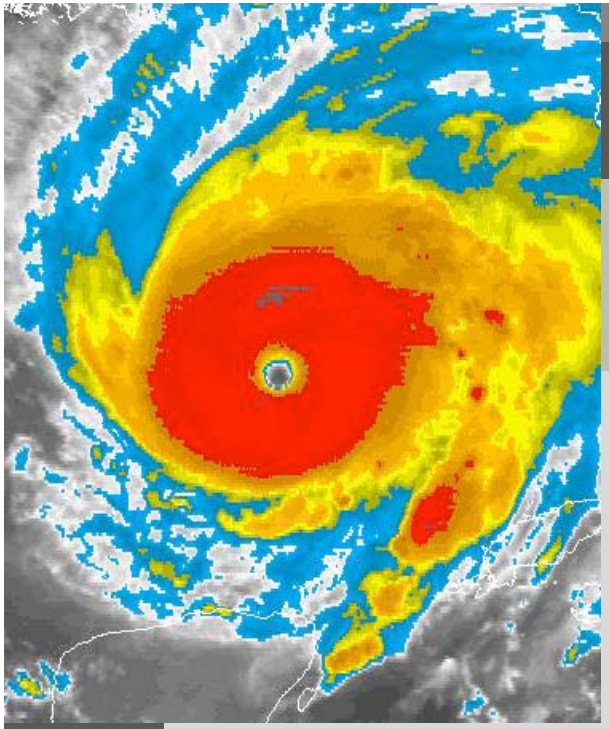


CLIMATE CHANGE

What does it mean for the insurance industry?

Katharine Hayhoe

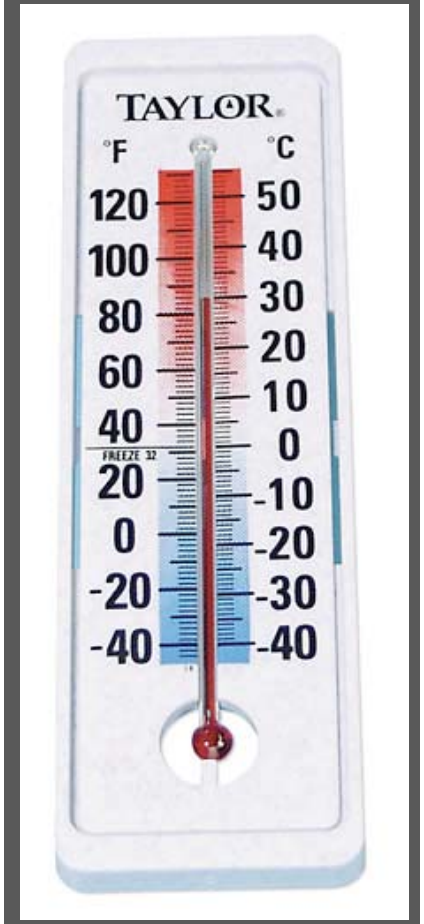
Texas Tech University

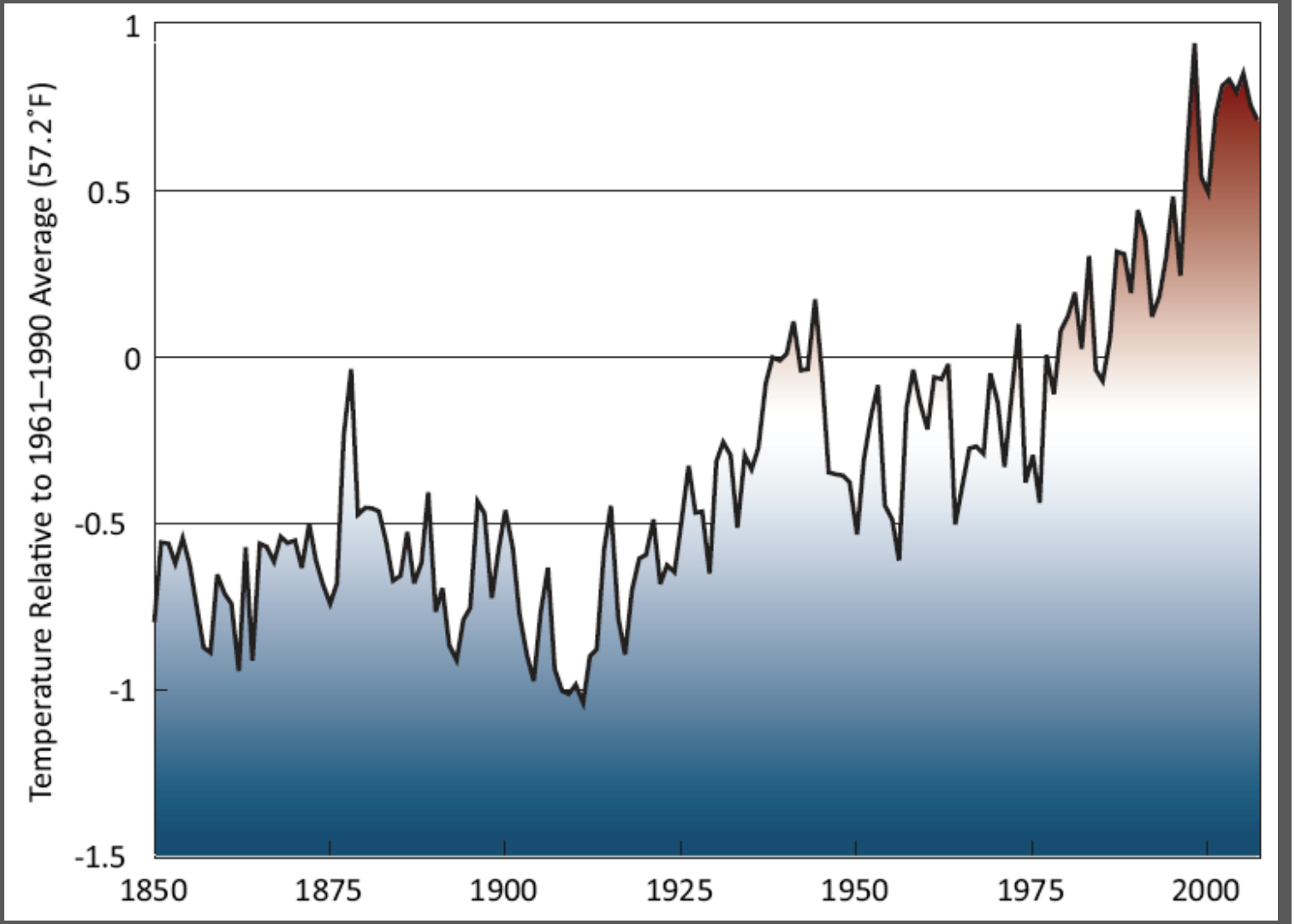
ATMOS Research

3 questions on climate change

1. **WHY** do we need to consider climate change?
2. **HOW** do we expect climate to change in the future?
3. **WHAT** impacts will it have on our world?

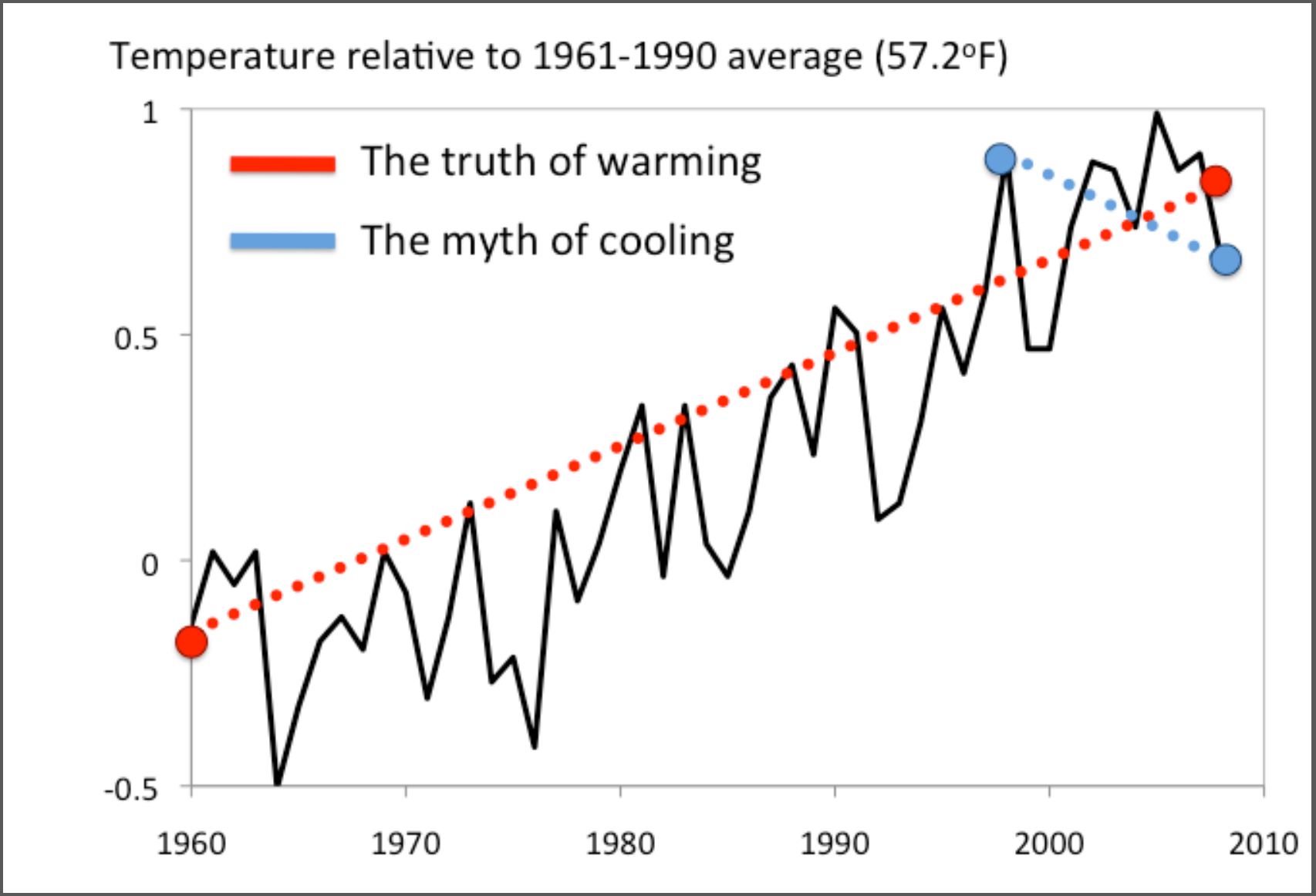
The Earth is getting warmer …



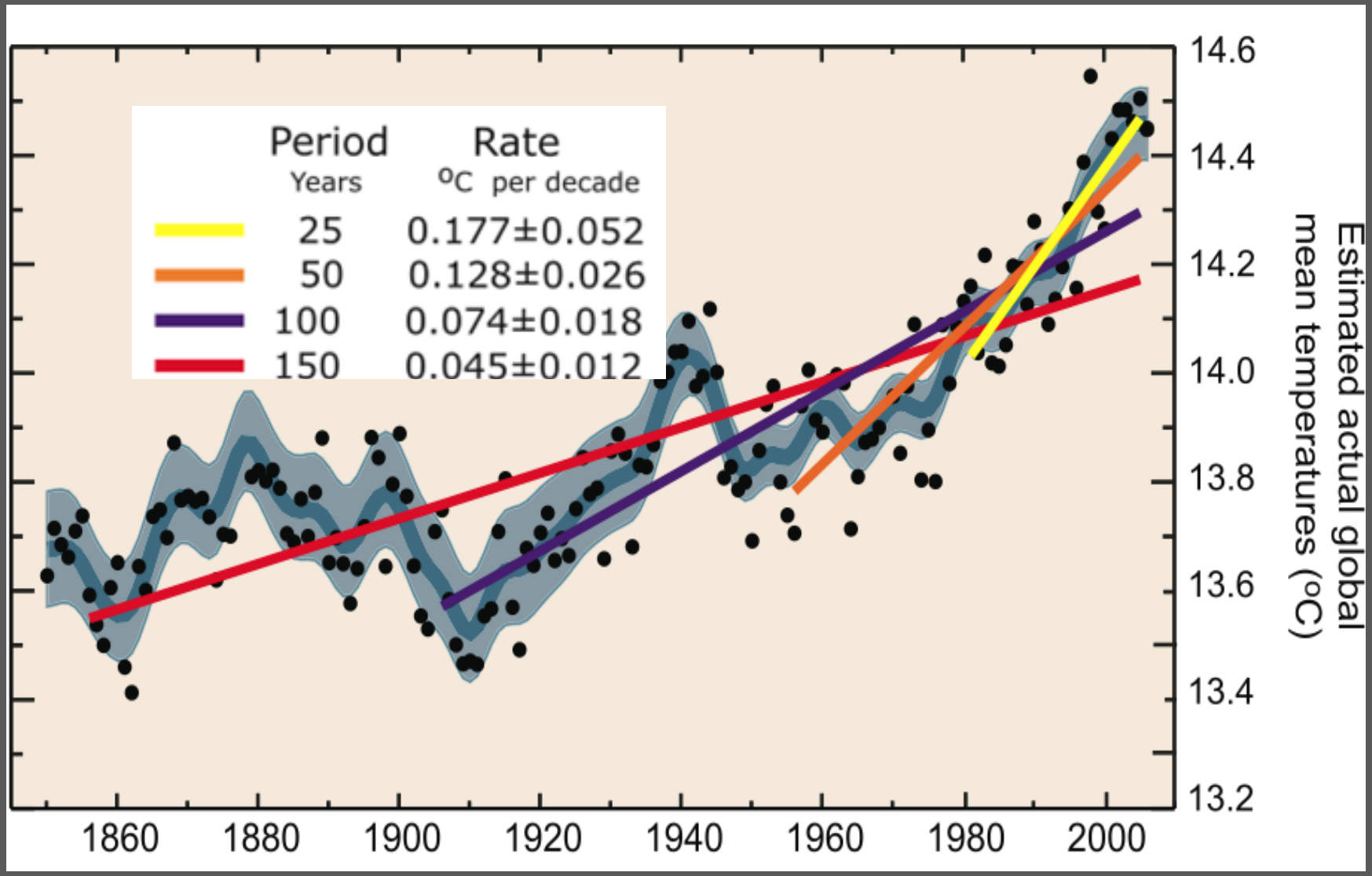


11 out of the last 12 years have been the warmest on record.

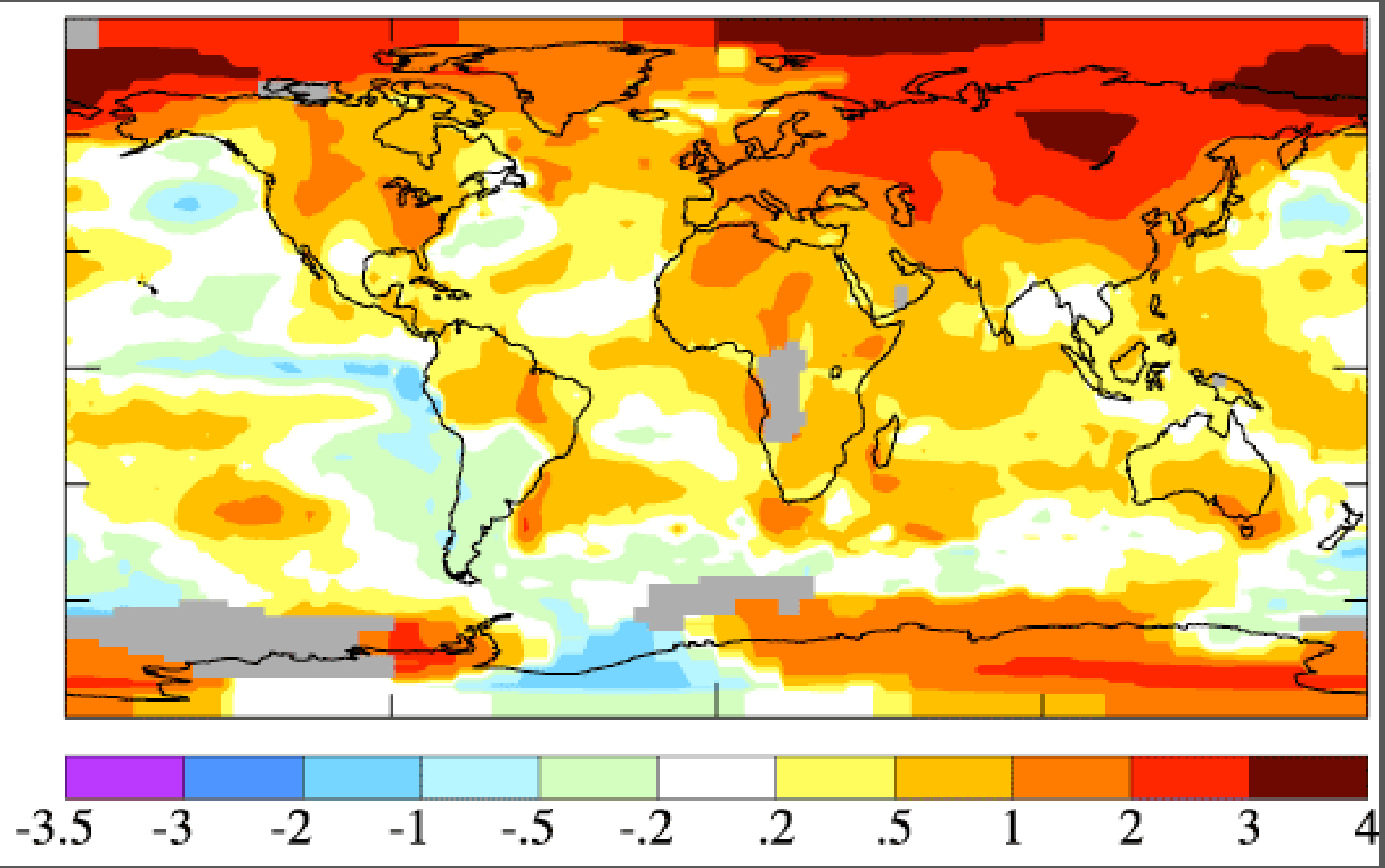
… despite recent claims of “cooling”



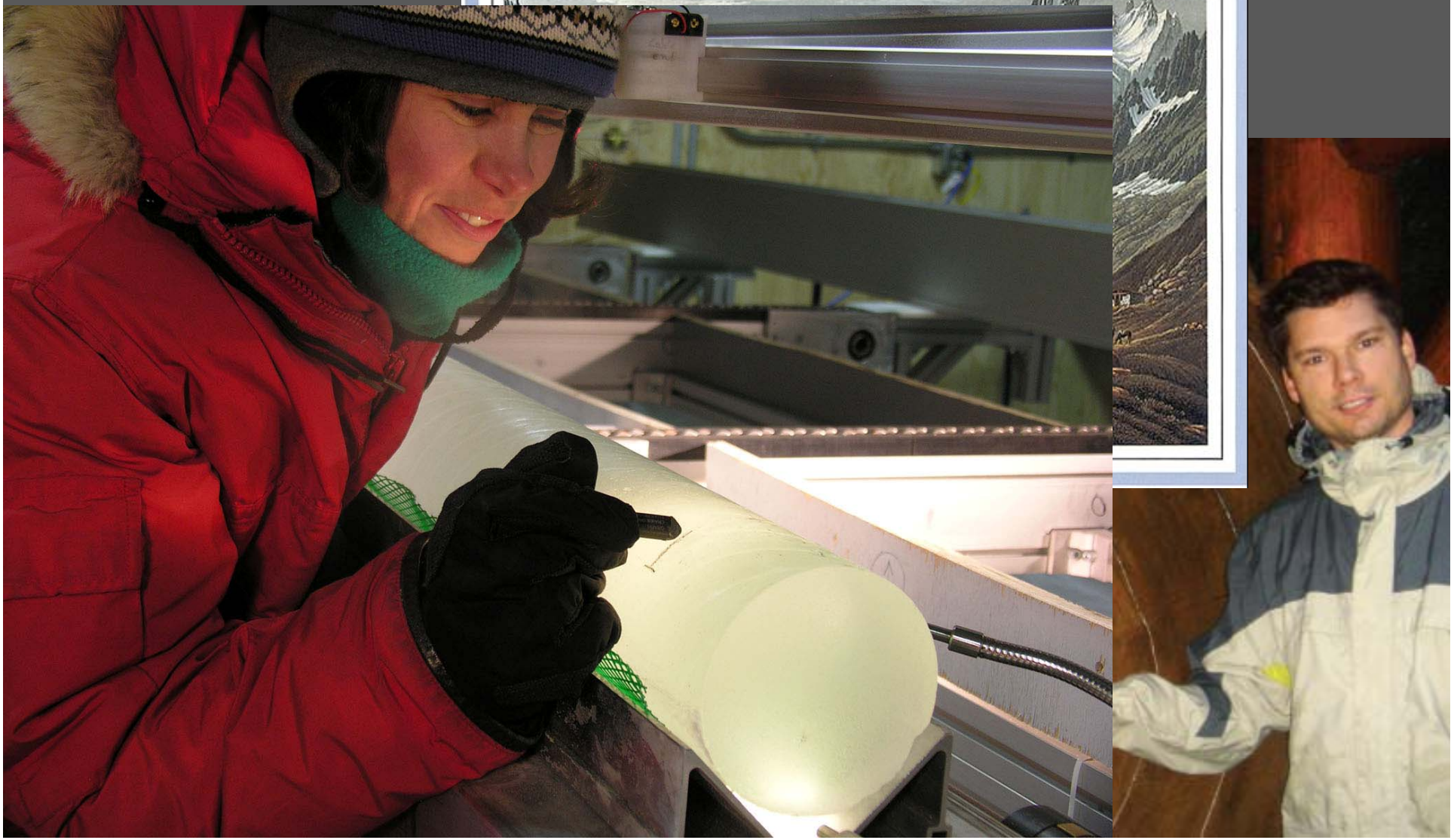
It’s happening faster and faster



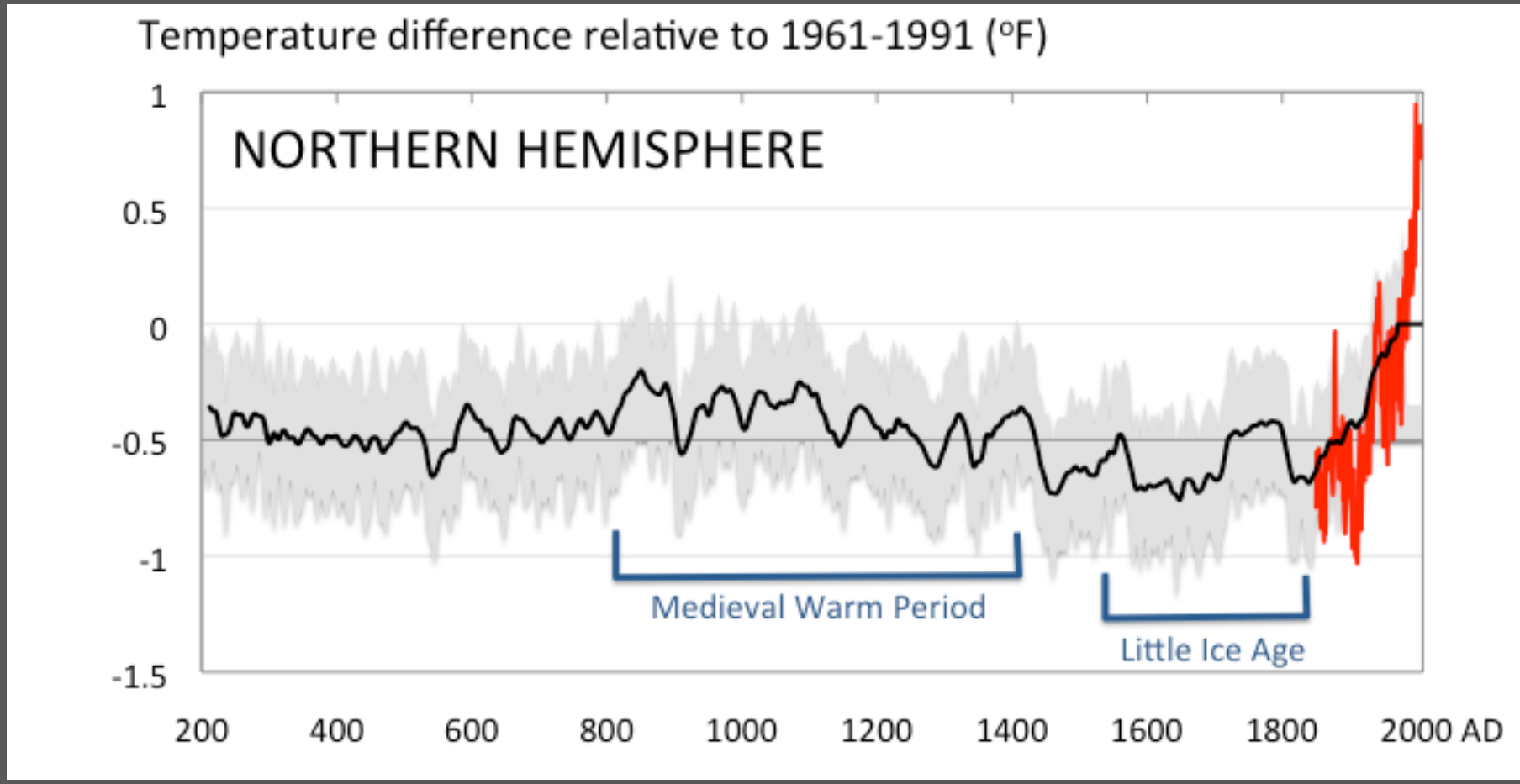
…and is greatest over land& at higher latitudes



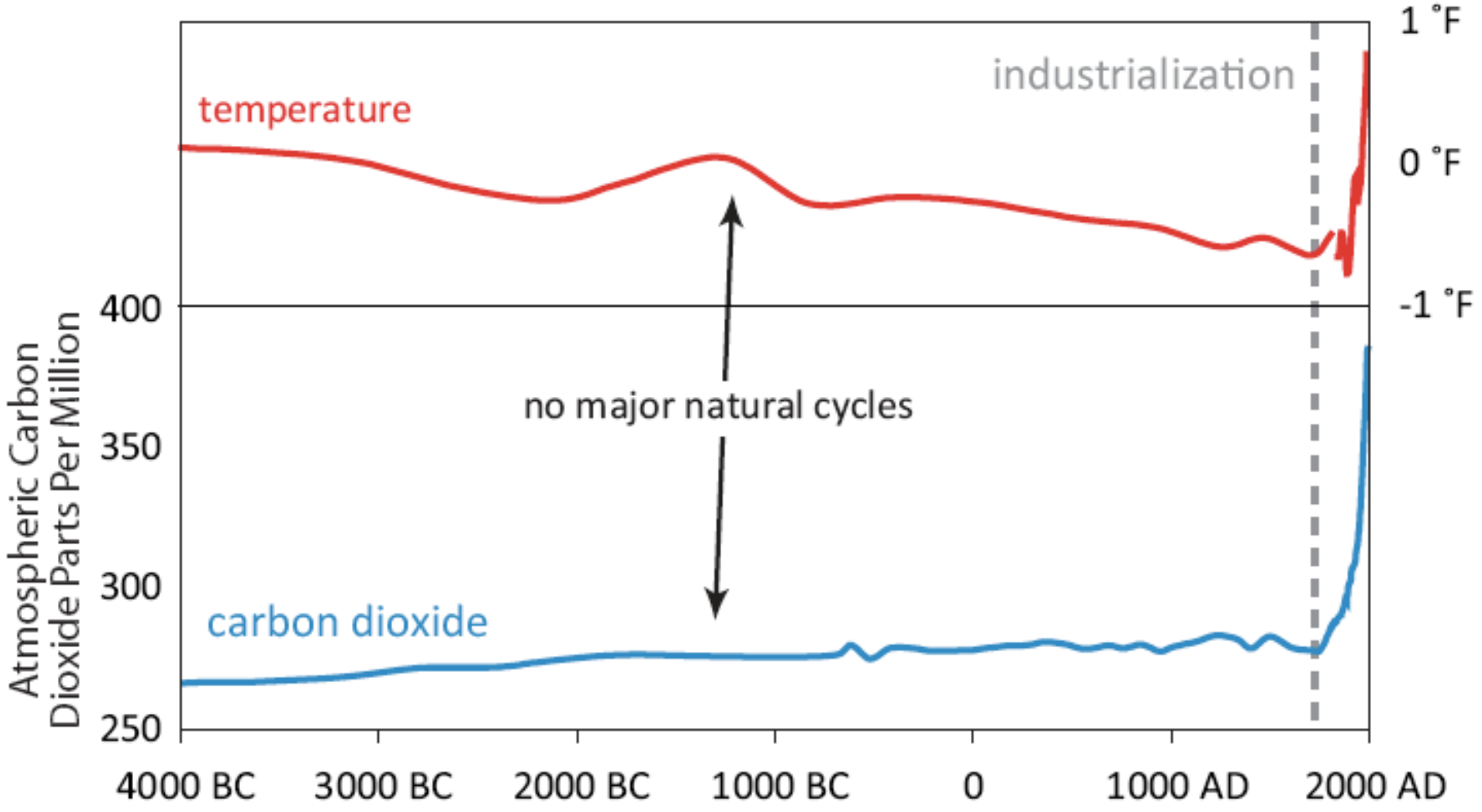
How do we know this warming is unusual?



Conditions today are unusual in the context of the last 2,000 years …

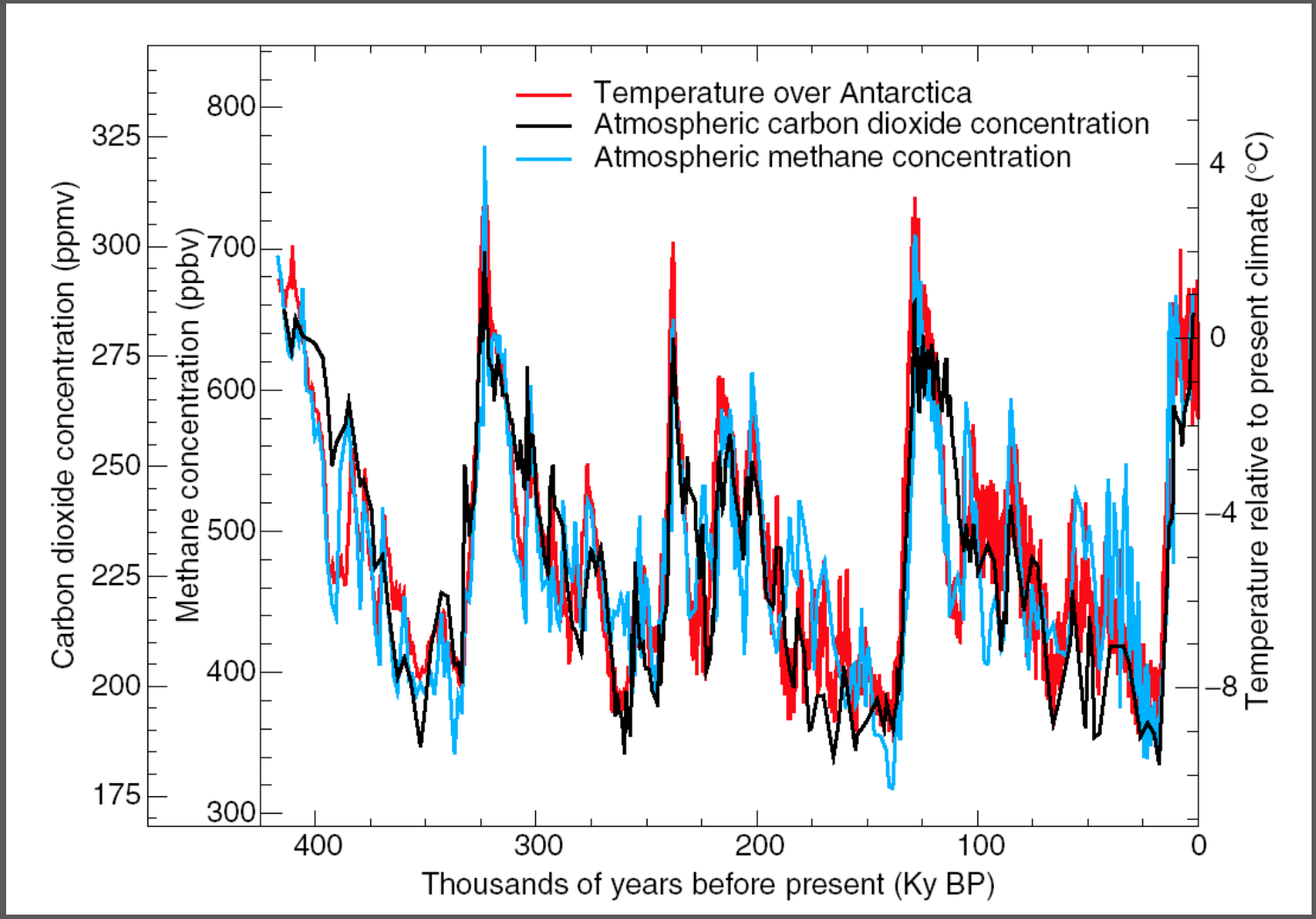


… the last 6,000 years



… and even the last 400,00 years.

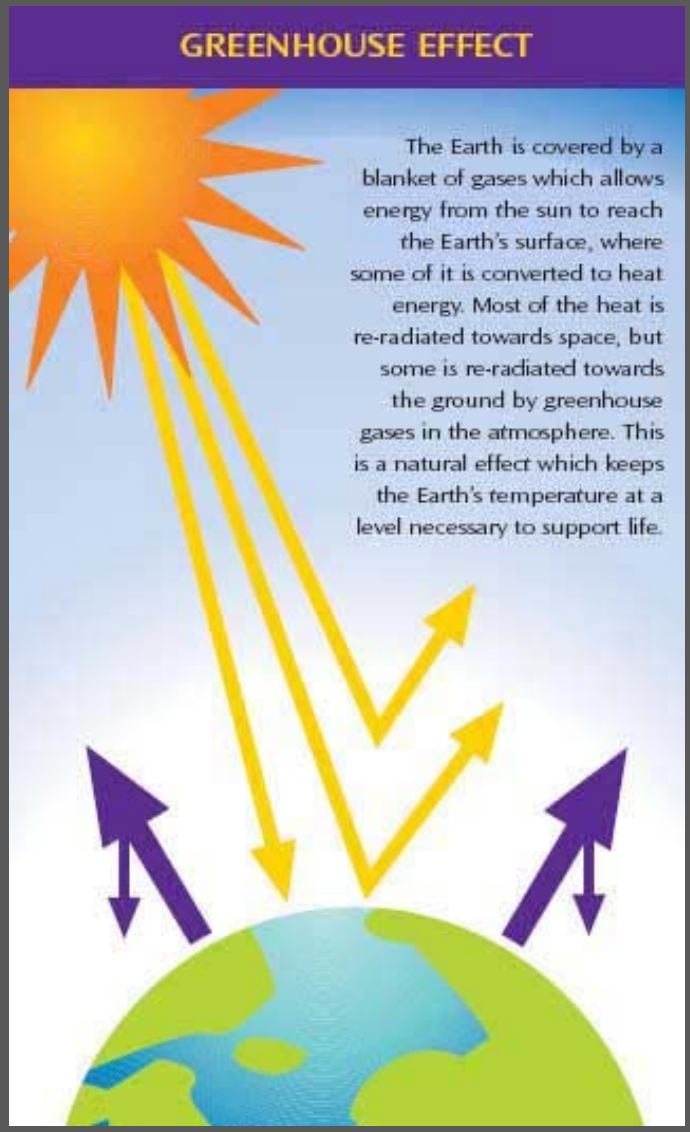
385 ppm



Natural warming

THE GREENHOUSE EFFECT…

- …is 100% natural.
  - Heat is trapped in the atmosphere.
- …sustains life on Earth.
  - Keeps average temperatures at 55°F, instead of–20°F.



Unnatural warming

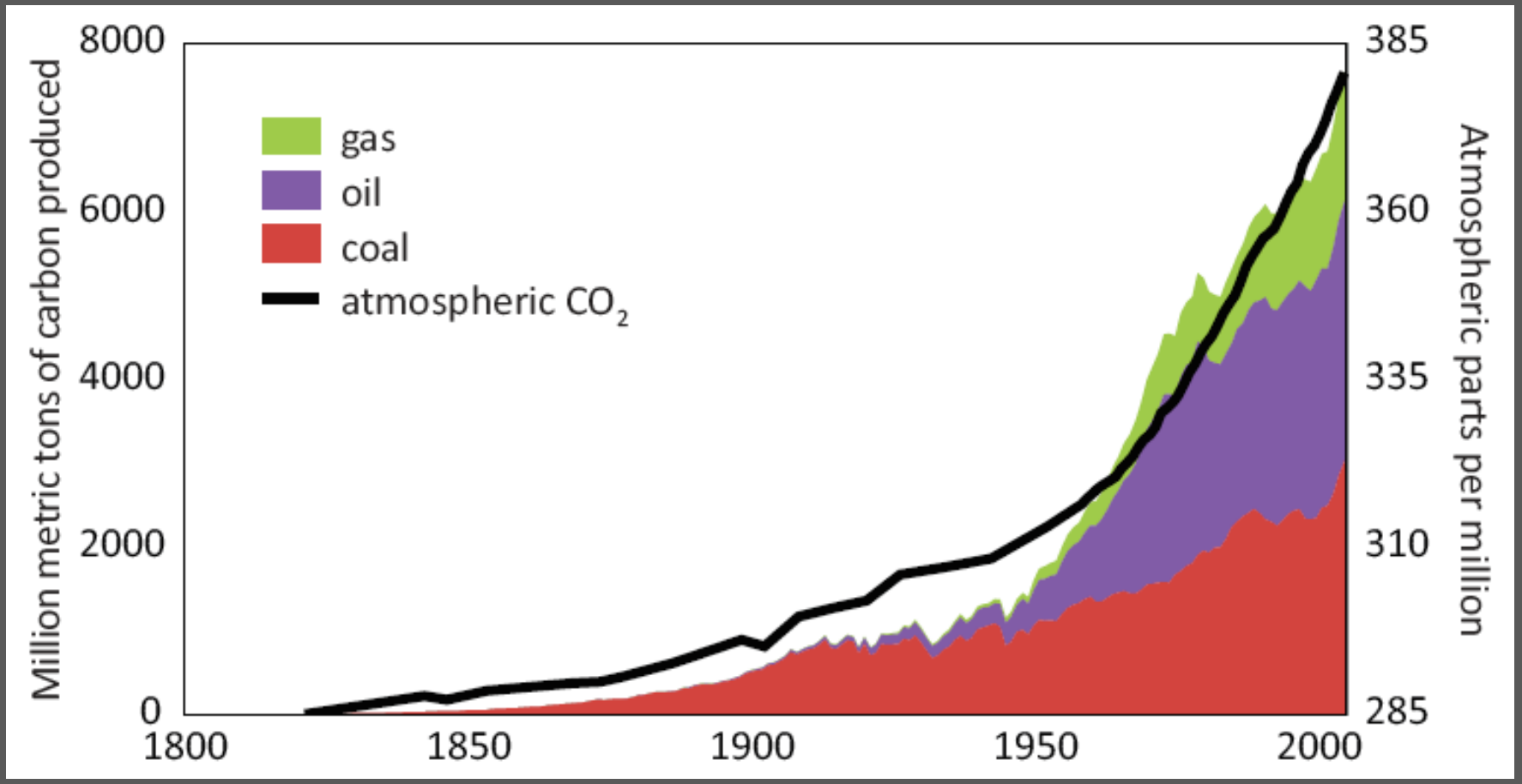
THE ENHANCED GREENHOUSE EFFECT

(or GLOBAL WARMING)

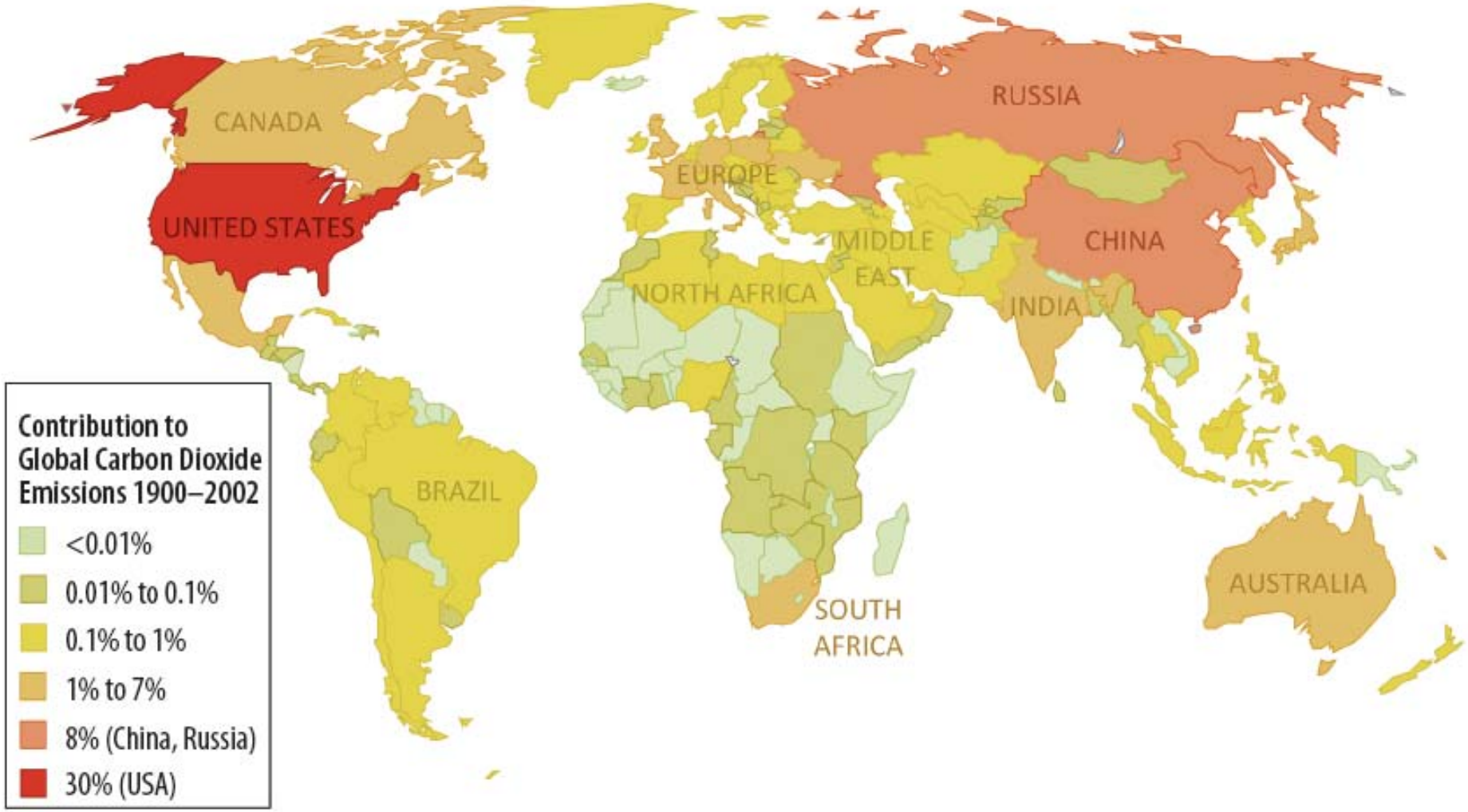
- … is primarily human-induced
  - We're increasing heat-trapping gases in the atmosphere.
- … is like wrapping an extra blanket around the Earth.

How is this happening?

Human production of heat-trapping gases



Why this is such a political hotbutton



3 questions on climate change

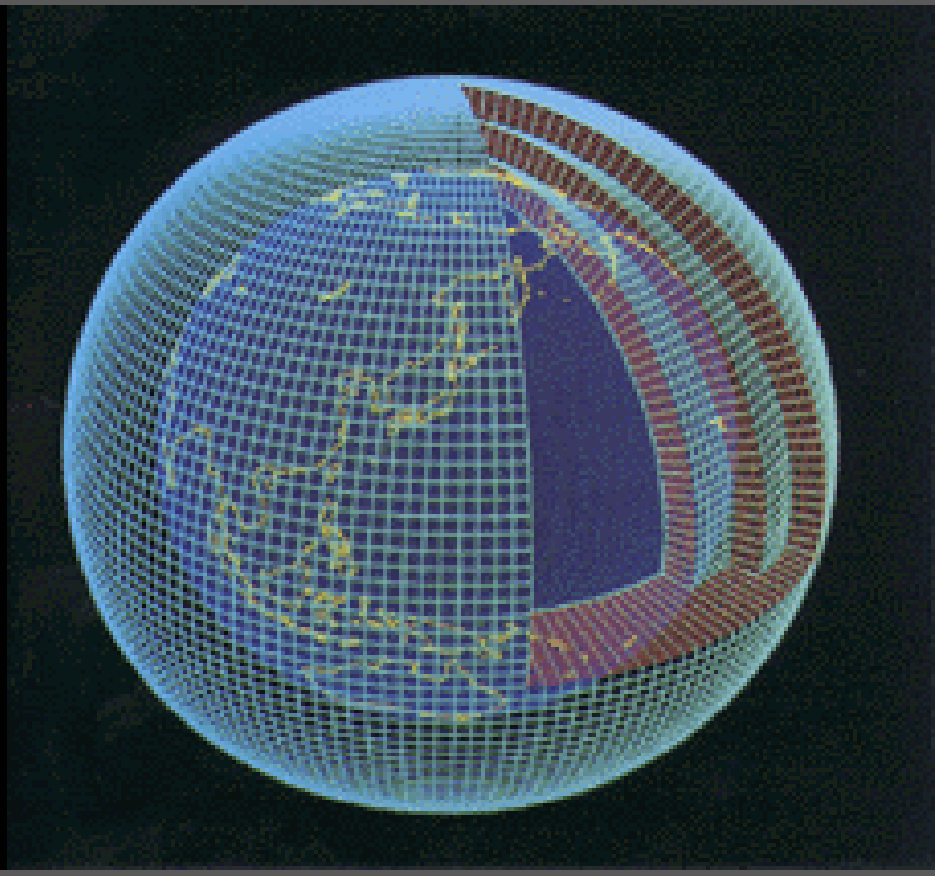
1. **WHY** do we need to consider climate change?

Climate today is changing in ways that can't be predicted by the past.

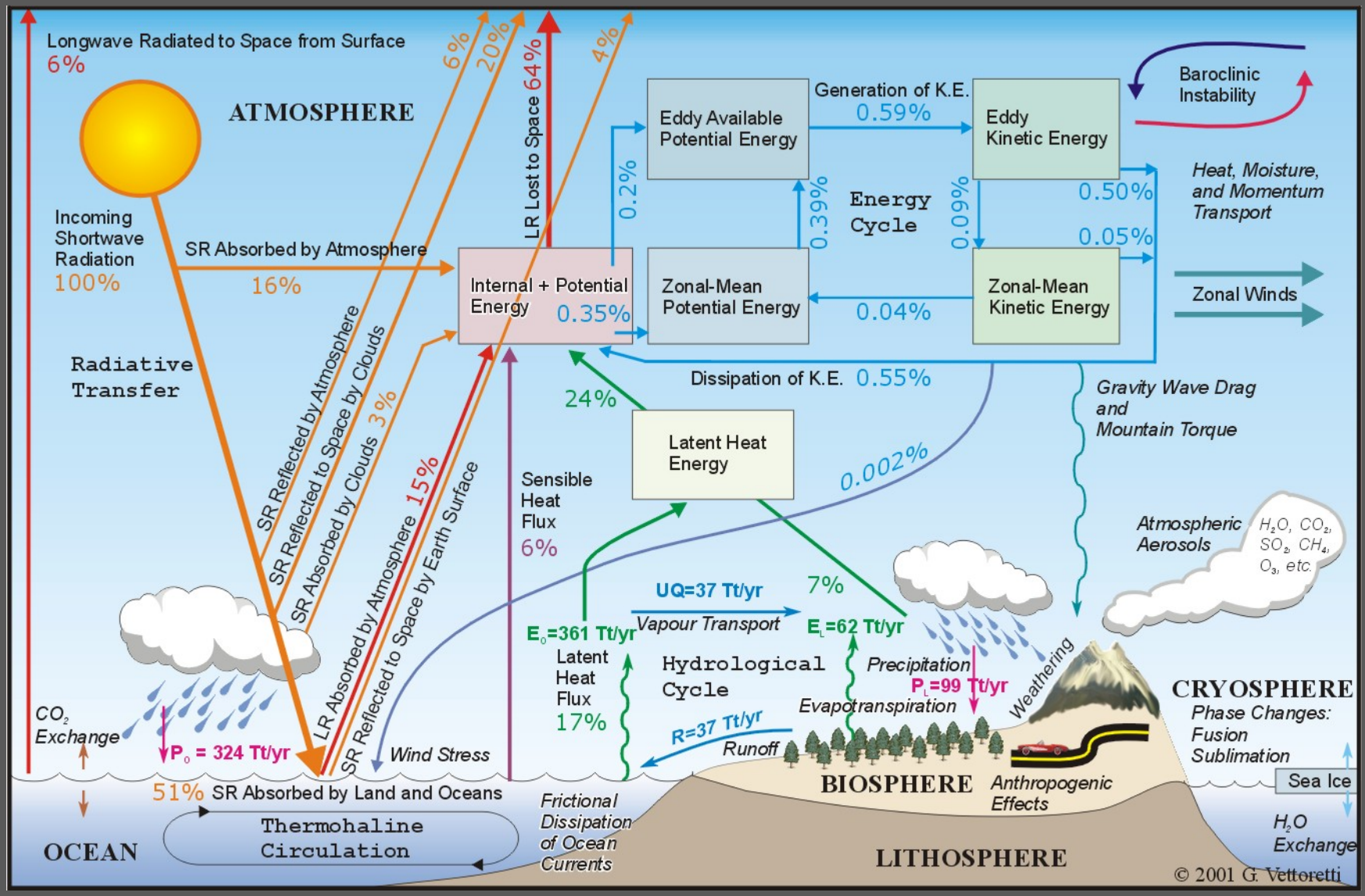
Humans have taken over the reins.

How do we know that humans are causing the warming today?

Computer simulations of the earth system



Modeling the Climate System



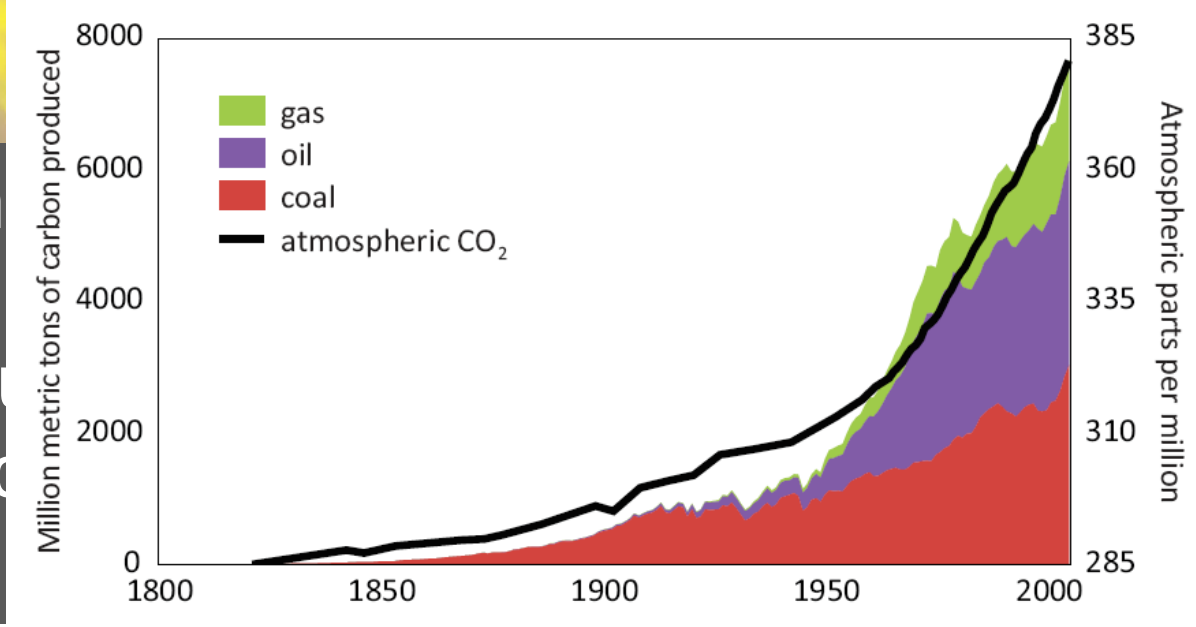
Chaos and Stability in the Climate System

- Some components are **chaotic**
  - weather systems in the atmosphere and ocean
- Others are **stable**
  - storm tracks, low-frequency oscillations

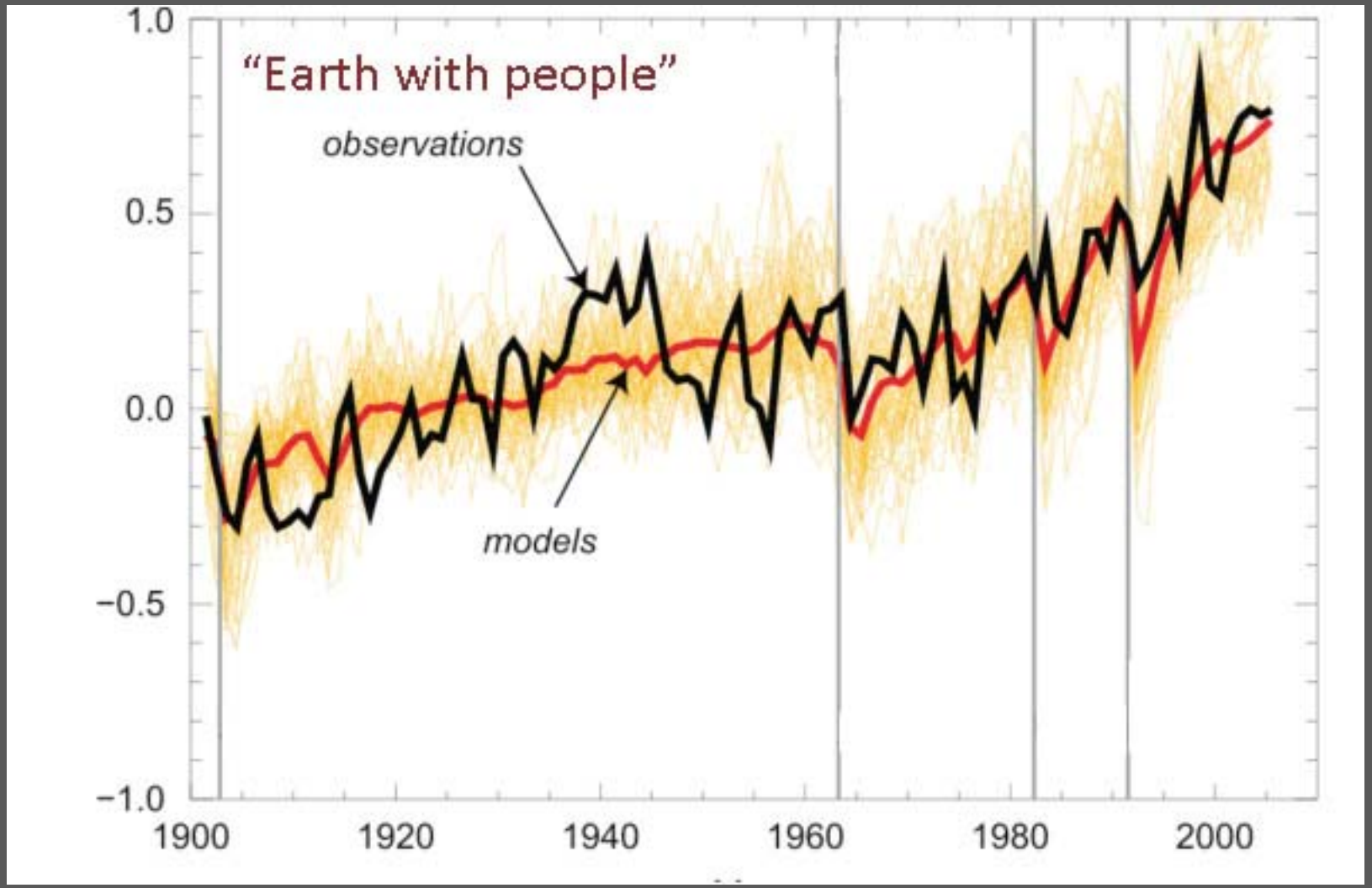
Weather vs. Climate

Weather changes unpredictably, as a result of chaotic forces.

Climate chan
predicta
as a result of natu
& human forc

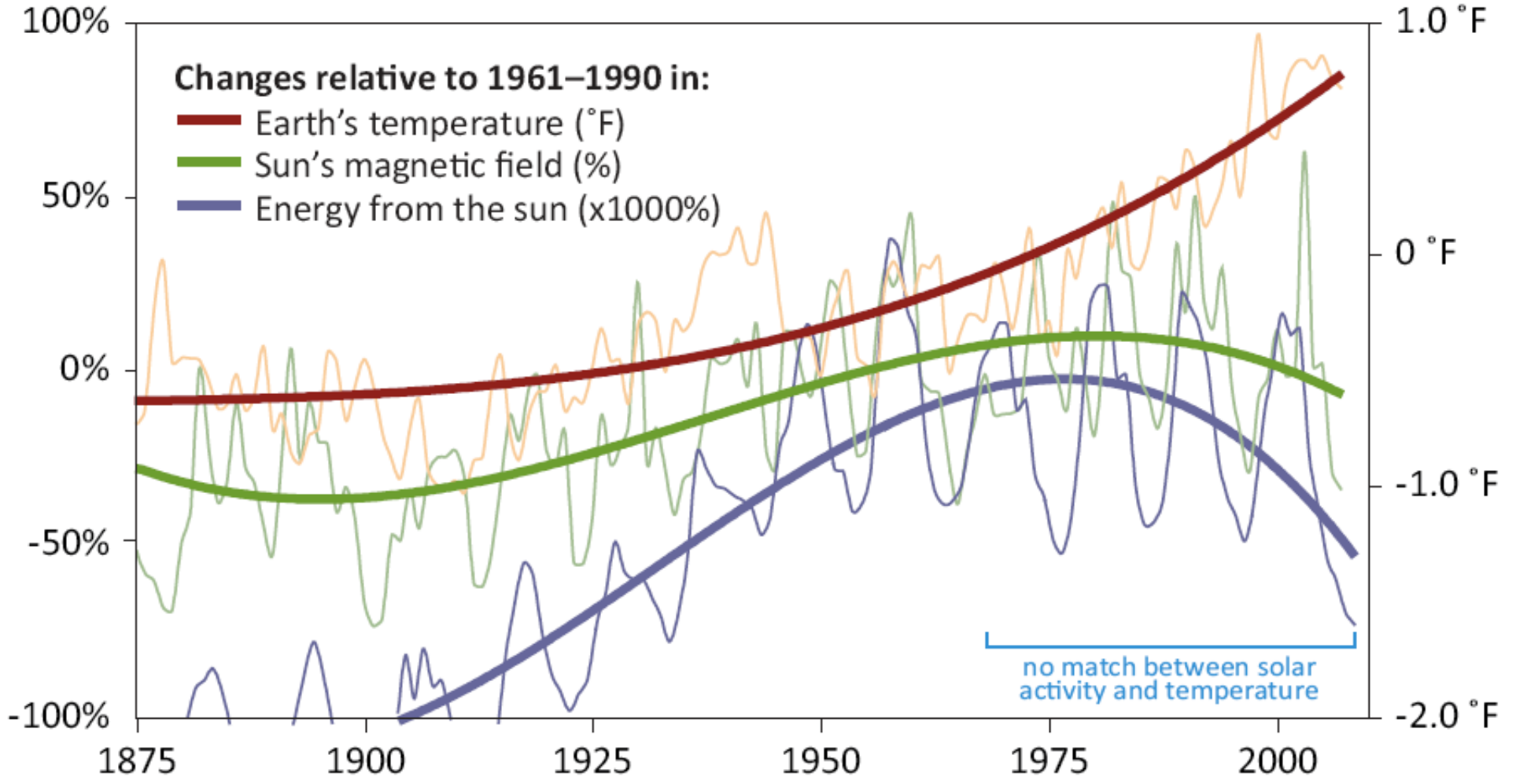


Quantifying the human influence



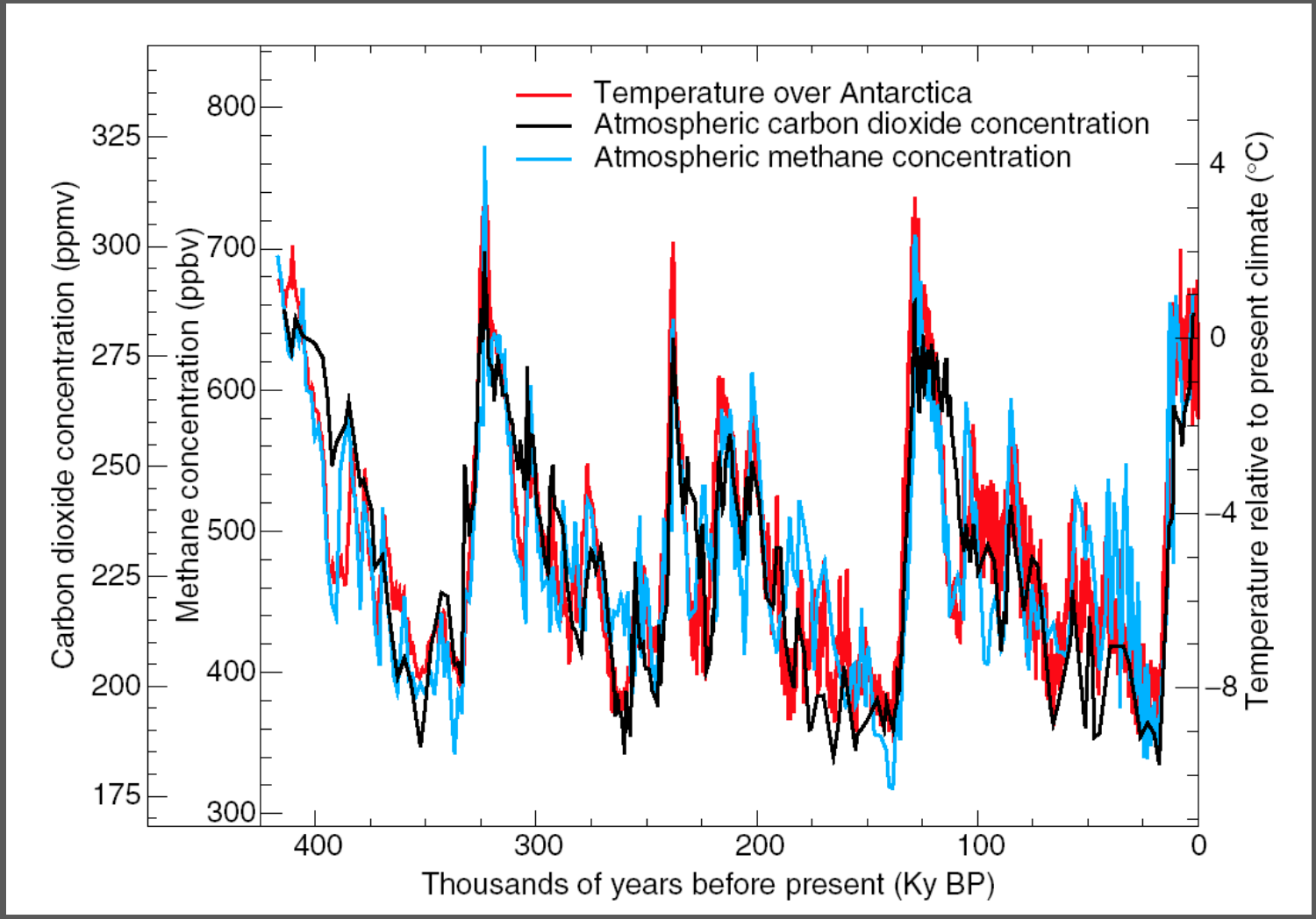
IPCC, 2007

How do we know it's not the sun?



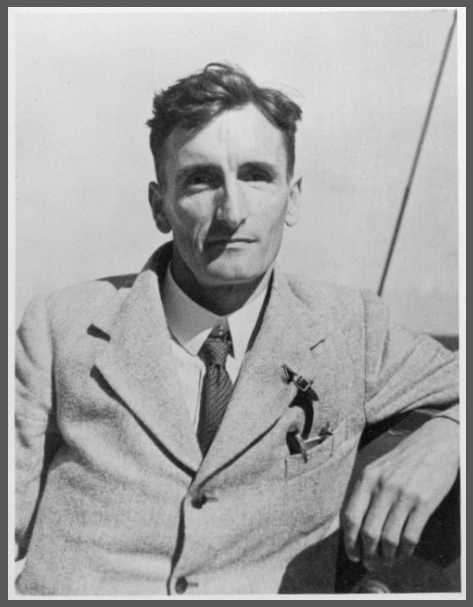
What about natural cycles?

385 ppm



AREN'T SCIENTISTS ALWAYS CHANGING THEIR MINDS?
(JUST 30 YEARS AGO, THEY WERE PREDICTING GLOBAL COOLING!)

Warming of the climate system is now evident from observations. Most of the increase is very likely (>90%) due to the observed increase in heat-trapping gas concentrations due to human activities [including burning fossil fuels].



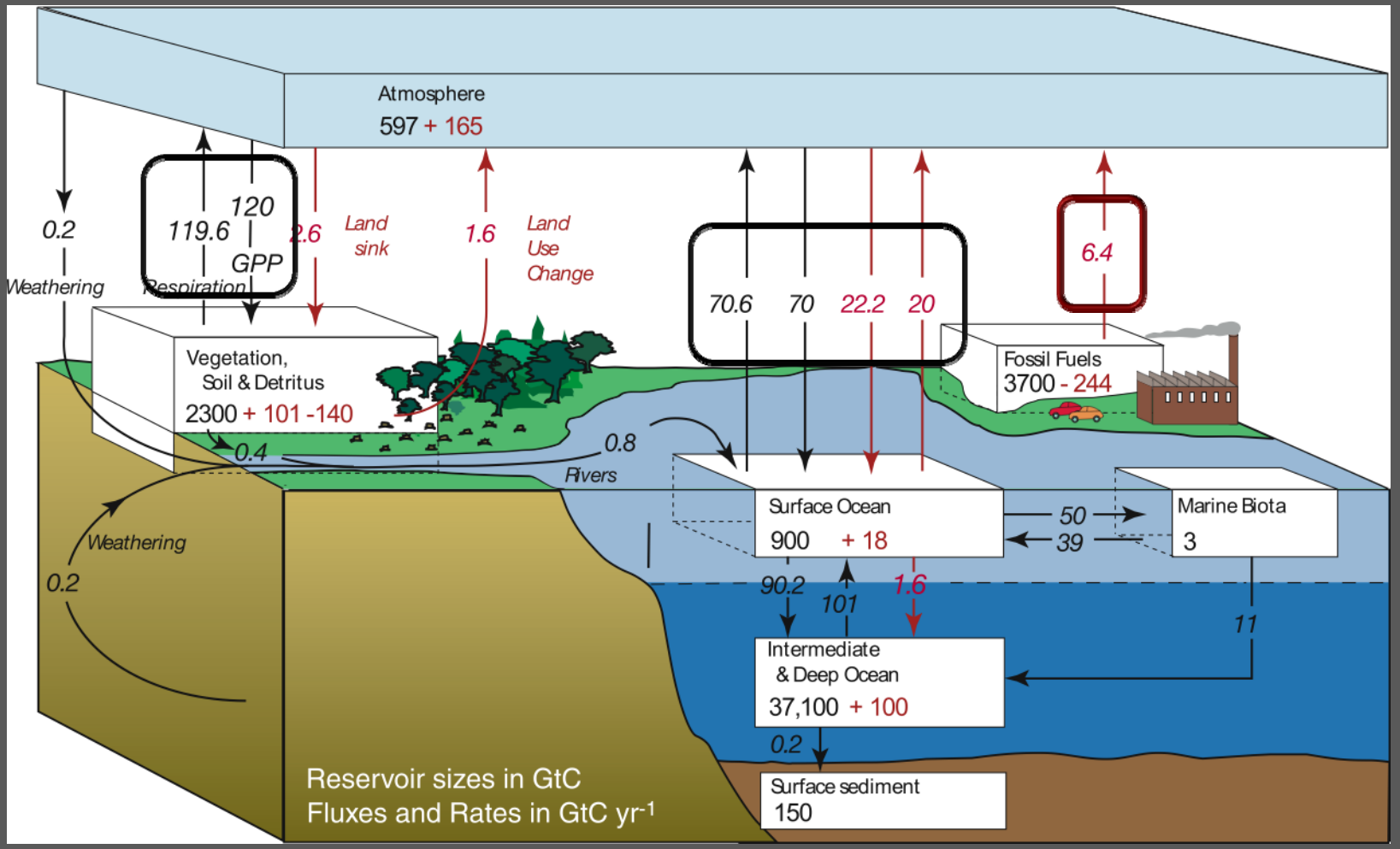
The United Nations Intergovernmental Panel on Climate Change, 2007

Climatic change is being brought about by human-induced increases in the concentration of atmospheric carbon dioxide, primarily through the processes of combustion [burning] of fossil fuels.

"The Artificial Production of Carbon Dioxide and Its Influence on Temperature"

Guy Callendar, 1938

Aren't plants to "blame" more than us?



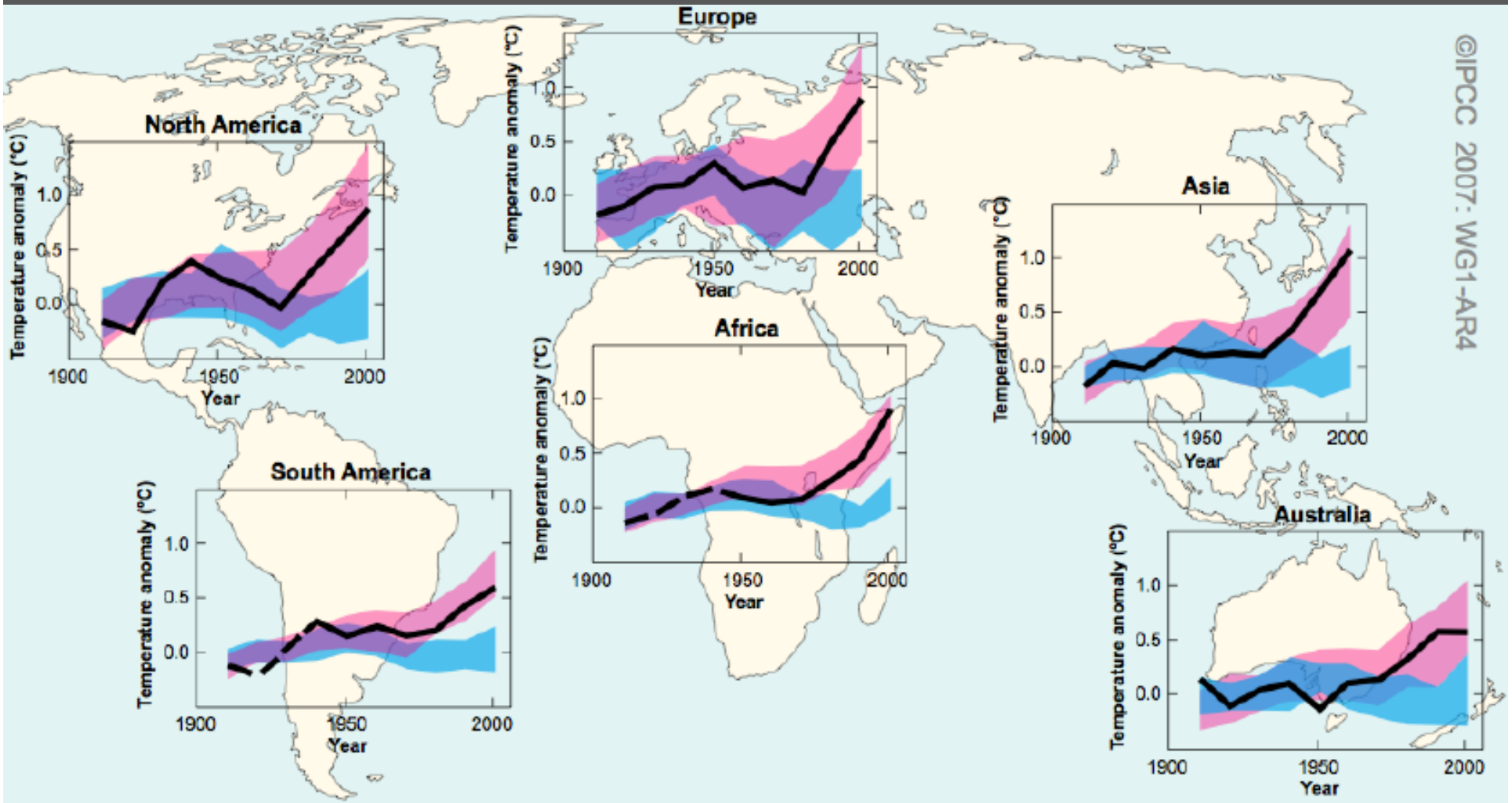
The biosphere and the ocean create a natural balance.
what comes out = what goes back in

We are disrupting the natural balance.

FACT: EVEN A 5% INCREASE IS ENOUGH TO TIP THE BALANCE.

Humans are the only explanation.

Comparing observations (black) with what climate models show for natural (blue) or natural + human (pink) temperature increases from 1900 to 2000



The Scientific Consensus

Warming of the climate system is unequivocal, as is now evident from observations.

Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely (>90%) due to the observed increase in greenhouse gas concentrations due to human activities.

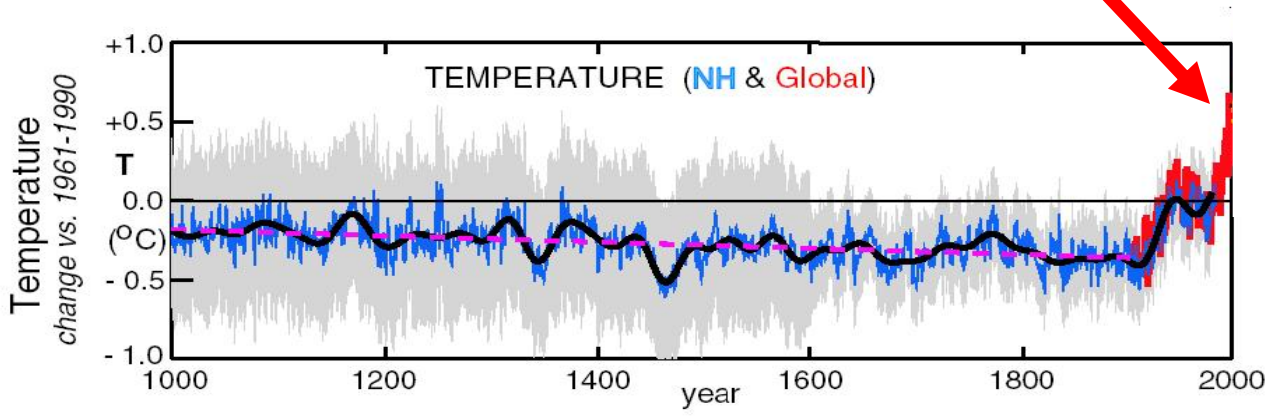
IPCC 2007

3 questions on climate change

1. **WHY** do we need to consider climate change?
2. **HOW** do we expect climate to change in the future?

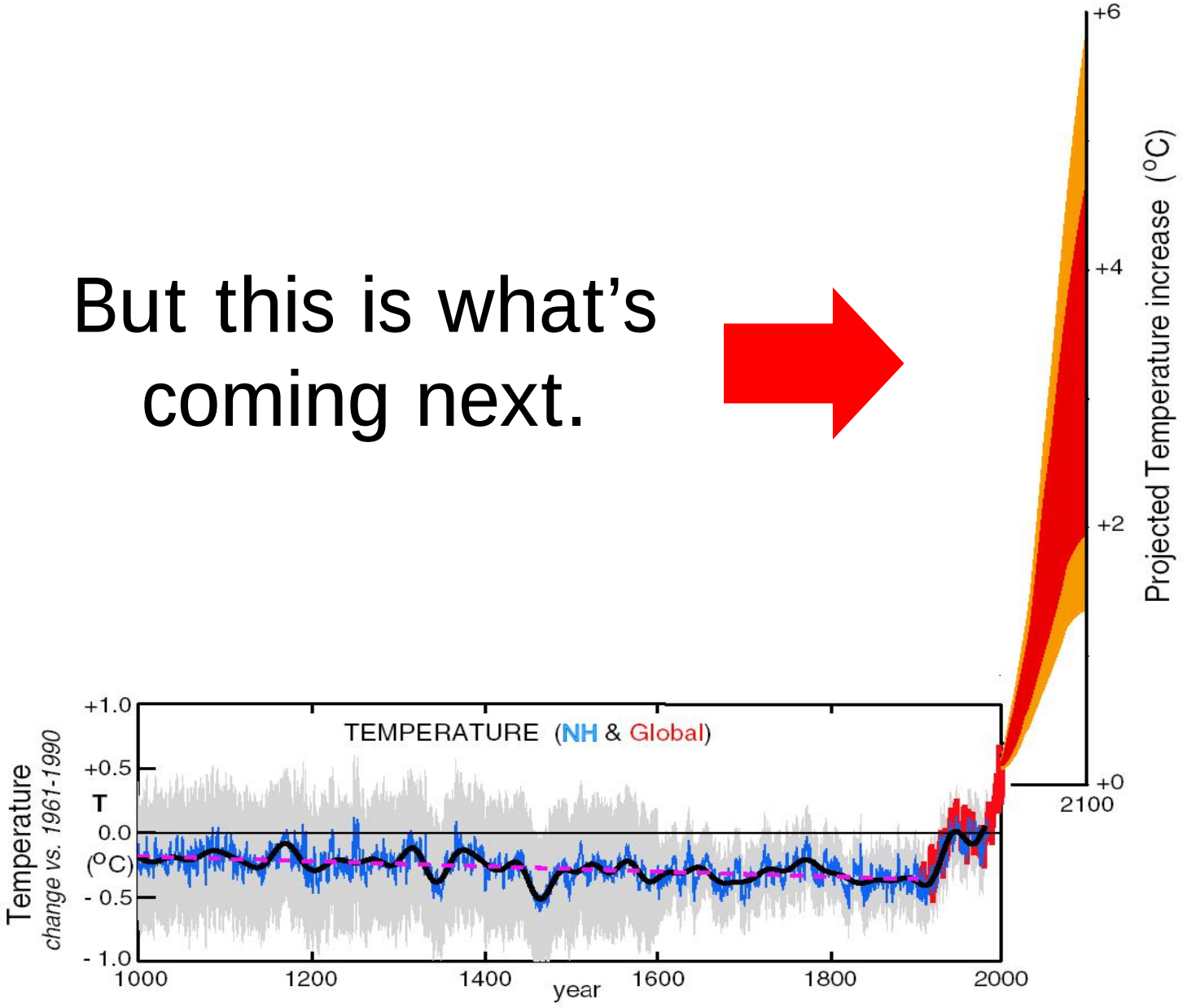
What can we expect in the future?

We're already concerned about this

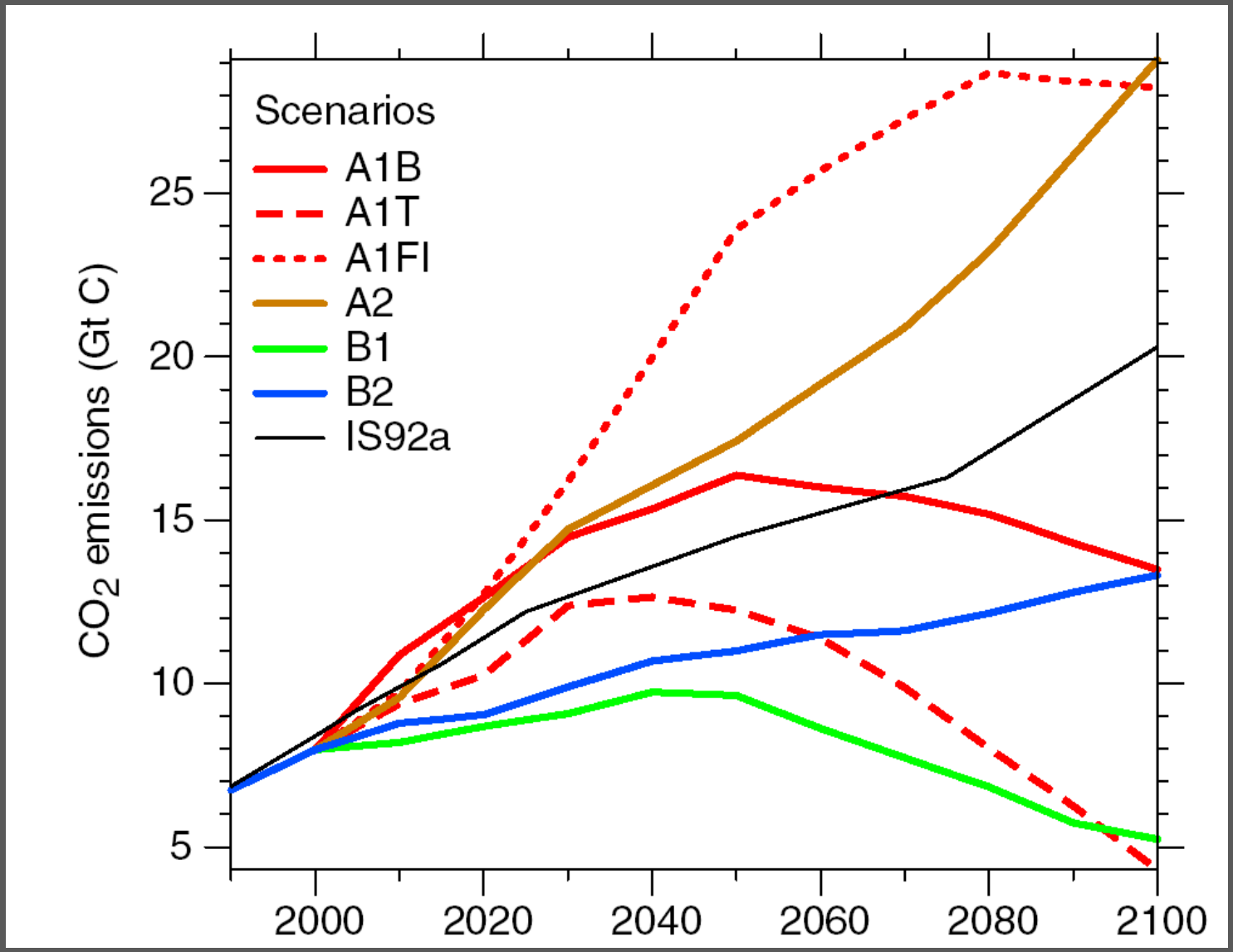


What can we expect in the future?

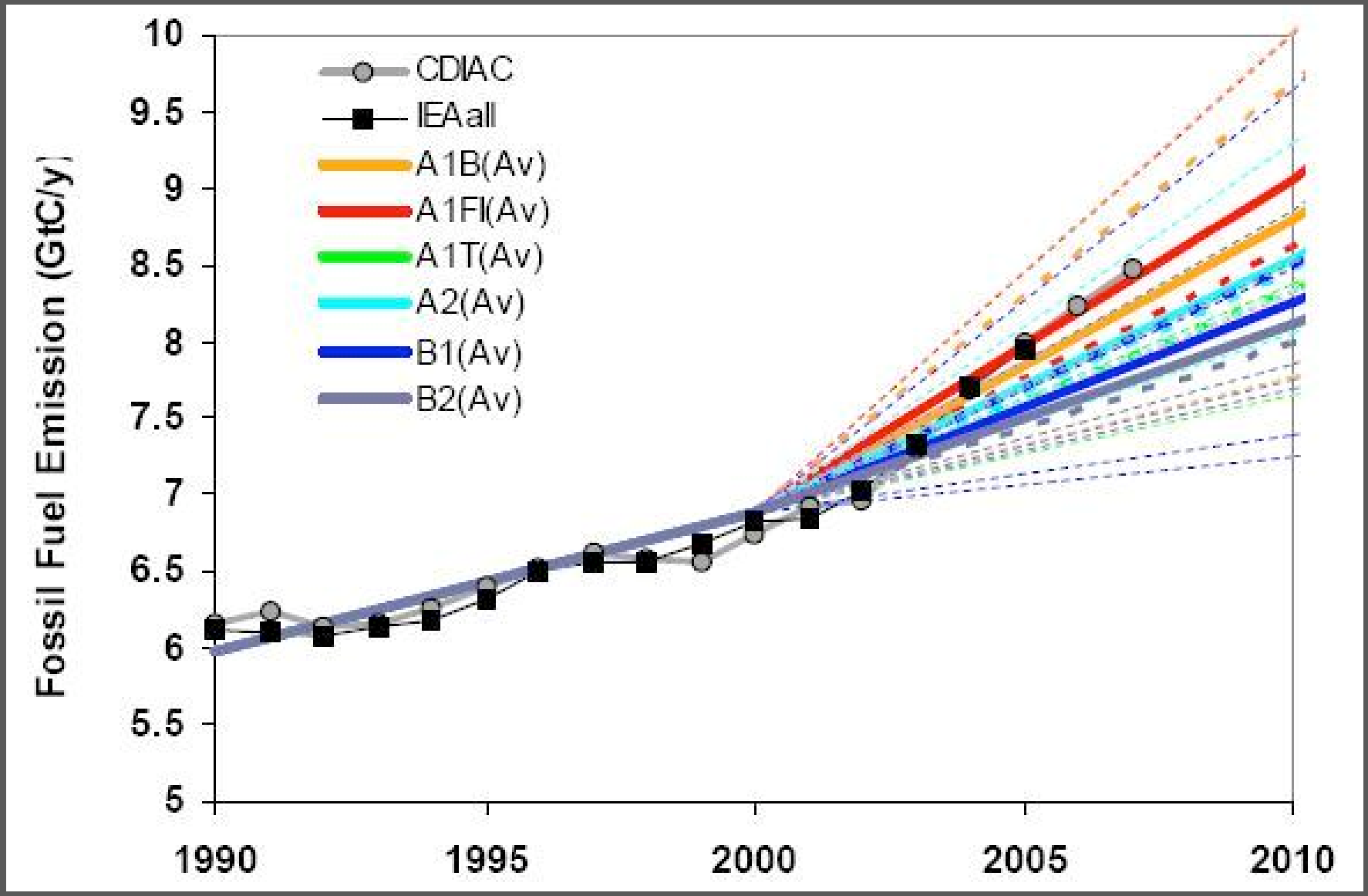
But this is what's coming next.



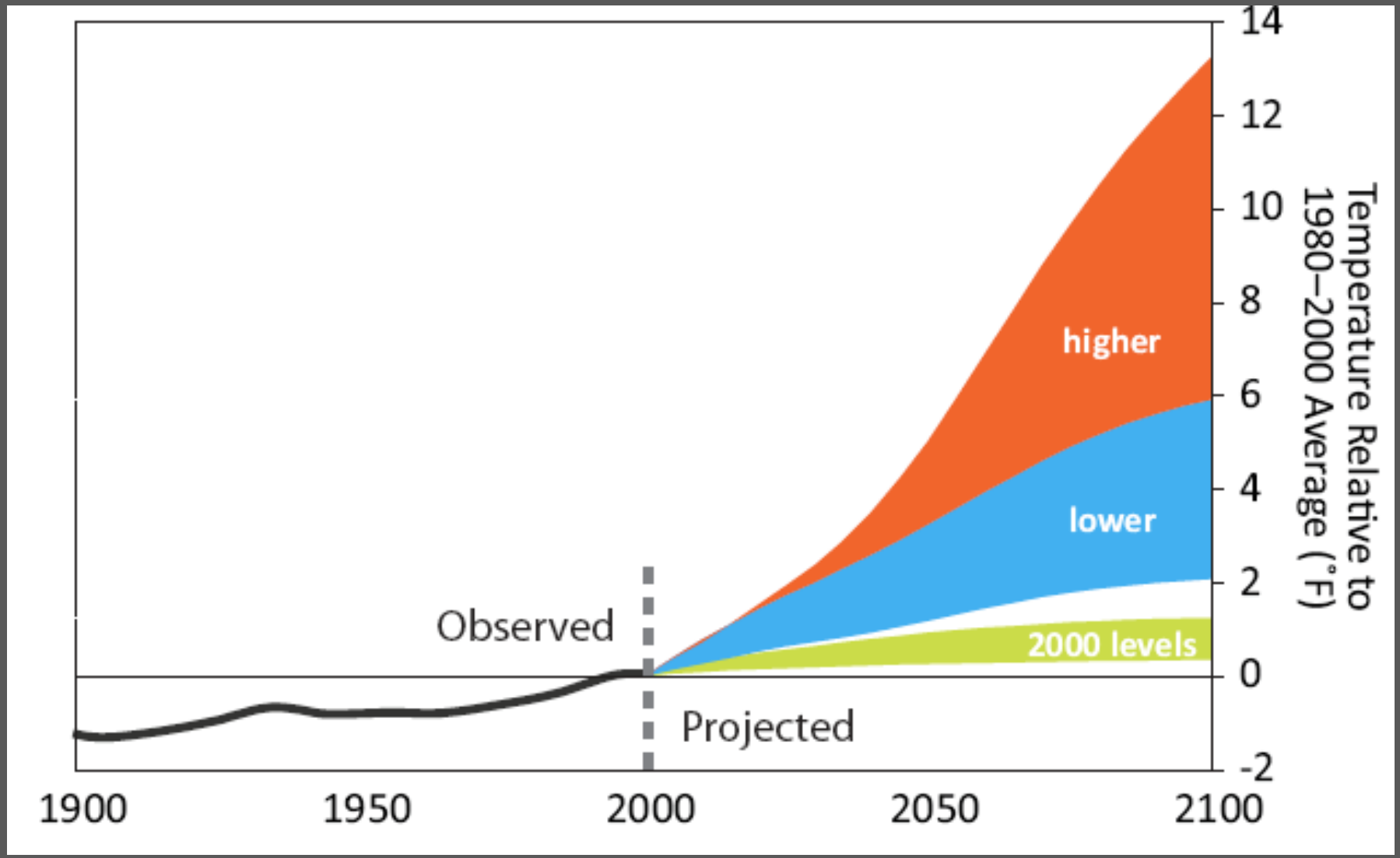
Greenhouse gas emission projections



Reality check: where are we now?



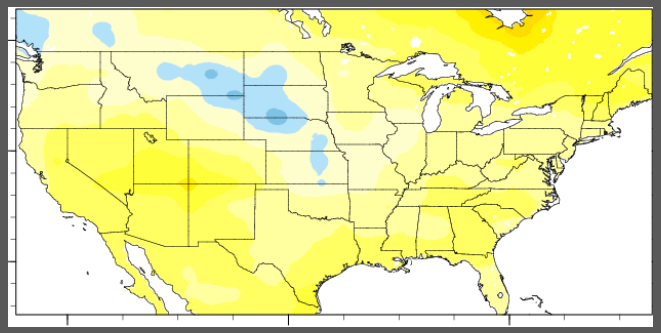
What can we expect in the future?



Average conditions continue to warm

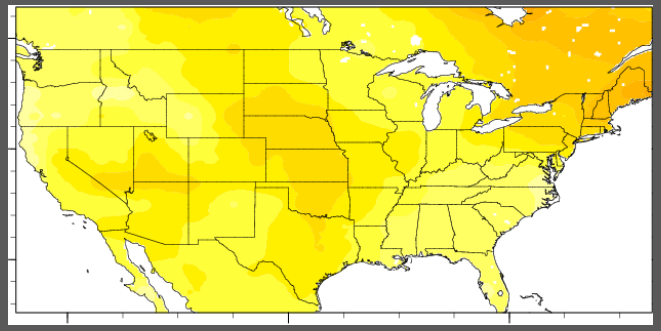
Winter: Mid-High Emissions

2010-2039



Winter: Lower Emissions

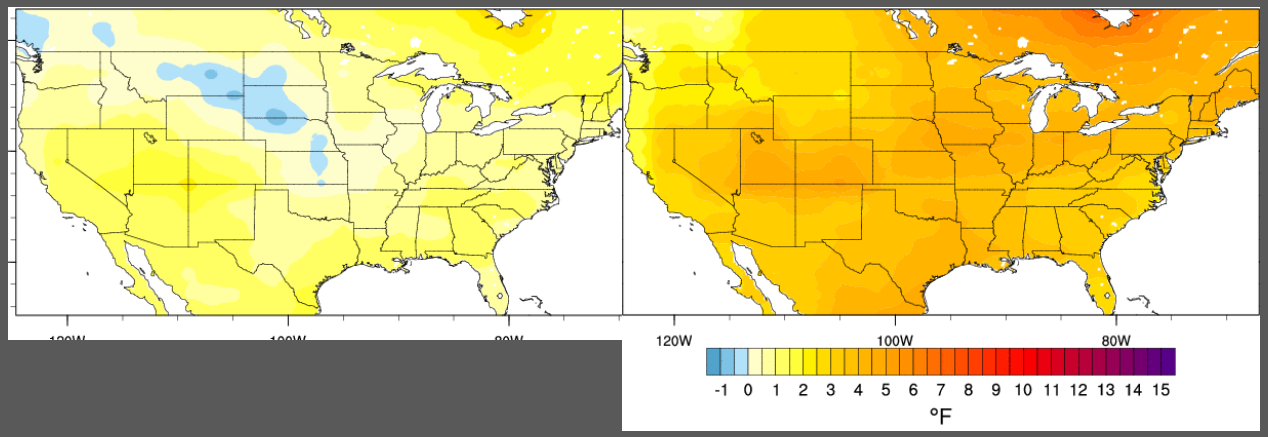
2010-2039



Average conditions continue to warm

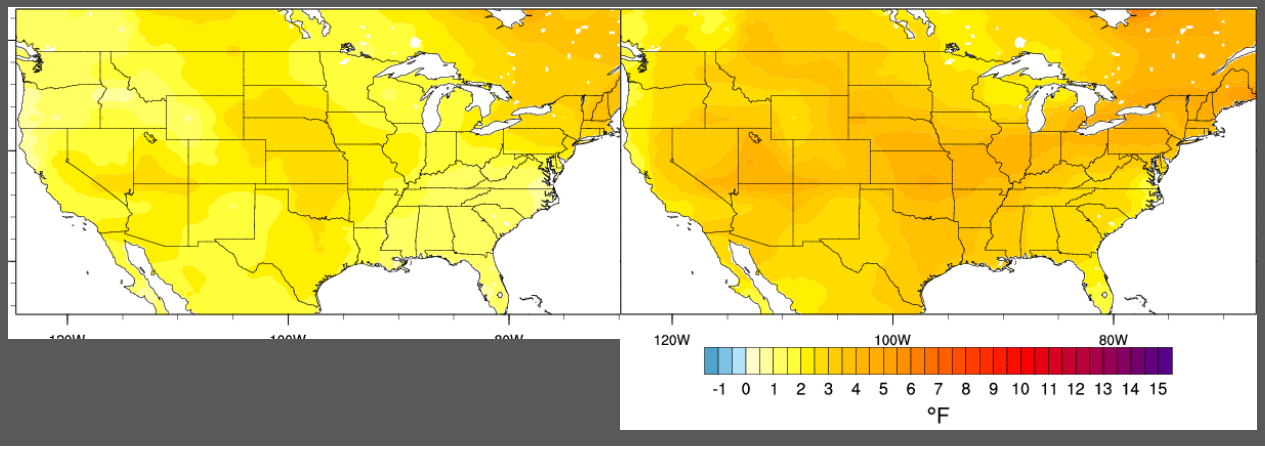
Winter: Mid-High Emissions

2010-2039 2040-2069



Lower Emissions

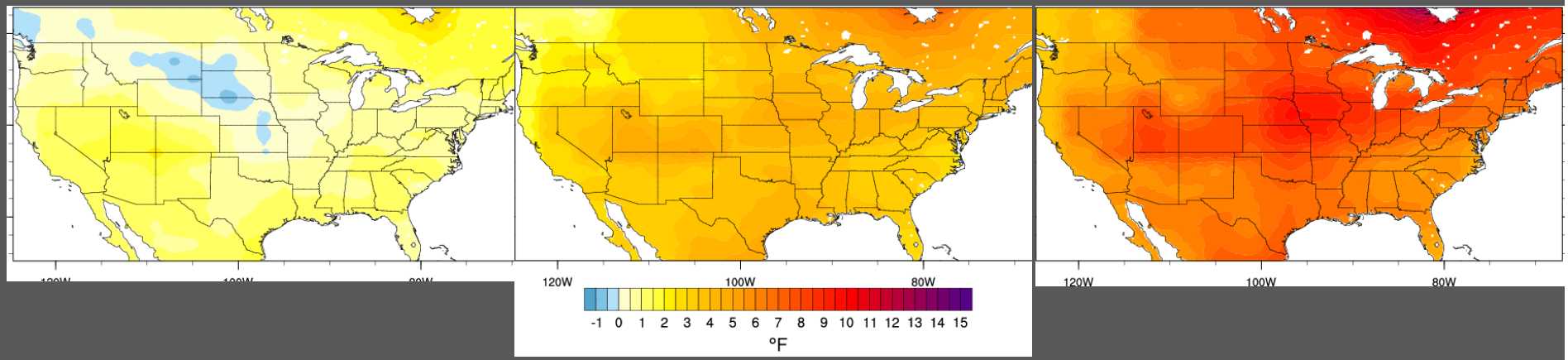
2010-2039 2040-2069



Average conditions continue to warm

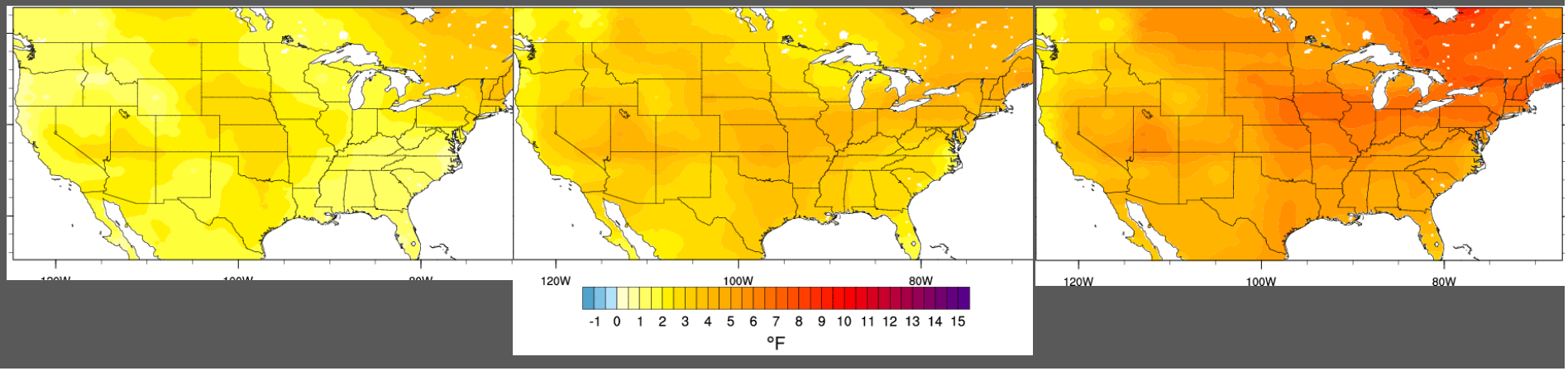
Winter: Mid-High Emissions

2010-2039 2040-2069 2070-2099



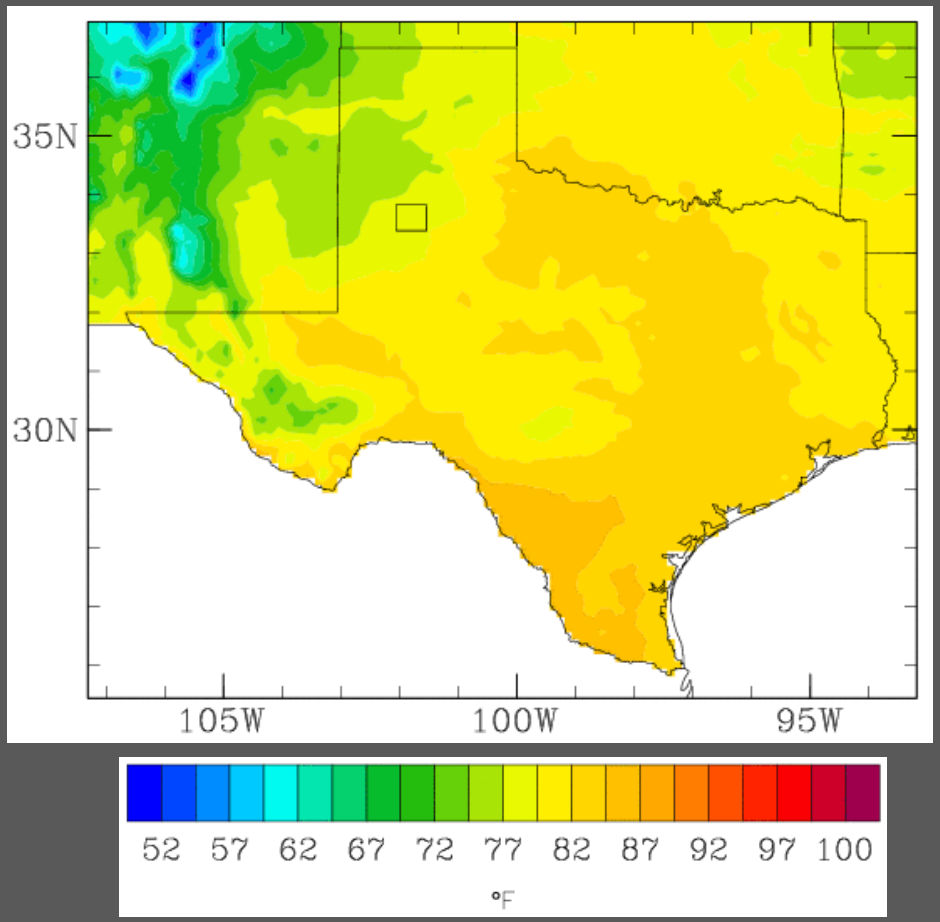
Lower Emissions

2010-2039 2040-2069 2070-2099



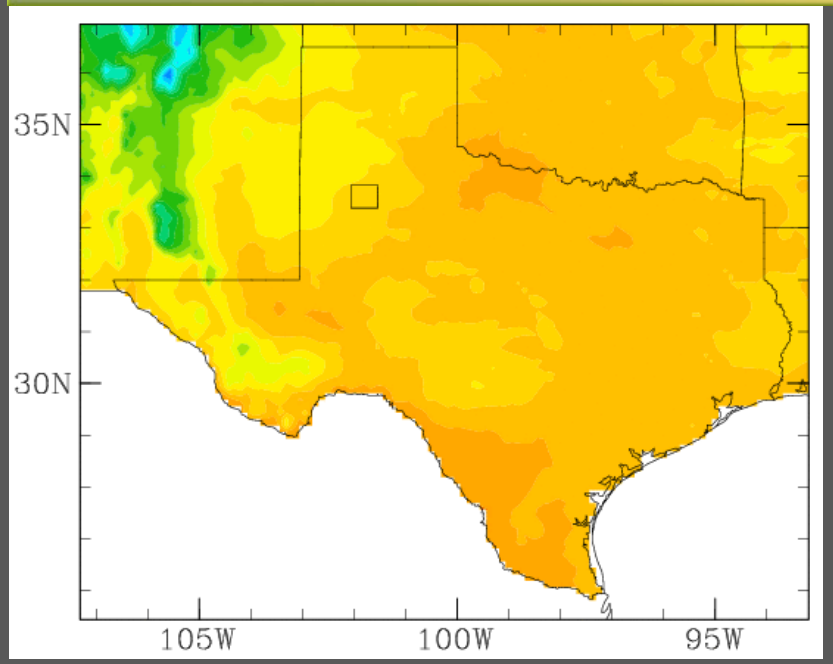
Summer temperatures in Texas

1961-1990

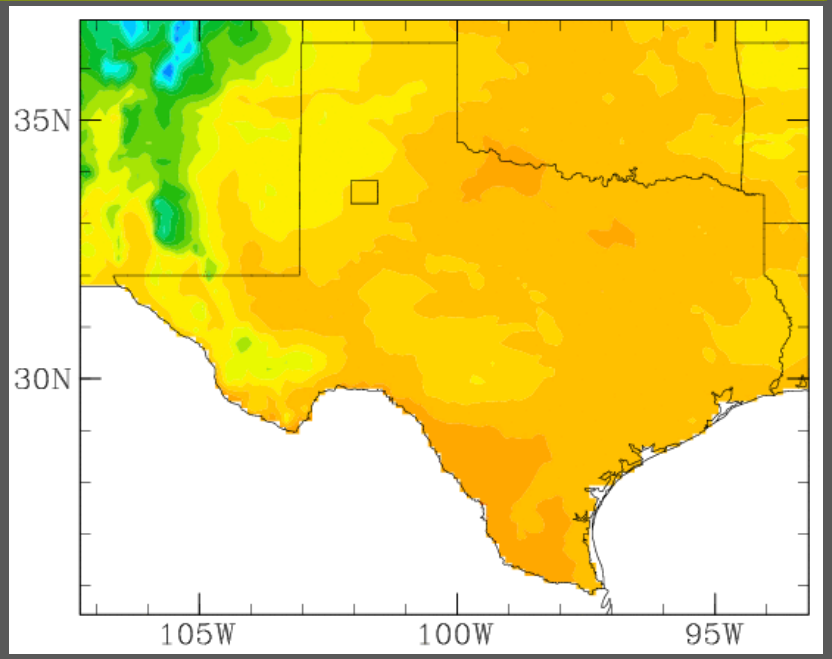


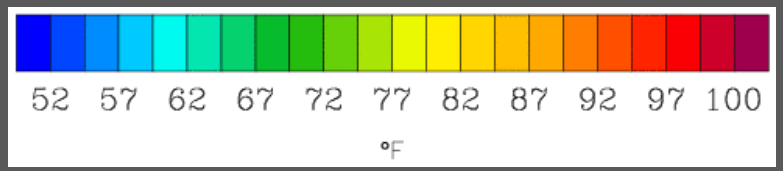
Summer temperatures in Texas

HIGHER EMISSIONS



LOWER EMISSIONS

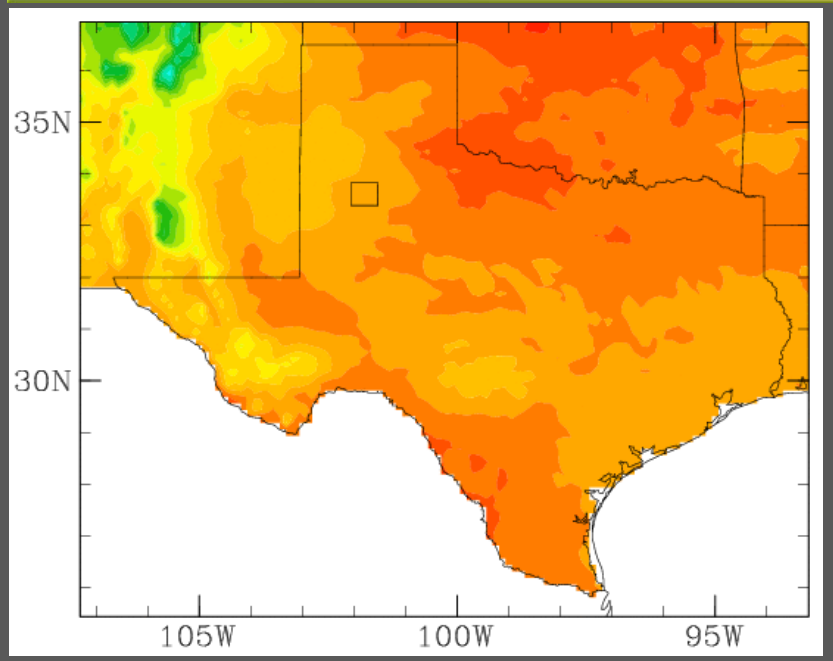




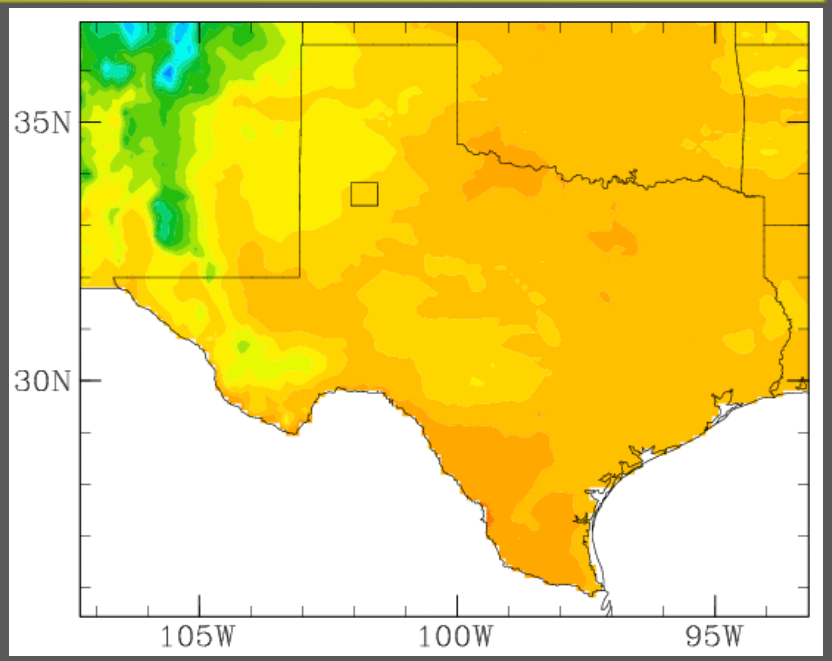
NEAR FUTURE: 2010-2039

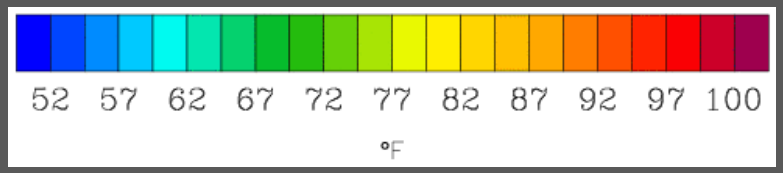
Summer temperatures in Texas

HIGHER EMISSIONS



LOWER EMISSIONS

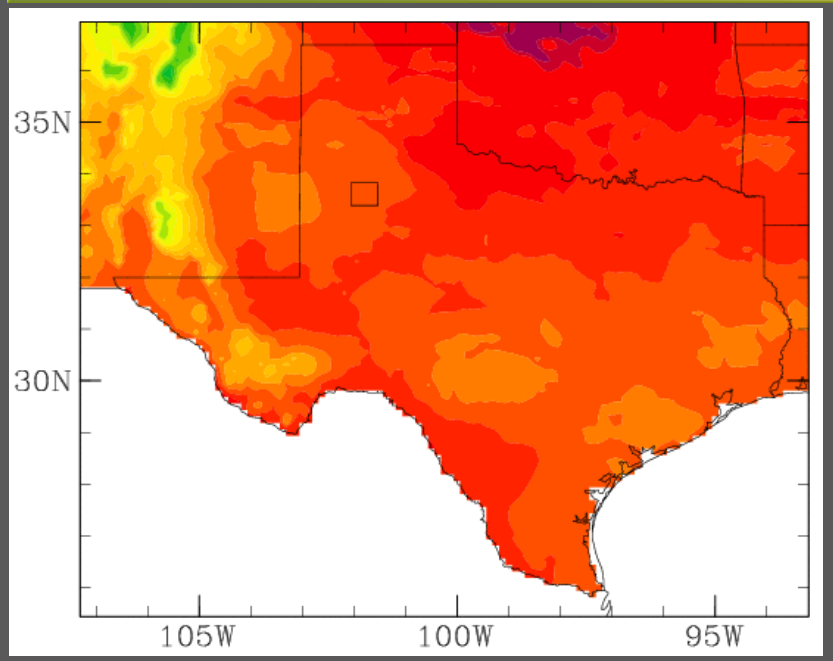




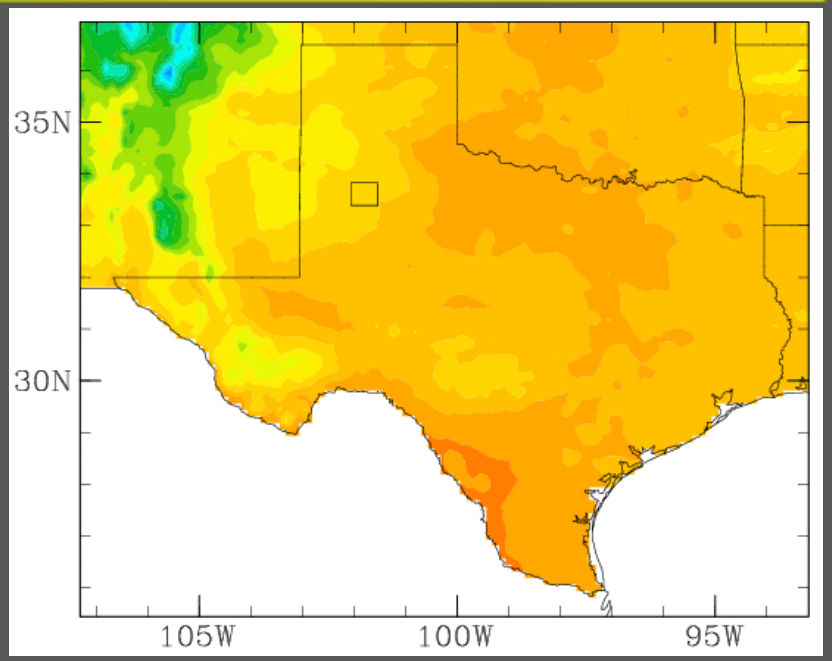
MID-CENTURY: 2040-2069

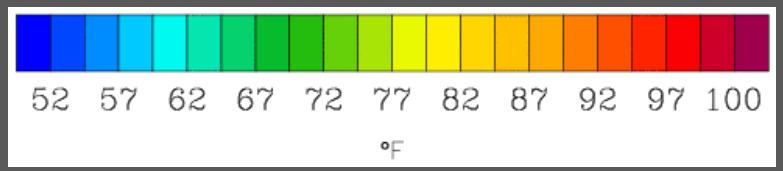
Summer temperatures in Texas

HIGHER EMISSIONS



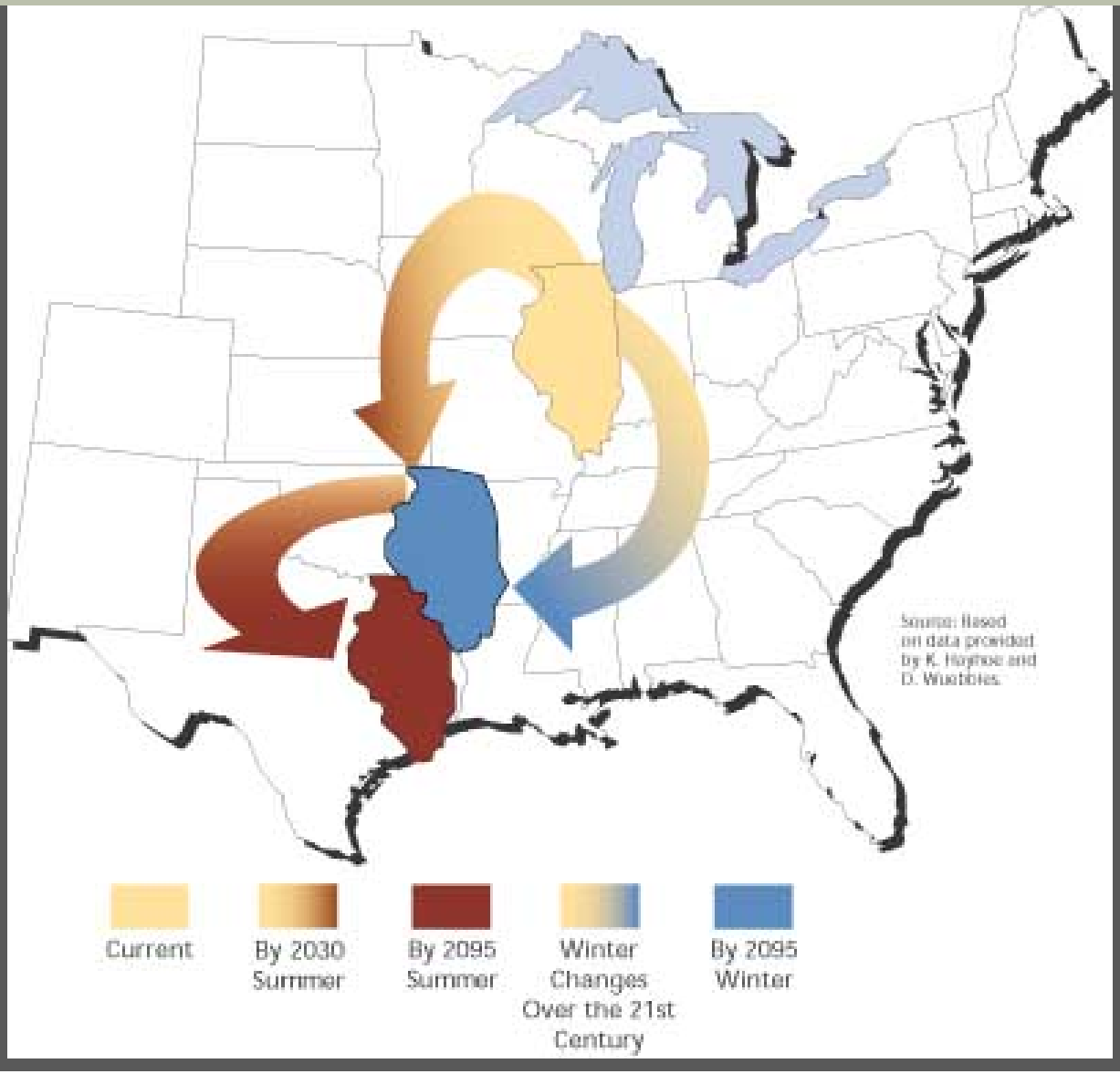
LOWER EMISSIONS





END-OF-CENTURY: 2070-2099

Migrating Illinois Climate



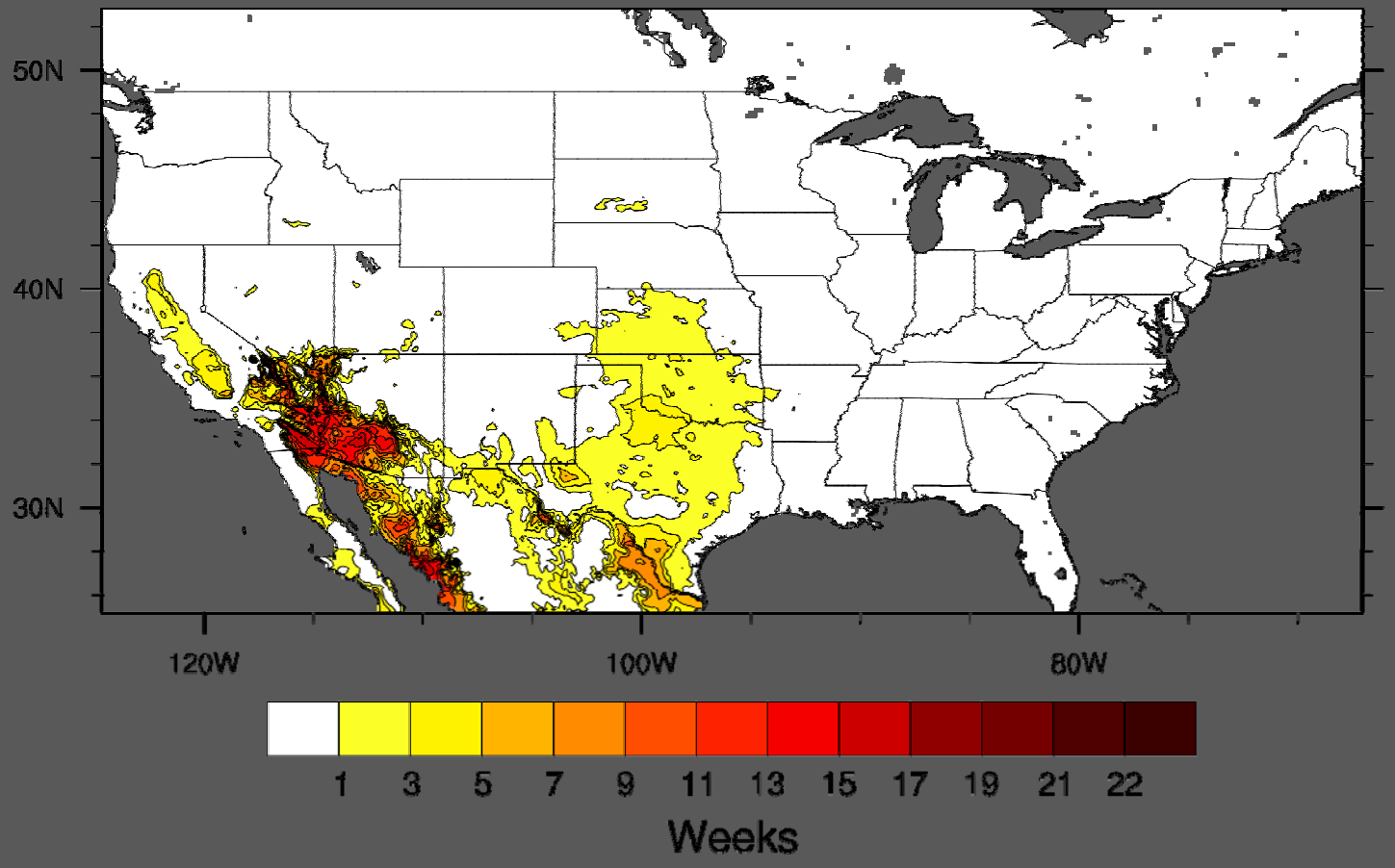
Focus on Chicago

What will a typical Chicago summer feel like in the future?

- under higher emissions
- under lower emissions

Weeks with maximum temperature > 100oF

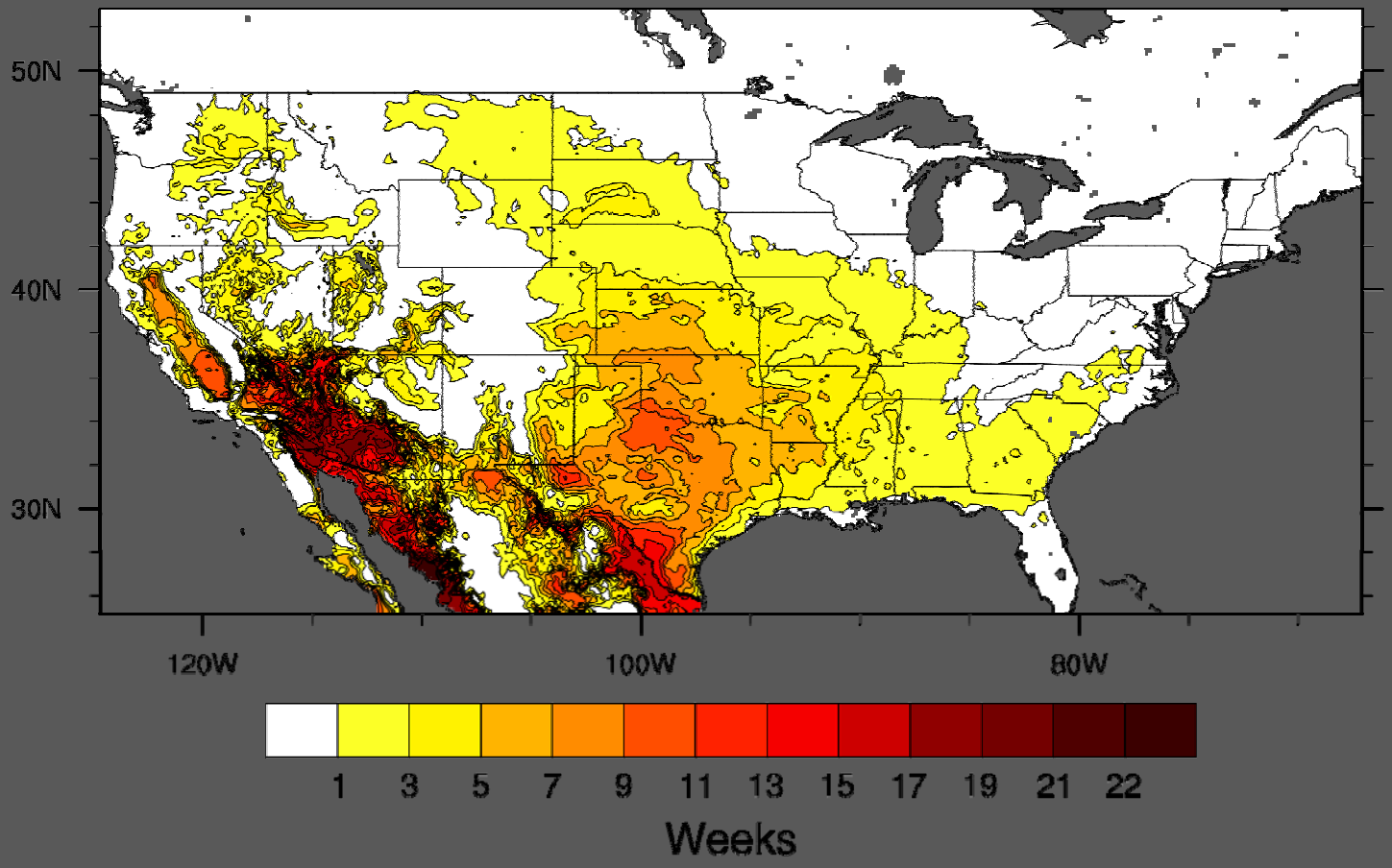
1961-1979



From: Hayhoe & Farley, A Climate for Change, 2009

Weeks with maximum temperature > 100oF

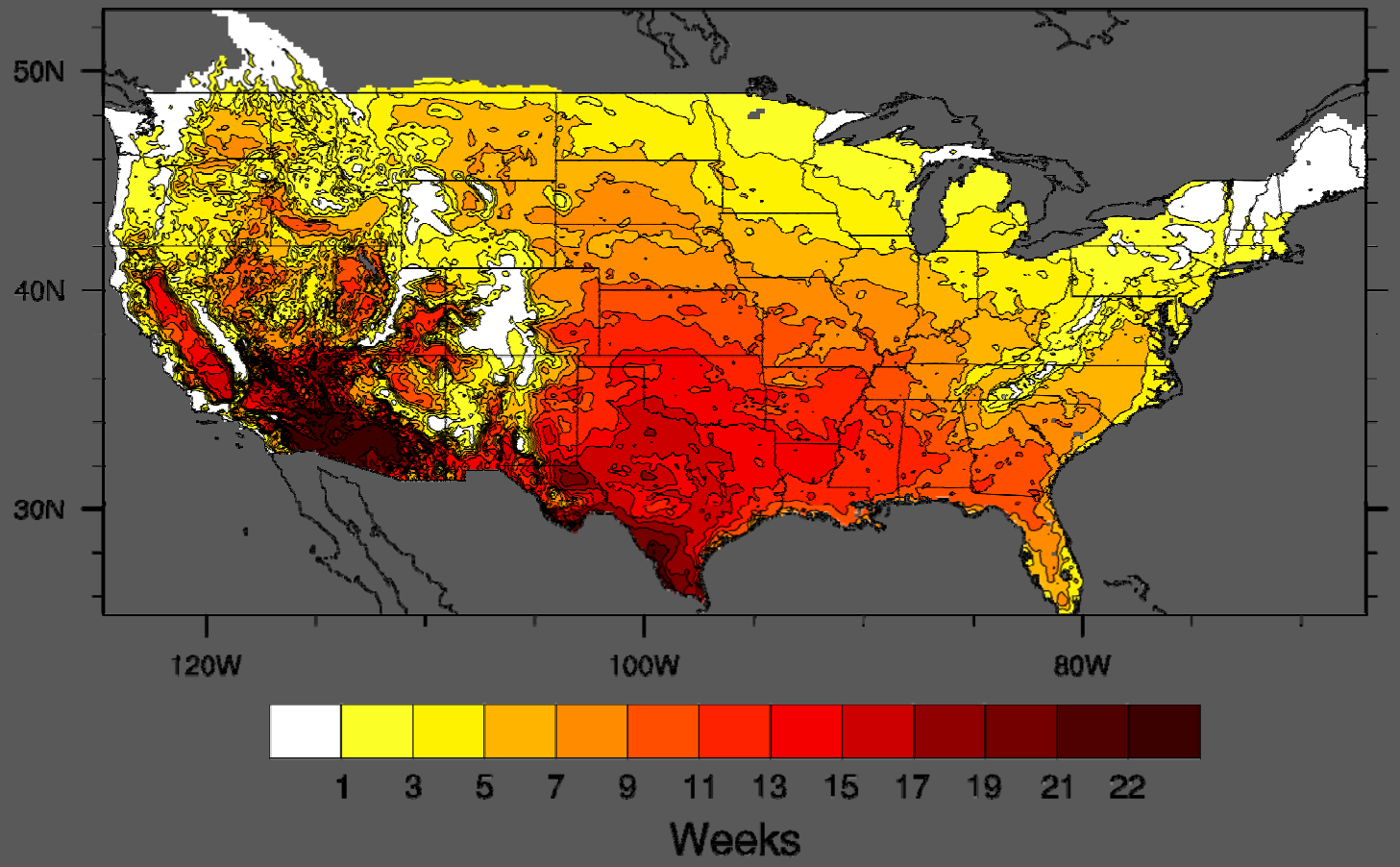
2070-2099 (B1 lower emissions)



From: Hayhoe & Farley, A Climate for Change, 2009

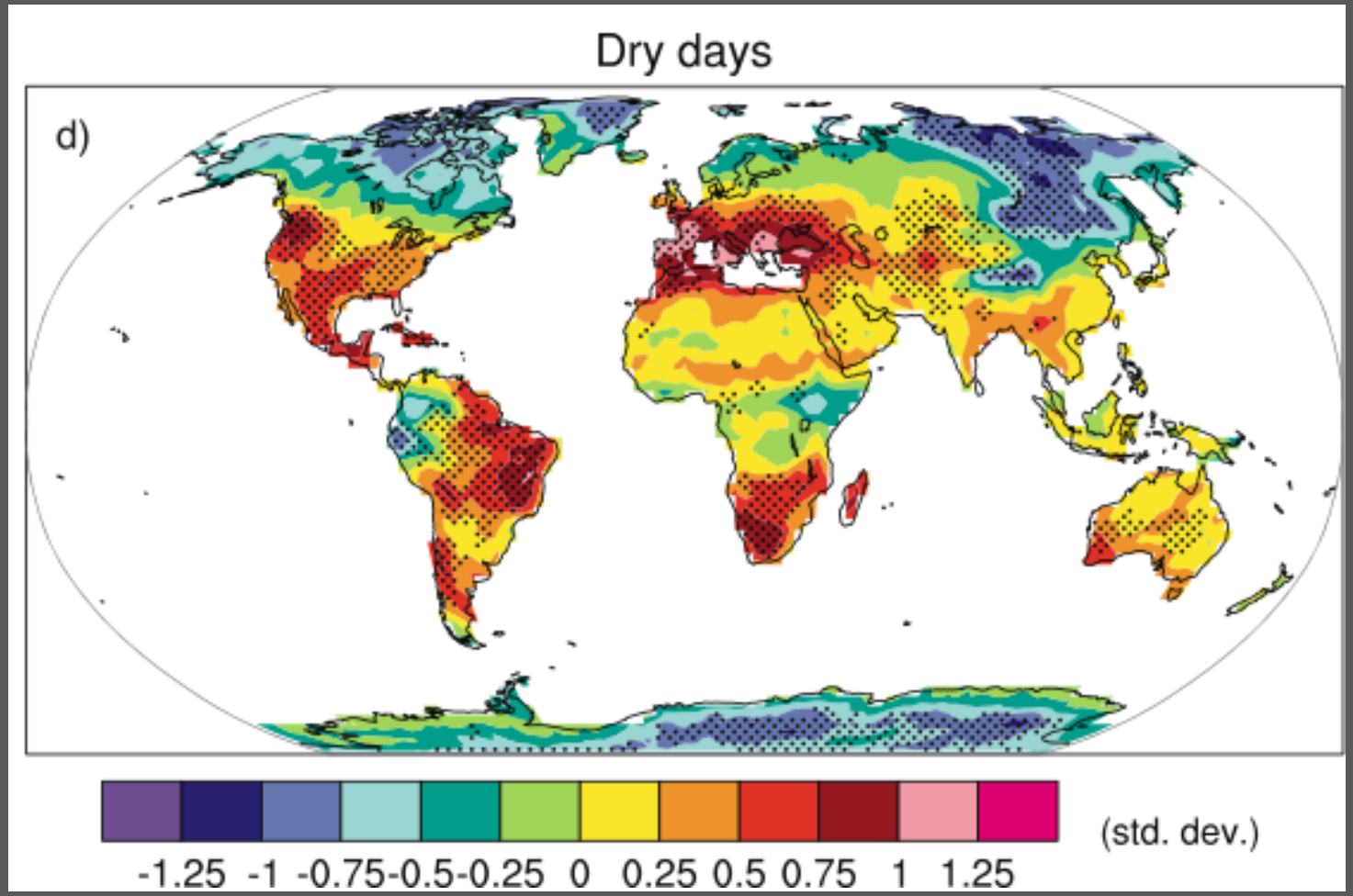
Weeks with maximum temperature > 100oF

2070-2099 (A1FI higher emissions)

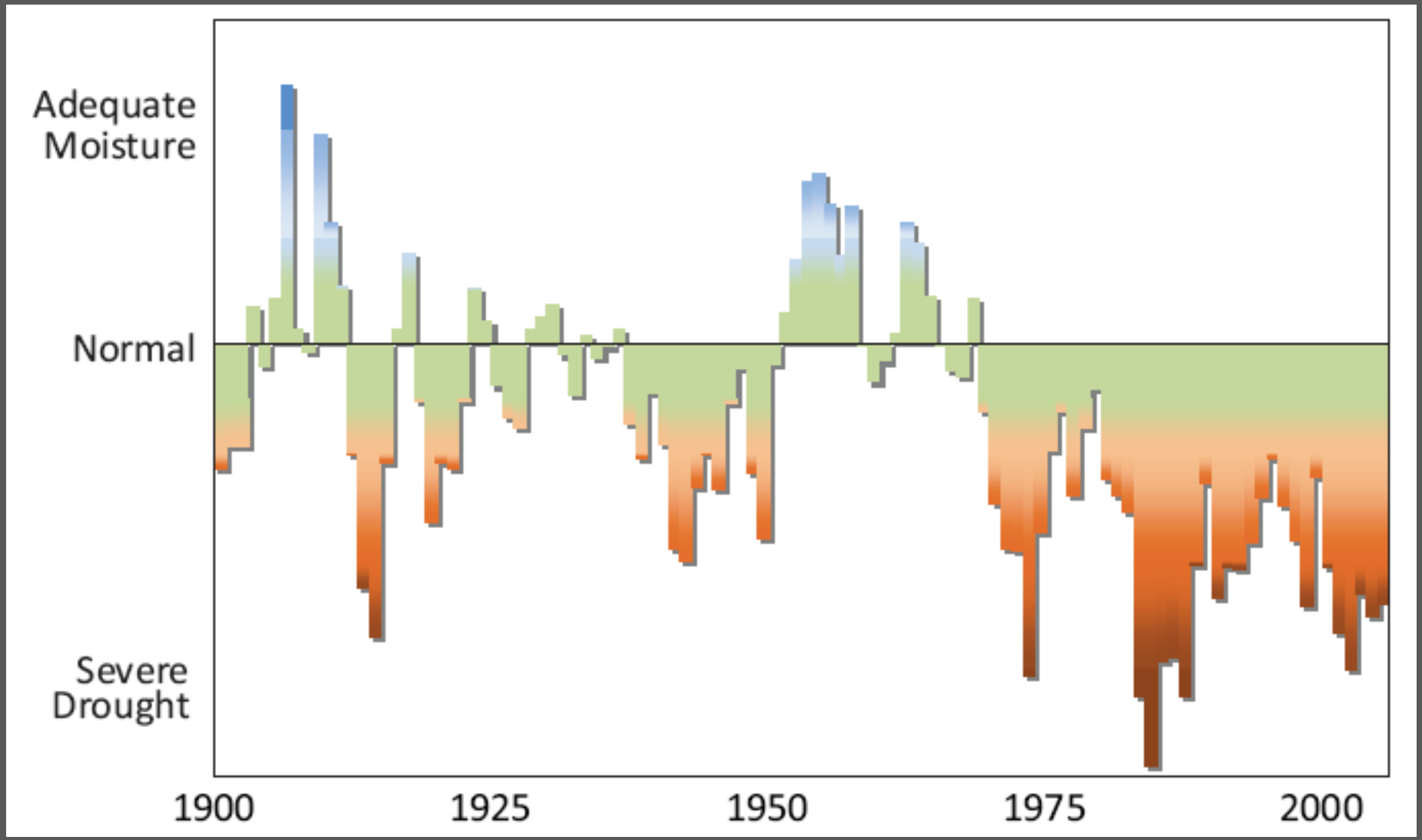


From: Hayhoe & Farley, A Climate for Change, 2009

More water where you don't want it
Less, where you do

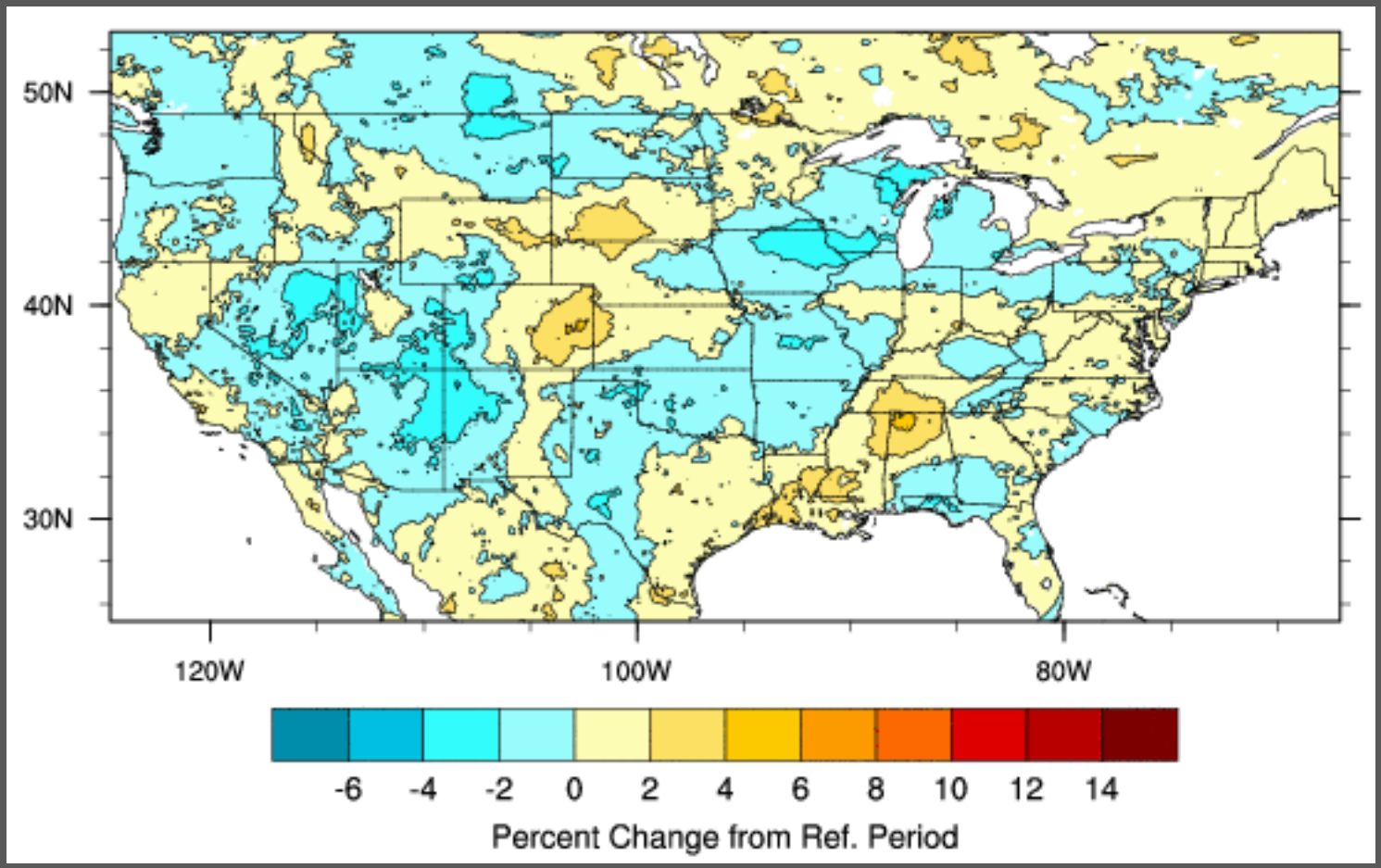


Drought in central Africa



Time in drought

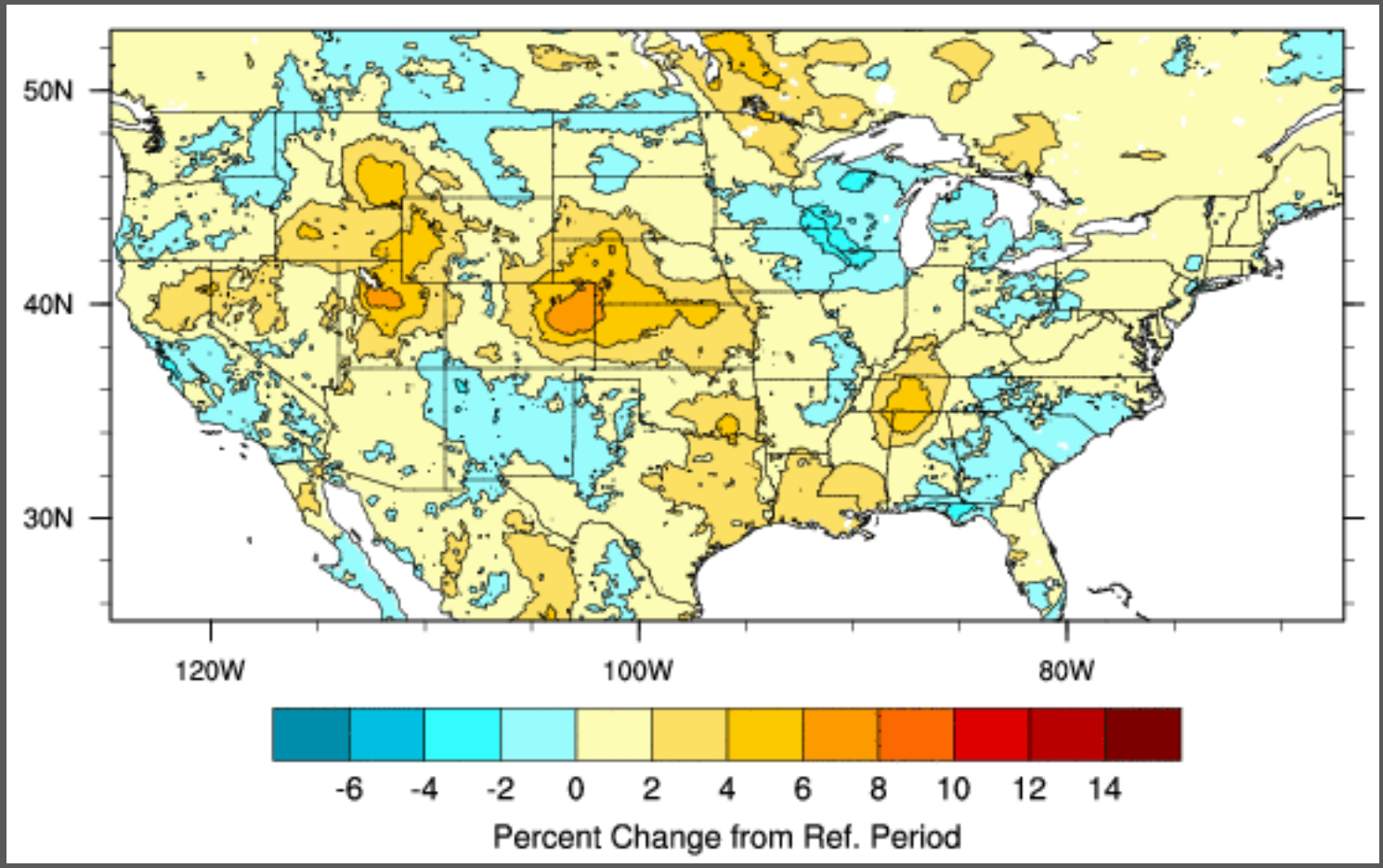
2010-2029



Hayhoe, unpublished

Time in drought

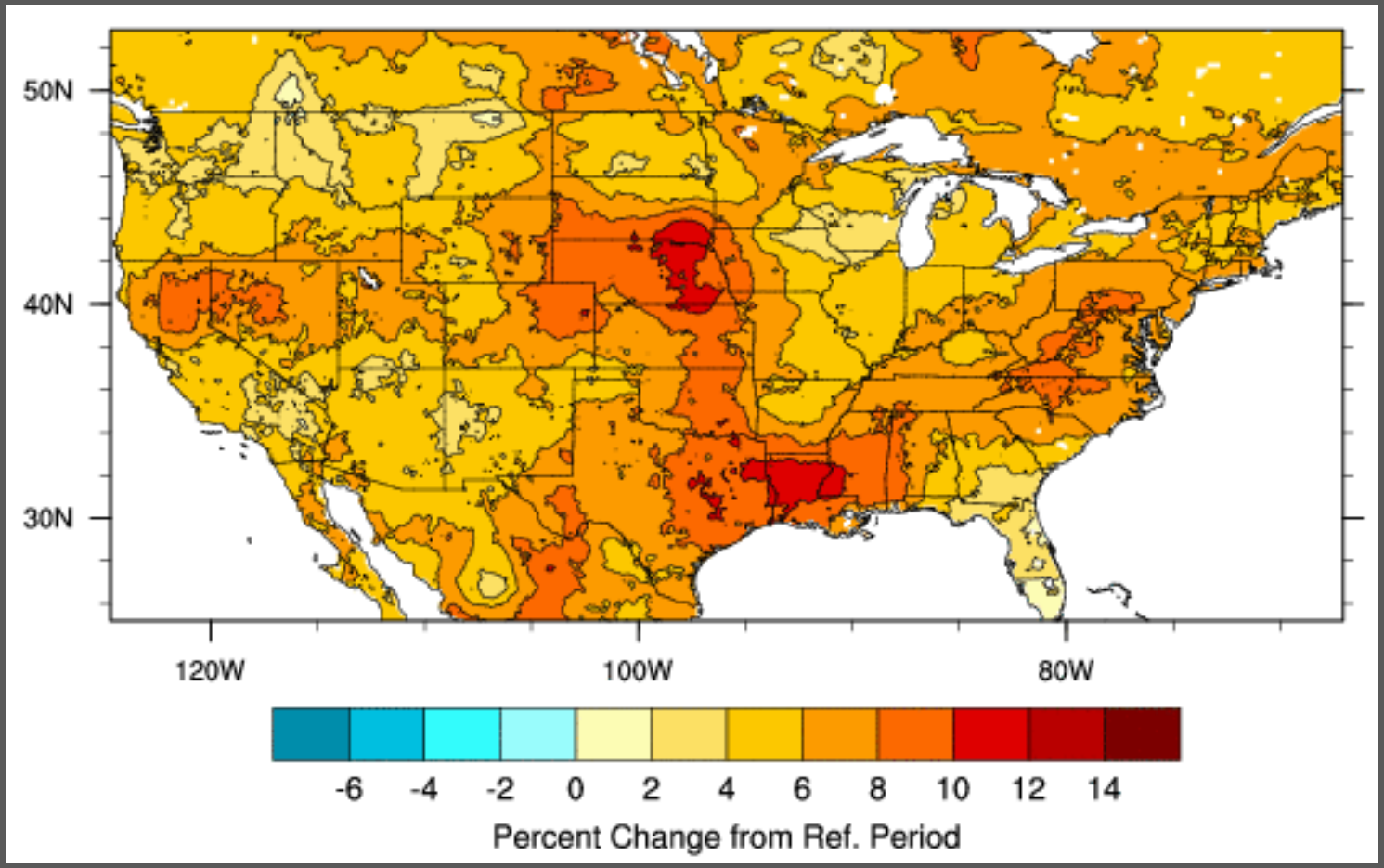
2040-2059



Hayhoe, unpublished

Time in drought

2080-2099 (mid-high emissions)



Hayhoe, unpublished

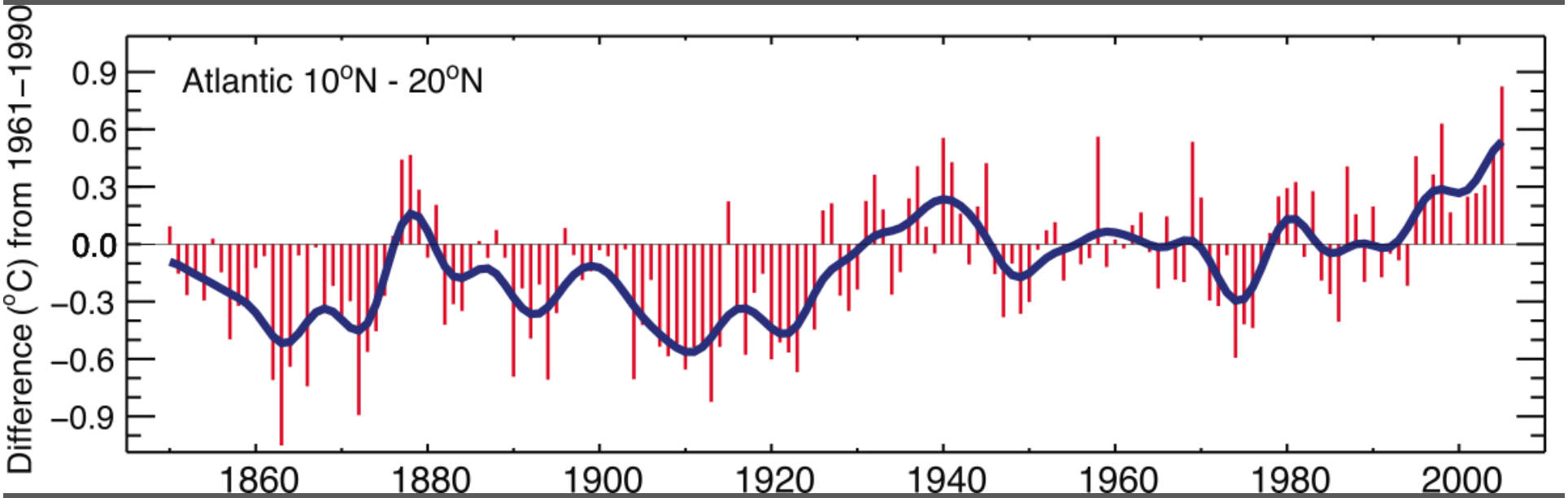
3 questions on climate change

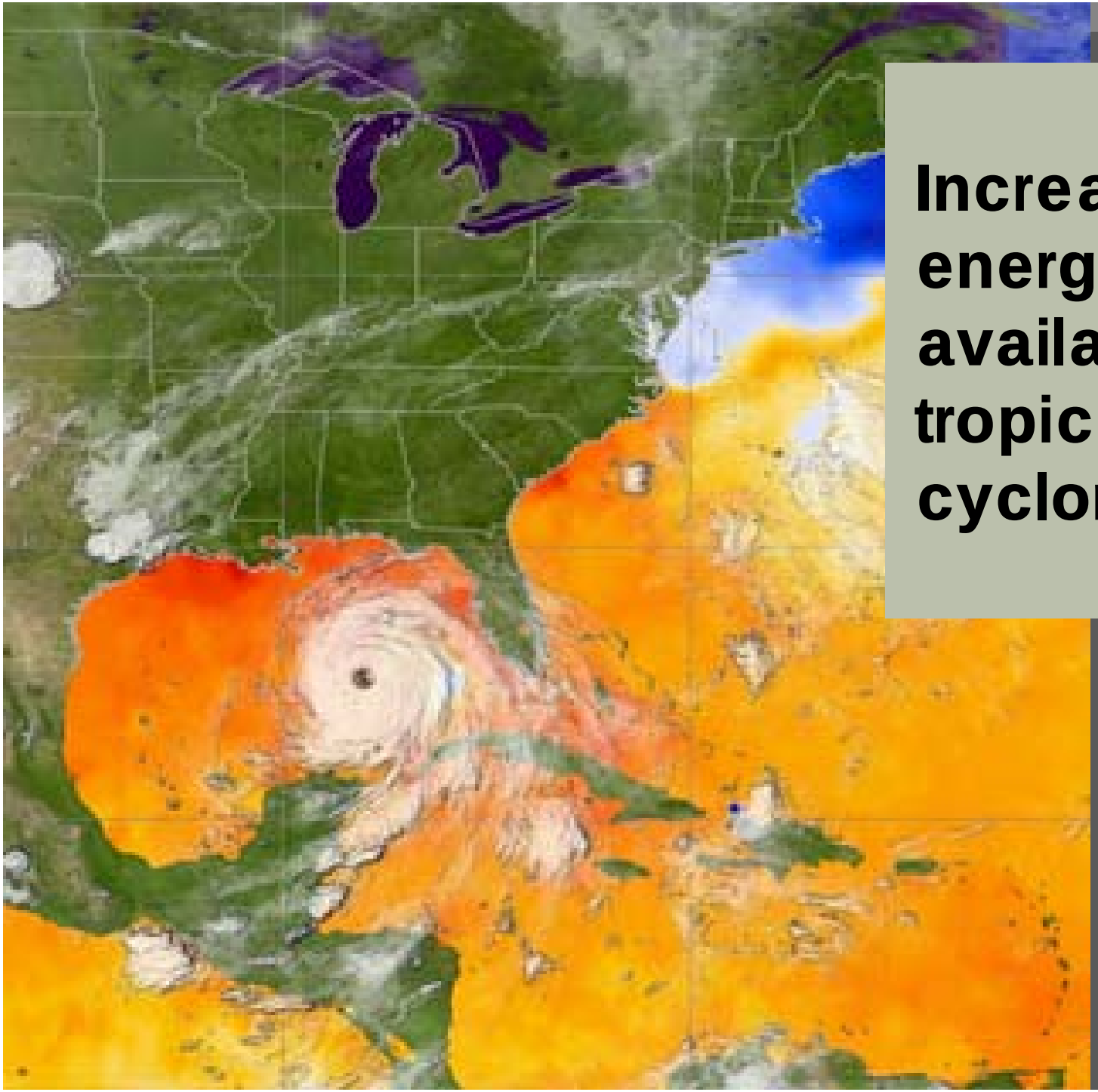
1. **WHY** do we need to consider climate change?
2. **HOW** do we expect climate to change in the future?
3. **WHAT** impacts will it have on our world?

3 questions on climate change

3. **WHAT** impacts will it have on our world?
   - Hurricanes
   - Coastal areas
   - Heat extremes
   - Water

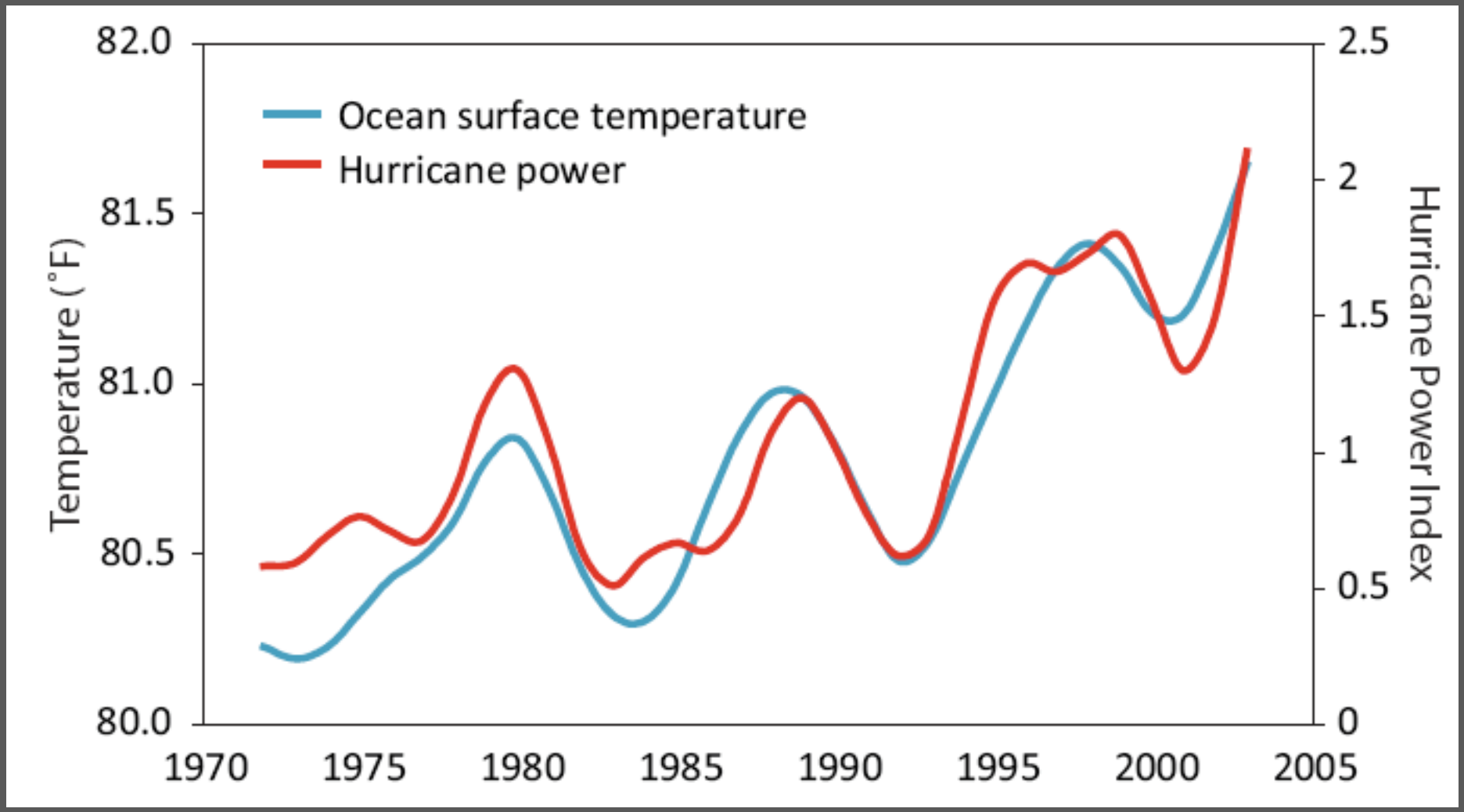
Hurricanes: the oceans are warming…





Increasing the energy available to tropical cyclones.

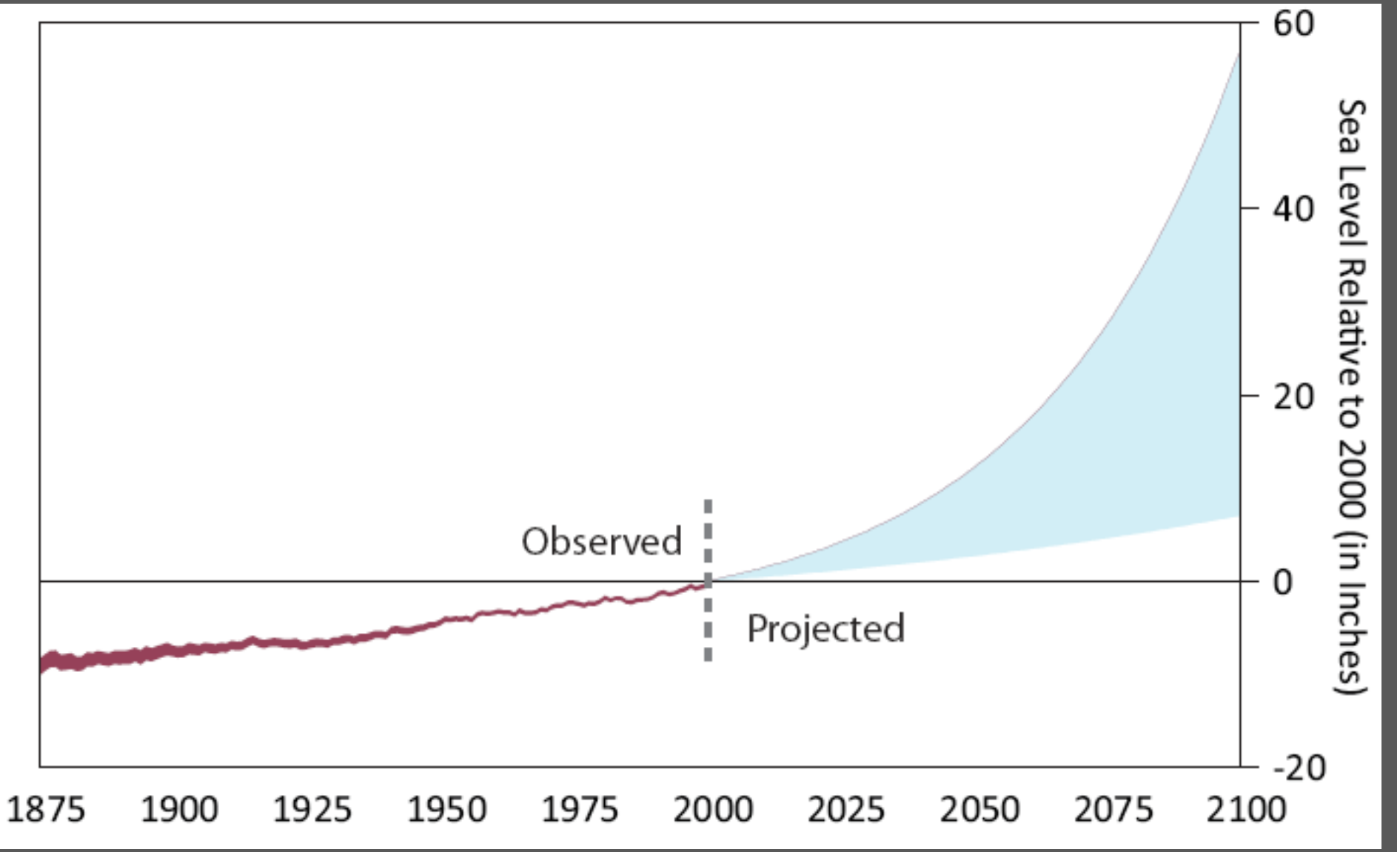
Hurricane power and ocean temperature



It’s not so simple

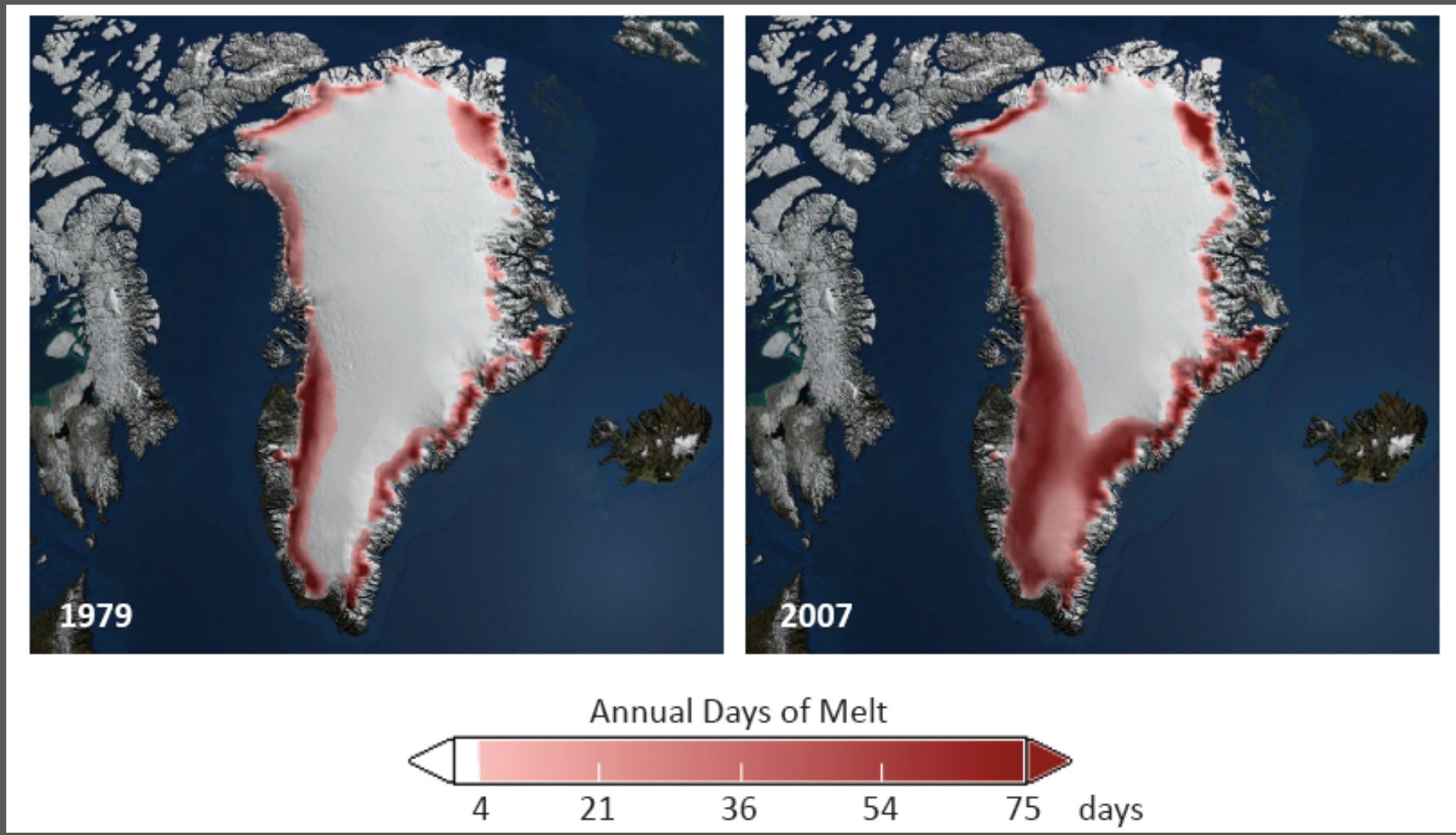
Mechanism	Likely change	Result
Ocean surface temperatures	Getting warmer	Longer season More powerful storms Greater number of storms
El Niño	More frequent	Suppresses hurricane formation
Atlantic Meridional Mode	Unsure	Alters location of hurricane formation; affects landfall frequency
Vertical wind shear	Decreasing	Conditions suitable for hurricane formation
Latent heat (condensation)	Increasing with warmer Ts	More rainfall associated with any hurricane

Sea level rise



Greenland is melting…

… twice as fast as a decade ago!

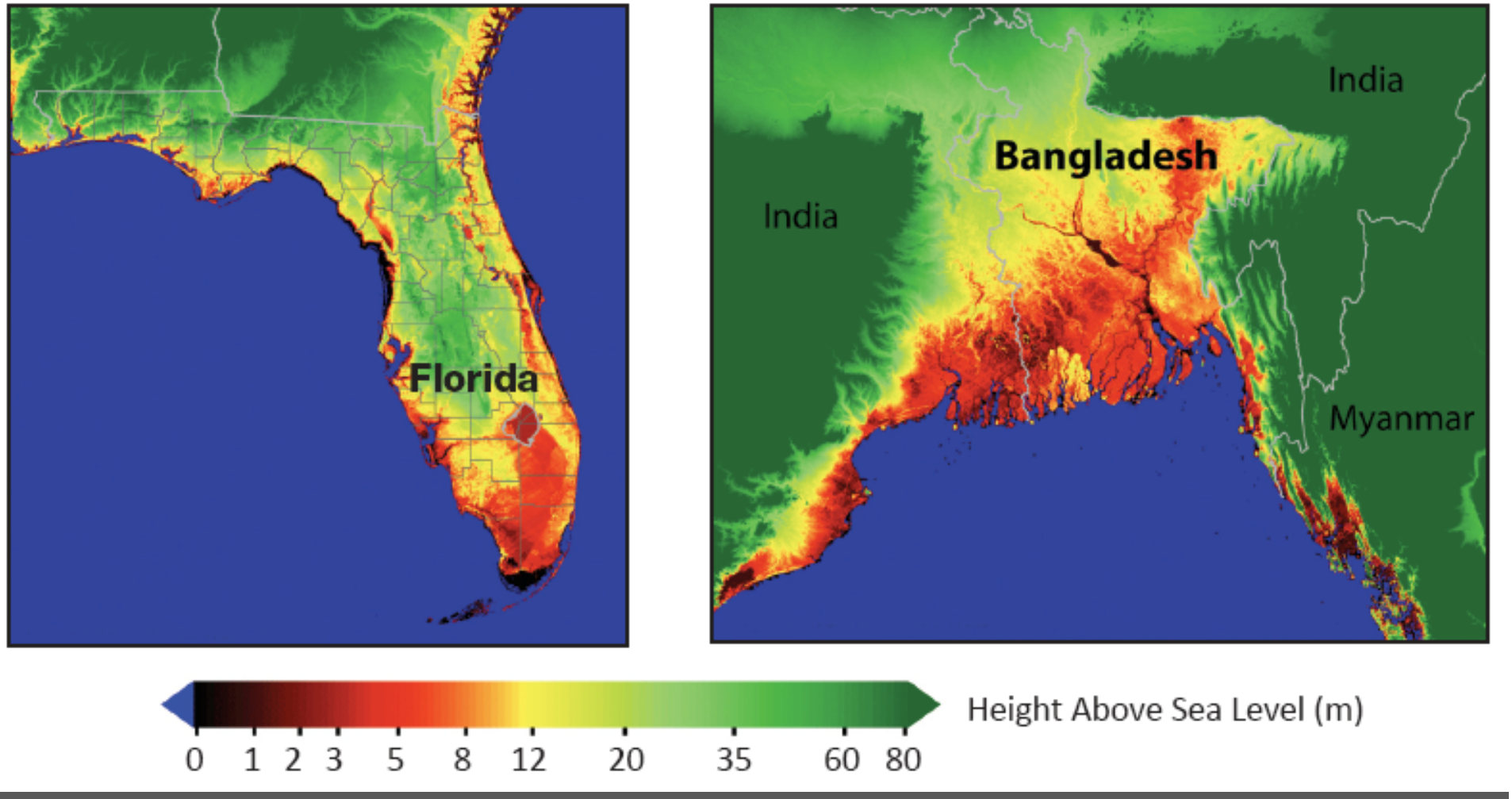


... endangering coastal areas and islands

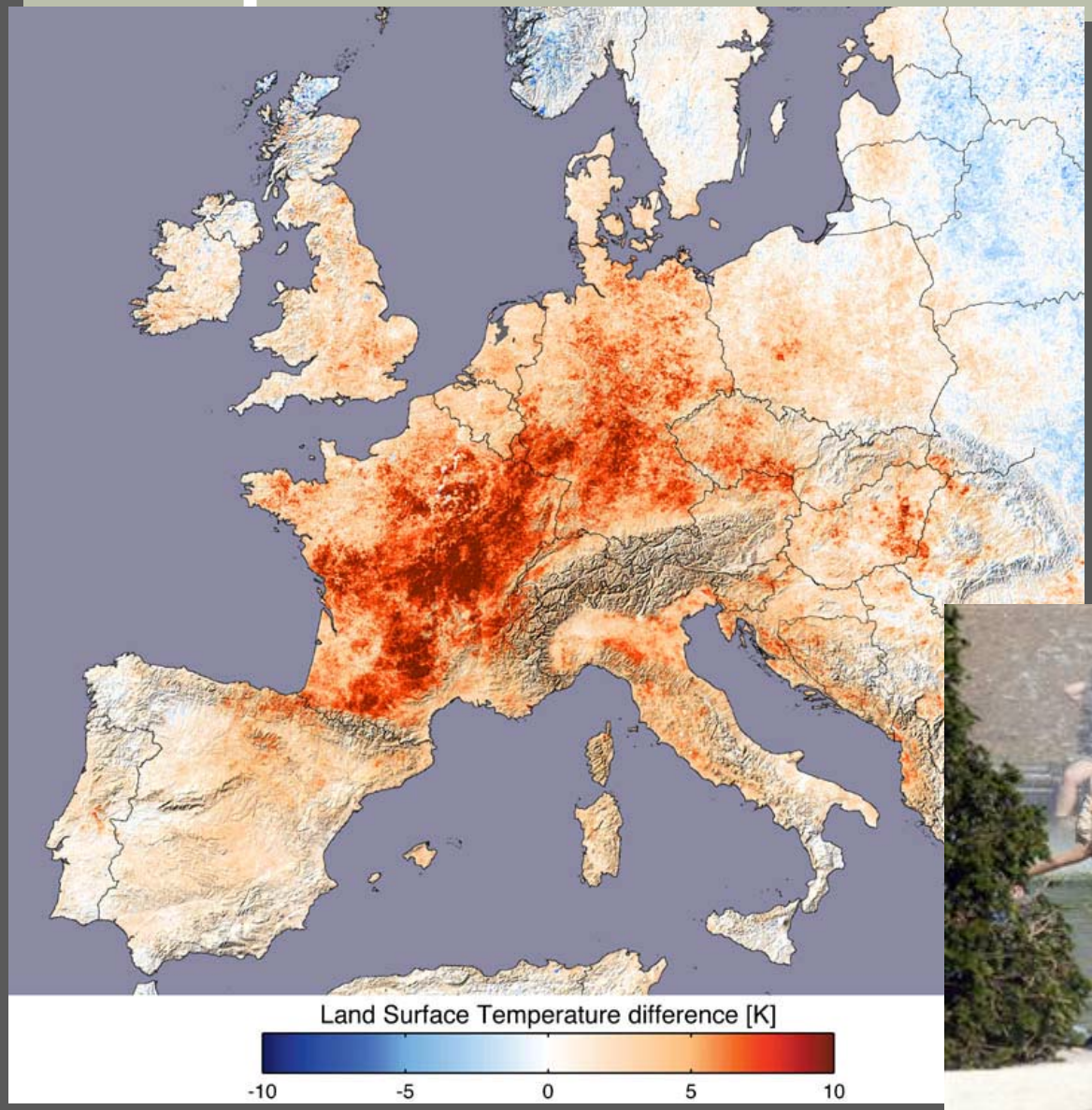
Tuvalu, South Pacific

... endangering coastal areas and islands

Area at risk from sea level rise



EXTREME HEAT:
European Heatwave 2003



>70,000 deaths

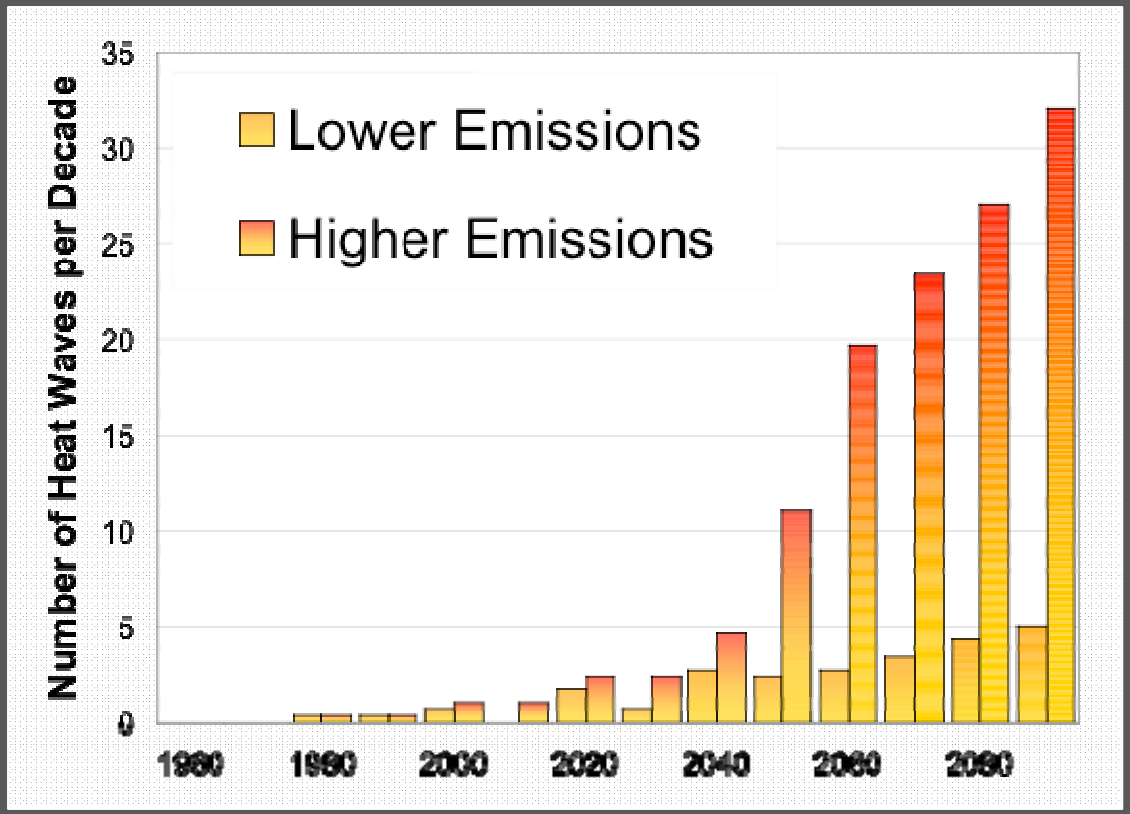
15,000 in France

20,000 in Germany

15% of Portugal's forests destroyed by fire (+18 deaths)

Flash floods in the Alps from melting glaciers

Heat waves – Chicago 1995



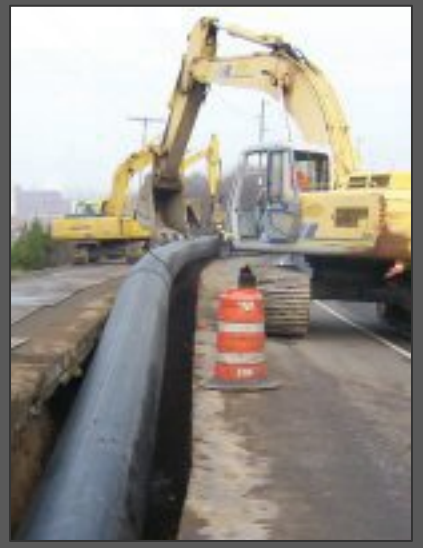
By mid-century, Chicago could experience several 1995-like events per decade.

By end-of-century, Under lower emissions, every other year could have a 1995-like heat wave.

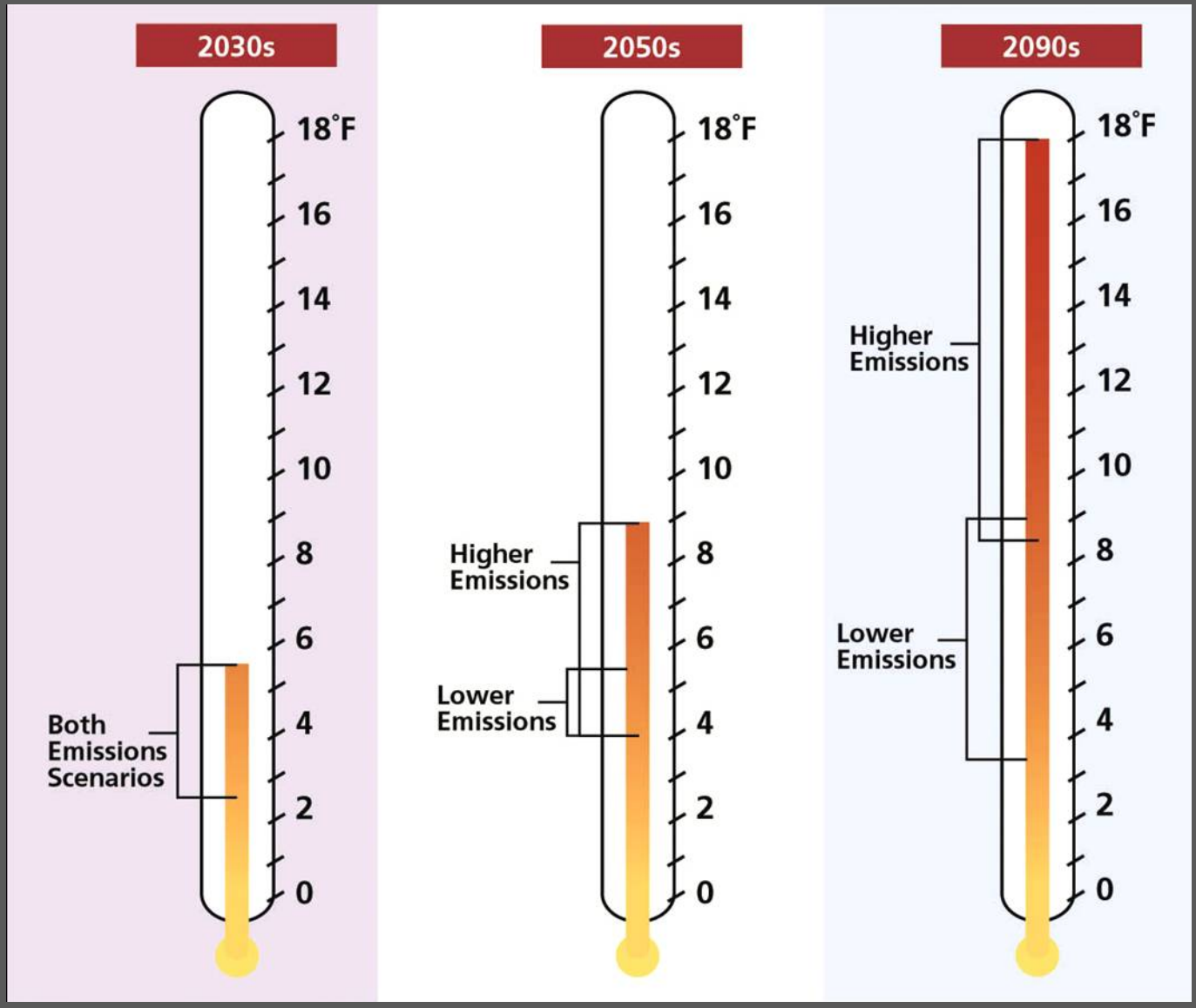
Under higher emissions, there could be as many as 3 heat waves PER YEAR.

How will climate change affect our energy and infrastructure?

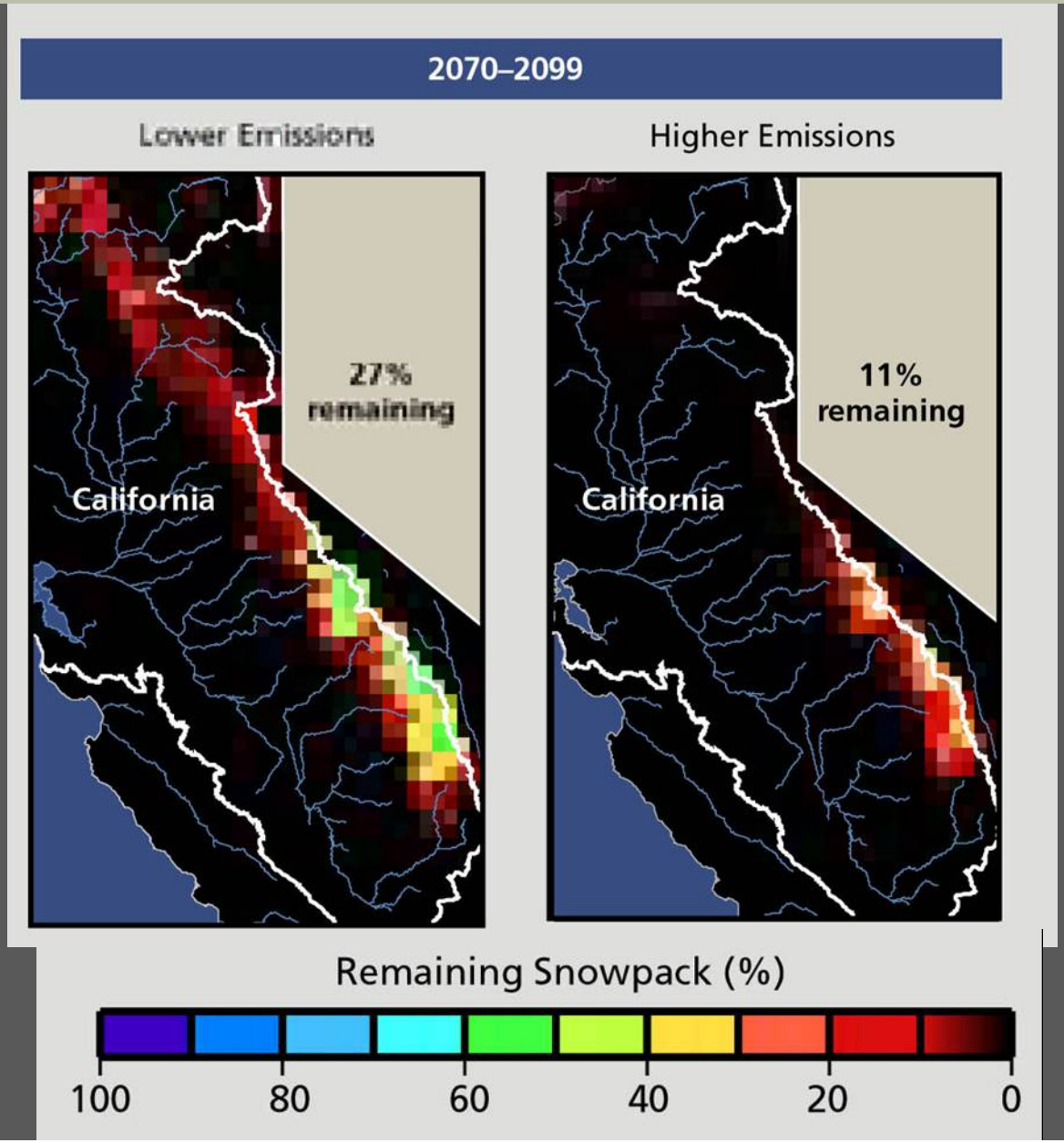
- Increased stress from higher temperatures, temperature swings, more flooding, higher sea levels
- Greater demand for electricity for air conditioning – higher risk of shortages
- More frequent infrastructure interruptions by extreme events
- Costs for Chicago:
  - $2.5B under higher emissions
  - $0.5B under lower emissions



Water resources



… in California



Glaciers are melting

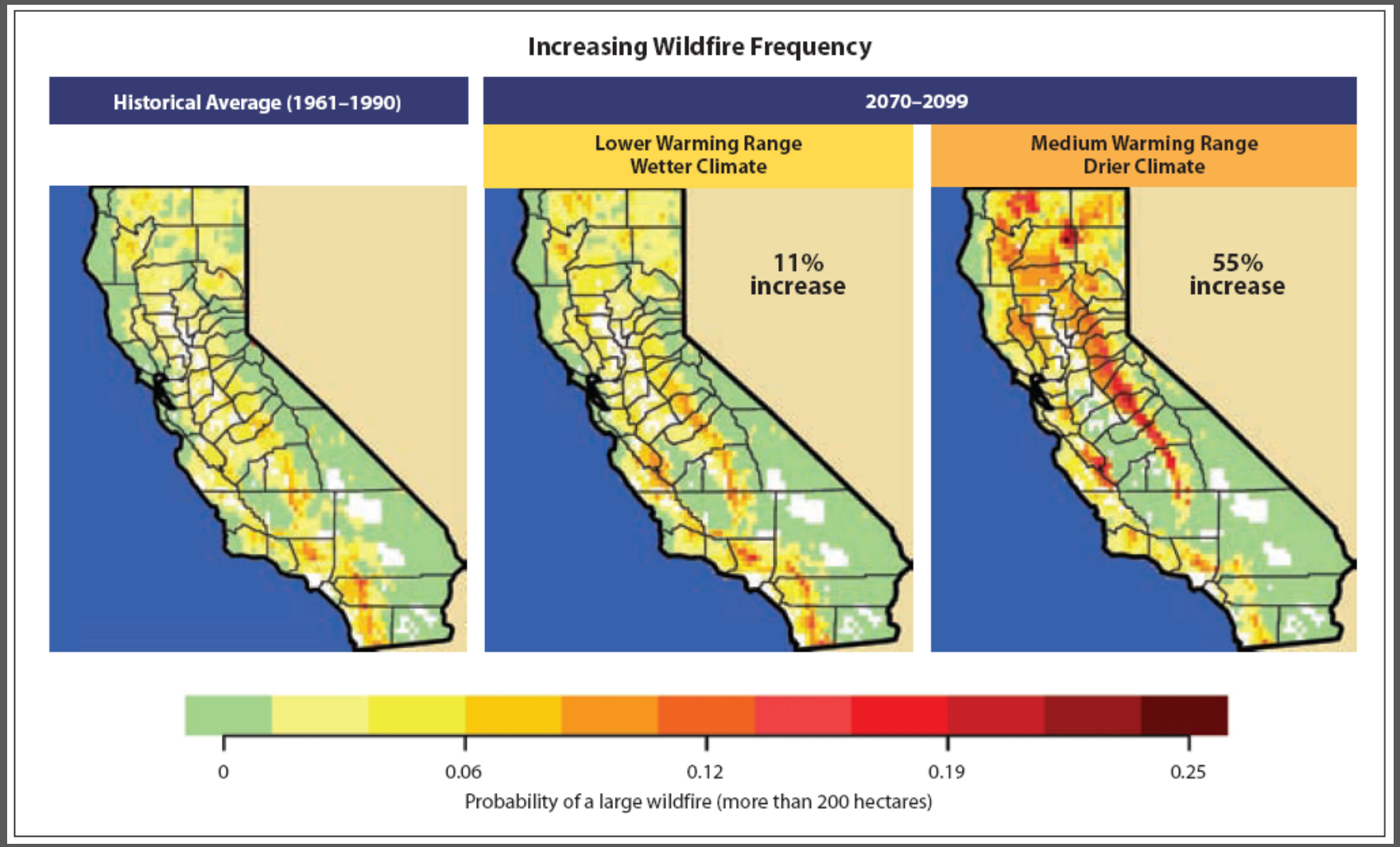
Grinell Glacier, Glacier National Park, USA

By 2030, Glacier National Park could be glacier-free.

Water supply for Lima, Peru

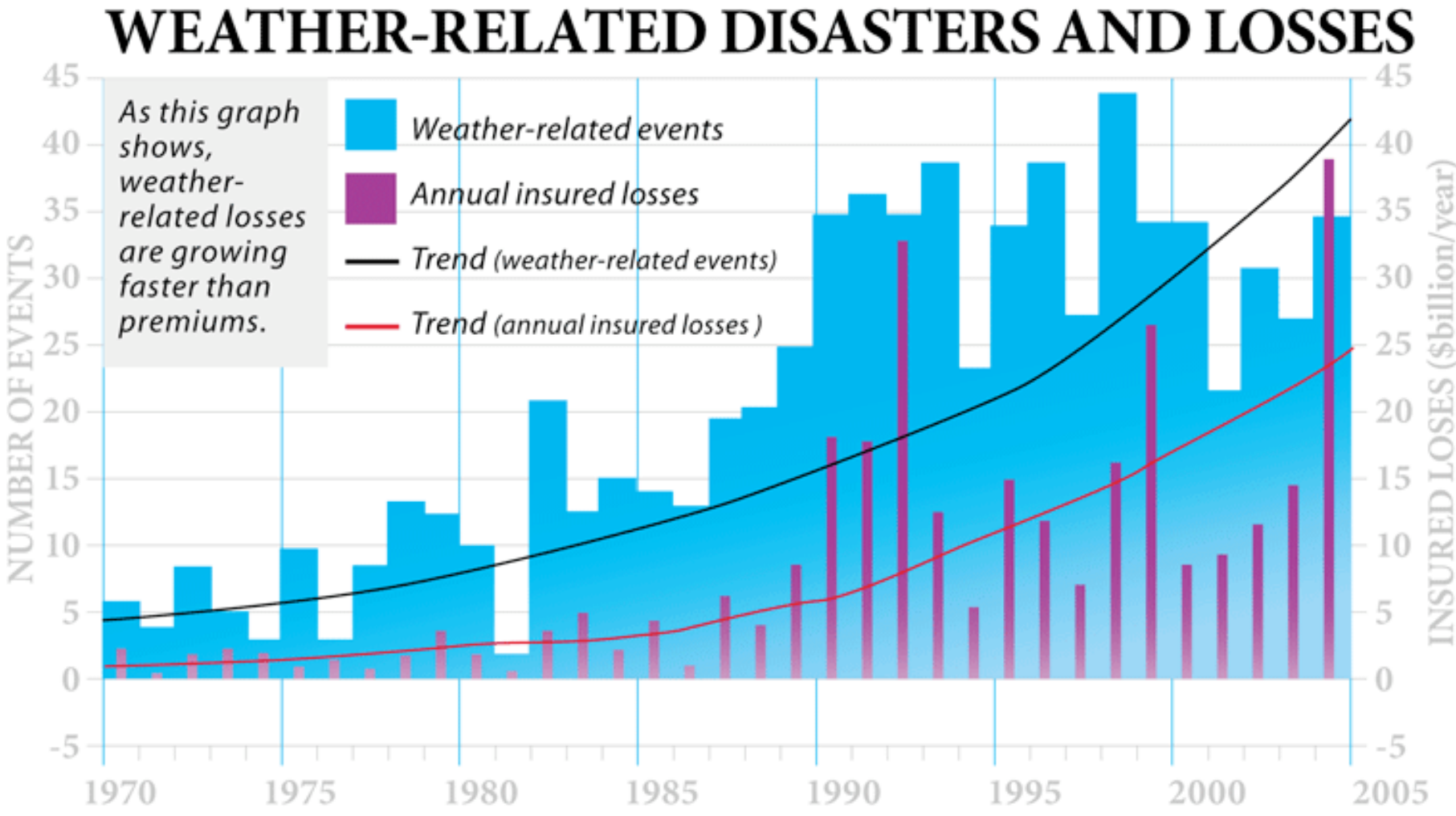
1 billion depend on glacier melt for water supply

Increasing wildfire frequency



Westerling et al., Science 2006

More extreme weather: events & losses

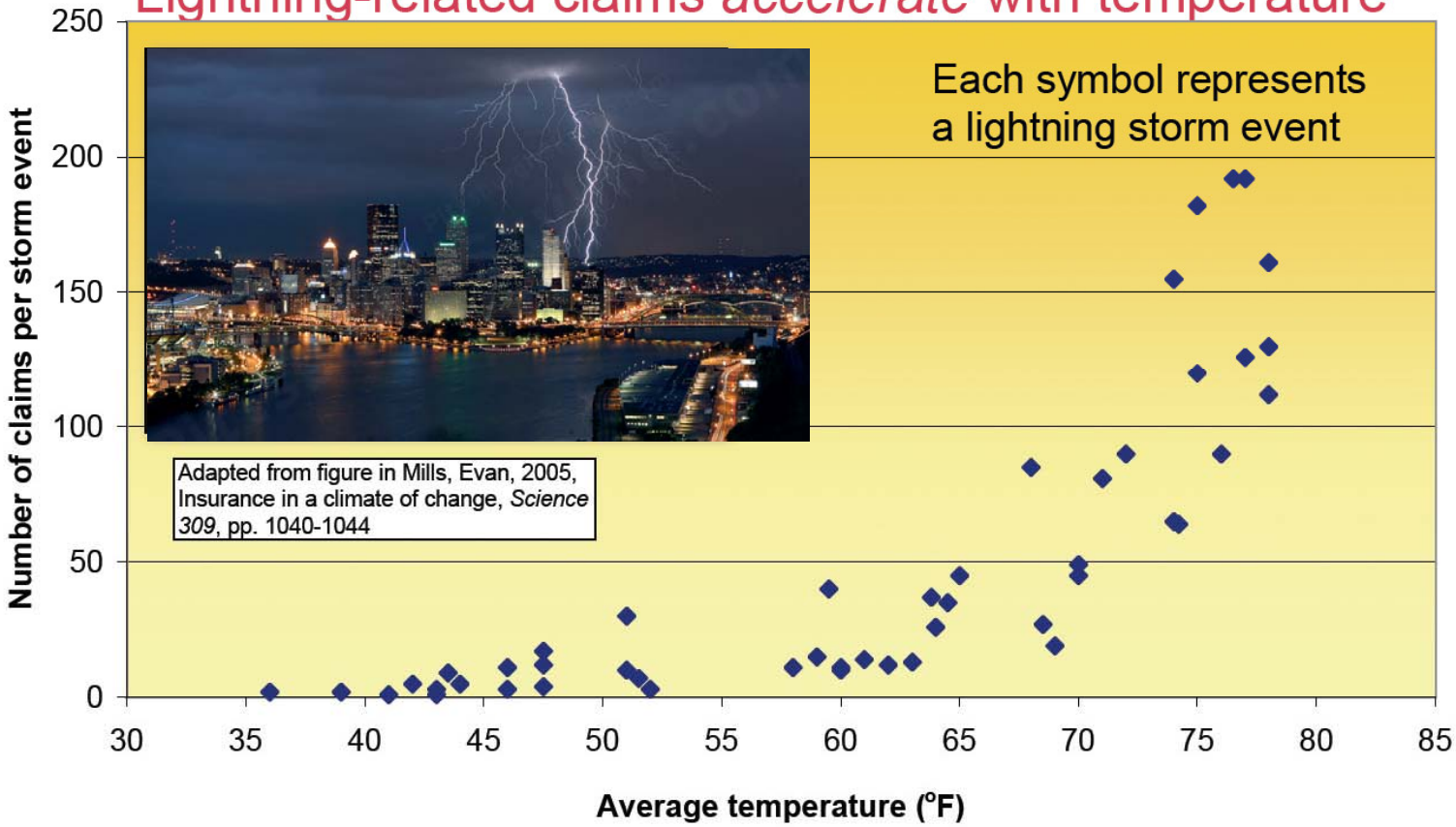


From "Financial Risks of Climate Change," 2005, Association of British Insurers, Sigma database.

Small-scale losses:

Lightning

Lightning-related claims *accelerate* with temperature



Source: Hartford Steam Boiler Inspection and Insurance Co.

The Three Choices We Have

"We basically have three choices: mitigation, adaptation, and suffering. We're going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required and the less suffering there will be."

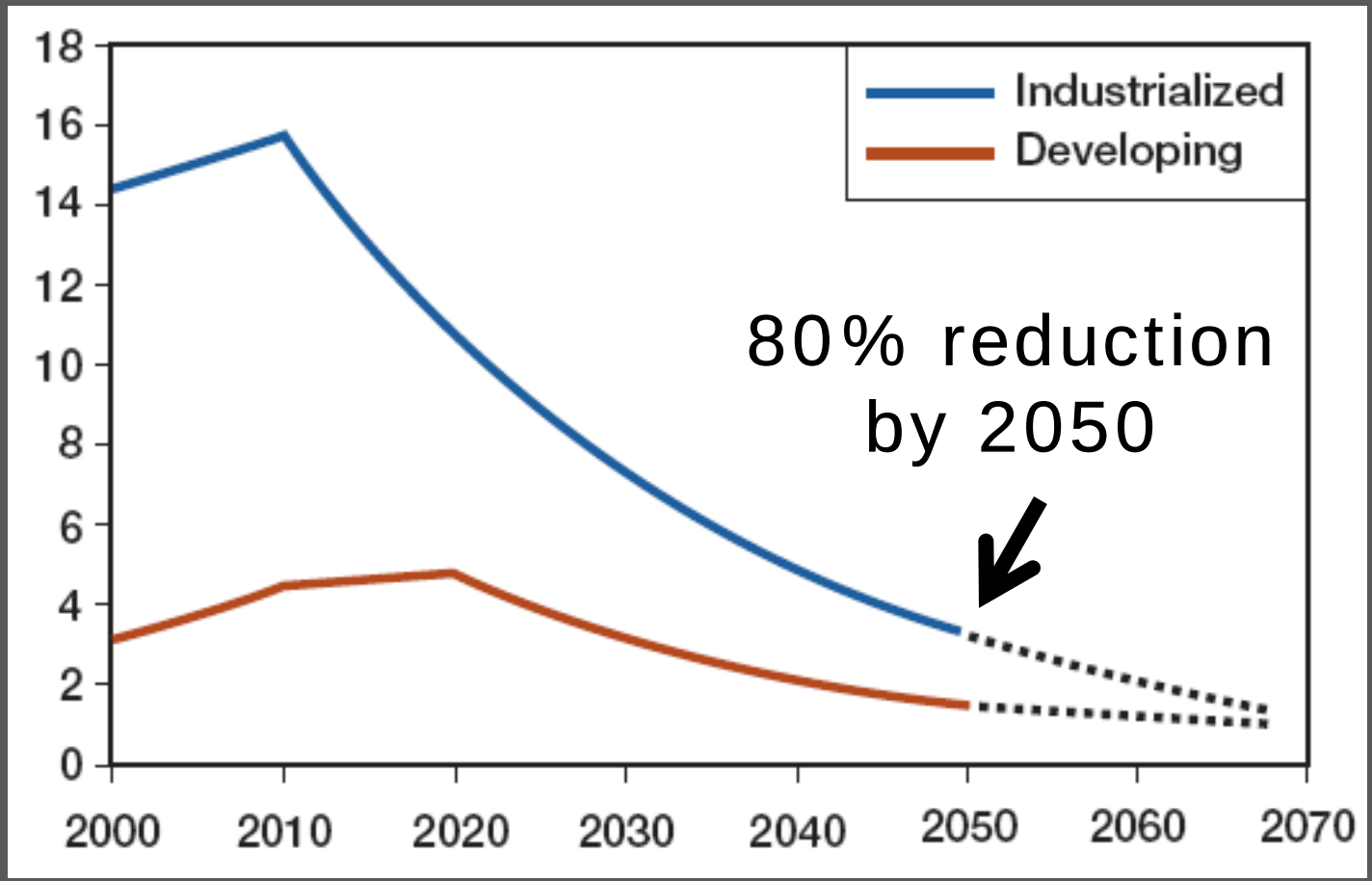
John Holdren

President of the American Association for the Advancement of Science; Harvard University

(cited in *The New York Times*, 01-30-07)

WHAT CAN WE DO ABOUT IT?

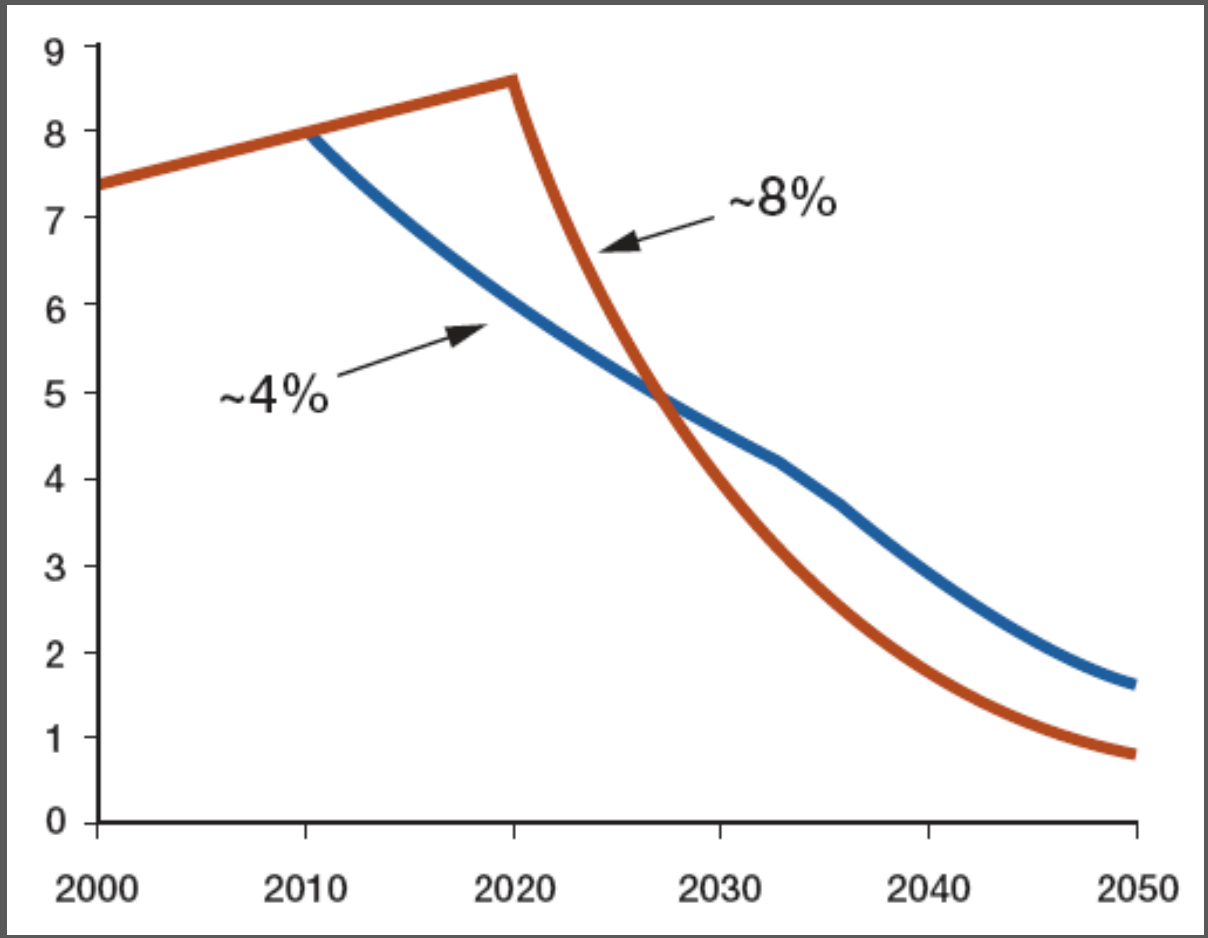
1. Reduce our emissions



WHAT CAN WE DO ABOUT IT?

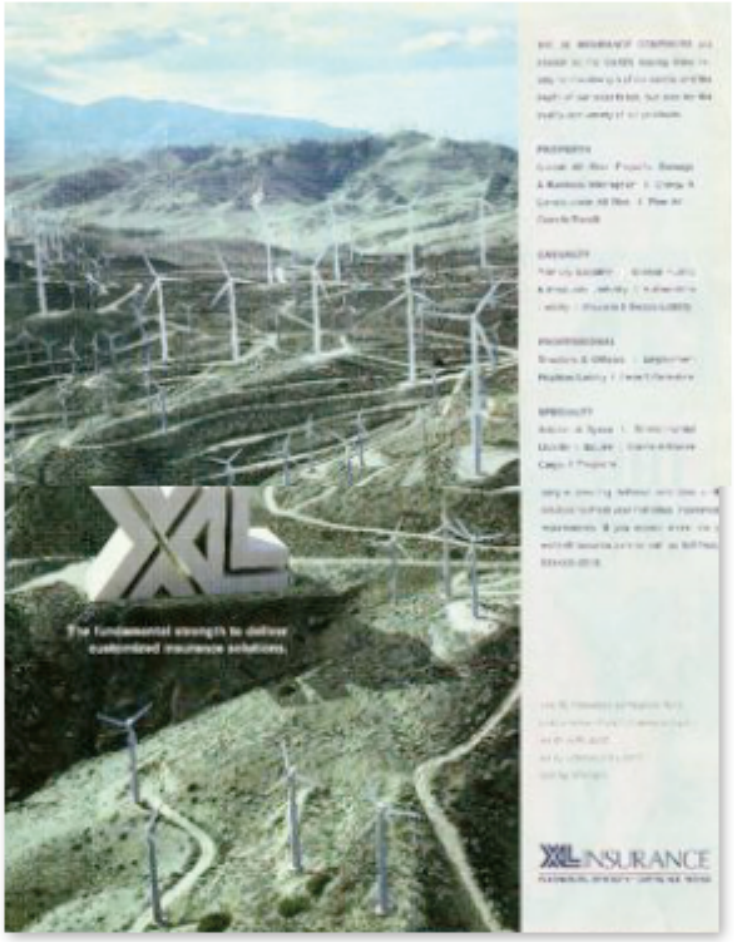
2. Start now: 2010 vs. 2020

4% per year
=
carpool or telecommute 1.5 days per month



Business climate is changing ...

Global Renewable Energy Investments: $85 *Billion* in 2007



Changing risk profiles

Changing sources of risk

Climate Change is #1 Risk, According to >70 Insurance Industry Analysts

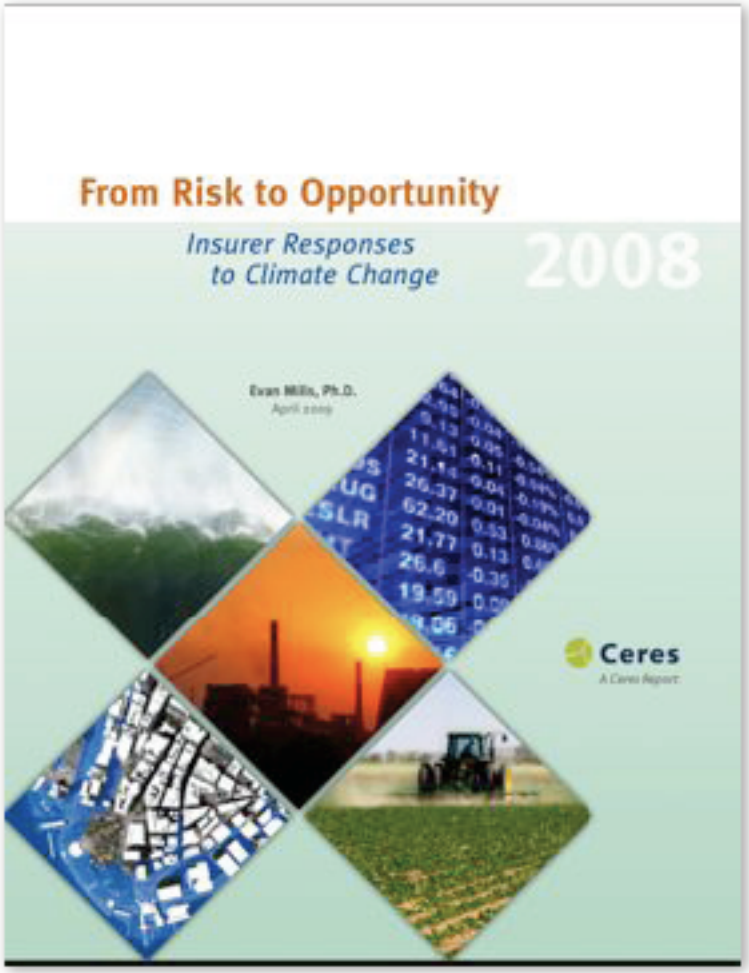
(Ernst & Young Survey, March 2008)

1. ***Climate change***
2. **Demographic shifts in core markets***
3. **Catastrophic events***
4. **Emerging markets***
5. **Regulatory intervention***
6. **Channel distribution**
7. **Integration of technology with operations & strategy**
8. **Securities markets***
9. **Legal risk***
10. **Geopolitical or macro-economic shocks***

* Also influenced by climate change

Moving from risk to opportunity

34 strategies; 643 examples
278 entities; 29 countries ... *and counting*



Opportunities: new markets

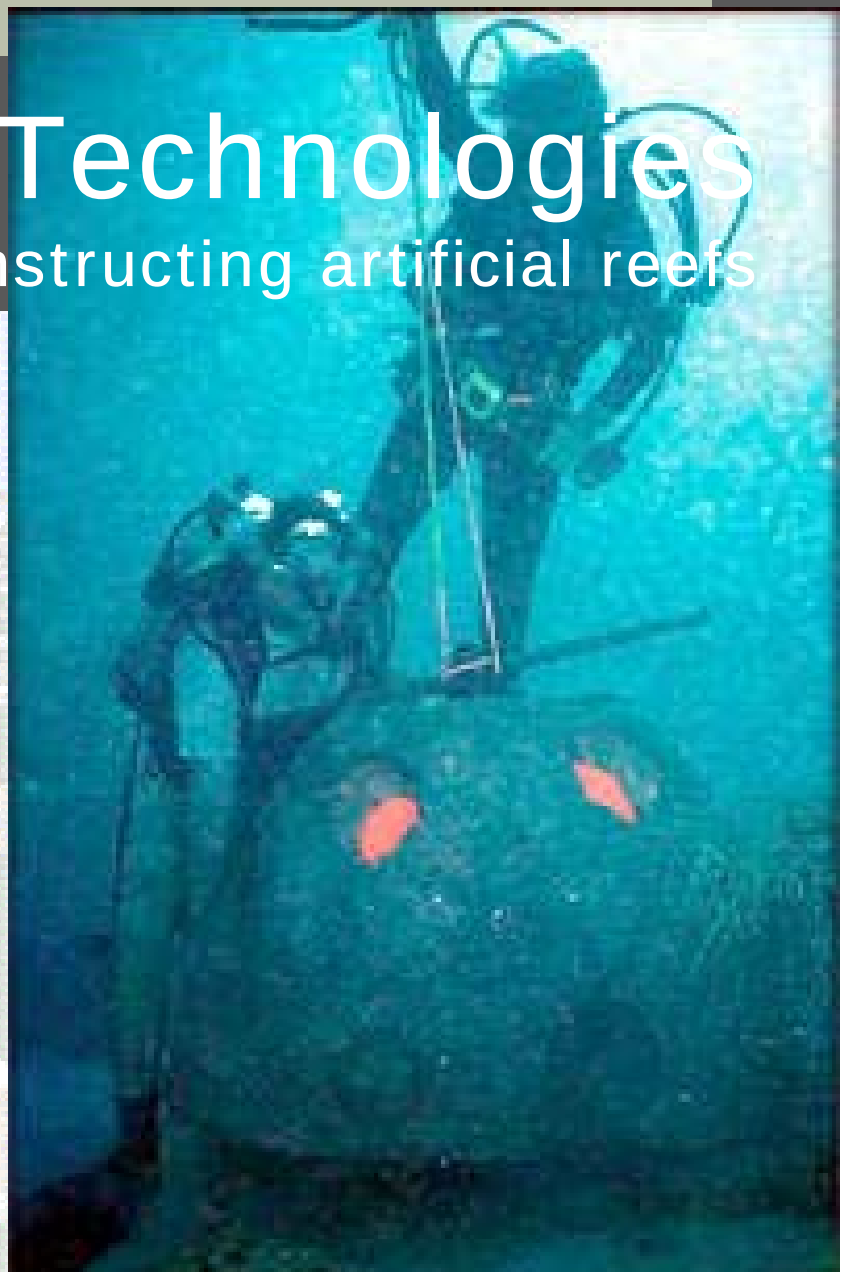
- ***Insurance Australia Group:*** offering on-line automobile carbon-offset service for customers

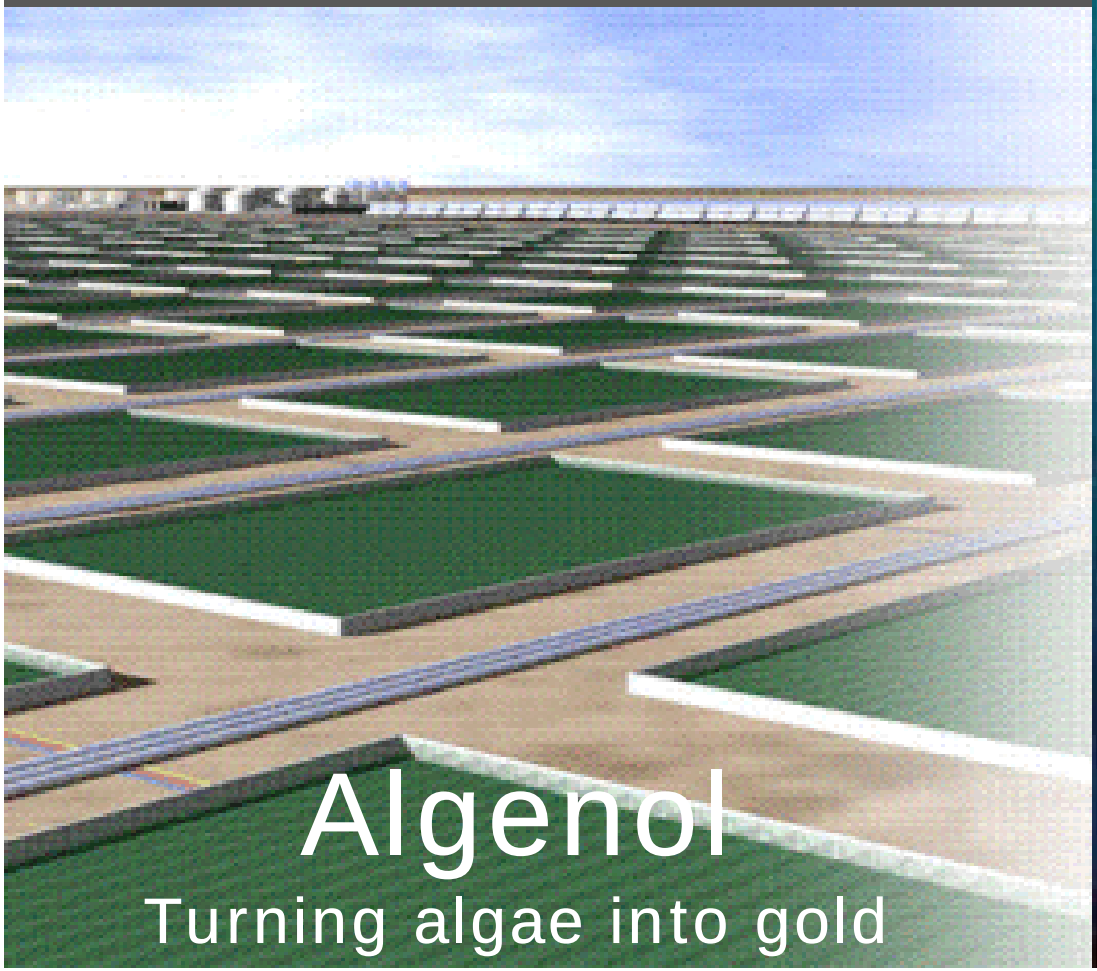
Source: http://www.climatehelp.com.au/

Opportunities: new products

Applied Marine Technologies

Constructing artificial reefs

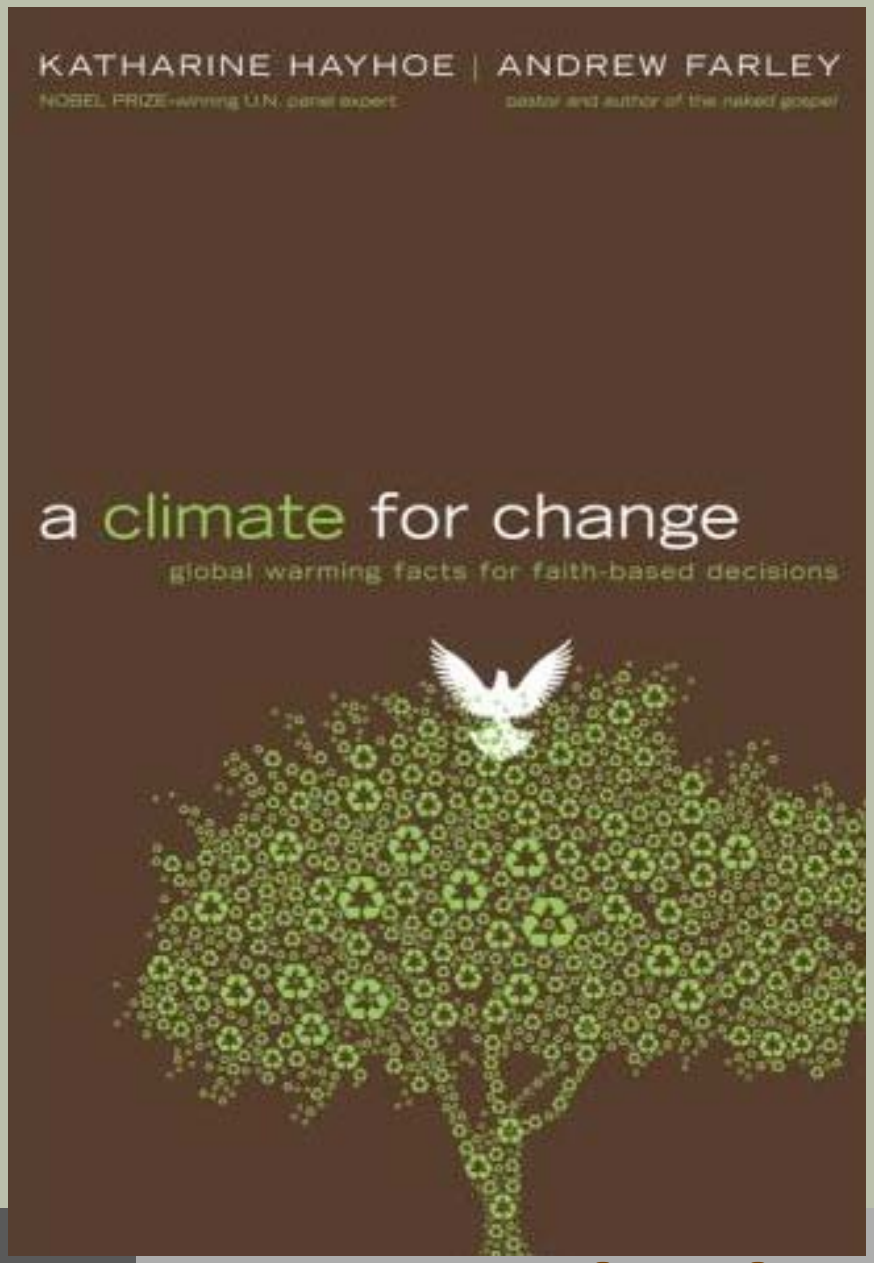




Algenol

Turning algae into gold

Opportunities: new incentives



www.katharinehayhoe.com