

# Climate Change and Human Health



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University of Colorado  
School of Medicine  
Department of Emergency Medicine

**Climate and  
Health Program**







# JAMA

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 COMMENTARY

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## Physicians and the Environment

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Paul S. Auerbach, MD, MS

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# WILDERNESS & ENVIRONMENTAL MEDICINE

Official Publication of the Wilderness Medical Society  
Volume 23 • Number 1 • 2012  
wms.org

9th World Congress on Wilderness  
Medicine, Whistler, BC, Canada  
July 13-17, 2012



WILDERNESS & ENVIRONMENTAL MEDICINE, 23, 2–4 (2012)

EDITORIAL

## Lessons From Dr Strangelove

*Human health depends on a safe  
environment and stable climate...*



**IPPNW**



*Last year...*



*“Up until now, the criticism has been that climate science is like a house of cards, and if you pull out one or two sets of data, it all collapses. That narrative has been refuted. [AR5] shows that...the observational evidence for human-caused warming is overwhelming, compelling, and irrefutable.”*

--Former IPCC chair Bob Watson

**Lancet**

**Commission** on

**Health & Climate '15**



BRIEFING ROOM

ISSUES

THE ADMINISTRATION

PARTICIPATE

1600 PENN

Search



**ENERGY, CLIMATE CHANGE,  
AND OUR ENVIRONMENT**

The President has taken unprecedented action to build the foundation for a clean energy economy, tackle the issue of climate change, and protect our environment.

## JOINT ANNOUNCEMENT WITH CHINA

In a historic move, the U.S. and China came together and announced new targets to reduce carbon pollution.



Xi Jinping President of the P.R.  
Barack Obama President of the United States  
Angelsburg, North Carolina  
June 7-8, 2013

June 2015







G20 2016 CHINA

# 从巴黎到杭州 应对气候变化在行动

FROM PARIS TO HANGZHOU, CLIMATE RESPONSE IN ACTION

气候变化《巴黎协定》批准文书交存仪式

DEPOSIT OF INSTRUMENTS OF RATIFICATION OF THE PARIS AGREEMENT

中国·杭州 2016年9月3日 HANGZHOU CHINA 3 SEPTEMBER 2016



2015 & 2016

*Anni mirabiles?*

# Last Winter



Chicago  Tribune

— OPINION —

**Editorial: Worst winter ever?**





## NATIONAL FORECASTS

National Forecast

# July Chill Brought Record Cold Temperatures

LIVE

3:42 pm ET

U.S. SENATE

SEN. JAMES INHOFE  
R-Oklahoma

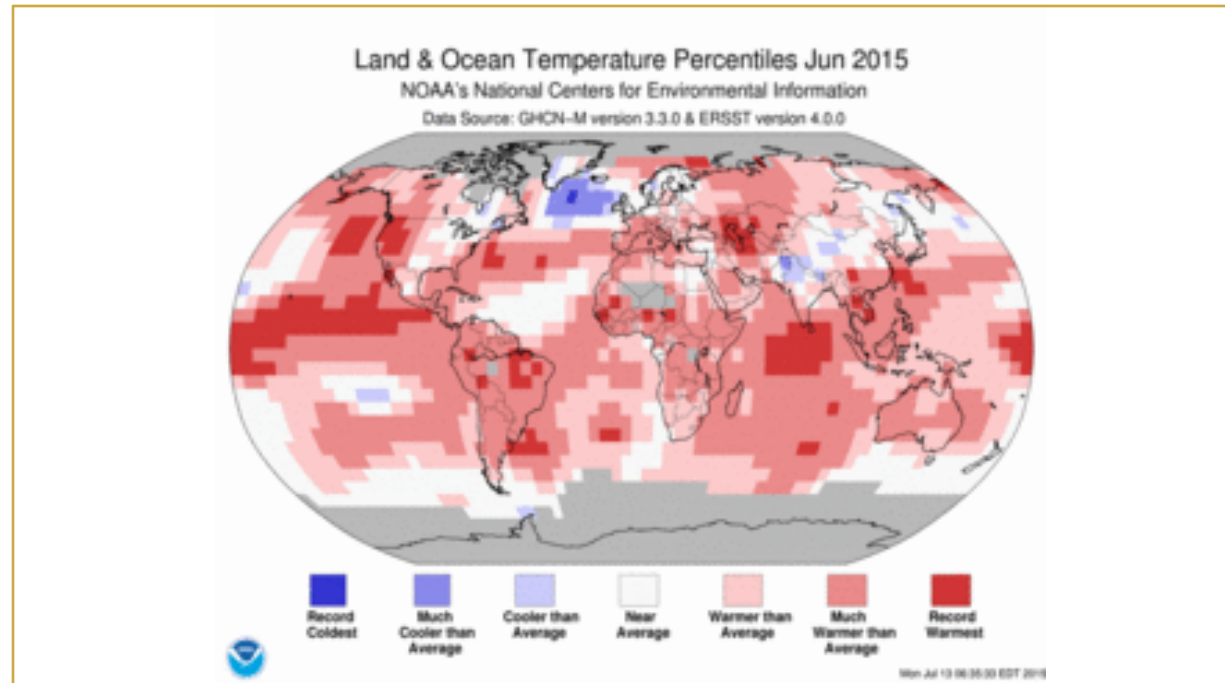
C-SPAN2  
c-span.org

# The Washington Post

By [Greg Sargent](#) June 2, 2014

**Never mind 2014. Climate change will be big issue in 2016.**

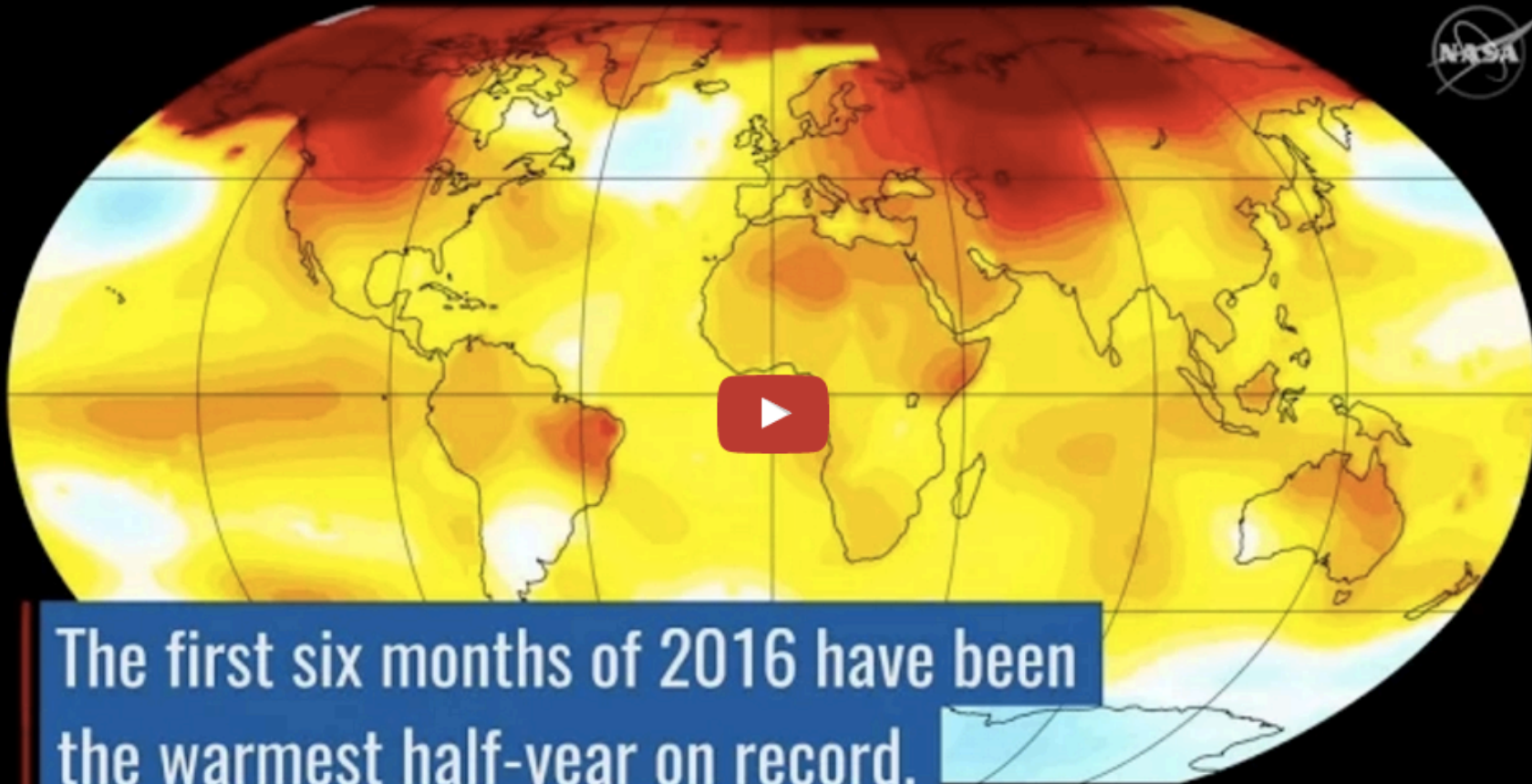




2015 warmest year on record to date.  
July 2015 was hottest month ever recorded.

-NOAA

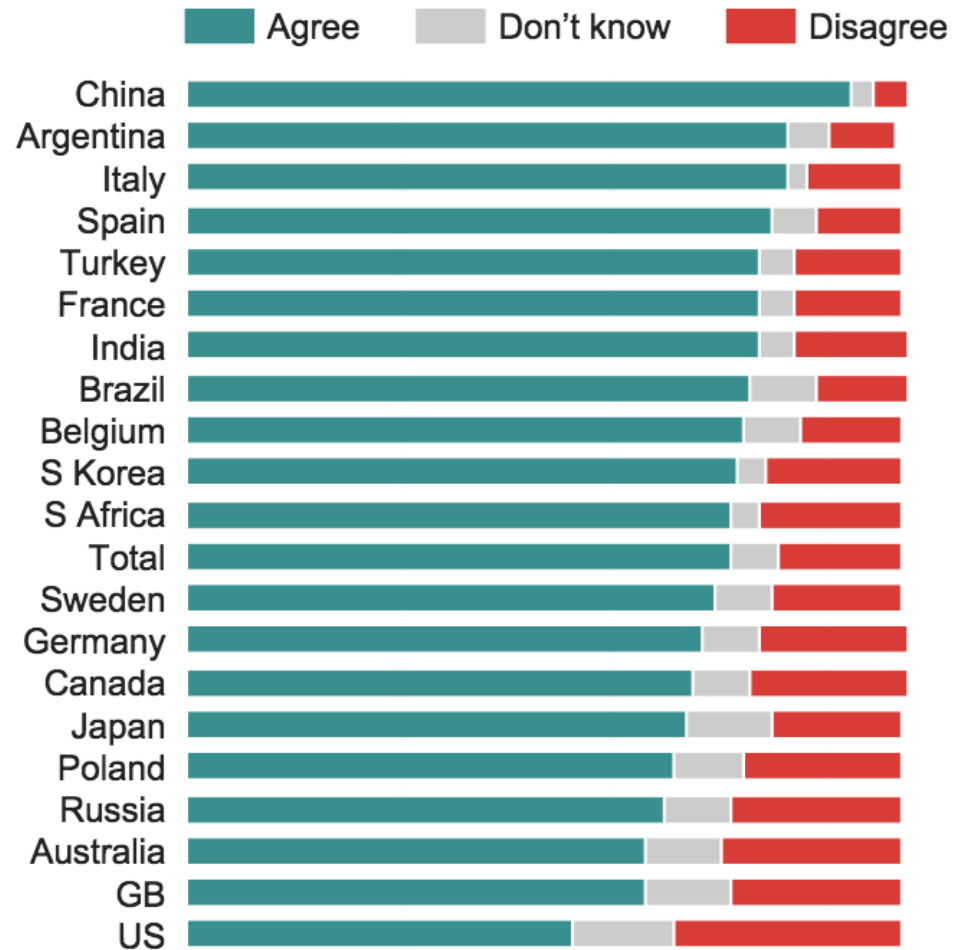
NASA Sees Temperatures Rise and Sea Ice Shrink - Climate Trends 2016

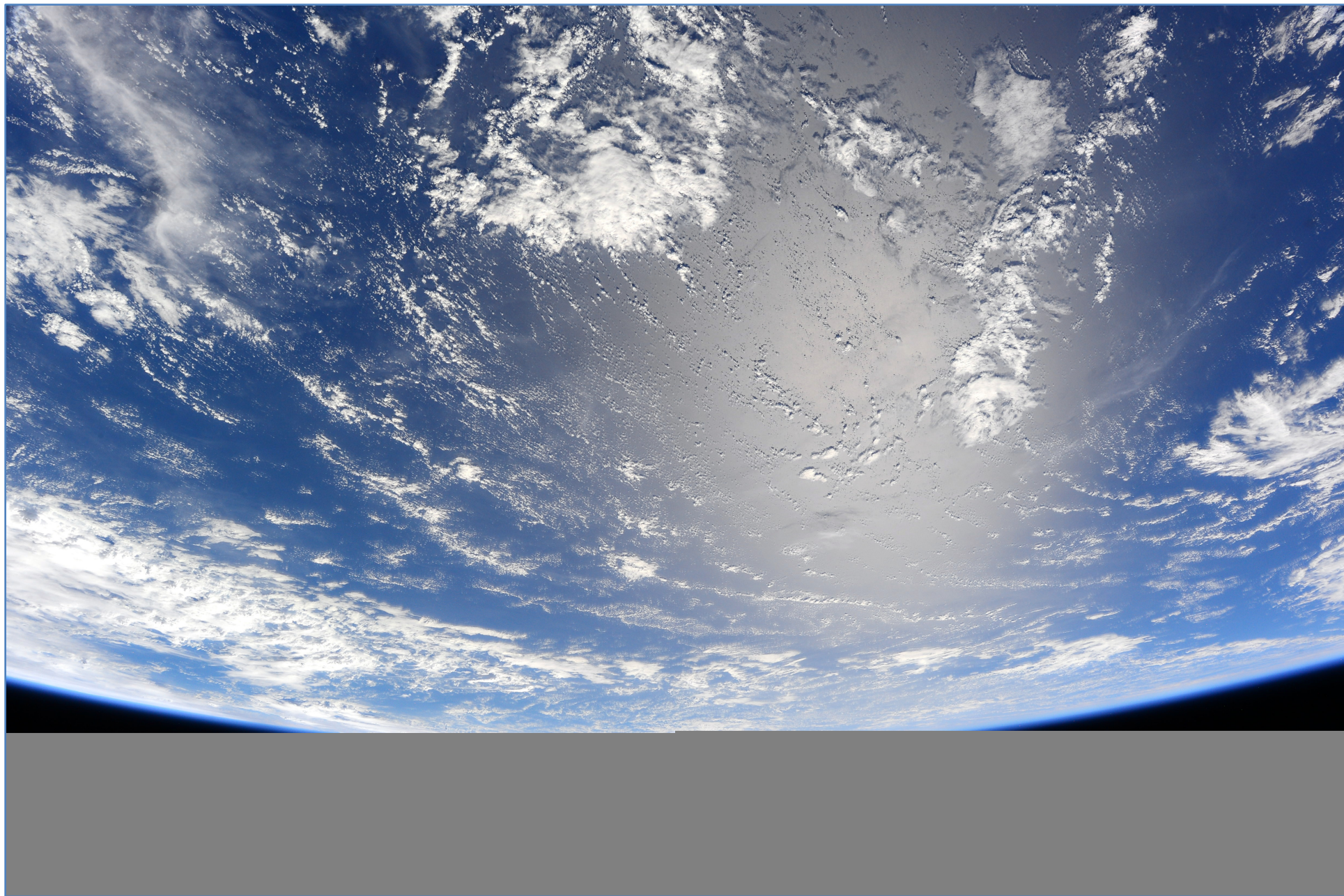


The first six months of 2016 have been the warmest half-year on record.



To what extent do you agree or disagree?  
*The climate change we are currently seeing is  
largely the extent of human activity*









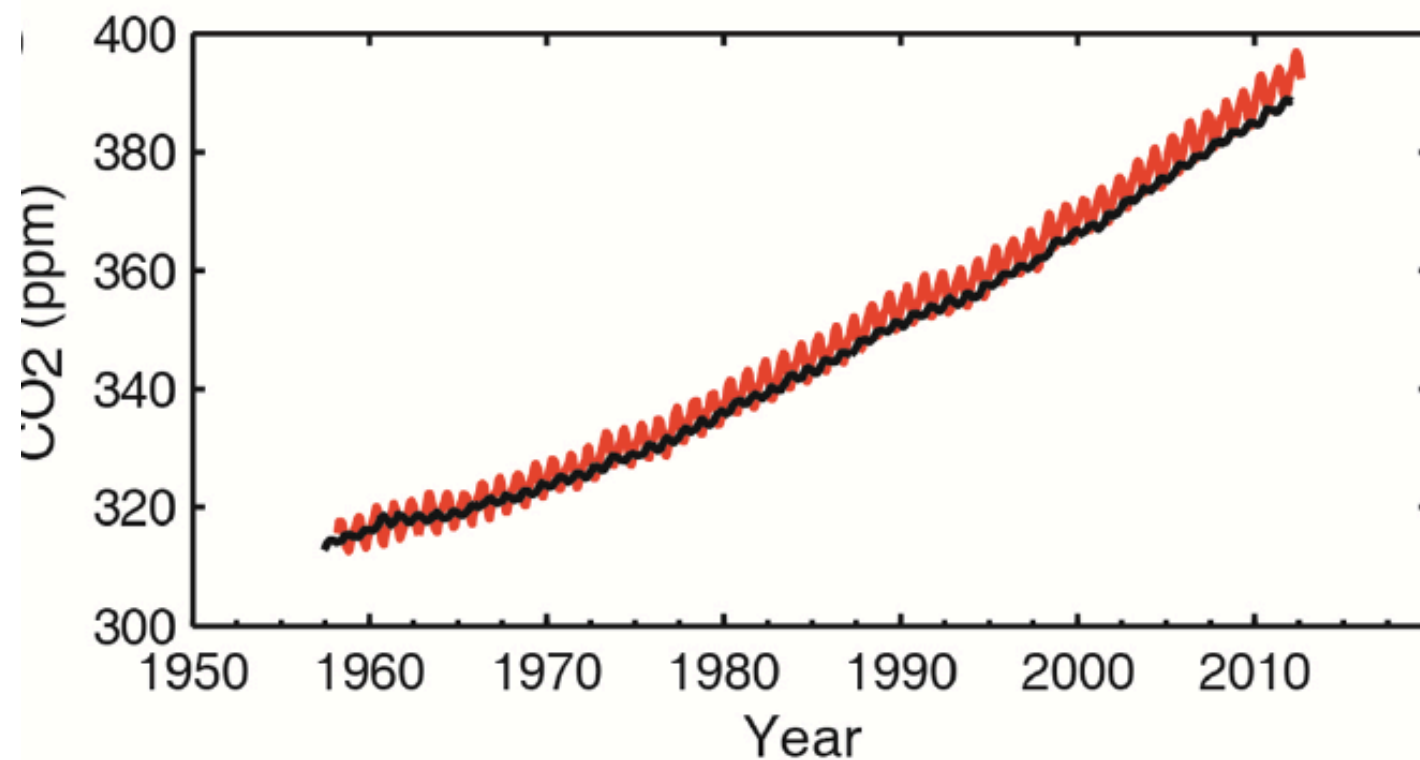
AR5 (9/27/2013)

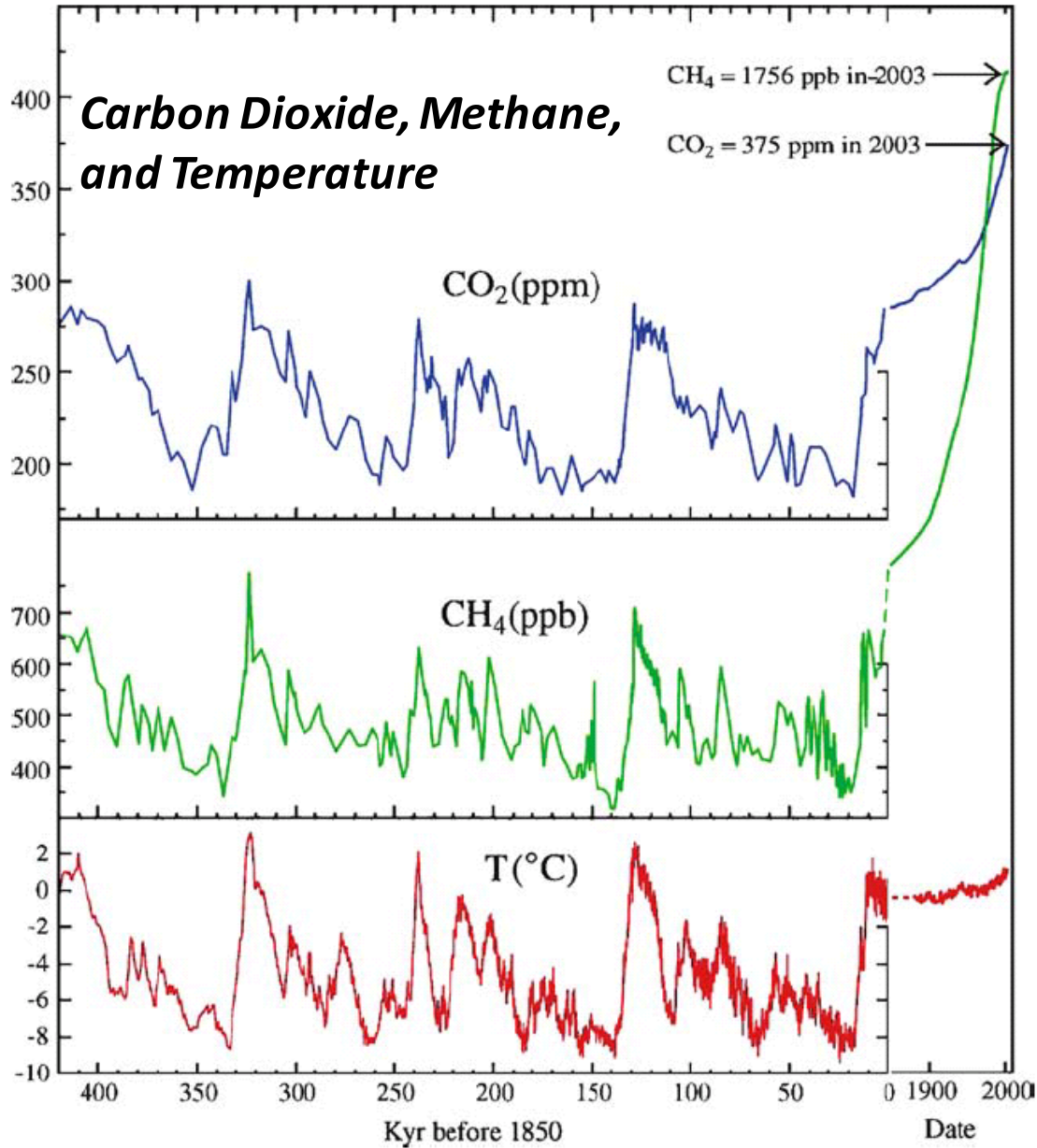
**physical science basis for CC**



**95-100% confidence that human activity is the principle cause of climate change since the Industrial Revolution in the 1850s.**

## Atmospheric CO<sub>2</sub>



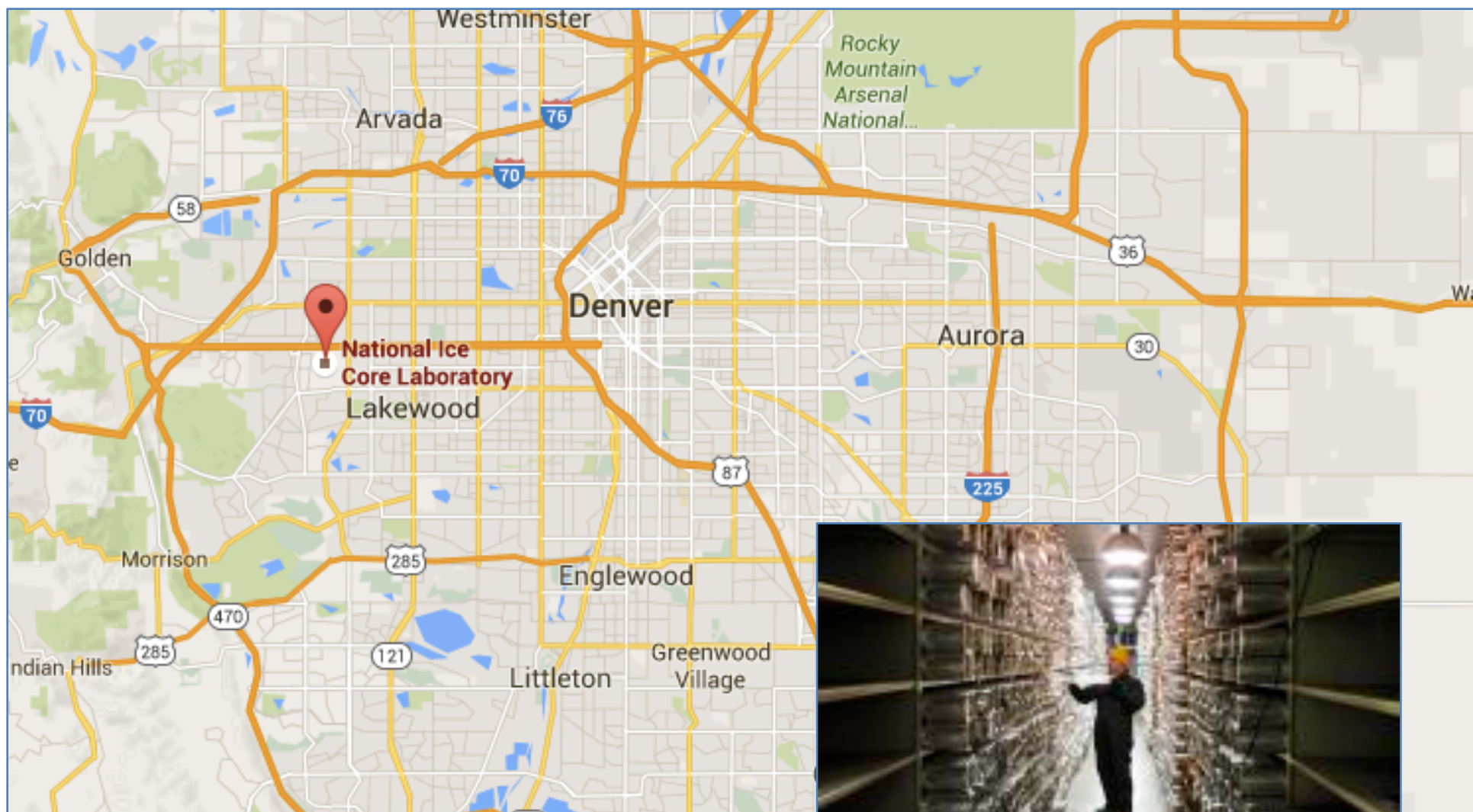


Greenhouse  
Gasses:

The Last  
500,000  
years  
and the last  
200 years











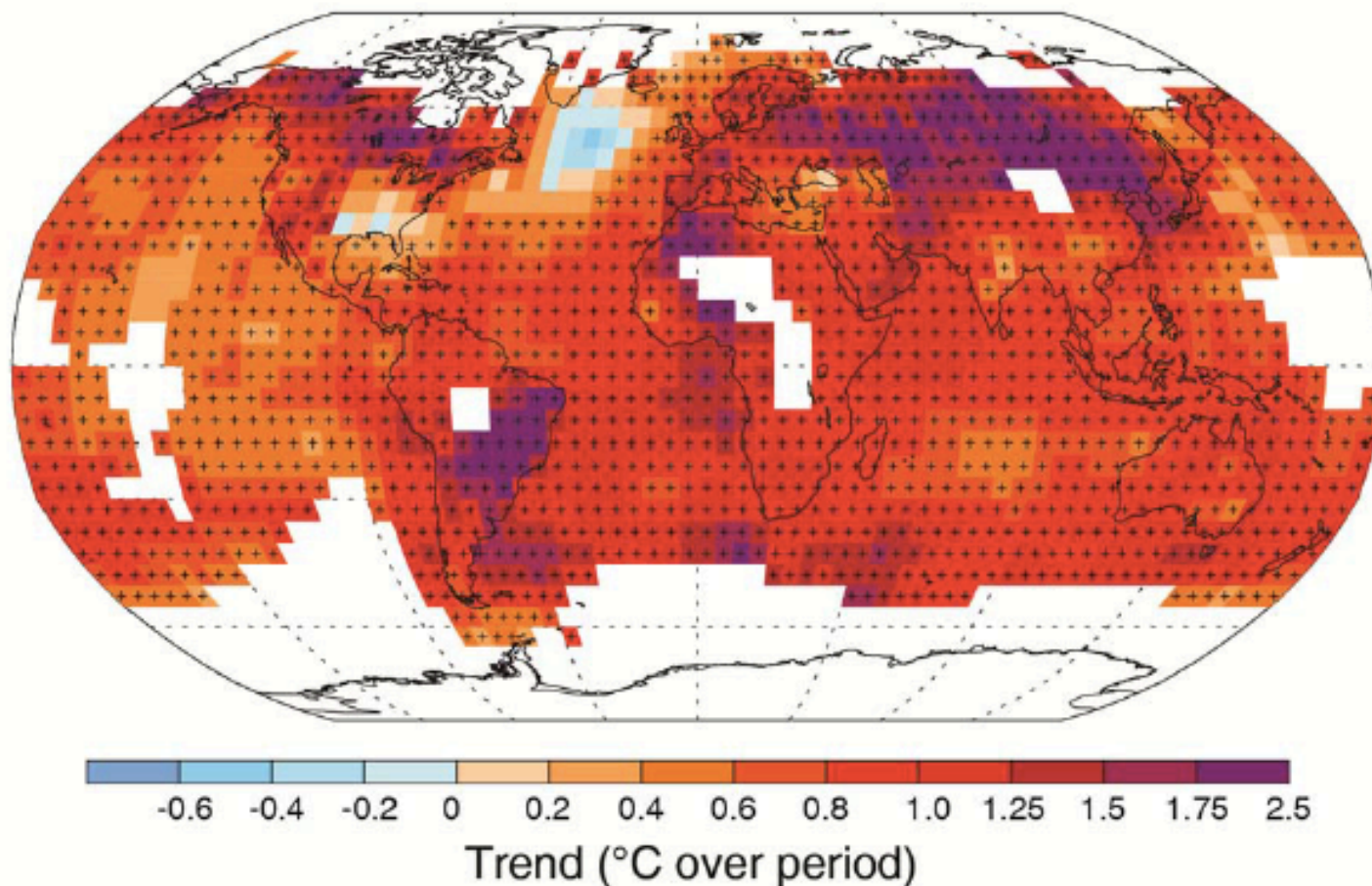
## Carbon limit:

IPCC has defined an *upper limit for carbon dioxide emissions*---3.6°F—since the Industrial Revolution

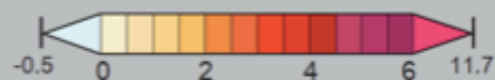
we have already spent over half of our “budget.”

*Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years.*

Observed change in average surface temperature 1901–2012



## Projected Temperature Change



Difference from  
1986-2005 mean (°C)

Solid Color

Very strong  
agreement

Gray

Divergent  
changes

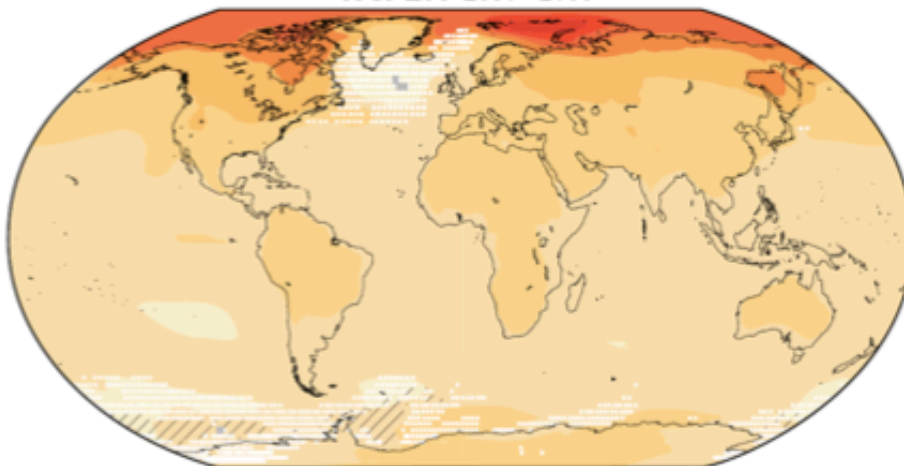
White Dots

Strong  
agreement

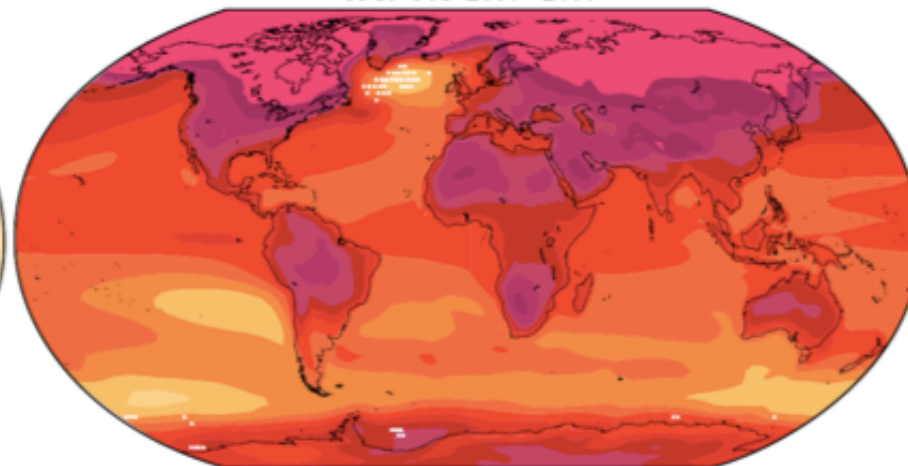
Diagonal Lines

Little or  
no change

RCP2.6 2081 - 2100



RCP8.5 2081 - 2100

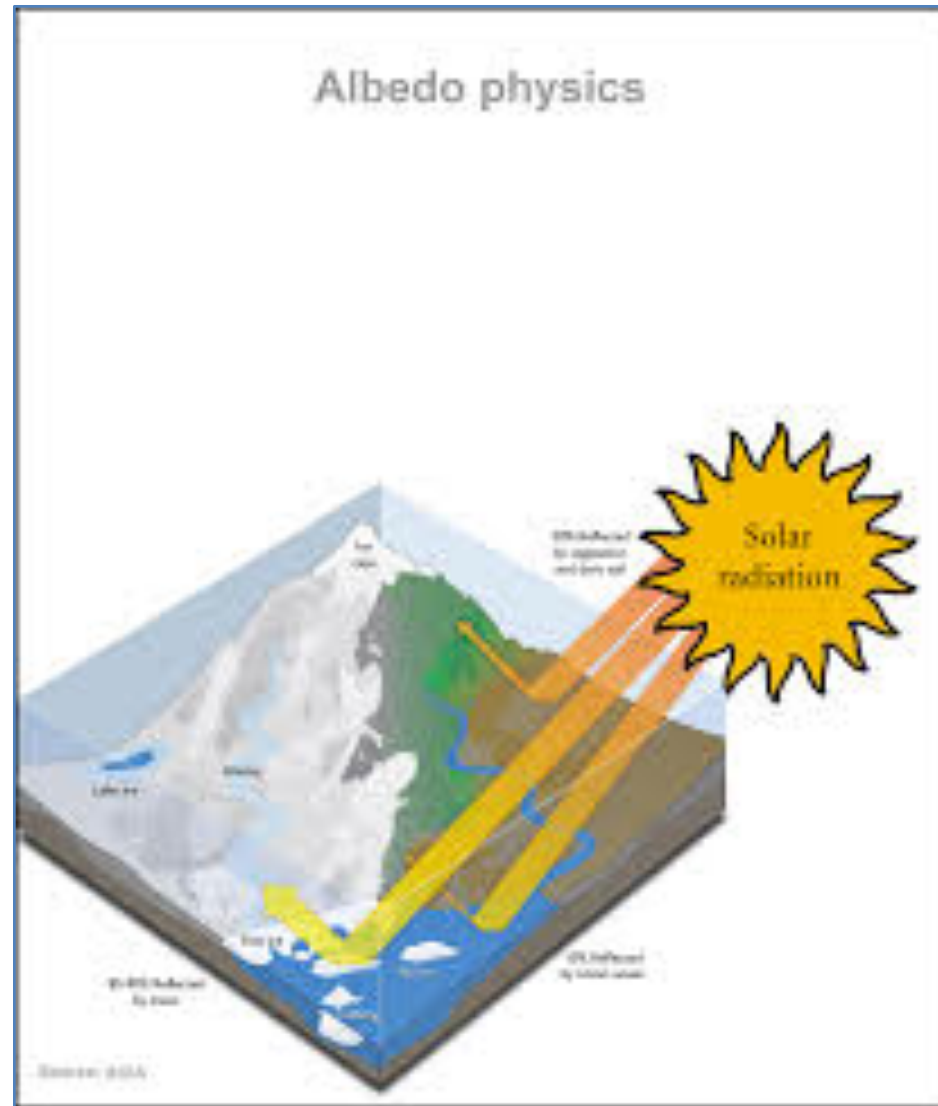




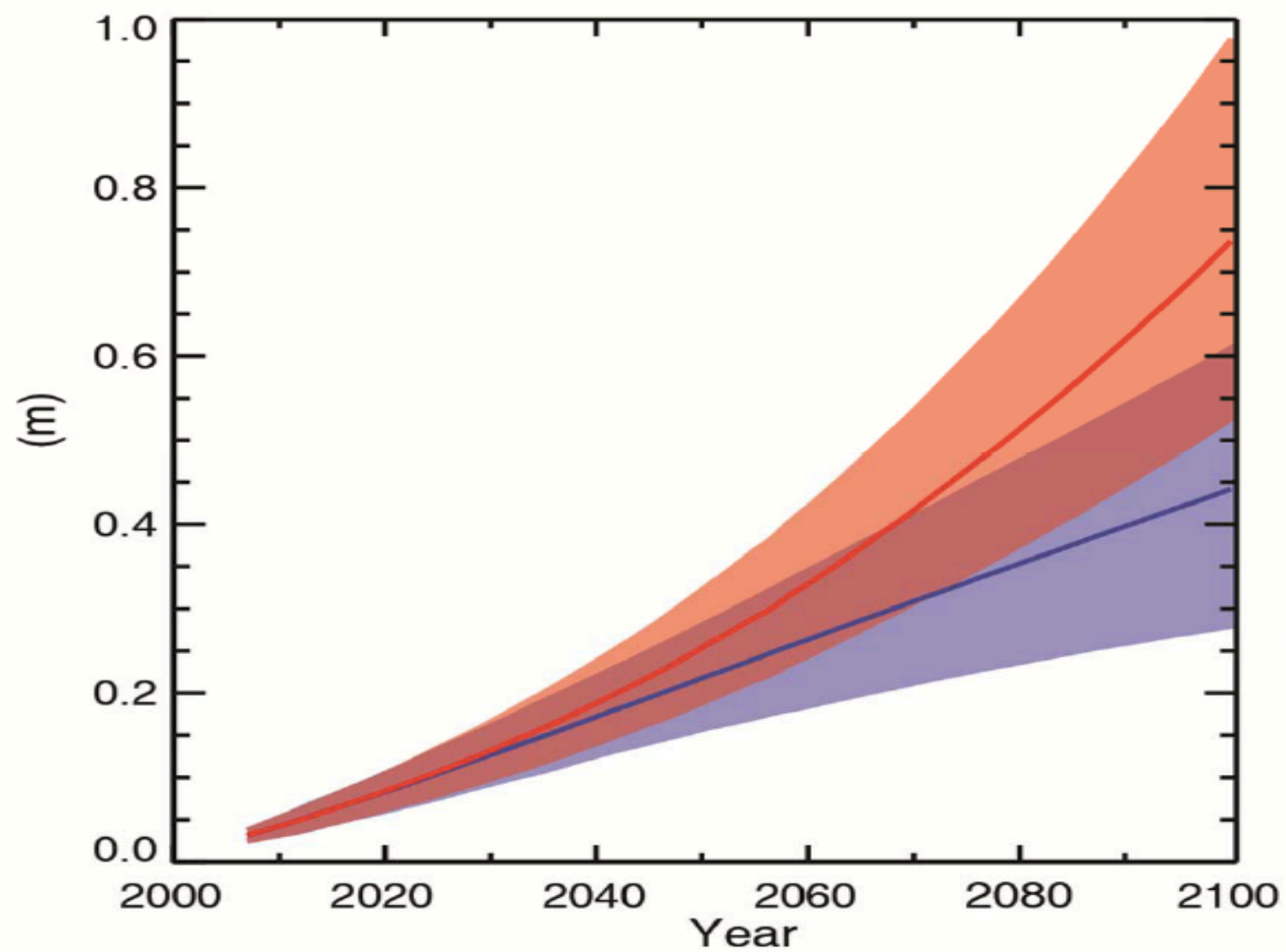
# Record Low Sea Ice Extent



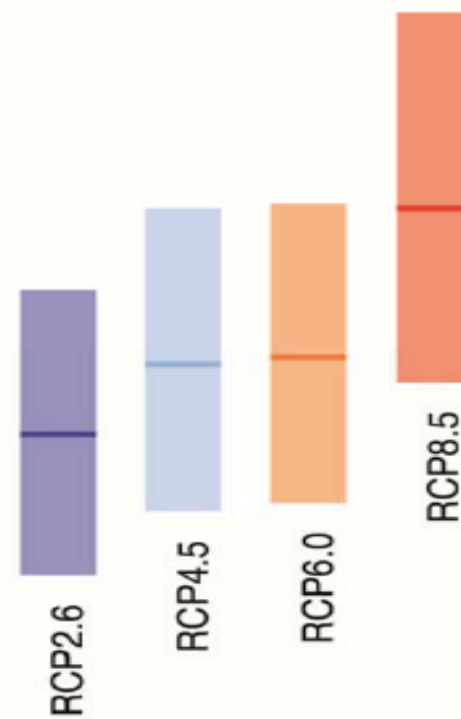
# Albedo refractive effect



## Global mean sea level rise



Mean over  
2081–2100



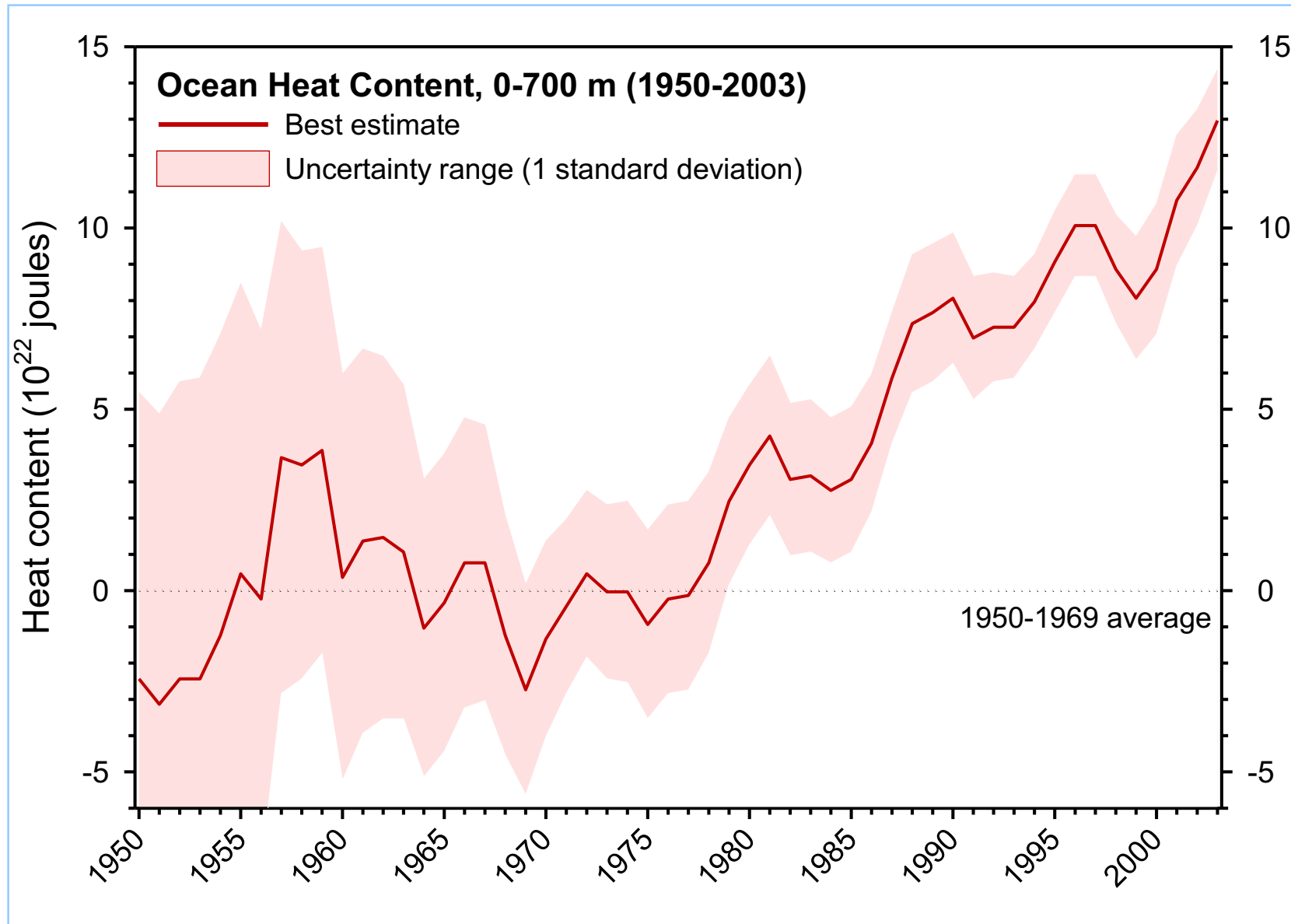


The global ocean will continue to warm and heat will penetrate from the surface to the deep ocean and affect ocean circulation.

Global glacier volume will further decrease.



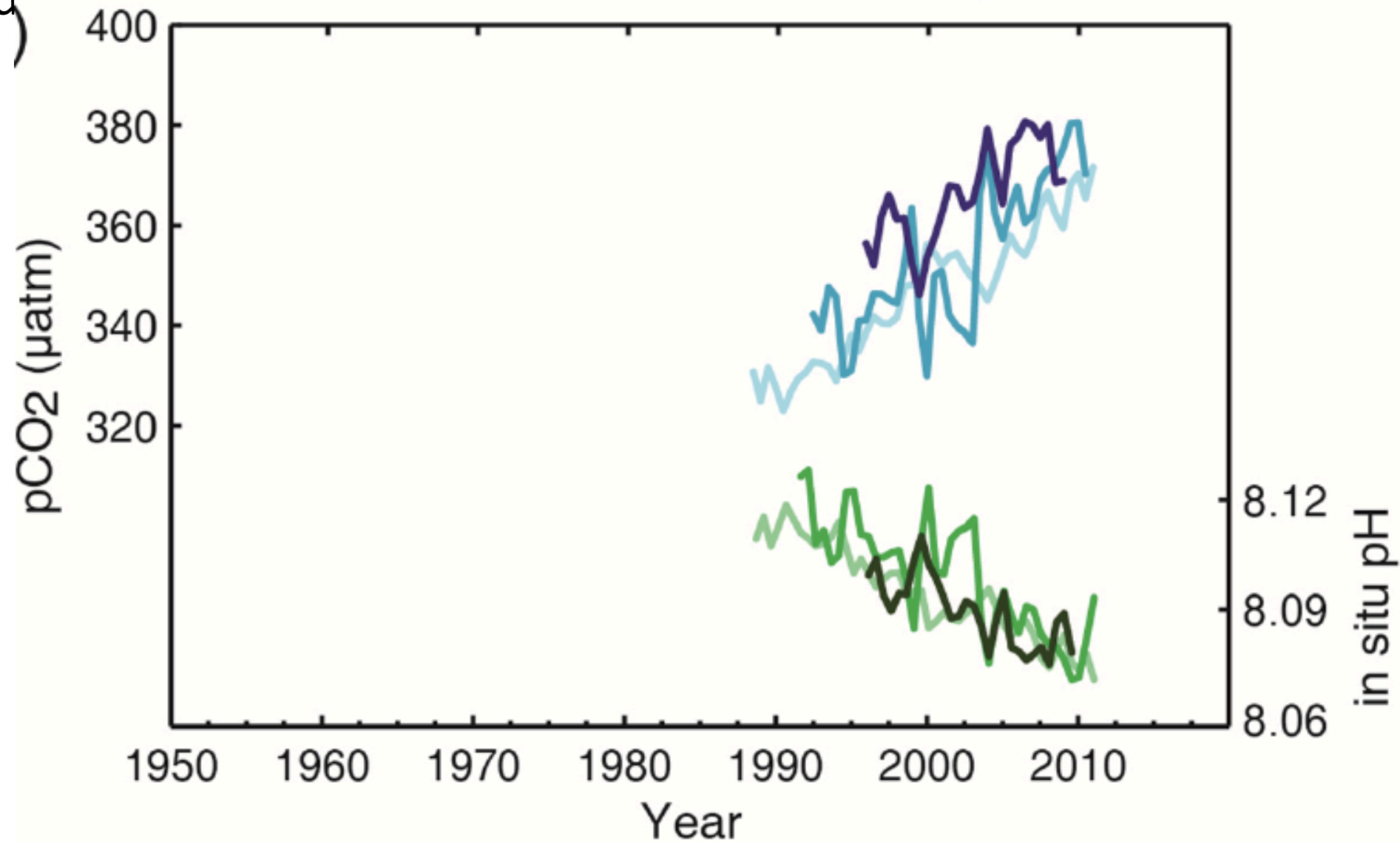
# Increasing Ocean Heat Content



The o  
dioxid

## Surface Ocean CO<sub>2</sub> and pH

bon

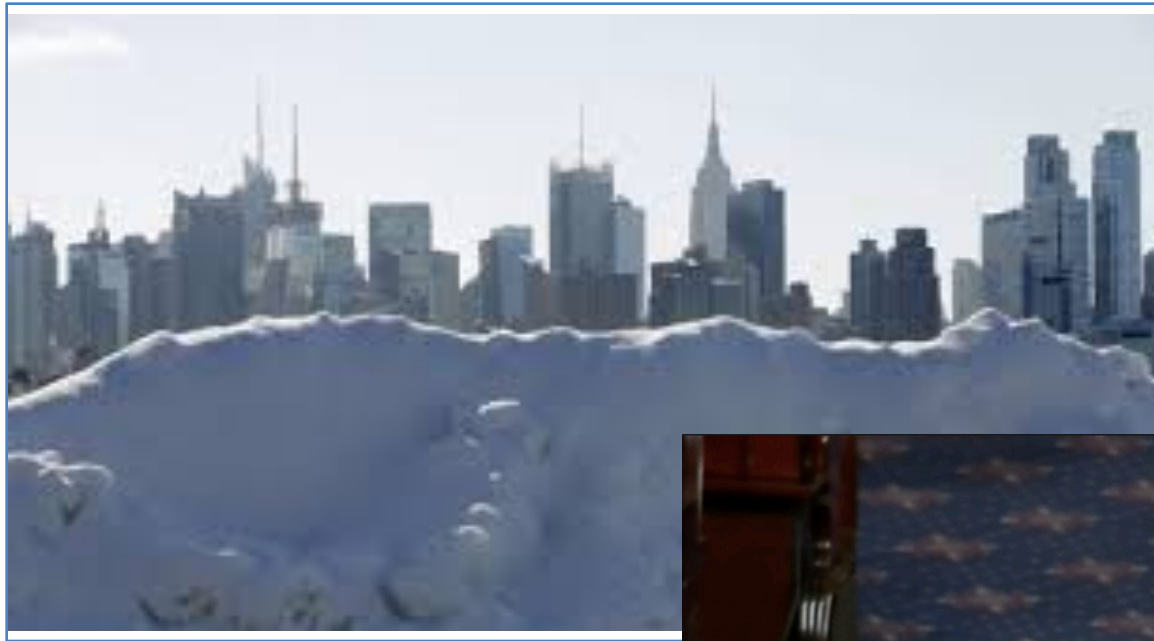




Changes in the global water cycle in response to the warming over the 21st century will not be uniform.

The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions

# The challenge of science communication



# The challenge of science communication

Complex system + energy= unpredictability

# The challenge of science communication

Complex system + energy= unpredictability

## **Global Warming**

# The challenge of science communication

Complex system + energy = unpredictability

~~**Global Warming**~~

***Global Energizing***



# A Complex System



+ Energy



















# Health Effects





# *5<sup>th</sup> Assessment Report (AR5)*

*Working Group II*

*March 2014*

*Impact on Human Health*

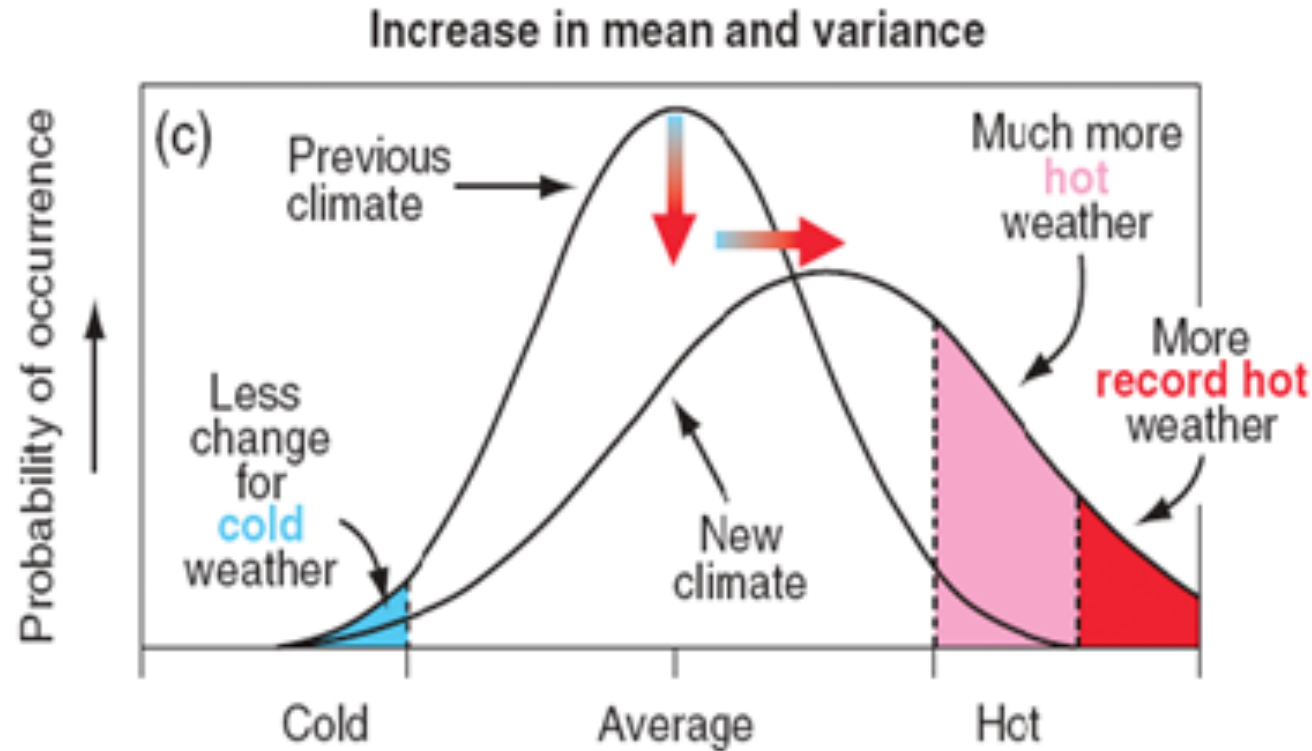


Until mid-century= **exacerbating health problems that already exist** (*very high confidence*).

Throughout the 21st century= **increases in ill-health** in many regions...

***especially in developing countries*** with low income, compared to baseline (*high confidence*)

# Increase in the frequency of Extreme Weather

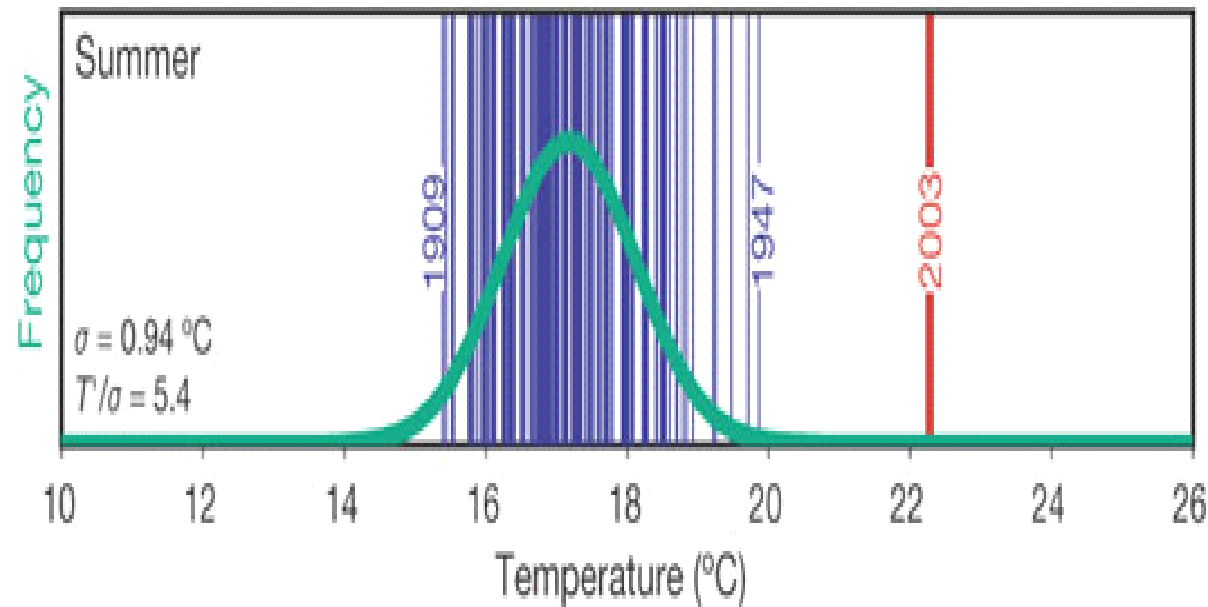


Not only  
changes in  
Mean  
(temp &  
precip)

But also  
increases in  
*Extremes*

# Some Extreme Events will be well beyond historical experience

## European Heat Wave of 2003



## Confirmed Mortality

|              |                      |
|--------------|----------------------|
| UK           | 2,091                |
| Italy        | 3,134                |
| France       | 14,802               |
| Portugal     | 1,854                |
| Spain        | 4,151                |
| Switzerland  | 975                  |
| Netherlands  | 1,400-2,200          |
| Germany      | 1,410                |
| <b>TOTAL</b> | <b>29,817-30,617</b> |

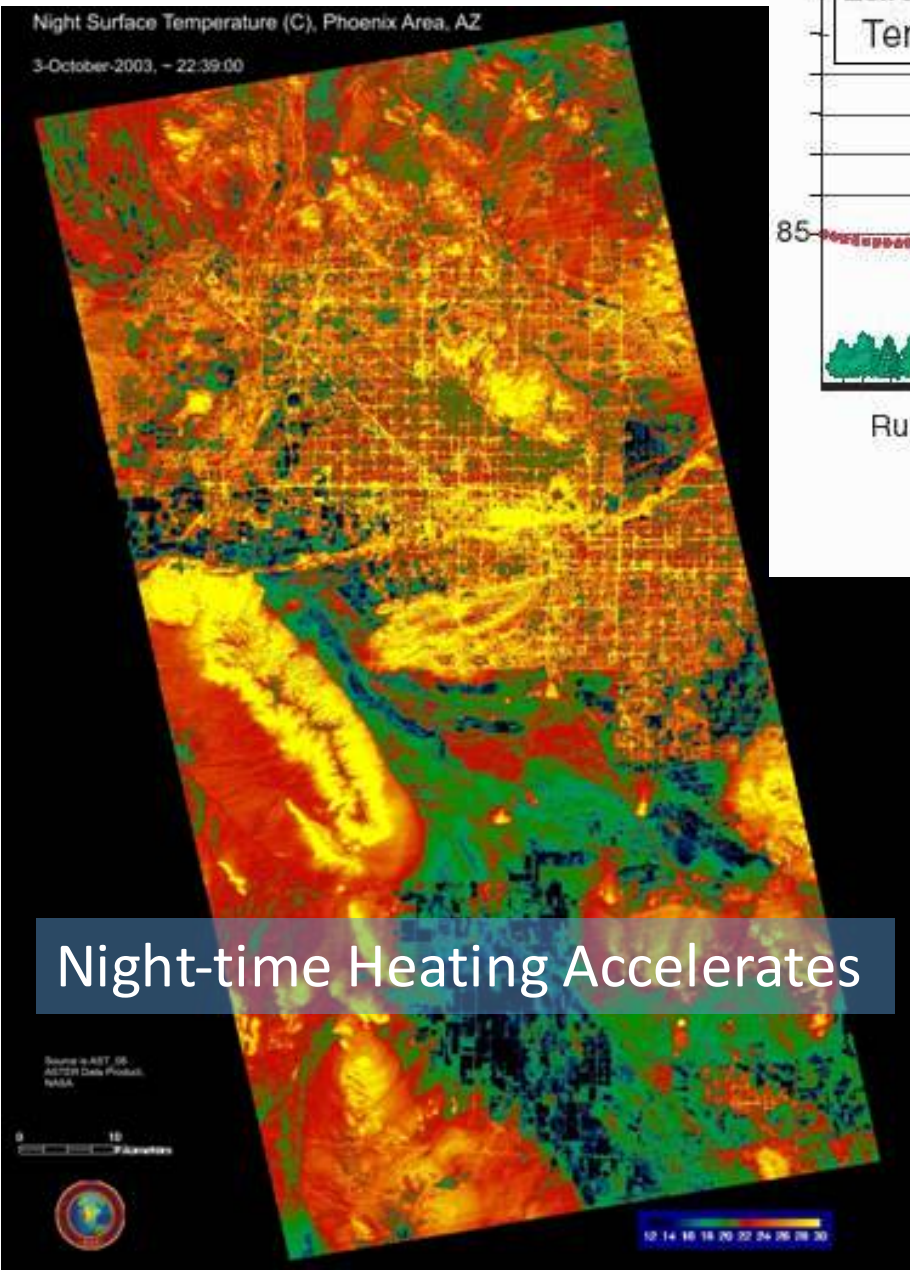
Haines et al. *Public Health* 2006;120:585-96.

Vandentorren et al. *Am J Public Health* 2004; 94(9):1518-20.

## Heat and Elderly Mortality (Harvard School of Public Health, 2012)

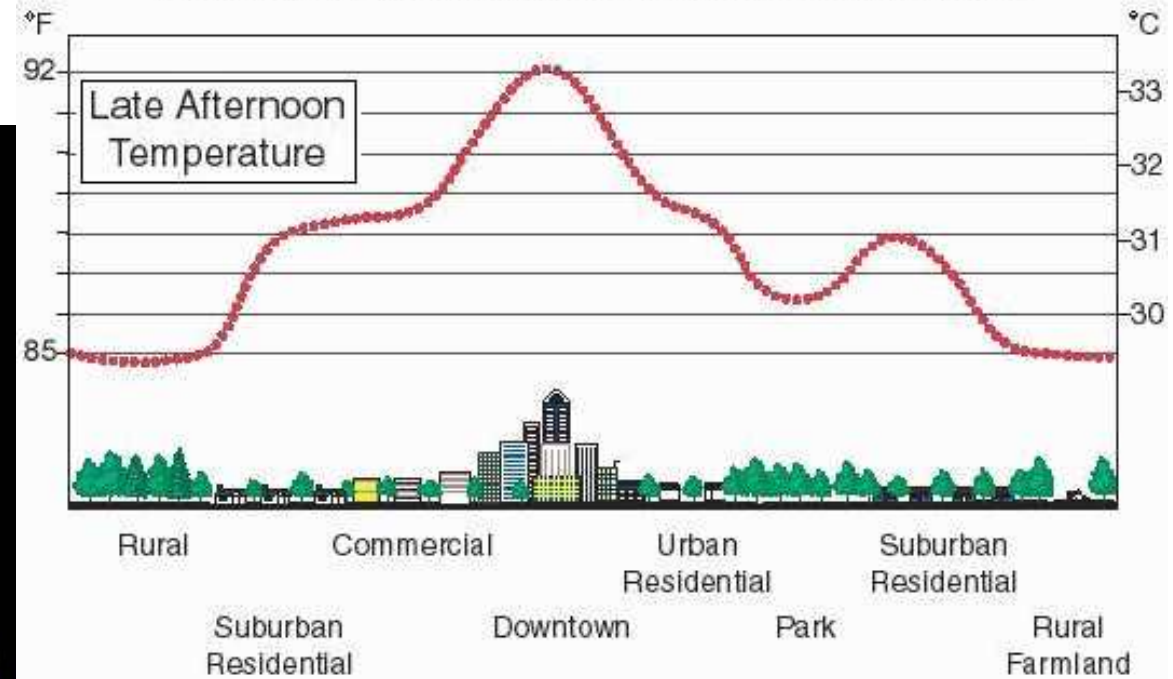
- Medicare data from 1985 to 2006 to follow the long-term health of 3.7 million chronically ill people over age 65 living in 135 U.S. cities.
- Each 1°C increase in summer temperature variability increased the death rate for elderly with chronic conditions between 2.8% and 4.0% depending on the condition.
- 4.0% for those with diabetes;
- 3.8% for those who'd had a previous heart attack;
- 3.7% for those with chronic lung disease;
- 2.8% for those with heart failure.
- Greater summer temperature variability in the U.S. could result in more than 10,000 additional deaths per year.





Night-time Heating Accelerates

Sketch of an Urban Heat-Island Profile

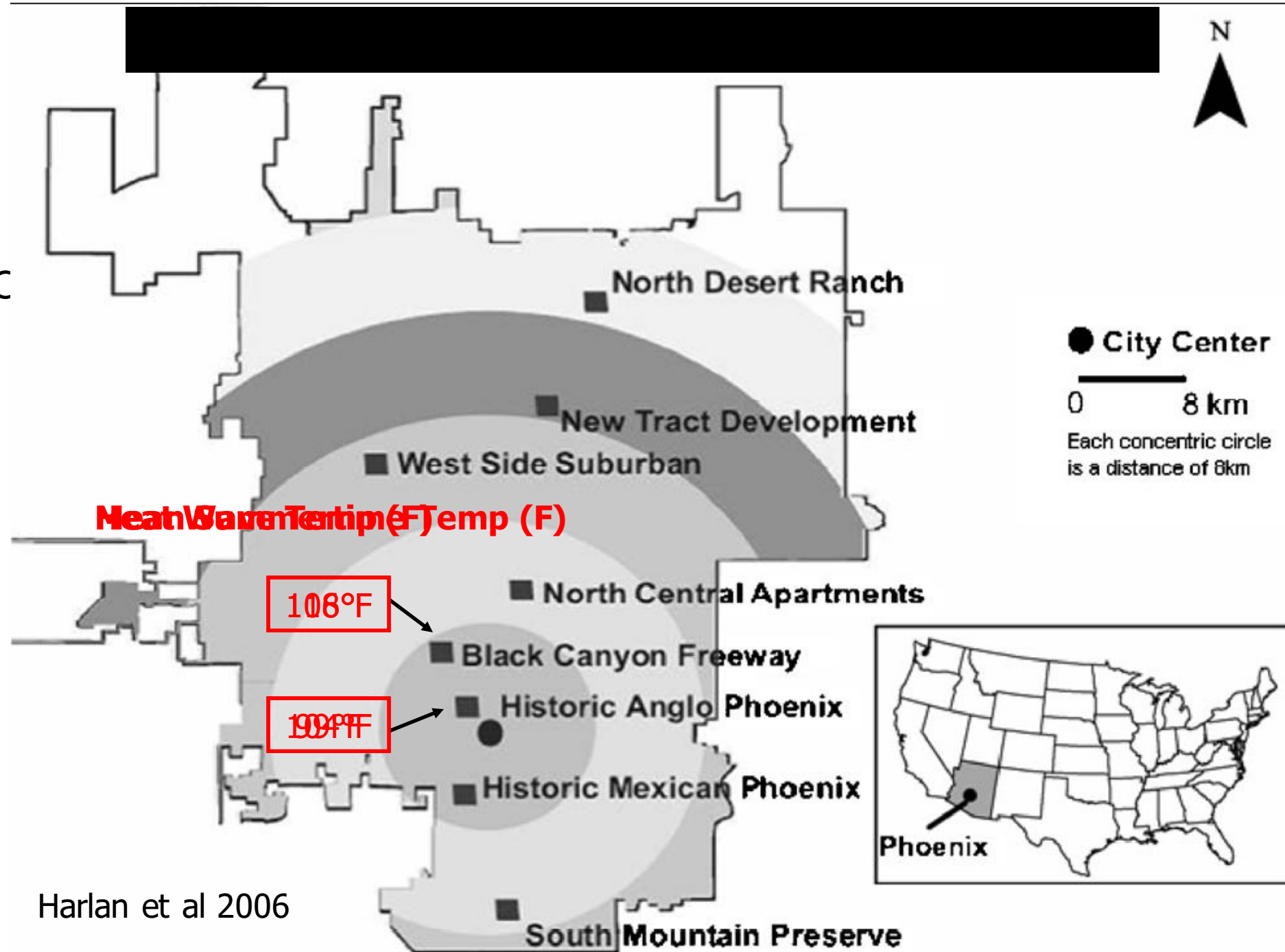


Urban Heat Island  
can add 7° – 12° F

Thermal Satellite Image of  
Phoenix, AZ Night Surface  
Temperature

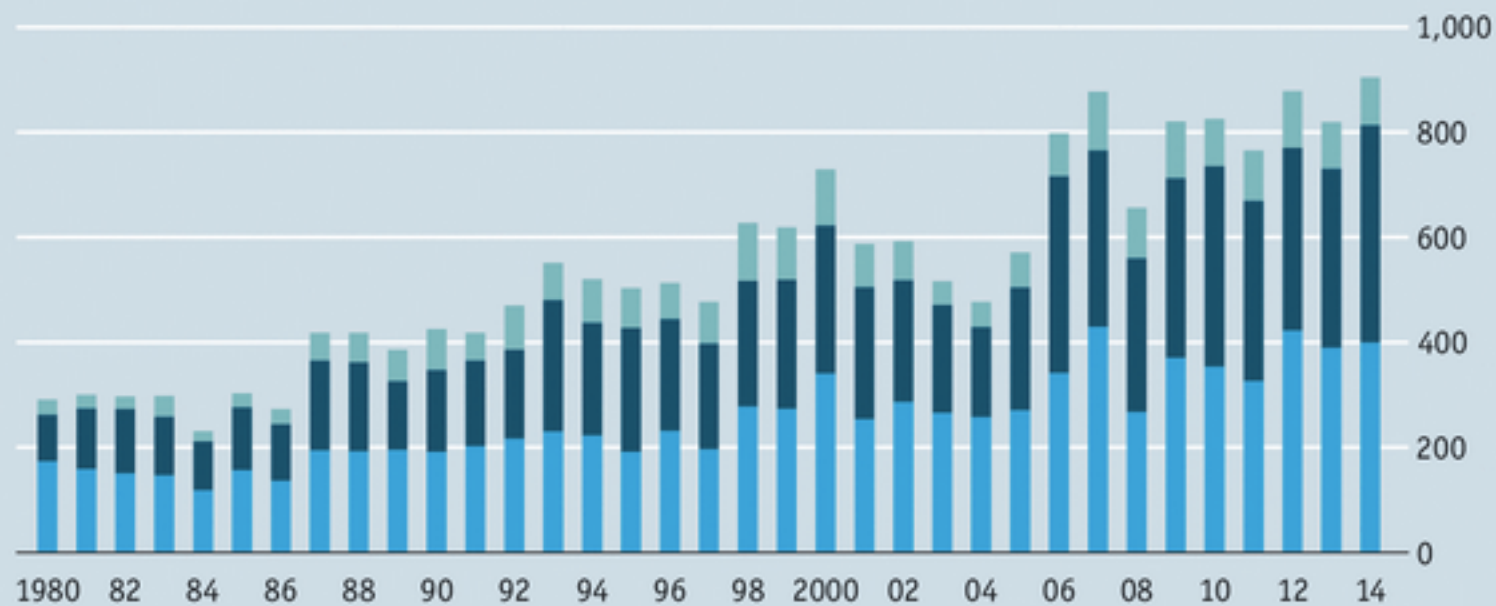


• Slic

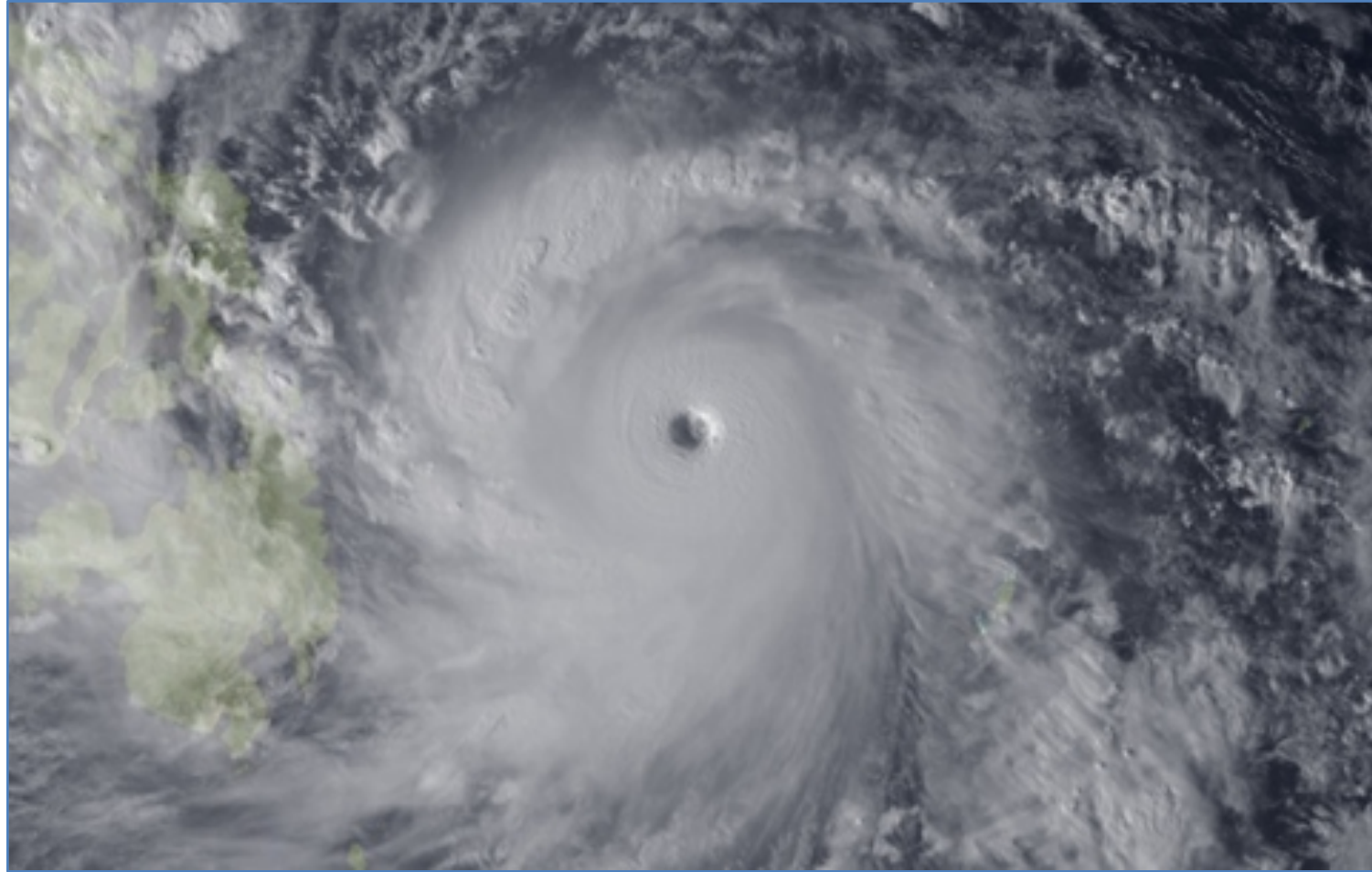


## Disasters caused by weather and climate

■ Meteorological events (*Storms*)   ■ Hydrological events (*Floods, landslides and avalanches*)  
■ Climatological events (*Extreme temperatures, droughts, forest fires*)



Source: Munich Re



**Typhoon Haiyan, max sustained winds 196 mph**  
[157mph = Category 5]





**Hurricane Patricia, max sustained winds 200 mph**  
[157mph = Category 5]



October 2012:



Hurricane Sandy swept through the Caribbean and Atlantic, at its peak covering more than 1,000 miles of the North American coastline– the **largest storm system in recorded history.**

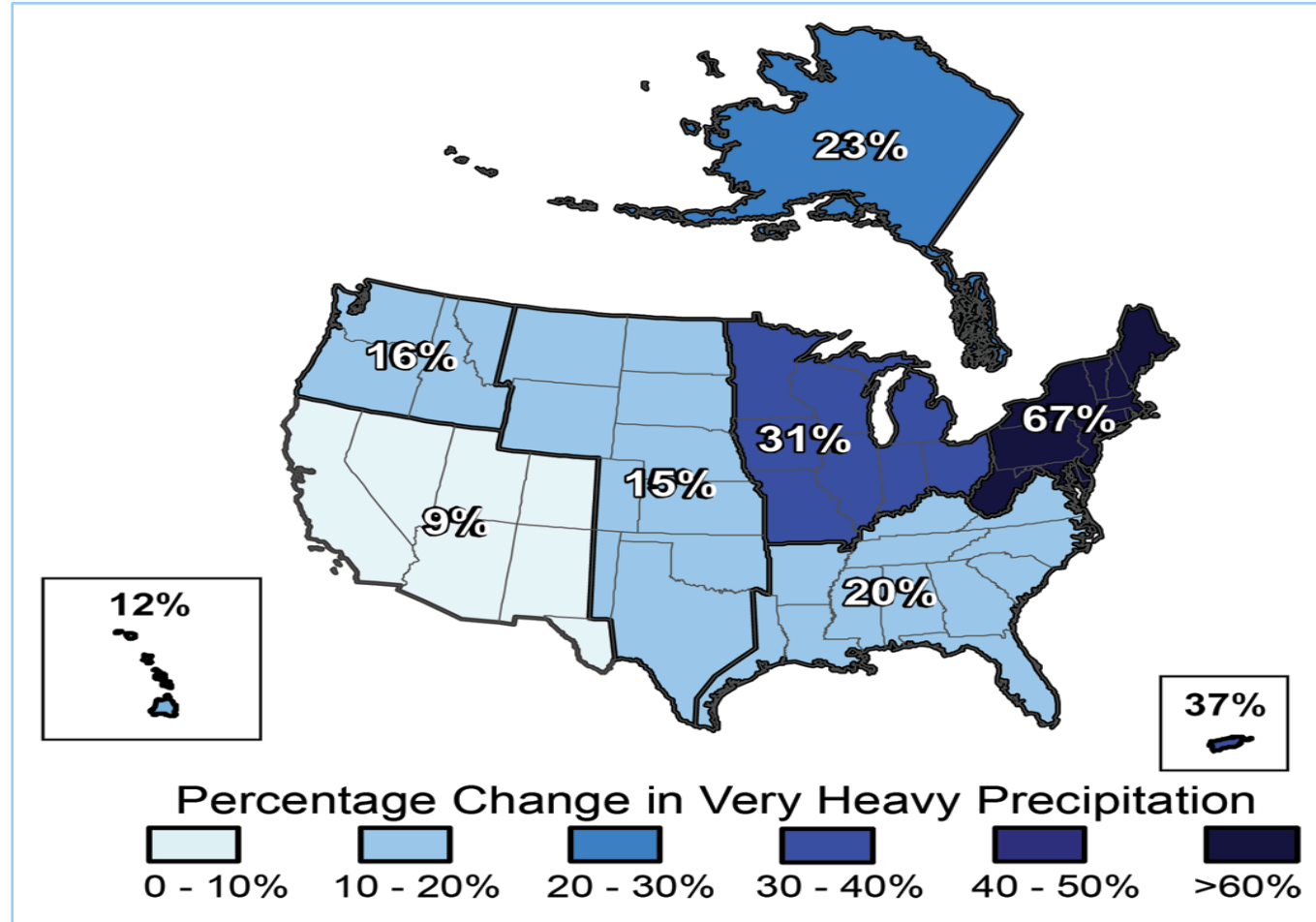




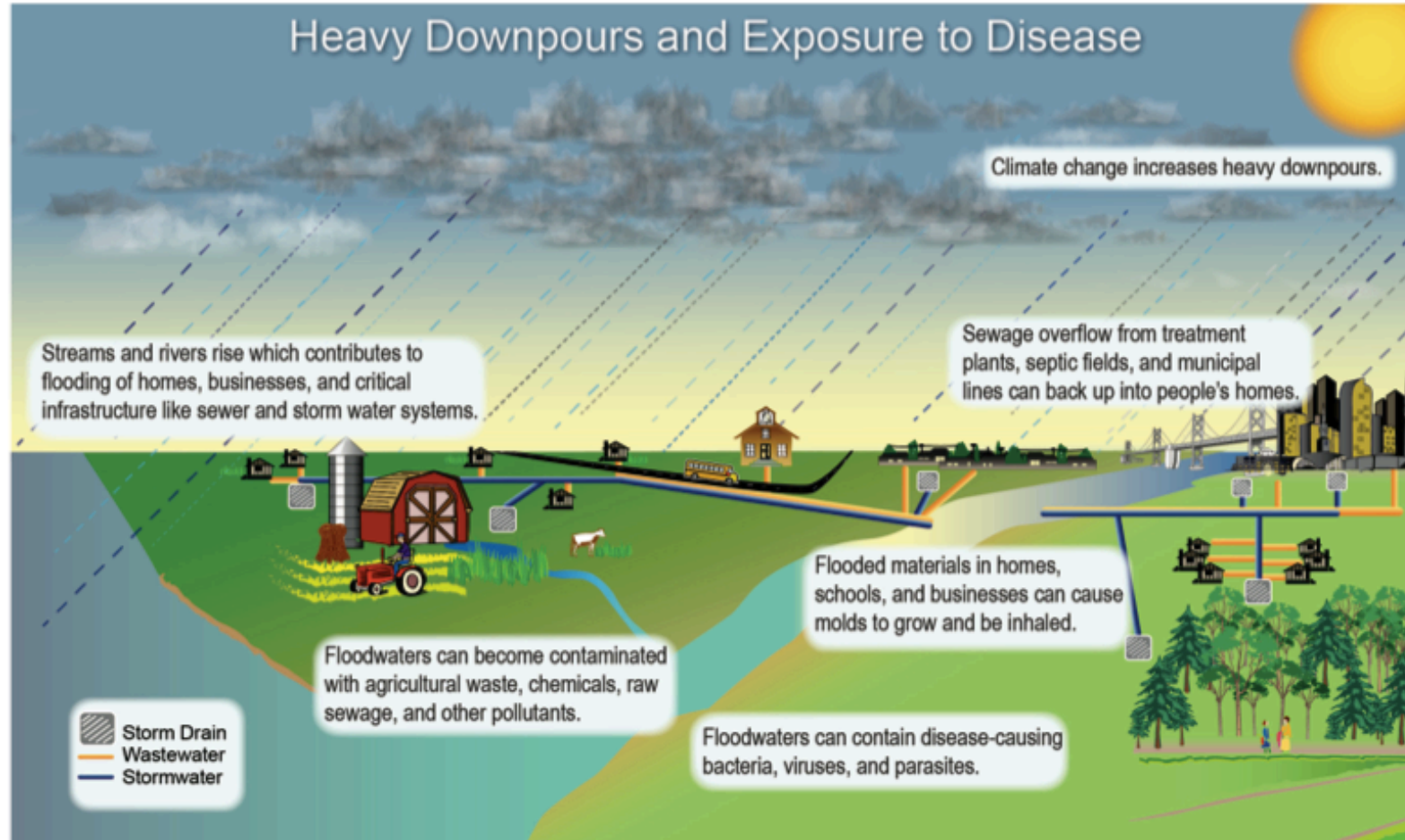
- >250 people lost their lives during the storm.
- >\$65 billion in immediate damage.

The long-term economic toll of Sandy, including reconstruction of power grids, infrastructure and homes, has not yet been fully tallied.

# Observational Record: Heavy Rain Events are More Frequent



## Heavy Downpours and Exposure to Disease



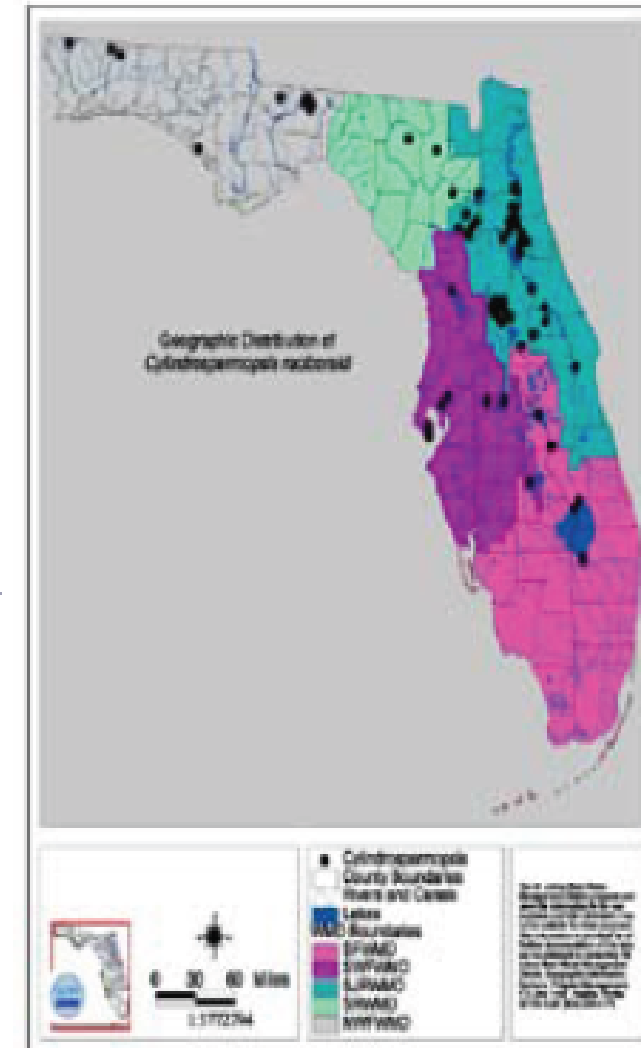
# Harmful Algal Blooms (Red-tides)

Enhanced by:

- Increased water temps
- Nutrient runoff
- Upwelling events



Figure 2. Distribution of the CyanoHAB, *Cylindrospermopsis raciborskii*, in Florida (Williams 2001, Fristachi et al. 2007). *C. raciborskii*, which produces potent hepatotoxins (Table 2), was originally found only in tropical areas but has recently spread to cooler regions.







# Direct Effects of Hydrologic Extremes



↑ drier climates= forest fires and smoke

## Vulnerable Populations:

- Young Children
- Elderly
- Pregnant Women
- People with Preexisting Respiratory and Cardiac Diseases



Wildfire forces out thousands of Californians - Photo 14 of 16

The Station Fire is visible Saturday night from the mountains near the Rose Bowl in Pasadena in a photo from iReporter Tammy Alsterlind. Courtesy Tammy Alsterlind



## BEFORE 1970

Cold temperatures caused freezing at high elevations and limited mosquitoes, mosquito-borne diseases and many plants to low altitudes

DENGUE FEVER  
OR MALARIA

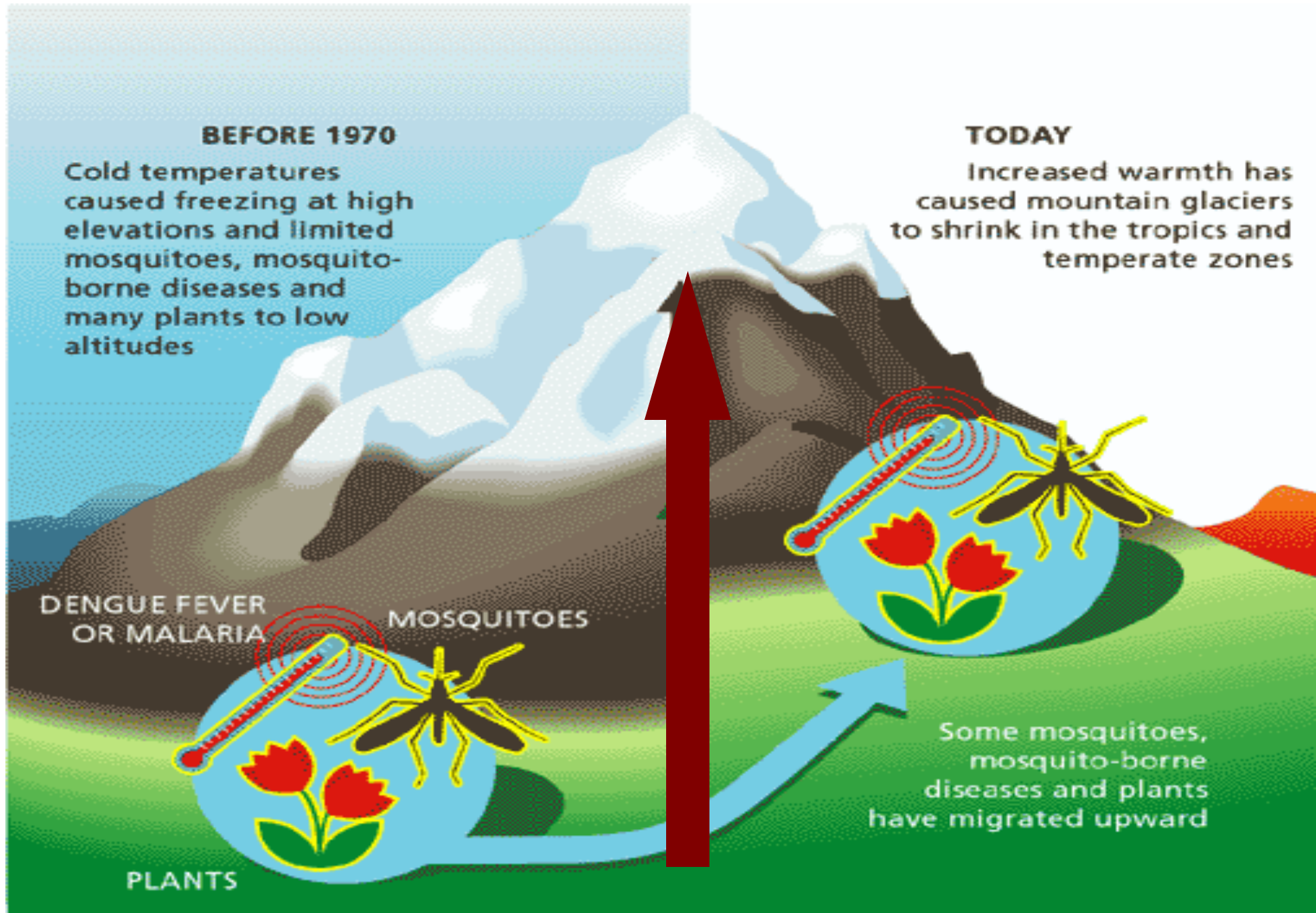
MOSQUITOES

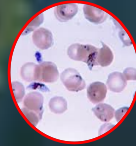
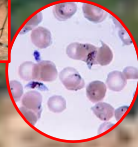
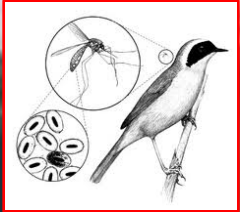
PLANTS

## TODAY

Increased warmth has caused mountain glaciers to shrink in the tropics and temperate zones

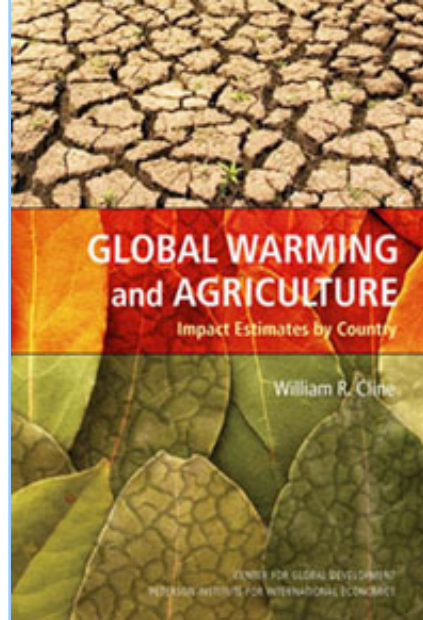
Some mosquitoes,  
mosquito-borne  
diseases and plants  
have migrated upward



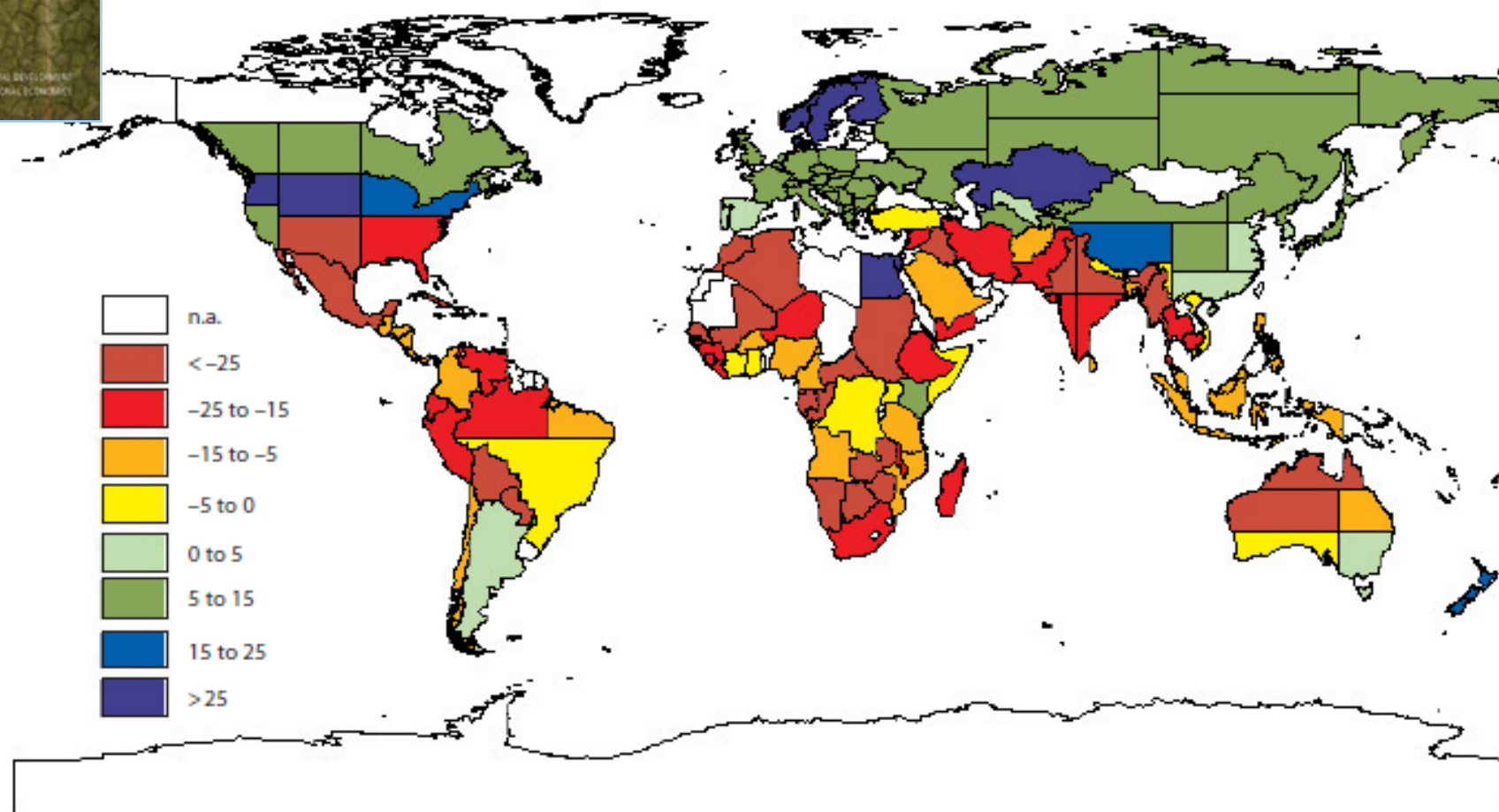




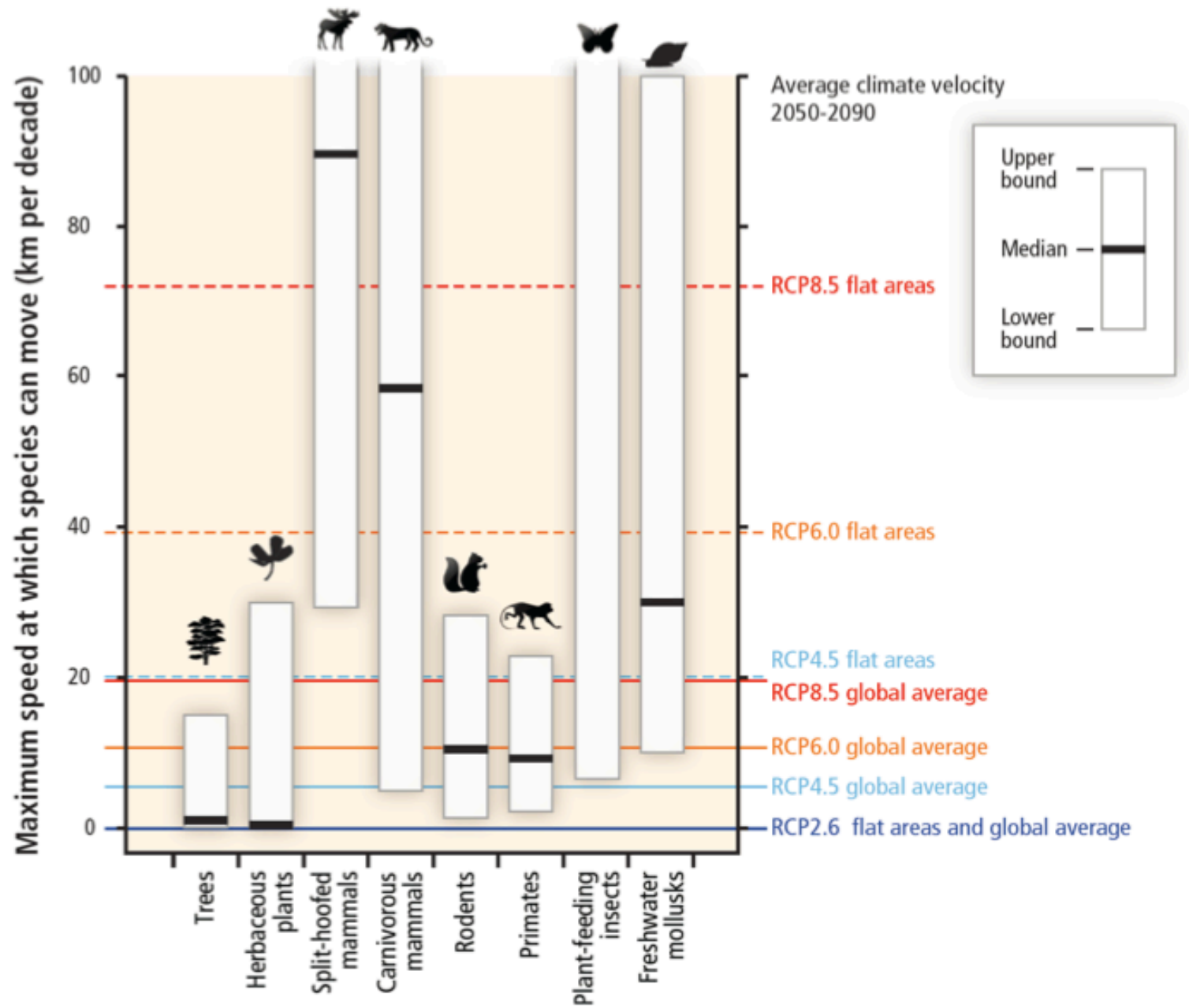




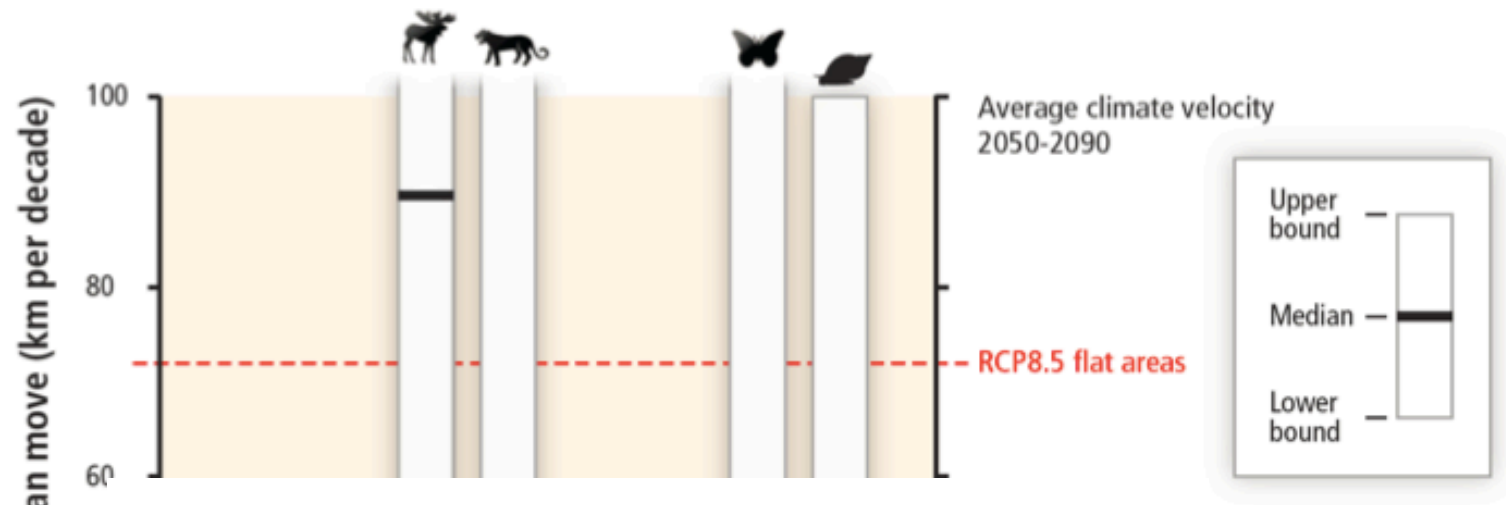
Impact on agricultural productivity with carbon fertilization (percent)



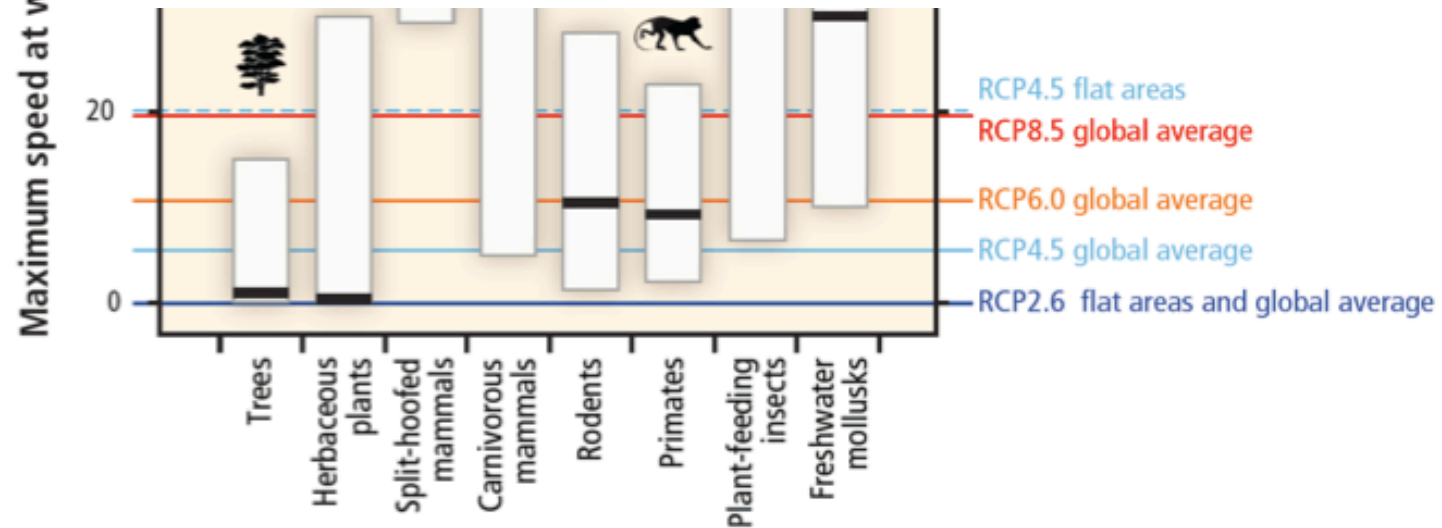
Adaptability?







# Humans?

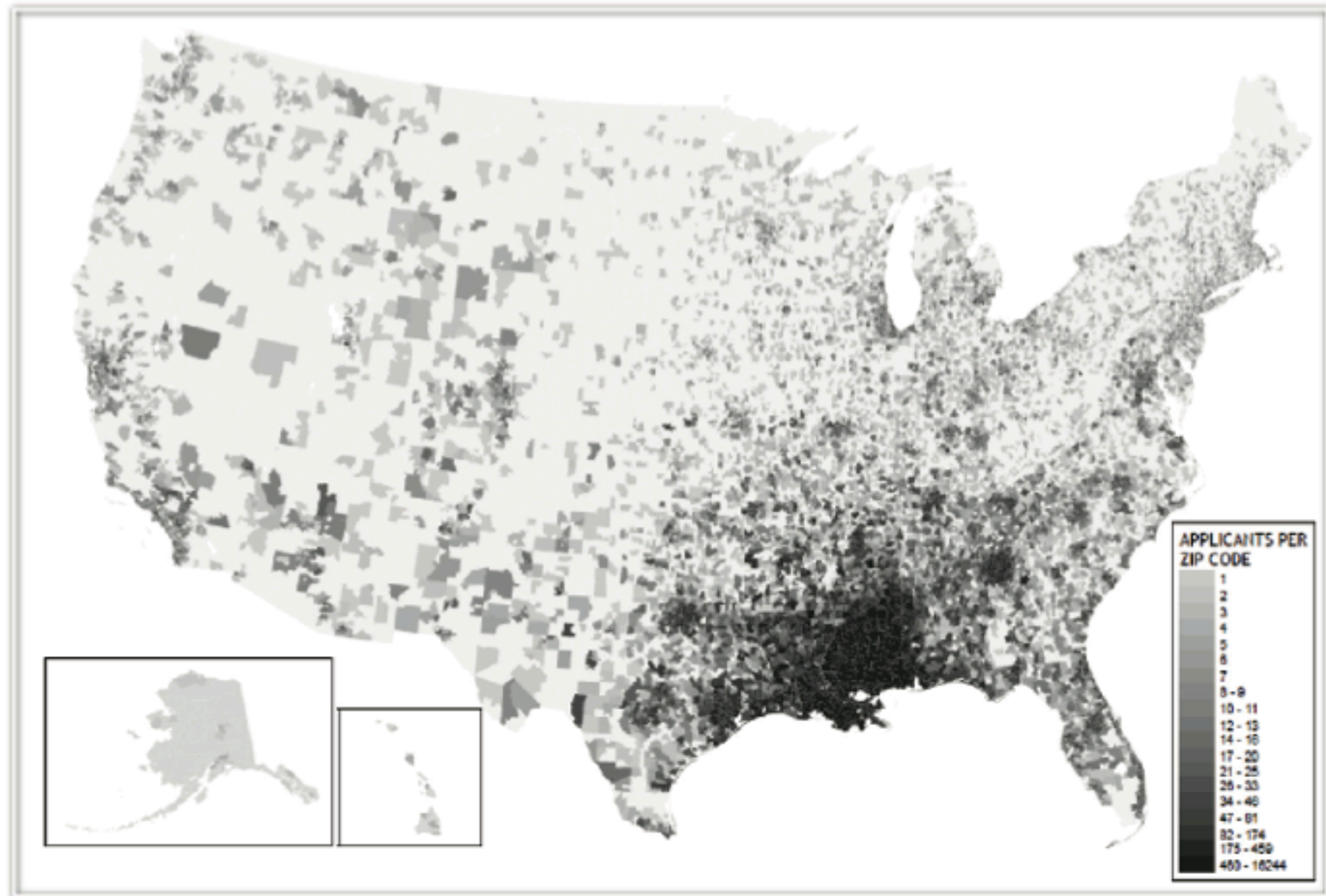




*New Orleans today?*



## Katrina Refugee Diaspora





**Climate change over the 21st century is projected to increase displacement of people** *(medium evidence, high agreement).*



By 2050: 75 million Islanders will be forced to relocate



# Threat Multipliers

Climate change and resource scarcity are rarely sole cause of violent conflict

Better understood as “threat multiplier” that will interact with other risk drivers ...

...All with diverse sources of vulnerability



Climate change can indirectly increase risks of violent conflicts in the form of **civil war and inter-group violence**

Amplifying **poverty and economic shocks** (*medium confidence*).

***The rich will find their world to be more expensive,  
inconvenient, uncomfortable, disrupted and  
colorless — in general, more unpleasant and  
unpredictable, perhaps greatly so...***

***The poor will die...***

Kirk R. Smith, 2008

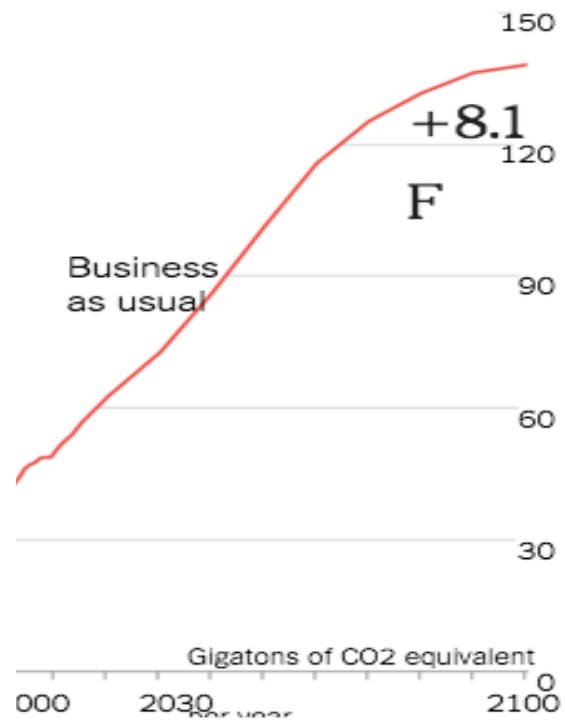
Professor, Environmental

Health Sciences, UC- Berkeley

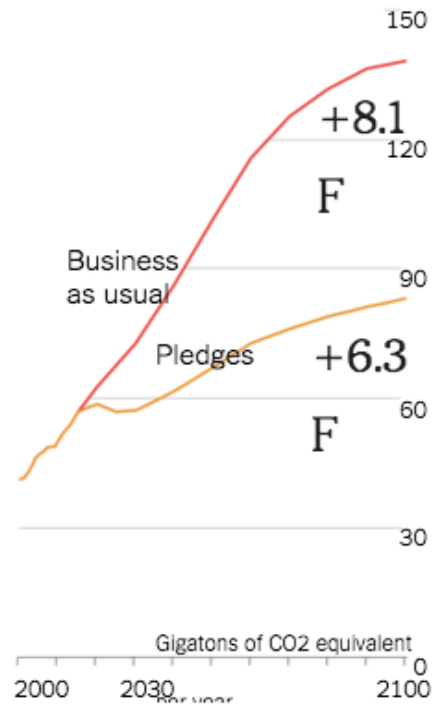
2016



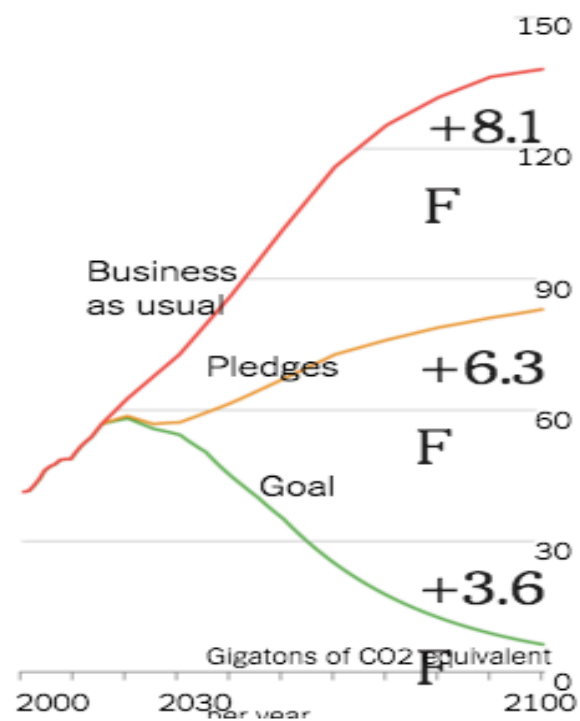




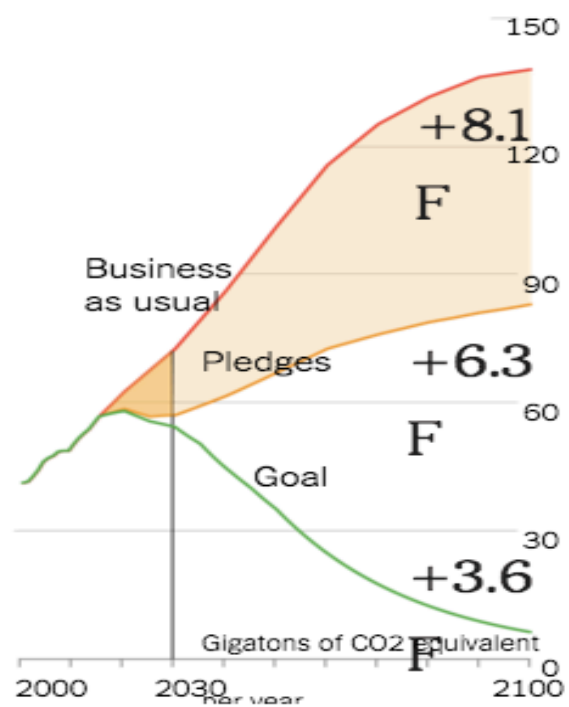
Without the pledges, **global temperatures** would likely jump more than 8°F by 2100.



The **Paris pledges** lower the likely increase to just over 6°F.

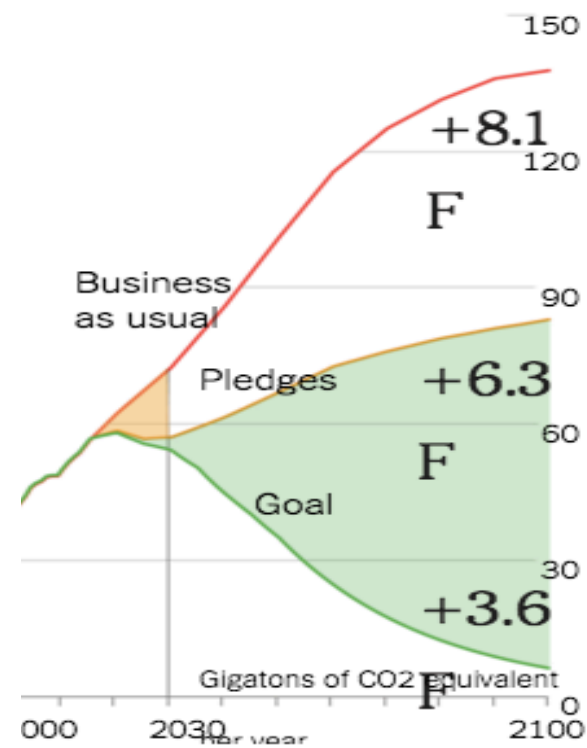


But **the goal countries agreed to** in 2010 was to limit the temperature increase to 3.6°F.



Right now, most of the pledges do not extend past 2030.





Delegates in Paris are discussing a plan to **ratcheting up national commitments** over time.

SOLUTIONS ?

# TIME

## **Rebranding Climate Change as a Public Health Issue**

Why medical professionals may be the best messengers for global warning right now

By [Courtney Subramanian @cmsub](#) | Aug. 08, 2013 | [26 Comments](#)

# Re-Framing the Climate Change Dialogue



# *The power of science communication*



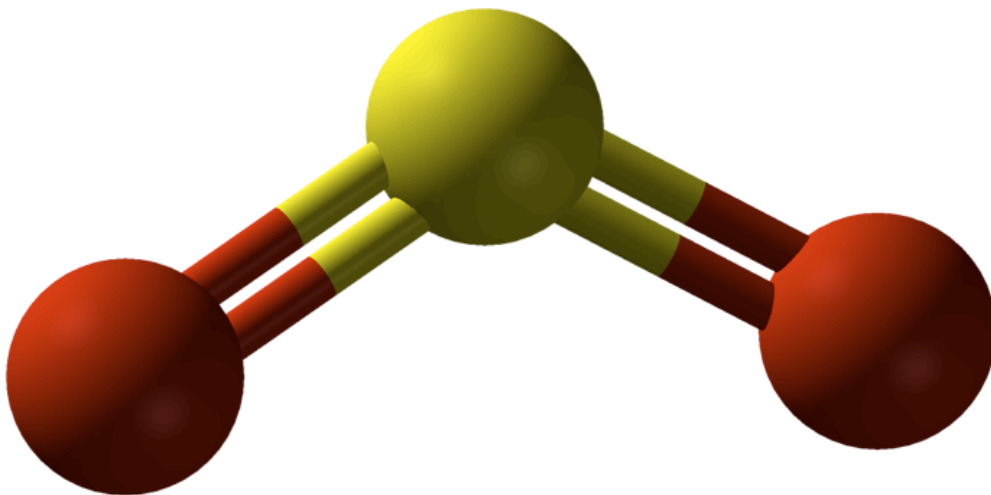




LOVE YOUR MOTHER...



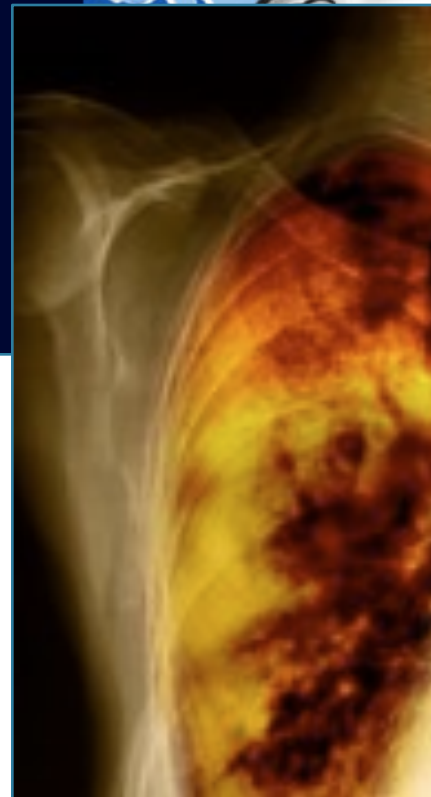
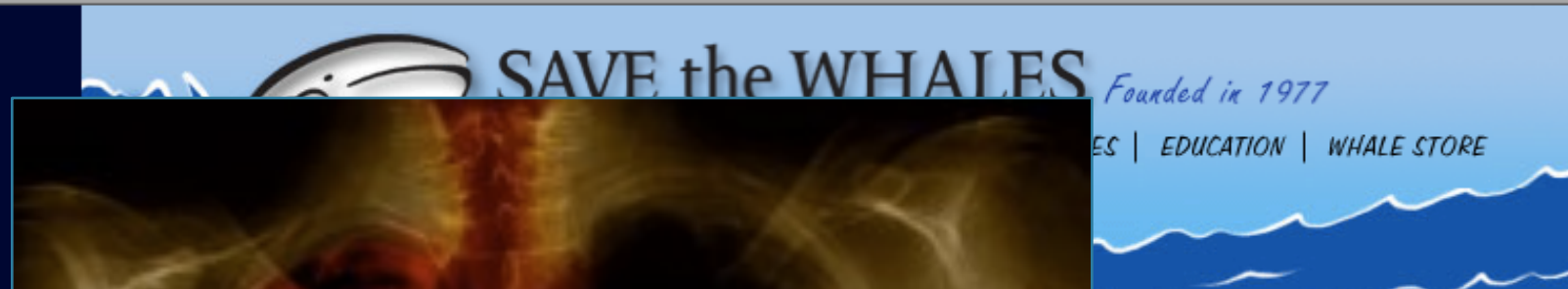
**EARTH**





**EARTH**





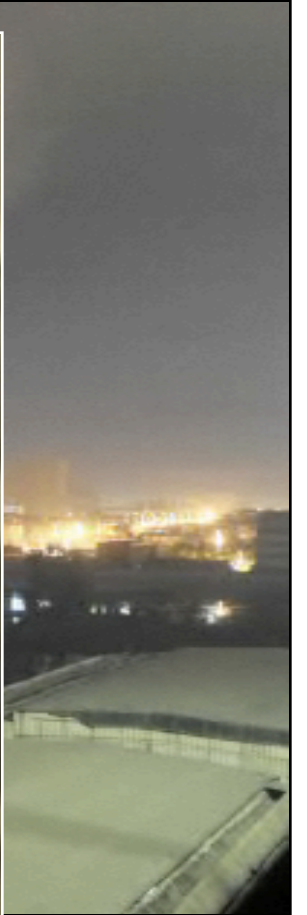
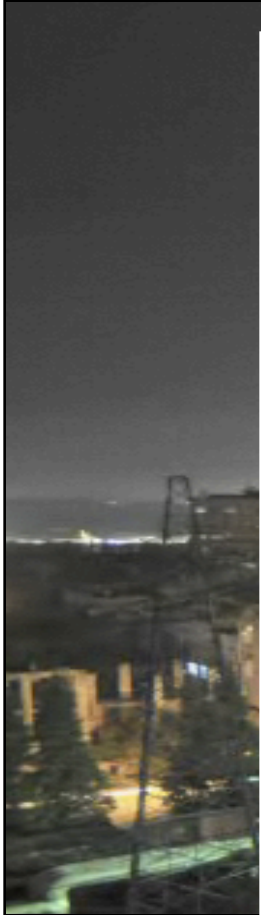
**EARTH**

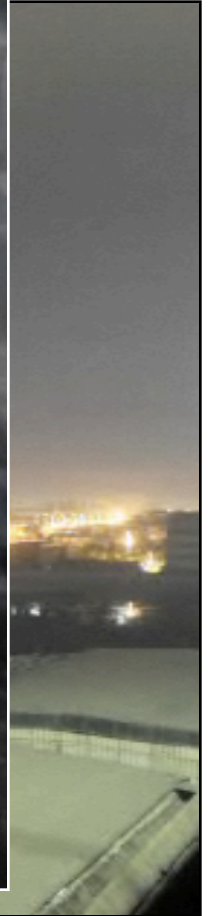
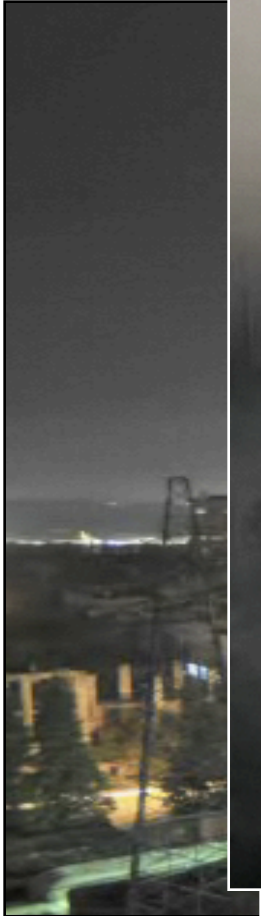


*Changing our collective risk  
assessment...*

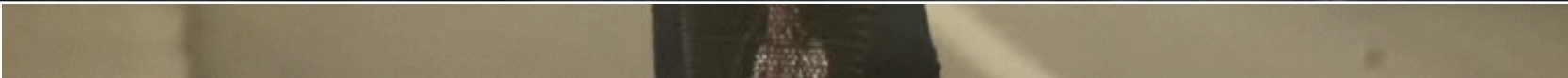
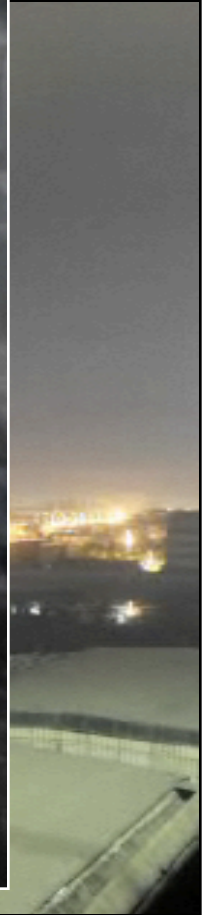
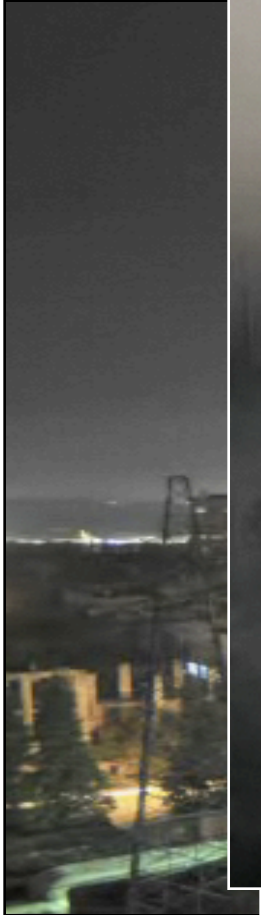




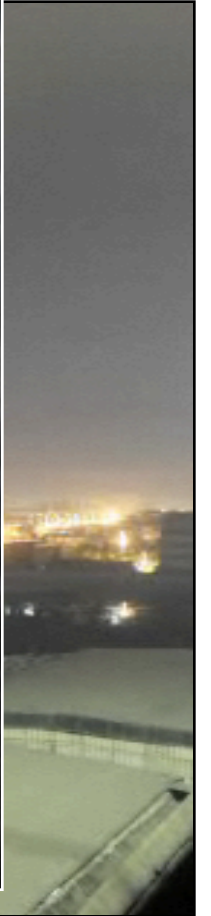
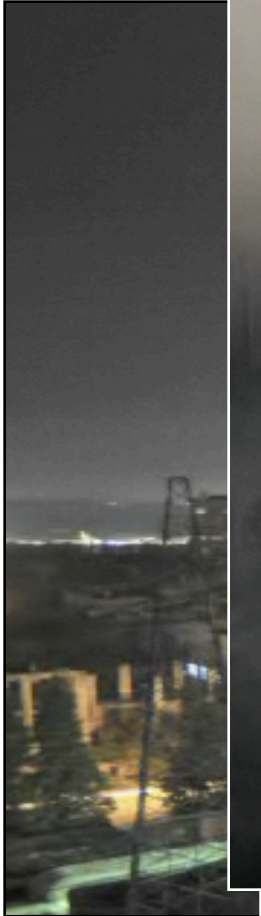
















# Cons<sup>CU</sup> on Climate Change & Health





A wooden desk sign with a dark brown frame and a lighter brown base. The word "THINK" is printed in large, bold, black, sans-serif capital letters on a white rectangular background. Below the word, in smaller black capital letters, is the text "COMPLIMENTS OF IBM CORPORATION".

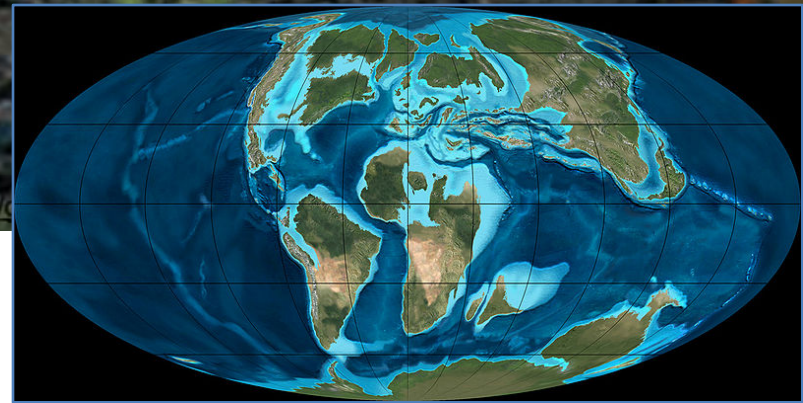
# THINK

COMPLIMENTS OF IBM CORPORATION

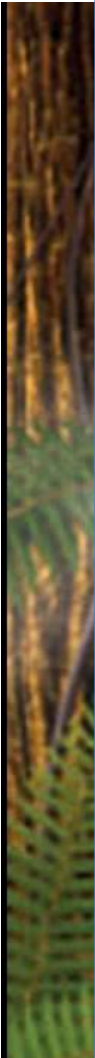




<http://www.bgs.ac.uk/discoveringGeology/climateChange/>

















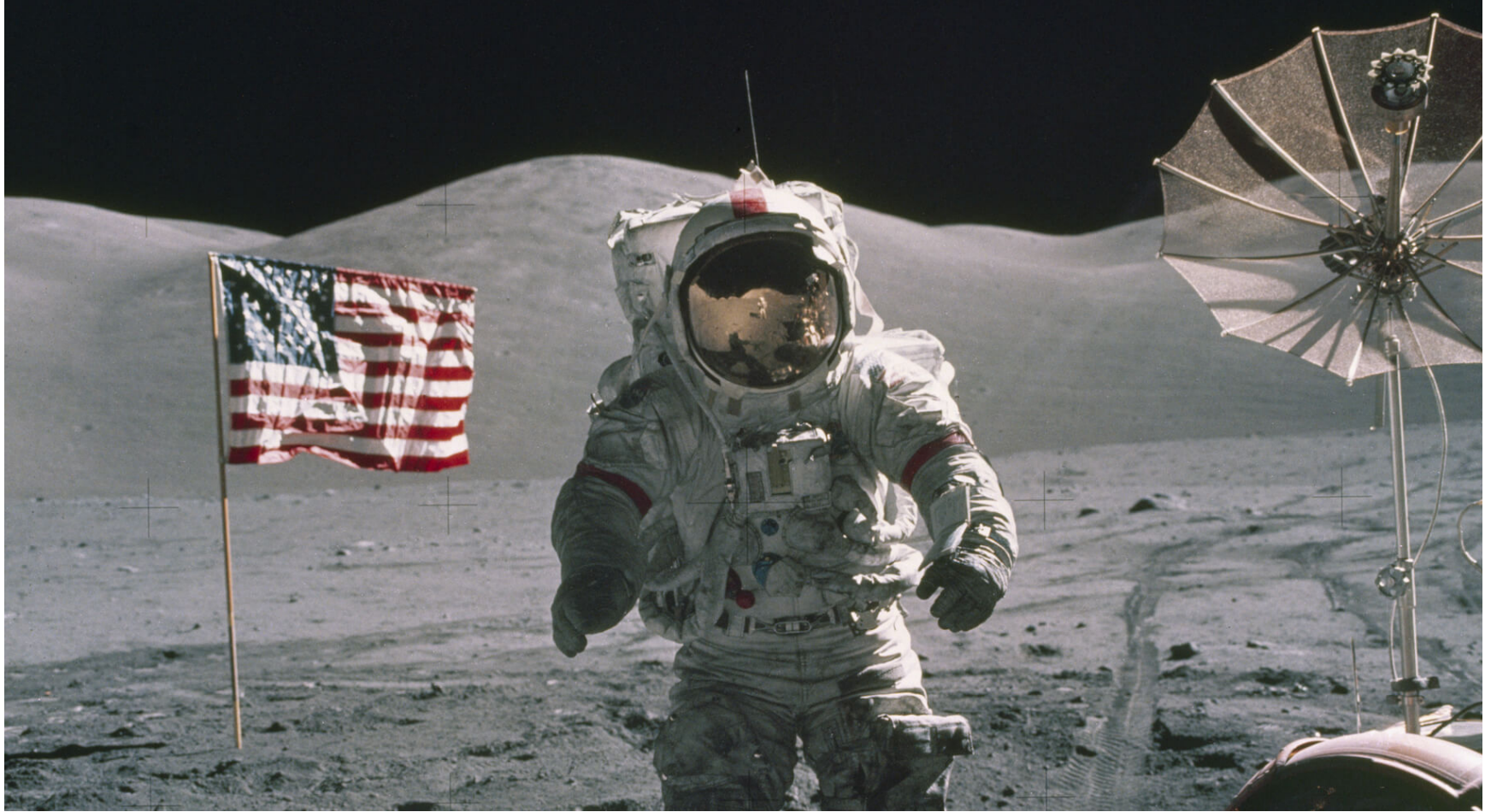


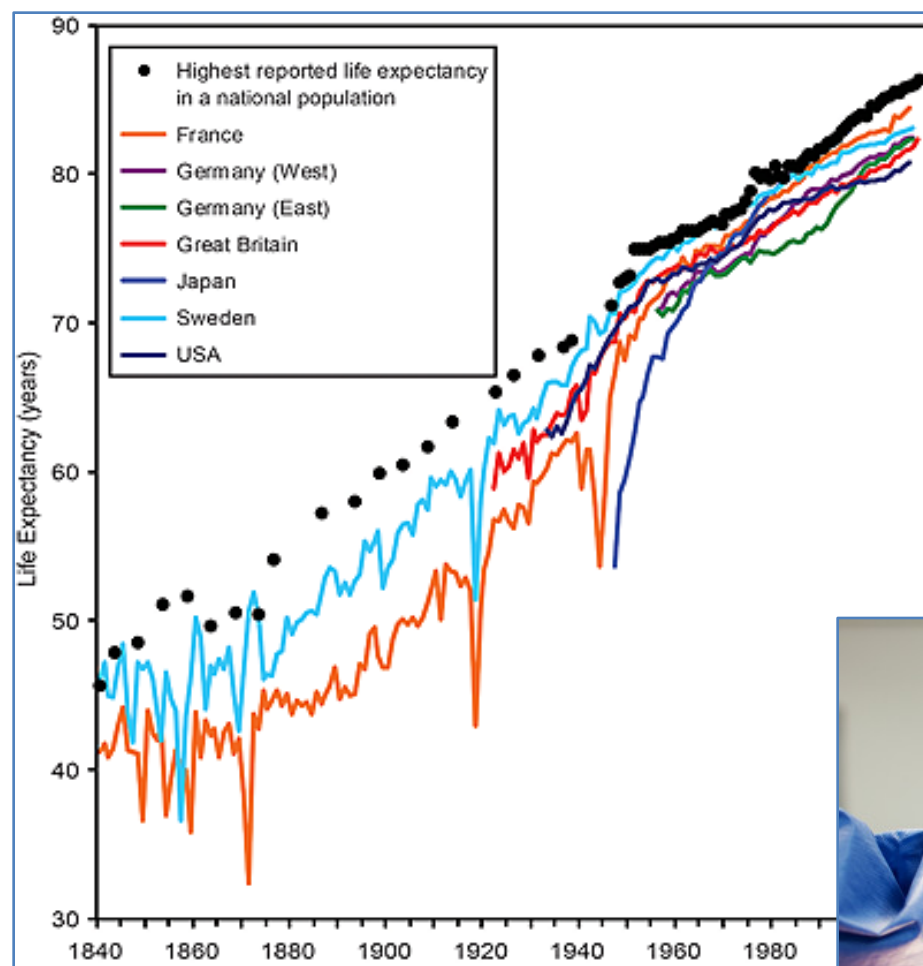


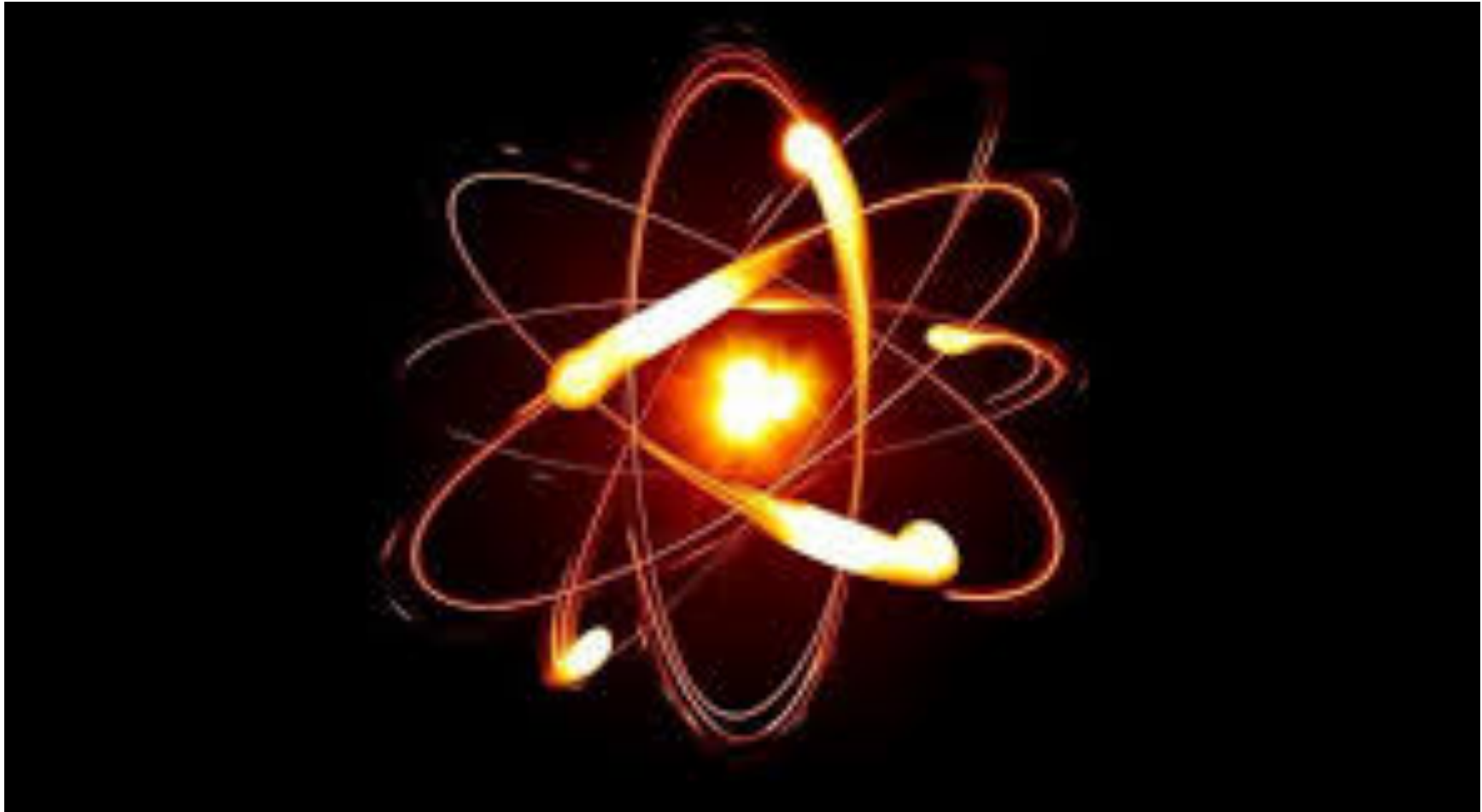


































# ***Thank You!***

Acknowledgement to:

Paul Auerbach

Skip Burkle

Laurie Garrett

Loren Greenway

George Luber

*Thank You!*

*@JayLemery* 

*coloradoWM.org*

***john.lemery@ucdenver.edu***