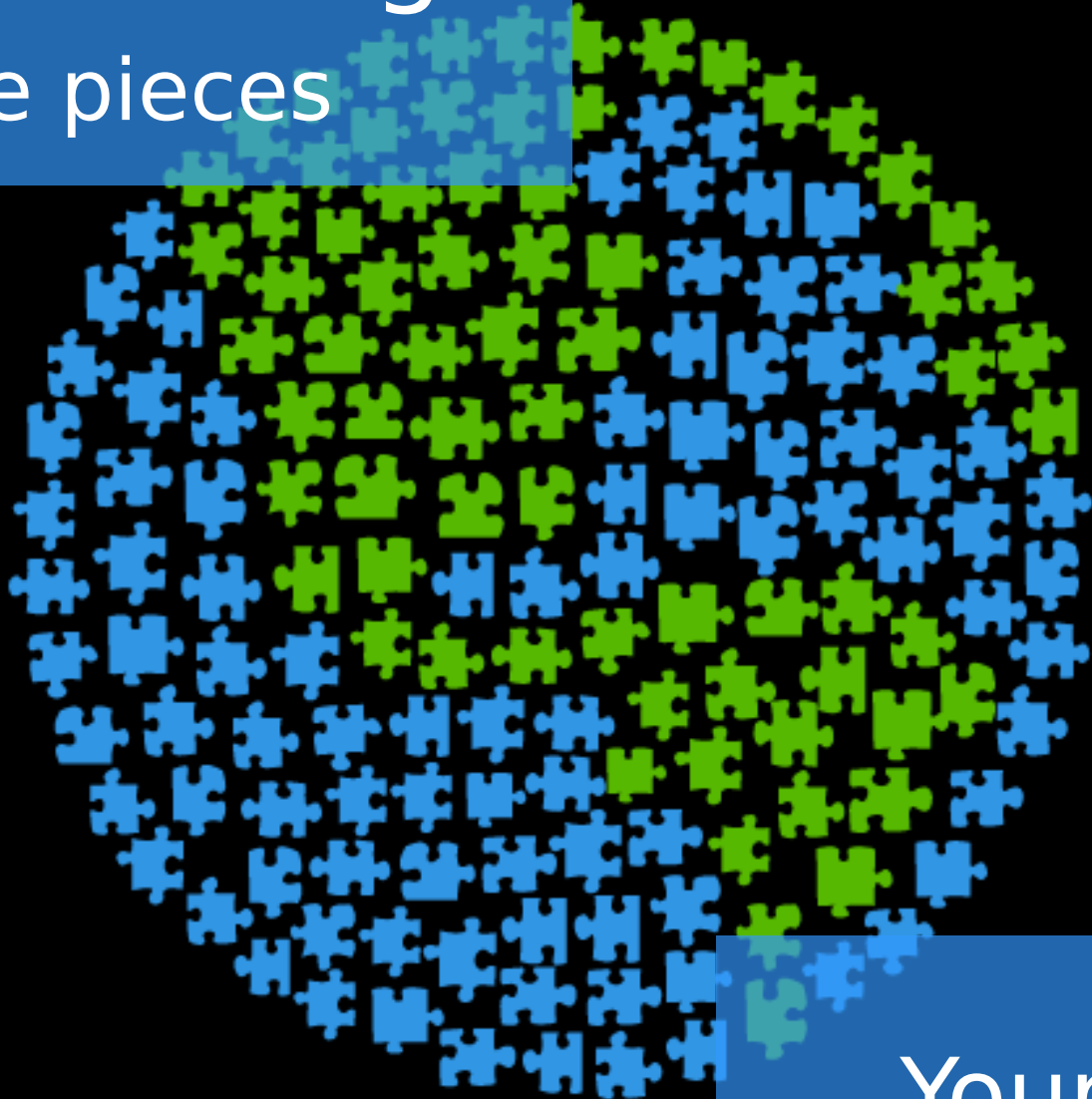


Climate Change:

Fitting the pieces
together



Presented by:

Your Name
Here



Outline

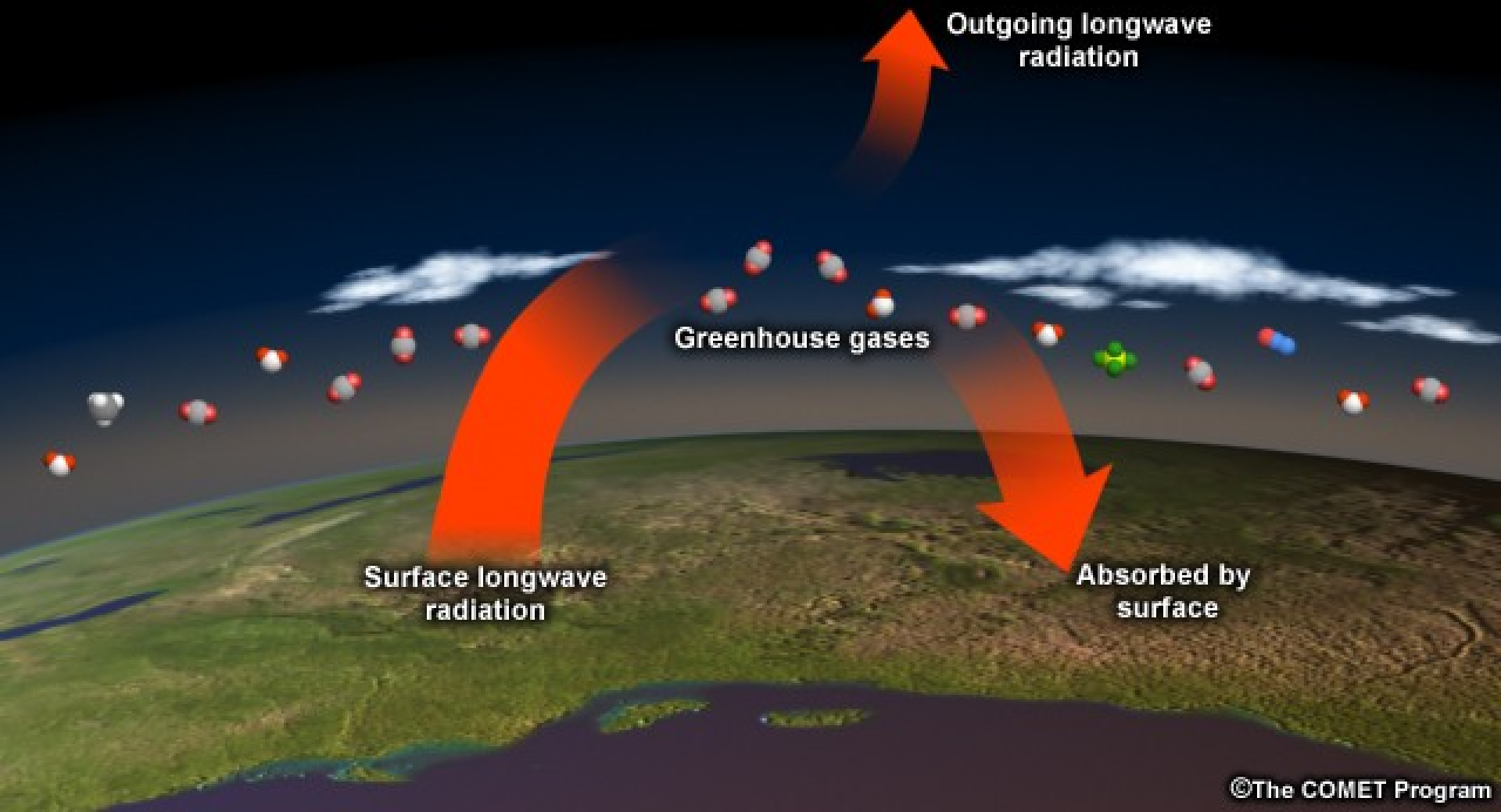
- What changes climate?
- Is it real?
- How do we know?
- Why should we care?
- How sure are scientists?
- What next—what can we do?

What changes climate?

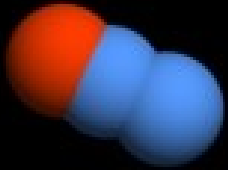
- Changes in:
 - Sun's output
 - Earth's orbit
 - Drifting continents
 - Volcanic eruptions
 - Greenhouse gases



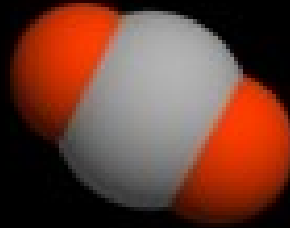
Increasing greenhouse gases trap more heat



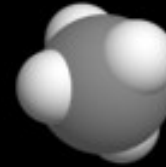
Greenhouse gases



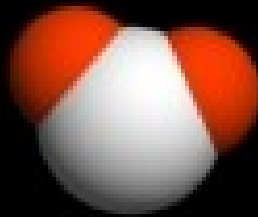
Nitrous oxide



Carbon dioxide



Methane



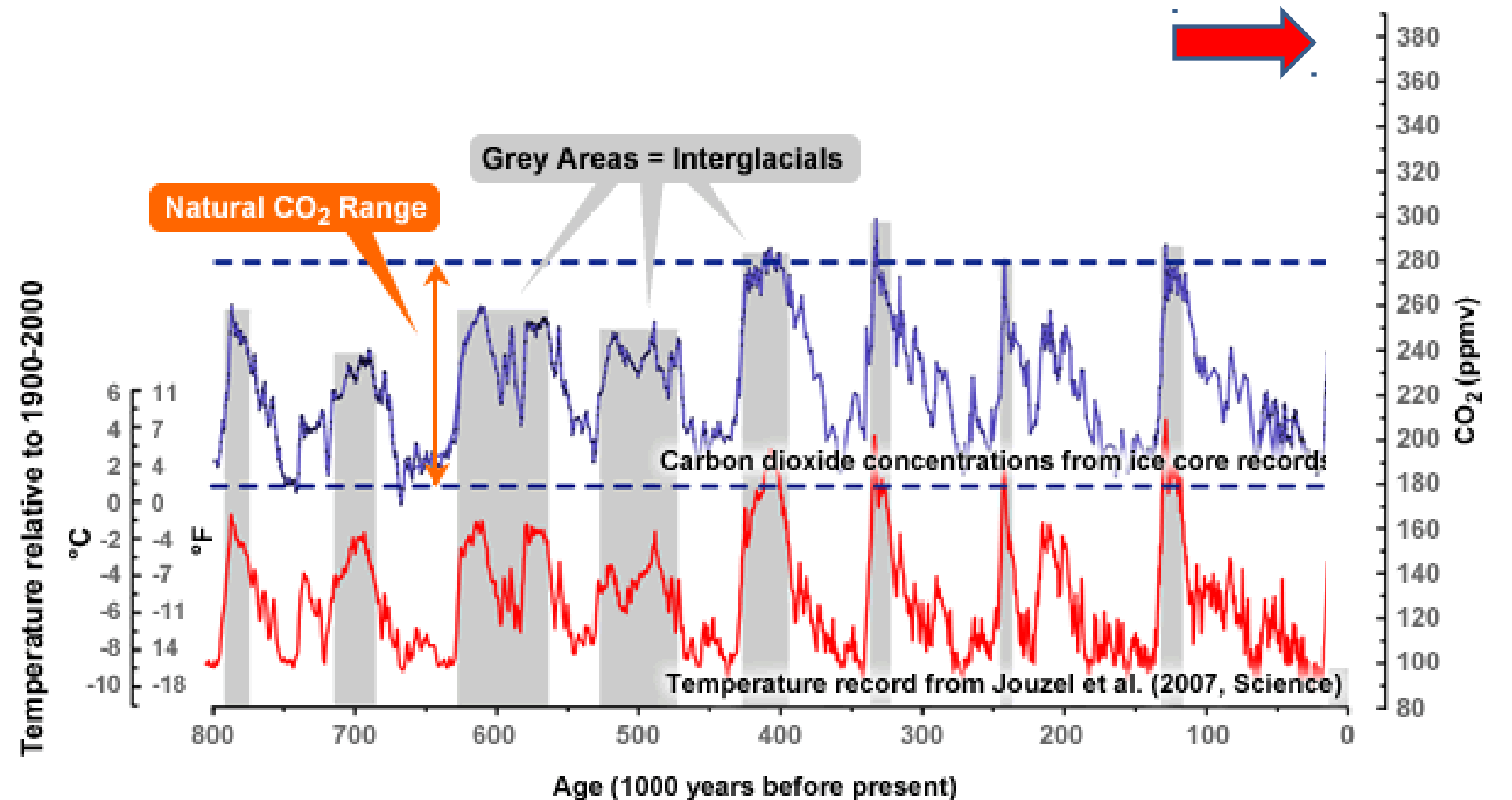
Water



Sulfur hexafluoride



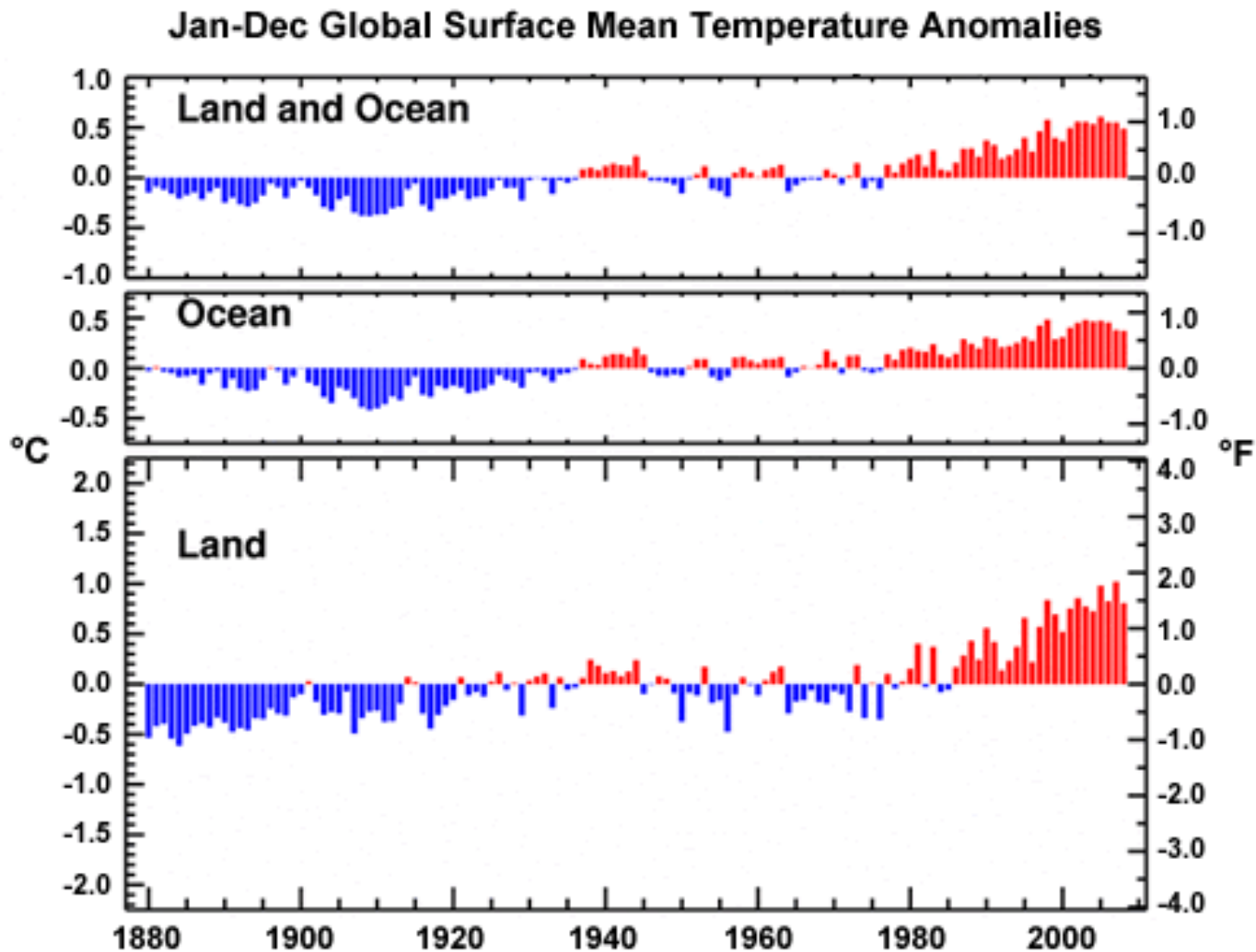
Could the warming be natural?



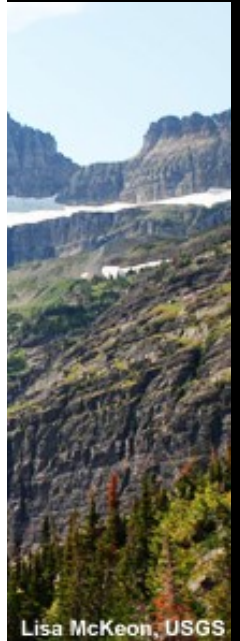
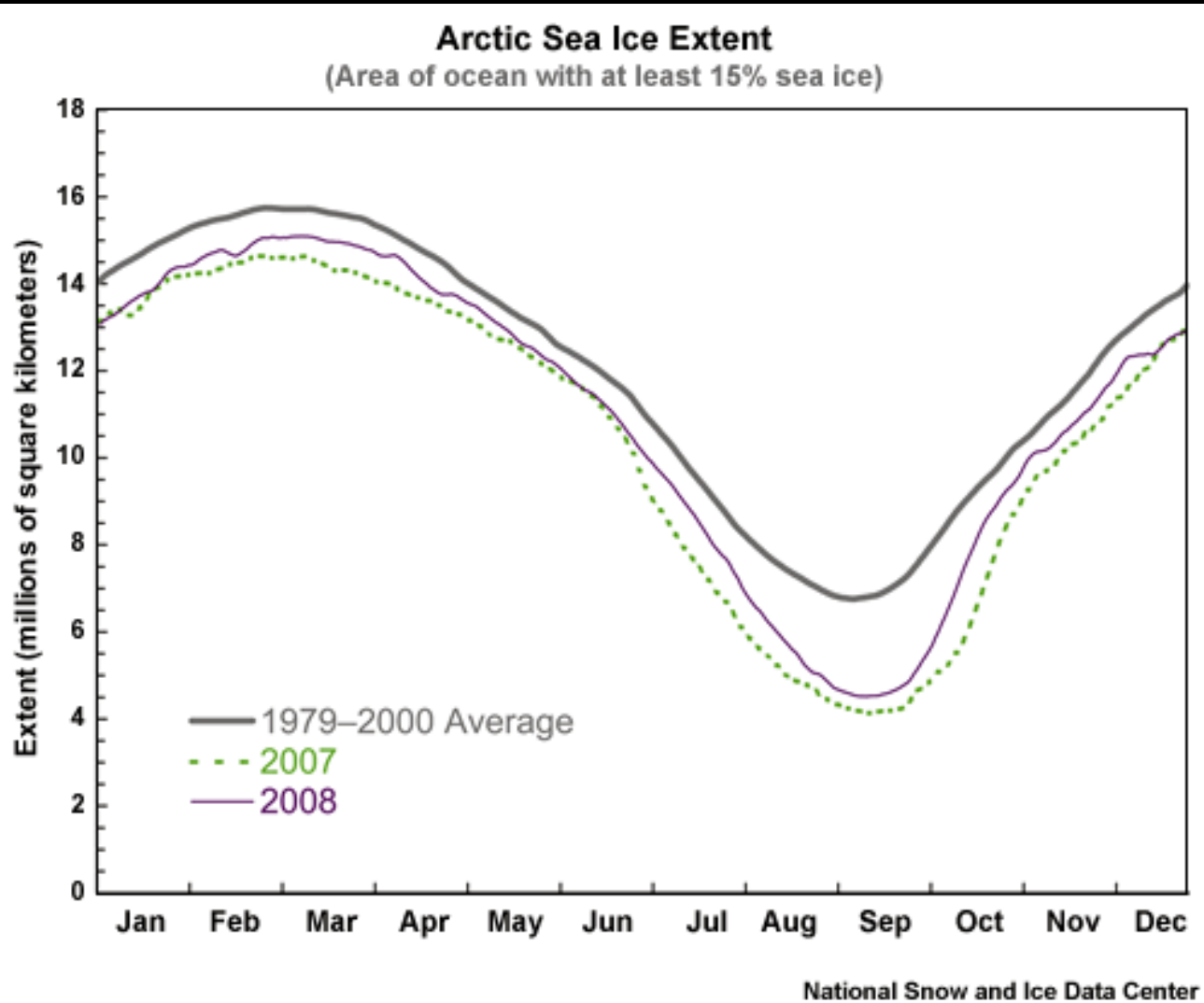
Courtesy of Dieter Luthi



Is it real?

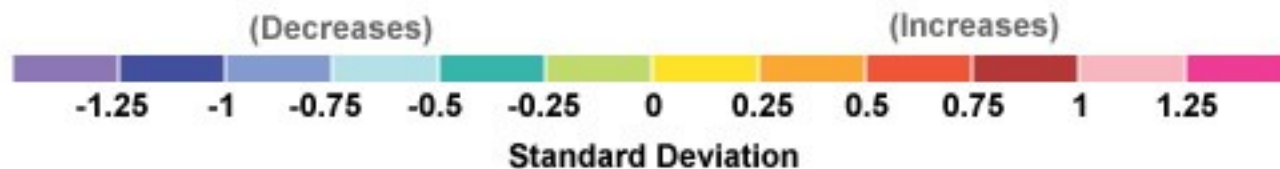
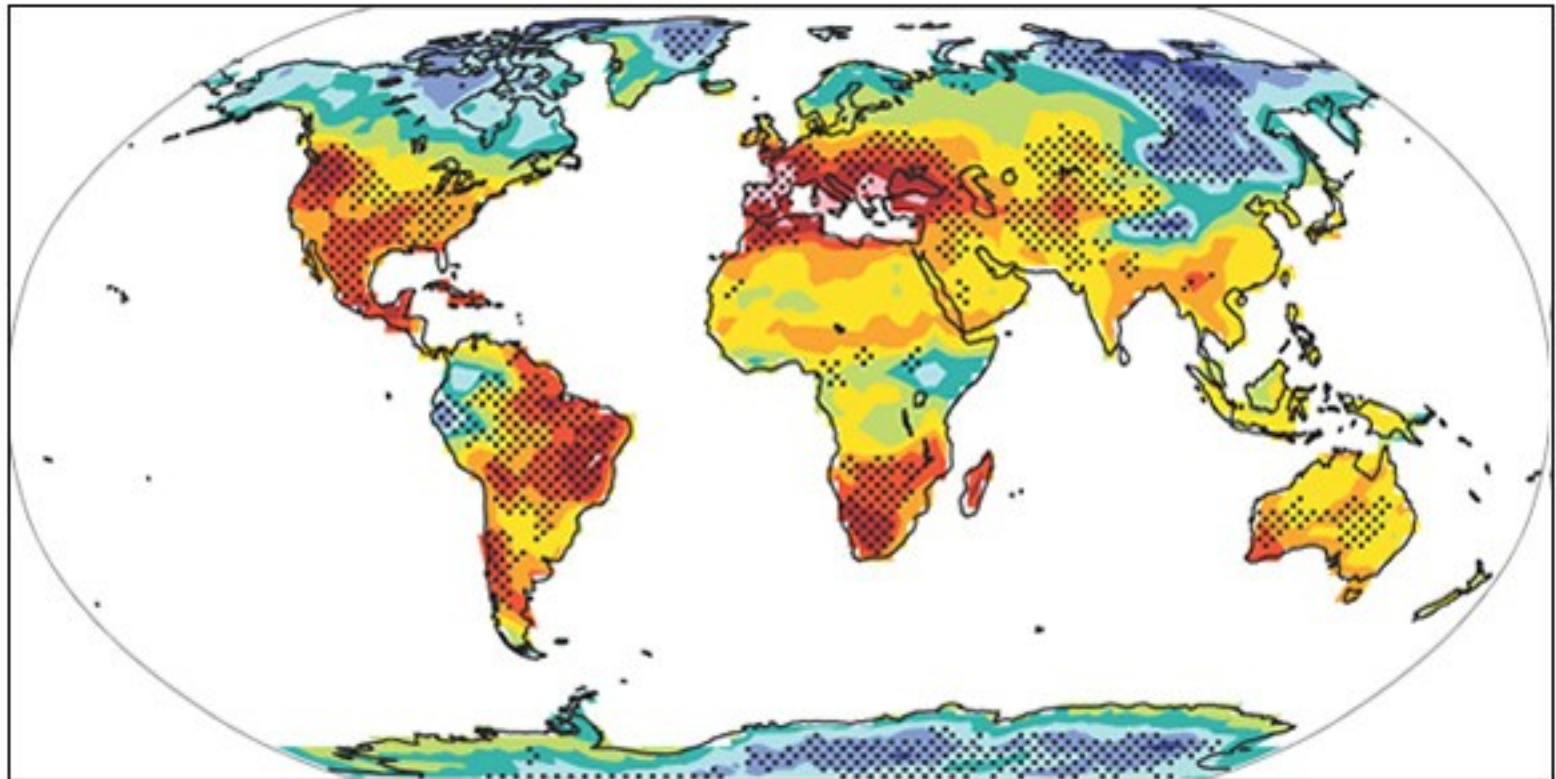


Effects: Snow and ice



Effects on precipitation

Multi-model Simulation of Changes in Dry Days
Years 2080-2099 Minus Years 1980-1999 (middle emissions scenario)



Effects on ecosystems





How do we know?



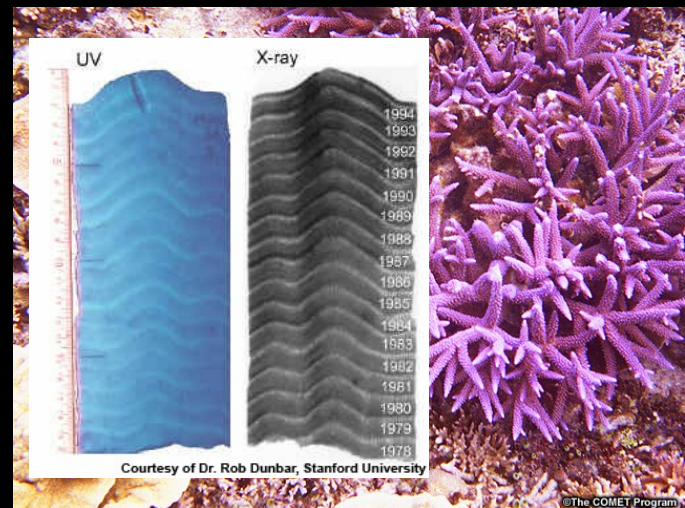
©UCAR / NCU



National Science Foundation, photo by Emily Stone



National Science Foundation, photo by Steve Roof

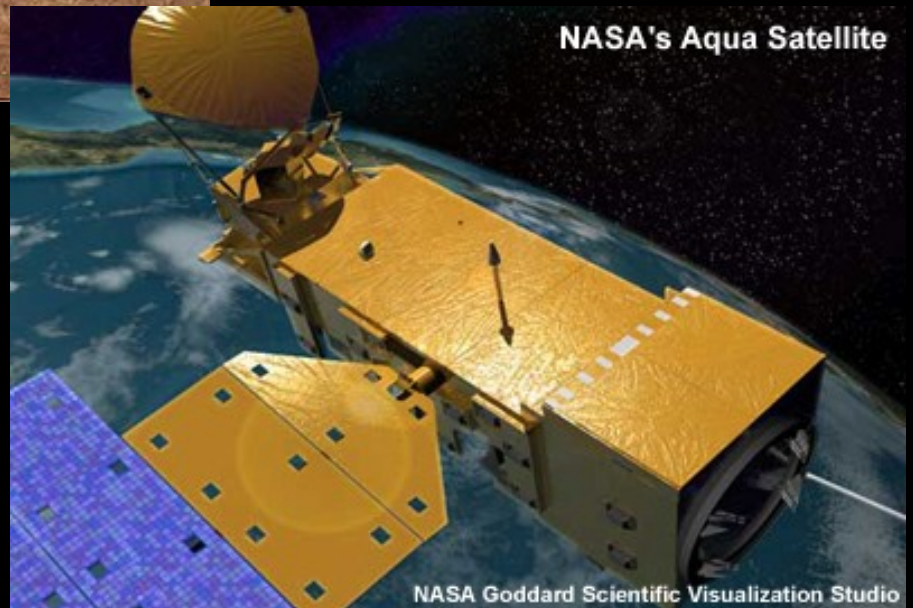


Present day observations

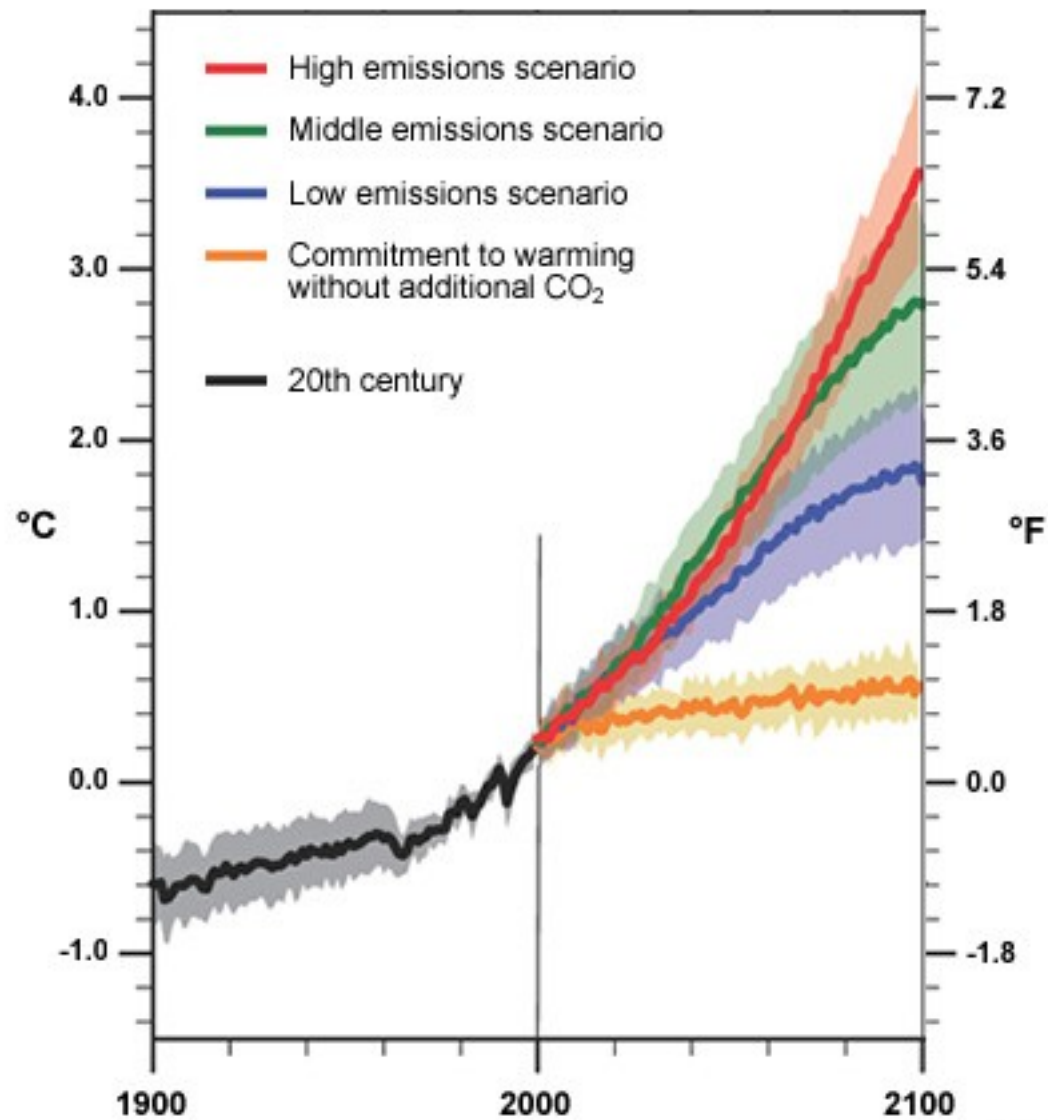
U.S. Climate Reference Network Station



NASA's Aqua Satellite



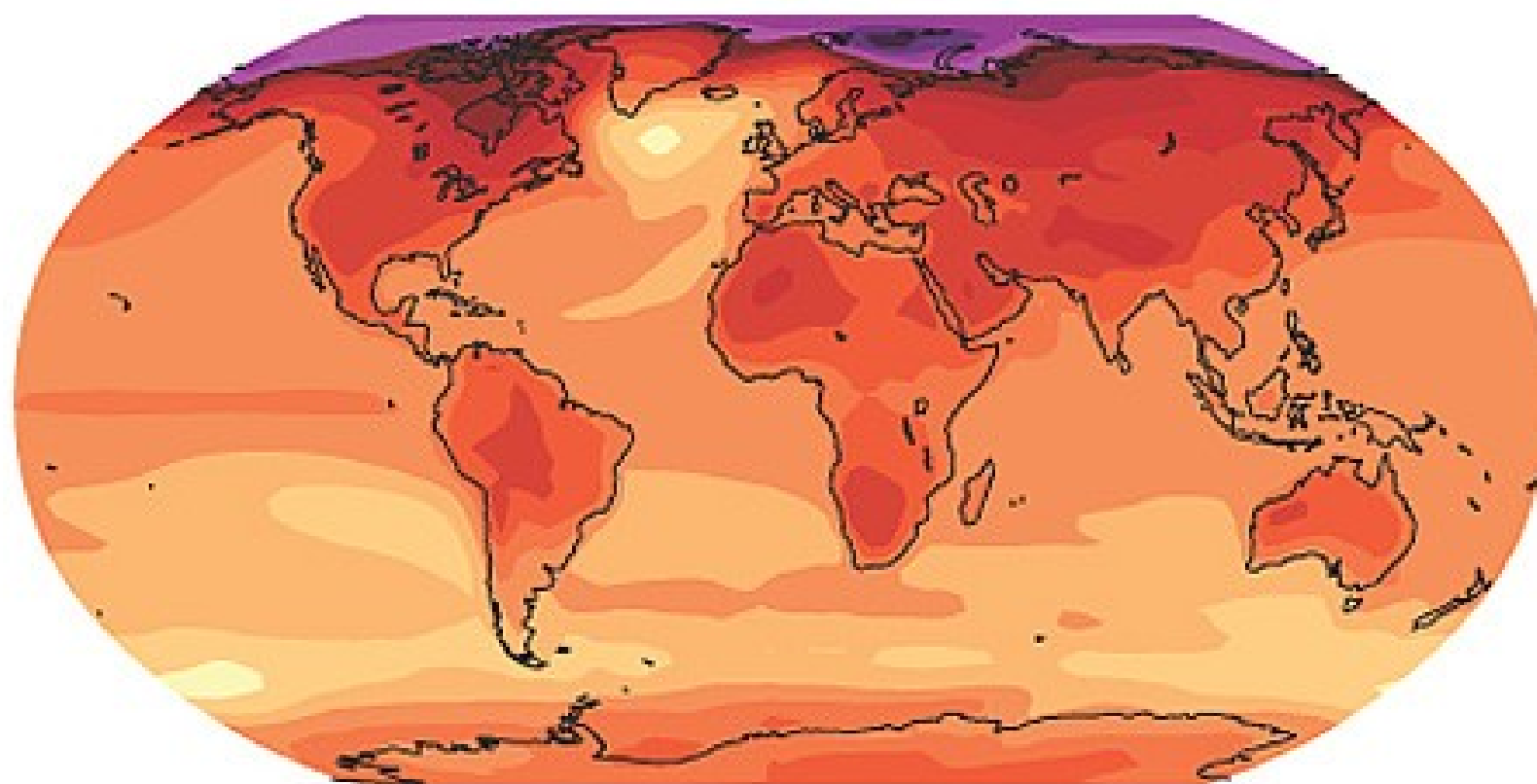
Temperature Increases for Various Emission Scenarios



IPCC

NOAA

Projected Temperature Increases Middle Emissions Scenario, 2080 - 2099



°F

0

1.8

3.6

5.4

7.2

9

10.8

12.6

°C

0

1

2

3

4

5

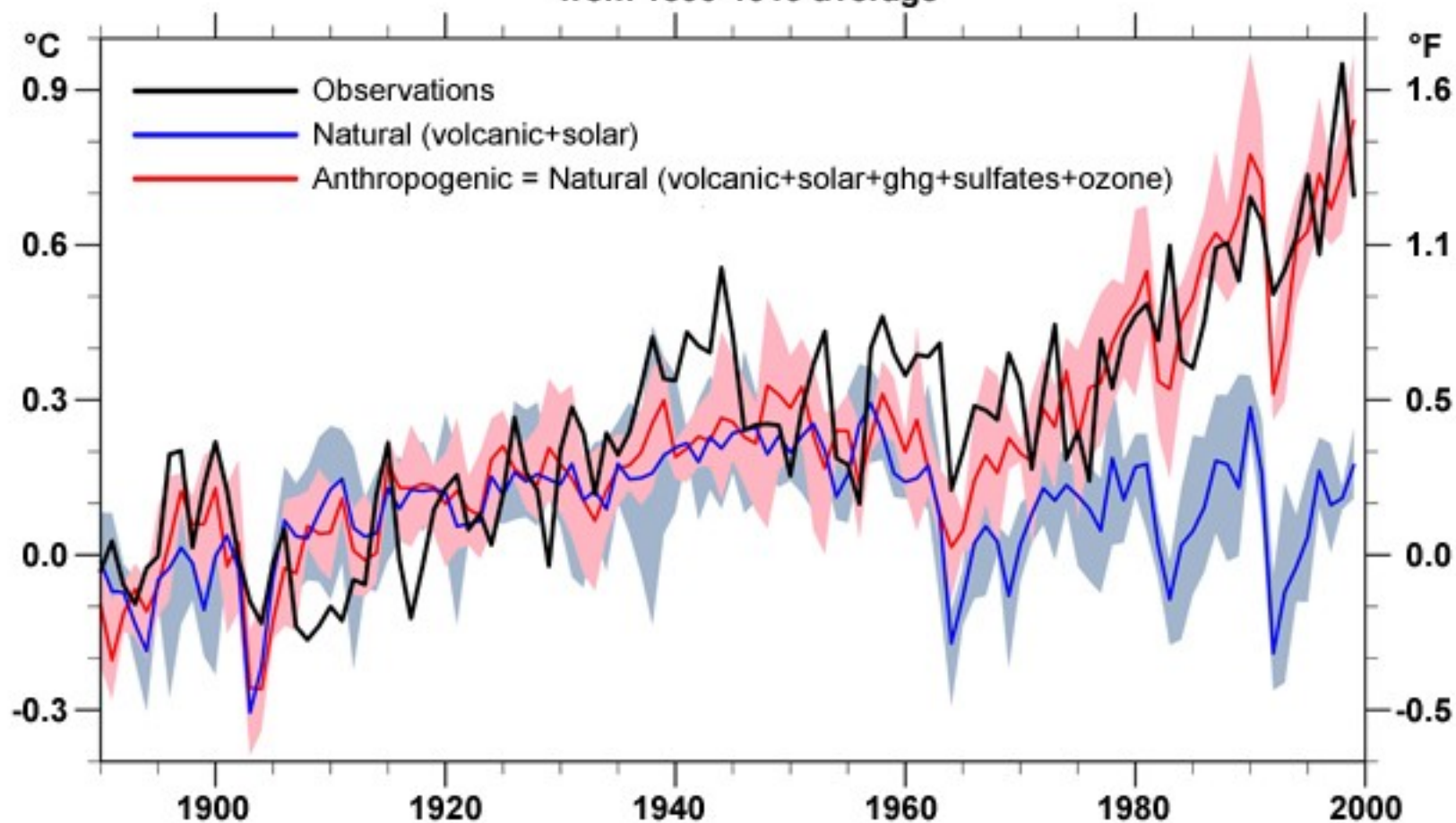
6

7

IPCC

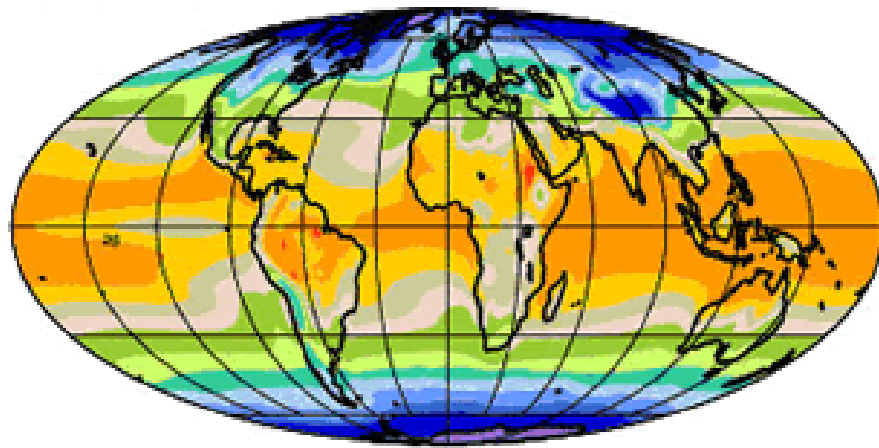
Climate Model Runs With/Without Greenhouse Gases

Global Temperature Anomalies
from 1890-1919 average

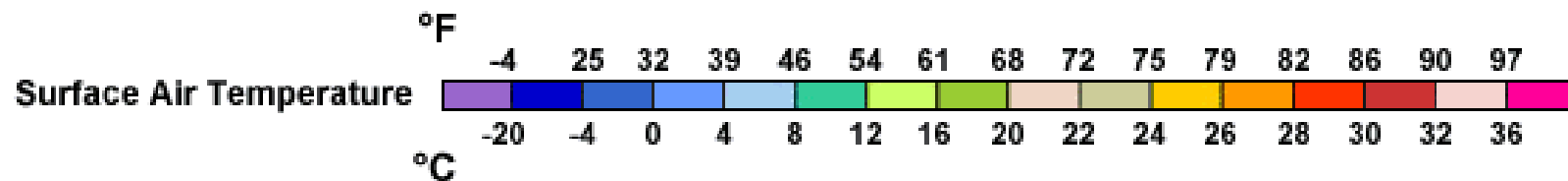
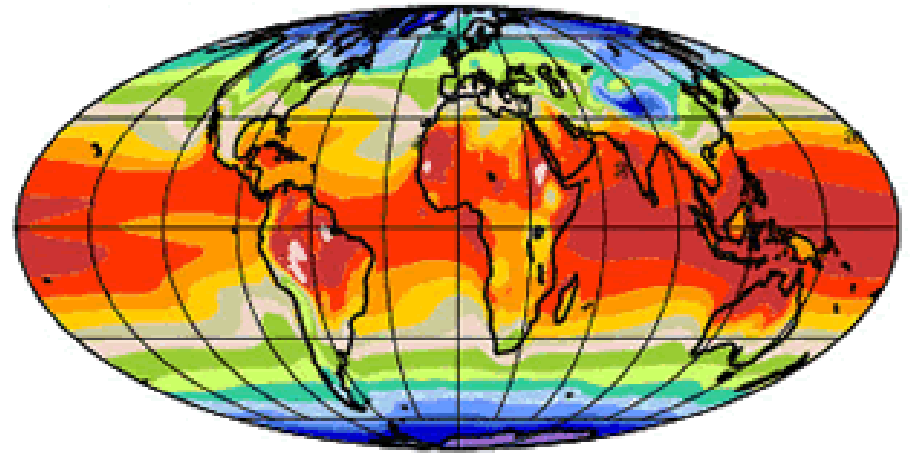



Why should we care?

Present Day
(1990s)



Possible Future
(2090s)





U.K.: Train rails
buckle

Germany: Lowest river
levels this century

France:
>14,000
deaths

Switzerland: Melting
glaciers, avalanches

Portugal: Forest
fires



Sea-level rise projections : a few inches to a few feet

- **2 ft: U.S. would lose 10,000 square miles**
- **3 ft: Would inundate Miami**
- **Affects erosion, loss of wetlands, freshwater supplies**
- **Half of the world's population lives along coasts**
- **Big question: Ice sheets**



©The COMET Program



CDC / James Gathany



Photo courtesy of USDA NRCS



©UCAR / NCU

How sure are scientists?



What don't we know?

- Is there some critical piece of the about climate process we don't understand?
- How and when will our fossil fuel use change?
- Will future , yet-to-be-discovered technologies mitigate the problem?
- How will changing economics, global population, and political processes affect our ability to tackle the problem?

The IPCC



Courtesy of Kevin Trenberth / NCAR

2007 Conclusions

- Warming of the climate system is **unequivocal**
- **Very high confidence** that global average net effect of human activities since 1750 one of warming
- Human-caused warming over last 30 years has **likely** had a visible influence on many physical and biological systems
- Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would **very likely** be larger than those observed during the 20th century.”

Consensus?

- **Do we know enough about the drivers of climate to know what causes change?**
- **Are we underestimating the Earth system's complexity ?**
- **Can models accurately simulate the complex climate system?**

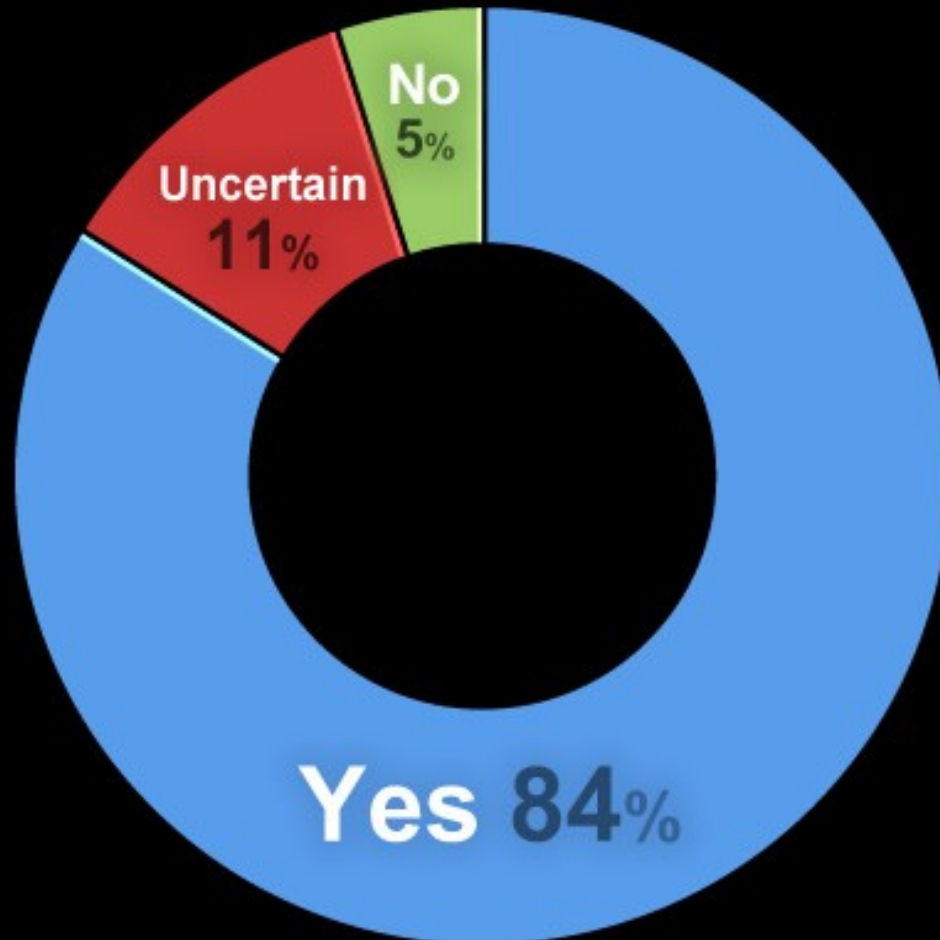
-

On the other hand...

- Arctic sea ice melting faster than predicted.
- Fossil fuel emissions exceeded most IPCC projections.
- Are assumptions about global energy use are too optimistic?
- How quickly can developing countries reduce GHG emissions?
- Calculations don't include unexpected melting in Greenland and Antarctica.

What do climate scientists really think?

Climate Scientists: Are humans responsible for observed warming?

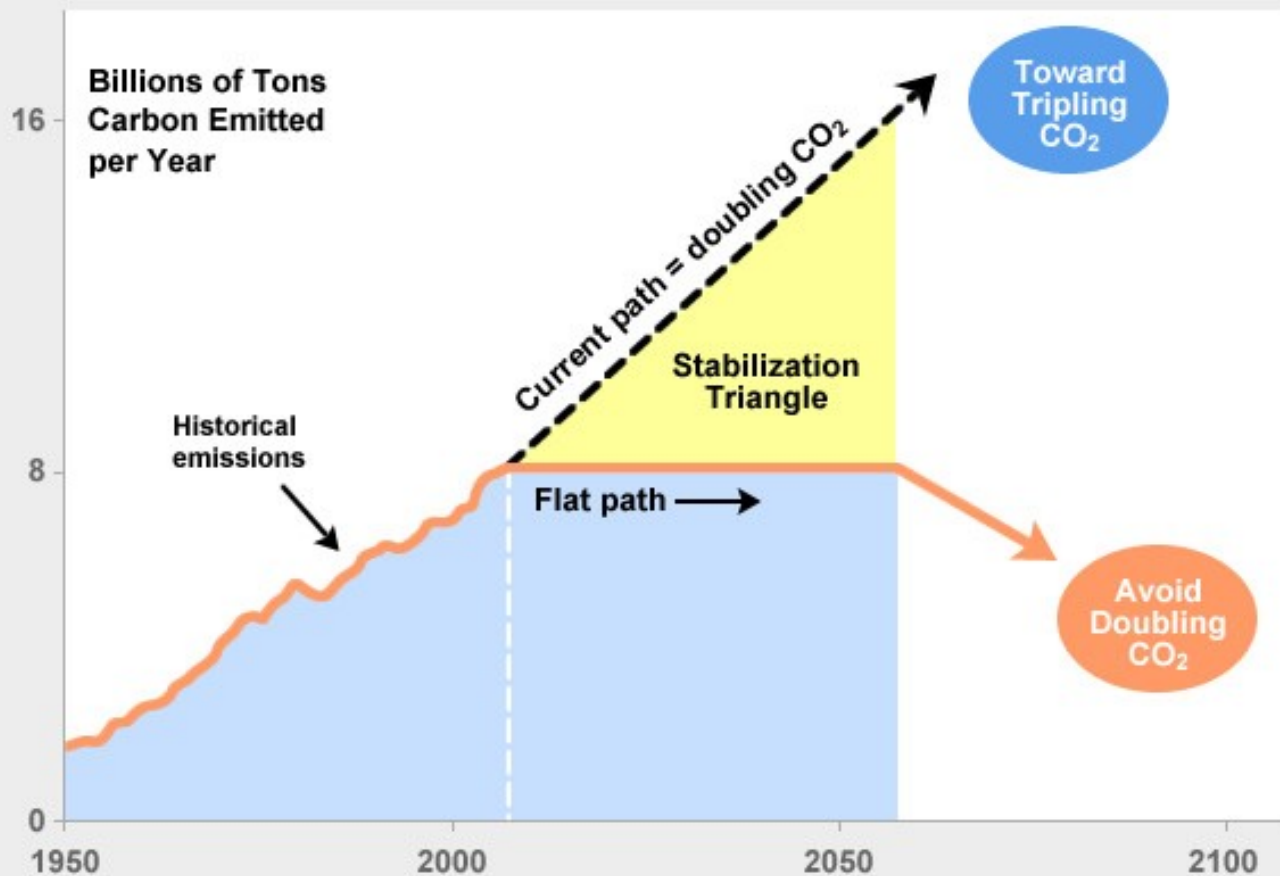


Be an educated consumer

- IPCC AR4 Synthesis Report (<http://www.ipcc.ch/ipccreports/ar4-syr.htm>)
- Other organizations:
 - NAS (<http://dels.nas.edu/climatechange/>)
 - US CCSP (<http://www.climate-science.gov/>)
- Look for contrasting opinions
- Evaluate the source

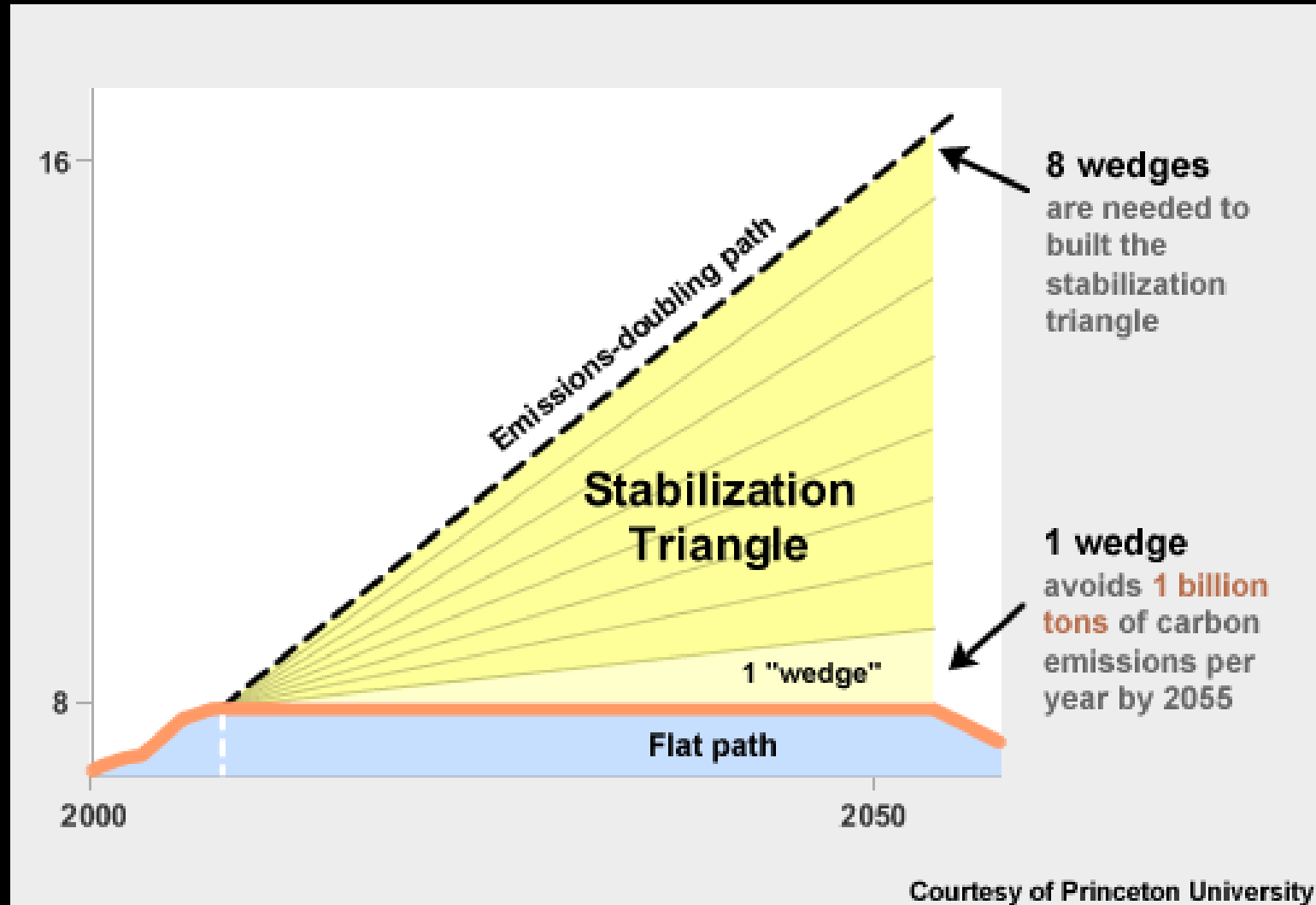


What next—what can we do?





What next—what can we do?



- ▶ Produce more fuel-efficient vehicles
- ▶ Reduce vehicle use
- ▶ Improve energy-efficiency in buildings
- ▶ Develop carbon capture and storage processes
- ▶ Triple nuclear power
- ▶ Increase solar power
- ▶ Decrease deforestation/plant forests
- ▶ Improve soil carbon management strategies

Individual actions



**Use mass transit,
bike,
walk,
roller
skate**



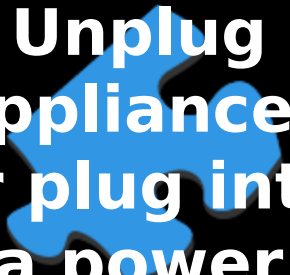
**Buy water-
saving
appliances
and toilets;
installing
low-flow
shower**



**Tune
up your
furnace**



**Caulk,
weatherstr
ip,
insulate,
and
replace old
windows**



**Unplug
appliances
or plug into
a power
strip and
switch it off**



**Buy
products
with a U.S.
EPA Energy
Star label**



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