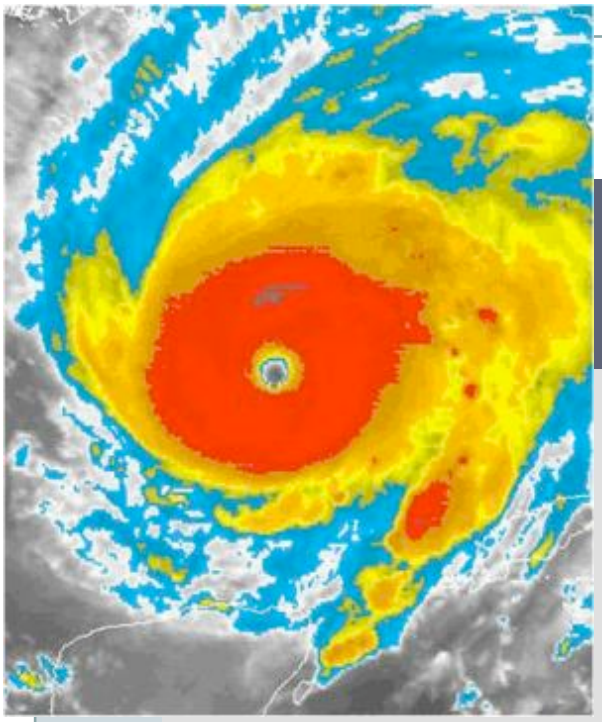


CLIMATE CHANGE

What does it mean for the insurance industry?

KATHARINE HAYHOE

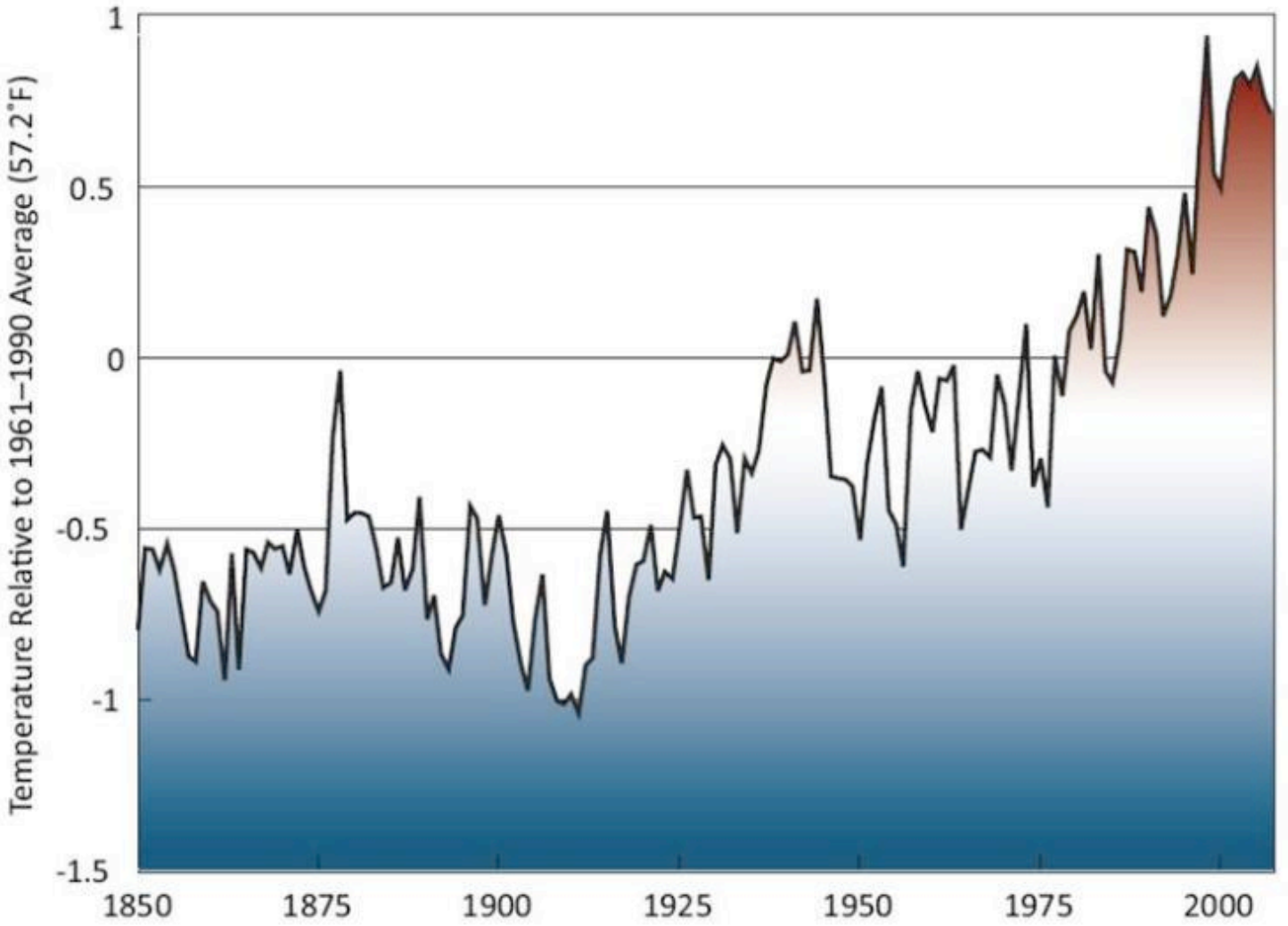
Texas Tech University

ATMOS Research

Why consider climate change?

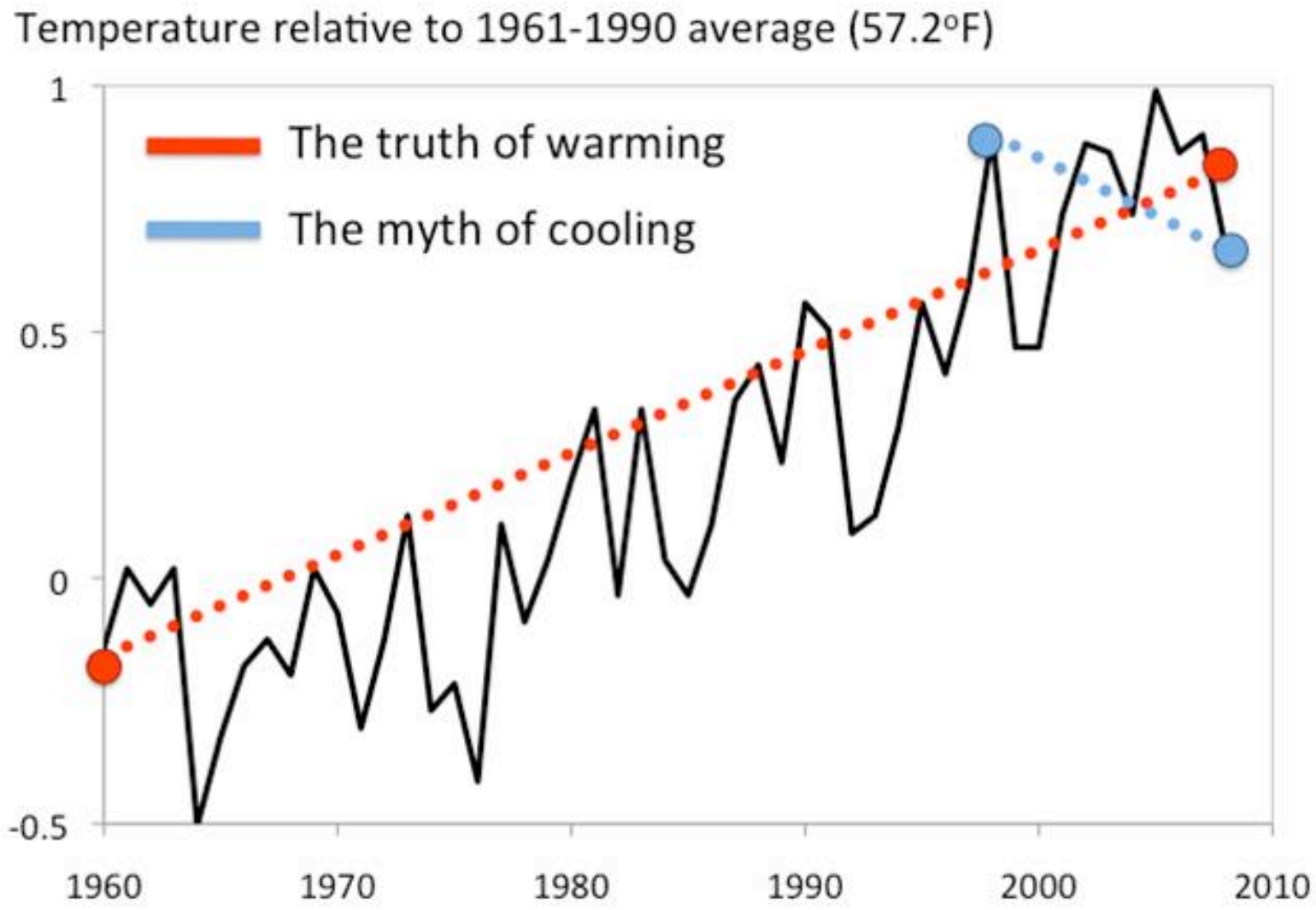
PART ONE

The Earth is getting warmer …

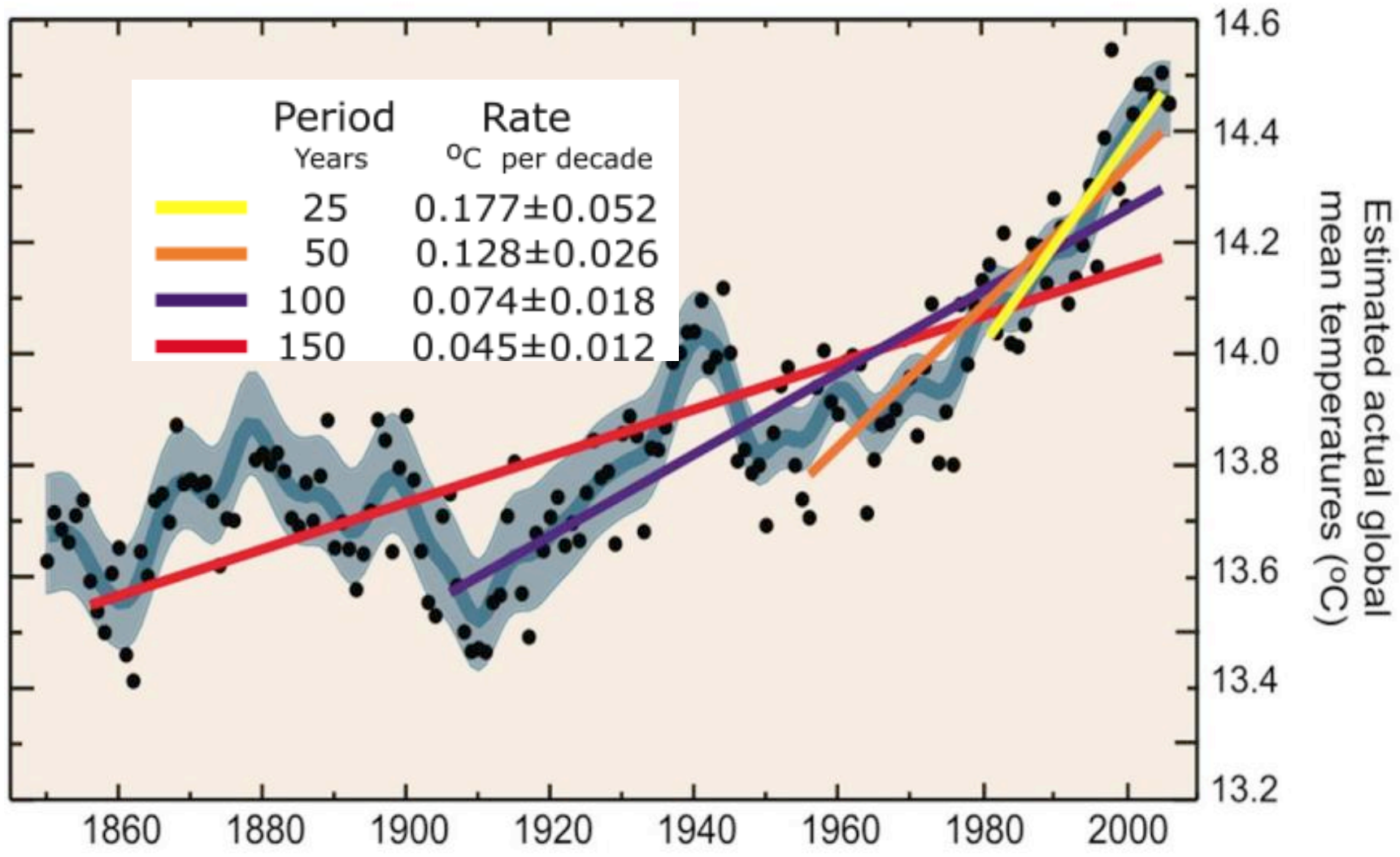


11 out of the last 12 years have been the warmest on record.

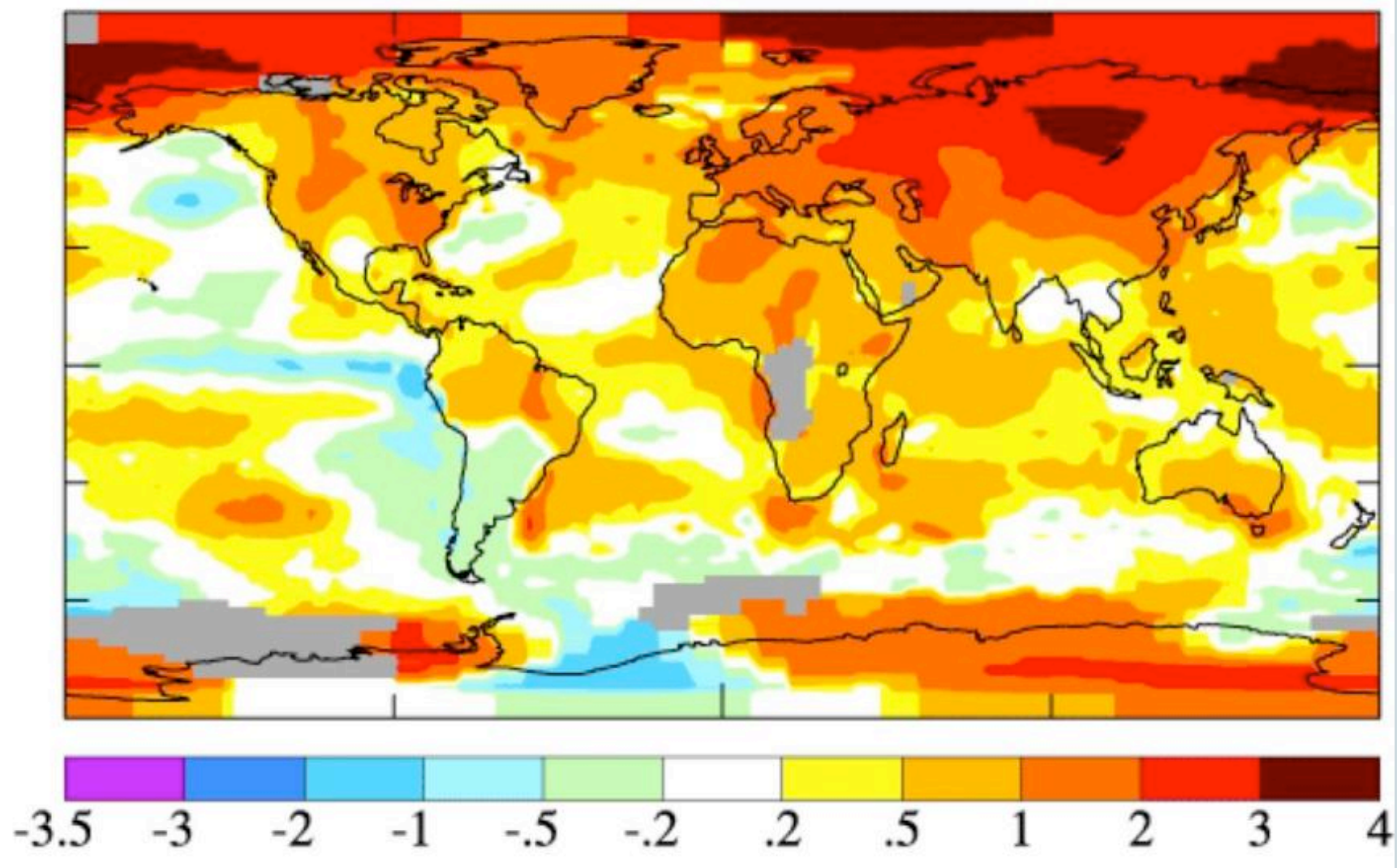
… despite recent claims of "cooling"



It's happening faster and faster



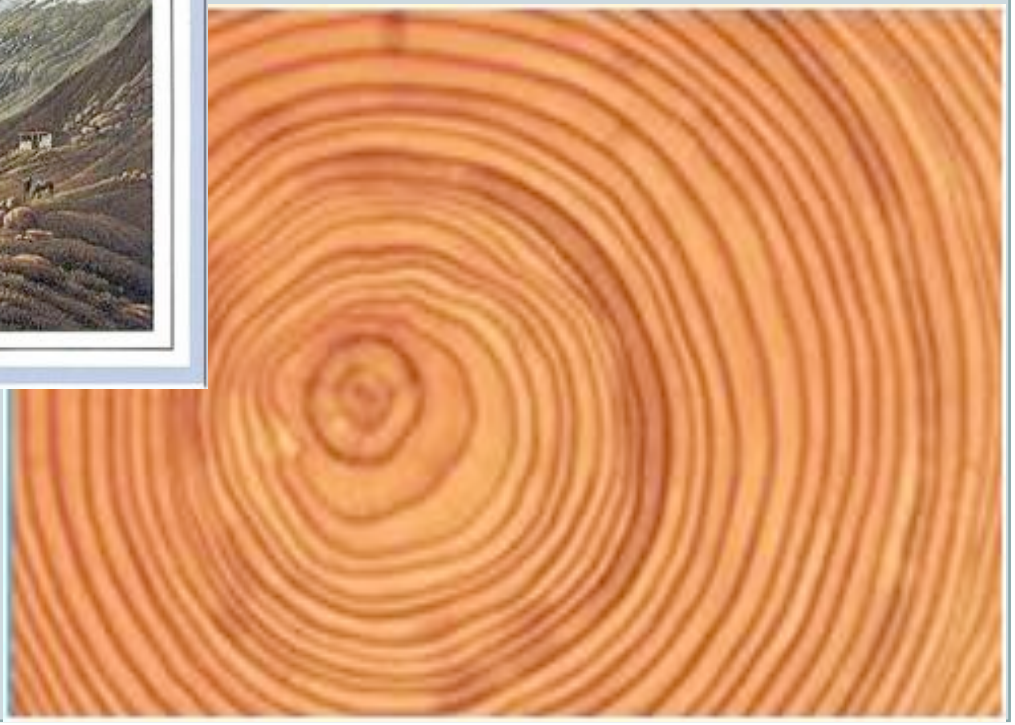
…and is greatest over land & at higher latitudes



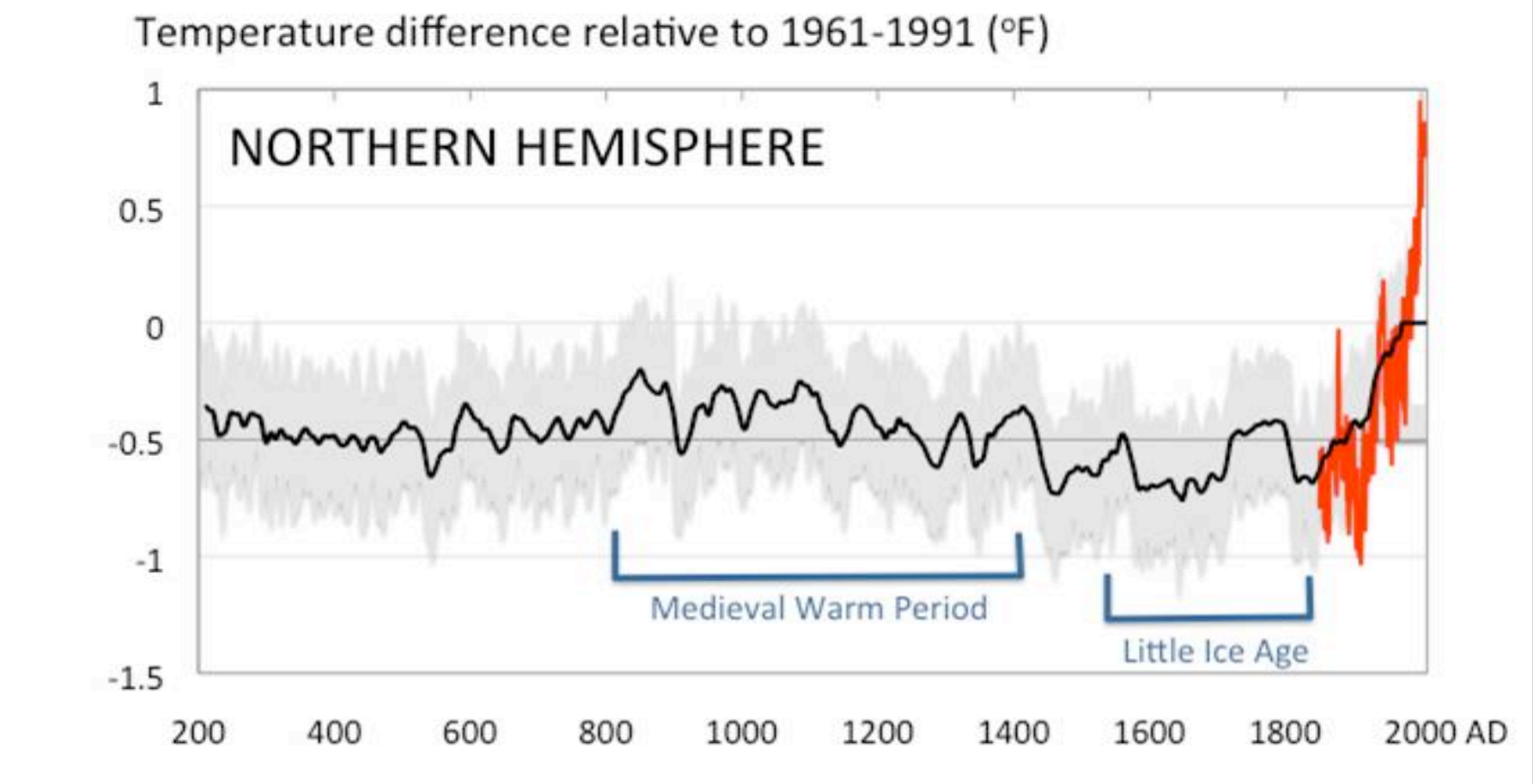
Are these conditions unusual?

PART TWO

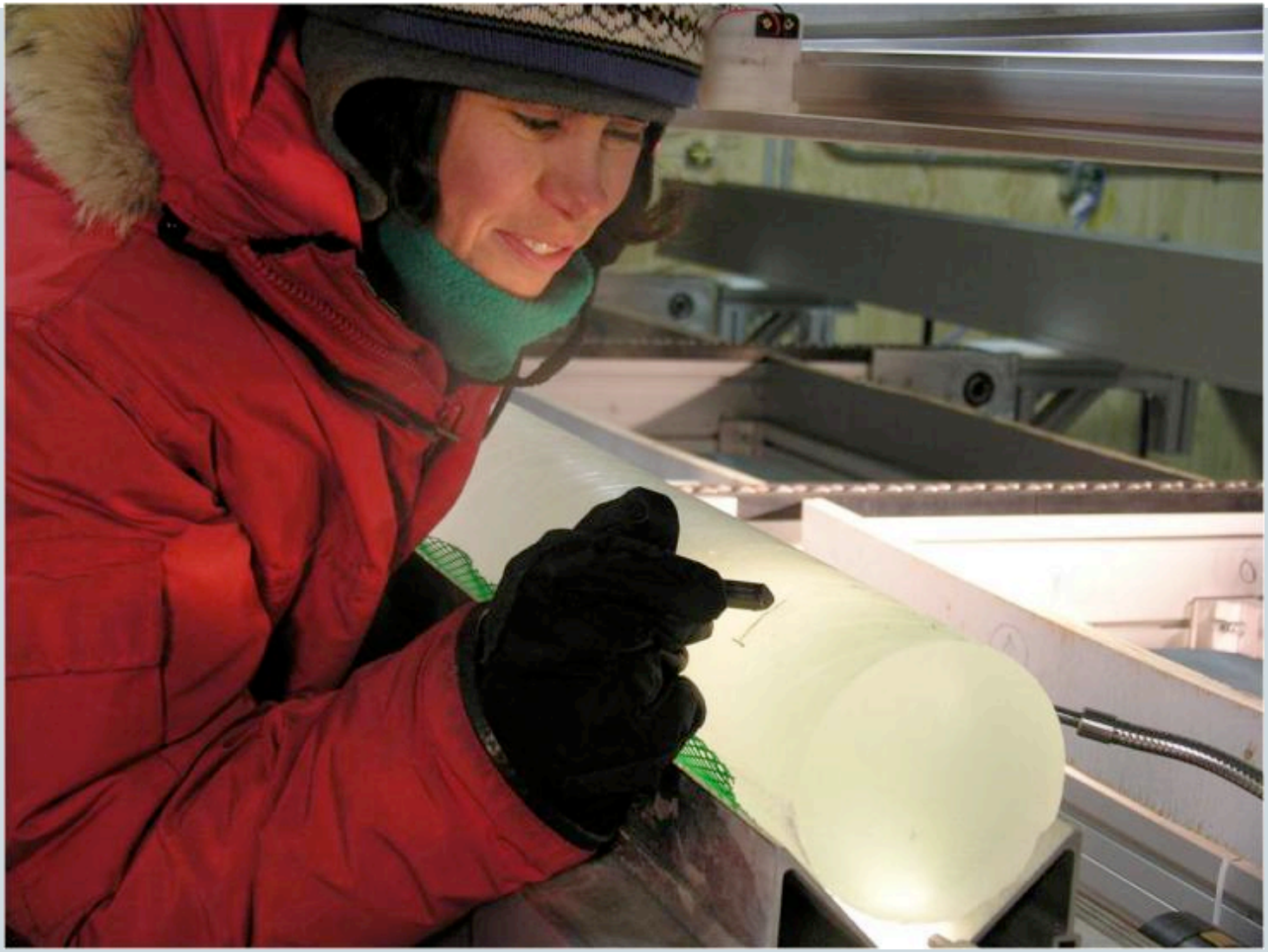
“Natural thermometers”



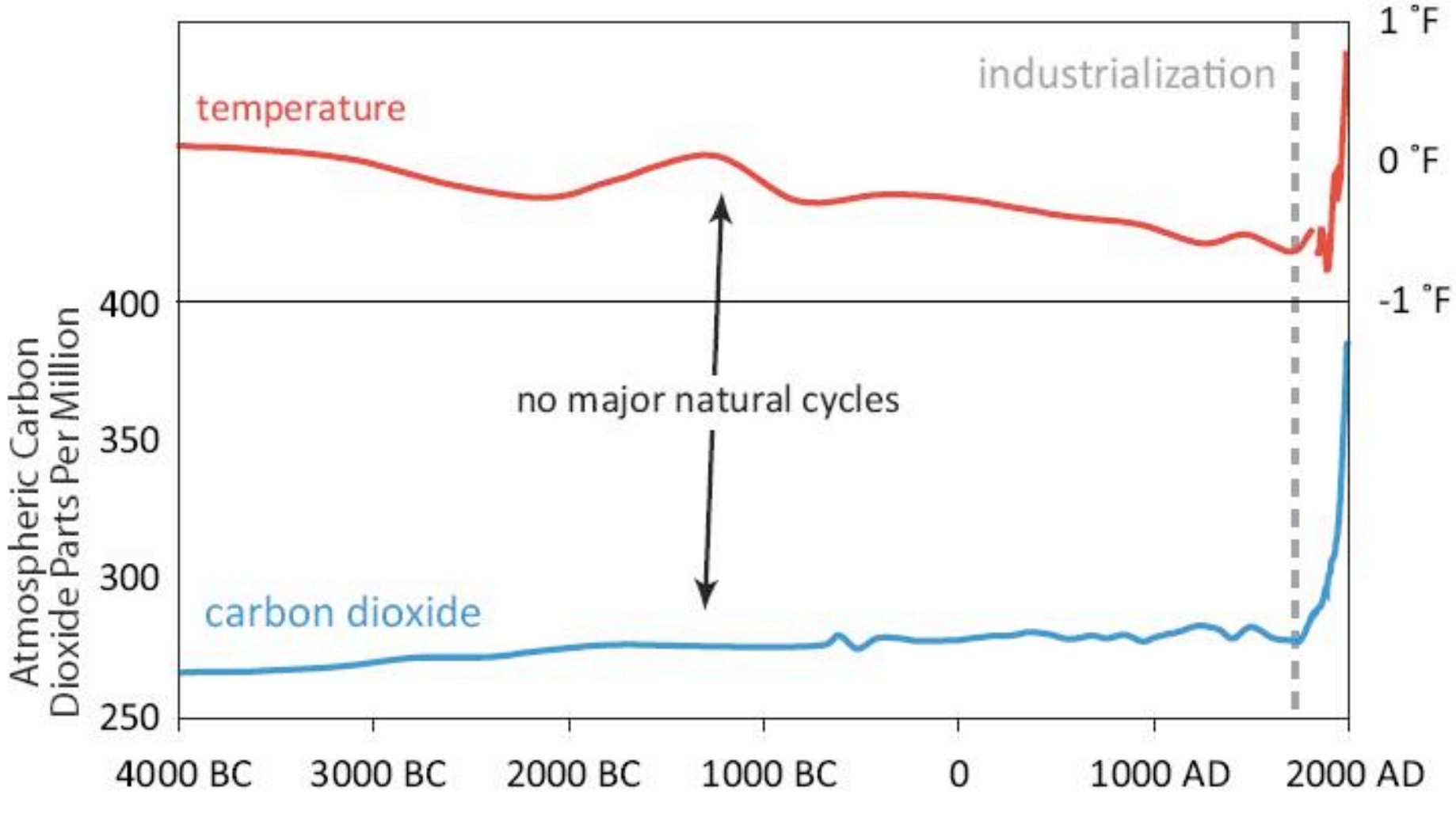
Conditions today are unusual in the context of the last 2,000 years …



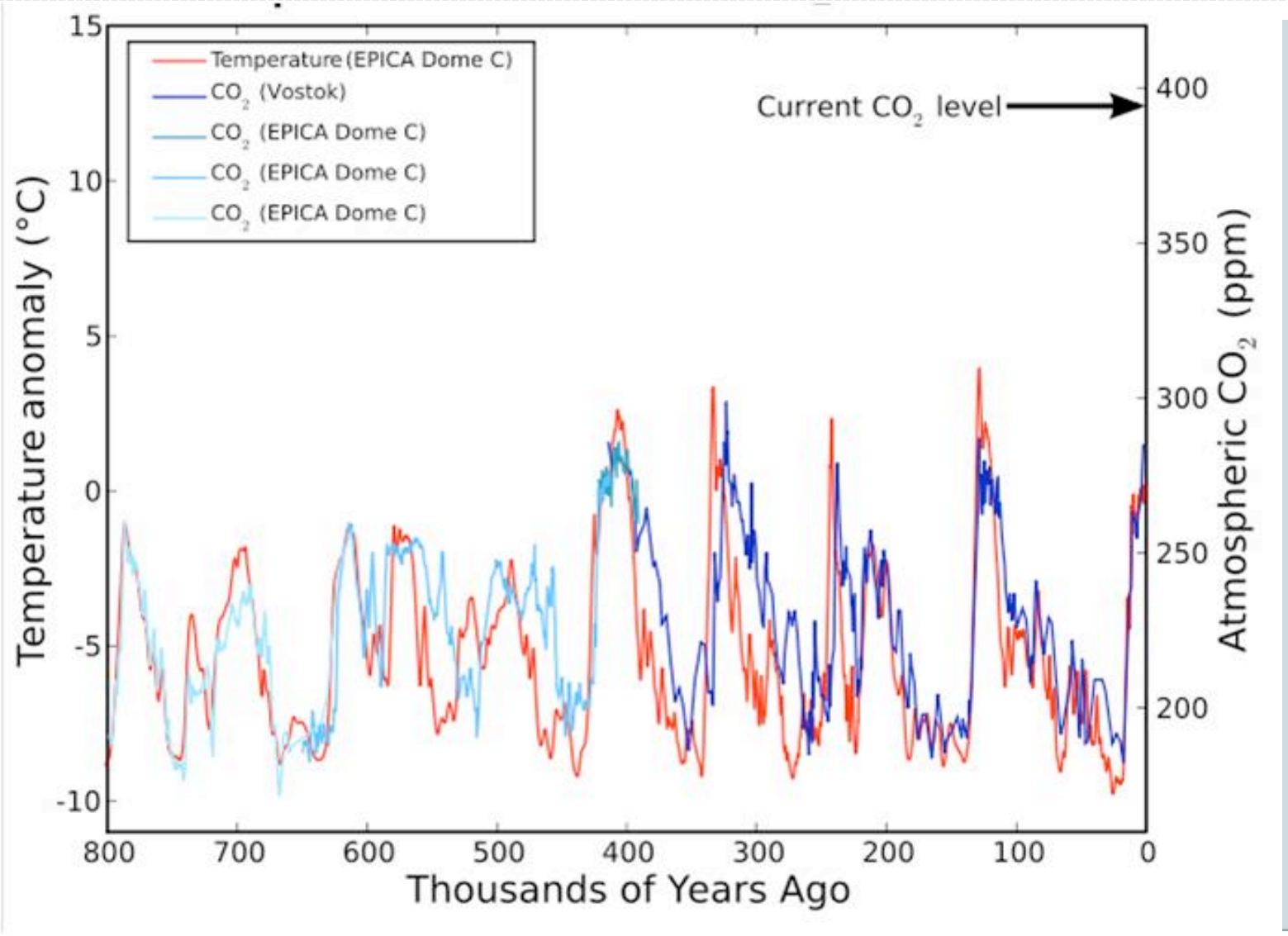
“Natural thermometers”



… the last 6,000 years



… and even the last 800,000 years.



What is causing the warming?

PART THREE

Why is this happening?

THE NATURAL GREENHOUSE EFFECT

naturally increases Earth's temperature by 70^{o}F

Why is this happening?

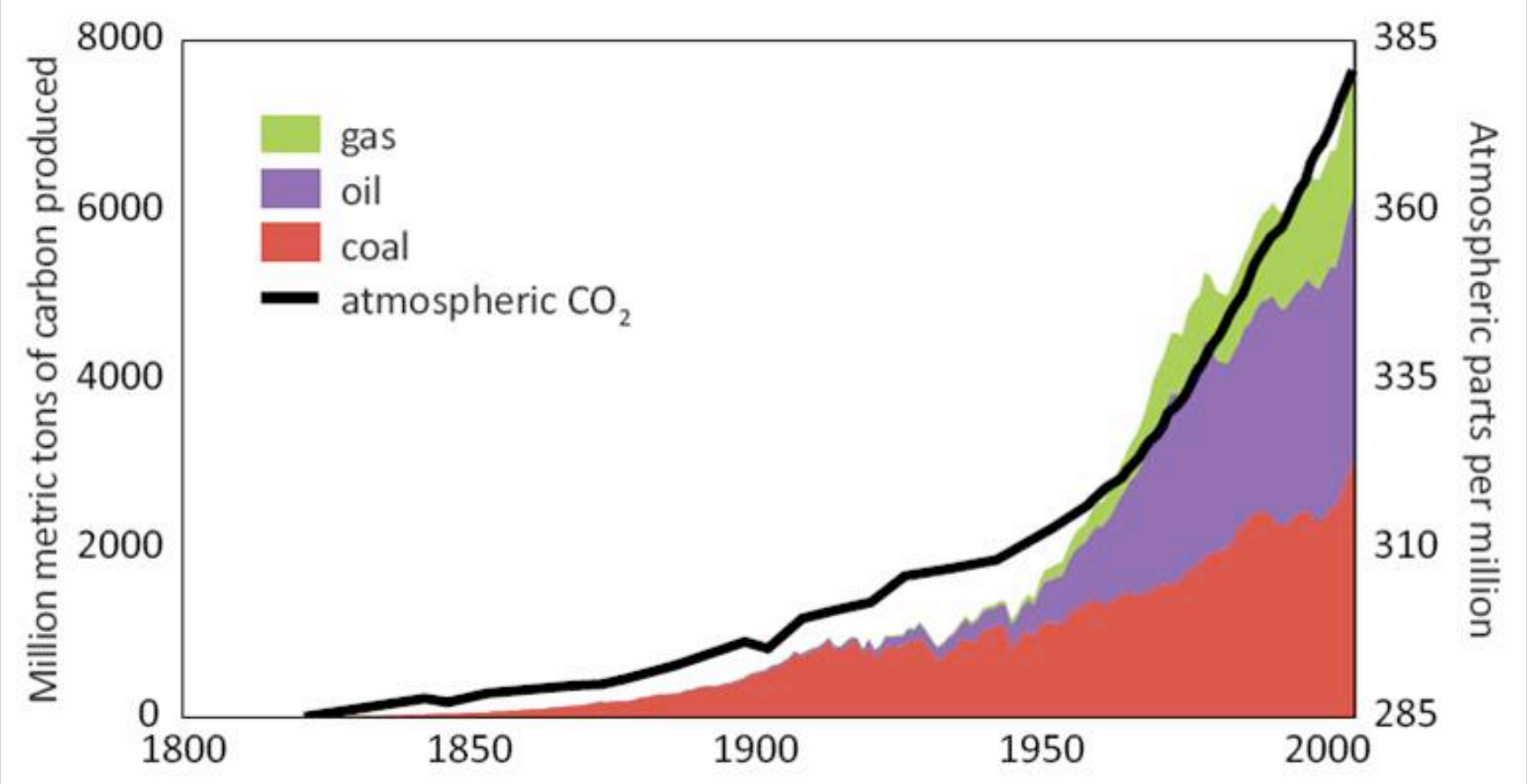
THE NATURAL GREENHOUSE EFFECT

naturally increases Earth's temperature by 70^{o}F

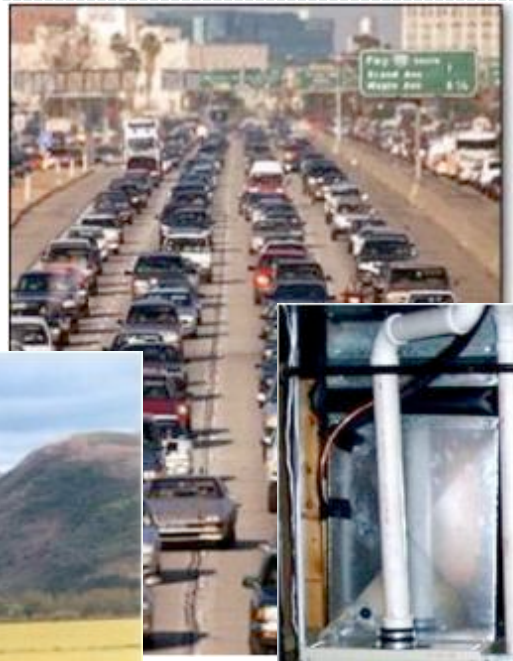
THE ENHANCED GREENHOUSE EFFECT

has artificially increased Earth's temperature by 1.4^{o}F

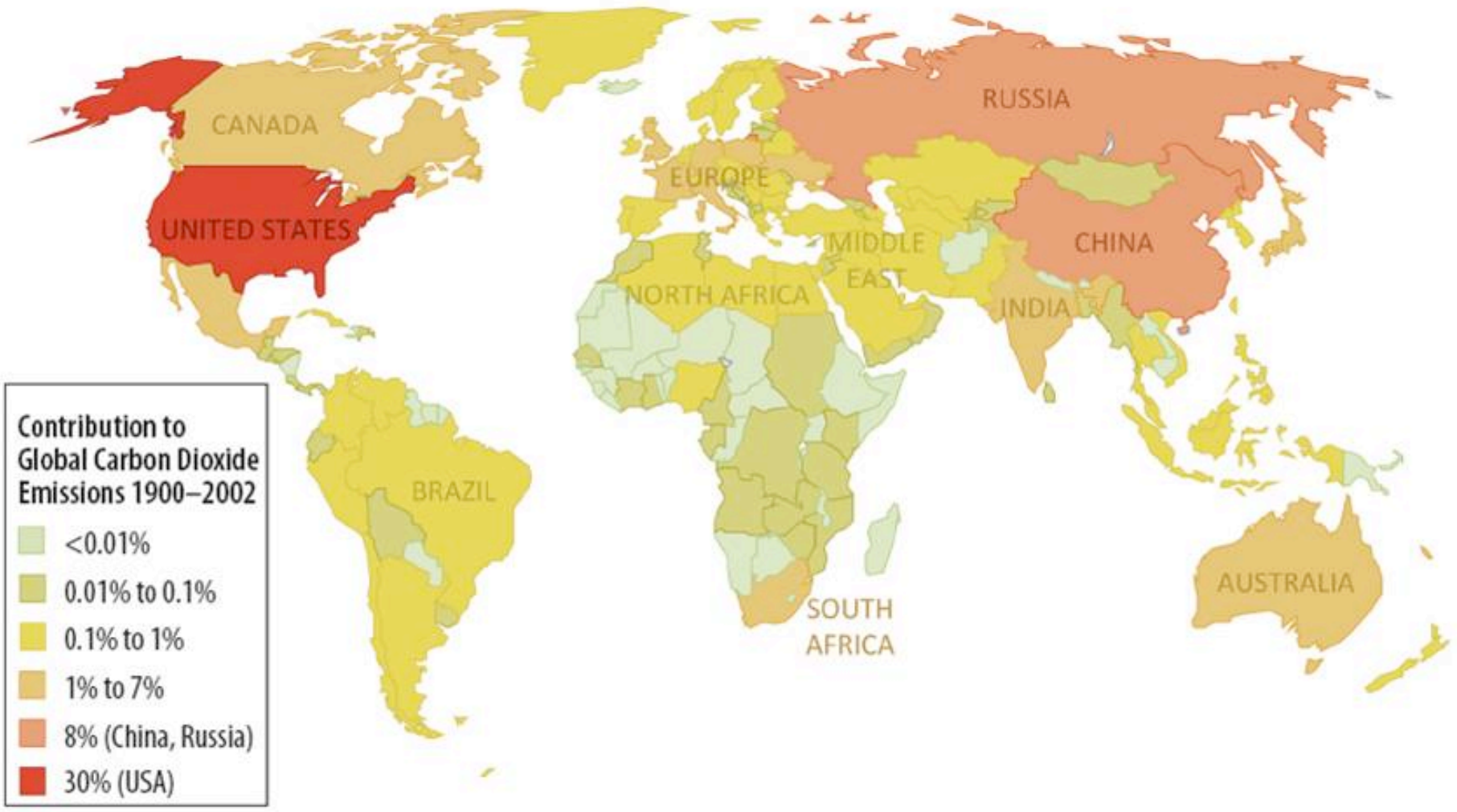
Human production of heat-trapping gases



Where do these gases come from?

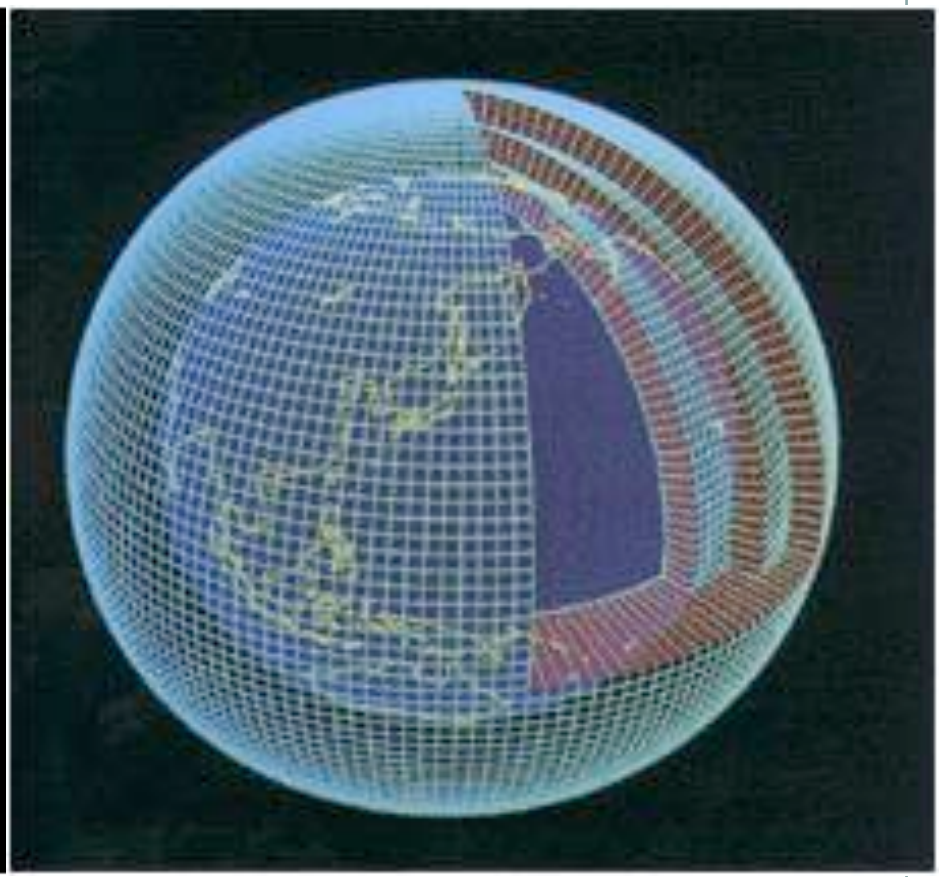


Who is responsible?

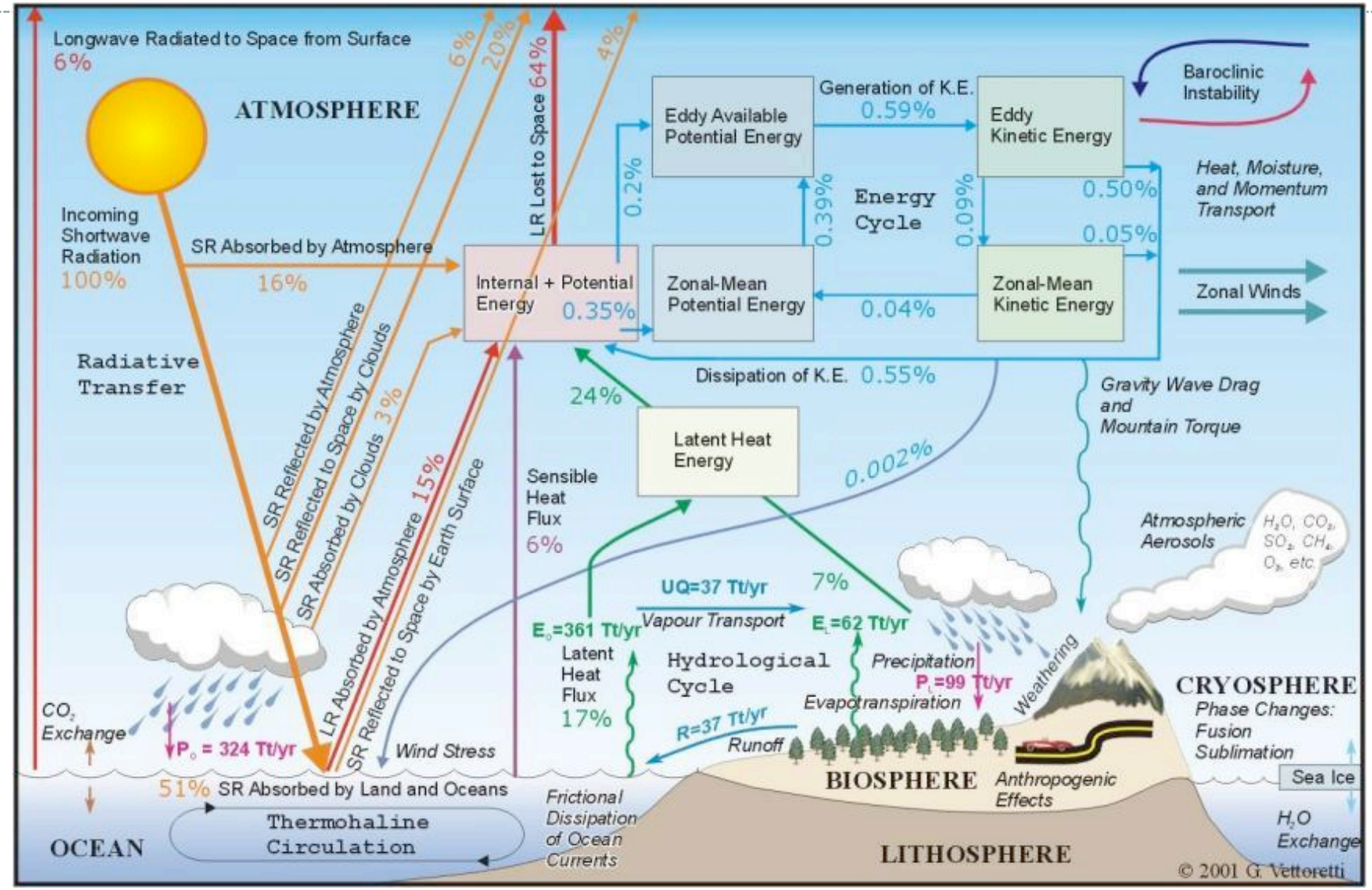


How do we know these gases are causing the warming?

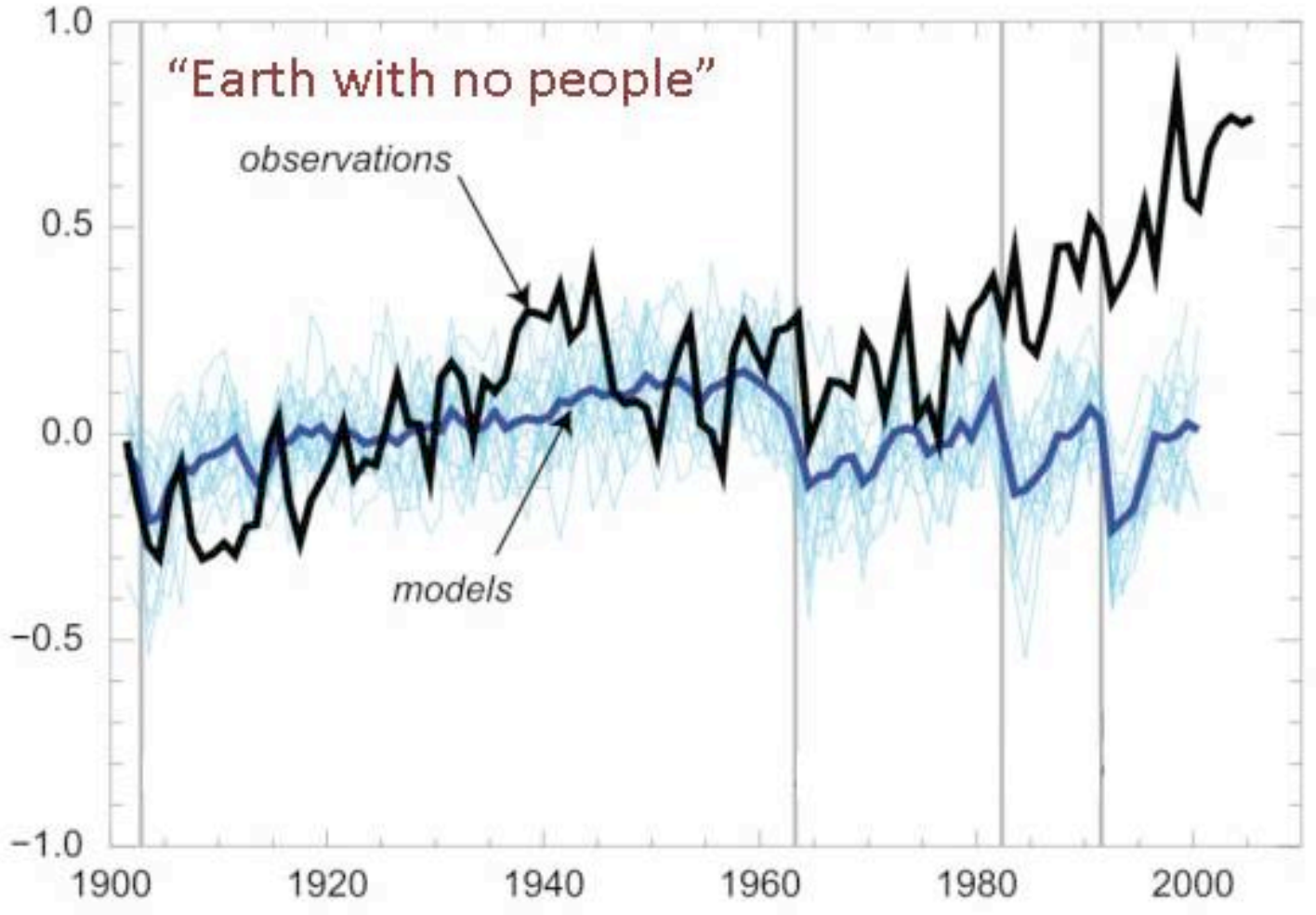
How do we know these gases are causing the warming?



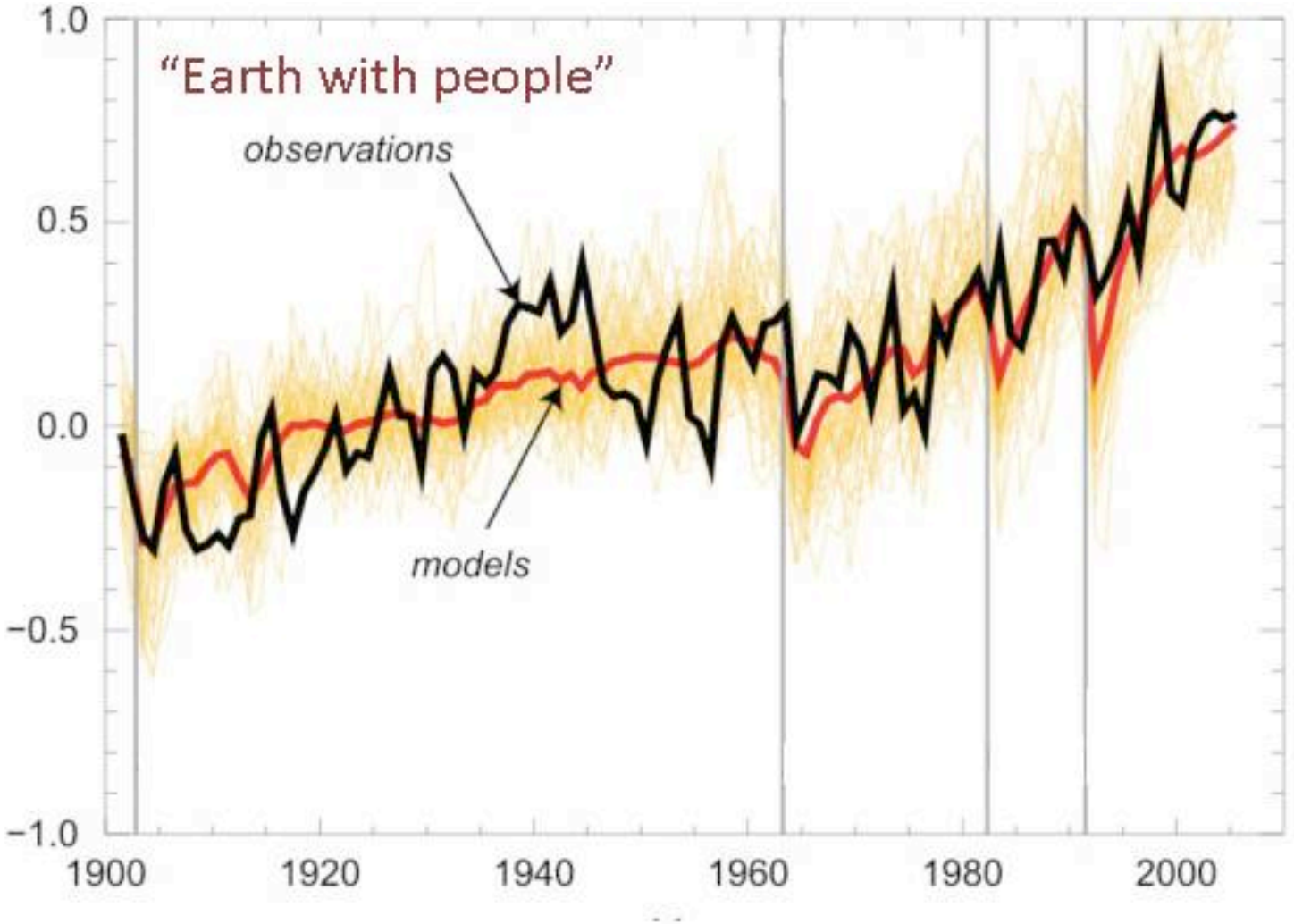
Modeling the climate system



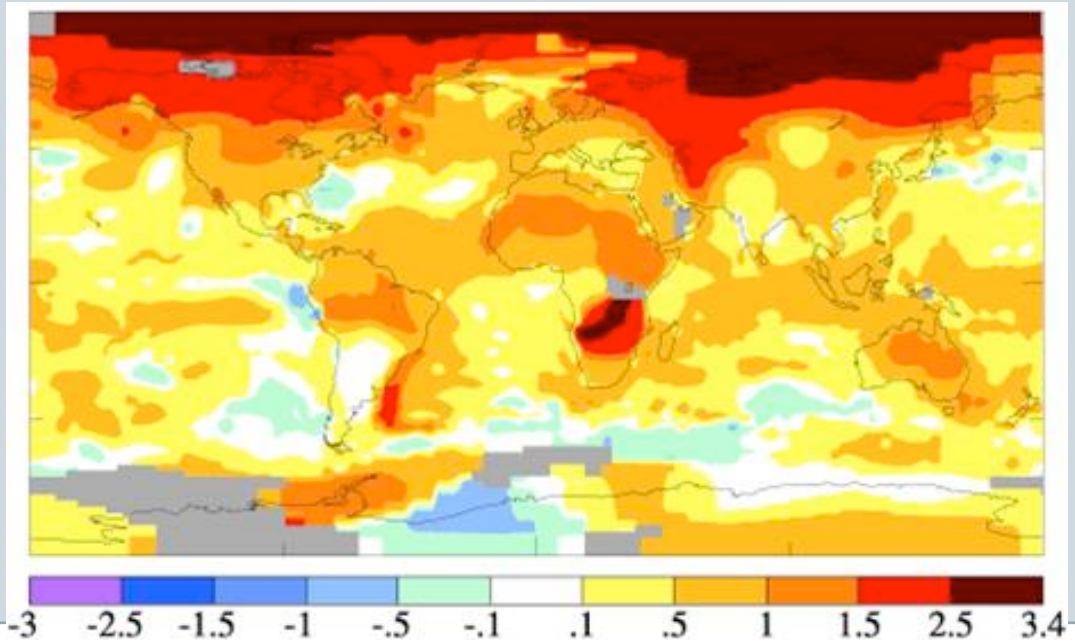
Quantifying the human influence



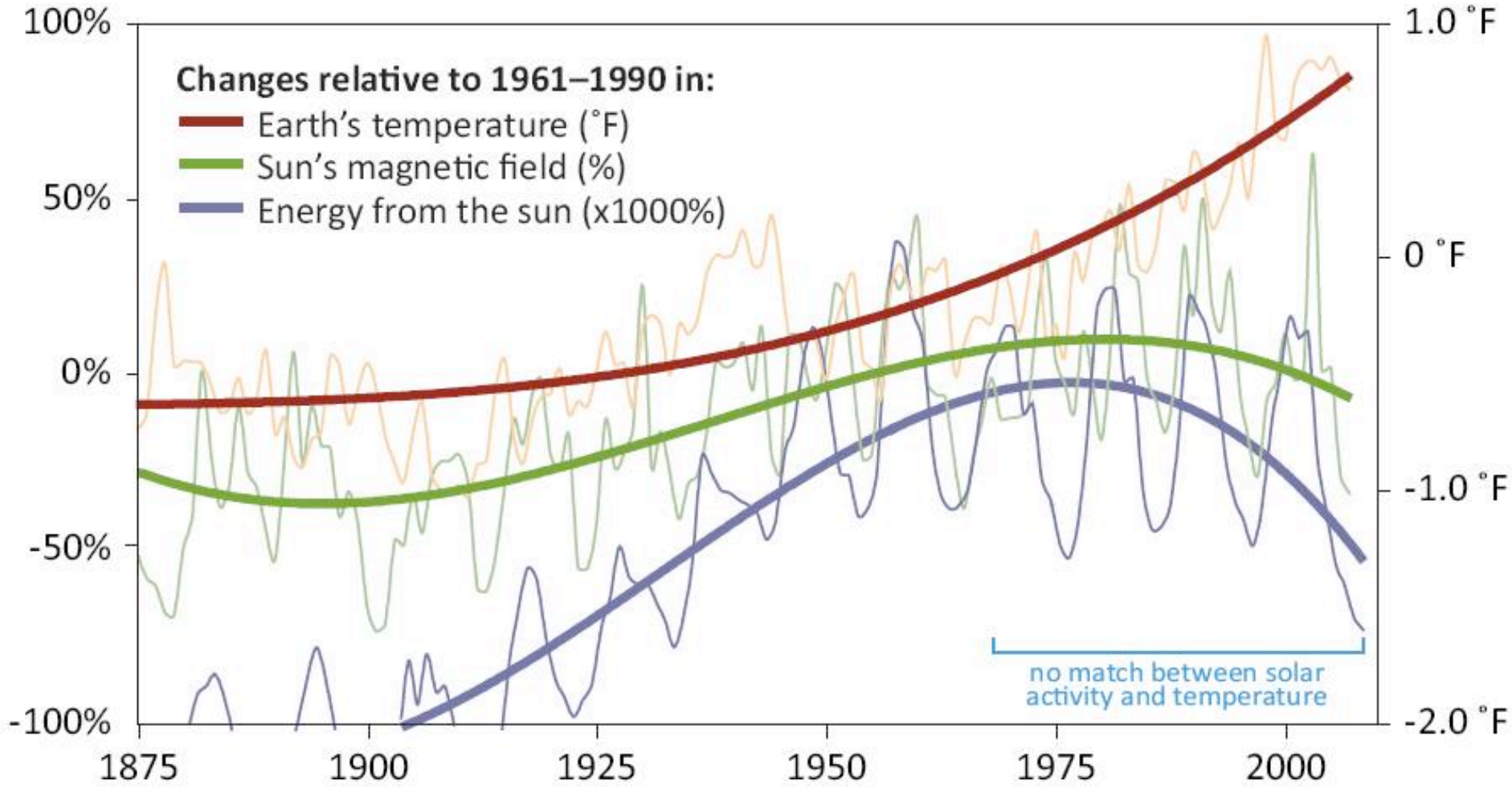
Quantifying the human influence



Isn't it just the urban heat island effect?



How do we know it's not the sun?



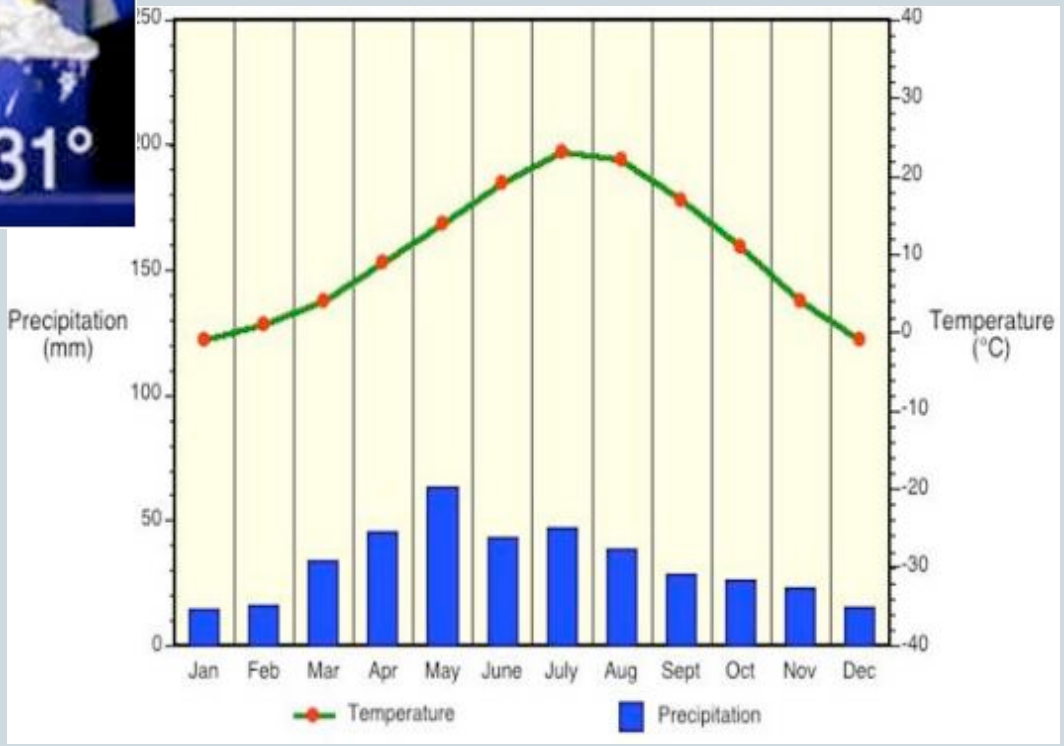
What about the record cold weather they've been having in Walla Walla?

WEATHER: How conditions change from day to day or even year to year

What about the record cold weather they've been having in Walla Walla?

WEATHER: How conditions change from day to day or even year to year

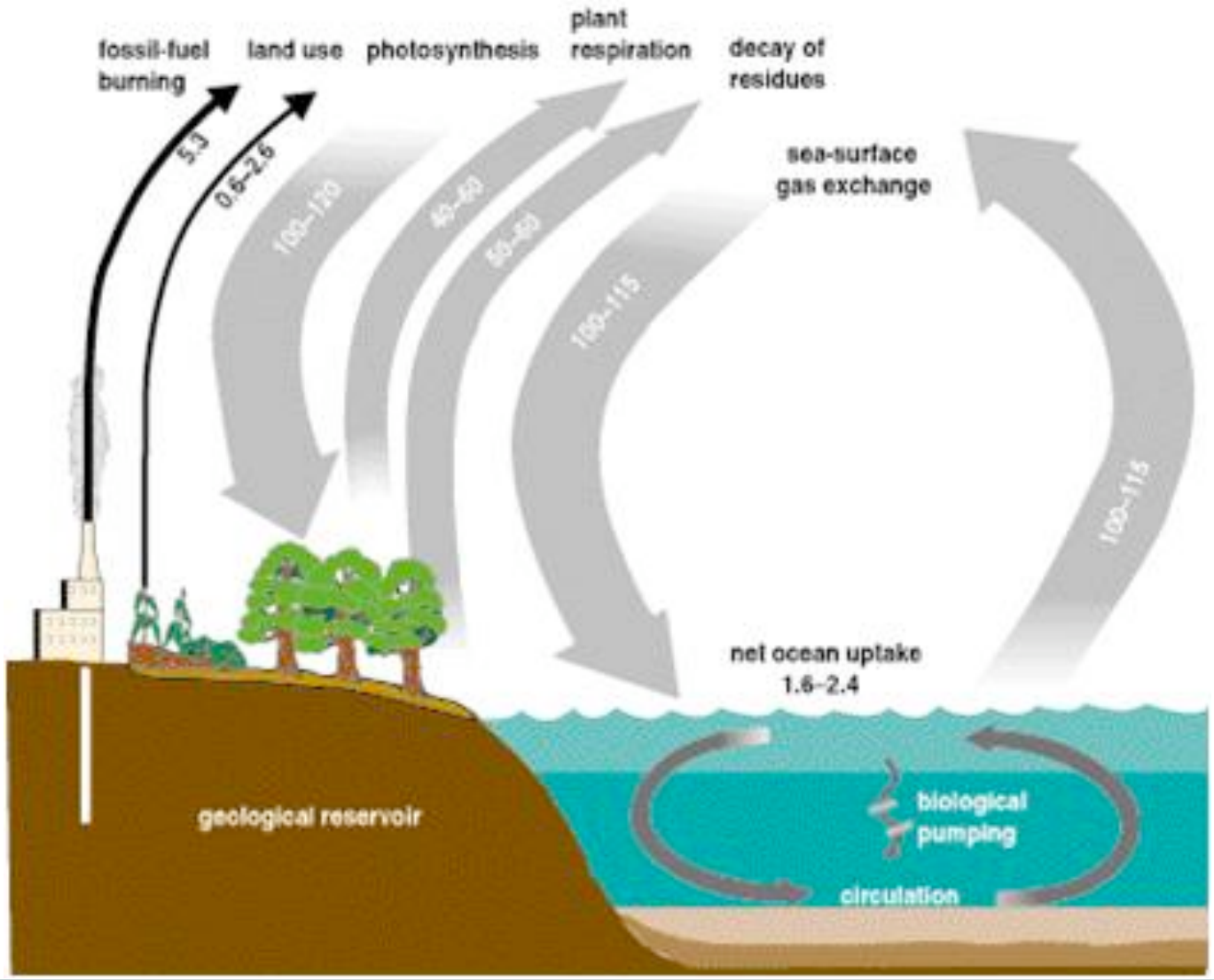
CLIMATE: The long-term average of weather over decades



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

Natural carbon sources take up as much or more than they produce.

Human carbon sources absorb *nothing*.



Aren't scientists always disagreeing?

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].

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.

Aren't scientists always disagreeing?

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].

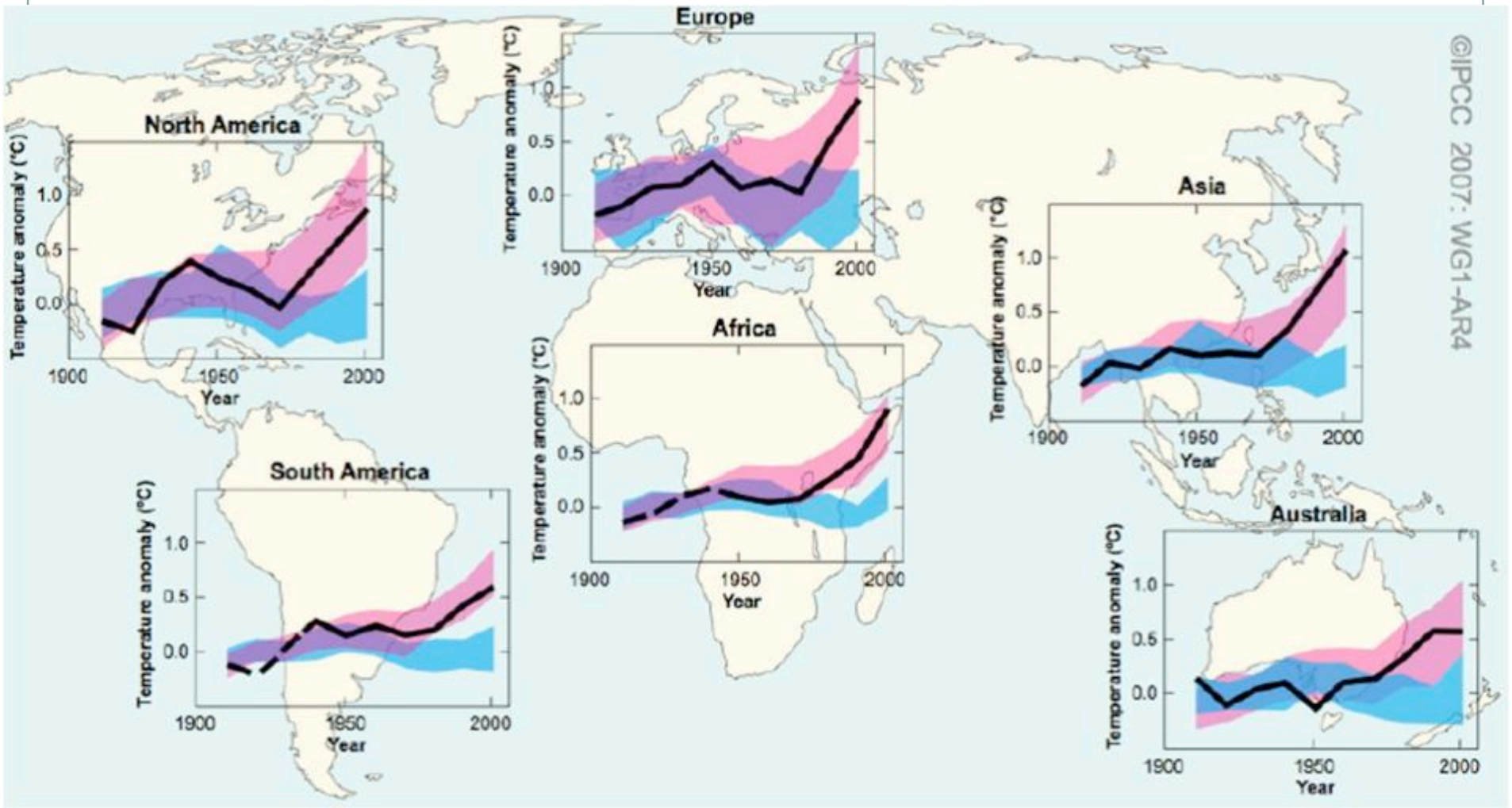
The United Nations Intergovernmental Panel on Climate Change, 2007

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

Humans are the only explanation.



How is this warming already affecting our planet?

PART FOUR

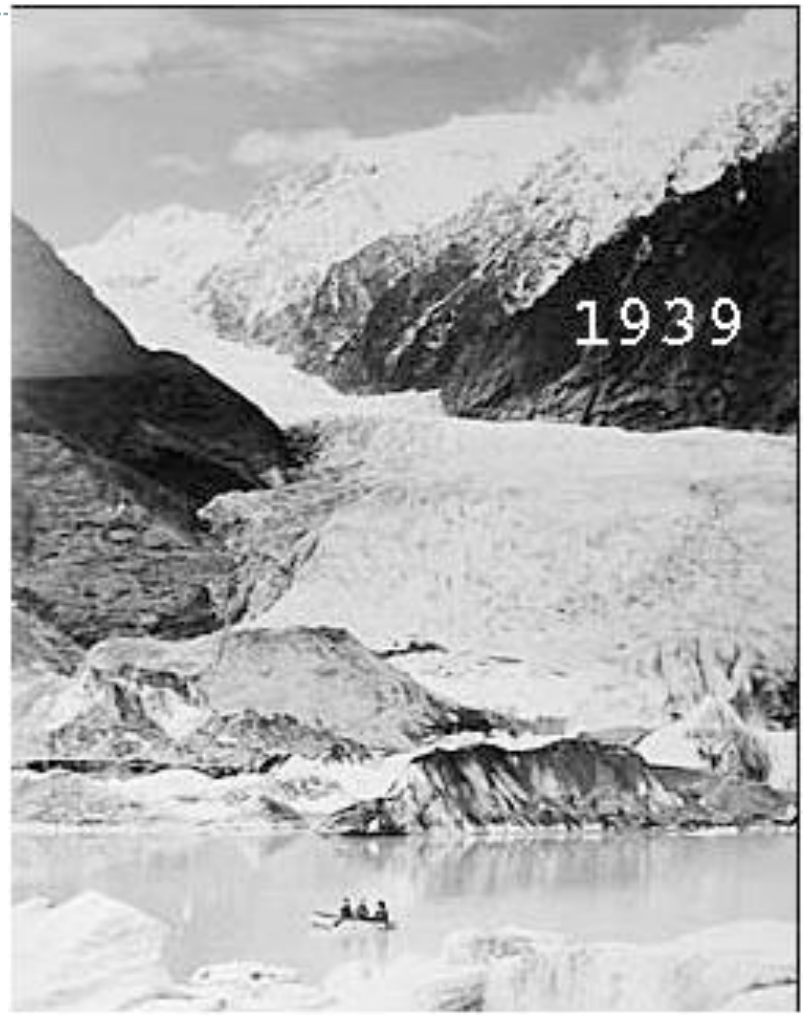
Glaciers are melting

Blomstrandbrennen Glacier in Norway

Glaciers are melting

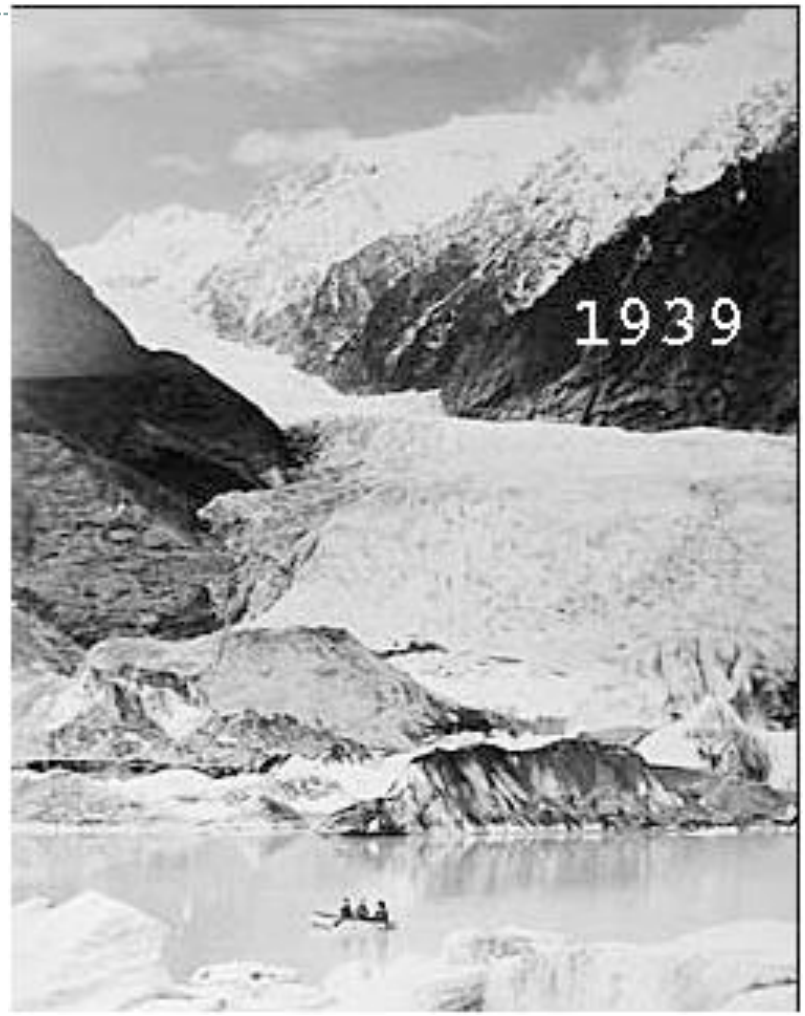
Blomstrandbrennen Glacier in Norway

Glaciers are melting



Franz Josef Glacier, New Zealand

Glaciers are melting



Franz Josef Glacier, New Zealand

Glaciers are melting

Orubare Glacier, Uganda

Glaciers are melting

Orubare Glacier, Uganda

By 2030, the snows of Kilimanjaro will be gone.

Glaciers are melting

The Rhone glacier in the Bernese Oberland, Switzerland

Glaciers are melting

The Rhone glacier in the Bernese Oberland, Switzerland

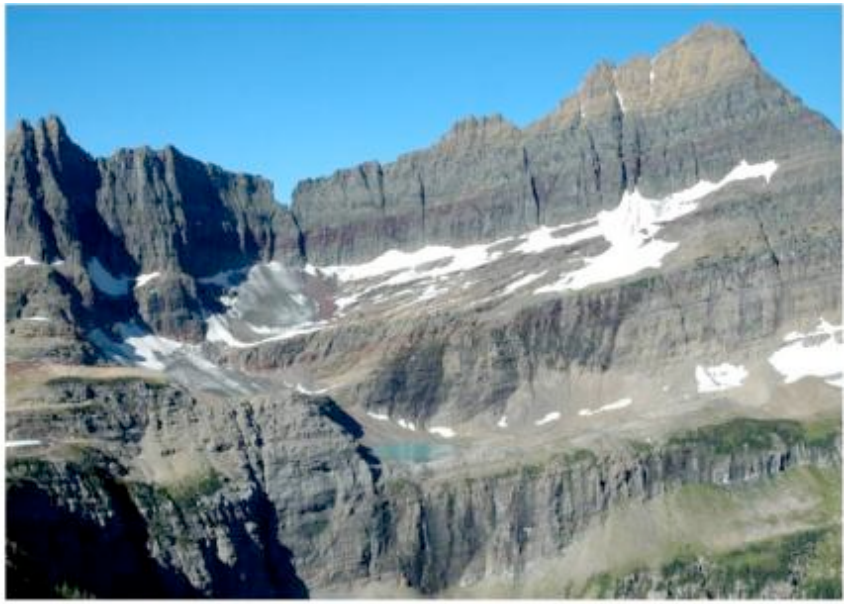
Glaciers are melting

1913

Shepard Glacier, Glacier National Park, USA

Glaciers are melting

1913



2005

Shepard Glacier, Glacier National Park, USA

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

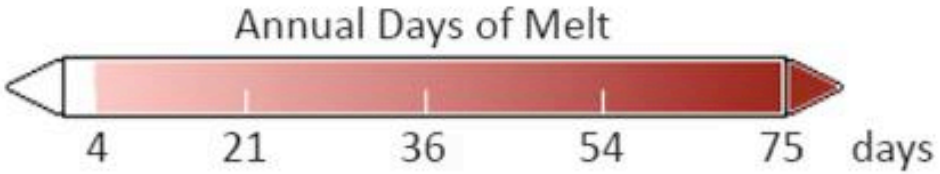
Why do we care:

1 billion depend on glacier melt for water supply

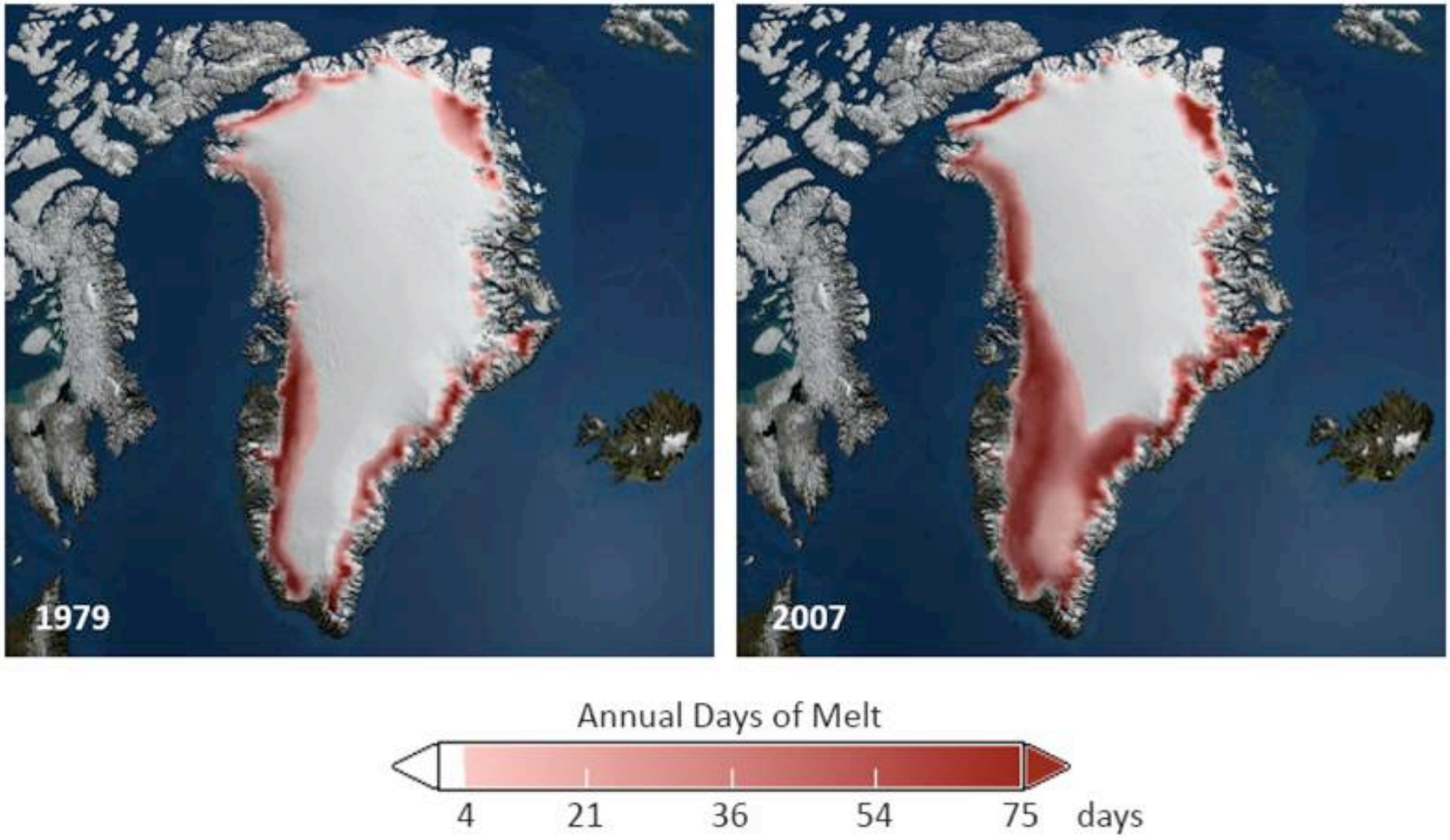
Lima's water supply is disappearing

1 billion depend on glacier melt for water supply

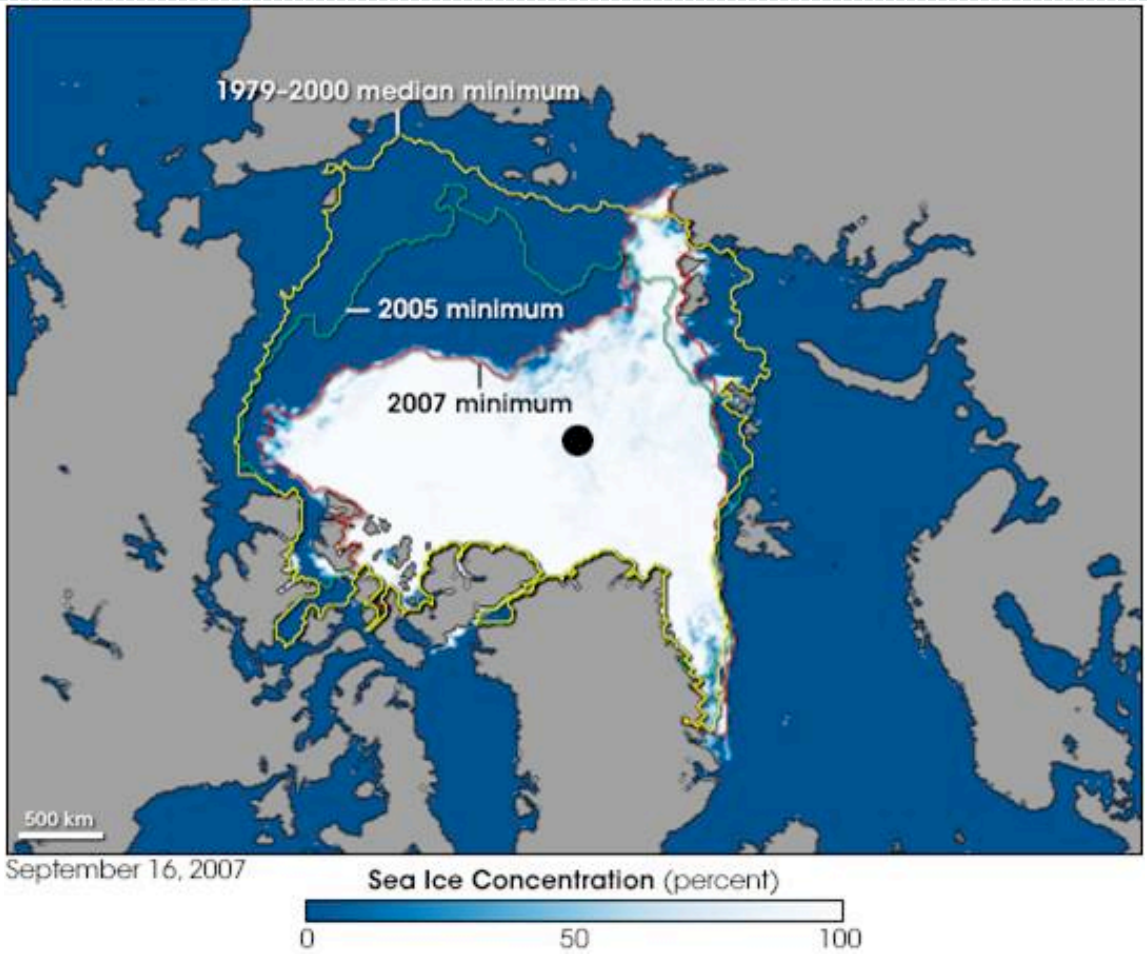
Ice sheets are melting



Ice sheets are melting

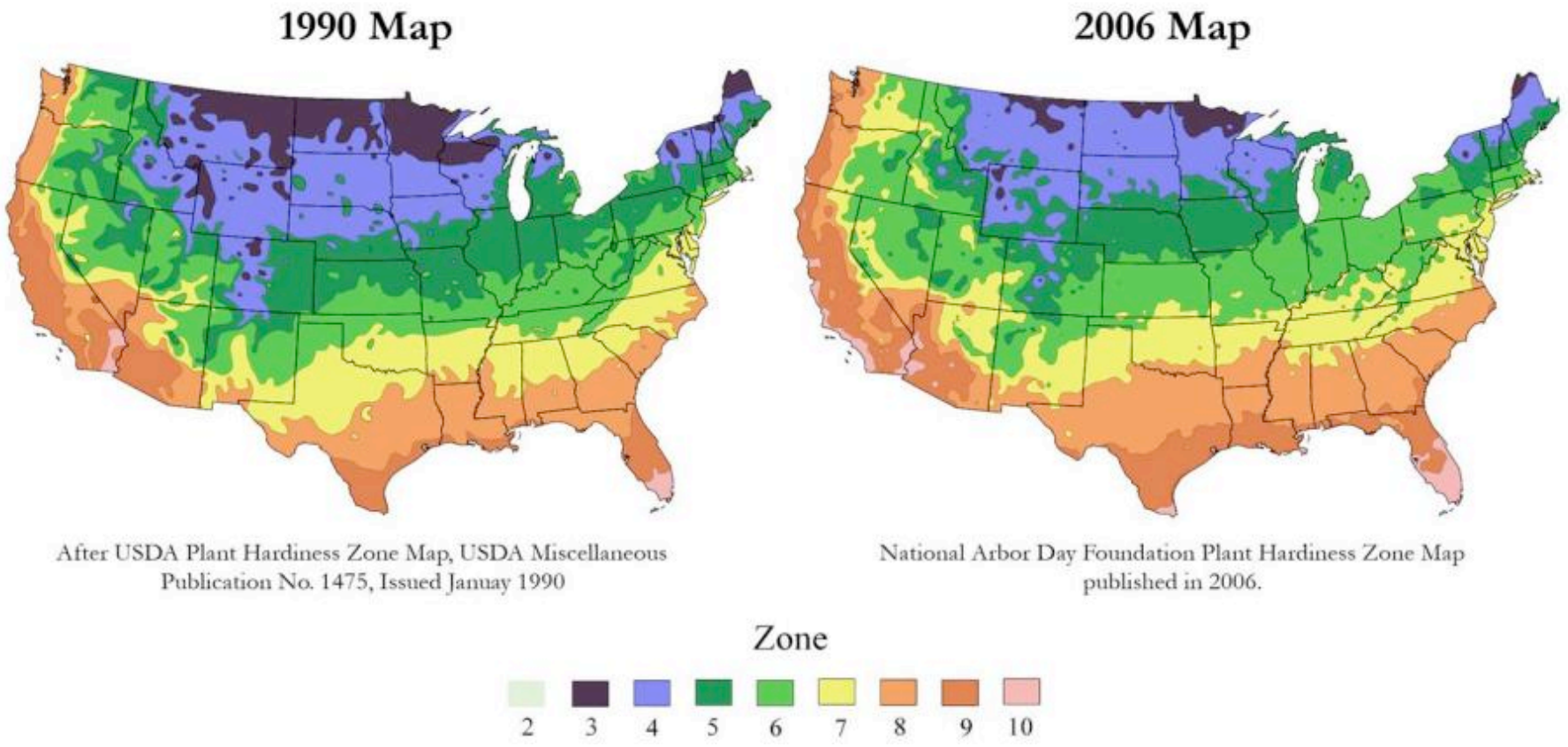


Arctic sea ice is shrinking



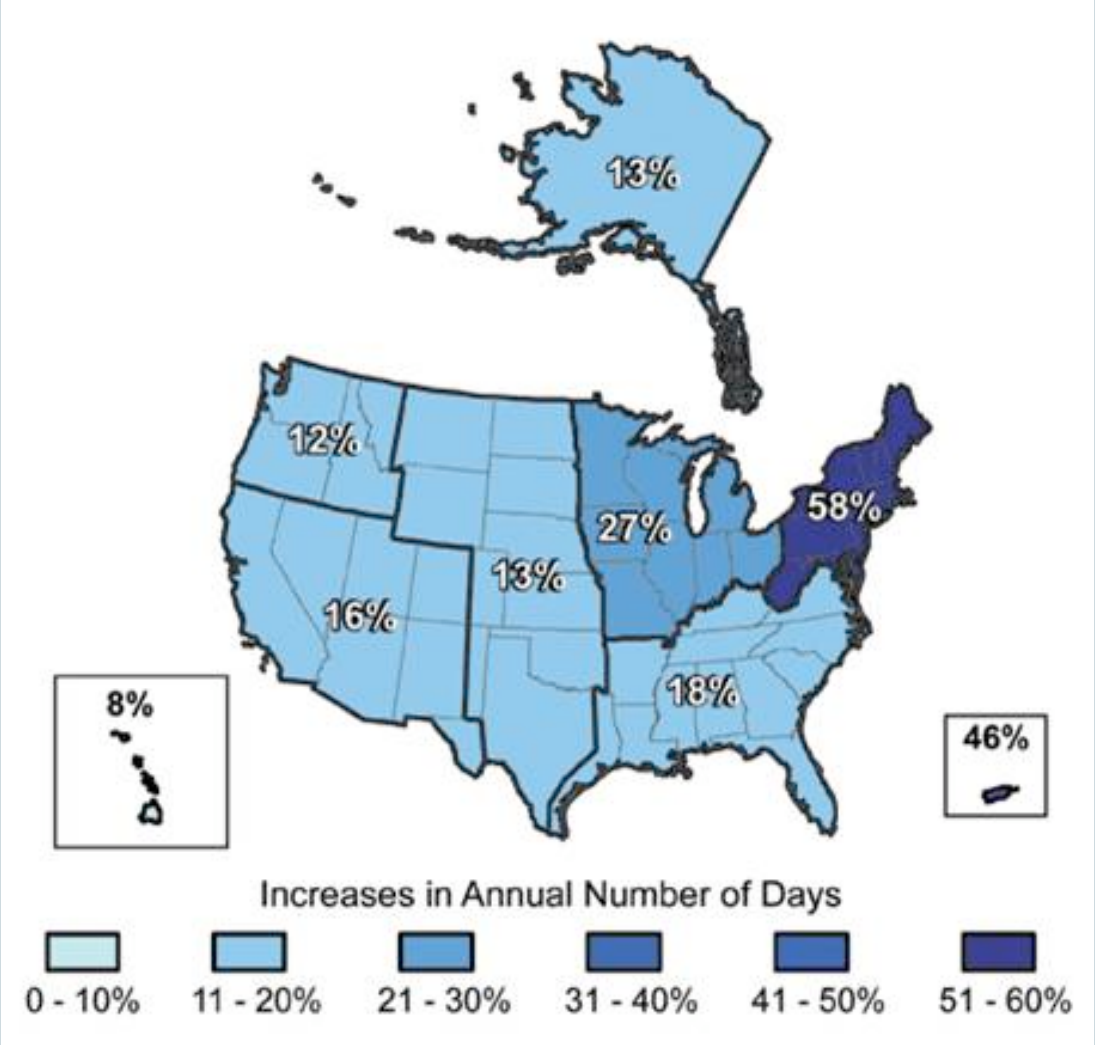
- Summer sea ice extent decreased 15-20% over last 40 yrs
- Ice-free summers likely within a few years

Plant hardiness zones moving north



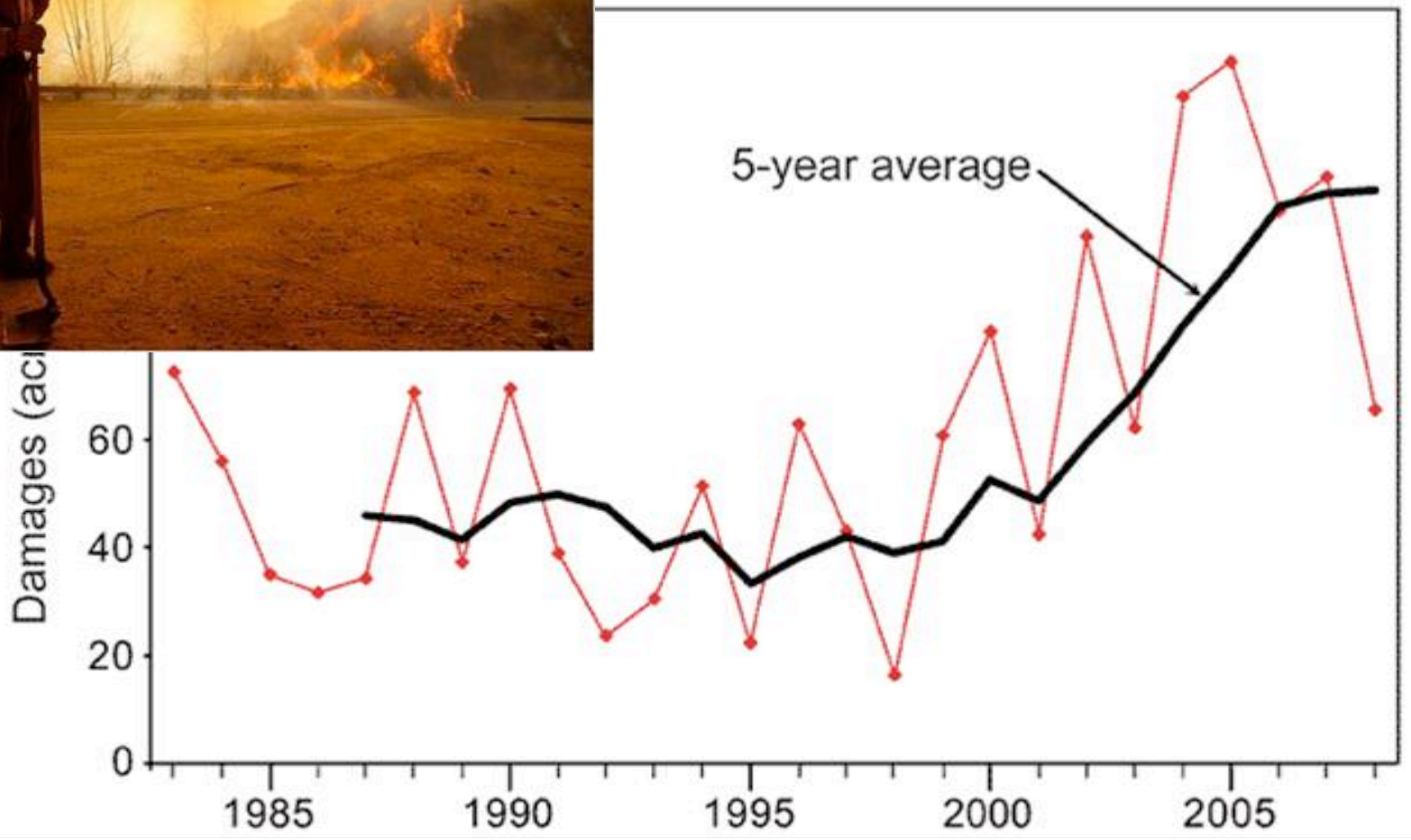
Most locations in US now feel like it used to about 200 miles south—just 20 yrs ago.

Extreme rainfall more frequent

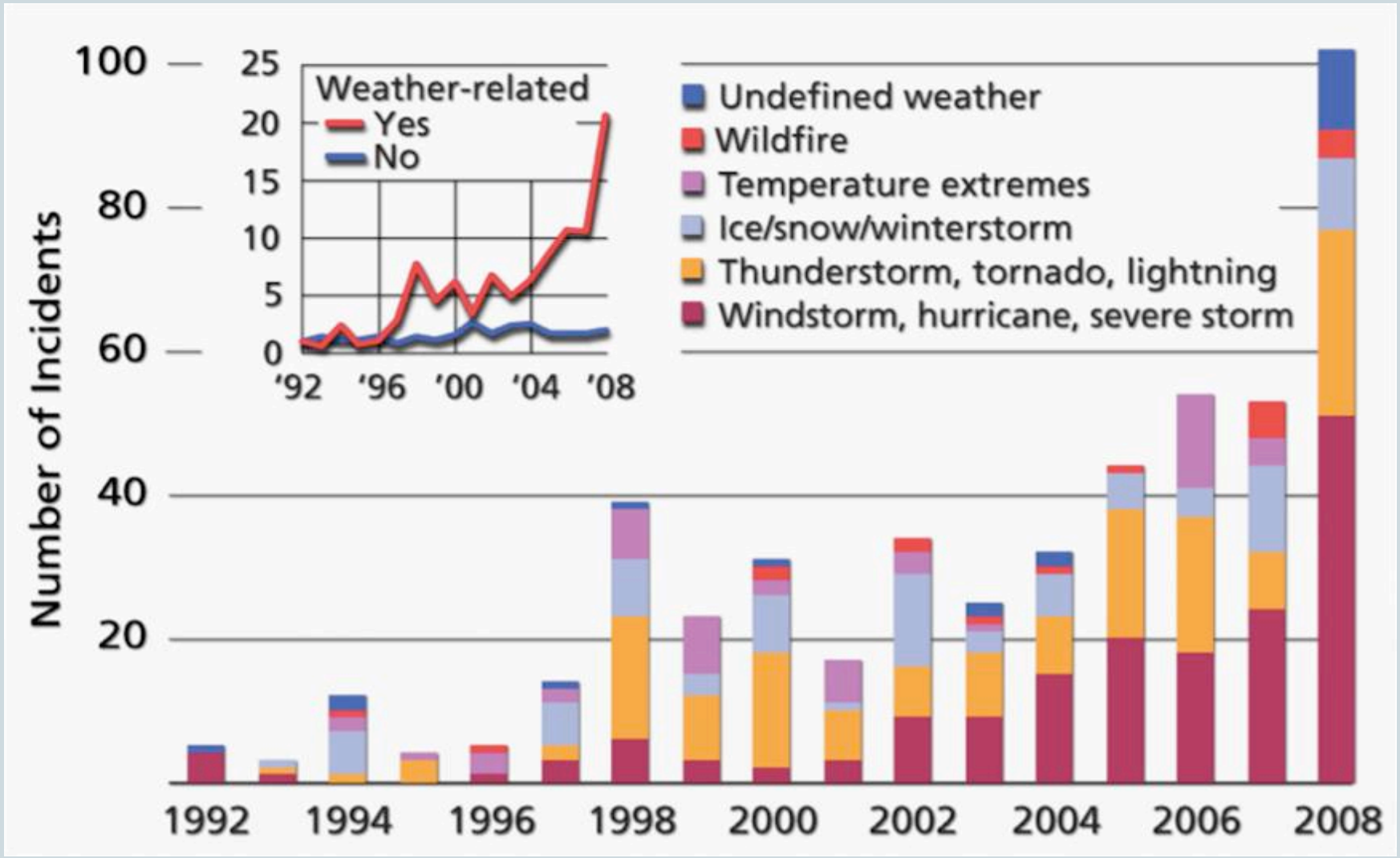


Increases in average number of days with very heavy precipitation (1958 to 2007)

Larger & more damaging fires in the West



More frequent weather-related electricity outages

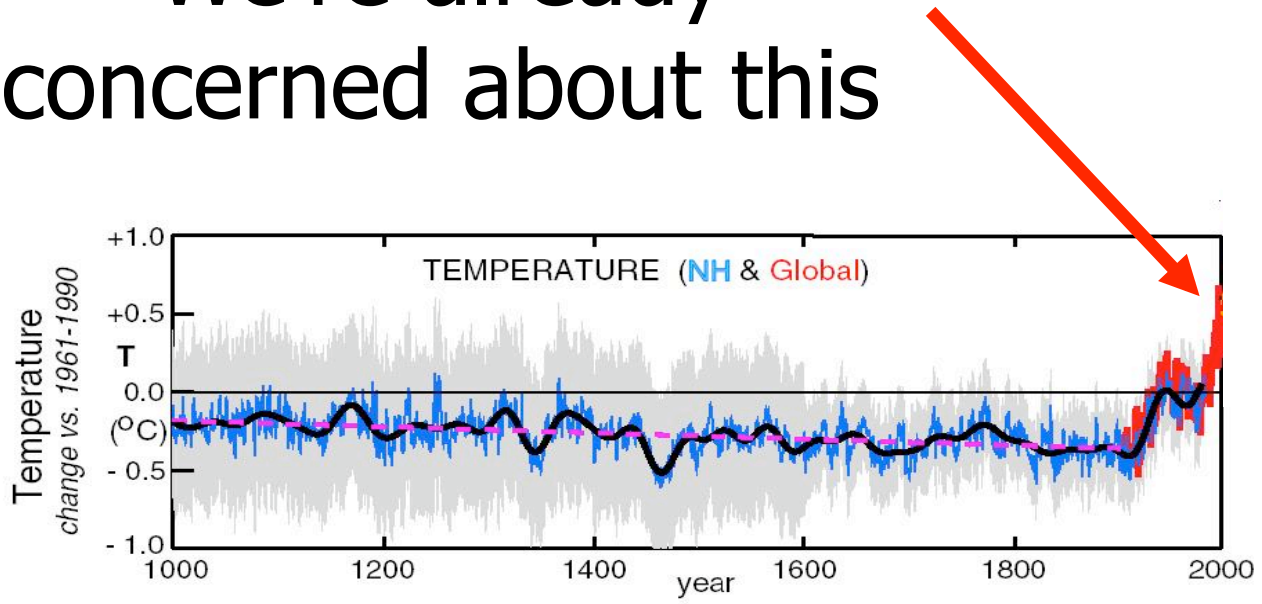


What might the future hold?

PART FIVE

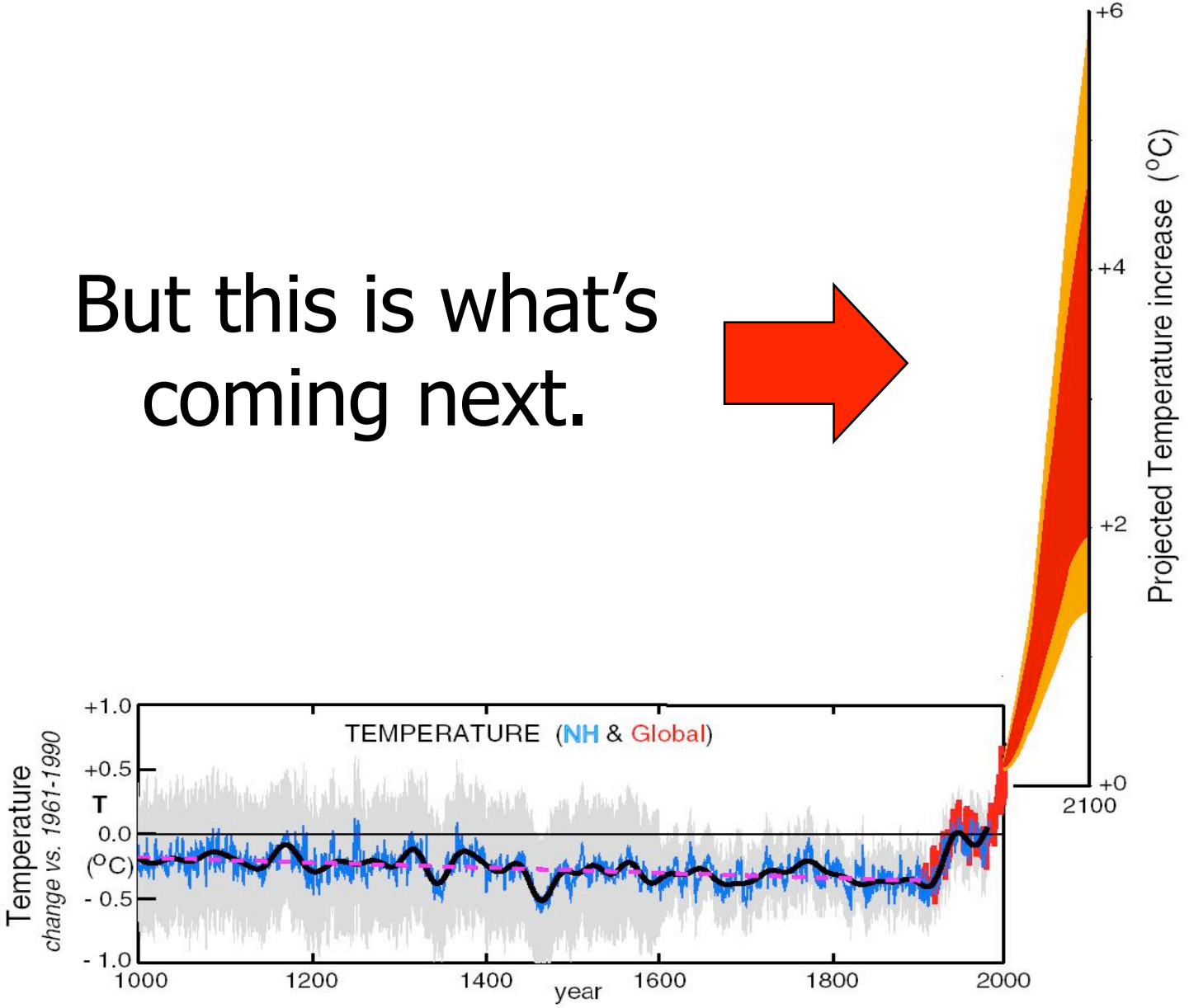
What can we expect in the future?

We're already concerned about this

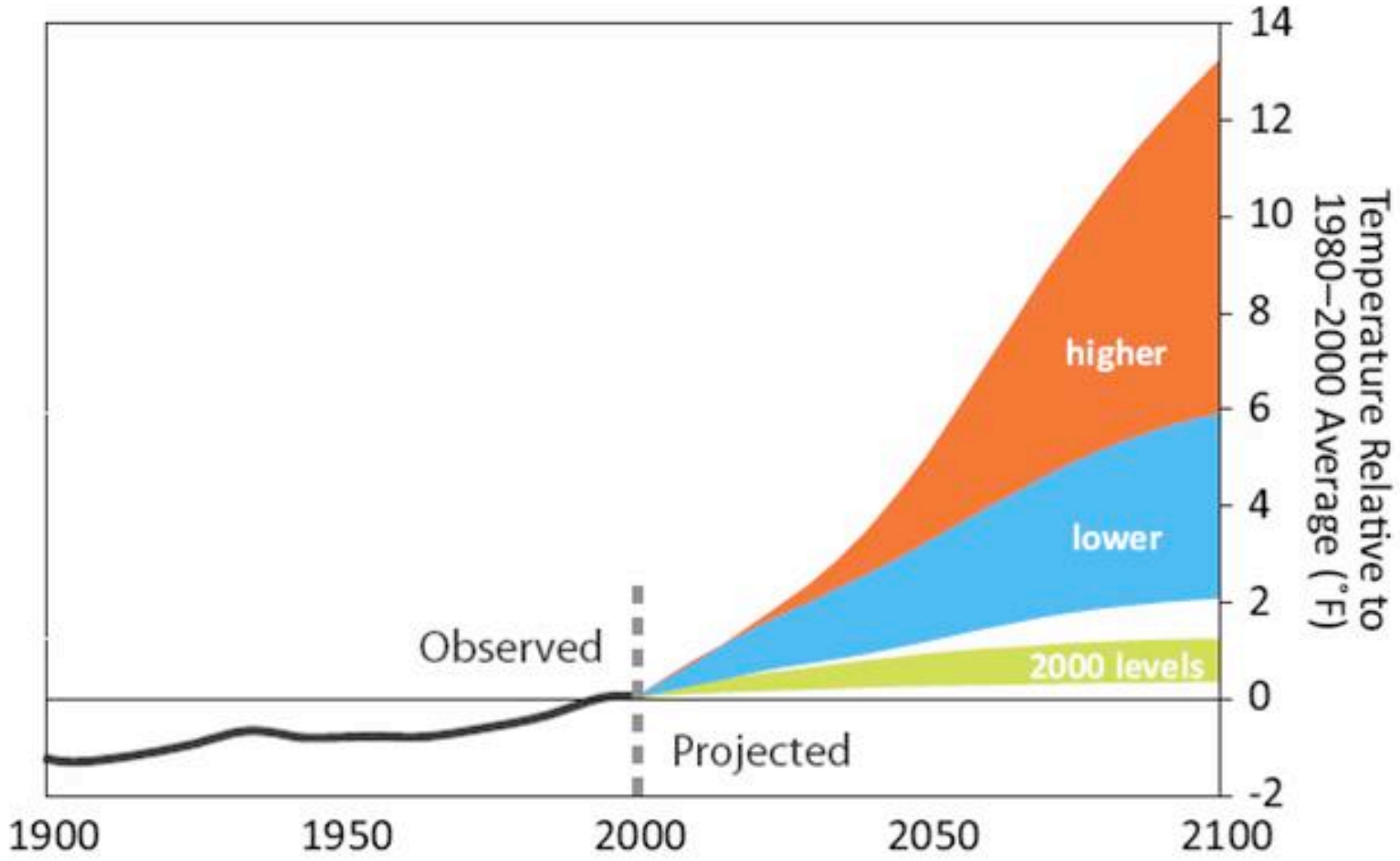


What can we expect in the future?

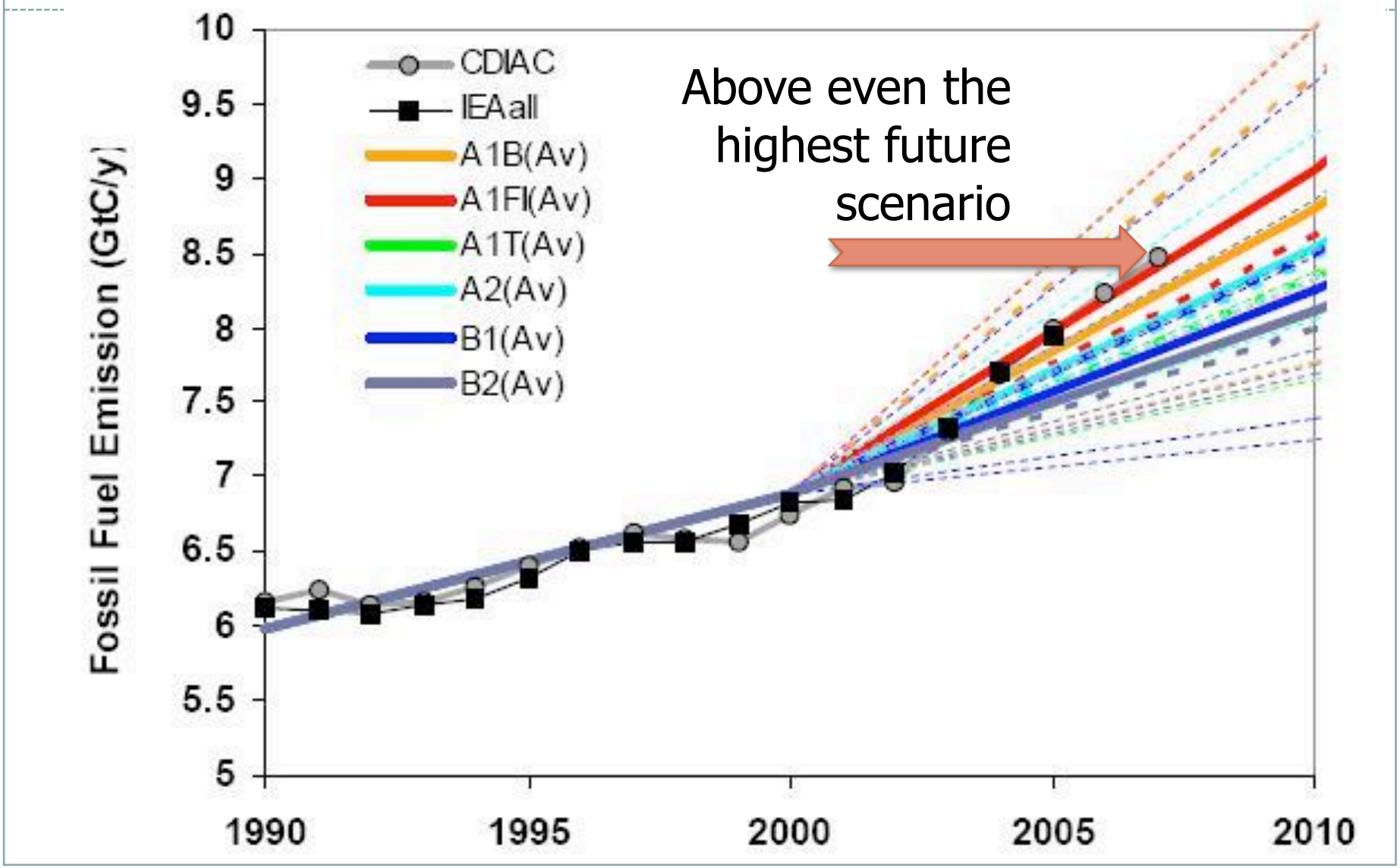
But this is what's coming next.



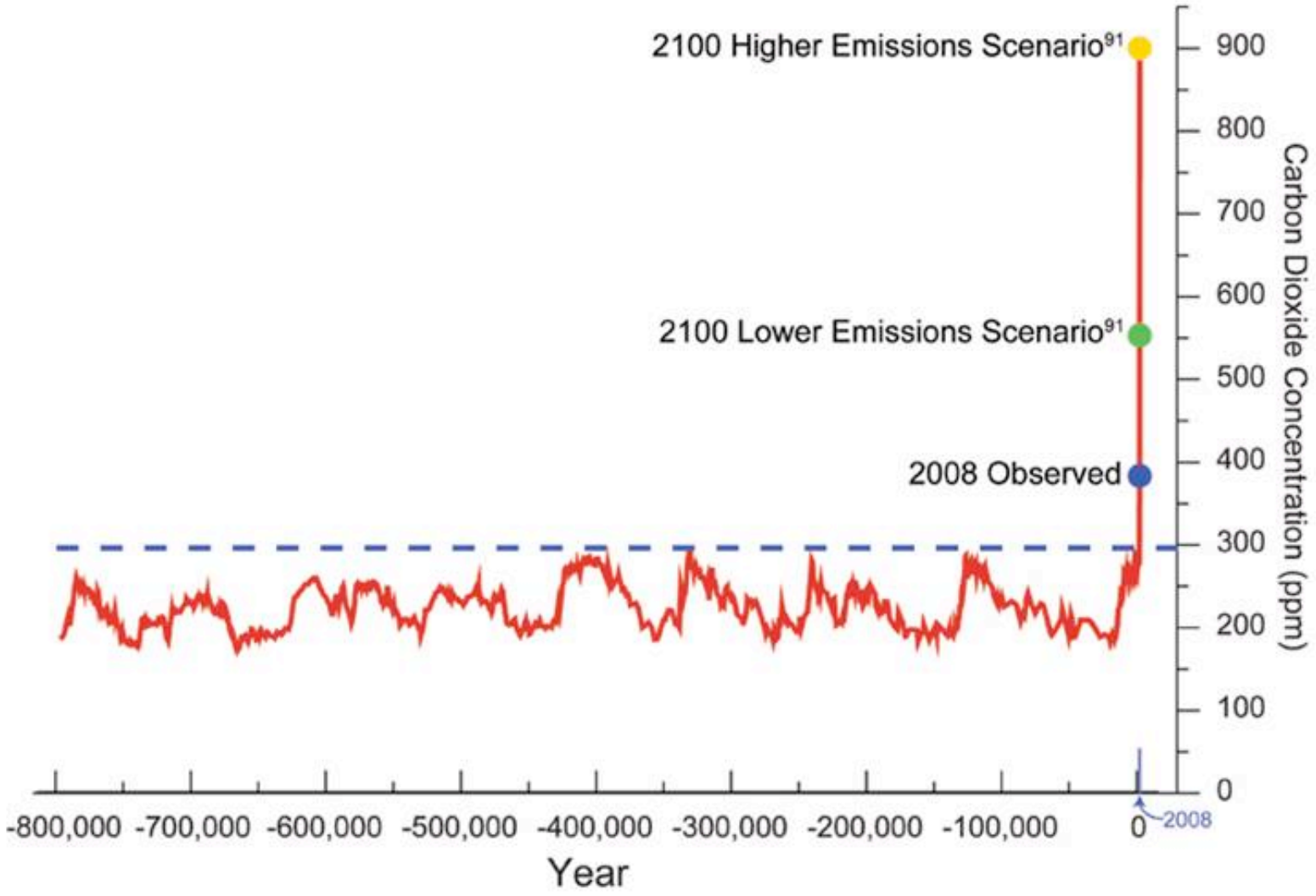
The magnitude of future change depends on our near-term choices

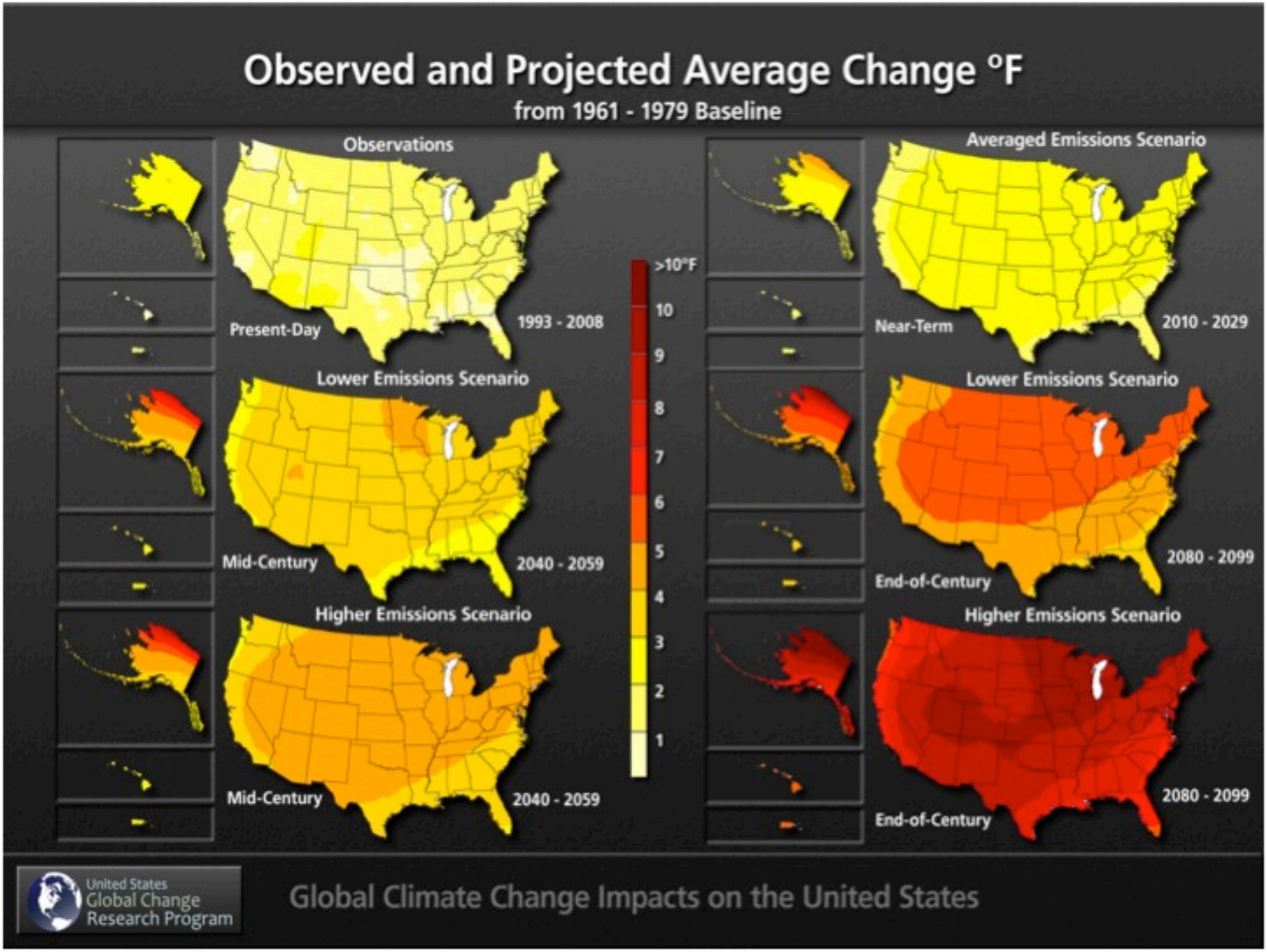


Reality check: where are we now?

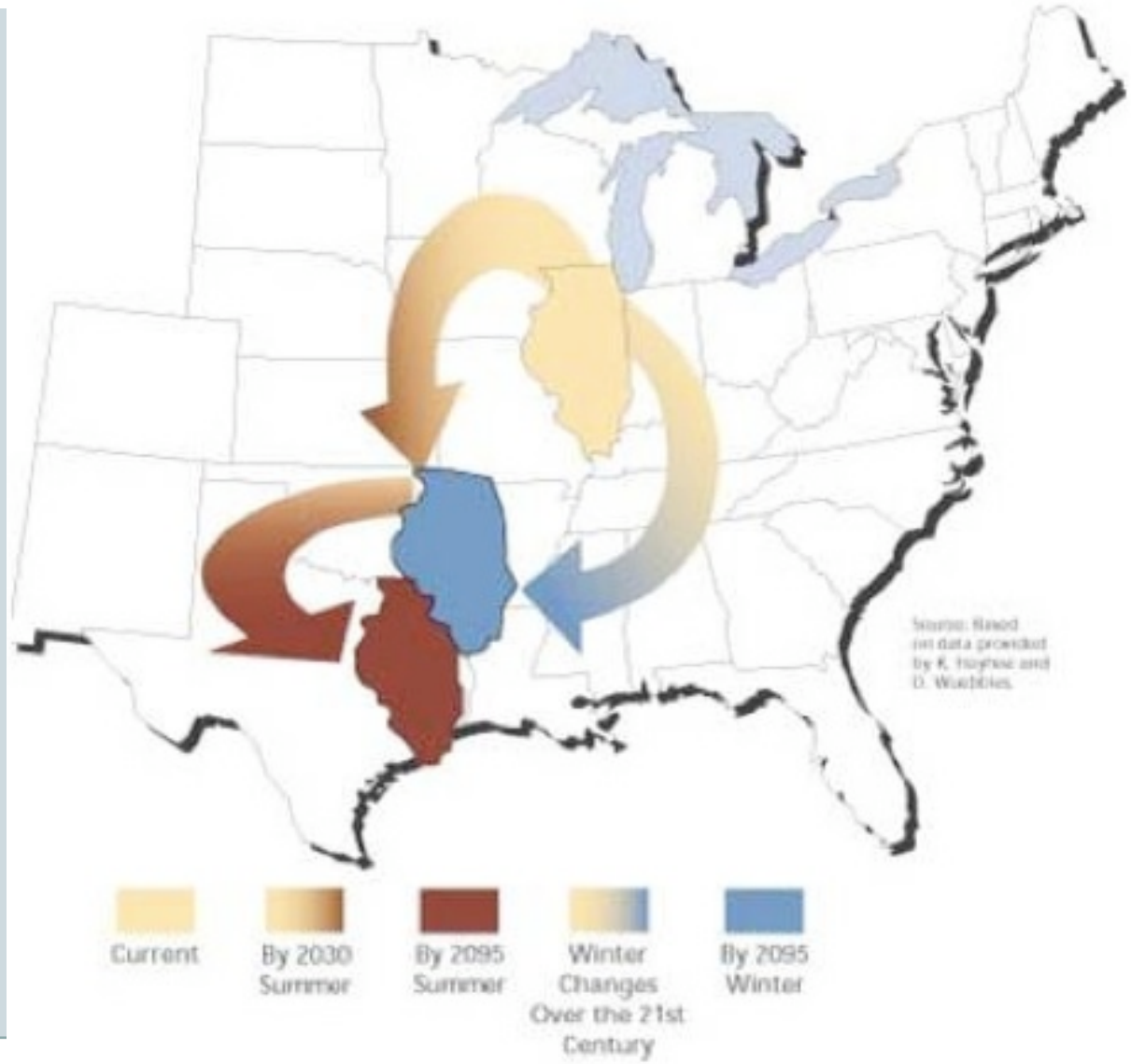


… and in context of the last 800,000 yrs




Observed and Projected Average Change °F
from 1961 - 1979 Baseline
Observations
Present-Day
1993 - 2008
Lower Emissions Scenario
Mid-Century
2040 - 2059
Higher Emissions Scenario
Mid-Century
2040 - 2059
>10°F
10
9
8
7
6
5
4
3
2
1
Averaged Emissions Scenario
Near-Term
2010 - 2029
Lower Emissions Scenario
End-of-Century
2080 - 2099
Higher Emissions Scenario
End-of-Century
2080 - 2099
United States
Global Change
Research Program
Global Climate Change Impacts on the United States

“Migrating states”



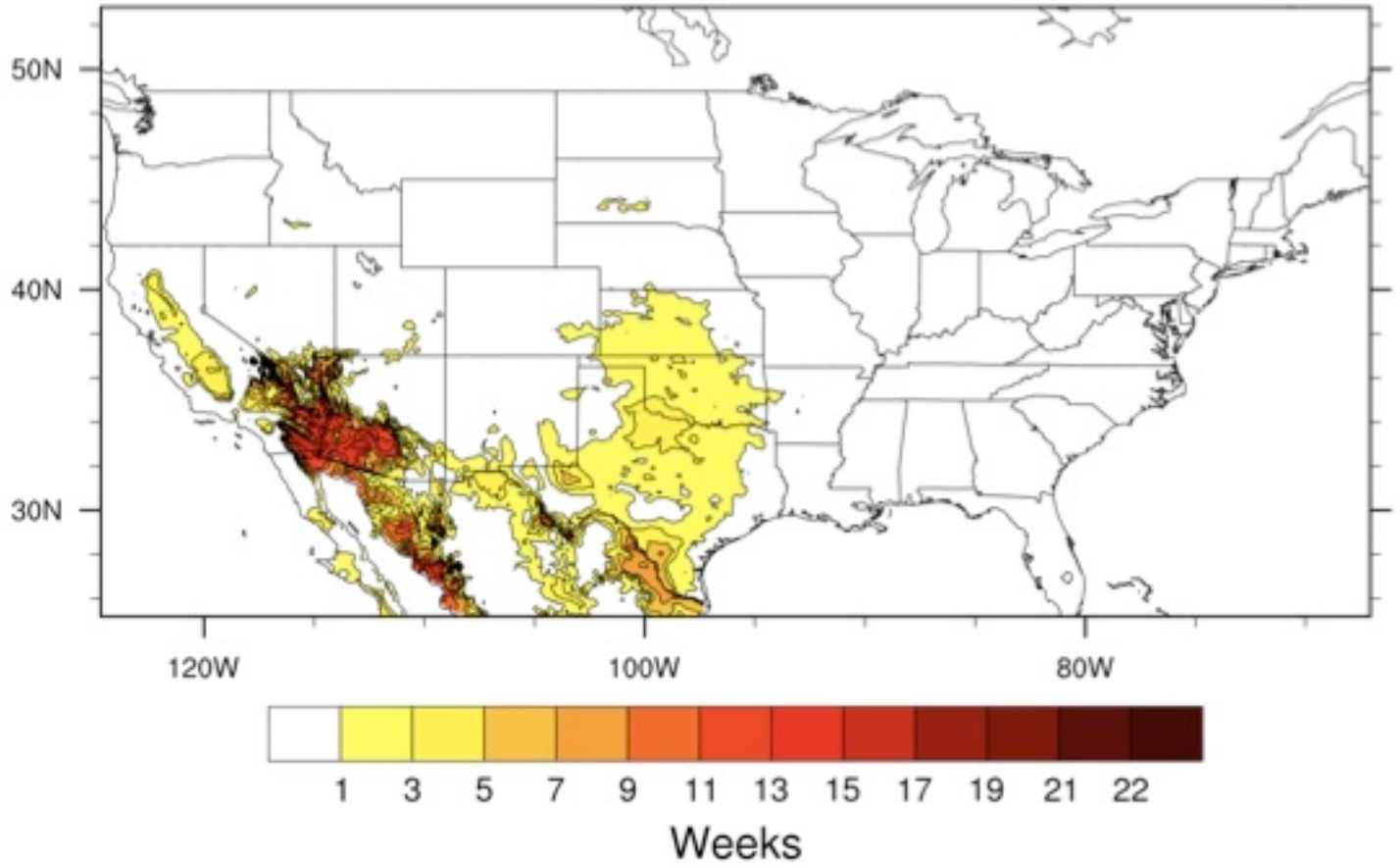
Focus on Chicago

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

- **under higher emissions**
- **under lower emissions**

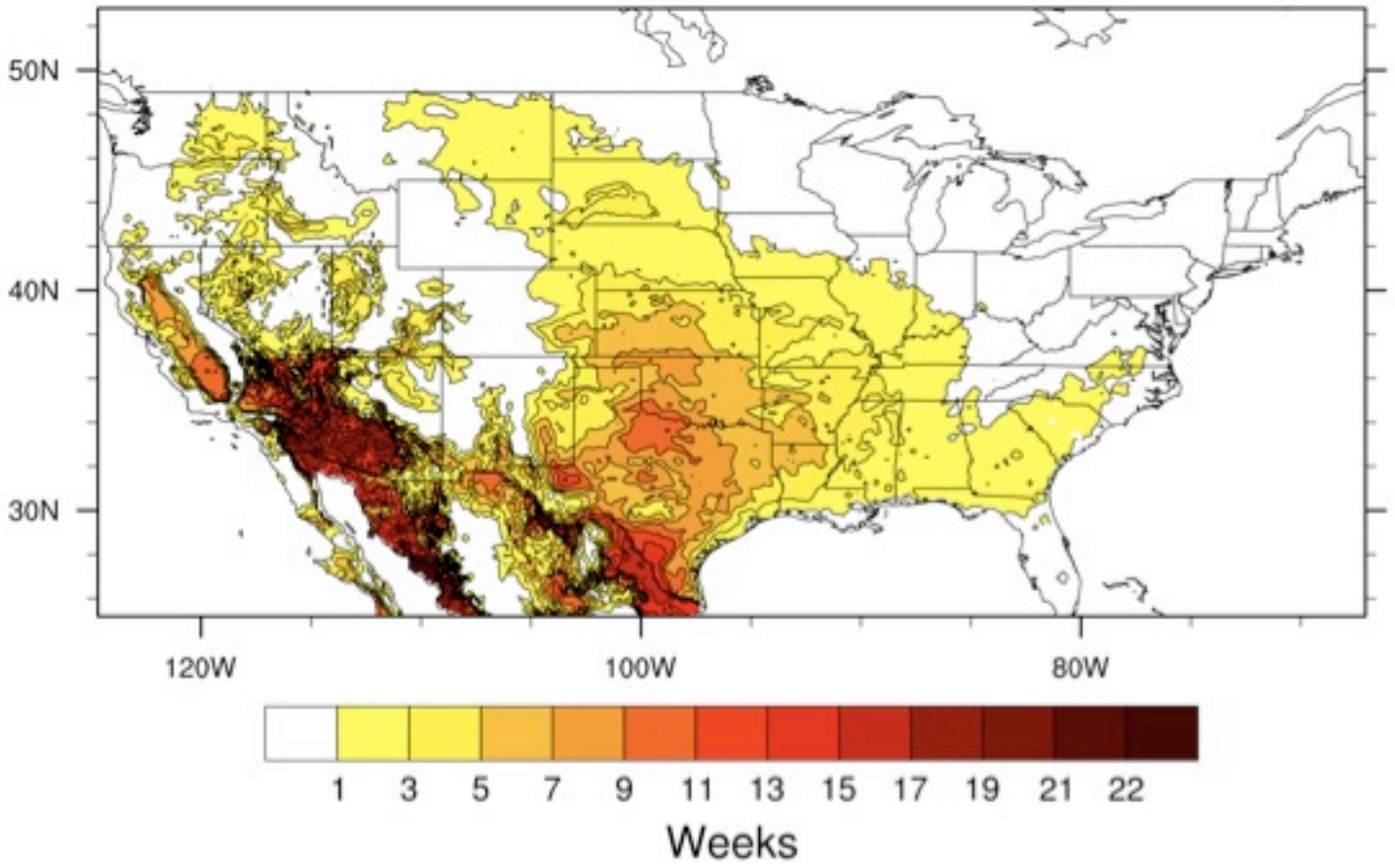
Extreme Heat: Days > 100oF

1961-1979



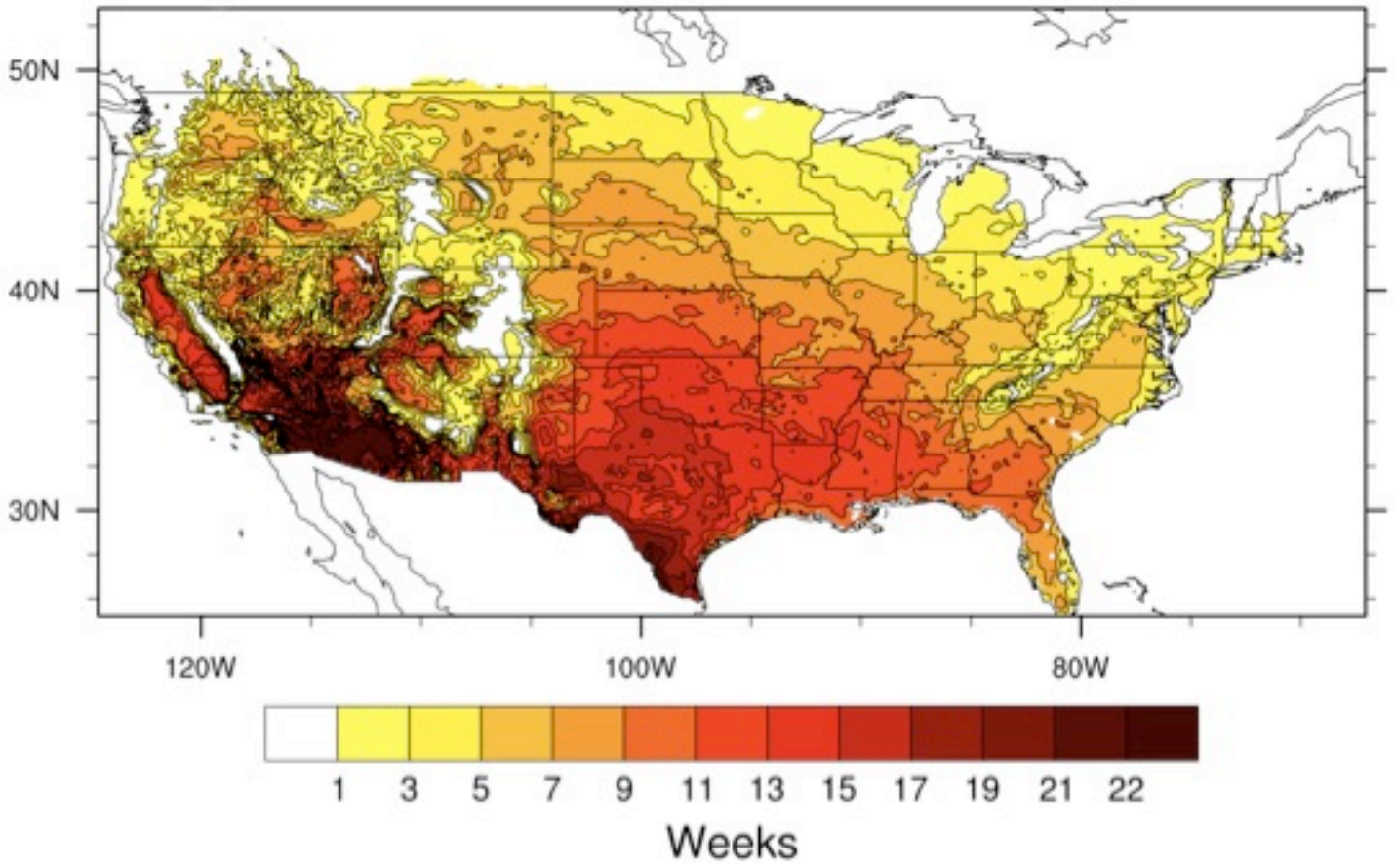
Extreme Heat: Days > 100oF

Lower Emissions: 2070-2099

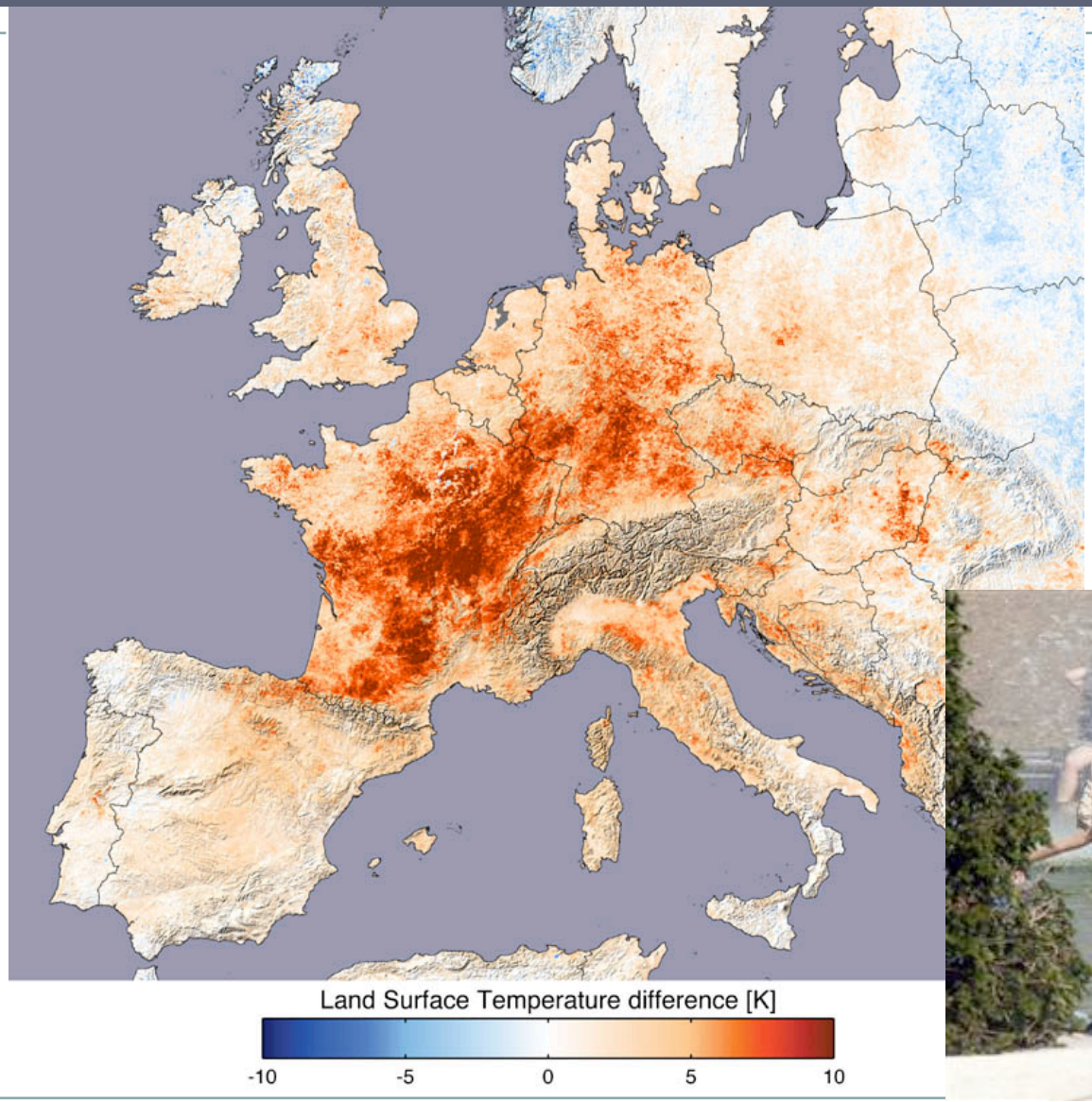


Extreme Heat: Days > 100oF

Higher Emissions: 2070-2099



More frequent & severe heat waves

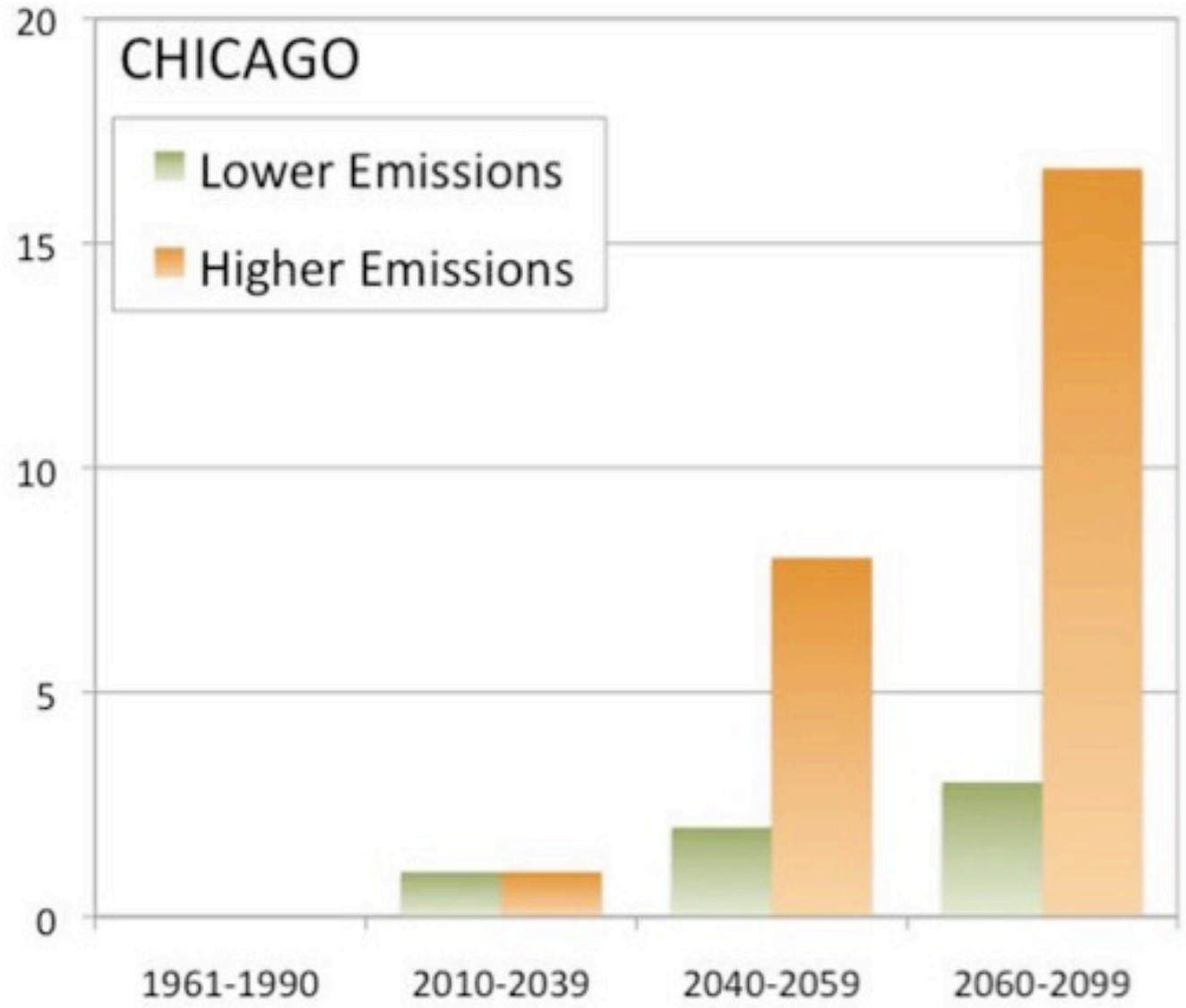


2003 European Heat Wave >70,000 deaths

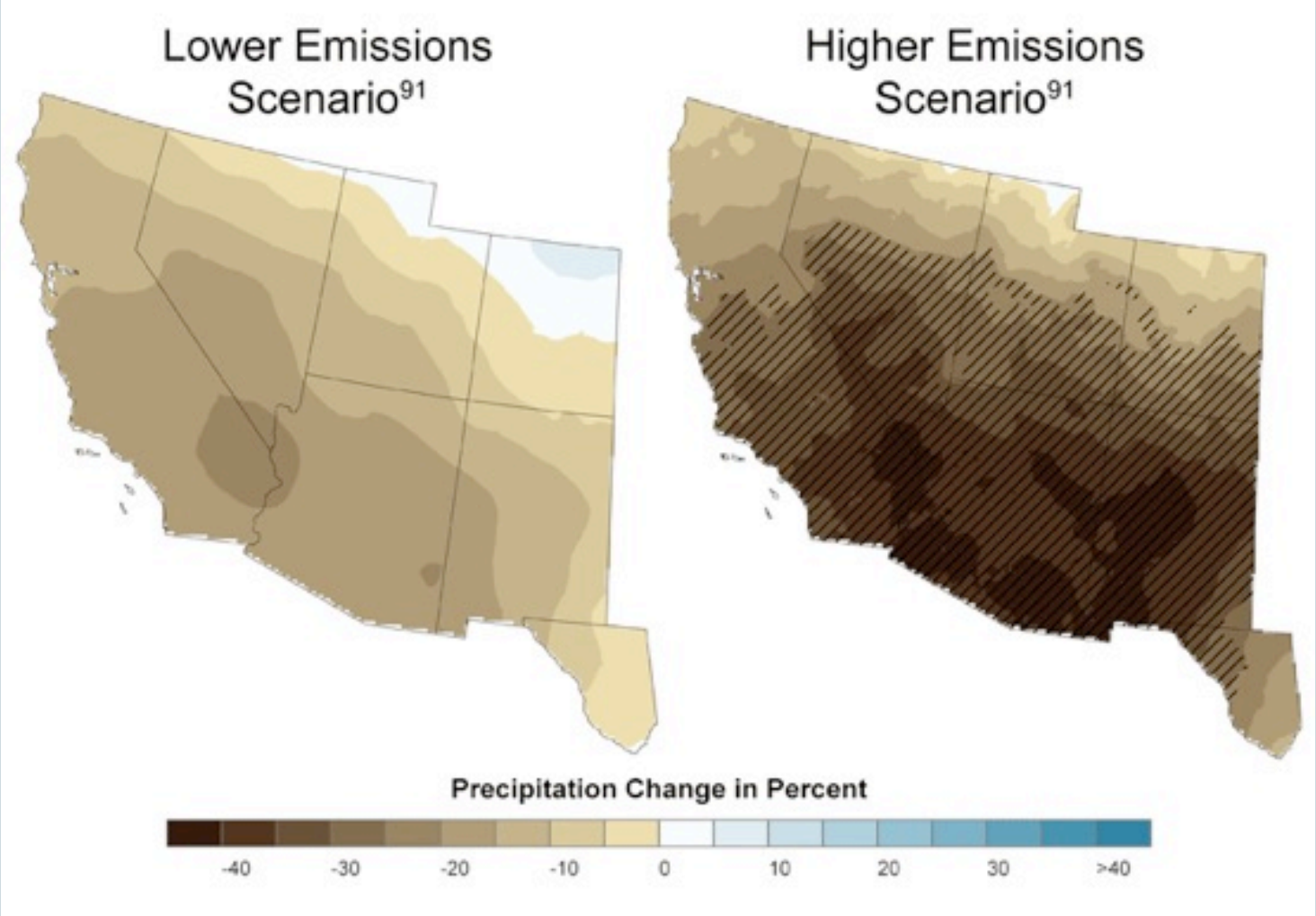
15% of Portugal's forests destroyed by fire (+18 deaths)

Flash floods in the Alps from melting glaciers

What are the chances of a Europe 2003 heat wave in Chicago?

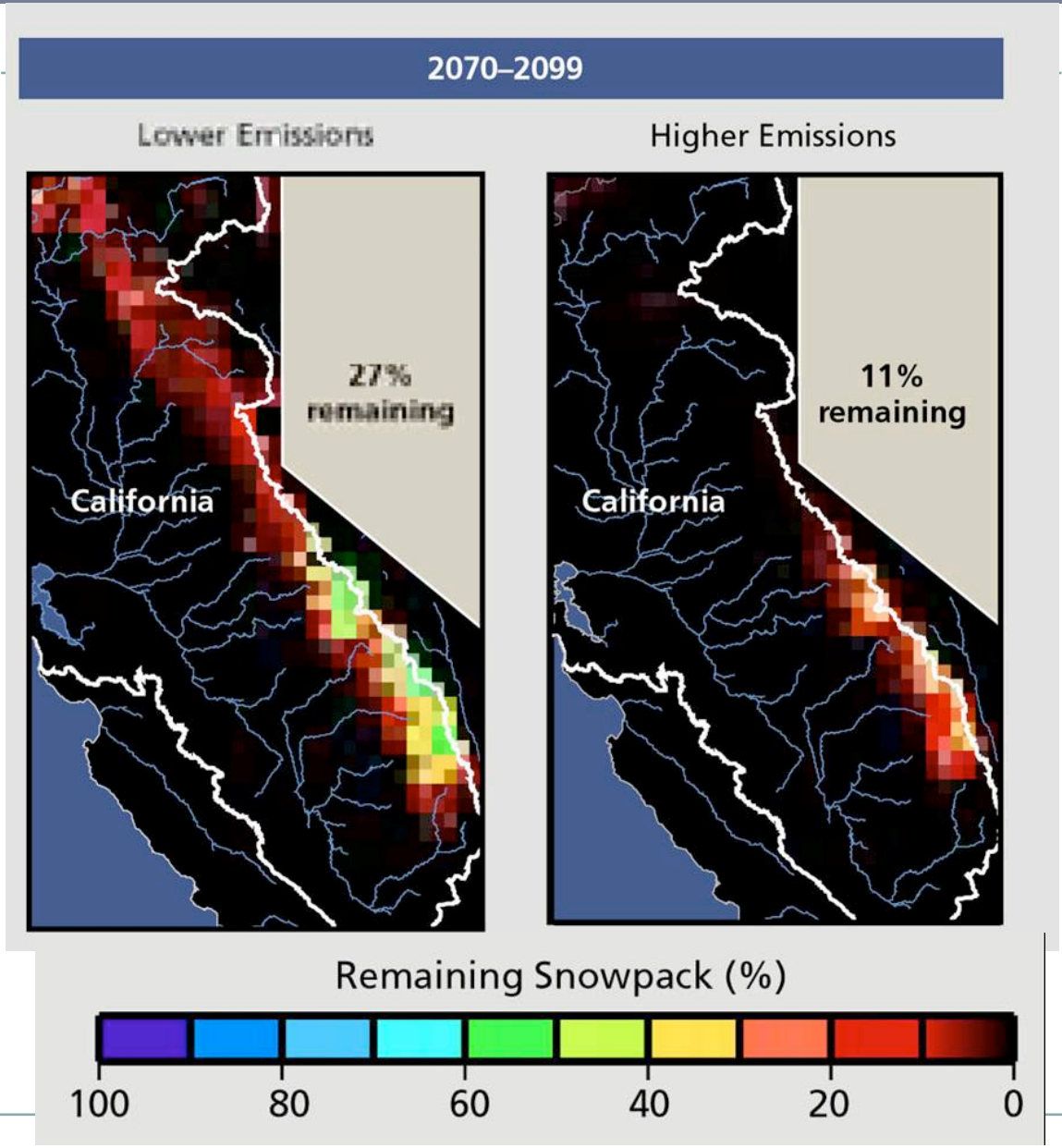


Increasing risk of drought

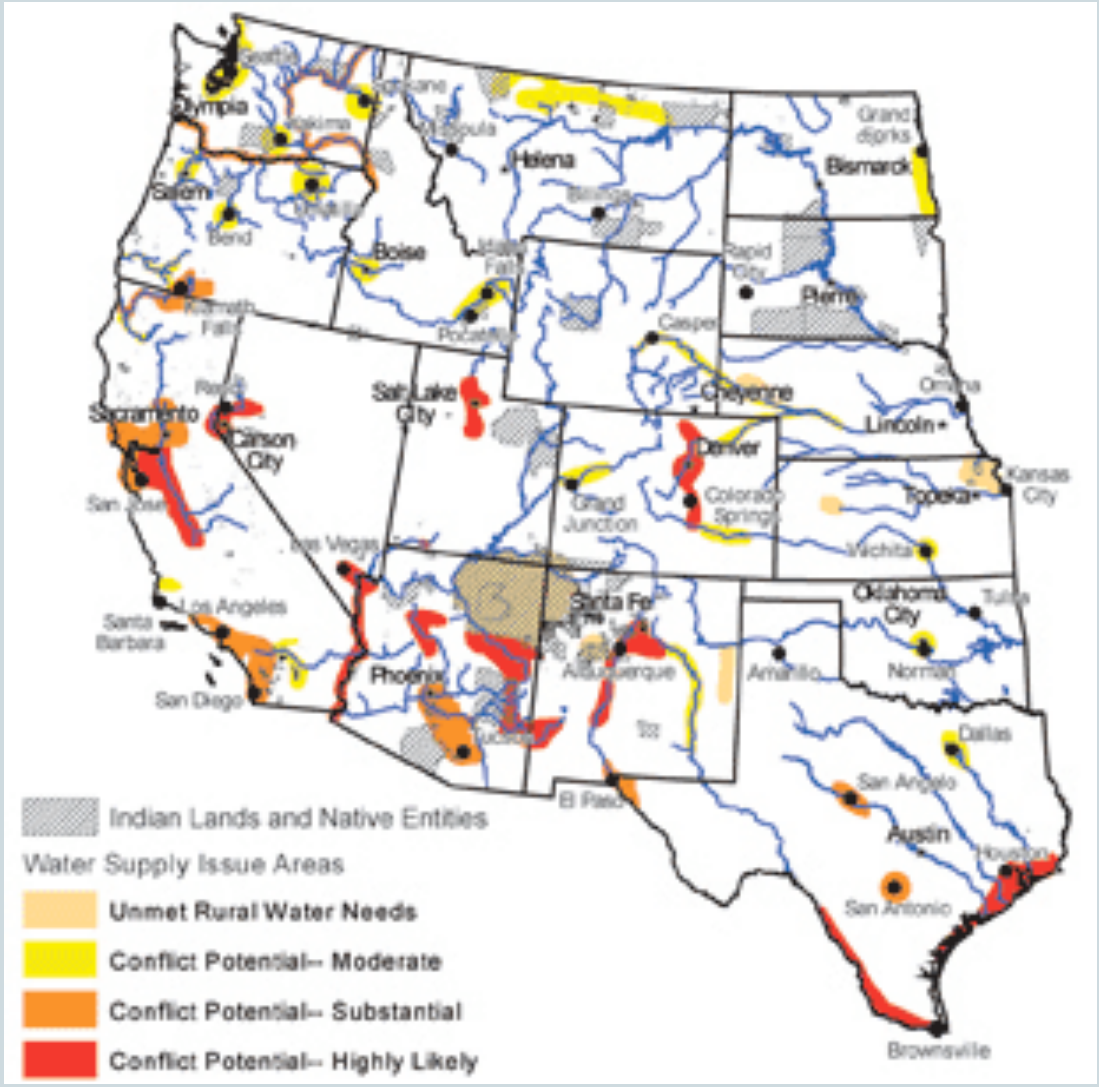


Change in March-April-May precipitation for 2080-2099 compared to 1961-1979

Shrinking snowpack and water resources

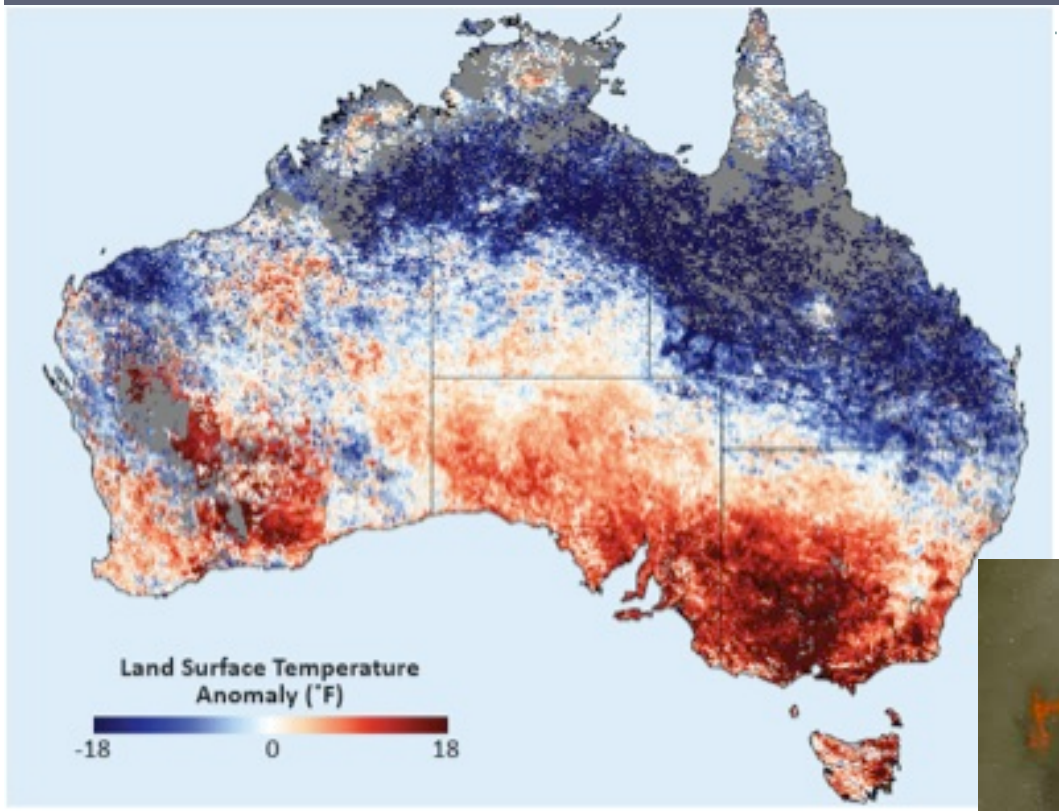


Increasing potential for water supply conflicts



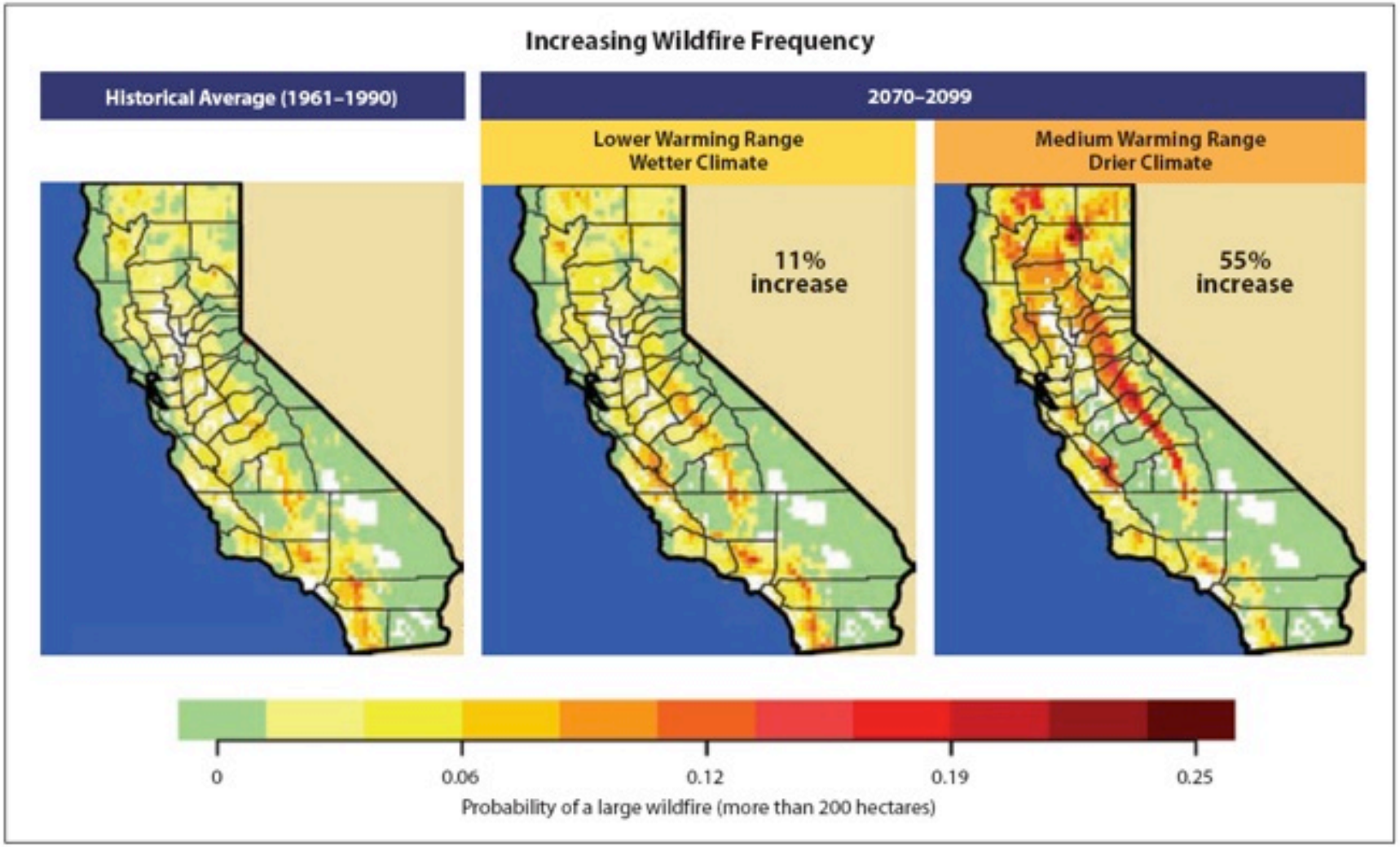
- regions where water supply conflicts are likely to occur by 2025
- based on population trends & potential endangered species
- *analysis does not factor in climate change*

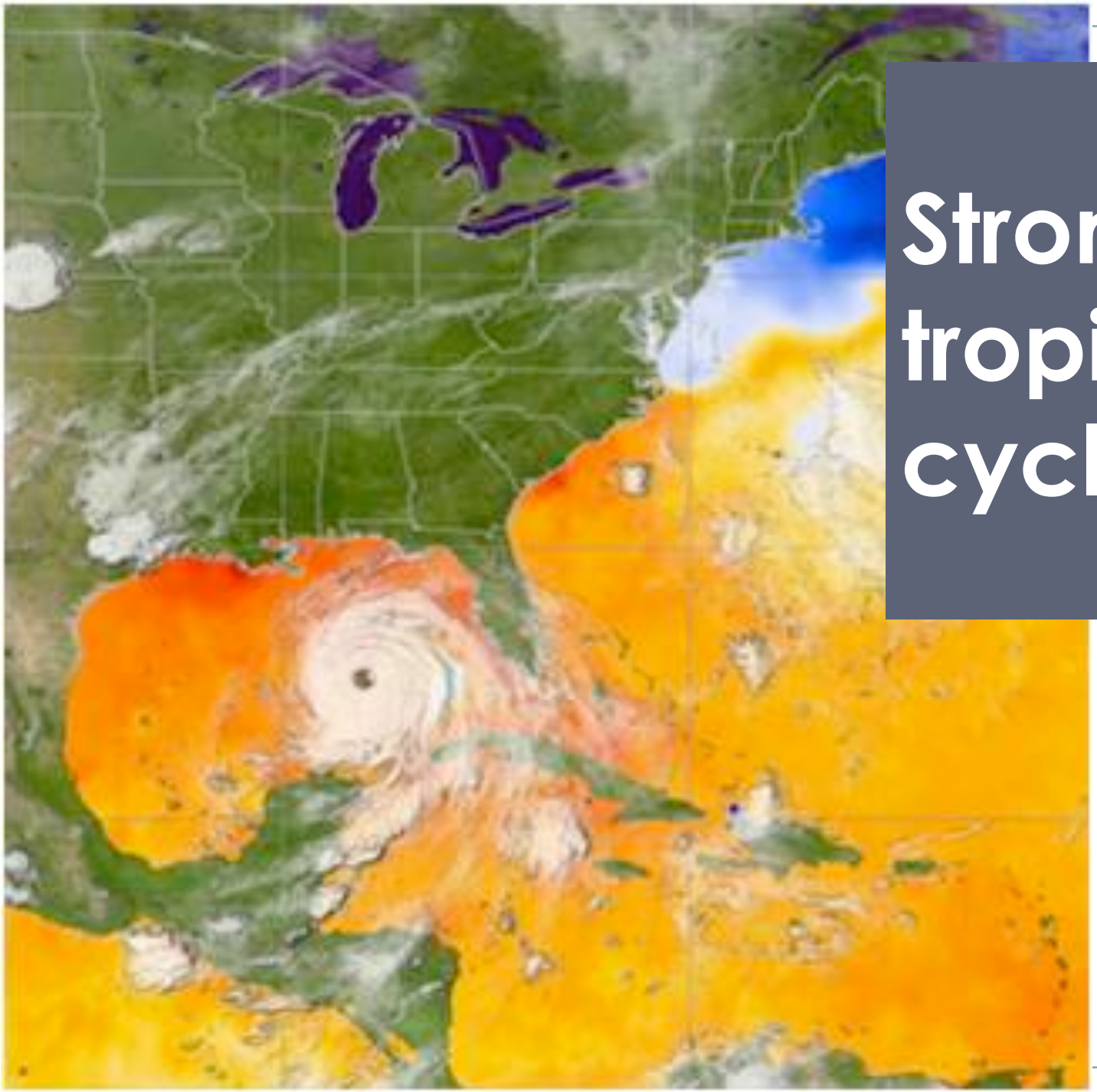
More frequent heat, drought, and fire



AUSTRALIA
Jan-Feb 2009

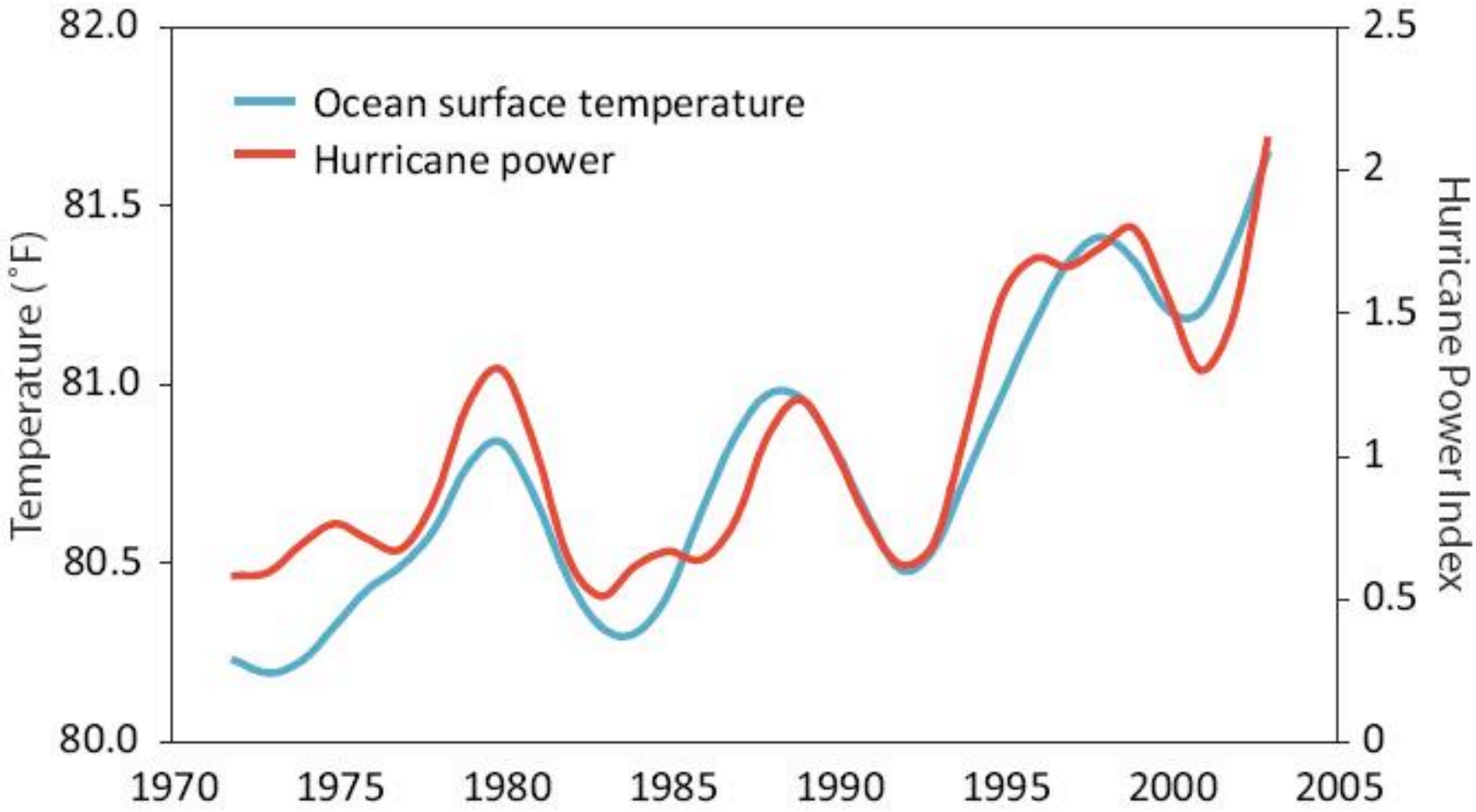
Wildfire frequency in California





Stronger tropical cyclones

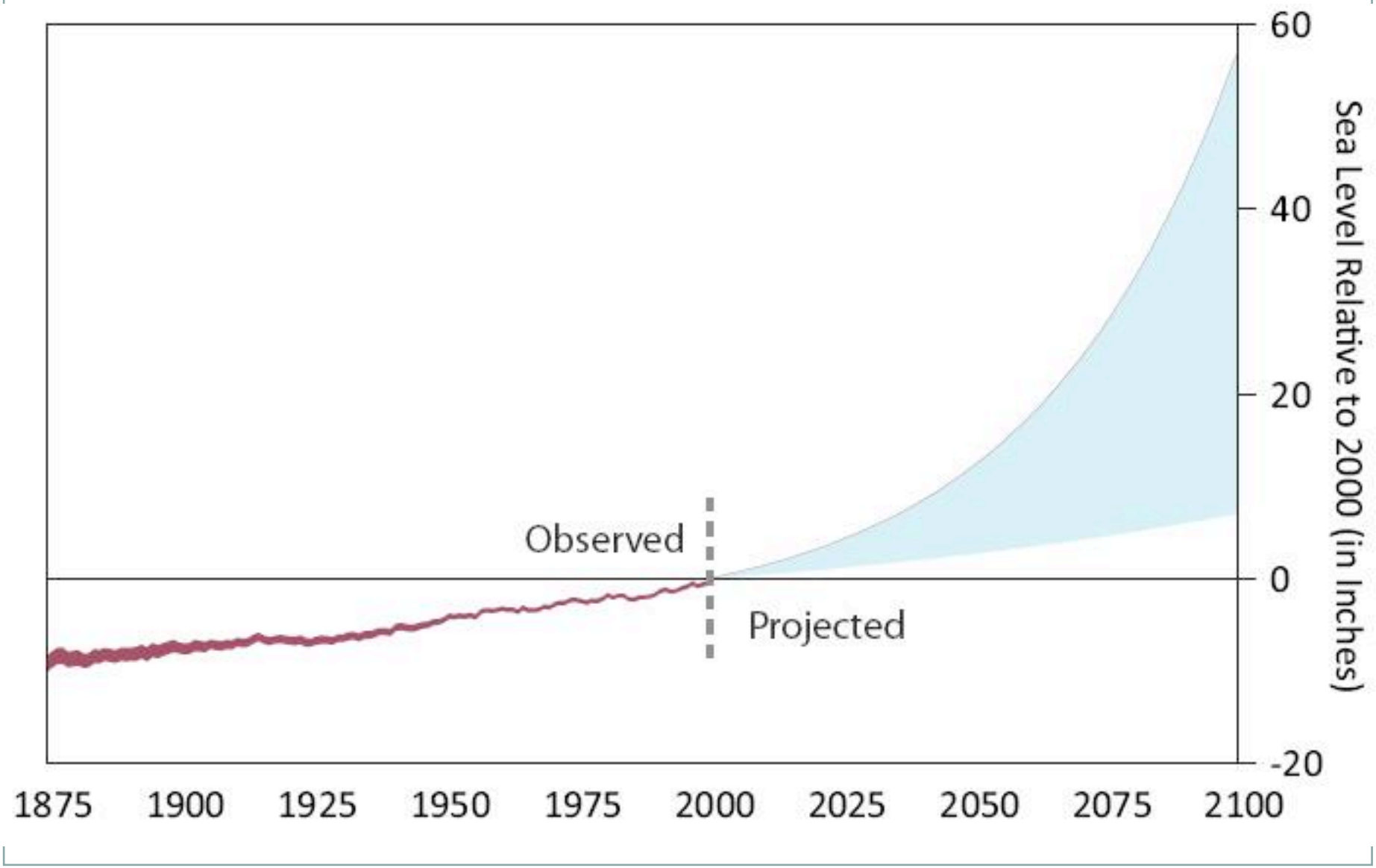
Hurricane power and ocean temperature



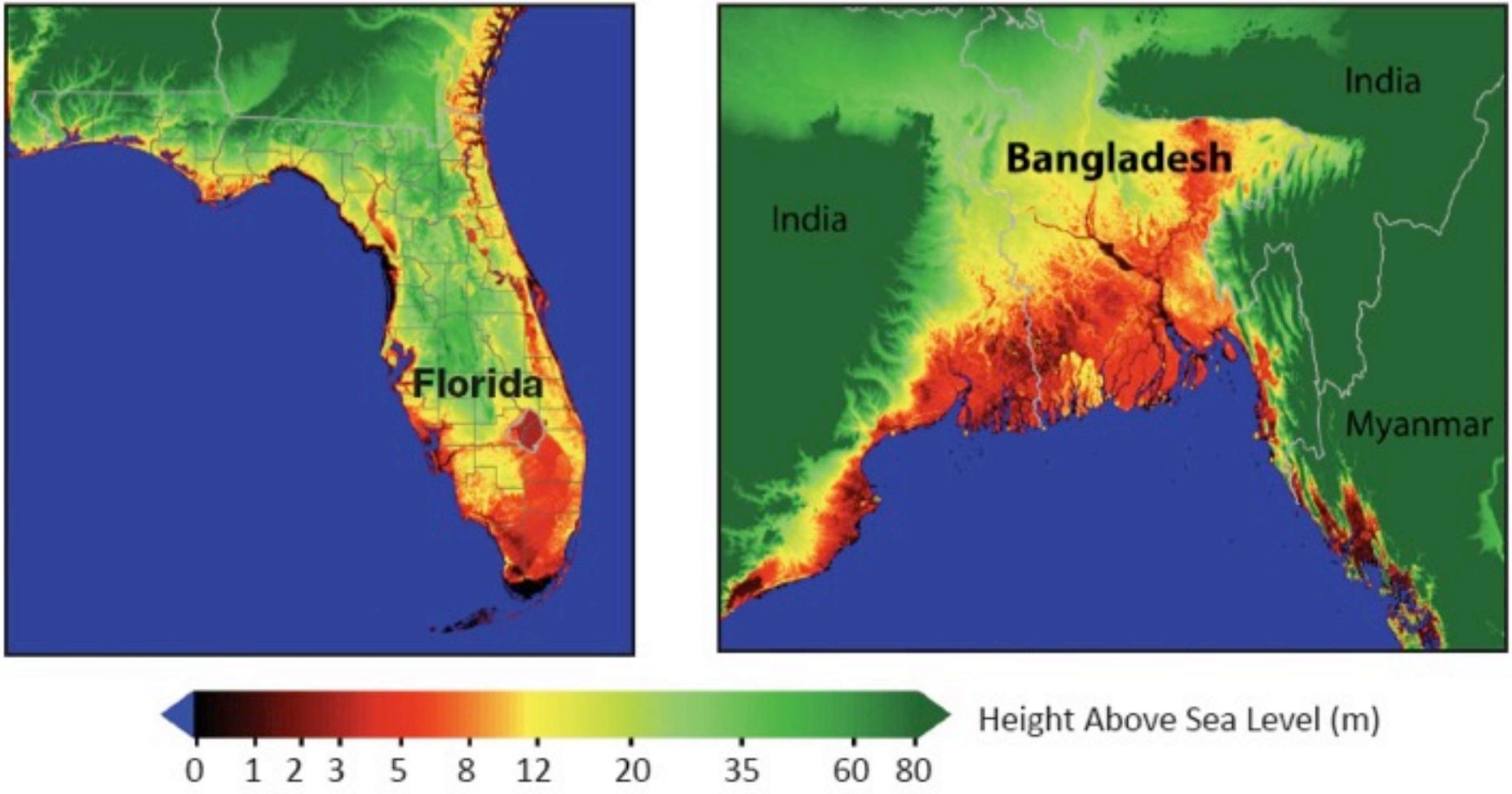
It's not so simple

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

Rising sea level



Area at risk from sea level rise



How can we respond?

PART SIX

Small things matter

stop using this

start using this

Ultimately we need a fundamental change

stop using this

start using this

What can we do about it?

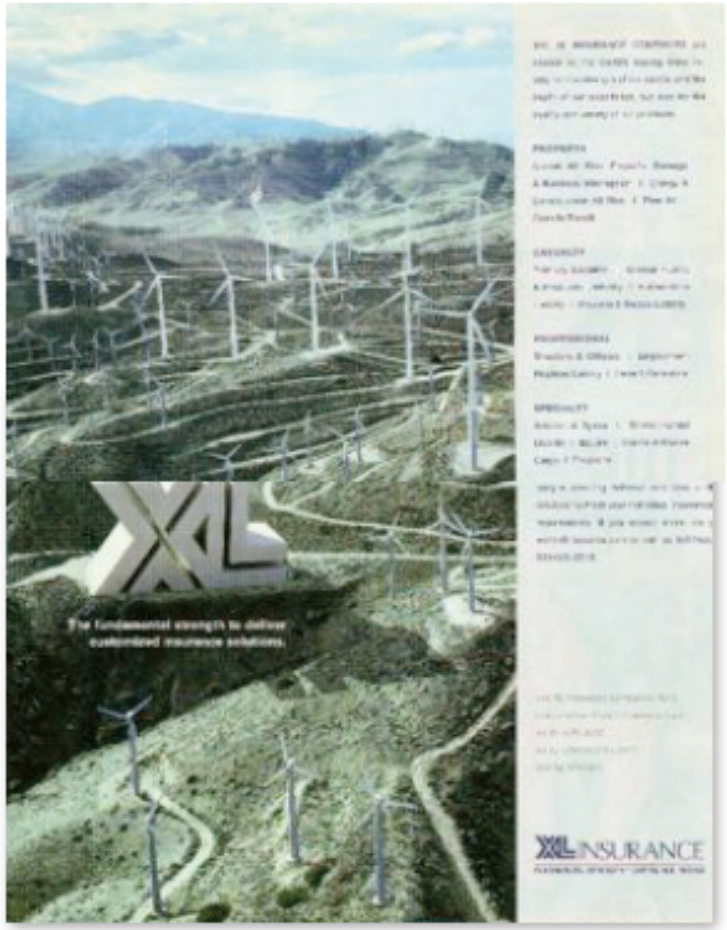
"We basically have three choices: mitigation, adaptation, and suffering. We're going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required and the less suffering there will be."

John Holdren

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

Business climate is changing …

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



Risk profiles are changing

Sources of risk are changing

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

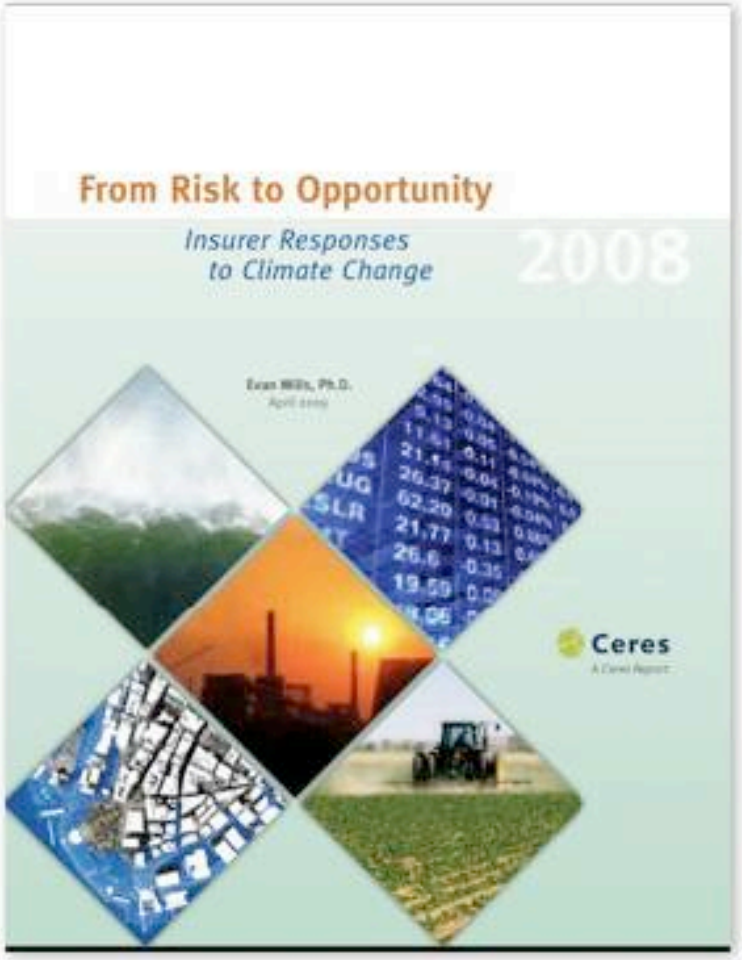
(Ernst & Young Survey, March 2008)

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

It's time to move *from* risk *to* opportunity

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



Opportunities: new markets

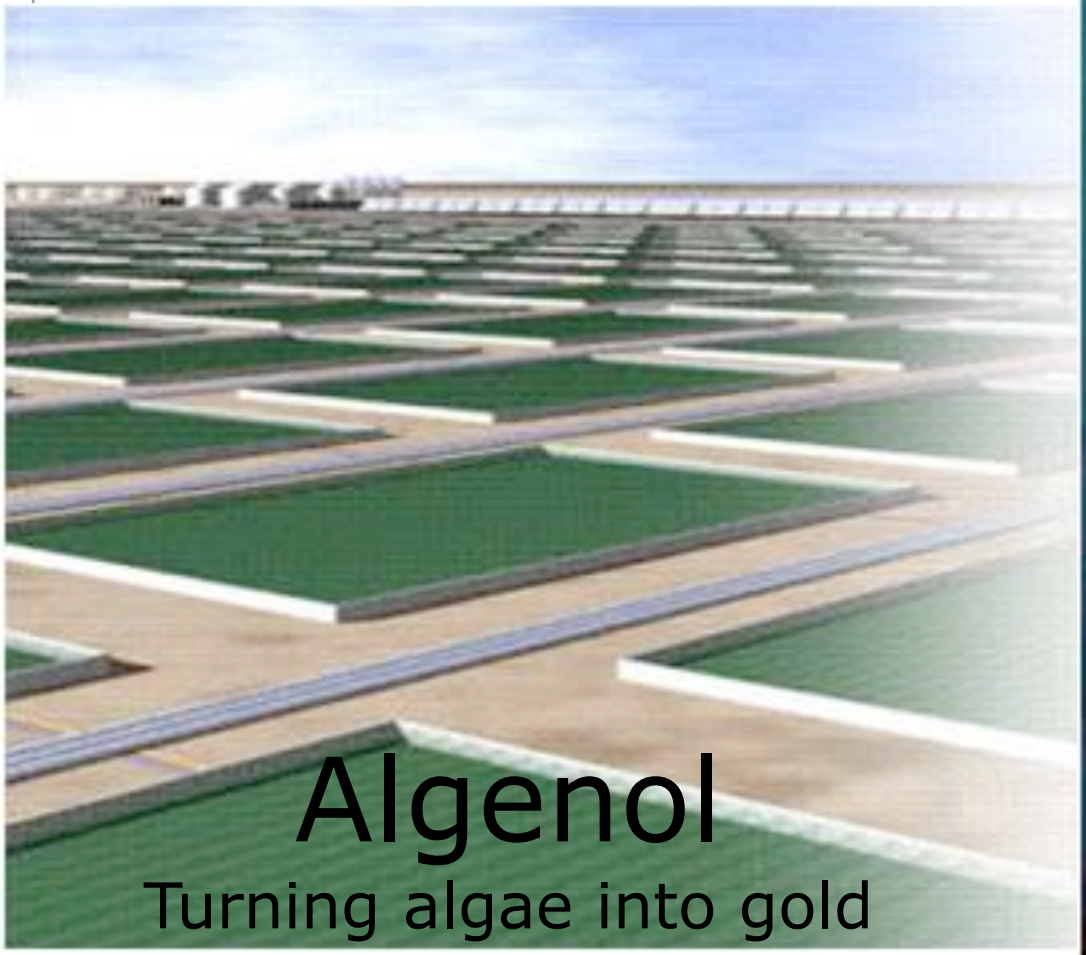
- ***Insurance Australia Group:*** offering on-line automobile carbon-offset service for customers

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

Opportunities: new products

Applied Marine Technologies

Constructing artificial reefs



Algenol

Turning algae into gold

Opportunities: new incentives

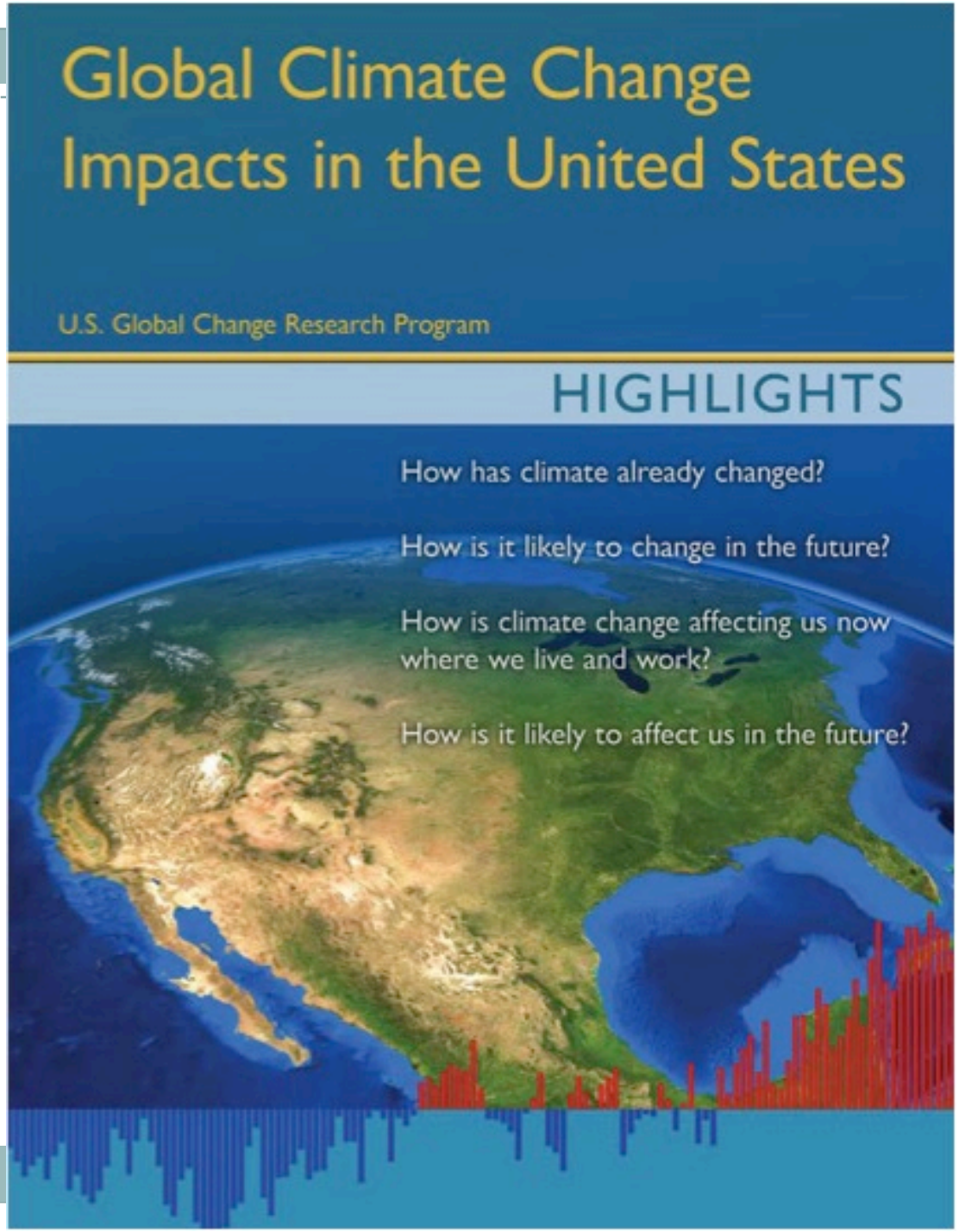
Resource 1

Global Climate Change Impacts in the United States

What climate change means for the places we care about …

PDF & educational materials free online at:

www.globalchange.gov/usimpacts



Resource 2

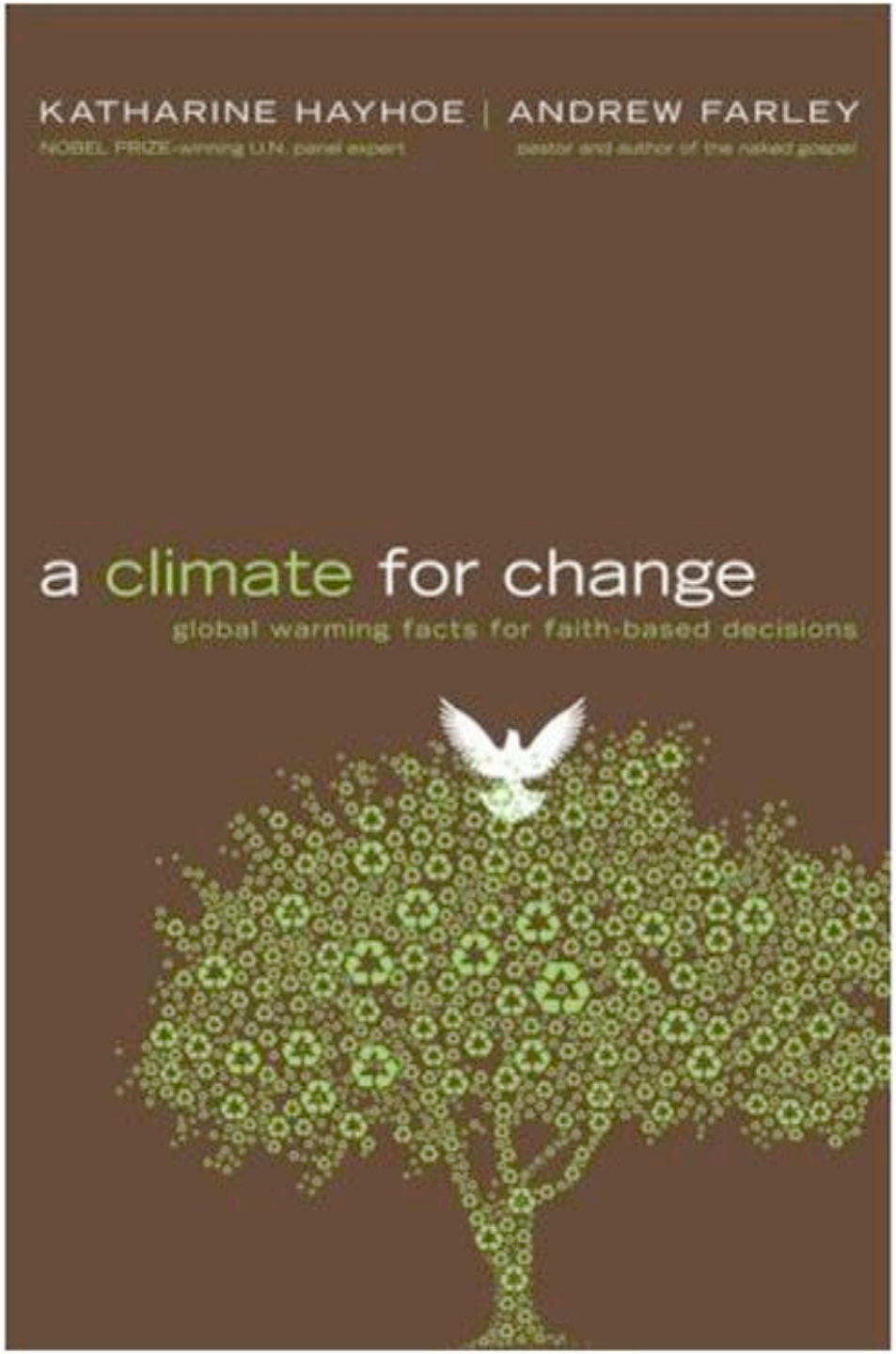
A Climate for Change

Global Warming Facts for Faith-Based Decisions

Why climate change is happening, and how it is affecting our world …

Free preview at:

www.katharinehayhoe.com



THE END

FOR MORE INFORMATION

WWW.KATHARINEHAYHOE.COM
WWW.GLOBALCHANGE.GOV/USIMPACTS