

Engaging Organized Climate Change Denial



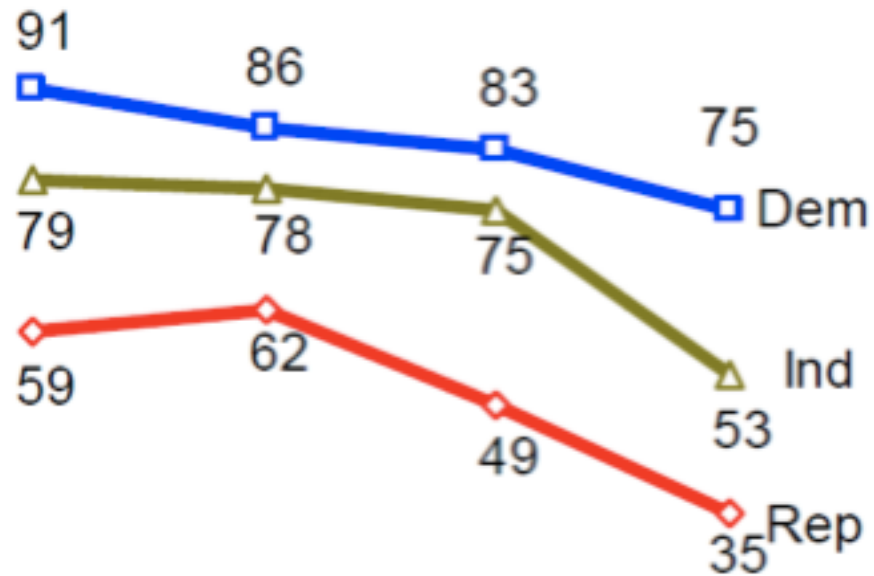
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<http://ChangingClimates.ColoState.edu>

Across Partisan Lines, Fewer See Solid Evidence of Global Warming



Changing
Public
Opinions

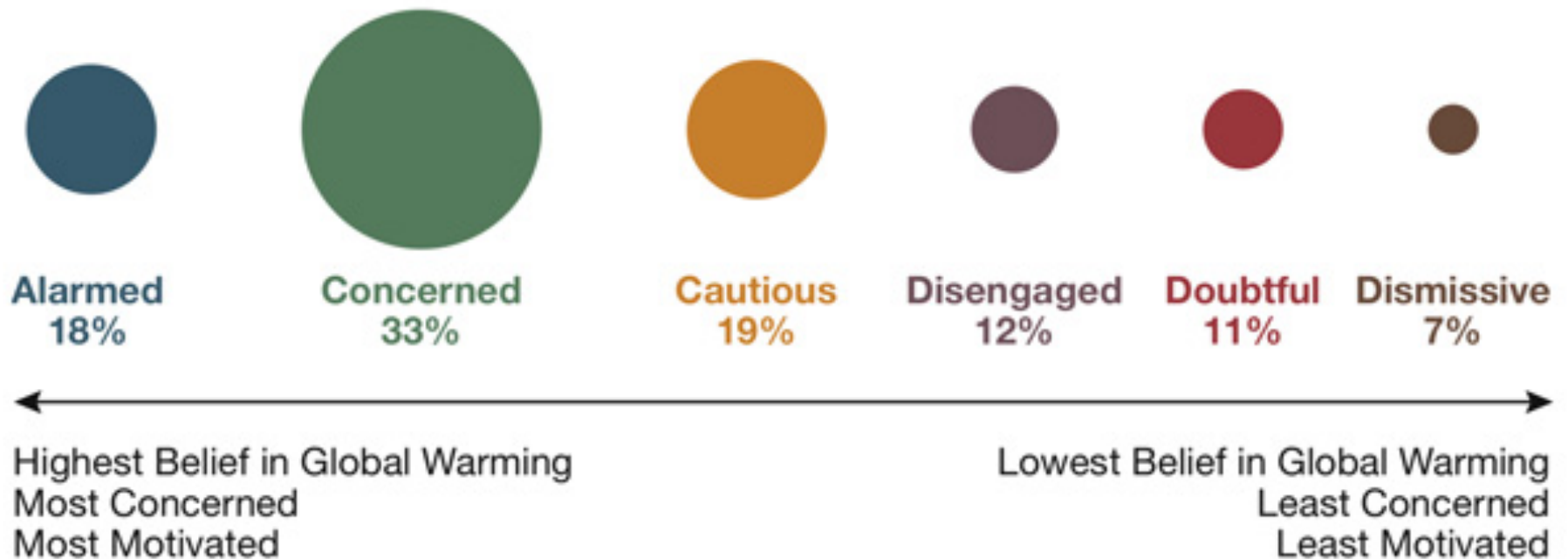
GLOBAL WARMING'S SIX AMERICAS 2009: An Audience Segmentation Analysis



Six Americas

Figure 1: Proportion of the U.S. Adult Population in the Six Americas

Proportion represented by area



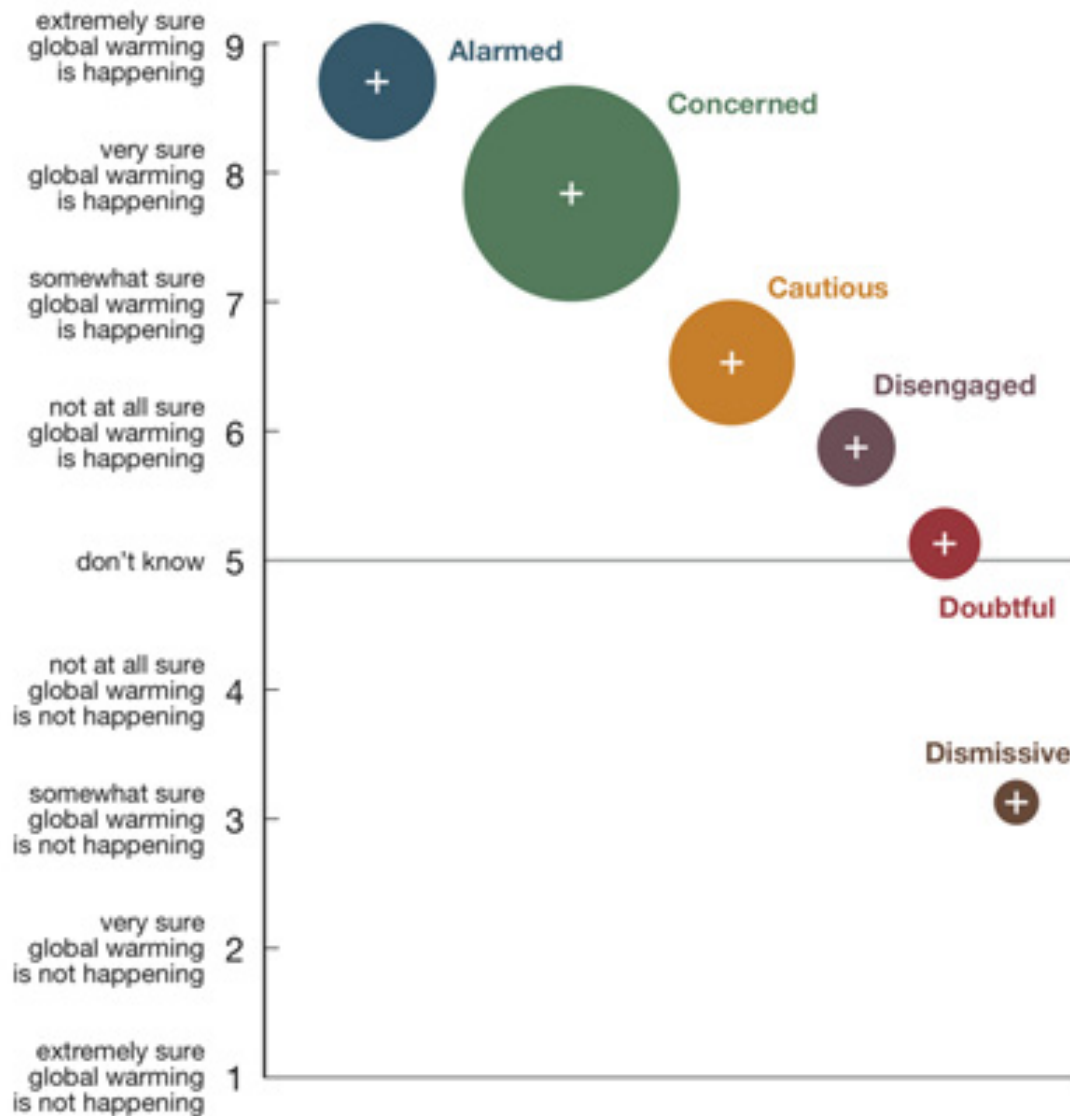
Leiserowitz, Maibach & Roser-Renouf (2008)

Global Warming's Six Americas: An Audience Segmentation

Figure 2: Certainty of belief in the reality of global warming

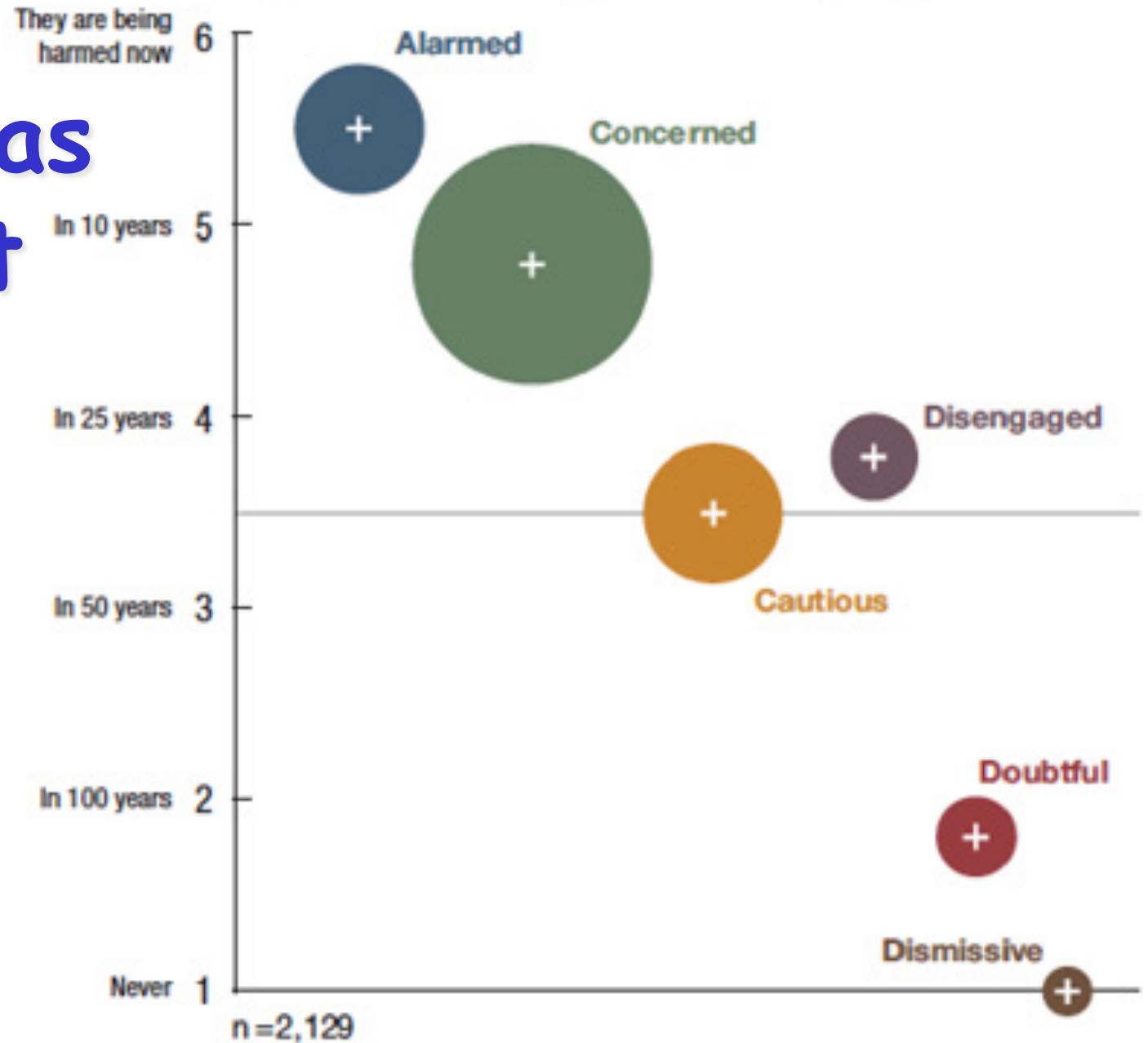
*Do you think that global warming is happening?
How sure are you that global warming is happening? or
How sure are you that global warming is not happening?*

Six Americas



Six Americas Result

Figure 12: Timing of harm to people in U.S.



Objections

- World hasn't warmed lately
- Natural cycles, the Sun, volcanos, etc
- Past climate change didn't involve people
- "They can't even forecast the weather ..."
- Conspiracy theories (us vs them)
- Political or socioeconomic implications
- Can't solve it in USA alone
- Don't want to freeze hungry in the dark

What Doesn't Work

- Arguing about details of recent temperatures
- Appeals to authority, consensus, or peer-review
- Appeals to model output
- Taking partisan political positions
- “Fighting fire with fire”

What Works Better

- Respect and engagement
- Build trust by beginning from agreement
- Connect to audience as a person
- Be funny and friendly
- Use examples & stories from everyday life
- Stick to climate basics, not details
- Acknowledge diverse opinions on solutions
- Develop coherent message and stick to it

GLOBAL WARMING?

NOT MAN MADE

- It's natural variation
- Human impact is very small
- Computer models are flawed
- There is no "consensus"

NOT HARMFUL

- Past warmings were beneficial
- No current harms
- Future warmings will be modest
- Warmer is better



The
Heartland
INSTITUTE



James Delingpole:

Author, Broadcaster, Blogger

Common Myths about Climate

Be skeptical ... be very skeptical !

- Climate is **complicated** ... have to ask experts
- Concern about global warming is based on recent **temperature trends**
 - “9 of the 10 hottest years on record ...”
 - If somebody could find some other cause for recent warming, we could quit worrying
- Global warming is a theory based on complicated **computer models**
- If we stop burning coal, we’ ll **freeze in the dark!**

Weather vs Climate

what's the difference?

- If you don't like the **weather**:
 - *Wait five minutes!*
- If you don't like the **climate**:
 - *Move!*

Climate is Place

- Depends on **where you live**:
 - Latitude!
 - Altitude (mountains vs valley)
 - What's upwind (ocean vs land)
- **Changes very slowly**
- Very **predictable**
- We can predict that Miami is warmer than Minneapolis for precisely the same reasons that we can predict a warmer future!

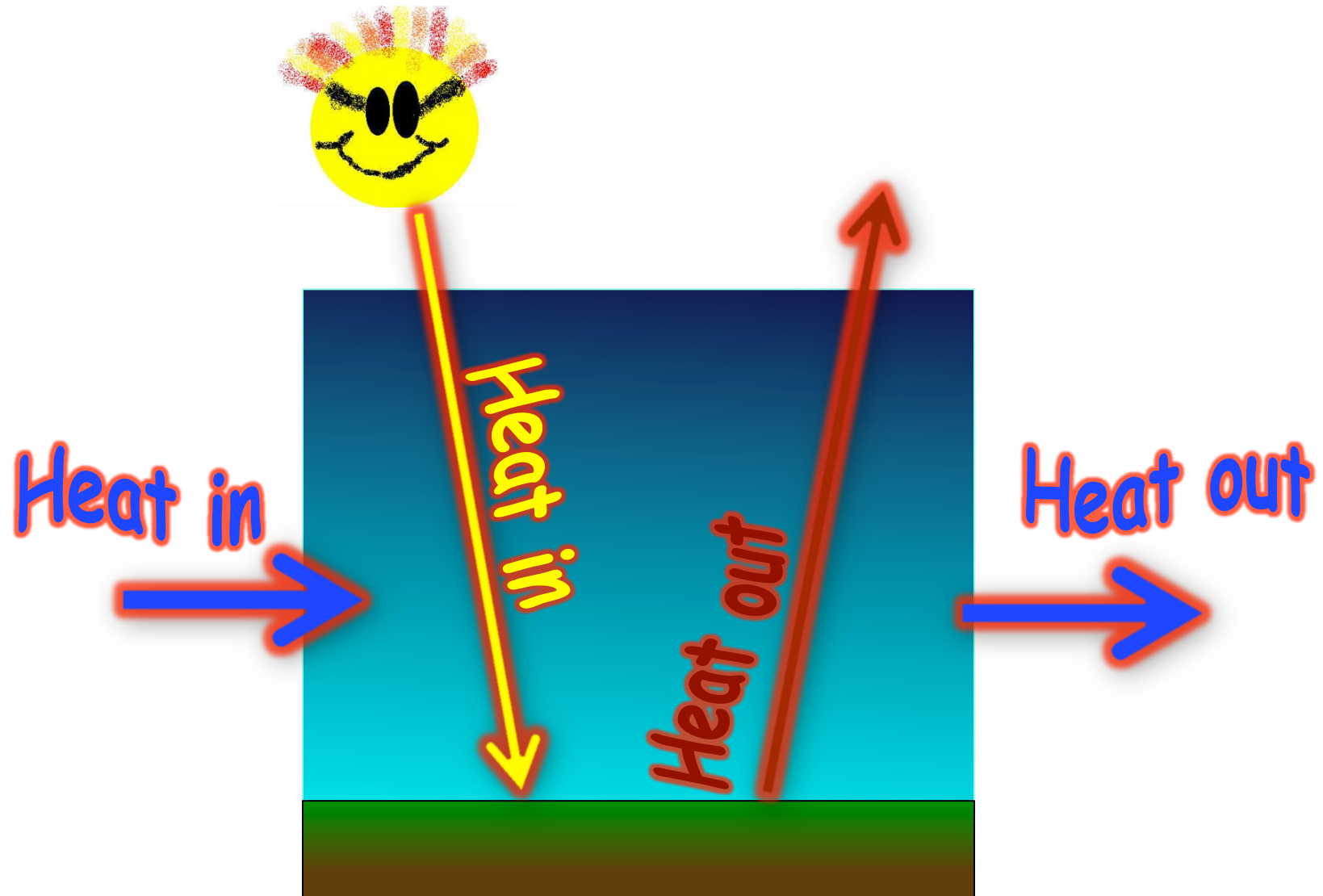
Location! Location! Location!

Ever Wonder Why?

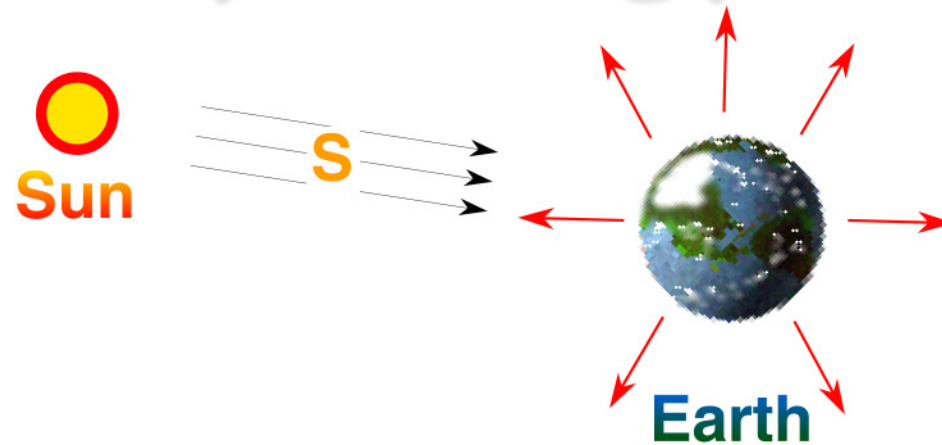


- Night is usually colder than day
- Winter is usually colder than summer
- Minneapolis is usually colder than Miami

Heat Budgets



Planetary Energy Balance



Energy In = Energy Out

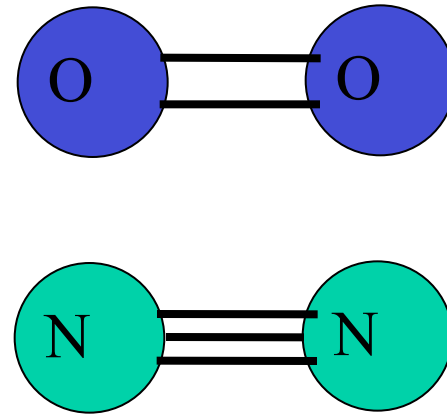
$$S(1 - \alpha)\pi R^2 = 4\pi R^2 \sigma T^4$$

$$T \approx -18^\circ \text{C}$$

But the observed T_s is about 15°C

Dancing Molecules and Heat Rays!

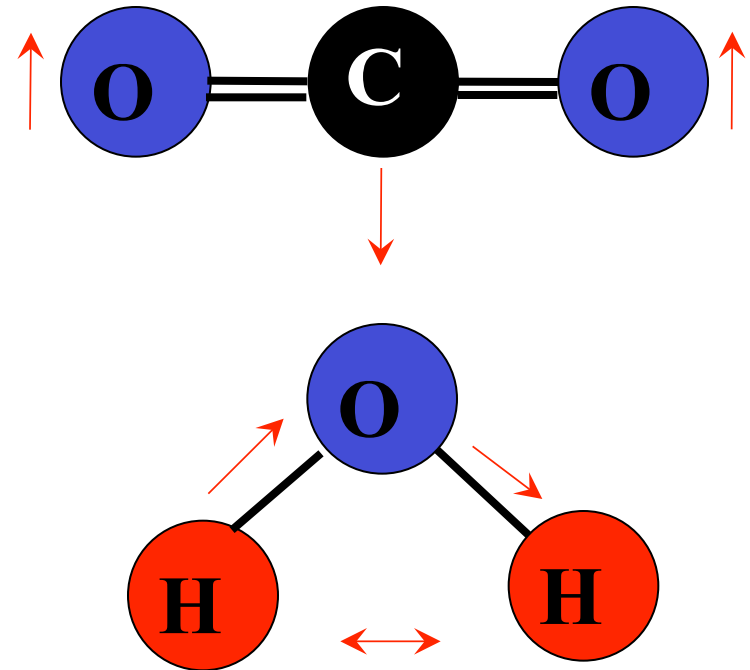
- Nearly all of the air is made of oxygen (O_2) and nitrogen (N_2) in which **two atoms of the same element** share electrons
- Infrared (heat) **energy radiated up from the surface can be absorbed** by these molecules, but not very well



Diatomc molecules can vibrate back and forth like balls on a spring, but the ends are identical

Dancing Molecules and Heat Rays!

- Carbon dioxide (CO_2) and water vapor (H_2O) are different!
- They have **many more ways to vibrate** and rotate, so they are very good at absorbing and emitting infrared (heat) radiation



Molecules that have many ways to wiggle are called "Greenhouse" molecules

Absorption spectrum of CO₂ was measured by John Tyndall in 1863

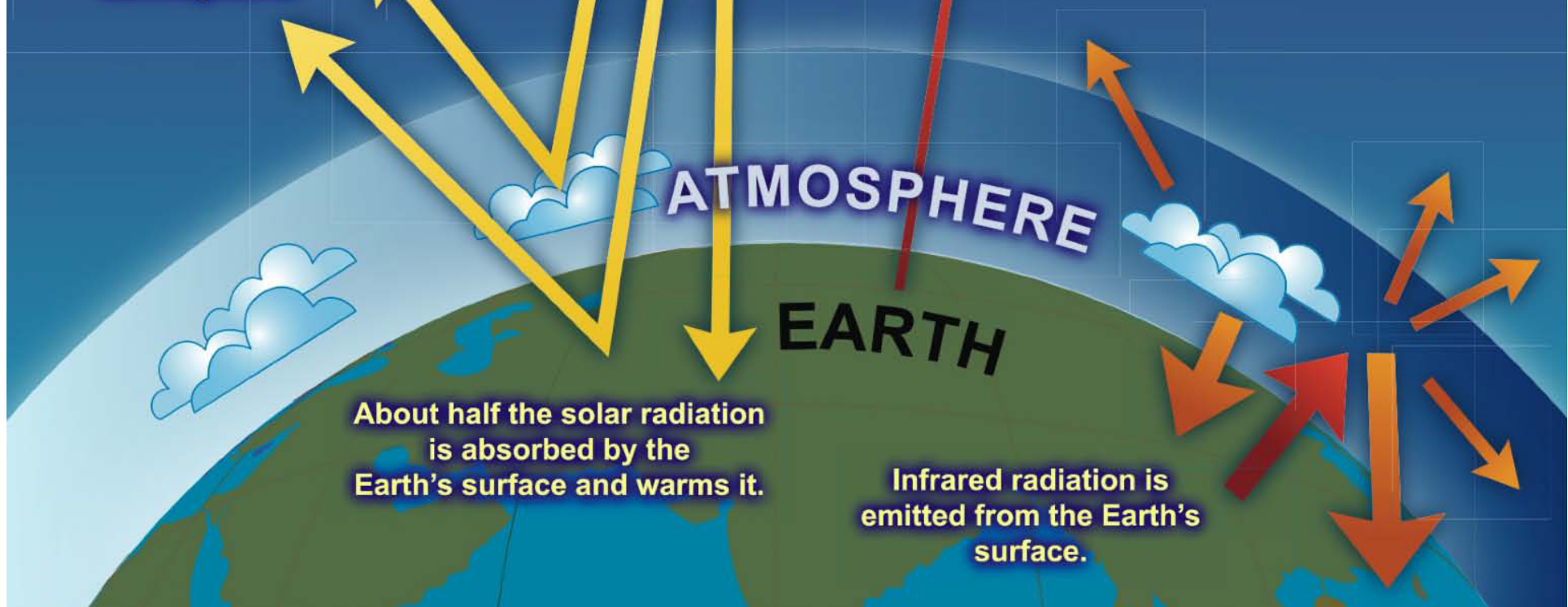
Solar radiation powers the climate system.



The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

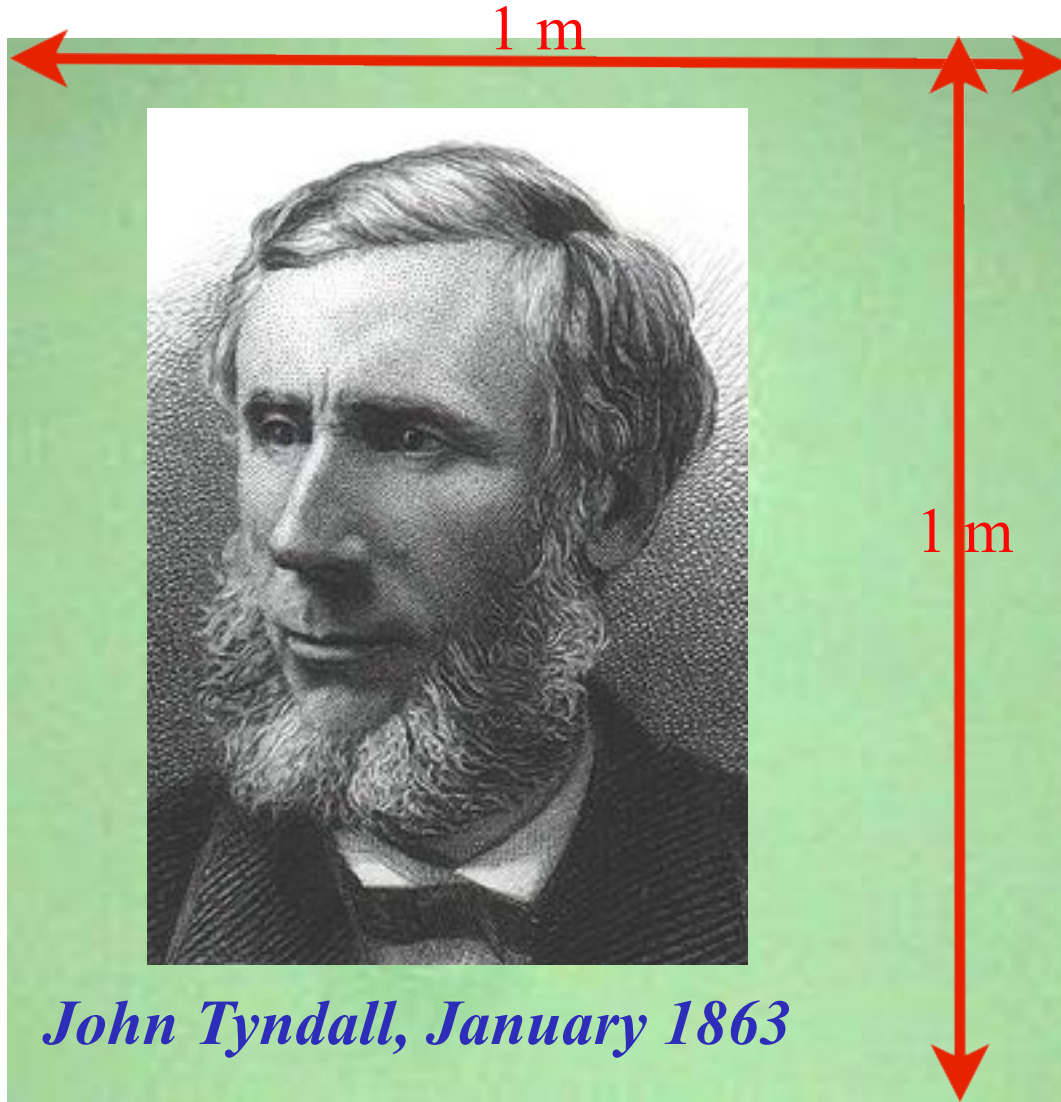
Some solar radiation is reflected by the Earth and the atmosphere.



About half the solar radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted from the Earth's surface.

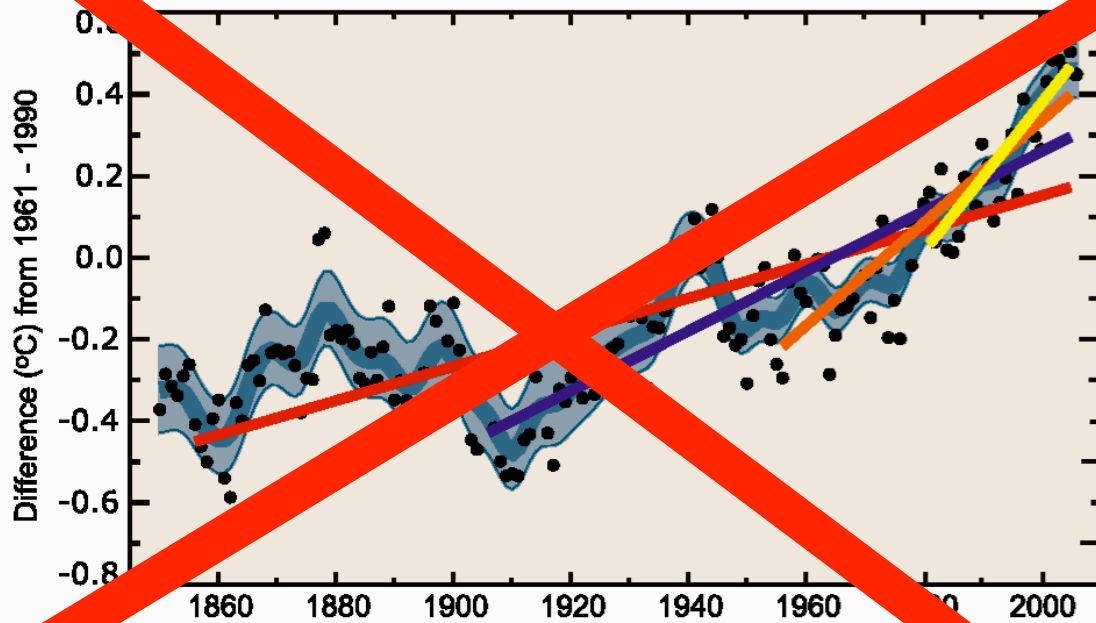
Common Sense



- Doubling CO_2 would add **4 watts** to **every square meter** of the surface of the Earth, **24/7**
- Doing that would make the surface **warmer**
- This was known before light bulbs were invented!

Common Misconception #1

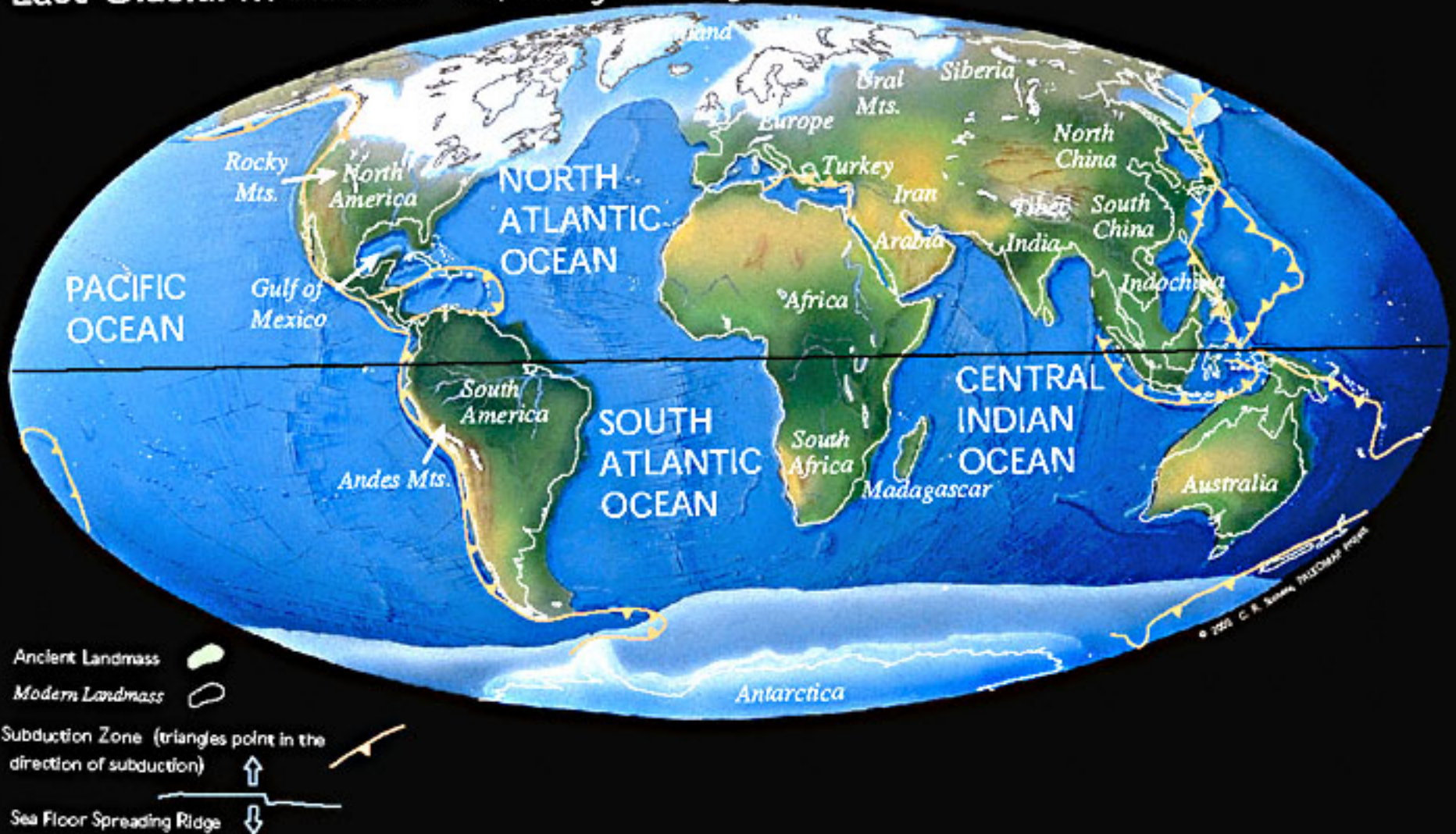
“People are worried about climate change because it’s been getting warmer lately”



WRONG! We’re concerned because we know that when we add energy to things, they warm up

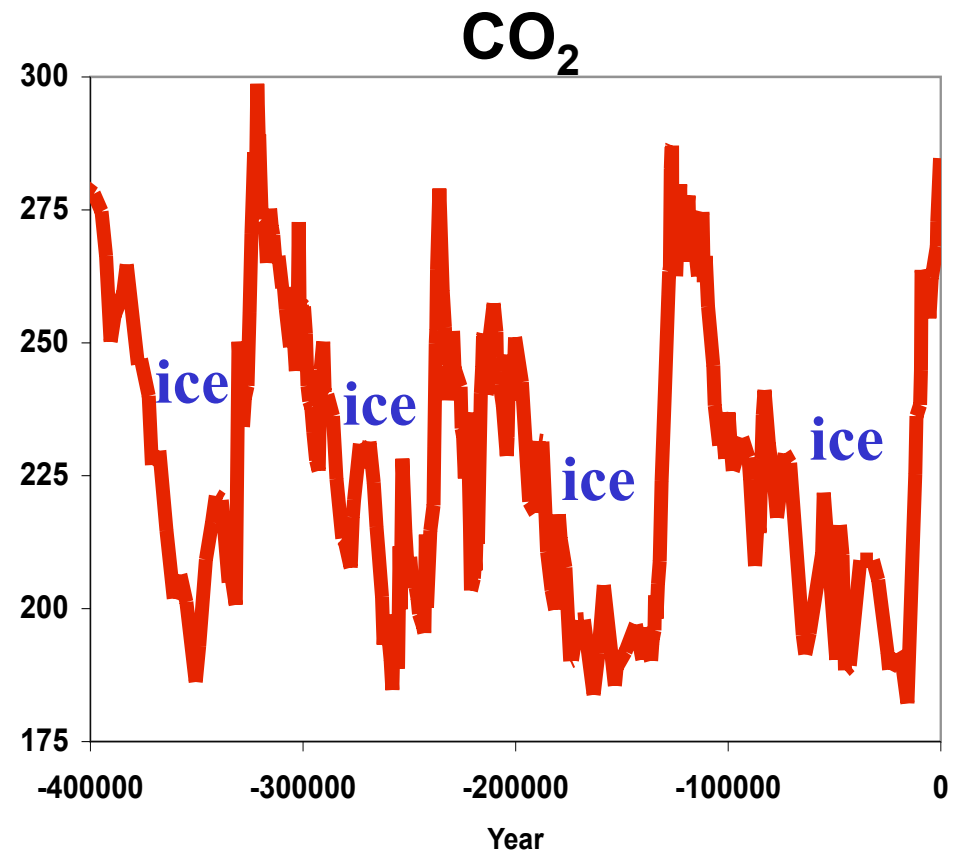
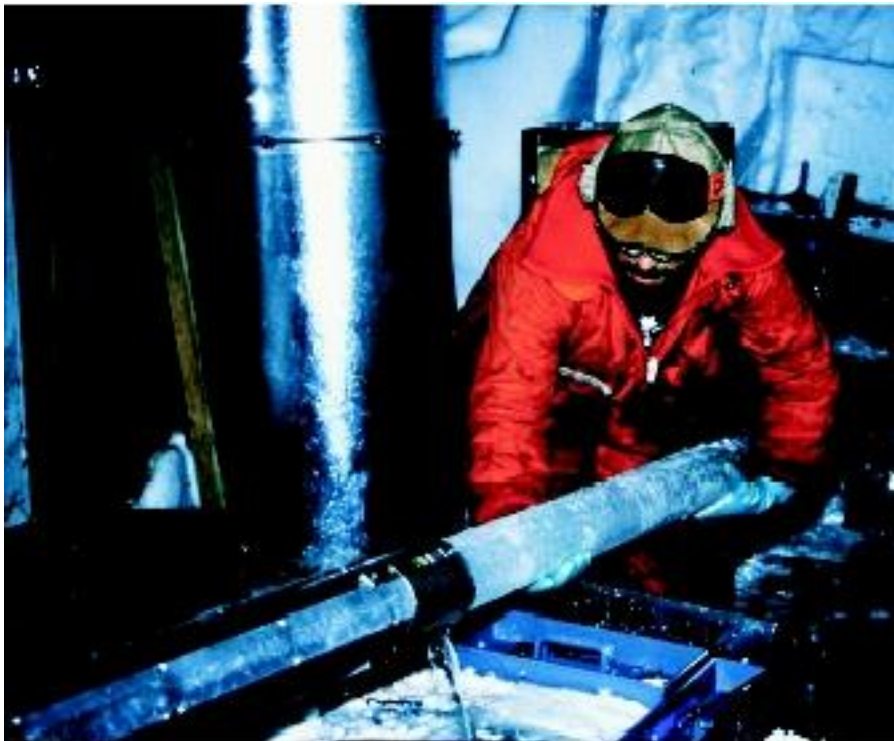
Learning from the Past

Last Glacial Maximum 18,000 years ago



CO₂ and the Ice Ages

- Over the past 420,000 years atmospheric CO₂ has varied **between 180 and 280** ppm, beating in time with the last four glacial cycles



Estimating Total Climate Sensitivity

- At the Last Glacial Maximum (~ 18k years ago) surface temp ~ 5 °C colder
- CO₂ was ~ 180 ppm (weaker greenhouse, 3.7 W m⁻² more LW↑)
- Brighter surface due to snow and ice, estimate 3.4 W m⁻² more reflected solar ↑

$$\lambda = \frac{\Delta T_s}{\Delta F} = \frac{T_s(\text{now}) - T_s(\text{then})}{F(\text{now}) - F(\text{then})}$$
$$= \frac{5K}{(3.7 + 3.4)Wm^{-2}} = 0.70 \frac{K}{Wm^{-2}}$$

*Almost 3× as sensitive as suggested by Arrhenius in 1897 ...
Other feedbacks must be going on as well*

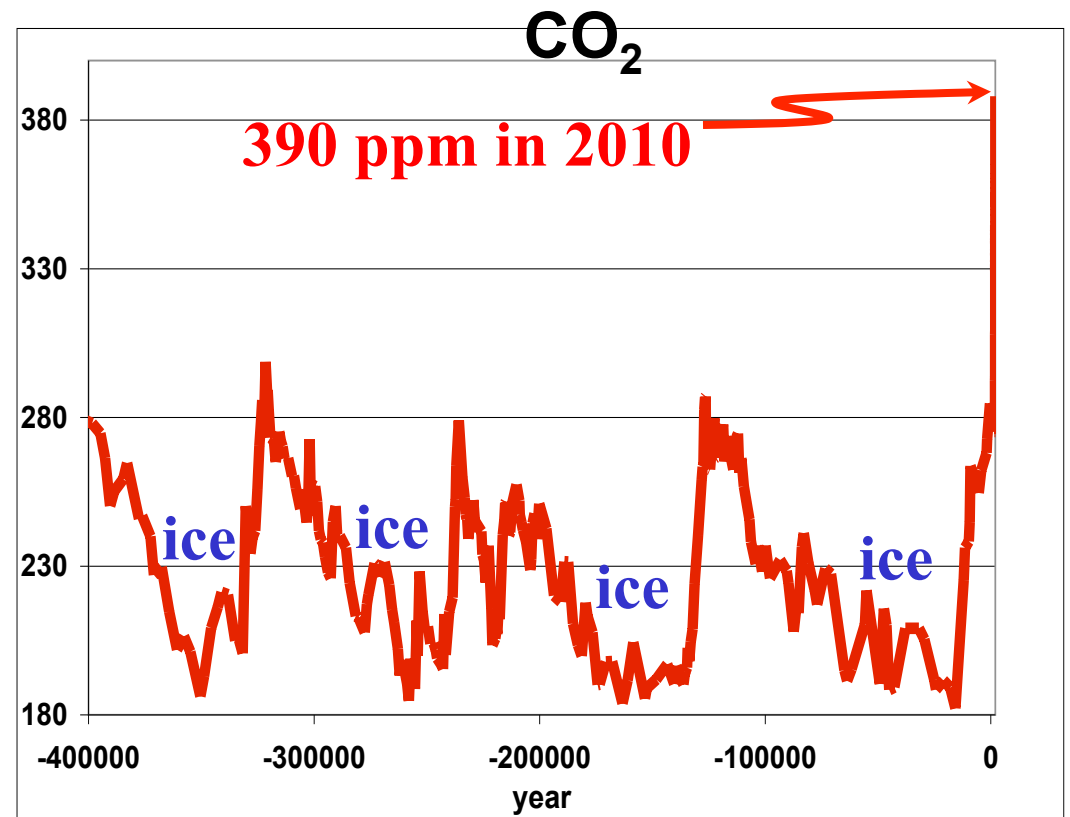
Review: 19th Century Physics (updated using paleo-data)

- **Forcing:** changes in properties of atmosphere as measured by spectroscopy (4 W m⁻² per doubling of CO₂)
- **Feedback:** both positive and negative, total response to forcing estimated from Ice Age climate data (about 0.8 °C per W m⁻²)
- **Response:** about 3.2 °C warming for 2 × CO₂

*No climate models required ... just based on observations
(modern calculations agree ... coincidence?)*

CO₂ and the Modern Age

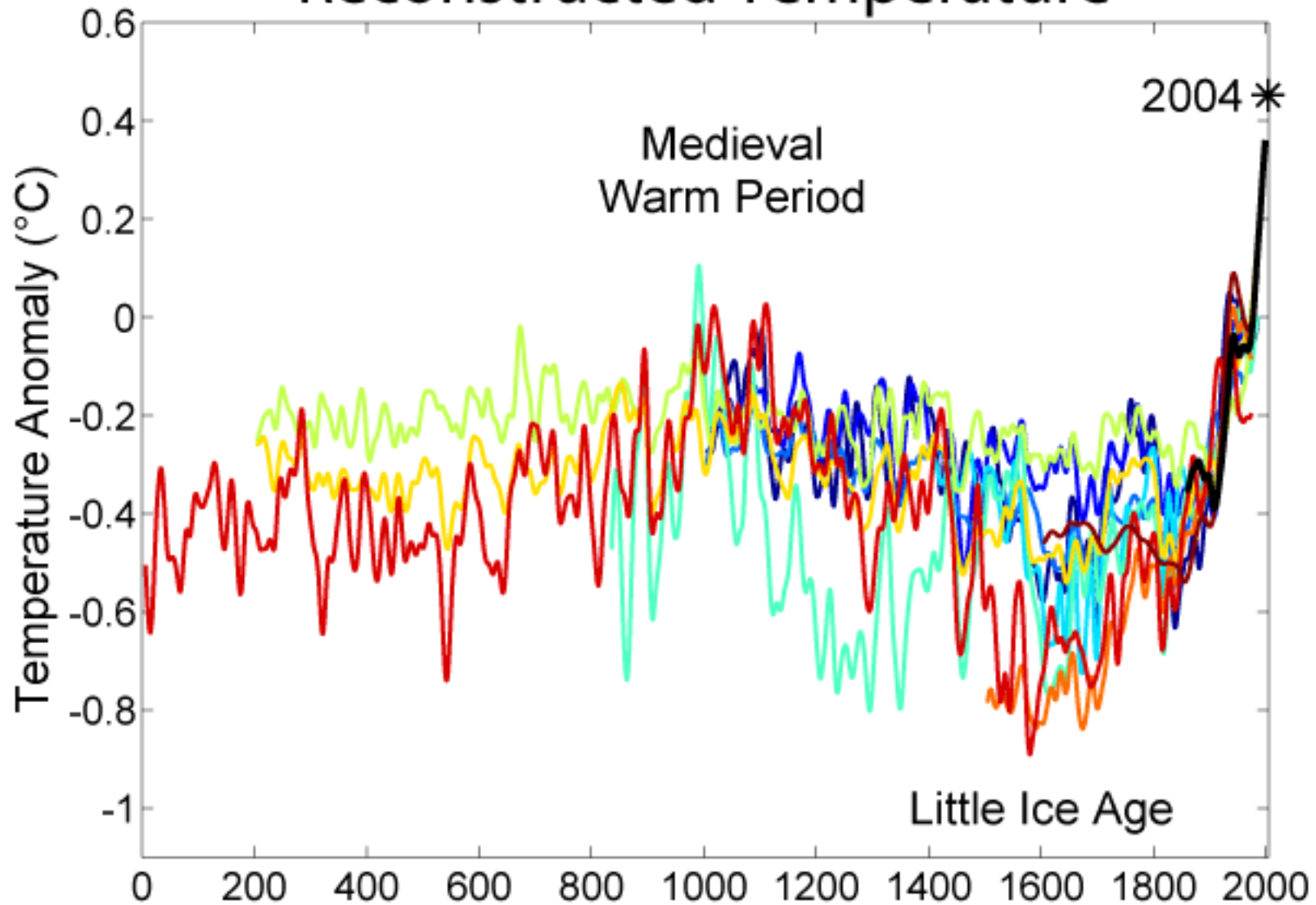
- Over the past 420,000 years atmospheric CO₂ has varied **between 180 and 280** parts per million, beating in time with the last four glacial cycles
- Since the **Industrial Revolution**, CO₂ has risen very rapidly



from measurements

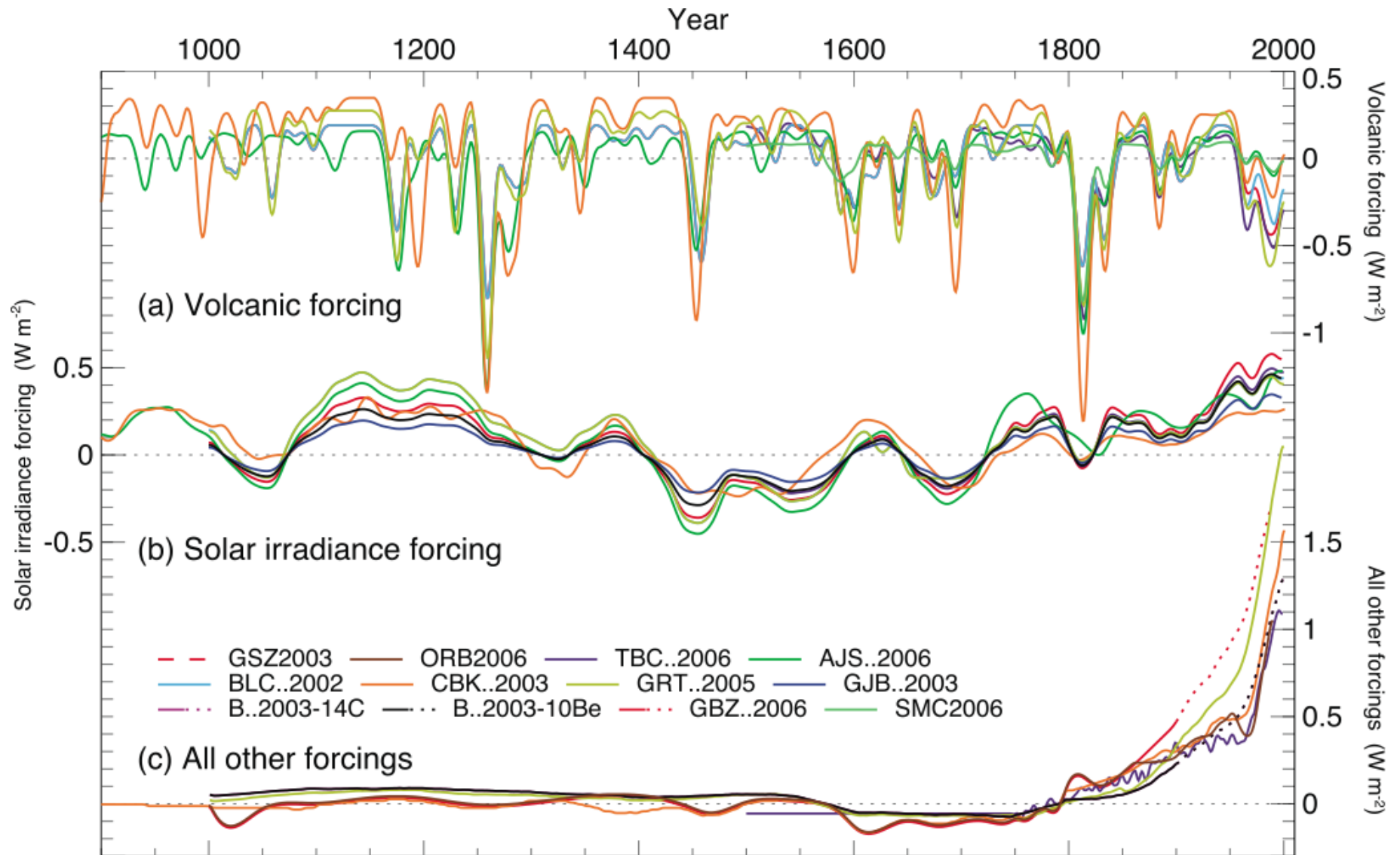
The Past 2000 Years

Reconstructed Temperature



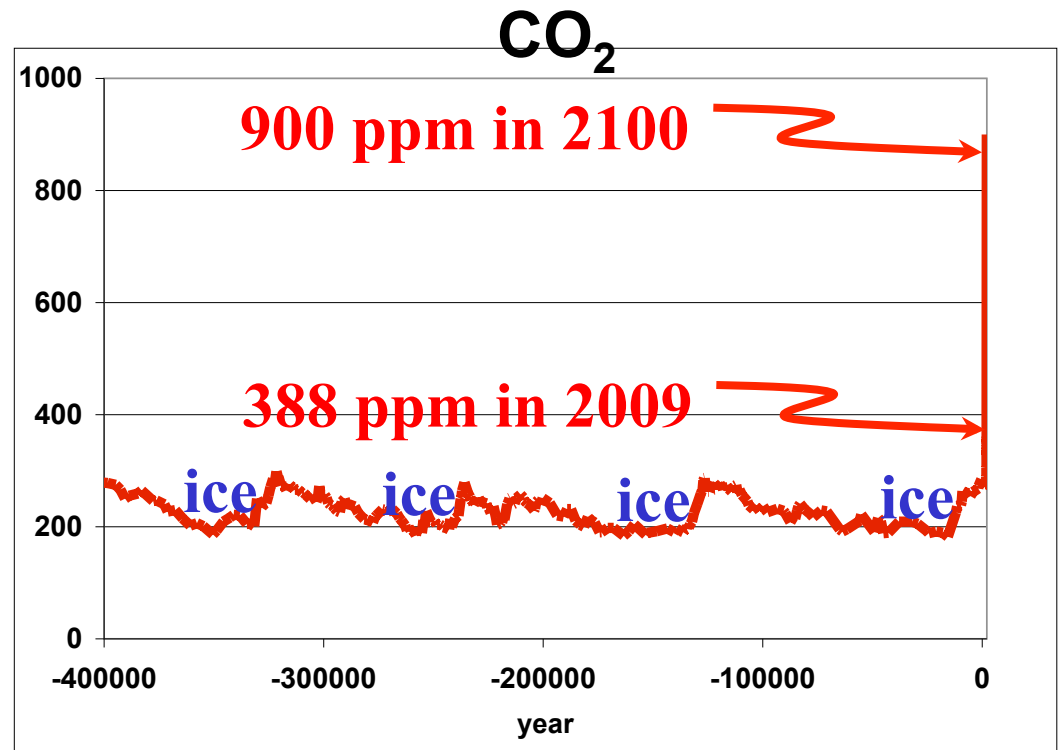
http://commons.wikimedia.org/wiki/File:2000_Year_Temperature_Comparison.png

Reconstructed Radiative Forcings



CO₂ and the Future

- Over the past 420,000 years atmospheric CO₂ has varied **between 180 and 280** parts per million, beating in time with the last four glacial cycles
- Since the **Industrial Revolution**, CO₂ has risen very rapidly
- If China & India develop using 19th Century technology, CO₂ will reach **900 ppm** in this century

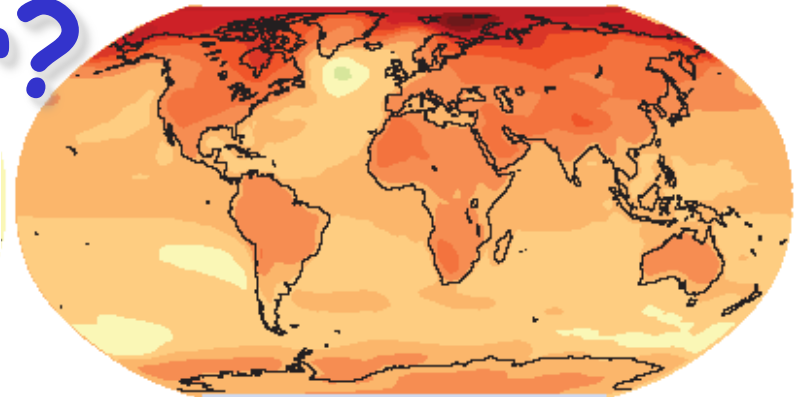


You ain't seen nothing yet!

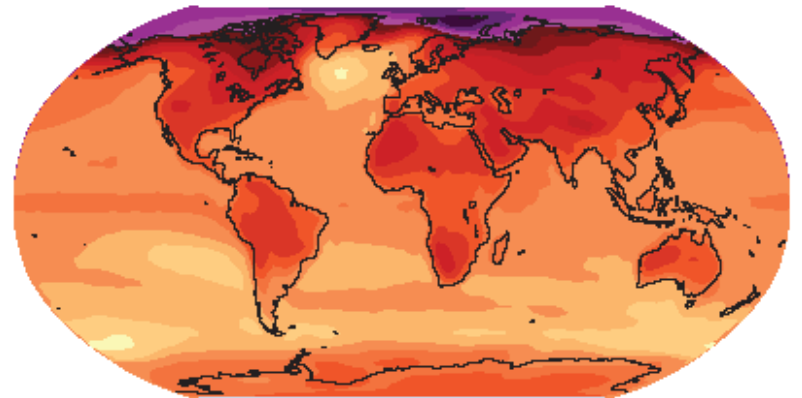
How much warmer?

- Land vs ocean!
- North vs South
- Global mean warming of 2° to 5° C
- North American warming of 3° to 6° C
= 5° to 11° F
- Arctic warming of 8° to 14° F

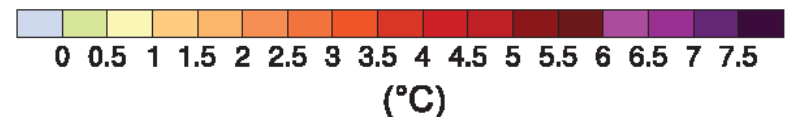
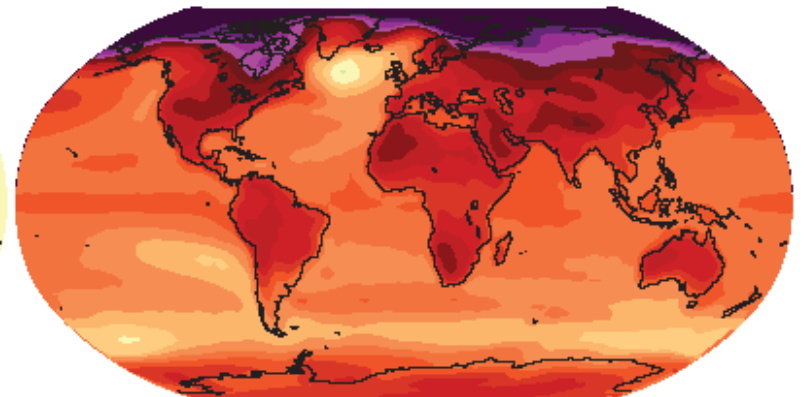
Low
Emissions



Moderate
Emissions



High
Emissions



Rainfall?

Agriculture?

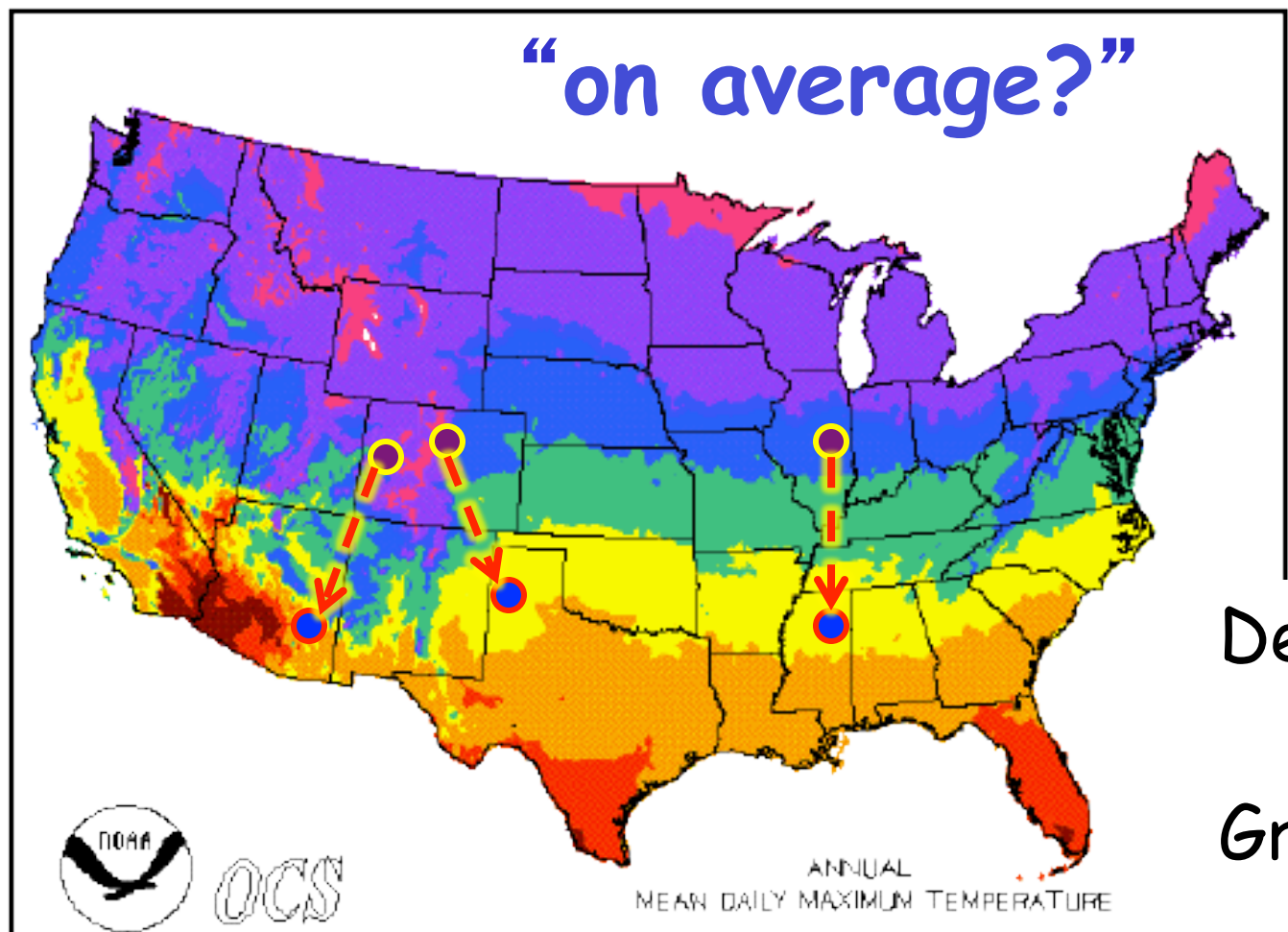
Water supply?

Ski industry?

Mass immigration?

Where is it 10°F Warmer

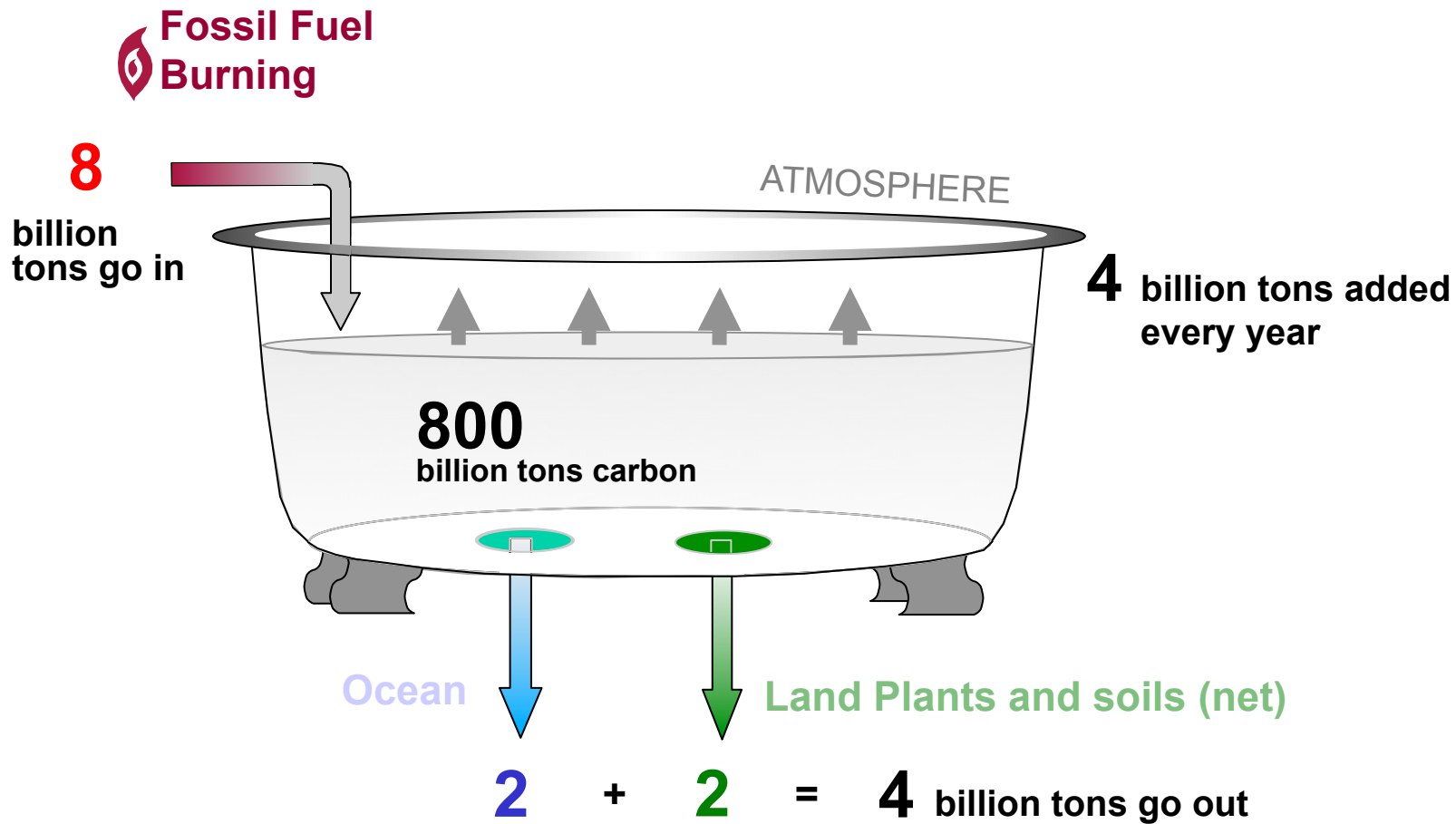
“on average?”



Denver →
Amarillo
Grand Junction
→ Tucson
Illinois →
Mississippi

*Water? Crops?
Real Estate? Health?*

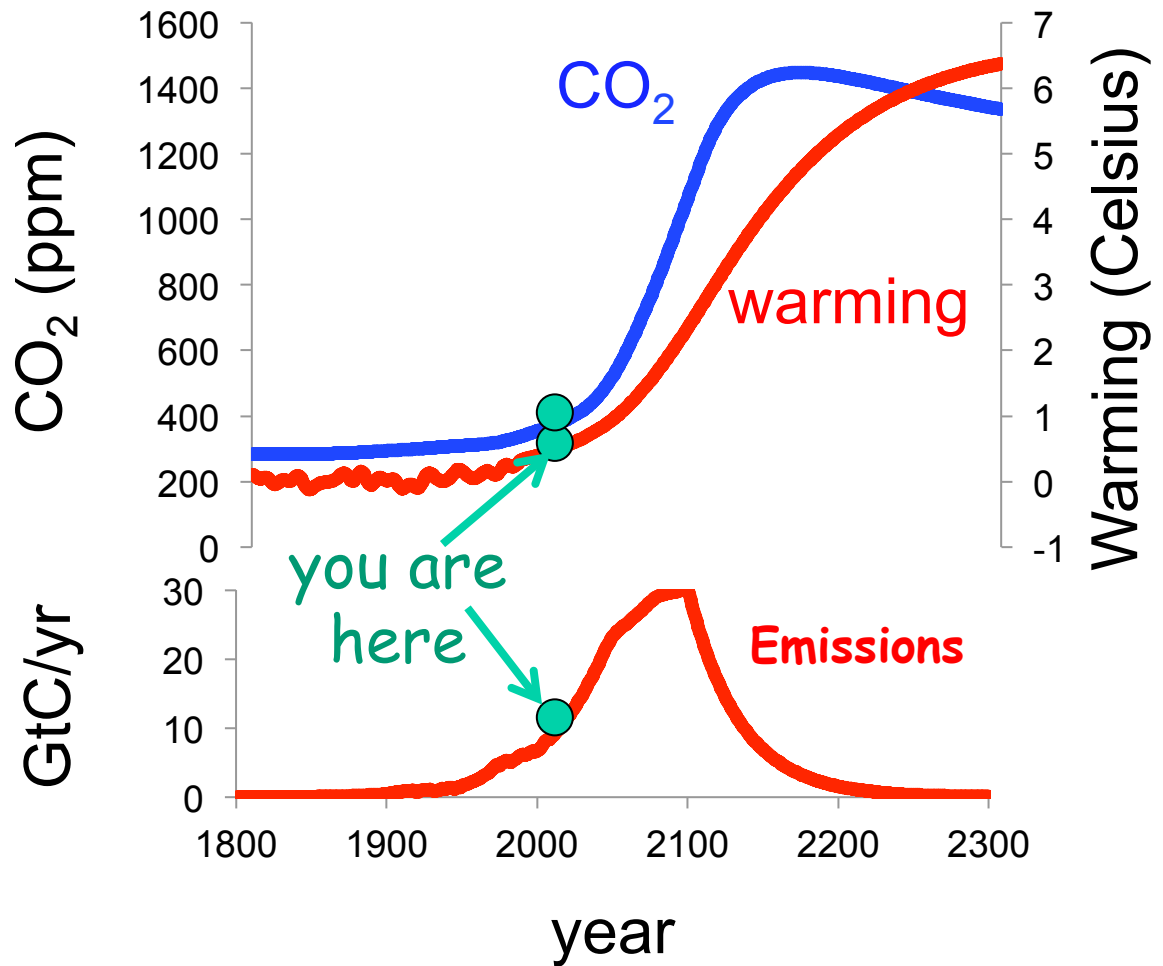
CO₂ “Budget” of the World



Extra heat comes from the water, not the faucet!

How Much Warmer?

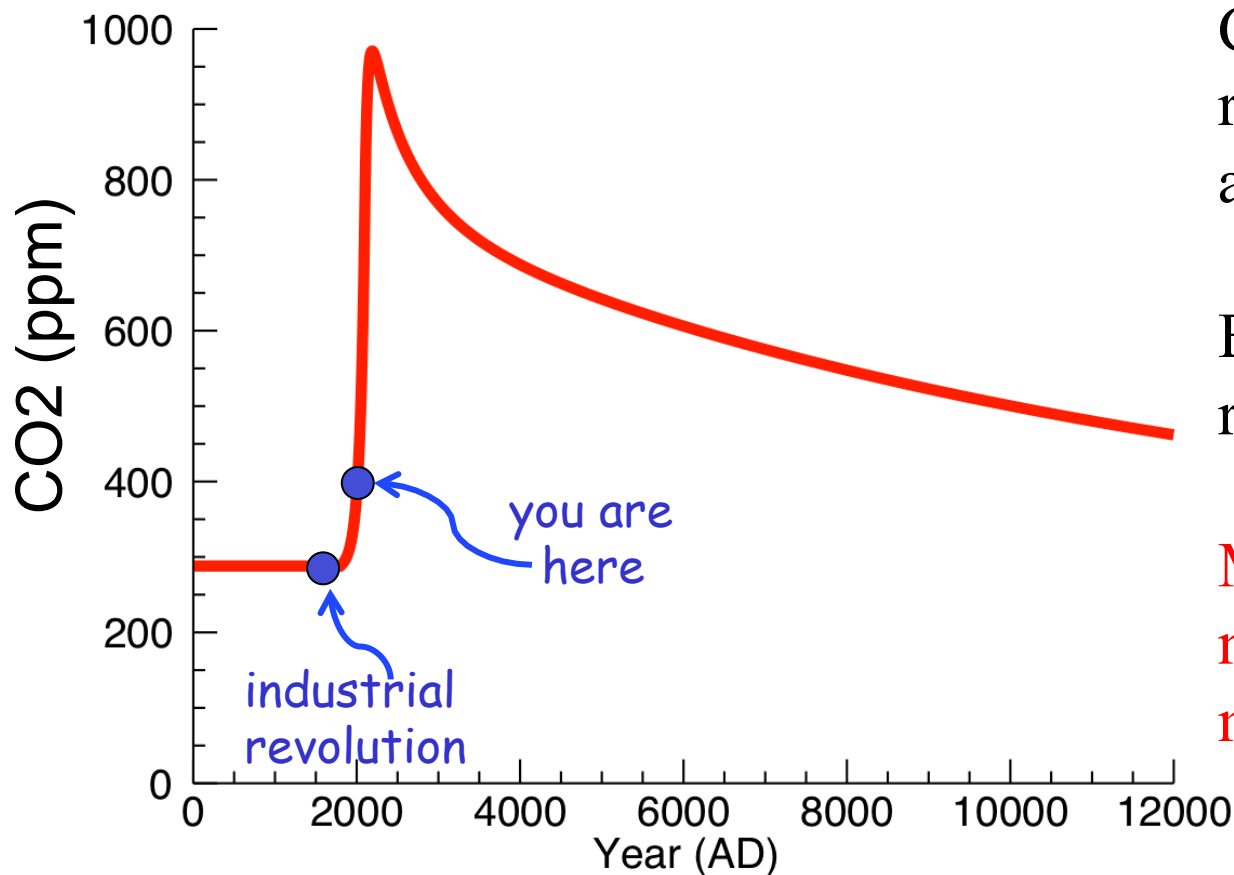
- If China and India industrialize with coal, CO_2 will rise to **4x preindustrial**
- Extra CO_2 will last for **centuries** after coal is gone



The heck with Polar Bears ... what would that do to farmers?

Common Myth #2

“When we reduce or stop the burning of fossil fuel, the CO_2 will go away and things will go back to normal”



CO_2 from fossil fuel will react with oceans, but only as fast as they “mix”

Eventually, fossil CO_2 will react with rocks

Much of the CO_2 we emit now will stay in the air for many thousands of years!

The Worst Myth of All

- Without the subsidy of cheap fossil energy, civilization will crumble
- People will freeze in the dark!
- **We'll starve!**

“The sky is falling!”

Be skeptical ... be very skeptical !

Imagine it's 1800, and you're in charge ...

Somebody presents you with a grand idea for transforming the world economy:

- ✓ Dig 8 billion cubic feet of the ground every year
- ✓ Build a system of oil tankers, railroads, highways to deliver it to every street corner
- ✓ Build millions of cars, and millions of miles of roads
- ✓ Generate and pipe enough electricity to every house to power lights & stereos & plasma TVs



... ***“and here's the itemized bill ...”***

Thinking about Co\$t+\$

- Our global society built that very system
- We didn't all go broke building it ...
- We got **rich** beyond the avarice of kings!

- 
- 
- Now we get to do it again!
 - How?

Free Market Solutions

- A **new industrial revolution** won't happen because people want to “do the right thing”
- The government **can't just pass a law** and create a new global energy economy, any more than they could 200 years ago
- If low-carbon-footprint goods and services cost less than “dirtier” ones, **people will buy them**

Choose Your Future

- Some people say:
 - “Modern wealth is due to the subsidy of cheap fossil fuel. If we stop burning coal we’ ll freeze in the dark!”
- I prefer:
 - “Modern wealth results from ingenuity and hard work. Before we run out of oil, we’ ll invent energy technologies for the 21st Century.
 - **Our future is bright.”**

Objections

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- Past climate change didn't involve people
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