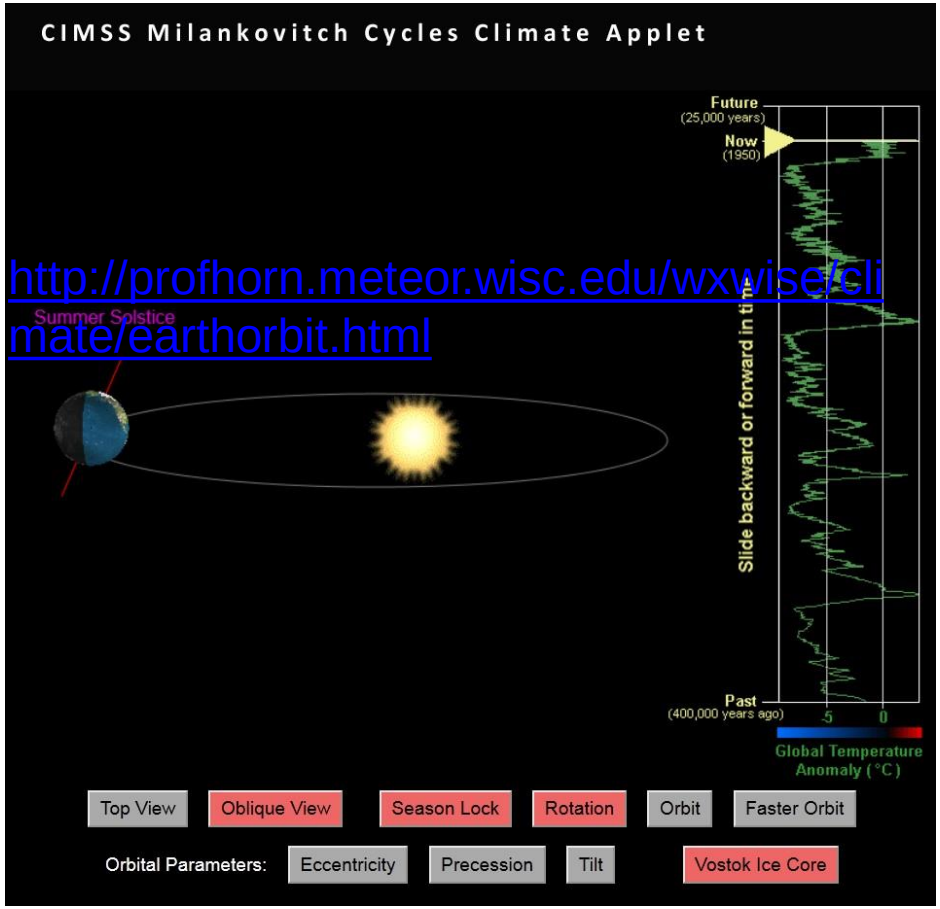


Ice Core data connections between temperatures (red) and greenhouse gases



CIMSS Milankovitch Applet

A computer activity that shows how changes in Earth's Eccentricty, Precession and Tilt over the last 400,000 years corresponds to past climates and proxy data from the Vostok Ice Cores.



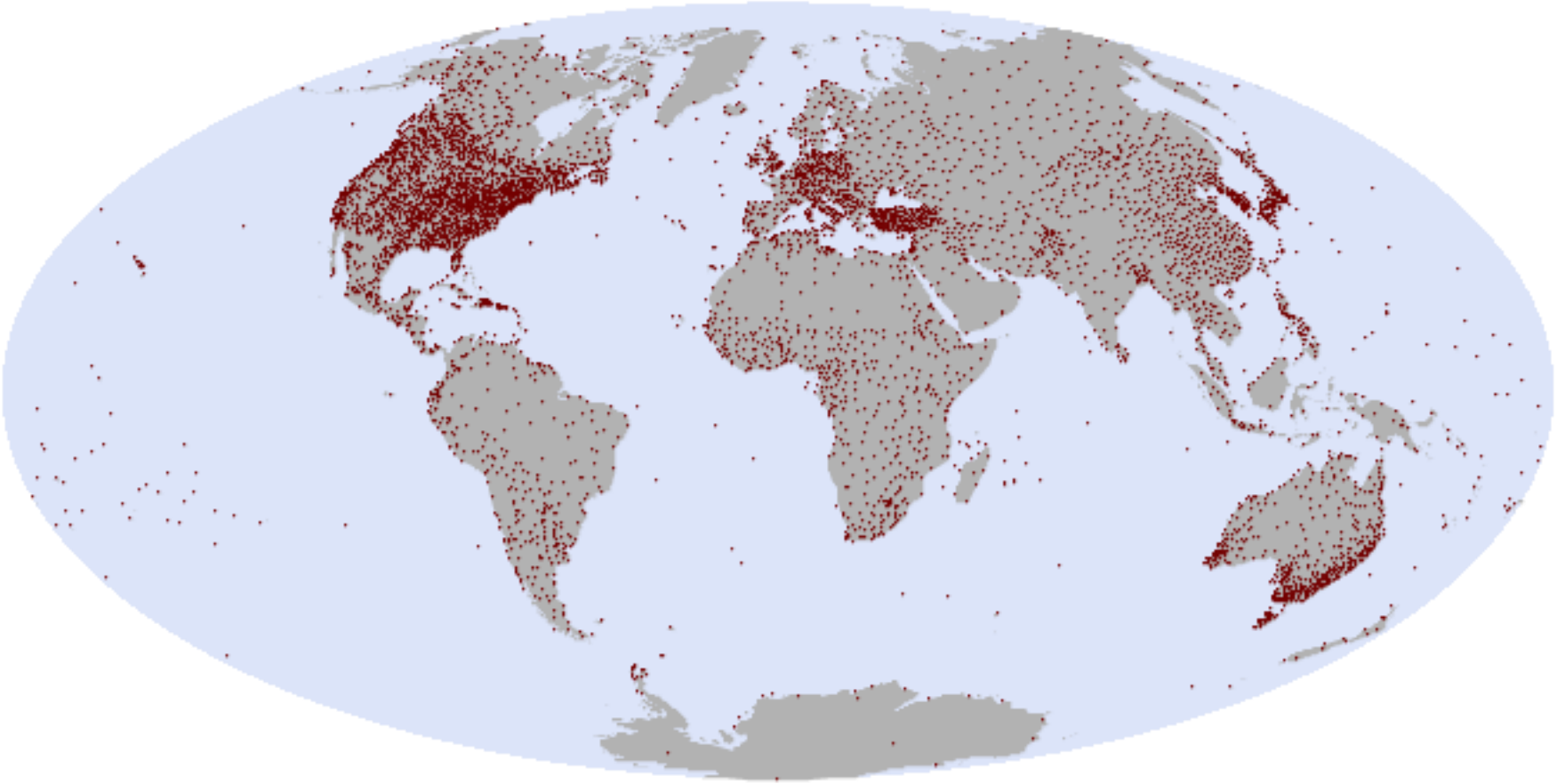
http://profhorn.meteor.wisc.edu/wxwise/climate/earthorbit.html

http://profhorn.meteor.wisc.edu/wxwise/climate/earthorbit.html

Direct Observations

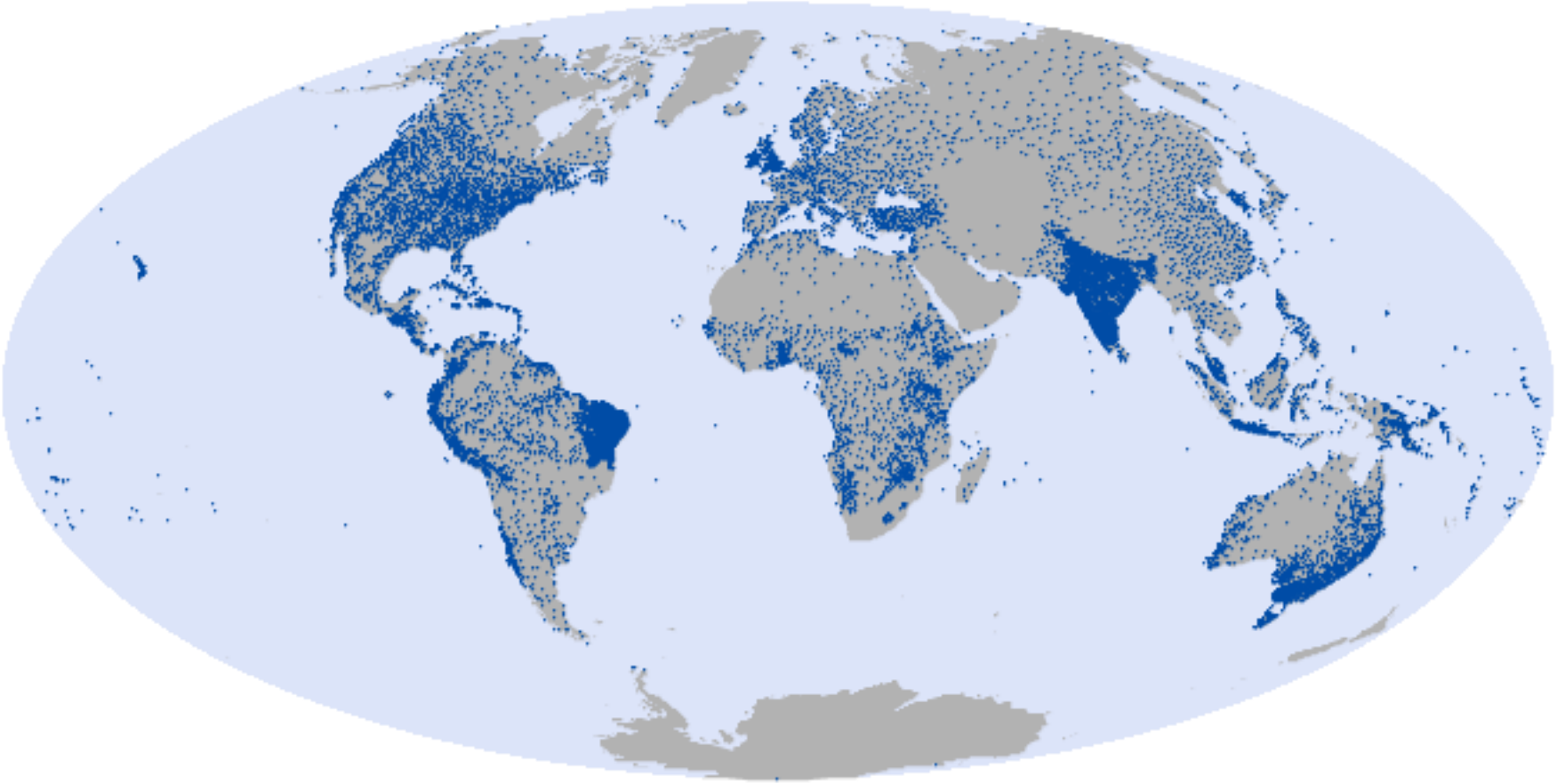
Consistent, repeated, long-term observations of weather are the foundation of climate science

Hundreds of stations record and report high and low temperatures every day



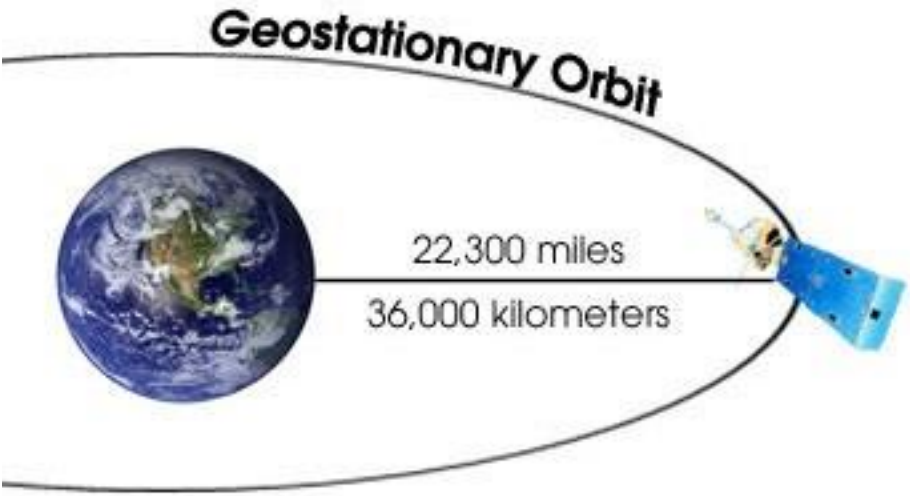
Temperature stations

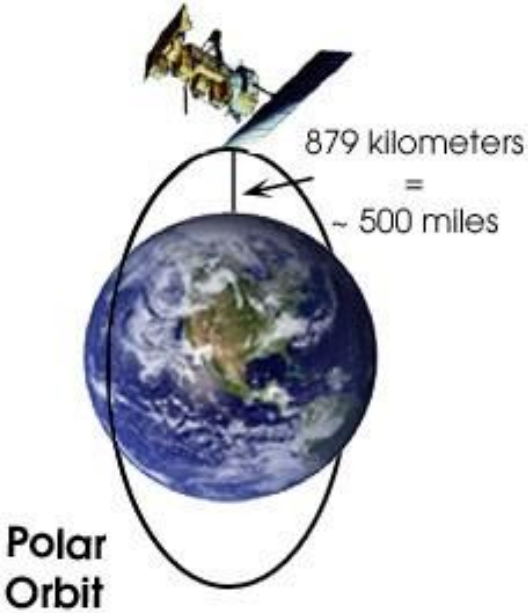
Even more stations report precipitation totals, especially where agriculture depends on rain

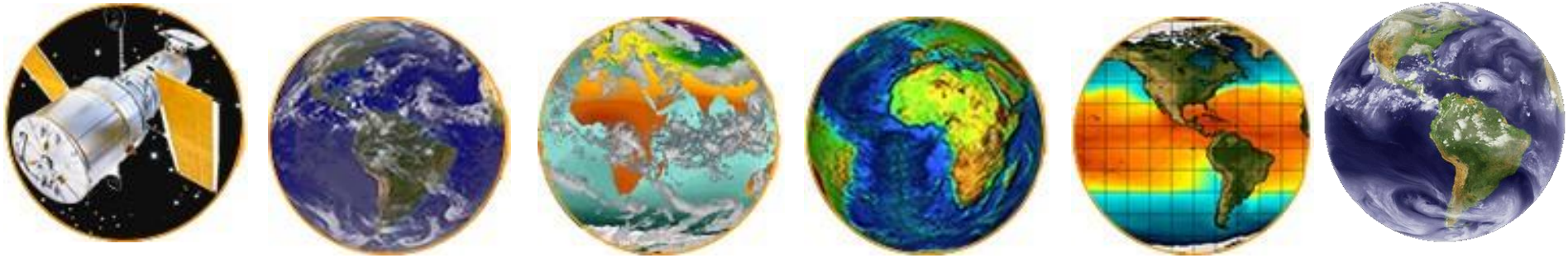


Precipitation stations

Since 1960, an ever increasing number of satellites monitor Earth's status from orbit







Direct Observations

All Figures © IPCC 2013

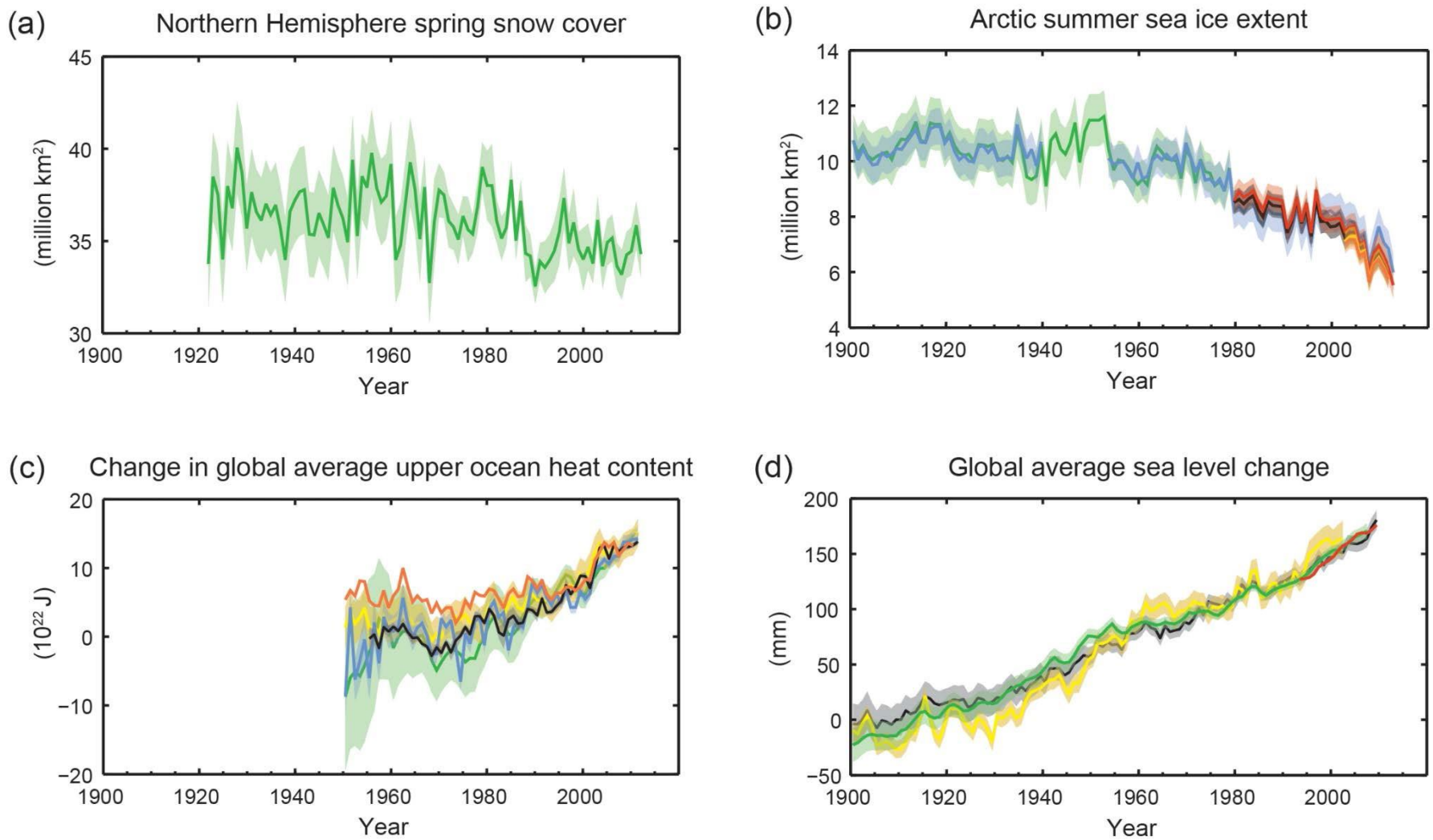


Figure SPM.3 - Multiple observed indicators of a changing global climate – **IPCC 2013**

Direct Observations

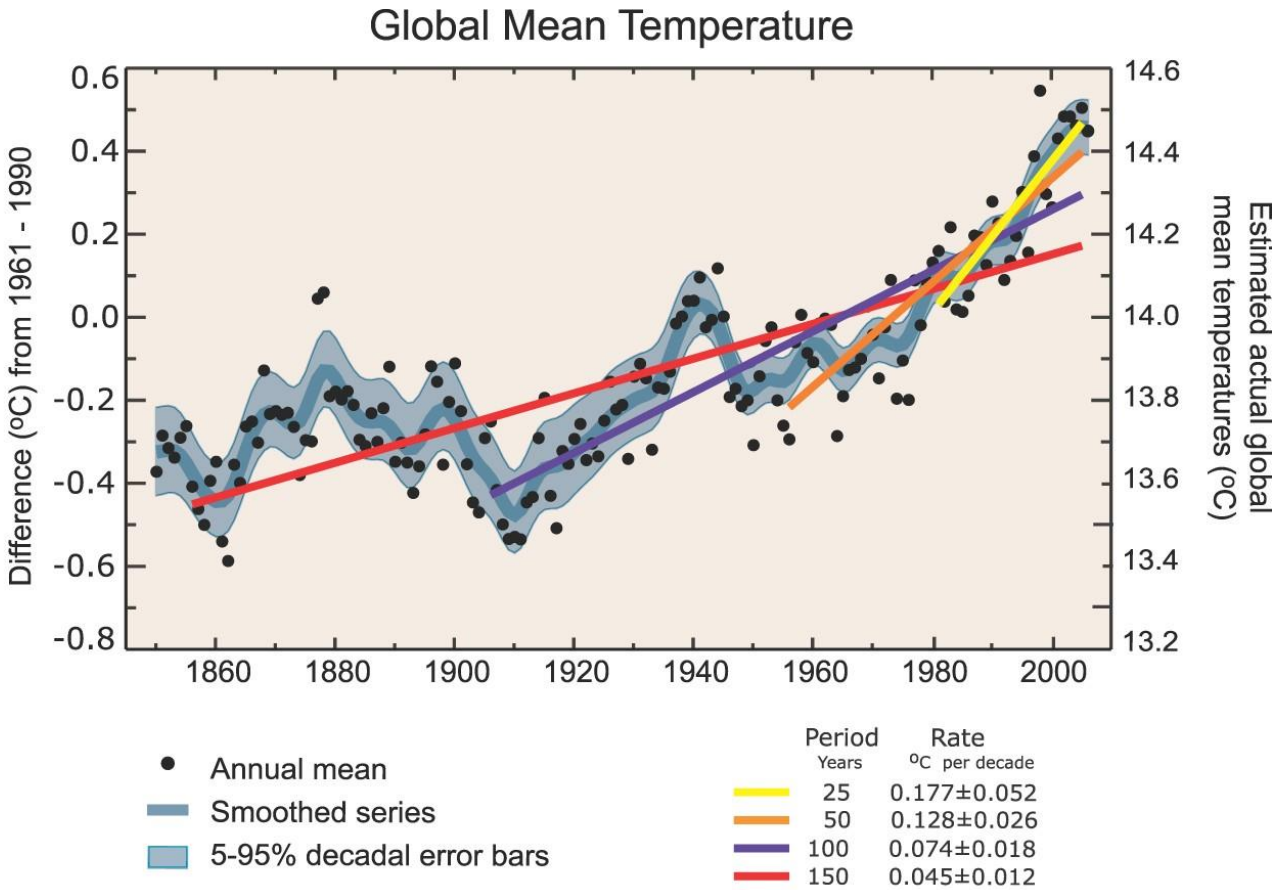
http://climate.nasa.gov/

Direct Observations

http://cpo.noaa.gov/warmingworld/

How is the current climate change different from previous changes?

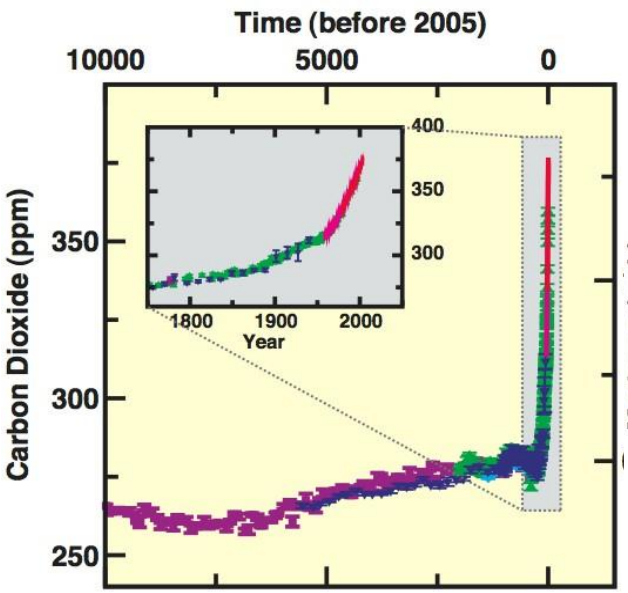
Earth's climate system is warming **at an unprecedented rate**



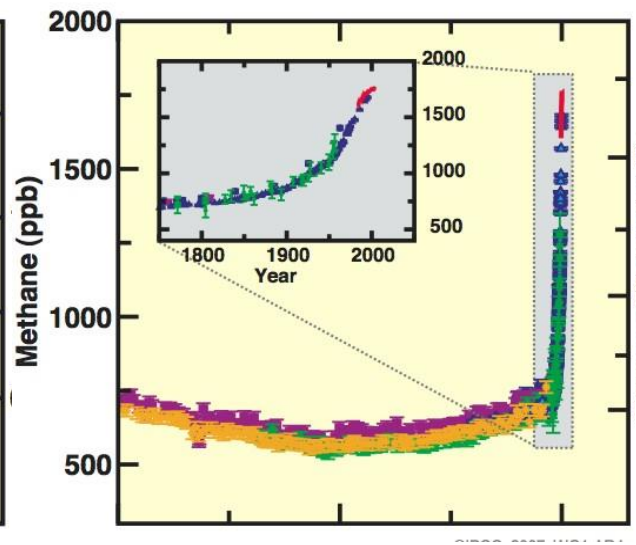
Source: 2007 IPCC report

Industrial revolution and the atmosphere

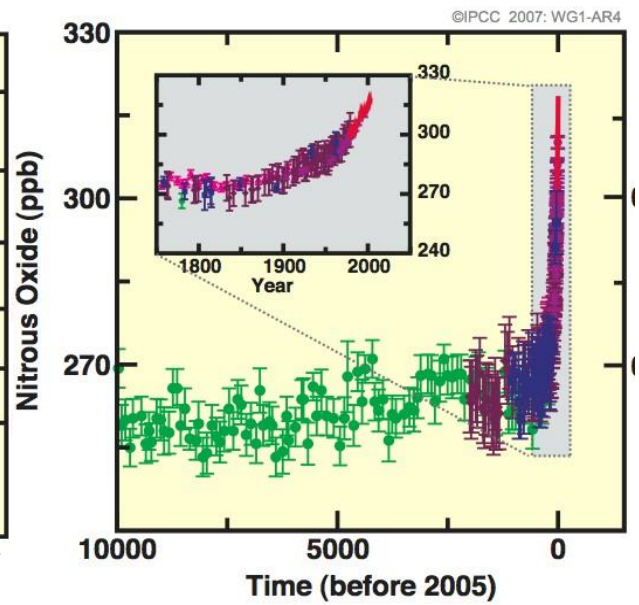
The current concentrations of key greenhouse gases, and their rates of change, are unprecedented.



Carbon dioxide



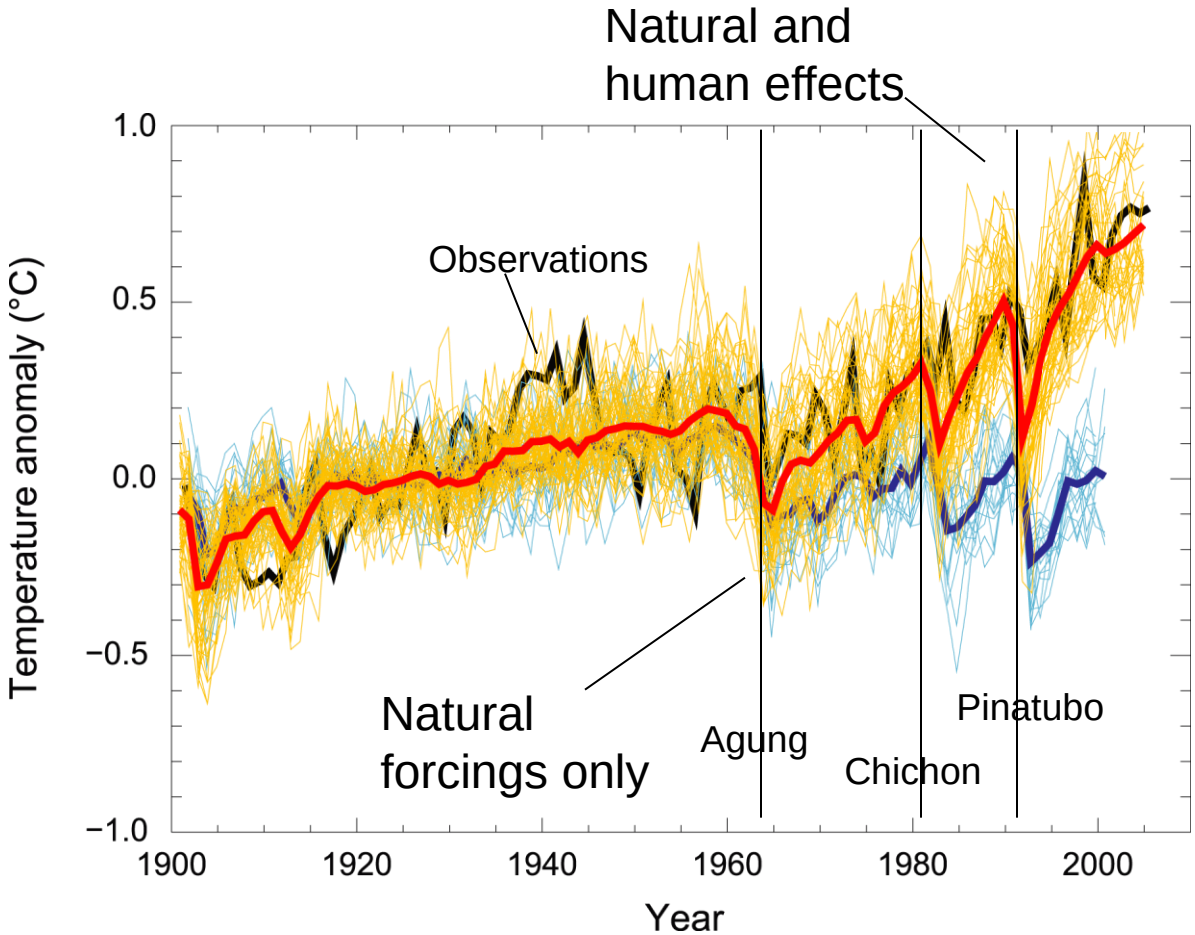
Methane



Nitrous Oxide

Intergovernmental Panel on Climate Change 2007

Are Humans Responsible?



IPCC WG1 - 2007
(Intergovernmental Panel on Climate Change)

IPCC increased confidence assessing human influence on climate

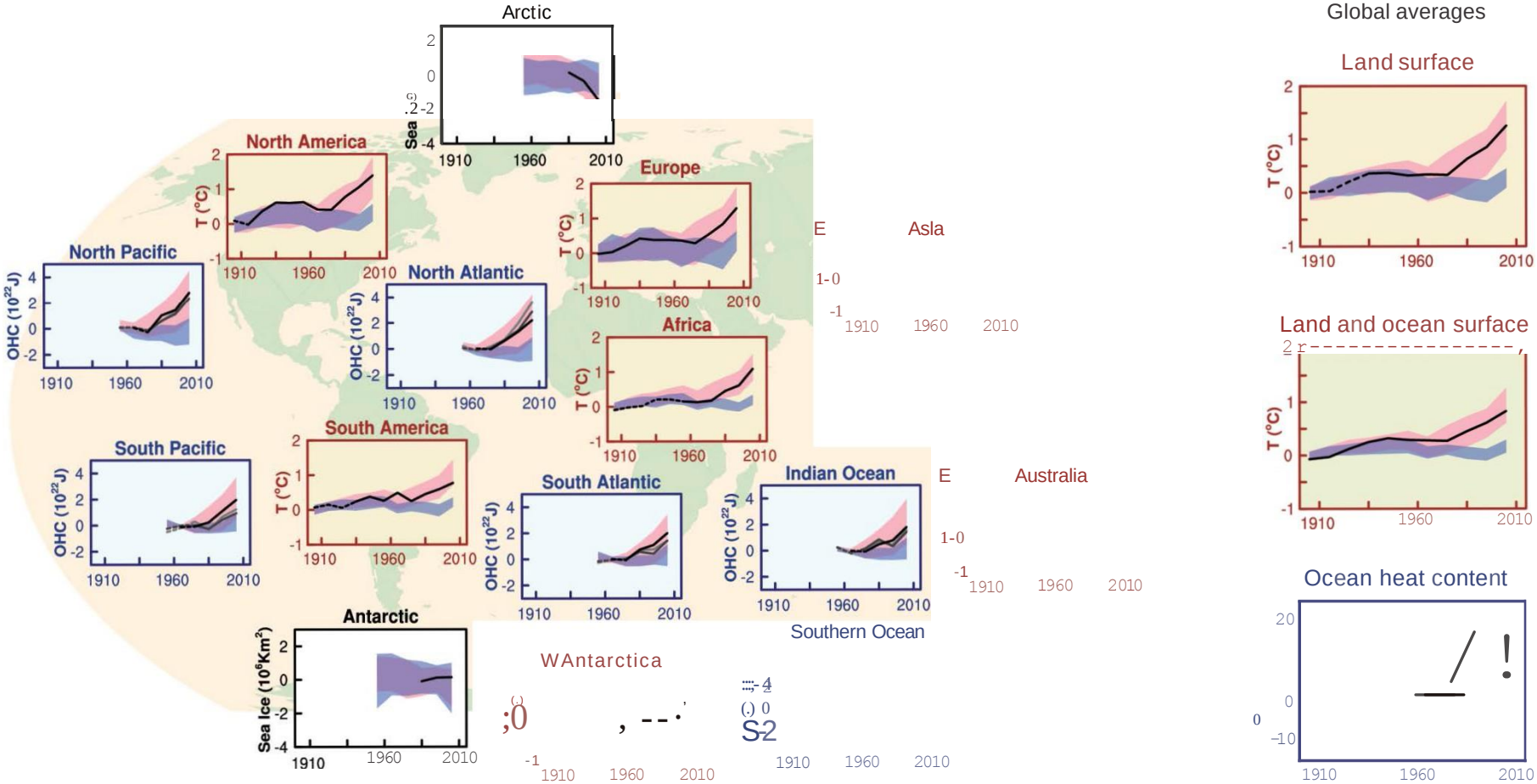
"The balance of evidence suggests a discernible human influence on global climate".
--IPCC Second Assessment Report, **1995**

"There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities".
--IPCC Third Assessment Report, **2001**

"Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".
--IPCC Fourth Assessment Report, **2007**

"It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century."
--IPCC Fifth Assessment Report, **2013**

Comparing the Results from Computer Models of Climate Change with Actual Observations Shows That Models That Include Human Impacts Are More Accurate.



Observations - Models using only natural forcings Models using both natural and anthropogenic forcings

IPCC AR5 Working Group I
Climate Change 2013: The Physical Science Basis

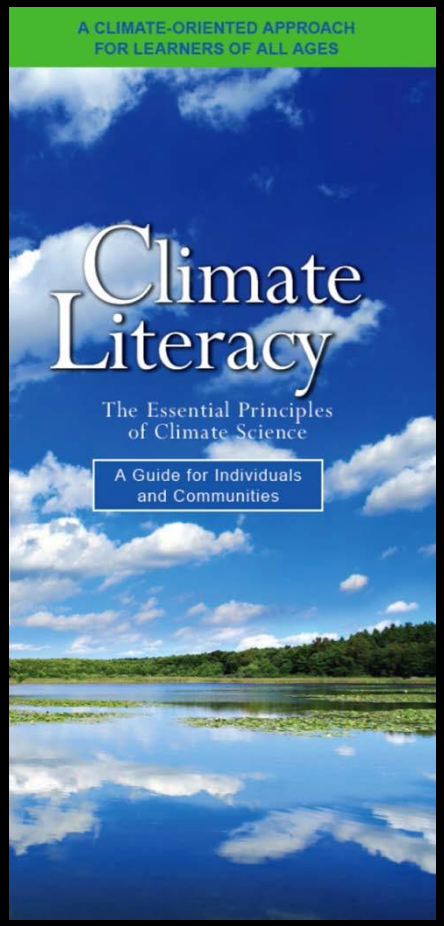
Figure SPM6 Comparison of observed and simulated climate change

All Figures© IPCC 2013

INTERGOVERNMENTAL PANEL ON clima1e chan e

What is currently being done to reduce climate change?

What else can be done?

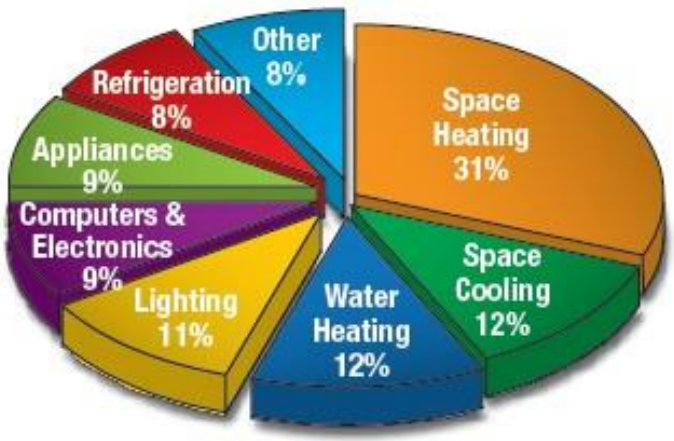


Guiding Principle:

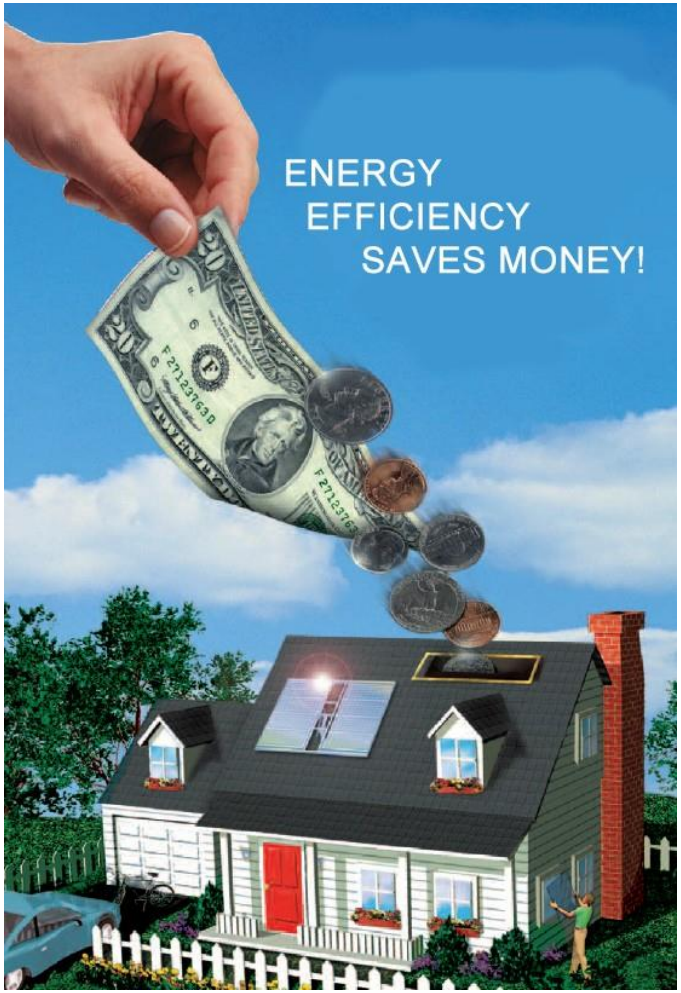
Humans can take actions to reduce climate change and its impacts

Many actions have co-benefits

Co-Benefits of Carbon Mitigation



How We Use Energy in Our Homes



- By using less energy, you can **reduce carbon emissions** *and* **save money**
- By walking or riding a bike to work a few days a week you can **improve your health** *and* **save money**

Co-Benefits of Driving Less: Clean Air

Along with saving money on gas ….

Asthma and Air Pollution

- Natural experiment during 1996 Summer Olympic games in Atlanta
- Peak morning traffic decreased 23% and peak ozone levels decreased 28%

- Asthma-related emergency room visits by children decreased 42%
- Children's emergency visits for non-asthma causes did not change during same period

Friedman et al. *JAMA* 2001;285:897

Can you commit to car pooling, walking or riding to work one day a week? (or two or three?)

Co-Benefits of Driving Less: Health

Along with saving money on gas ….

Personal Fitness and Health

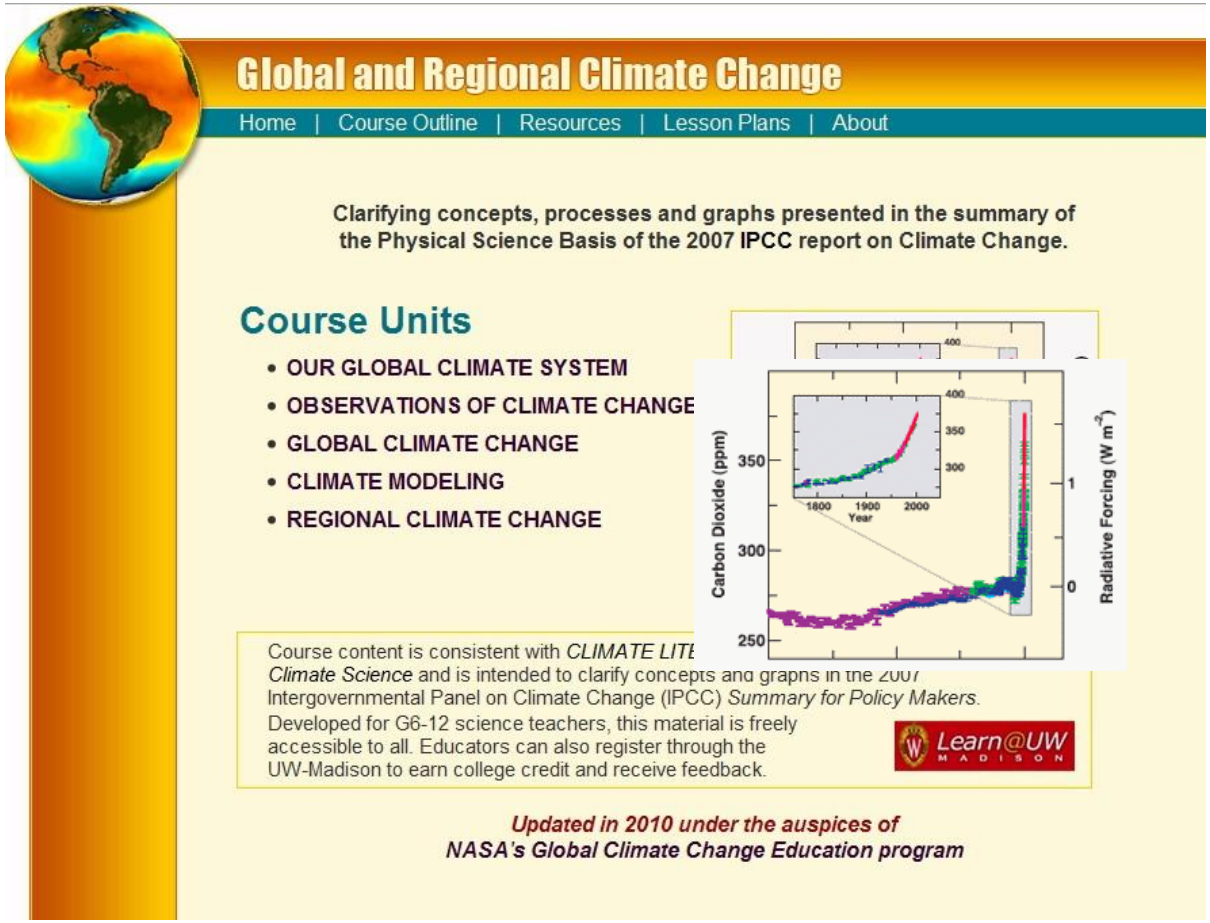
- Average Bicycle Commute in Madison is **3.4 miles**
- Energy Expenditure: **144 kcal** round trip
- Around 200 minutes additional physical activity

- **9-10 lbs** weight loss in year

- Reduce risk of ischaemic heart disease by 47%
- Reduce risk of stroke by 39%
- Reduce risk of breast cancer for women by 34%
- Reduce risk for colon cancer by 43%
- Reduce risk for type II diabetes by 31%

WHO, CRA 2002

Teacher Resources

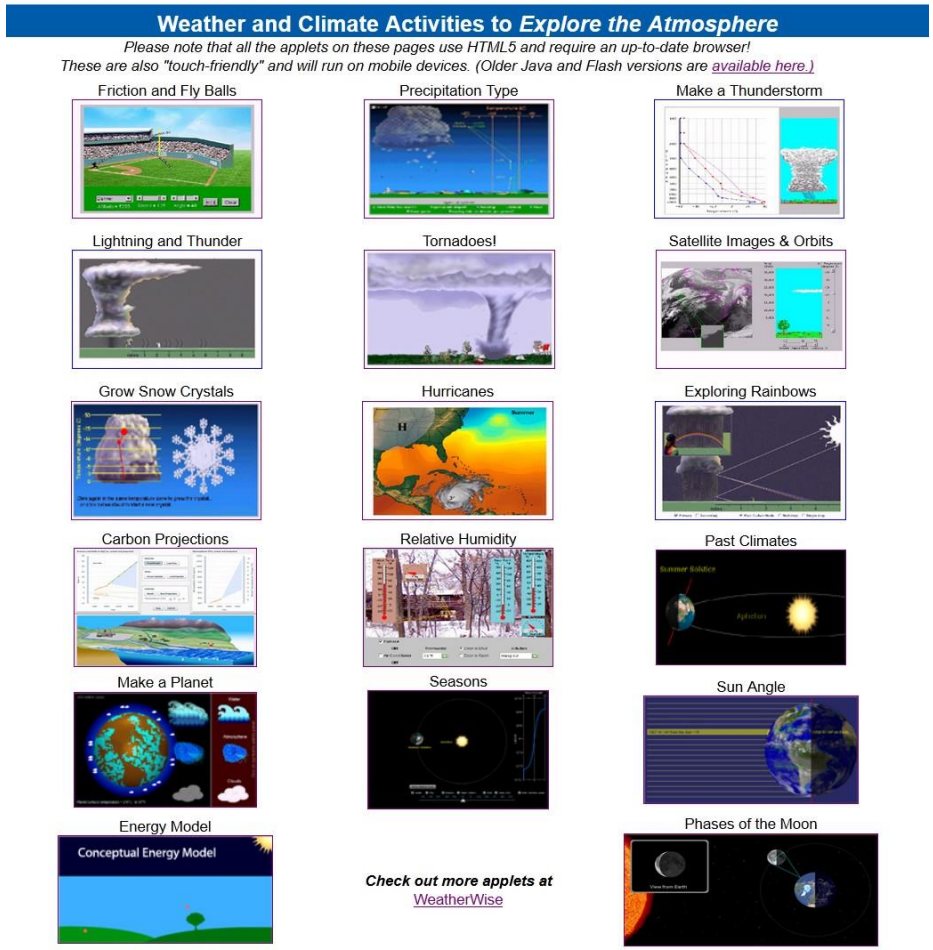


- Based on 2007 IPCC report *(incorporating 2013 data)*
- Can print out Certificate

- Lesson plans by teachers

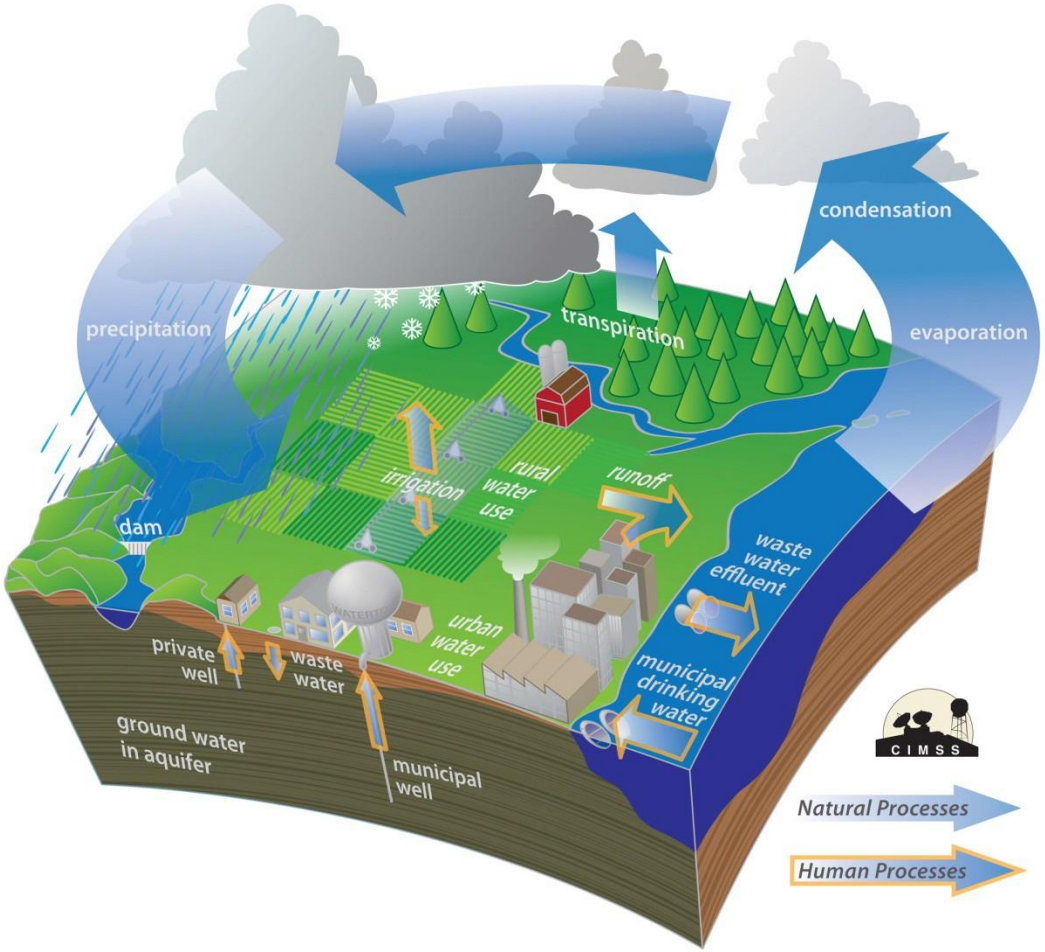
http://cimss.ssec.wisc.edu/climatechange/

More Resources
- CIMSS Weather & Climate Applets



http://cimss.ssec.wisc.edu/wxfest/

More Resources
– Modern Water Cycle Diagram



http://cimss.ssec.wisc.edu/climatechange/GreatLakesModernWaterCycleCIMSS.jpg

More Resources

Climate Digest from the CIMSS EarthNow Blog

http://sphere.ssec.wisc.edu/

More Resources …

AAAS - What we Know
http://whatweknow.aaas.org/

NASA Climate Change
http://climate.nasa.gov/

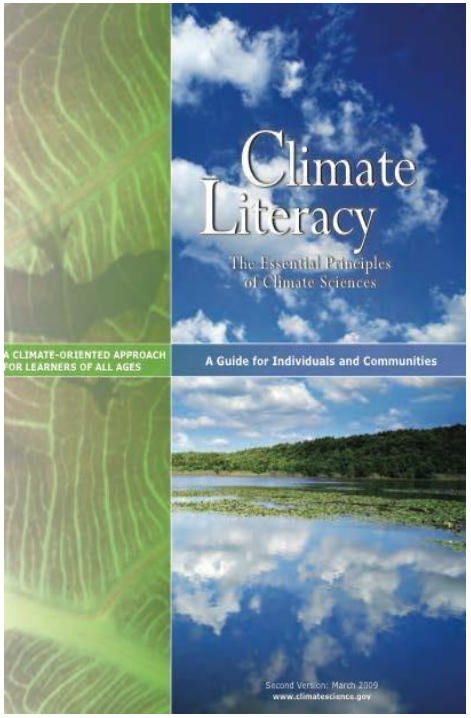
NOAA Climate.gov
http://www.climate.gov/teaching

Intergovernmental Panel on Climate Change (IPCC)
http://www.ipcc.ch/

Paleoclimate perspectives -
http://cimss.ssec.wisc.edu/climatechange/observations/lesson5/intro.html

Skeptical Science
http://www.skepticalscience.com/

The CIMSS Climate Literacy Ambassadors program (http://cimss.ssec.wisc.edu/education/cla/) **was developed to raise awareness of climate science and lay the foundation for the guiding principle of the Climate Literacy:**

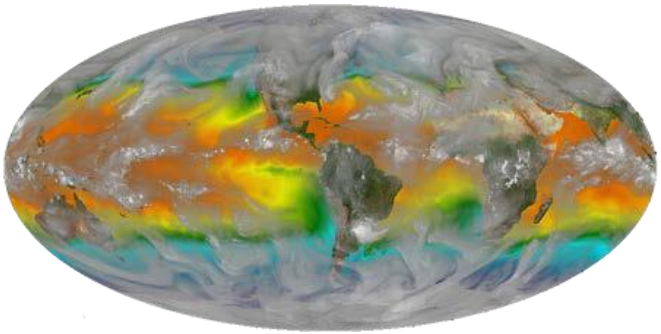


Humans can take actions to reduce climate change and its impacts

Climate Change Summary
What we know and how we know it

Margaret Mooney
Cooperative Institute for Meteorological Satellite Studies (CIMSS)
April 2014

margaret.mooney@ssec.wisc.edu



http://cimss.ssec.wisc.edu/education/