

# CLIMATE CHANGE

What does it mean for  
the insurance industry?

Katharine Hayhoe

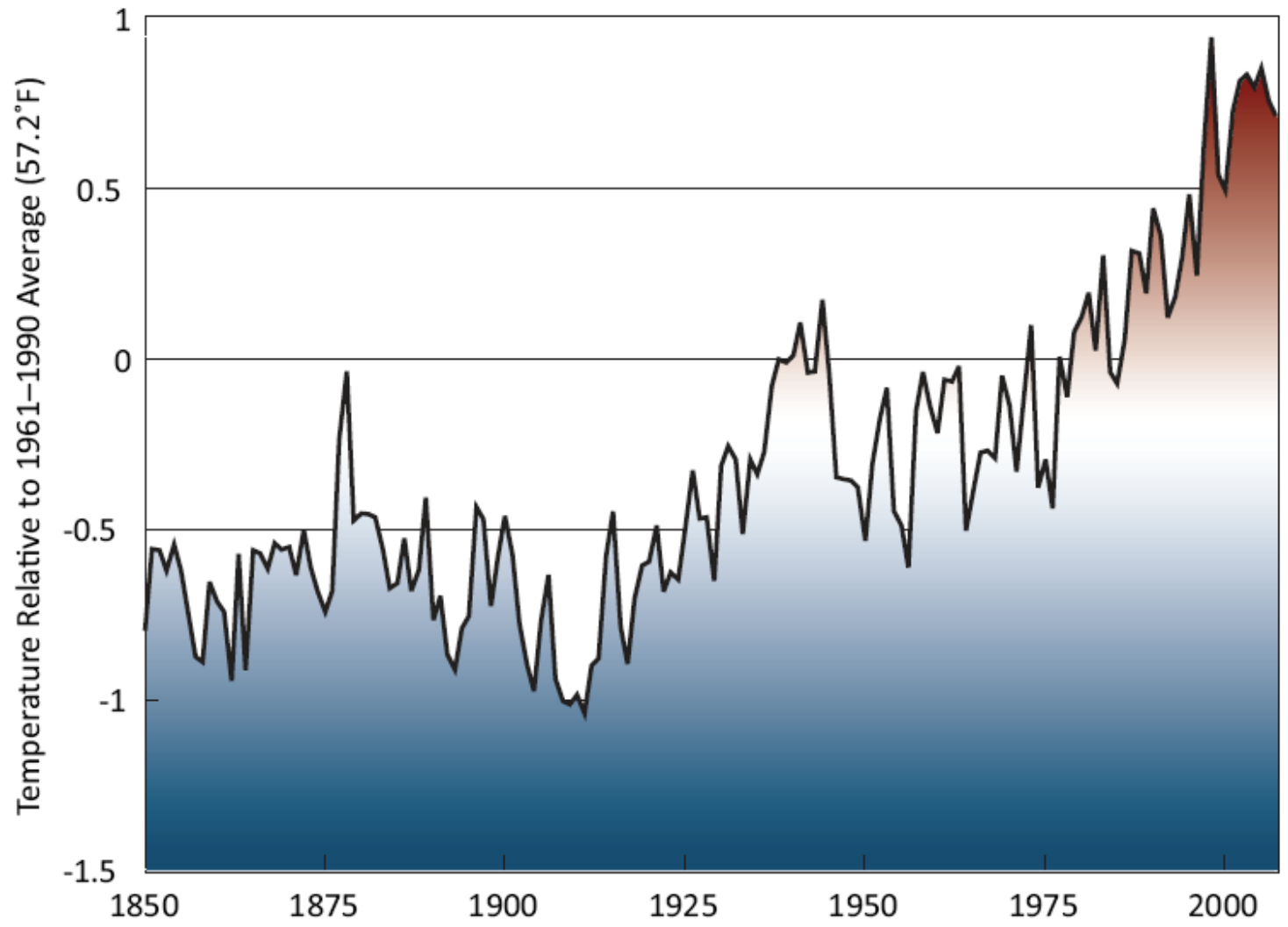
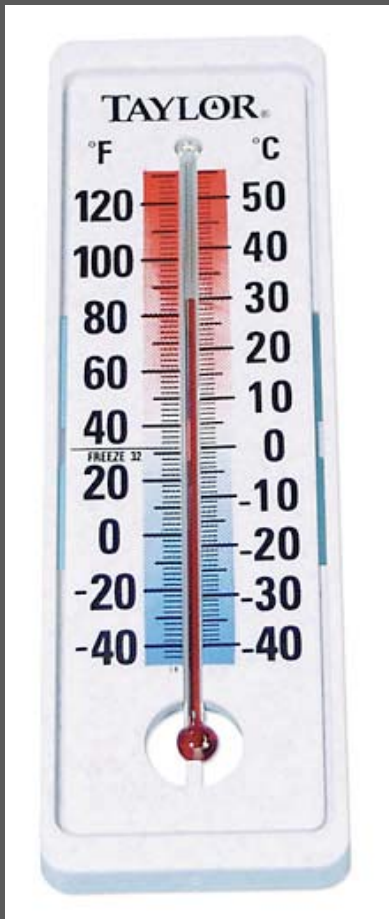
Texas Tech University

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?

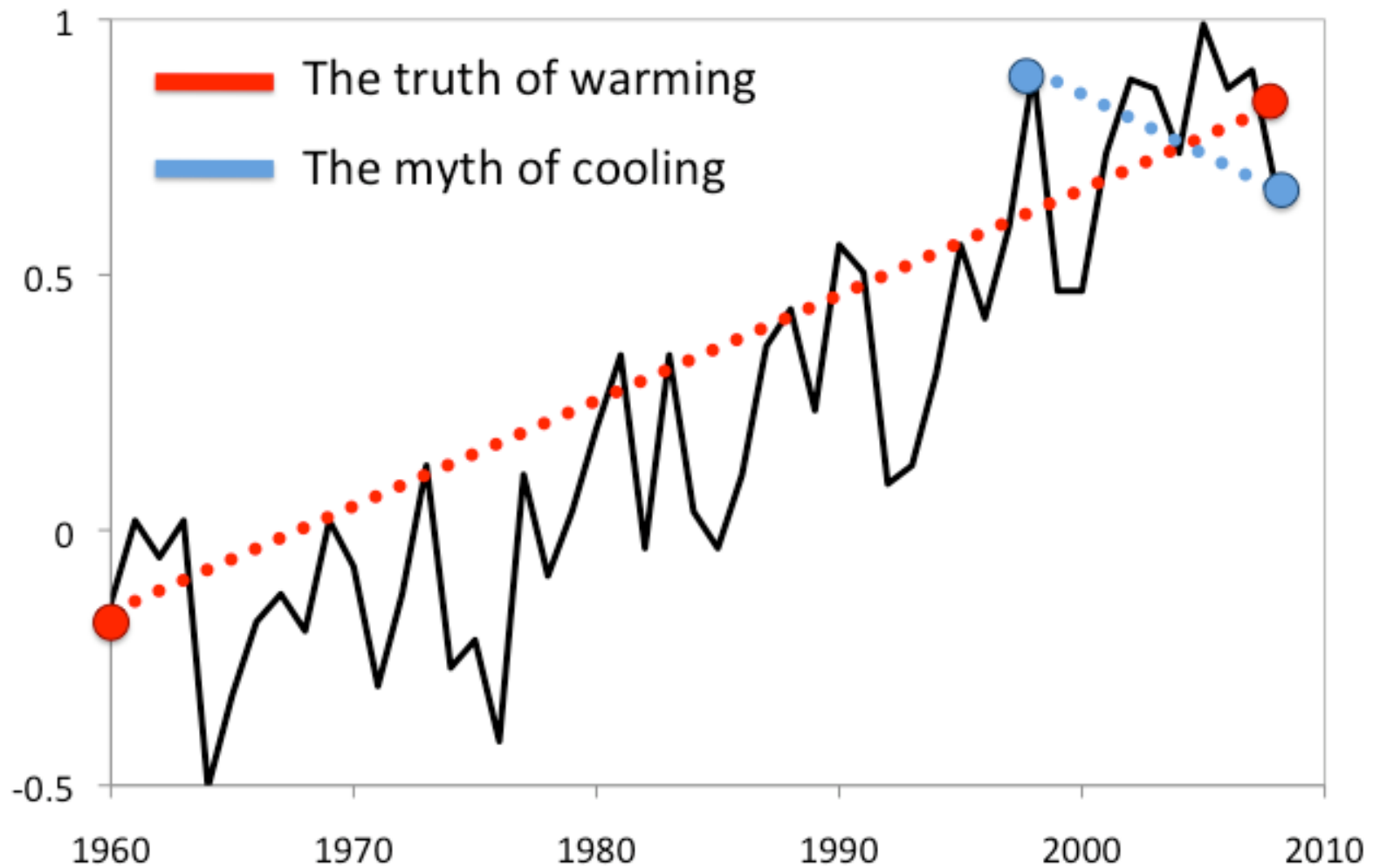
# The Earth is getting warmer ...



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

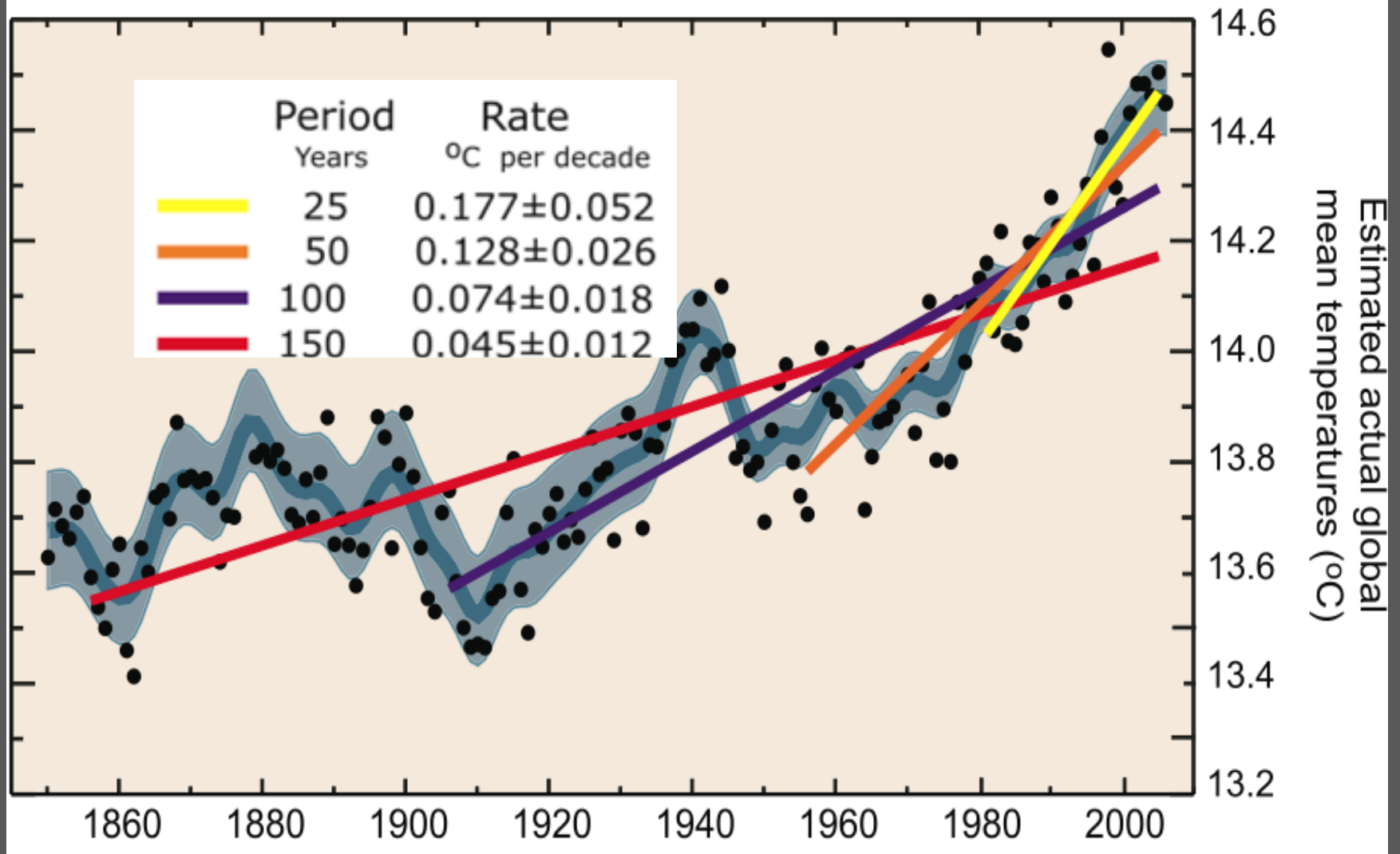
... despite recent claims of “cooling”

Temperature relative to 1961-1990 average (57.2°F)

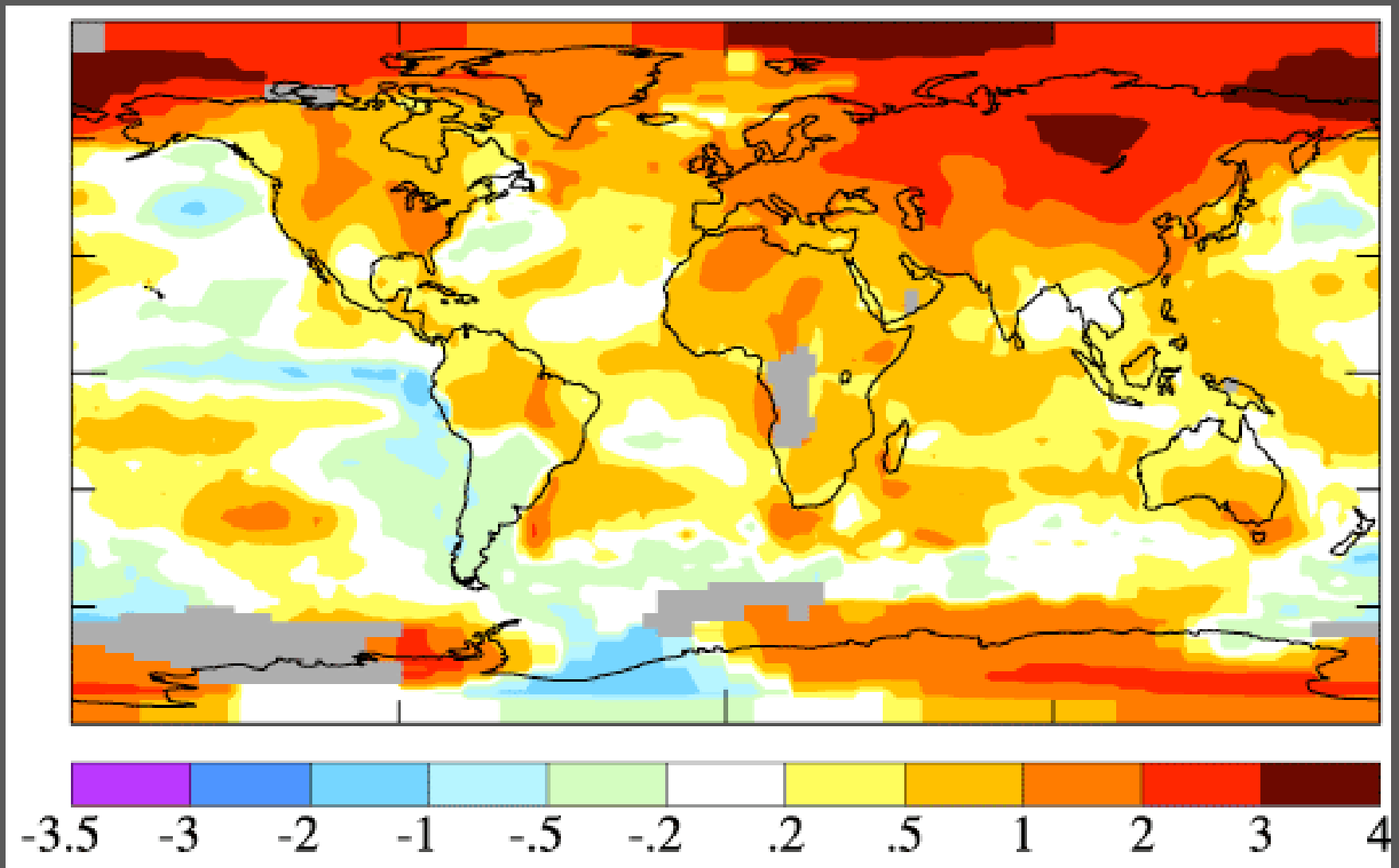




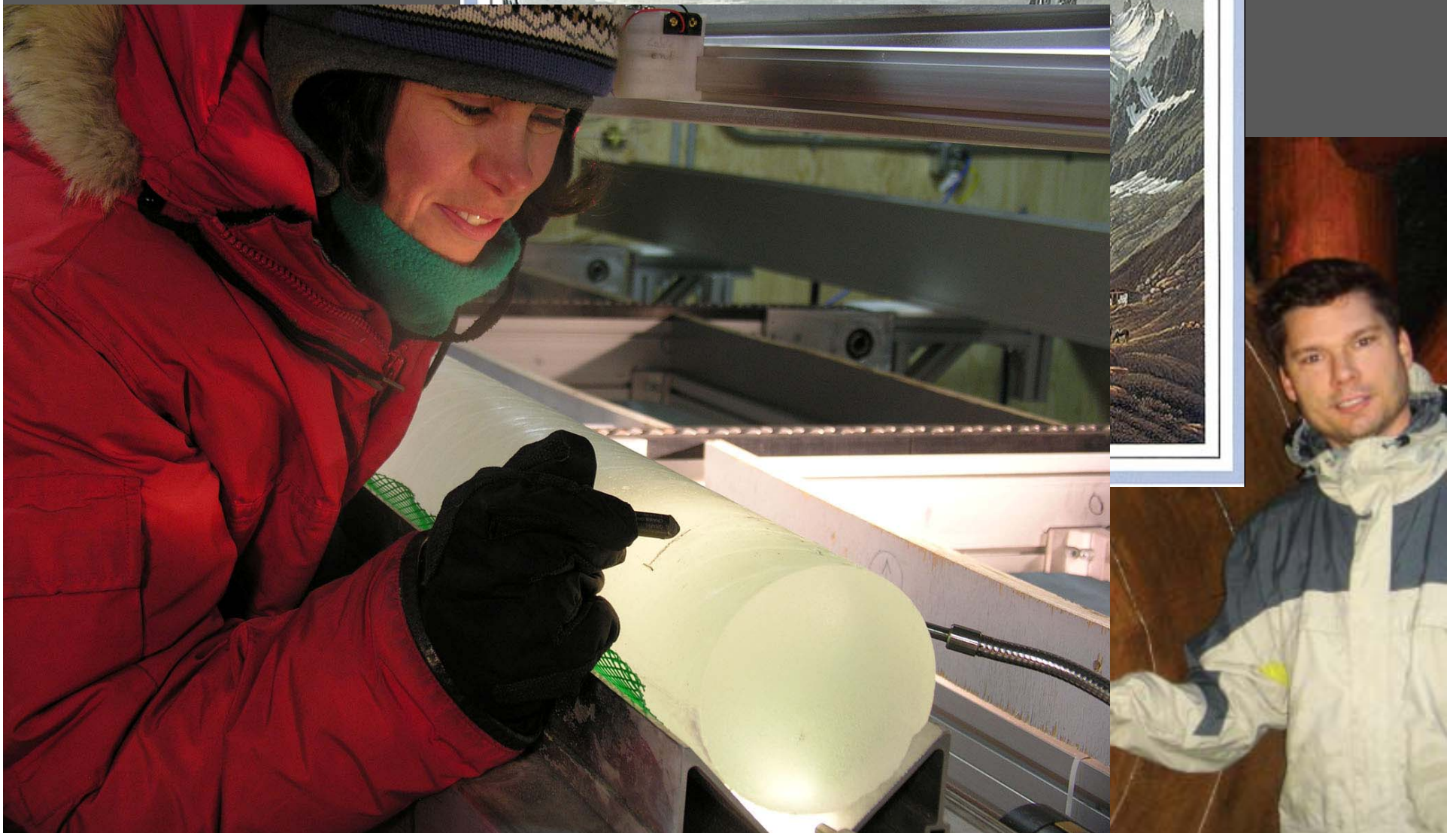
# It's happening faster and faster



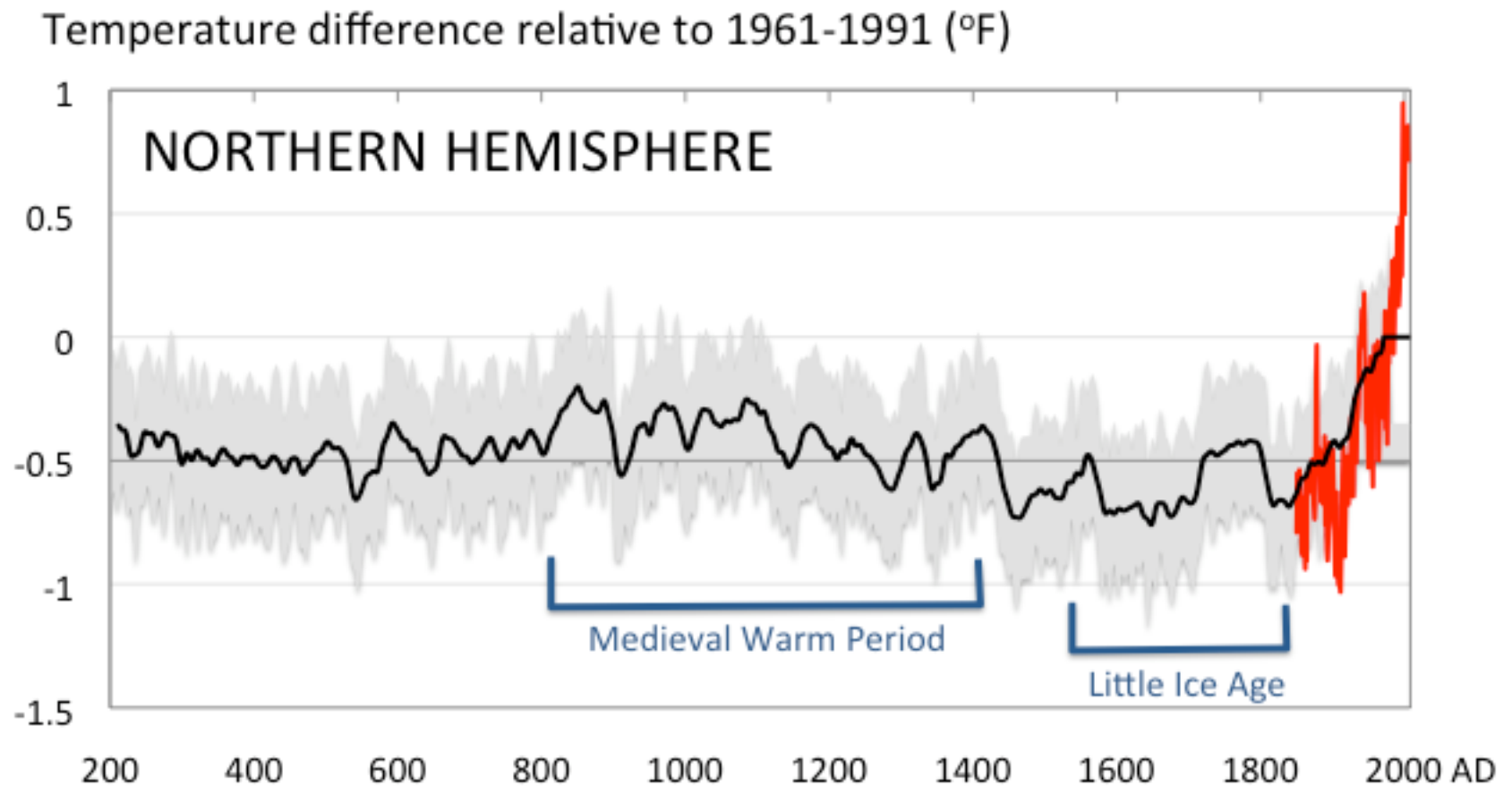
...and is greatest over land & at higher latitudes



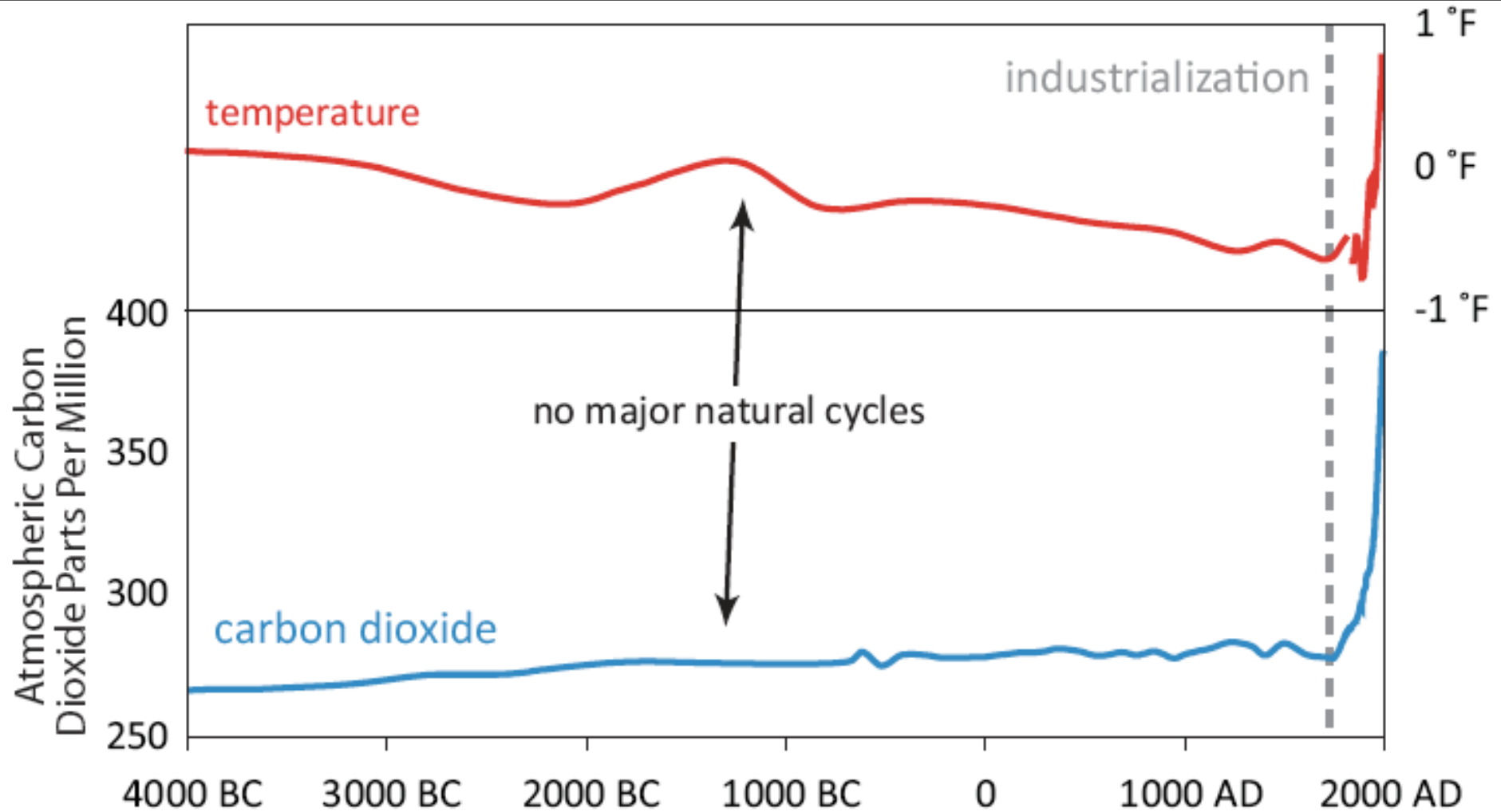
# How do we know this warming is unusual?



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

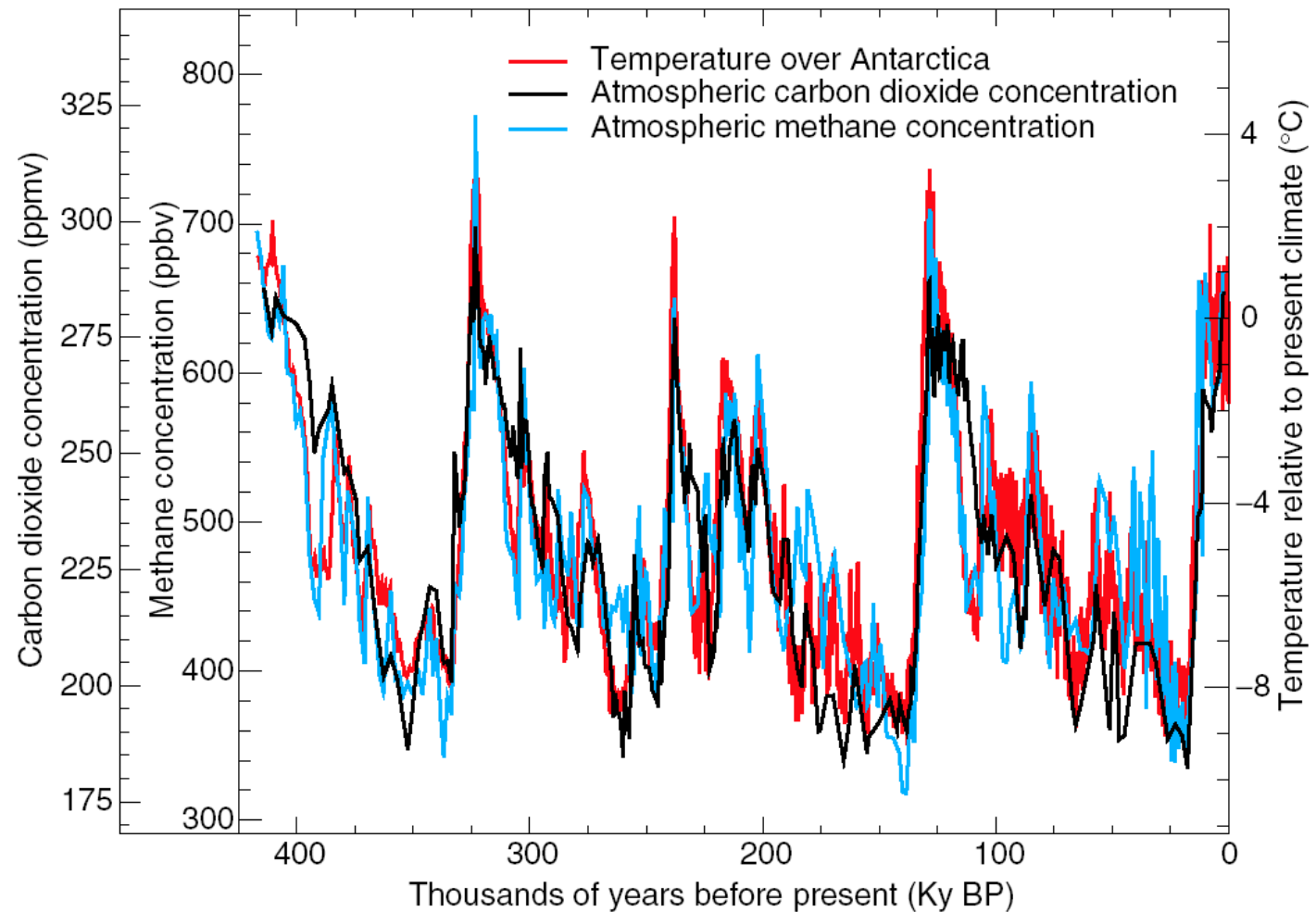


# ... the last 6,000 years



... and even the last 400,00 years.

385 ppm

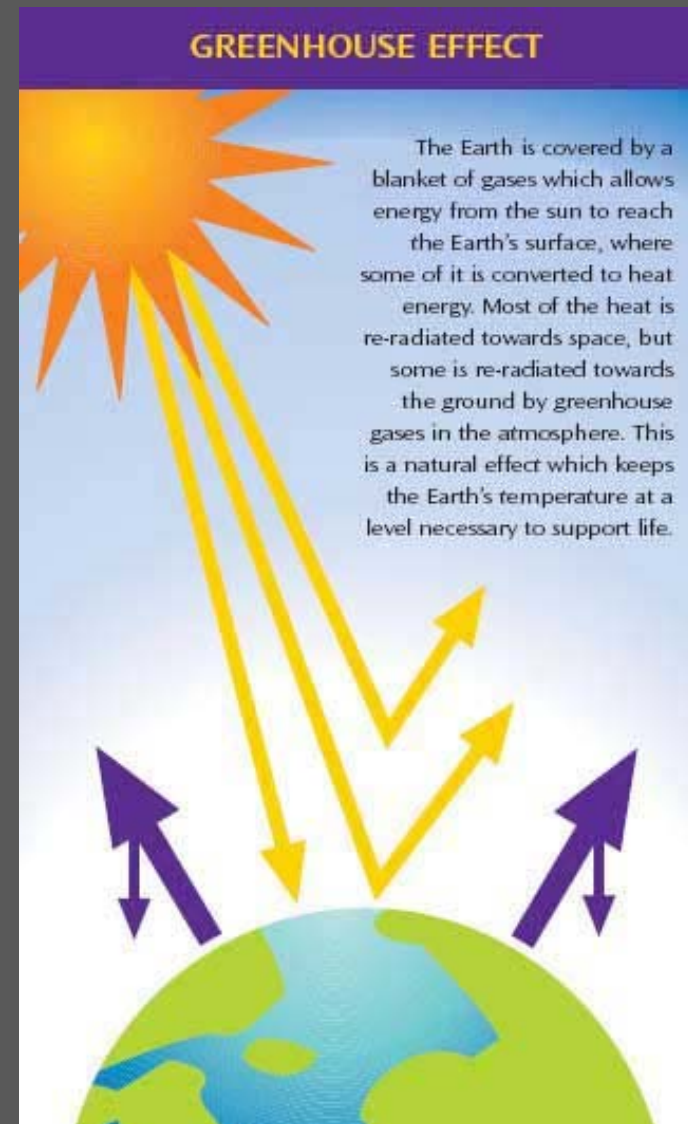




# Natural warming

## 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)

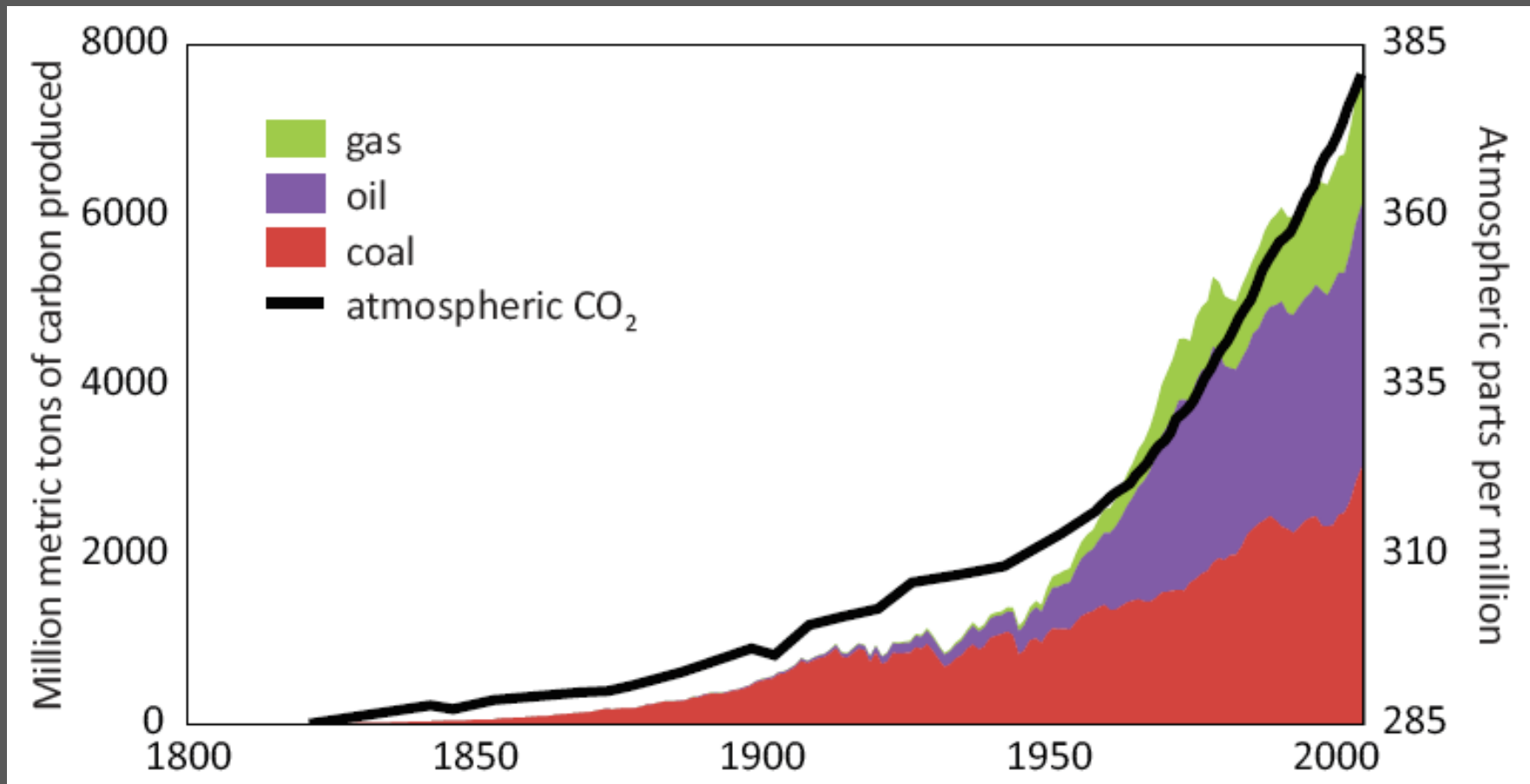
- ... is primarily human-induced
  - We're increasing heat-trapping gases in the atmosphere.
- ... is like wrapping an extra blanket around the Earth.



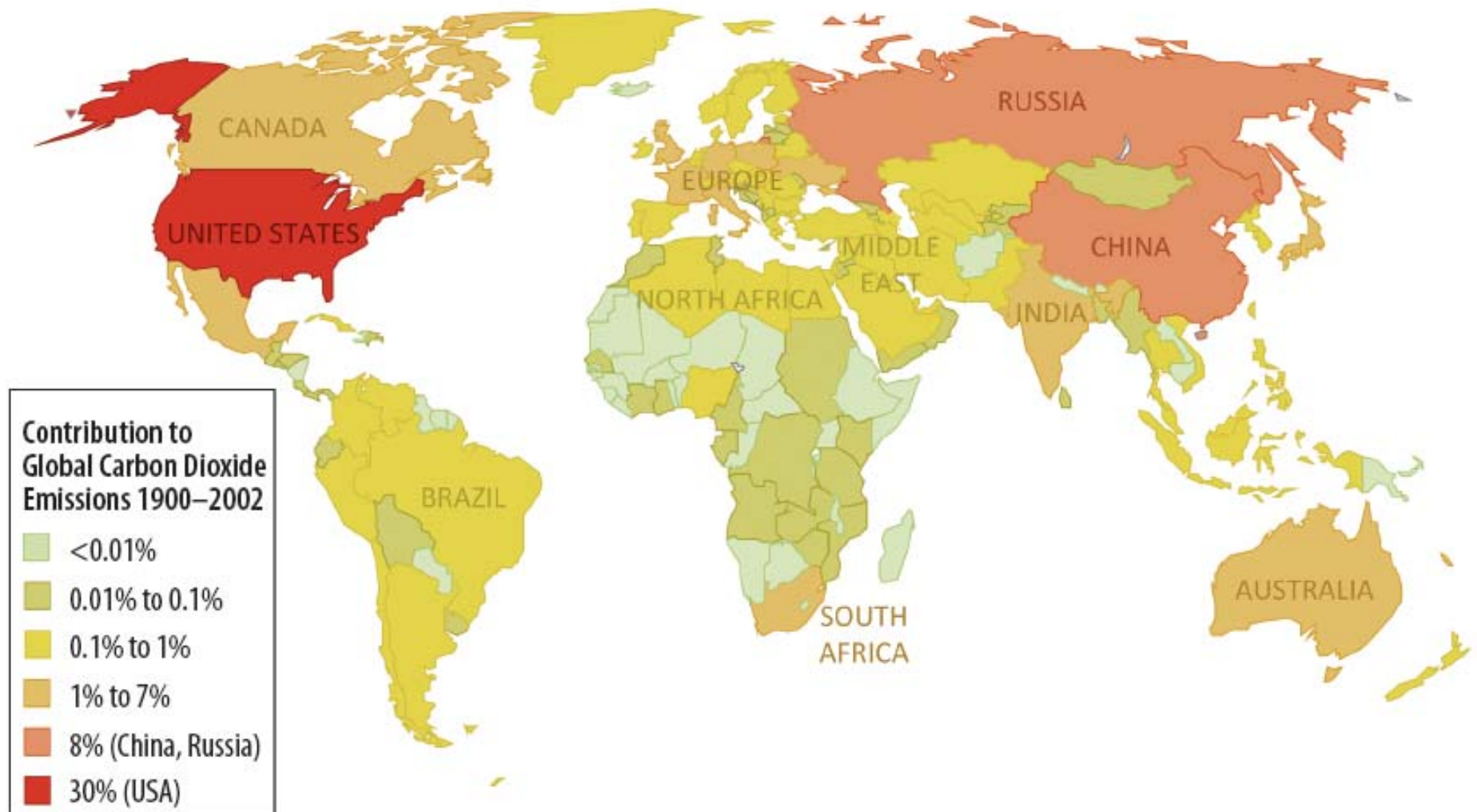


# How is this happening?

## Human production of heat-trapping gases



# Why this is such a political hotbutton



## 3 questions on climate change

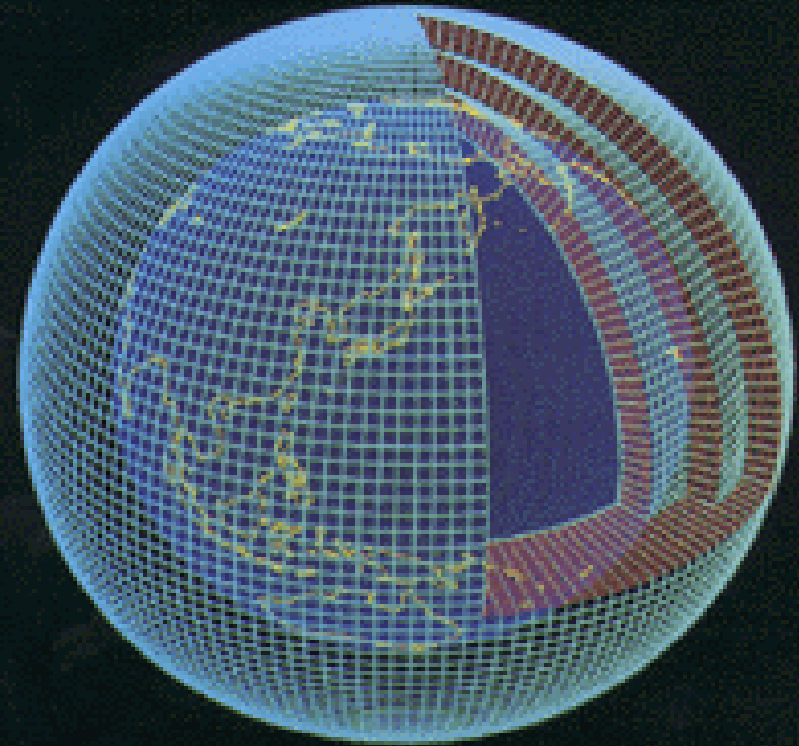
### 1. **WHY** do we need to consider climate change?

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

Humans have taken over the reins.

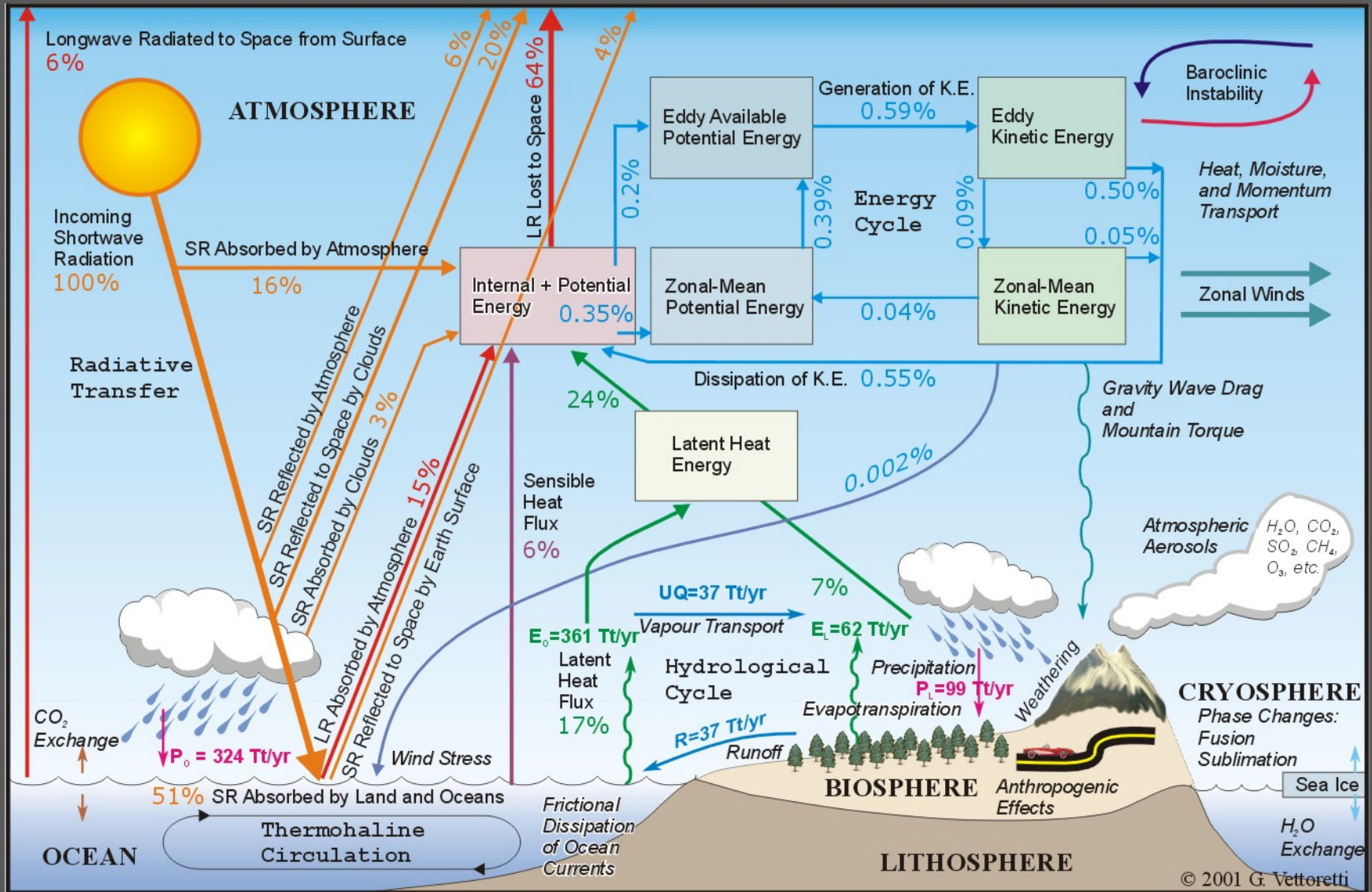
**How do we know that humans are causing the warming today?**

Computer simulations of the earth system





# Modeling the Climate System



# Chaos and Stability in the Climate System

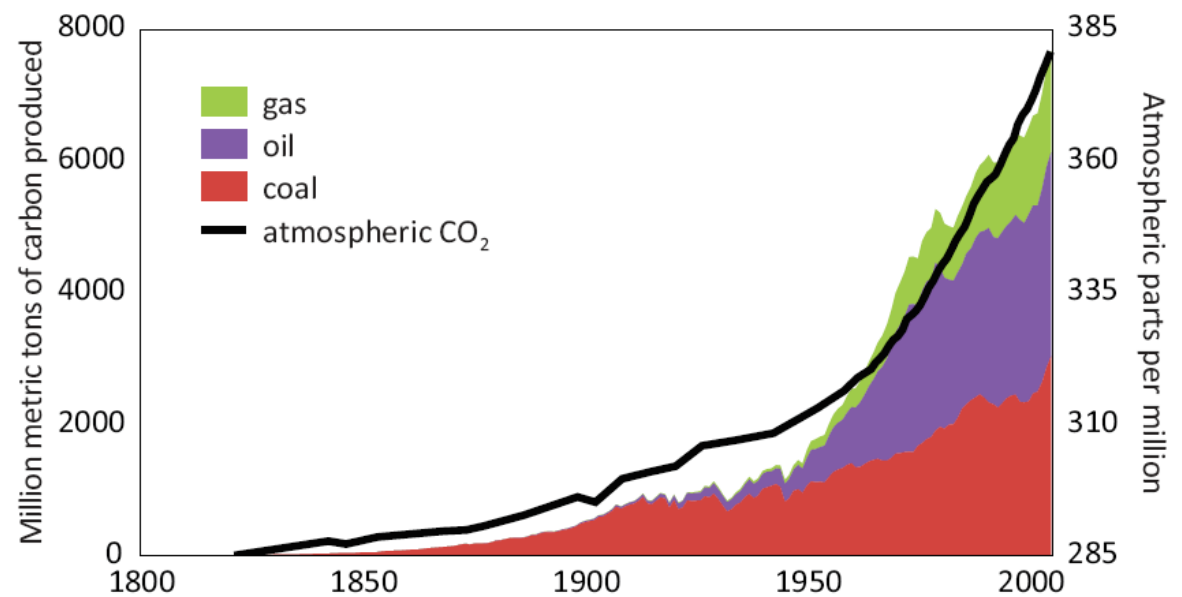
- Some components are **chaotic**
  - weather systems in the atmosphere and ocean
- Others are **stable**
  - storm tracks, low-frequency oscillations

# Weather vs. Climate

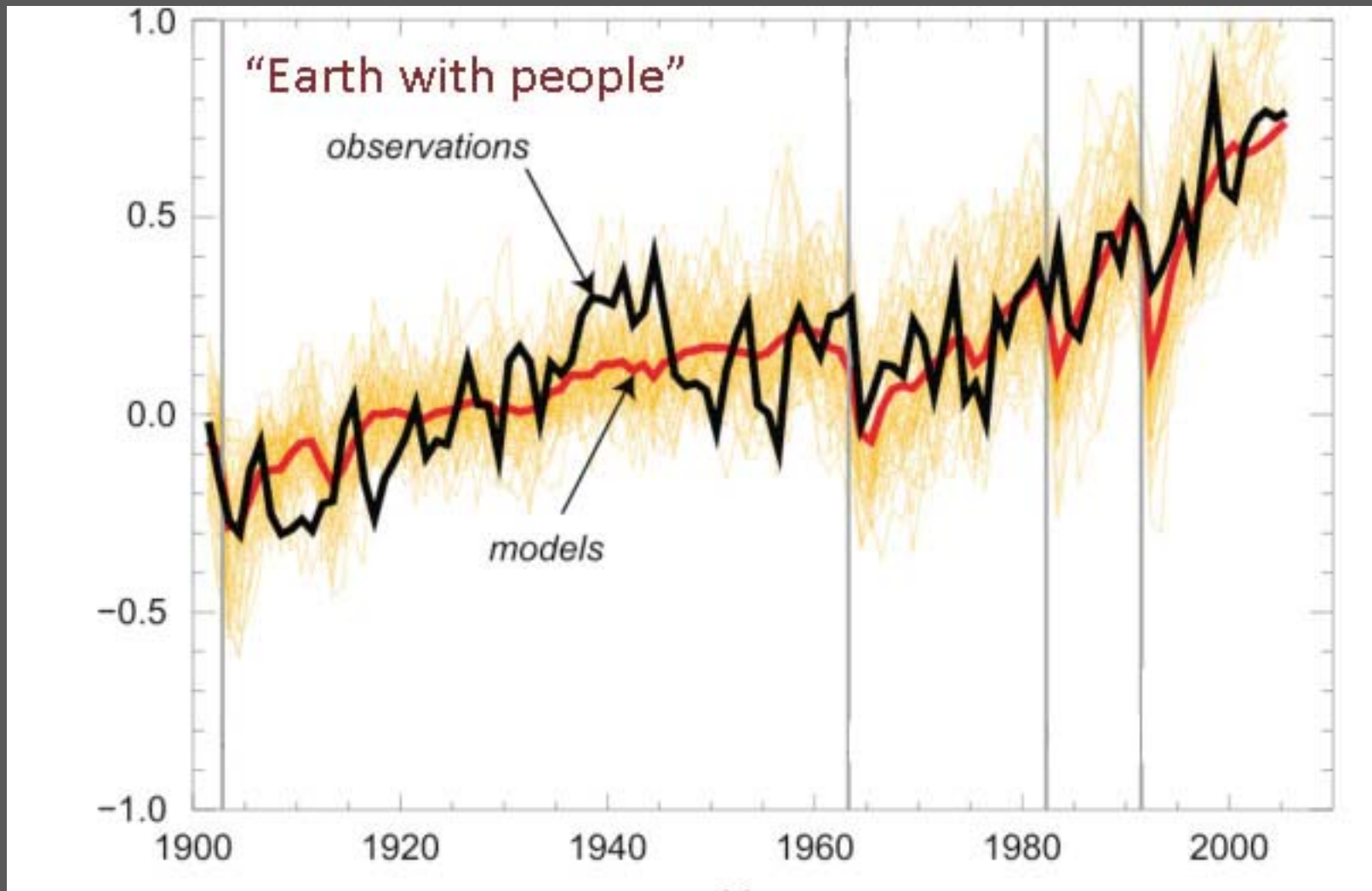
Weather changes unpredictably, as a result of chaotic forces.



Climate change is predictable as a result of natural & human forces.

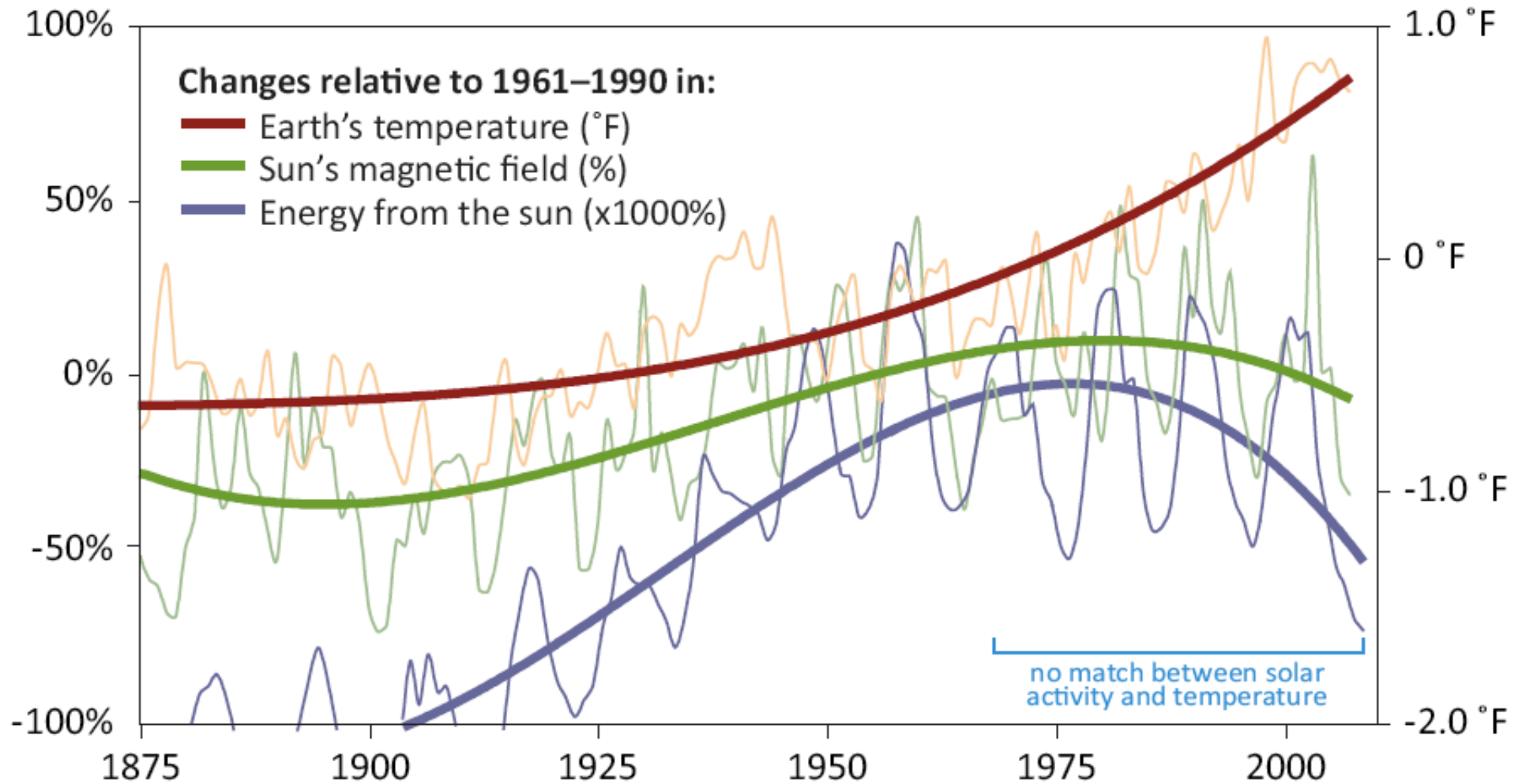


# Quantifying the human influence



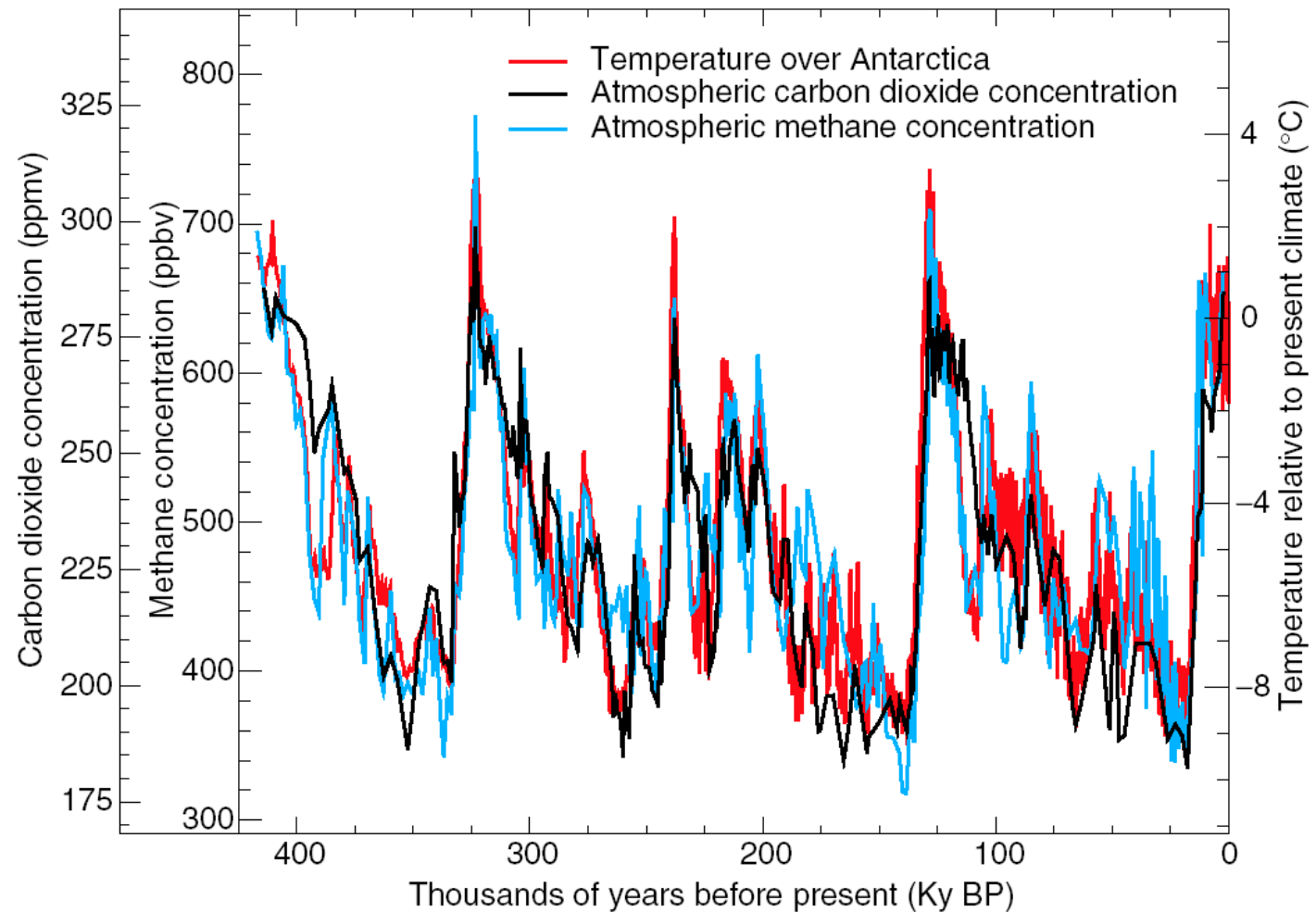


# How do we know it's not the sun?



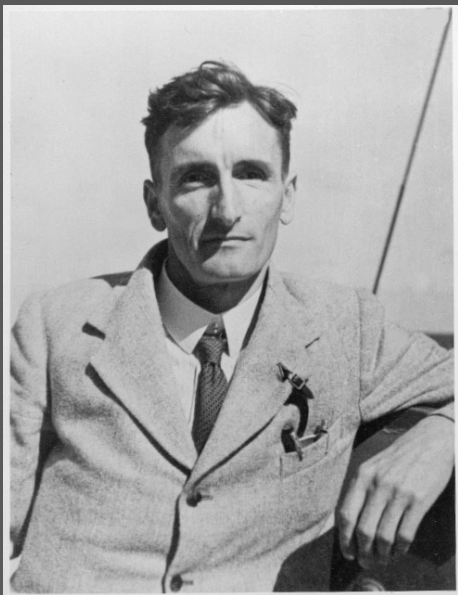
# What about natural cycles?

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].



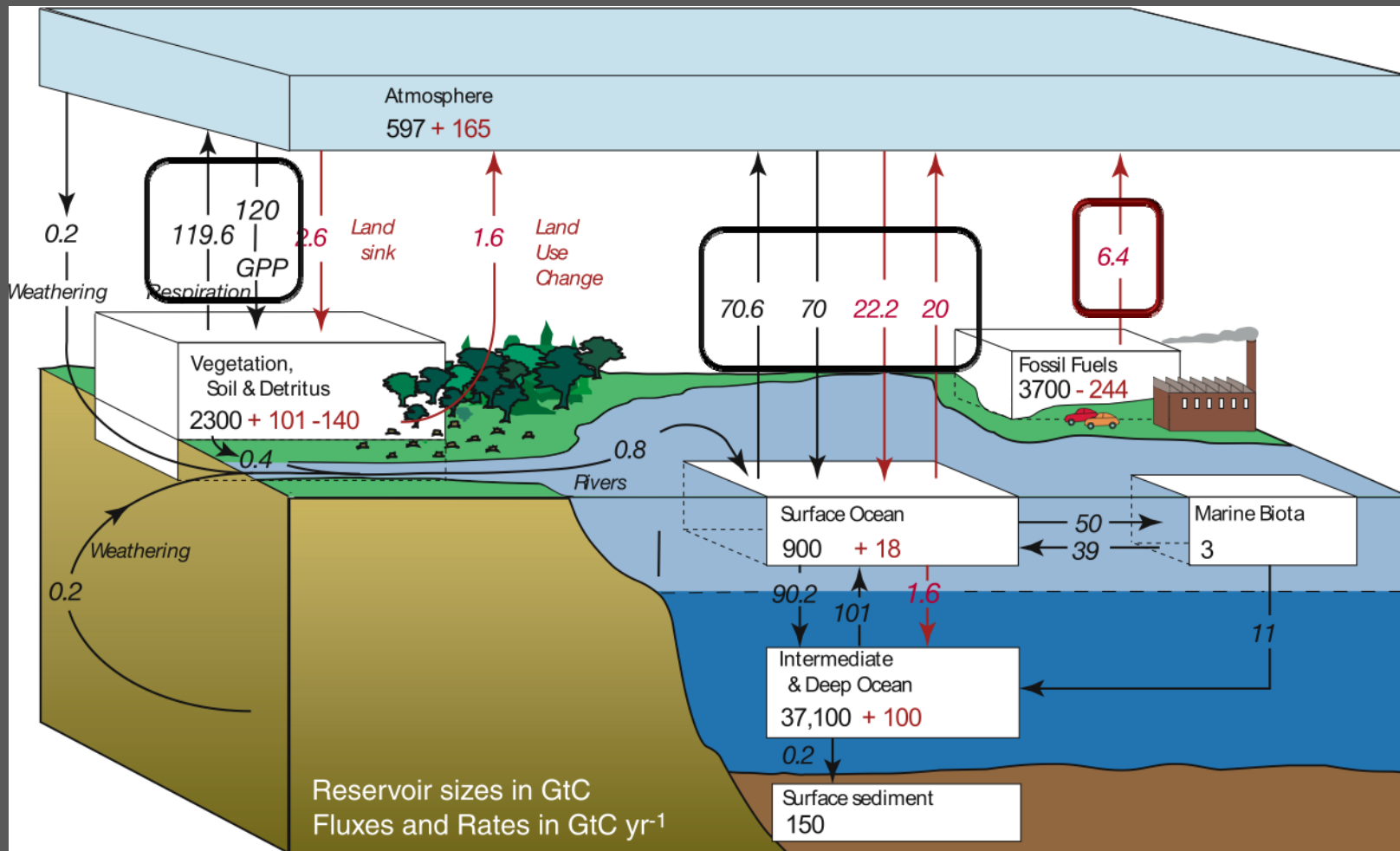
**The United Nations Intergovernmental Panel on Climate Change, 2007**

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

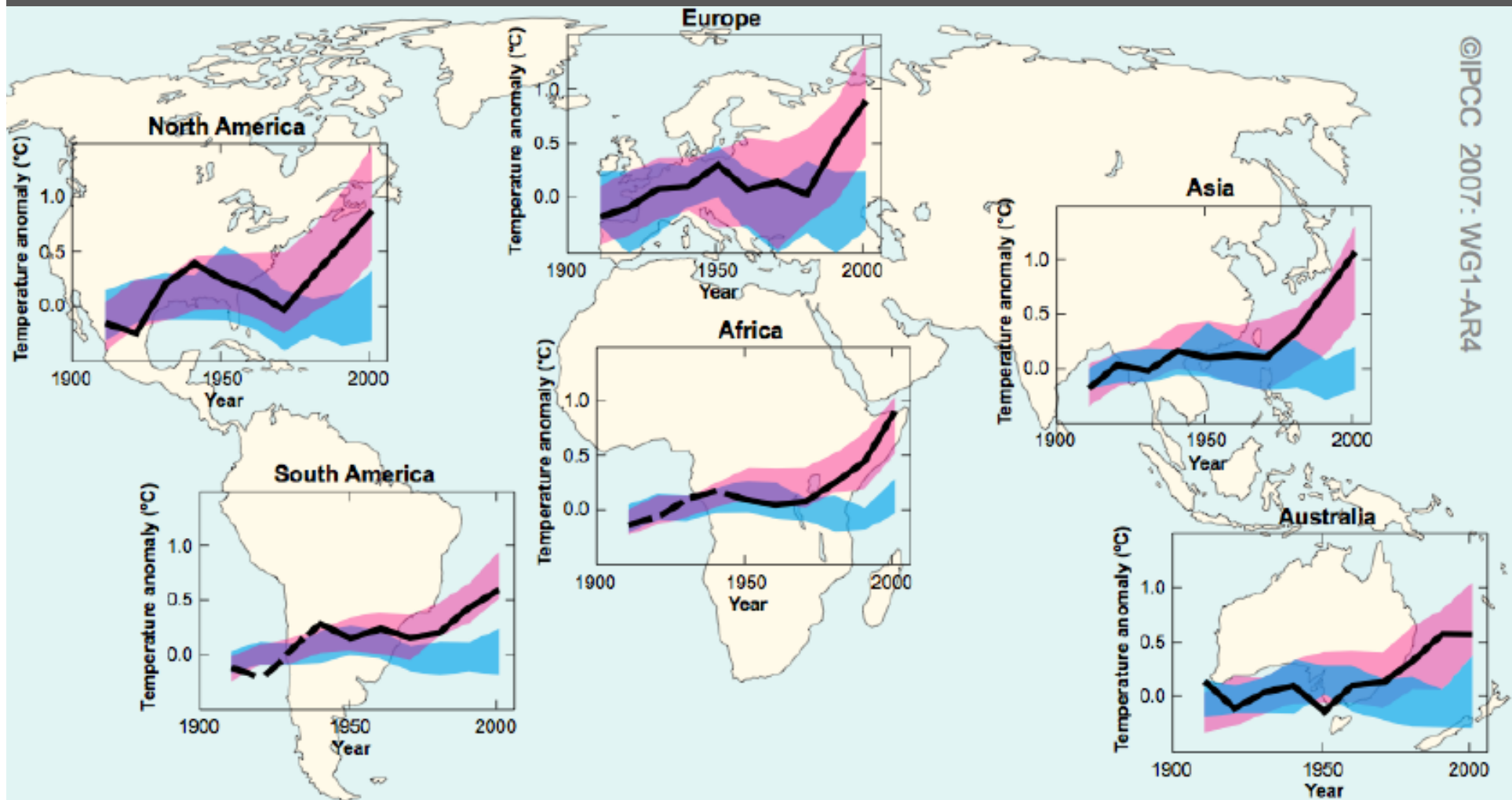
We are disrupting the natural balance.



**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

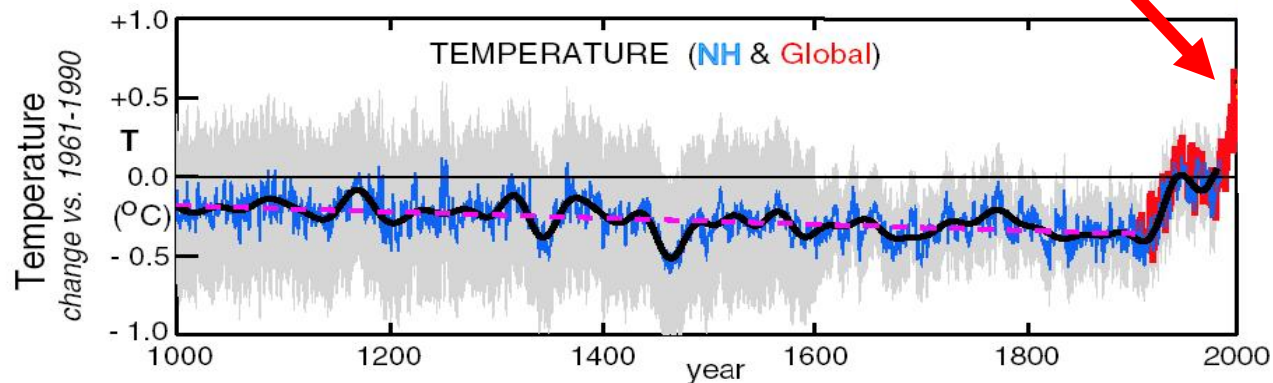
## 3 questions on climate change

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



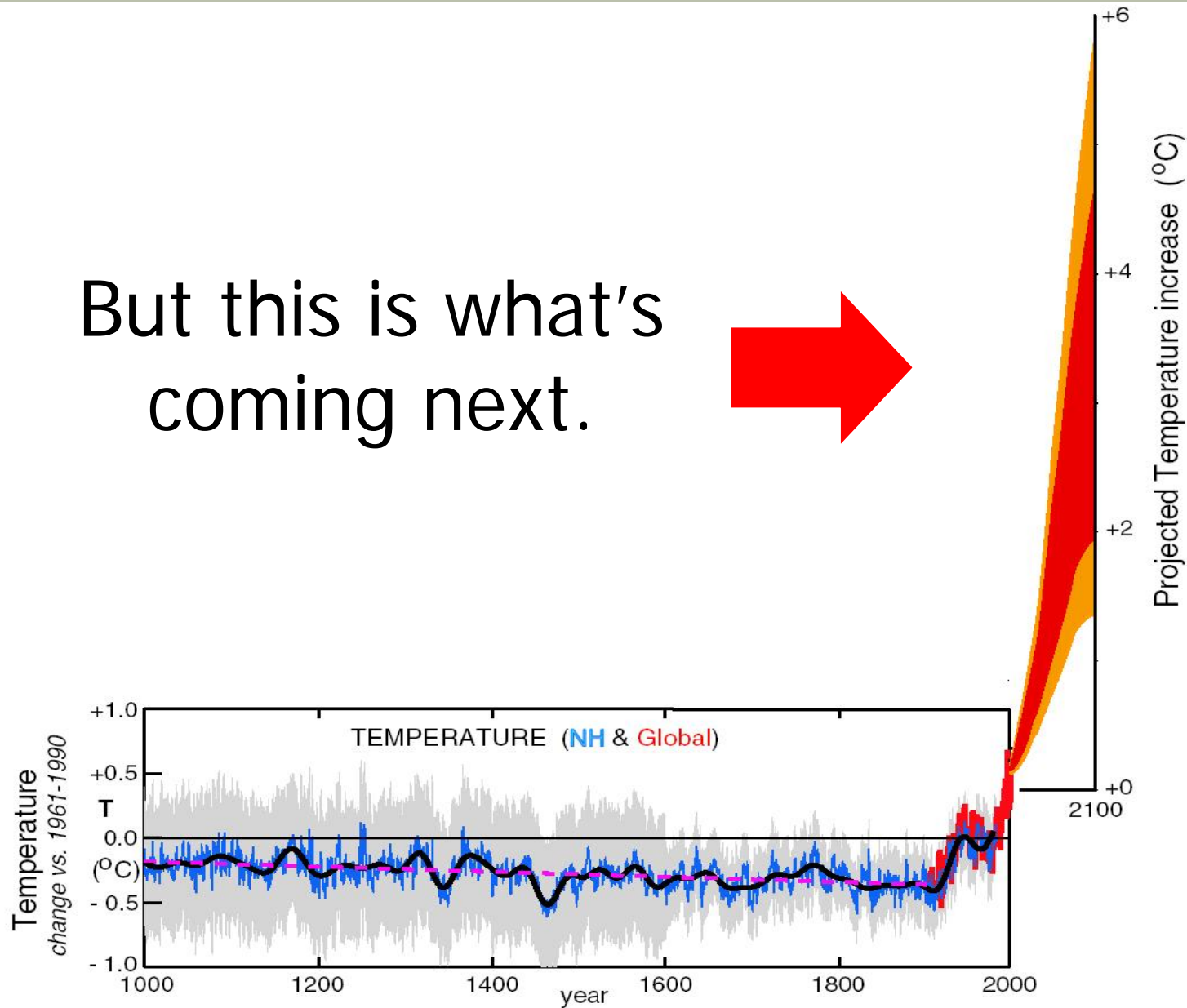
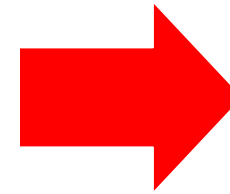
# What can we expect in the future?

We're already  
concerned about this

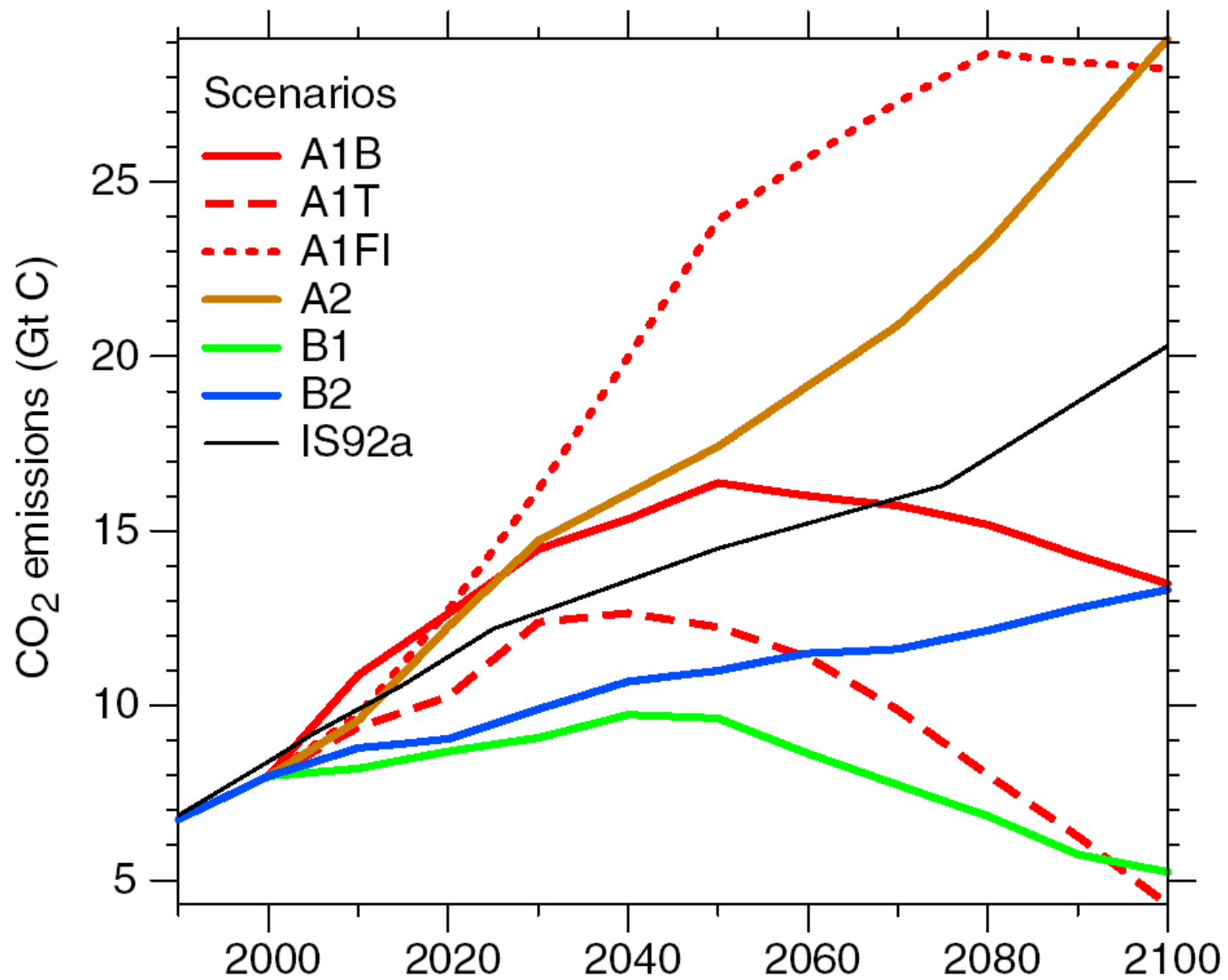


# What can we expect in the future?

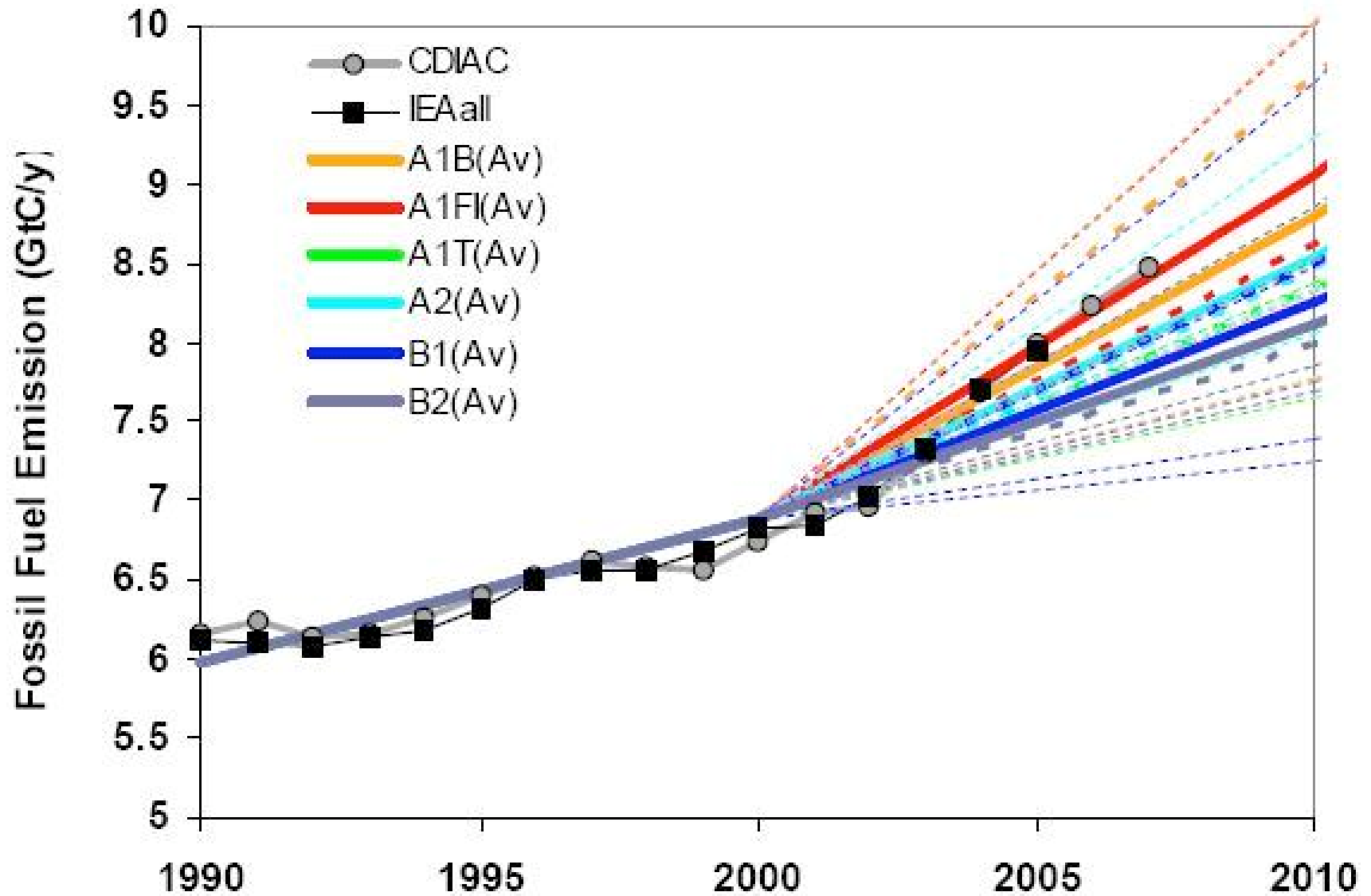
But this is what's coming next.



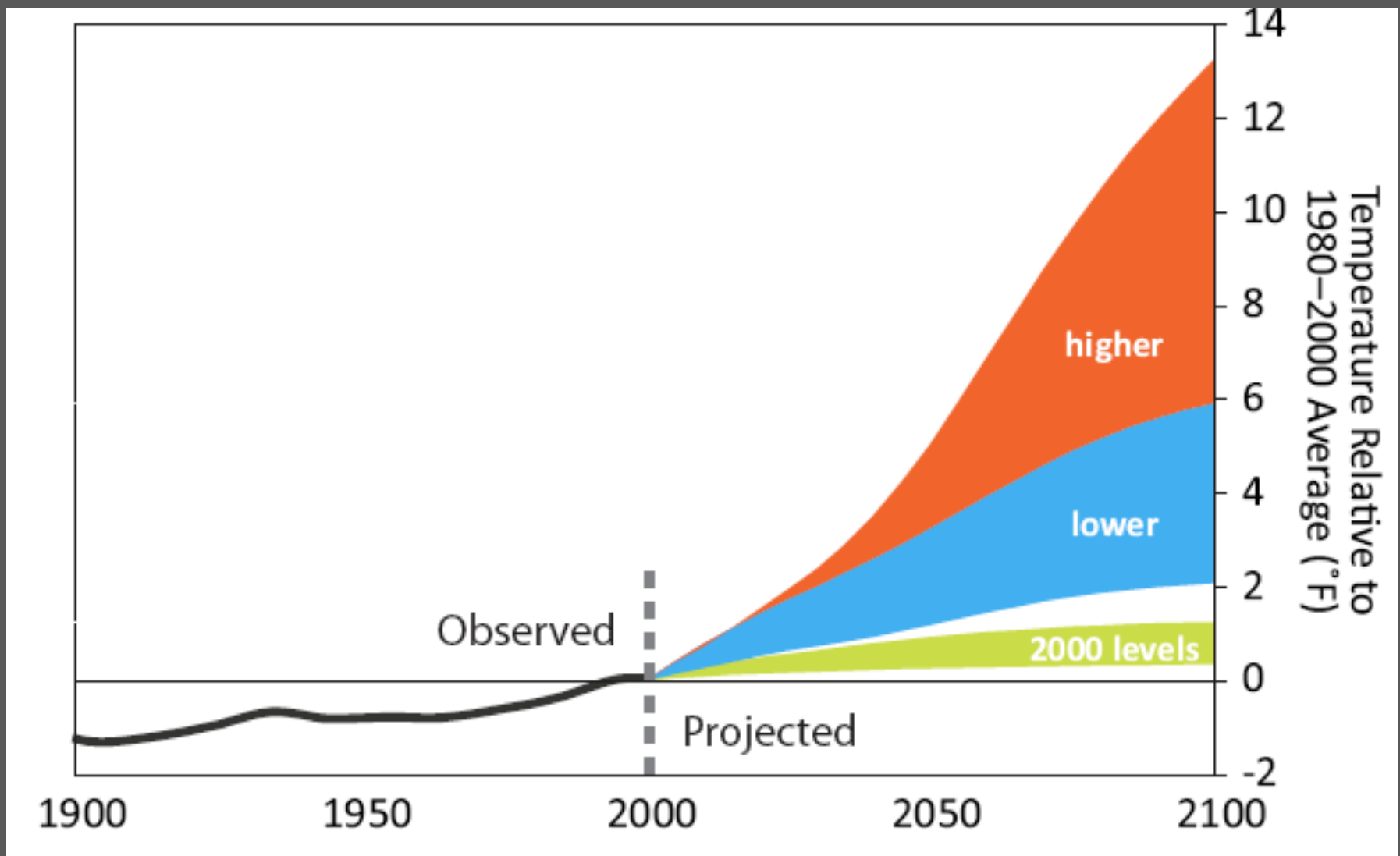
# Greenhouse gas emission projections



# Reality check: where are we now?



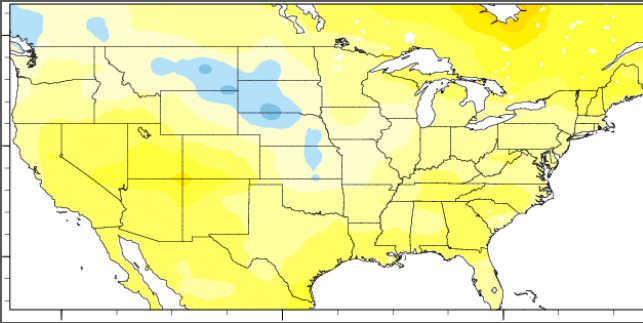
# What can we expect in the future?



# Average conditions continue to warm

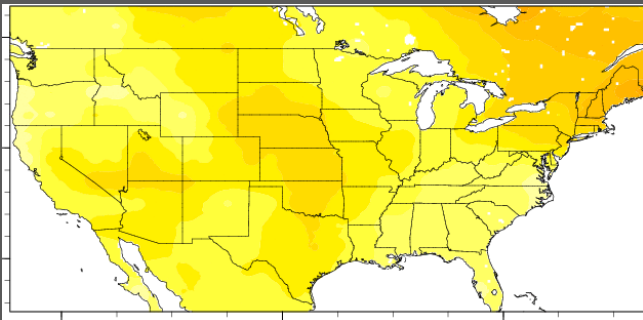
Winter: Mid-High Emissions

2010-2039



Winter: Lower Emissions

2010-2039

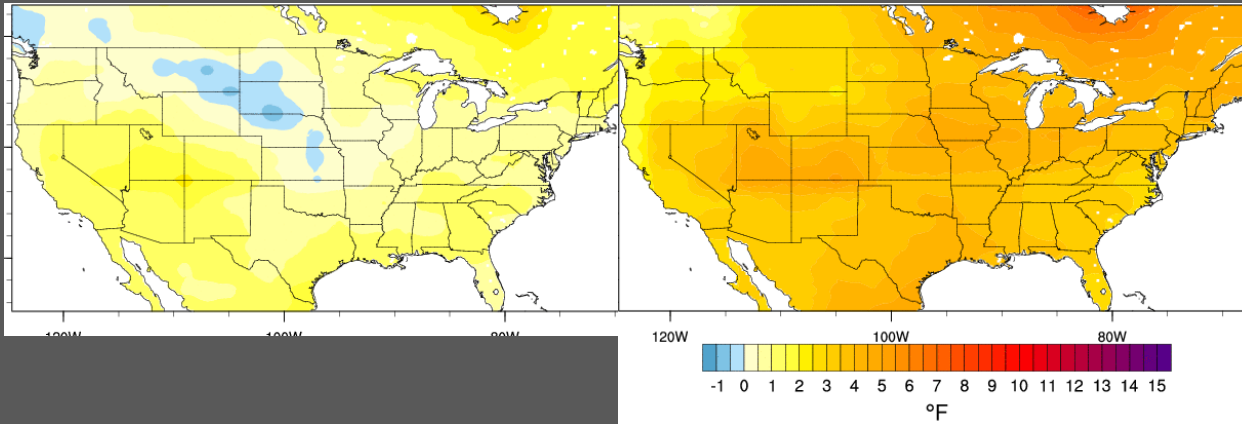


# Average conditions continue to warm

Winter: Mid-High Emissions

2010-2039

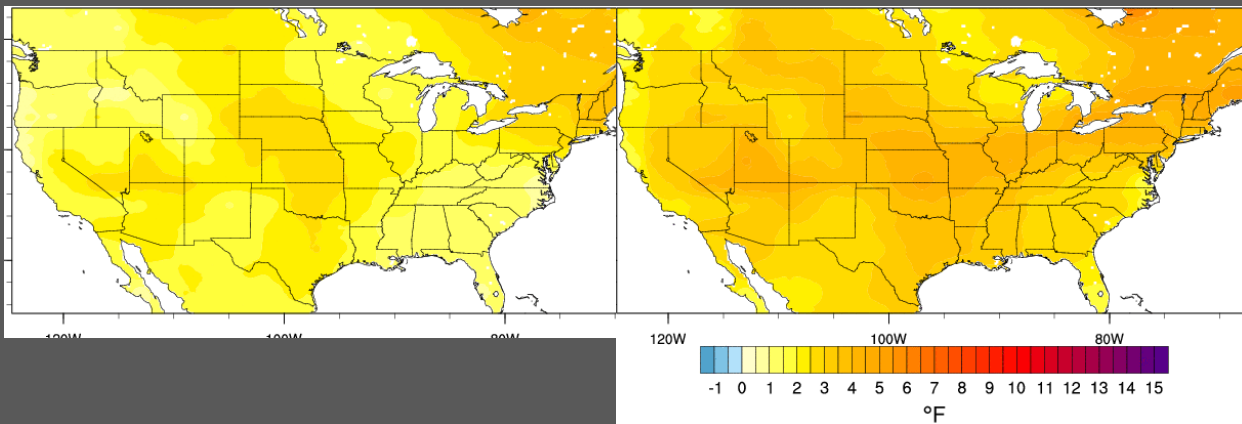
2040-2069



Lower Emissions

2010-2039

2040-2069



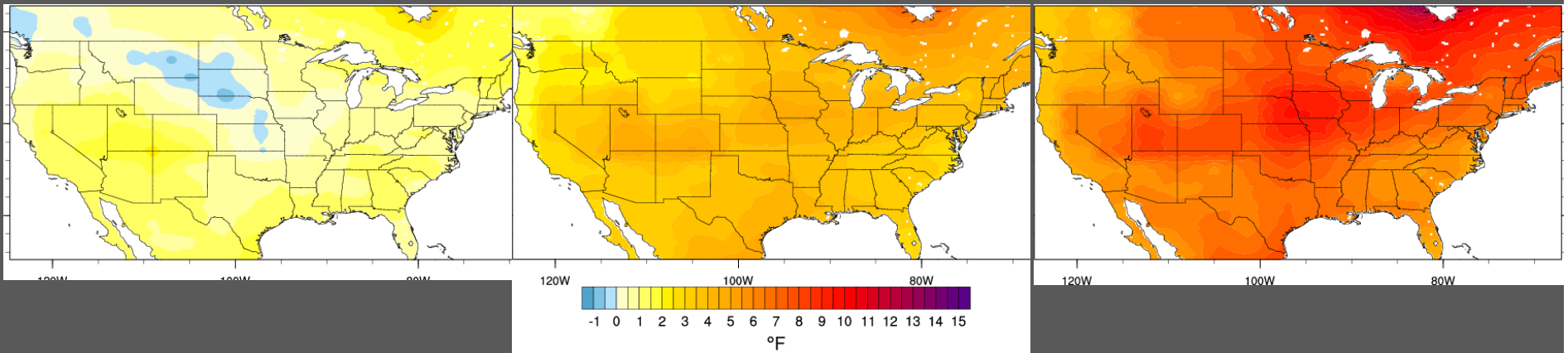
# Average conditions continue to warm

## Winter: Mid-High Emissions

2010-2039

2040-2069

2070-2099

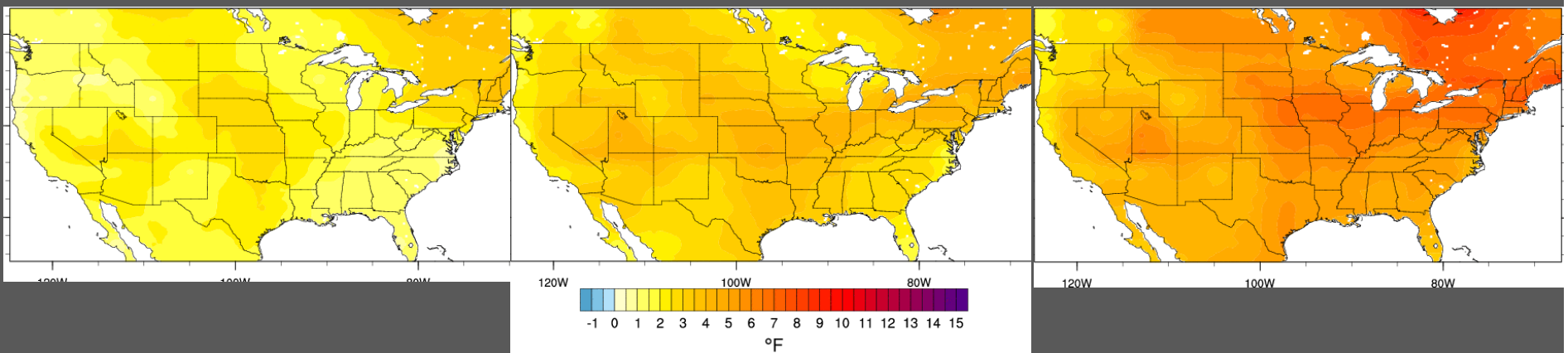


## Lower Emissions

2010-2039

2040-2069

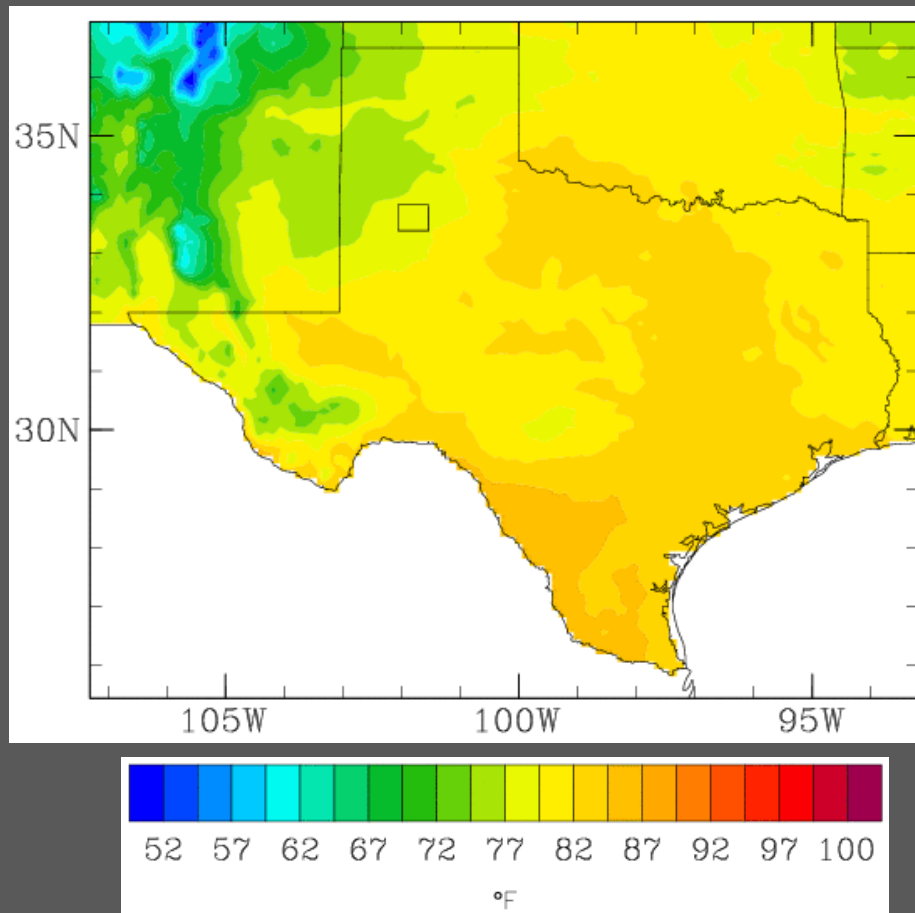
2070-2099





# Summer temperatures in Texas

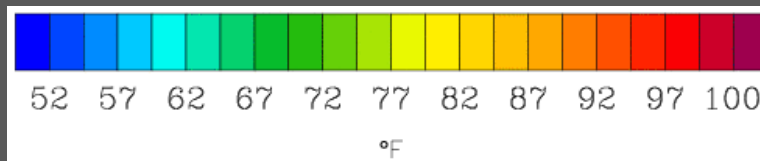
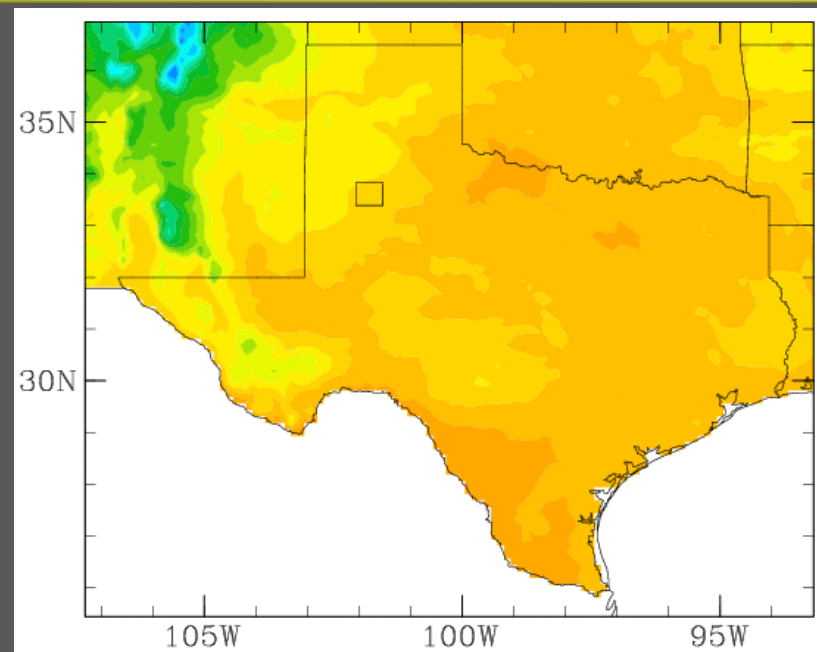
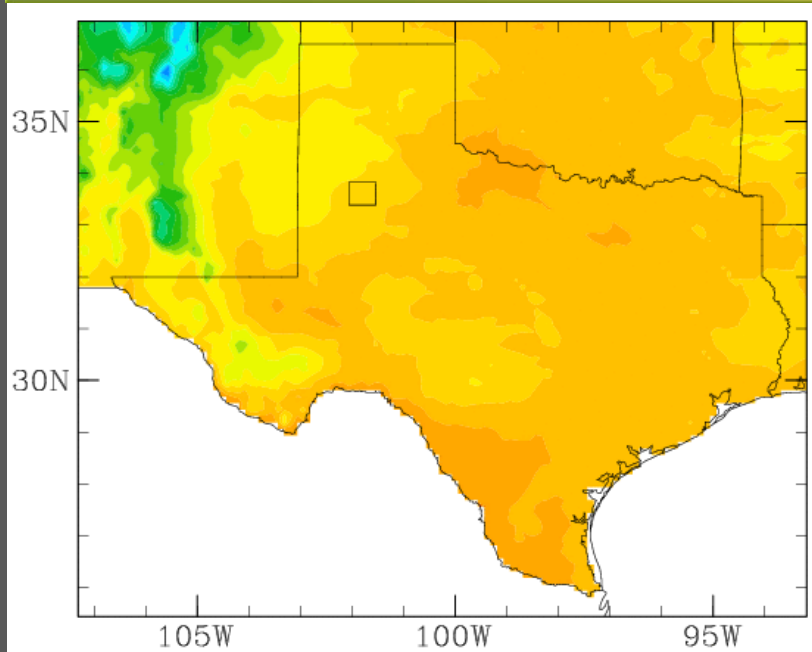
1961-1990



# Summer temperatures in Texas

HIGHER EMISSIONS

LOWER EMISSIONS

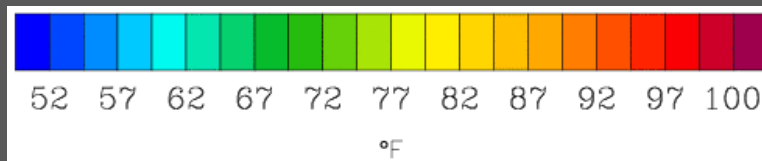
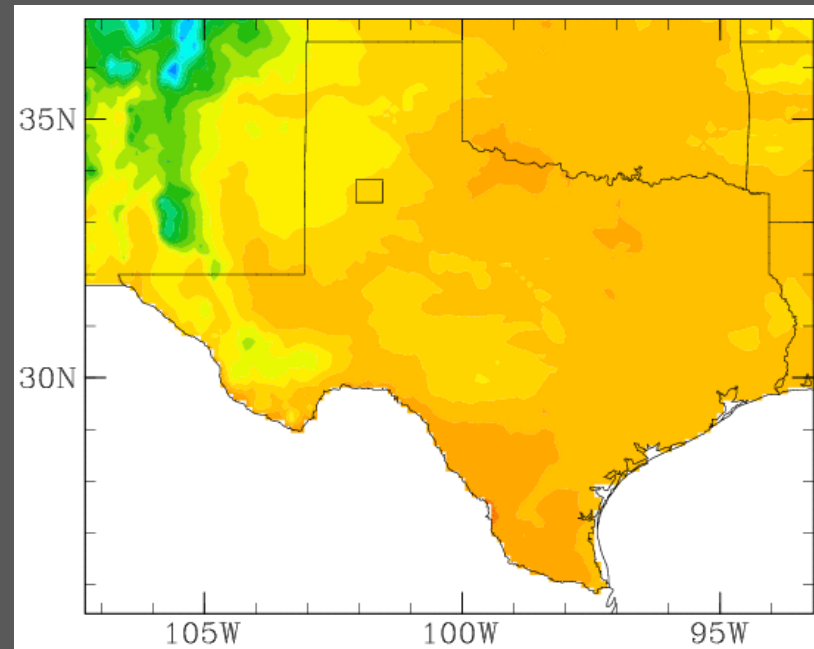
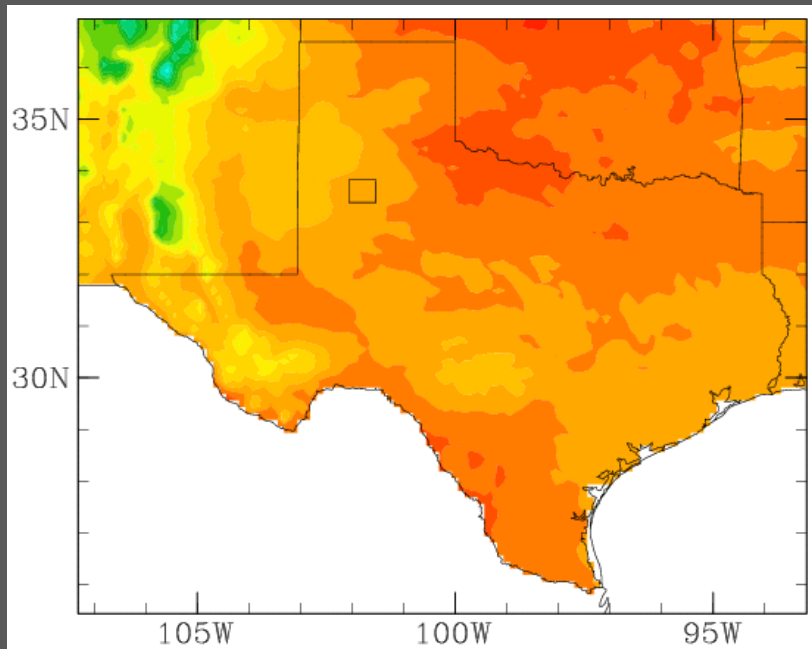


NEAR FUTURE: 2010-2039

# Summer temperatures in Texas

**HIGHER EMISSIONS**

**LOWER EMISSIONS**

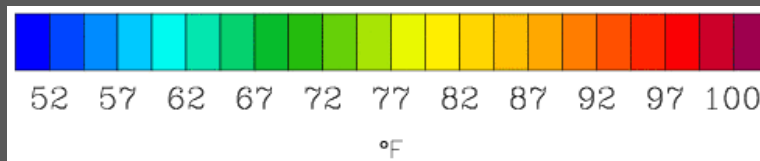
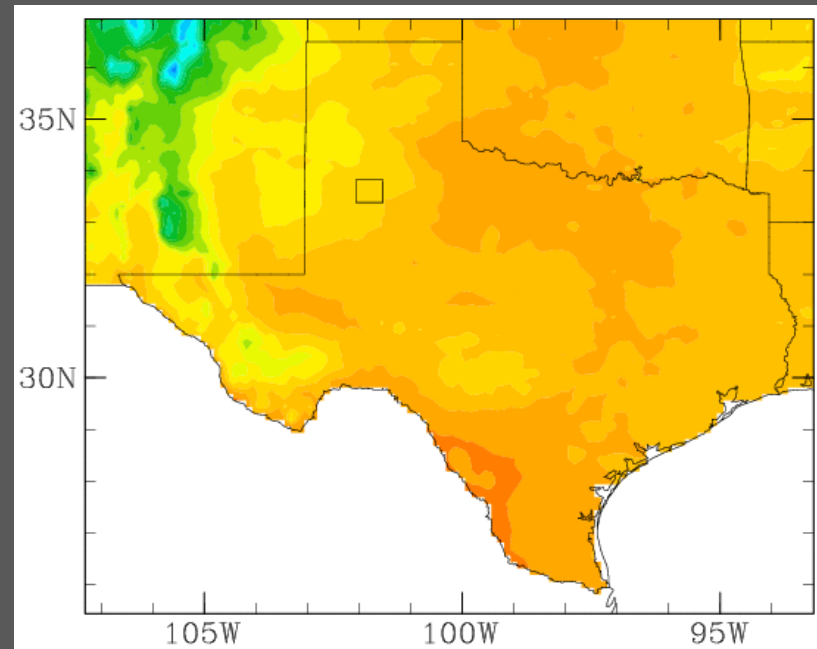
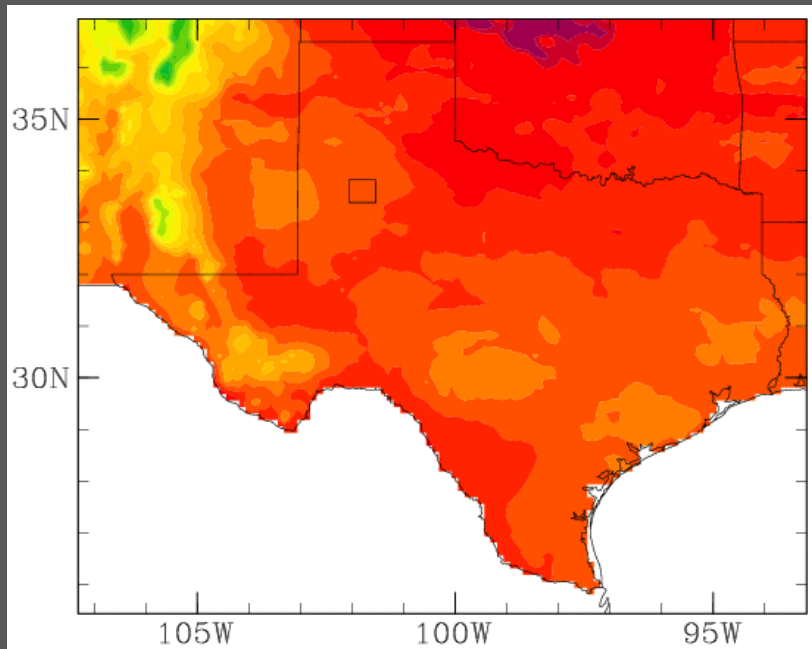


**MID-CENTURY: 2040-2069**

# Summer temperatures in Texas

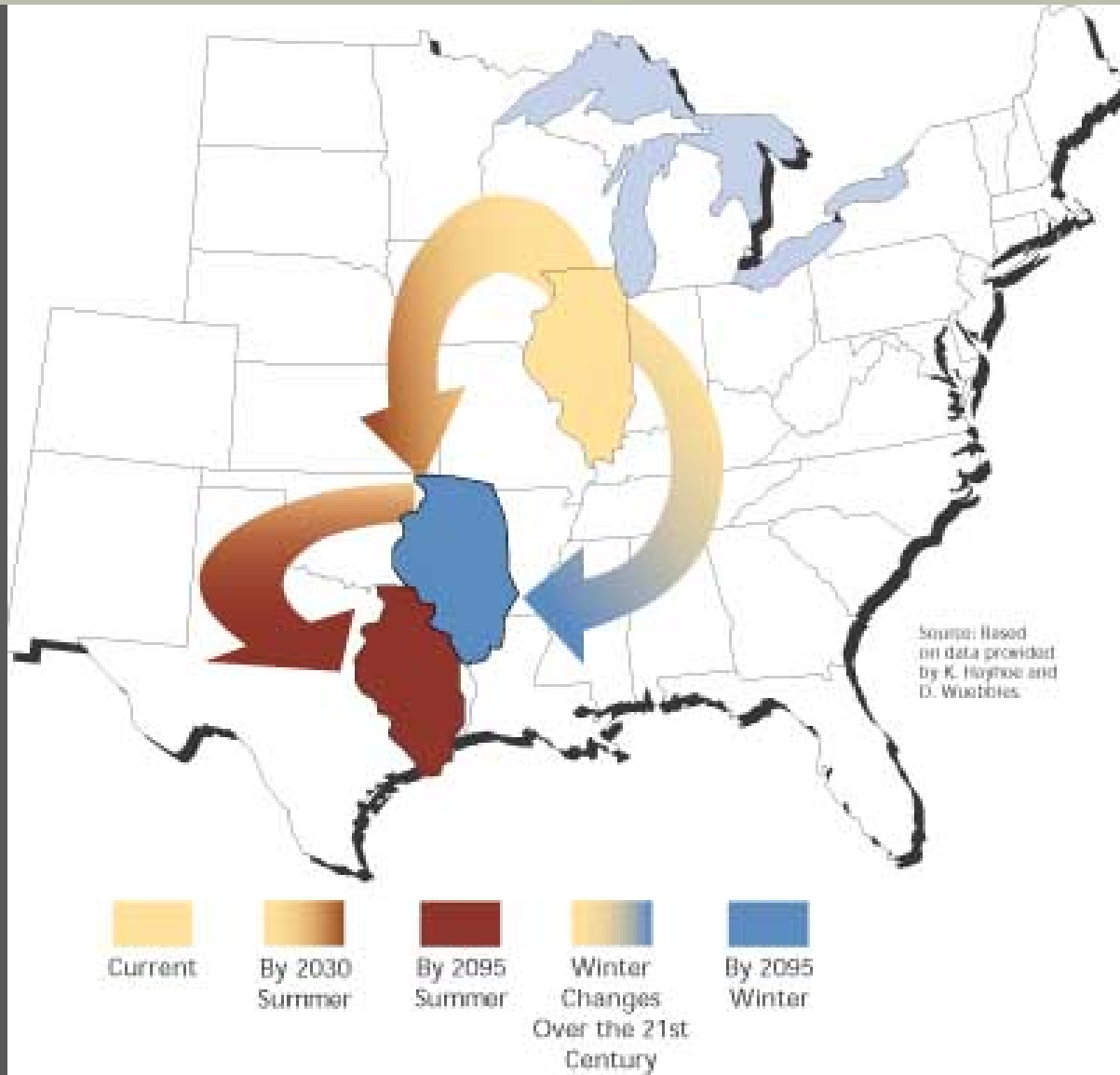
**HIGHER EMISSIONS**

**LOWER EMISSIONS**



**END-OF-CENTURY: 2070-2099**

# Migrating Illinois Climate



# Focus on Chicago

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

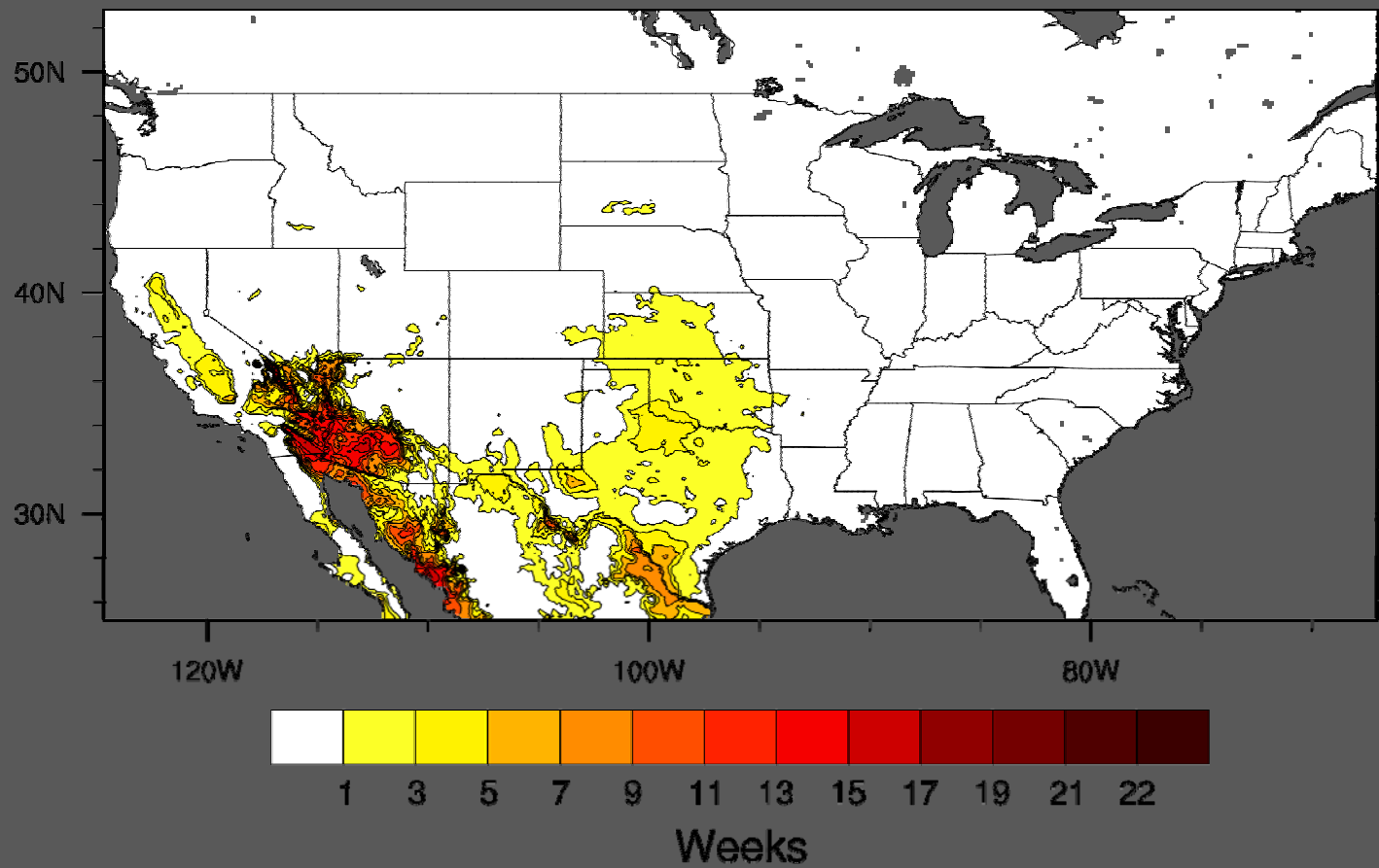
 under higher emissions

 under lower emissions



# Weeks with maximum temperature > 100oF

1961-1979

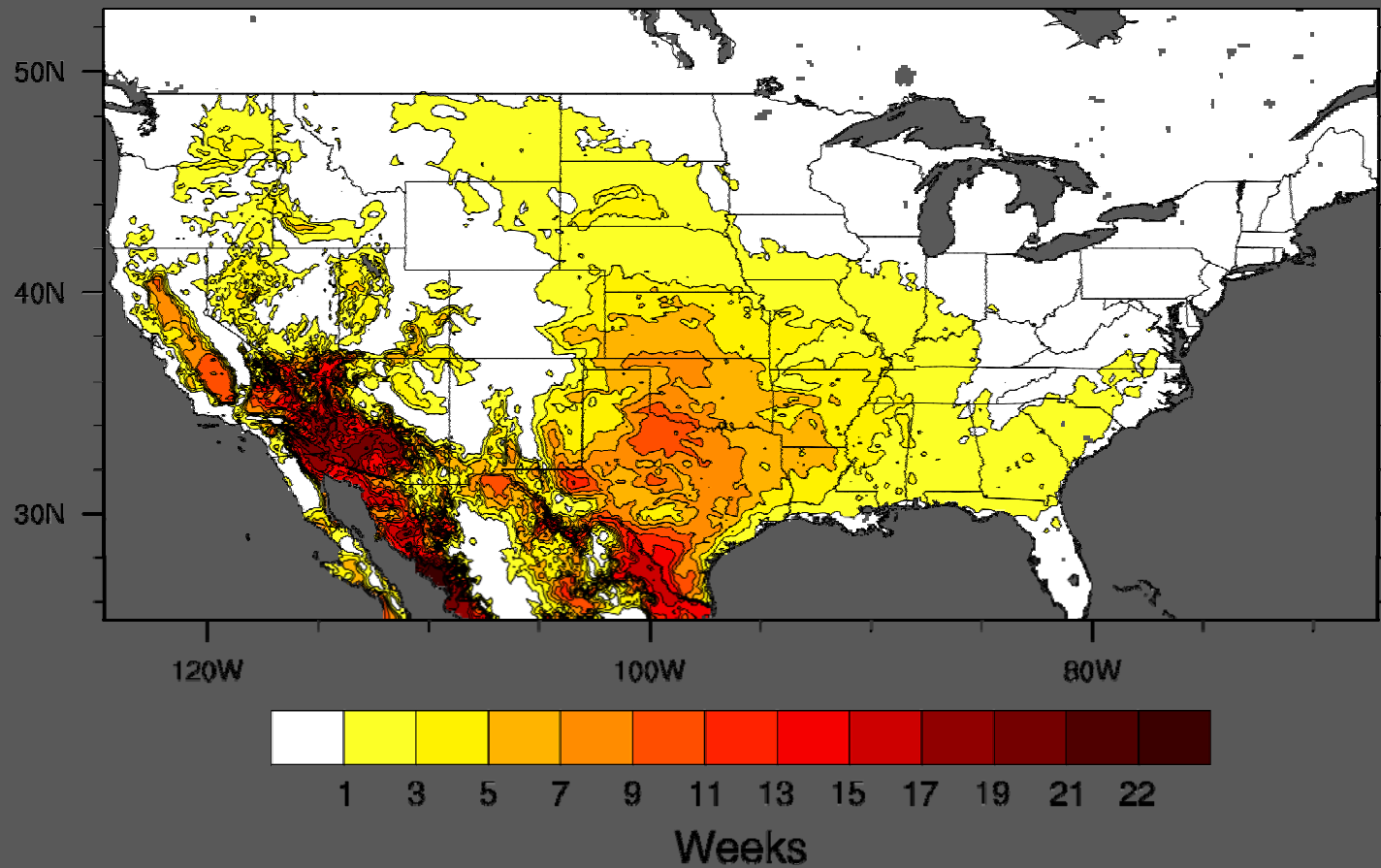


From: Hayhoe & Farley, A Climate for Change, 2009



# Weeks with maximum temperature > 100oF

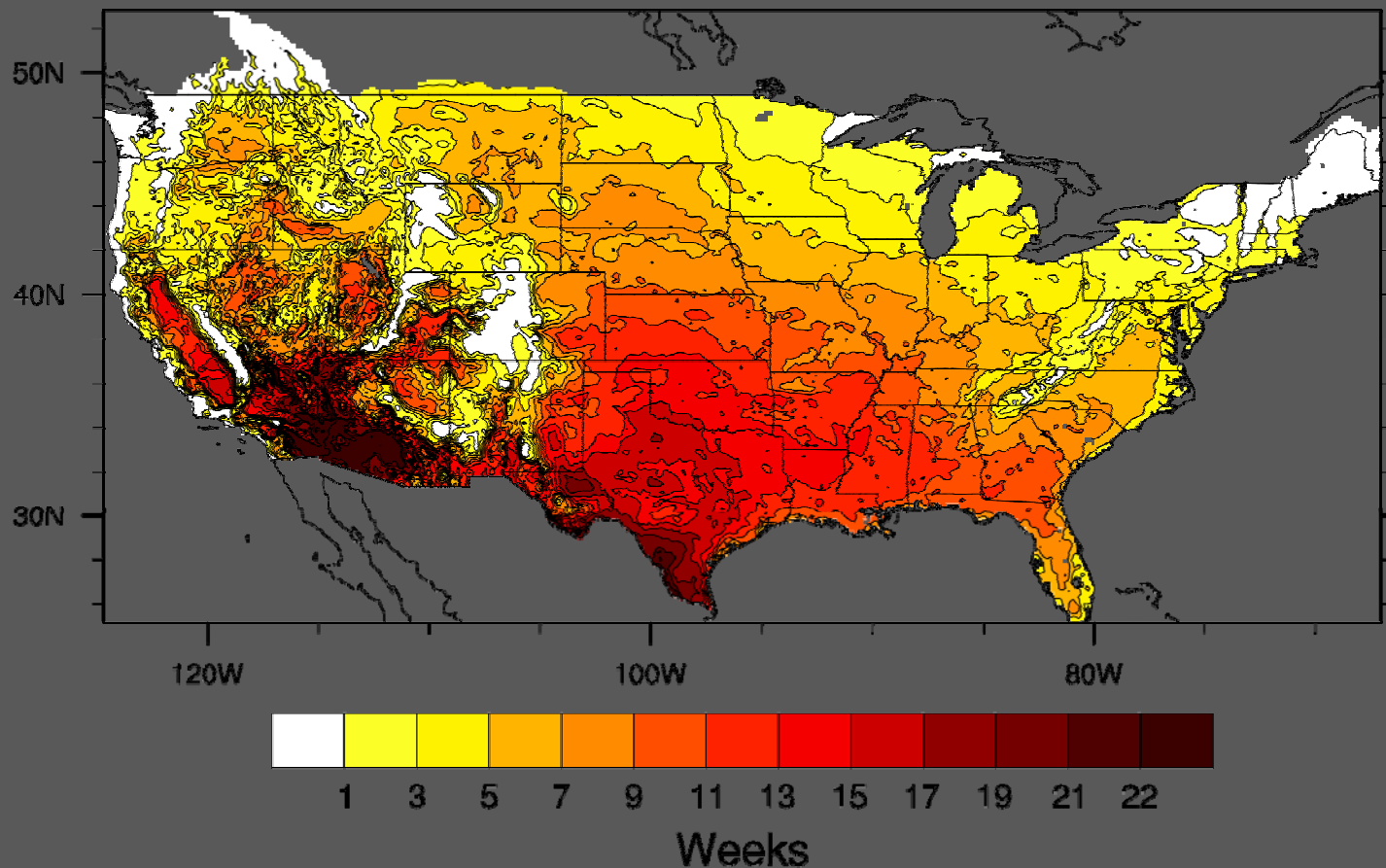
2070-2099 (B1 lower emissions)



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

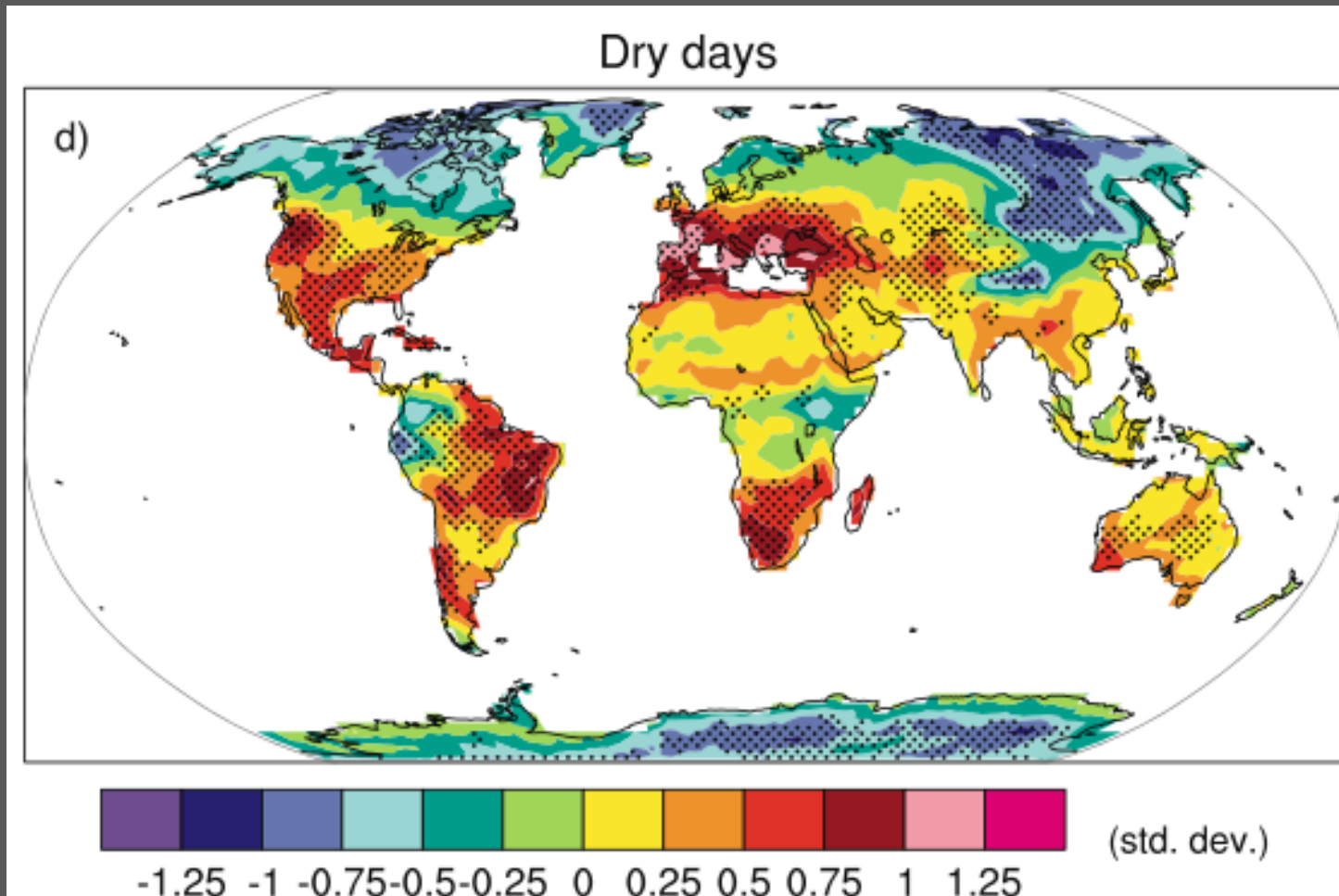
# Weeks with maximum temperature > 100oF

2070-2099 (A1FI higher emissions)

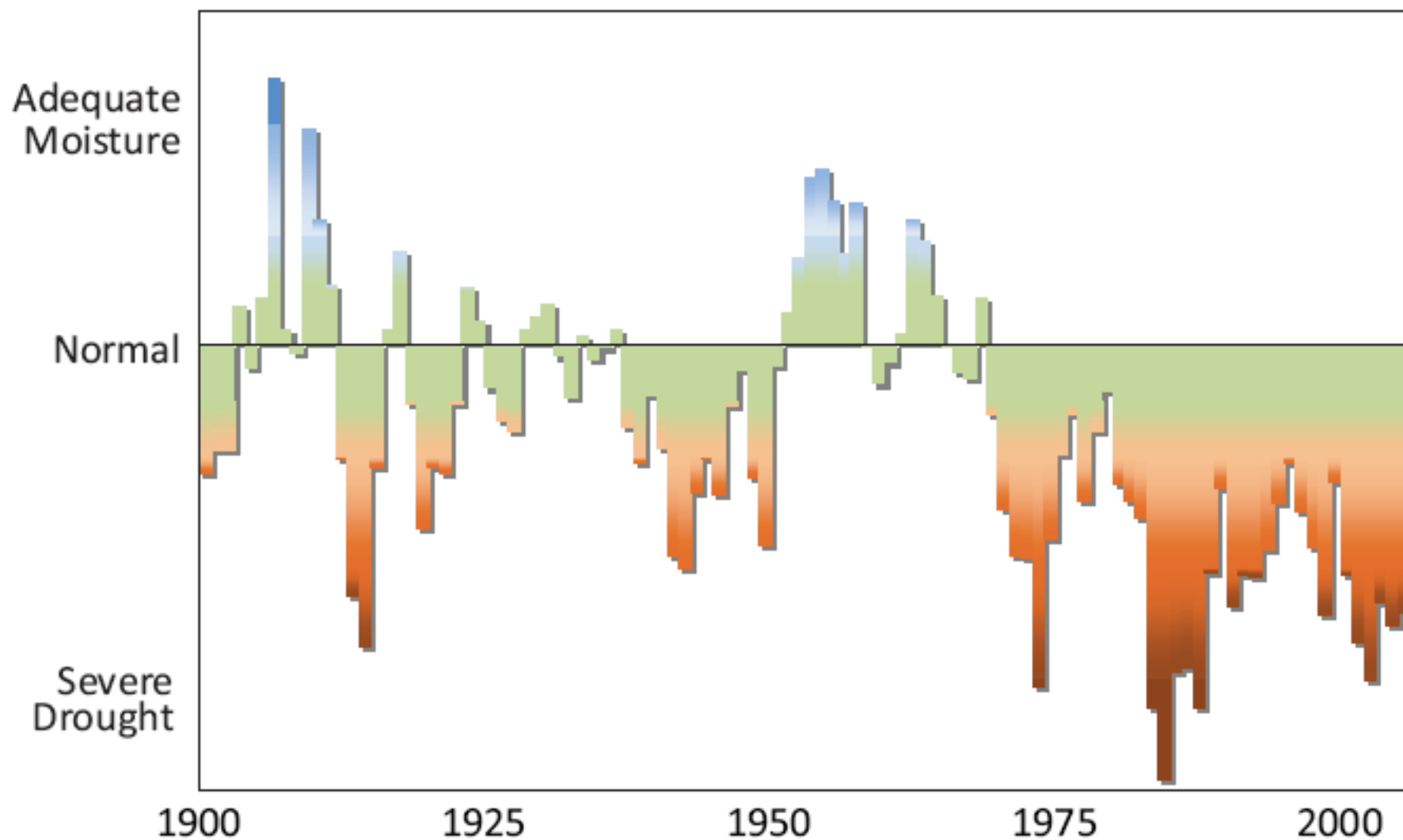


From: Hayhoe & Farley, A Climate for Change, 2009

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

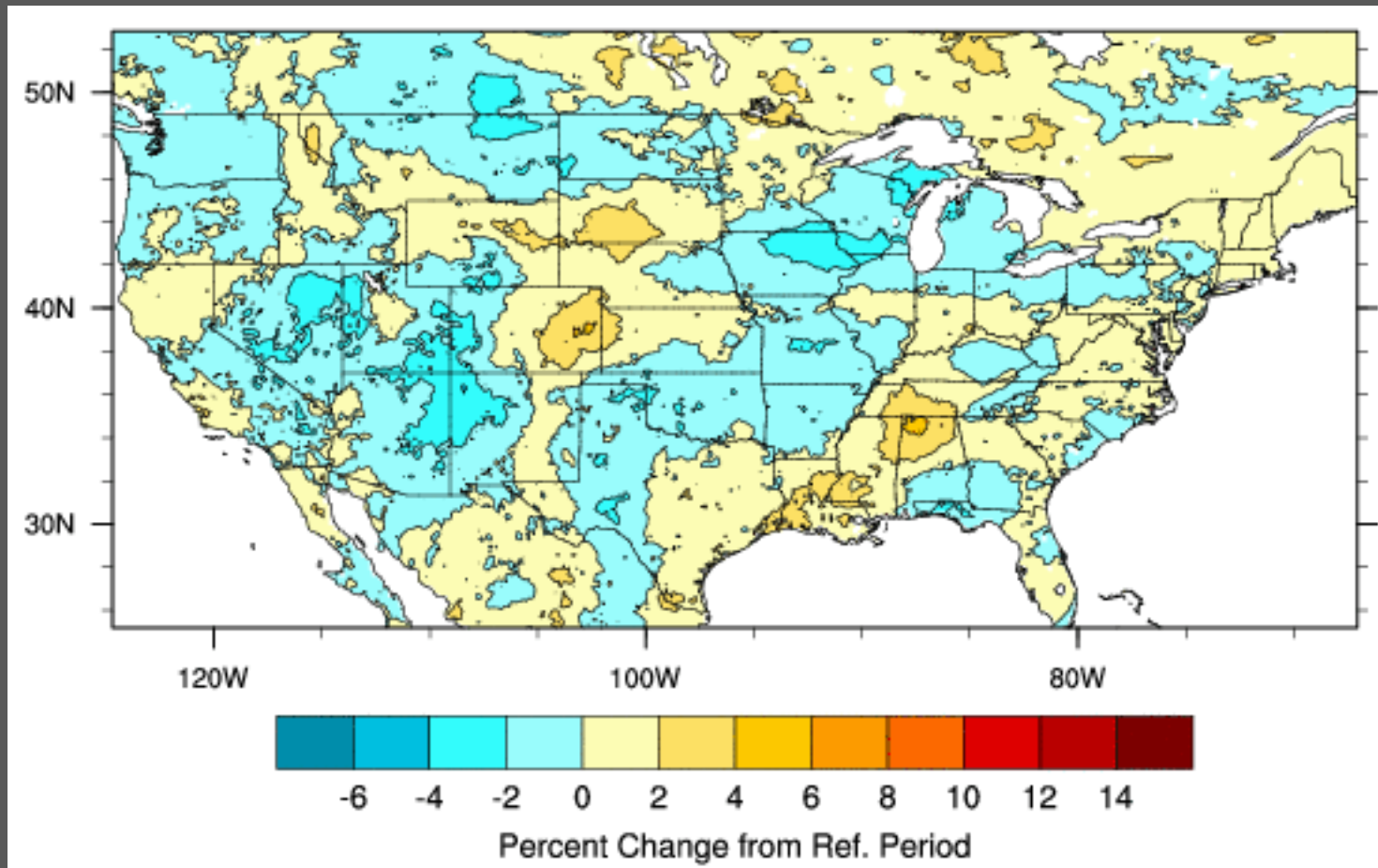


# Drought in central Africa



# Time in drought

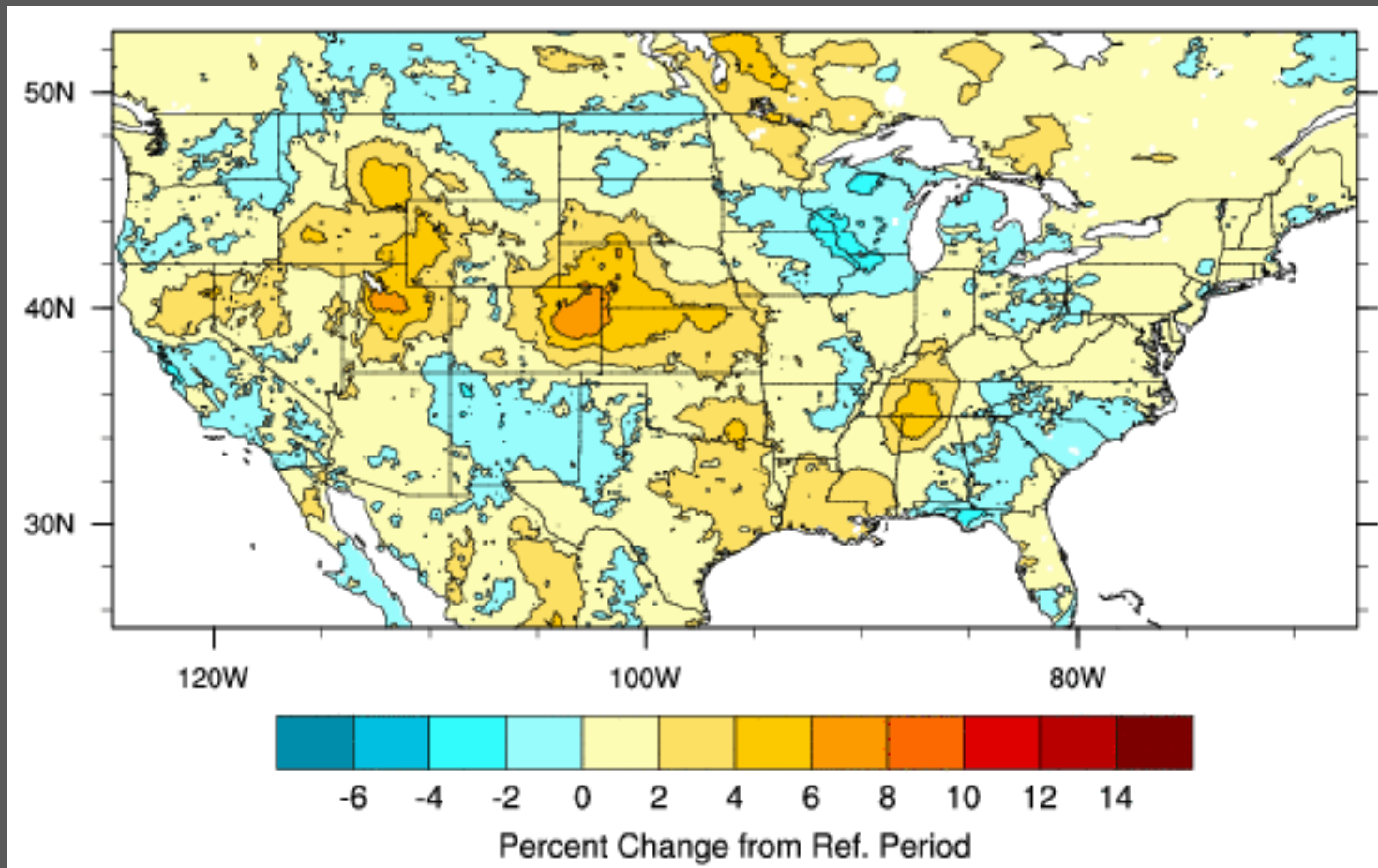
2010-2029



Hayhoe, unpublished

# Time in drought

2040-2059

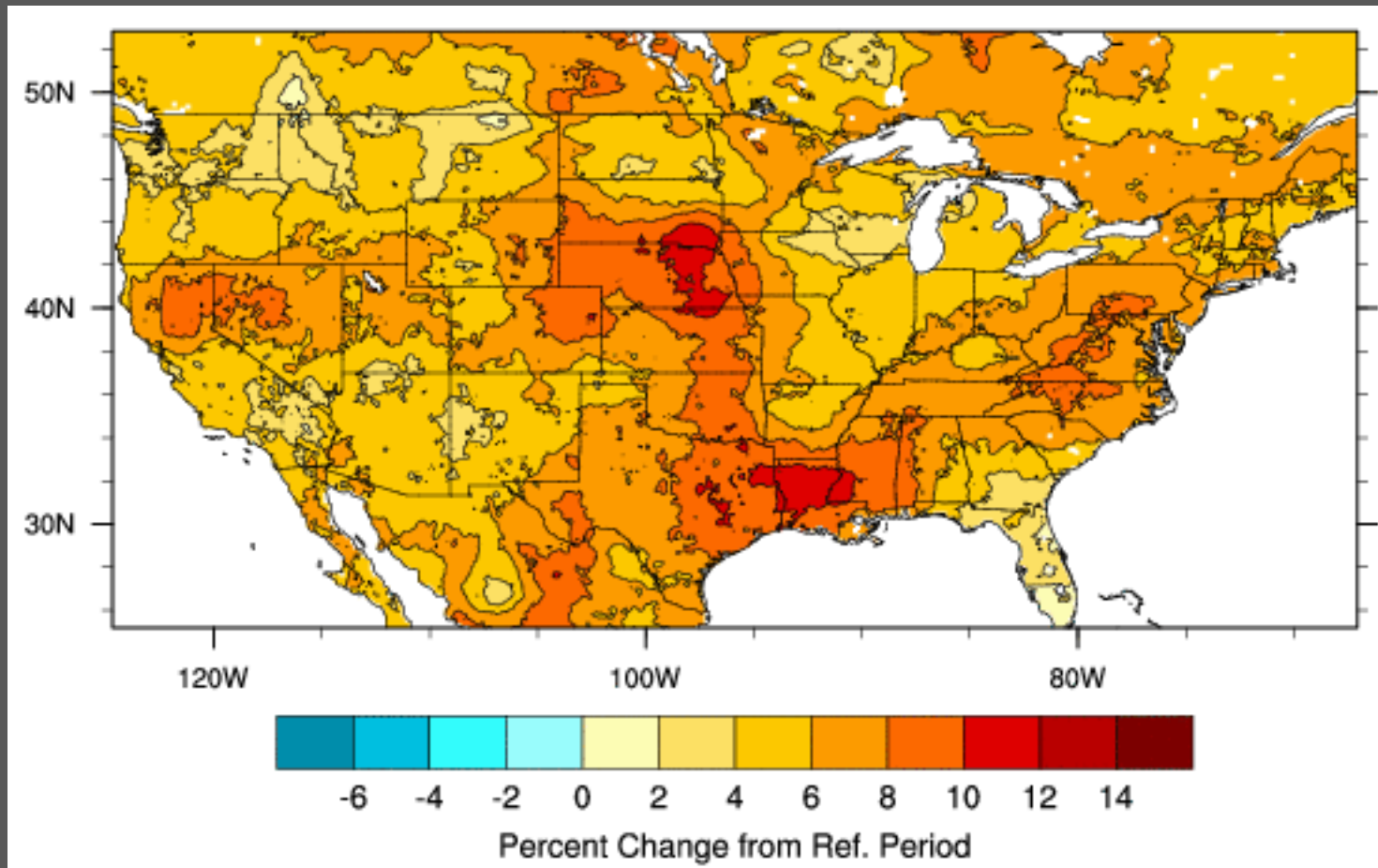


Hayhoe, unpublished



# Time in drought

2080-2099 (mid-high emissions)



Hayhoe, unpublished



## 3 questions on climate change

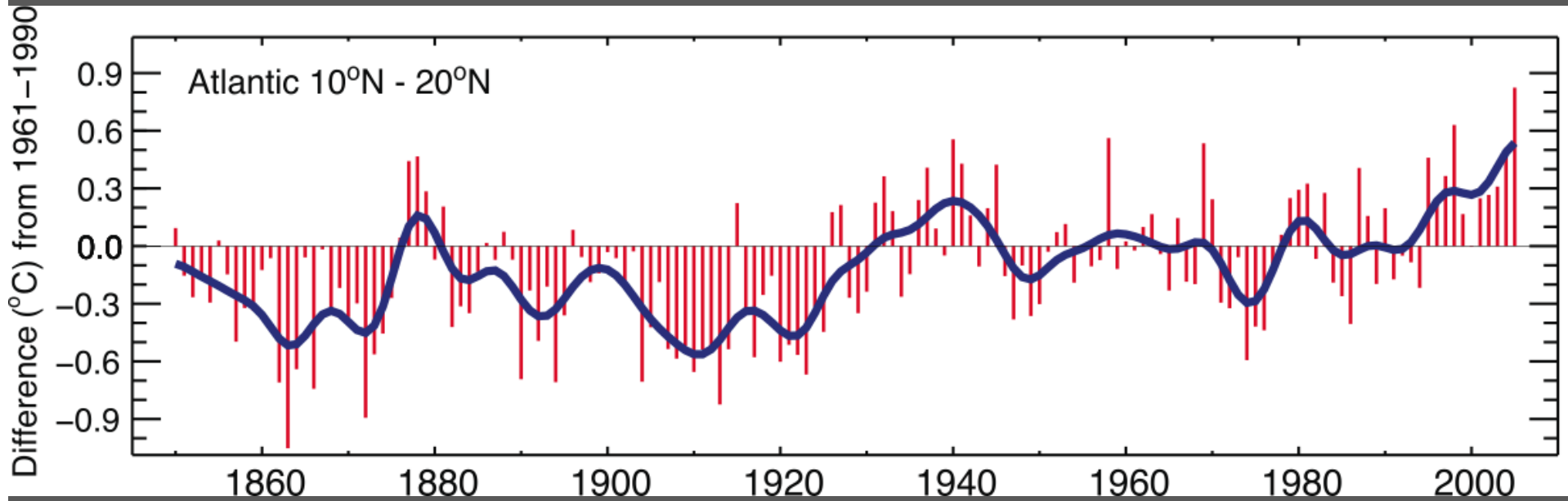
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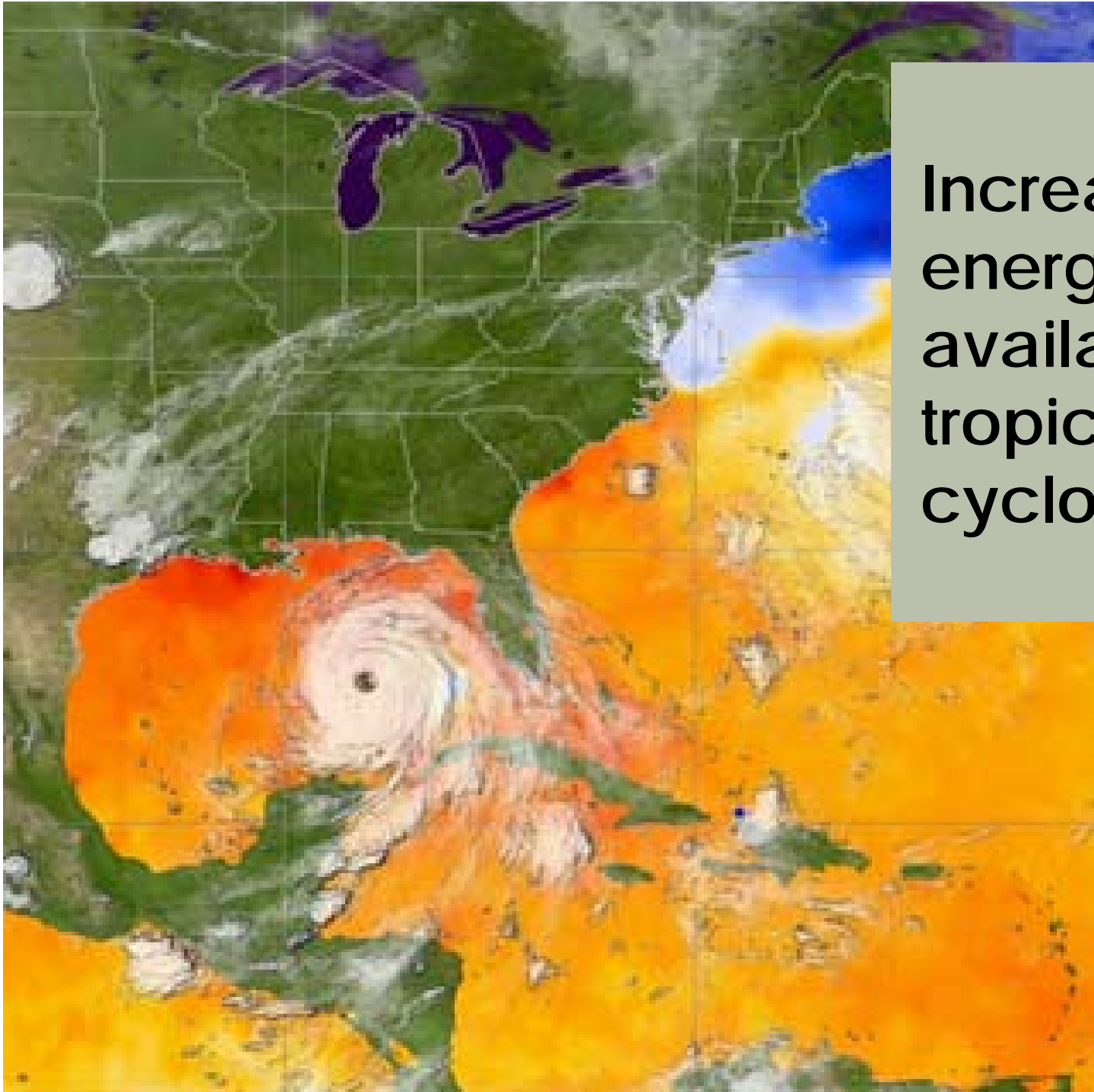
## 3 questions on climate change

**3. WHAT** impacts will it have on our world?

- Hurricanes
- Coastal areas
- Heat extremes
- Water

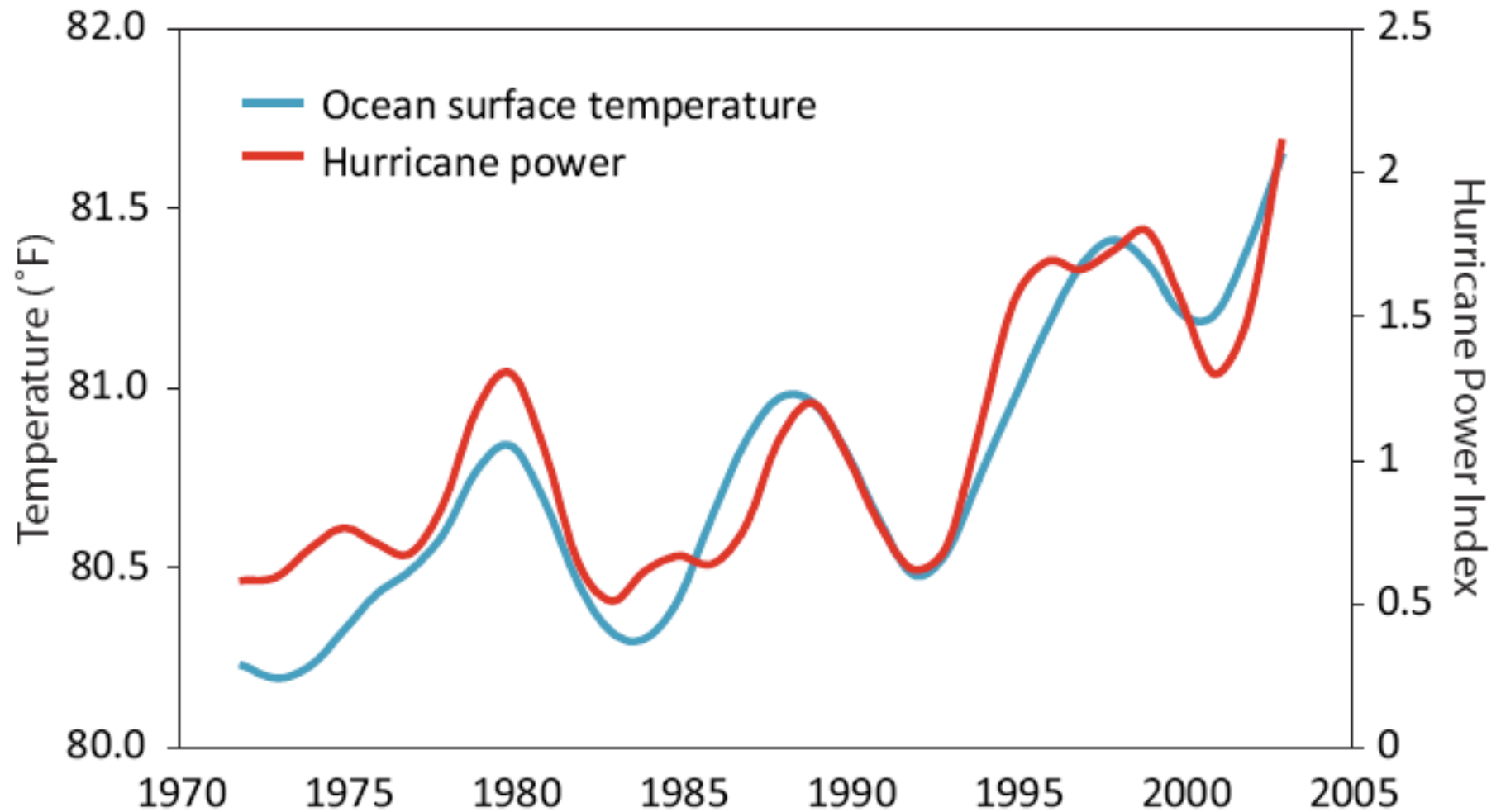
# Hurricanes: the oceans are warming...





Increasing the energy available to tropical cyclones.

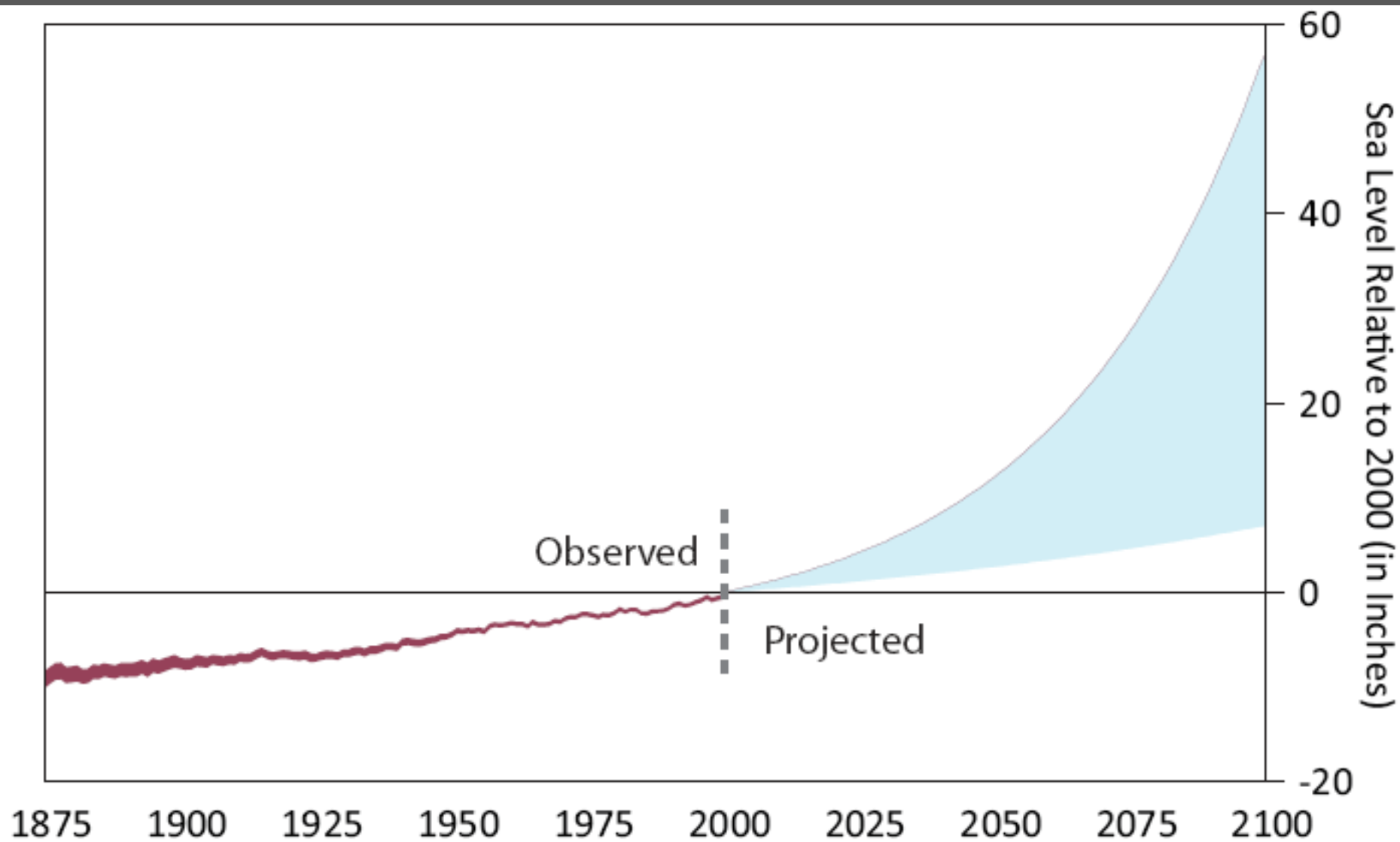
# Hurricane power and ocean temperature



# 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

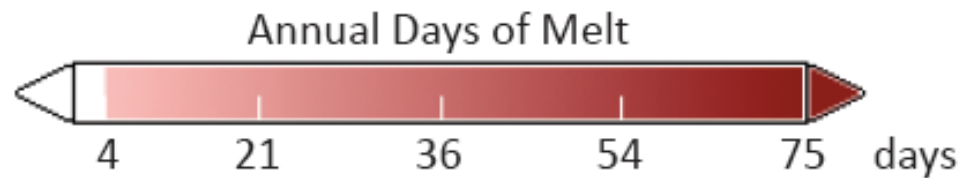




Greenland is melting...



... twice as fast as a decade ago!



... endangering coastal areas and islands

Tuvalu, South Pacific

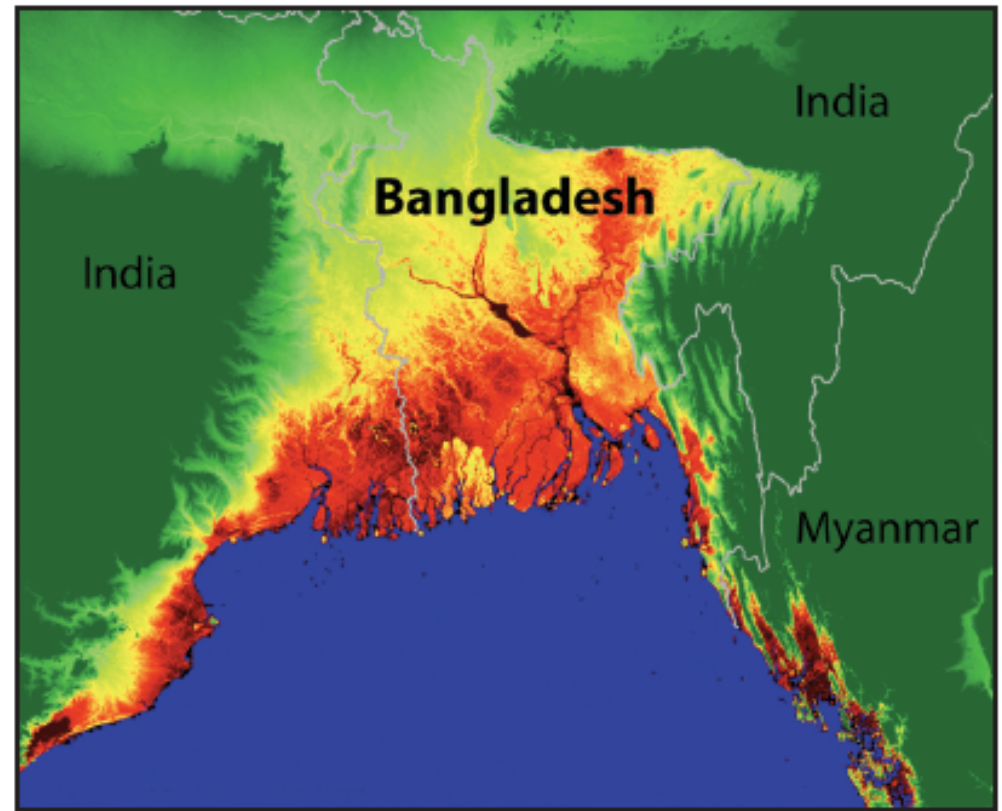




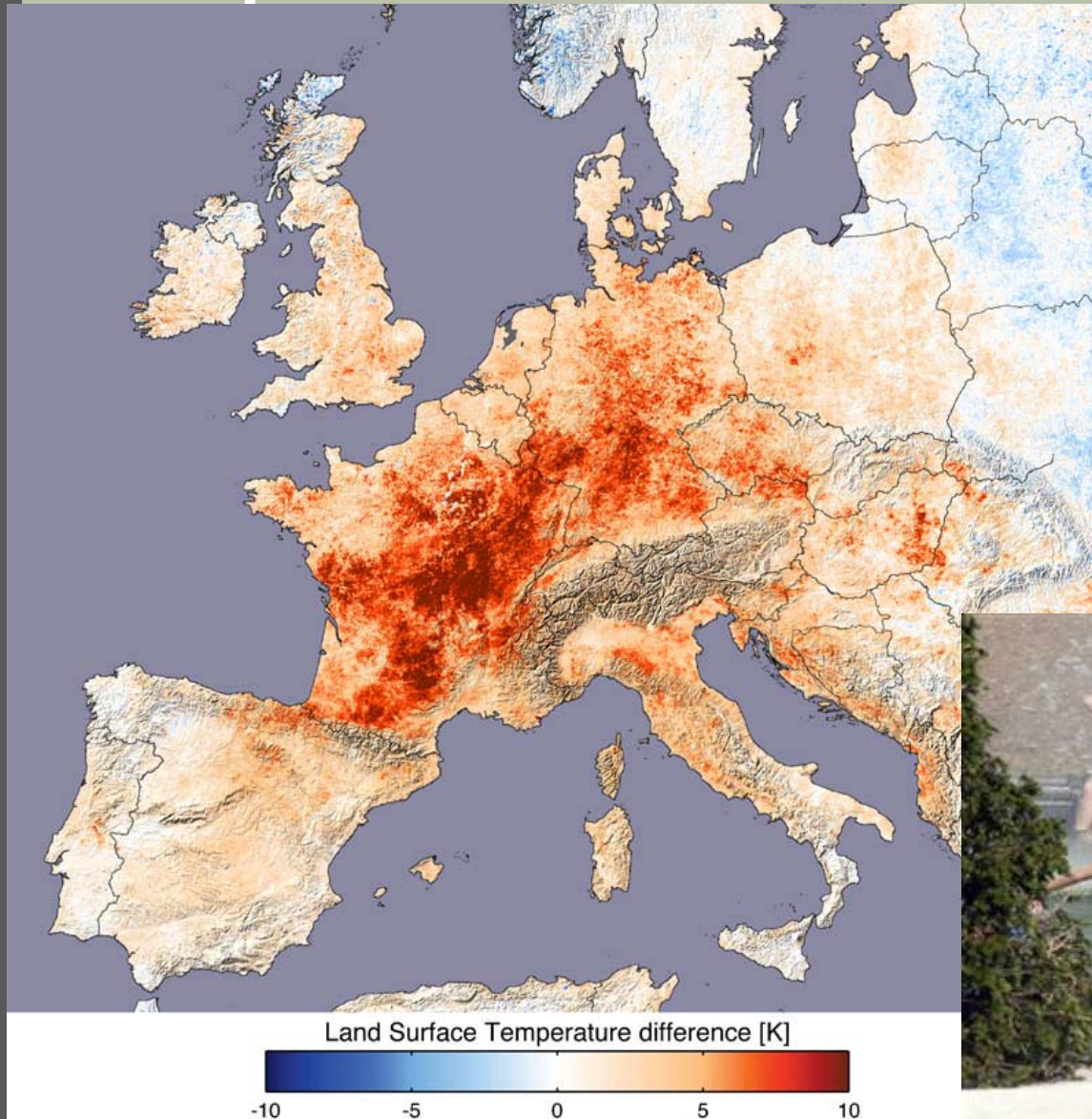
... endangering coastal areas and islands



# Area at risk from sea level rise



# EXTREME HEAT: European Heatwave 2003



**>70,000 deaths**

15,000 in France

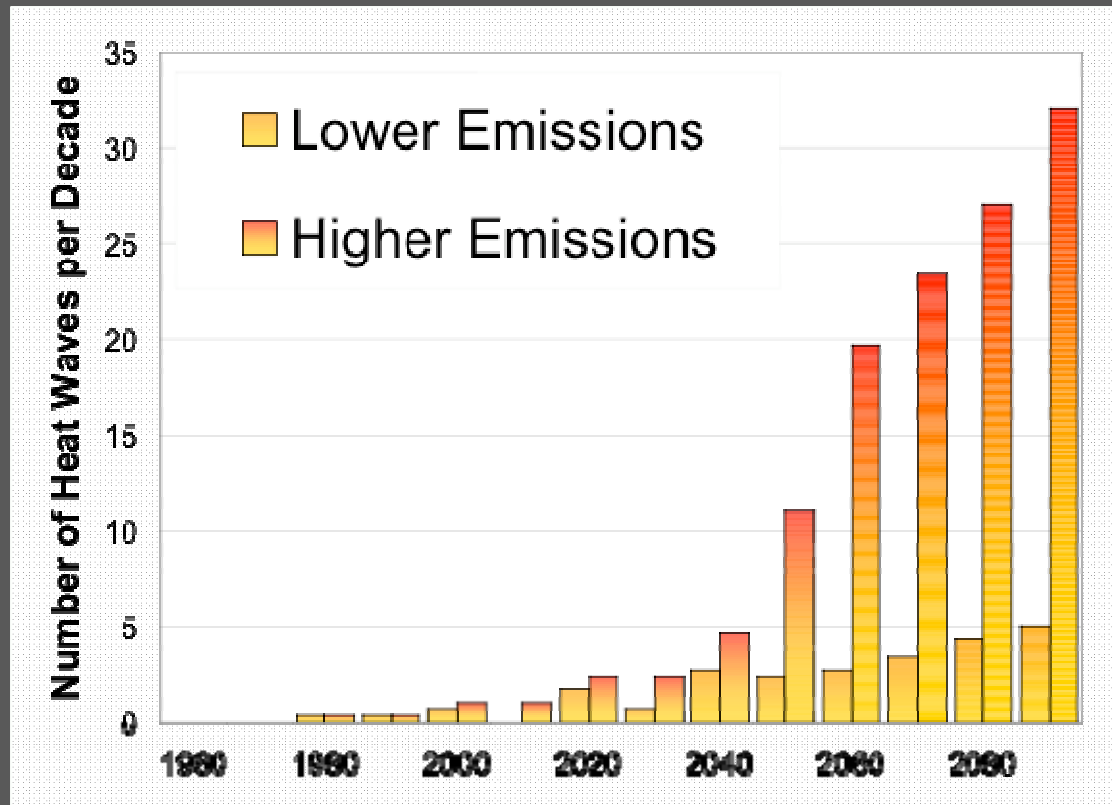
20,000 in Germany

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.

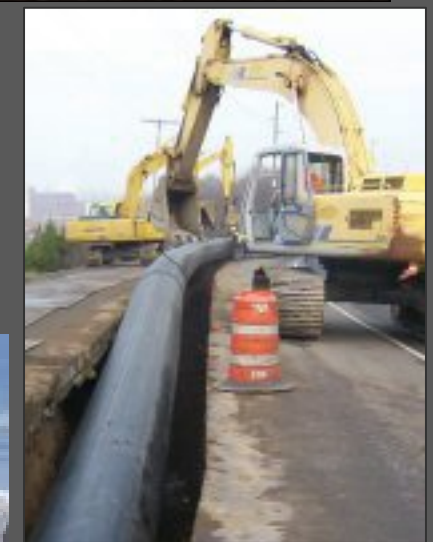
By end-of-century, Under lower emissions, every other year could have a 1995-like heat wave.

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

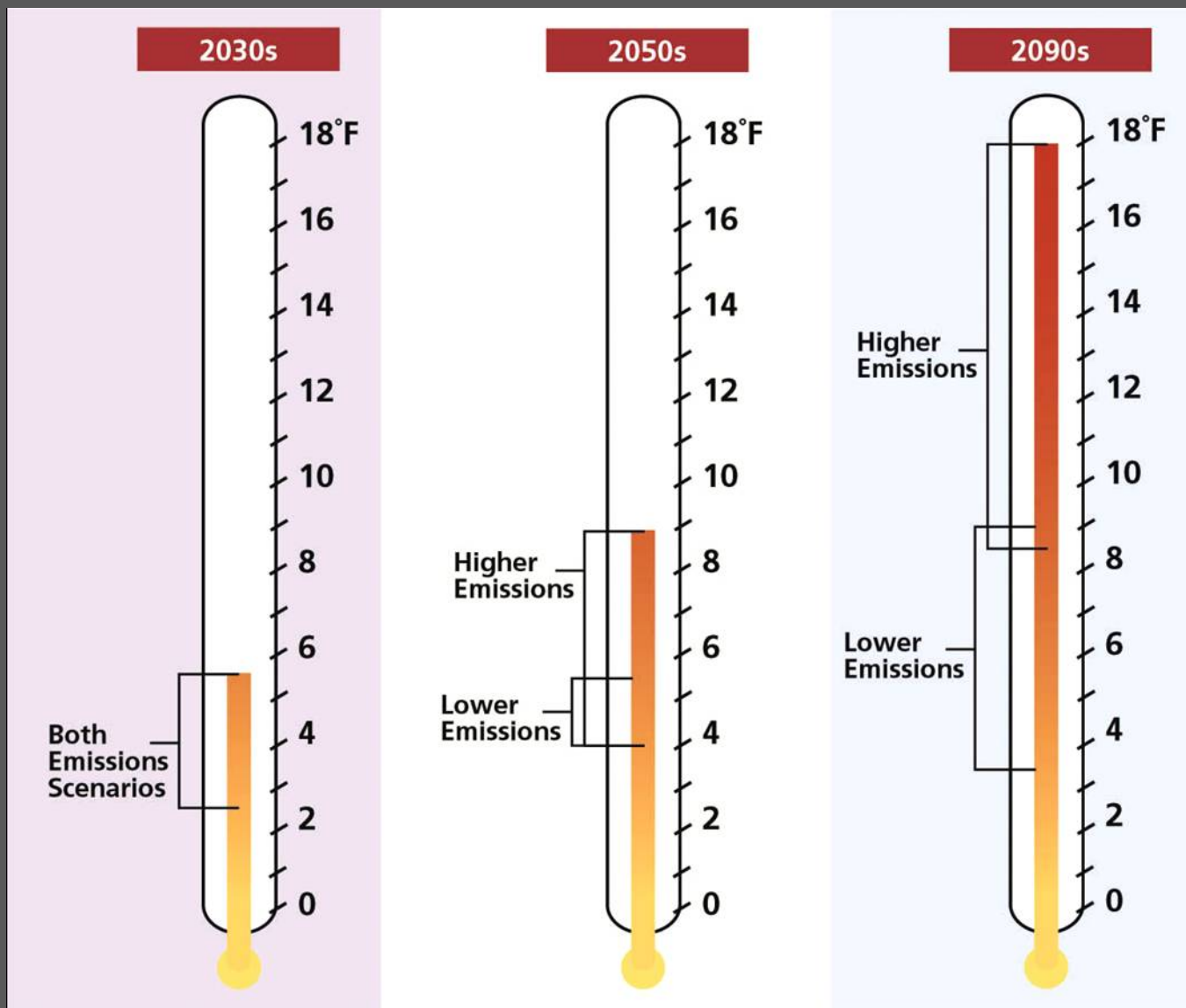


# How will climate change affect our energy and infrastructure?

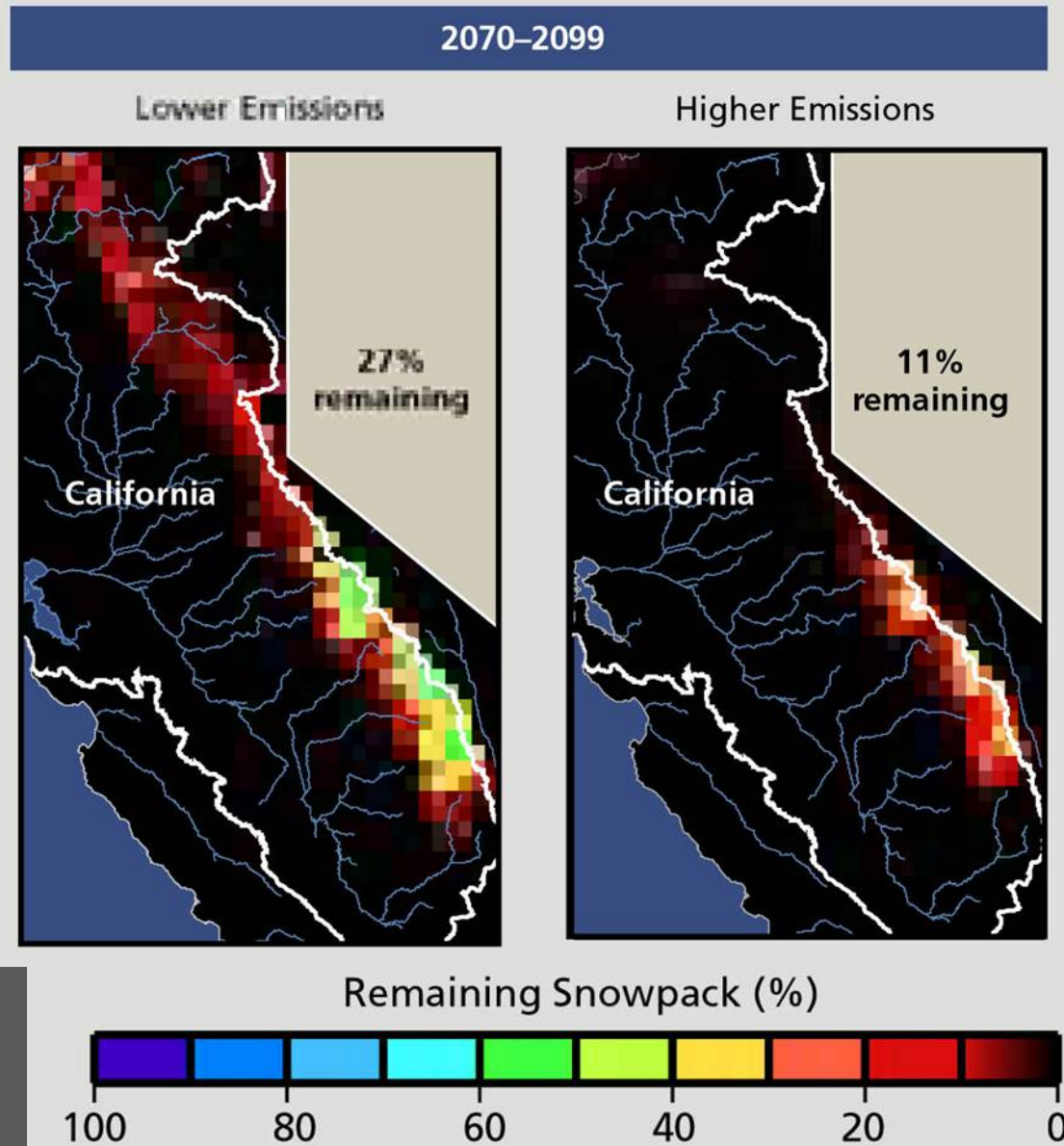
- Increased stress from higher temperatures, temperature swings, more flooding, higher sea levels
- Greater demand for electricity for air conditioning – higher risk of shortages
- More frequent infrastructure interruptions by extreme events
- Costs for Chicago:
  - \$2.5B under higher emissions
  -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



# Water resources



# ... in California



# Glaciers are melting



Grinnell Glacier, Glacier National Park, USA

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

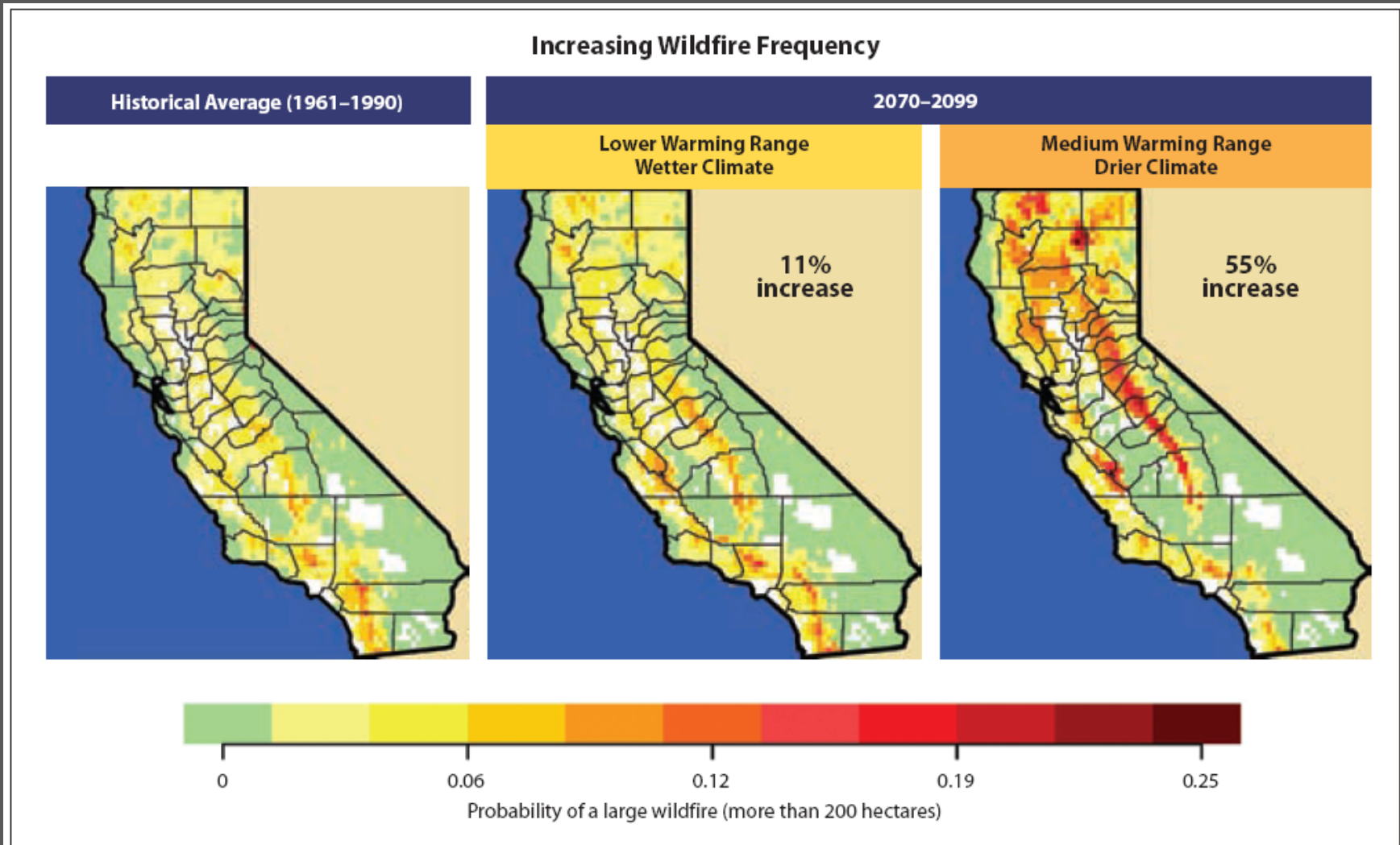


# Water supply for Lima, Peru



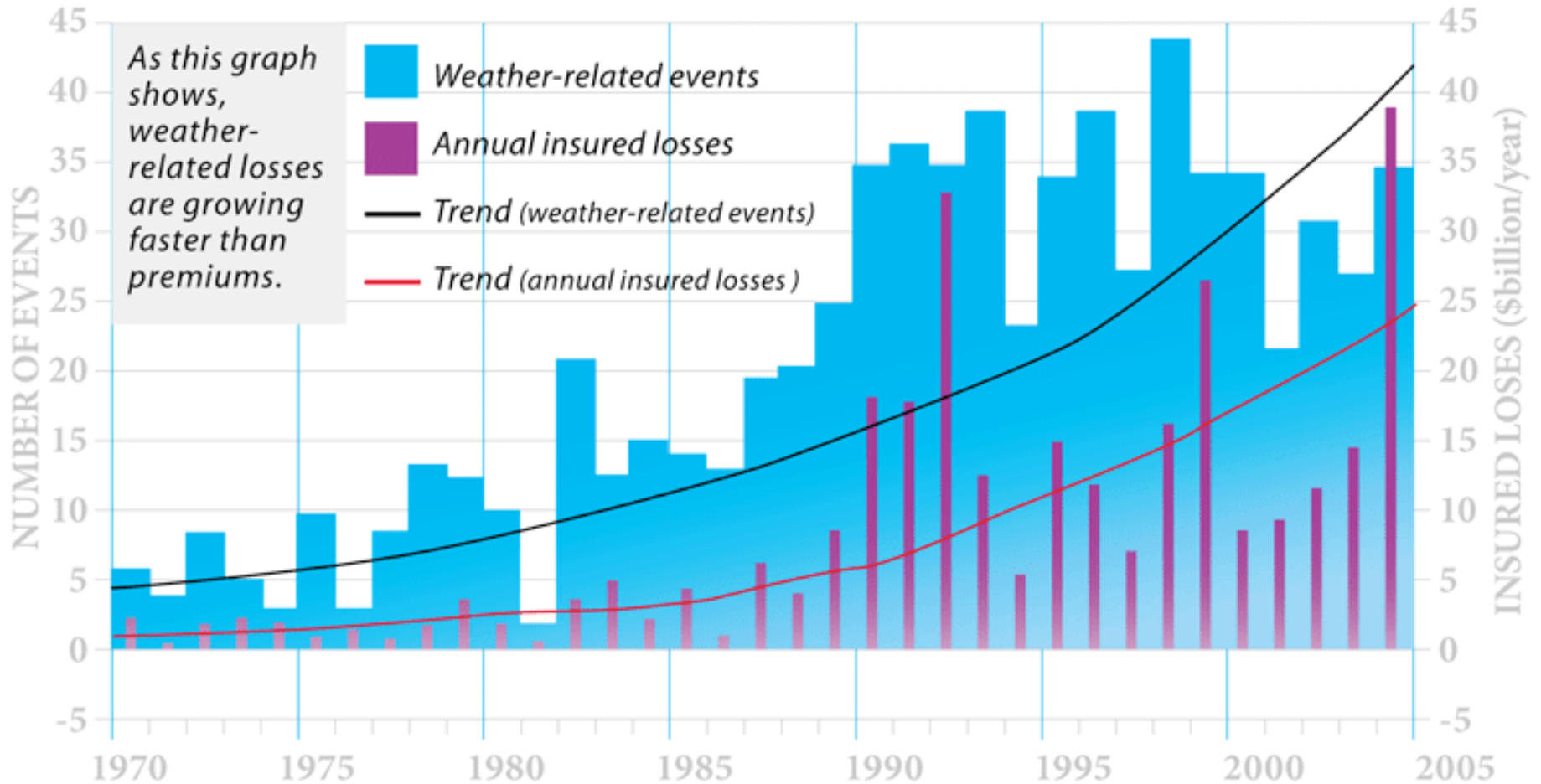
1 billion depend on glacier melt for water supply

# Increasing wildfire frequency



# More extreme weather: events & losses

## WEATHER-RELATED DISASTERS AND LOSSES



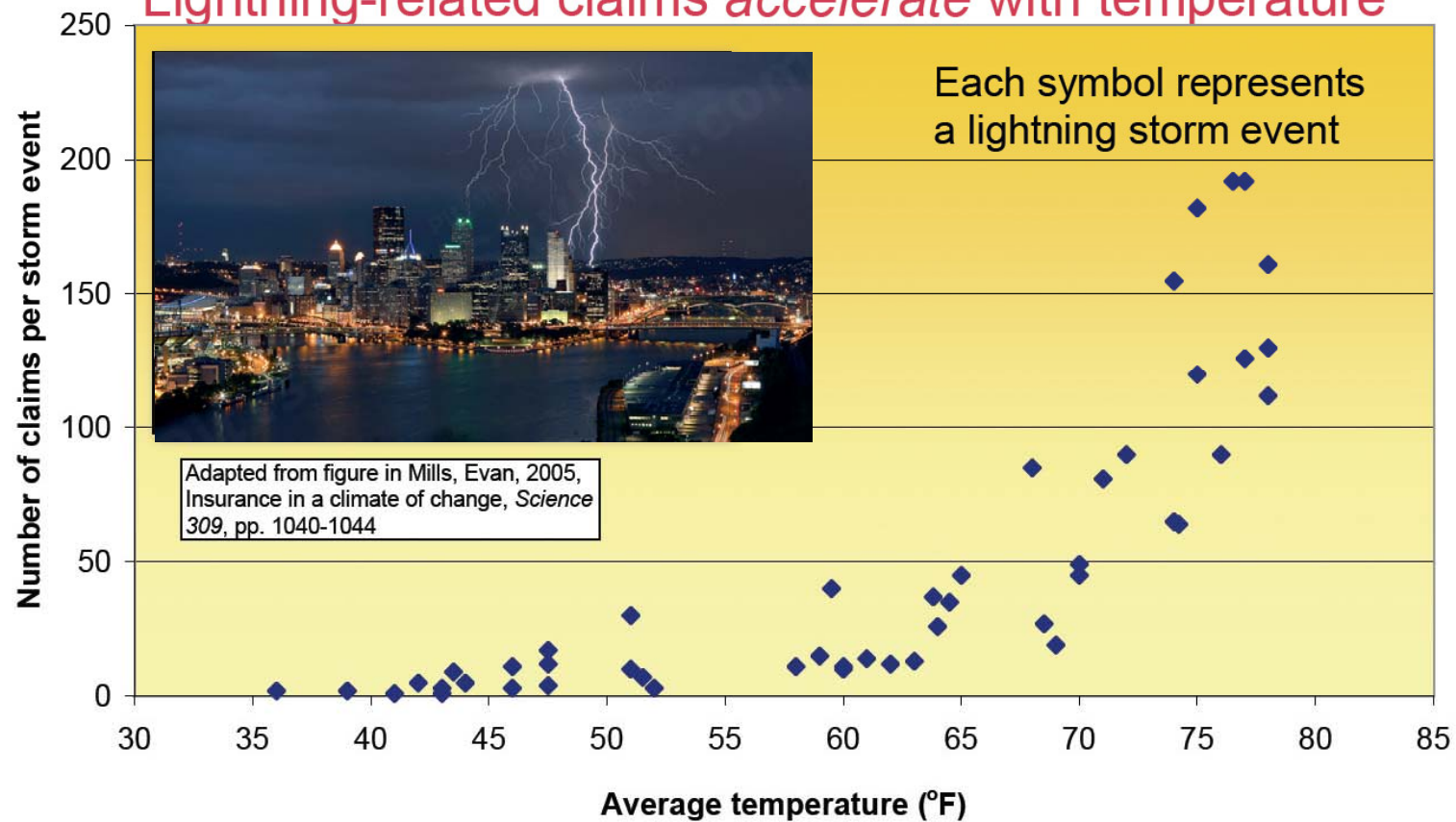
From "Financial Risks of Climate Change," 2005, Association of British Insurers, Sigma database.



# 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

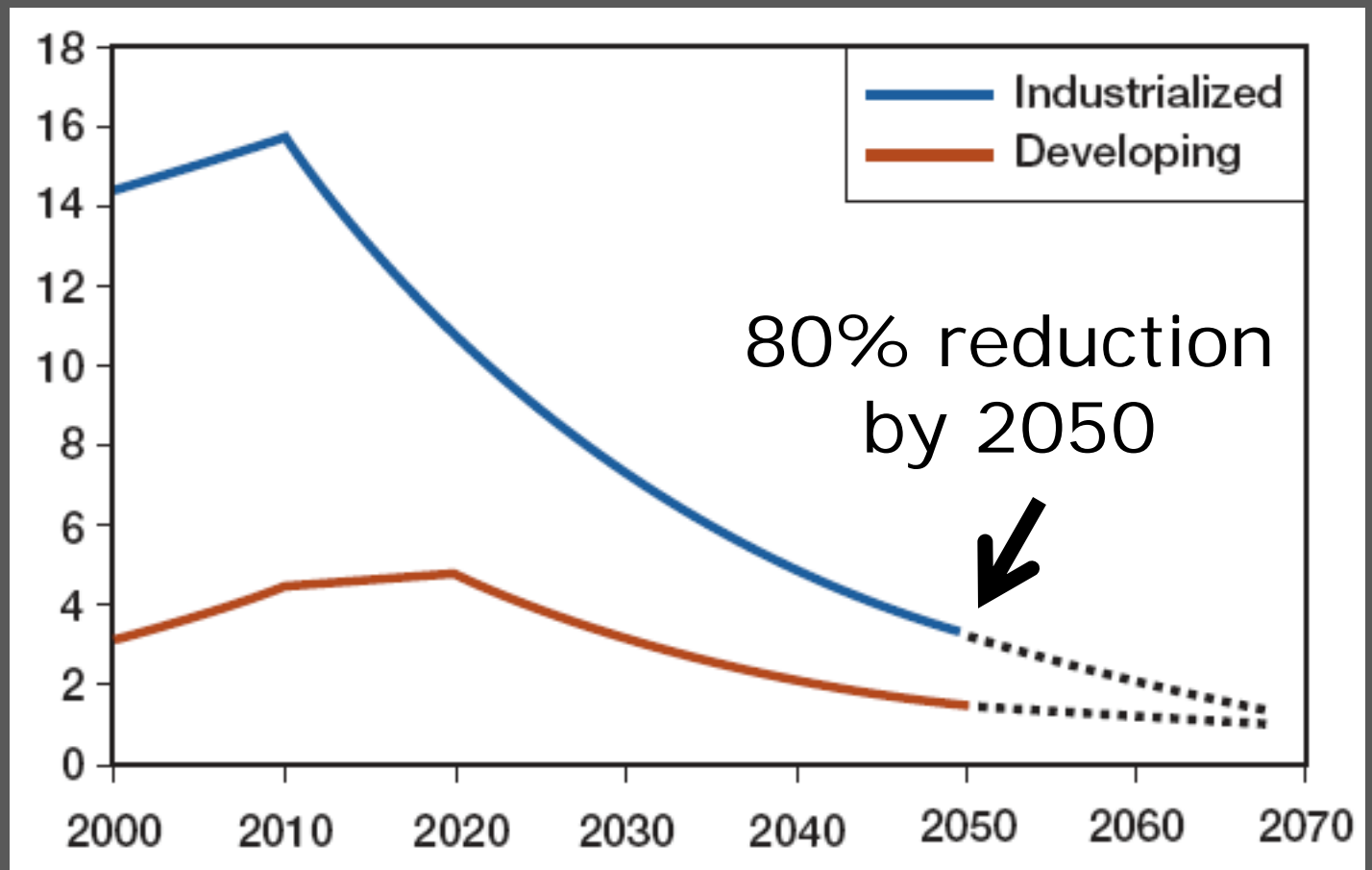
Advancement of Science; Harvard University

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

# WHAT CAN WE DO ABOUT IT?

## 1. Reduce our emissions

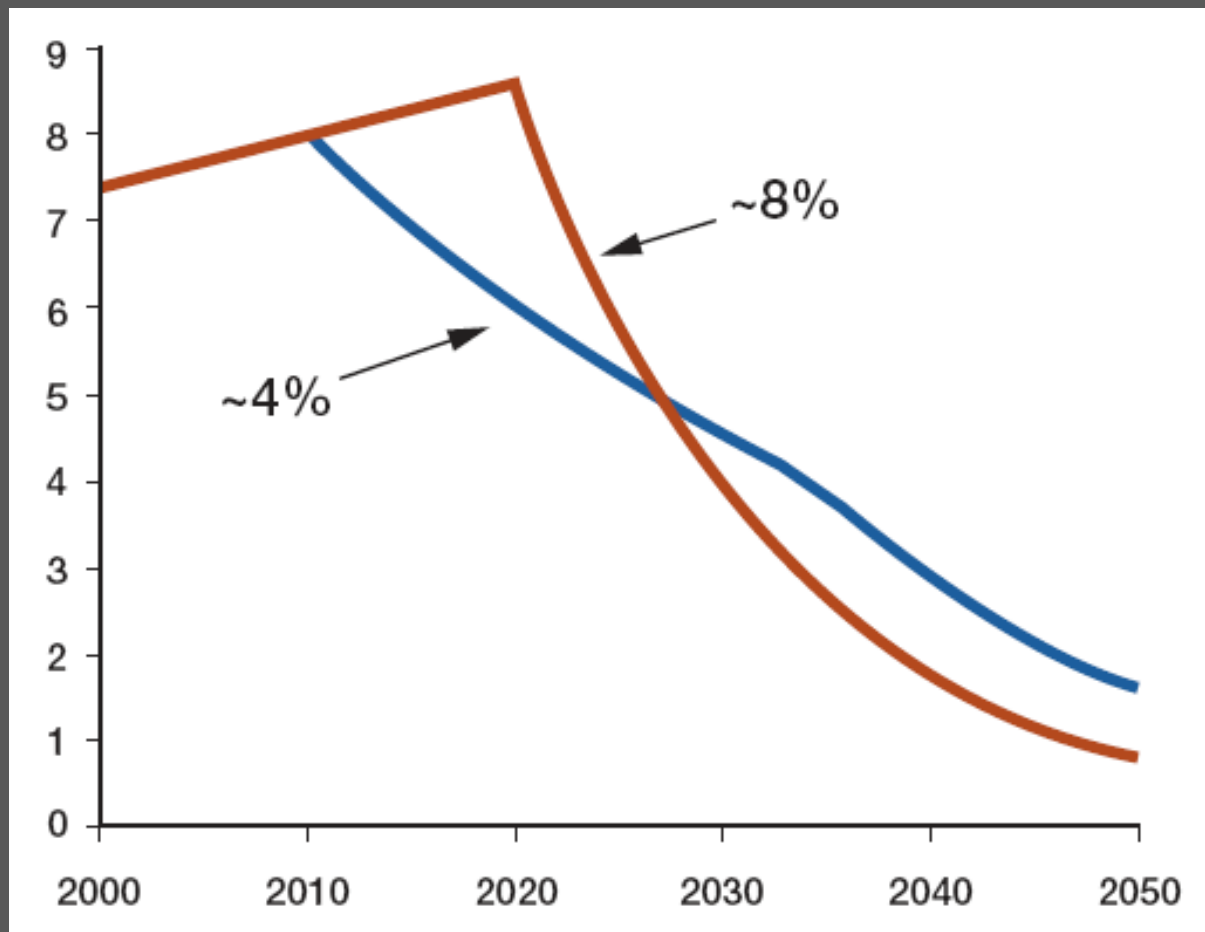
Greenhouse Gas Emissions  
tonnes per person



# 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



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The fundamental strength to deliver customized insurance solutions.


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XL Insurance Company of New York, Inc. (NYSE: XLN) is a leading provider of insurance and risk management solutions for a wide range of clients. XL Insurance Company of New York, Inc. is a member of the XL Group, which includes XL Insurance Company of Canada, XL Insurance Company of the United Kingdom, and XL Insurance Company of the United States of America.

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**XL INSURANCE**

# Changing risk profiles



The world is changing. We're changing how we insure it.

Real estate challenges are changing the world. That's why we created our Upgrade to Green™ coverage and Historic Rehabilitation Tax Credit insurance for commercial risks. These landmark coverages set a new standard and are just two of the 70 products we've developed since 2002 and 15 in 2007 alone. Because when a world changes this fast, you need an insurance company who can change right along with it.

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# Changing sources of risk

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

(Ernst & Young Survey, March 2008)

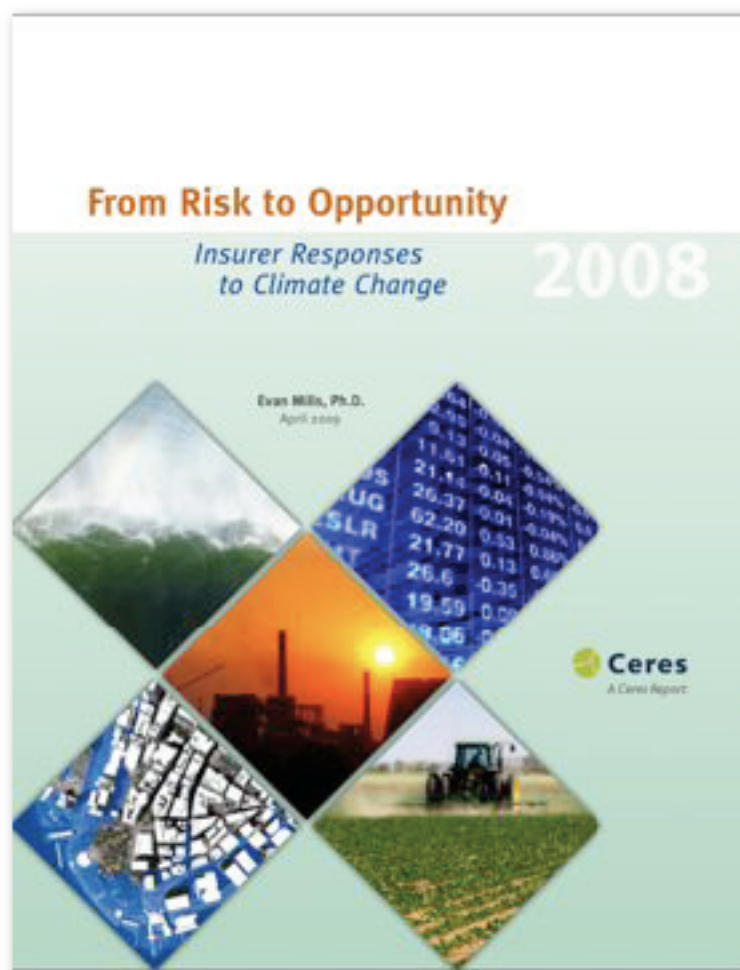
1. **Climate change**
2. **Demographic shifts in core markets\***
3. **Catastrophic events\***
4. **Emerging markets\***
5. **Regulatory intervention\***
6. **Channel distribution**
7. **Integration of technology with operations & strategy**
8. **Securities markets\***
9. **Legal risk\***
10. **Geopolitical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



The screenshot shows the landing page for 'Climate Help' by NRMA Insurance. At the top, there are four navigation buttons: 'Calculate your CO<sub>2</sub>', 'Offset your emissions', 'Take our survey', and 'Play the game'. The main heading is 'Climate Help' with sub-headings: 'Climate change', 'Going carbon neutral', 'What we're doing', and 'How you can help'. Below these are links for 'FAQ' and 'Contact'. The central text reads: 'Don't underestimate the effects of climate change. With recent events like Hurricane Katrina, persistent droughts, and worsening bushfire seasons, there are now more signs than ever that our climate is changing. Because cars are a significant cause of climate change, NRMA Insurance has created a new environmental program called Climate Help. It shows you how to offset your car's emissions, and how to help combat climate change with a unique method called carbon credits.' An illustration shows a car on a road emitting CO<sub>2</sub>, with trees on a hillside absorbing it. A 'Next >' button is at the bottom right. The NRMA Insurance logo is at the bottom left. Copyright information at the bottom states: '© 2006 Insurance Australia Limited ABN 11 880 018 722 AF 2 Licence No. 227801 trading as NRMA Insurance An IAG Company. By accessing and using this website you agree to the Terms of Use including the disclaimer.'



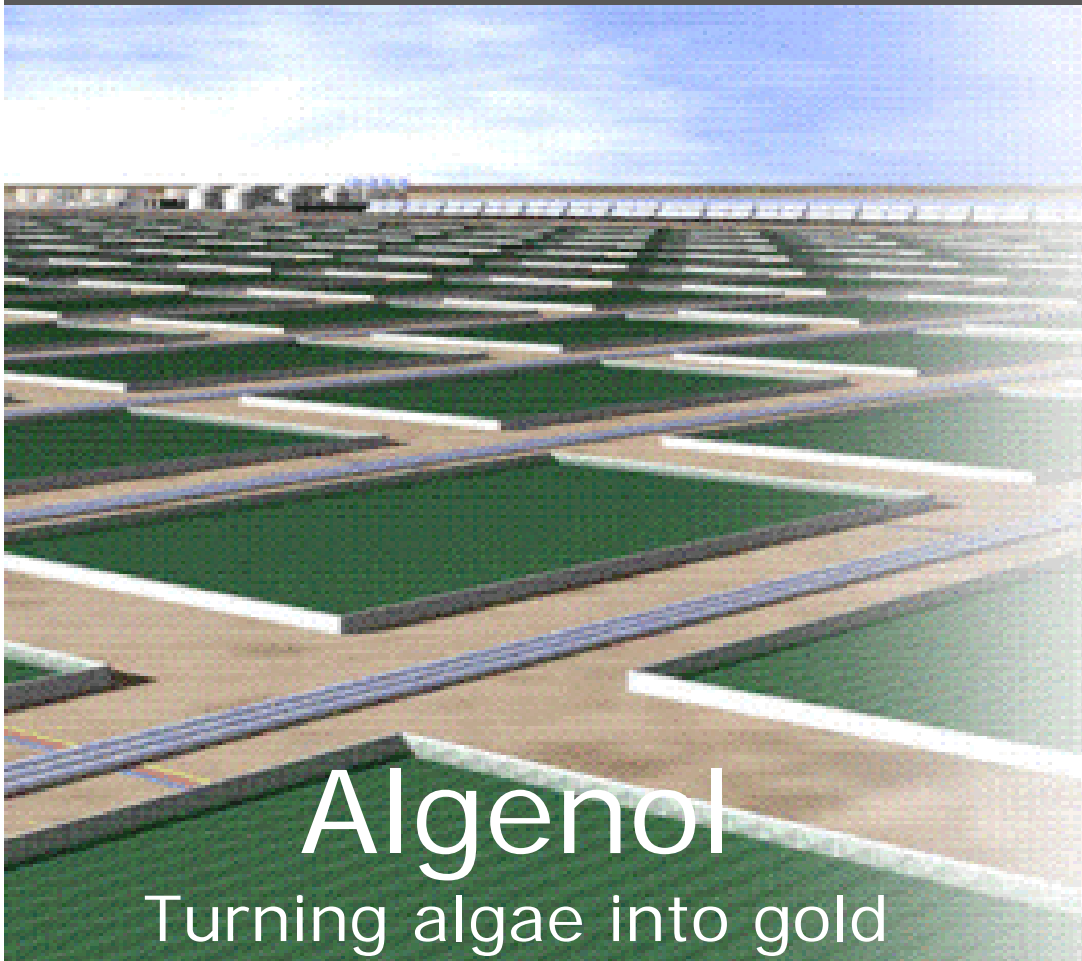
The screenshot shows the payment page for 'Climate Help'. The heading is 'Climate Help Pay for your emissions' with a 'Back to Climate Help' link. The text says: 'Paying for your emissions is one of the simplest things you can do to help the environment. And we've tried to make it even simpler by allowing you to pay online with your credit card. It's good to know you're doing the right thing, so we can also send you a certificate confirming that your car emissions will be offset. Just check the box on the next page and we'll email it to you in PDF format.' A 'Calculate your CO<sub>2</sub>' section shows a dropdown for 'Select', a dropdown for 'How far do you drive each year?' with a value of 'Between 10,000 kms and 15,000 kms per year', and a calculation: 'Your car emits 2.1 tonnes of CO<sub>2</sub> emissions annually. To offset your emissions for 12 months you need to pay \$32.93\*'. A note says '\*At rate \$15.68 to offset one tonne of CO<sub>2</sub>'. The 'Pay for your emissions' section has fields for 'Title', 'First name', 'Surname', 'Email', and 'Age' (18-34 years). It also has checkboxes for 'Are you an NRMA Insurance customer?' and 'Are you an IAG staff member?'. Below that are fields for 'Name on credit card', 'Credit card number', 'Expiry date', and 'Credit card type'. A note says 'We do not accept AMEX or Diners Club'. The total amount is 'You are paying \$32.93' with a 'Next >' button. Copyright information at the bottom states: '© 2006 Insurance Australia Limited ABN 11 880 018 722 AF 2 Licence No. 227801 trading as NRMA Insurance An IAG Company. By accessing and using this website you agree to the Terms of Use including the disclaimer.'

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

Opportunities: new products

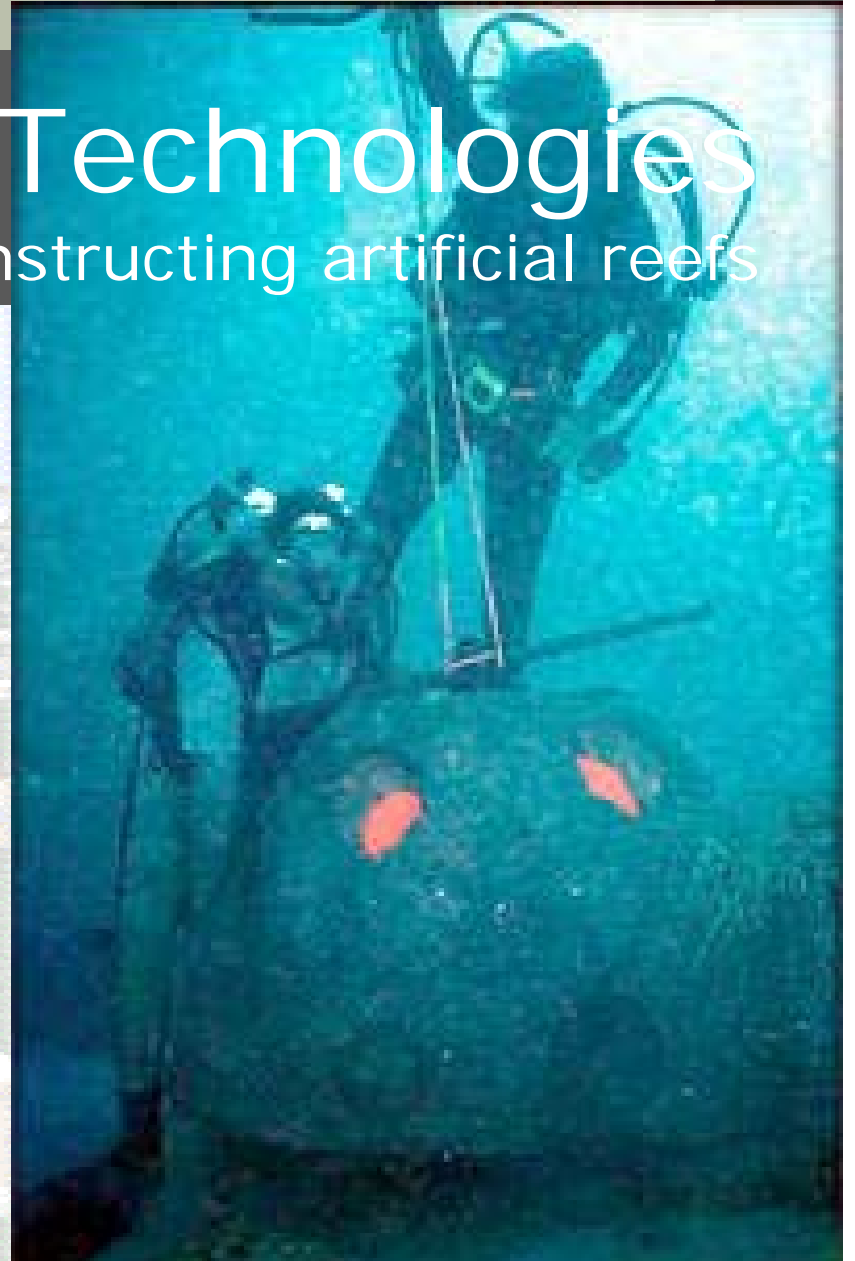
# Applied Marine Technologies

Constructing artificial reefs



Algenol

Turning algae into gold



# Opportunities: new incentives



KATHARINE HAYHOE | ANDREW FARLEY

NOBEL PRIZE-winning U.N. panel expert

pastor and author of *The Naked Gospel*

# a climate for change

global warming facts for faith-based decisions



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