Climate Change and Health: What Everyone Needs to Know

Ken Lans, M.D., M.B.A.

Washington Physicians For Social Responsibility
Climate Reality Leader

Source: NASA

We have a problem.

“And that problem is climate change. There’s good news and bad news. We’ll start with the bad news, but come back and finish off with the good news, because the intent is not to leave you feeling hopeless and helpless, and there is some reason for hope.

So, first the bad news……and it’s pretty bad.”

Source: NASA

The planet is warming and the impacts are already being felt

Burning fossil fuels spews huge amounts of CO_2 and pollution into the air and as a result we're seeing:

- **More Heatwaves!**
- **More Severe Storms & Floods!**
- **Increasing Drought!**
- **More Wildfires!**
- **Rising Sea Levels!**
- **Ocean Acidification**

This is a health emergency!

People, in ever larger numbers, will suffer.

The World Bank predicts that climate change will lead to:

- **Increasing political instability.**
- **Food shortages.**
- **Famine.**
- **Displacement of millions of people.**

Climate change is a public health issue!

Source: *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*, World Bank, 2013.

THE LANCET

Volume 373 · Number 9676 · Pages 1663–1734 · May 16–22, 2009 www.thelancet.com

"Climate change is the biggest global health threat of the 21st century."

See The Lancet Commissions page 1693

ISSN Registered as a newspaper · ISSN 0140-6736
Founded 1823 · Published weekly

The American Academy of Pediatrics has joined a growing list of leading medical voices calling for prompt, substantive action:

“The changing climate is causing physical, chemical, and ecological changes that are fundamentally altering the planet. These changes pose significant threats to human health, with children representing a uniquely vulnerable group.”

Policy Statement, American Academy of Pediatrics

PEDIATRICS, Volume 136, number 5

November 2015

UNICEF warns that children will bear the brunt of climate change and that it will make existing inequities even worse:

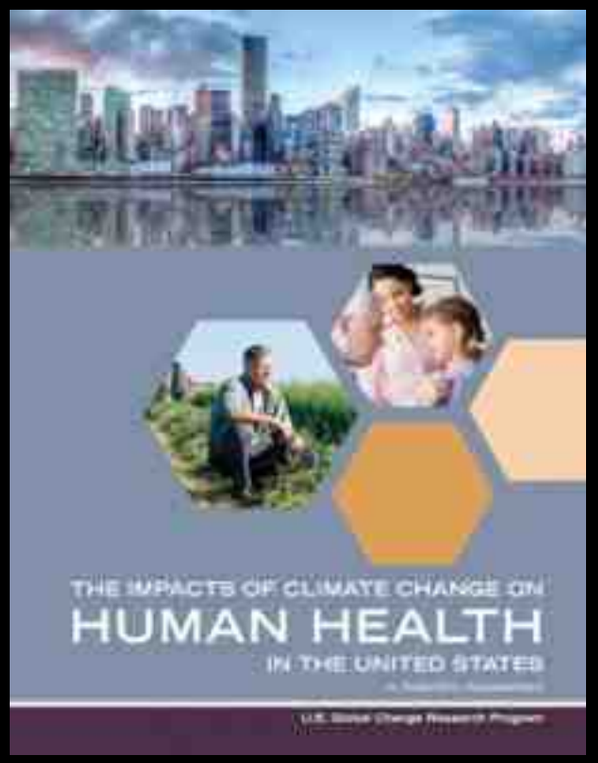
“There may be no greater, growing threat facing the world’s children – and their children – than climate change….Unless we act forcefully to stem the climate crisis now, the danger will only escalate.”

Unless we act now: The impact of climate change on children

United Nations Children’s Fund (UNICEF)

November 2015

The medical experts who are part of the U.S.'s ongoing National Climate Assessment make it clear that:



"Climate change is a significant threat to the health of the American people…. Every American is vulnerable to the health impacts associated with climate change."

The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.

U.S. Global Change Research Program, Washington, DC

April 2016: **http://dx.doi.org/10.7930/J0R49NQX**

American College of Physicians

“It will have devastating health effects across the world.”

“The ACP urges physicians to help combat climate change by advocating for effective climate change adaptation and mitigation policies, helping to advance a low-carbon health care sector, and by educating communities about potential health dangers posed by climate change.”

Policy Statement, American College of Physicians

Annals of Internal Medicine, Climate Change and Health.

April 19, 2016

The science is clear.

The planet is warming.

The Hottest Year Ever Measured

A whole 0.29°C hotter than 2014, the previous hottest year, and 2016 is even hotter.

Source: Japan Meteorological Association, NASA, & NOAA

The 15 Hottest Years on Record

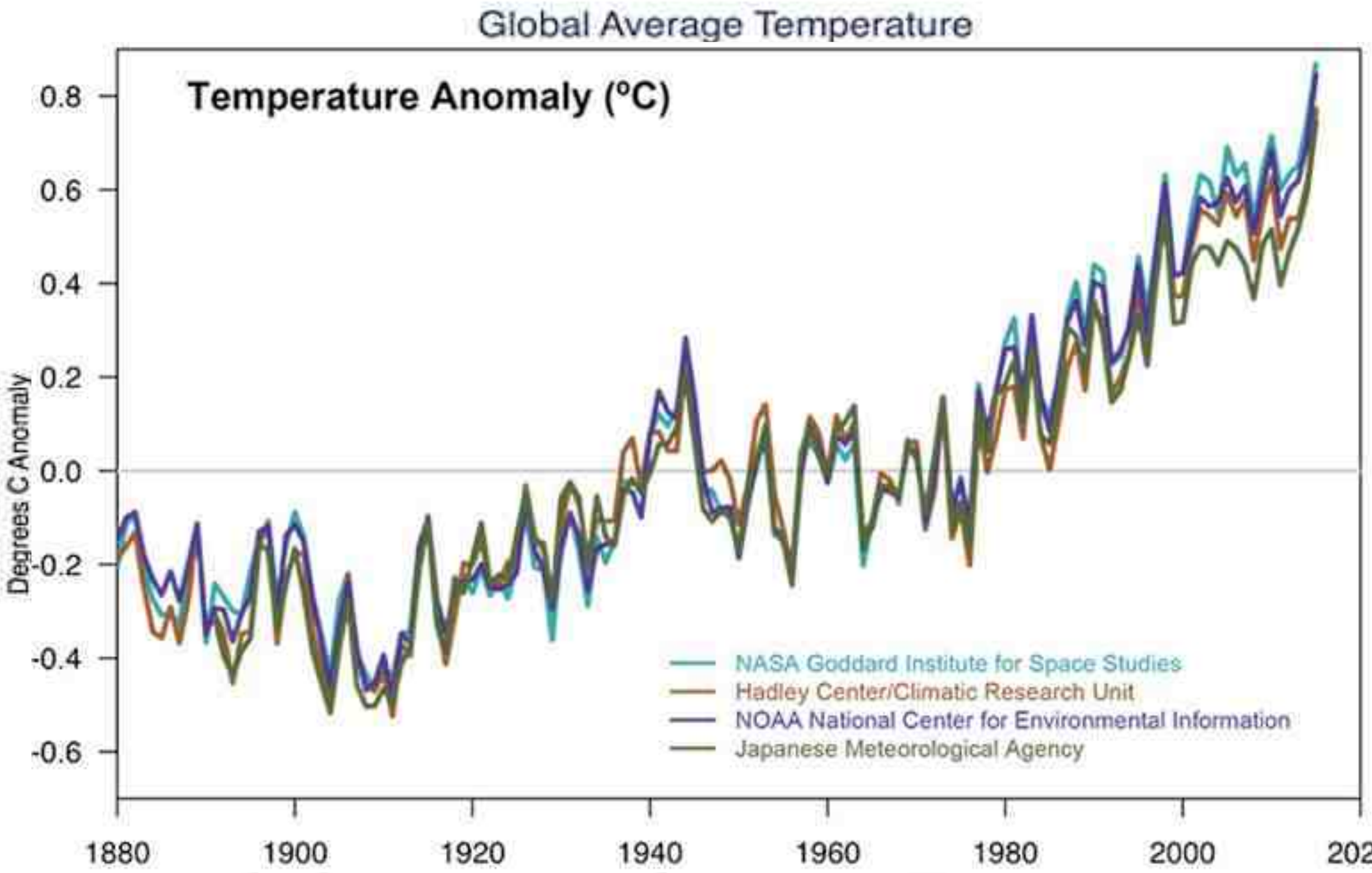
have **all** come since 1998

2015 2014 2010 2013 2005

1998 2009 2012 2003 2006

2007 2002 2004 2011 2008

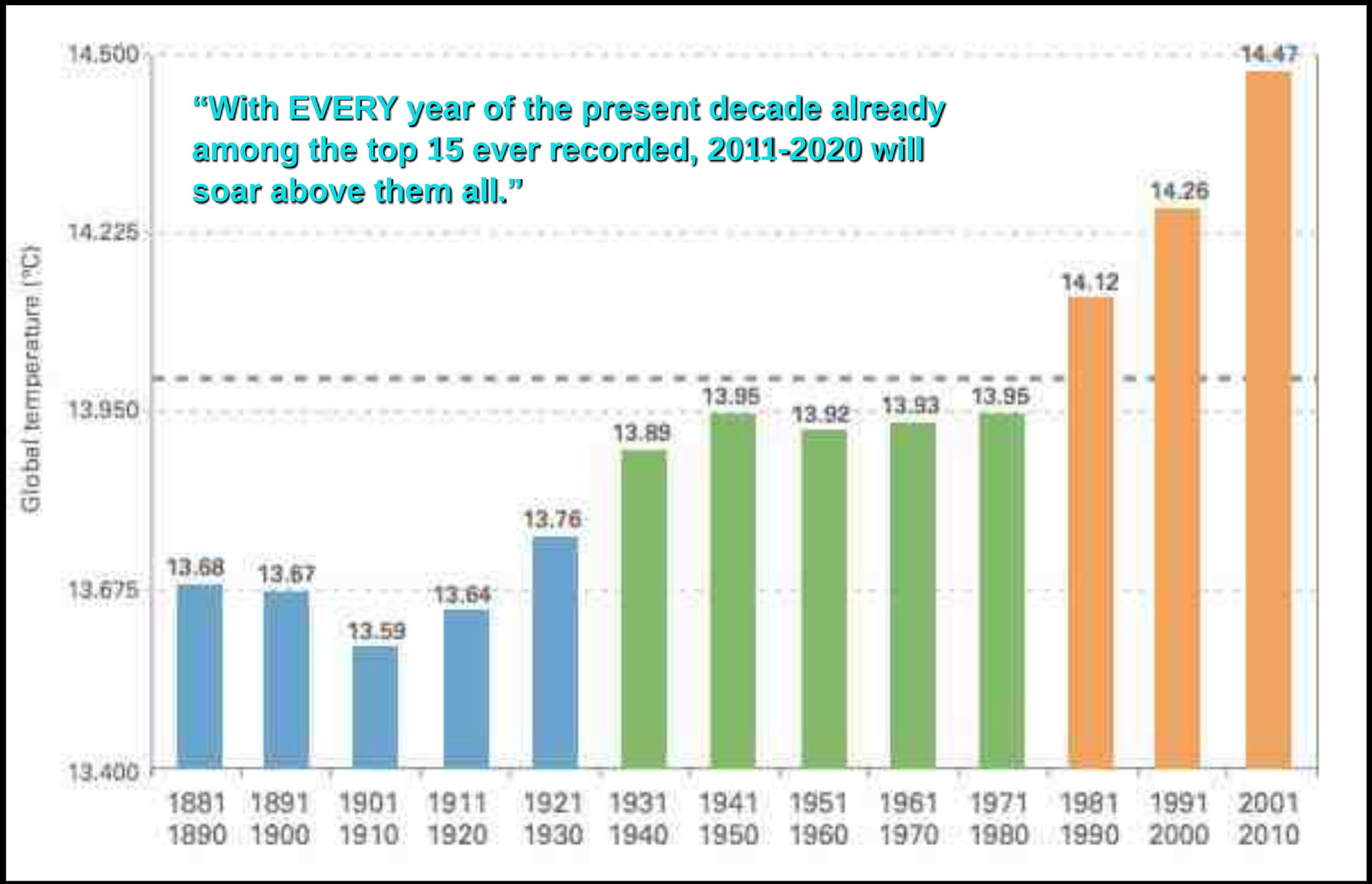
Consensus Among Multiple Sources



http://climate.nasa.gov/scientific-consensus/

Global Temperature by Decade

1881 – 2010



Data: World Meteorological Organization, "*The Global Climate 2001 - 2010, A Decade of Climate Extremes Summary Report,*" Fig. 1, 2013

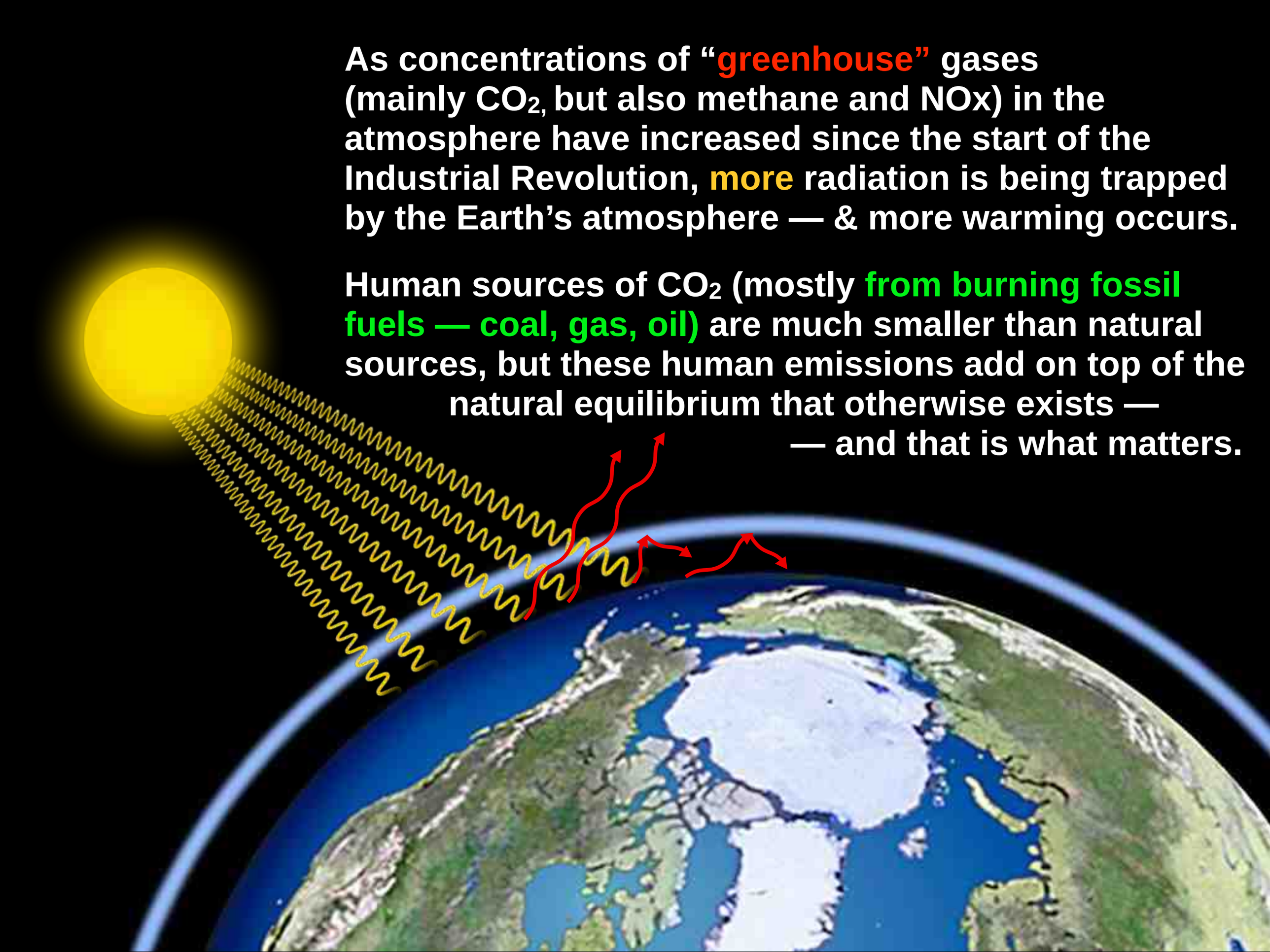
Positive proof of global warming.

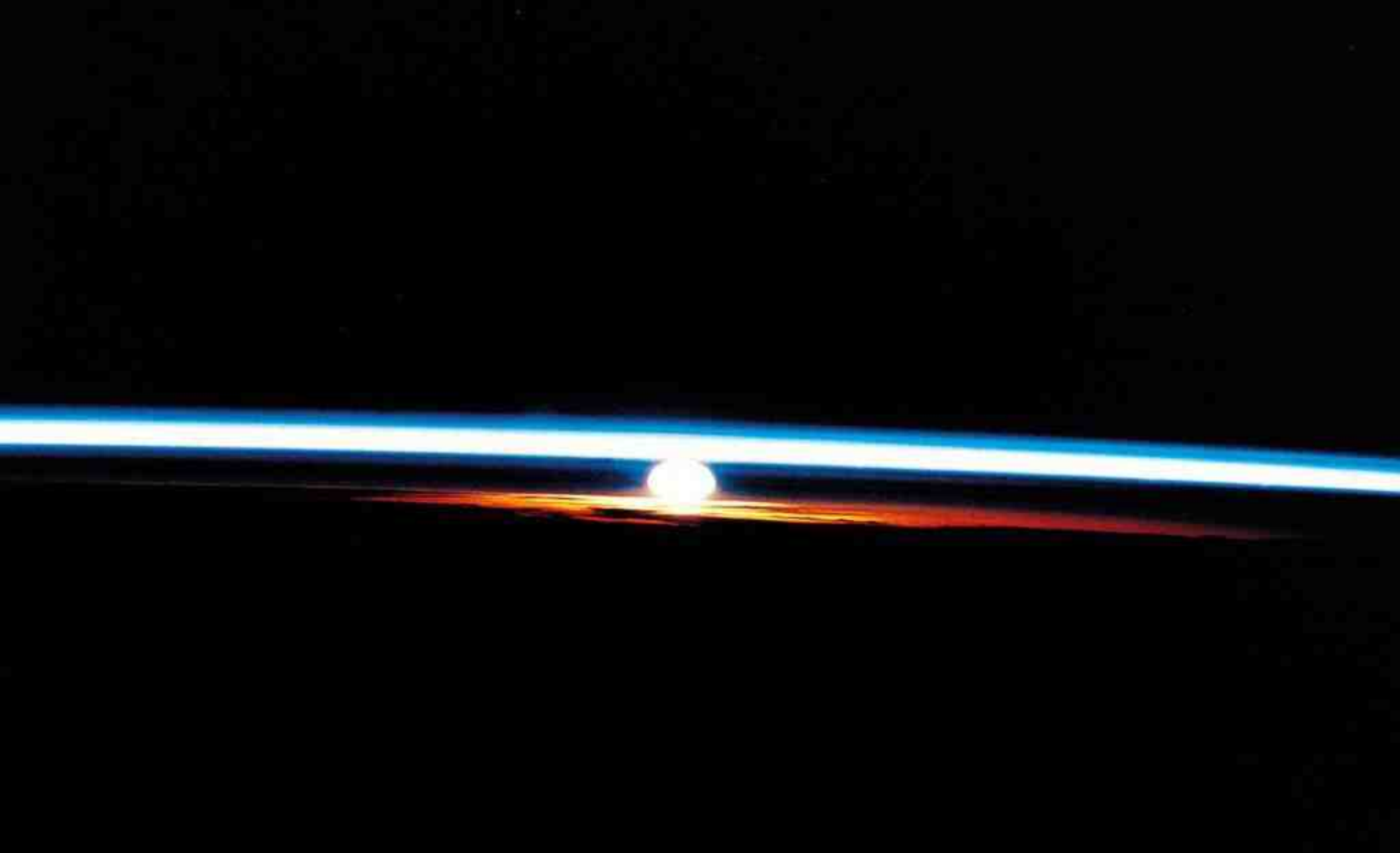
People <u>are</u> the cause of global warming.

We are profoundly changing the climate!

As concentrations of “greenhouse” gases (mainly CO_2, but also methane and NOx) in the atmosphere have increased since the start of the Industrial Revolution, more radiation is being trapped by the Earth’s atmosphere — & more warming occurs.

Human sources of CO_2 (mostly from burning fossil fuels — coal, gas, oil) are much smaller than natural sources, but these human emissions add on top of the natural equilibrium that otherwise exists — — and that is what matters.





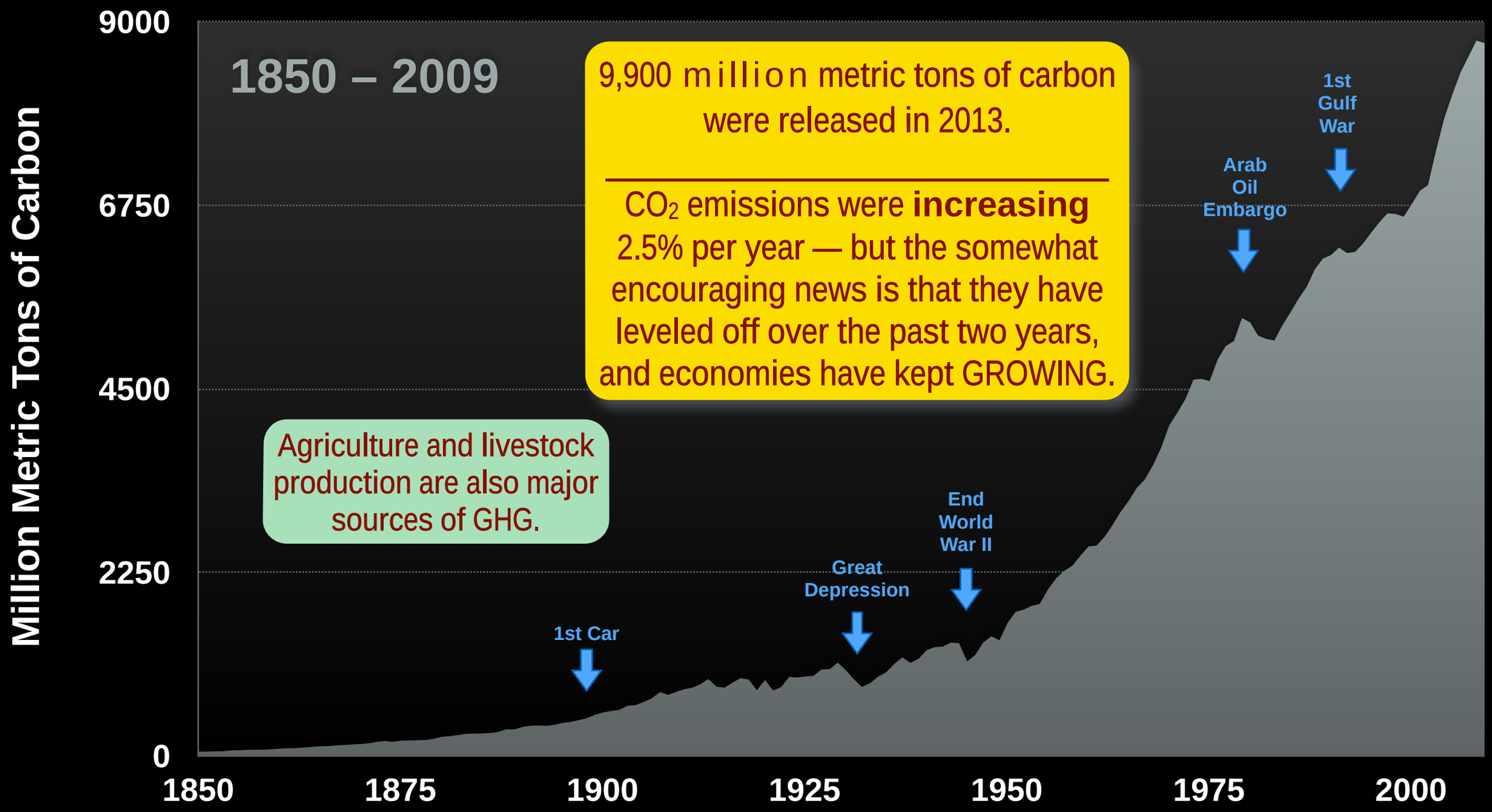
This image from the International Space Station illustrates a fundamental fact about the Earth’s atmosphere – it’s very thin.

Source: NASA

“And into this thin layer of atmosphere we keep dumping enormous amounts of pollution and greenhouse gases.”

Global Carbon Emissions from Fossil Fuels

Mostly burned for energy production, industry, transportation



Source: U.S. Department of Energy/CDIAC

Where Do Greenhouse Gases Come From?

Energy production remains the primary driver of GHG emissions

35%
Energy Sector

24%
Agriculture, forests and other land uses

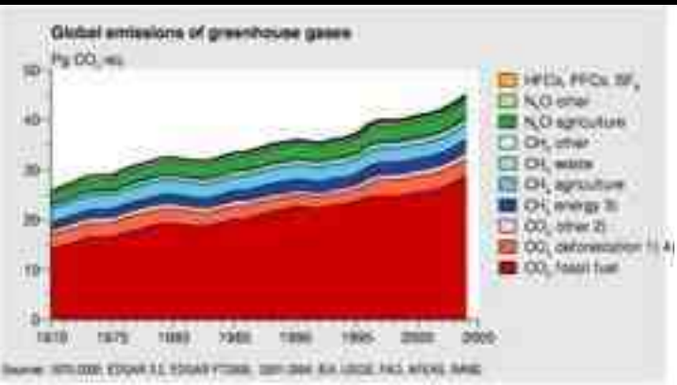
21%
Industry

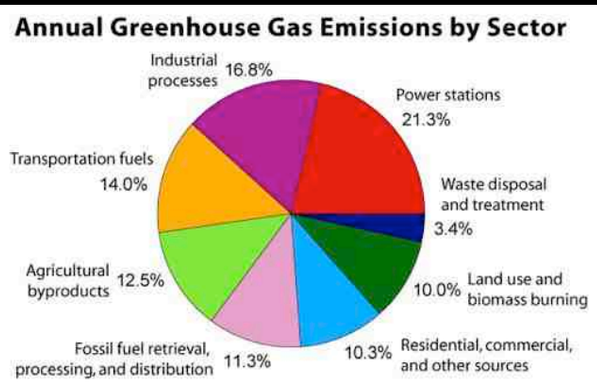
14%
Transport

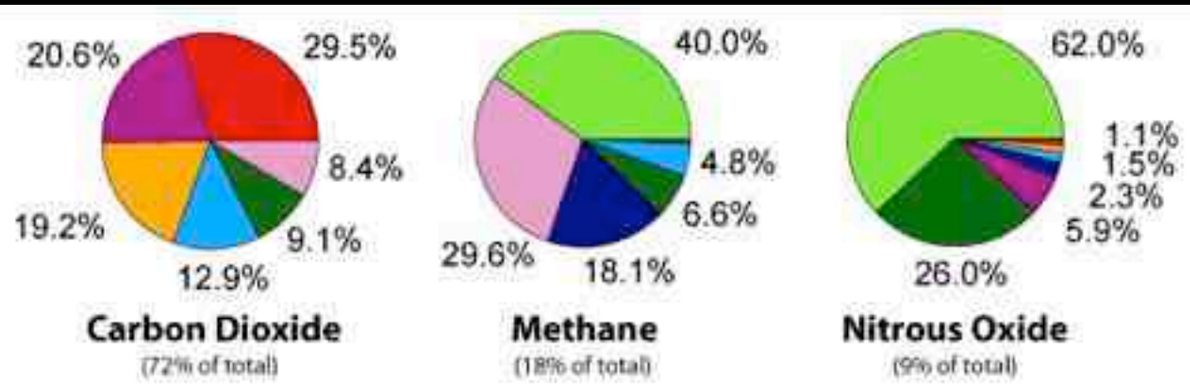
6.4%
Building Sector

2010 GHG emissions

AR5 WGIII SPM

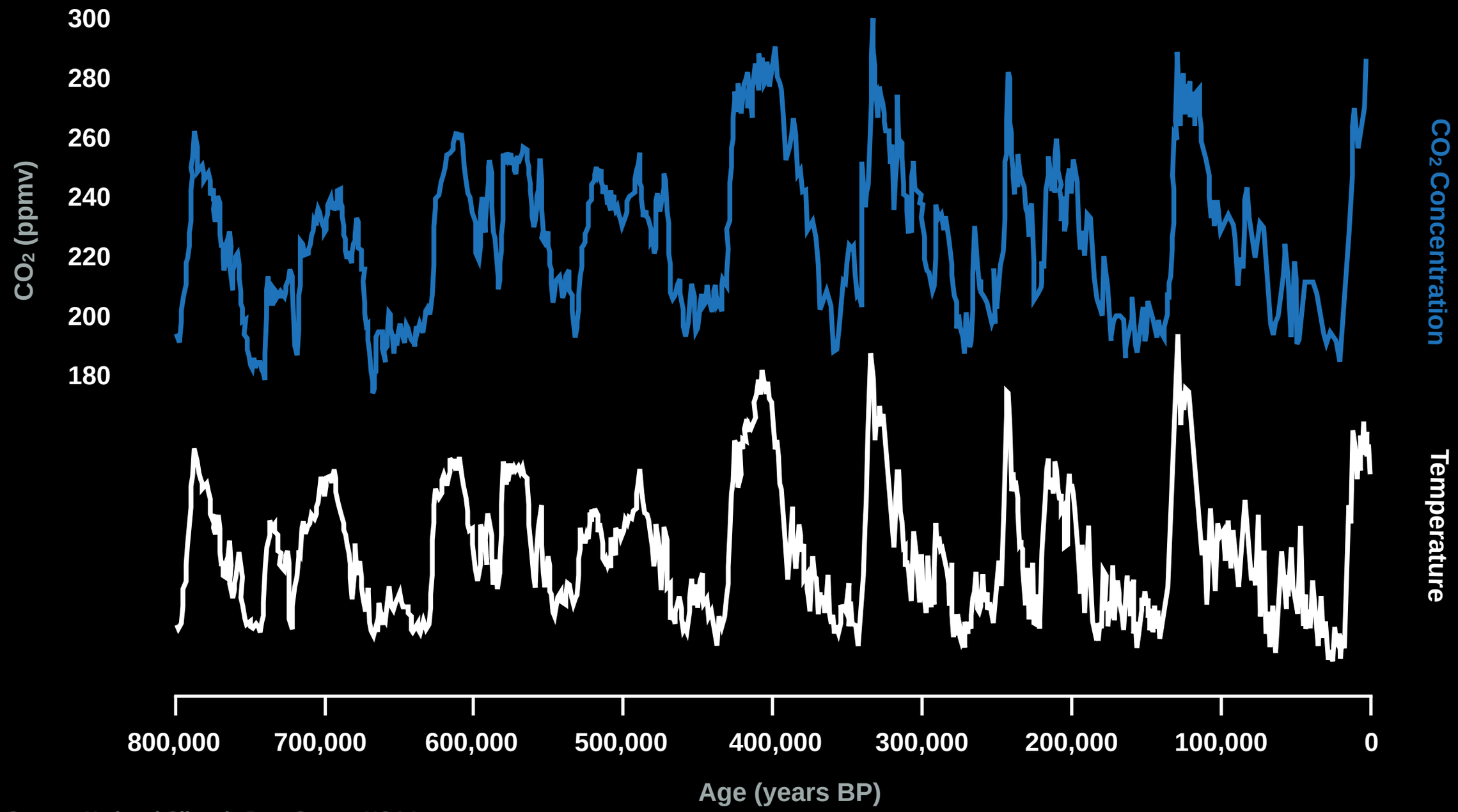






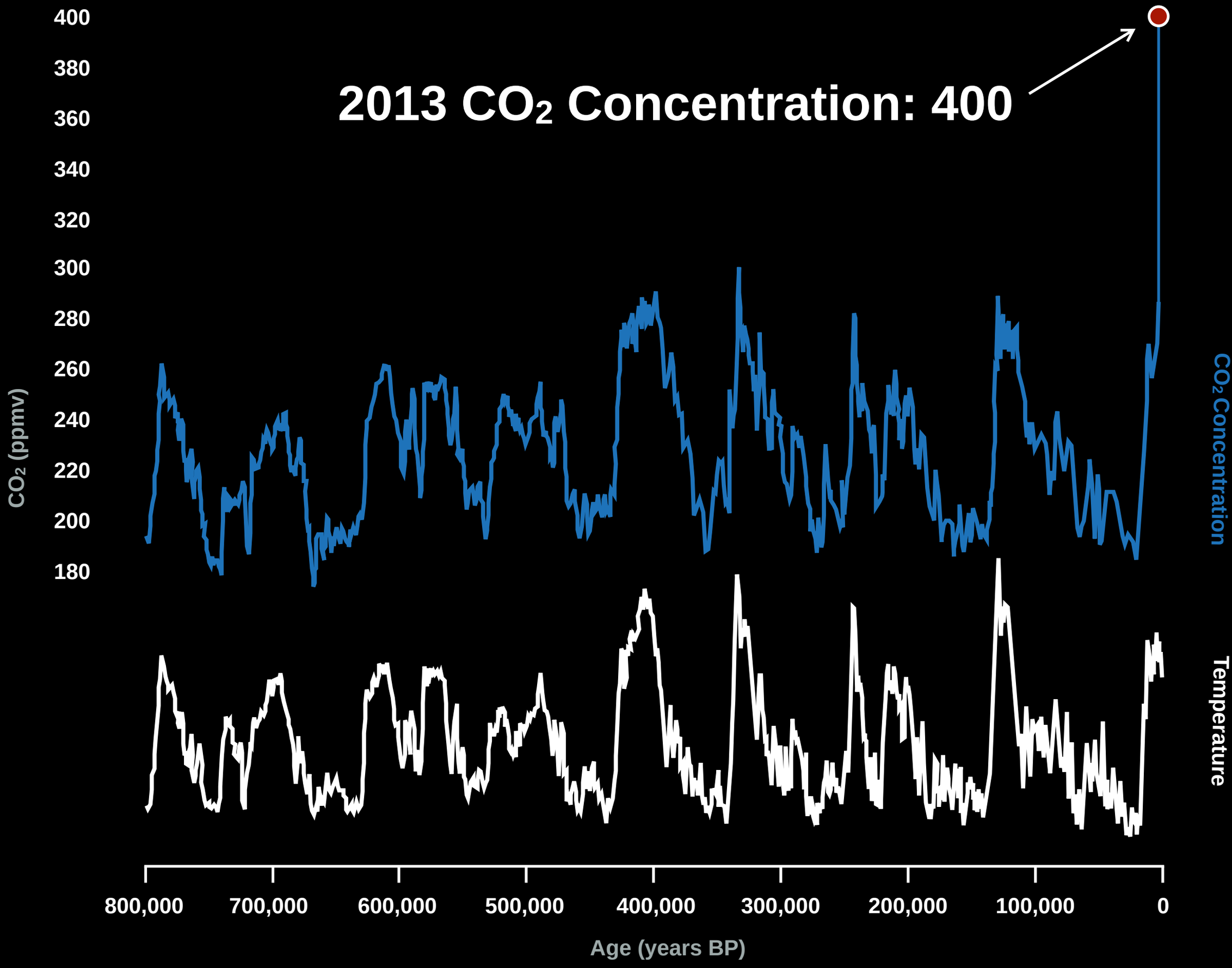
Historical CO_2 Concentration

**Carbon dioxide and temperature go up and down together.
Throughout the last 800,000 years, the concentration
of carbon dioxide has never gone above 300 parts per million.**

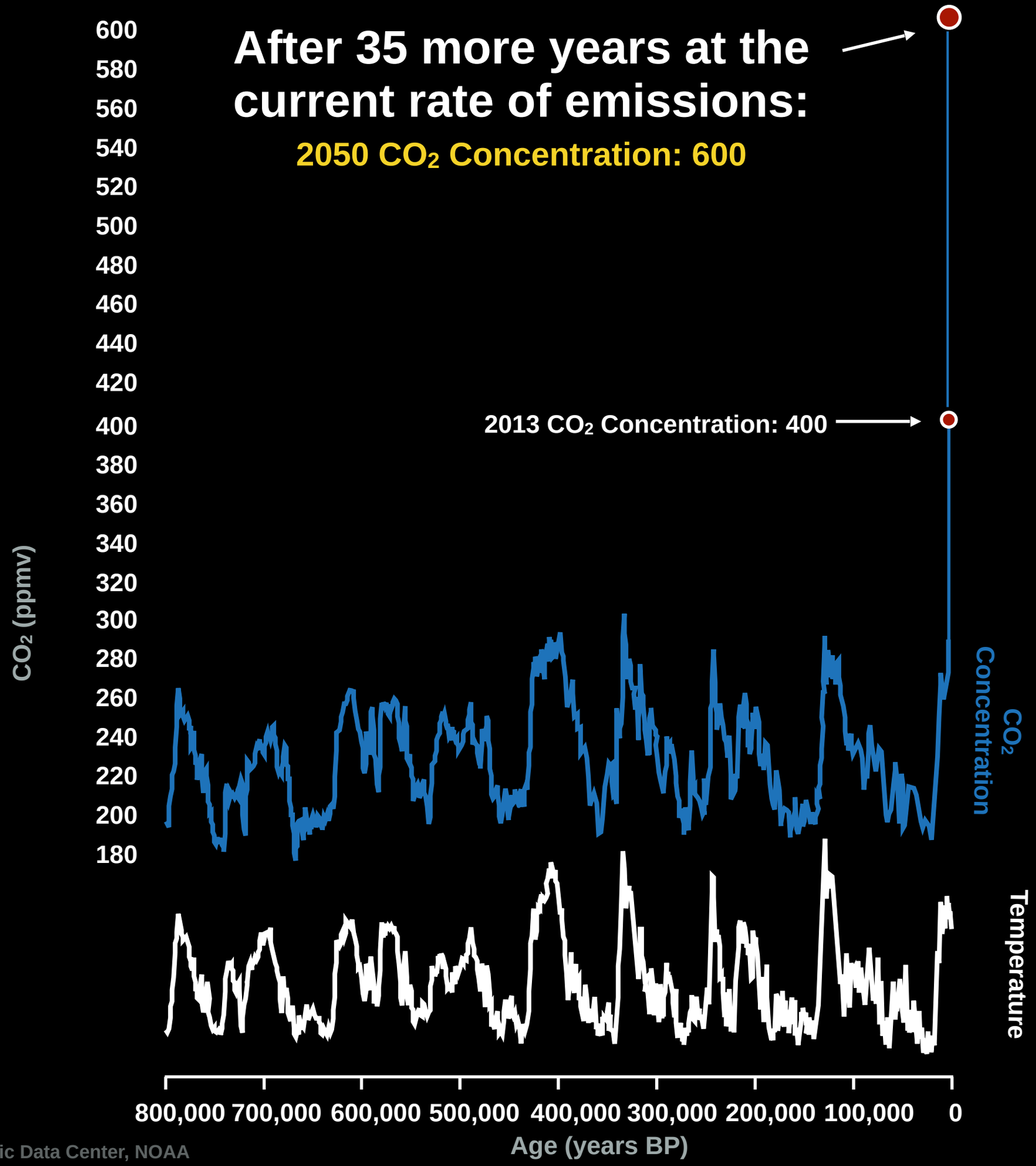


Source: National Climatic Data Center, NOAA

2013 CO_2 Concentration: 400



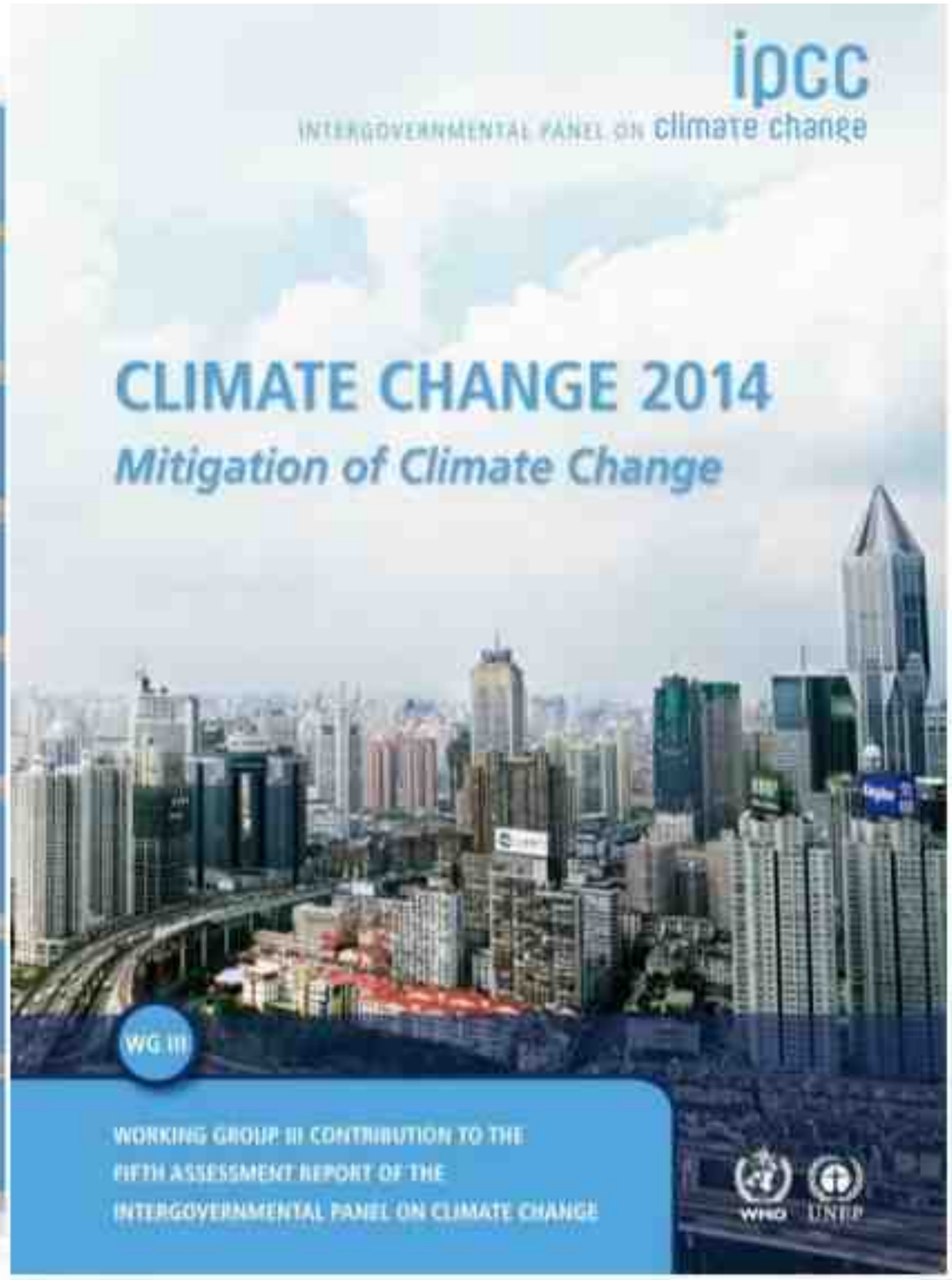
Source: National Climatic Data Center, NOAA



Source: National Climatic Data Center, NOAA

IPCC reports present the most extensively peer-reviewed scientific consensus.

- 1 Summary for Policymakers
- 1 Technical Summary
- 16 Chapters
- 235 Authors
- 900 Reviewers
- More than 2000 pages
- Close to 10,000 references
- More than 38,000 comments

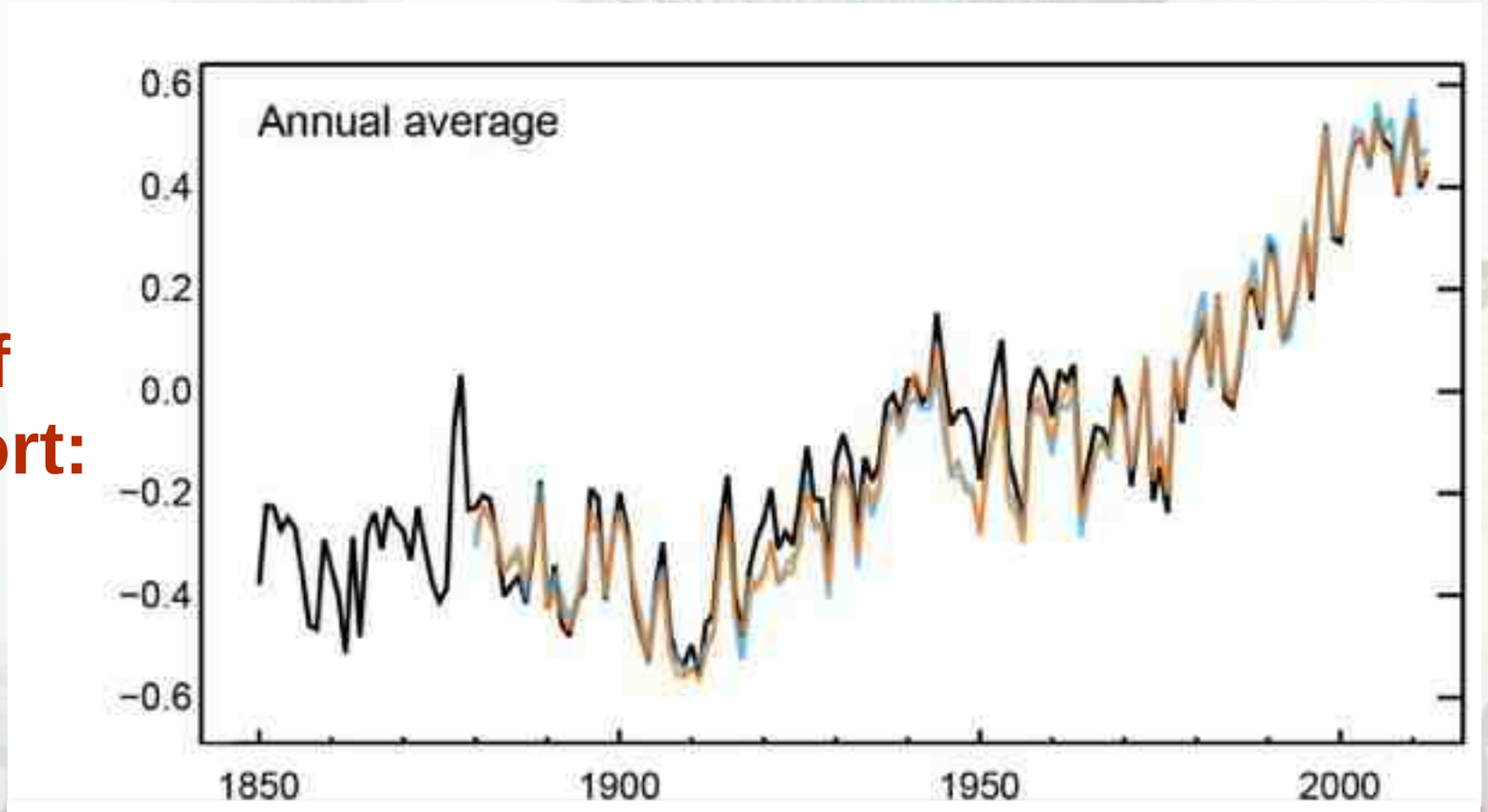


ipcc
INTERGOVERNMENTAL PANEL ON climate change

Humans are changing the climate

It is extremely likely that we are the dominant cause of warming since the mid-20th century

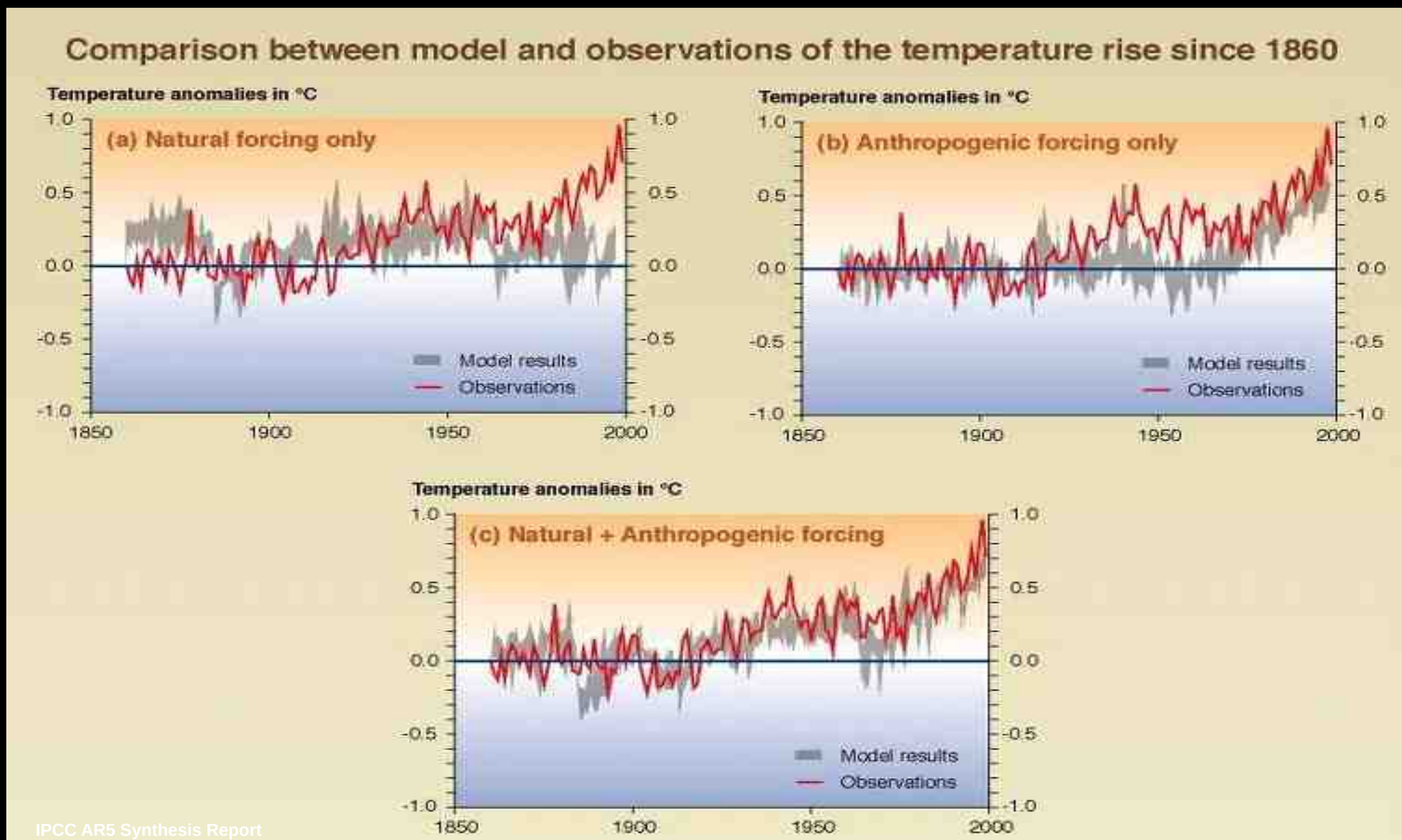
Findings of the 2014 report:



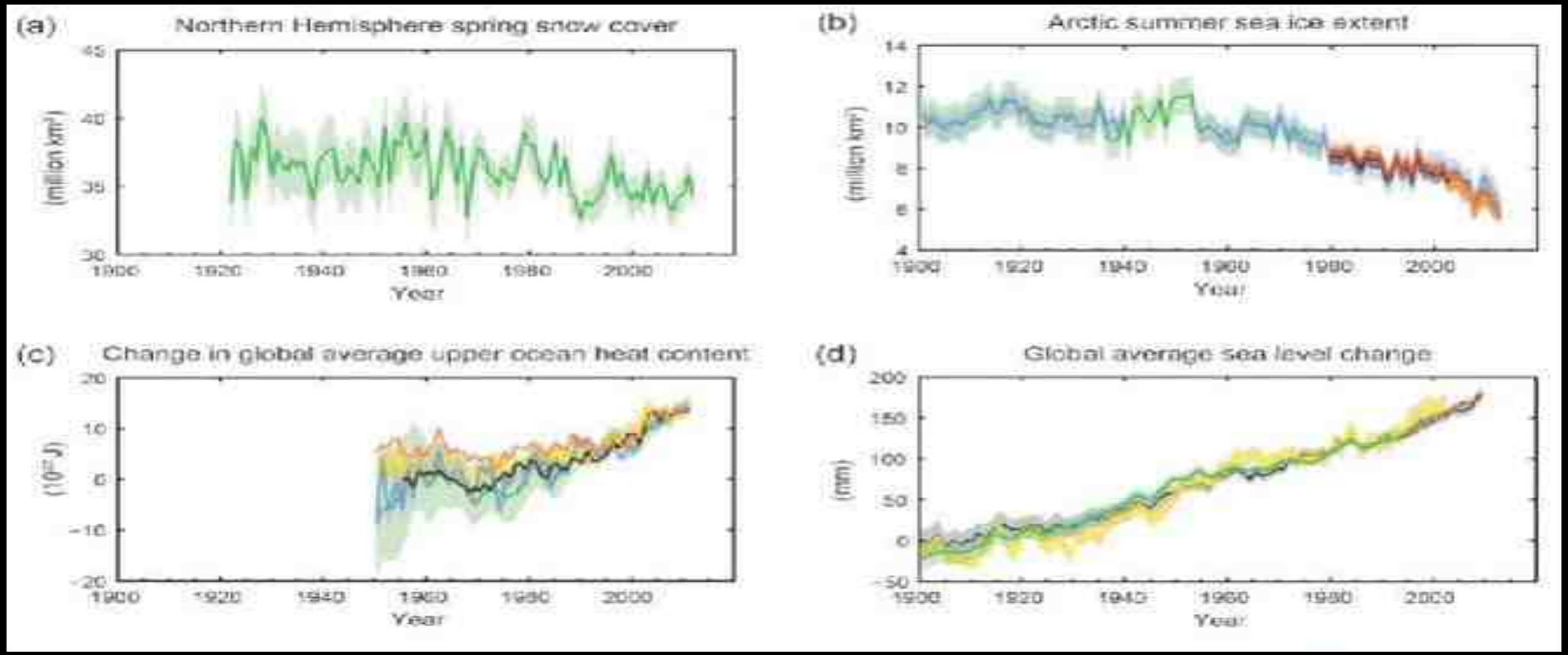
Globally averaged combined land and ocean surface temperatures

AR5 WGI SPM

Only Human Influence Can Explain Recent Warming



There are multiple observed indicators of a changing global climate



“Warming of the climate system is unequivocal…the atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.”

Source: IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis.

More than just warmer.

There is a linkage between:

A Warming Planet

and the increased frequency and severity of

Extreme Weather Events

As ocean temperatures increase,
they evaporate more moisture into the sky.

Warmer air can also
hold a lot more water vapor.

So we get more (and bigger) storms
and more extreme weather.

“Global warming
is contributing to an
increased incidence of
extreme weather
because the environment
in which all storms form has changed
from human activities.”

Kevin Trenberth

U.S. National Center for Atmospheric Research

June 15, 2011

So the rainstorms
(and snowstorms)
are getting
bigger and more intense

Causing bigger
and more frequent
FLOODS

2016 Louisiana flooding is the country’s ‘worst natural disaster’ since Hurricane Sandy, Red Cross says.

“Louisiana is always at risk of floods, naturally, but climate change is exacerbating that risk, weighting the dice against us,” Katharine Hayhoe, a climate researcher at Texas Tech University, told The Washington Post. “How long will it be until we finally recognize that the dice are loaded?”

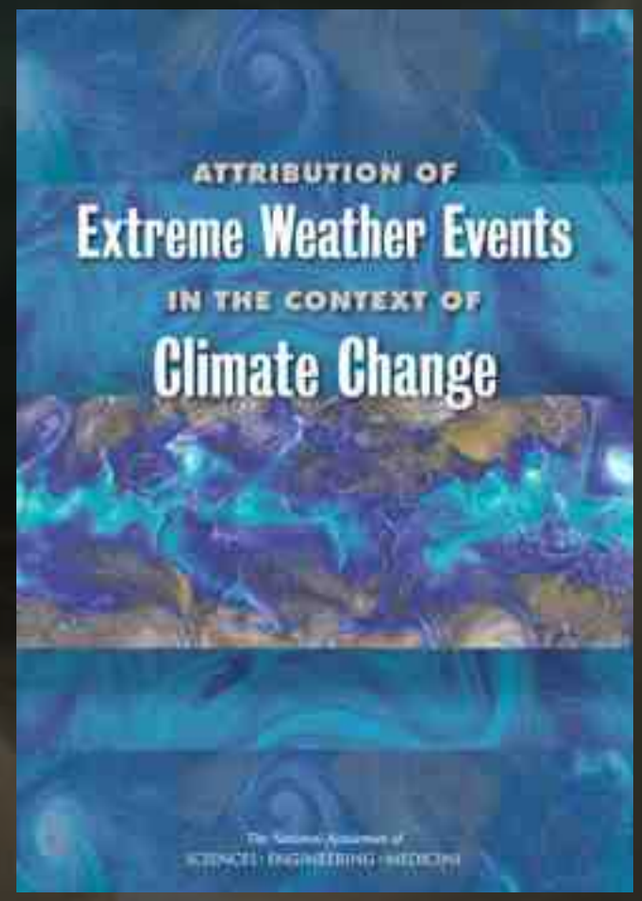
David Grunfeld/The Times-Picayune, via Associated Press

Attribution of Extreme Weather

!

“As climate has warmed over recent years, a new pattern of more frequent and more intense weather events has unfolded across the globe. !

…Warming increases the likelihood of extremely hot days and nights, favors increased atmospheric moisture that may result in more frequent heavy rainfall and snowfall, and leads to evaporation that can exacerbate droughts.”



National Academies of Sciences, Engineering, and Medicine

March 2016

Committee on Extreme Weather Events and Climate Change Attribution; Board on Atmospheric Sciences and Climate; Division on Earth and Life Studies; National Academies of Sciences, Engineering, and Medicine. 2016. http://www.nap.edu/catalog/21852/attribution-of-extreme-weather-events-in-the-context-of-climate-change

“The only plausible explanation for the rise in weather-related catastrophes is climate change.”

Munich Re

One of the two largest reinsurance companies in the world

September 27, 2010

Sukkur, Pakistan. August 8, 2010, © 2010 Reuters/Akhtar Soomro

“What keeps us up at night is climate change. We see the long-term effect of climate change on society, and it really frightens us.”

J. Eric Smith, CEO, Swiss Re

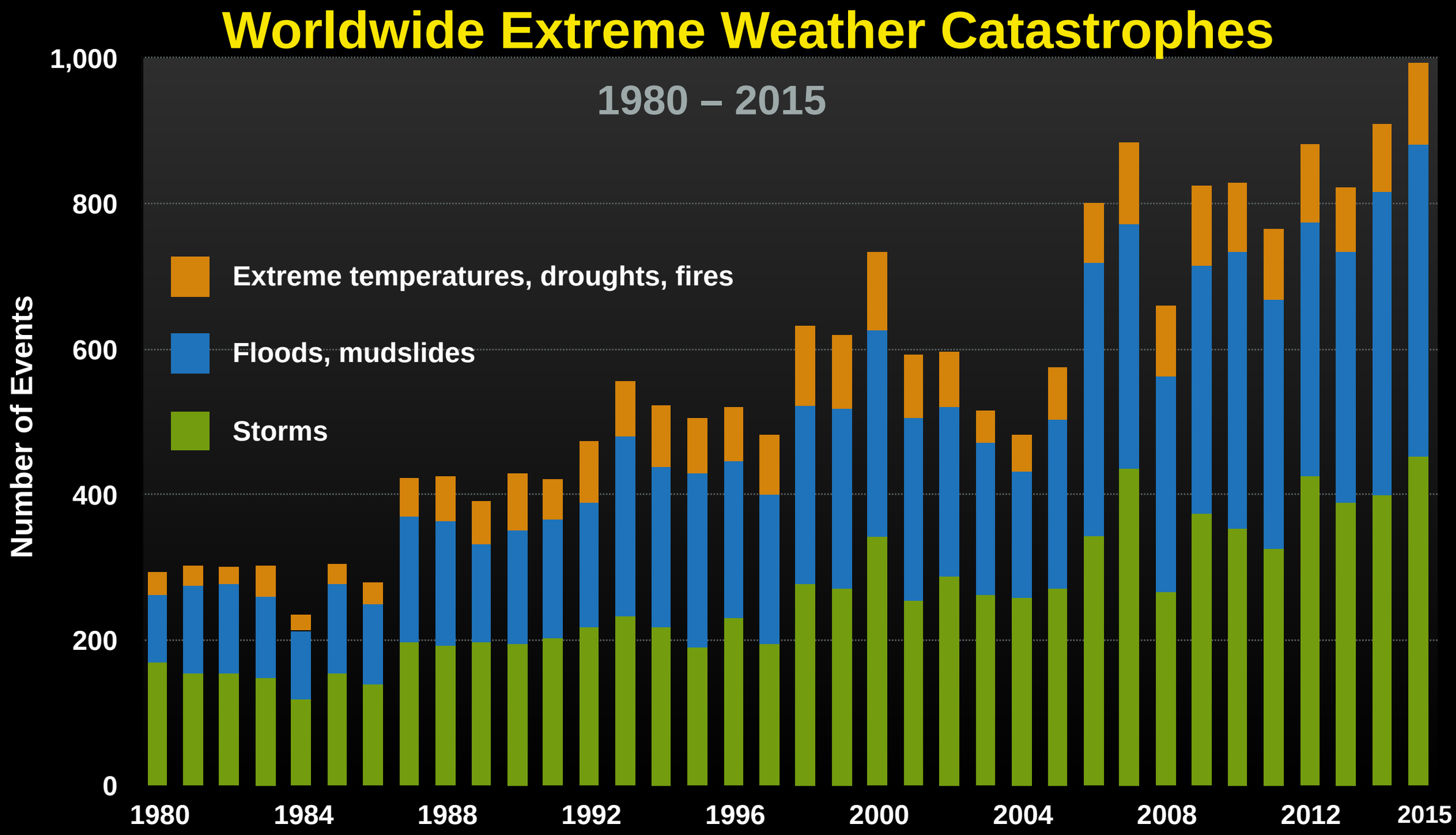
(the other largest reinsurance company in the world)

!

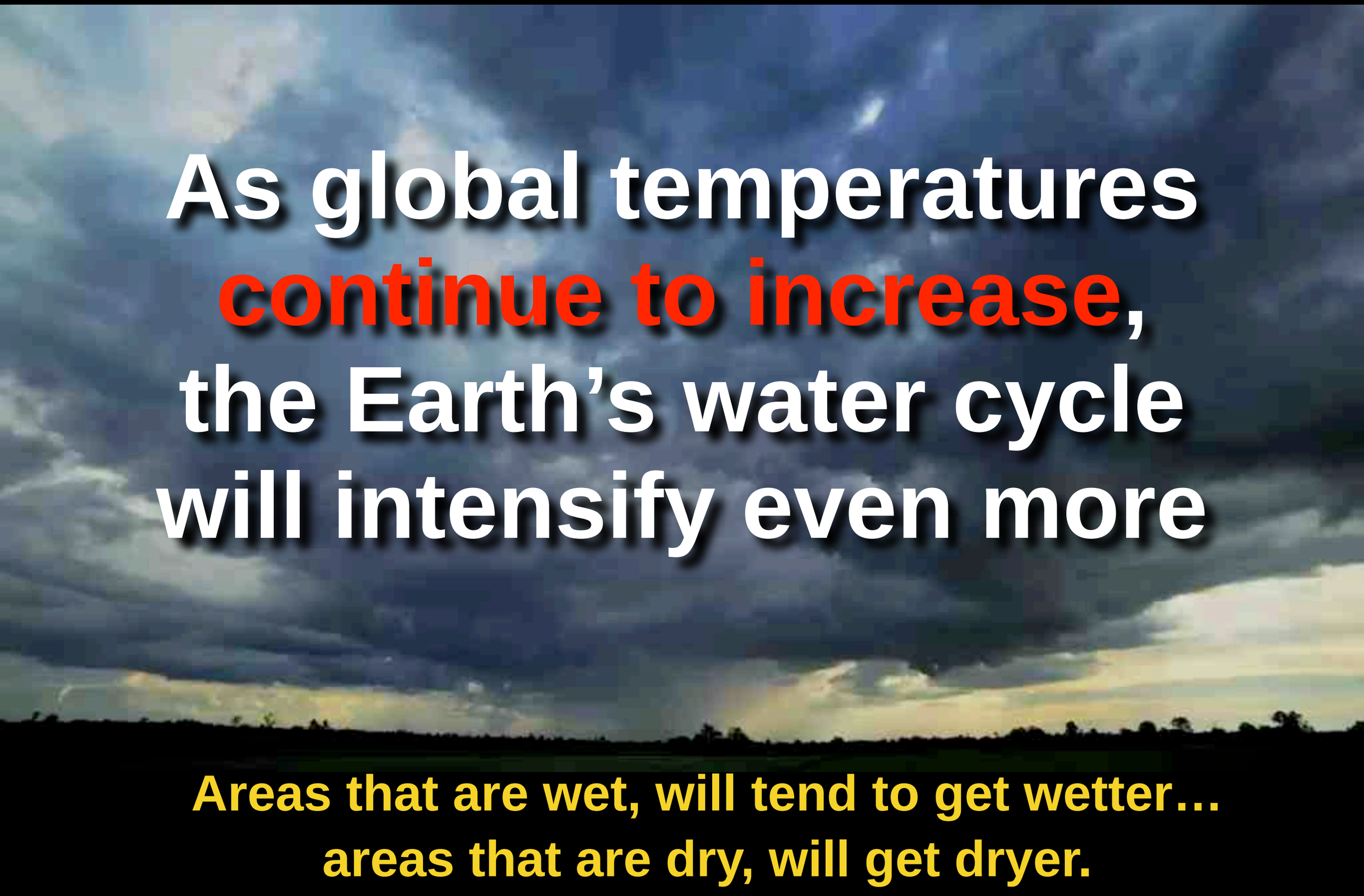
July 2013

Eastern Chad, where rainfall in this region has been in decline since 1950. © UNHCR/H.Caux

Increase is Real, Not Just More News Coverage



Data: 2016 Munich Re, Geo Risks Research, NatCatSERVICE. As of January 2016.


As global temperatures
continue to increase,
the Earth's water cycle
will intensify even more
Areas that are wet, will tend to get wetter…
areas that are dry, will get dryer.

When droughts do occur, warmer temperatures can amplify their impacts.

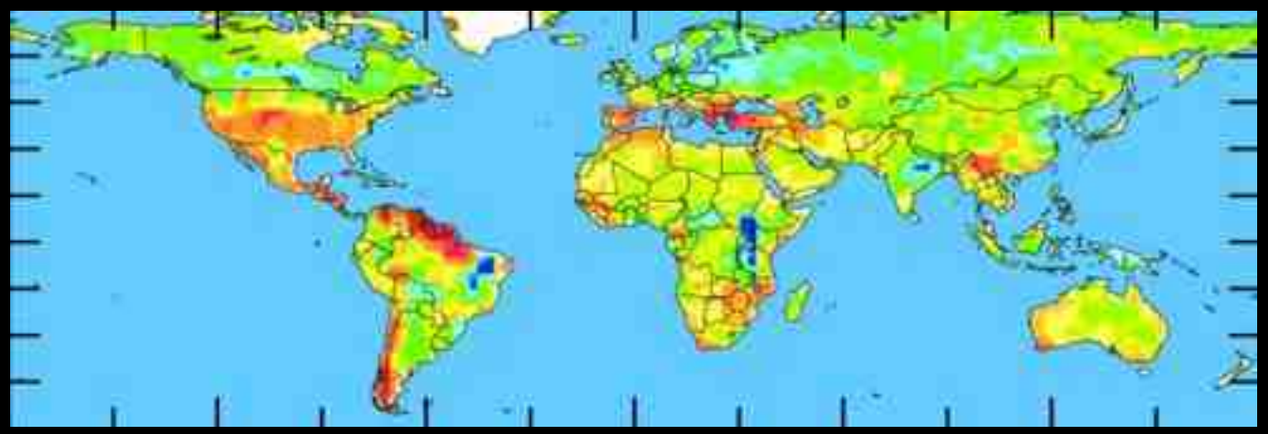
- With higher temperatures, water evaporates MORE QUICKLY from the soil (making it harder for plants to grow — which, in turn, can lead to less local rainfall).
- And when the rain does fall, it tends to find hard, parched earth — running off instead of soaking in.

May 4, 2011
Poyang Lake, Jiangxi Province, China

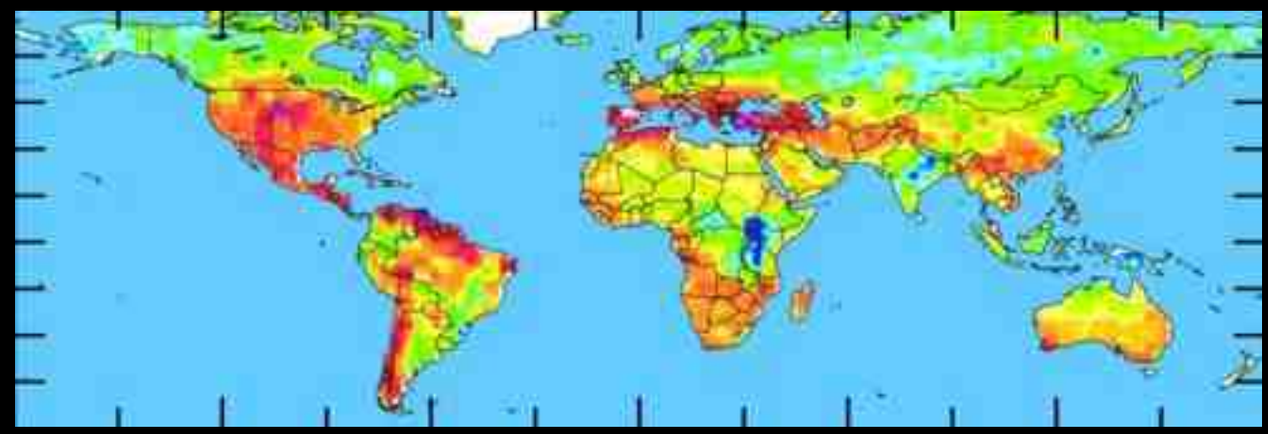
Expanding Drought Conditions

Warming temperatures are likely to continue creating drier conditions in many parts of the world, potentially reaching levels not seen in modern times.

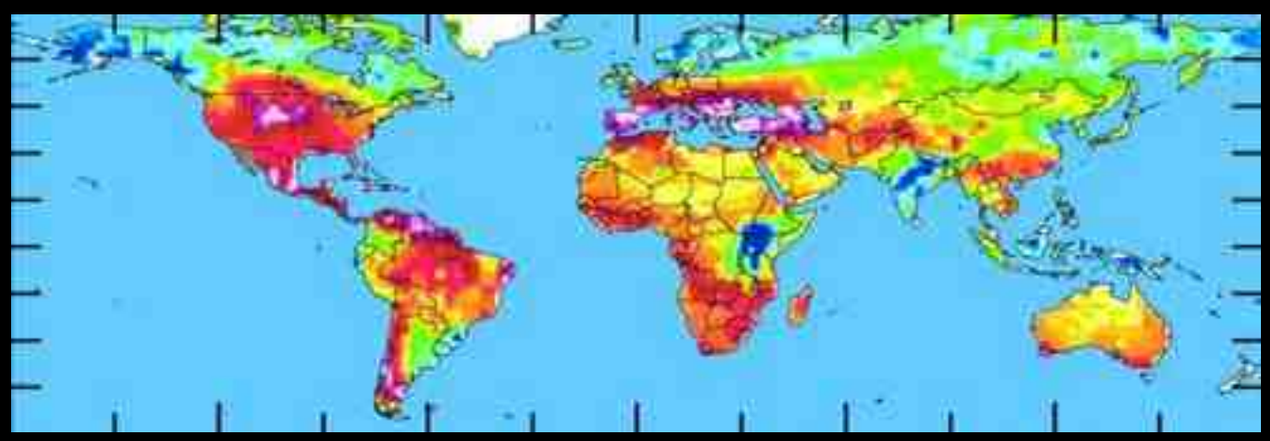
2000 – 2009



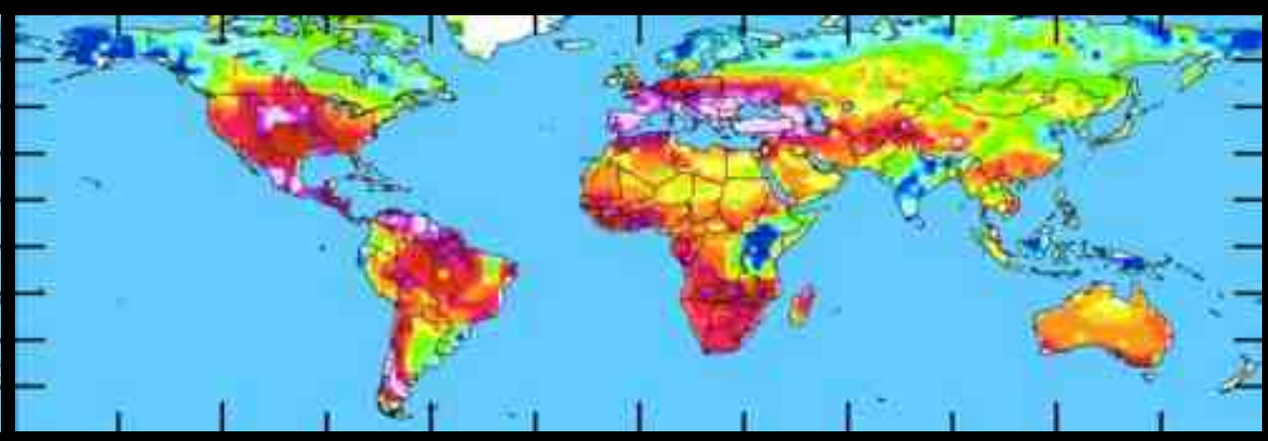
2030 – 2039



2060 – 2069



2090 – 2099



Dry — Wet

Courtesy 2012 Wiley Interdisciplinary Reviews via University Corporation for Atmospheric Research

Severe Droughts Leave Africans Hungry and Desperate

Food crisis spreads across continent, exacerbated by diminishing foreign aid, rising prices; 'There is nothing to harvest'

A woman fetched drinking water from a well near the a dry river near Gokwe, Zimbabwe, in May. *PHOTO: PHILIMON BULAWAYO/REUTERS*

By NICHOLAS BARIYO and PATRICK MCGROARTY

Updated Sept. 24, 2015 9:47 p.m. ET

The 2006 – 2010 drought turned 60% of Syria's fertile land into desert

…and drove 1.5 million people into Syria's already crowded cities

Syrian Refugees Fleeing Strife and Civil War Pass 4 Million Mark, According to UN

By EVAN SIMON • Jul 9, 2015, 11:28 AM ET

Source: http://abcnews.go.com/International/syrian-refugees-fleeing-strife-civil-war-pass-million/story?id=32327149

Lefteris Pitarakis/AP Photo

October 13, 2014

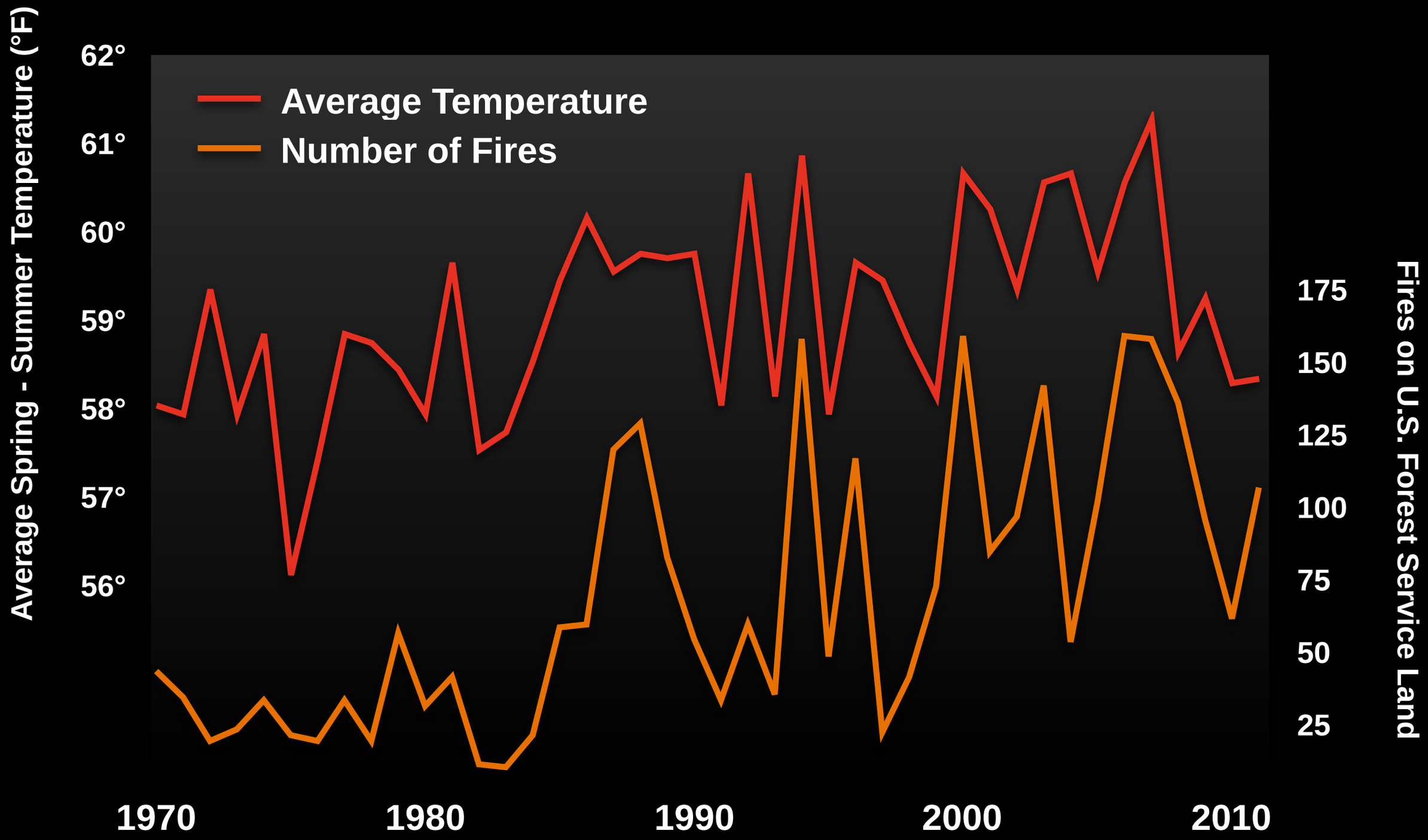
U.S. Department of Defense

2014 Climate Change Adaptation Roadmap

Climate change "will likely lead to food and water shortages, pandemic disease, disputes over refugees and resources, and destruction by natural disasters in regions across the globe."

Hotter Years Typically Have More Fires

40 Years of Western U.S. Fire and Temperatures

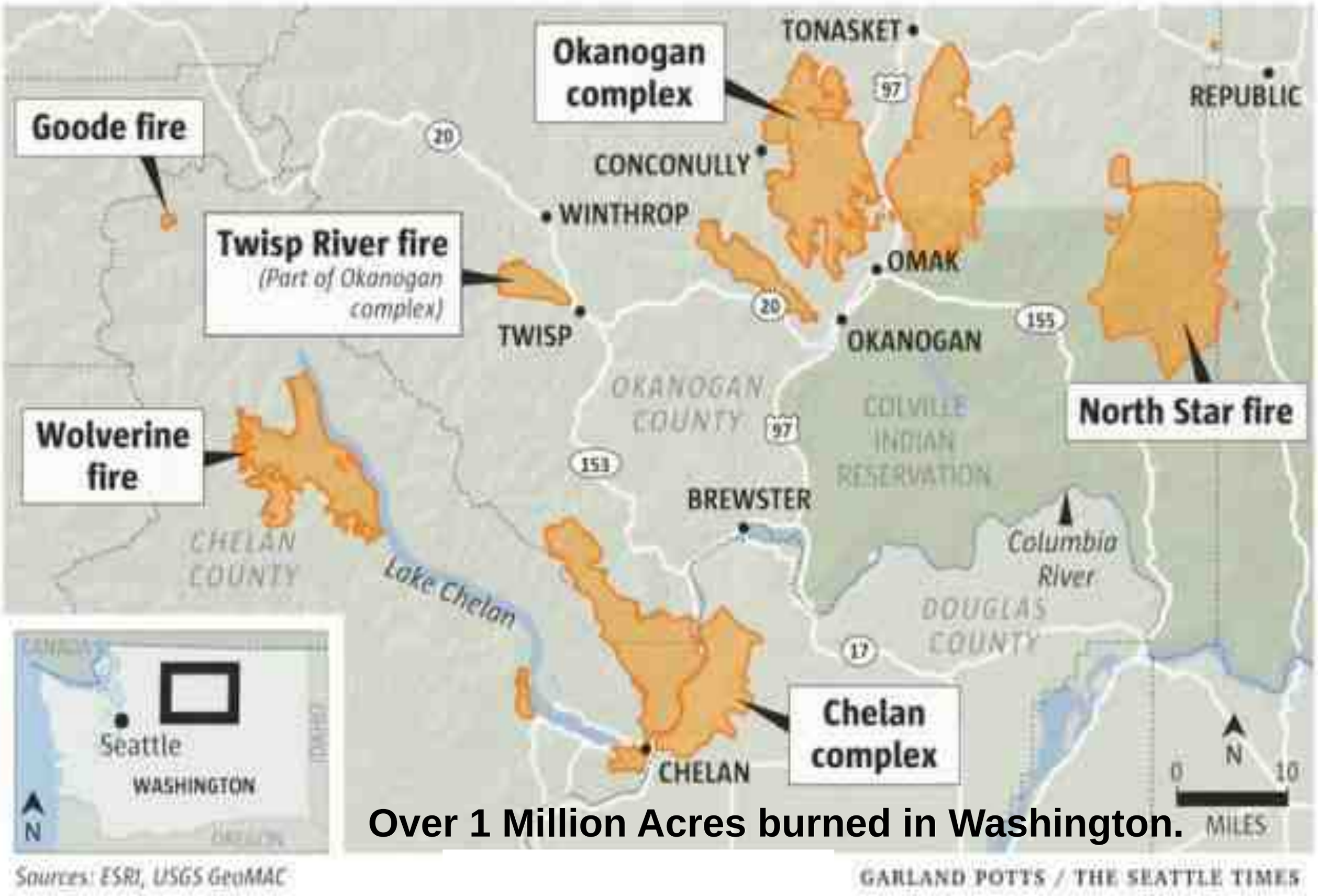


Data: Climate Central, "*The Age of Western Wildfires,*" Fig. 9., September, 2012

2014 Carleton Complex Fire

Was the Largest in Washington History

2015 brought even bigger fires!



Over 1 Million Acres burned in Washington.

Sources: ESRI, USGS GeoMAC

GARLAND POTTS / THE SEATTLE TIMES

“Thick blankets of smoke, carried by the prevailing winds and easily seen from outer space, covered large areas of the US, affecting not just those living immediately downwind, but causing breathing difficulties for people in many other states.”

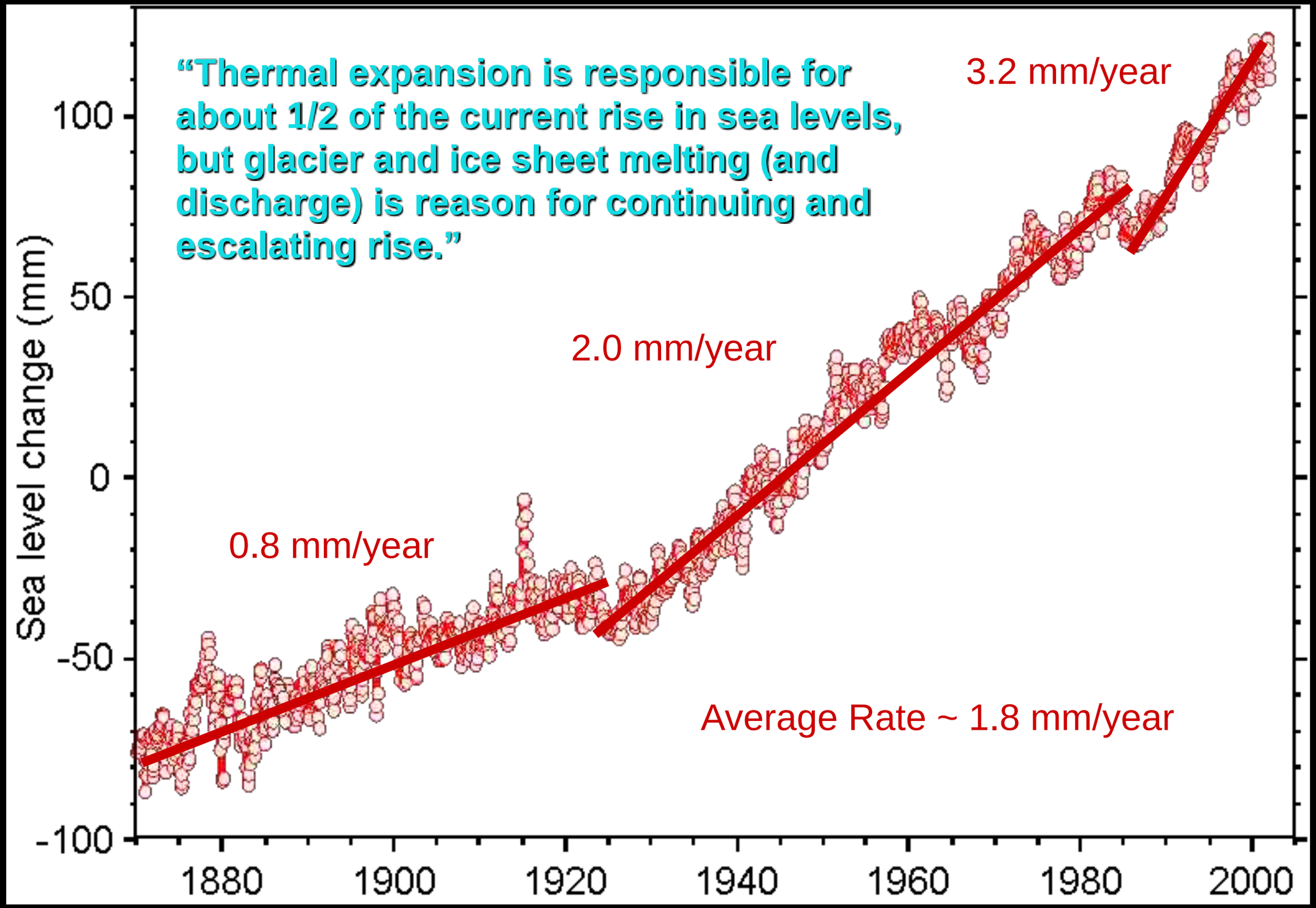
Warmer Temperatures are Speeding Ice Melting in the Arctic and Greenland

“The Arctic is warming even faster than the rest of the planet, exacerbating the melting of the Greenland ice sheet.”

In the Antarctic, in addition to melting, warmer seas undermine the ice sheet.

Source: NBC Learn and the National Science Foundation (NSF)

Sea Level Rise is Now Accelerating



Source: Church and White 2006, GRL 33:L01602
Courtesy R.S. Nerem

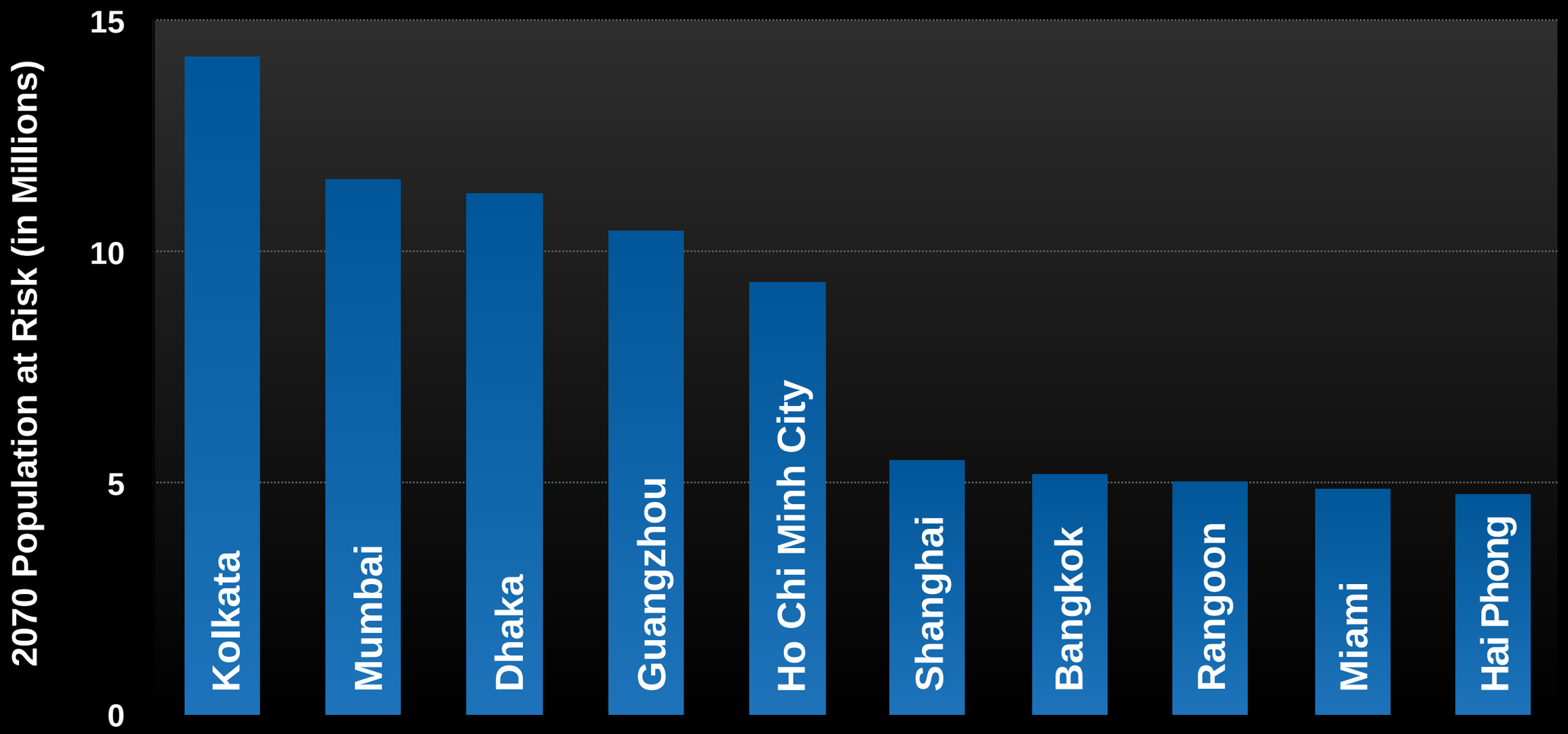
Consequences of Rising Sea Levels

Multi-Millions of People Endangered | $Trillions at Risk

- **Permanent inundation of low-lying coastal areas/ submerging of Pacific island nations.!**
- **Amplified storm surges with catastrophic damage to homes and infrastructure.!**
- **Shoreline erosion and degradation.!**
- **Saltwater intrusion into coastal groundwater sources.!**
- **Increased salinity of farmlands.**

Top 10 Cities at Risk from Sea Level Rise in 2070

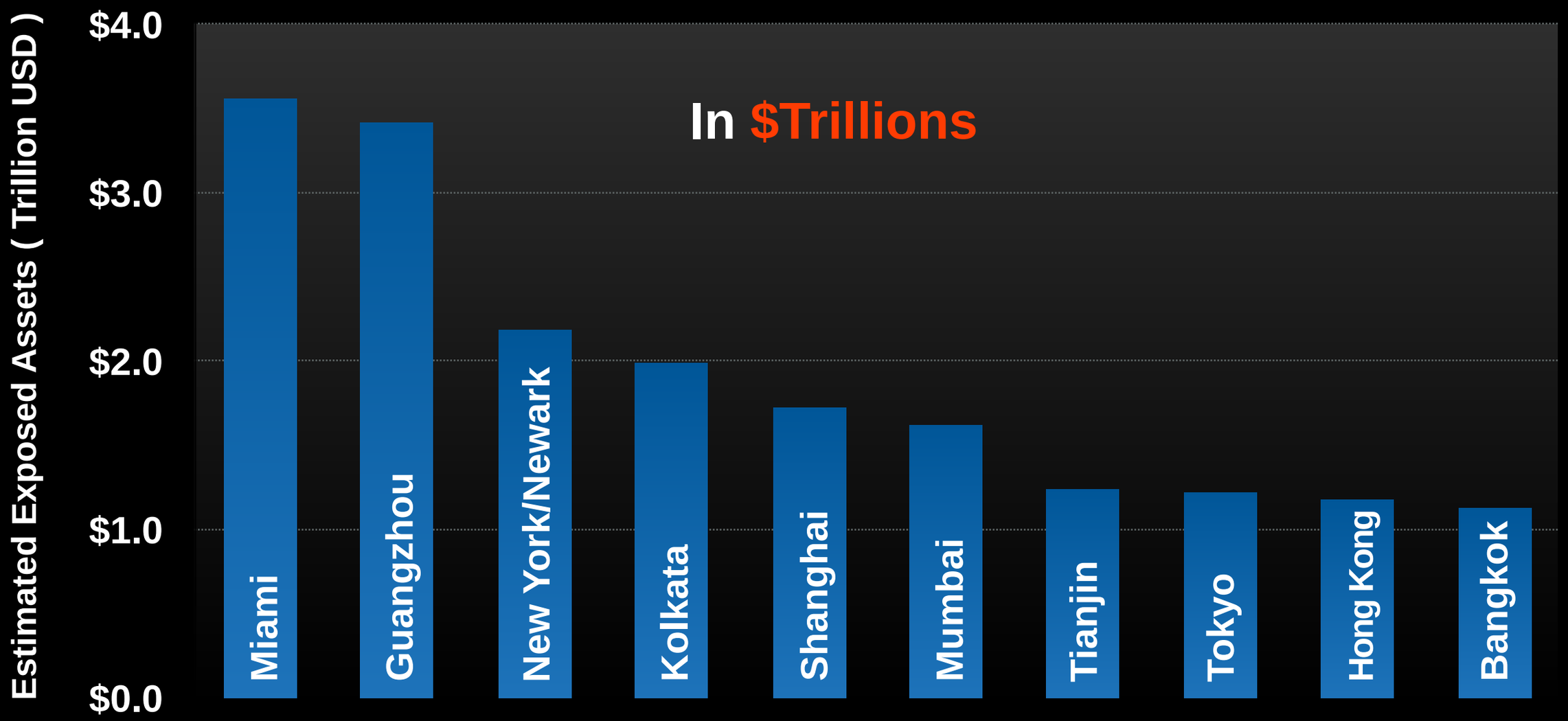
By Population at Risk



Data: Nichols, et al., 2007, OECD

Top 10 Cities at Risk from Sea Level Rise in 2070

By Assets at Risk



Data: Nichols, et al., 2007, OECD

Climate change + Add to myFT

Warming oceans make parts of world 'uninsurable', say insurers

Insurers say warming oceans threaten cost of protection

JUNE 24, 2013 by: Alistair Gray and Pilita Clark in London

Insurers have issued a rare warning that the speed at which the oceans are warming is threatening their ability to sell affordable policies in a growing number of places around the world.

Parts of the UK and the US state of Florida were already facing "a risk environment that is uninsurable", said the global insurance industry trade body, the Geneva Association.

Source: Falk Niehörster, et al, Warming of the Oceans and Implications for the (Re)insurance Industry (June 2013). https://www.genevaassociation.org/media/616661/GA2013-Warming_of_the_Oceans.pdf

Methane Melt Pools

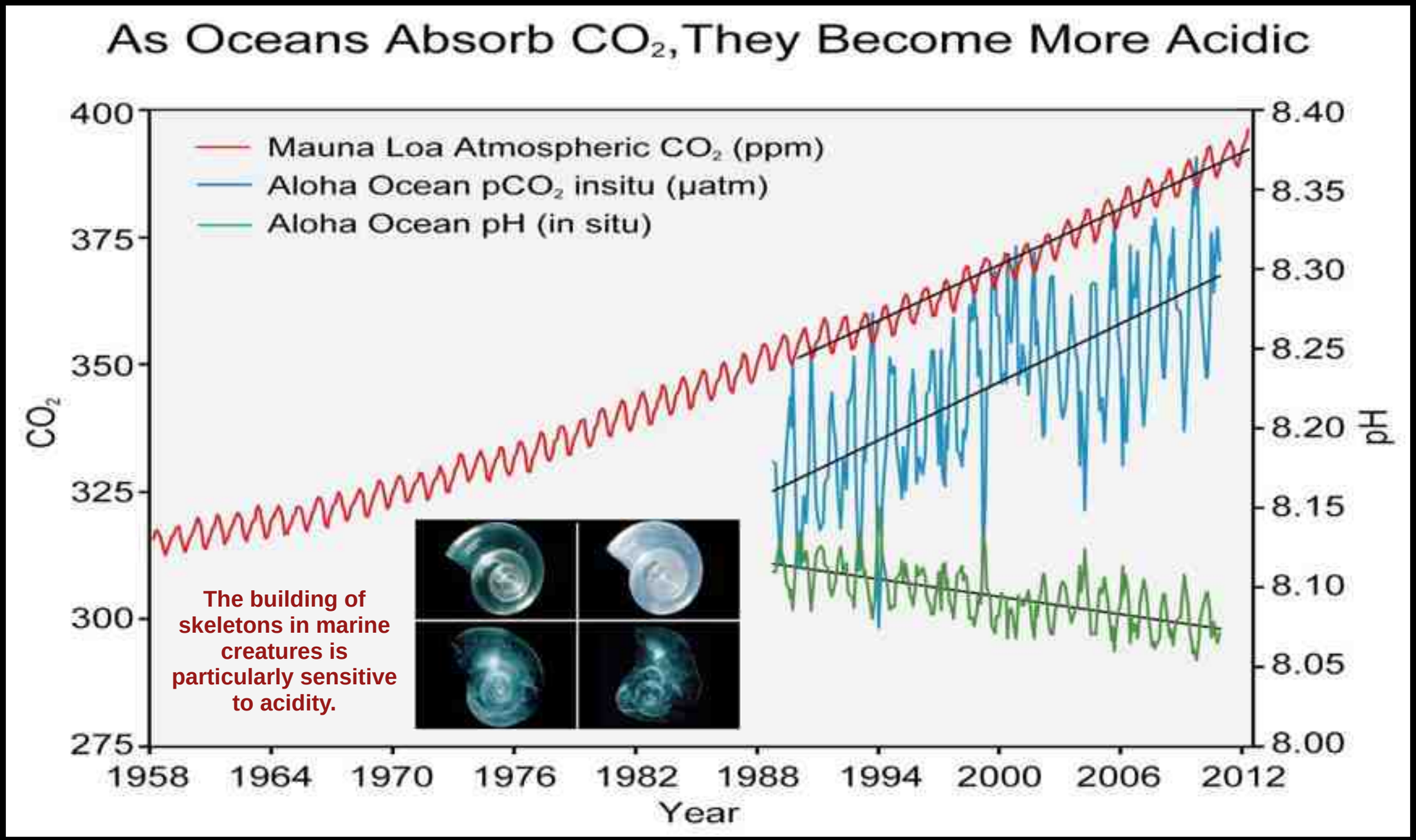
South-Central Alaska

As permafrost thaws, geologic seeps in Alaska may release 250,000 metric tons of methane to the atmosphere each year

Source: *Alaska Dispatch*, May 22, 2012
Photo: © 2010 Marie Laure Geai

Growing Ocean Acidification

More CO_2 in Air Means More CO_2 in Oceans



Source:Modified after R.A. Feely, Bulletin of the American Meteorological Society, July 2008.

Impacts of Climate Change on Human Health

Developing World is Most Vulnerable

Rank	Country	Category
1	Haiti	extreme
2	Bangladesh	extreme
3	Zimbabwe	extreme
4	Sierra Leone	extreme
5	Madagascar	extreme
6	Cambodia	extreme
7	Mozambique	extreme
8	DR Congo	extreme
9	Malawi	extreme
10	Philippines	extreme

“The burdens of climate change are not felt equally — those already most impacted will be hit even harder as climate change worsens.”

“Even is U.S., the poor, communities of color, and children are more vulnerable.”

Some of the largest disease burdens are climate-sensitive

- **Already each year:**
  - Undernutrition kills 3.5 million.
  - Diarrhoea kills 2.2 million.
  - Malaria kills 900,000.
  - Extreme weather events kill 60,000.

WHO estimates that the climate change that has occurred since the 1970s already kills over 140,000 per year from these causes.

5th IPCC: In the near term, most effective measures to reduce vulnerability…

Programs that implement and improve basic public health such as:

- Providing clean water and sanitation.
- Providing secure, essential health care including vaccination & child health services.
- Increasing capacity for disaster preparedness & response.
- Alleviating poverty.

Source: IPCC, Fifth Assessment Report, Synthesis Report, Topic 4, Adaptation and Mitigation, 2014, http://ar5-syr.ipcc.ch/topic_adaptation.php

WHO: five major health impacts of climate change

1. Malnutrition, Famine and Starvation
2. Deaths and injuries caused by storms and floods. (Flooding can also be followed by outbreaks of diseases, such as cholera)
3. Water scarcity / contamination (droughts and sudden floods — increased burden of diarrhoeal disease).
4. Heatwaves – direct increases in morbidity and mortality; indirect effects via increases in ground-level ozone & hastening of onset of pollen season, contributing to asthma attacks.
5. Vector-borne disease – malaria and dengue.

Malnutrition, Famine & Starvation

- **Rising temperatures, more frequent droughts & floods affect crop productivity.**
  - **For every day during growing season temperatures go above 29°C (84° F), corn yields decline by 0.7% (rice, wheat & soy also decline in high heat).**
- **High CO_2 levels decrease protein production in important food crops.**
- **Rising seas cover fields, salinity ruins soil.**

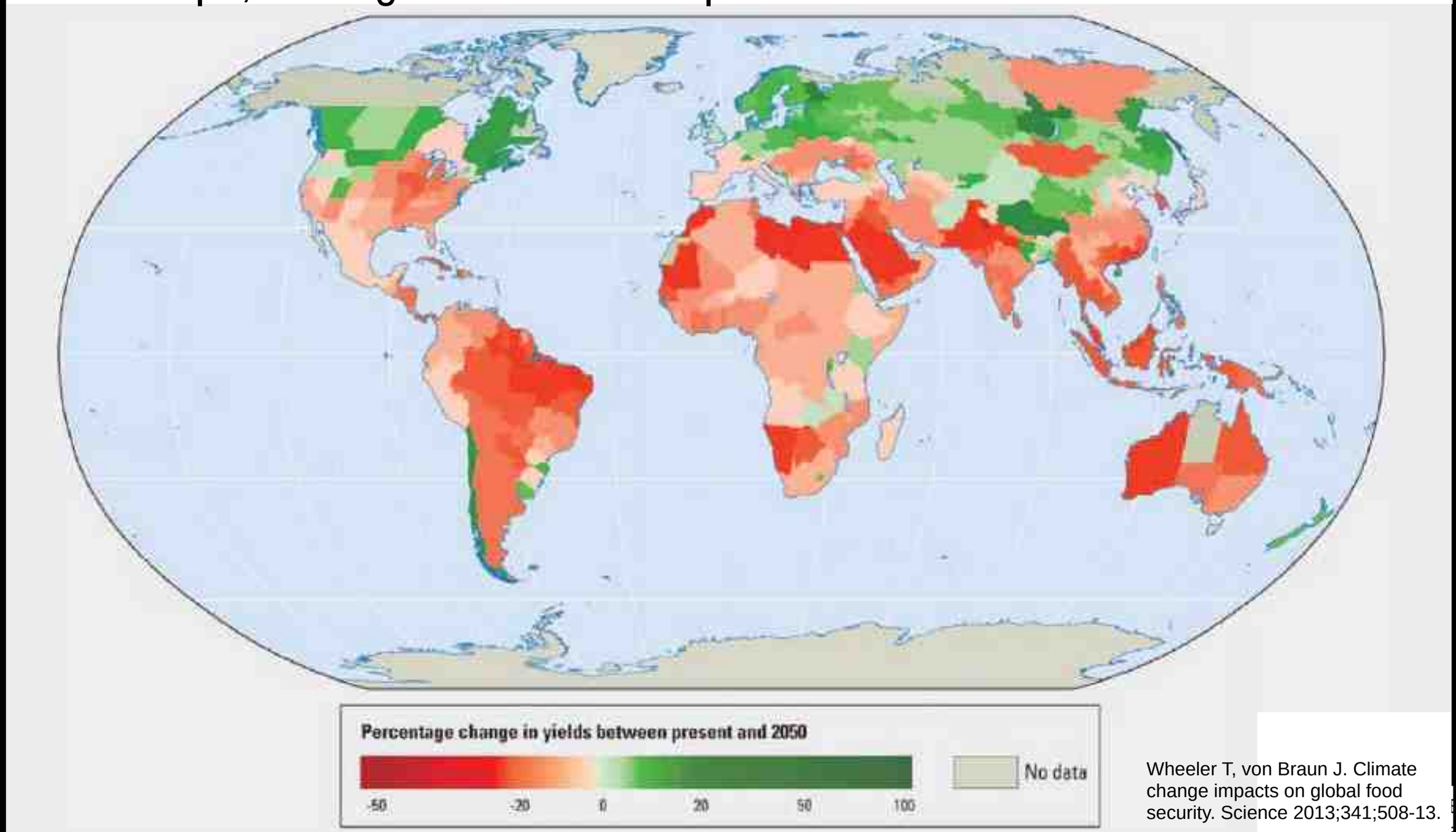
Sources: Global Change Biology (2008) 14, 565-575, doi: 10-1111/j.1365-2486.2007.01511.

W. Schlenker, M. J. Roberts, "Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change," *Proc. Natl. Acad. Sci. USA*, 10.1073 August 29, 2009.

Malnutrition, Famine & Starvation

Projected Crop Yields, 2050

11 crops, averaged across multiple emission scenarios and GCMs.

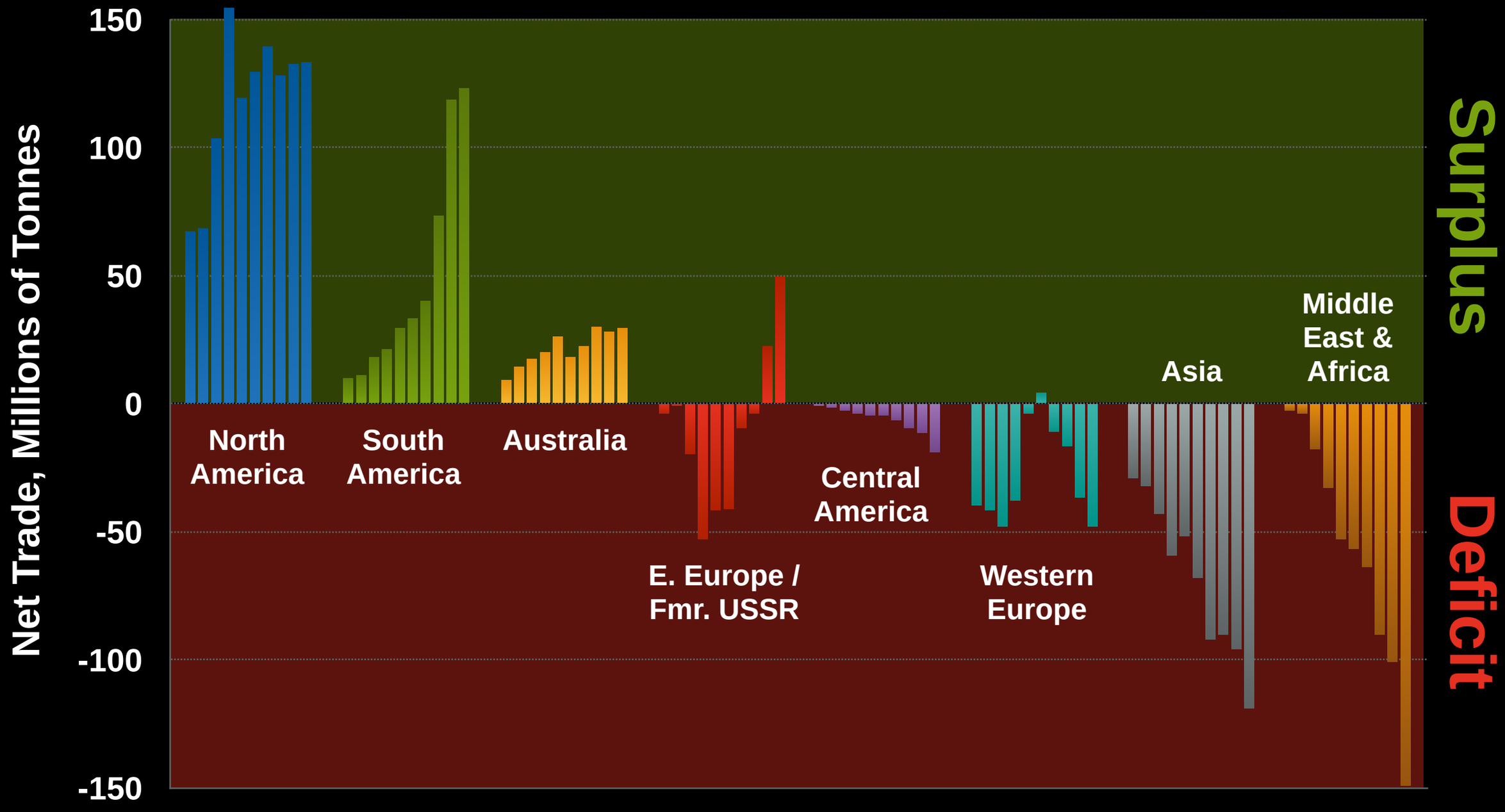


Wheeler T, von Braun J. Climate change impacts on global food security. Science 2013;341;508-13.

Malnutrition, Famine & Starvation

Big Food Disparities Already Exist

1965 – 2010



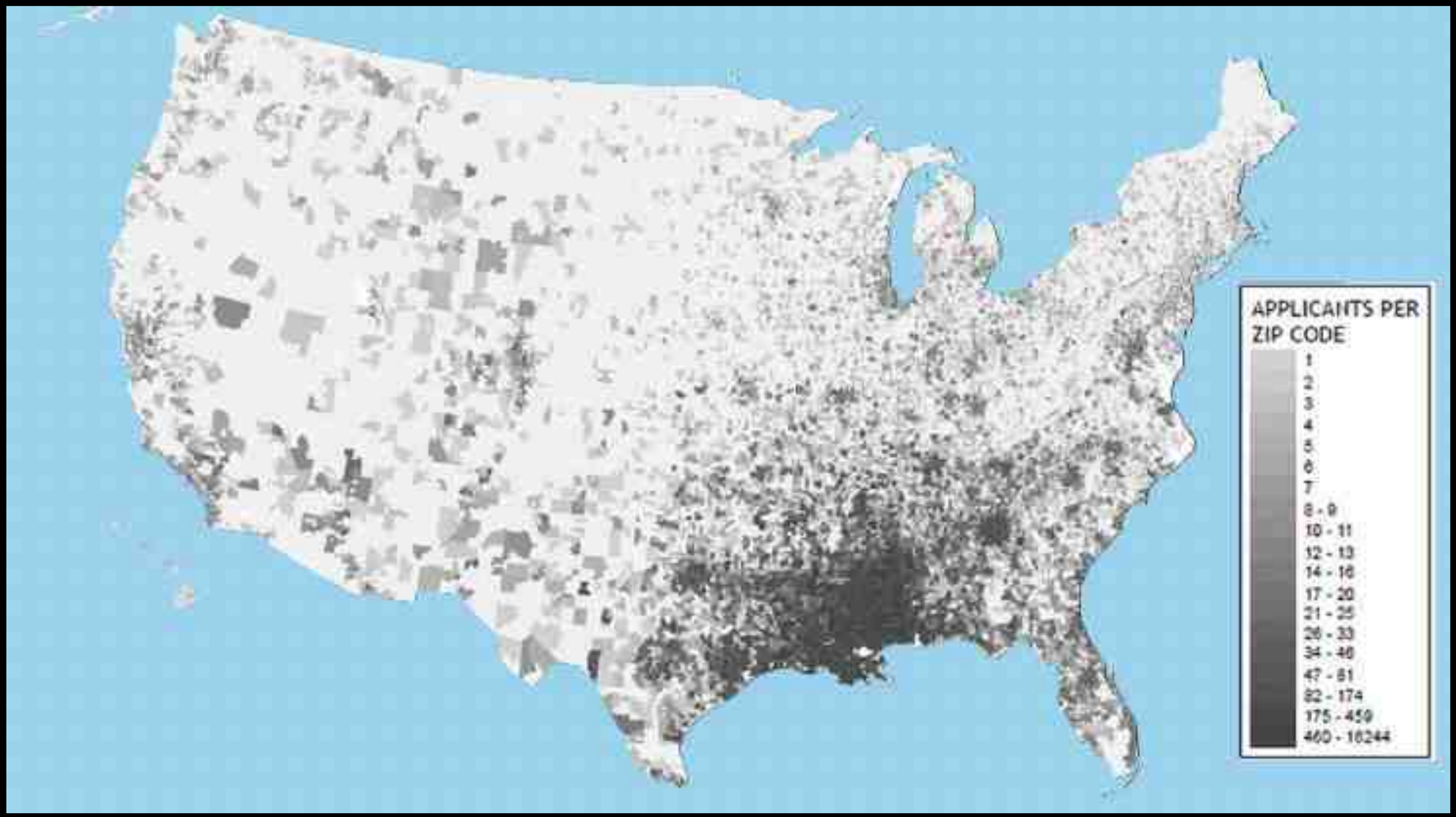
Severe Weather

More Extreme Weather Events

- **Storms, floods, drought, & fires directly cause widespread trauma, drowning, burns, & death.**
- **Extreme events increase the probability of “complex emergencies” where multiple system failures can occur which can exceed response capacity.**

Severe Weather

Katrina Diaspora



Water-Borne Infections

Increased Burden of Diarrheal Diseases

- **Flooding & heavy rains overflow sewage plants and spread “open” fecal waste — causing contamination of drinking water.**
- **Relationship between an increase in sea-surface temperature and the onset of cholera epidemics.**

Diarrheal disease is already the second leading infectious cause of childhood mortality, accounting for approximately 1.8 million deaths each year.

Water-Borne Diseases

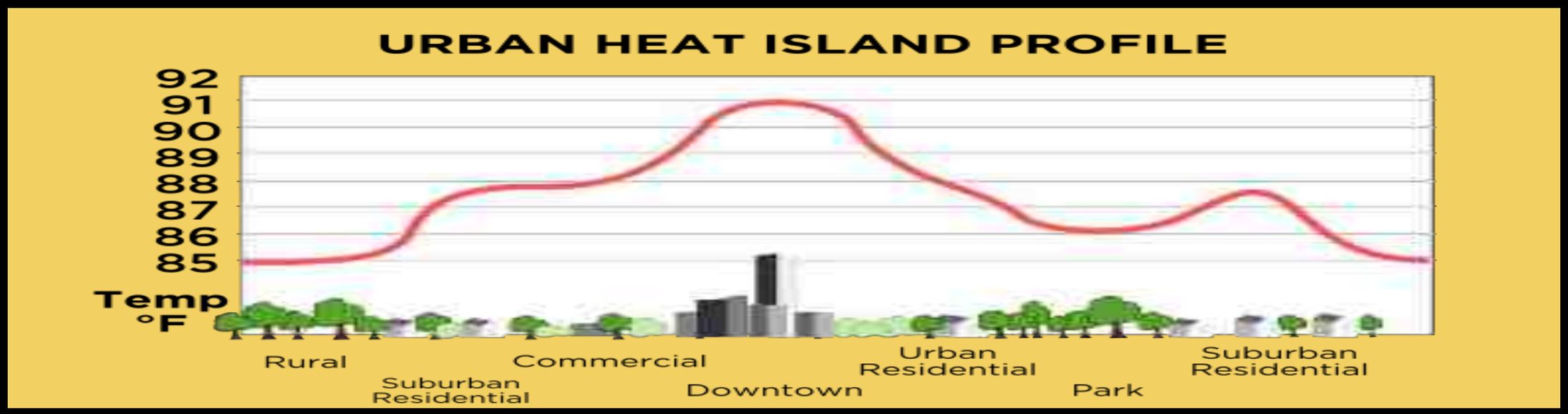
Even is U.S., 67% of waterborne disease outbreaks were preceded by precipitation above 80th percentile (across 50 year climate record). Great Lakes an area of particular concern.

Milwaukee 1993

- **Cryptosporidiosis epidemic, 405,000 cases, 54 deaths**
- **Preceded by heaviest rainfall in 50 years.** (Curriero et al., 2001)
- **$31.7 million in medical costs, $64.6 million in lost productivity.** (Corso et al., 2003)

Extreme Heat

The increased frequency, duration, and magnitude of extreme heat events — and increasing urban populations — may lead to a rise in heat-related deaths and illness.



Greatest impact: elderly, the chronically ill, young children, economically disadvantaged, outdoor workers.

Extreme Heat

Direct impacts to health:

- **Heat cramps –** muscular pains and spasms, occur with strenuous activity in the presence of heat.
- **Heat exhaustion –** intense thirst, heavy sweating, weak, pale, headache, nausea/vomiting, dizziness/ fainting, fatigue. Core temp normal or slightly elevated. Skin moist/cool.
- **Heat stroke –** is life threatening. Core body temperature of 105°F+, hot/dry skin. Delirium > convulsions > coma >death.

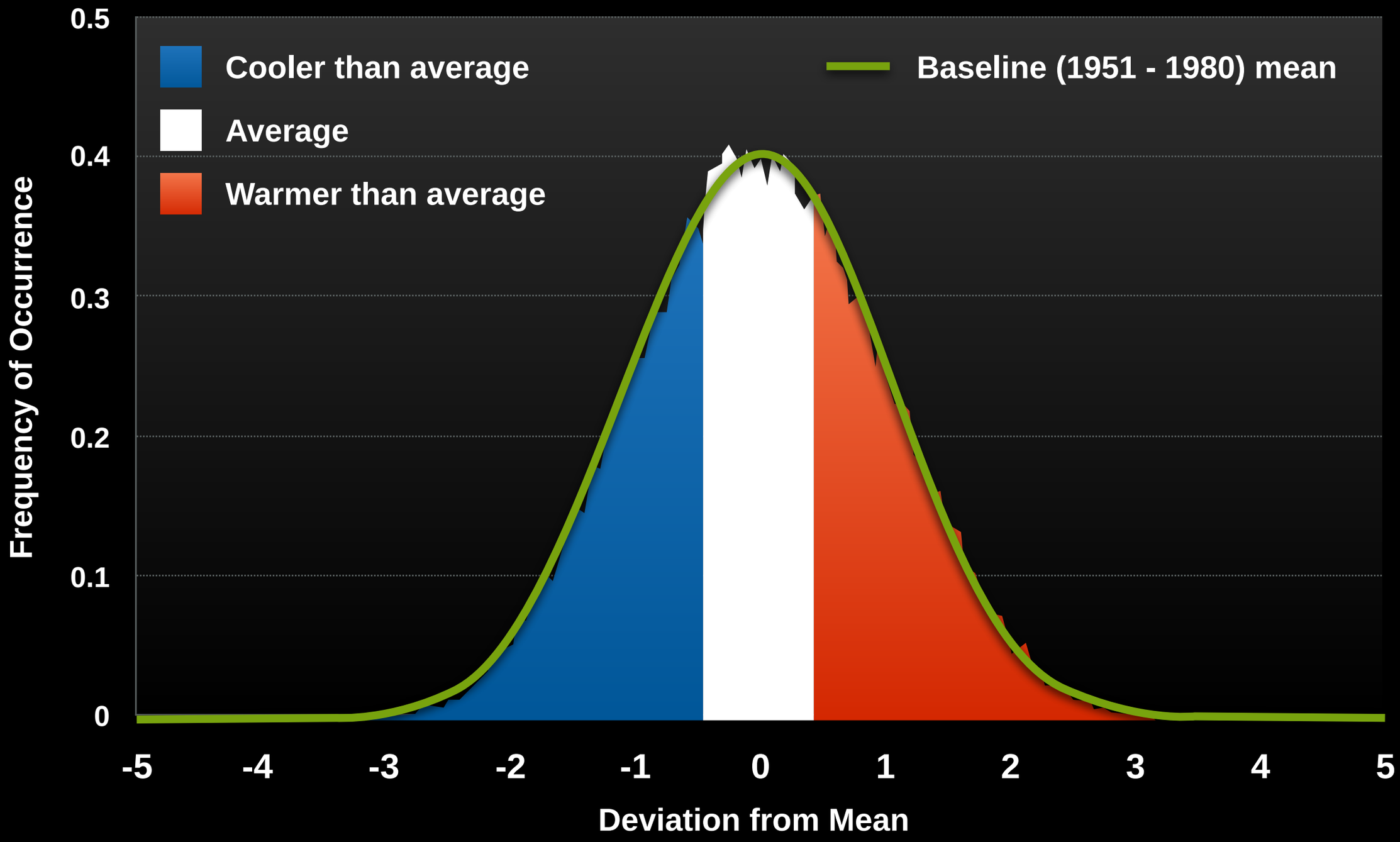
- **Greatest impact:** elderly, the chronically ill, young children, economically disadvantaged, outdoor workers.

Extreme Heat

Extreme Heat incident	Deaths
Philadelphia heat wave, 1993	**118**
Chicago heat wave, 1995	**739**
California heat wave, 2006	**650**
Russian heat wave, 2010	**11,000-50,000**
India heat wave, 2015	**2,330**

Summer Temperatures Have Shifted

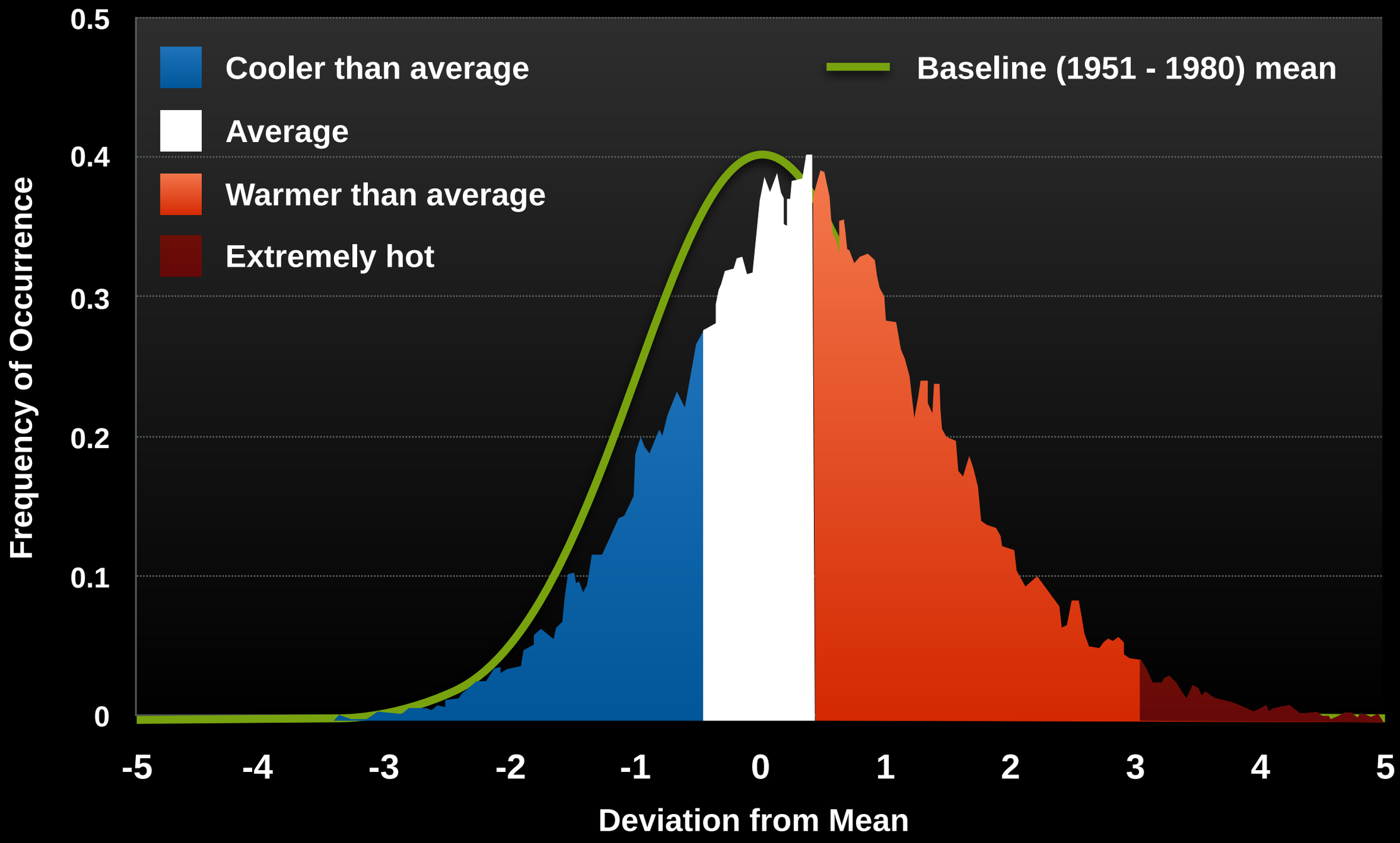
1951 – 1980



Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," *Proc. Natl. Acad. Sci. USA* 10.1073, August 2012

Summer Temperatures Have Shifted

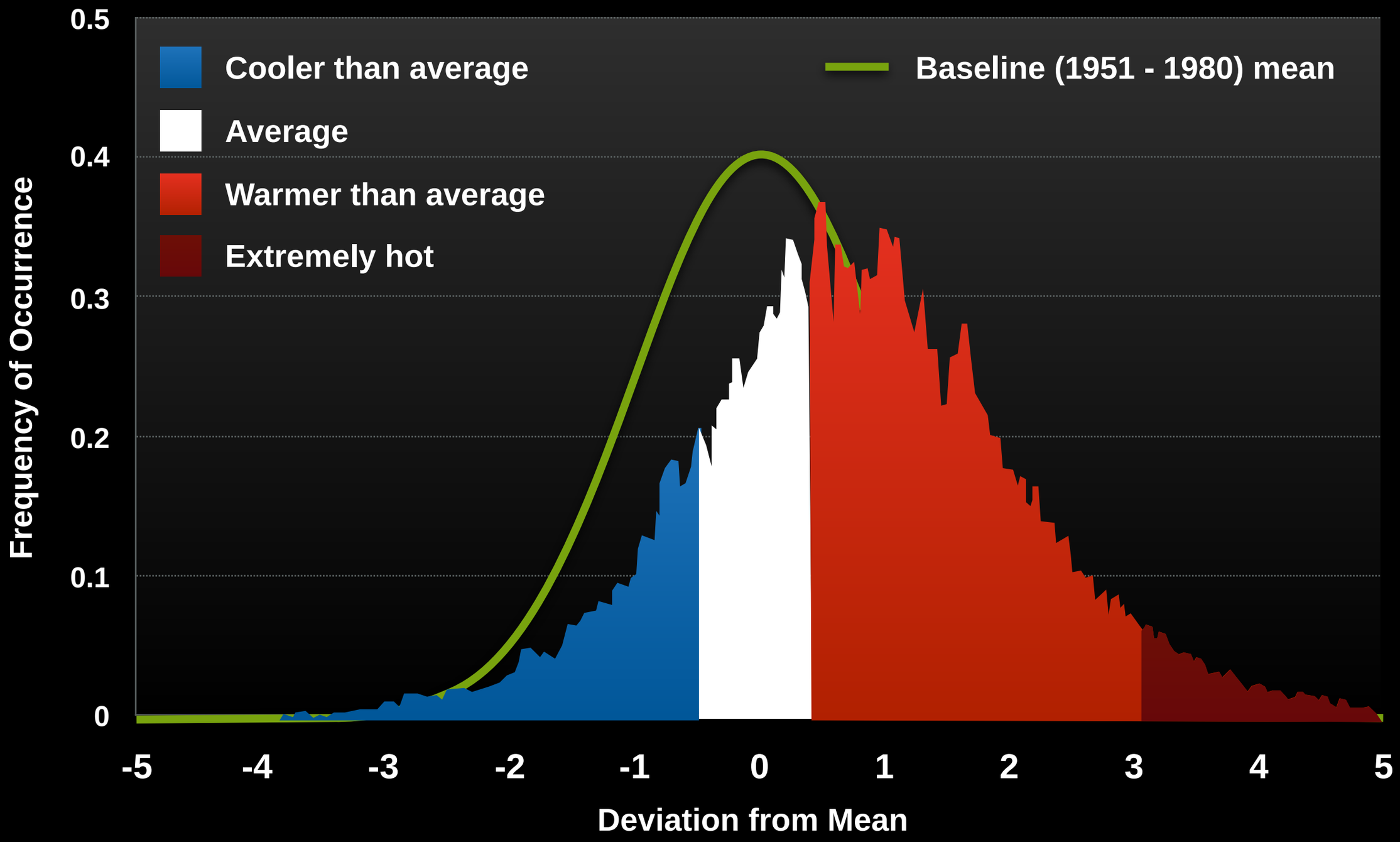
1981 – 1991



Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," *Proc. Natl. Acad. Sci. USA* 10.1073, August 2012

Summer Temperatures Have Shifted

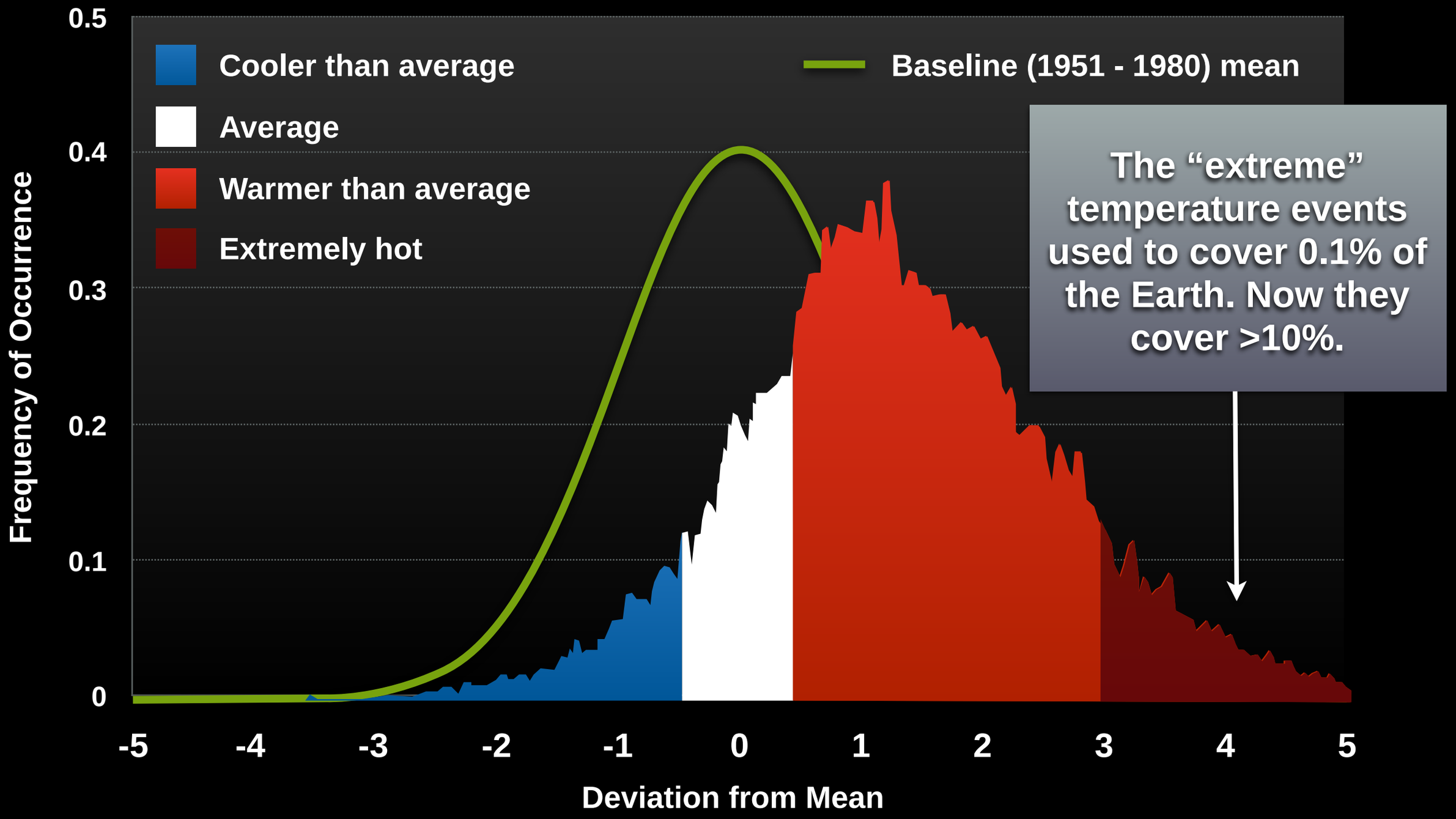
1991 – 2001



Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," *Proc. Natl. Acad. Sci. USA* 10.1073, August 2012

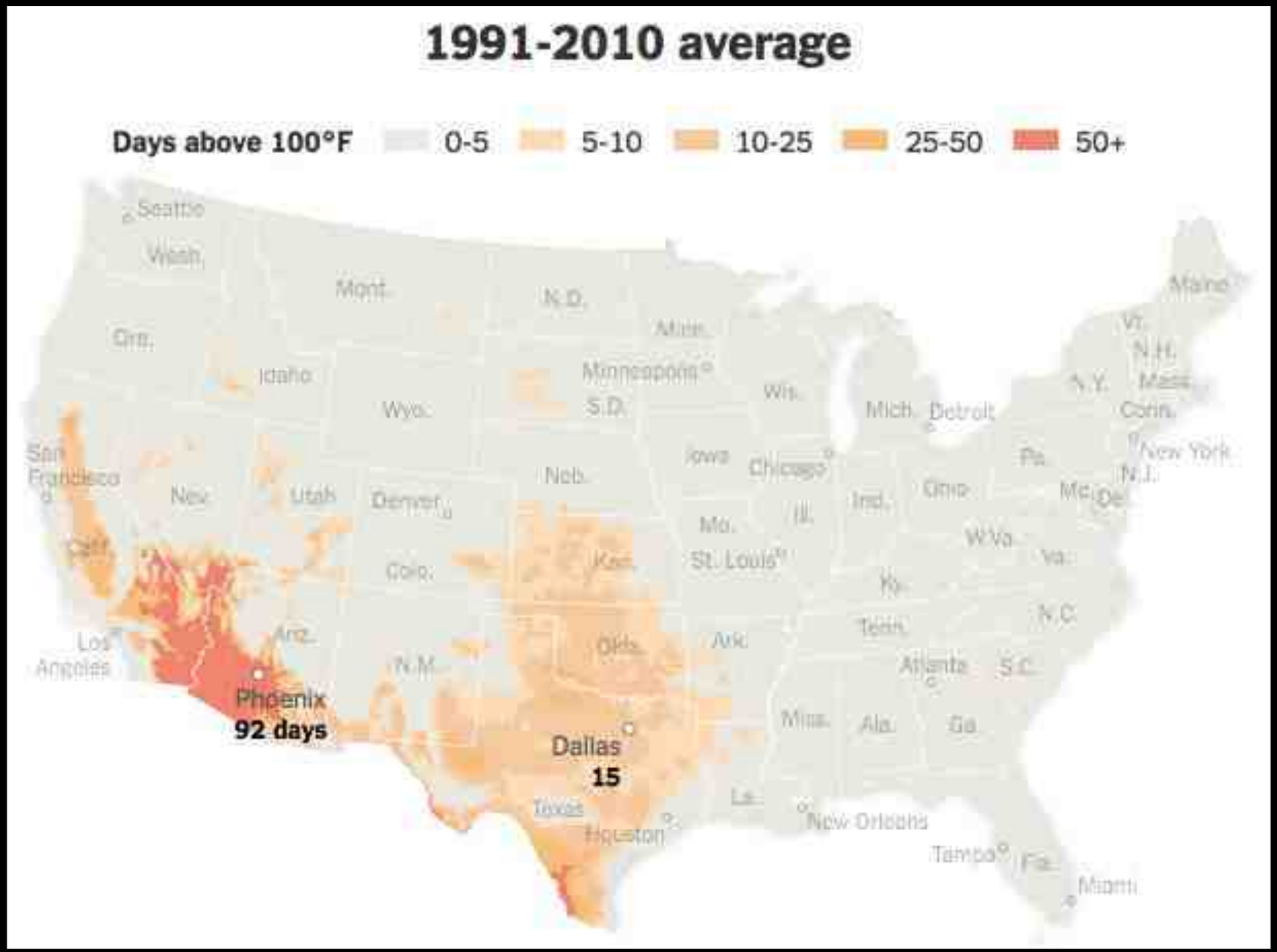
Summer Temperatures Have Shifted

2001 – 2011



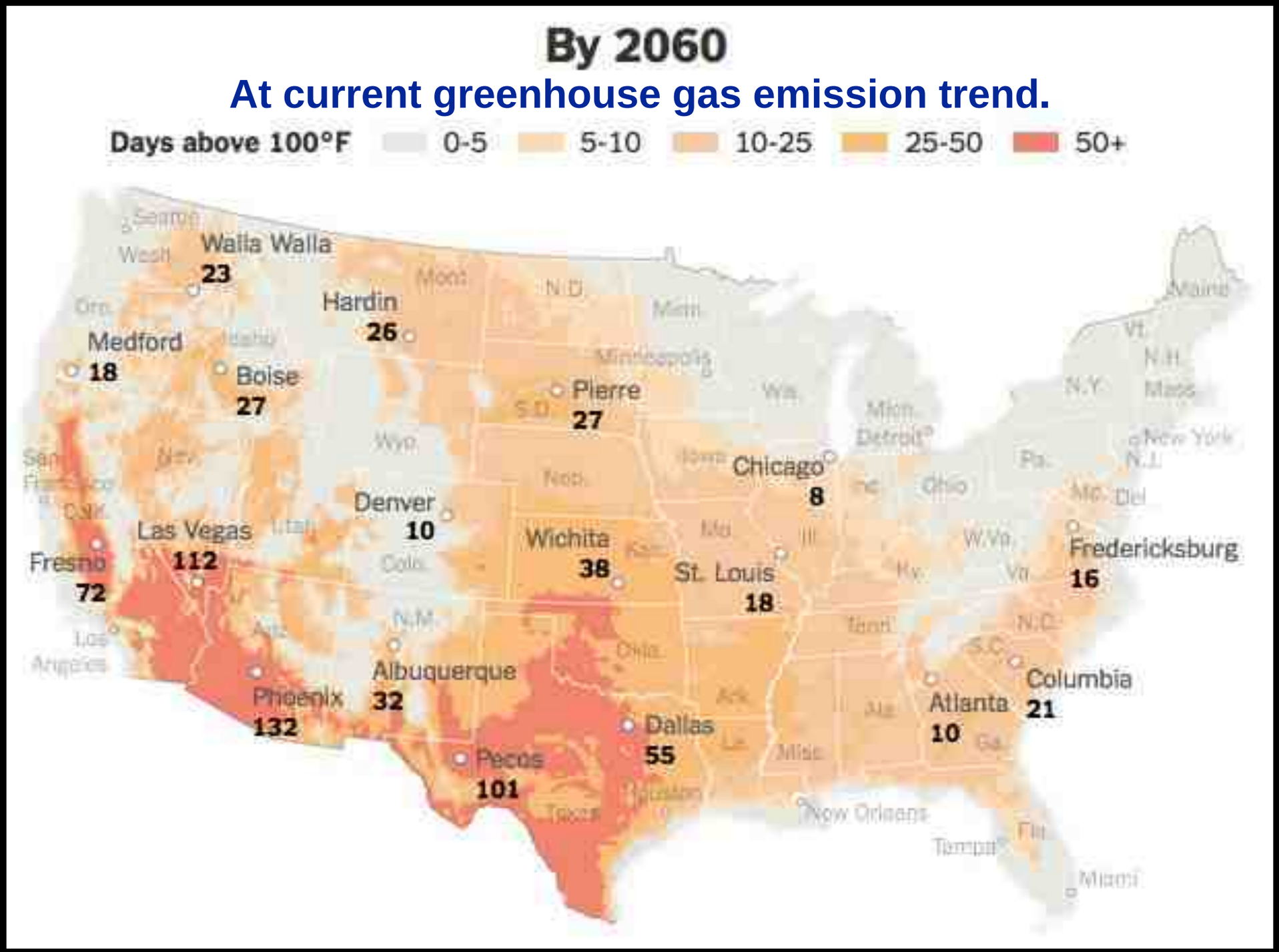
Source: NASA/GISS; Hansen, et al., “Perceptions of Climate Change,” *Proc. Natl. Acad. Sci. USA* 10.1073, August 2012

A glimpse of our future (in next 3 slides) if nothing is done to slow climate change.



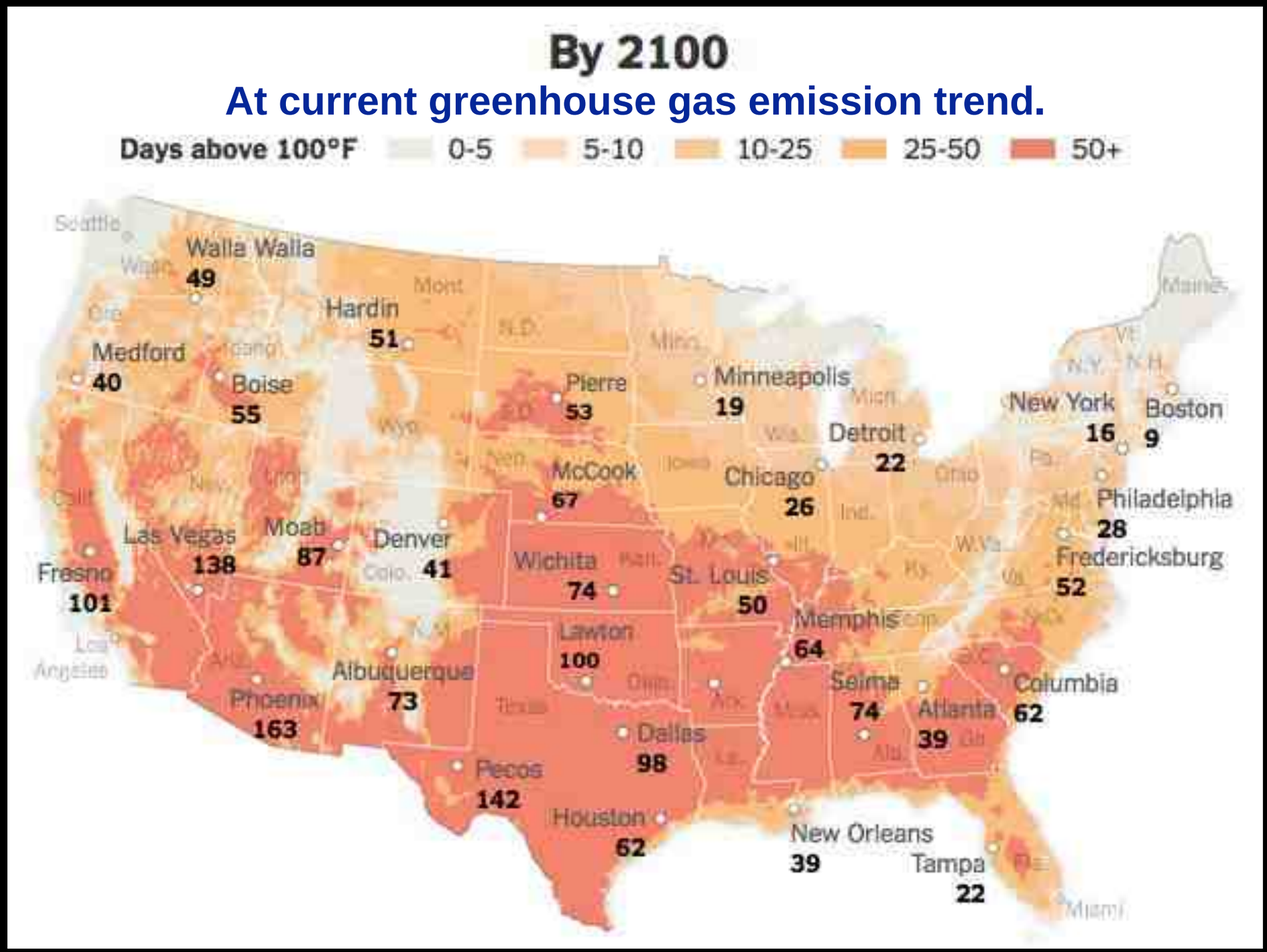
Daily maximum values for the average of the years 1991 to 2010 are based on meteorological data compiled by Ed Maurer at Santa Clara University.
http://www.engr.scu.edu/~emaurer/data.shtml

A glimpse of our future if nothing is done to slow climate change.



These calculations by Climate Central are based on projections by the World Climate Research Programme that assume that greenhouse gas emission trends will continue unabated through 2100.http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

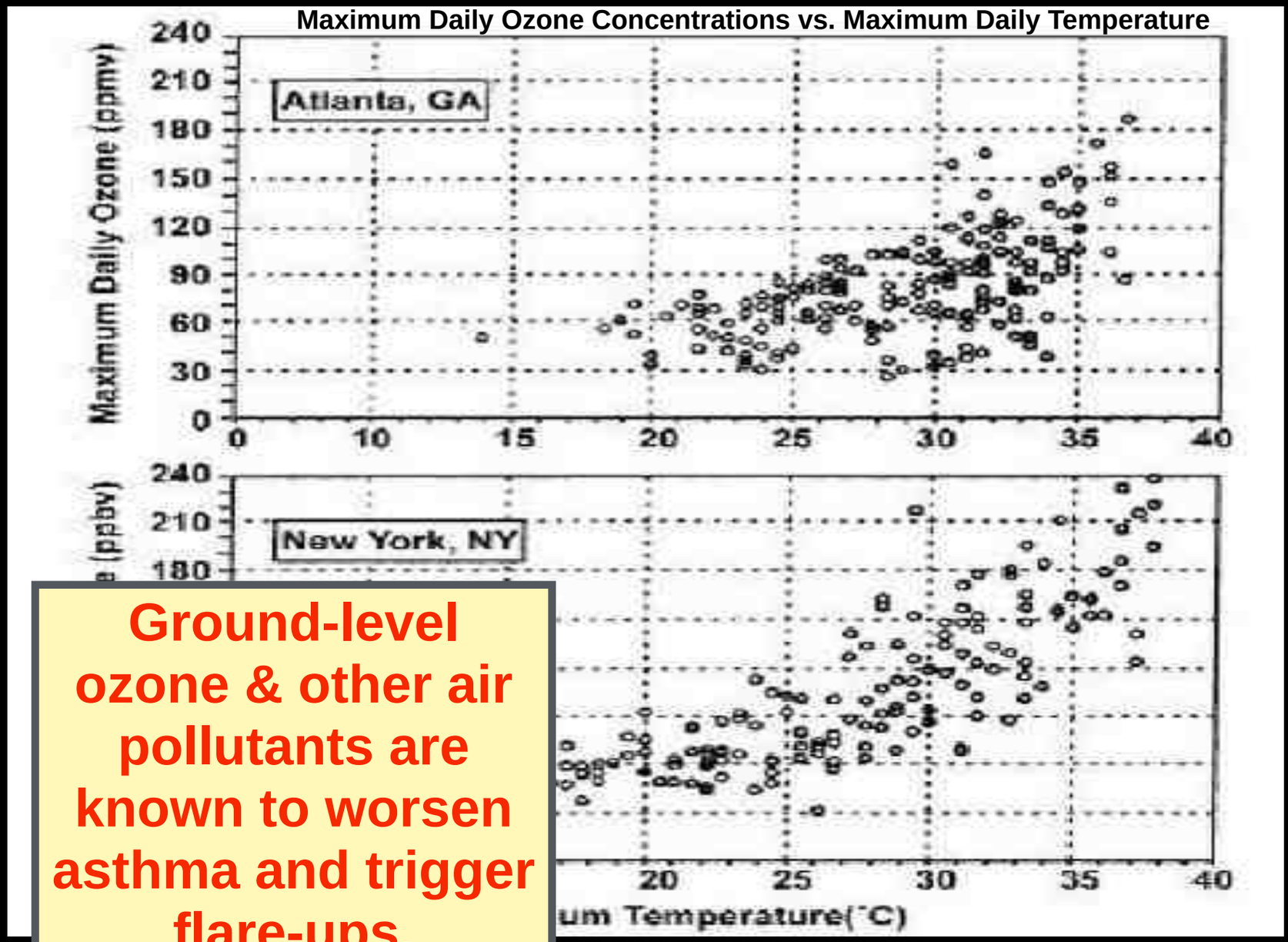
A glimpse of our future
if nothing is done to slow climate change.



Extreme Heat

Heat impacts on ground level ozone

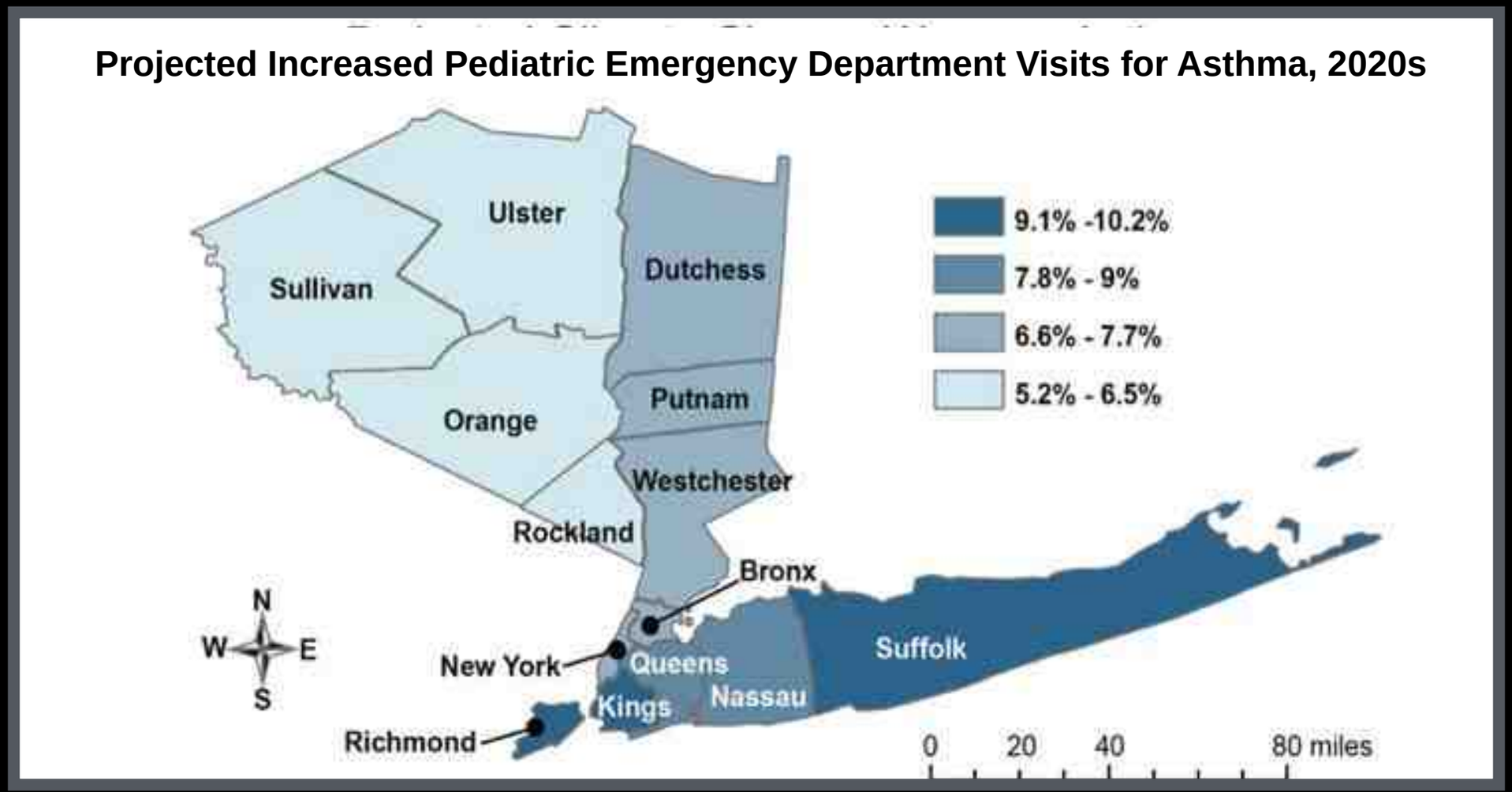
Ground level ozone is produced when sunlight reacts with emissions released into the air by cars, power plants, and factories.



Ground-level ozone & other air pollutants are known to worsen asthma and trigger flare-ups.

Extreme Heat

Ground-level ozone & other air pollutants can trigger worsening symptoms and asthma flare-ups.



Source: Sheffield PE, Knowlton K, Carr JL, Kinney PL. 2011. Modeling of Regional Climate Change Effects on Ground-Level Ozone and Childhood Asthma. American Journal of Preventive Medicine 41(3):251-257

Vector-Borne Diseases

- **Changing temperatures and patterns of rainfall are expected to alter the geographical distribution of insects that spread infectious diseases.**
- **Of these diseases, malaria and dengue (and now zika) are of greatest public health concern.**

Tropical Diseases on the Move

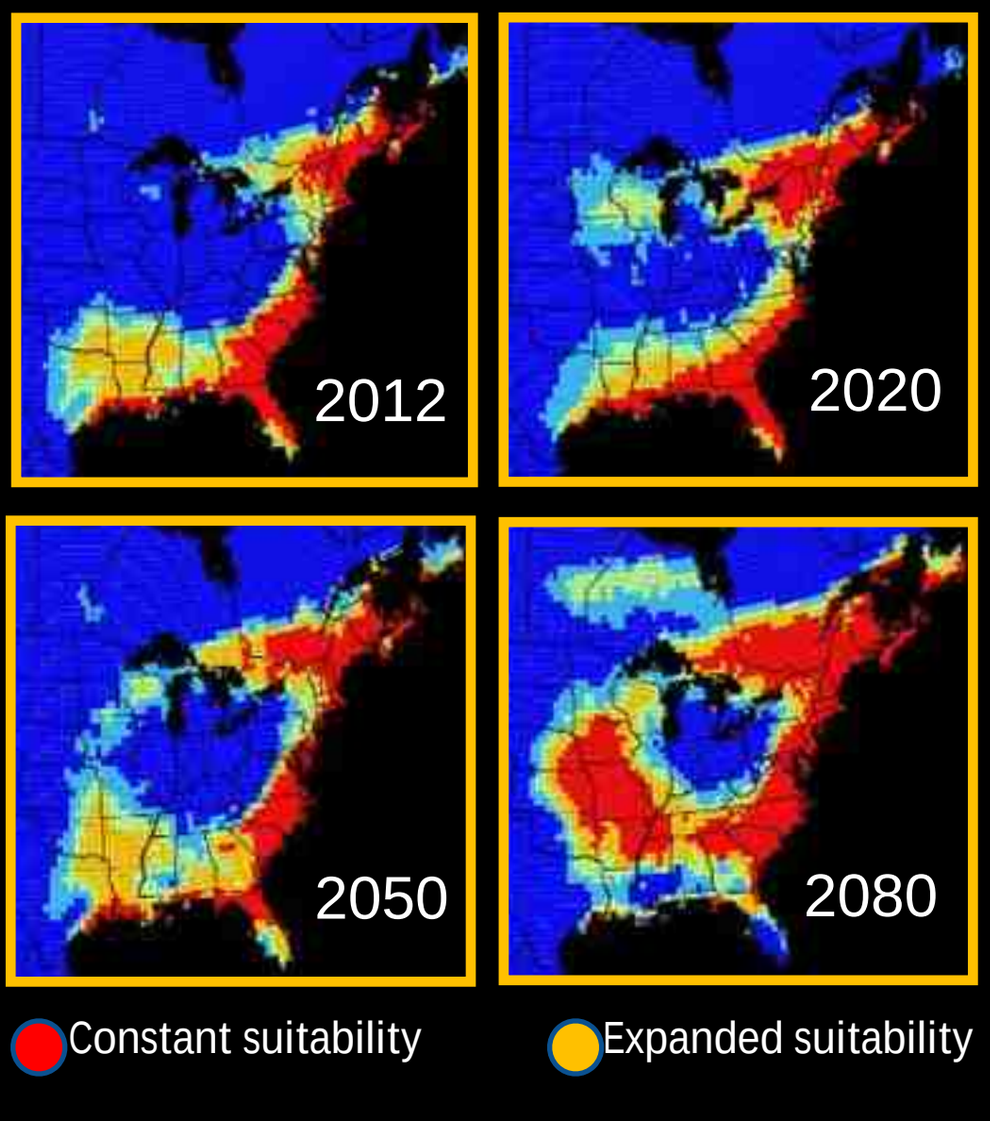
*The exact point of origin of many diseases is uncertain

Vector-Borne Diseases

Precipitation, Humidity, and Temperature Changes Impact Range of Lyme Disease

Factors in spread of Lyme disease:

- Climate
- Ecological
- Social



Range of suitable conditions for Ixodes scapularis, the Lyme disease tick

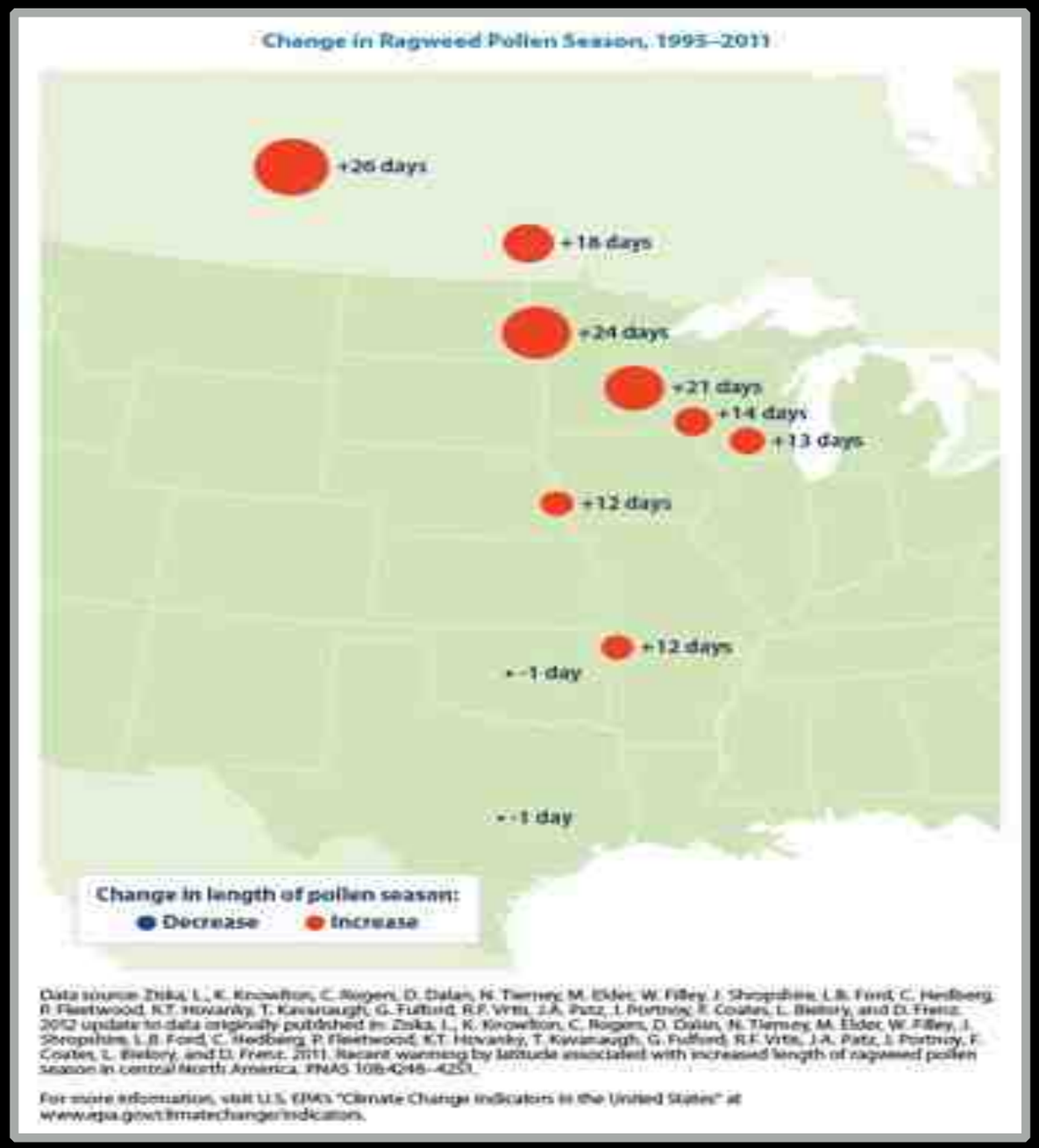
Source: Brownstein JS, Holford TR, Fish D. A climate-based model predicts the spatial distribution of the Lyme Disease vector Ixodes scapularis in the United States. Environ Health Persp 2003;111(9):1152-57.

Allergies

Warming is increasing pollen exposure

- **Ragweed pollen seasons are starting earlier & lengthening in the northern latitudes**
  (Ziska et al., 2012)

- **Pollen production increases as CO_2 levels rise**
  (Ziska, U.S. Dept. of Agriculture)



Allergies

Pollen and Health

- **Outdoor allergenic pollen and mold are the primary cause for allergic rhinitis or hay fever.** (Grammer, Greenberger, 2009).

- **Annual treatment costs for allergic rhinitis are $11.2B (Blaiss, 2010) ; annual economic costs $5.4B.** (Kessler et al., 2001)

- **As pollen count increases, allergy-related illnesses also increase.** (Heguy et al. 2008, Darrow et al., 2011)

Allergies

Poison ivy is growing bigger and badder

- With rising levels of CO_2, poison ivy grows more vigorously and with bigger leaves.
- It also produces a larger quantity and a more toxic form of the rash-inducing compound urushiol.

John Kaprielian/Science Source

Source: L. H. Ziska, R. C. Sicher, K. George, and J. E. Mohan Rising Atmospheric Carbon Dioxide and Potential Impacts on the Growth and Toxicity of Poison Ivy (Toxicodendron Radicans). *Weed Science,* Jul 2007 / pg(s) 288-292.

Mental Health

Anxiety, Post-traumatic Stress, Depression, Despair

Last Updated: Tuesday November 14 2006 11:15 GMT

E-mail this to a friend Printable version

Climate change is kids' top fear

How we're damaging the environment is more of worry to you than getting a girl or boyfriend, say survey.

The results showed three quarters of 11 to 14-year-olds worry about climate change, compared to 41% who are worried about going out with someone.

And it looks like you lot aren't just all talk - 63% turn off the lights when you leave a room, 82% of you recycle, and 75% say we should recycle more.

The survey quizzed 1,554 kids on their views on the

Mental Health Problems From Katrina Persist

By Dorie Turner
Associated Press
Thursday, November 9, 2006; Page A12

ATLANTA, Nov. 8 -- Hurricane Katrina left more than gutted houses and empty streets along the Gulf Coast.

The most devastating impact of the storm, which killed thousands of people and destroyed entire towns, can be seen in the desperate faces of people more than a year later, survivors and rescue workers said in a panel discussion Wednesday

---

Clinical Psychiatry News

Katrina Survivors' Psychiatric Needs Unpredictable

'Cascade of disasters' magnifies trauma.

Climate change takes a mental toll

The Boston Globe

By Emily Anthes
Globe Correspondent / February 9, 2009

Email | Print | Single Page | Yahoo! Buzz | ShareThis Text size

Last year, an anxious, depressed 17-year-old boy was admitted to the psychiatric unit at the Royal Children's Hospital in Melbourne. He was refusing to drink water. Worried about drought related to climate change, the young man was convinced that if he drank, millions of people would die. The

Air Pollution

The Seattle Times
Winner of Nine Pulitzer Prizes

Opinion

By Howard Frumkin, Renee Klein and Craig Kenworthy
Special to The Times

Howard Frumkin is dean of the University of Washington School of Public Health. Renee Klein is the President and CEO of the American Lung Association of the Mountain Pacific. Craig Kenworthy is the executive director of the Puget Sound Clean Air Agency.



Originally published January 9, 2015 at 2:08 PM

Guest: Adopting clean-fuels standard is a public-health imperative

Air pollution adds to health care costs, causes lost days at work and school and is impacting climate change. Washington can do better by adopting a clean-fuels standard.

But carbon pollution (from burning fossil fuels) isn't the only problem. Gasoline and diesel combustion is also responsible for most of our state's other air pollutants — particulate matter, ozone, nitrogen oxides. These aggravate heart disease, lung disease and other health problems. The result? Higher health-care costs, and more lost days at work and school.

◊

In our state, more than a half million adults and 105,000 youths have asthma. Dirty air can trigger severe asthma attacks and presents a host of other lung, heart and cancer health risks. Prolonged exposure can even lead to early death.

Those who live, work or attend school near major roadways — often communities of color and low-income families — are at greatest risk. Children, older adults and people living with lung and heart disease are especially vulnerable.

Air Pollution

Carbon Reduction Efforts Would Have an Enormous Co-benefit to Improved Public Health

- Source of most air pollution is same as of greenhouse gas -- burning of fossil fuels.
- CO_2 is not direct health hazard, but particulate matter, sulfur dioxide, & nitrogen dioxide are.
- Air pollution is directly linked to mortality, heart disease and respiratory illnesses, including asthma in young children.

In U.S., power plants, buildings, and vehicles account for not only for 92% of greenhouse gases, but also for 95% of the sulfur oxides (SOx) that cause acid rain and create particulate matter, and for 99% of the nitrogen oxides (NOx) that form smog. U.S. Environmental Protection Agency. Inventory of U.S. greenhouse gas emissions and sinks: 1990 –2005. U.S. Environmental Protection Agency. Six common air pollutants. 2001.

Air Pollution

China's air pollution has cut life expectancy by an average of 5.5 years in the north of the country

Beijing, China

January 28, 2013

Source: "Evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River policy, " The Proceedings of the National Academy of Sciences, July 8, 2013

Air Pollution

UW study shows how it harms your heart

Accelerates deposits of calcium in coronary arteries

- **Shows linkage between air pollution & actual evidence of atherosclerosis progression.**
- **People living in areas with more outdoor pollution -- even at lower levels common in U.S. -- accumulate deposits faster than people living in less polluted areas.**

Source: Joel D Kaufman et al. Association between air pollution and coronary artery calcification within six metropolitan areas in the USA (the Multi-Ethnic Study of Atherosclerosis and Air Pollution): a longitudinal cohort study. The Lancet, 2016 DOI: 10.1016/S0140-6736(16)00378-0

Air Pollution

Where There's Fire, There's Smoke

And People Who Breath That Smoke

In 2015, with its record wildfires, Eastern Washingtonians were exposed to an average of about 11 days where air quality was either Unhealthy or worse, compared to an average of about 7 days in recent years with bad wildfires.

http://wasmoke.blogspot.com/

Climate Refugees

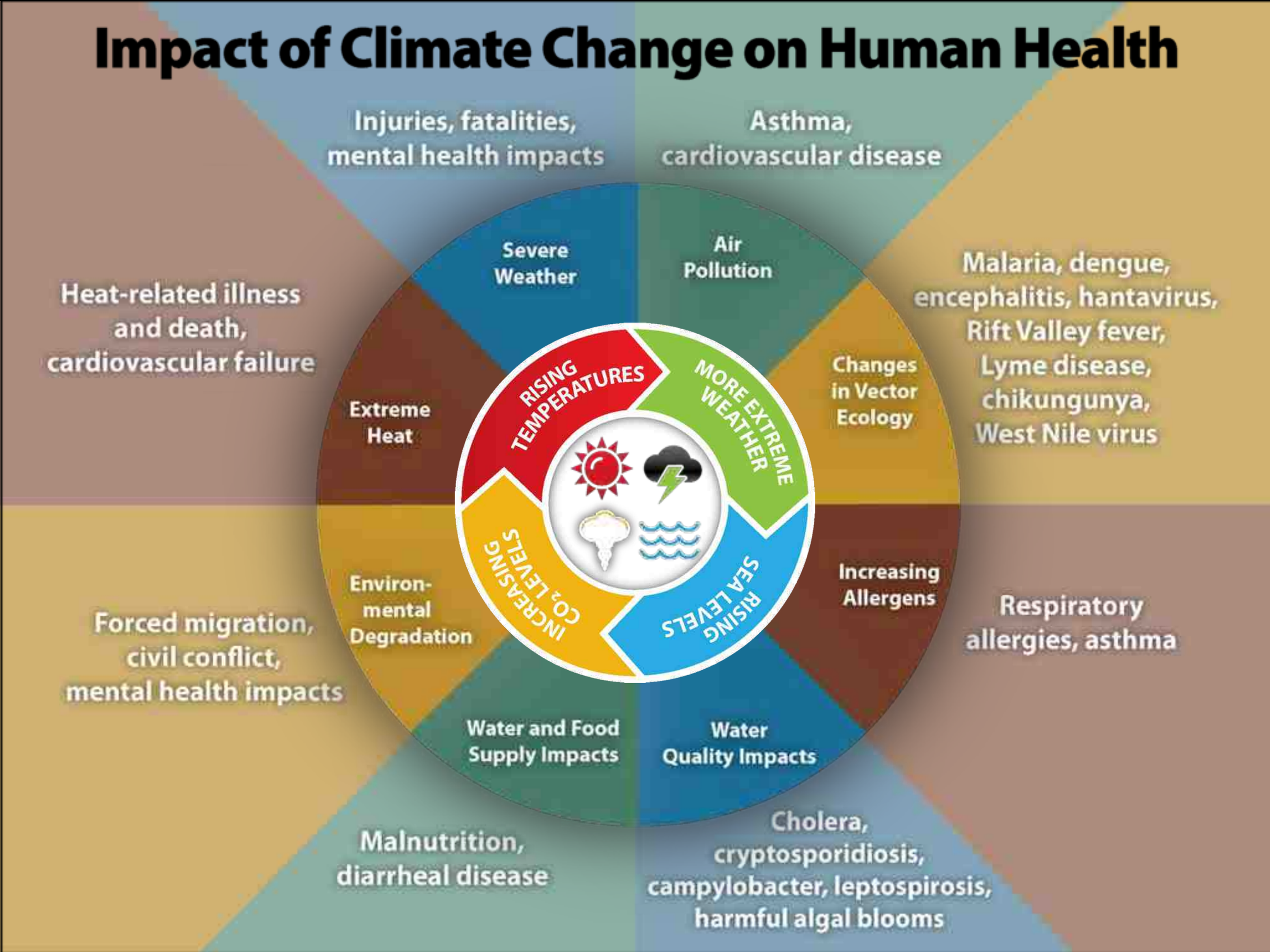
Climate change could become the biggest driver of population displacement

In 2009, UN High Commissioner for Refugees António Guterres pointed to a growing link between climate change and conflict.

"Climate change can enhance the competition for resources – water, food, grazing lands – and that competition can trigger conflict."

Source: António Guterres, a press conference at the United Nations Climate Change Conference, 2009.

Impact of Climate Change on Human Health



Things have to change!

Time to Act is Now!!!

Unless global carbon emissions actually start to fall within the next decade, we can expect to see:

- **Further and more drastic changes to the weather and climate.**
- **Growing adverse health impacts all over the world.**

The window for action is rapidly closing

65% of our carbon budget compatible with a 2° C goal already used

WGI SPM

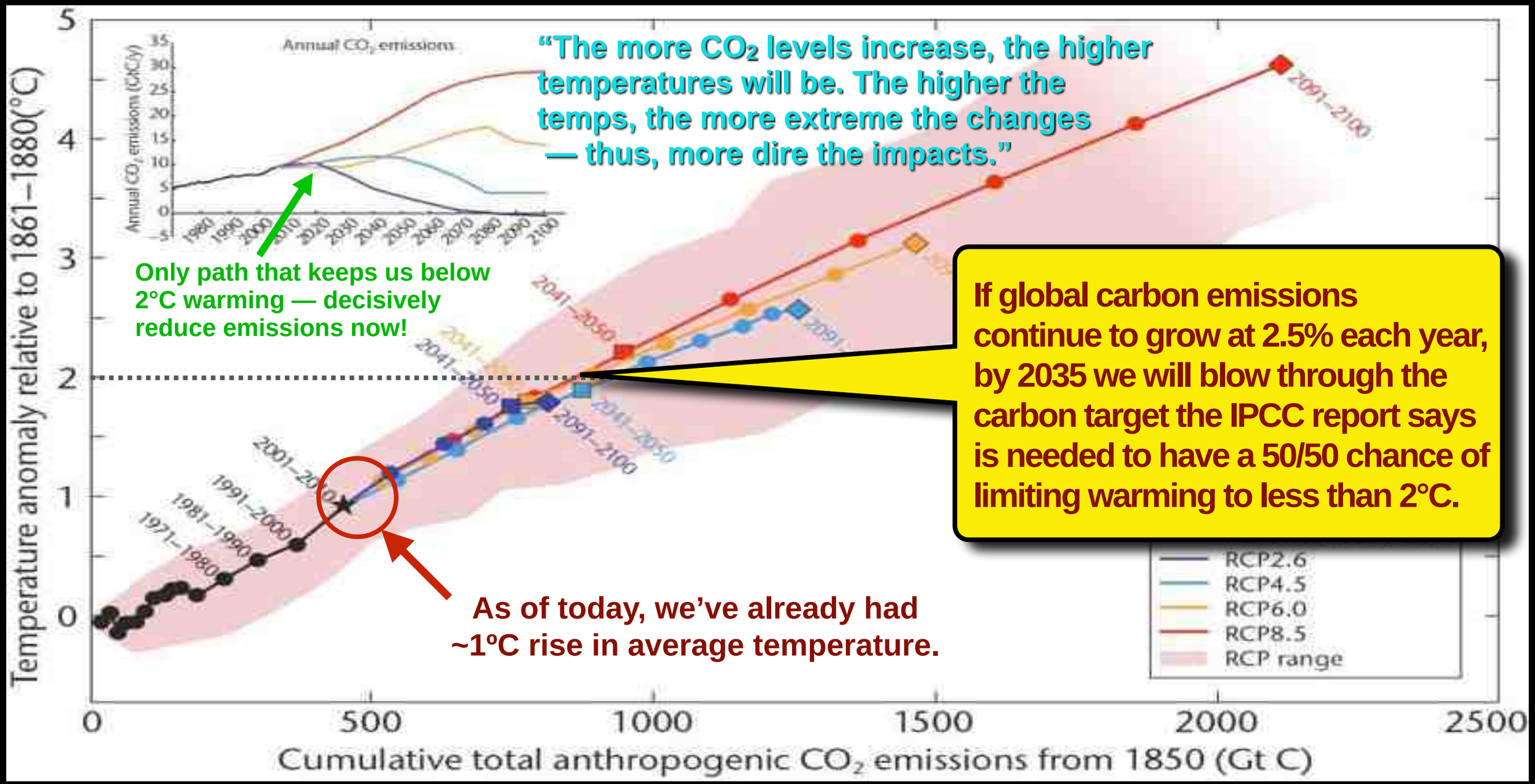
To preserve a planet similar to that on which civilization developed and to which life on Earth is adapted.

Whatever temperature rise we target as posing acceptable risk (1 vs. 2ºC), the message needs to remain the same:

There isn't much (if any) time left for inaction.

CO_2 Accumulates in the Atmosphere

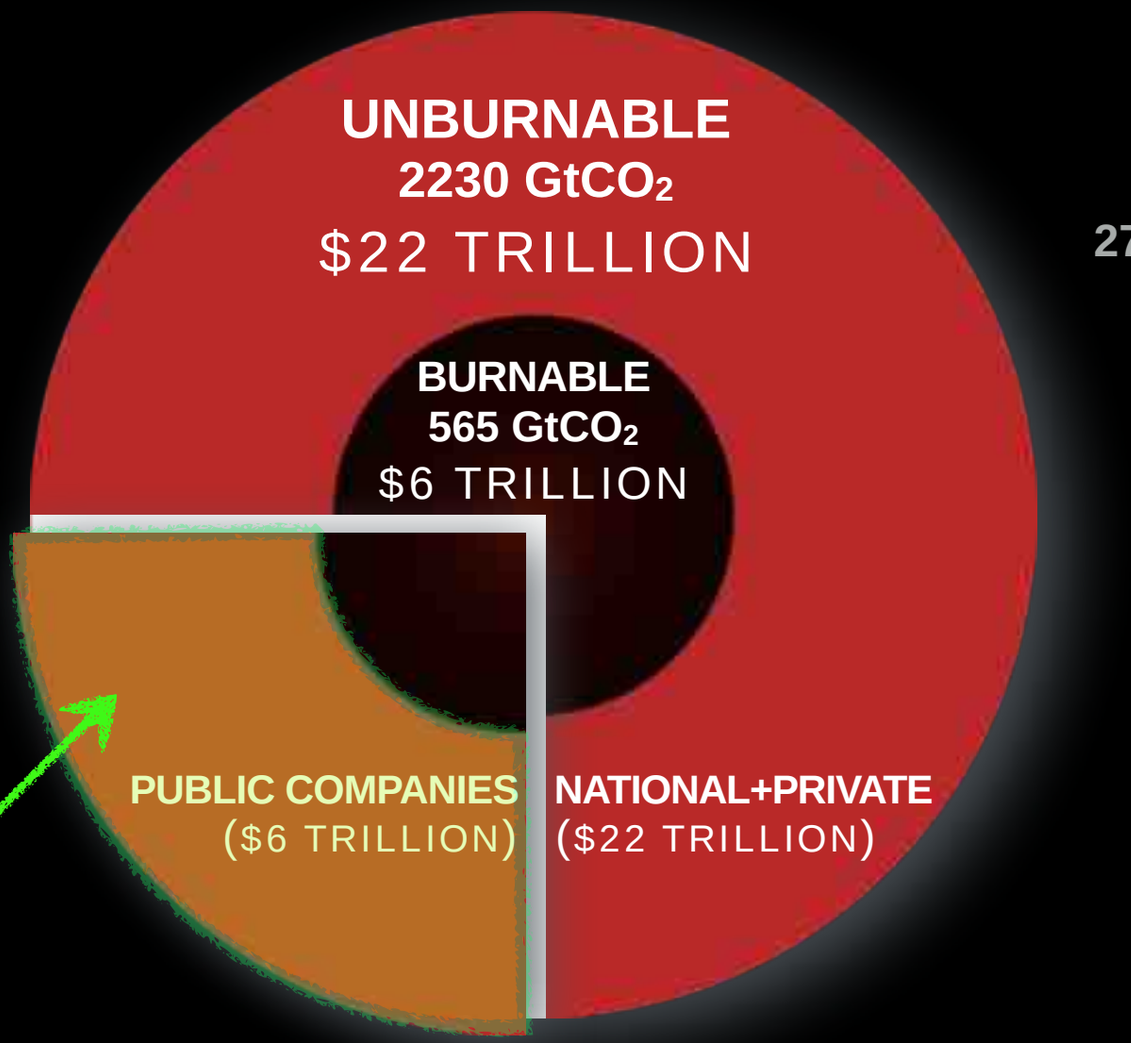
Risks from climate change depend on cumulative $C0_2$ emissions which in turn depend on annual emissions over the next decades.



We are at a crucial crossroads!

- Even the 2ºC target will soon be out of reach if no further action is taken.
- To meet targets, all countries need to cut GHG emissions 40 to 70% by 2050 (net added CO_2 needs to be 0 by 2100).
- The longer we wait to cut emissions, the greater the challenges and costs.

What this means is that we need to leave the vast majority of the world's known reserves of fossil fuels in the ground.



PROVEN FOSSIL FUEL RESERVES
2795 $GtCO_2$ $28 TRILLION

Stranded Asset
~$5 Trillion

We can only "afford" to burn ~ 20% of our proven reserves!

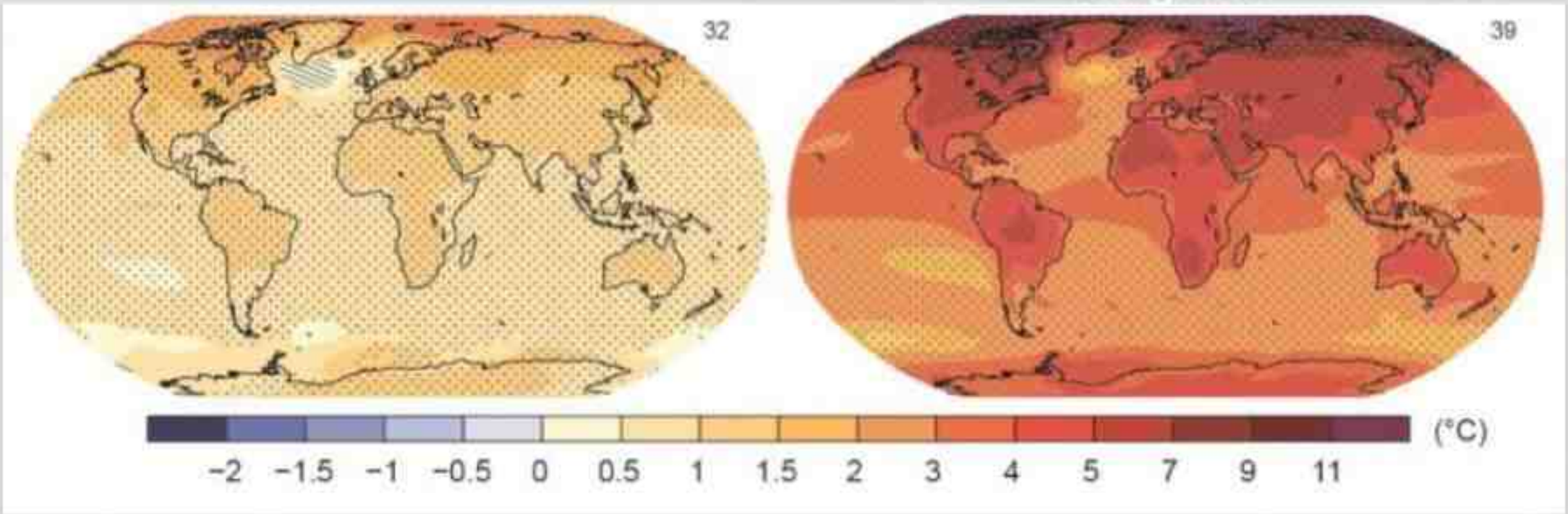
Sources: Meinshausen et al. 2009; Allen et al. 2009 Sokolov et al. 2009; Carbon Tracker Initiative 2011. Carbon reserves as of start 2011; since then >50 $GtCO_2$ have been burned.

The Choices We Make Will Create Different Outcomes

If greenhouse gas emissions continue rising at current rates.

With substantial mitigation

Without additional mitigation



Change in average surface temperature (1986–2005 to 2081–2100)

AR5 WGI SPM

"There will be more warming even if we act now — temperature increases lag CO_2 level rises."

IPCC AR5 Synthesis Report

ipcc INTERGOVERNMENTAL PANEL ON climate change

WHO UNEP

What stands in our way?

“There’s a lot of money — and power — tied up in fossil fuels. Wars have been fought over it.”

Attacking science. Creating doubt.

Those who deny
the existence of the
Climate Crisis
often claim there is
“no scientific consensus,”
however...

Every National Academy of Science of Every Major Country in the World Confirms Anthropogenic Global Warming

African Academy of Science

Australia

Belgium

Brazil

Cameroon

Canada

The Caribbean

China

France

Ghana

Germany

Indonesia

Ireland

Italy

India

Japan

Kenya

Madagascar

Malaysia

Mexico

Nigeria

New Zealand

Russia

Senegal

South Africa

Sudan

Sweden

Tanzania

Turkey

Uganda

United Kingdom

United States

Zambia

Zimbabwe

National Academies *Rejecting* the Science of Anthropogenic Global Warming

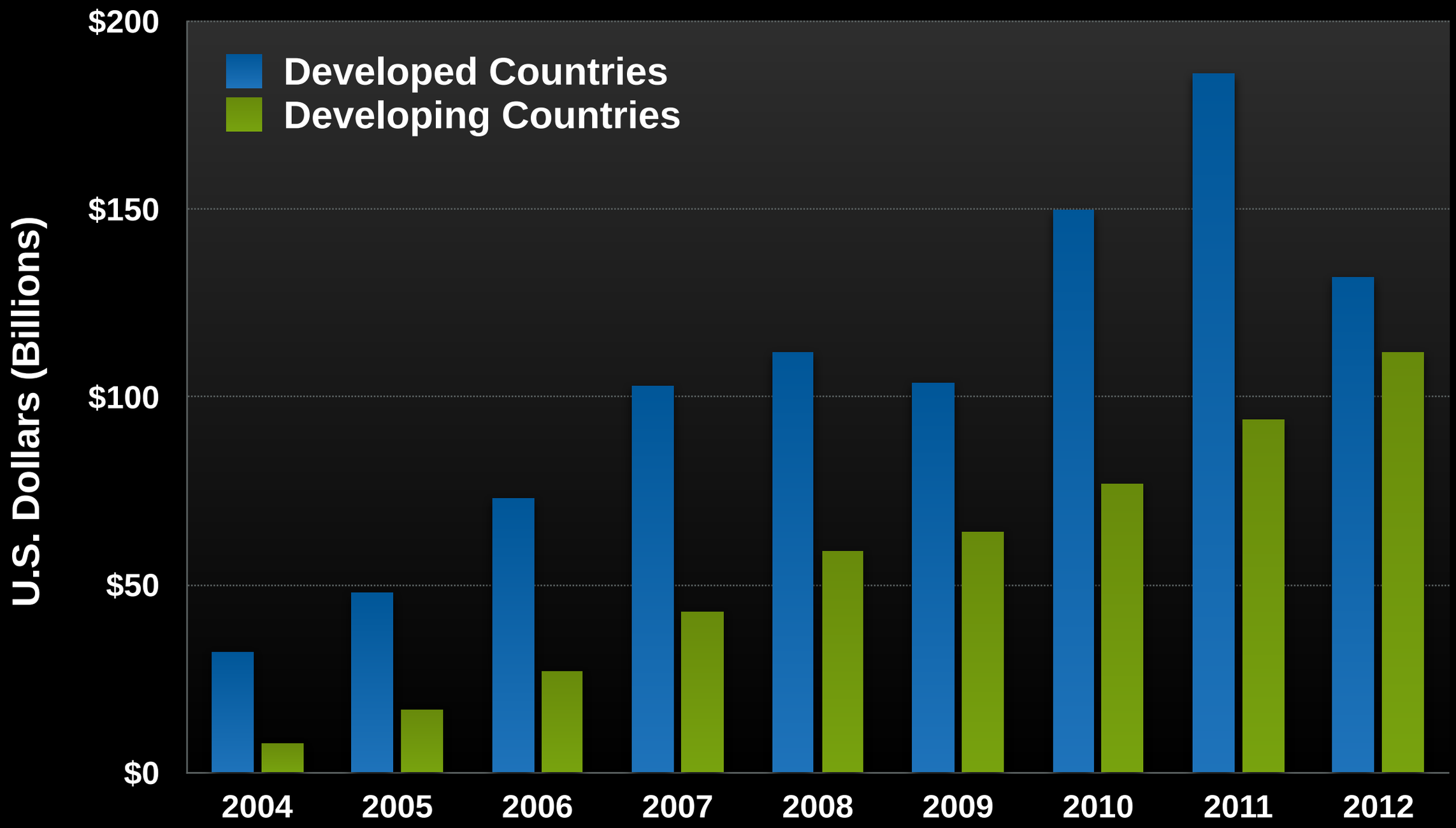
None

It’s clear that we have to reduce our carbon footprint!

We DO have solutions at hand…

New Investment in Renewable Energy

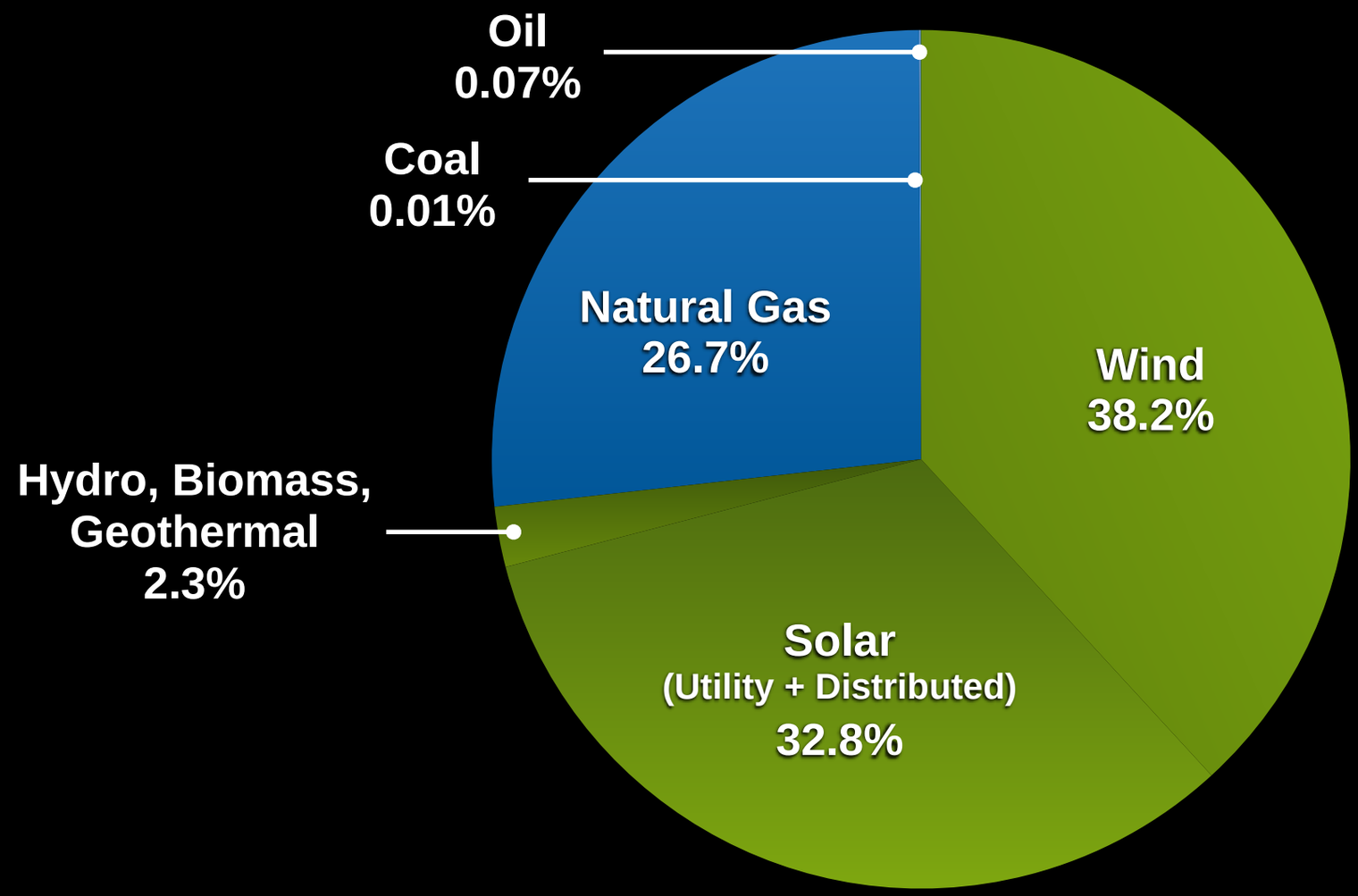
2004 – 2012



Source: © 2013 Frankfurt School of Finance & Management gGmbH, "*Global Trends in Renewable Energy Investment 2013*," Fig 4.
Data: UNEP, Bloomberg New Energy Finance

New Electric Generation Capacity in the U.S.

2015

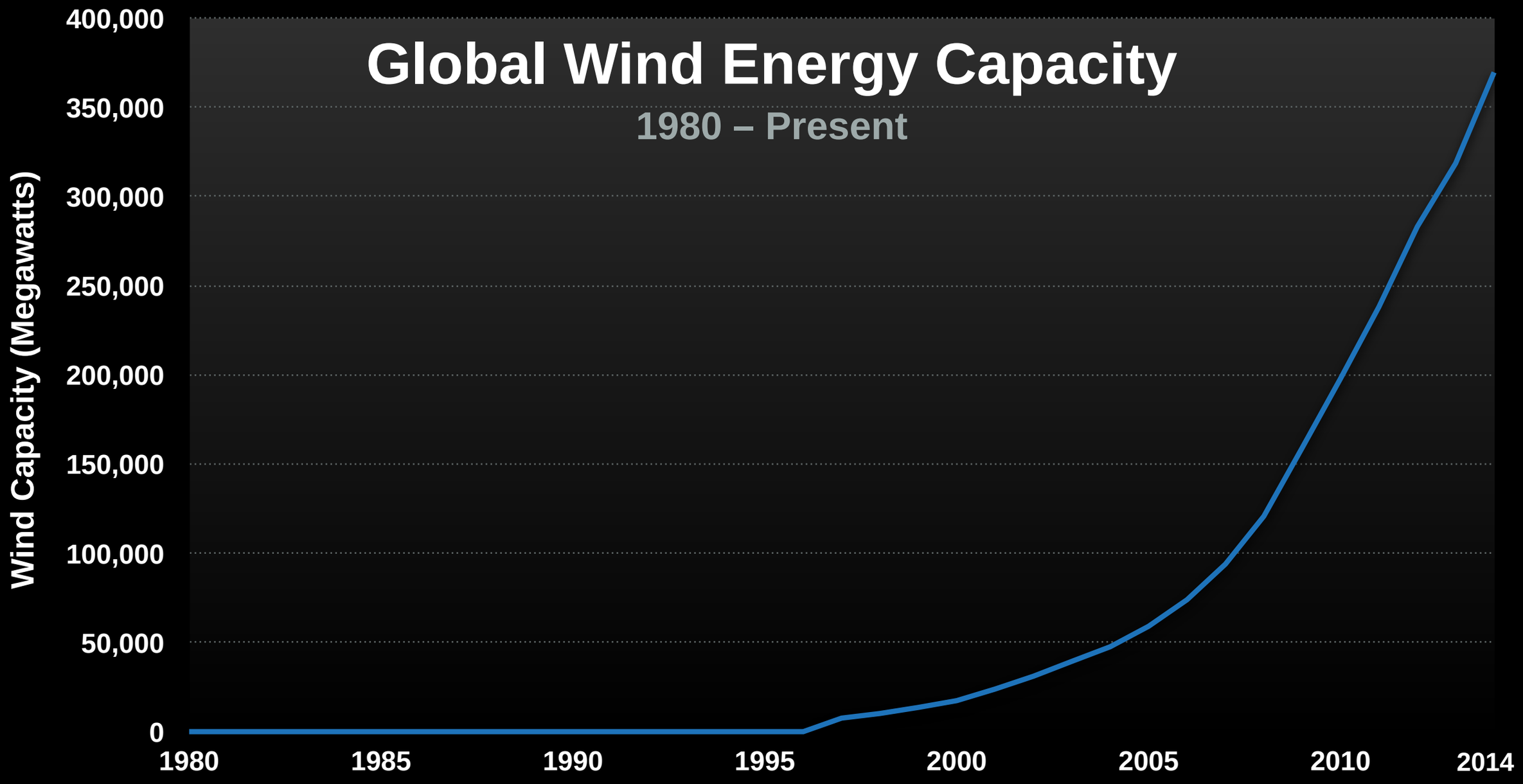


Source: U.S. Department of Energy/FERC, February 2016; BNEF

The Ngong Hills, Kenya

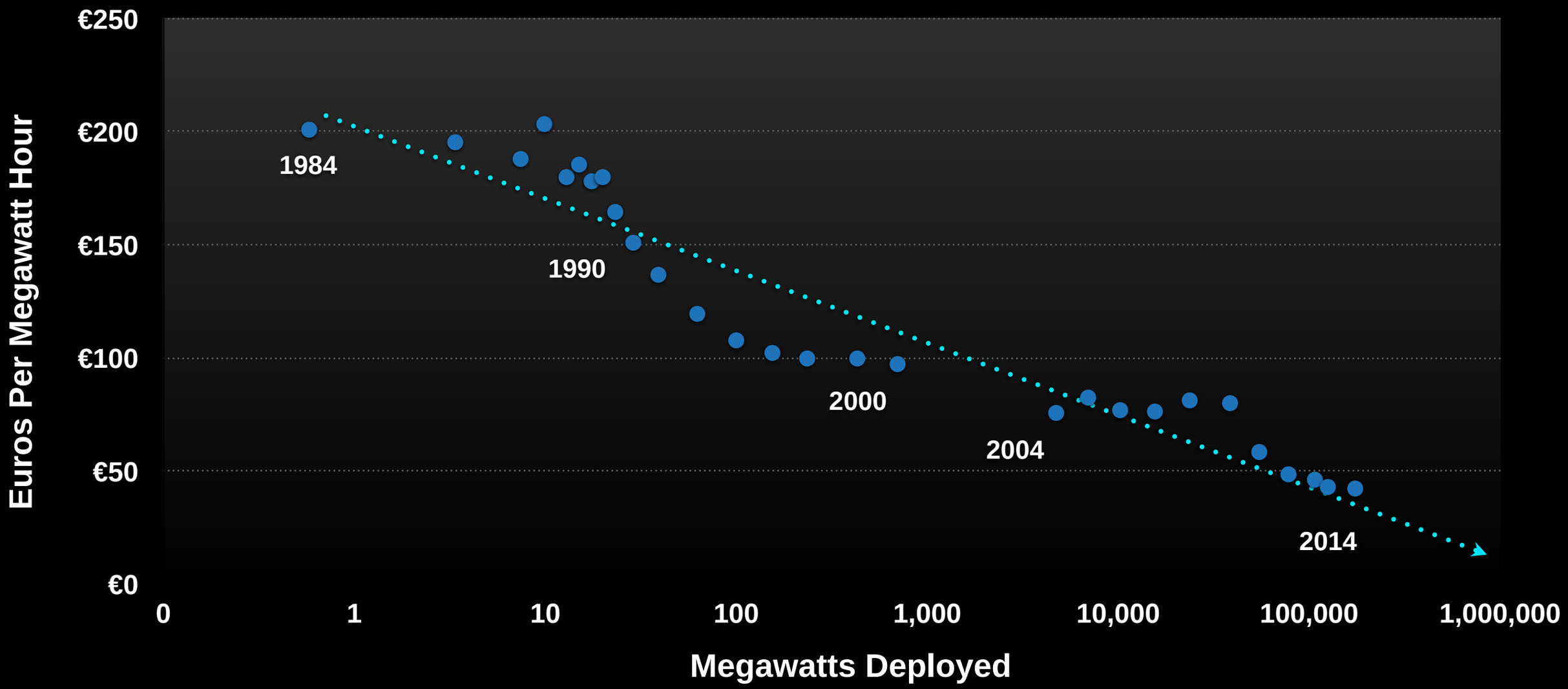
Global Wind Energy Capacity

1980 – Present



Data: Earth Policy Institute

Onshore Wind Cost
1984 – 2014



Data: Bloomberg New Energy Finance

Hut in Africa

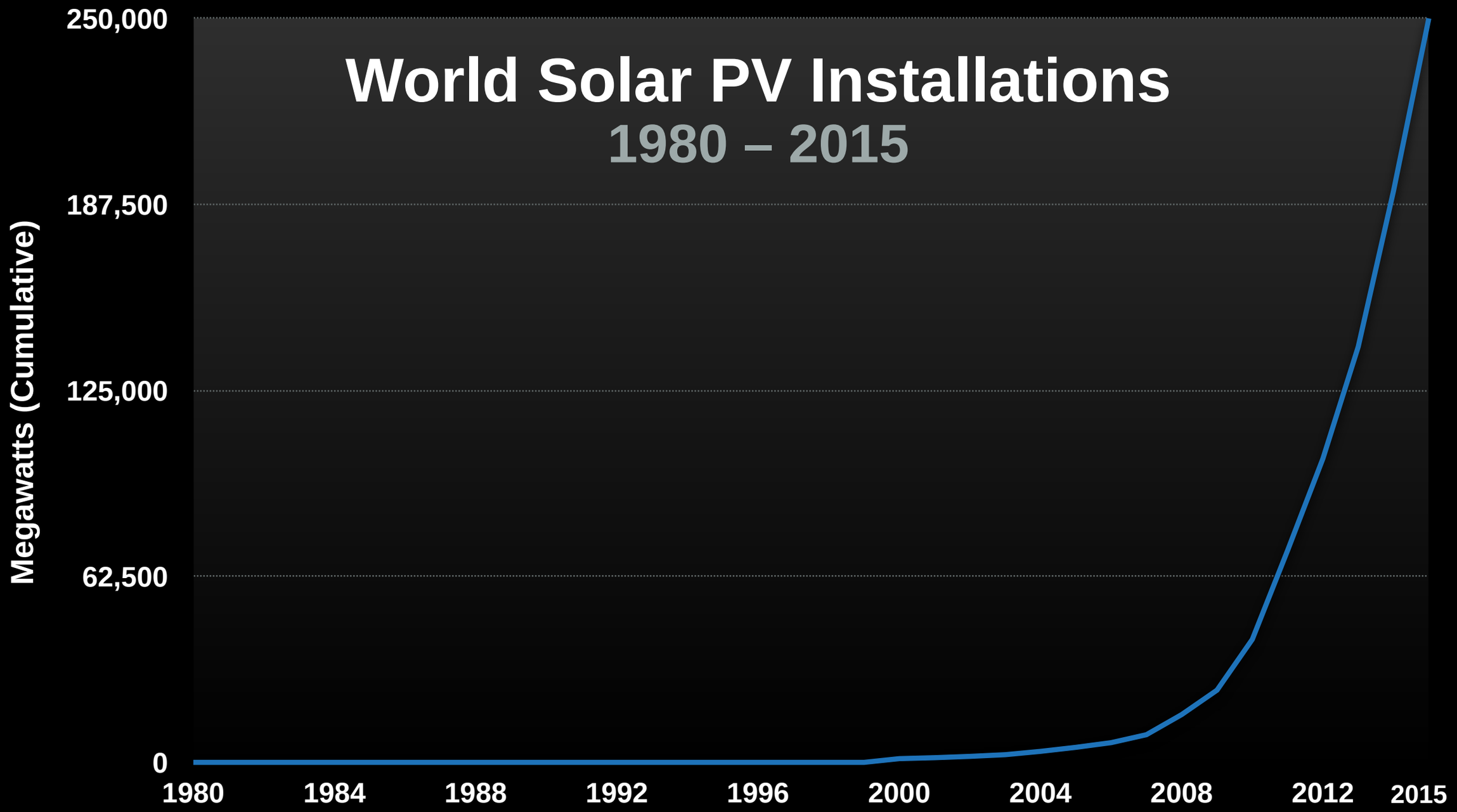
Bangladesh

Bangladesh is now installing solar PV systems at the rate of two per minute, 24 hours a day

The Vatican

CNS Photo/Paul Haring

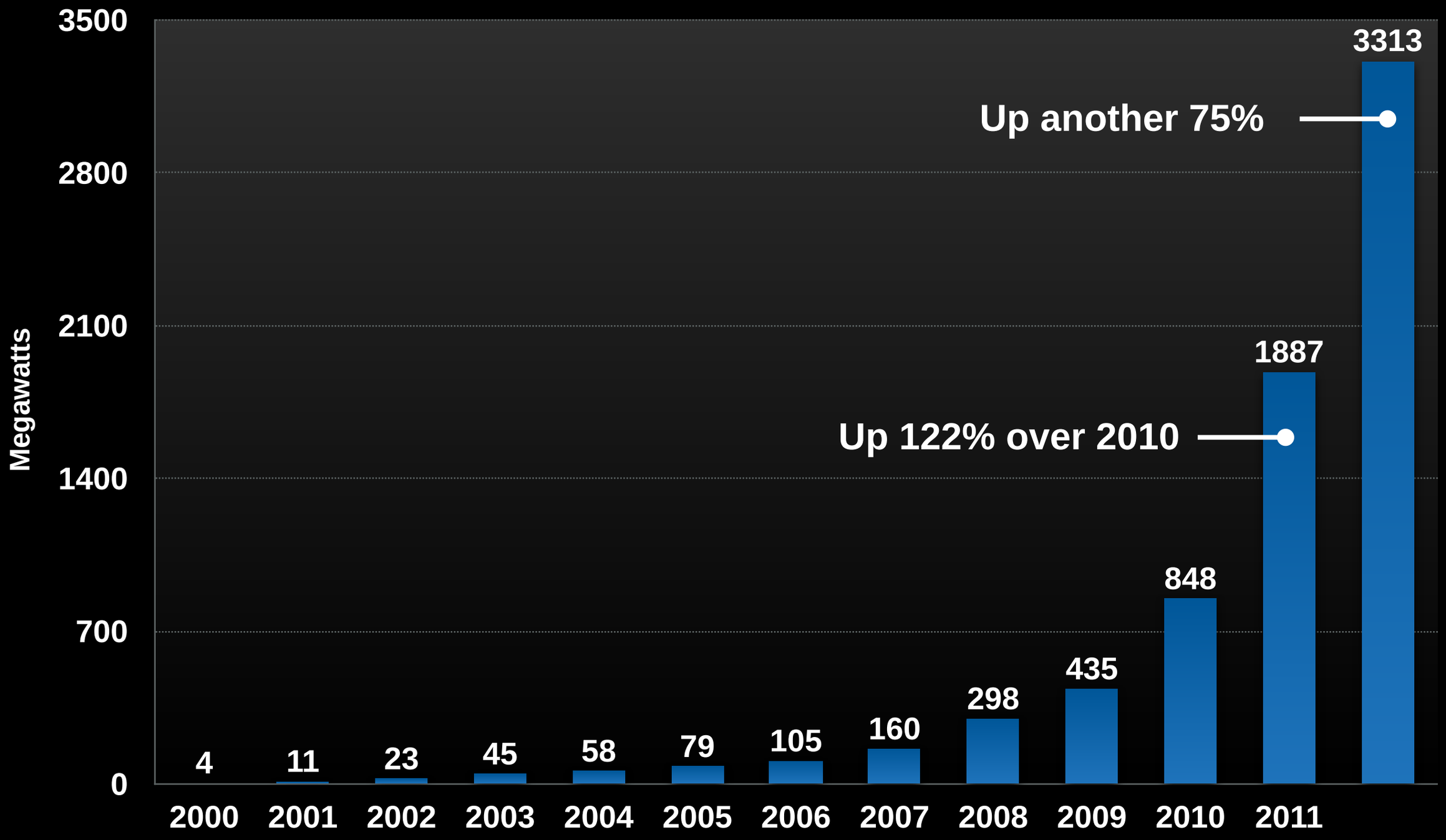
World Solar PV Installations
1980 – 2015



Data: Earth Policy Institute/BP, *Statistical Review of World Energy June 2014* (London: 2014).

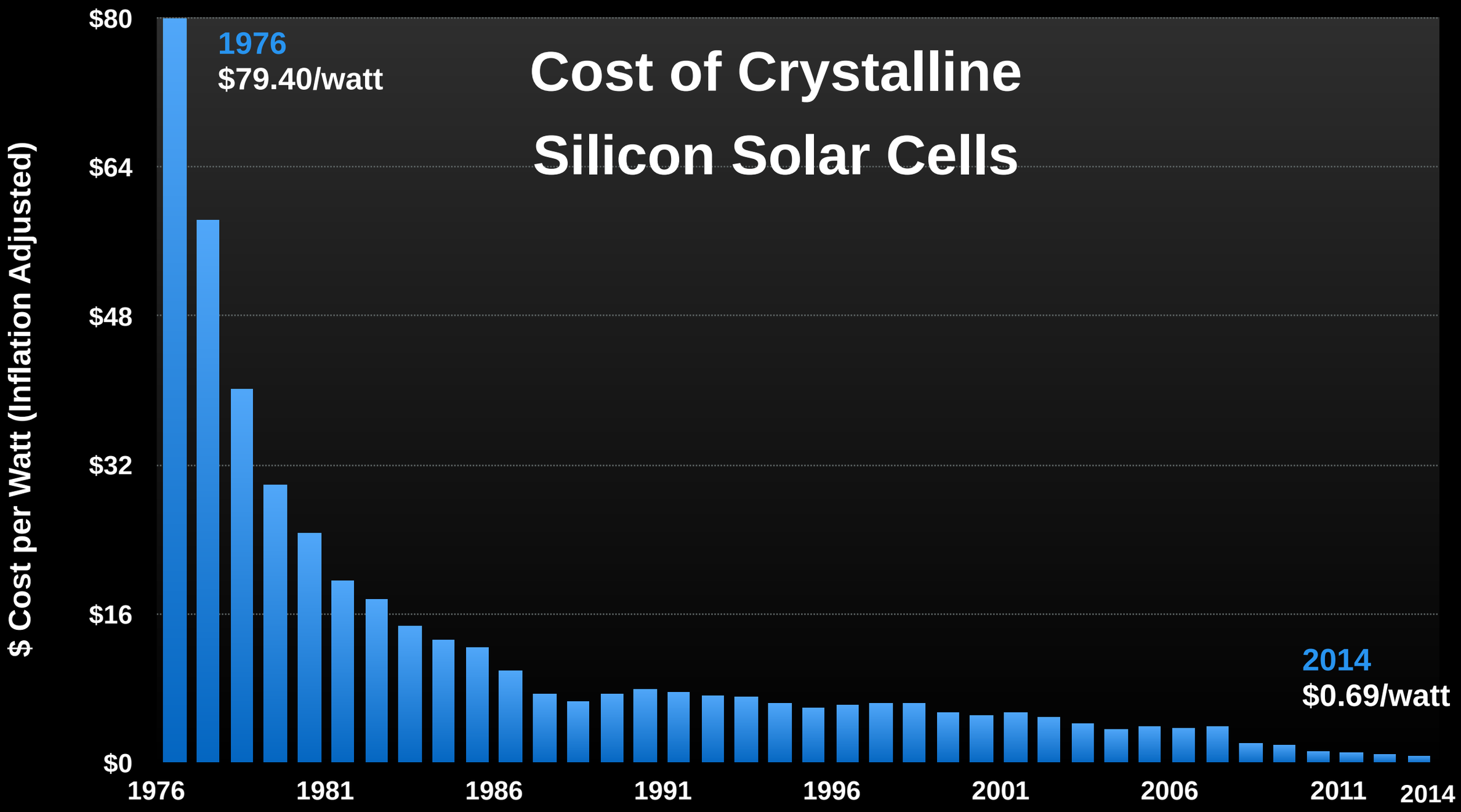
U.S. Solar PV Installations

Each Year, in Megawatts



Data: Solar Energies Industry Association/GTM Research, 2013, "*U.S. Solar Market Insight 2012 Year-In-Review*"

Cost of Crystalline Silicon Solar Cells



Data: Bloomberg New Energy Finance

January 8, 2015

“…we believe the trend is clear:
grid parity
without subsidies
is already here,
increasing parity will occur, and
solar penetration rates
are set to ramp worldwide.”

Deutsche Bank

Is there any
precedent
for such a rapid adoption
of a new technology?

In 1980 AT&T commissioned a study to forecast cell phone use by the year 2000

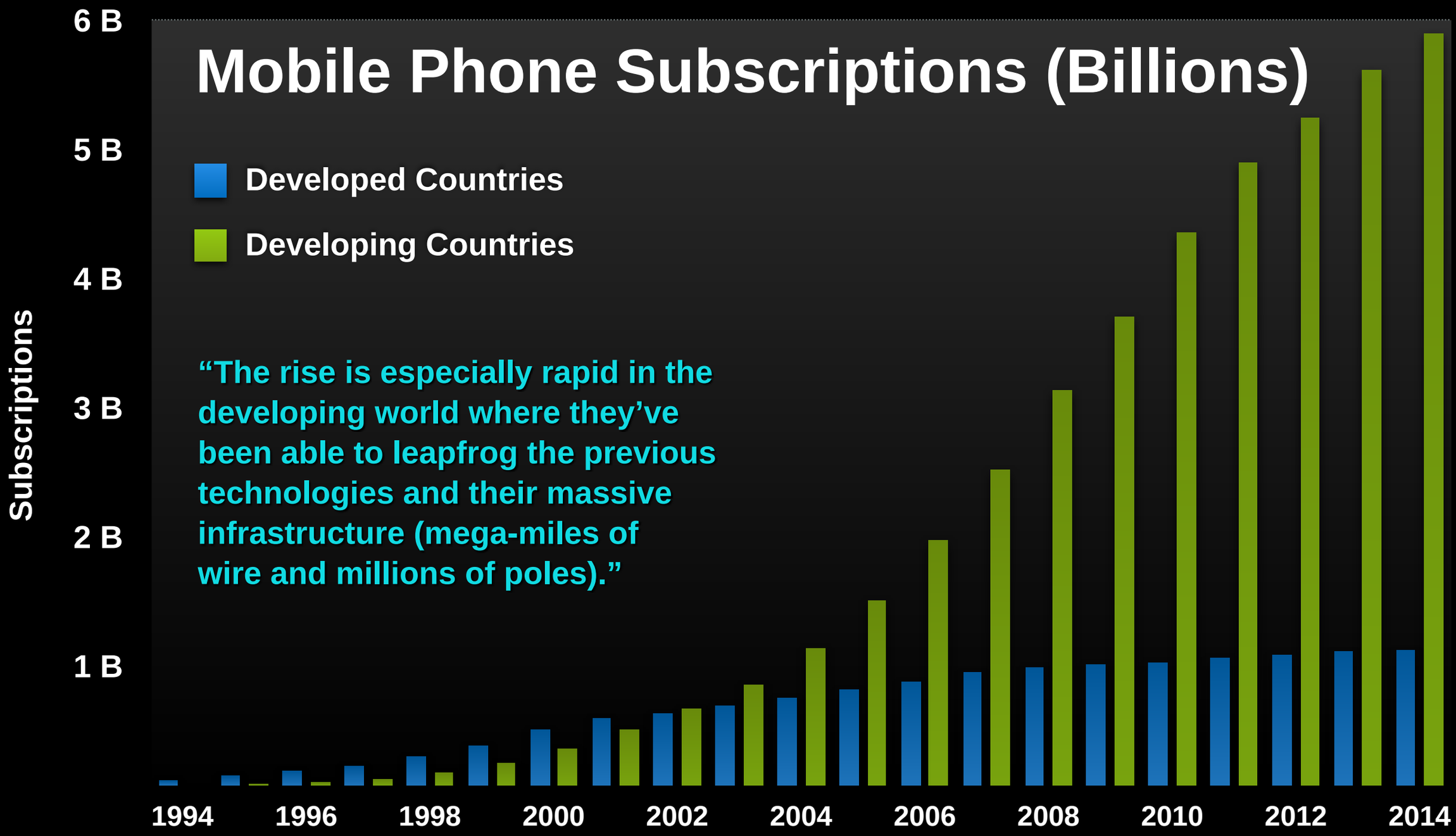
They projected 900,000 users

The actual figure was

109 million

120 x higher

Mobile Phone Subscriptions (Billions)



“The rise is especially rapid in the developing world where they’ve been able to leapfrog the previous technologies and their massive infrastructure (mega-miles of wire and millions of poles).”

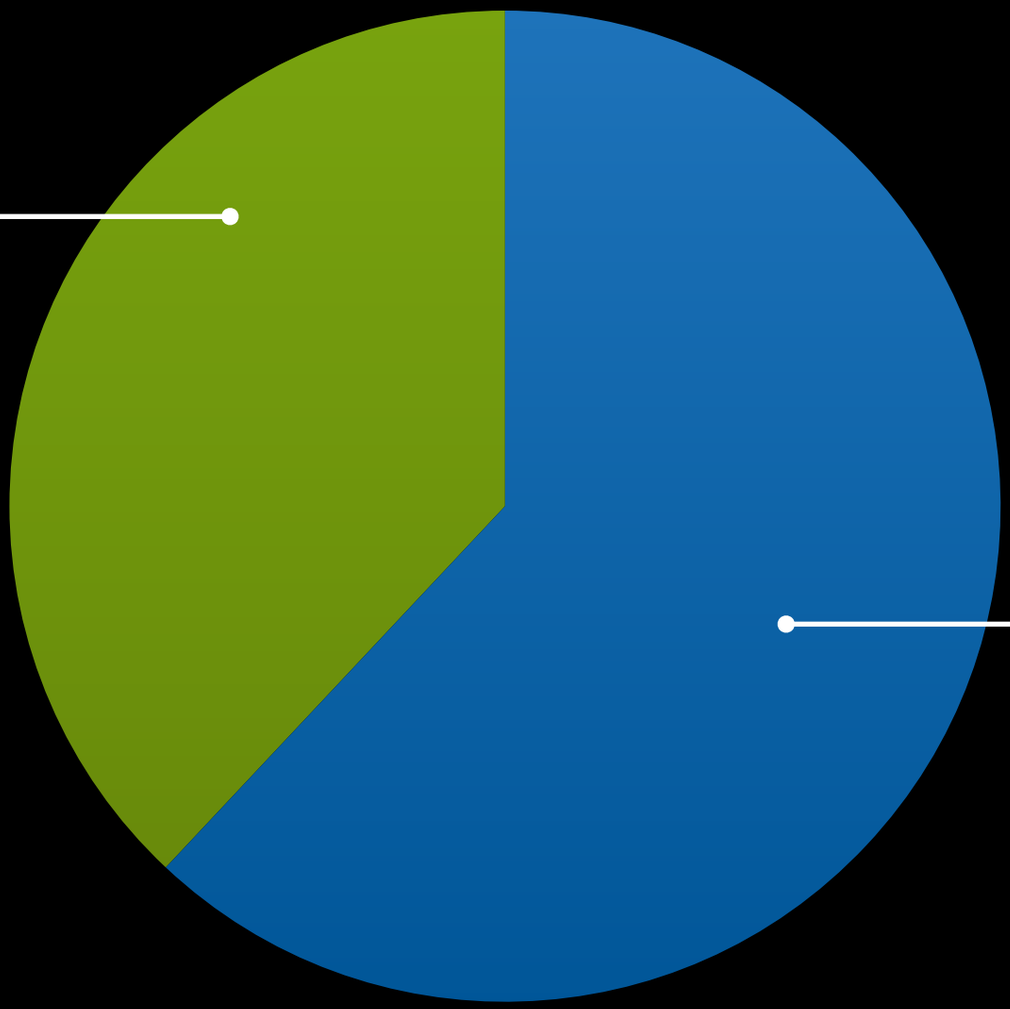
There are now 7.6 Billion cell-phone connections

Source: World Bank

It’s Not Inexpensive, but Look Who’s Investing

Who Pays For Clean Energy and Low Carbon Development?

Out of $391 Billion Invested in 2014



THIRTY-EIGHT PERCENT

PUBLIC

$148 BILLION

SIXTY-TWO PERCENT

PRIVATE

$243 BILLION

Source: World Bank

But the Price for Doing Nothing is Even Larger

The Cost <u>of</u> Carbon

- $ *Political Instability*
- $ *Floods & Mudslides*
- $ *Wildfires*
- $ *Drought*
- $ *Storm Damage*
- $ *Infrastructure Loss*
- $ *Ocean Acidification*
- $ *Climate Refugees*

- $ *Species Extinction*
- $ *Melting Glaciers*
- $ *Famine*
- $ *Water Scarcity*
- $ *Ecosystem Loss*
- $ *Our Way of Life*
- $ *Infectious Diseases*
- $ *Sea Level Rise*

$ ***"The #1 Threat to the Global Economy"***

In the 2015 Paris Agreement, virtually every nation in the world agreed to work together to achieve net zero greenhouse gas emissions

“For now, while a hopeful and important step, these are just words on paper. We need to turn these agreements into quick, decisive action.”

We need to change business as usual.

We need coordinated policies that drive the transition quickly, effectively & equitably.

- **Clean Power Plan, clean air rules, energy efficiency, building & fuel use standards.**
- **Putting price <u>on</u> carbon is part (but only one part) of that.**
  - **Make things cost more and people will use less.**
  - **Factor the cost of pollution into the price of oil, gas, & coal and the market can make informed energy investment decisions.**

ALLIANCE FOR jobs and clean energy

Climate Action Policy

Effective and equitable

- **Adopts science-based standards for carbon emission reductions.**
- **Advances a policy that prices and reduces emissions.**
- **Reinvests carbon fee proceeds in clean energy, energy conservation, clean air and water, and in the workers, businesses, and communities most impacted by this transition and by climate change.**

http://jobscleanenergywa.com/

Fund the Solutions, Price the Pollution.

AN EQUITABLE CLIMATE ACTION POLICY

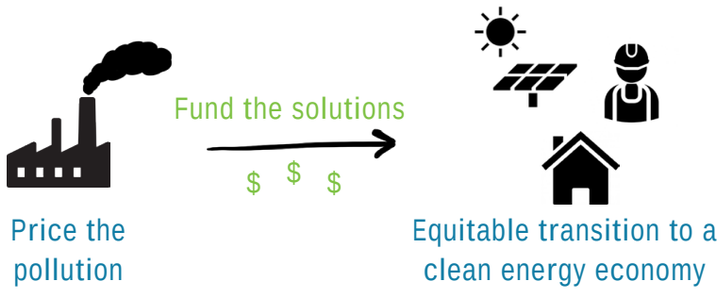
Alliance for Jobs and Clean Energy | 2016

Washington state can – and should – join the growing number of countries and regions acting to reduce carbon emissions and build a clean energy future.

We must reduce greenhouse gas emissions to address the harmful effects of climate change in order to protect our health, communities, and economy. When we make the transition to clean, efficient energy we will grow our economy, creating a new wave of jobs and prosperity.

In Washington, a group of social justice, labor, faith, environmental and health advocates have used our collective experiences and values and built on existing policies to create what we believe is the most effective and equitable carbon reduction policy to date for transitioning to a clean energy economy.

OUR POLICY



Our policy will:

- Drive significant investment in clean energy, healthy forests, and water infrastructure – to reduce climate pollution more quickly and address the impacts of climate change in Washington.
- Fund these investments with a tax on climate pollution, which has a price that is linked to how well we are on track to meeting our emissions limits. These limits will be based on best available science in order to contribute to achieving a healthy, stable climate.
- Bolster economic stability and equity in the transition to clean energy:
  - Ensure that communities hardest hit by pollution and climate change receive a significant share of clean energy, forest, and water investments.
  - Provide financial assistance to low-income families to make low-carbon options realistically available and accessible to all.
  - Provide support to workers and communities during the transition to a clean energy economy.
  - Keep energy intensive and trade exposed industries in the state, rather than driving their business and pollution elsewhere.

http://jobscleanenergywa.com/wp-content/uploads/2015/06/Alliance-Policy_full.pdf

What Can YOU Do?

What Can YOU Do?

Use & Consume Less

- **Drive a more efficient car (or use other transportation), and/or walk and bike more. (That more exercise is good for your health is a great co-benefit).**
- **Use more efficient light bulbs, fix leaks in your house.**
- **Be part of your business's sustainability and carbon footprint reduction efforts.**
- **Eat less meat, especially beef.**

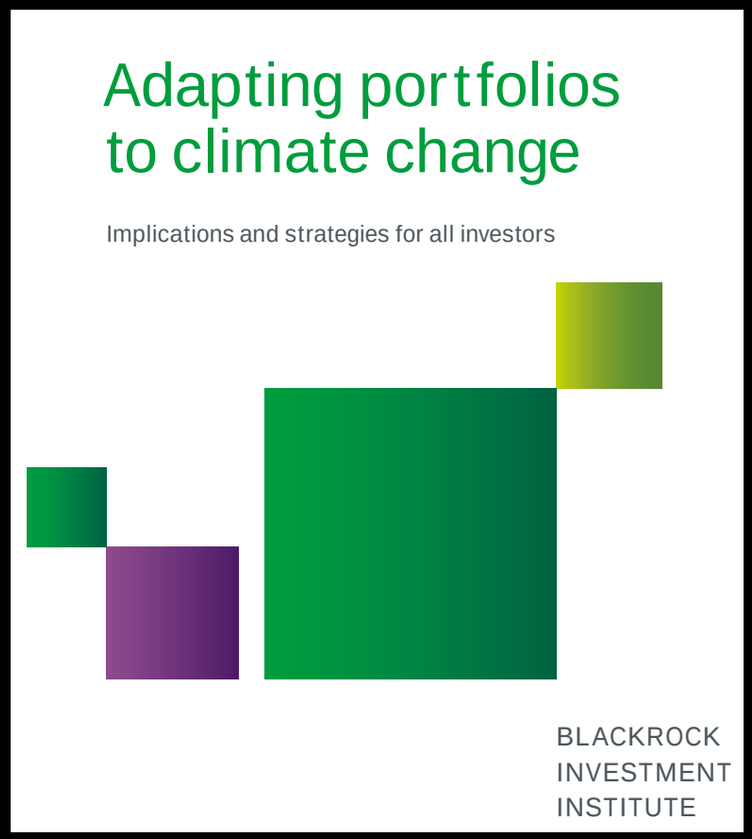
Climate & Health Co-benefits of Reduced Meat Consumption

Eating & producing meat has a significant GHG impact

Environment	Health Co-benefits
Reduced: • Greenhouse gas emissions • Antibiotic use • Water pollution (nitrates) • Air pollution • Soil erosion • Unsustainable H_2O use • Pesticide Use	**Reduced:** • Ischemic heart disease • Obesity • Colorectal cancer • Breast & prostate cancers • Type II Diabetes • Antibiotic resistance • Respiratory disease • Pesticide health effects

What Can YOU Do?

Invest & Spend Wisely (& Greenly)



"Our overall conclusion: We believe all investors should incorporate climate change awareness into their investment processes."

Blackrock Investment Institute, Global Insights, September 2016

- **Consider carbon footprint/eco impact of items you buy (such as food made with palm oil).**

Source: https://www.blackrock.com/investing/literature/whitepaper/bii-climate-change-2016-us.pdf

What Can YOU Do?

Educate & Speak Up

- **Tell people this matters to you!**
- **Make it clear, this is a public health issue.**
- **Don’t be afraid to talk to friends, family and colleagues.**
- **Write Letters to the Editor.**

http://www.climatechangecommunication.org/images/files/4C%20Communication%20Primer%20-%20Conveying%20the%20Human%20Implications%20of%20Climate%20Change.pdf

What Can YOU Do?

Get Involved

- **Join and/or follow an organization committed to solving the climate crisis.**
  - **Washington Physicians for Social Responsibility (WPSR):** http://wpsr.org.
  - **Climate Reality Project:** http://climaterealityproject.org.

What Can YOU Do?

Speak Up More

- **Be a leader: talk to your community, key decision makers, and politicians.**
- **Become an advocate for clean air and clean energy policies.**
- **Tell your leaders this matters to you!**
  - **Changing laws is even more important than changing light bulbs.**

What Can YOU Do?

Local Issues

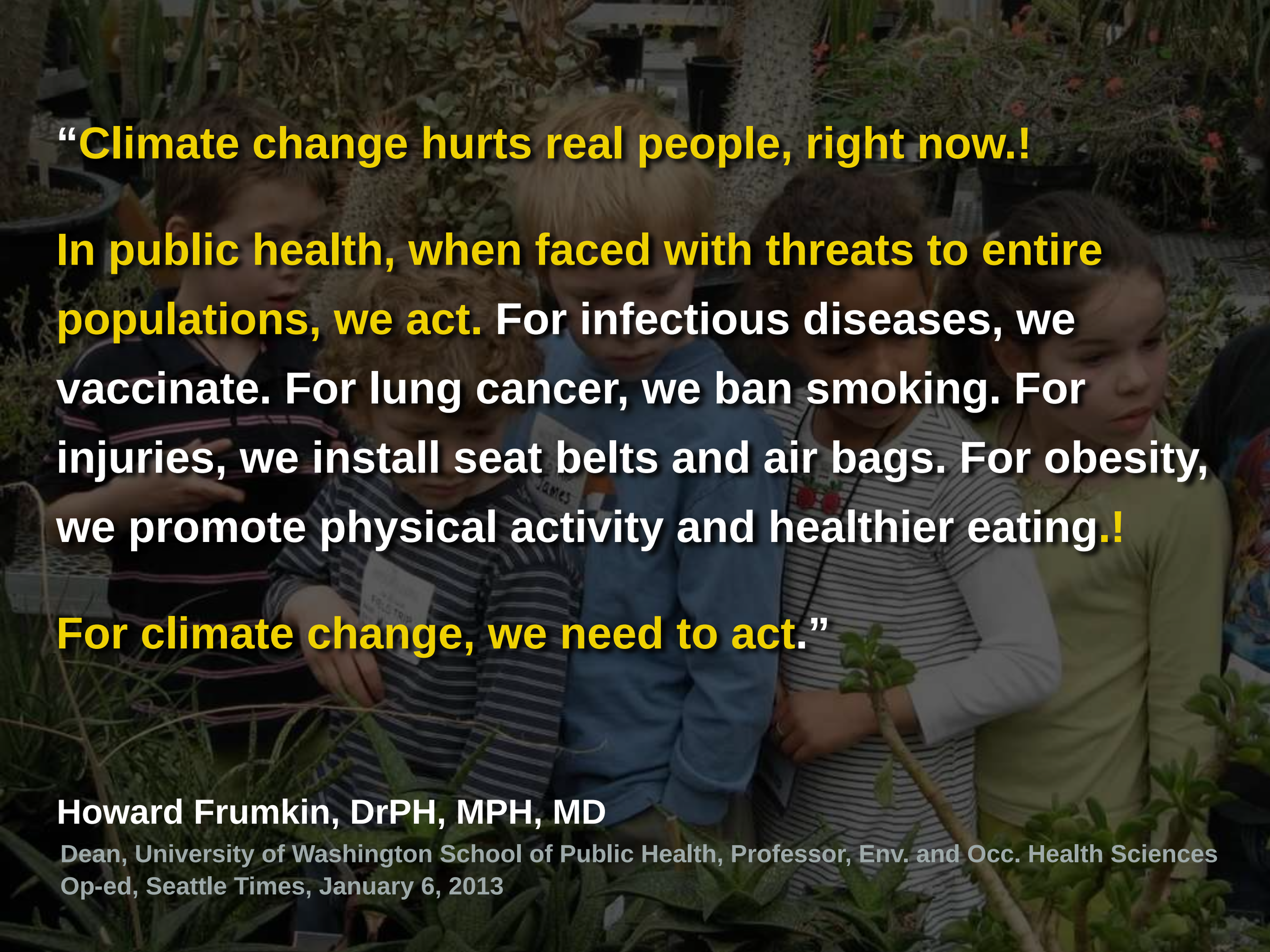
- New <u>oil export</u> terminals proposed for Grays Harbor (Imperium) & Vancouver (Tesoro Savage) that would bring many mile-long trains, carrying volatile Bakken crude oil, through Washington.
- Huge <u>coal export</u> terminals proposed for Longview.

Get informed. Add your voice to say “NO!”

It’s not enough for health professionals to prepare adaptations and treatments for the consequences of climate change we can no longer prevent. It’s imperative that we also get involved in mitigation:

- **Ensure that the causes & health impacts of climate change are understood by policy makers and the public.**
- **Advocate for policies that quickly and decisively begin to reduce carbon emissions.**

Reframing the Climate Change Dialogue



“Climate change hurts real people, right now.!

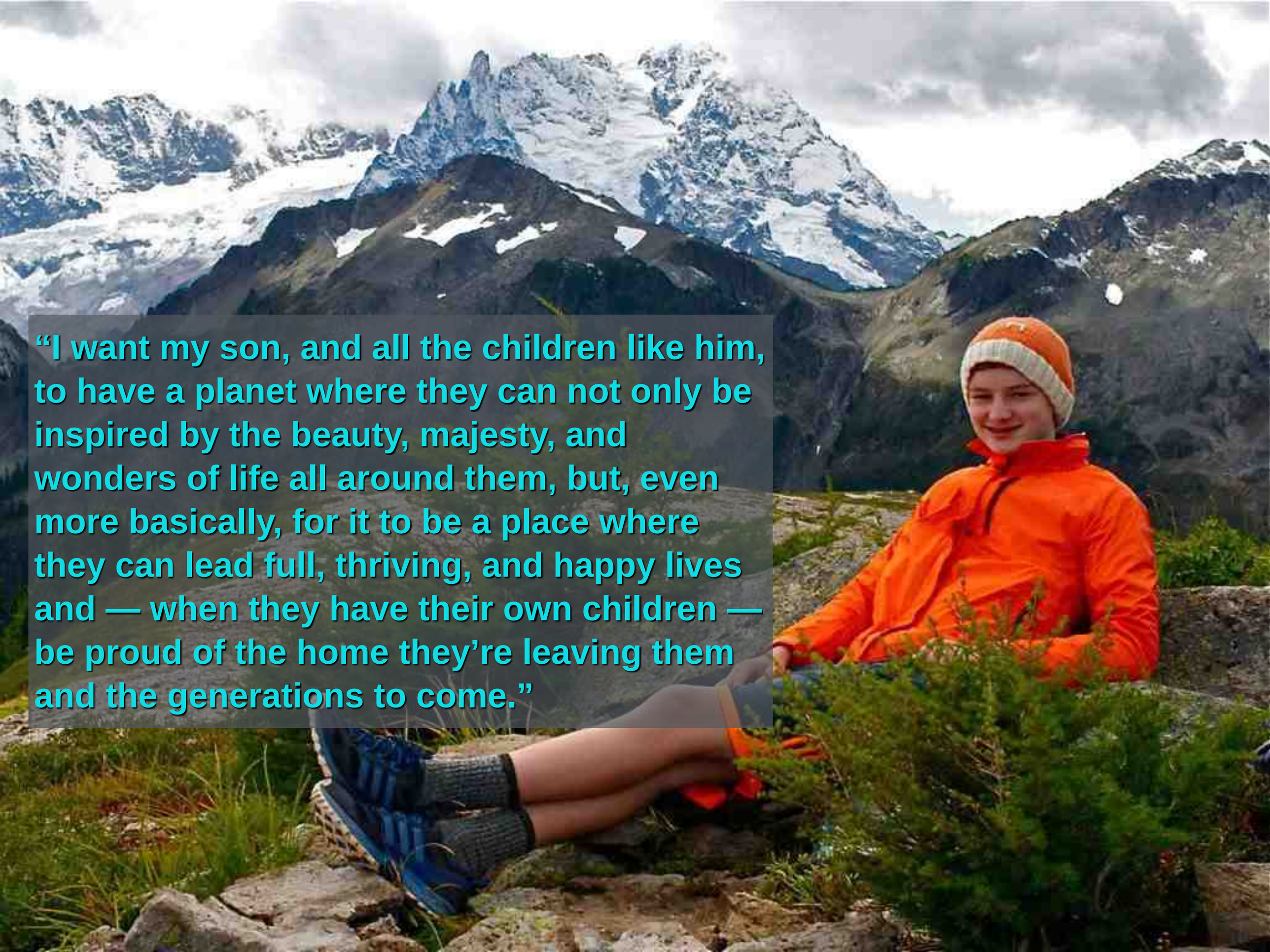
In public health, when faced with threats to entire populations, we act. For infectious diseases, we vaccinate. For lung cancer, we ban smoking. For injuries, we install seat belts and air bags. For obesity, we promote physical activity and healthier eating.!

For climate change, we need to act.”

Howard Frumkin, DrPH, MPH, MD

Dean, University of Washington School of Public Health, Professor, Env. and Occ. Health Sciences

Op-ed, Seattle Times, January 6, 2013


“I want my son, and all the children like him, to have a planet where they can not only be inspired by the beauty, majesty, and wonders of life all around them, but, even more basically, for it to be a place where they can lead full, thriving, and happy lives and — when they have their own children — be proud of the home they’re leaving them and the generations to come.”

"There is no Plan B,
because we do not have a Planet B"

UN Secretary General Ban Ki-moon

Climate Week NYC 2014

Thank you

kenlans@raincity.com

Source: NASA