Climate Change and Human Health

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University of Colorado
School of Medicine
Department of Emergency Medicine

Climate and Health Program

CDC
Environmental Health

1. Where are we? (a recent inventory)
2. Climate science 101
3. Health effects
4. Business and economic perspective
5. Wrap-up

Consortium on Climate Change & Health

A cross-sector collaboration, grounded in science and policy, to address this dynamic sphere

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 communicaton


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LOVE YOUR MOTHER...
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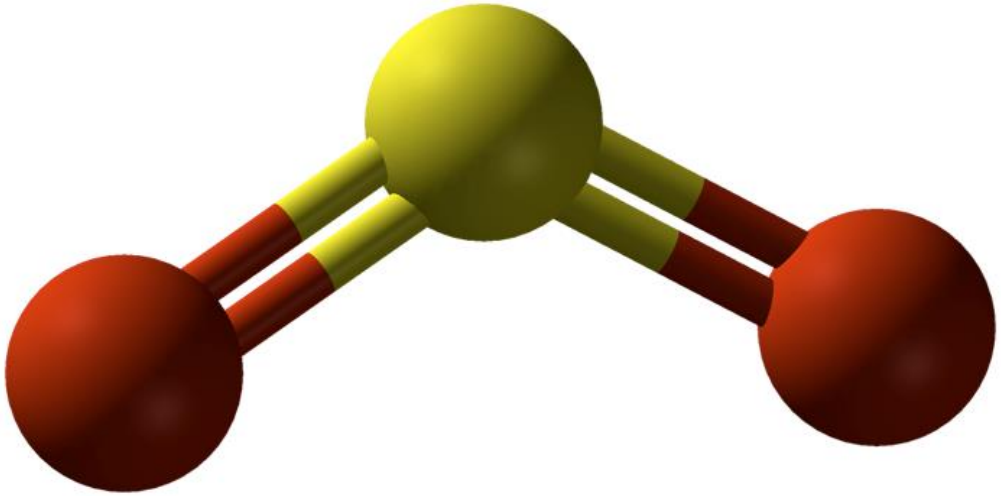


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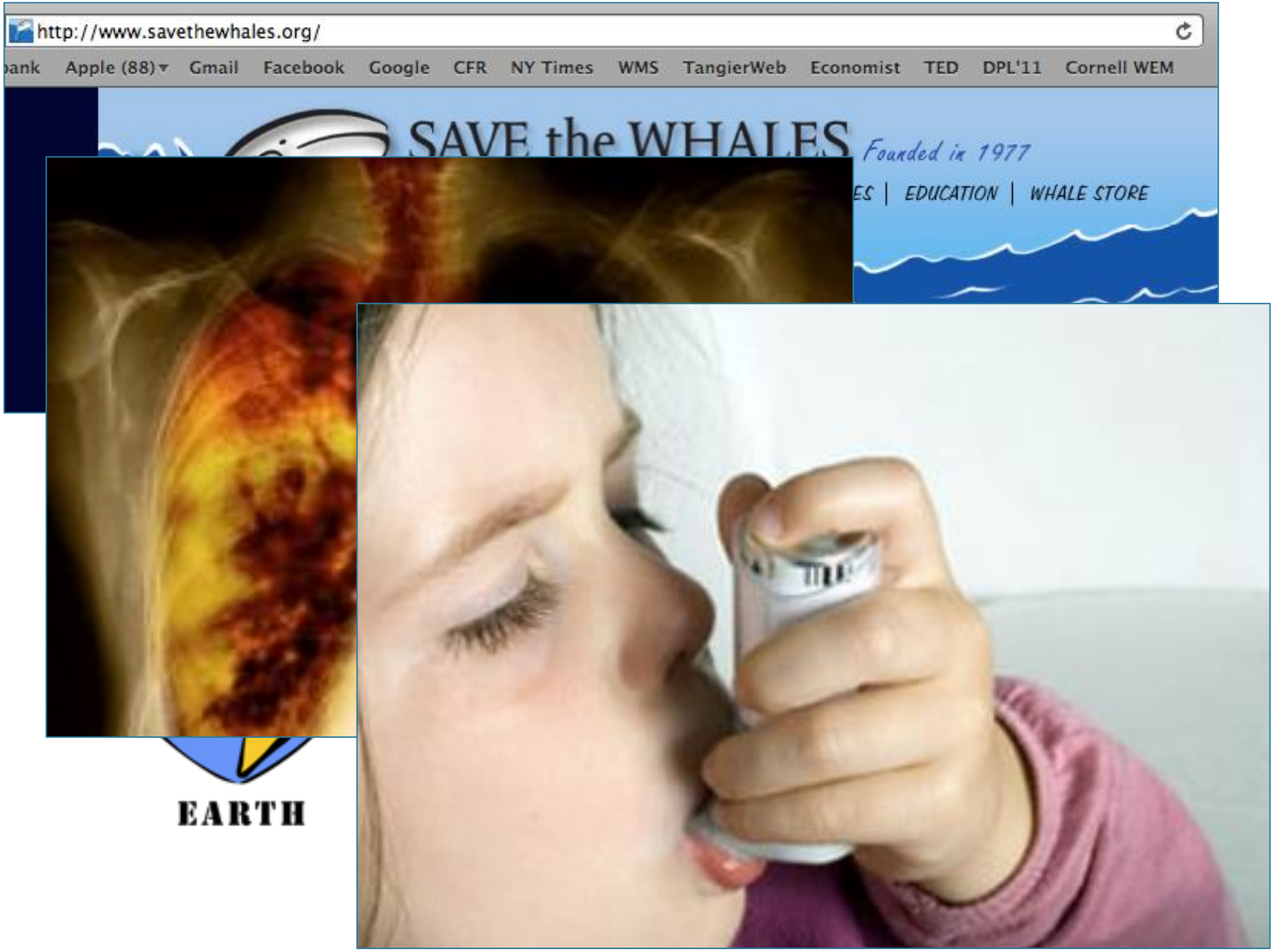
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JAMA

COMMENTARY

Physicians and the Environment

Paul S. Auerbach, MD, MS

6th World Congress on Wilderness Medicine, Whistler, BC, Canada
July 13-17, 2012

WILDERNESS & ENVIRONMENTAL MEDICINE

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

WMS

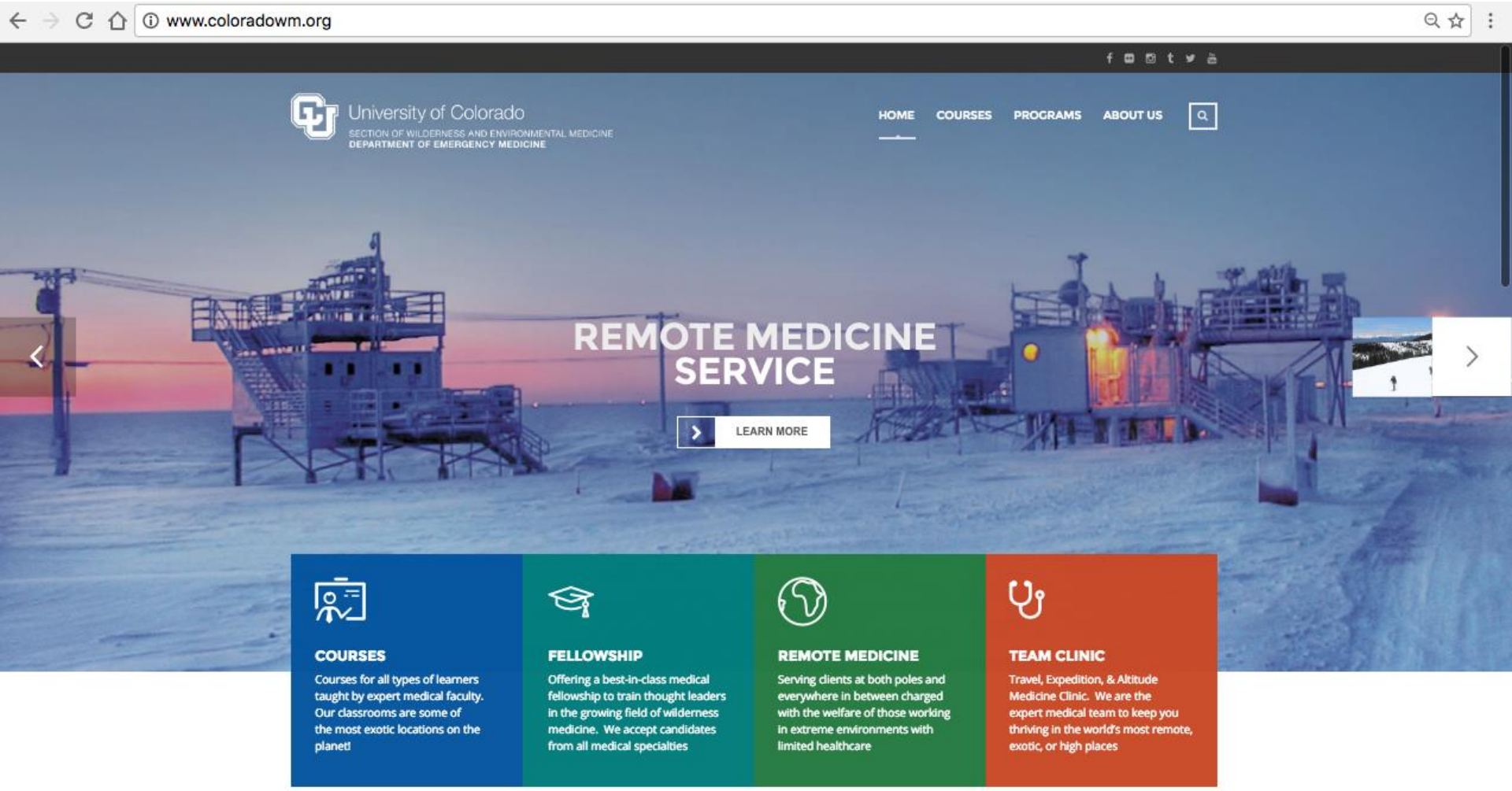
WILDERNESS & ENVIRONMENTAL MEDICINE, **23,** 2–4 (2012)

EDITORIAL

Lessons From Dr Strangelove

Human health depends on a safe environment and stable climate…

IPPNW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GEORGE LUBER · JAY LEMERY
EDITORS

GLOBAL CLIMATE CHANGE AND HUMAN HEALTH

FROM SCIENCE TO PRACTICE

JOSSEY-BASS
A Wiley Brand

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

ENERGY, CLIMATE CHANGE, AND OUR ENVIRONMENT

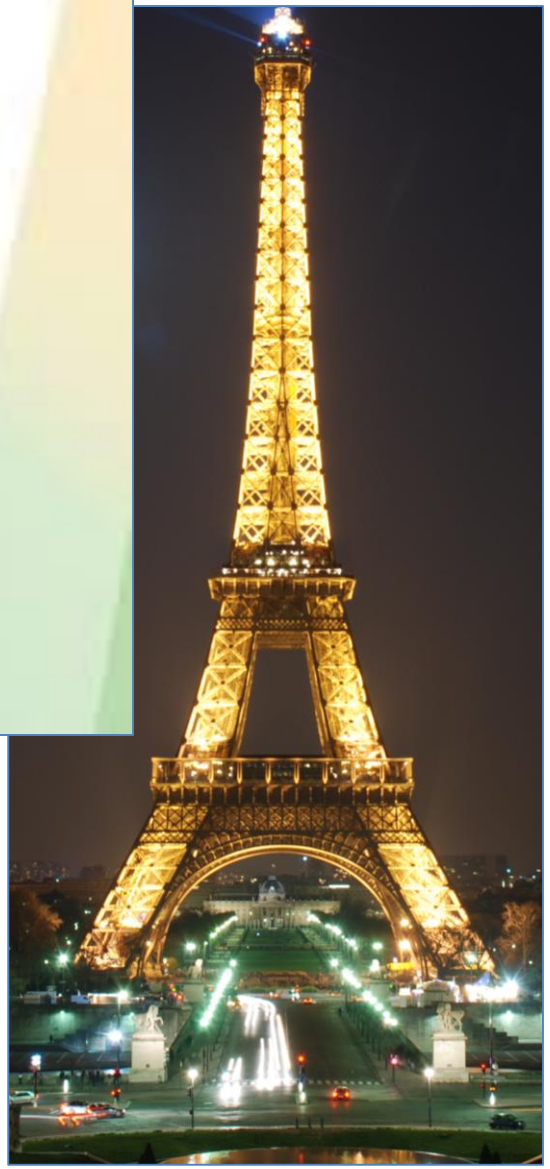
The President has taken unprecedented action to build the foundation for a clean energy economy, tackle the issue of climate change, and protect our environment.

June 2015

PARIS2015

UN CLIMATE CHANGE CONFERENCE

COP21·CMP11




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 INST MENTS OF ING TH RIS AGREEMENT
中国 · 杭州 20 9月3日 ZHOU CHIN TEMBER 2016

2015 & 2016

Anni mirabiles?

Last Winter

Chicago Tribune
OPINION

Editorial: Worst winter ever?

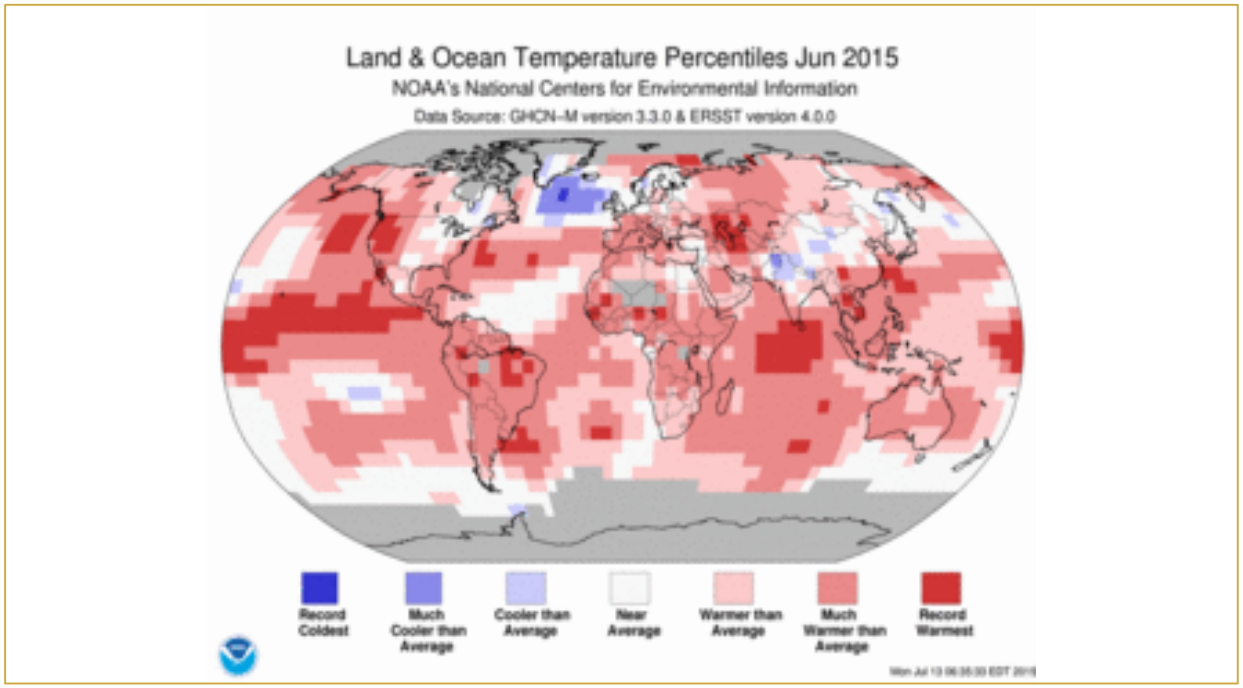

The Weather Channel
74° Fire Island ...
1
79° New York, ...
1
NATIONAL FORECASTS
National Forecast
July Chill Brought Record Cold Temperatures


LIVE
3:42 pm ET
U.S. SENATE
SEN. JAMES INHOFE
R-Oklahoma
C-SPAN2
c-span.org

The Washington Post

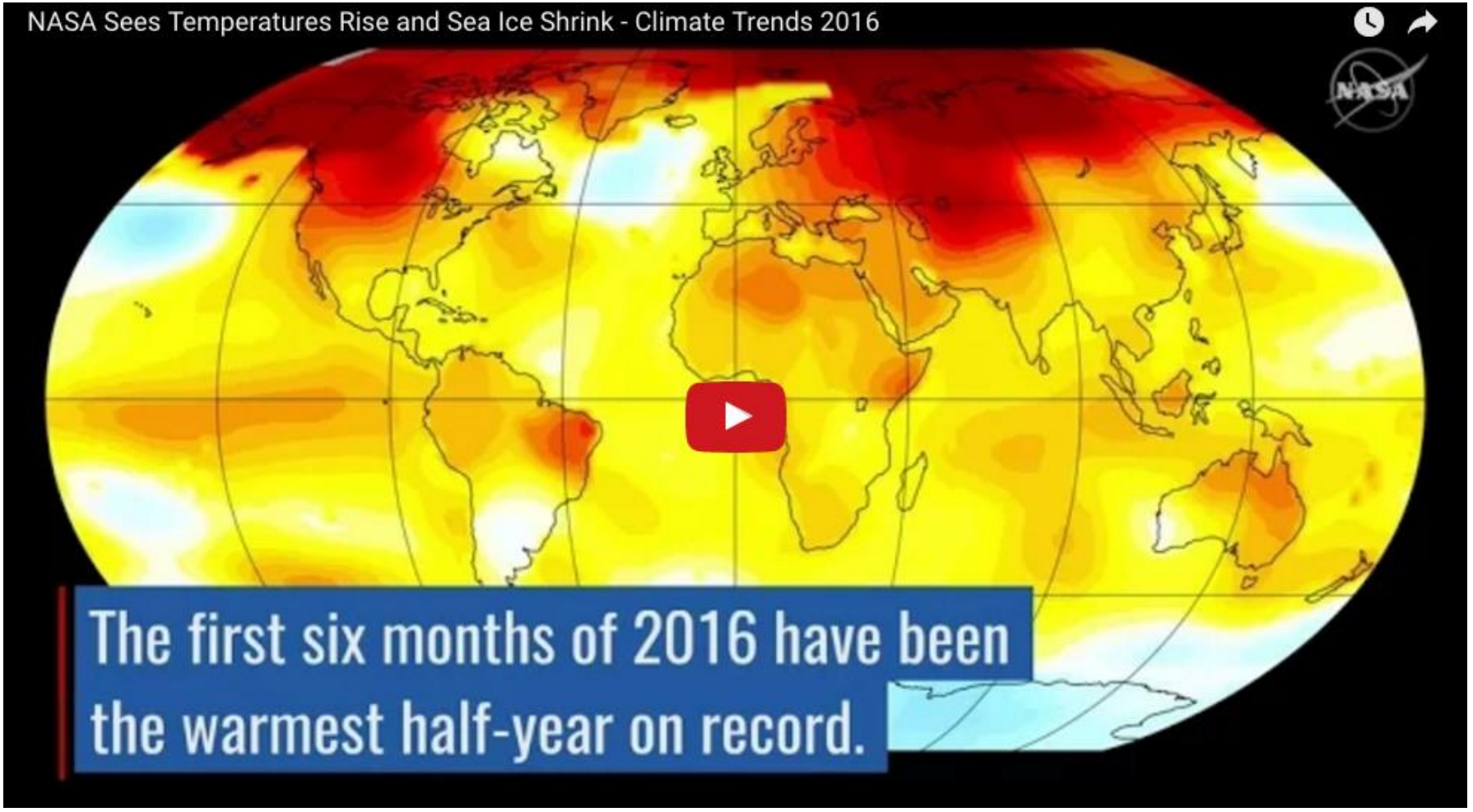
By Greg Sargent June 2, 2014

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



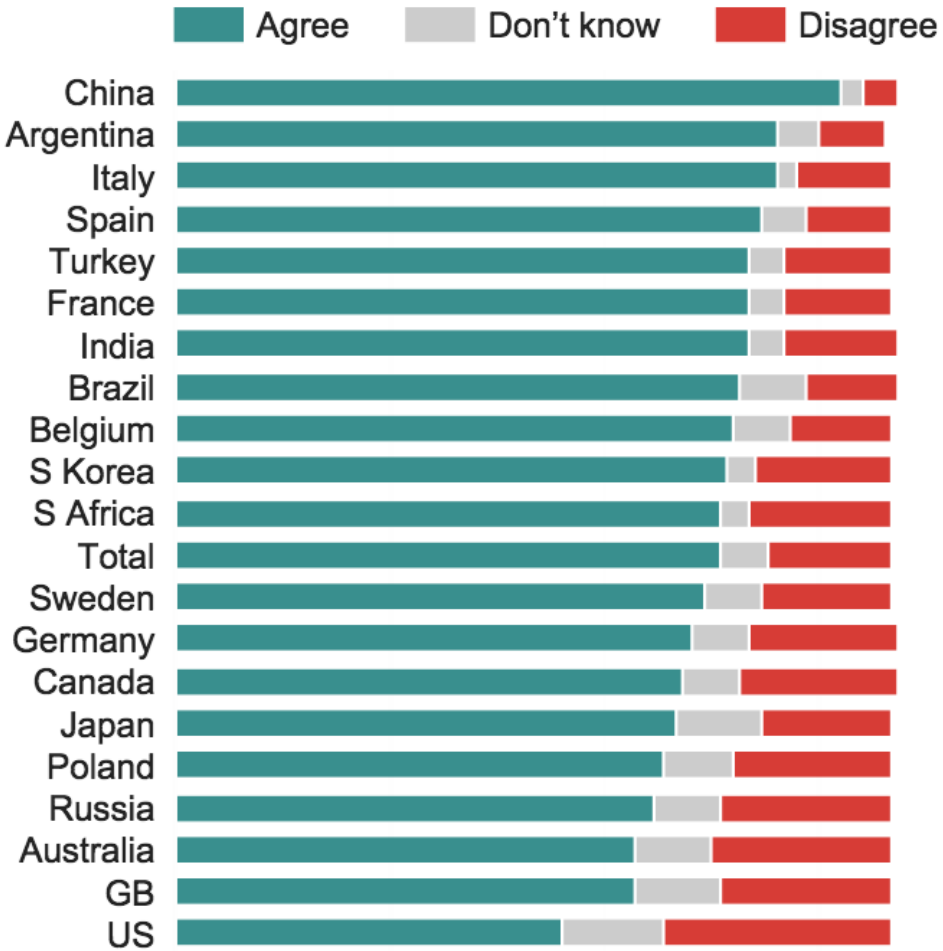
2015 warmest year on record to date. July 2015 was hottest month ever recorded.

-NOAA

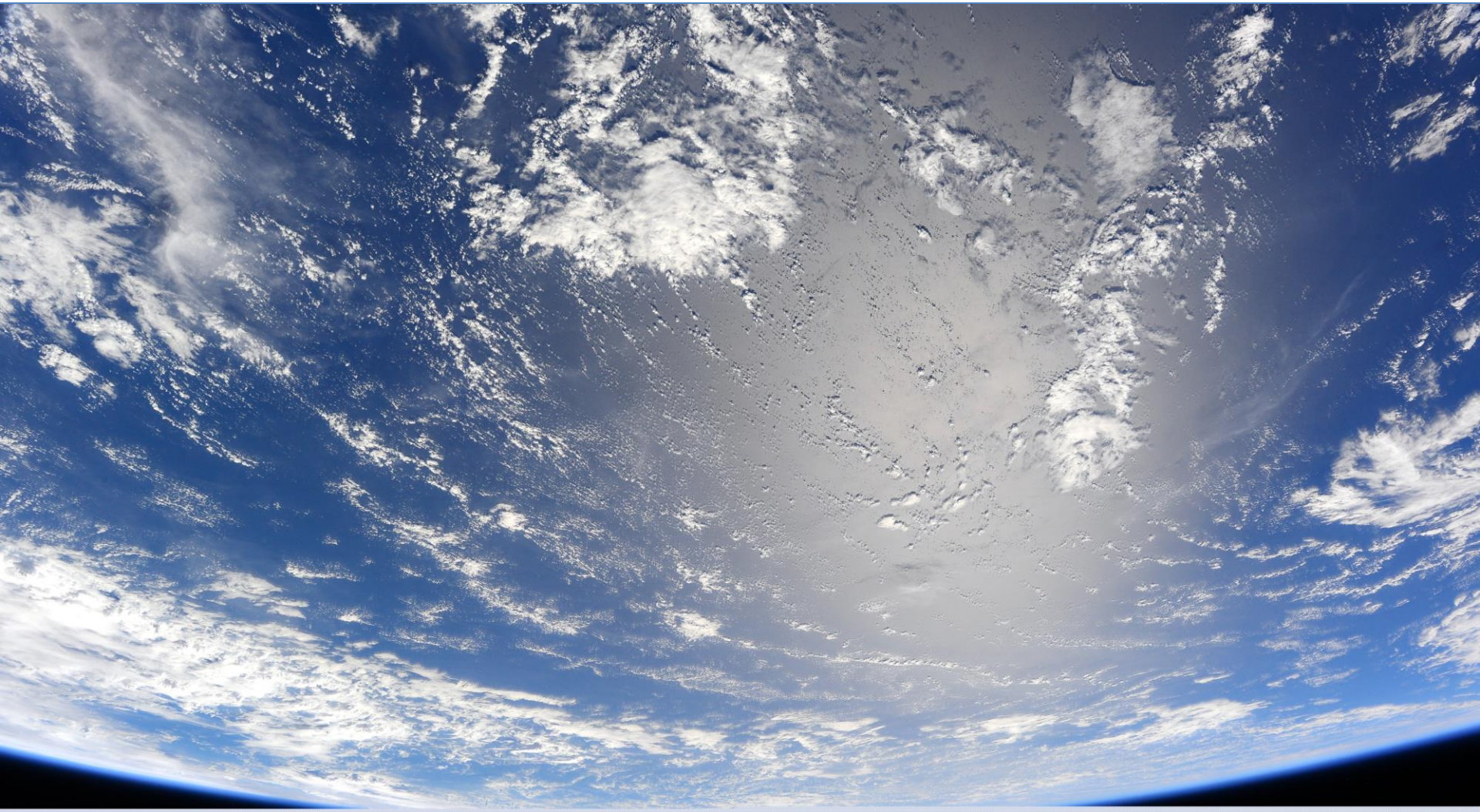

NASA Sees Temperatures Rise and Sea Ice Shrink - Climate Trends 2016
NASA
The first six months of 2016 have been
the warmest half-year on record.

To what extent do you agree or disagree?

The climate change we are currently seeing is largely the extent of human activity



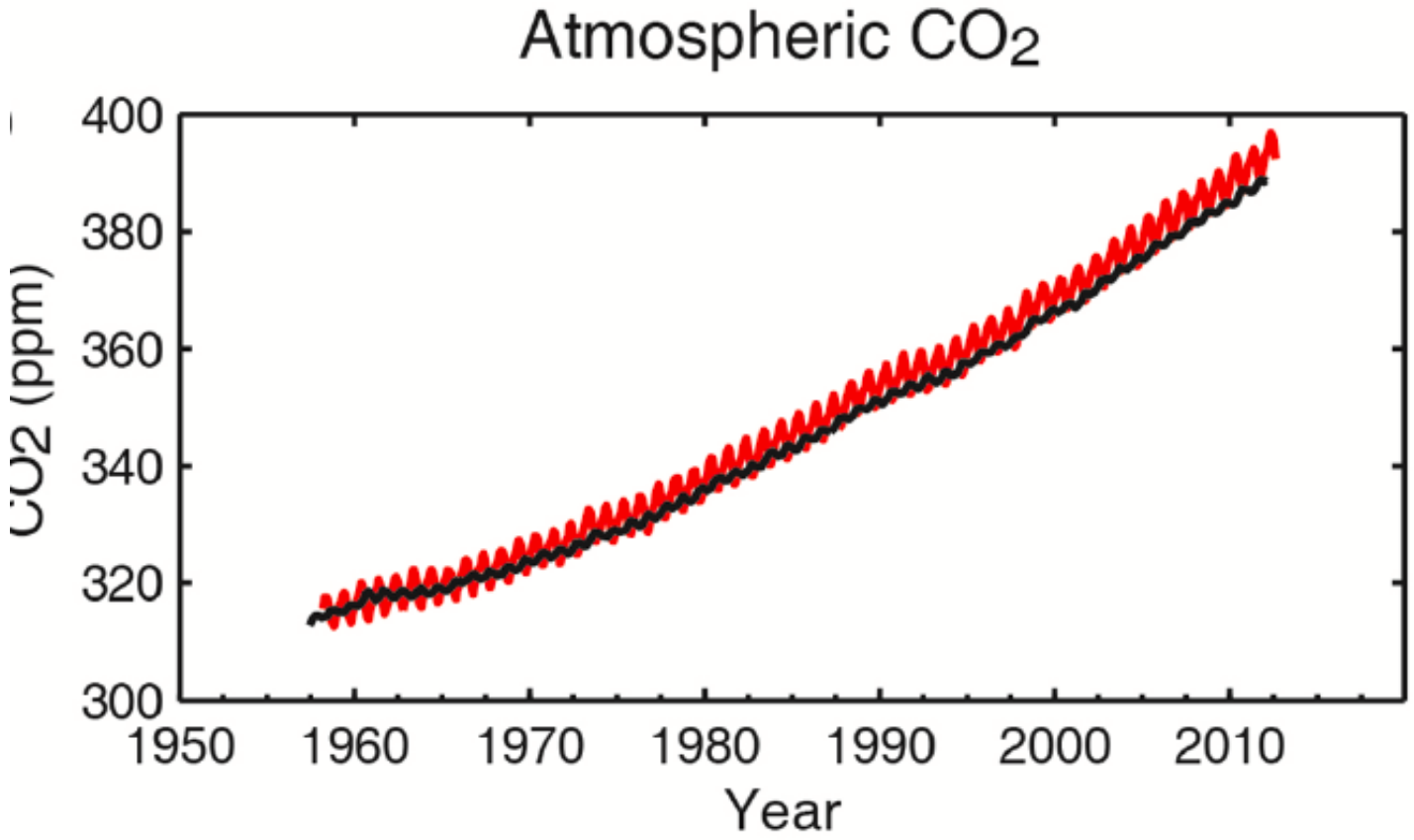
Economist, 12/15

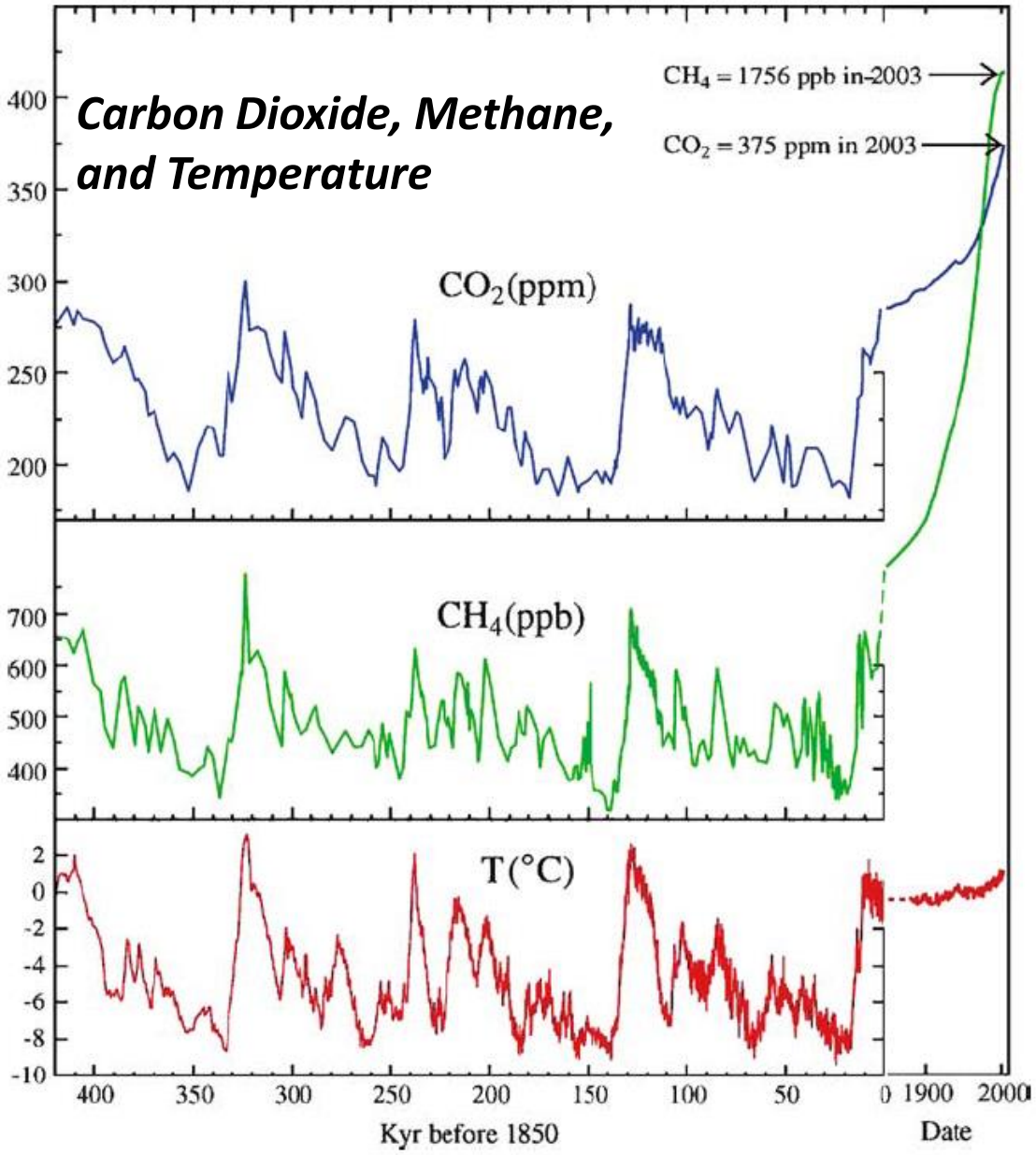


AR5 (9/27/2013)

physical science basis for CC

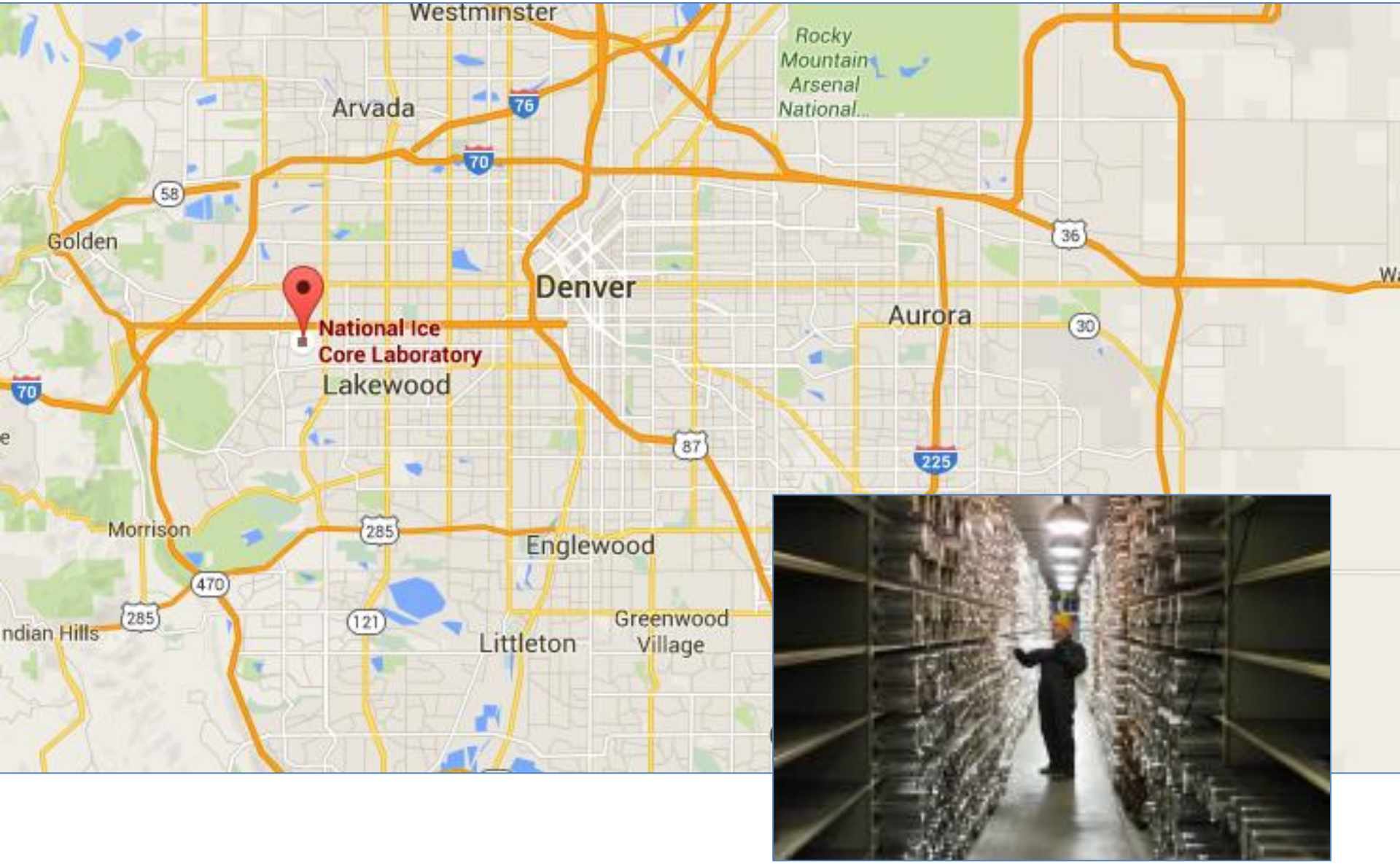
95-100% confidence that human activity is the principle cause of climate change since the Industrial Revolution in the 1850s.


Atmospheric CO_2
CO2 (ppm)
400
380
360
340
320
300
1950
1960
1970
1980
1990
2000
2010
Year



Greenhouse Gasses:

The Last 500,000 years and the last 200 years

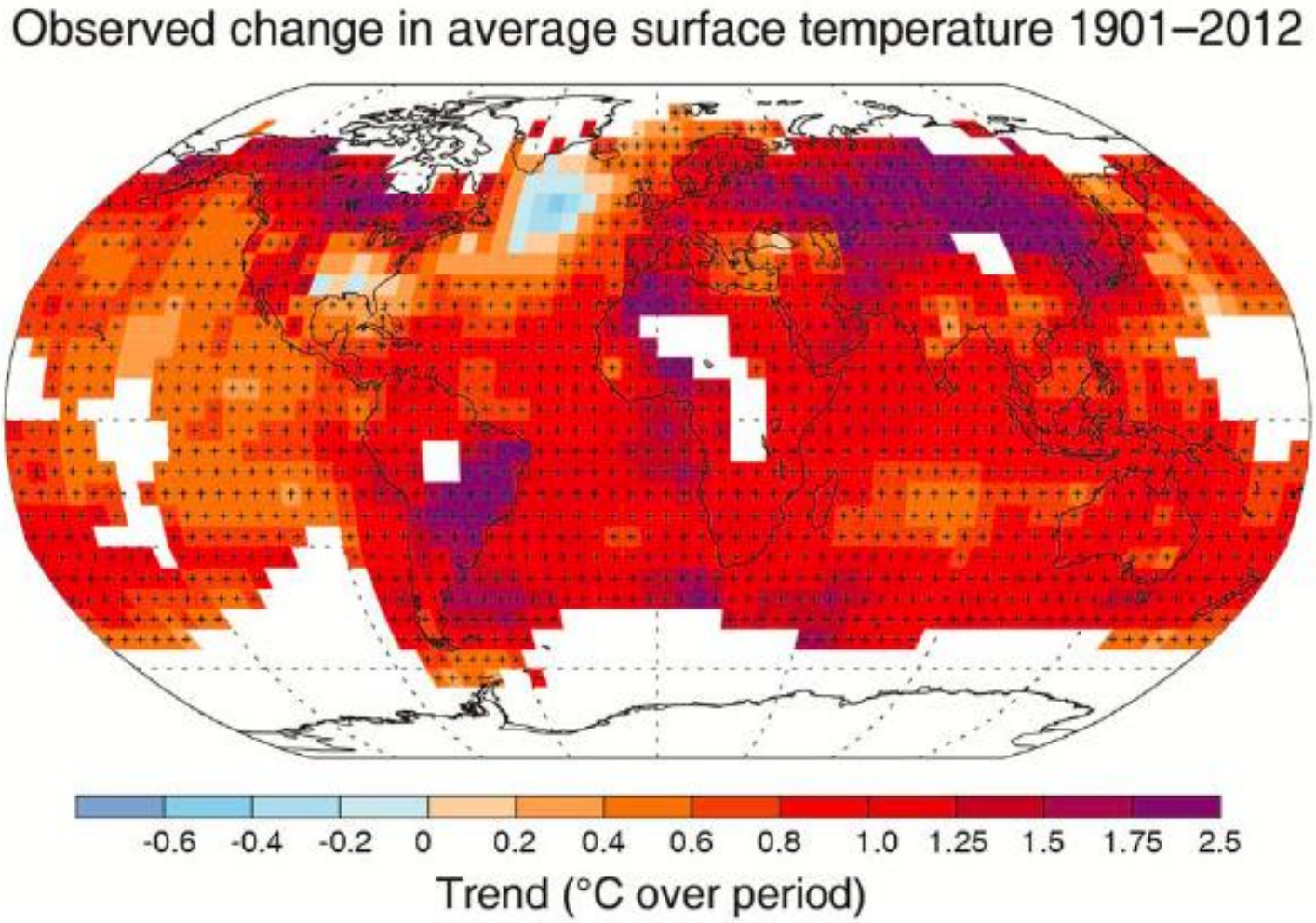

Westminster
Arvada
Rocky Mountain Arsenal National...
Golden
Denver
Aurora
National Ice Core Laboratory
Lakewood
Morrison
Englewood
Littleton
Greenwood Village
ndian Hills
58
70
76
36
30
87
225
285
470
121

Carbon limit:

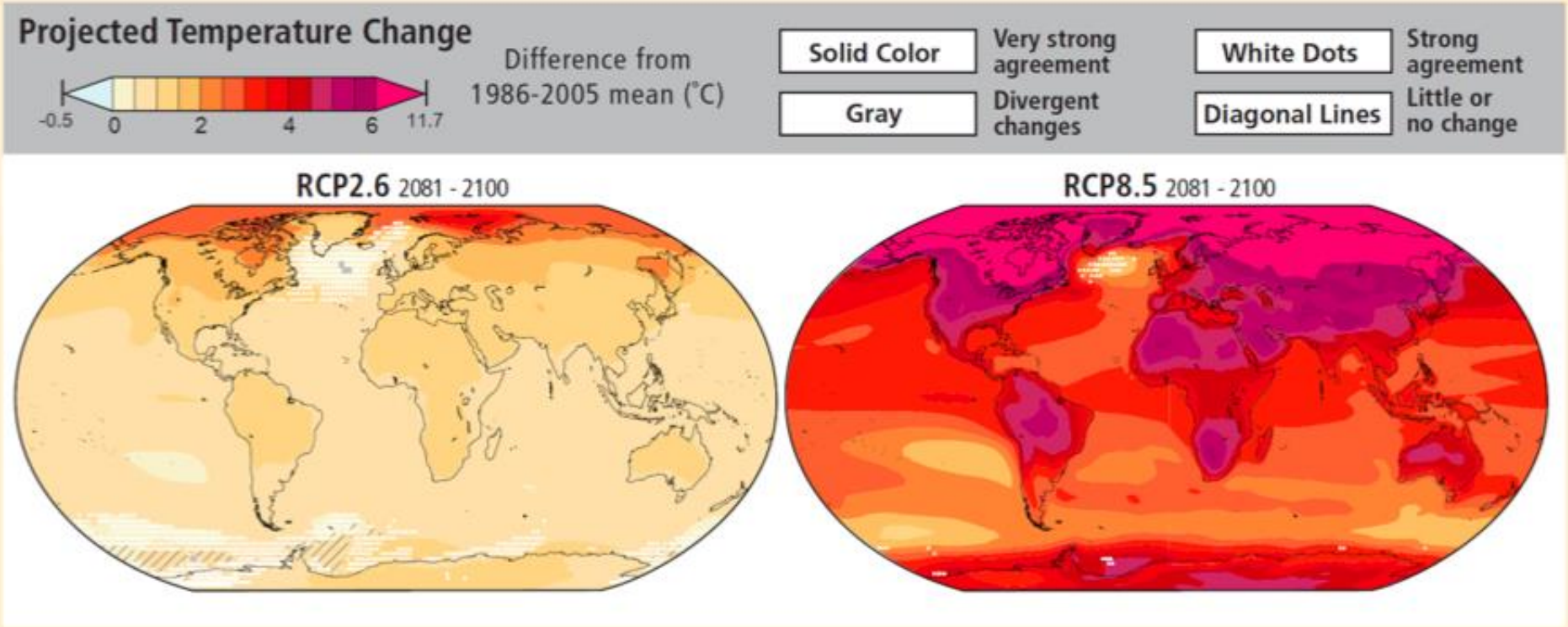
IPCC has defined an ***upper limit for carbon dioxide emissions***---3.6°F–since the Industrial Revolution

we have already spent over half of our "budget."

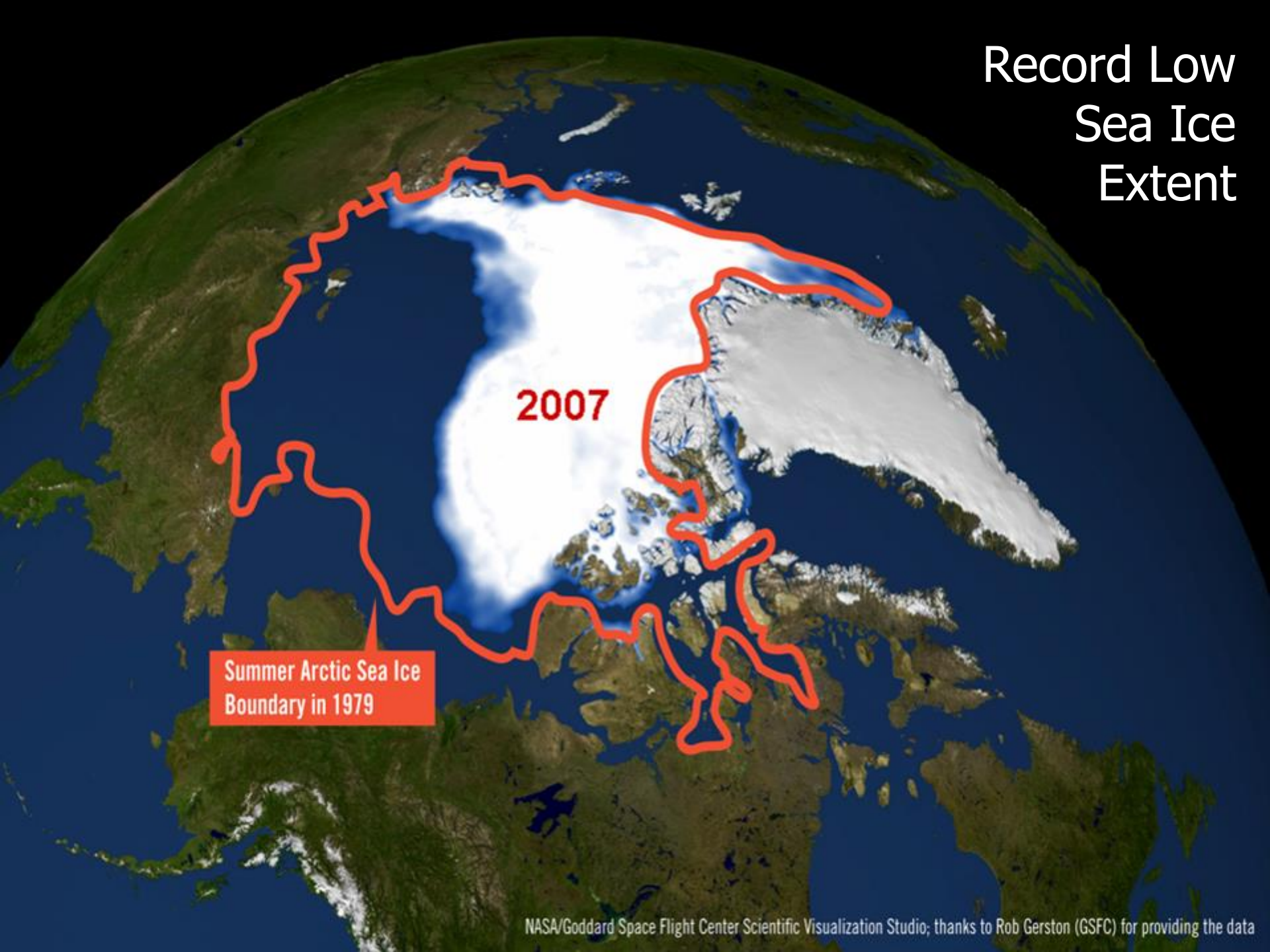
Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years.



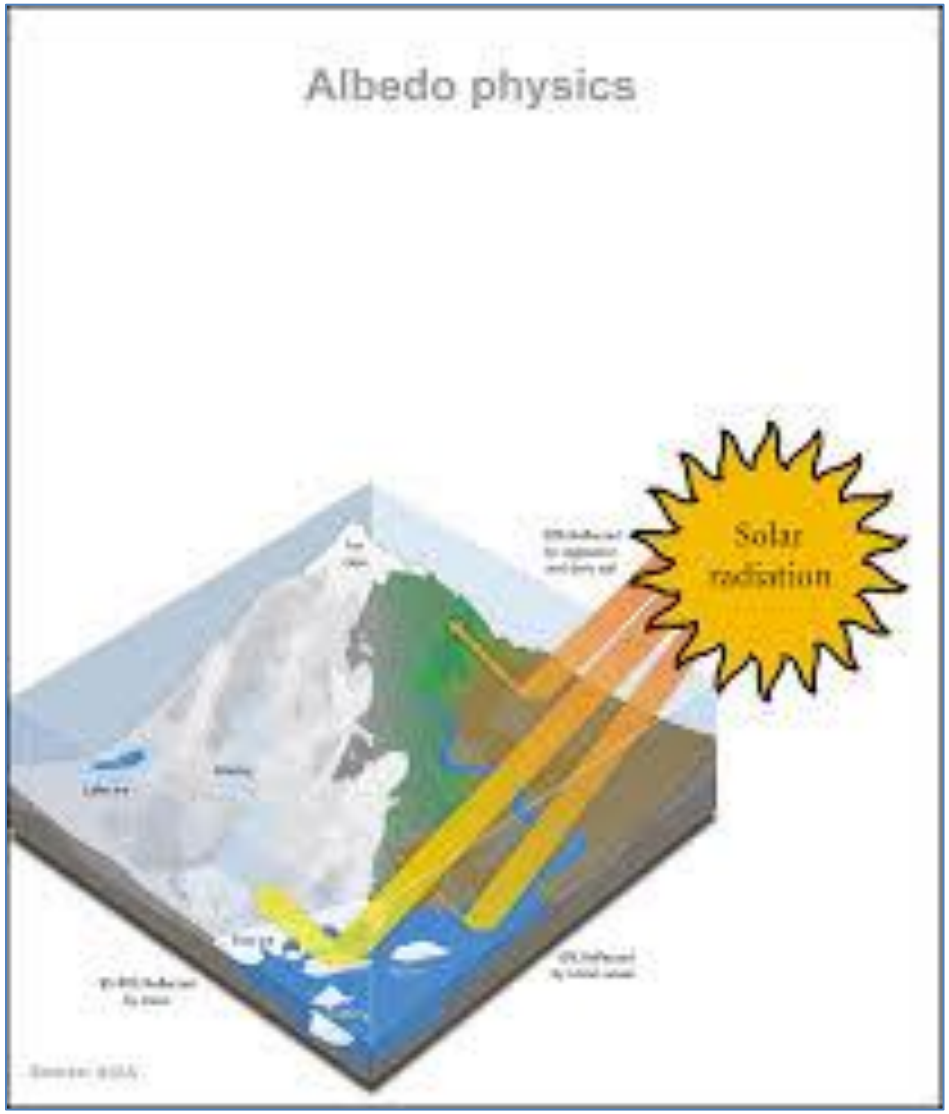
http://www.climate-lab-book.ac.uk/2016/spiralling-global-temperatures/

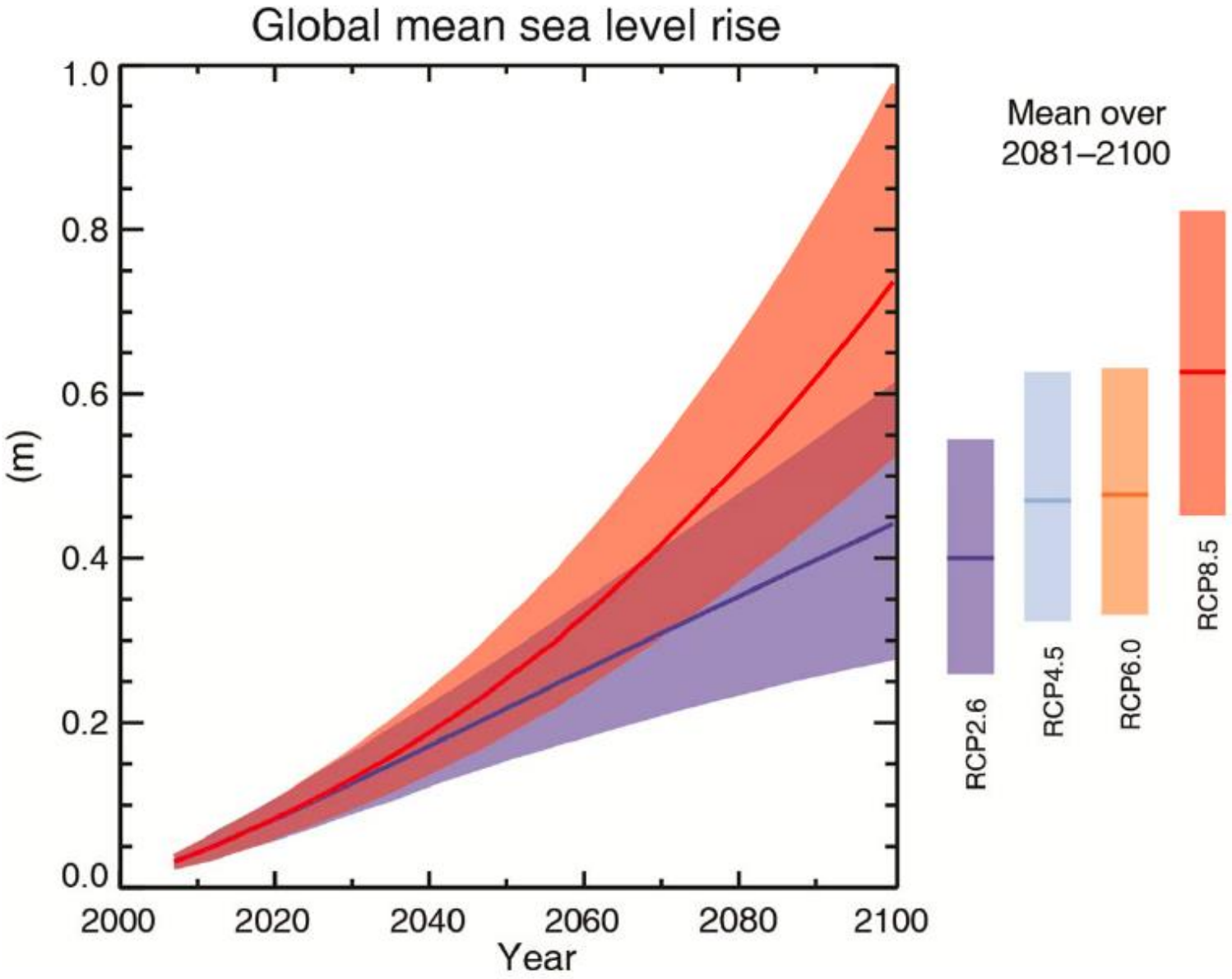

Projected Temperature Change
-0.5
0
2
4
6
11.7
Difference from
1986-2005 mean (˚C)
Solid Color
Very strong agreement
White Dots
Strong agreement
Gray
Divergent changes
Diagonal Lines
Little or no change
RCP2.6 2081 - 2100
RCP8.5 2081 - 2100

Record Low Sea Ice Extent



Albedo refractive effect

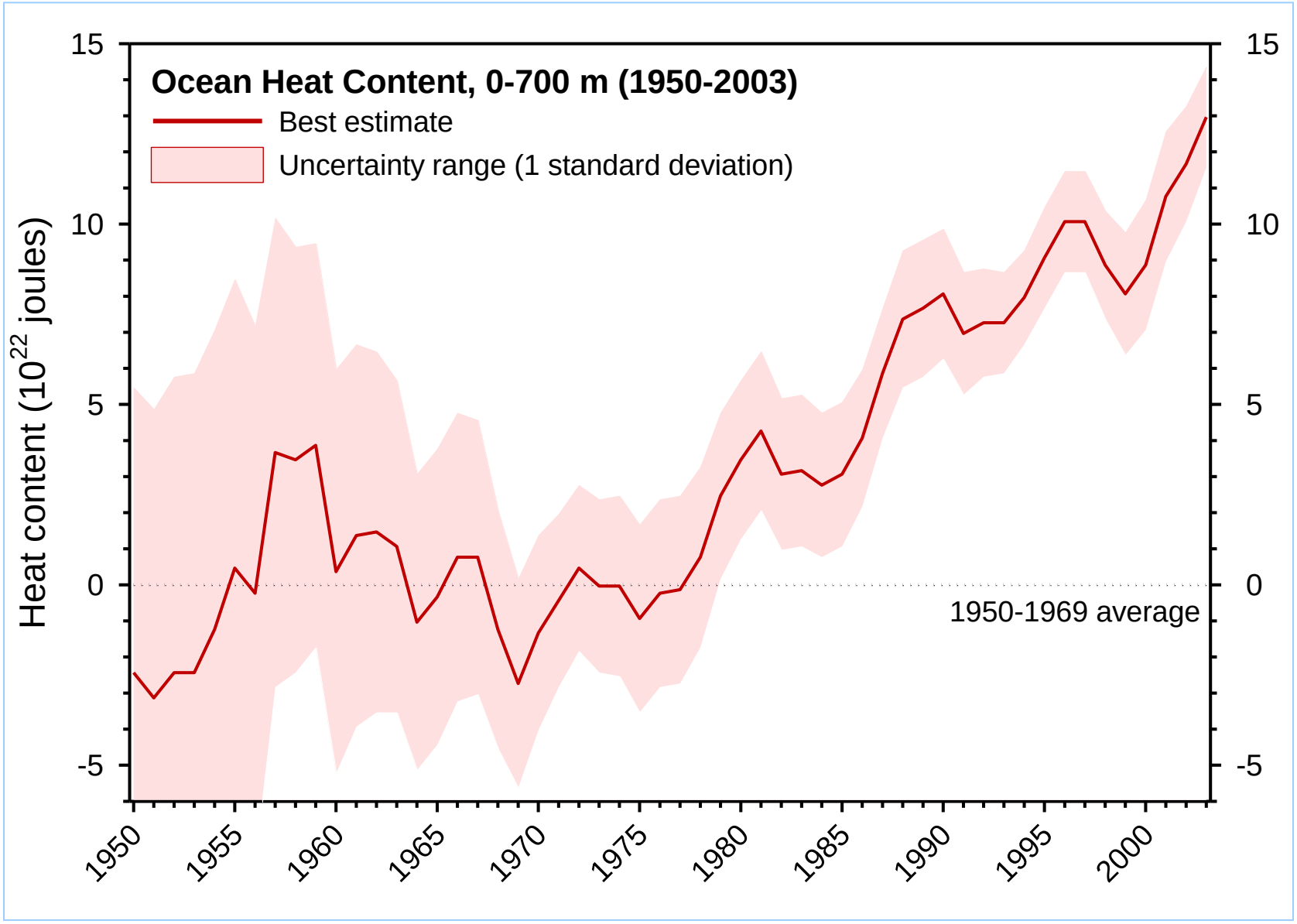


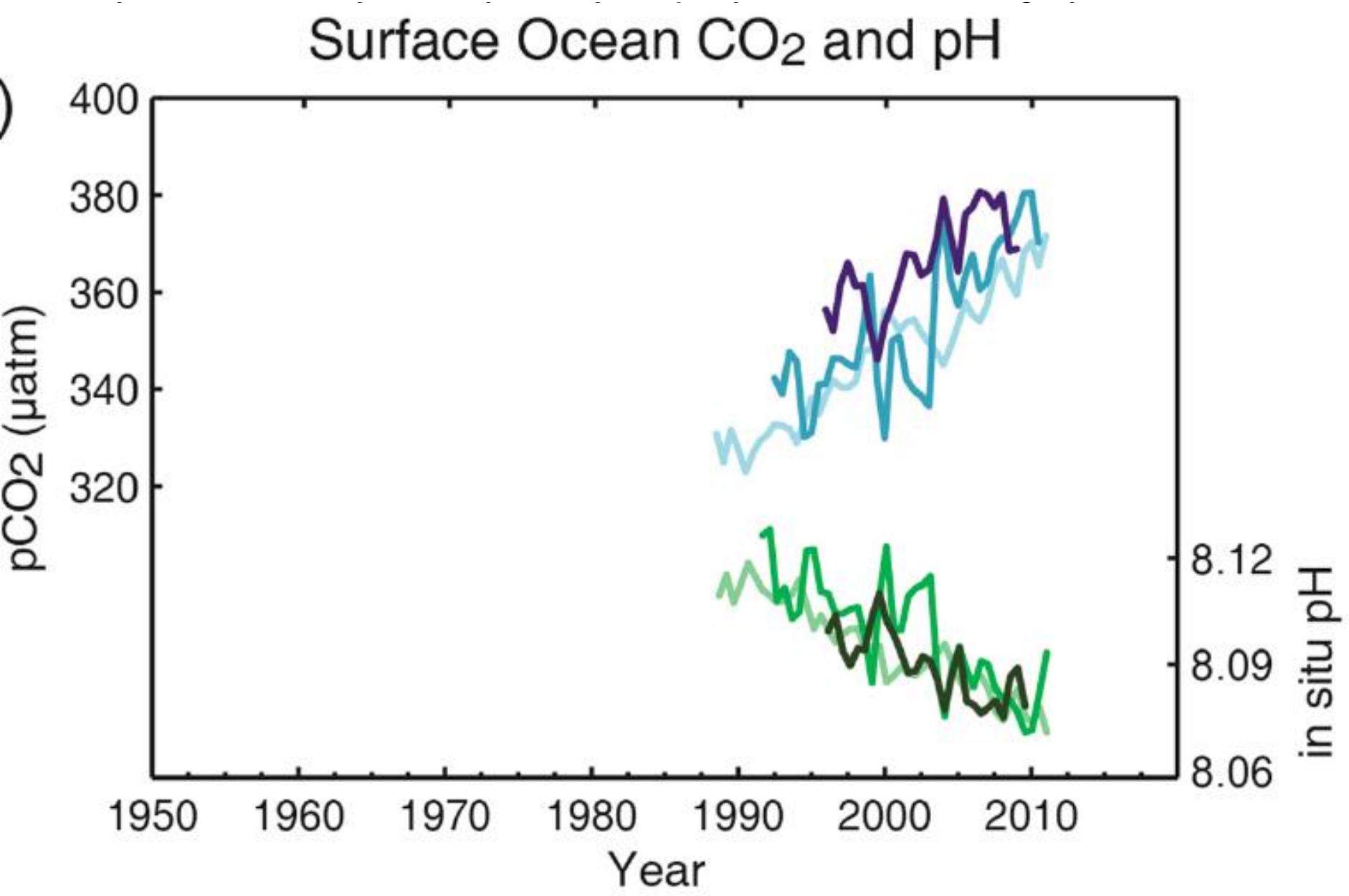

Global mean sea level rise
1.0
0.8
0.6
0.4
0.2
0.0
(m)
2000
2020
2040
2060
2080
2100
Year
Mean over
2081–2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5

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




Surface Ocean CO_2 and pH
400
380
360
340
320
pCO2 (µatm)
8.12
8.09
8.06
in situ pH
1950
1960
1970
1980
1990
2000
2010
Year

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

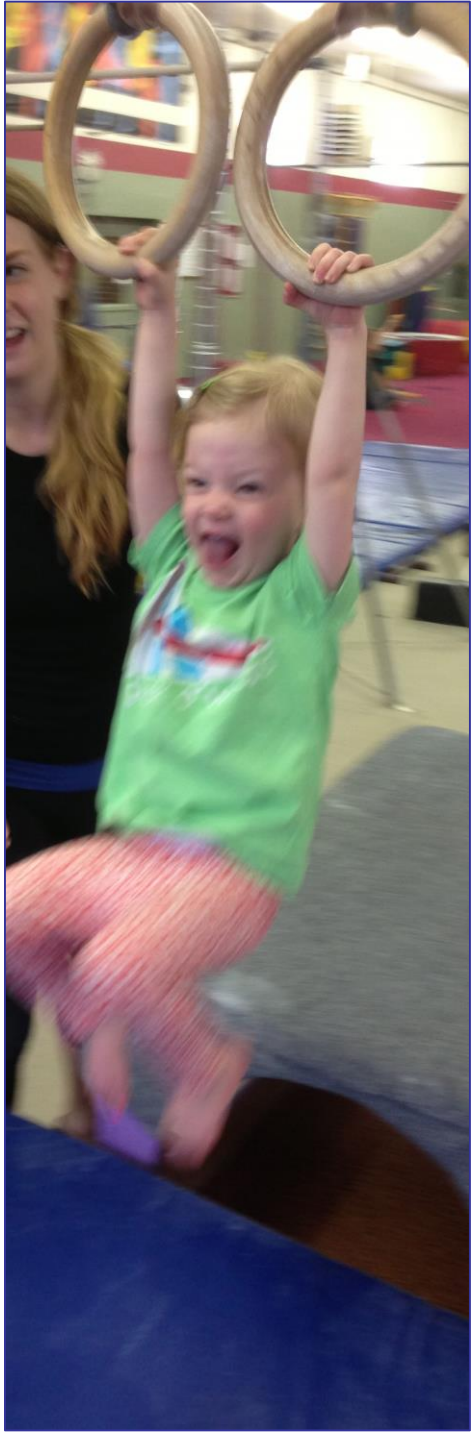
Complex system + energy= unpredictability

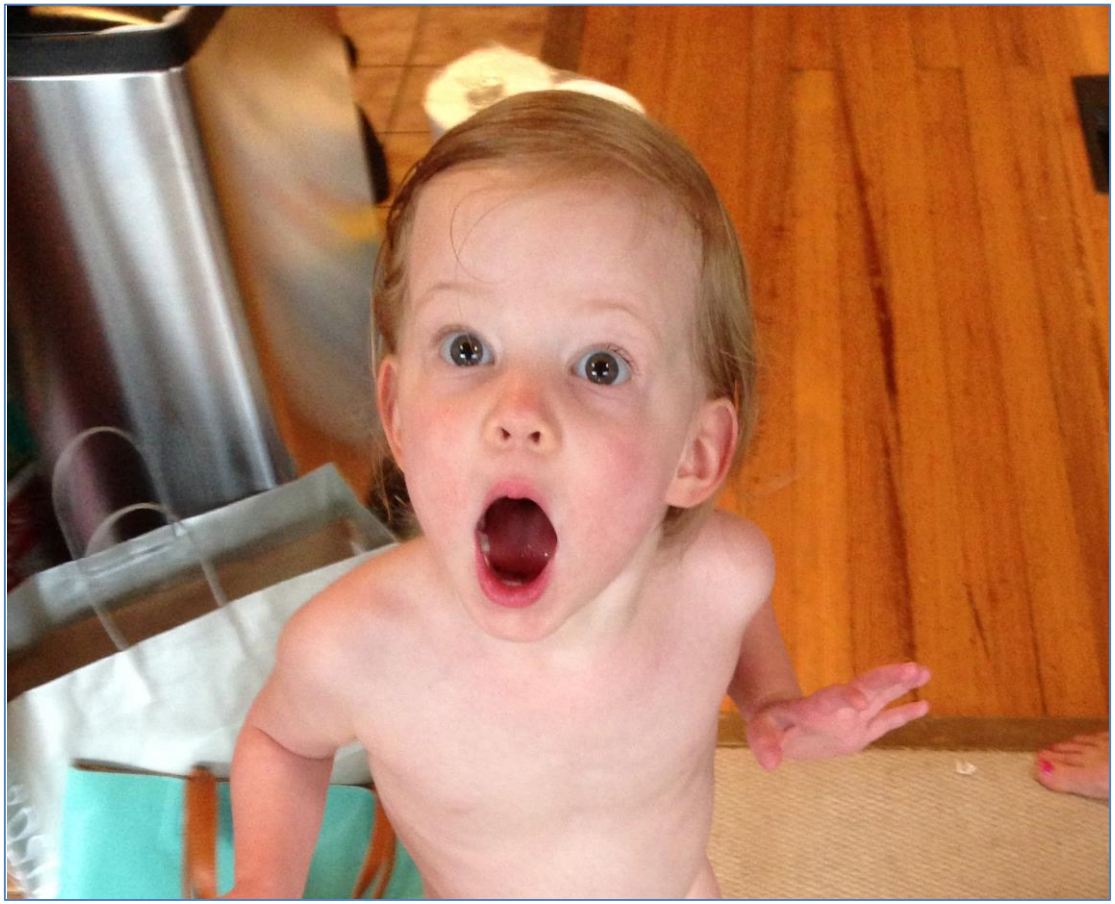
~~**Global Warming**~~

Global Energizing

A Complex System

+ Energy





Health Effects

5th Assessment Report (AR5)

Working Group II

March 2014

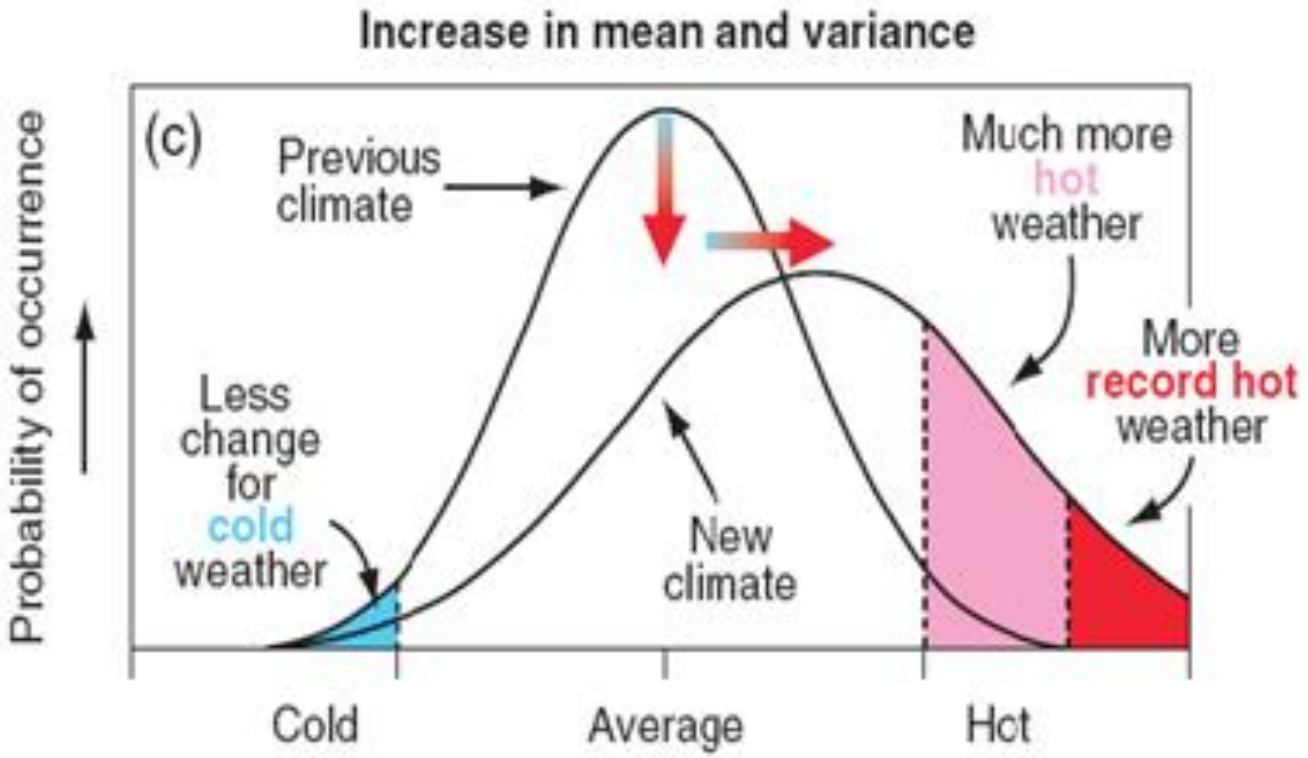
Impact on Human Health

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

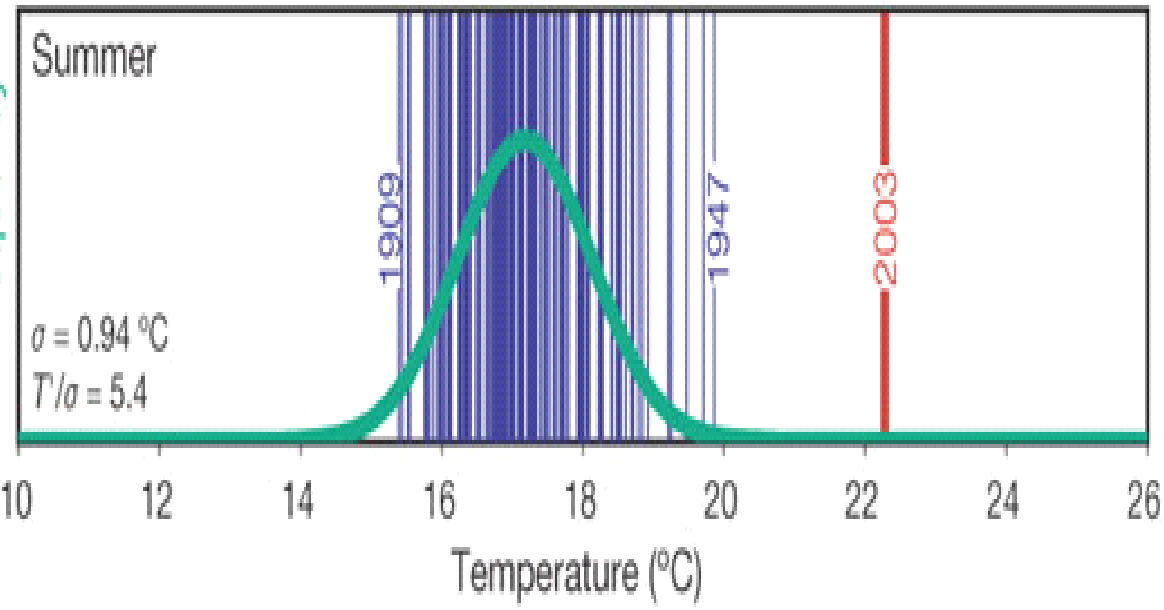


Not only changes in Mean (temp & precip)

But also increases in *Extremes*

Some Extreme Events will be well beyond historical experience

European Heat Wave of 2003



Confirmed Mortality

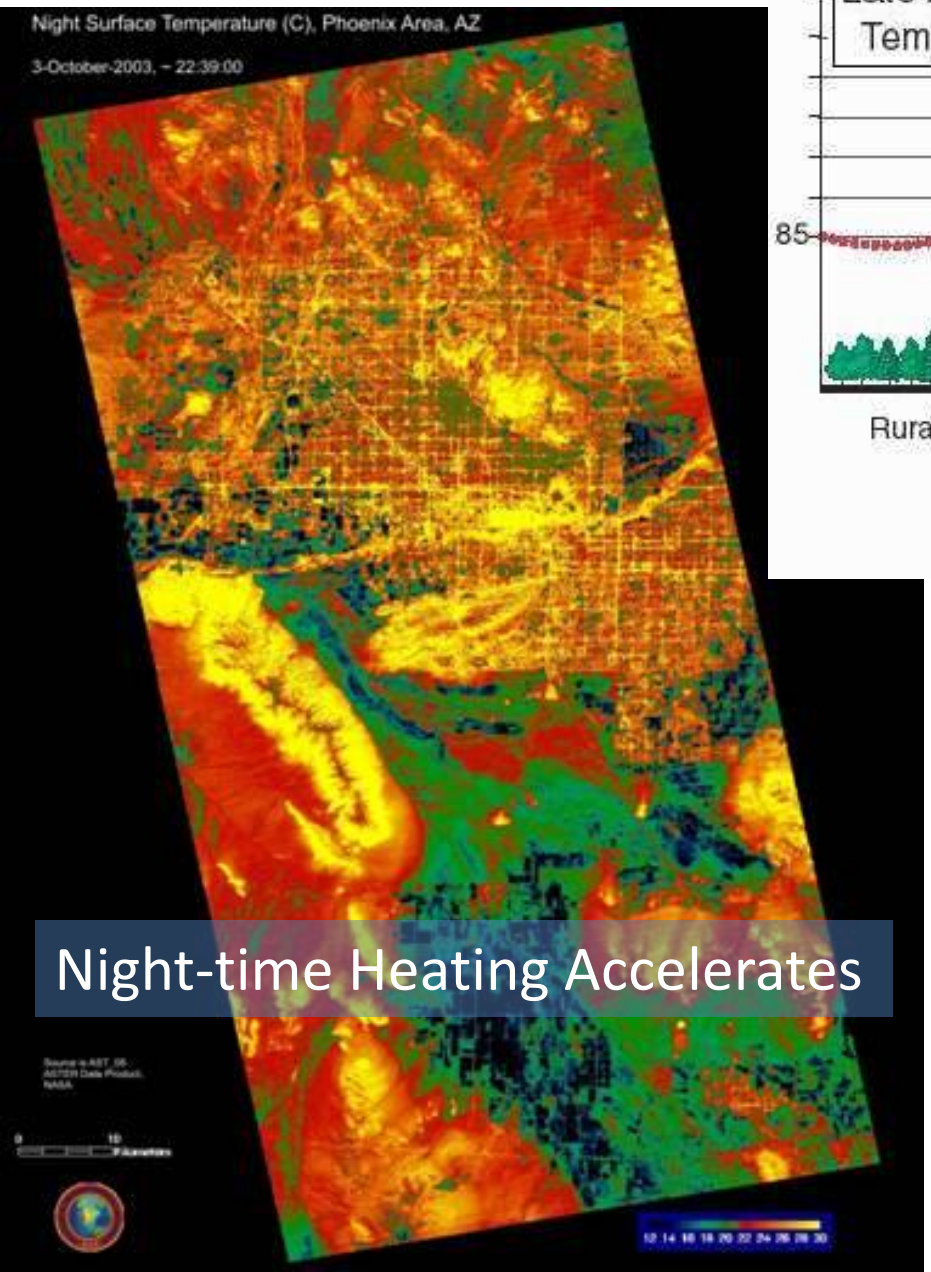
UK	2,091
Italy	3,134
France	14,802
Portugal	1,854
Spain	4,151
Switzerland	975
Netherlands	1,400-2,200
Germany	1,410
TOTAL	**29,817-30,617**

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

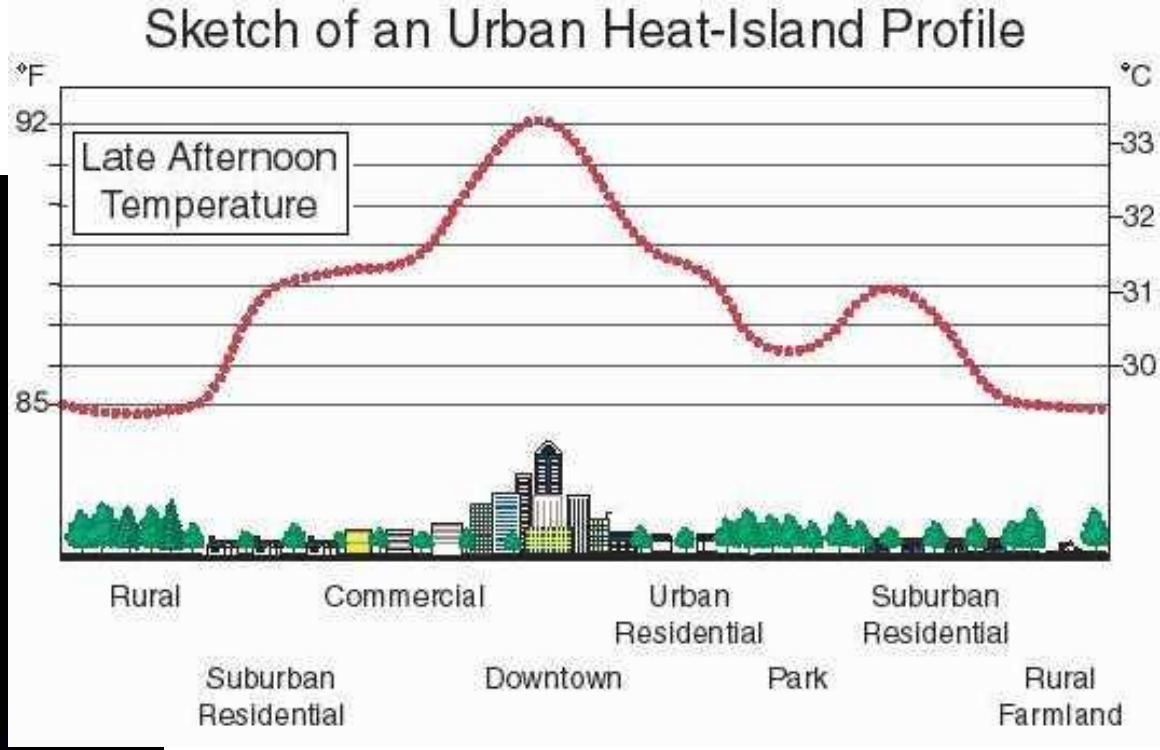
Vandentorren et al. *Am J Public Health 2004; 94(9):1518-20.*

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.



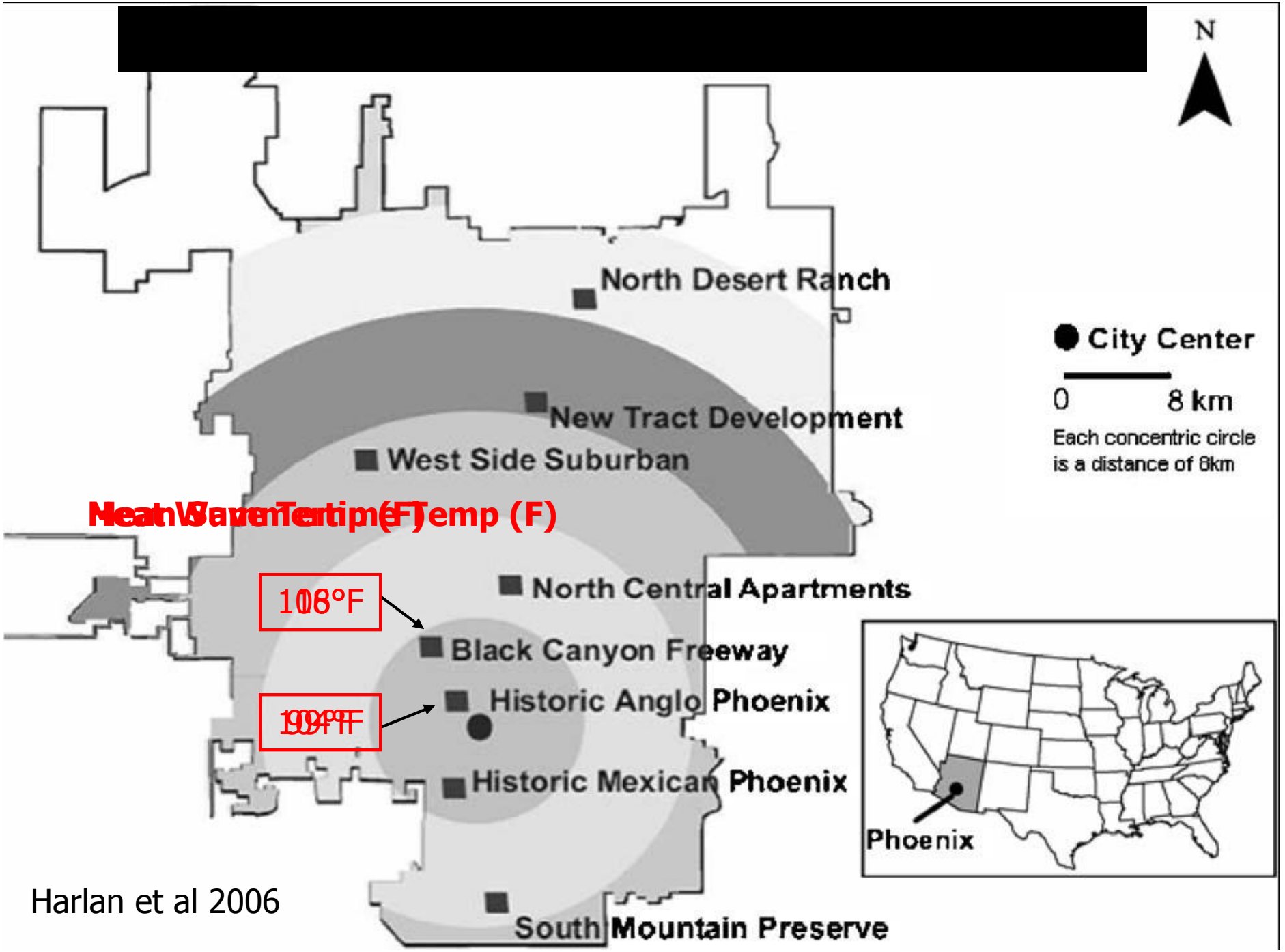
Night-time Heating Accelerates



Urban Heat Island can add 7° – 12° F

Thermal Satellite Image of Phoenix, AZ Night Surface Temperature

CDC Environmental Health



Harlan et al 2006

Climate Change and the Emergent Epidemic of Chronic Kidney Disease from Heat Stress (Heat Stress Nephropathy) in Rural Communities

Jason Glaser1*, Jay Lemery2*, Balaji Rajagopalan3, Henry F. Diaz4, Ramon Garcia-Trabanino5, Gangadhar Taduri6, Magdalena Madero7, Mala Amarasinghe8, Georgi Abraham9, Sirirat Anutrakulchai10, Vivekanand Jha11, Peter Stenvinkel,12 Carlos Roncal-Jimenez13, Miguel A Lanaspa13, Ricardo Correa-Rotter14, David Sheikh-Hamad15, Emmanuel A. Burdmann16, Ana Andres-Hernando13, Tamara Milagres13, Ilana Weiss1, Mehmet Kanbay17, Catherina Wesseling18, L. Gabriela Sánchez-Lozada19, Richard J Johnson12 *co-first authors

@CJASN

Figure 2. Mechanism for Heat Stress Nephropathy

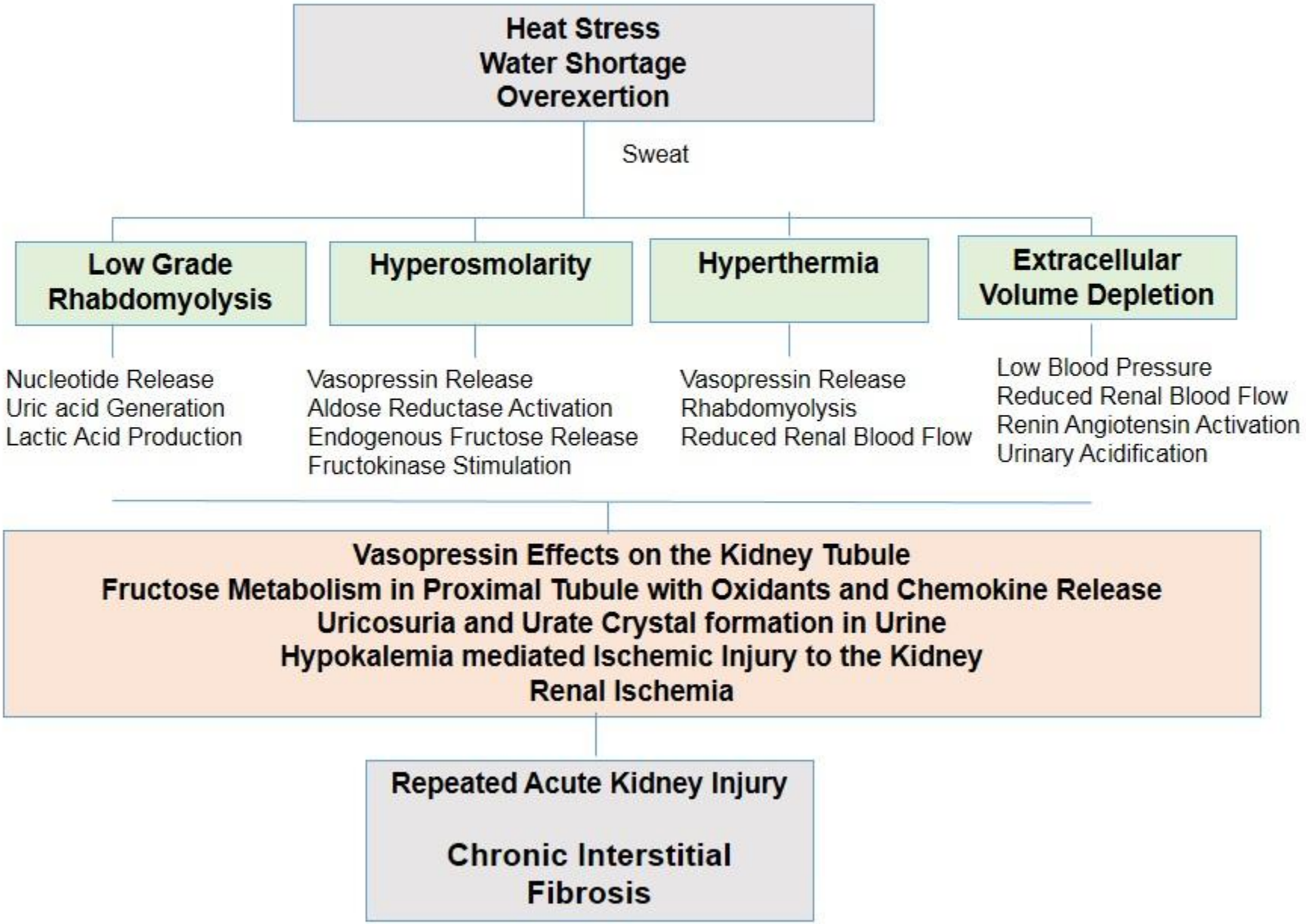


Figure 3 Changing Temperatures in El Salvador.

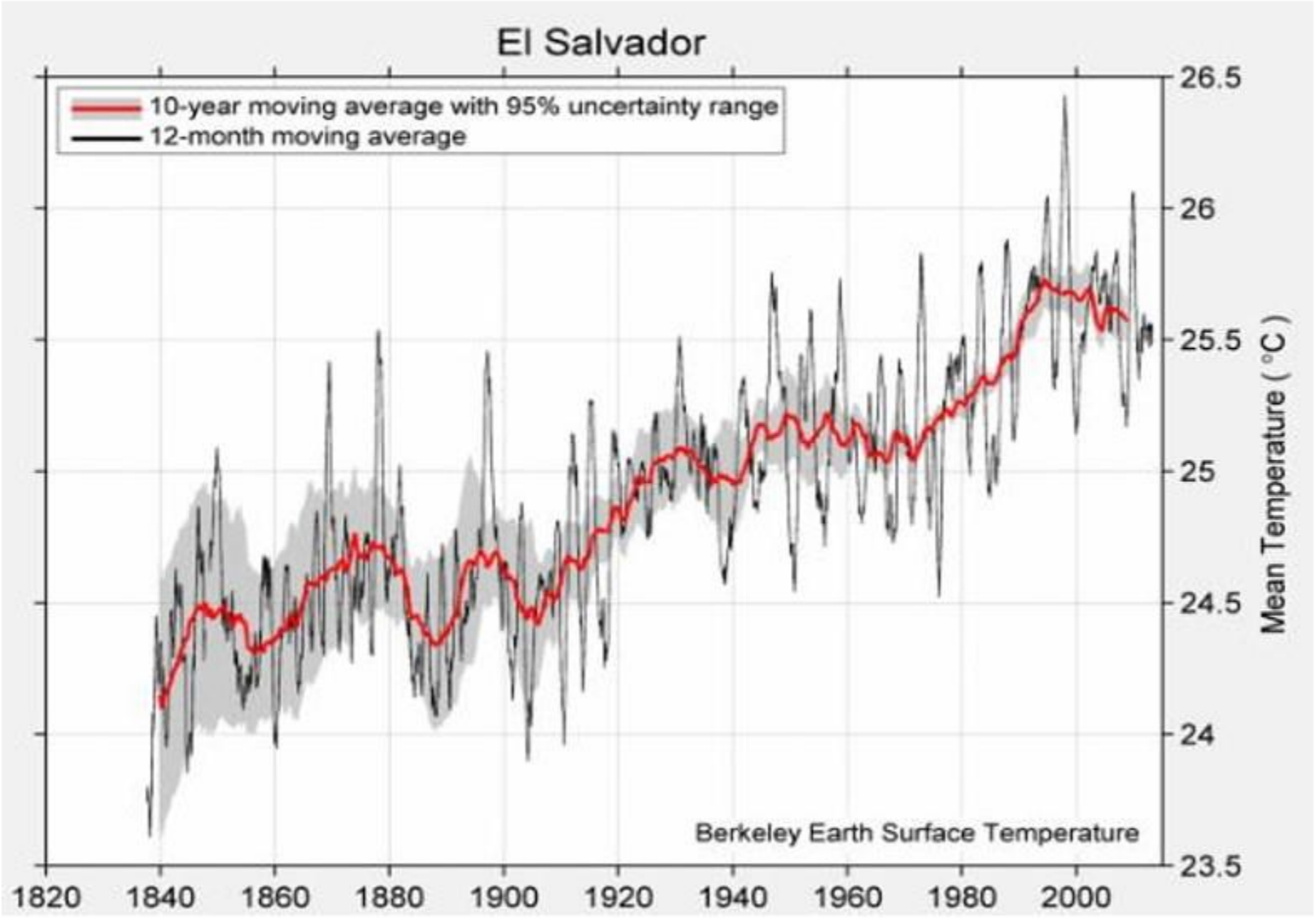


Figure 1 Temperature Trends in Central America

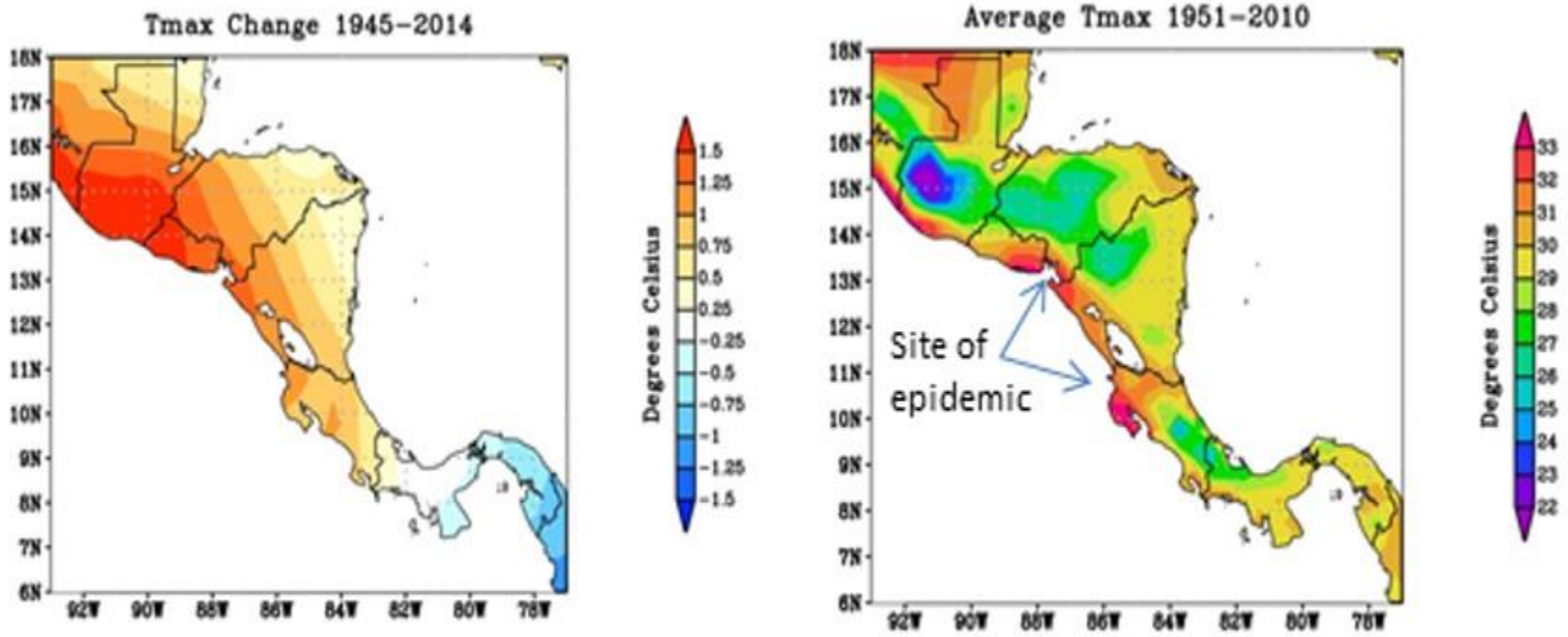
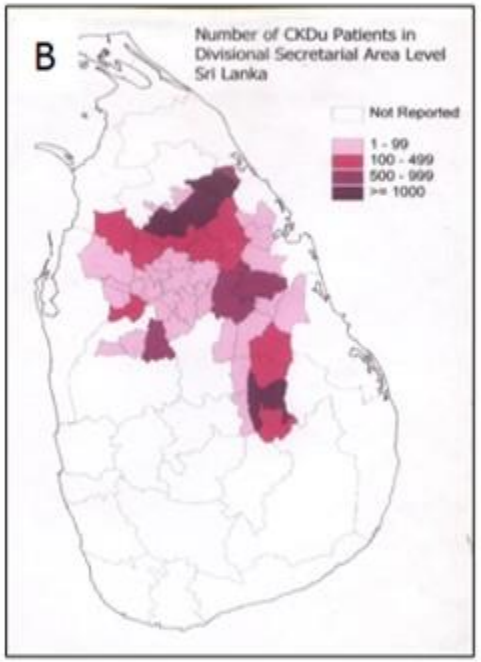
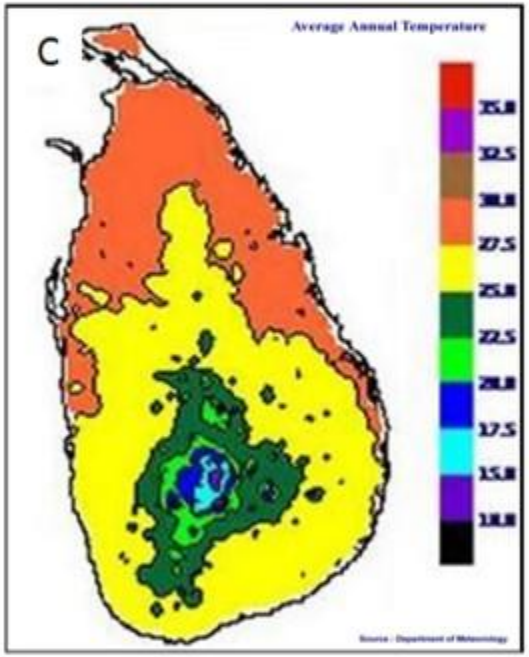
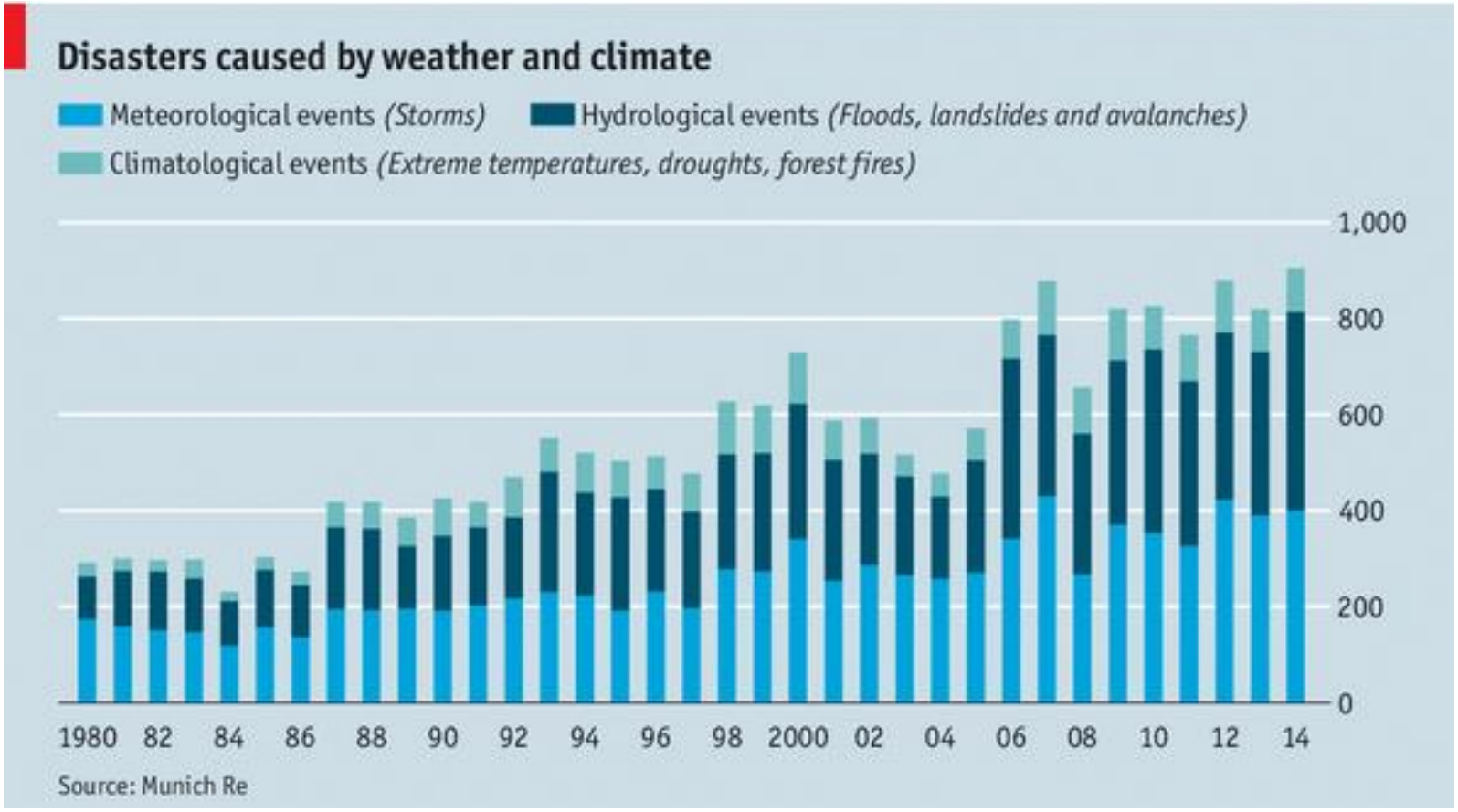


Figure 4. Sri Lankan Nephropathy





Disasters caused by weather and climate



Source: Munich Re

Typhoon Haiyan, max sustained winds 196 mph

[157mph = Category 5]

Hurricaine Patricia, max sustained winds 200 mph

[157mph = Category 5]

<u>October 2012</u>:

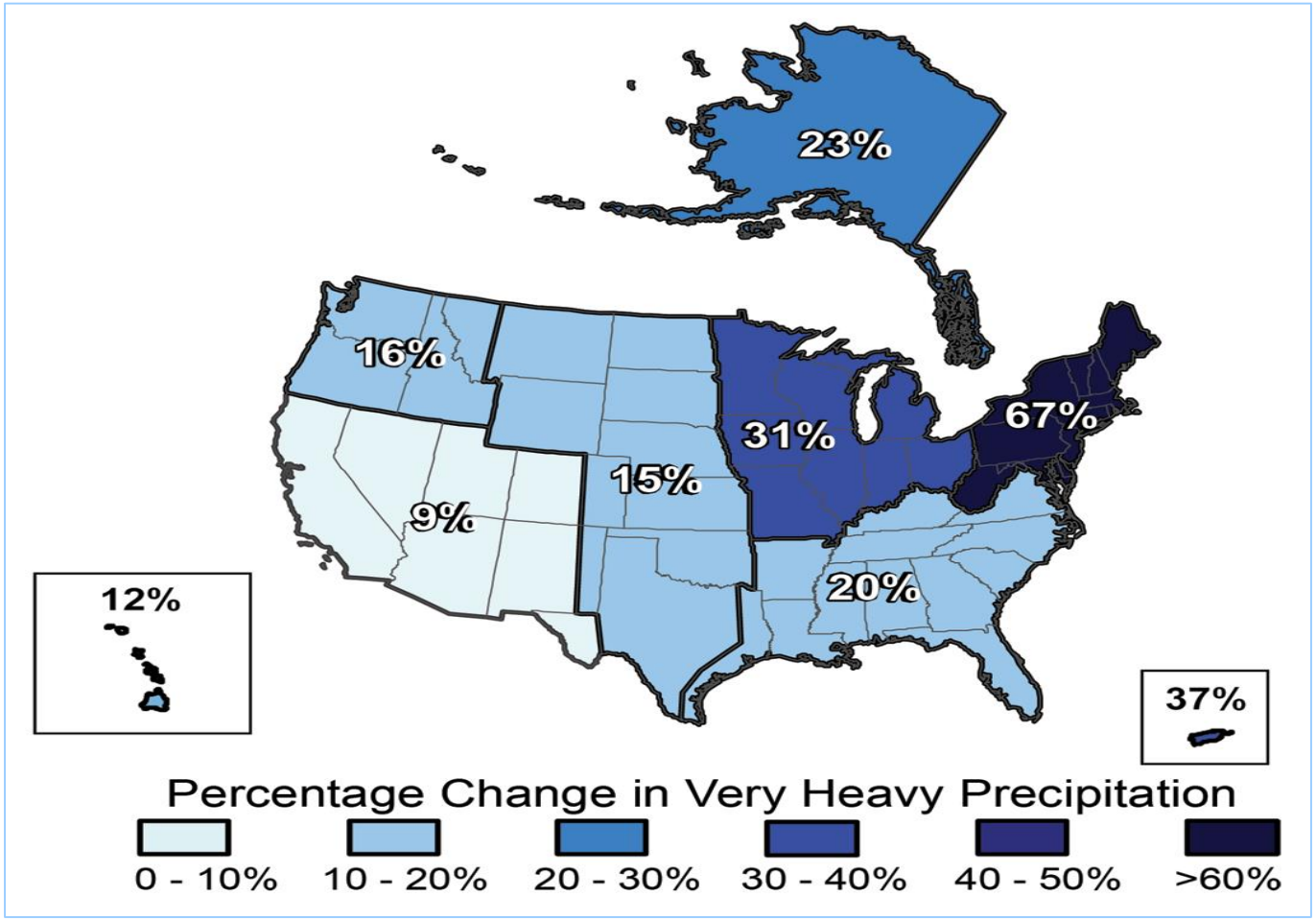
Hurricane Sandy swept through the Caribbean and Atlantic, at its peak covering more than 1,000 miles of the North American coastline– the **largest storm system in recorded history.**

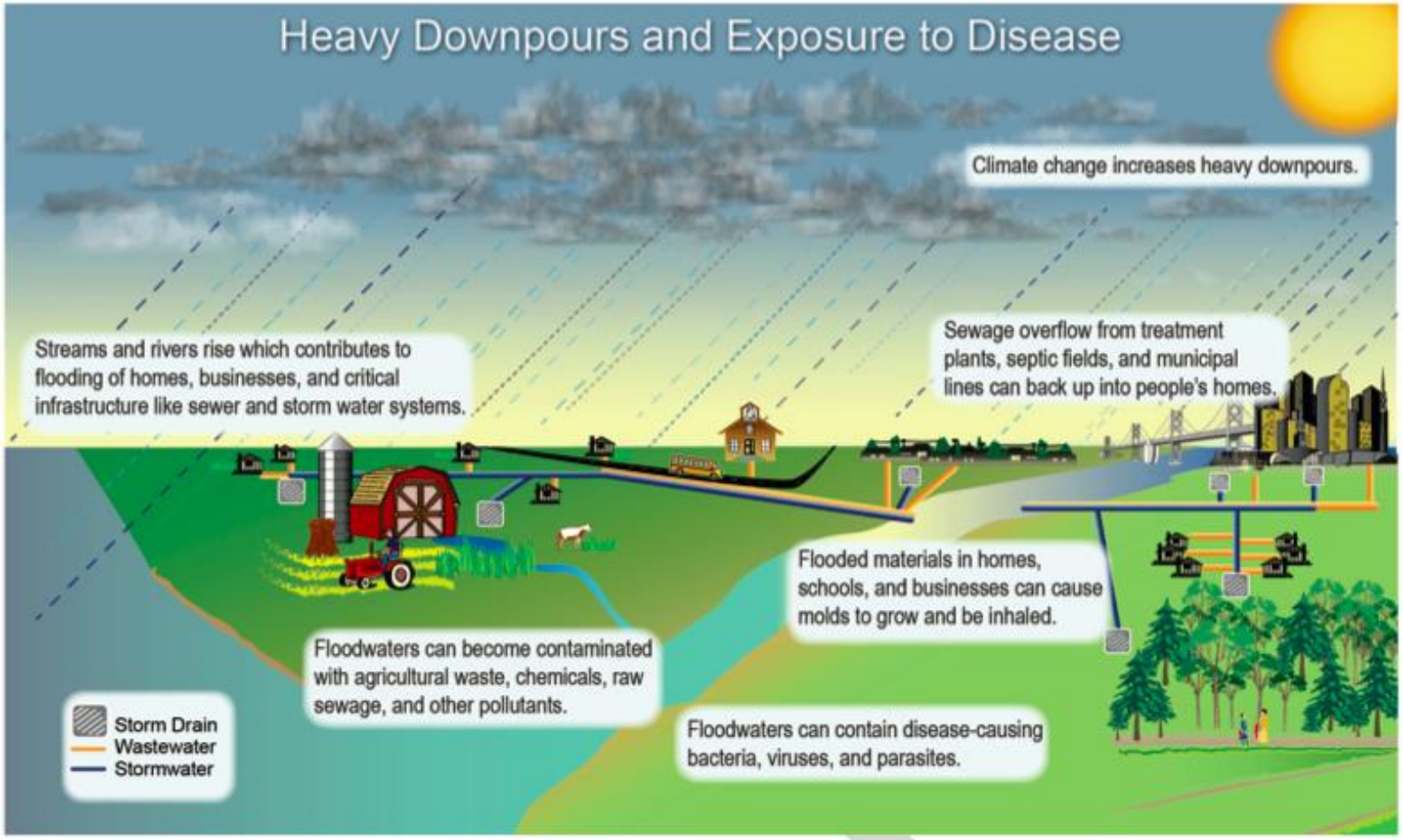
>250 people lost their lives during the storm.

>$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



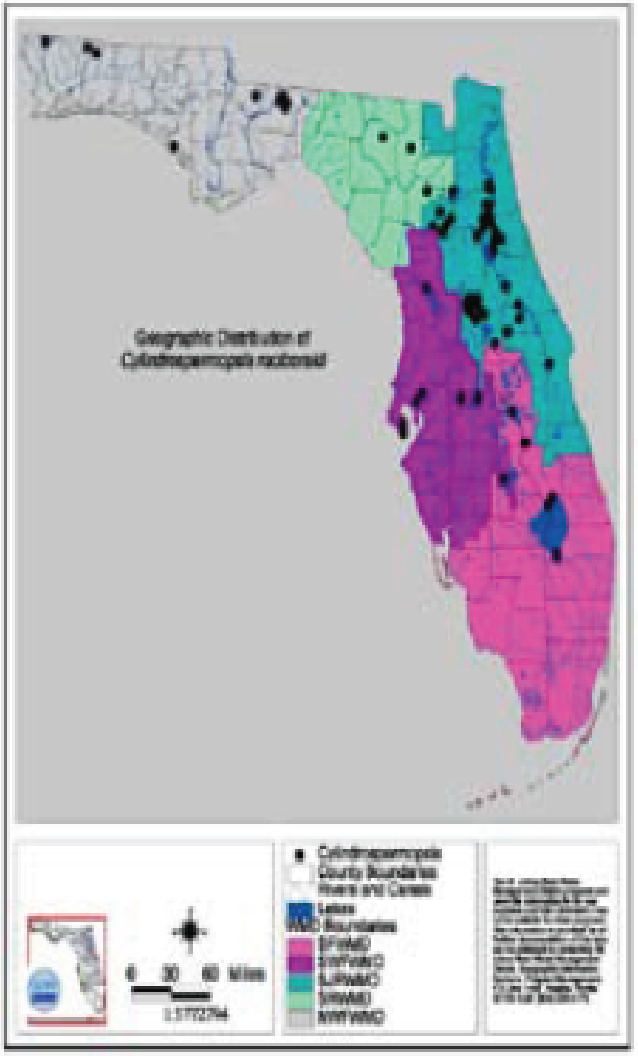

Heavy Downpours and Exposure to Disease
Climate change increases heavy downpours.
Streams and rivers rise which contributes to flooding of homes, businesses, and critical infrastructure like sewer and storm water systems.
Sewage overflow from treatment plants, septic fields, and municipal lines can back up into people's homes.
Flooded materials in homes, schools, and businesses can cause molds to grow and be inhaled.
Floodwaters can become contaminated with agricultural waste, chemicals, raw sewage, and other pollutants.
Floodwaters can contain disease-causing bacteria, viruses, and parasites.
Storm Drain
Wastewater
Stormwater

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.

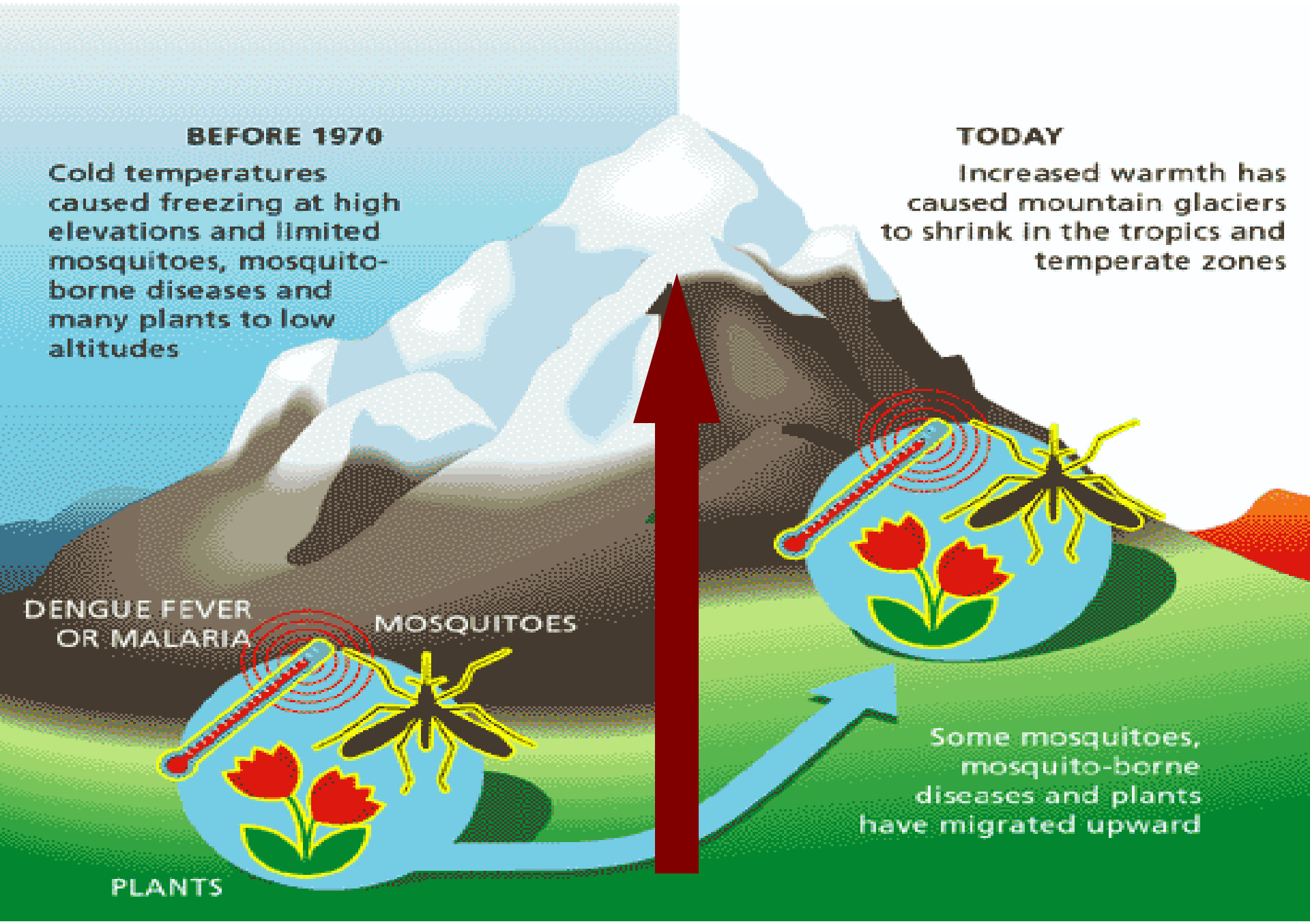


Direct Effects of Hydrologic Extremes

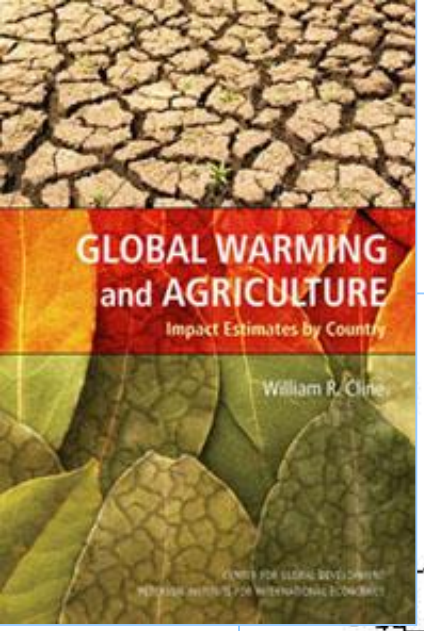
↑ drier climates= forest fires and smoke

<u>Vulnerable Populations</u>:

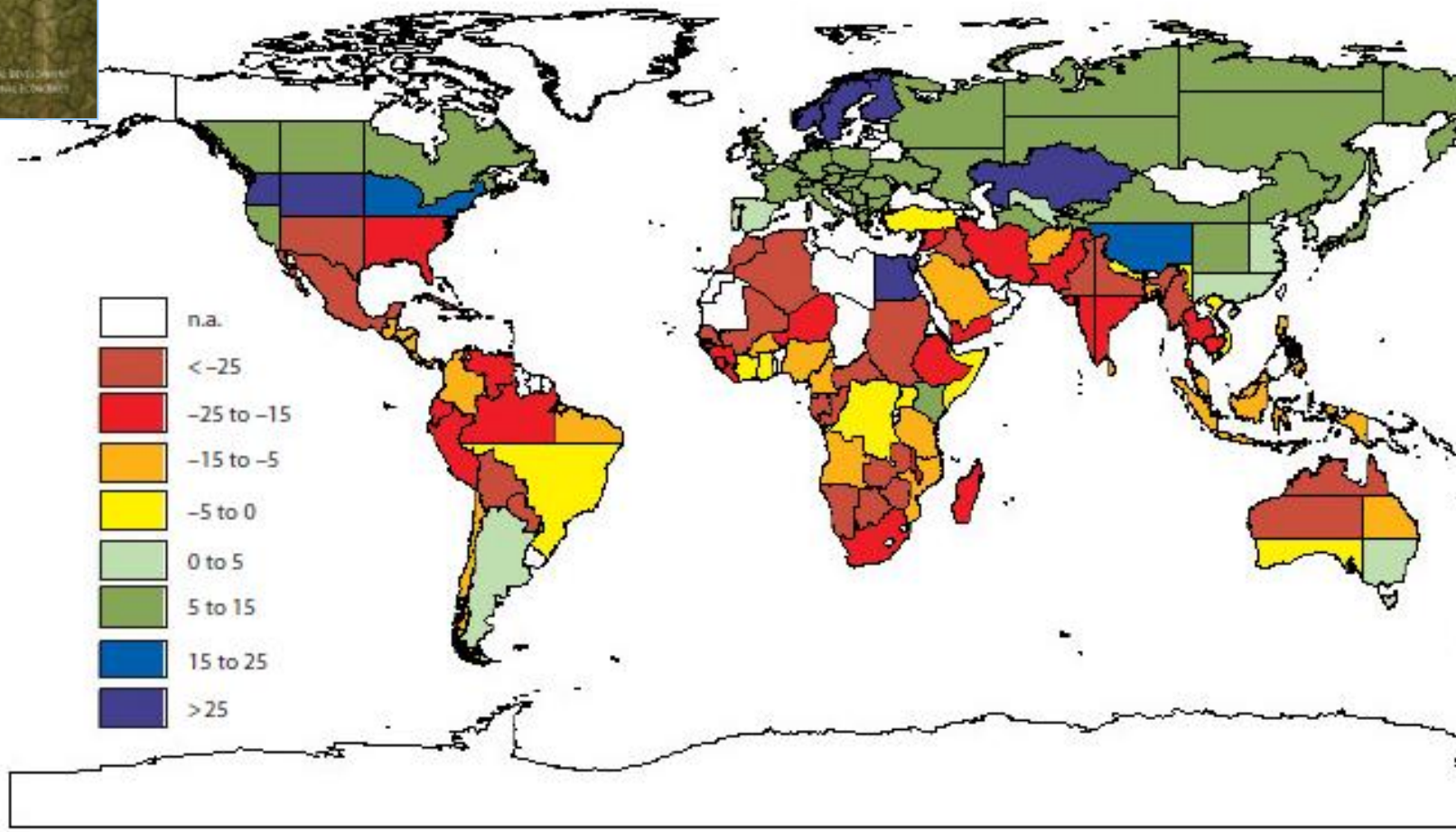
- Young Children
- Elderly
- Pregnant Women
- People with Preexisting Respiratory and Cardiac Diseases


BEFORE 1970
Cold temperatures caused freezing at high elevations and limited mosquitoes, mosquito-borne diseases and many plants to low altitudes
TODAY
Increased warmth has caused mountain glaciers to shrink in the tropics and temperate zones
DENGUE FEVER OR MALARIA
MOSQUITOES
PLANTS
Some mosquitoes, mosquito-borne diseases and plants have migrated upward

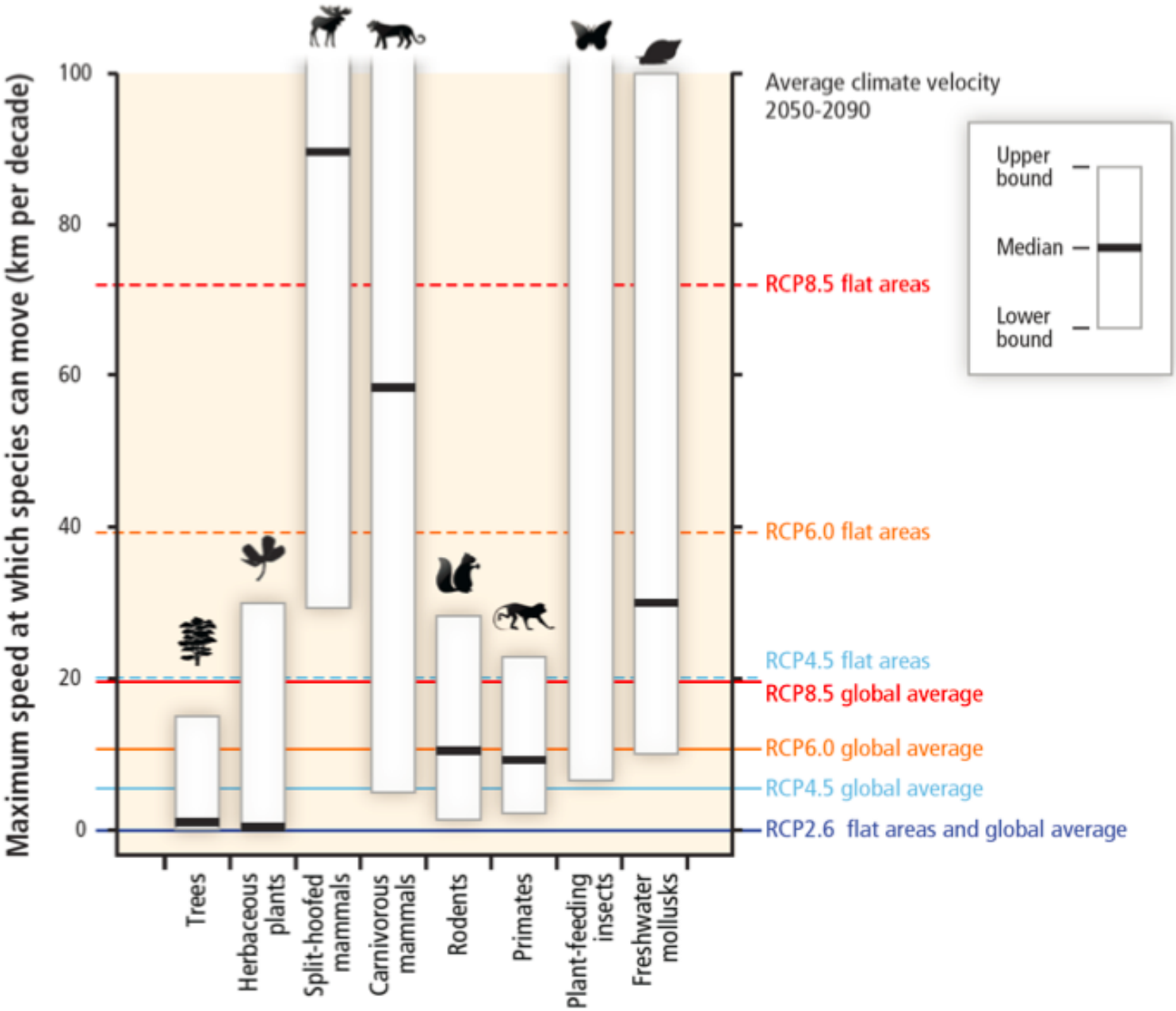

Zika!

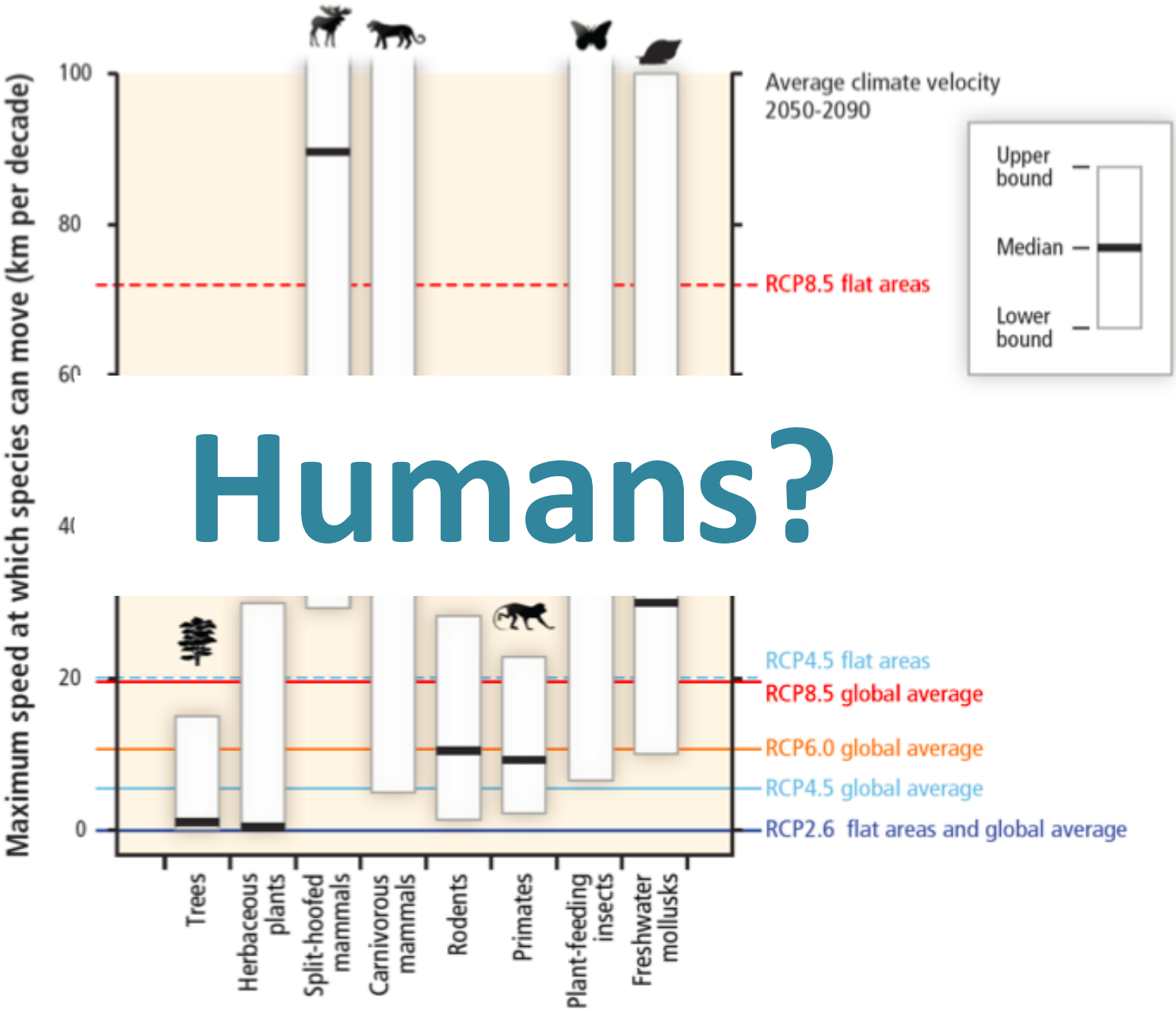


Impact on agricultural productivity with carbon fertilization (percent)



Adaptability?


Maximum speed at which species can move (km per decade)
100
80
60
40
20
0
Average climate velocity
2050-2090
Upper bound
Median
Lower bound
RCP8.5 flat areas
RCP6.0 flat areas
RCP4.5 flat areas
RCP8.5 global average
RCP6.0 global average
RCP4.5 global average
RCP2.6 flat areas and global average
Trees
Herbaceous plants
Split-hoofed mammals
Carnivorous mammals
Rodents
Primates
Plant-feeding insects
Freshwater mollusks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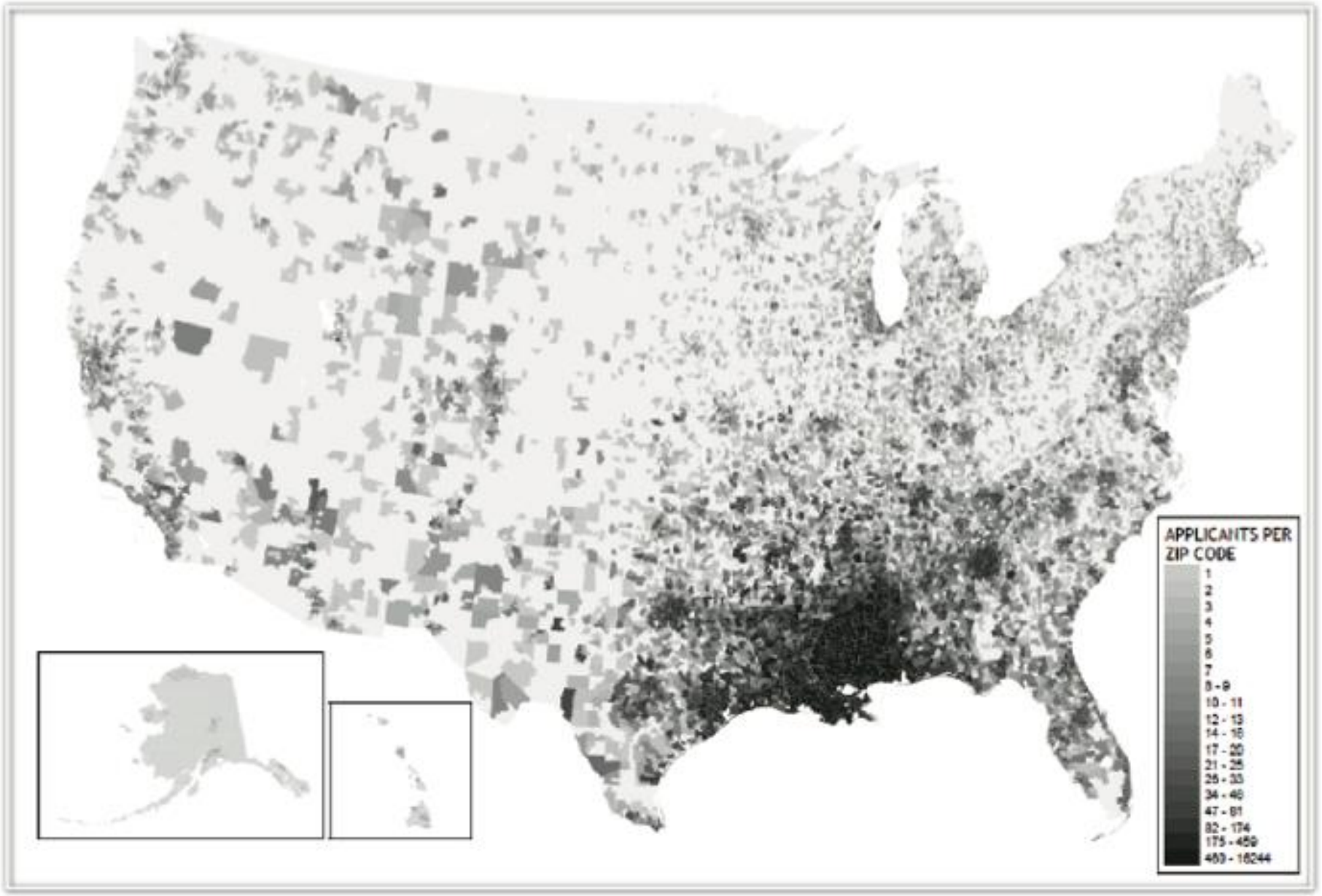
RCP2.6 flat areas and global average
Trees
Herbaceous plants
Split-hoofed mammals
Carnivorous mammals
Rodents
Primates
Plant-feeding insects
Freshwater mollusks

Humans?


The Water
is
Rising
Pleas

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

-Skip Burkle

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

Climate Justice

…those who are affected by the negative impacts are least responsible for the causes of the problem.

http://www.hhrjournal.org

Climate Justice Issue 16.1

June 16, 2014

HEALTH AND HUMAN RIGHTS

advancing health as an issue of human rights and social justice

AN INTERNATIONAL JOURNAL

UNITED NATIONS
HUMAN RIGHTS
OFFICE OF THE HIGH COMMISSIONER

Foreword by Mary Robinson, former President of Ireland and Former UN HCHR

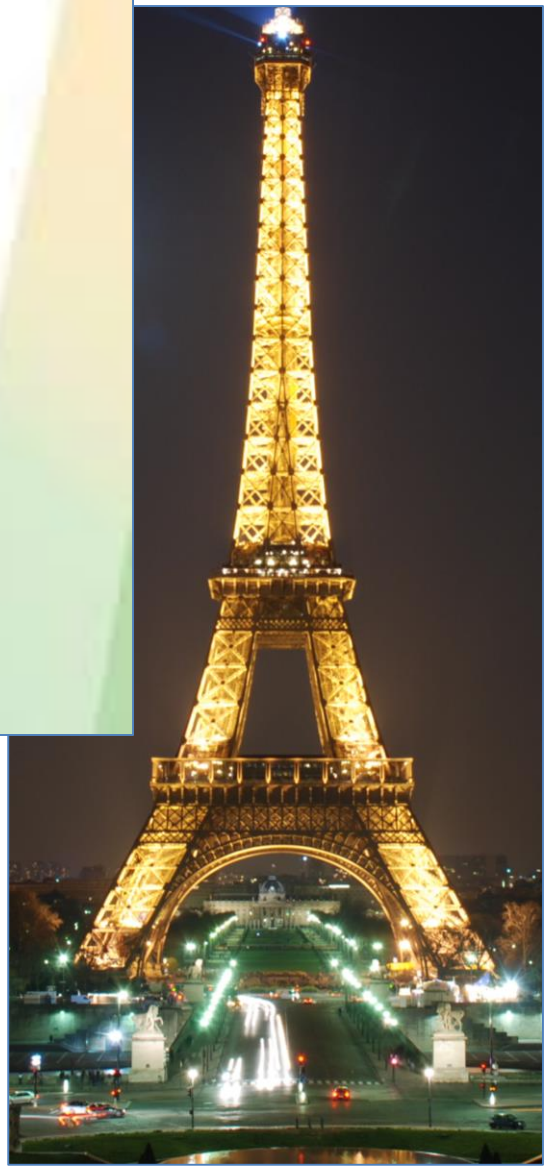
Mary Robinson
Foundation
Climate Justice

2016

PARIS2015

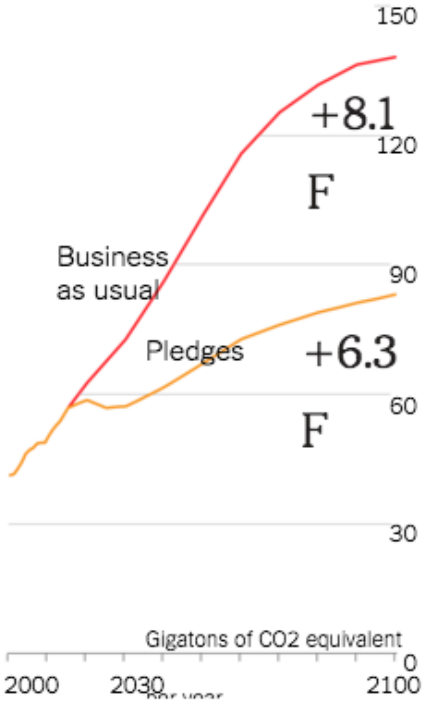
UN CLIMATE CHANGE CONFERENCE

COP21·CMP11

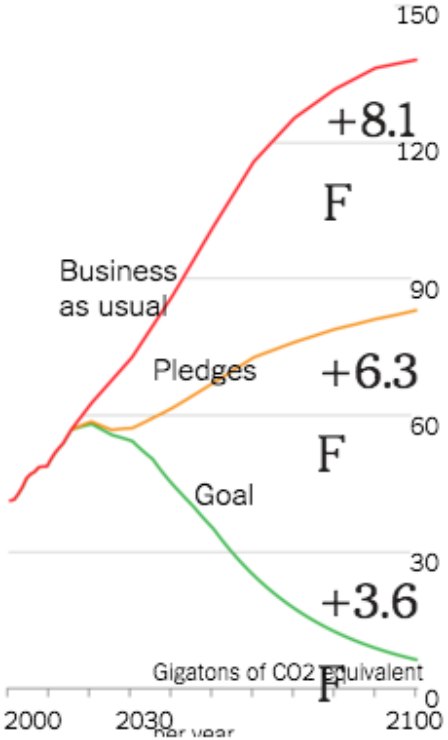


Without the pledges, **global temperatures** would likely jump more than 8°F by 2100.

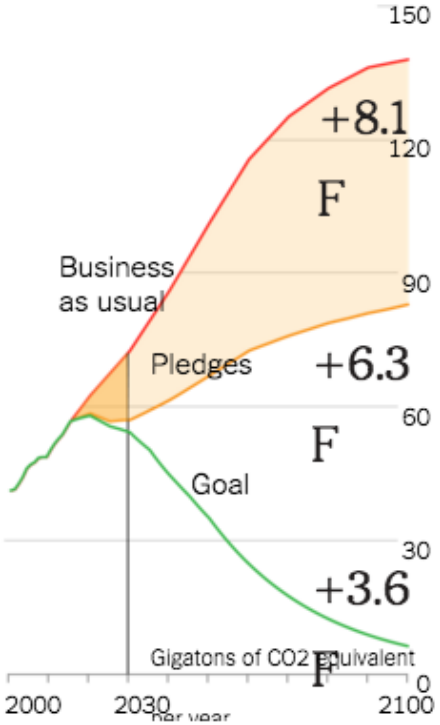
New York Times



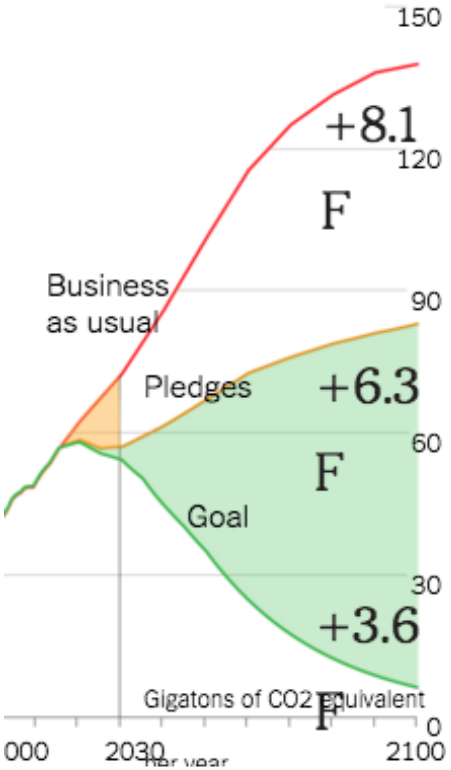
The **Paris pledges** lower the likely increase to just over 6°F.



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 fo **ratcheting up national commitments** ove time.

Business & Economic Perspective

2009…resistance to change

Discernable gap between a low carbon economy and the capital market's ability to deliver on it

- Nascent and costly clean energy technology
- Climate science skepticism
- Deeply embedded reliance on coal (from US to China)

2016…

2016…

1) ***Businesses accept that climate change is happening and impacting their bottom lines…***

   "Yes, climate change is real. And yes, renewable energy is an indispensable part of the future energy mix"

   – Shell CEO Ben van Beurden, February 2015

2016…

2) ***Renewable energy is achieving cost competitiveness with fossil fuels.***

- The cost of solar photovoltaic power has plunged the past few years and
- Utility-scale PV projects in the West are competitive in cost and size even with natural gas plants.
- Energy storage, a key cog in catalyzing large-scale renewable energy, has achieved remarkable breakthroughs in the past few years

2016…

3) Investors are realizing the risks of fossil fuels, especially coal and oil.

- Goldman Sachs found nearly $1 trillion of oil projects at risk of being “stranded” due to shrinking demand and plummeting oil prices (Arctic drilling and Canada’s oil sands).
- Coal is in a “slow death spiral” from plummeting global demand

2016…

4) **Companies are advocating publicly for strong policies to reduce carbon pollution, supporting:**

- state-level renewable portfolio standards
- EPA efforts to reduce power plant pollution
- Strong international climate agreements
- More than 200 companies signed a letter supporting EPA's Clean Power Plan: Kellogg, IKEA, VF Corp., Unilever, Mars, and Nestle.
- >1,300 companies have signed "Ceres' Climate Declaration" for a sustainable global economy

2016…

5) **Investors are weighing in on climate action**

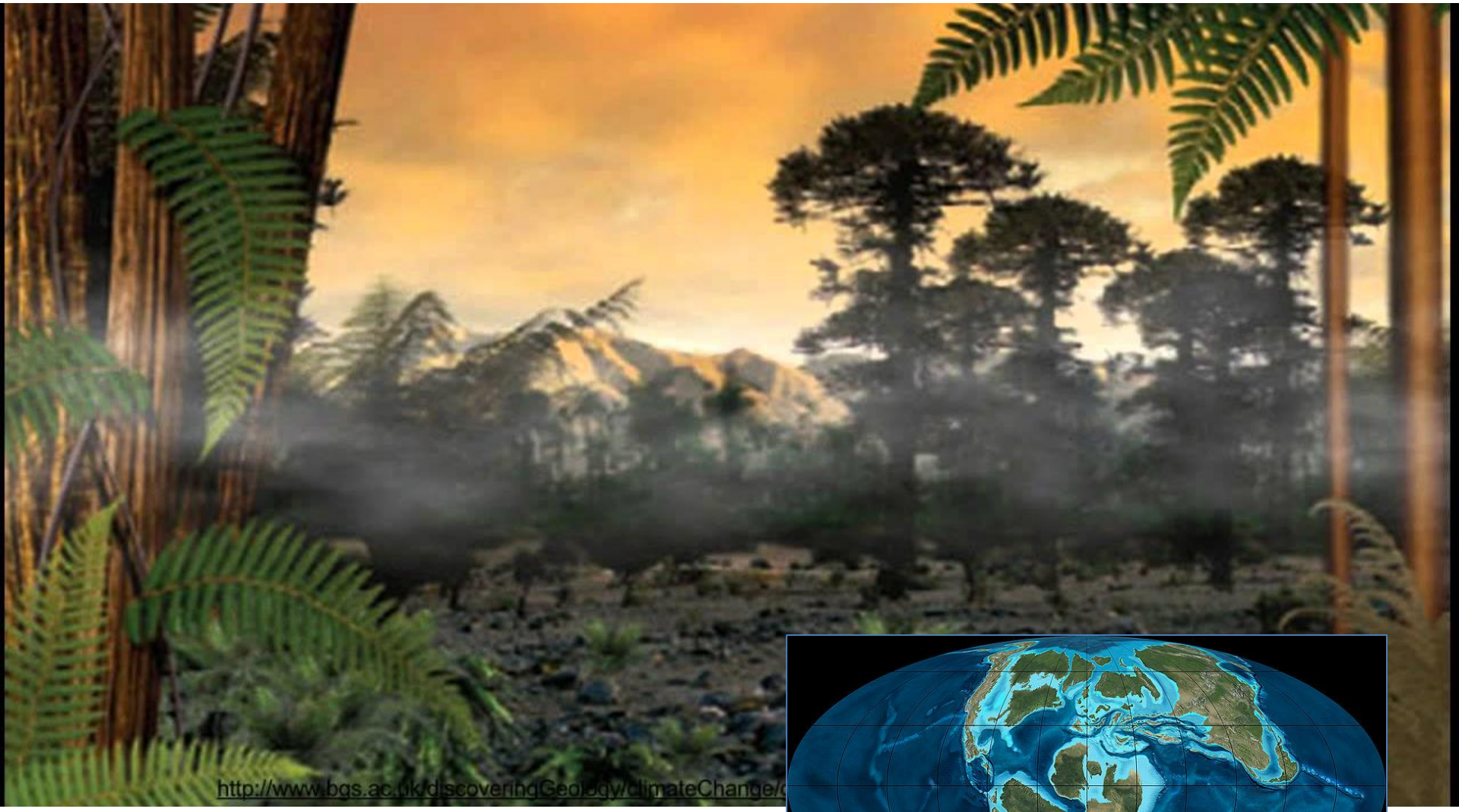
- Last year, nearly 350 investors managing $24 trillion in assets called on government leaders to adopt meaningful carbon pricing, an ambitious climate accord, and an end to fossil fuel subsidies.
- Moving away from the mutual exclusivity of *economic well being* ***or*** *climate stability*

Consortium on Climate Change & Health

An opportunity for multi-sector collaboration?

- *Innovation*
- *Advocacy*
- *Leadership*

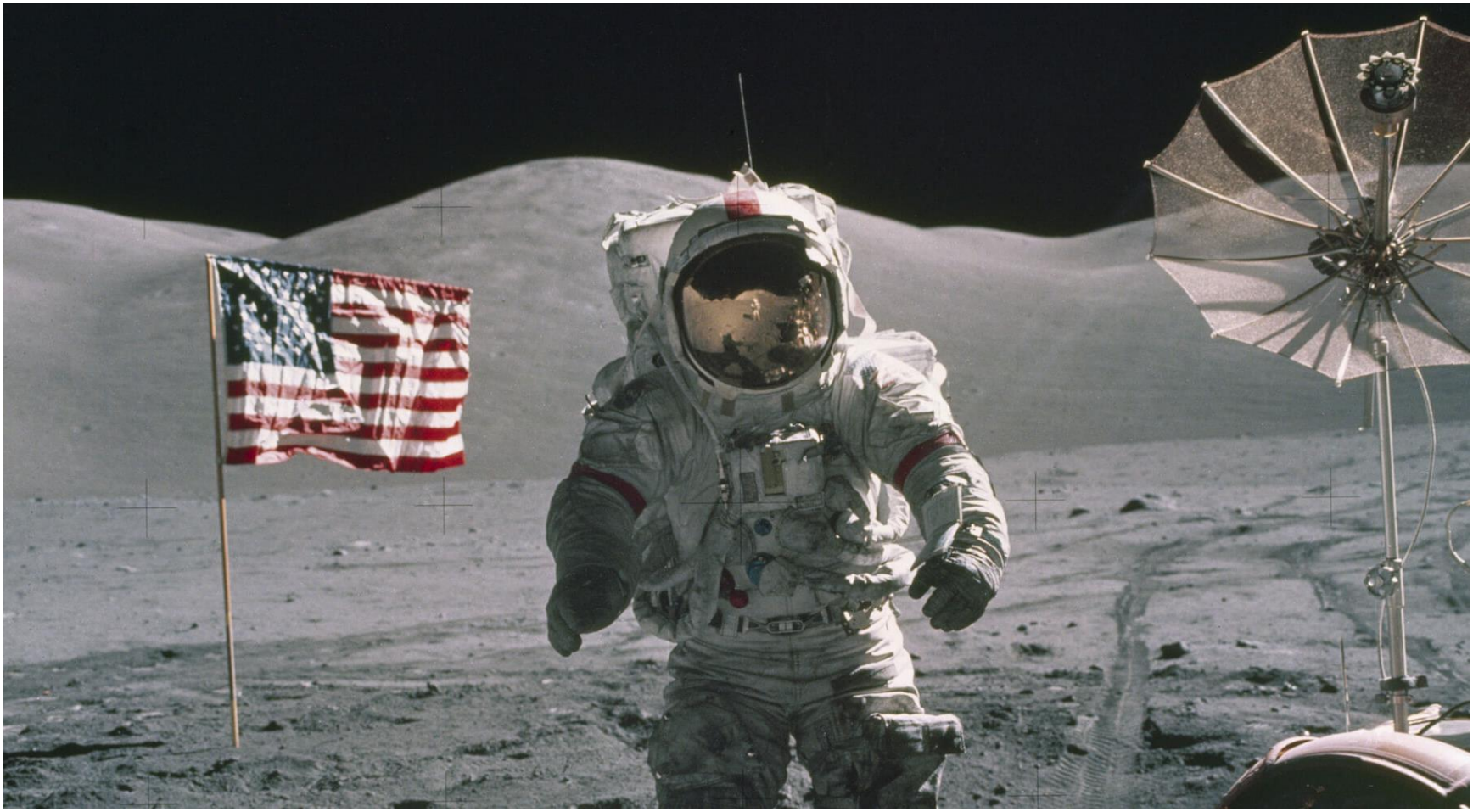
Changing our collective risk assessment…

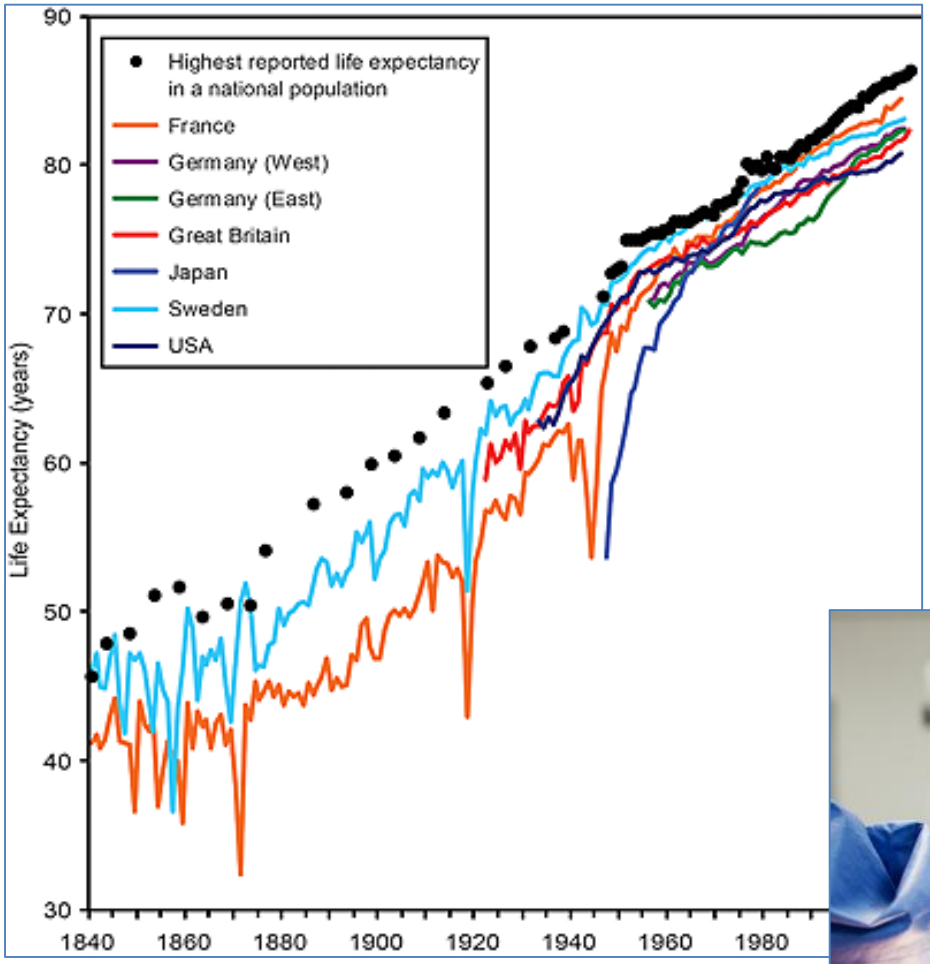

http://www.bgs.ac.uk/discoveringGeology/climateChange/

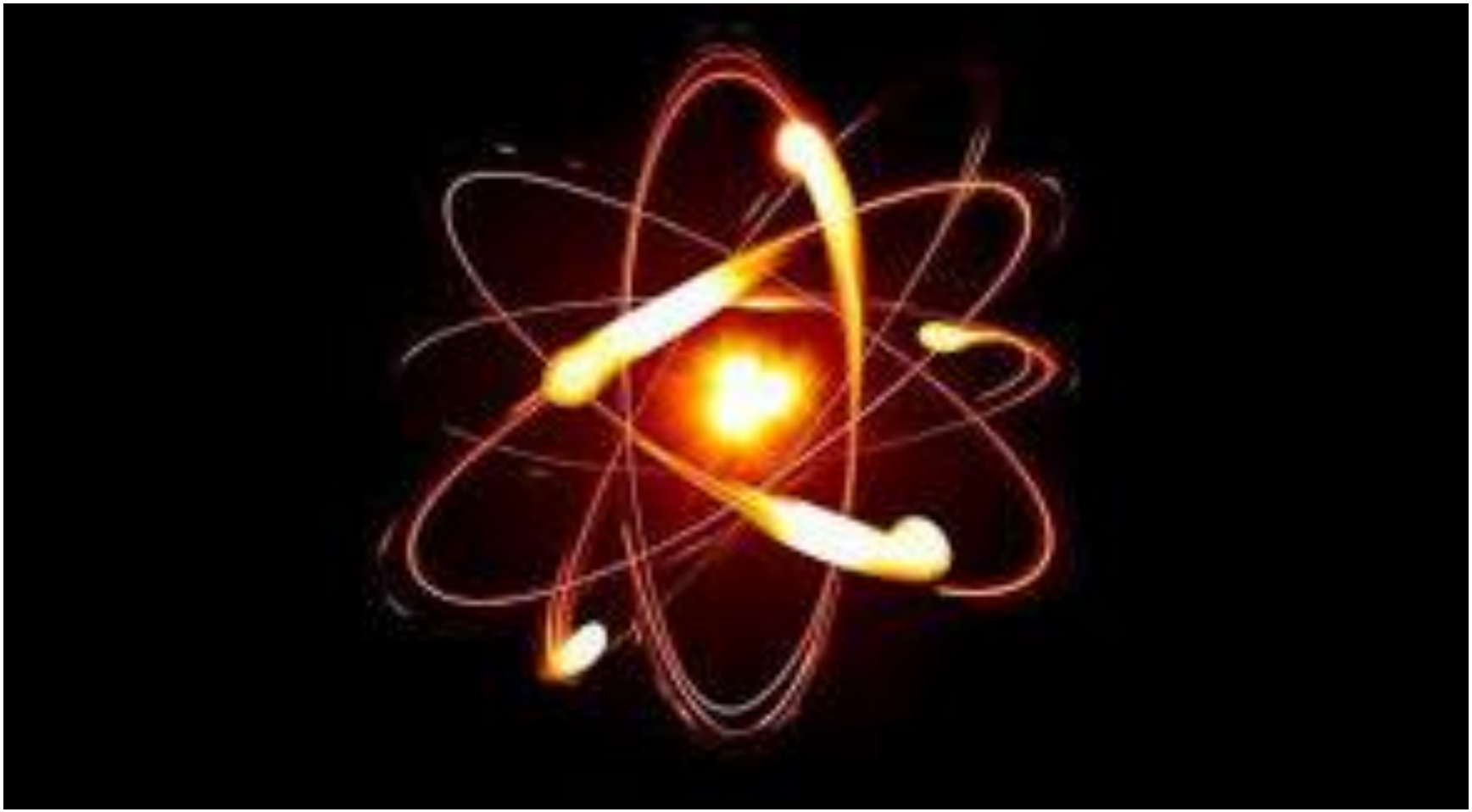

BOAR'S HEAD BRAND
PROVISIONS
Bartlett
BIKE LANE
GREY



GREY


Highest reported life expectancy in a national population
France
Germany (West)
Germany (East)
Great Britain
Japan
Sweden
USA
Life Expectancy (years)
90
80
70
60
50
40
30
1840
1860
1880
1900
1920
1940
1960
1980




We the Peop
provide for the com
tablish this


PRESIDENT WILSON
This is the time to support Woman Suffrage.

Consortium on Climate Change & Health

Acknowledgement to:

Paul Auerbach
Skip Burkle
Laurie Garrett
Loren Greenway
George Luber

Consortium on Climate Change & Health

Thank You!

@JayLemery

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john.lemery@ucdenver.edu

END