

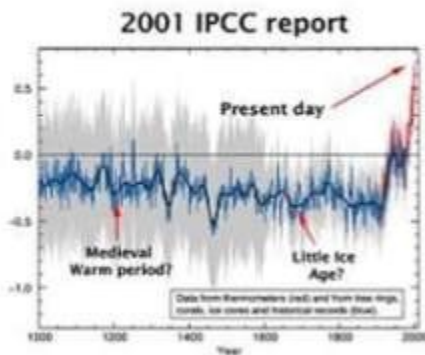
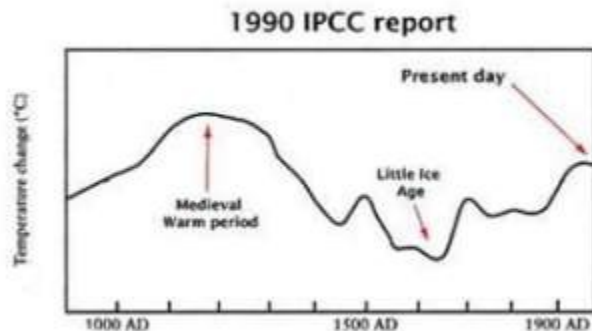
# Do We Have A Climate Crisis?

Dr. Heinz Lycklama

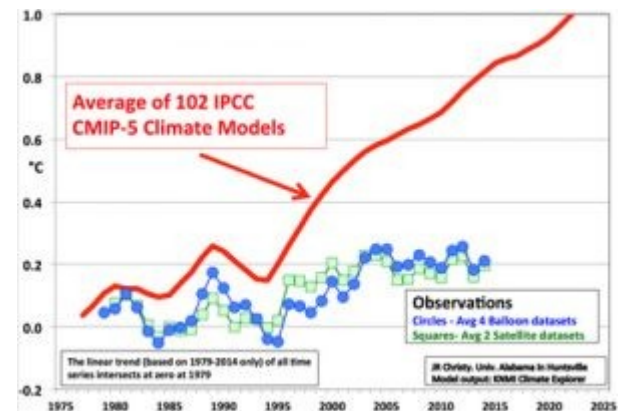
[heinz@osta.com](mailto:heinz@osta.com)

[HeinzLycklama.com/messages](http://HeinzLycklama.com/messages)

Climate change over the past 1000 years as shown by the IPCC



The Hockey Stick Chart

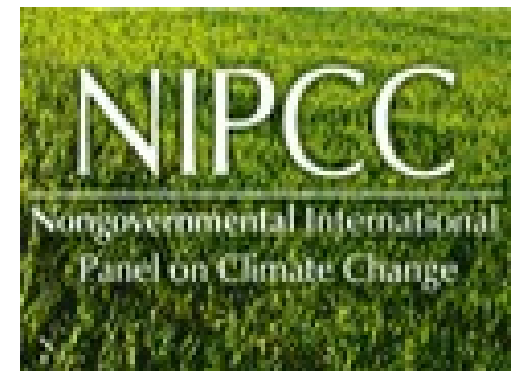


# Do We Have a Climate Crisis?

- Biblical Mandate
- The Global Warming (GW)/CC Claims
- Some Climate Change (CC) Facts
- Greenhouse Effect
- Greenhouse Gases
- UN IPCC (Intergovernmental Panel on CC)
- NIPCC (Nongovernmental International Panel on CC)
- Consideration of 16 Key Issues
- Benefits of Warming and More CO<sub>2</sub>
- What Do The Experts Say?
- In Conclusion

**IPCC**

INTERGOVERNMENTAL  
PANEL ON  
CLIMATE CHANGE



# Biblical Mandate

- Be fruitful and multiply and fill the earth and subdue it, and have dominion over the fish of the sea and over the birds of the heavens and over every living thing that moves on the earth. **Gen. 1:28**
- While the earth remains, seedtime and harvest, cold and heat, summer and winter, day and night, shall not cease. **Gen. 8:22**
- But test everything; hold fast what is good. **1 Th. 5:21**





# UN IPCC Claims

- Intergovernmental Panel on Climate Change (**IPCC**)
- GW occurring at a rapid rate
- Largely due to increased burning of fossil fuel
- Must cut back on CO<sub>2</sub> released into atmosphere
- Representatives of 190+ nations meet annually
- 6 IPCC reports issued over last 30+ years
- Claims refuted by Nongovernmental International Panel on Climate Change (**NIPCC**)
  - Nature, not human activity, rules the climate



# The Manmade GW/CC Claims

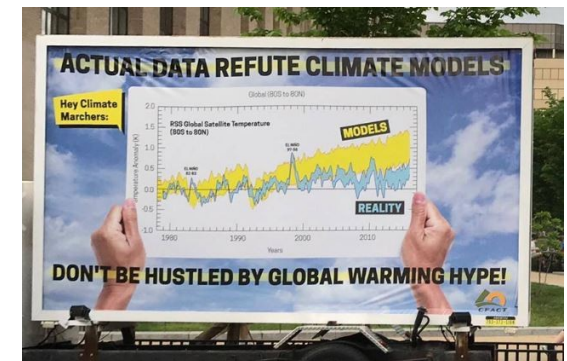
## ■ Predicted by the UN IPCC

- Real & human-caused
- +5 degrees C by 2100
- Arctic ice cap disappearing
- Polar bear population will decline
- Sea level will rise by 88+ cm in 2100
- Increased drought, extreme weather, more storms, heat waves, more wildfires, etc.
- Most significant threat to mankind
- Must act NOW!

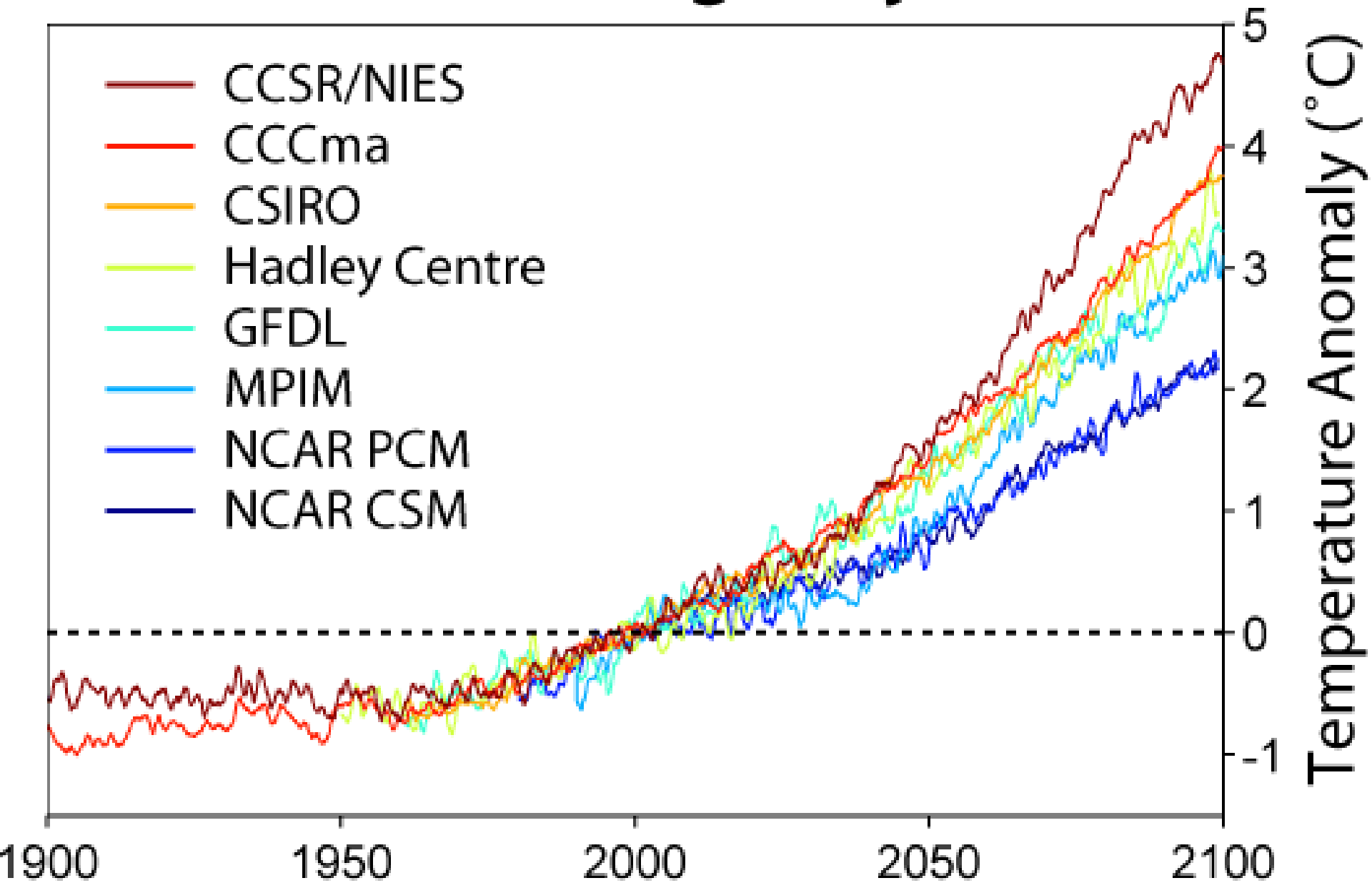
*“Before this century is over, billions of us will die ... “*

**James Lovelock**, scientist

## ■ What is the Reality?



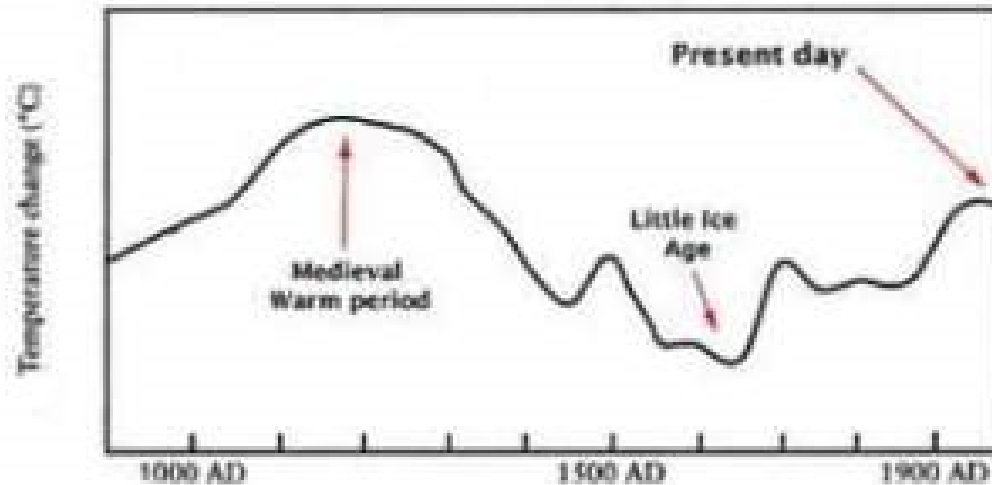
# Global Warming Projections



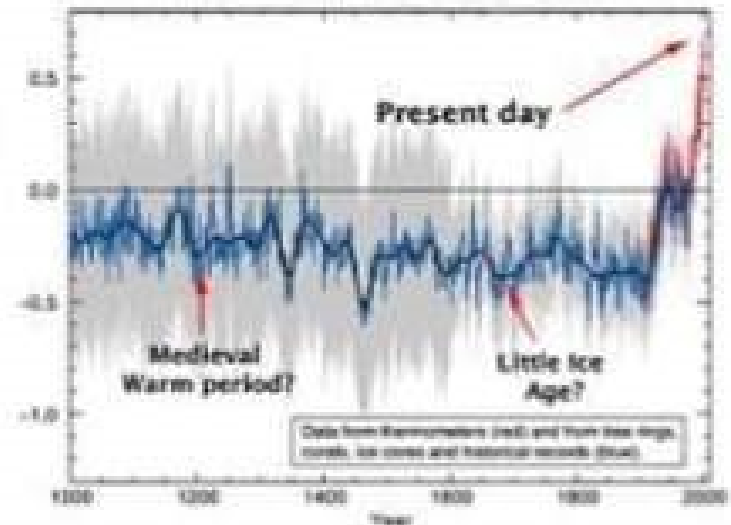
# The Changing UN IPCC Reports

Climate change over the past 1000 years as shown by the IPCC

1990 IPCC report

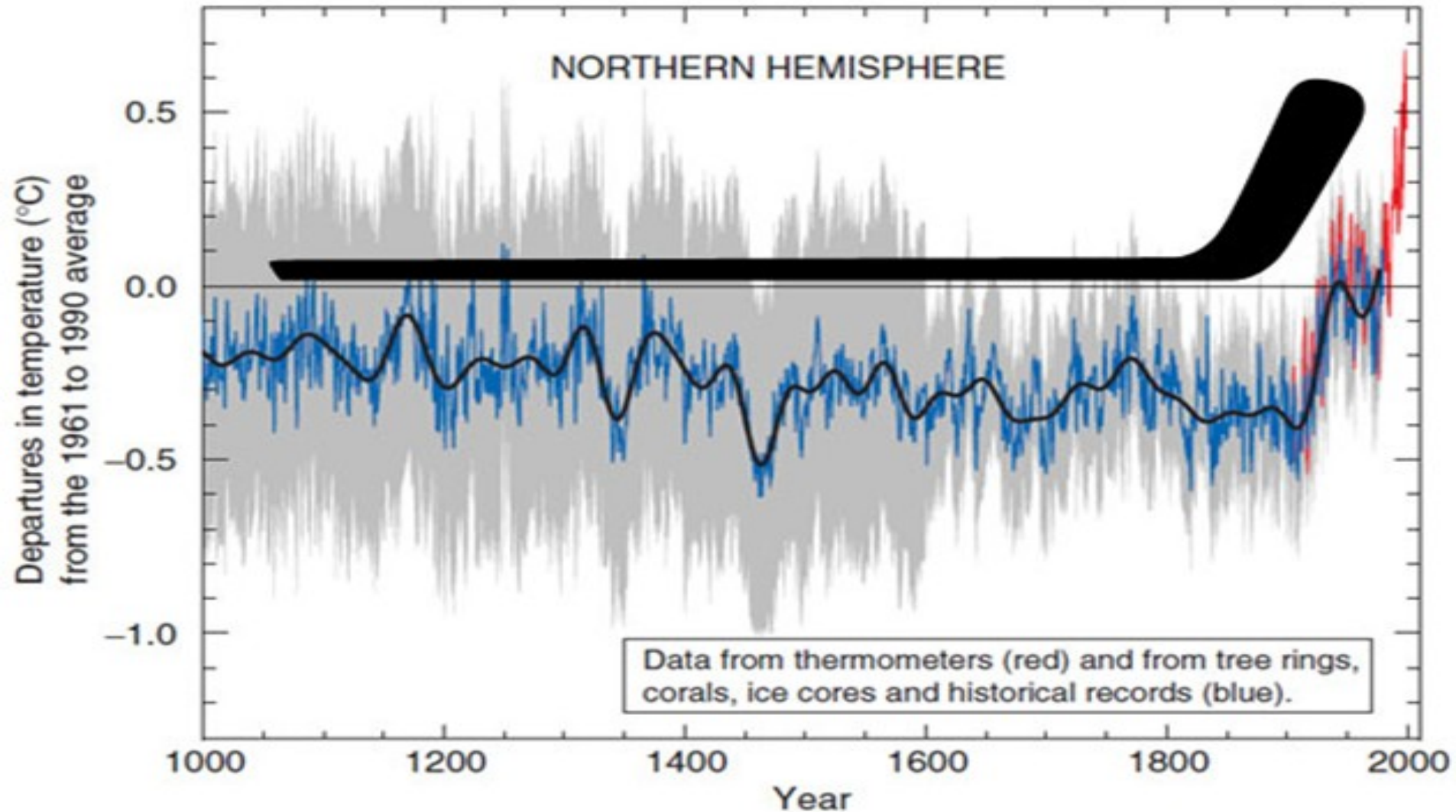


2001 IPCC report

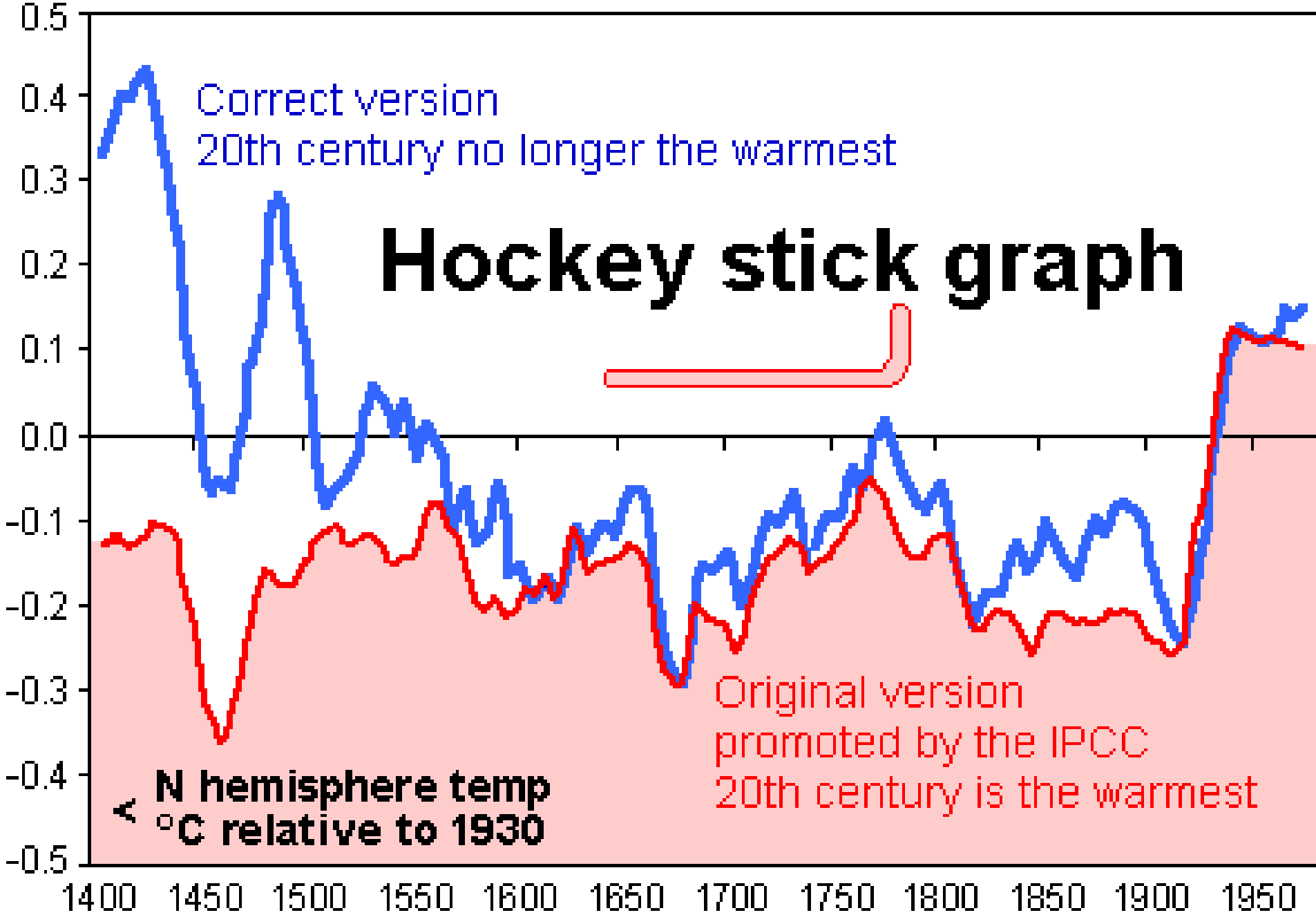


The Hockey Stick Chart

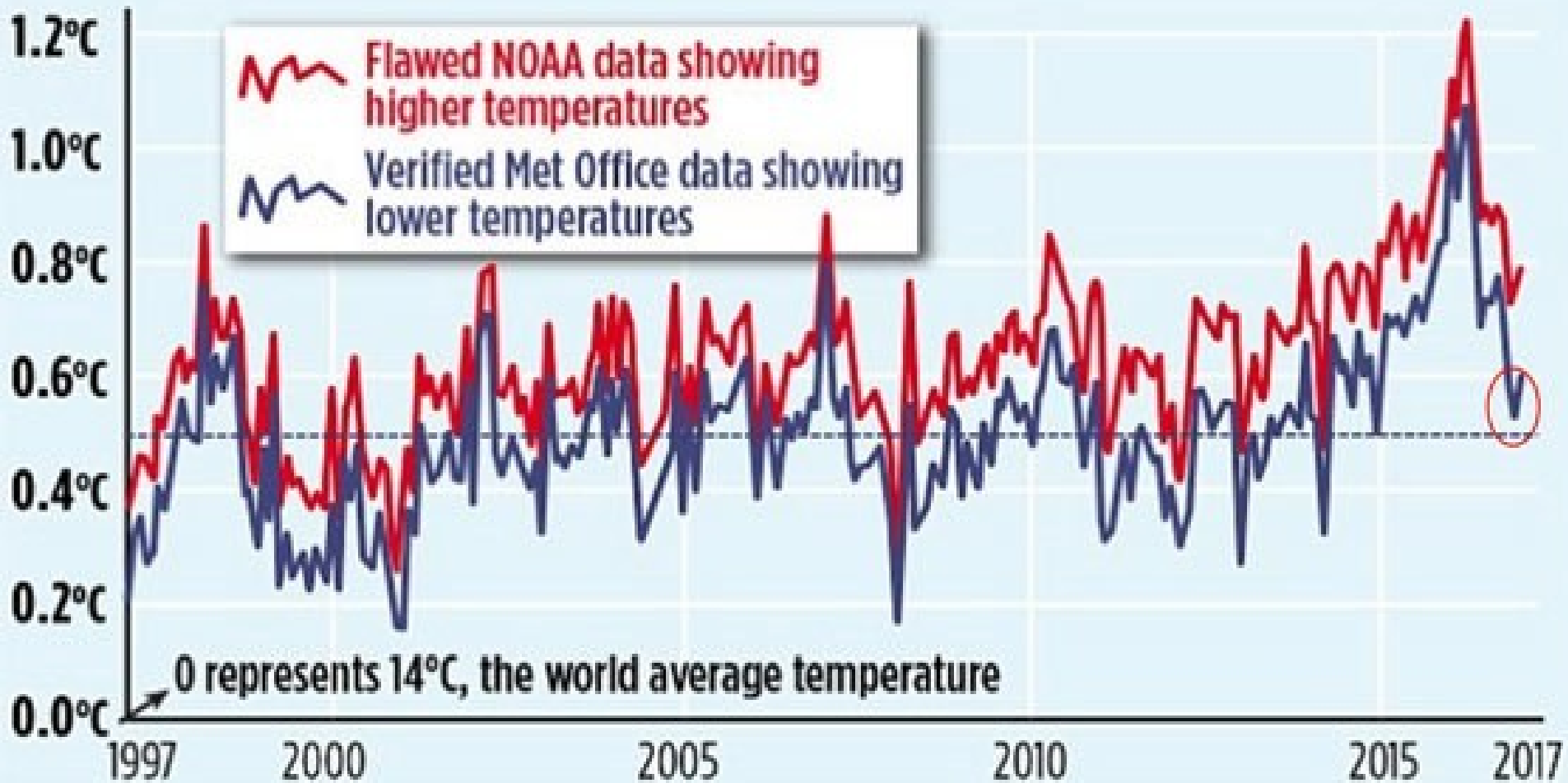
# Hockey Stick Chart







# MIT Researchers Slam GW Data

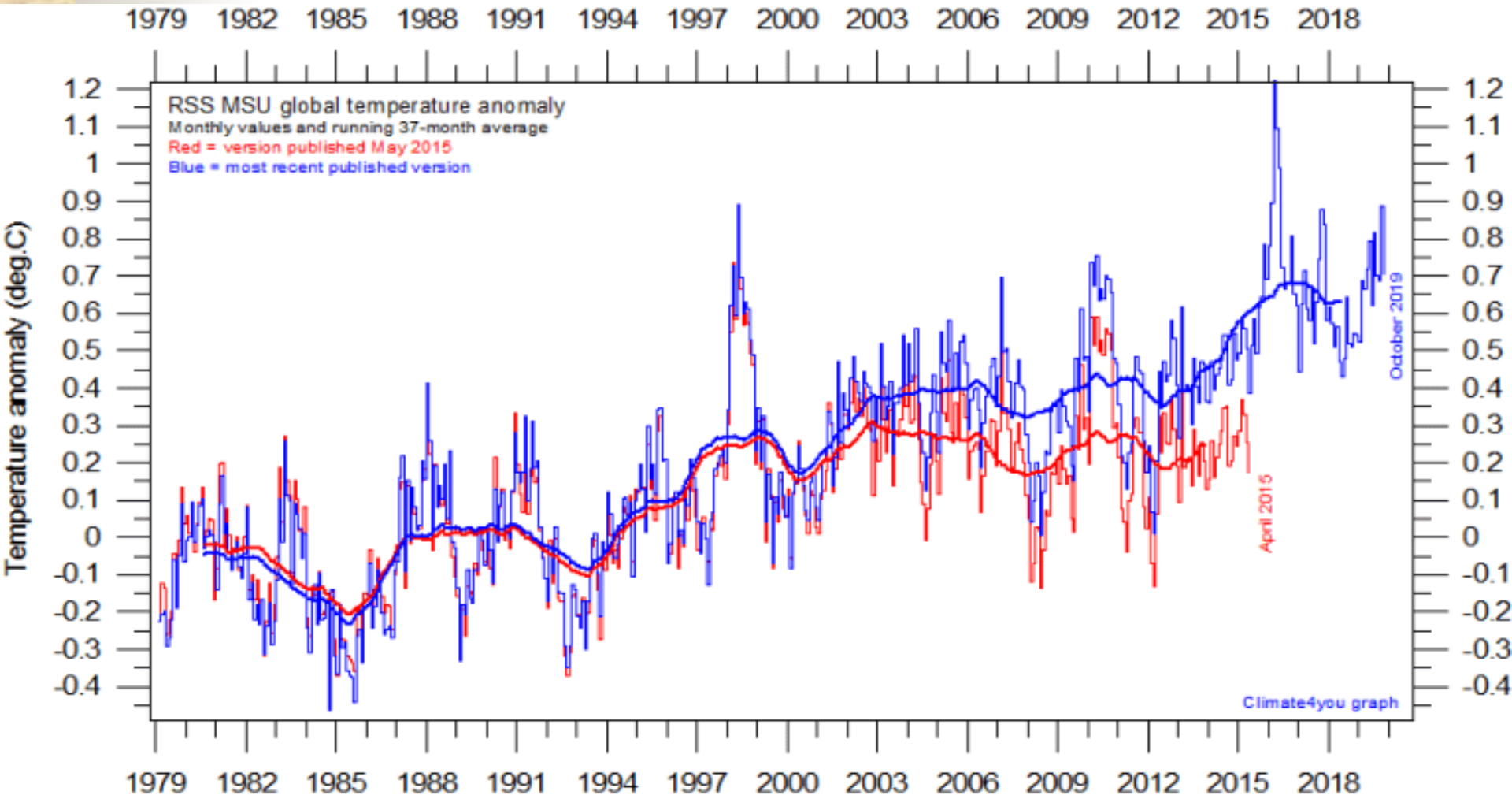


Reported on July 15, 2017

# UK MET Climate Fraud in 2002

RED – published in 2015

BLUE – most recently published





# NASA US Temperature, 1999-2019



# No Global Warming For 19 Years



# Global Cooling (GC) -> Global Warming (GW)?

GC alarmists: Gov. **Brown Jr.**, Dr. John **Holdren**, Dr. Paul **Ehrlich**

GW alarmists – Gov. **Brown Jr.**, Dr. John **Holdren**, Al **Gore**





# Global Cooling

December  
1973



January  
1977



April  
1977



December  
1979



# Global Warming

October  
1987



April  
2001



April  
2006



July  
2007





# Global Cooling? Global Warming?

Gov. Jerry Brown's 1977 Global Cooling BS, Recycled  
As Gov. Jerry Brown's 2014 Global Warming BS  
Posted on July 30, 2014



In 1977, Governor Brown warned that California was facing an unprecedented drought, blamed at the time on **Global Cooling**



# **CALIFORNIA GOVERNOR JERRY BROWN:**

**1977: 'UNPRECEDENTED  
CALIFORNIA DROUGHT  
CAUSED BY GLOBAL COOLING'**

**2015: 'UNPRECEDENTED  
CALIFORNIA DROUGHT  
CAUSED BY  
GLOBAL WARMING'**

**'HOT, COLD - WHAT'S  
THE DIFFERENCE?'**

**EMPHISKEY.COM**

“The entire North  
'polarized' cap will  
disappear in 5 years.”

-Al Gore, 2008

A satellite image of the Earth's North Pole, showing the ice cap and surrounding landmasses. The image is a composite of various satellite data, showing the extent of the ice and the surrounding ocean. The text "North Pole Ice Cap" and "August, 2013" is overlaid on the image.

North Pole Ice Cap  
August, 2013

# Global Energy Flows $\text{W m}^{-2}$

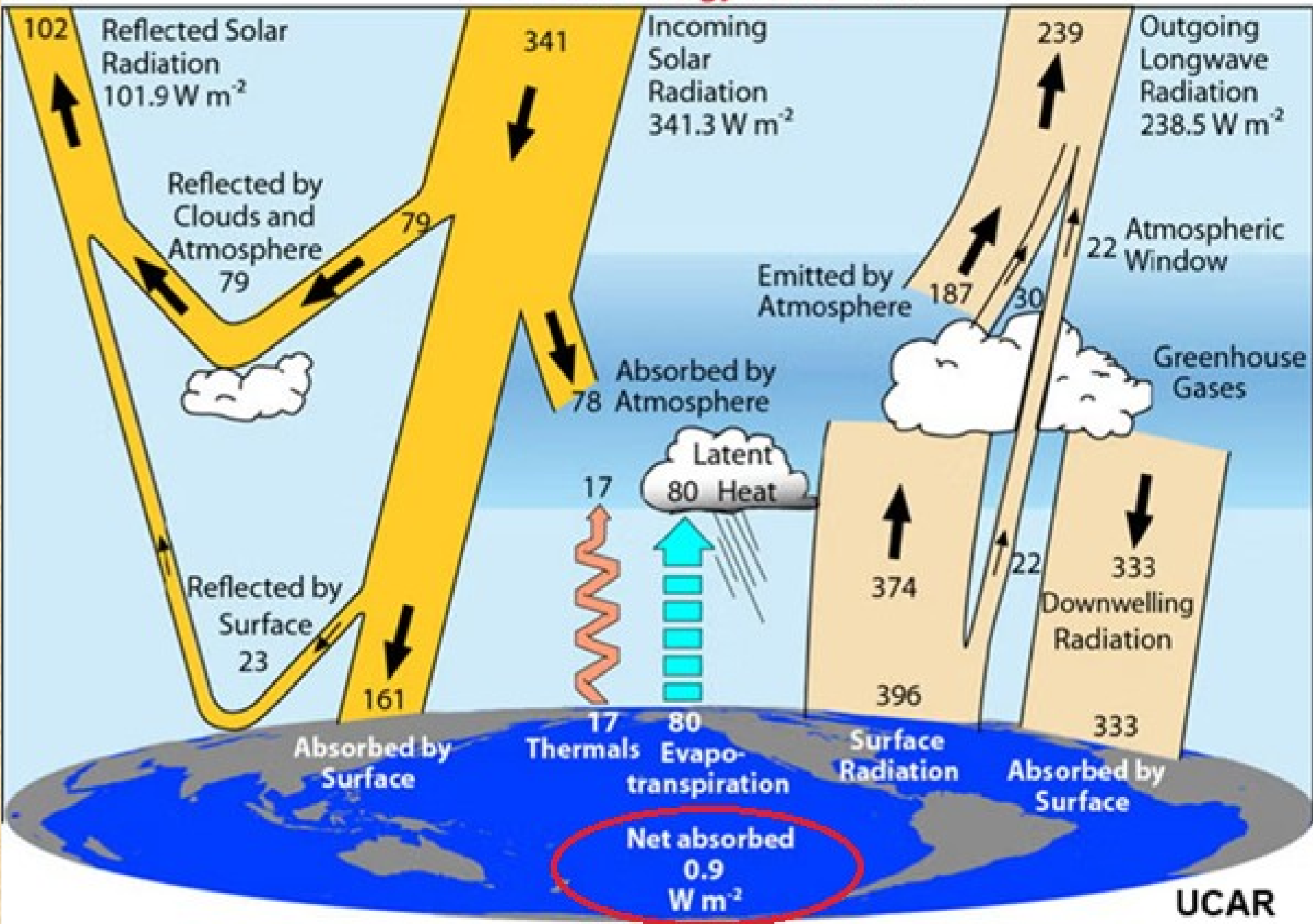
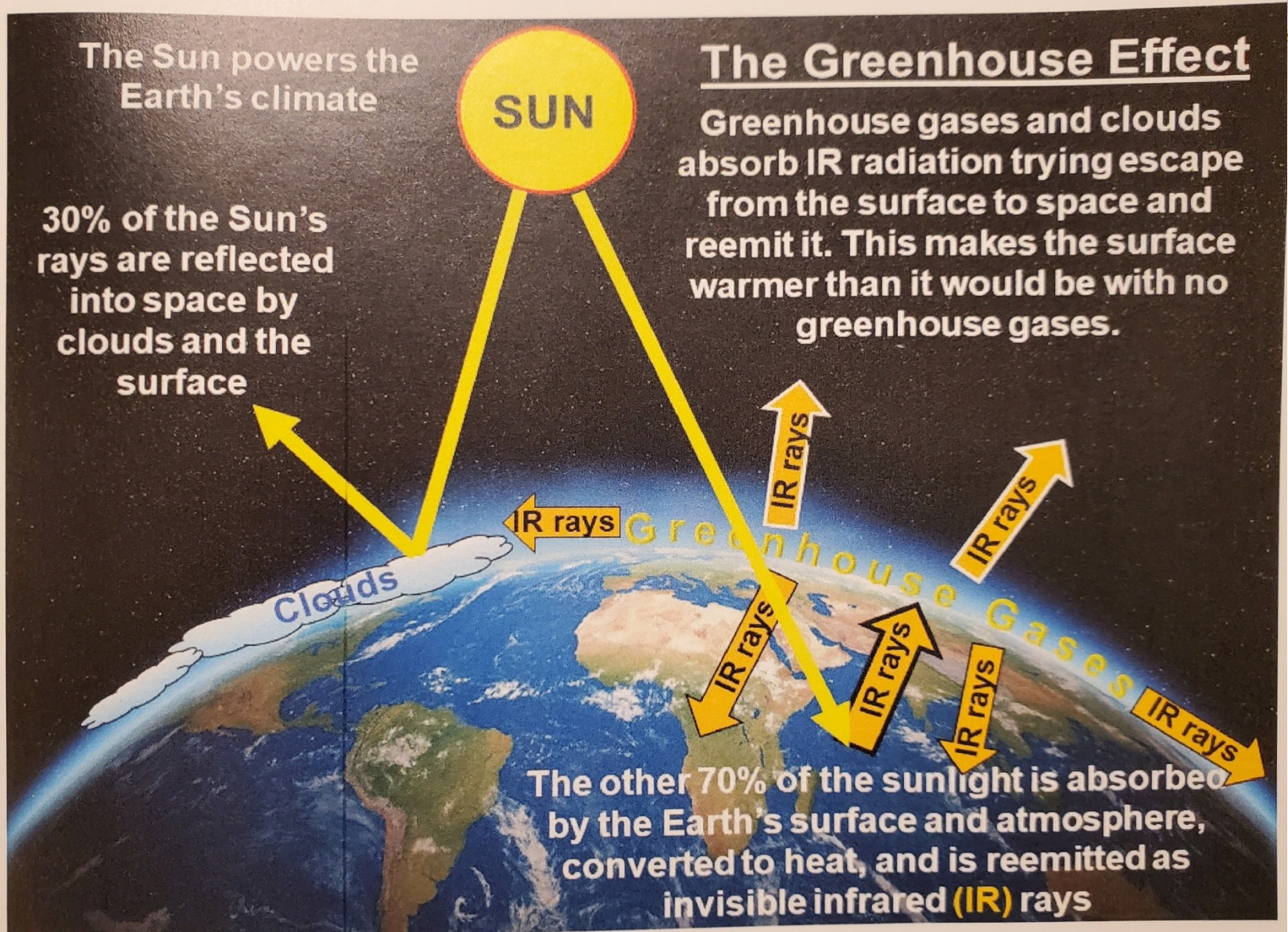




Figure 1: The greenhouse effect



(Modified from IPCC 2007)



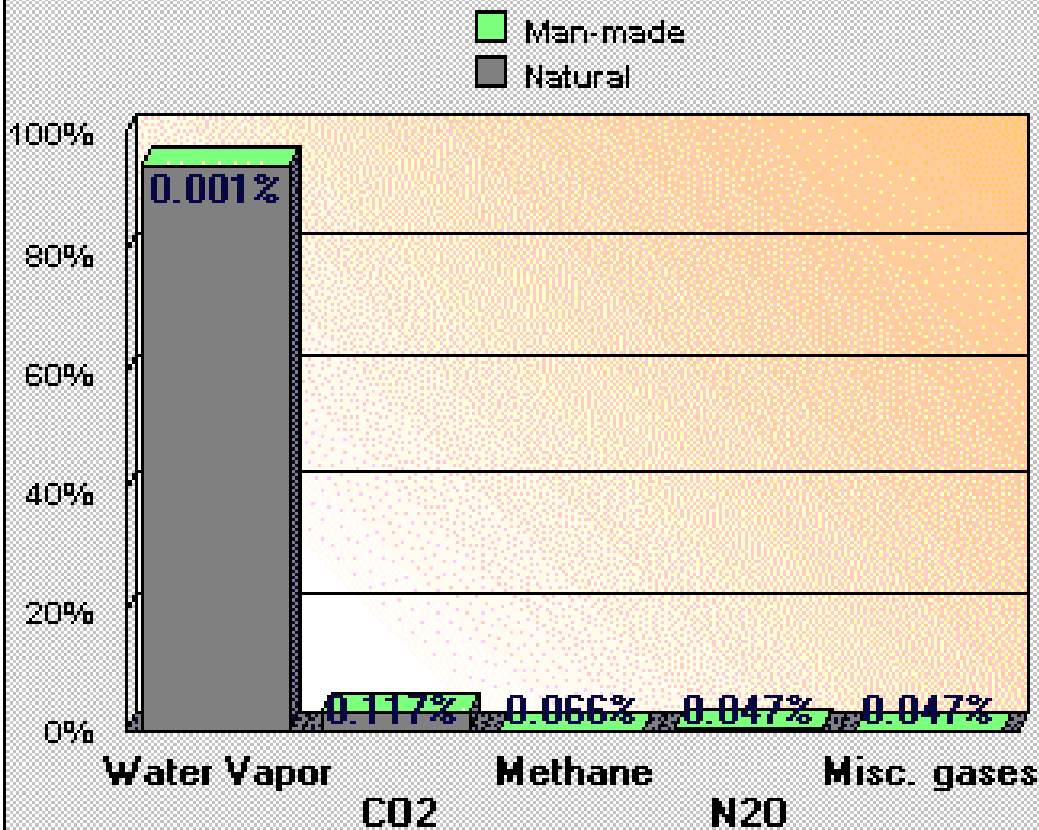
# Anthropogenic Contribution

**Anthropogenic (man-made) Contribution to the "Greenhouse Effect," expressed as % of Total (water vapor INCLUDED)**

Based on concentrations (ppb) adjusted for heat retention characteristics	% of All Greenhouse Gases	% Natural	% Man-made
Water vapor	95.000%	94.999%	<b>0.001%</b>
Carbon Dioxide (CO <sub>2</sub> )	3.618%	3.502%	<b>0.117%</b>
Methane (CH <sub>4</sub> )	0.360%	0.294%	<b>0.066%</b>
Nitrous Oxide (N <sub>2</sub> O)	0.950%	0.903%	<b>0.047%</b>
Misc. gases ( CFC's, etc.)	0.072%	0.025%	<b>0.047%</b>
Total	100.00%	<b>99.72</b>	<b>0.28%</b>

# Greenhouse Gases (with Water Vapor)

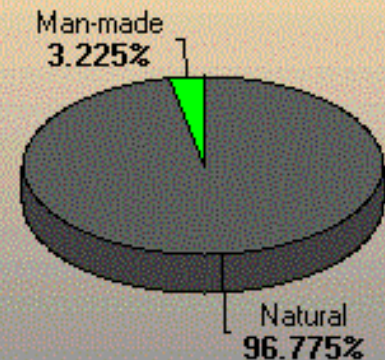
## Contribution to the Greenhouse Effect (Including water vapor)



## Greenhouse Gases

Water vapor & clouds ~95%  
Carbon dioxide [CO<sub>2</sub>] ~3.6%  
Methane [CH<sub>4</sub>] ~0.36%  
Nitrous Oxide [N<sub>2</sub>O] ~.95%  
Miscellaneous Gases ~.07

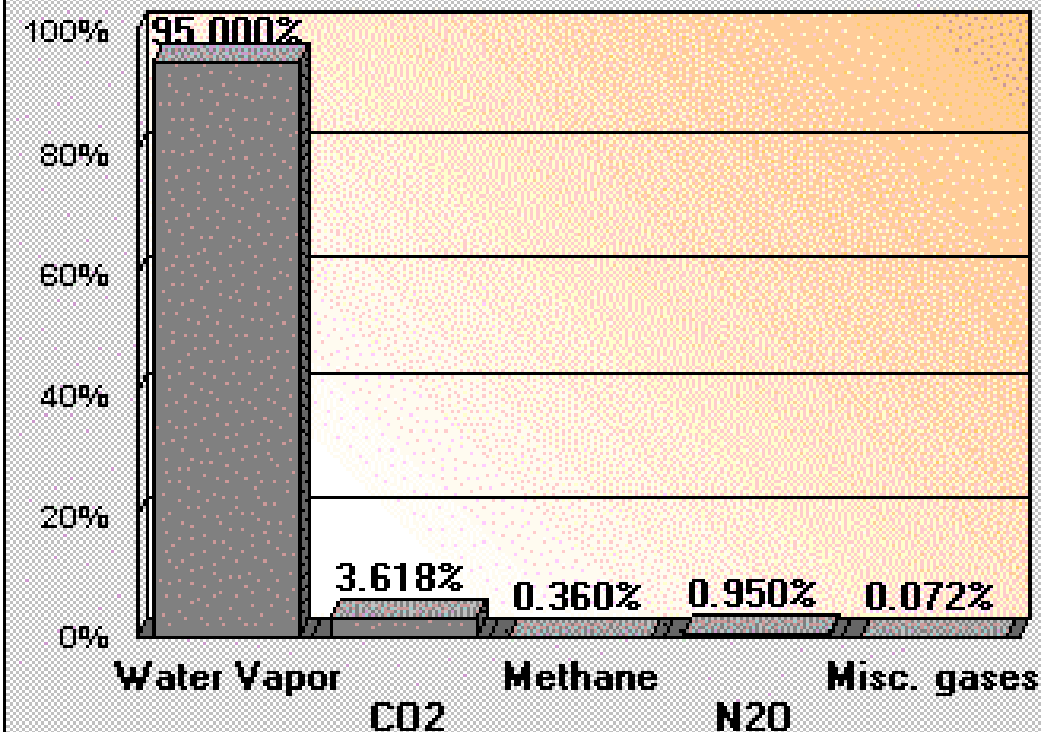
## Carbon Dioxide (CO<sub>2</sub>)



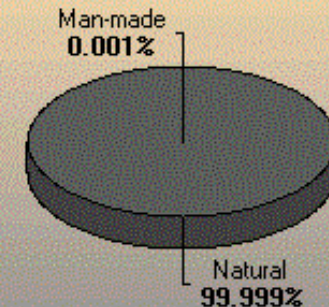
Human contribution to greenhouse effect = 0.28%

# Natural & Manmade Sources

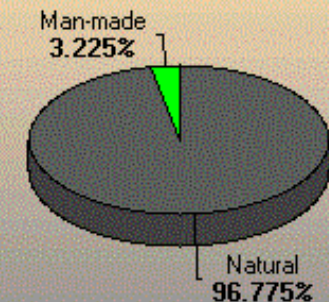
**Contribution to the "Greenhouse Effect"  
(Natural and Man-made Sources)**



**Water Vapor (not droplets)**



**Carbon Dioxide (CO2)**

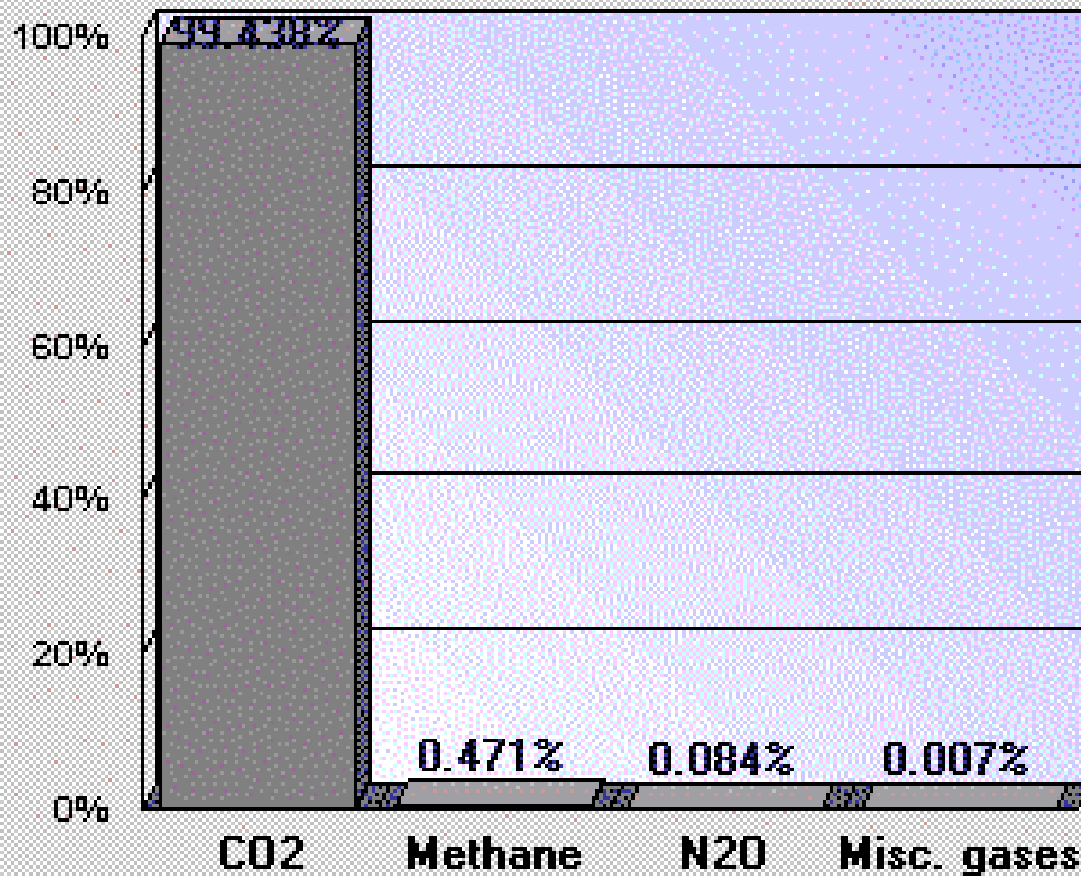


**Man-made CO2** contributions cause only about **0.117%** of Earth's greenhouse effect, (factoring in **water vapor**). This is insignificant!

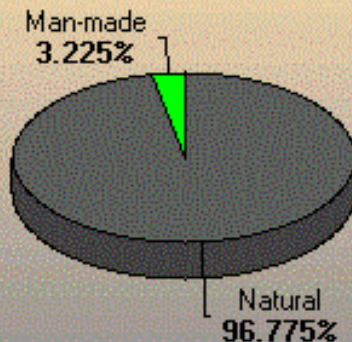


# Greenhouse Gases (no Water Vapor)

**Greenhouse Gas Concentrations (% of total)  
Natural and Man-made Sources (except water vapor)**



**Carbon Dioxide (CO2)**



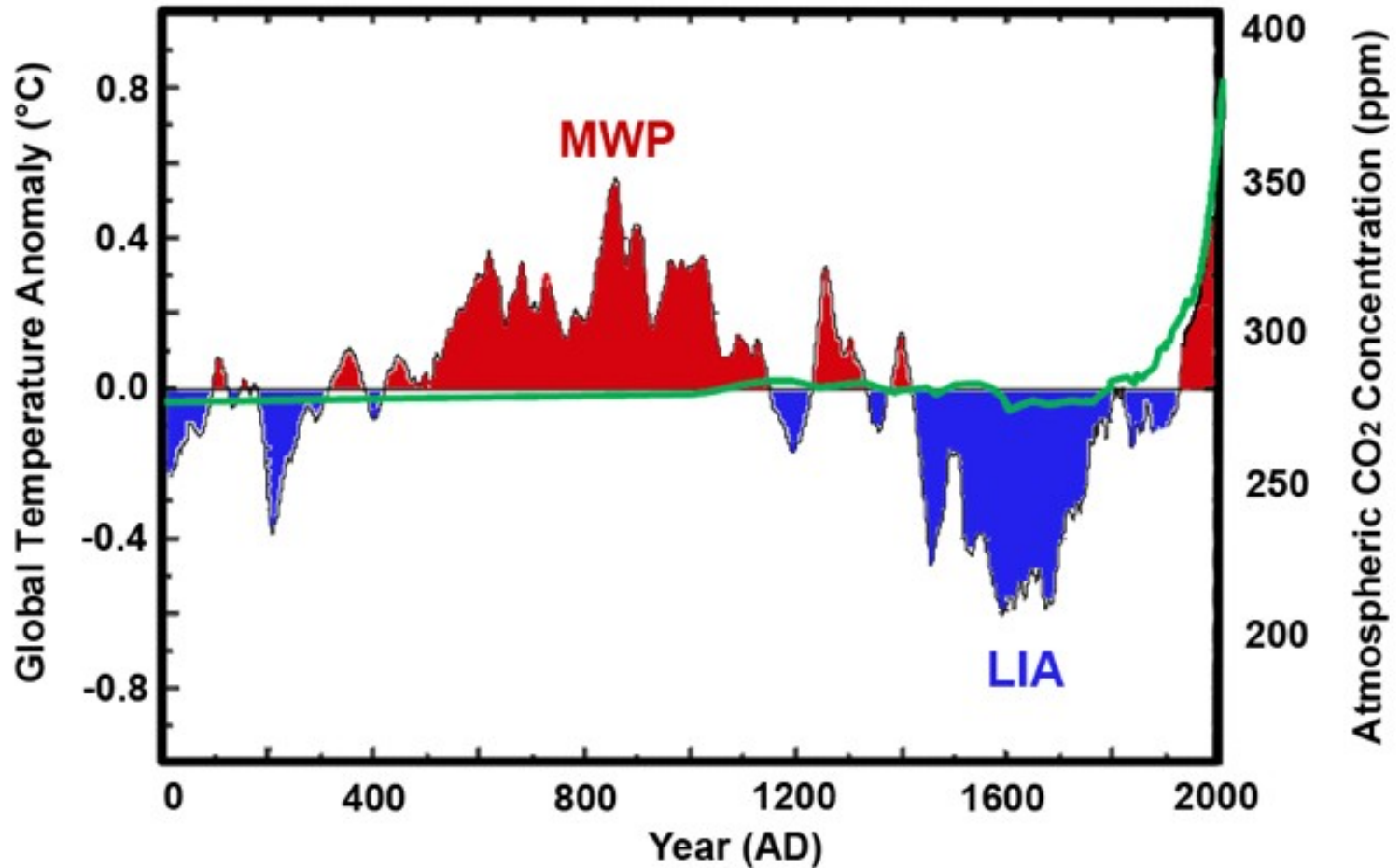




# Issue #1

## Climate Always Changing

# Mean Relative Temperature History



# GLOBAL TEMPERATURES (2500 B.C. TO 2040 A.D.)

## MAJOR GLOBAL COOLING FROM 2007 TO 2009

A 0.9 Degree Fahrenheit drop in global temperatures occurred from October 2007 to February 2009.

## MOUNT PINATUBO ERUPTION (Philippines)

1.1 Degree F. Rapid Cool Down (June 1991 to March 1992)  
Global Temperature Went From 0.6 Degrees Above Normal To 0.5 Degrees Below Normal.

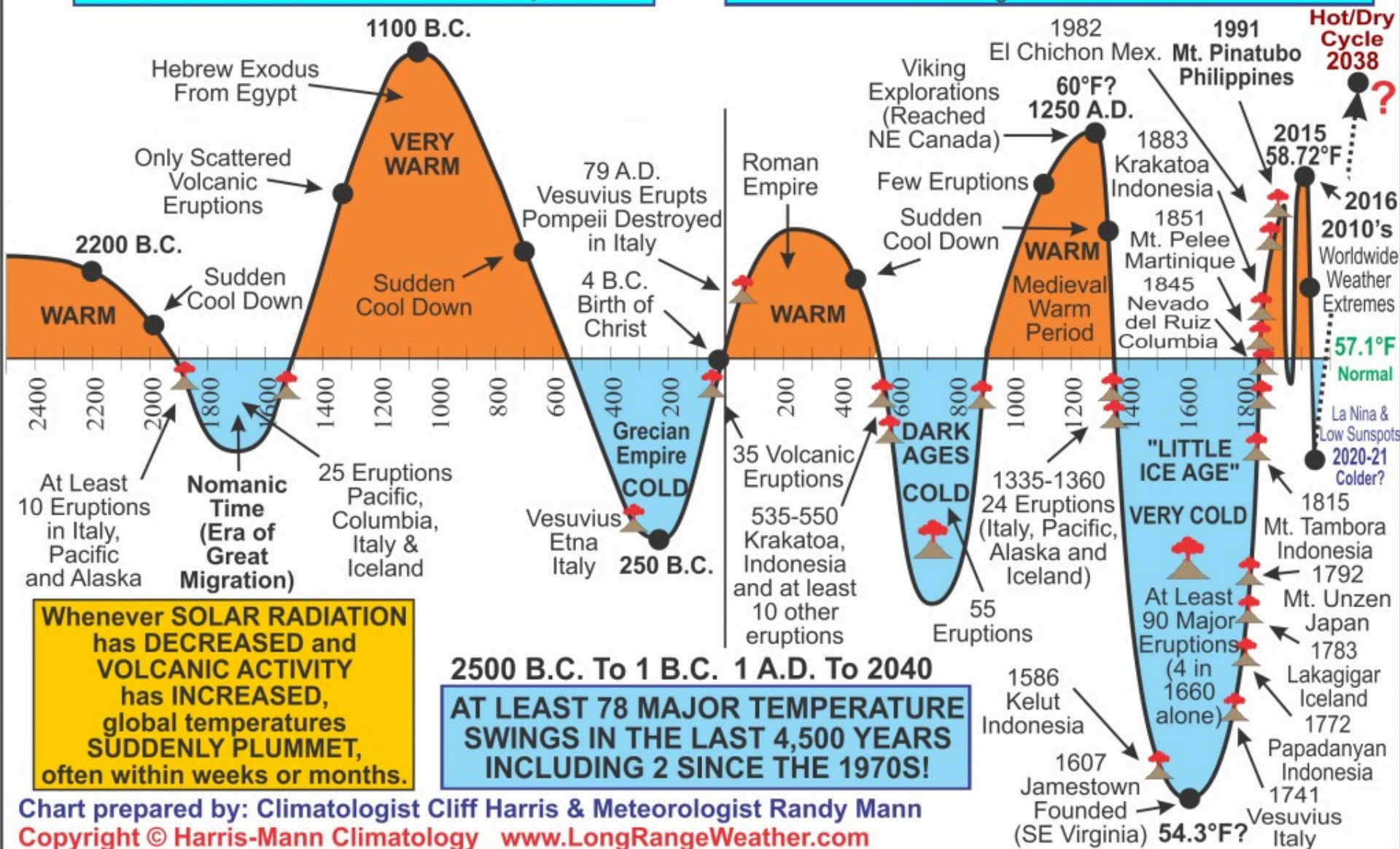
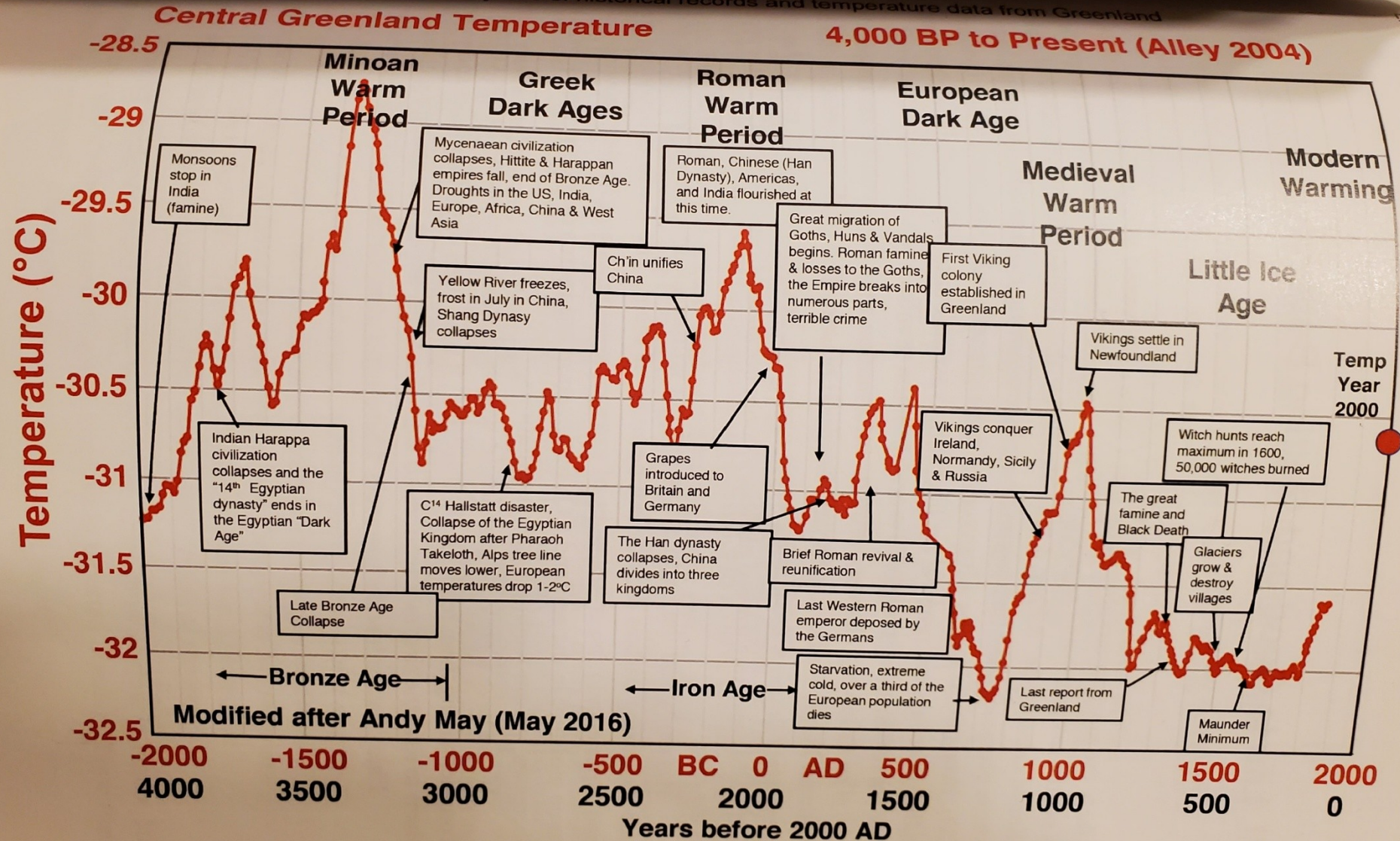


Chart prepared by: Climatologist Cliff Harris & Meteorologist Randy Mann

Copyright © Harris-Mann Climatology [www.LongRangeWeather.com](http://www.LongRangeWeather.com)



# Greenland Temperature Record







## Issue #2

CO<sub>2</sub> Is Required For Life  
CO<sub>2</sub> is Not a Pollutant  
CO<sub>2</sub> Increases Food Production

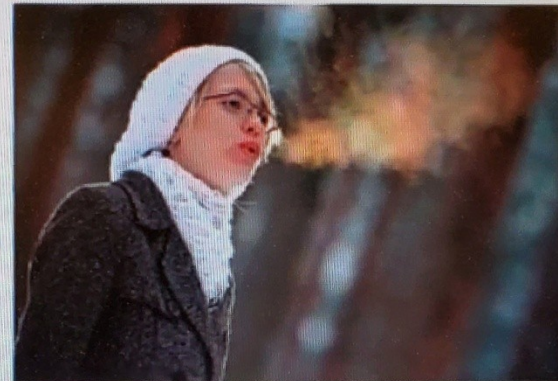
# CO<sub>2</sub> Is NOT A Pollutant!

CO<sub>2</sub> is not a pollutant!



**Power plant's breath:**

70% N<sub>2</sub>  
5% O<sub>2</sub>  
5% H<sub>2</sub>O  
20% CO<sub>2</sub>



**Alice's breath:**

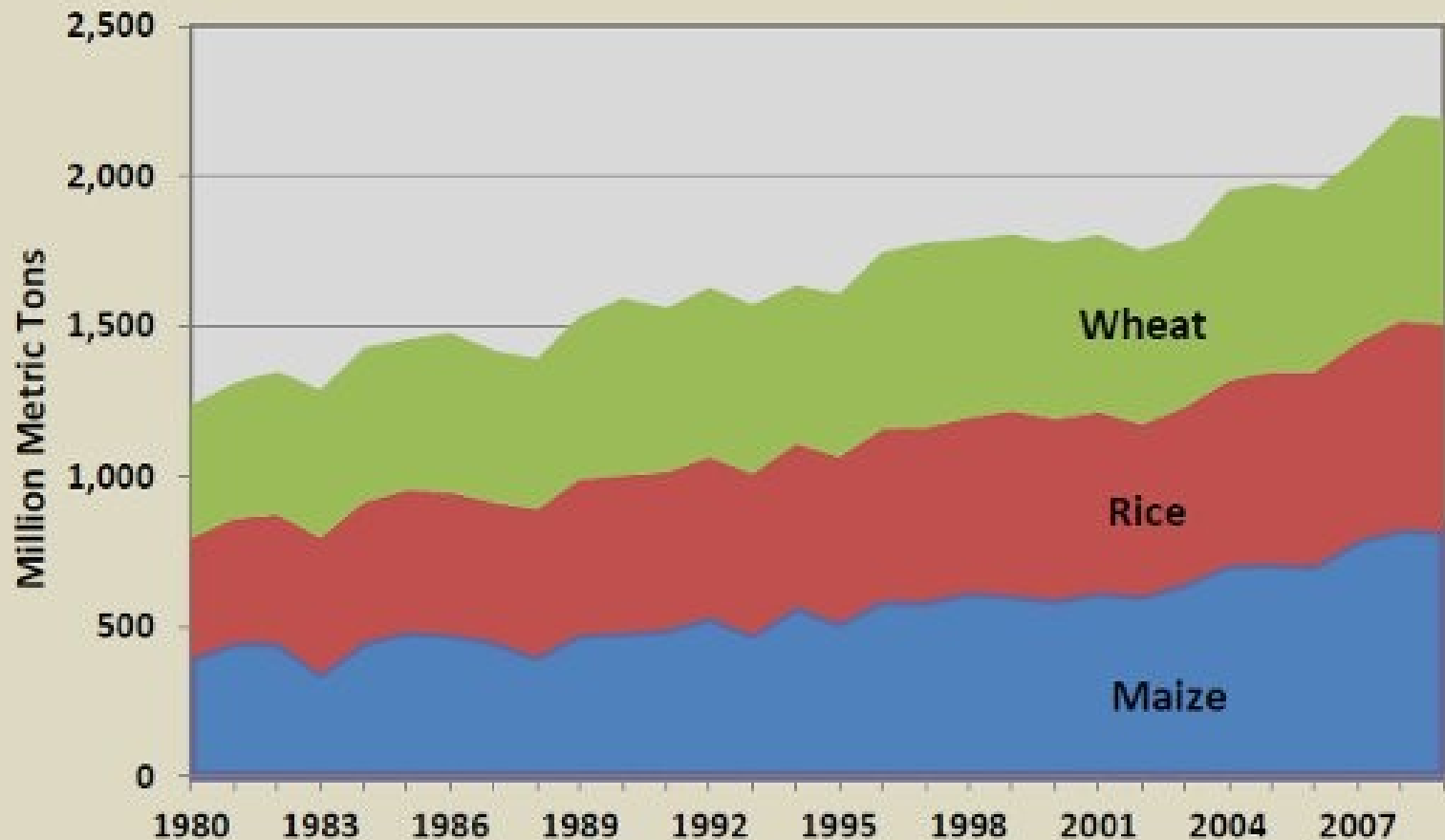
75% N<sub>2</sub>  
15% O<sub>2</sub>  
6% H<sub>2</sub>O  
4% CO<sub>2</sub>

Each human exhales about 2 pounds of CO<sub>2</sub> per day.



# Growth and Increased CO<sub>2</sub>

**Figure 1. World Grain Production, 1961–2010**

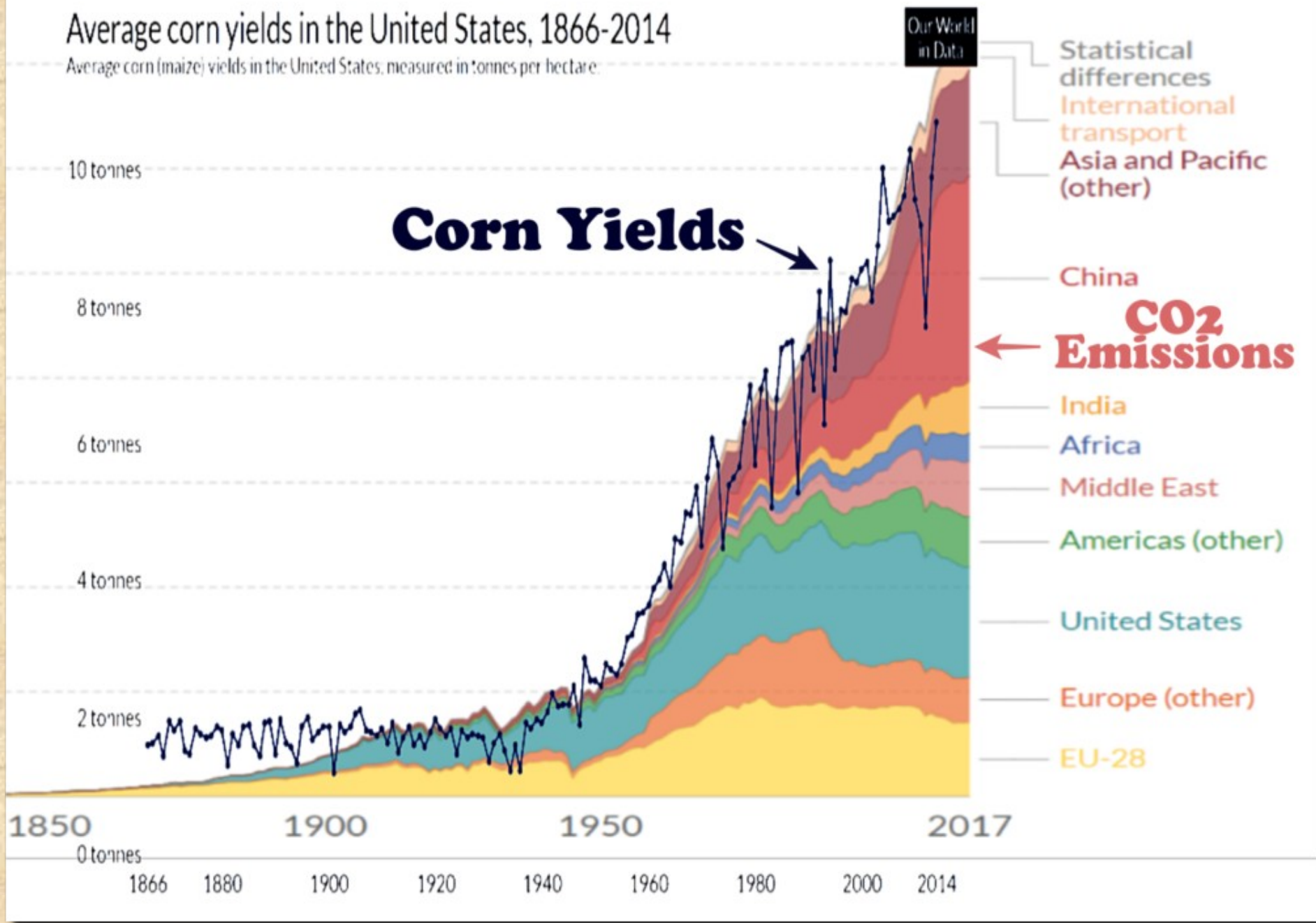


© Worldwatch Institute

Source: FAO

# Average corn yields in the United States, 1866-2014

Average corn (maize) yields in the United States, measured in tonnes per hectare:





# Is CO2 Plant Food?

Here is what happens with more CO2



385 ppm



535 ppm



685 ppm



835 ppm





# Issue #3

## The Science is Not Settled

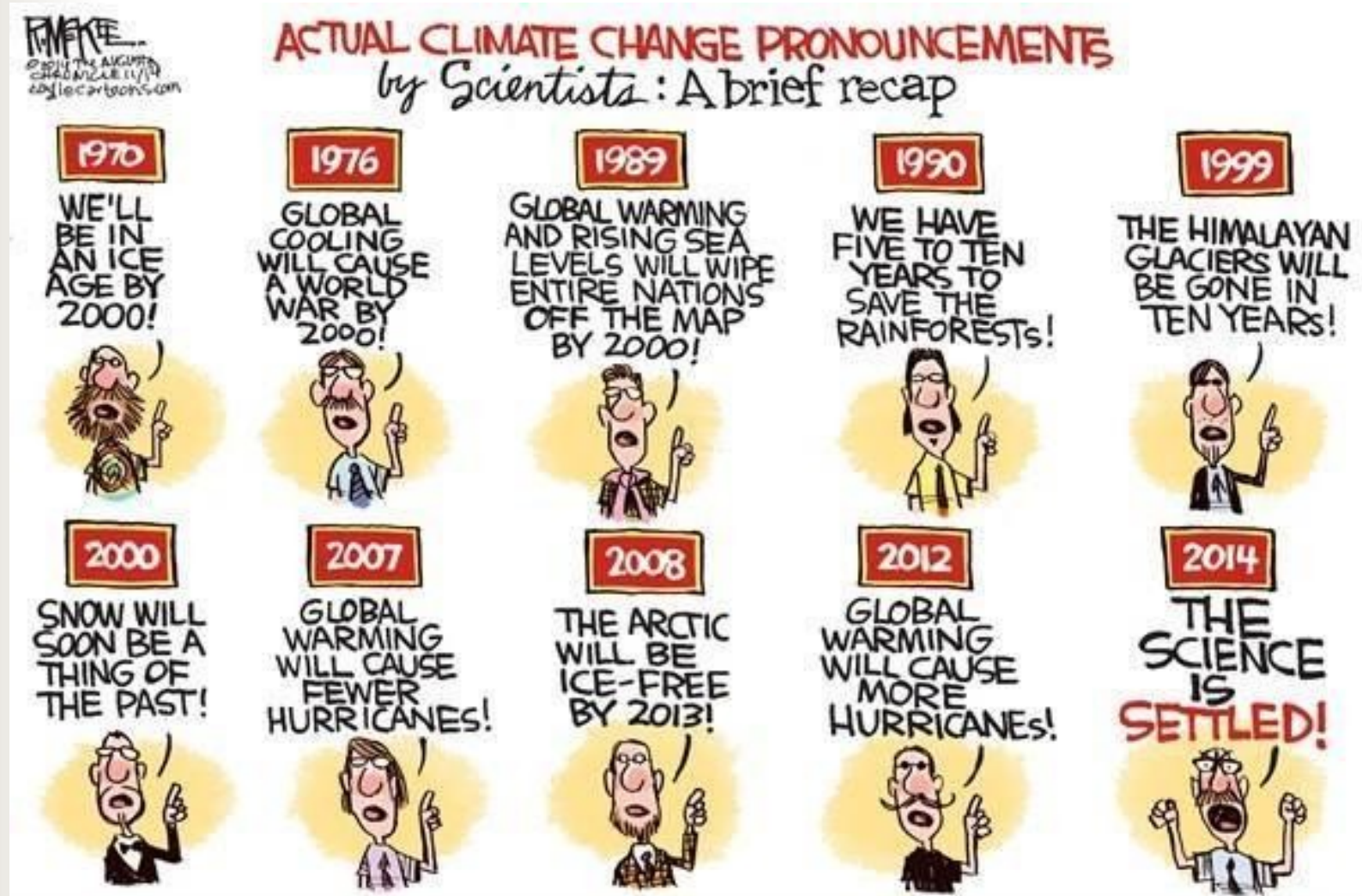


# Botched Predictions for 2015

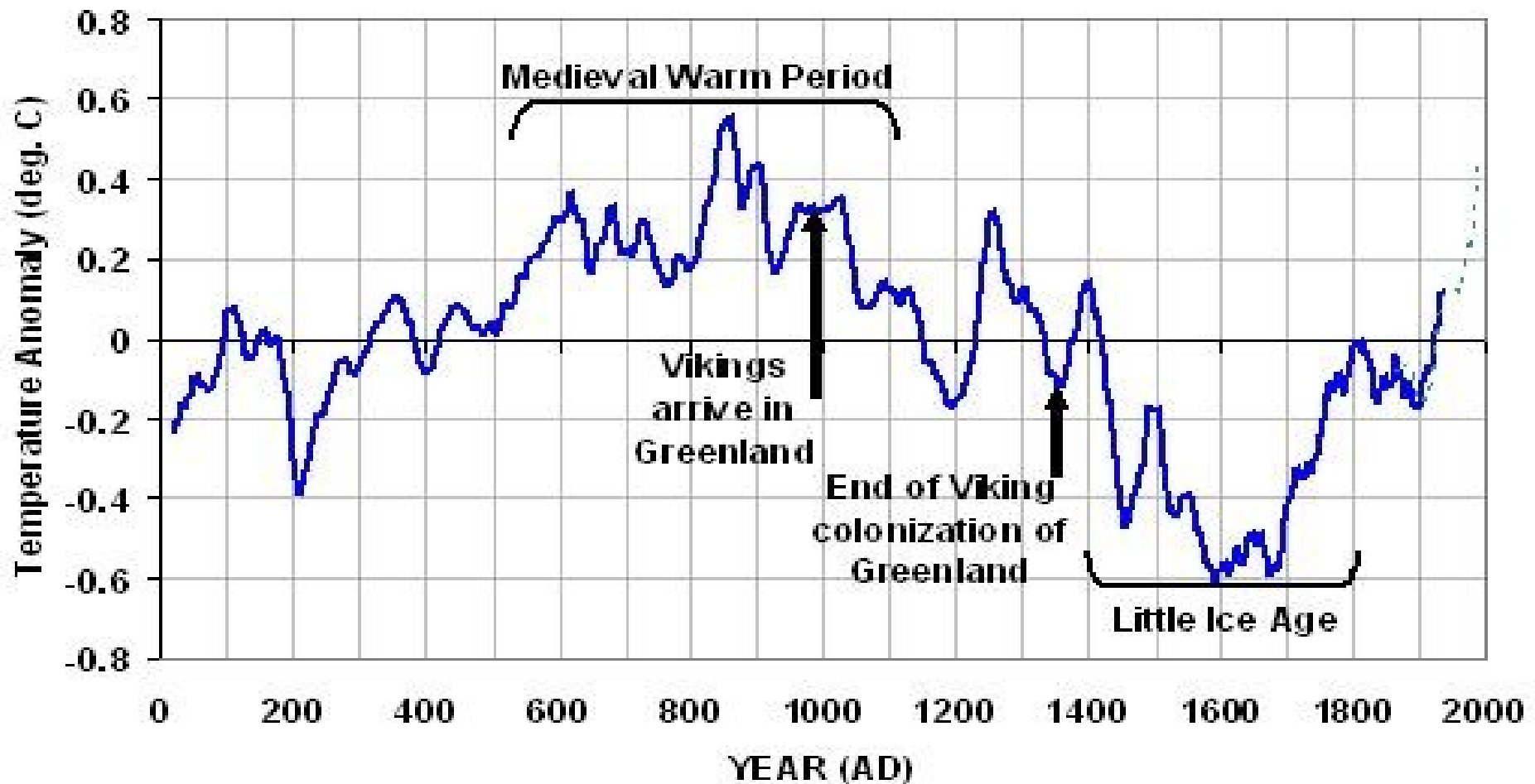
- Predictions by Dr. Paul Ehrlich, **Dr. John Holdren** [Obama's Science Advisor], the UN
  - Made in **1970's** and **1980's** about **Global Cooling**
- All came to naught:
  - UN overestimated GW by 2015
  - All Rainforest Species Will Be Extinct
  - Oil will run out by 2015
  - Arctic sea ice will disappear by 2015
  - Looking to the future: A billion people could die from climate change by 2020
- **Holdren in 1971: “new ice age likely”**



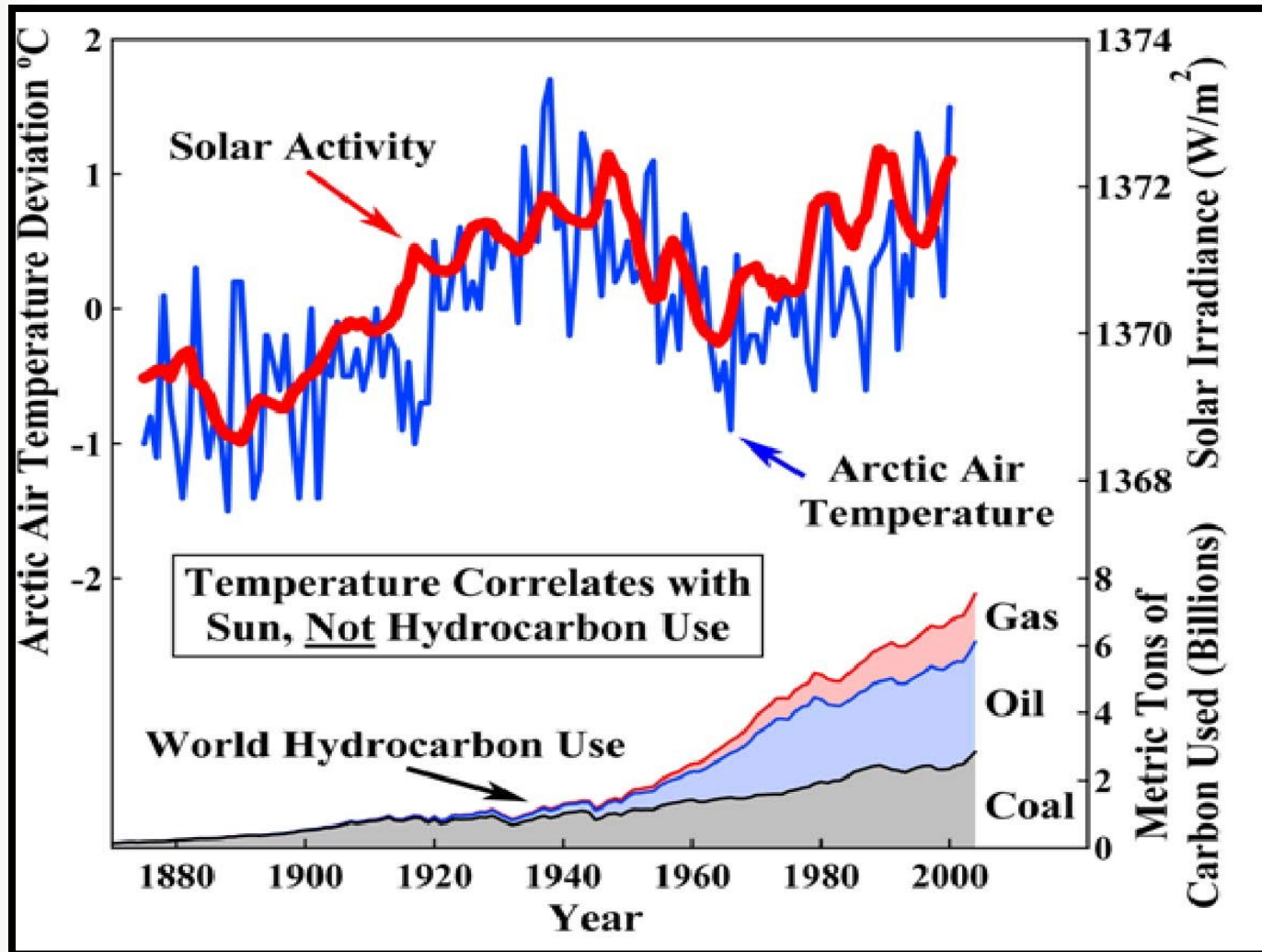
# Actual CC Pronouncements



# 2000 Years of Global Temperatures

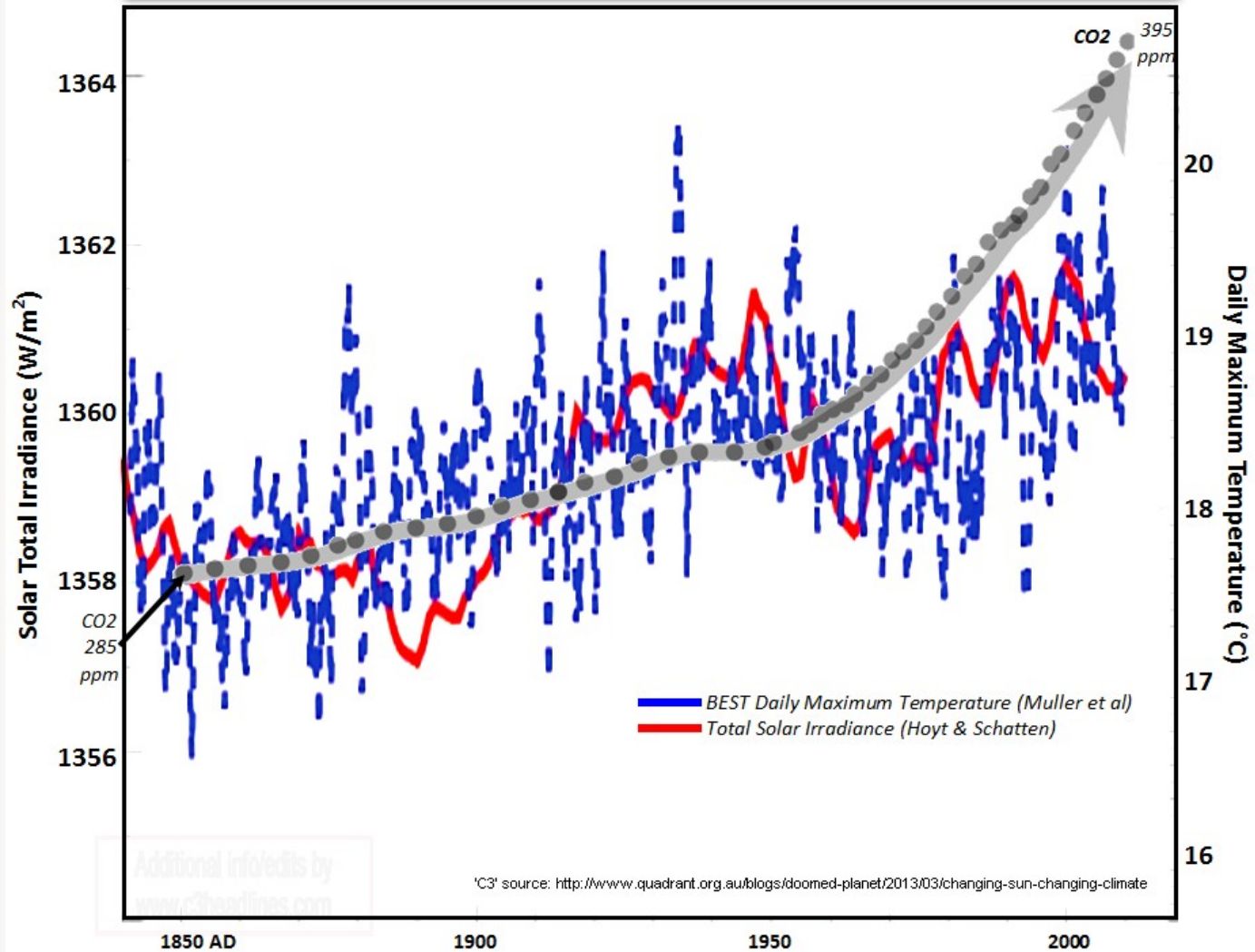


# 30-Year Cooling in Mid-Century



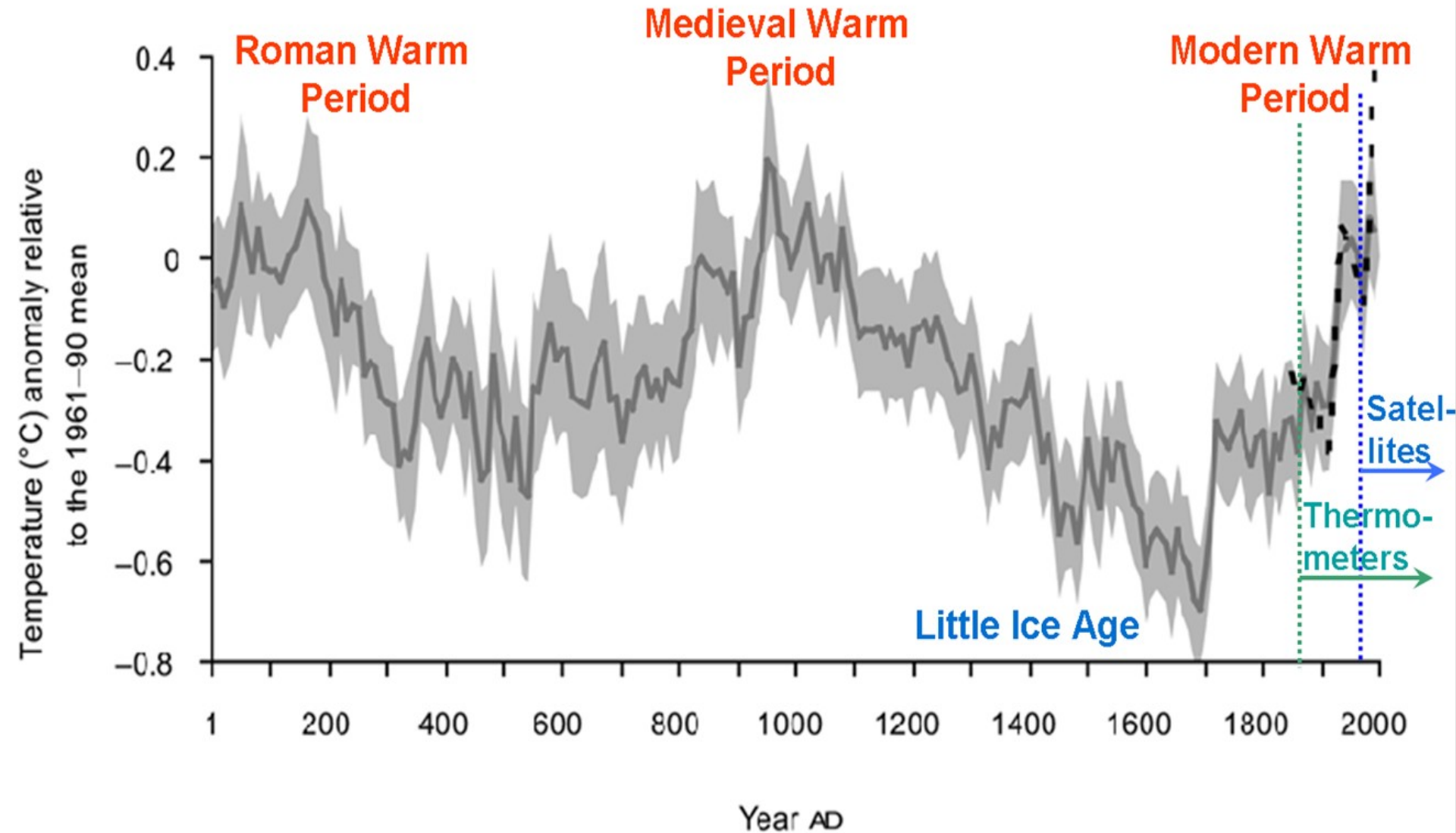


**Solar Activity Closely Related To Climate Temperature Change**  
*CO2 levels have a weak influence on U.S. maximum temperatures*



# Temperature Reconstruction\* for N. Hemisphere, 1 - 2000 AD

## Shows Modern Warm Period Not Exceptional



# Battle of the graphs: Mann versus Ball

## Temperature anomaly

Relative to 1900-1990

+1.0

+0.5 °C

0.0

-0.5

-1.0

Michael Mann's version

The IPCC  
"hockey stick"

1000

1200

1400

1600

1800

2000

## Climatic changes in europe

Over the past thousand years

Tim Ball's version

10.0

20th-century  
average  
temperature

9.5 °C

9.0

8.5

900

1000

1100

1200

1300

1400

1500

1600

1700

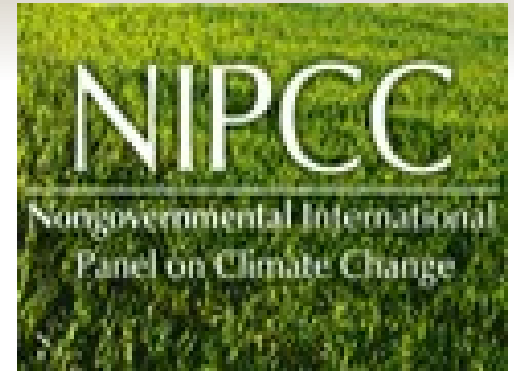
1800

1900

2000



# NIPCC



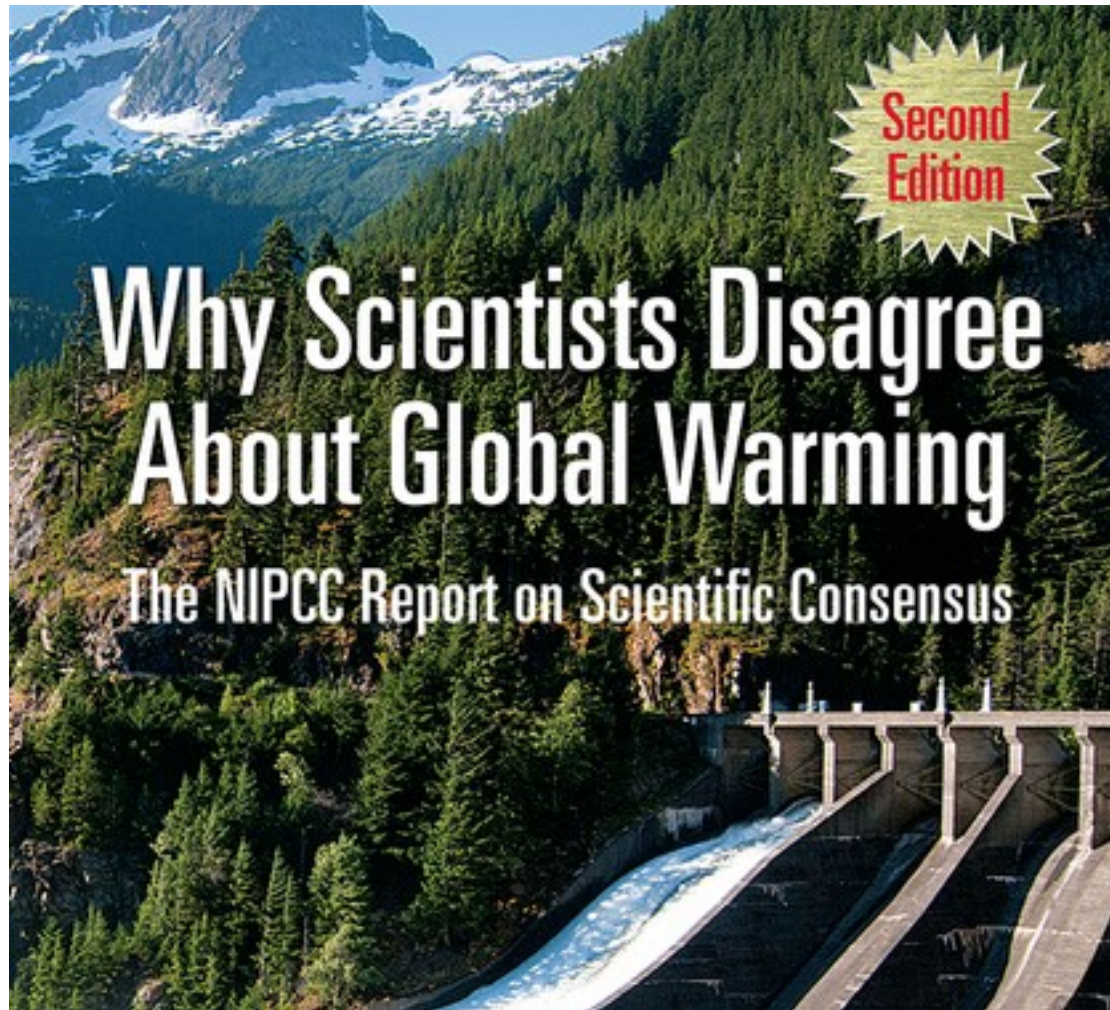
## ■ Nongovernmental International Panel on Climate Change

- Nongovernment scientists and scholars
- Peer reviewed technical papers
- Annual Climate Change conference

## ■ Published reports

- Nature, Not Human Activity, Rules the Climate
- Climate Change Reconsidered I and II
- Scientific Critique of IPCC's 'Summary for Policymakers
- Why Scientists Disagree About GW (2<sup>nd</sup> Edition)

# Second Edition of NIPCC Book






# NIPCC Key Findings

- No consensus
- Why scientists disagree
- Scientific method vs. political science
- Flawed projects
- False postulates
- Unreliable circumstantial evidence
- Policy implications





## **Specific Claims in WA Senate Bill 5802: Refuted by Easterbrook (Climate Scientist)**

1. Emissions of greenhouse gases from human activities is the principal cause of climate change.
2. Sea level is rising at an increasing rate because of GW
3. The frequency of severe storms is increasing because of GW
4. Reduced winter snow packs and decreased summer streamflows
5. Increasing acidification of the state's marine waters
6. Produce more electricity from renewable energy while phasing out coal-powered electricity generation




## Issue #4

# CO<sub>2</sub> Cannot Drive Global Warming



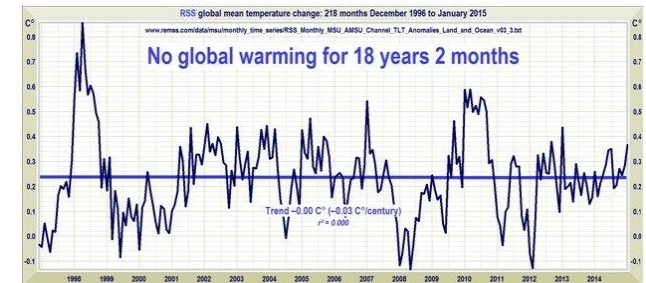
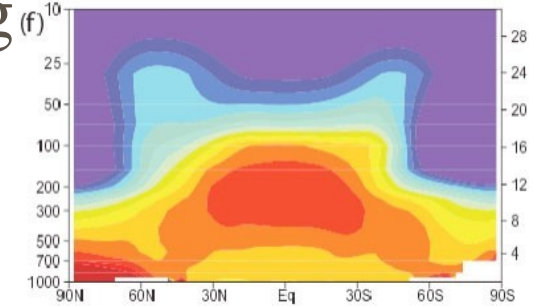
# Possible Global Warming Causes

- A. Increased **CO2** in atmosphere?
  - Insignificant **GHG**, follows **GW**
- B. GW by Sunspots Only?
  - Influence too small by themselves
- C. Solar Irradiance?  Most Likely!
  - Cloud Cover increase -> Cooling
  - Galactic Cosmic Radiation (**GCR**)
- D. Pacific Decadal Oscillation (**PDO**)?
  - Occurs every 30 years in North Pacific Ocean



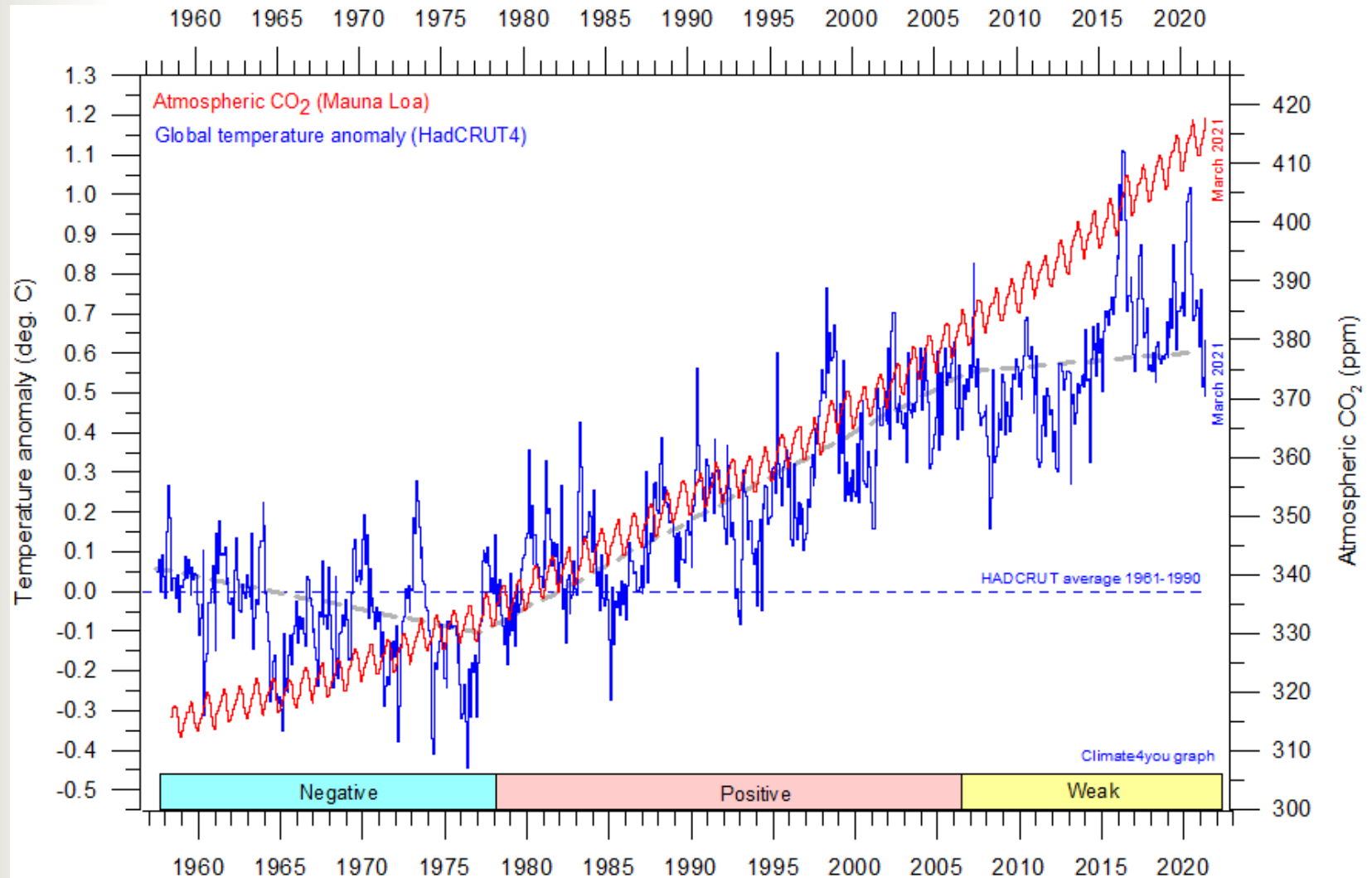
# A. Evidence for GW by CO2?

- The greenhouse gas signature missing
  - No telltale “hotspot” warming pattern
- Vostoc ice cores do not show **CO2** pushing up temperatures
  - Increased temperatures **800 years before CO2**
- Temperatures are not rising
  - Since 1999 temperatures have been flat
- CO2 already doing almost all the warming it can do
  - Twice the CO2 does not make twice the difference

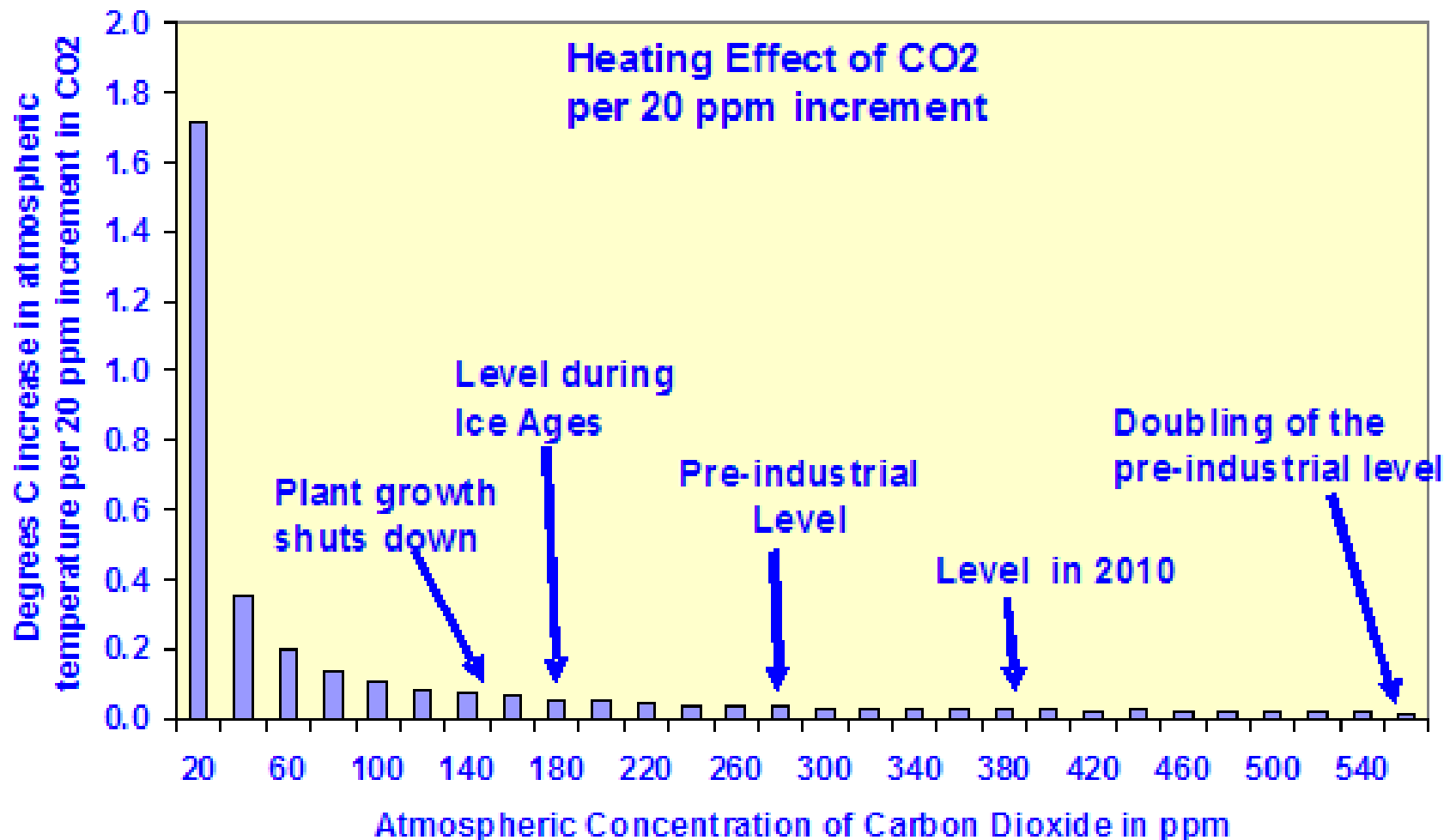


The Skeptic's Handbook, Joanne Nova 2009

# Atmospheric CO<sub>2</sub> (Mauna Loa)



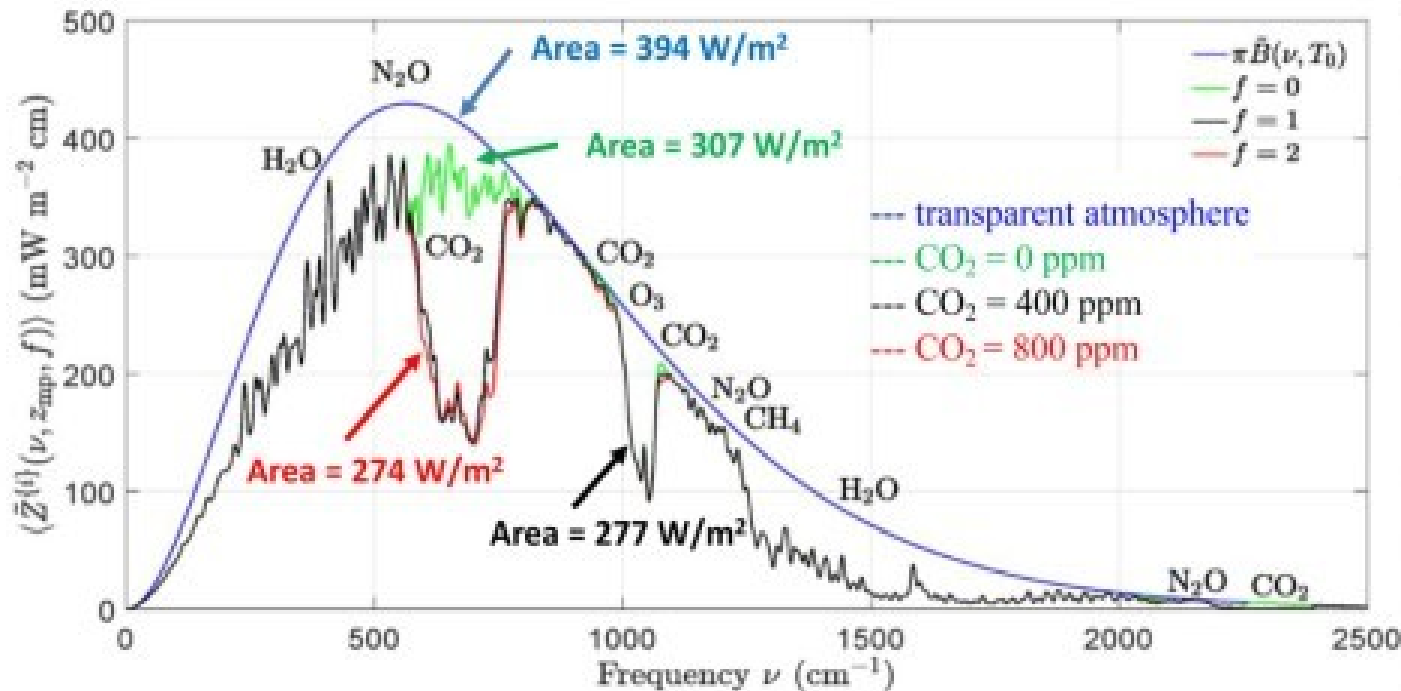
# CO2 in Atmosphere Insignificant





# Greenhouse Gases Essential

Earth's surface temperature,  $T = 60\text{ F} \rightarrow 16\text{ F}$   
without greenhouse gases

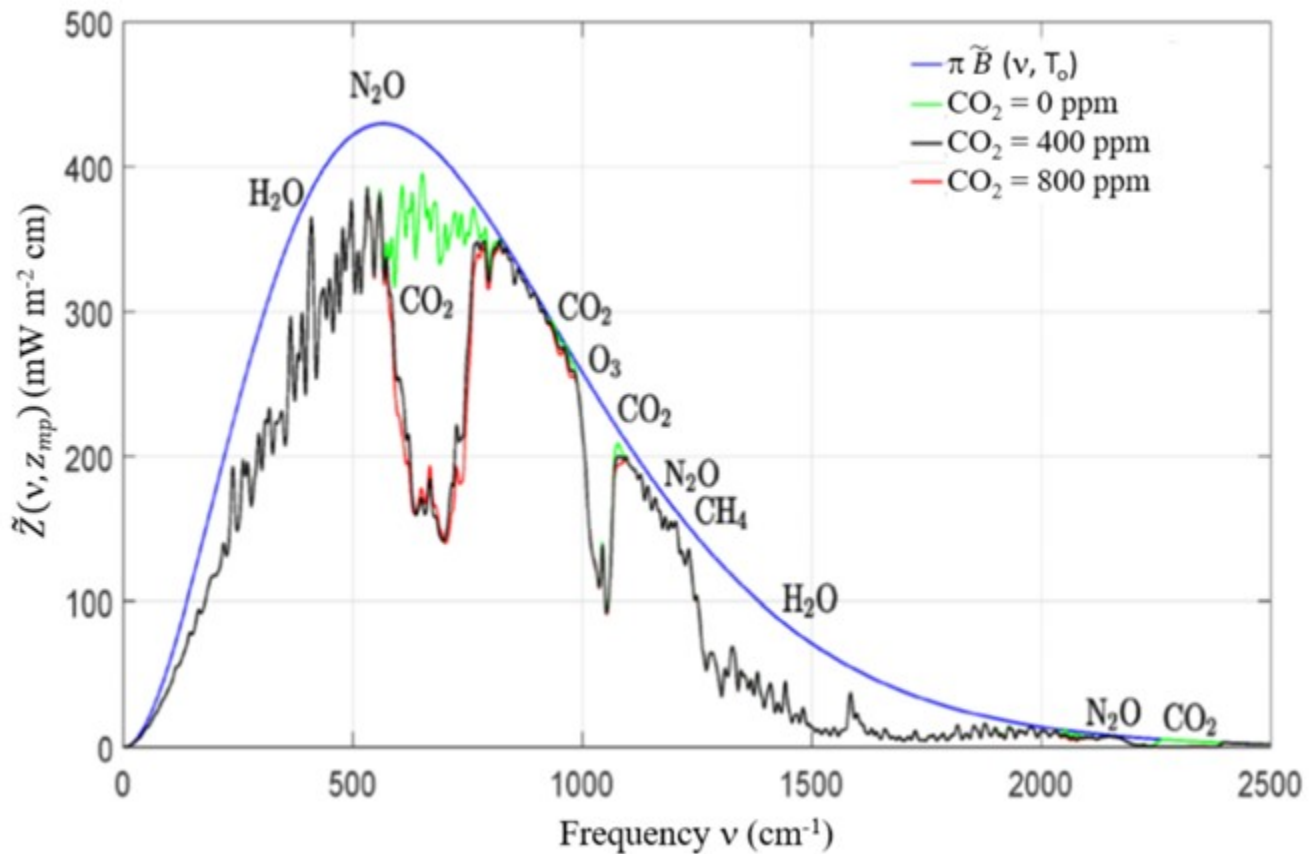


**Max Planck**  
1858–1947



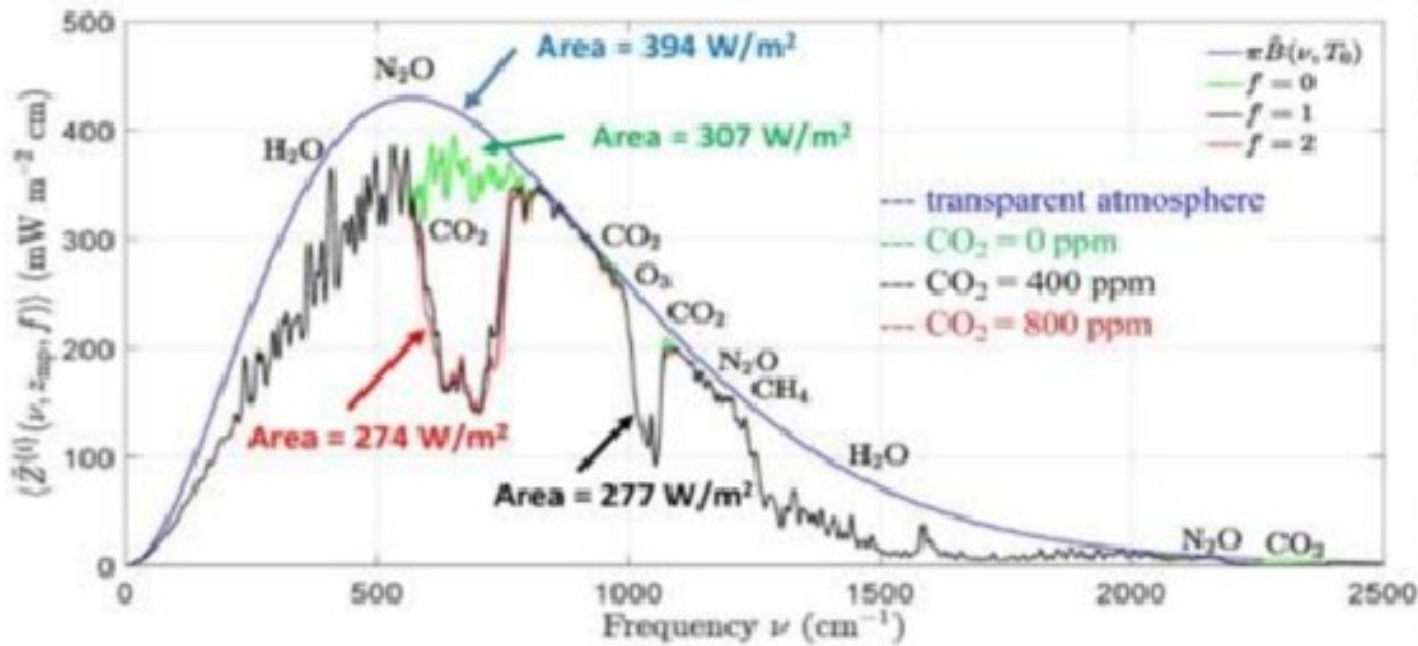
**Karl Schwarzschild**  
1873–1916

# Impact of Adding CO<sub>2</sub>



# Impact of CO<sub>2</sub> and CH<sub>4</sub> Increases Saturation Effect of CO<sub>2</sub> and CH<sub>4</sub>

Earth's surface temperature,  $T = 60\text{ F} \rightarrow 16\text{ F}$   
without greenhouse gases



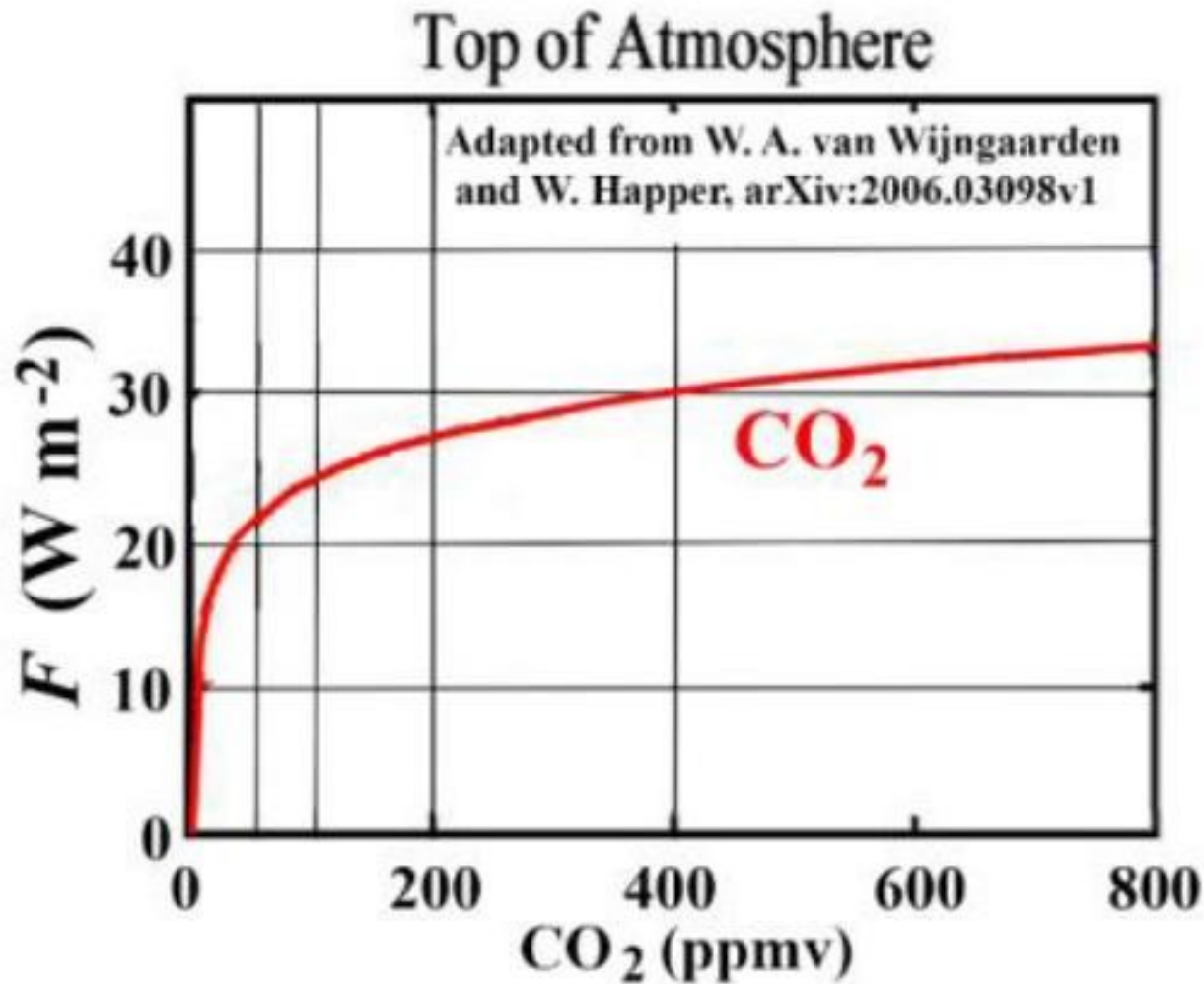
**Max Planck**  
1858–1947



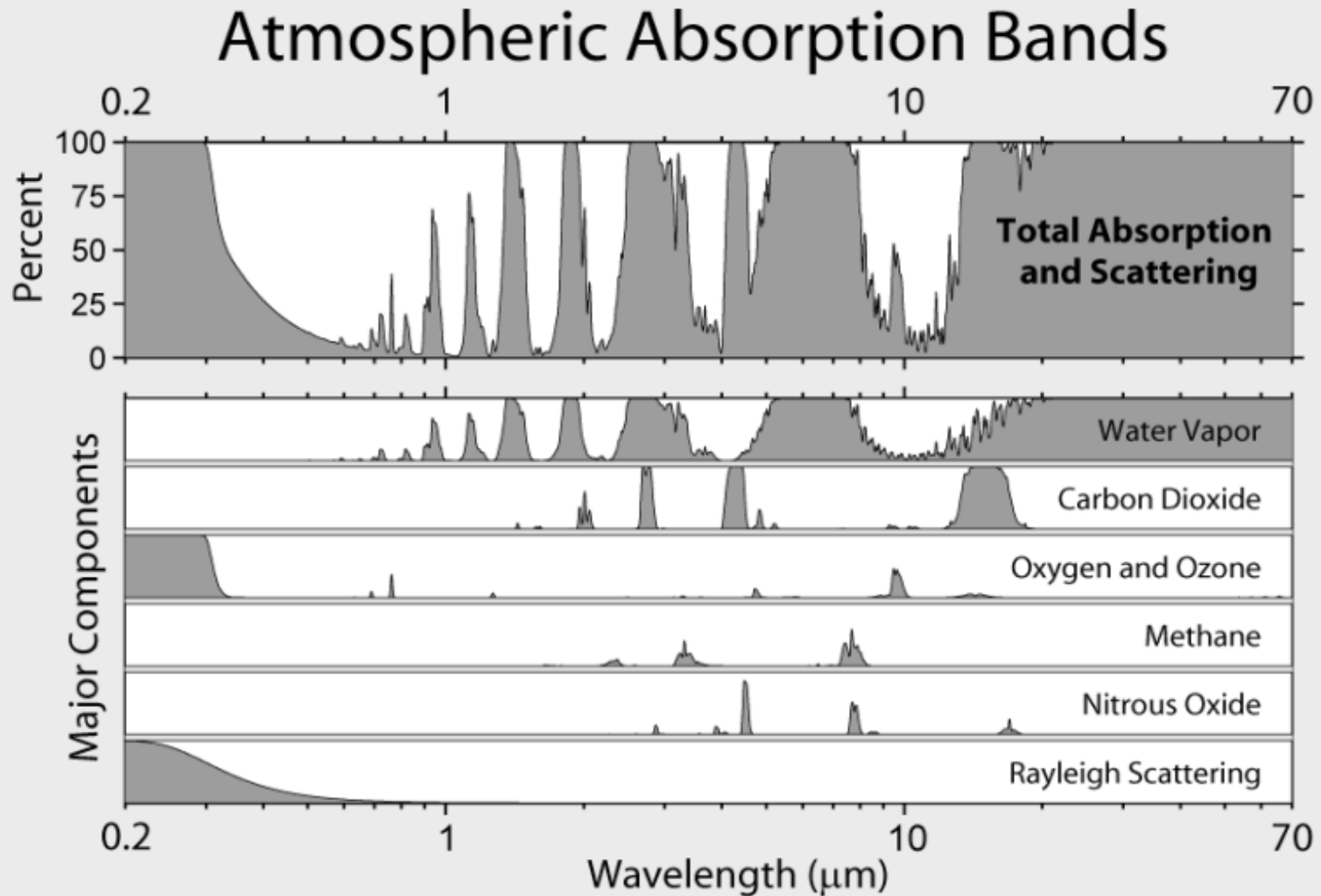
**Karl Schwarzschild**  
1873–1916



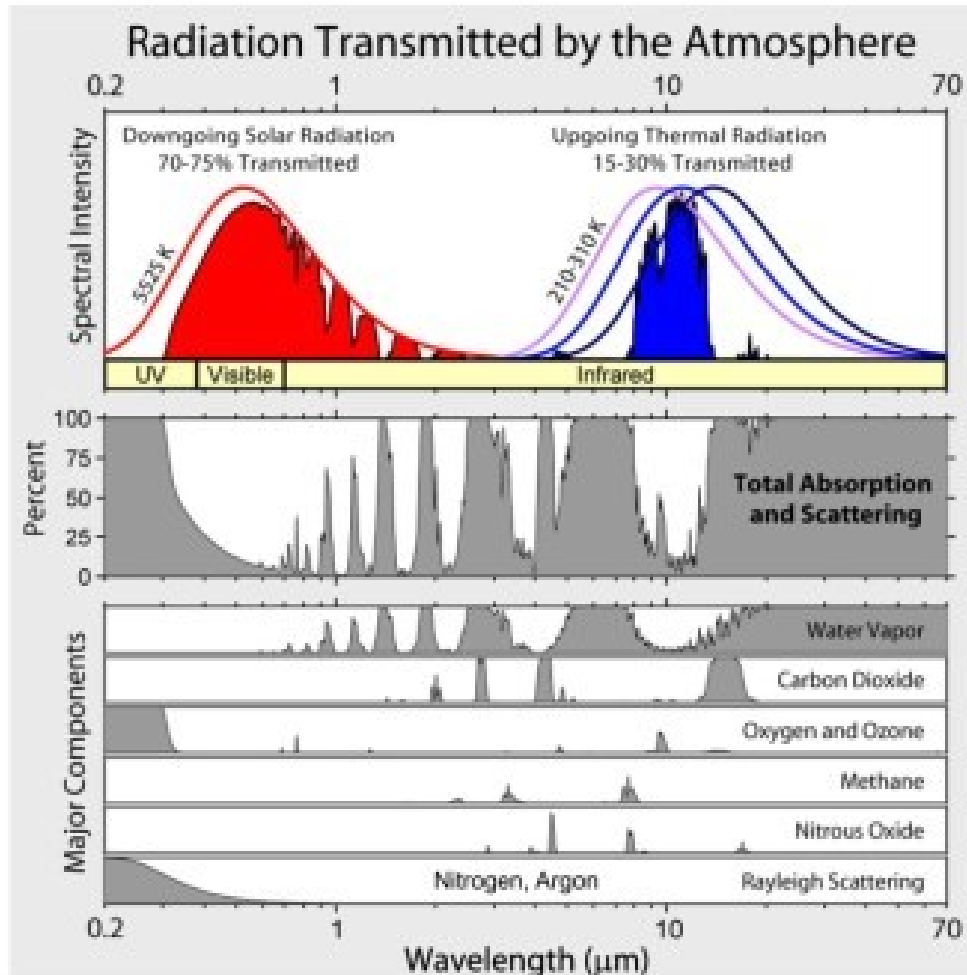
# Impact of Adding CO<sub>2</sub> (adapted)



# Atmospheric Absorption Bands



# Radiation Transmitted by the Atmosphere

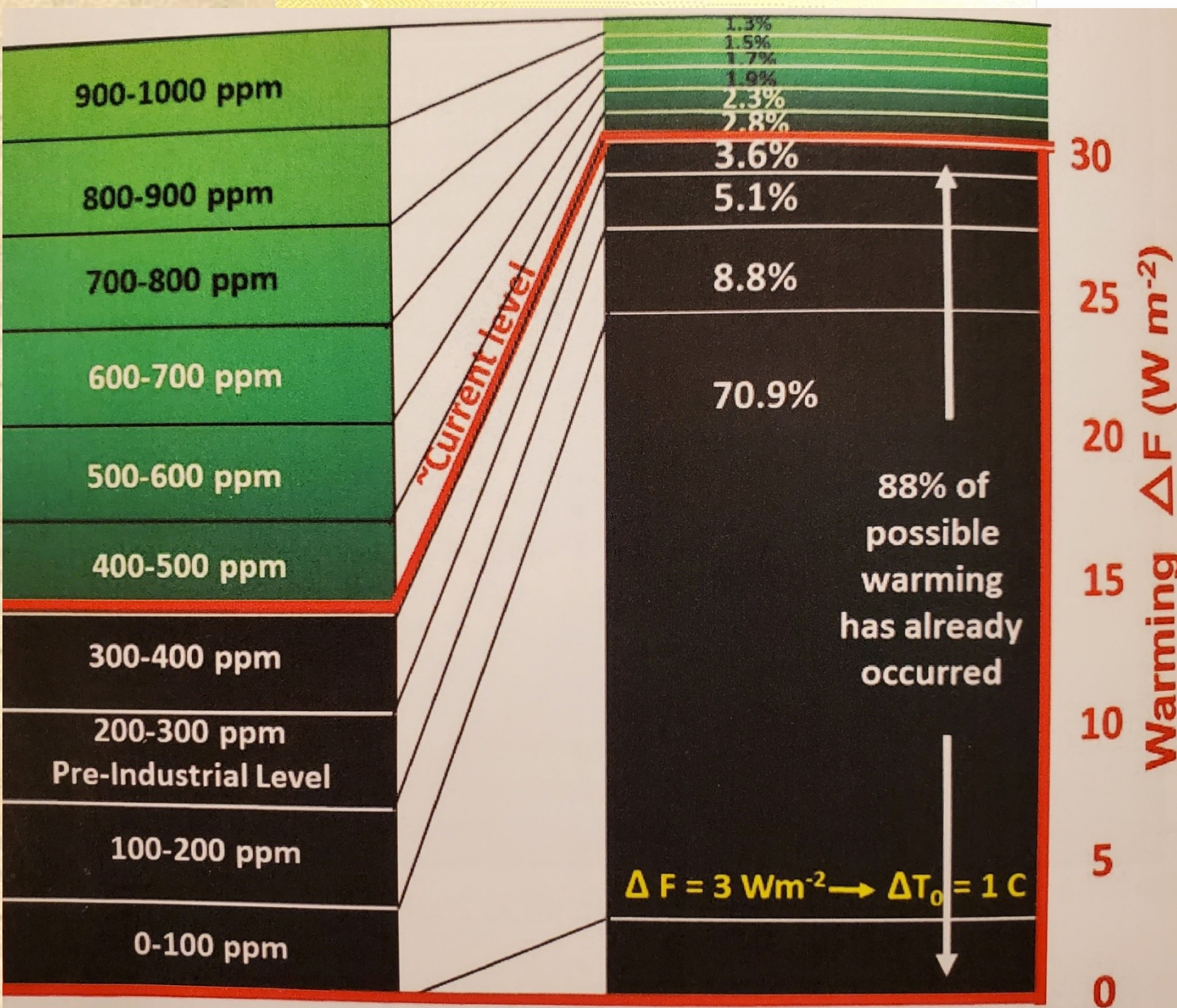


This graph shows the fraction of radiation absorbed or scattered on a vertical path from the top of Earth's atmosphere to the surface, or vice versa. The horizontal scale is the wavelength of the radiation.

The smooth curves on the top panel are "Planck intensities" for various temperatures, 5525 K, the effective temperature of the Sun's surface (red) and the much lower temperatures of Earth's surface, about 210 K (black) for the South Pole and 310 for a warm day in Phoenix (violet).

Most sunlight (red) is transmitted, only about a quarter of the thermal cooling radiation (blue) is transmitted because of absorption by greenhouse gases, shown in the lower panels.

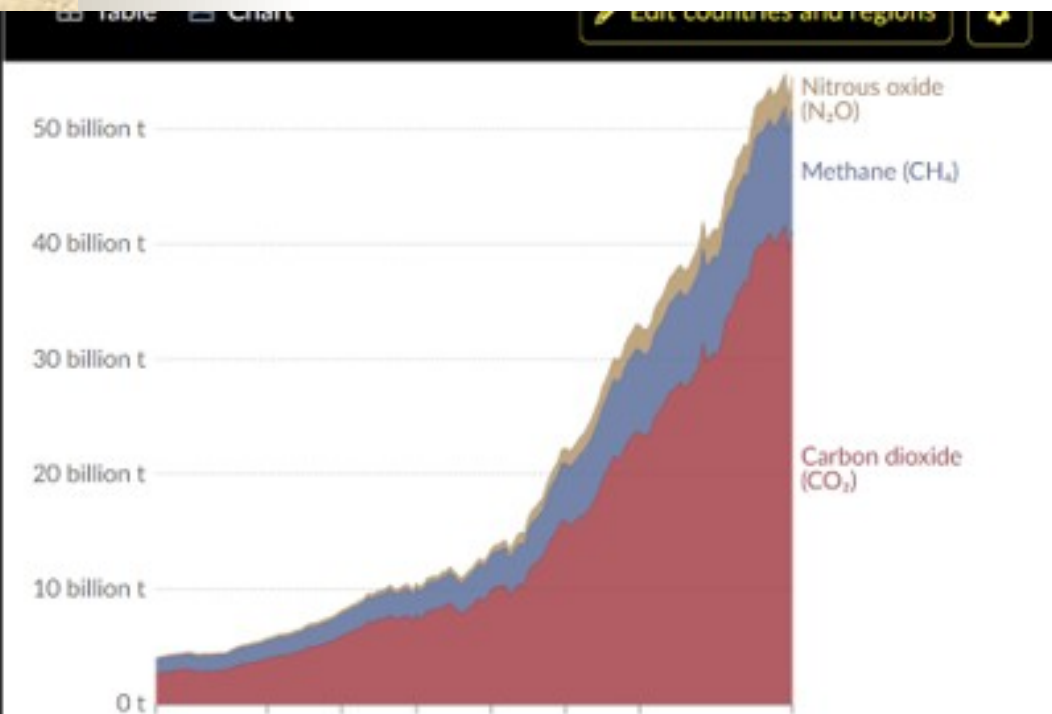




# The Warming Impact of CO<sub>2</sub>

(The warming ( $\Delta F$ ) from CO<sub>2</sub> of concentration  $c$  is described by the formula  $\Delta F = \delta F \log^2 (1 + c/c_0)$  for the top of the atmosphere.)

# Tons of GHG Added to Atmosphere



**2021**  
in tonnes

Nitrous oxide (N <sub>2</sub> O)	2.97 billion t
Methane (CH <sub>4</sub> )	10.51 billion t
Carbon dioxide (CO <sub>2</sub> )	41.12 billion t
Total	54.59 billion t



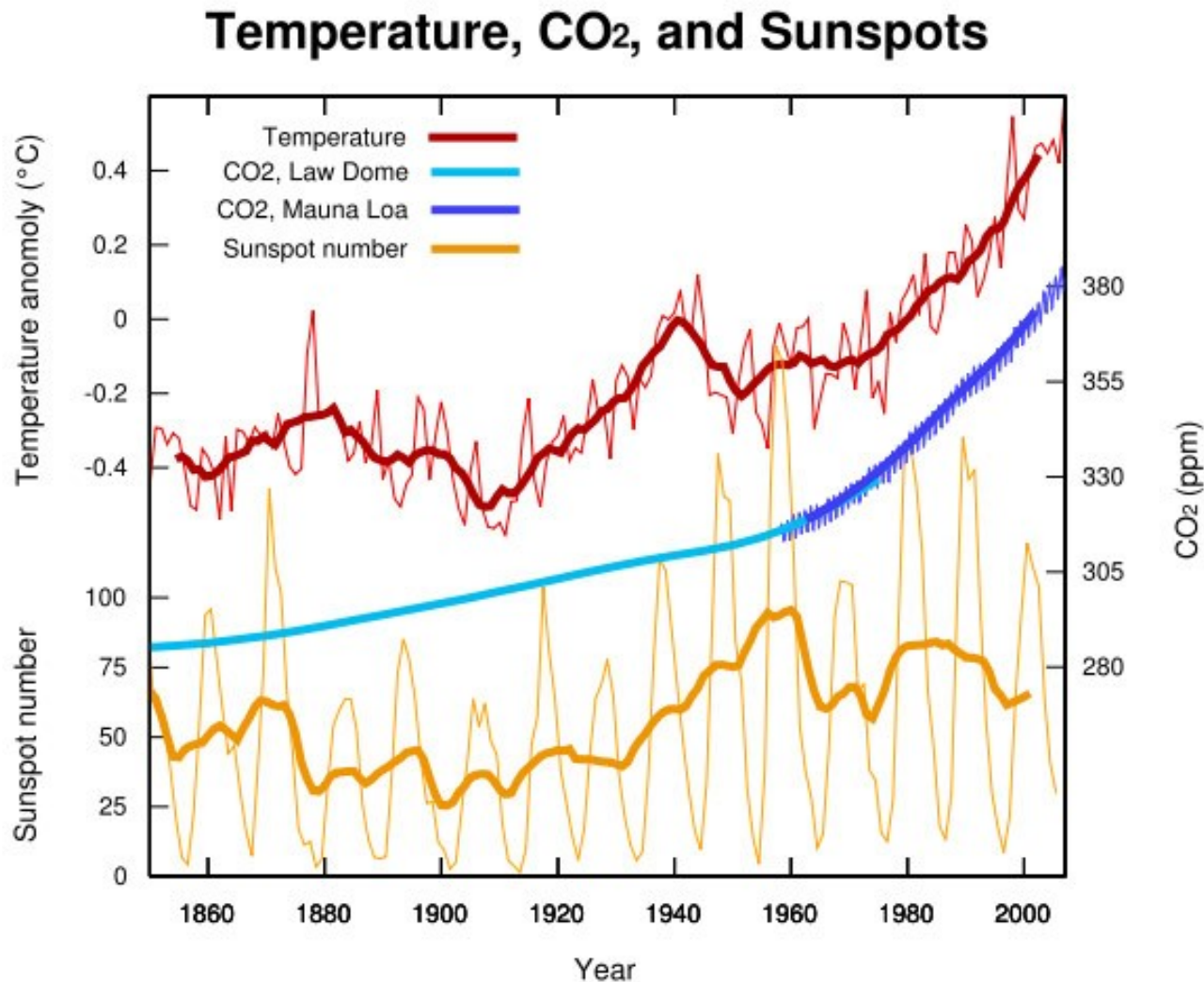


## Issue #5

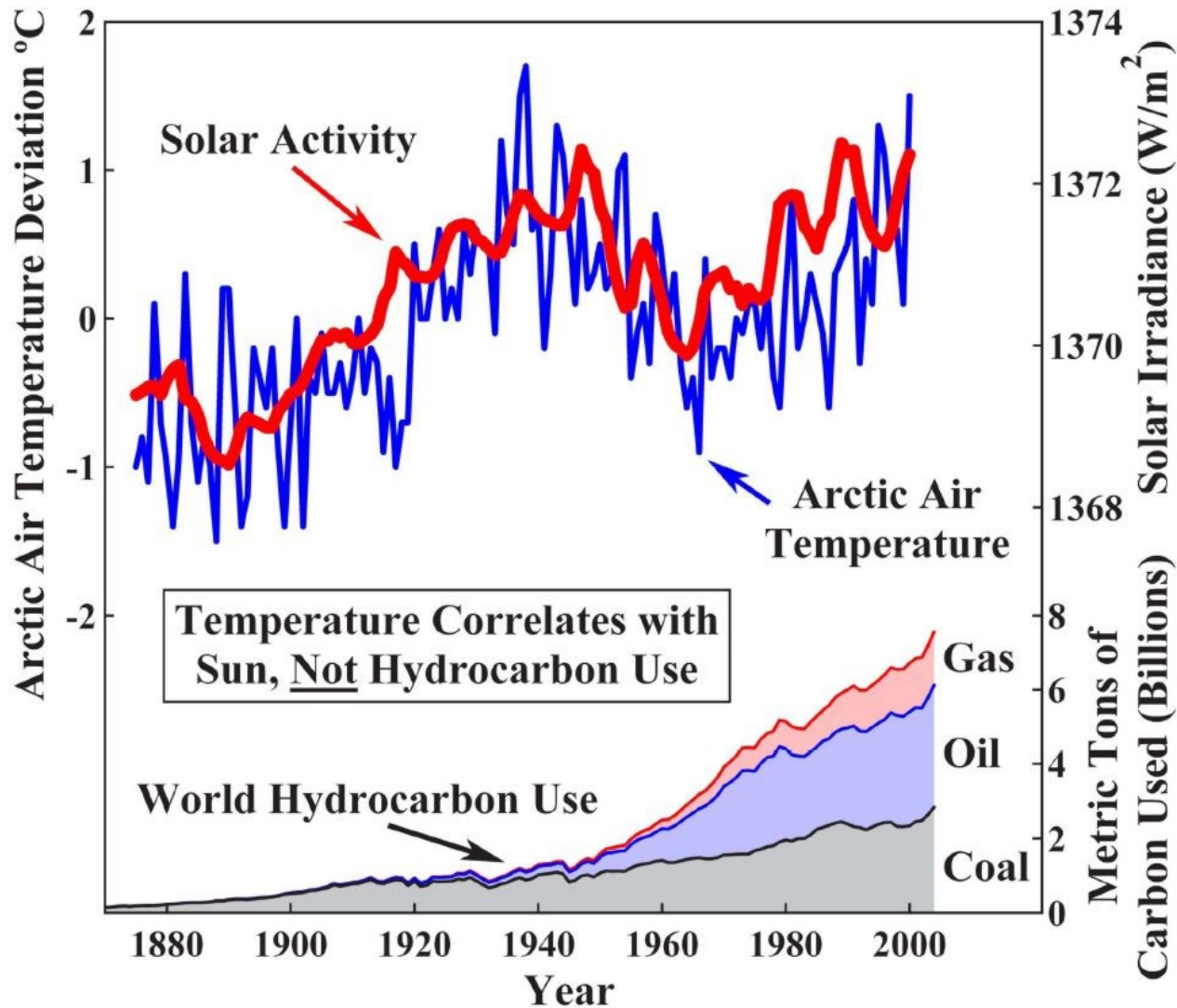
Total Solar Irradiation (TSI) Can  
Cause Significant Fluctuations  
in the Climate



## B. GW by Sunspots Only?

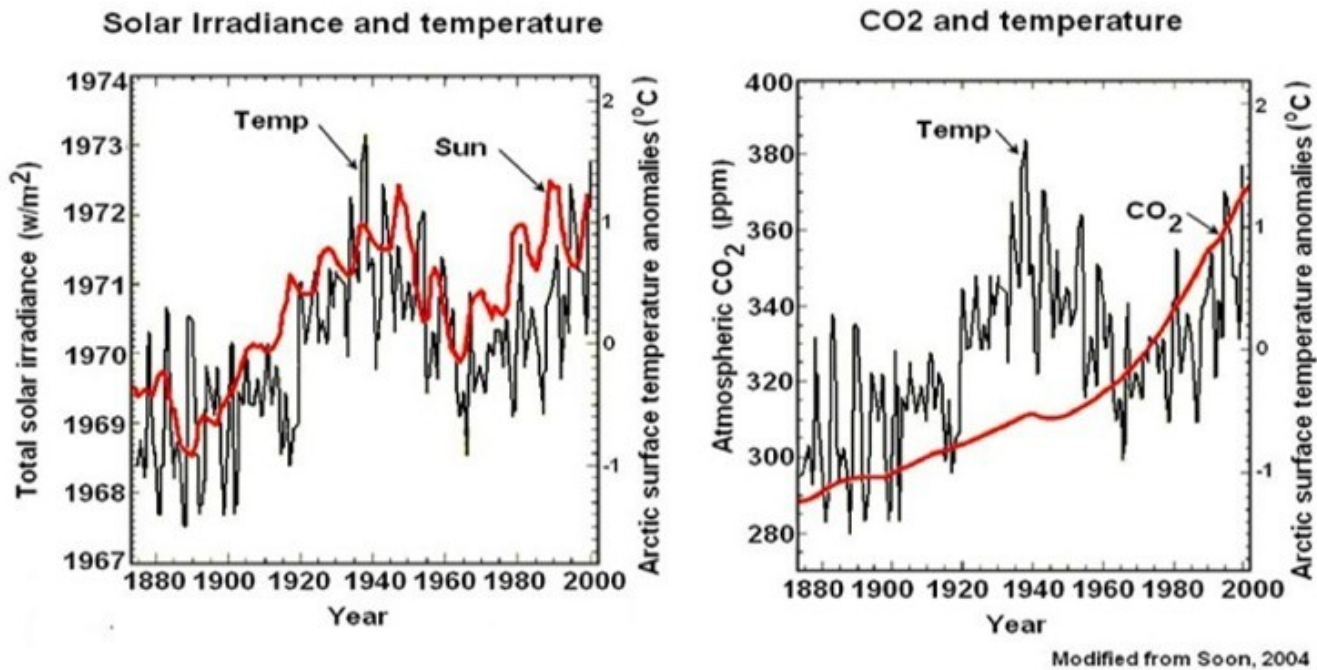


# Temperature Correlation With Sun



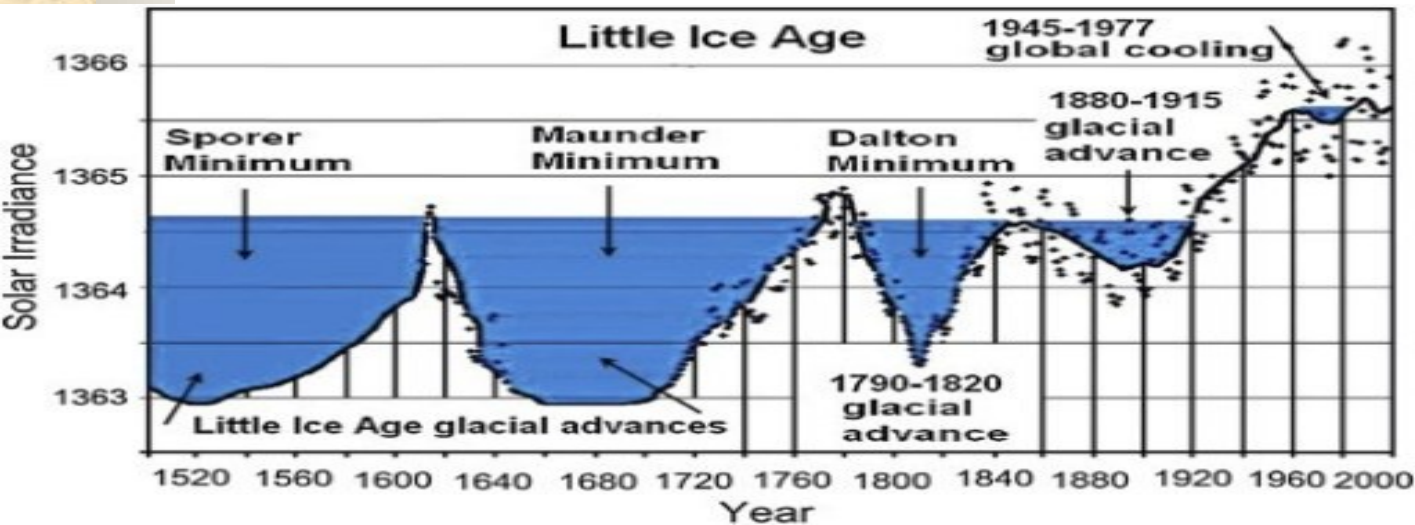
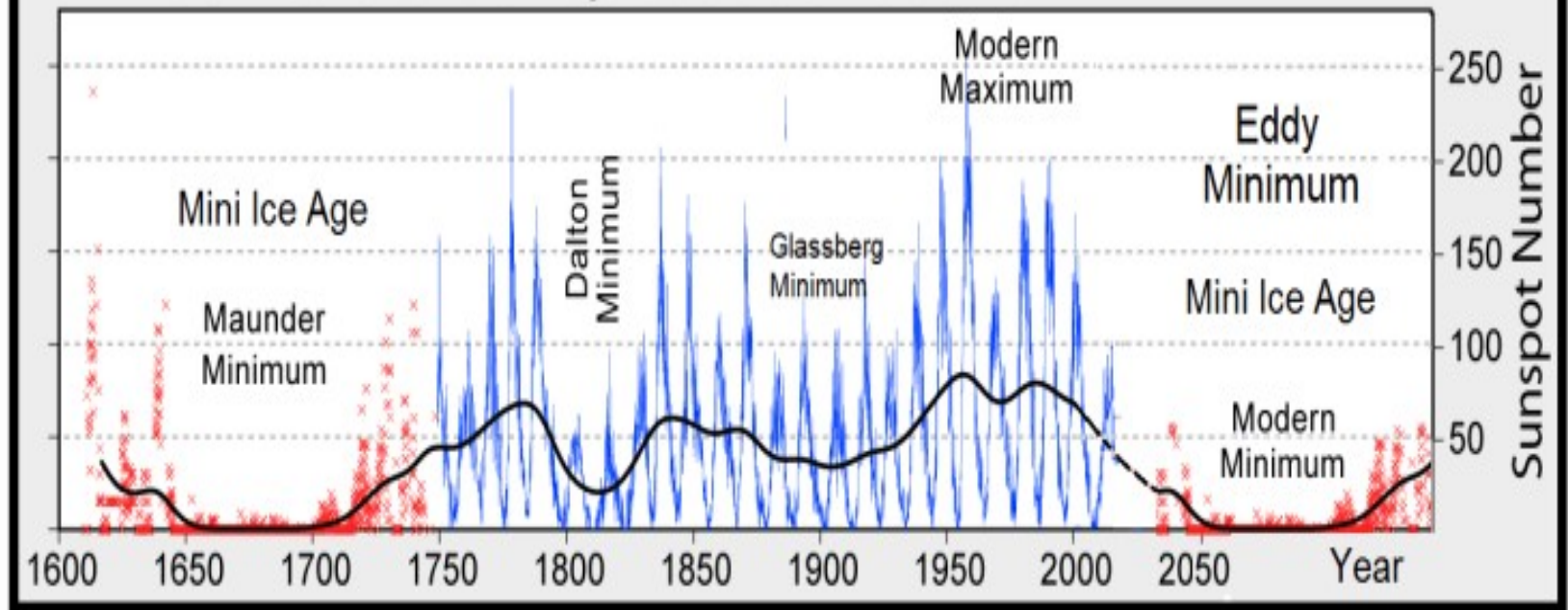
## C. Total Solar Irradiance?

The following charts show clearly that climate change seems to be directly correlated to Solar Irradiance, rather than CO<sub>2</sub>, as the "Global Warming Crisis" alarmist crowd would have you think.





# 400 Years of Sunspot Observations



# International Sunspot Number

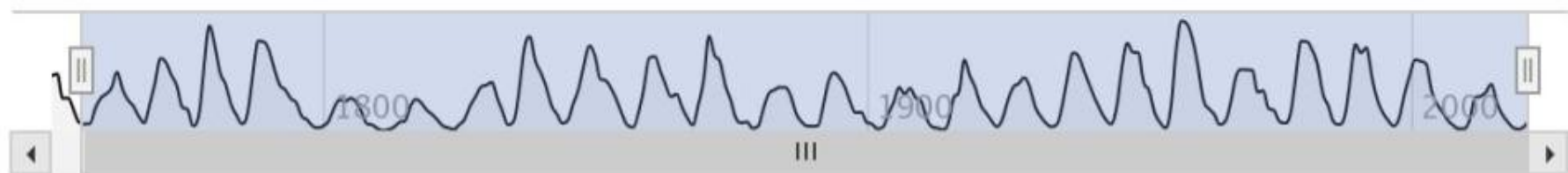
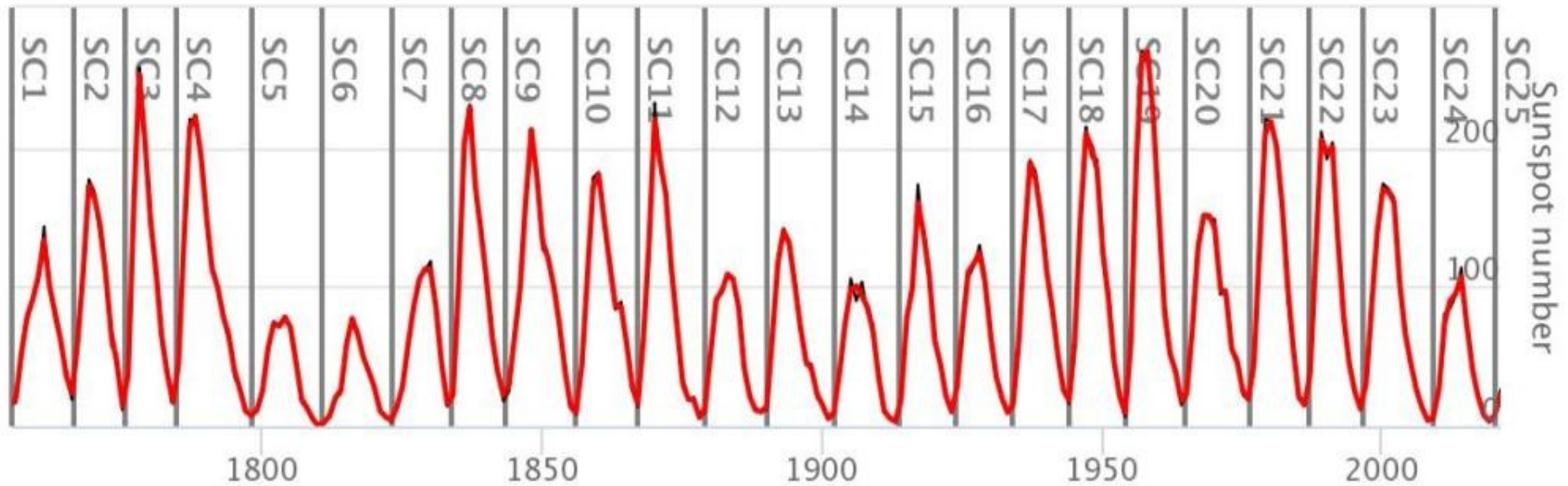
Zoom

3 cycles

5 cycles

10 cycles

Mar. 31, 1755 → Nov. 1, 2021



— Monthly mean total sunspot number

— 13-month smoothed monthly total sunspot number

WDC-SILSO, Royal Observatory of Belgium, Brussels

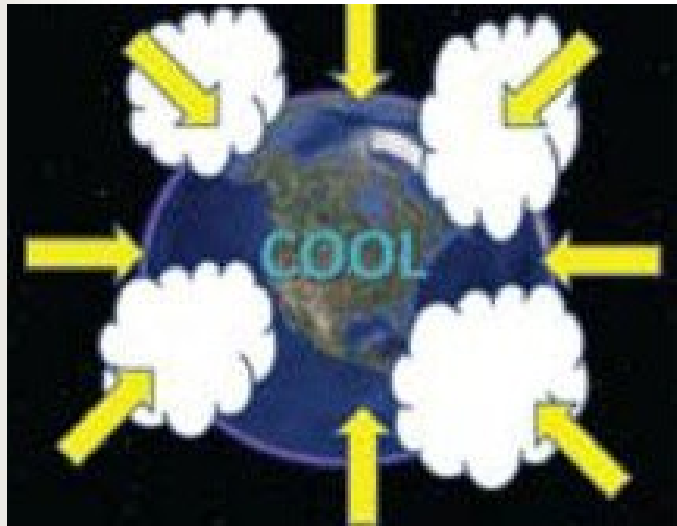
# Svensmark Global Cosmic Ray Theory

## Inactive Sun

High cosmic rays

More clouds

Cool earth

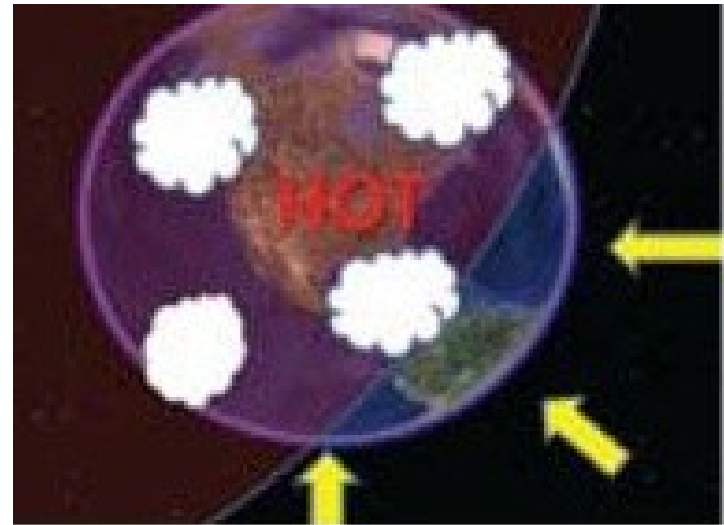


## Active Sun

Low cosmic rays

Fewer clouds

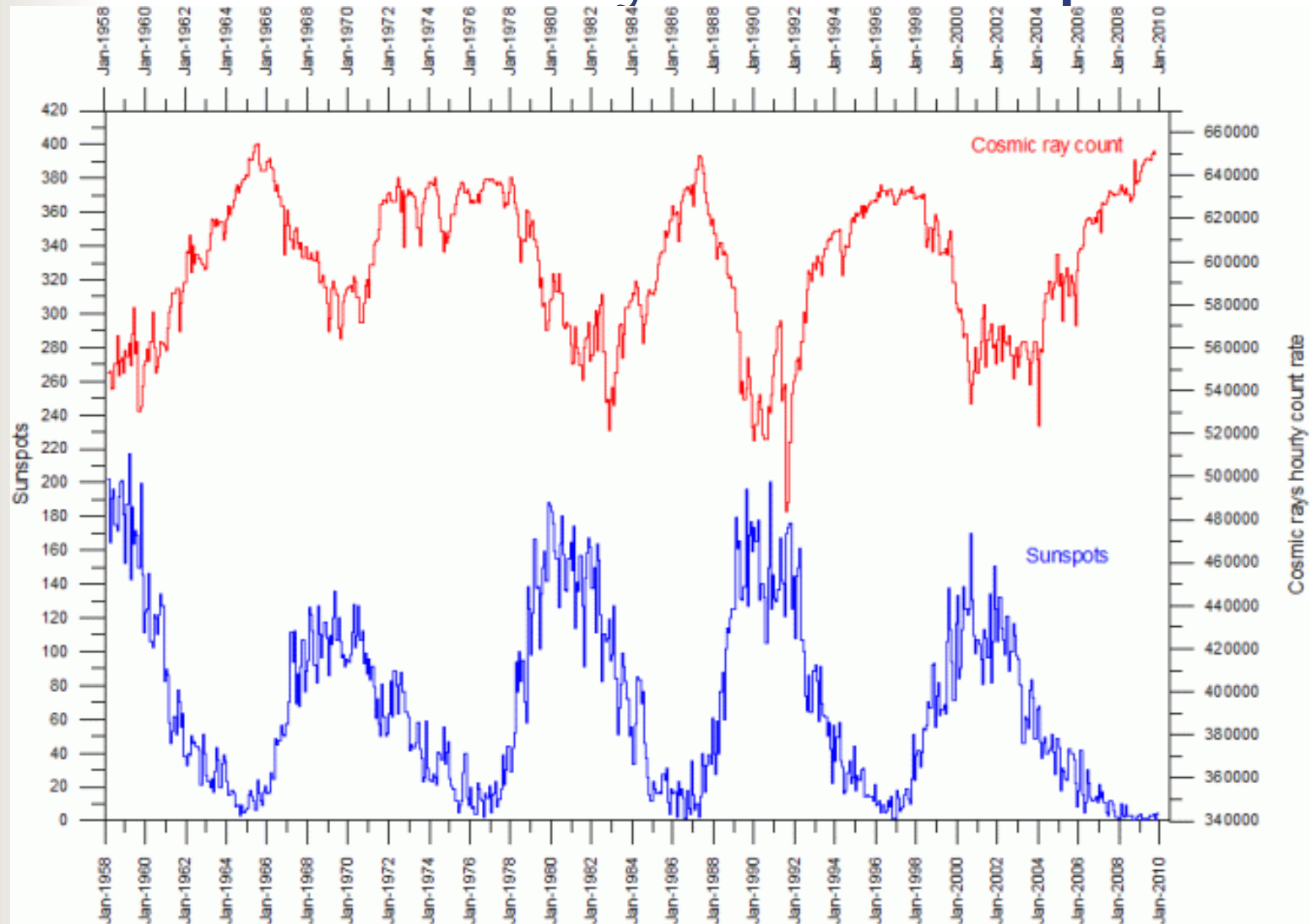
Hot earth



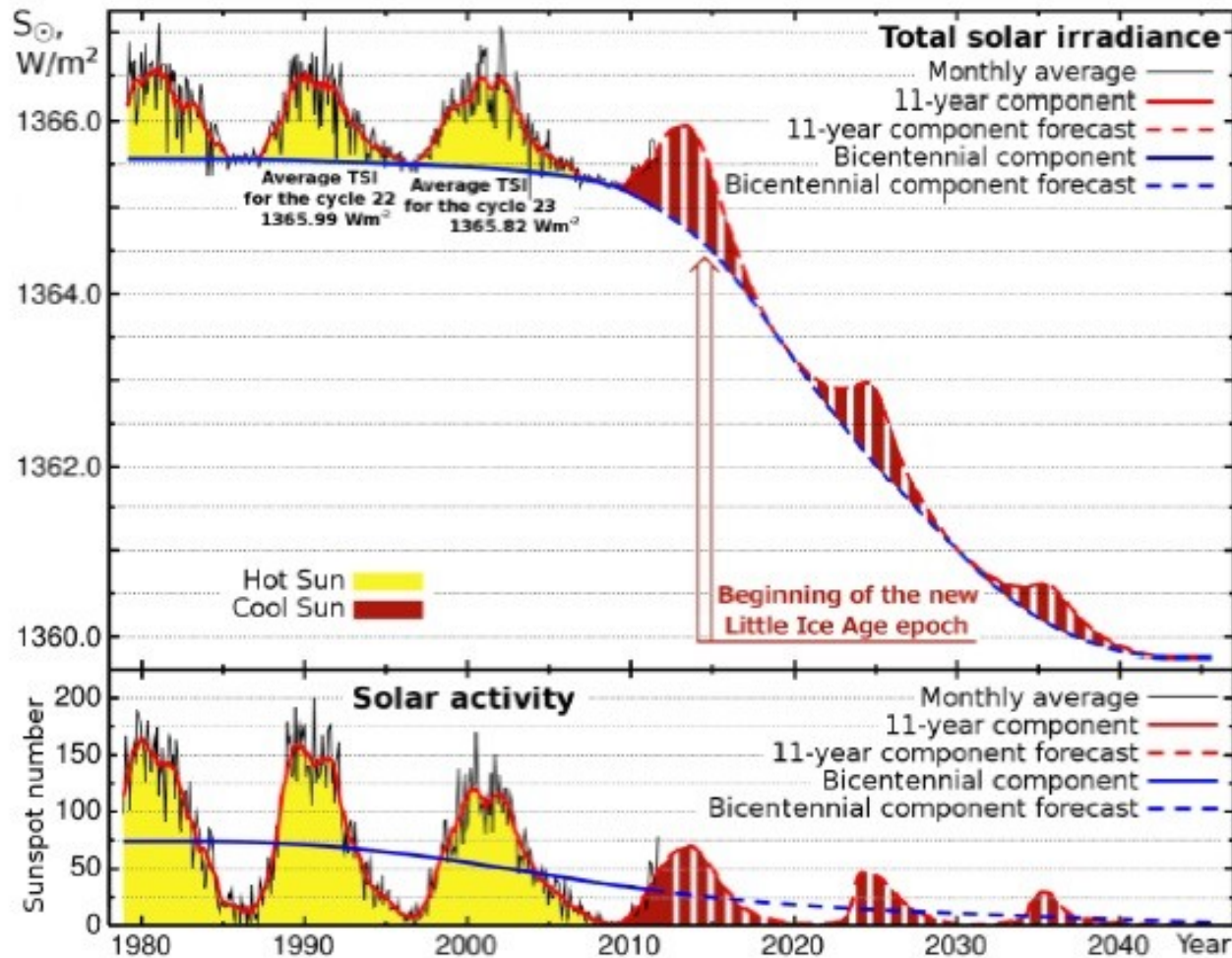
Cloud Experiment Supports GW Theory, Dr. Larry Vardiman



# Cosmic Rays vs. Sunspots

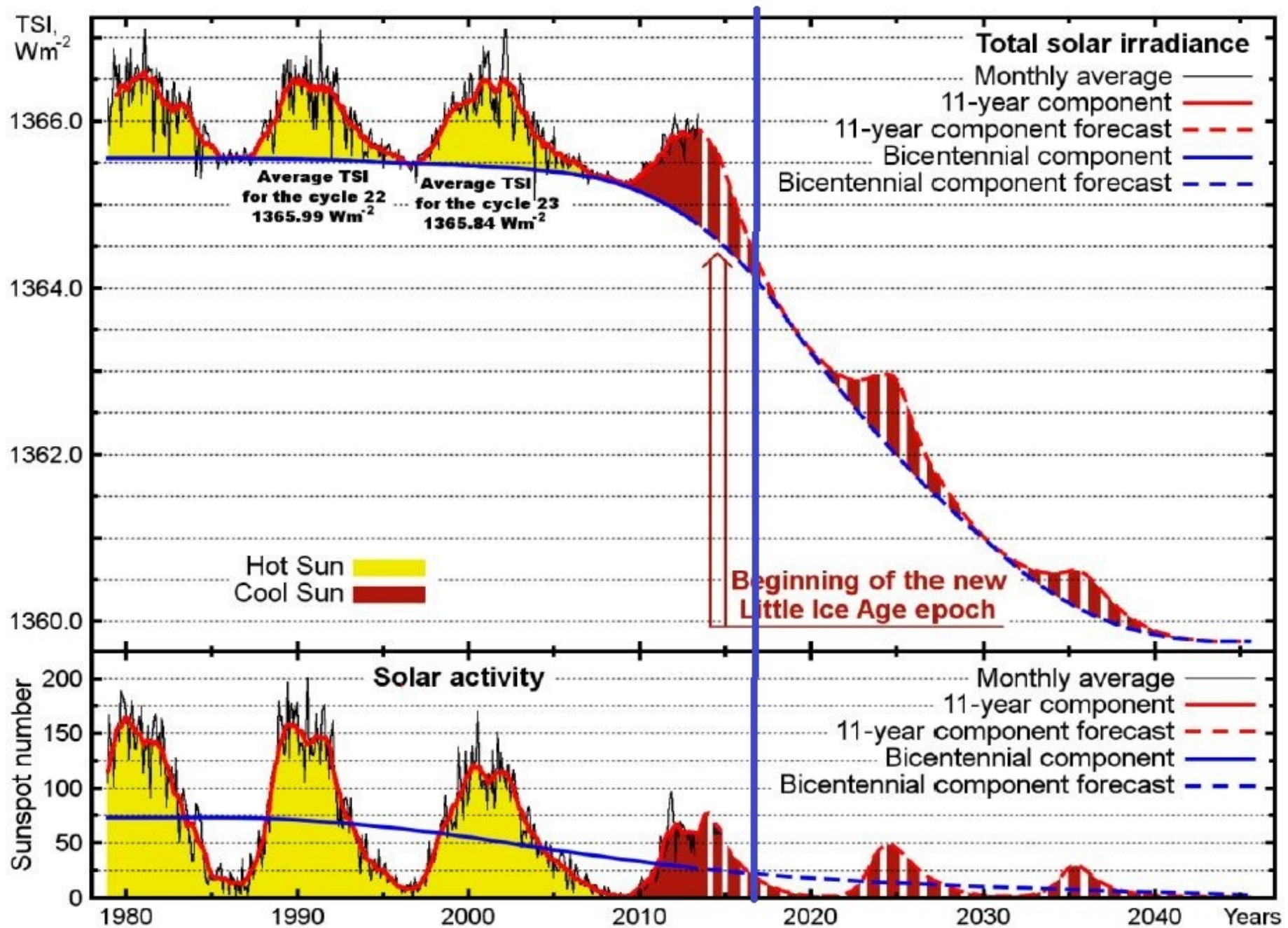


# Total Solar Irradiance Forecast



Variations of both the TSI and solar activity in 1978-2011 and a forecast of their variations in cycles 24-26 (up to the year 2045)







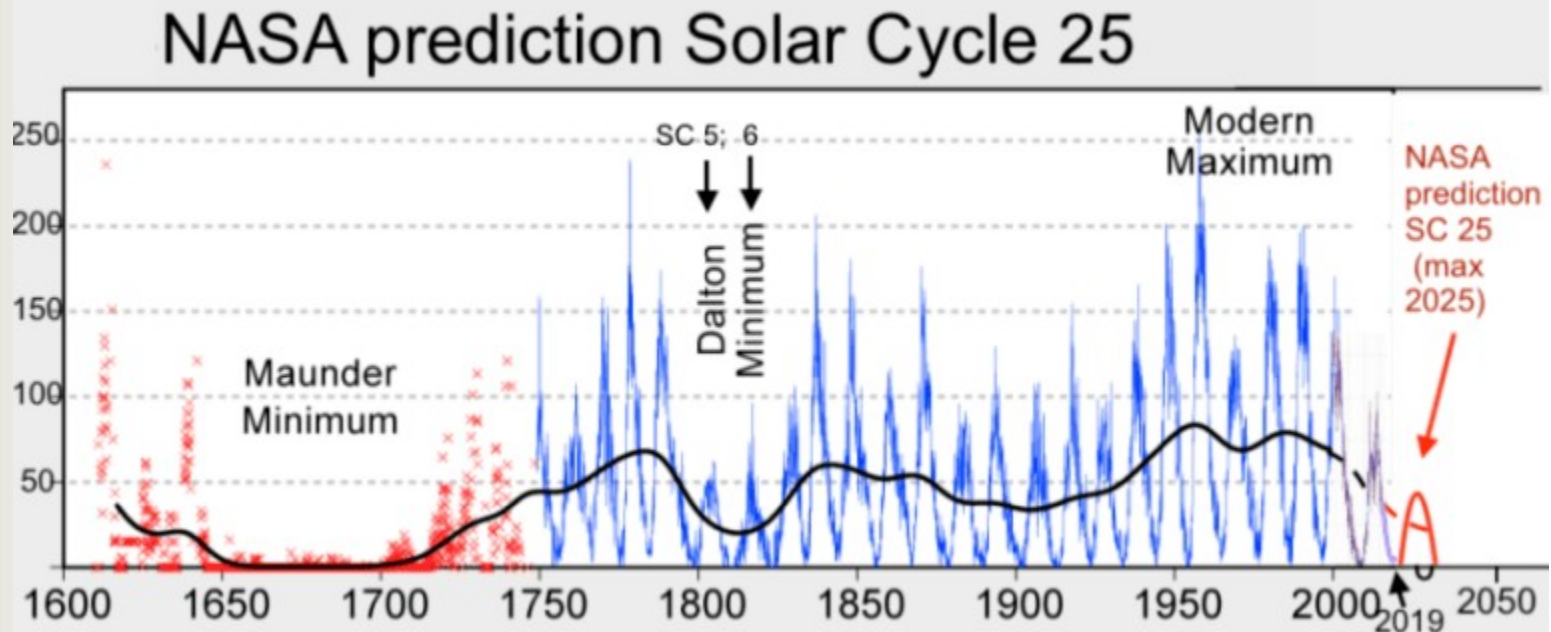


# Anthropic GW Hoax Unravelling

- **The Sun** is continually being revealed as the main driver of Earth's climate, and the Sun is shutting down (relatively), cloud-nucleating Cosmic Rays are on the increase, and a meridional jet stream flow is becoming evermore prevalent
- The upshot of all these forcings is most likely **Global Cooling**

# NASA Prediction – Solar Cycle 25

- Solar cycle (25) will be “the weakest of the past 200 years,” with the agency correlating previous solar shutdowns to prolonged periods of global cooling here



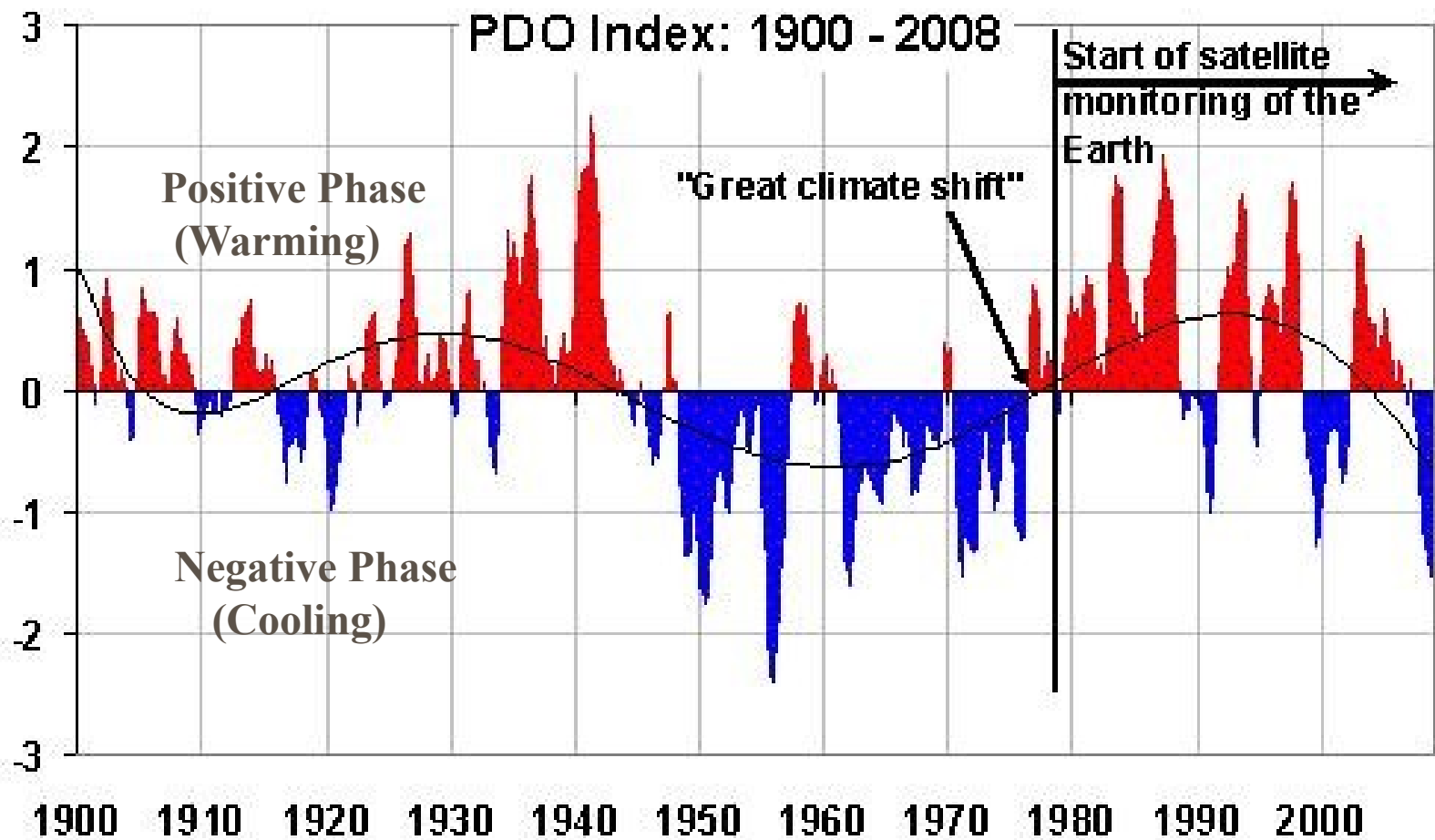


## Issue #6

Pacific Decadal Oscillations  
(PDO) Can Cause Significant  
Fluctuations in the Climate



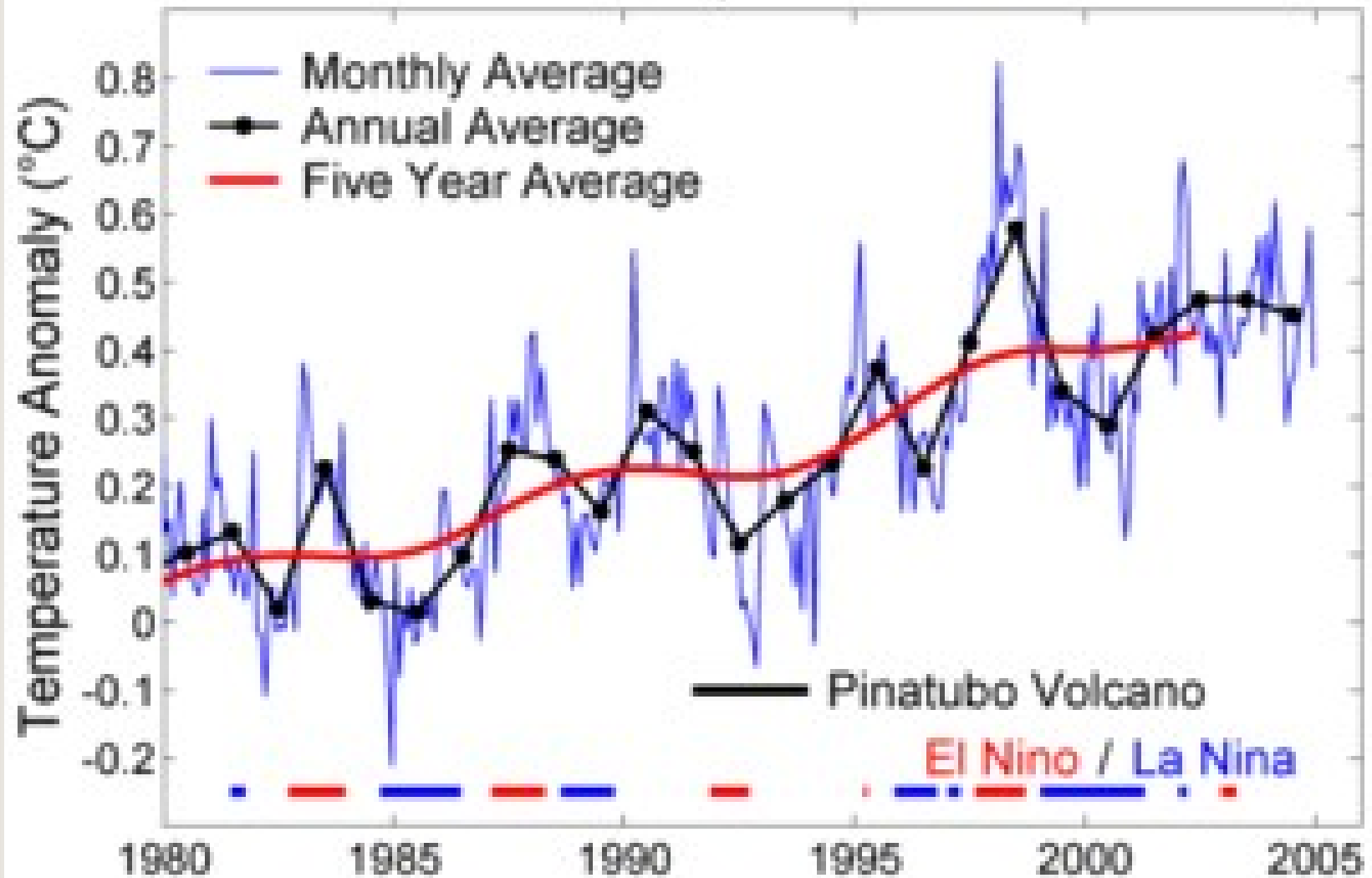
# D. Pacific Decadal Oscillation (PDO)



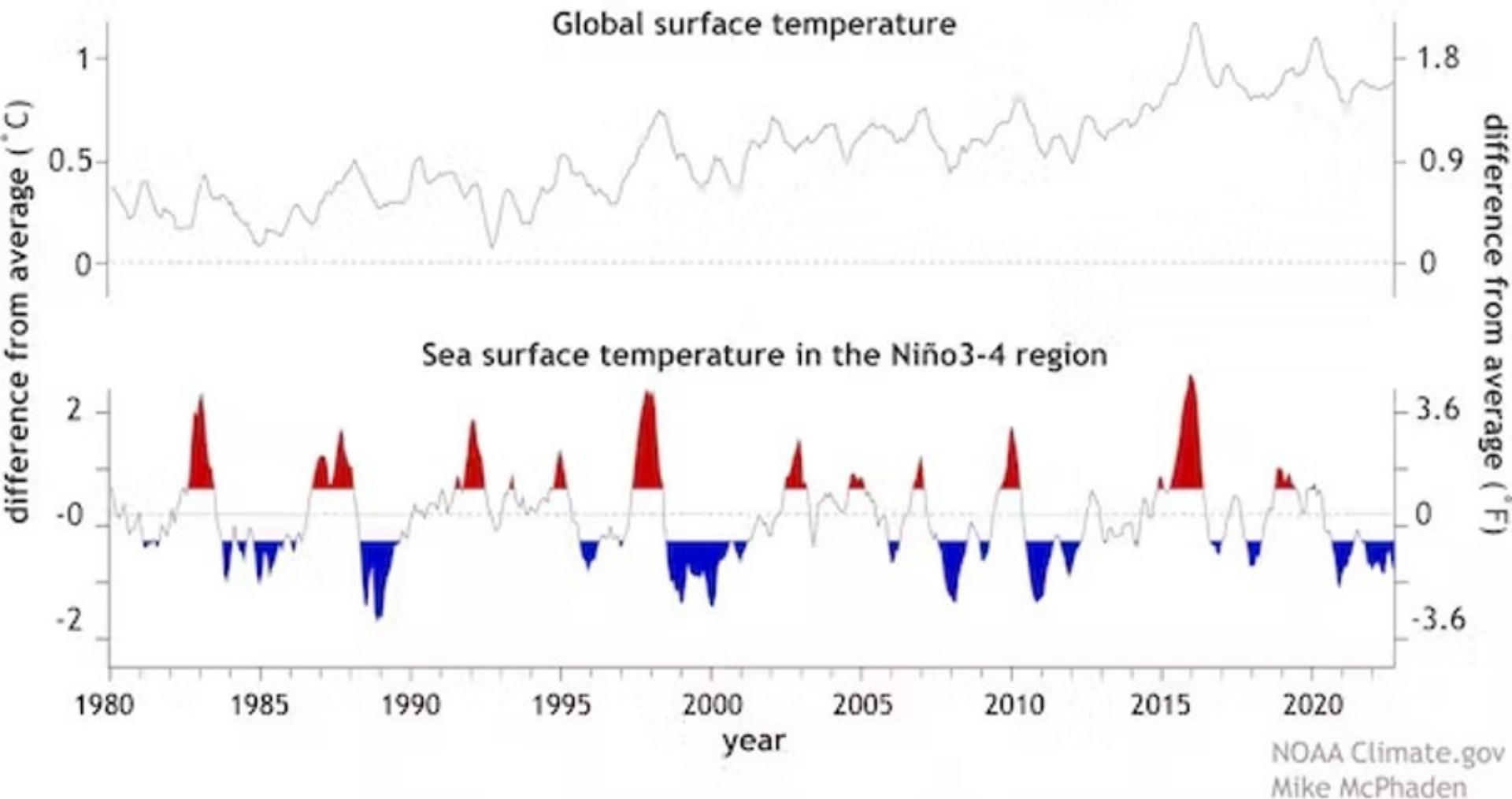
Preferred by Dr. Roy Spencer (Climate Scientist)

@ Dr. Heinz Lycklama

# Surface Temperature Record

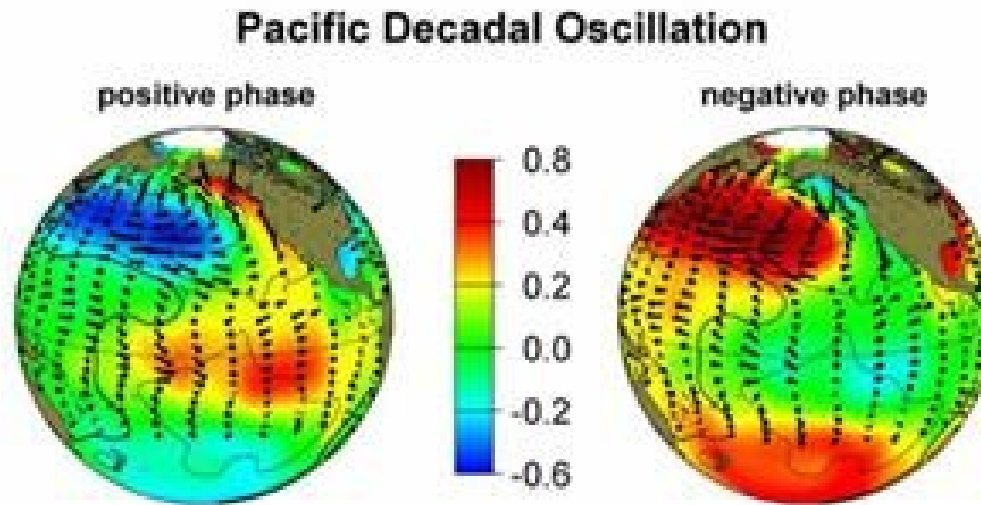


# How global surface temperature changes with El Niño and La Niña





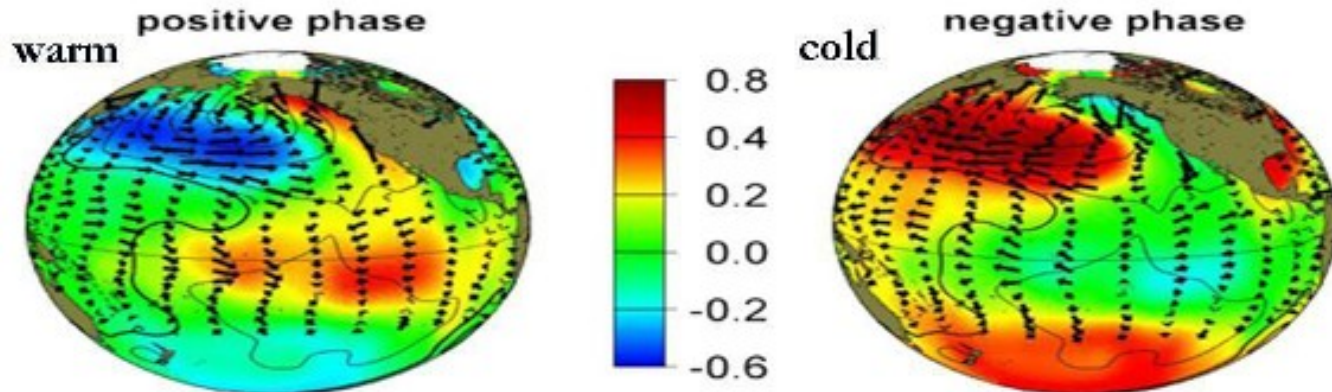
# PDO – Key to the GW Debate?



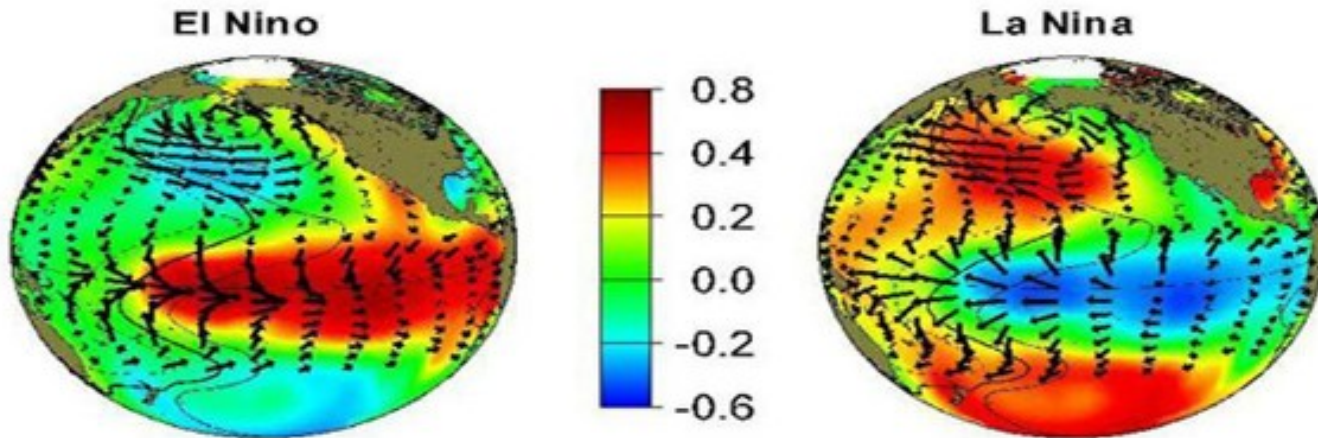
- Switch between two circulation patterns every 30 years in North Pacific Ocean
- ENSO – El Nino Southern Oscillation every few years of tropical Pacific Ocean

# Pacific Ocean Oscillations

## Pacific Decadal Oscillation

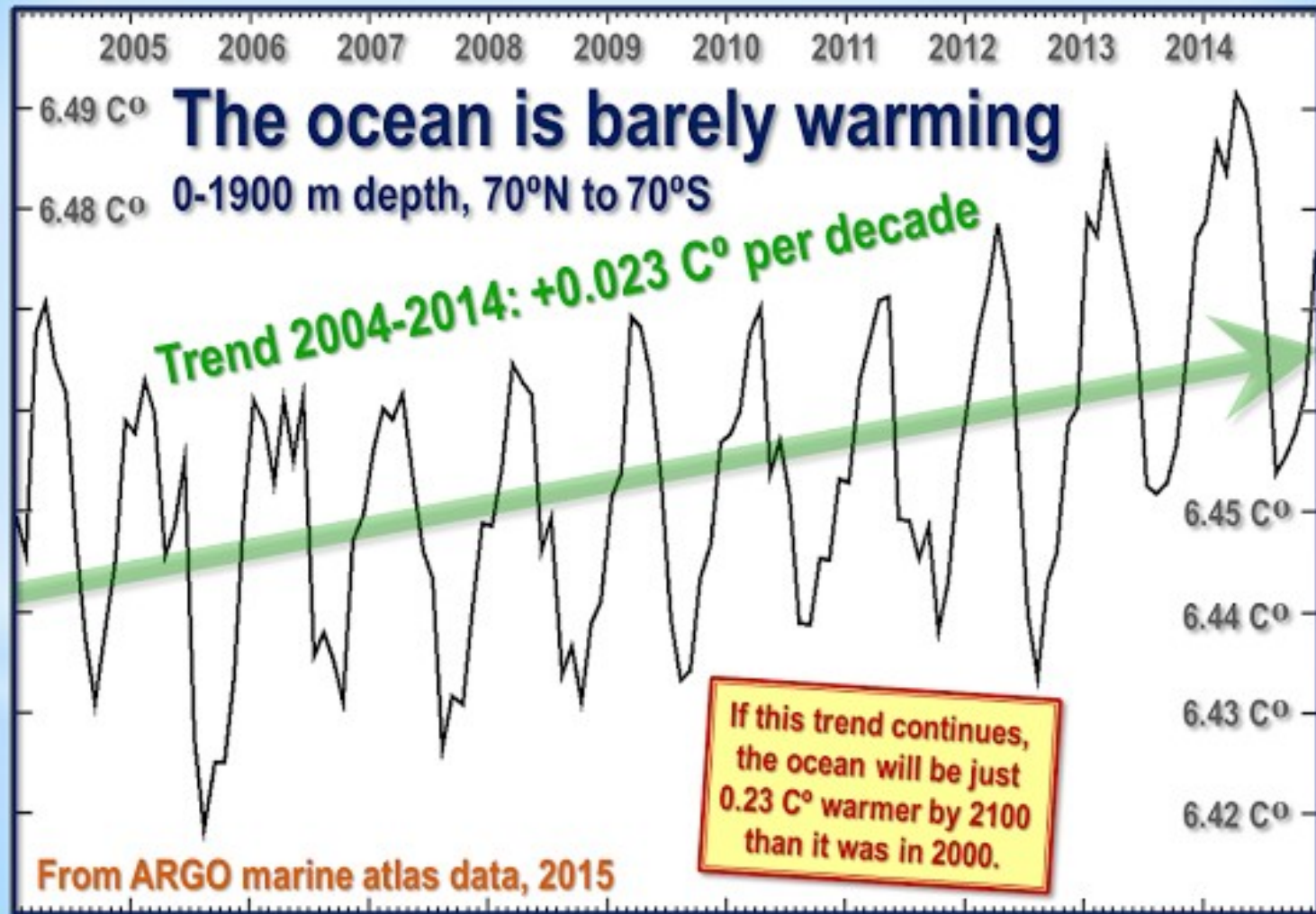


## El Nino Southern Oscillation





# Ocean Warming Minimal







## Issue #7

Full Implementation of the Paris  
Climate Agreement Would Have  
Almost No Effect on the  
Climate, Even by 2100



# Paris Climate Agreement

- Work of the UN Framework Convention on CC
- Deals with Green House Gas emissions mitigation, adaptation and finance
- Adopted on December 12, 2015
- Start planned for 2020
- Signed by 195 nations, ratified by 144
- Implementation implications
  - Prevent 0.306 degrees Fahrenheit of GW by 2100
  - At a cost of \$65 to \$132 Trillion, 2030 to 2100

# COP21 final deal: Key points...

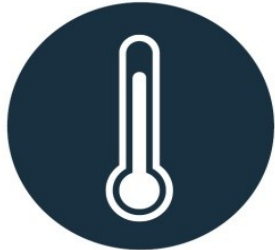
- COP21 President Laurent Fabius says text is "differentiated, balanced, durable and "legally-binding"
- Text "emphasises" need to keep warming "well below 2C"
- ... And "Pursuing" efforts to keep warming "below 1.5C"
- 5-year 'stocktake' of how countries are doing on their climate plans
- Issues of 'Differentiation' and 'Loss & Damage' included
- No clear timescale of when fossil fuels must be phased out





# SIX KEY POINTS OF THE PARIS CLIMATE AGREEMENT

The 31-page document that details a landmark agreement reached in Paris on 12 December 2015 could be a turning point in the struggle to contain global warming. The historic pact, approved by 195 countries, will take effect from 2020.



To keep global **temperature** increase below 2C (3.6F) and to pursue efforts to limit it to 1.5C.



186 countries submitted plans detailing how they reduce their **greenhouse gas pollution** through 2025 or 2030.



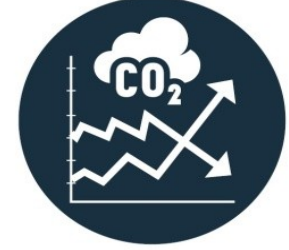
Overall assessment of how countries are doing in cutting their emissions compared to their **national plans** – starting in 2023, every five years.



**\$100 billion** a year in climate finance for developing countries by 2020, with a commitment to further finance in the future.



**Rich countries** to engage in absolute reductions in emissions, developing ones to continue enhancing their mitigation efforts.



Countries should reach global peaking of **greenhouse gas emissions** as soon as possible.

**Source:** UNEP, Global Trends in Renewable Energy Investment 2015



# Emissions Targets for USA & China

- The Obama administration agreed to an economy-wide target of reducing U.S. greenhouse gas (82% of which is carbon dioxide (CO<sub>2</sub>)) emissions by 26%-28% below its 2005 level in 2025.
- China agreed “to achieve the peaking of CO<sub>2</sub> emissions around 2030” and to other measures such as those designed to increase the share of non-fossil fuels in primary energy consumption. Taking into consideration expected economic growth in China and other factors, their target translates into about a 70% *increase* above its 2005 level in 2025.

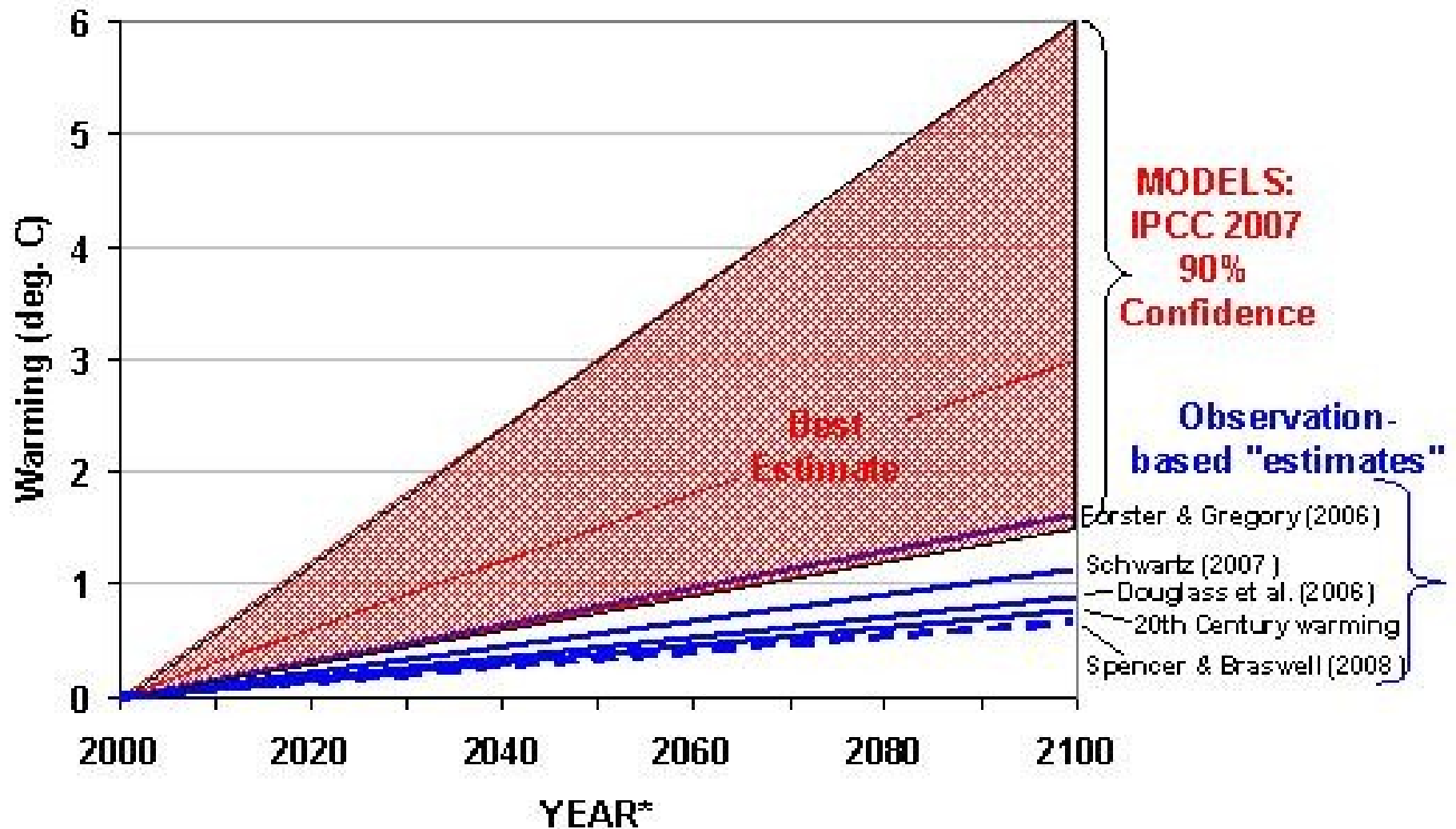


## Issue #8

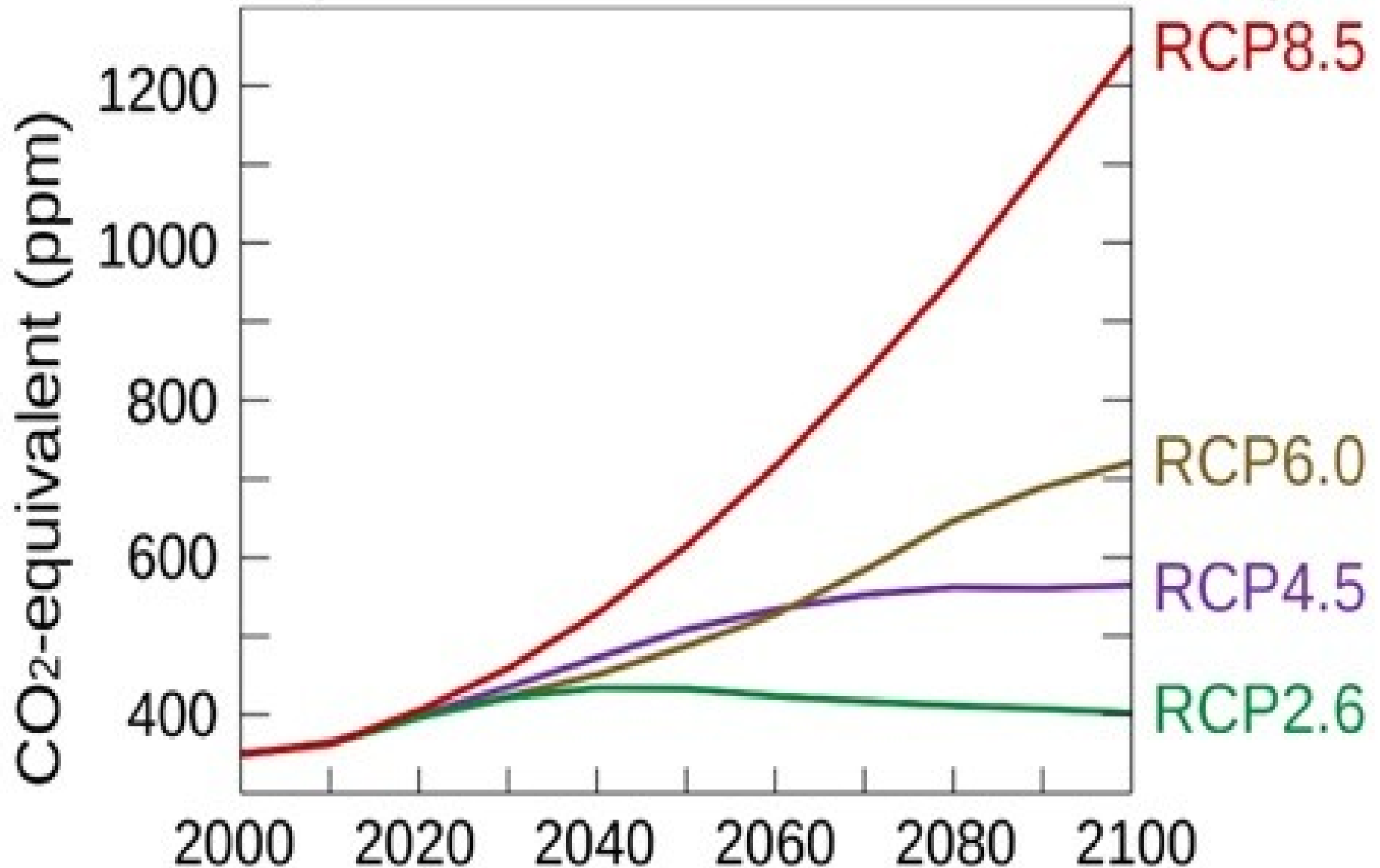
The UN IPCC Climate Models  
Are Not Realistic



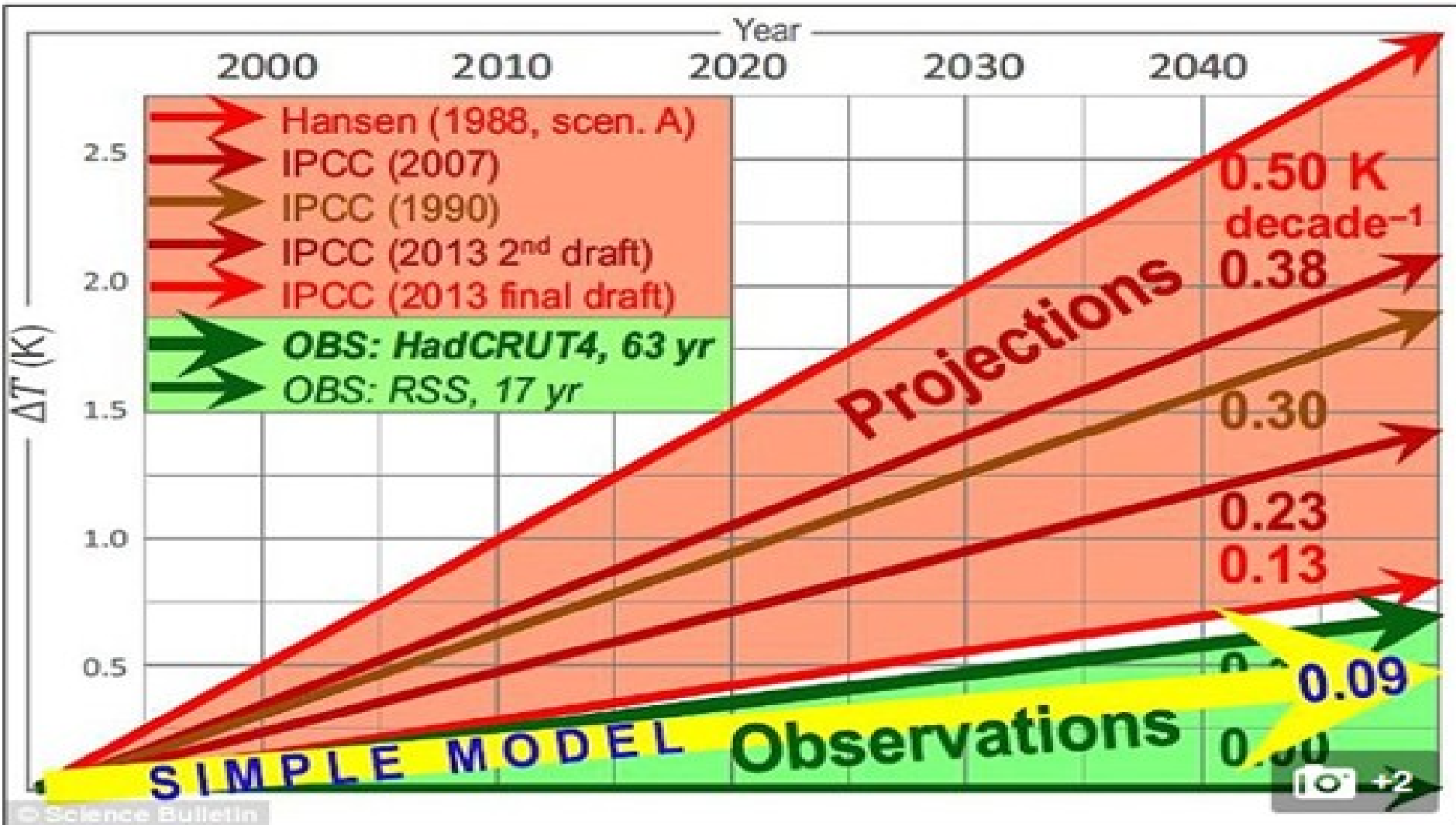
# Models & Estimates



# IPCC Representative Concentration Pathways



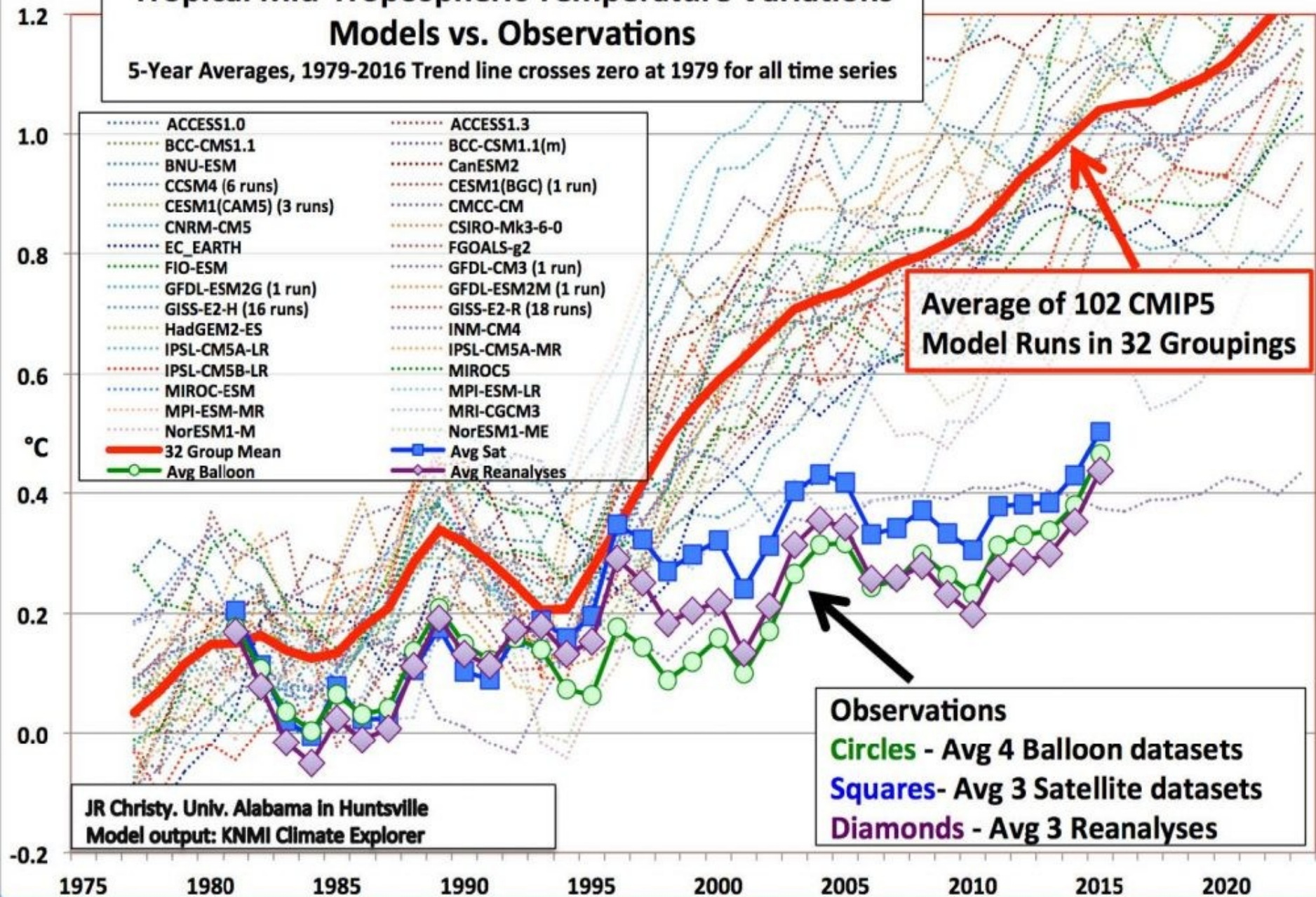
# IPCC Change in Projections



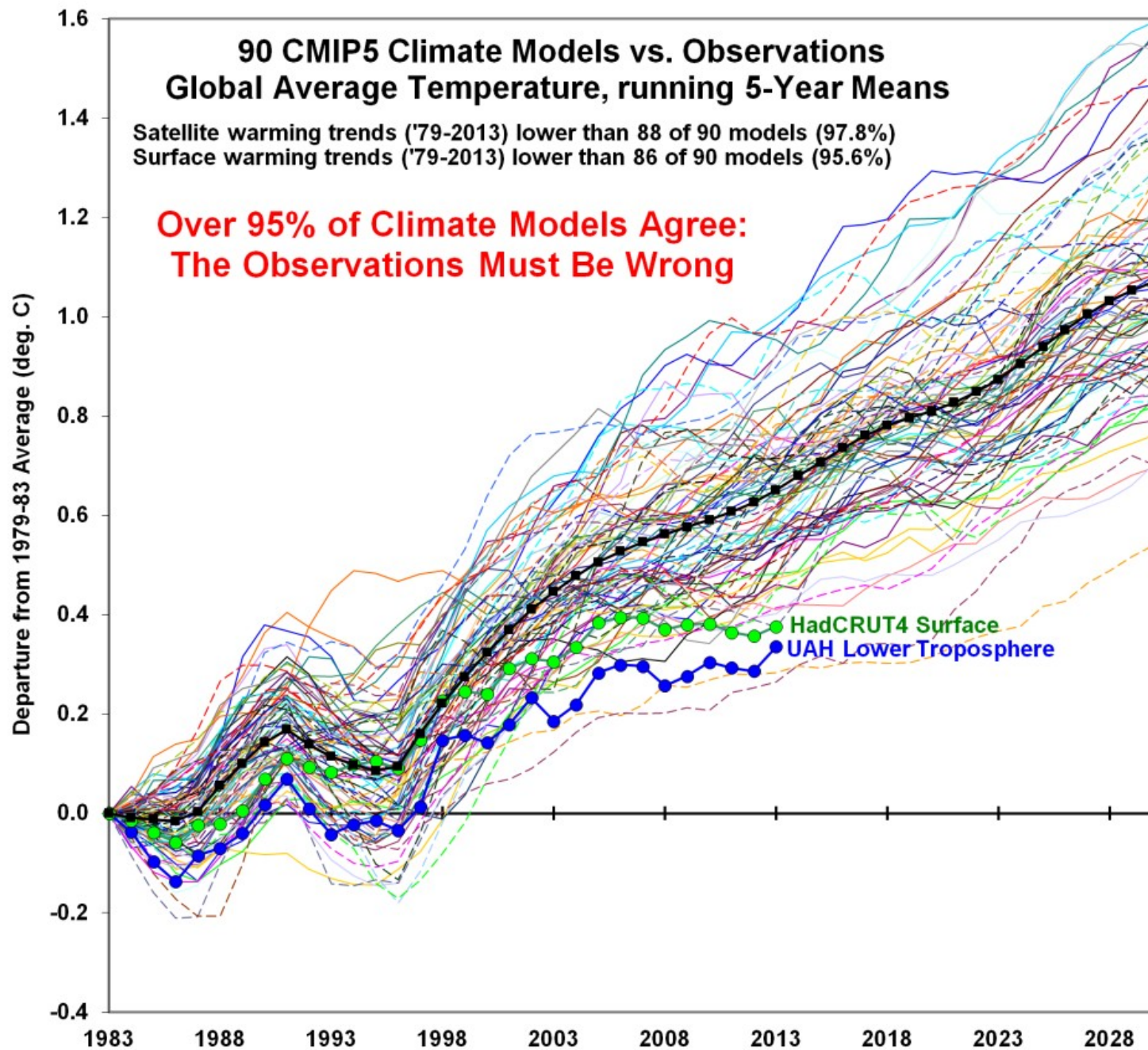


# Tropical Mid-Tropospheric Temperature Variations Models vs. Observations

5-Year Averages, 1979-2016 Trend line crosses zero at 1979 for all time series

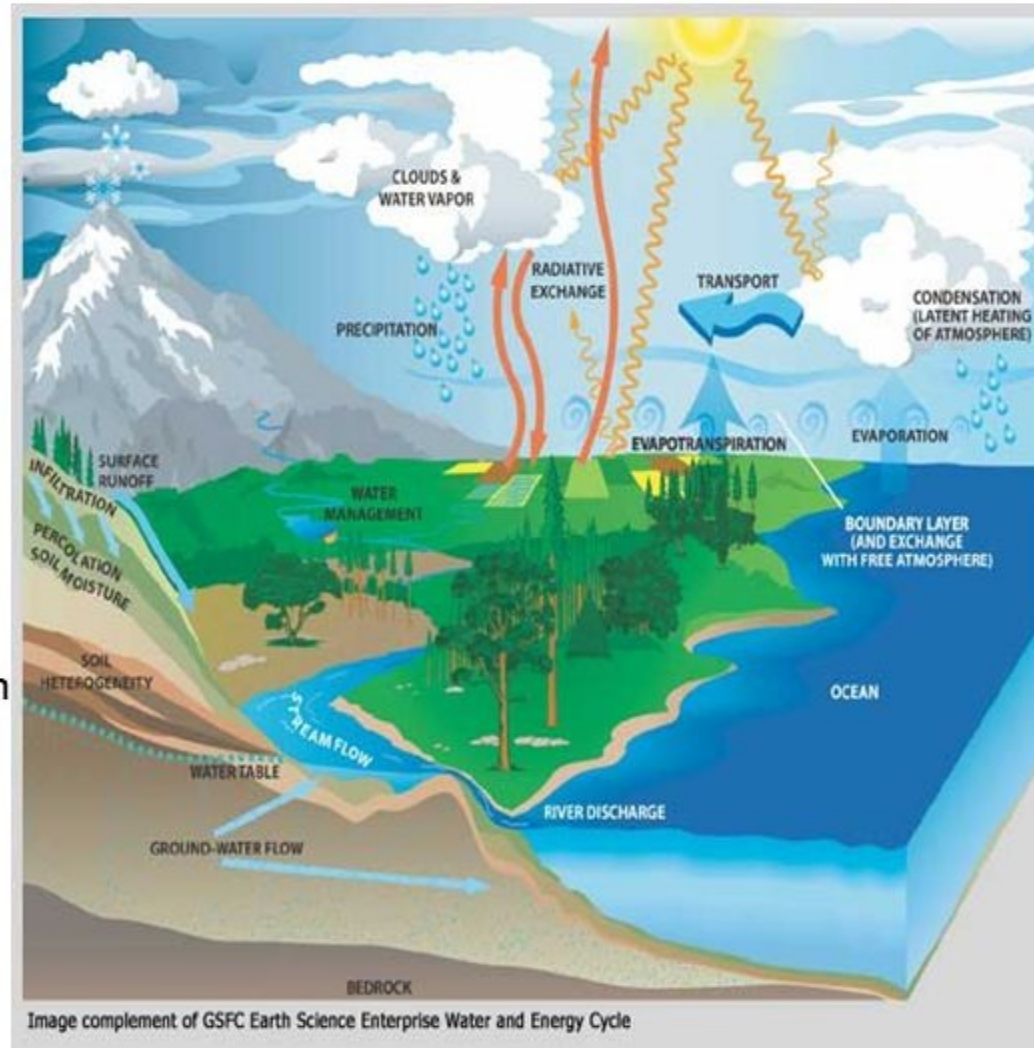
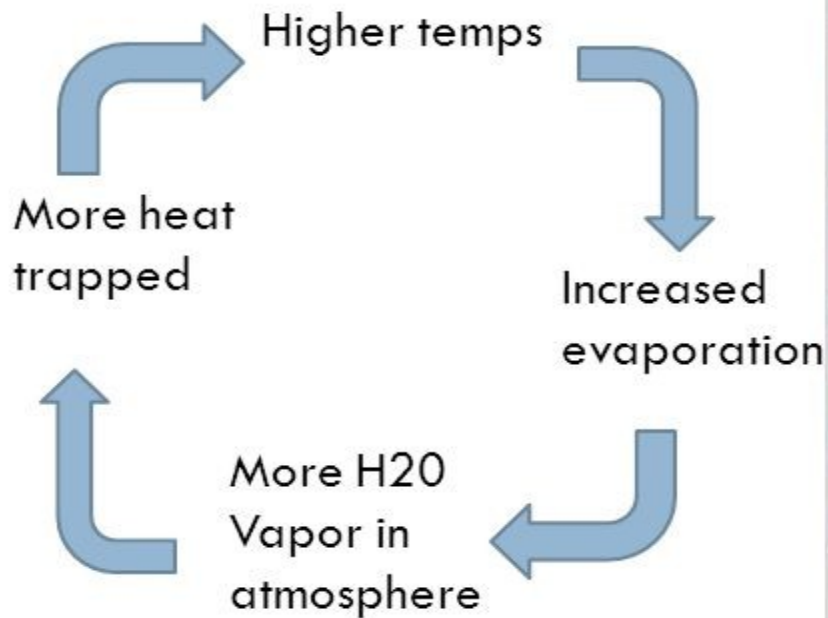






# Water Vapor ( $H_2O$ )

- Most Abundant greenhouse gas
- Positive Feedback Cycle





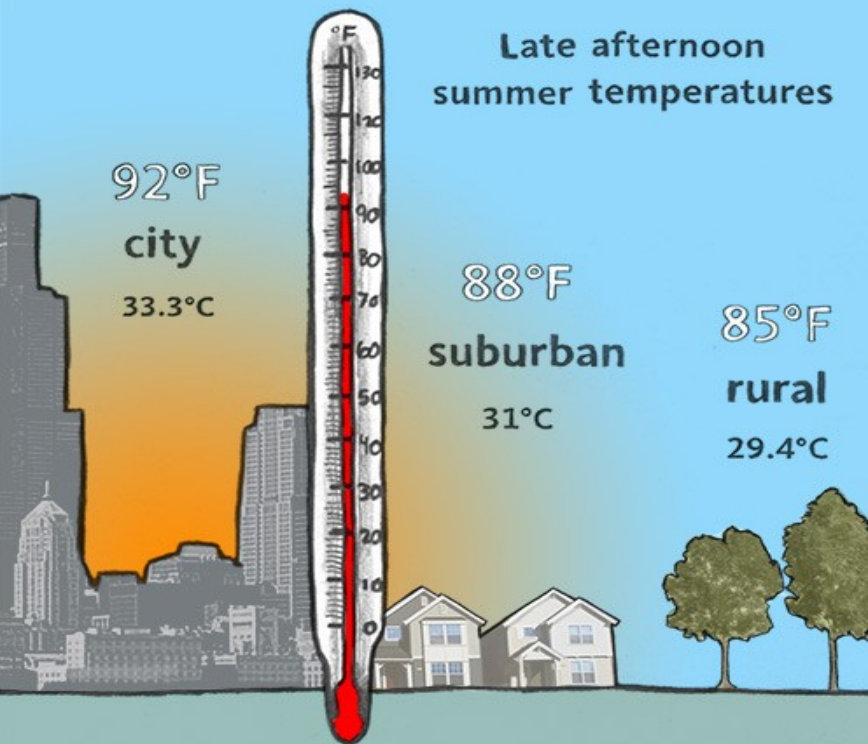


## Issue #9

Surface Weather Stations Give  
Less Accurate (and Higher  
Average) Temperatures Than  
Satellite Measurements

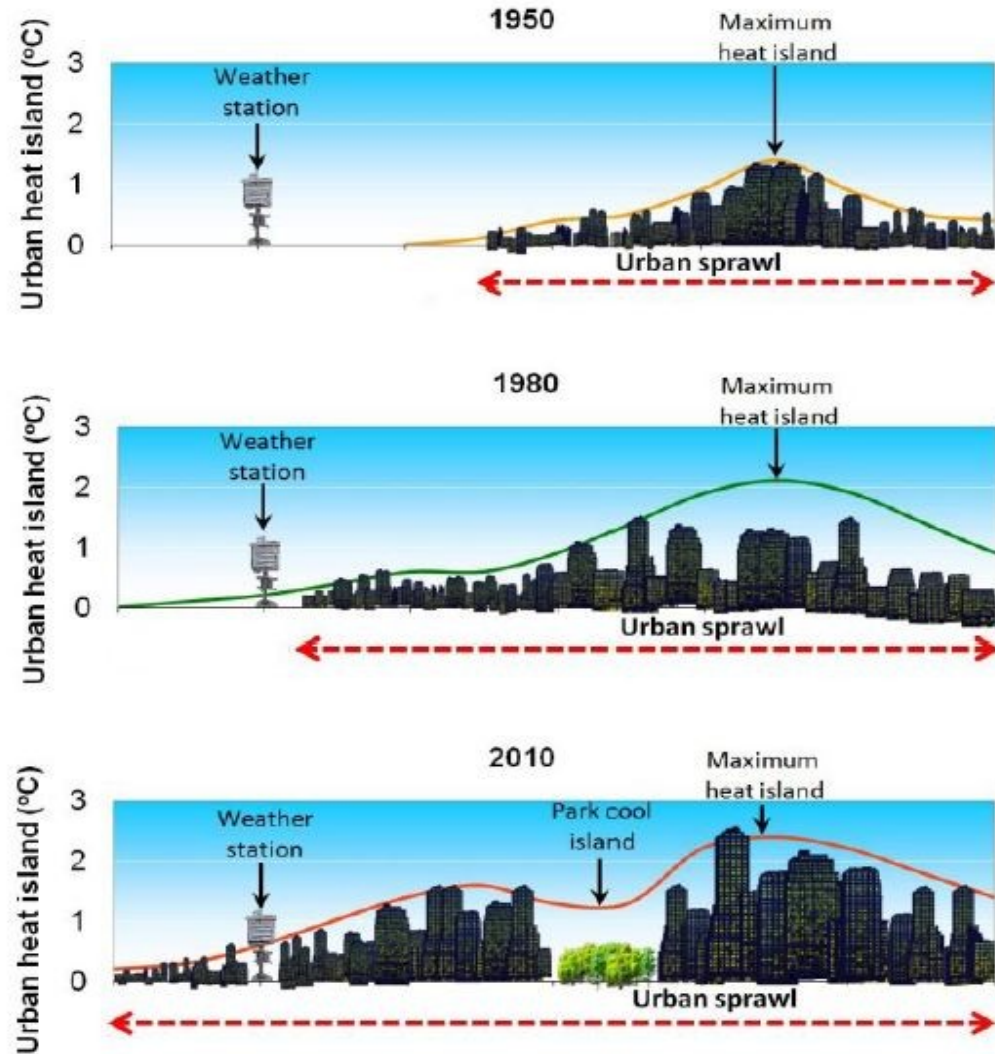
# Urban Heat Island Effect

## Urban Heat Islands



Why is it warmer in the city?\*

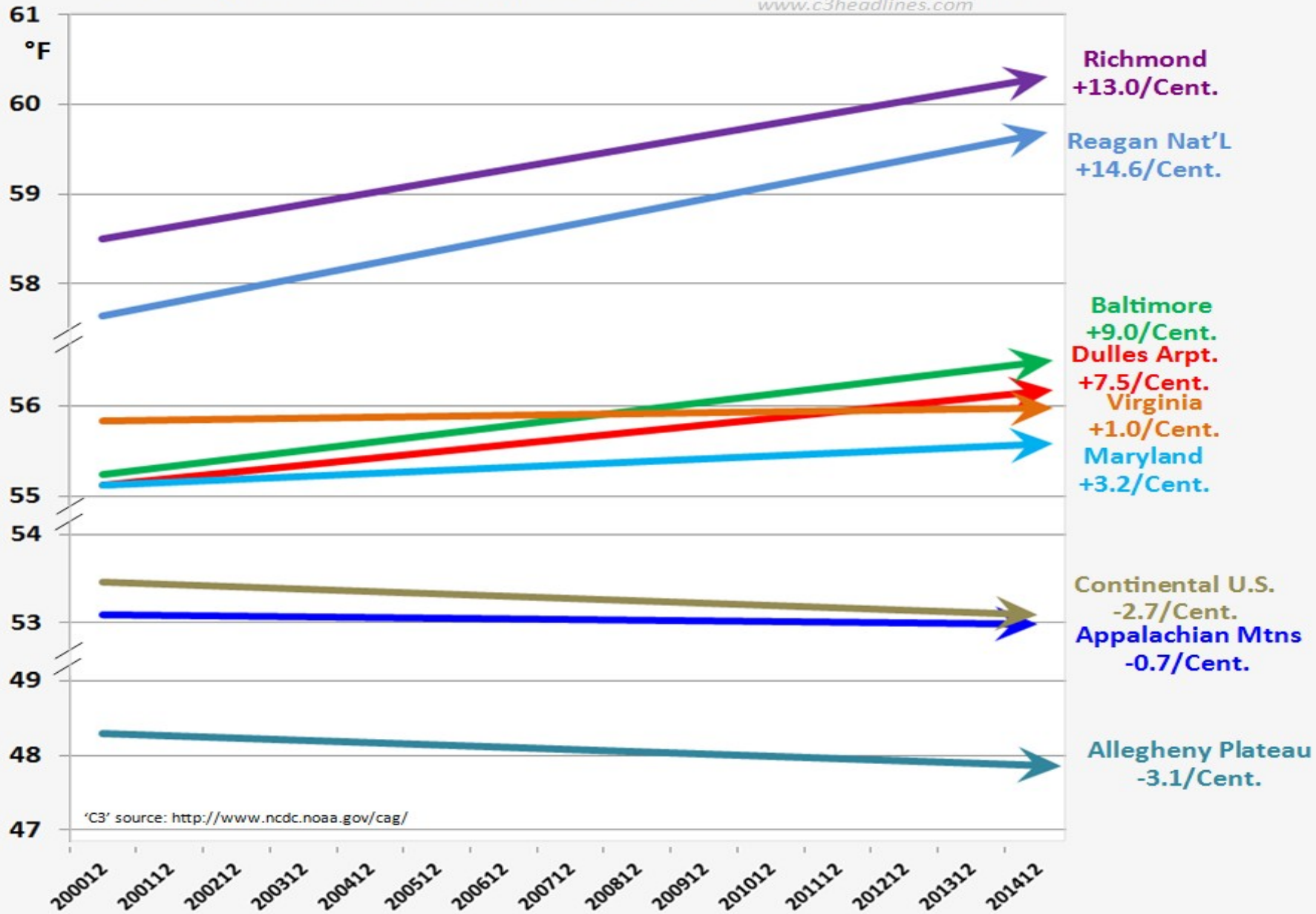
\* 1-3°C or 2-5°F warmer than the nearby rural areas



# Unequivocal "Global" Warming Does Not Exist

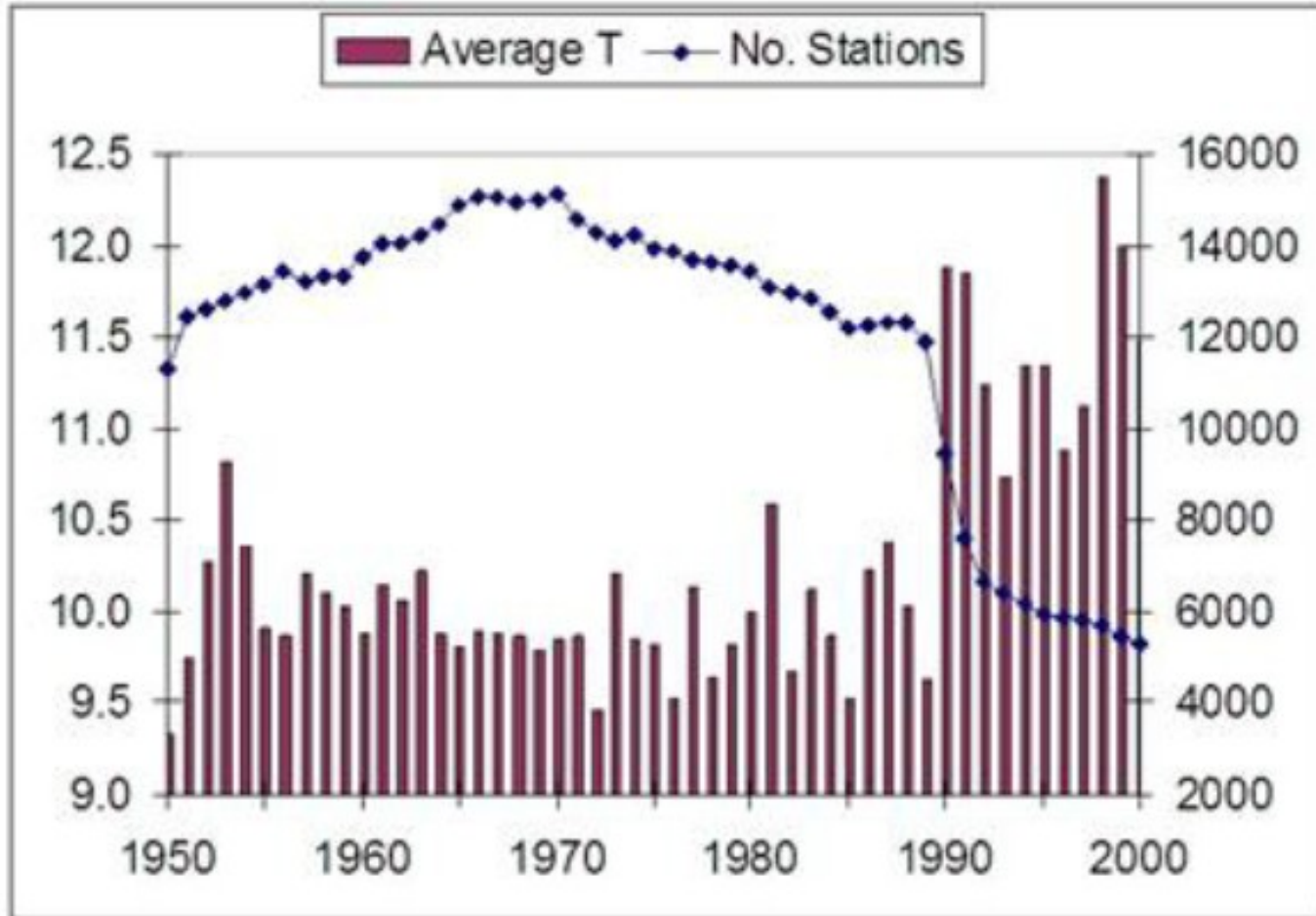
*Last 15 yrs: U.S. urban/airport areas vs. rural temperatures*

[www.c3headlines.com](http://www.c3headlines.com)



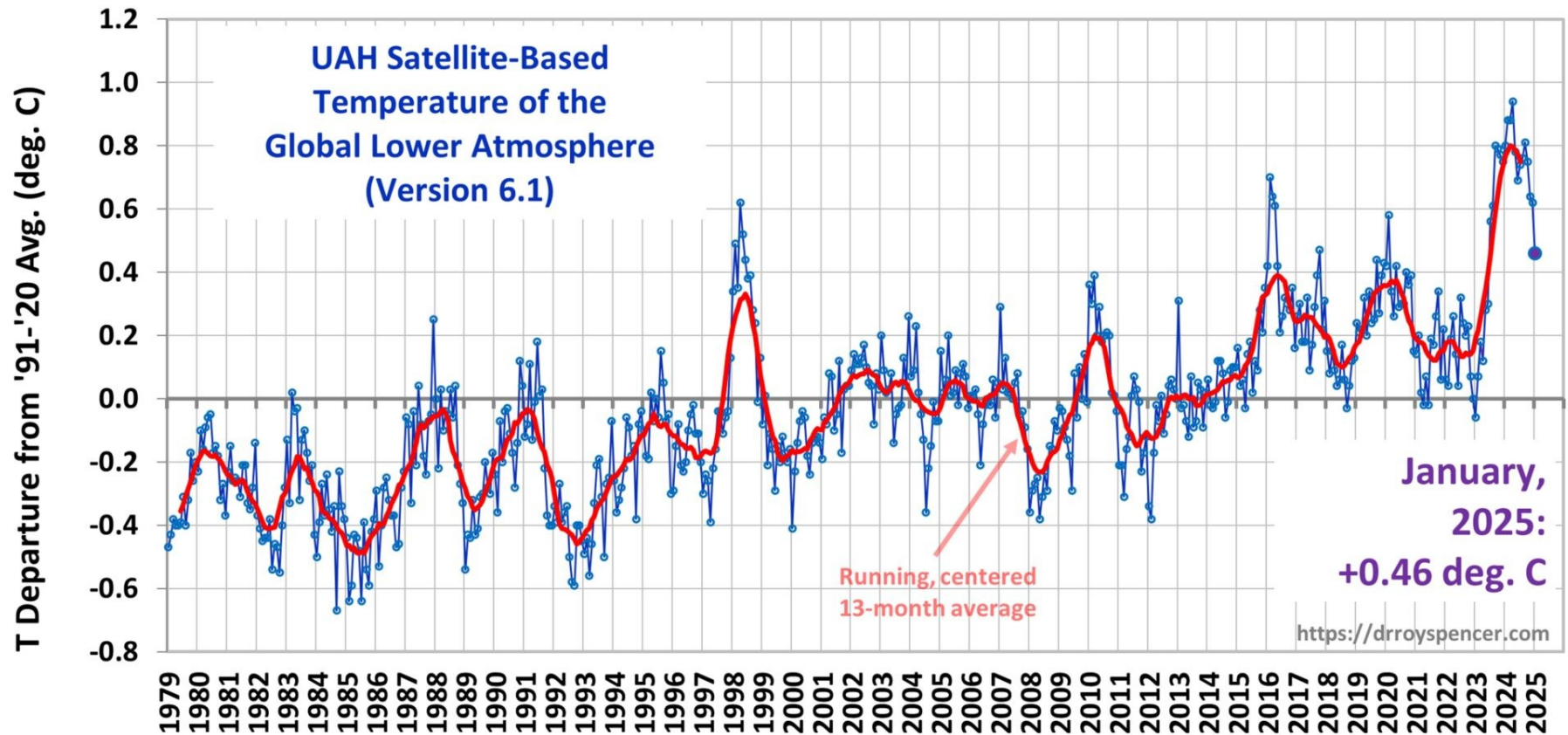


# Correlation of Average Temperature and Number of Surface Stations



Eliminated data from weather stations likely to show global cooling

# Satellite-Based Temperature



# Issue #10: Polar Bears Thriving, Not Becoming Extinct

**1960's - 5,000 Polar Bears**  
**Today - 25,000+ Polar Bears**



**Inconvenient Fact**

**CFACT.org**







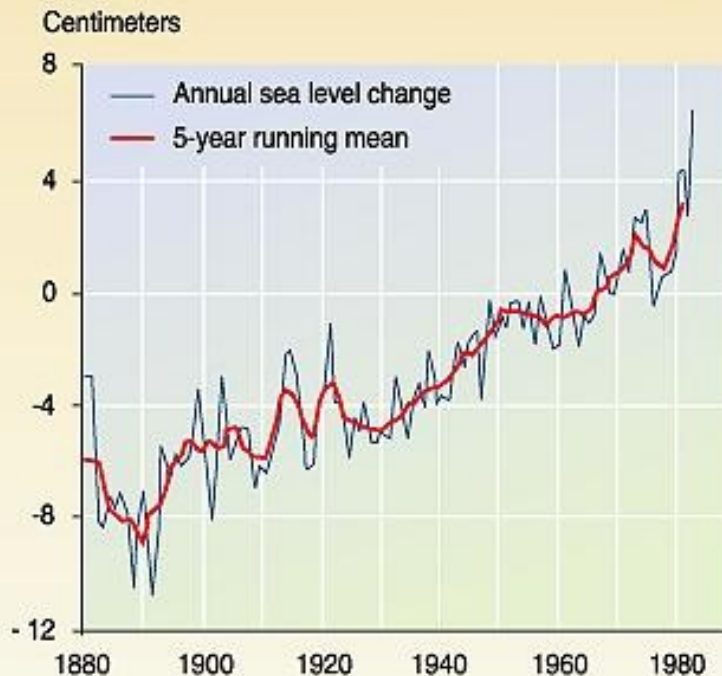
# Issue #11

Sea Levels Are Not Rising  
As Fast As Predicted

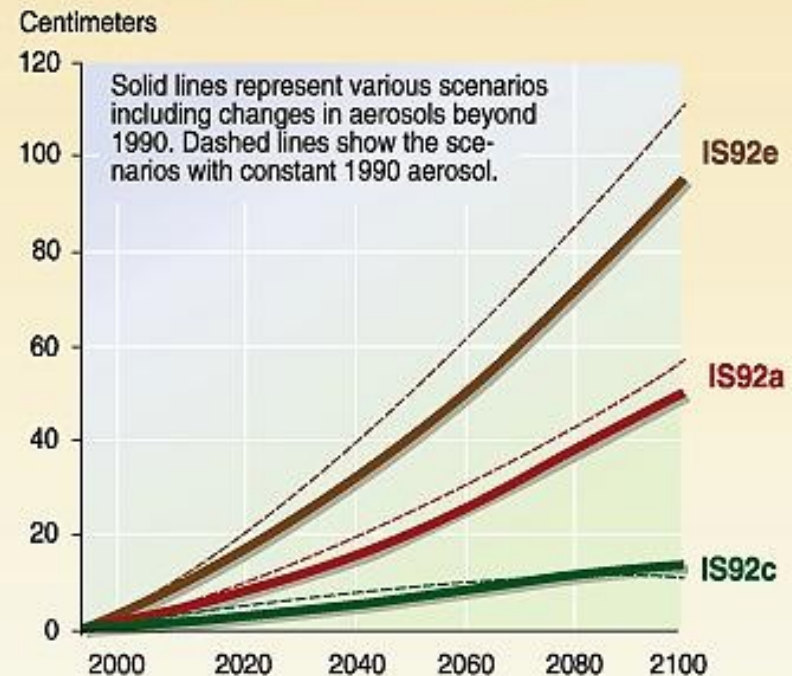
# Sea Level Rise Projections

## Sea level rise due to global warming

### Sea level rise over the last century



### Sea level rise scenarios for 2100

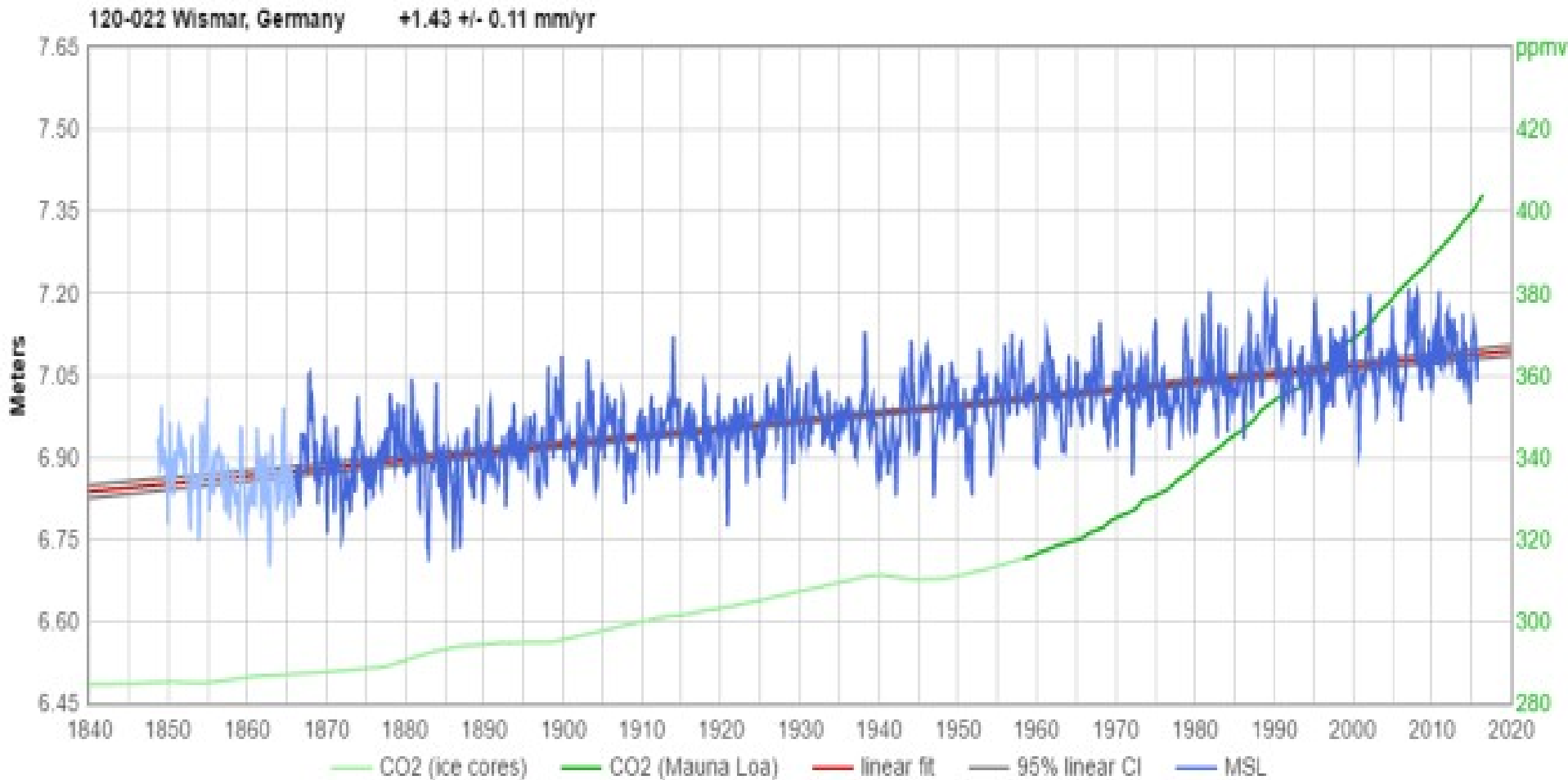


GRID  
Arendal UNEP

GRAPHIC DESIGN: PHILIPPE REKACEWICZ

Source: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1995; Sea level rise over the last century, adapted from Gornitz and Lebedeff, 1987.

# Sea Level Unaffected by CO2







# Sea Level Rise Reality

In the last 140 years, since 1880, we have increased CO<sub>2</sub> by 38%, yet the predicted sea rise hasn't happened. Look at Wismar, Germany? Wismar sits on the Mecklenburg Bend, in the Baltic Sea. It is halfway between Norway and Sweden, and the Netherlands. Both Norway and Sweden are actually rising, and have been doing so since the last Glacial Maximum, as melting ice removed weight. So, people in Norway are saying, "Hey, sea levels are falling!" Well, no, their land is rising. Then on the other side, you have Holland and Belgium. Here, the land is in fact sinking. It's like a seesaw. Norway goes up, Holland goes down.



## Issue #12

# Arctic Sea Ice Is Not Disappearing

**Hey Climate  
Marchers:**

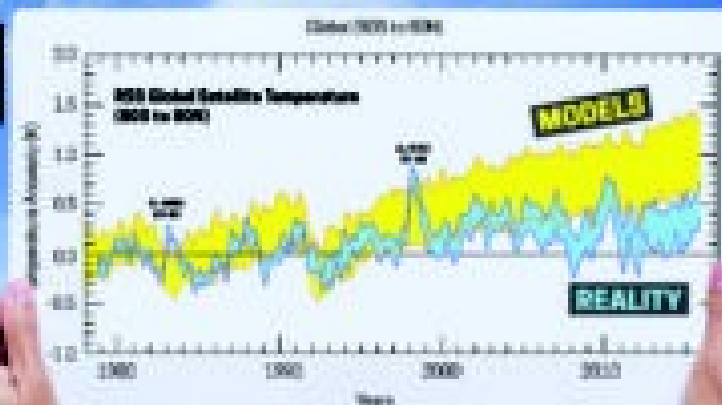
**THE SCIENCE IS  
SETTLED.  
YOU'RE BEING  
HUSTLED!**



[ClimateHustle.com](http://ClimateHustle.com)

**ACTUAL DATA REFUTE CLIMATE MODELS**

**Hey Climate  
Marchers:**



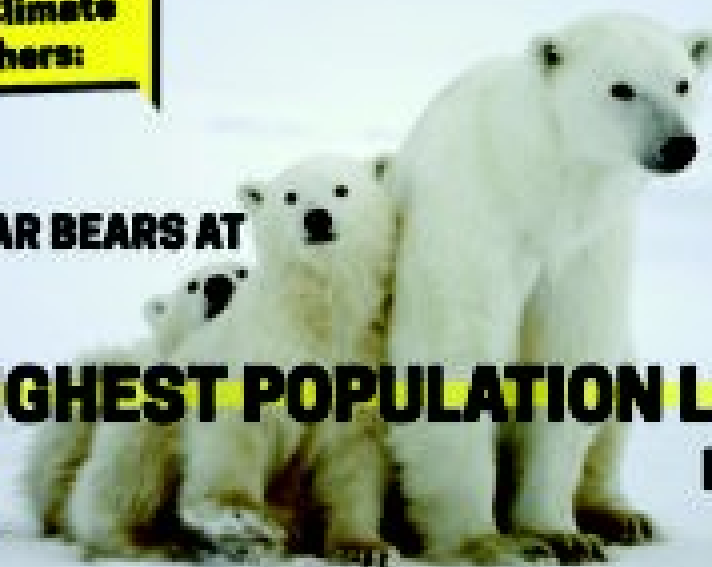
**DON'T BE HUSTLED BY GLOBAL WARMING HYPE!**



**Hey Climate  
Marchers:**

**"POLAR BEARS AT**

**HIGHEST POPULATION LEVELS  
IN 50 YRS"**

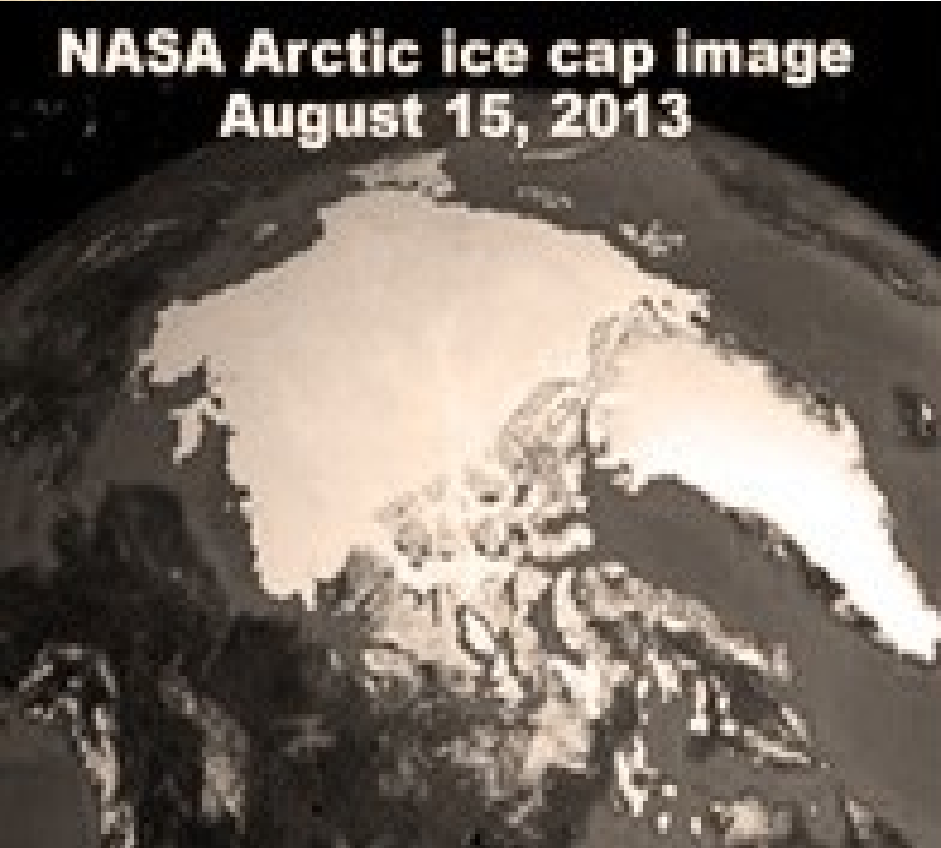


- Dr. Robert Godinard  
State of Alaska

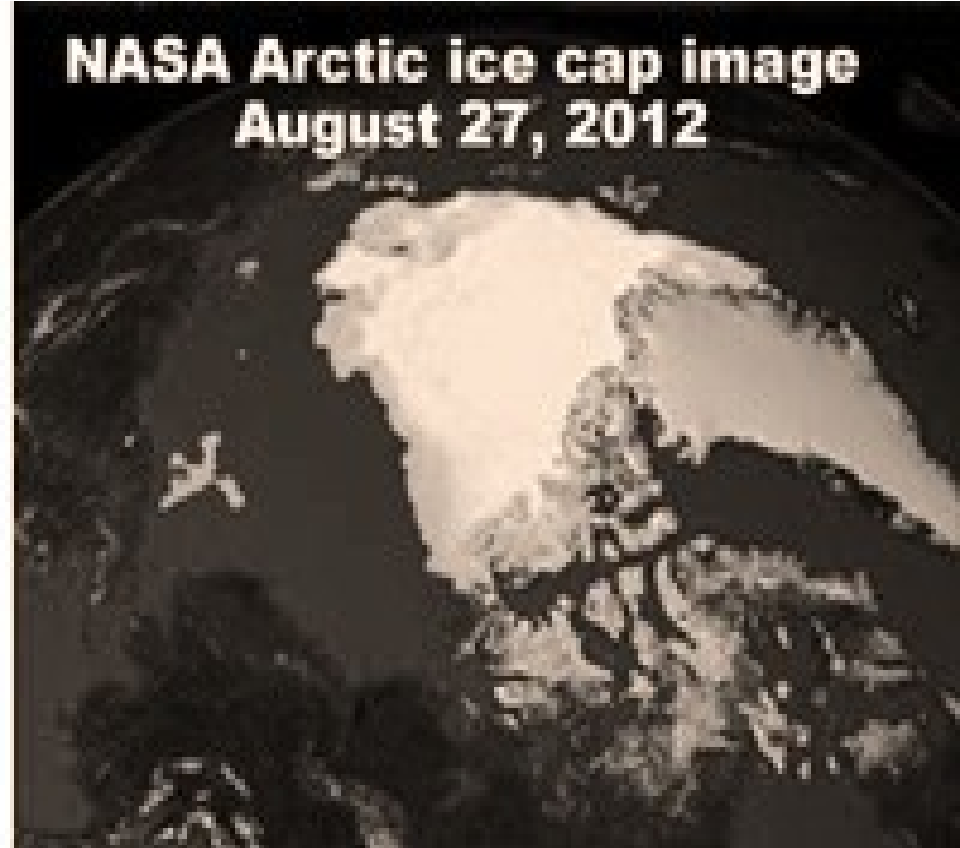


# Arctic Ice Cap Actual vs. Prediction

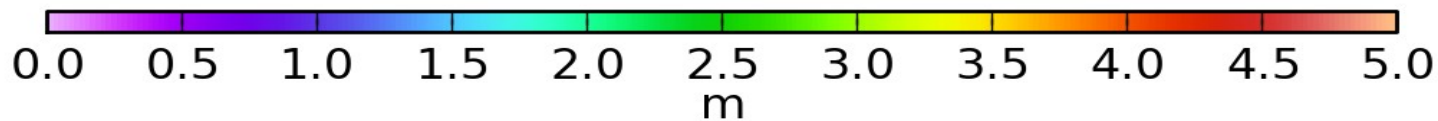
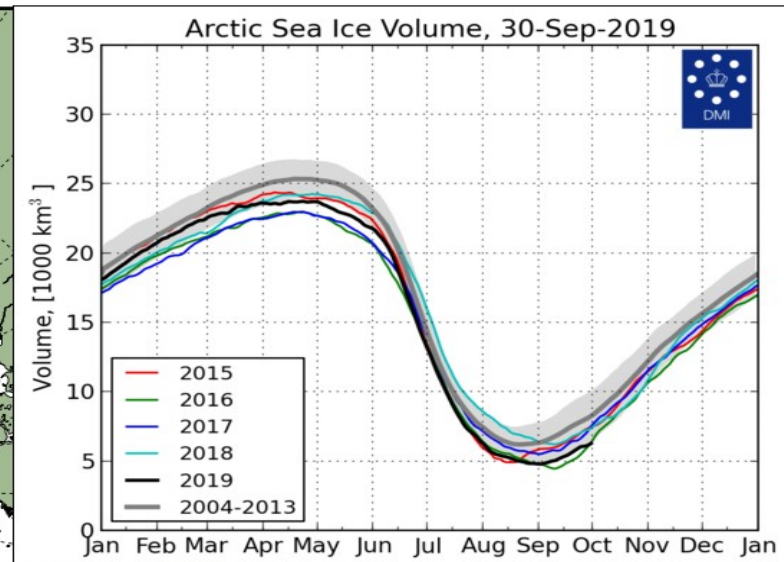
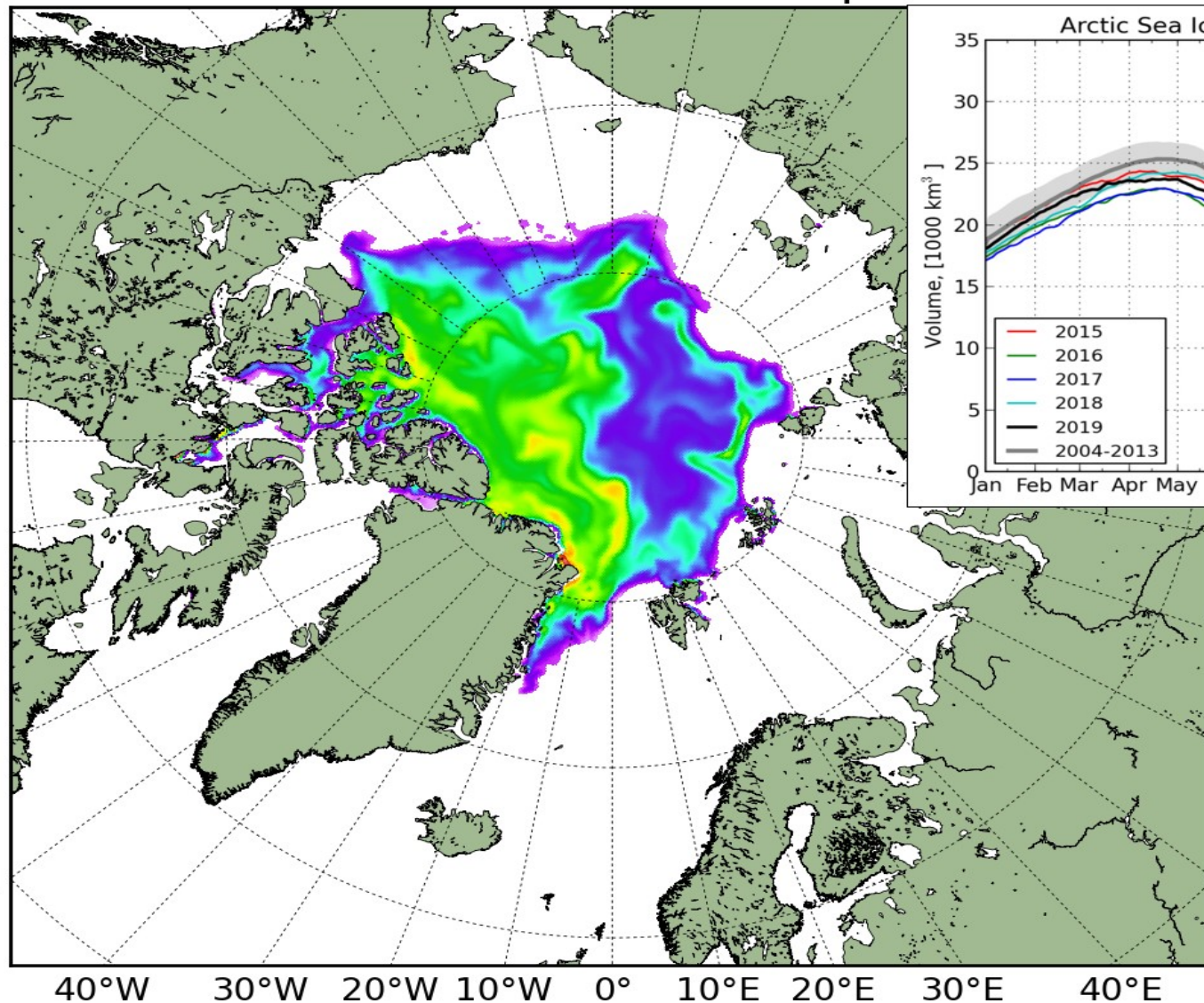
**NASA Arctic ice cap image  
August 15, 2013**



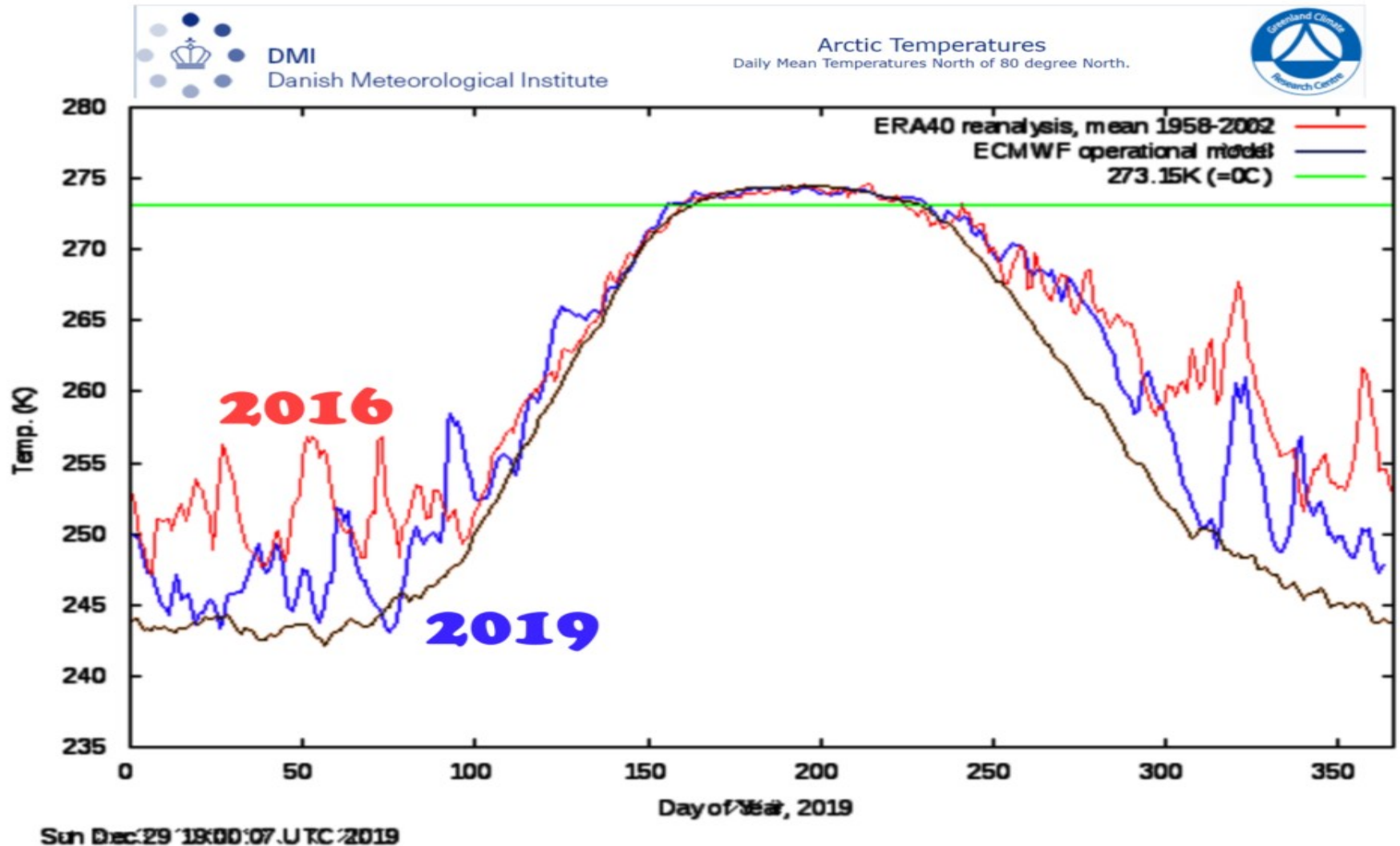
**NASA Arctic ice cap image  
August 27, 2012**



# Sea Ice Thickness, 30-Sep-2019



# Winter Temperatures near North Pole







## Issue #13

# Weather Extremes Are Not Increasing

*[Drought, hurricanes, tornadoes,  
more storms, heat waves, forest fires,  
ocean temperature, snow level]*

# Drought 800 -> 2000 AD

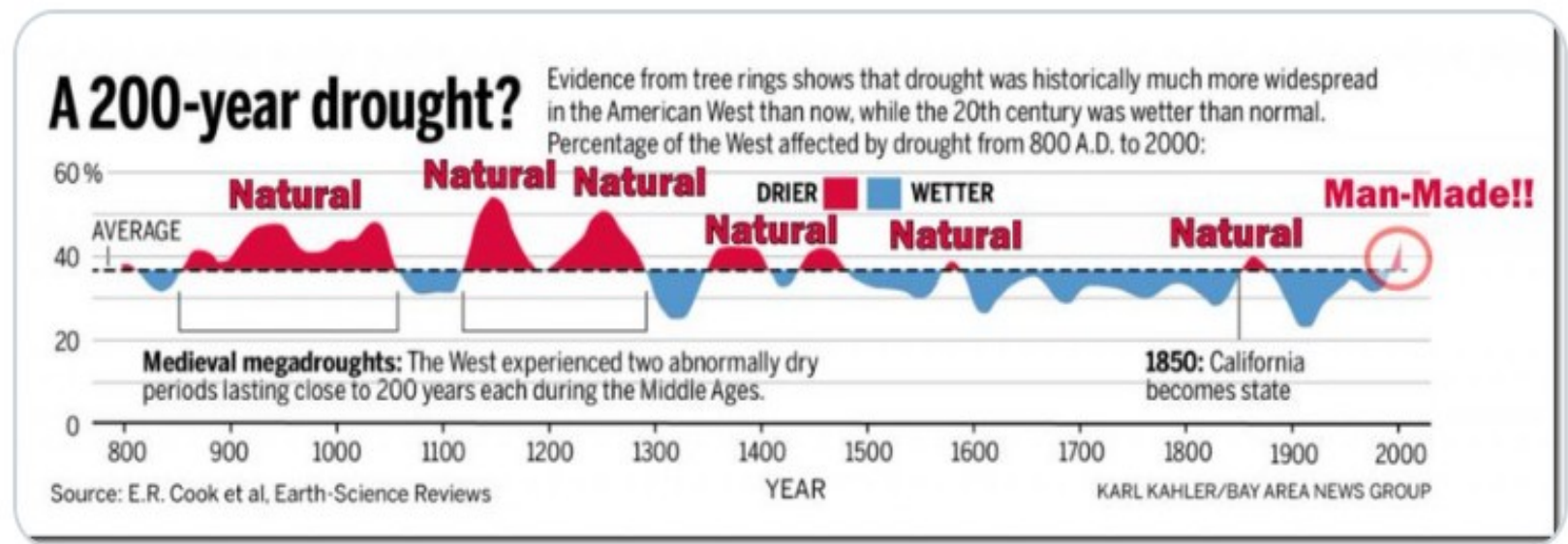


**Tony Heller** @Tony\_\_Heller · 5m

Replying to @RyanMaue

Ryan Maue gives in to superstition. Drought is the normal climate for California. The wet 20th century was the anomaly.

[mercurynews.com/2014/01/30/gra...](http://mercurynews.com/2014/01/30/gra...)



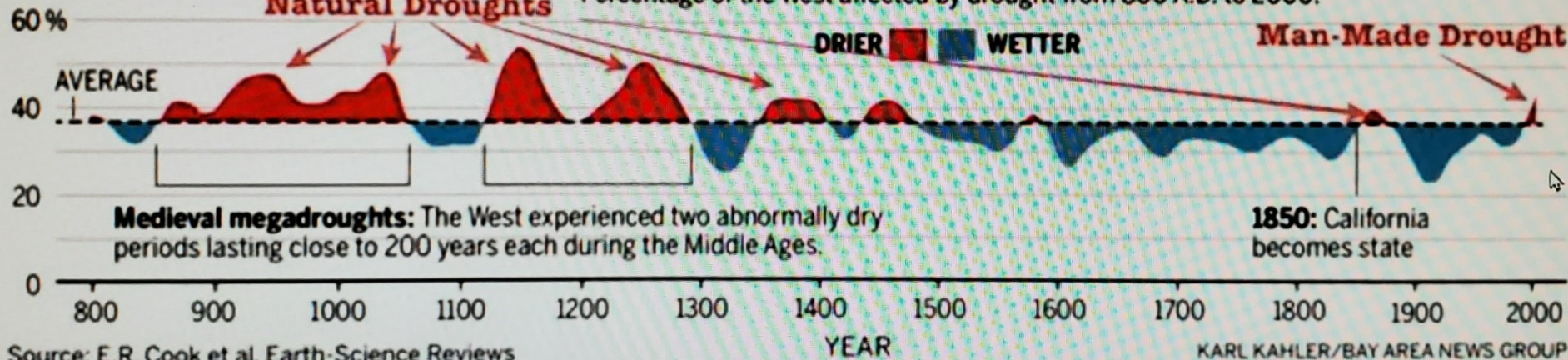


# Policy Based Science Fiction

## A 200-year drought?

Natural Droughts

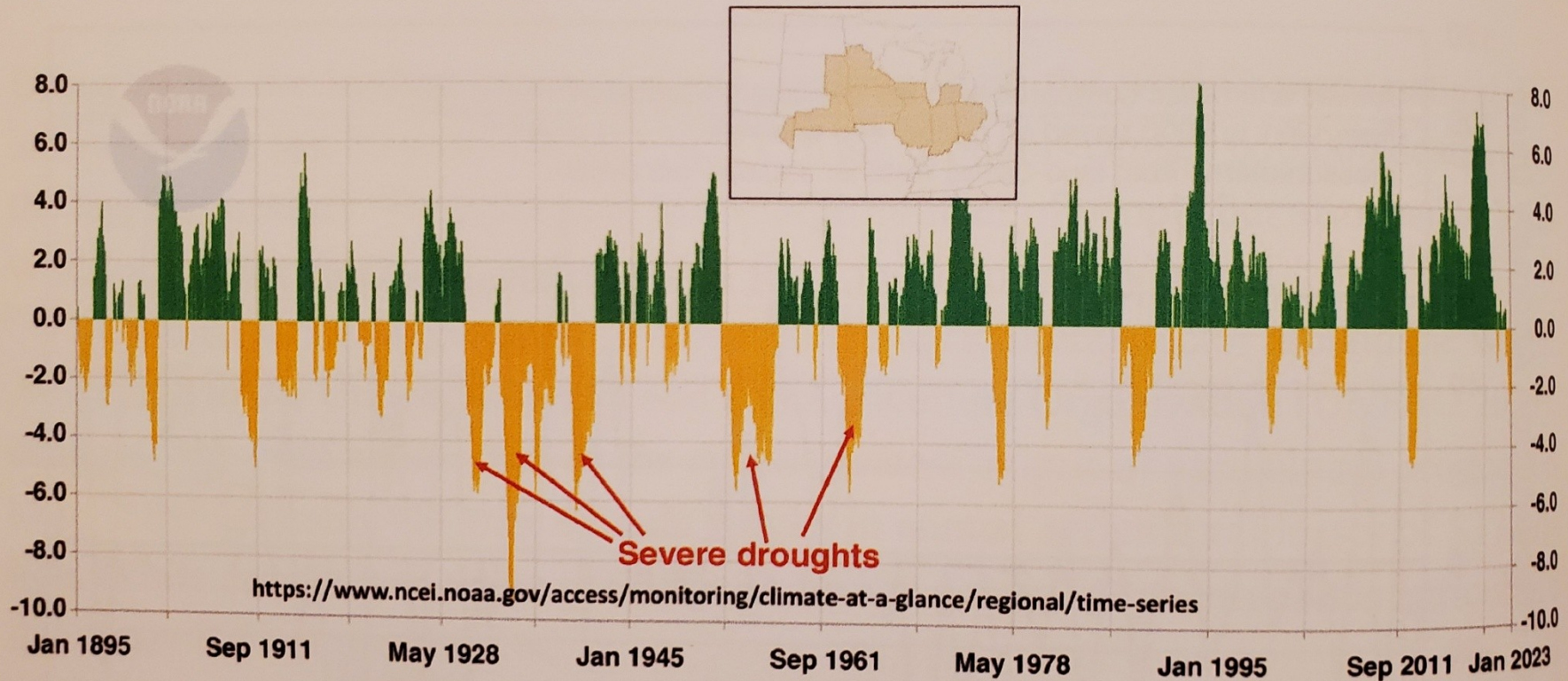
Evidence from tree rings shows that drought was historically much more widespread in the American West than now, while the 20th century was wetter than normal. Percentage of the West affected by drought from 800 A.D. to 2000:





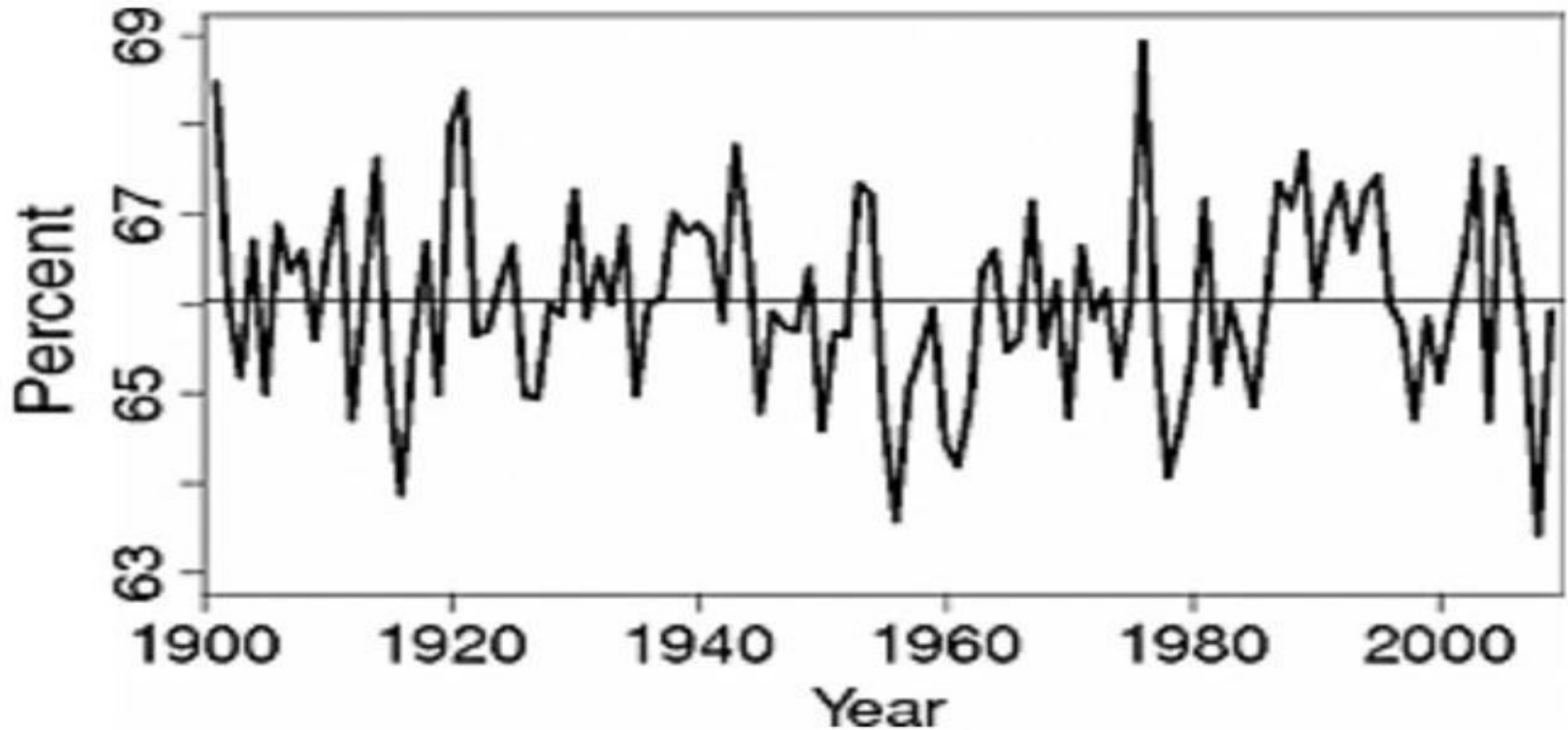
# Corn Belt Drought in the US

Figure 59: American Corn Belt Palmer Drought Severity Index



(National Centers for Environmental Information-Climate 2023)

# No change in **drought** percentage since 1901

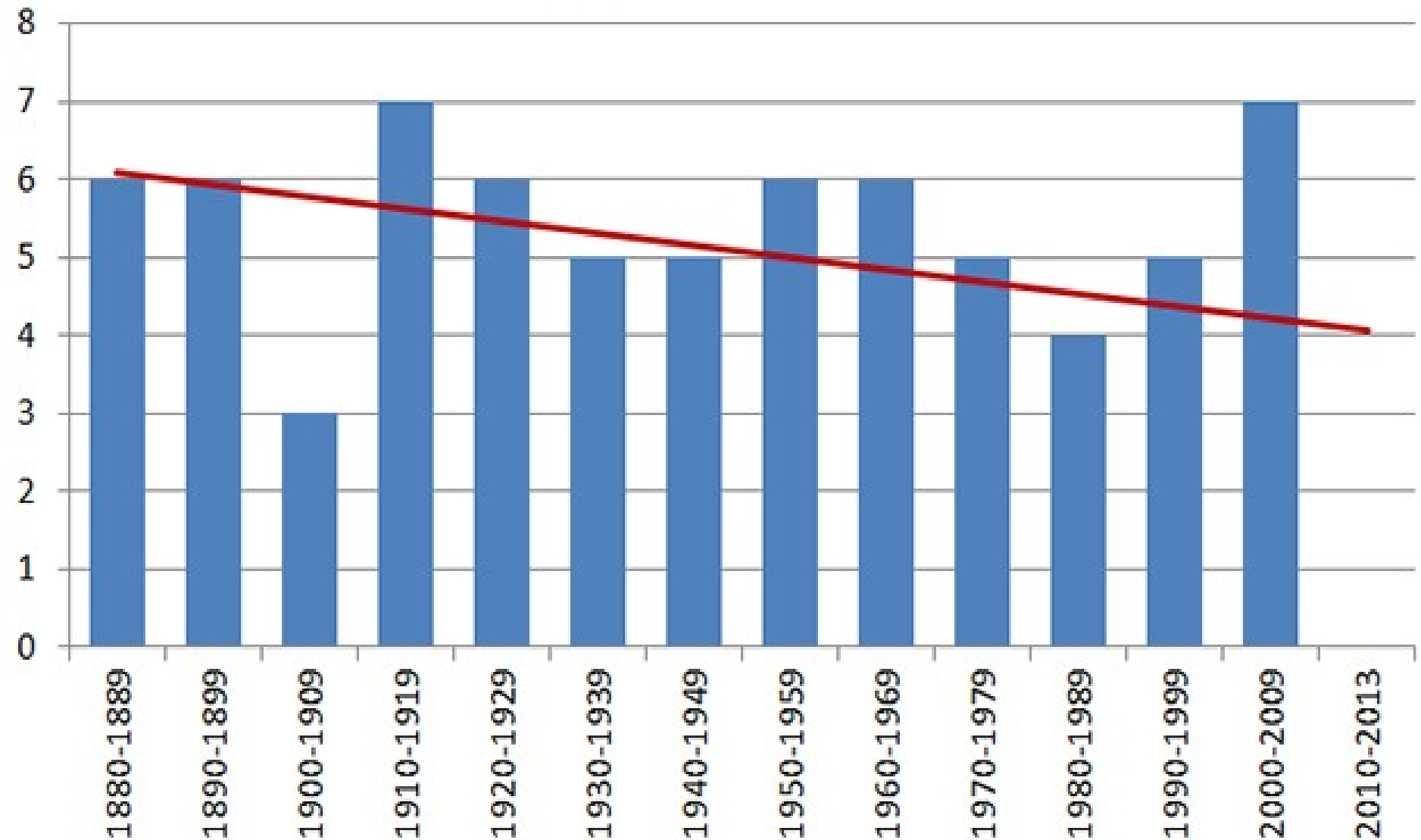


**Got warming?**

CFACT.org 

# Intense Hurricanes since 1880 by Decade

(Cat 3,4,5 - <http://www.nhc.noaa.gov/data/>)





### Deadliest United States hurricanes

Rank	Hurricane	Season	Fatalities
1	"Galveston"	1900	8,000–12,000
2	"San Ciriaco"	1899	3,400
3	Maria	2017	2,982*
4	"Okeechobee"	1928	2,823
5	"Cheniere Caminada"	1893	2,000
6	Katrina	2005	1,200
7	"Sea Islands"	1893	1,000–2,000
8	"Indianola"	1875	771
9	"Florida Keys"	1919	745

Play (k)



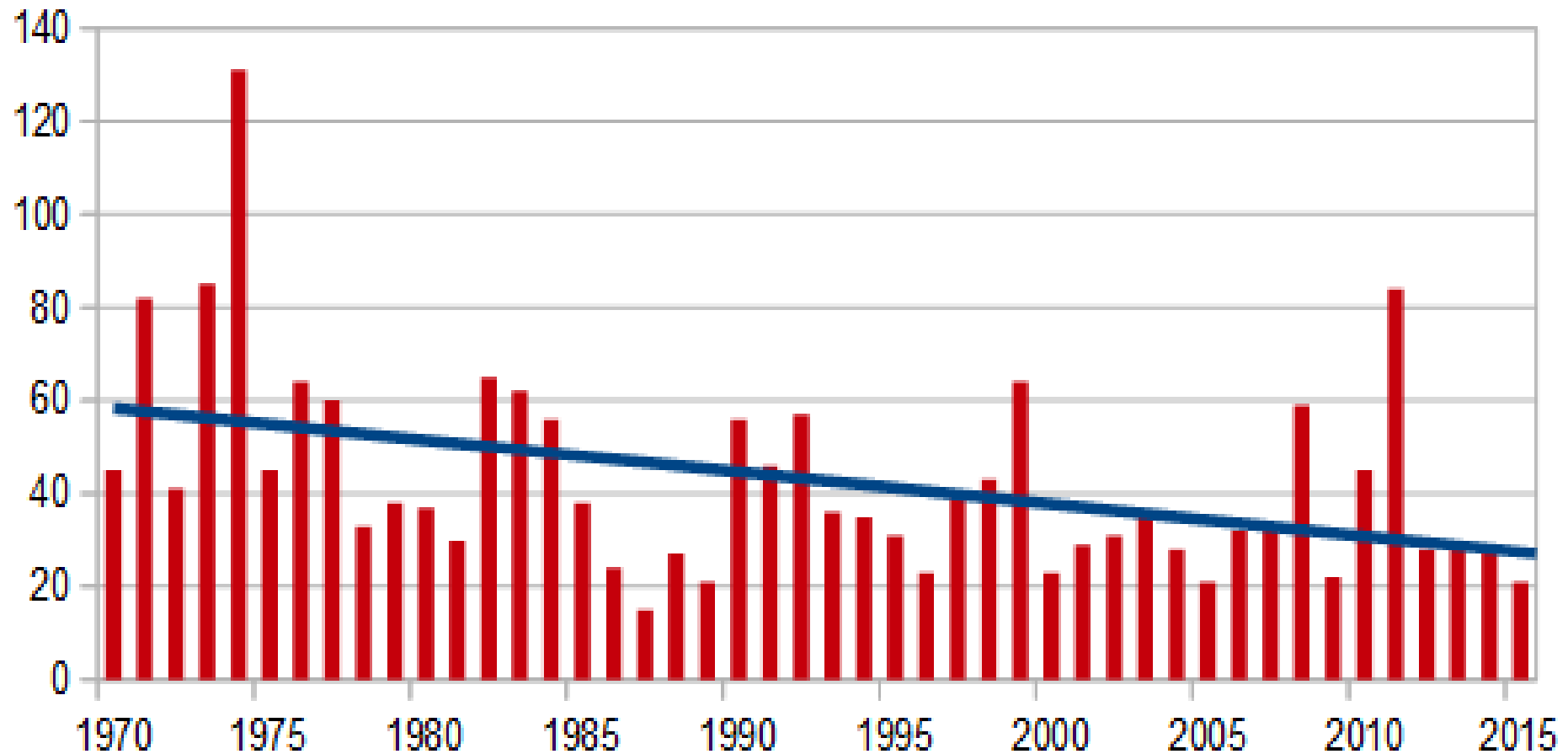
1:57 / 7:54



# US Tornadoes

Annual Count of US Tornadoes EF-3 and Stronger

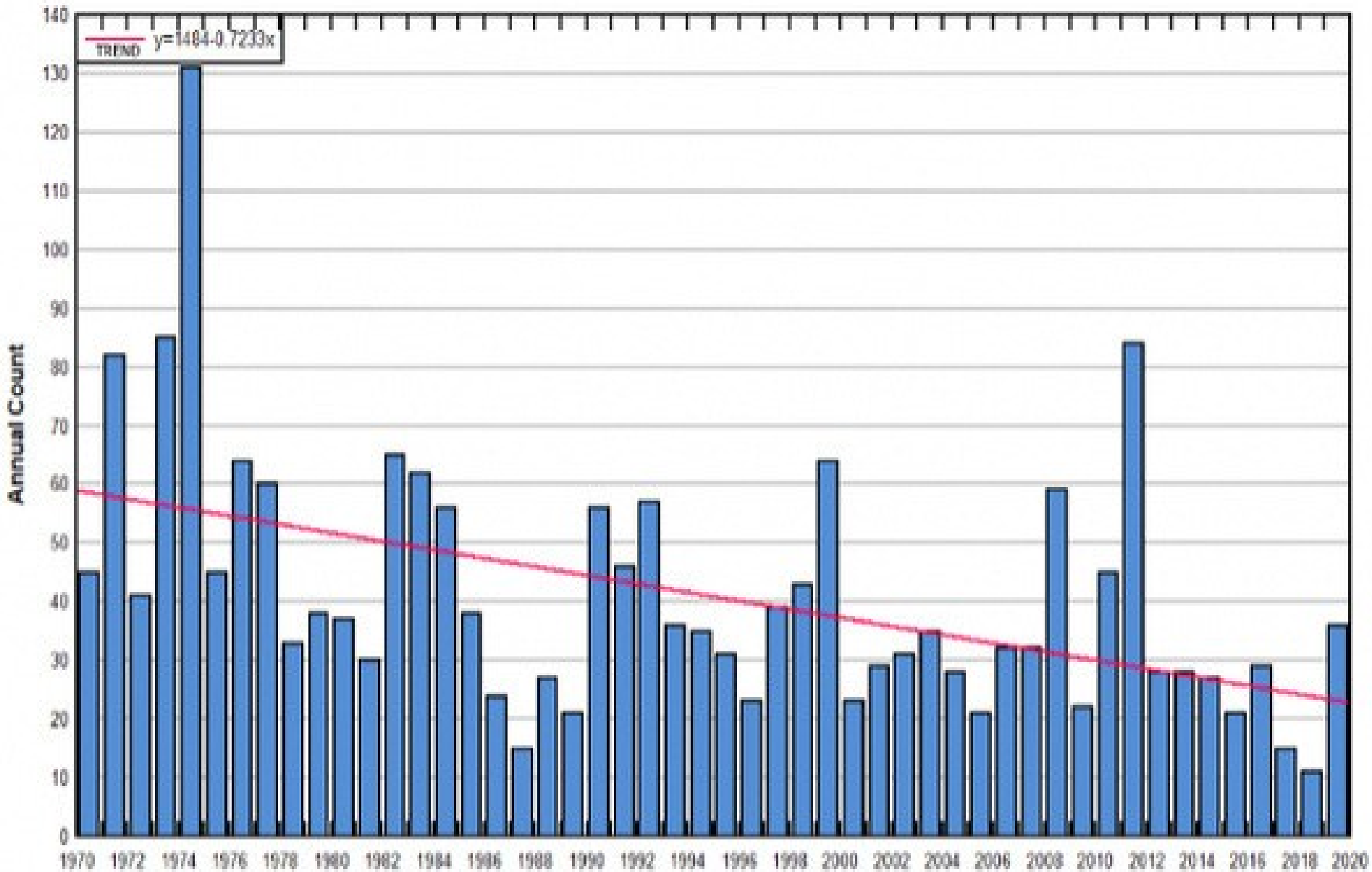
1970 to 2015





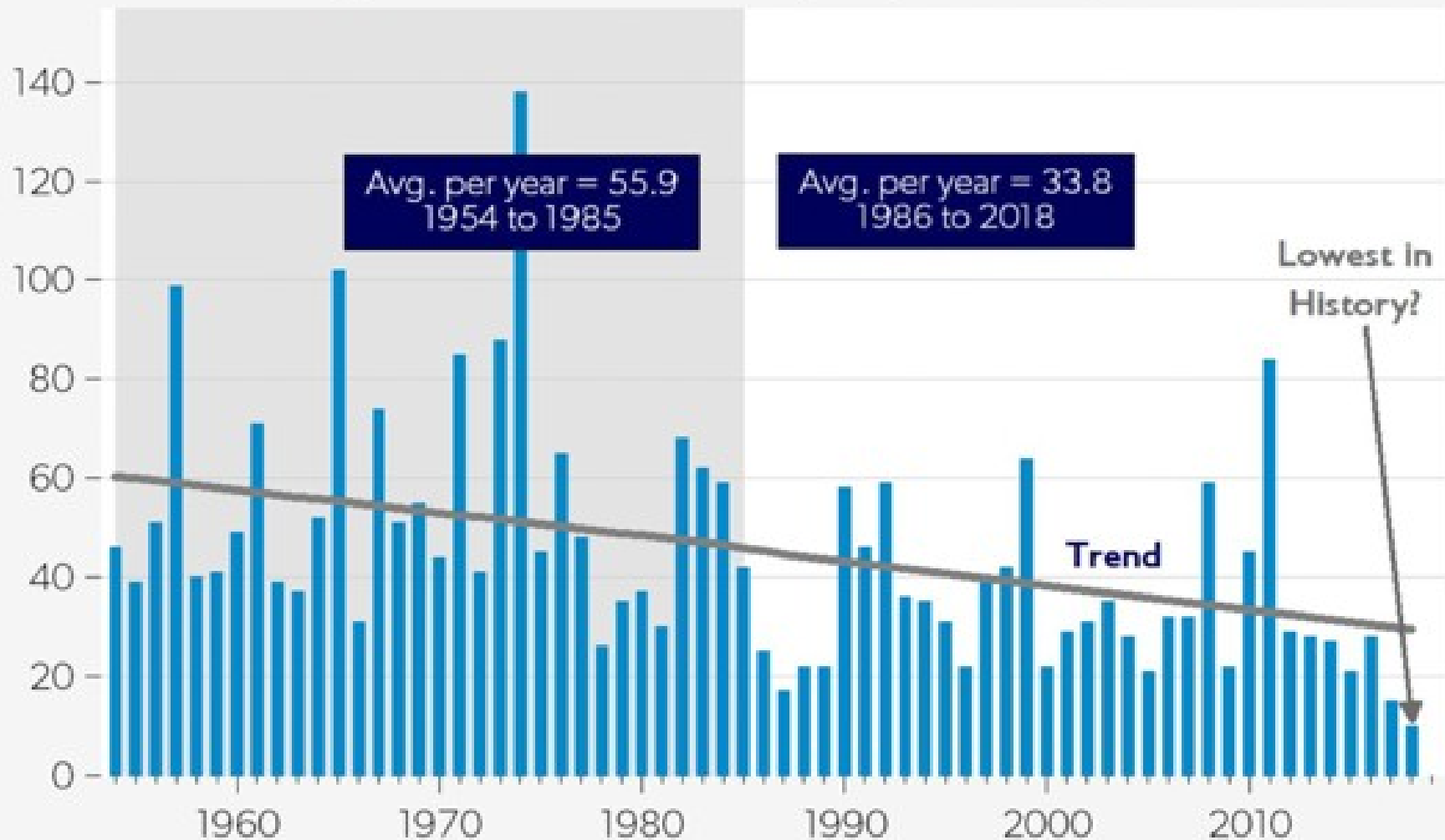
# U.S. Annual Count of Strong to Violent Tornadoes (F3+) 1970-2020

Data Source: NOAA/NWS Storm Prediction Center





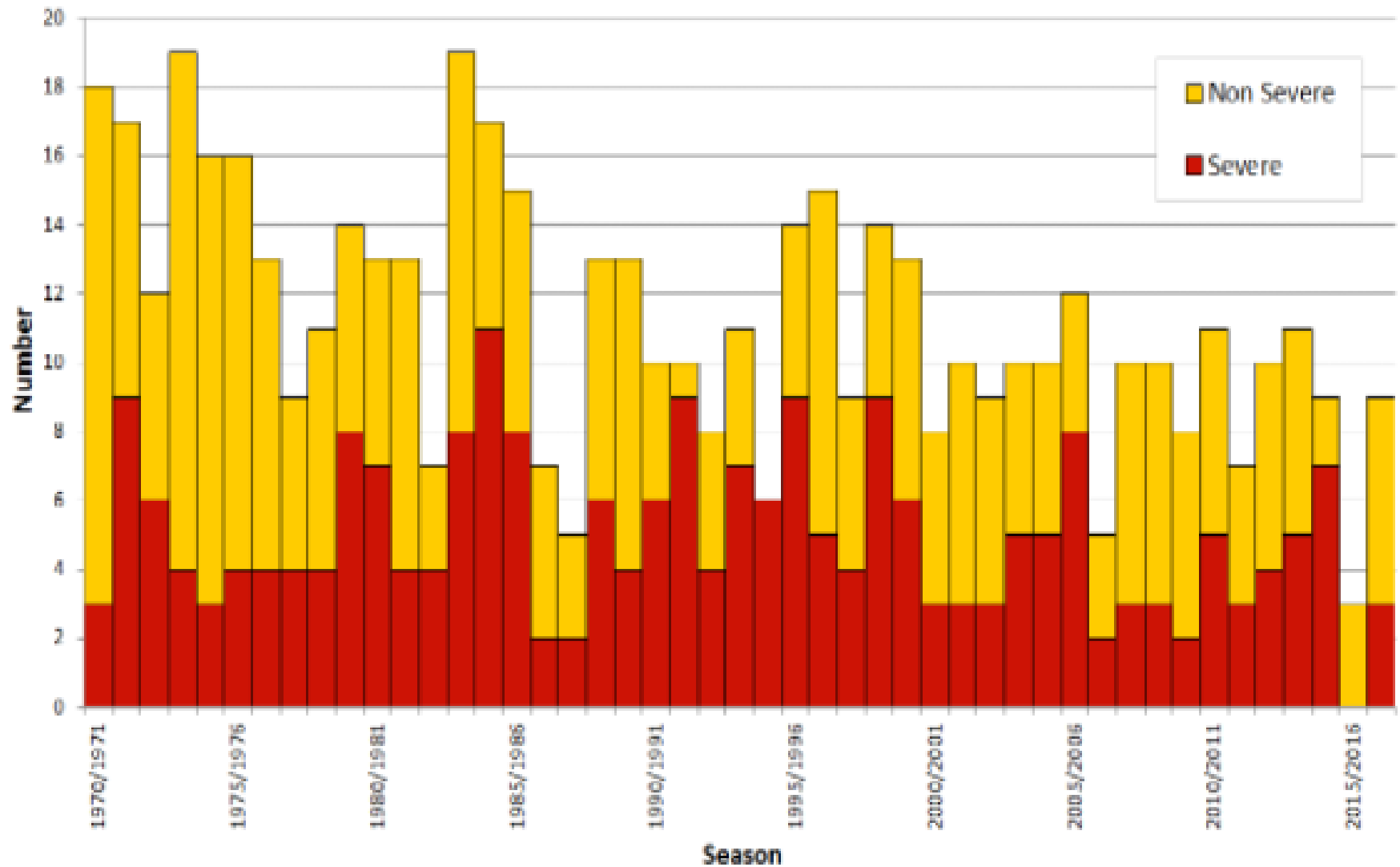
## Strong to Violent Tornadoes (F3+) in the US, 1954 to 2018



Source: National Oceanic and Atmospheric Administration

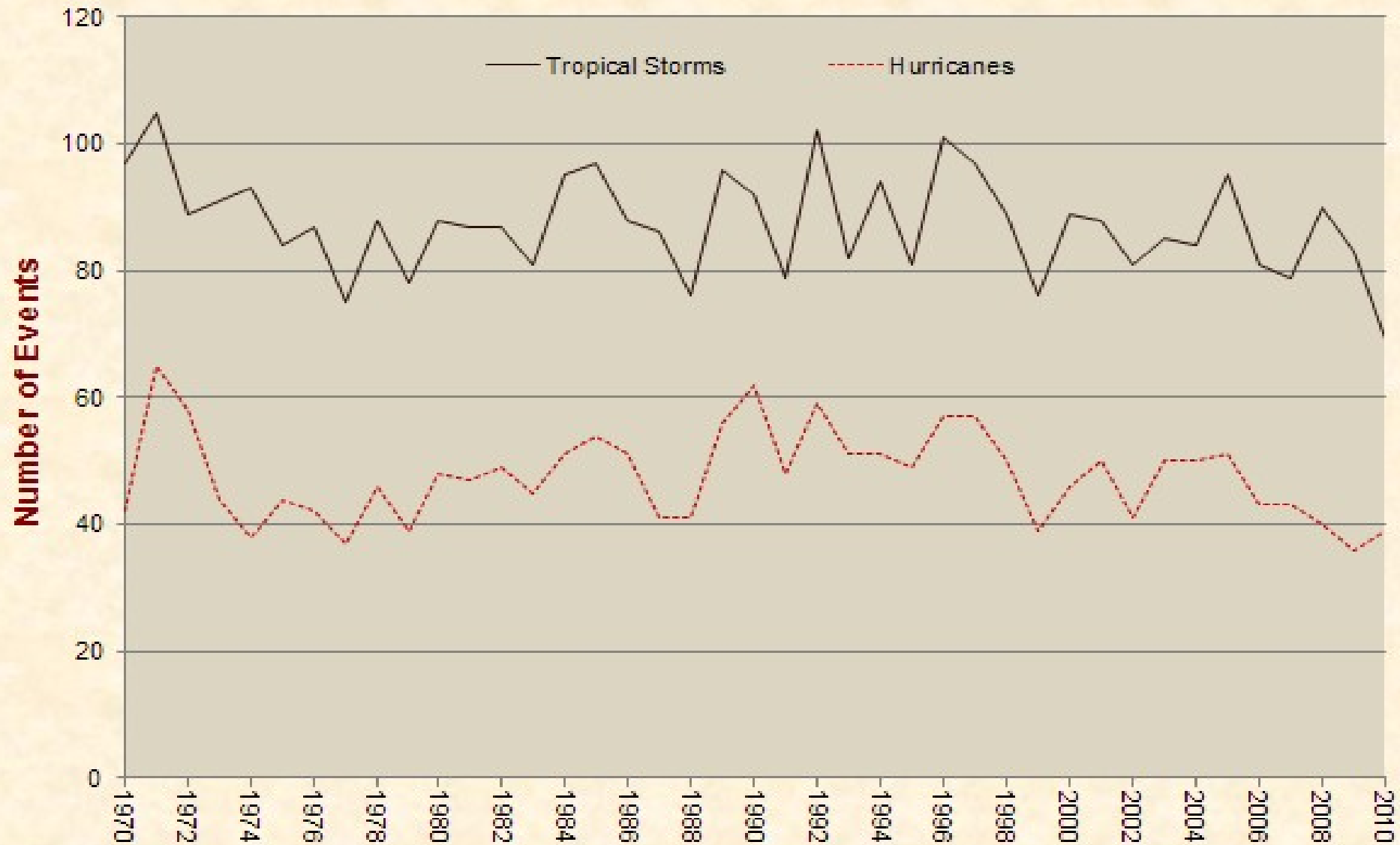
Carpe Diem **AEI**

Graph showing the number of severe and non-severe tropical cyclones from 1970-2017 which have occurred in the Australian region. Severe tropical cyclones are shown here as those with a minimum central pressure less than 970 hPa.



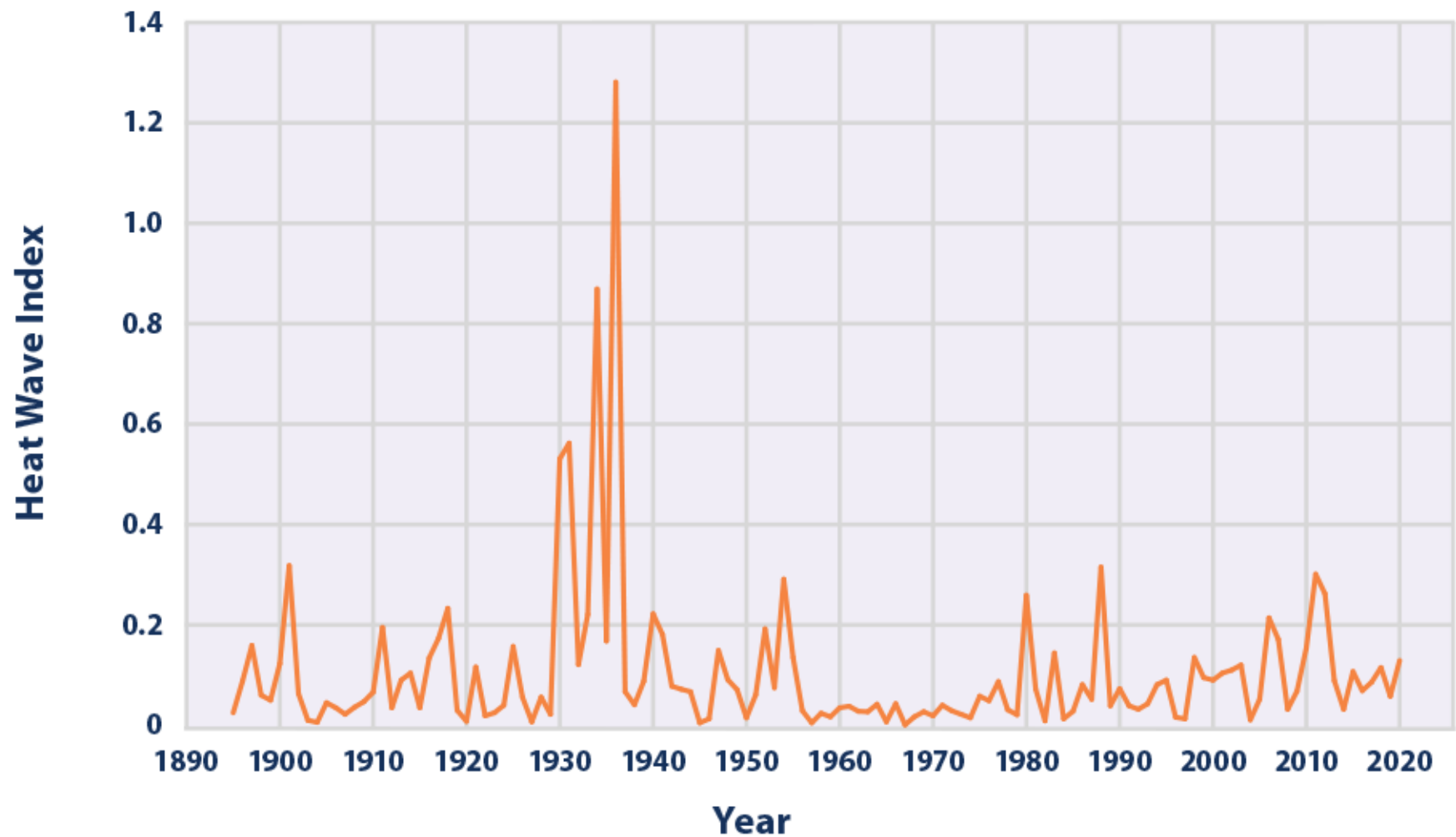
# Extreme Weather?

## Global Tropical Storm and Hurricane Frequency





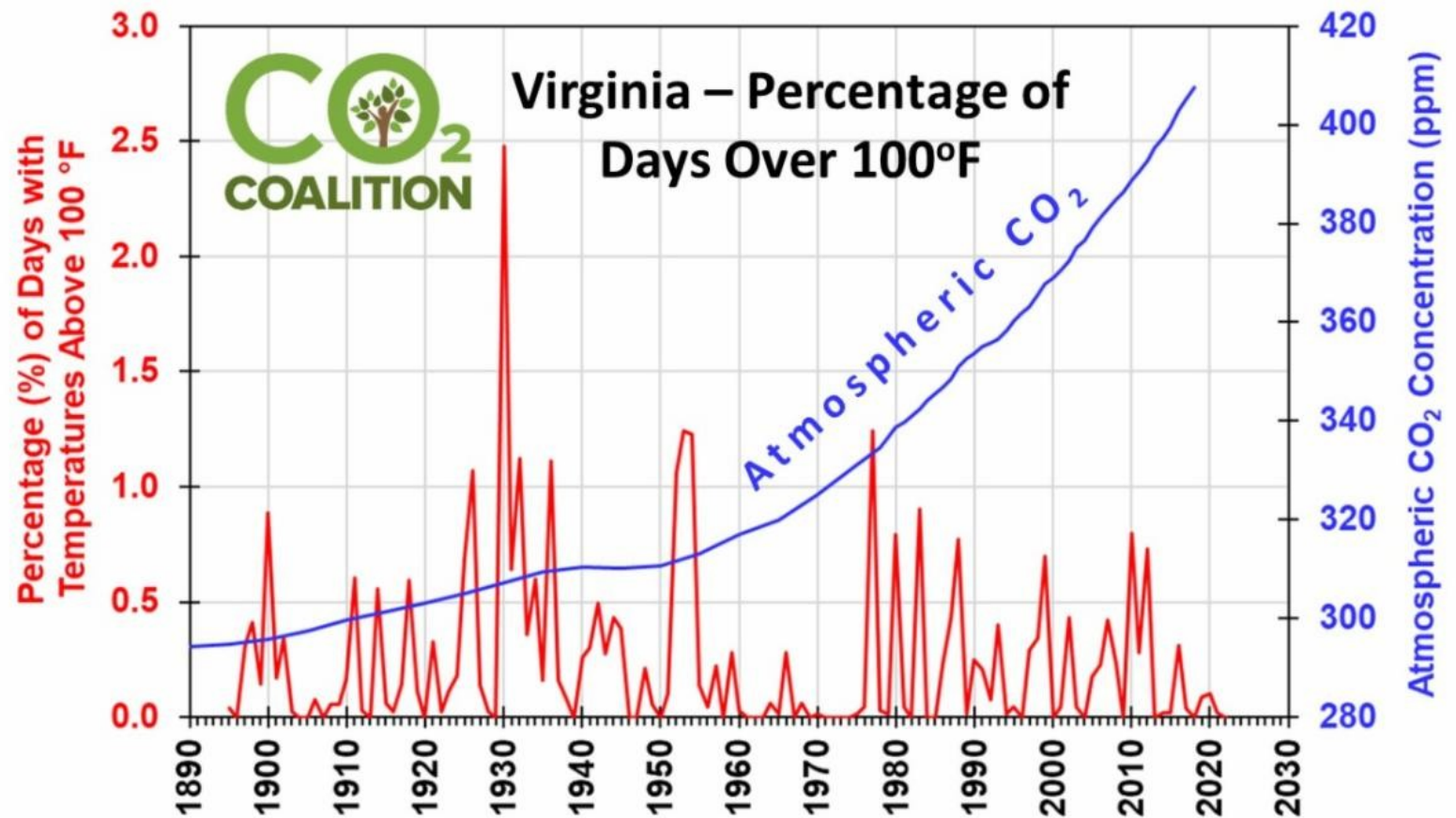
## U.S. Annual Heat Wave Index, 1895–2020



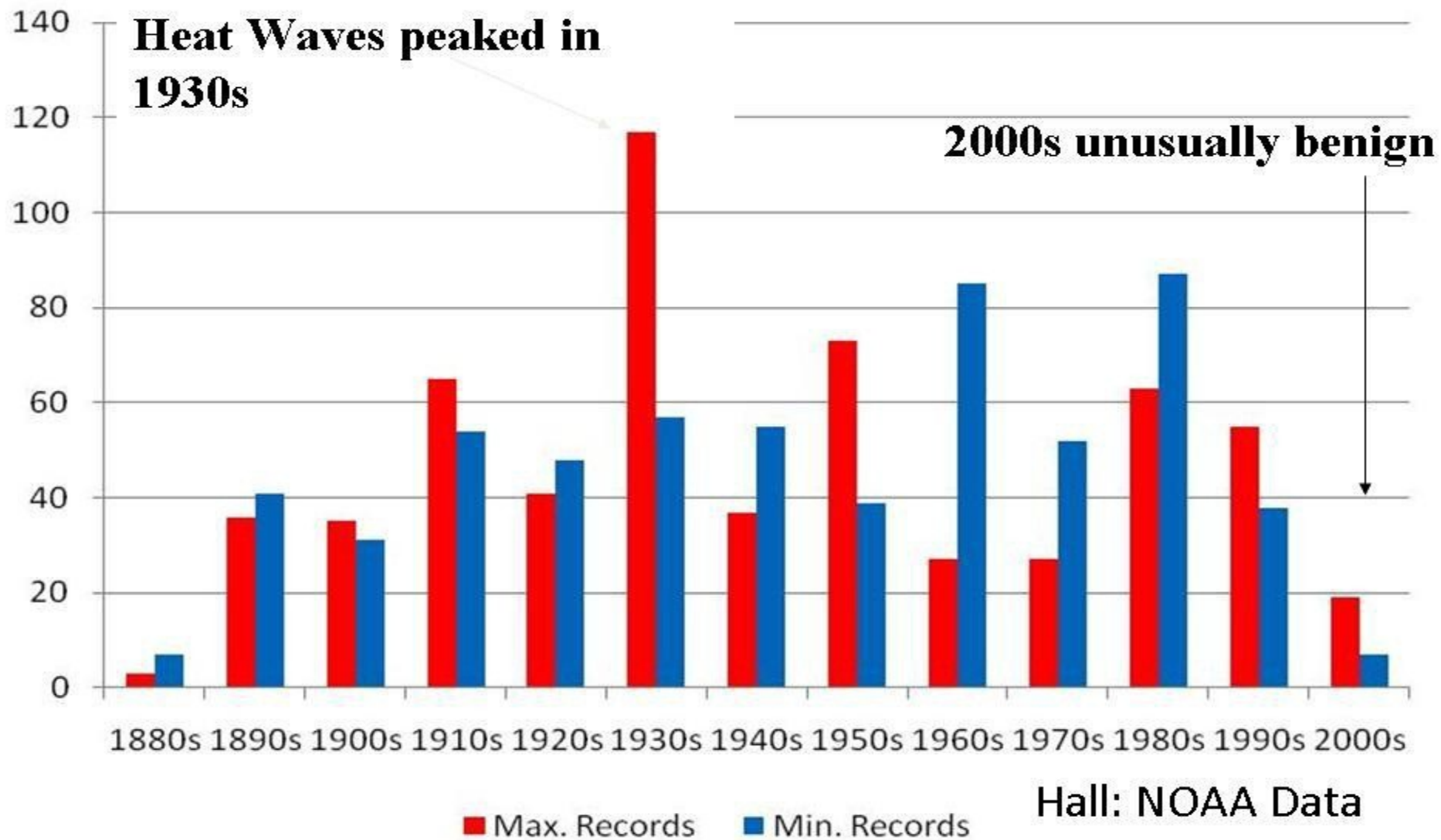
Data source: Kunkel, K. 2021. Updated version of Figure 2.3 in: CCSP (U.S. Climate Change Science Program). 2008. Synthesis and Assessment Product 3.3: Weather and climate extremes in a changing climate.  
[www.globalchange.gov/browse/reports/sap-33-weather-and-climate-extremes-changing-climate](http://www.globalchange.gov/browse/reports/sap-33-weather-and-climate-extremes-changing-climate).

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators).

# Percentage of Days Over 100 F

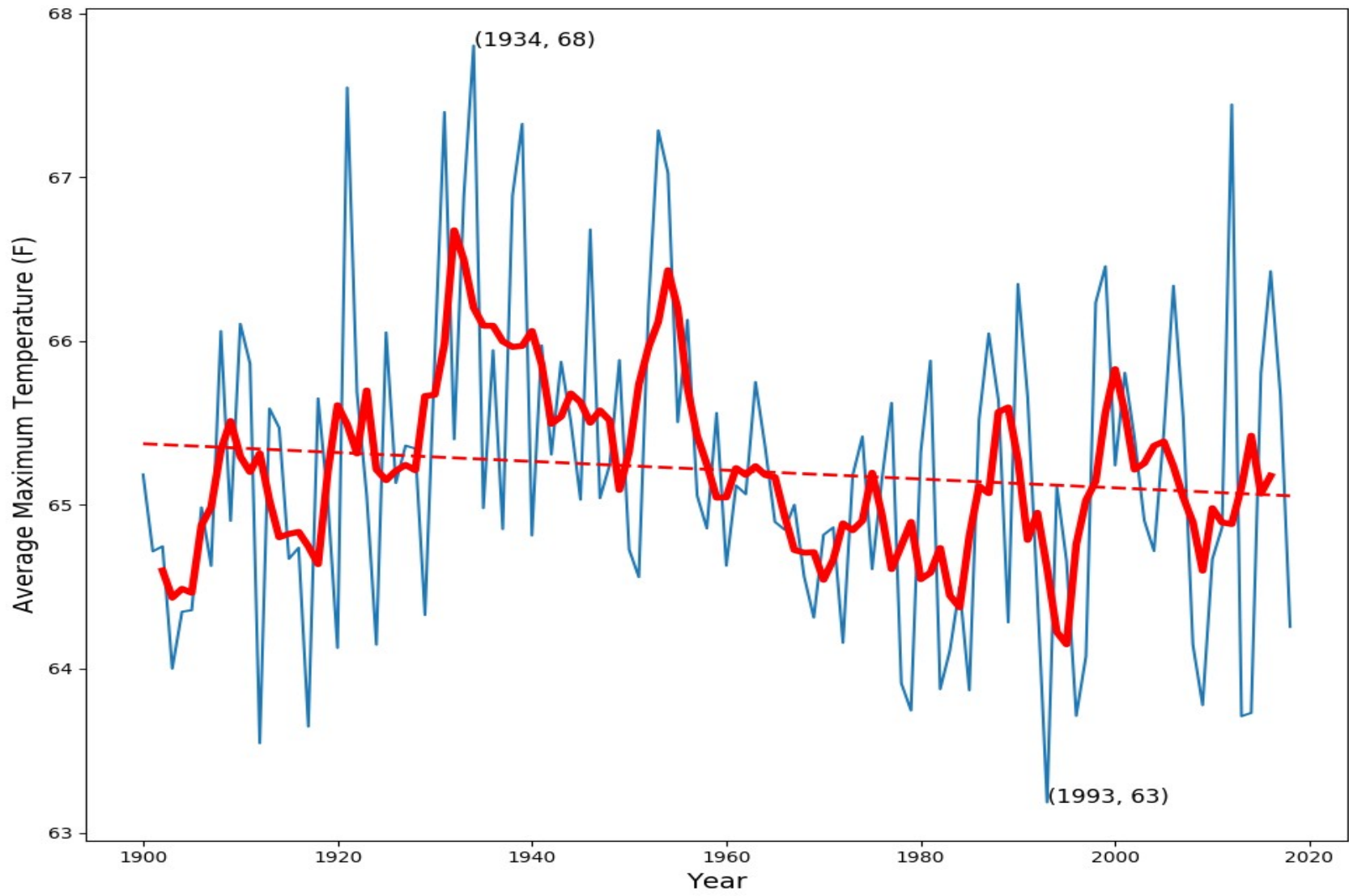


# U.S. State Maximum and Minimum Monthly Records by Decade

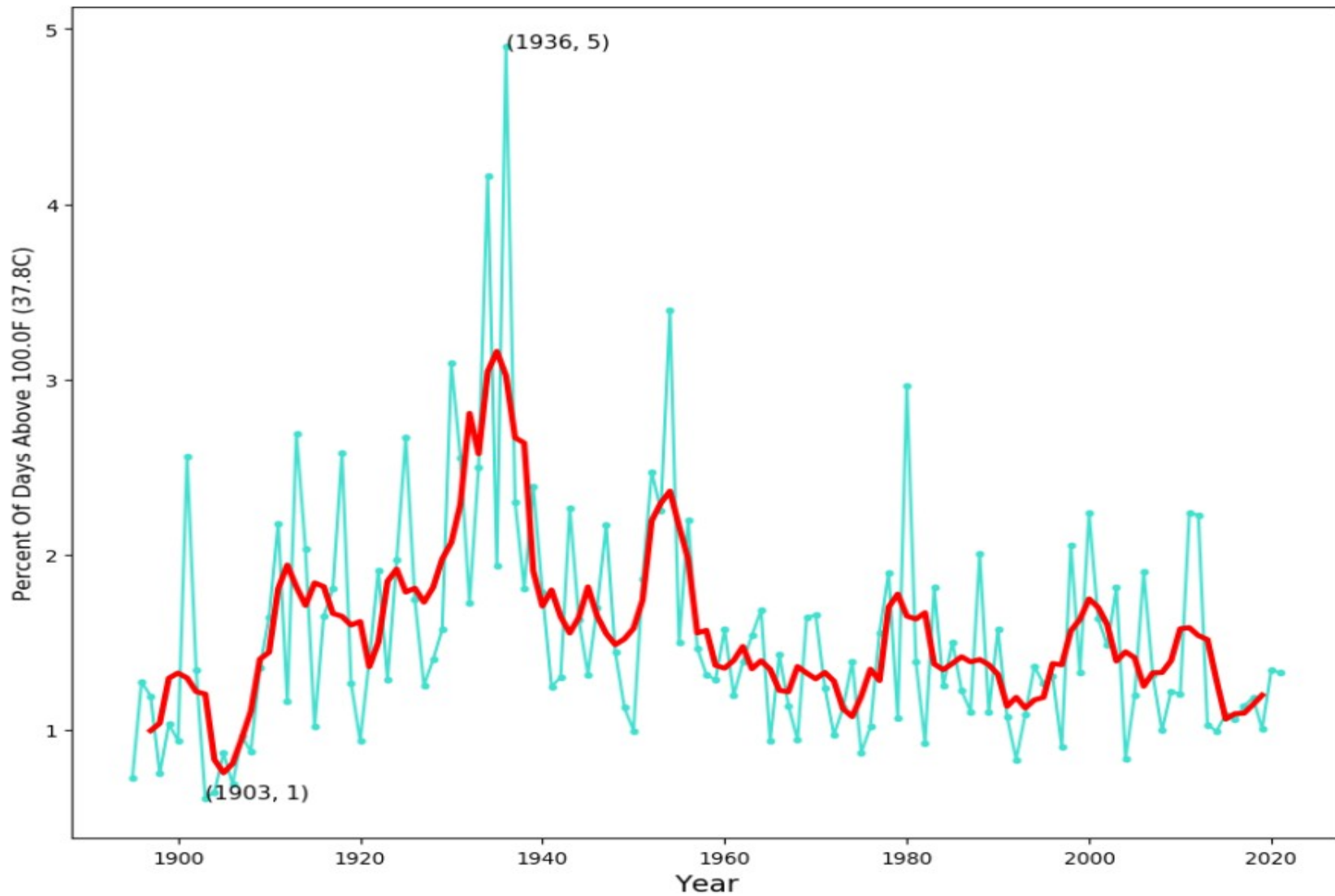




**Average Maximum Temperature Vs. Year 1900-2018**  
**At All US Historical Climatology Network Stations**  
**Red Line Is 5 Year Mean**



**Percent Of Days Above 100.0F (37.8C) Vs. Year 1895-2021**  
**At All US Historical Climatology Network Stations**  
**Red Line Is 5 Year Mean**



# U.S. Temperature, 1880-2000

## U.S. Temperature 1999



Temperature Anomaly (°C)

Inconvenient fact

-0.35C

*"The U.S. has warmed during the past century, but the warming hardly exceeds year-to-year variability. Indeed, in the U.S. the warmest decade was the 1930s and the warmest year was 1934."* James Hansen 1999

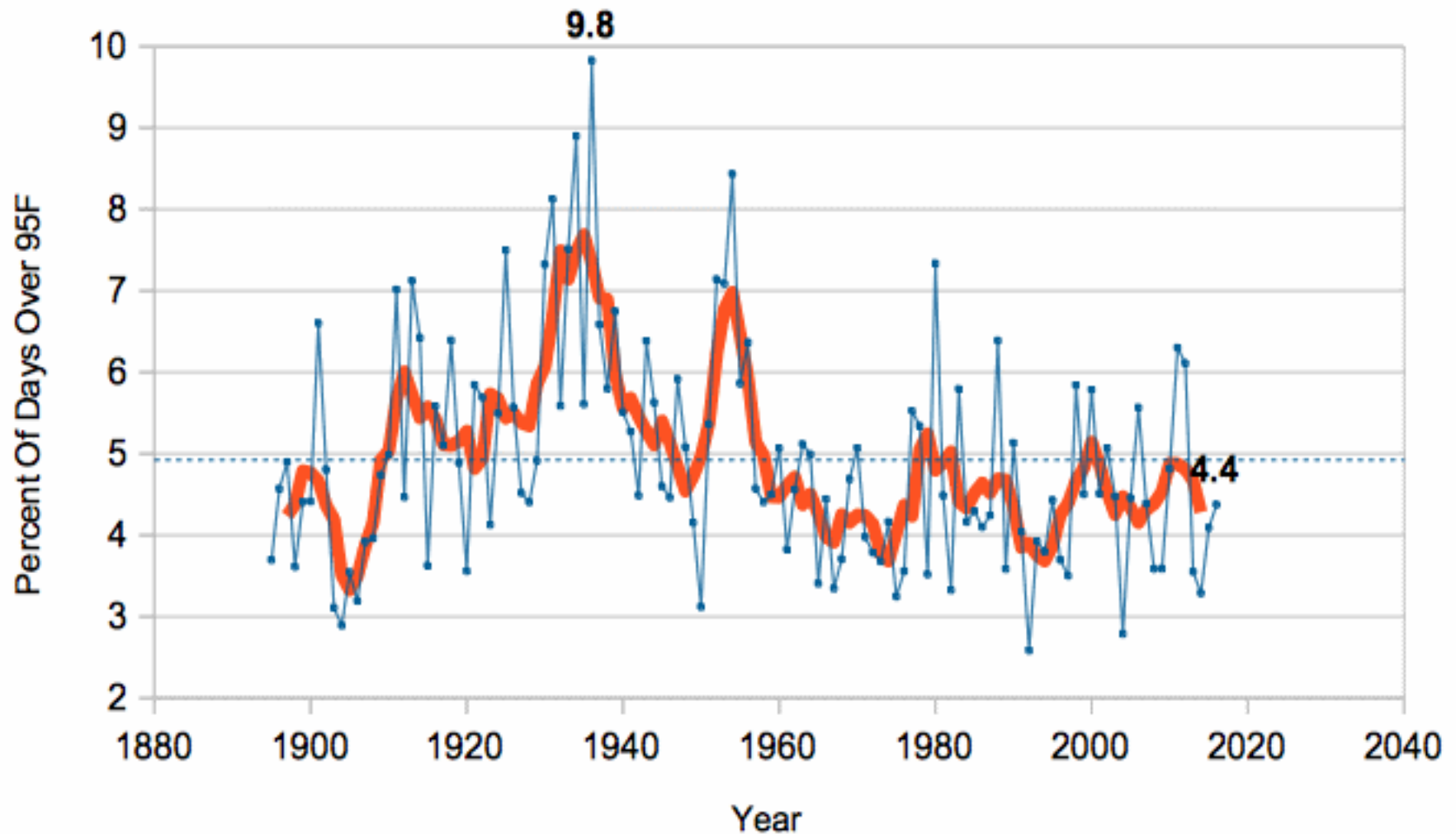
..... Annual Mean  
— 5-year Mean

1880 1900 1920 1940 1960 1980 2000

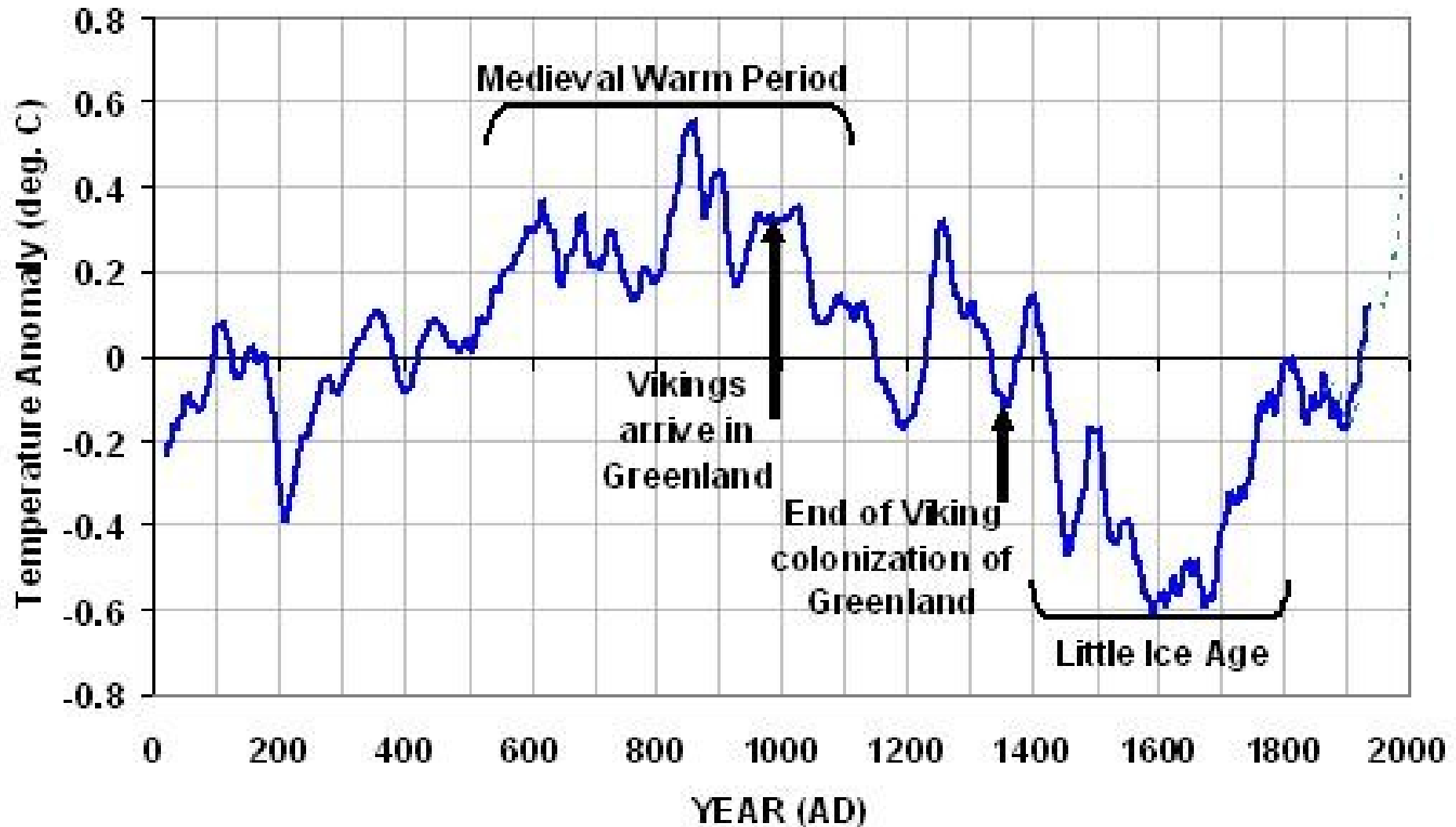


# US Average Percent Of Days Over 95F (35C)

At 1192 USHCN Stations

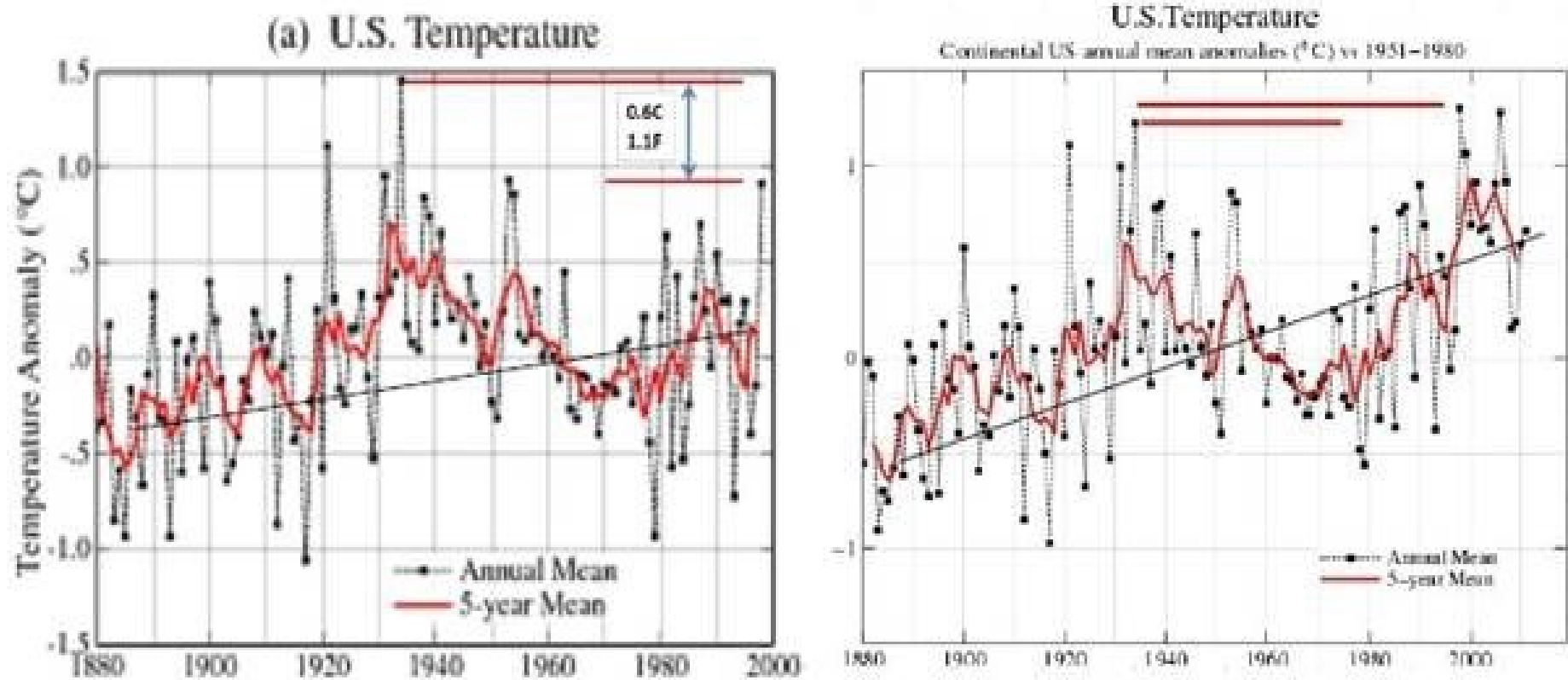


# 2000 Years of Global Temperature



# Temperature Data Manipulation

Fig. 2: Alteration of temperature data for the entire USA, 1920-1960 values were reduced, 1980 values increased:

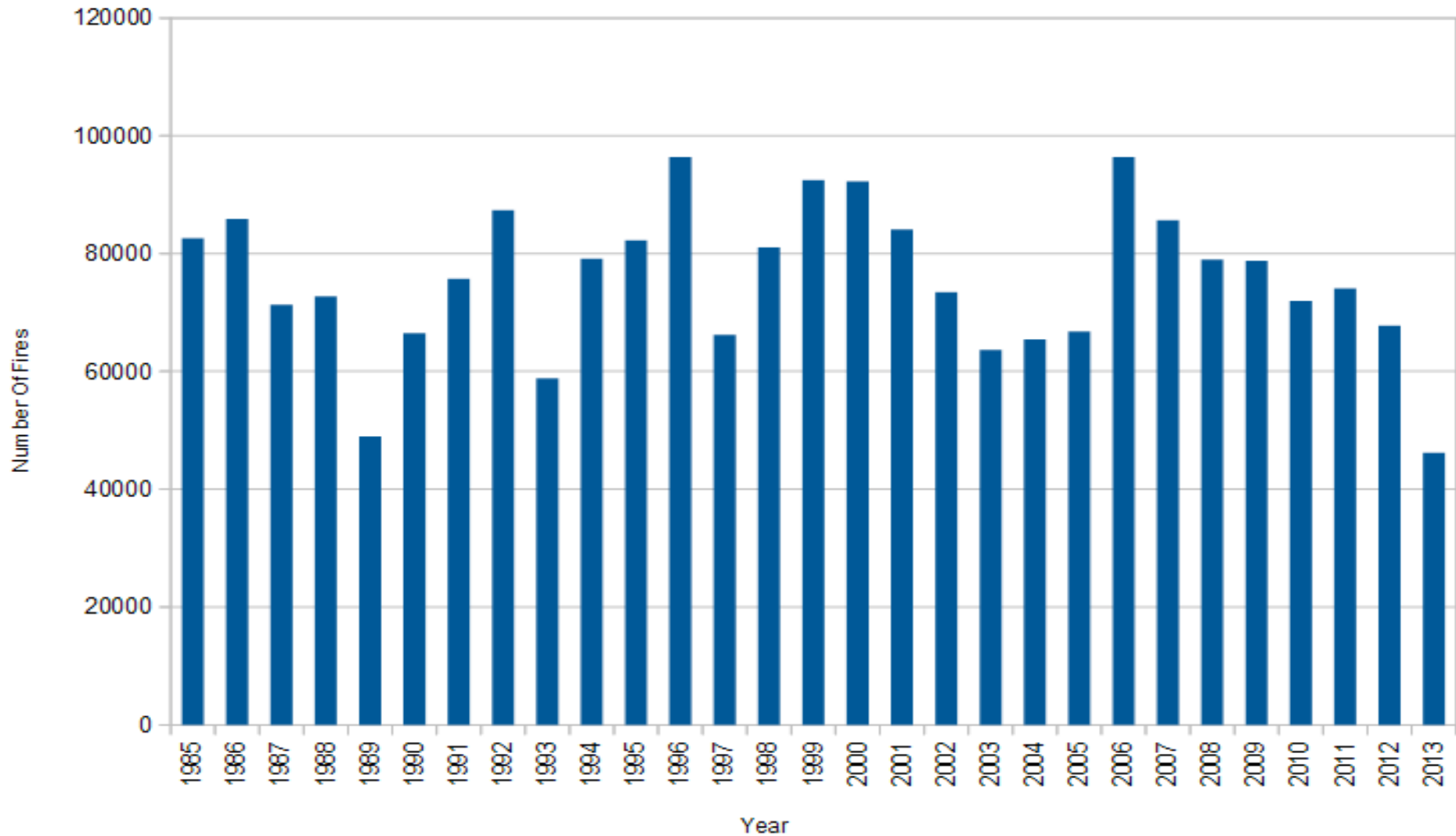


Source: Friedrich-Karl Ewert



# Frequency of U.S. Wildfires

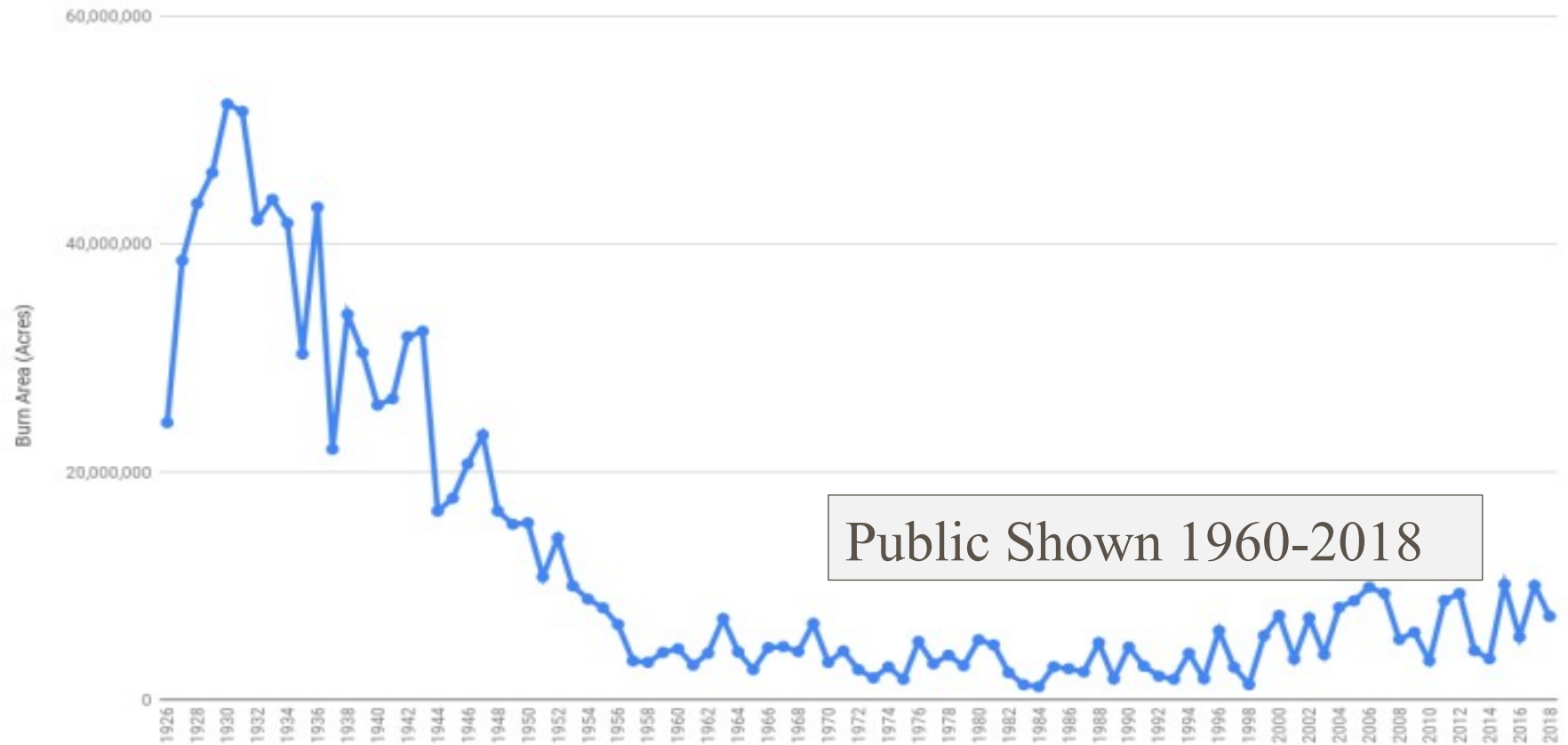
US Forest Fire Count



# US Forest Fire Burn Acreage

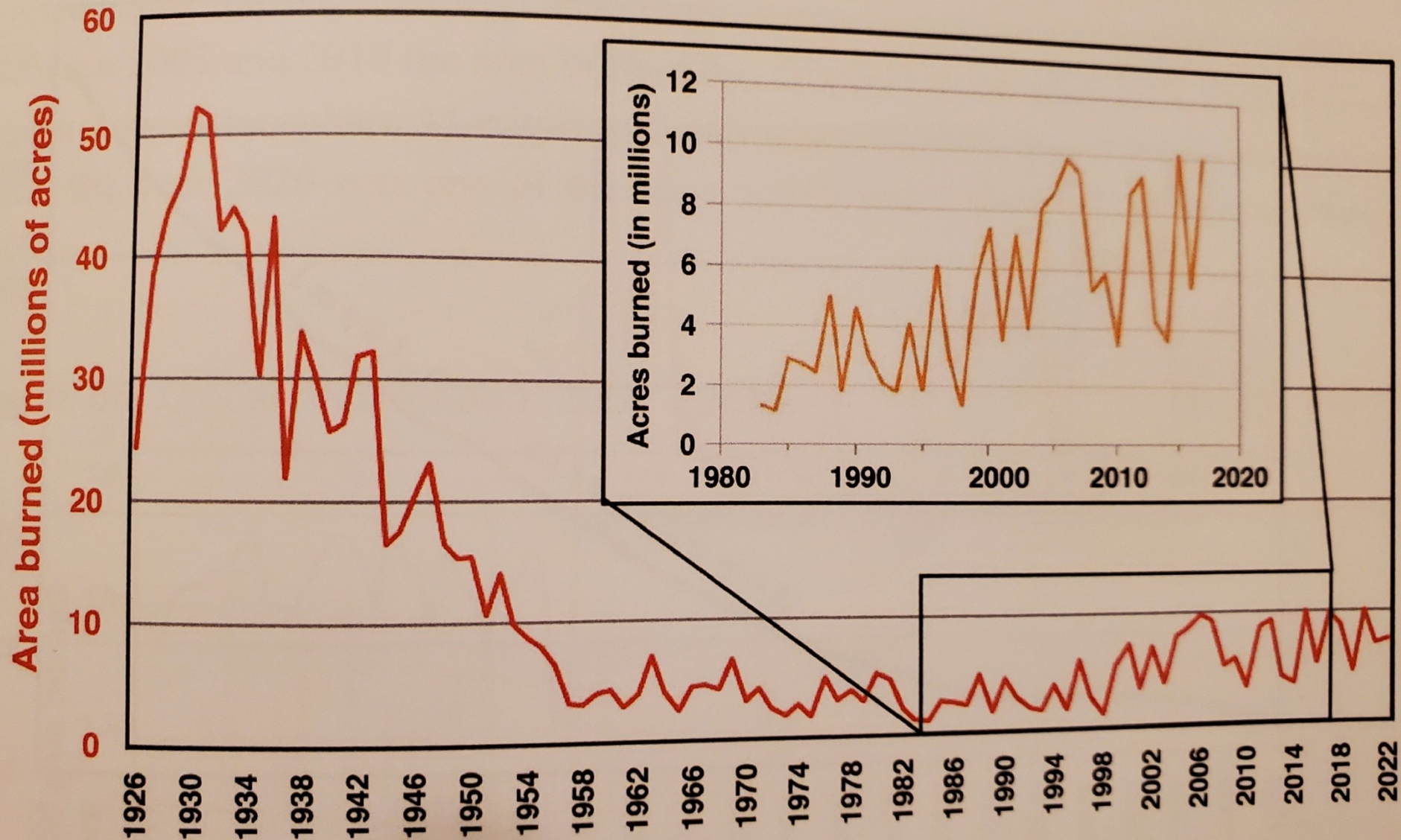
## US Forest Fire Burn Acreage

National Interagency Fire Center



Public Shown 1960-2018

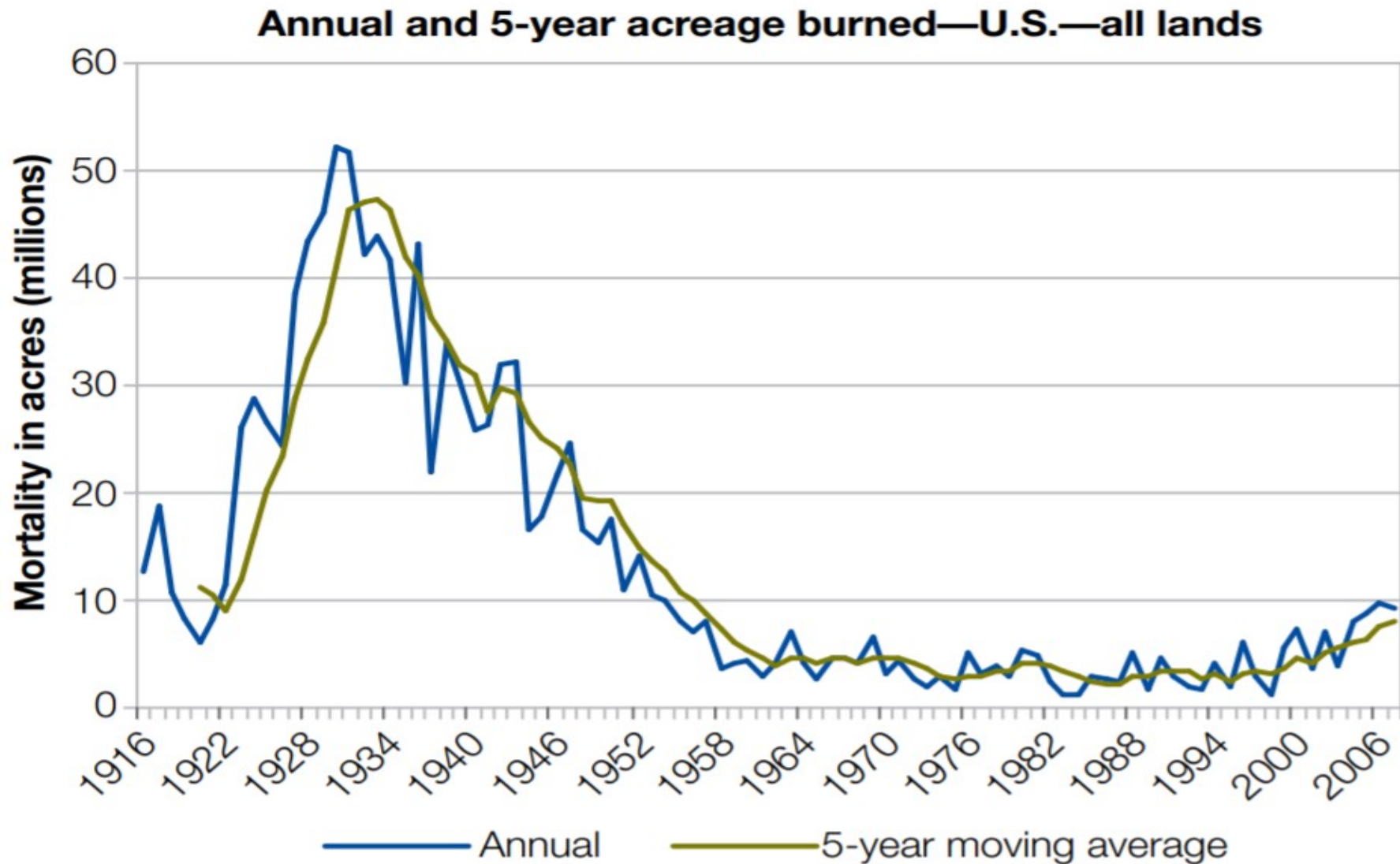
Figure 63: Area burned in the United States 1926 to 2018



(Source data for full data: NIFC 2022, inset NCA4 2017)



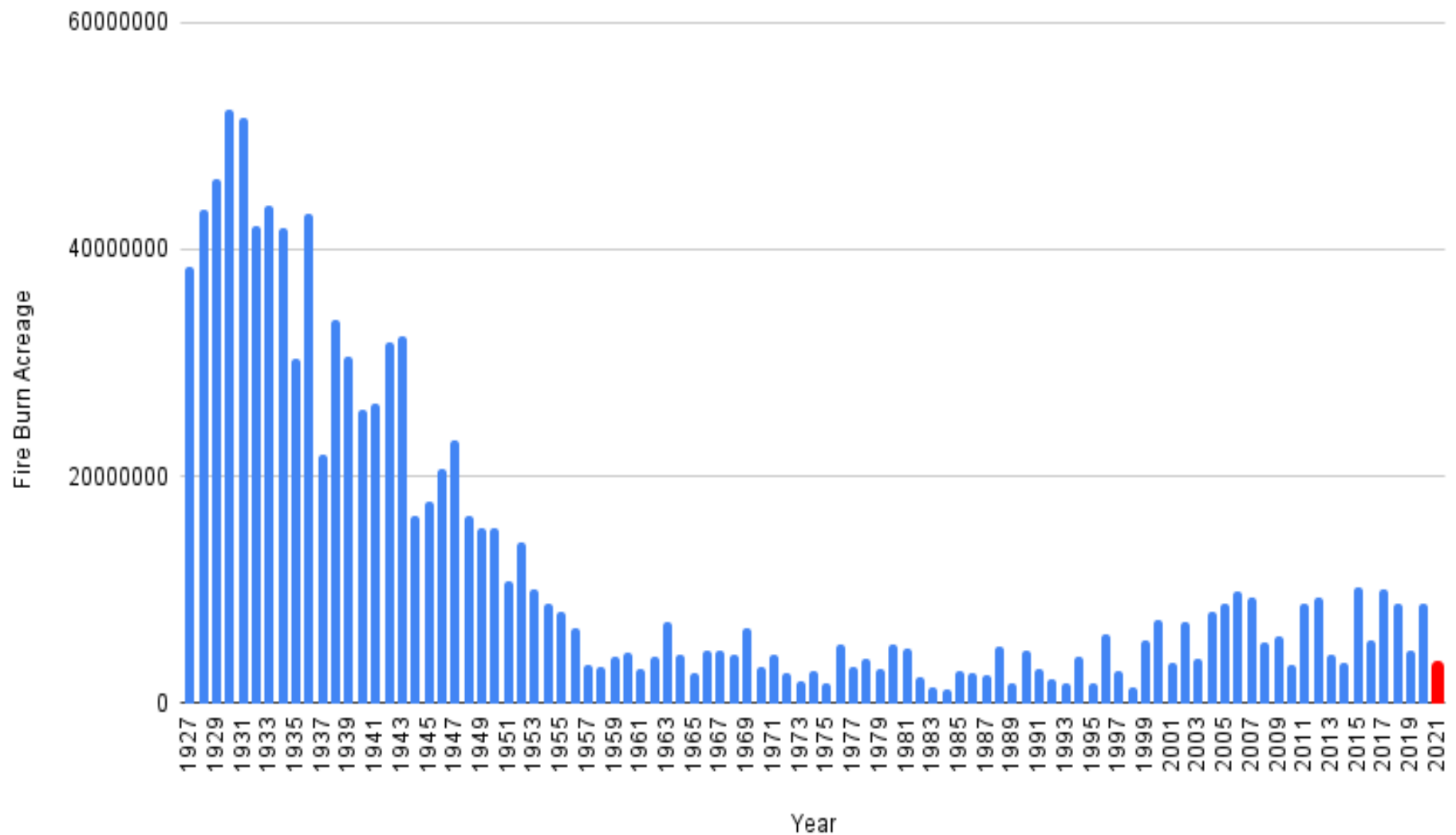
**Figure 16-1.** Total acreage burned.



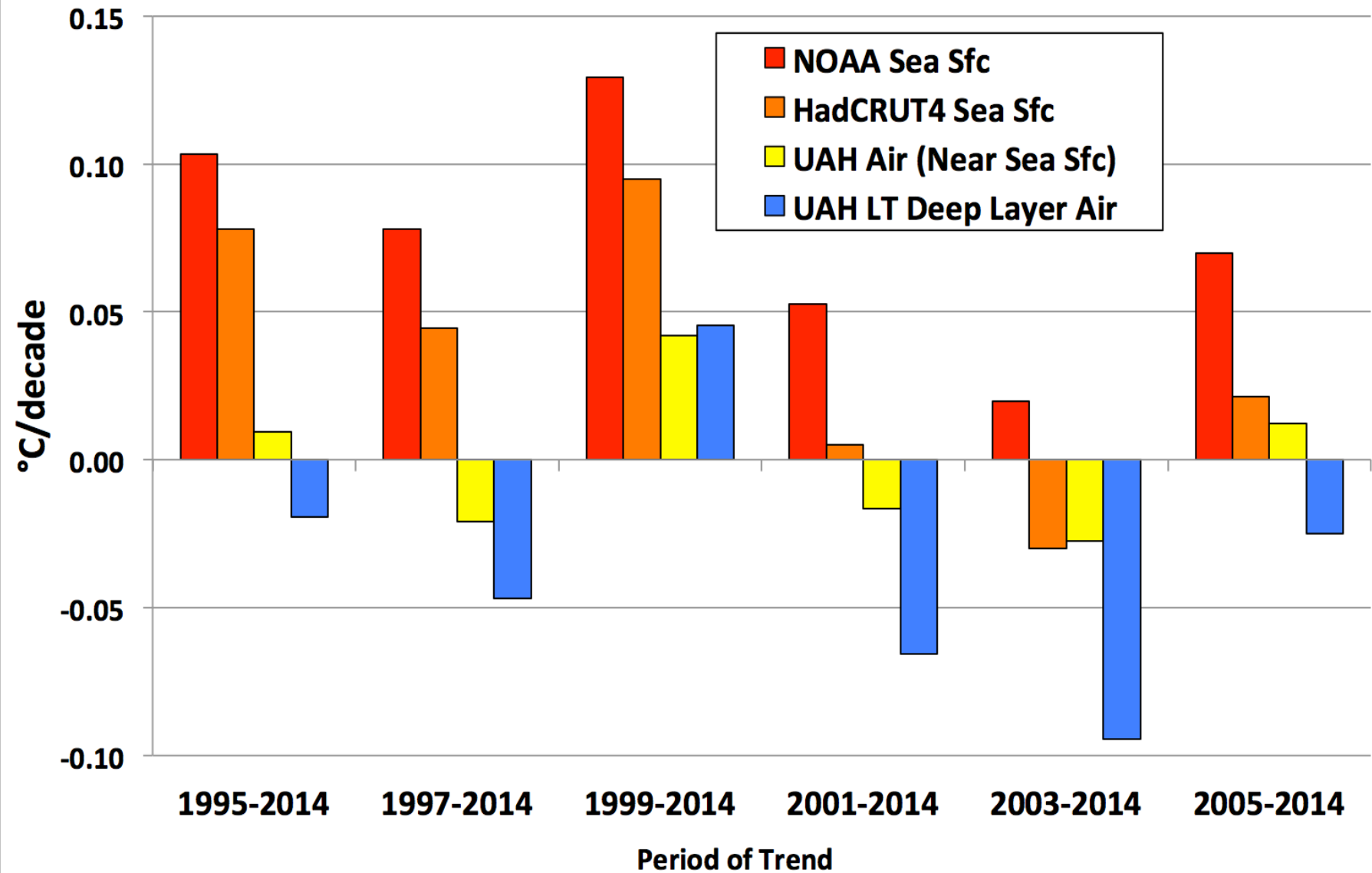
Source: USDA Forest Service, Forest Health Protection

# Fire Burn Acreage vs. Year

National Interagency Fire Center

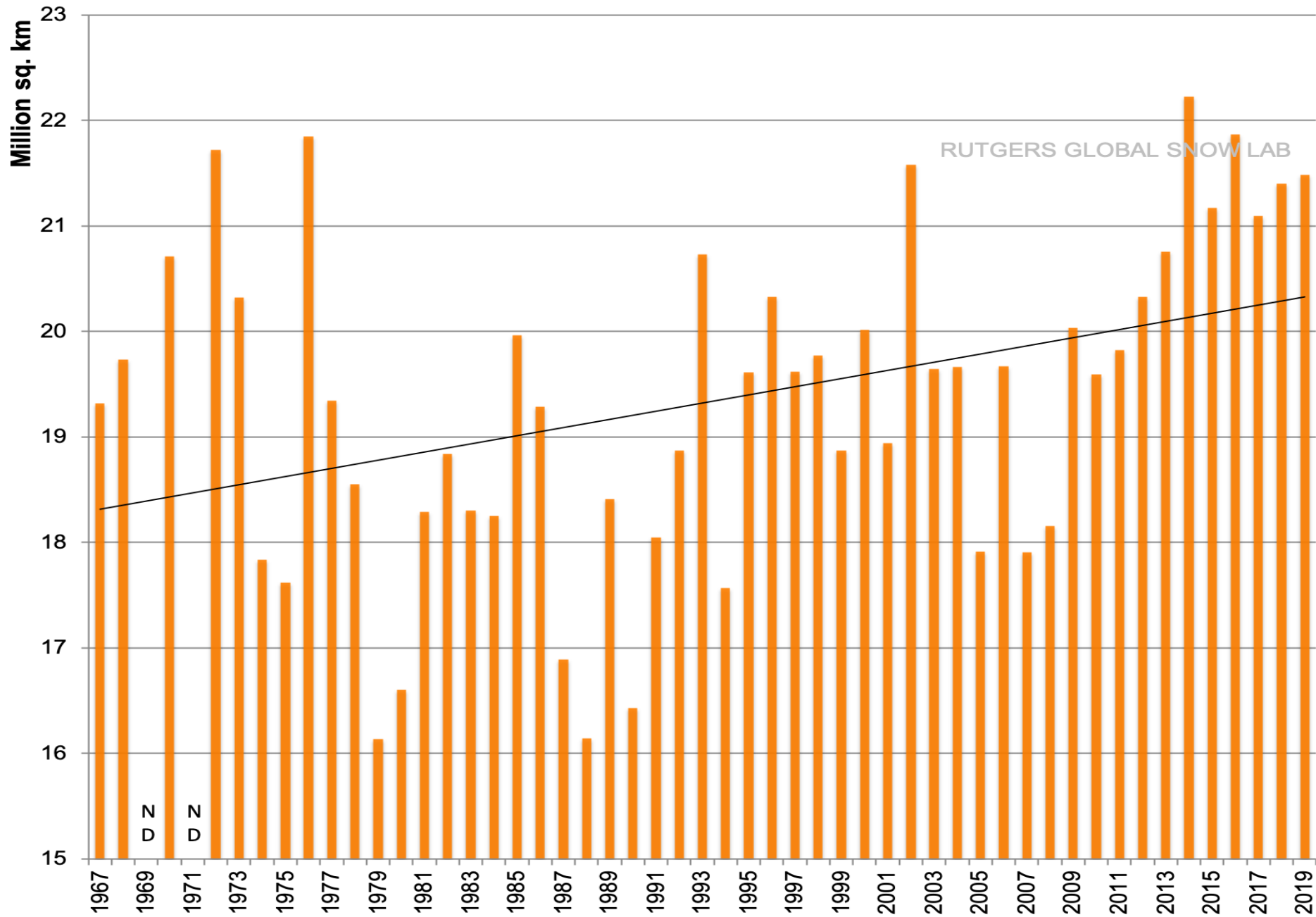


## Trends in Ocean Temperatures (20S-60N) 10 to 20 Year periods ending in 2014



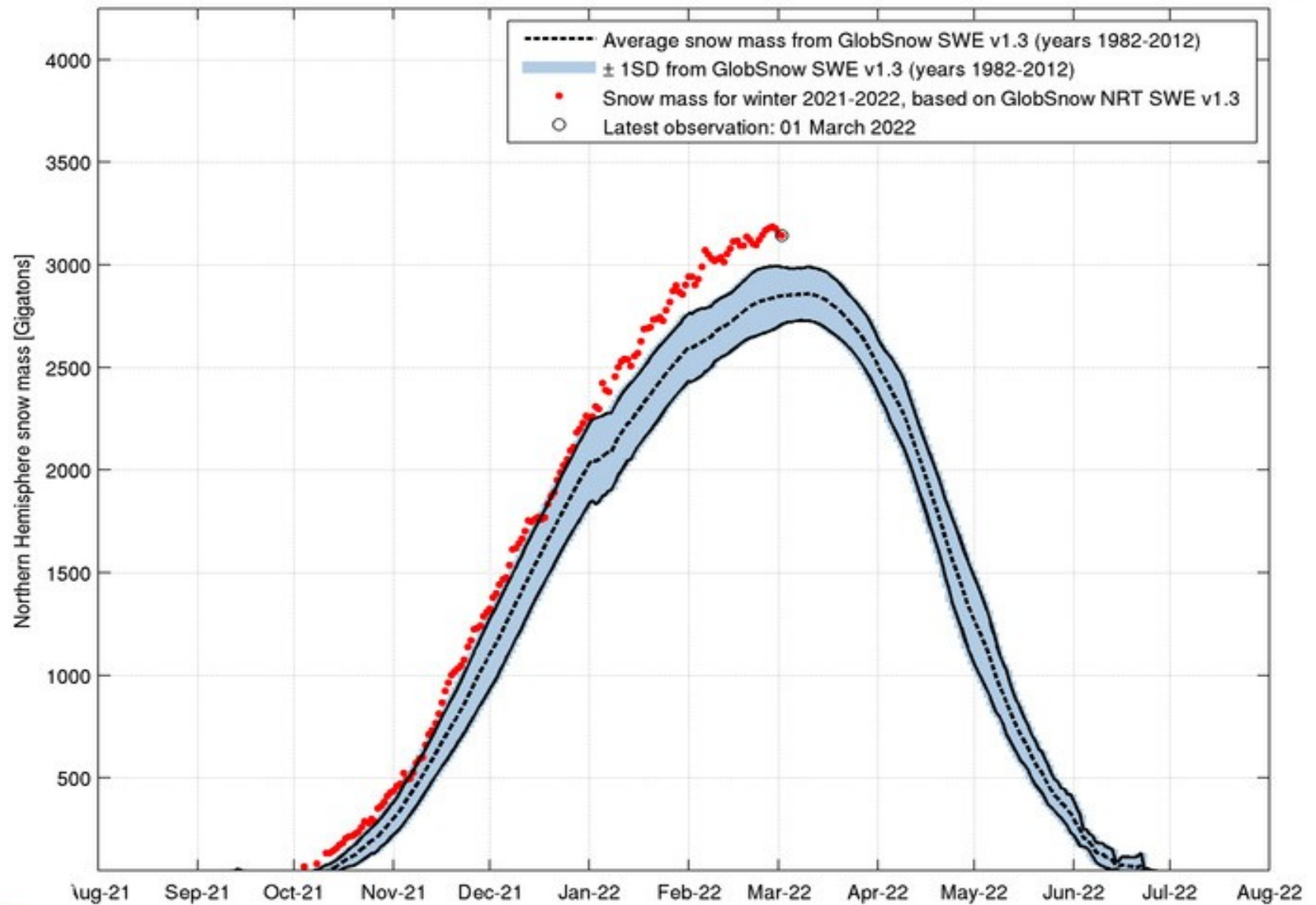


# Fall Northern Hemisphere Snow Extent



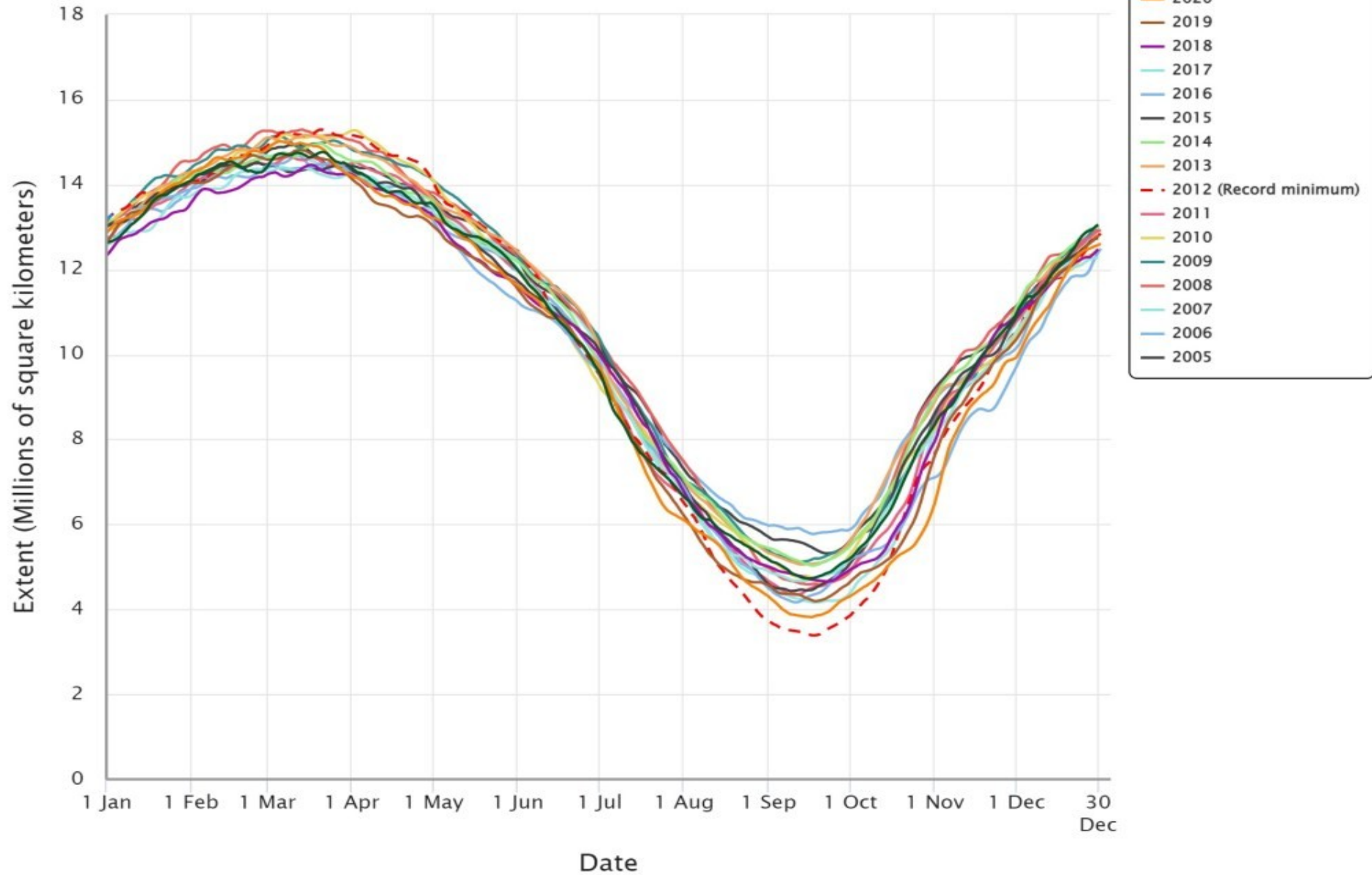


## Total snow mass for Northern Hemisphere, excluding mountains



# Arctic Sea Ice Extent

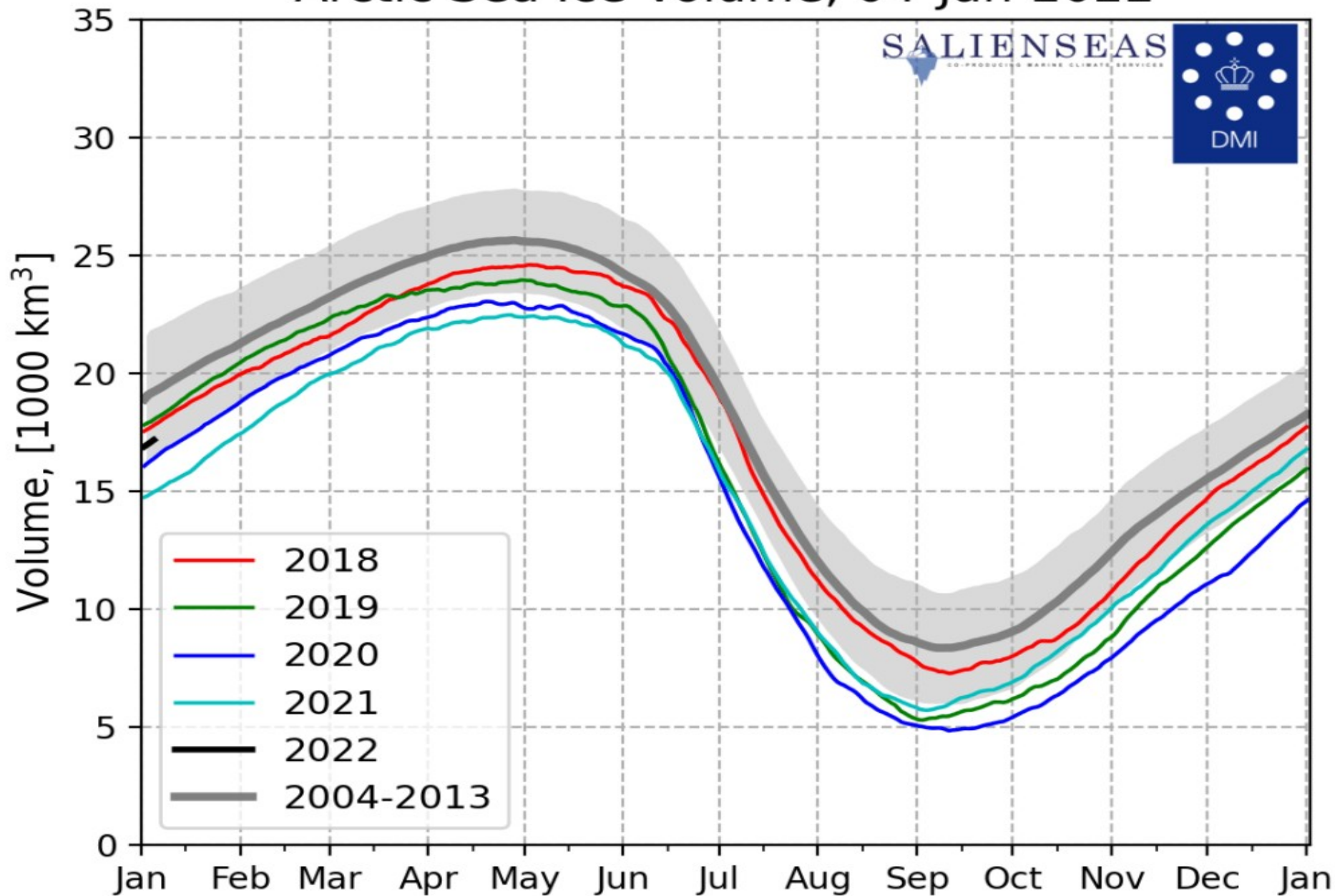
(Area of ocean with at least 15% sea ice)



National Snow and Ice Data Center, Boulder, CO



# Arctic Sea Ice Volume, 04-Jan-2022



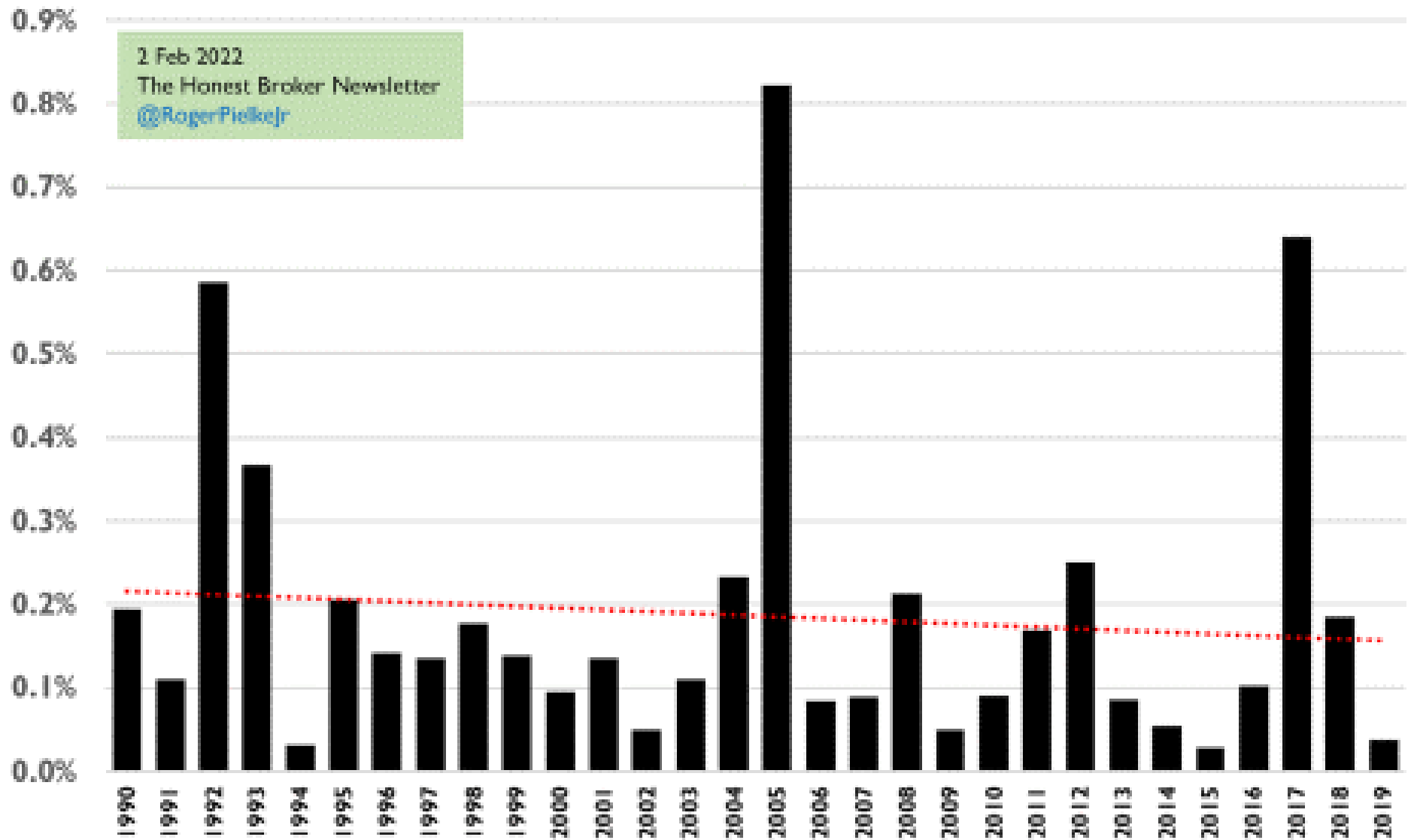
# US Weather and Climate Disasters: 1990 to 2019 as a proportion of GDP

Sources: SHELUS, OMB

2 Feb 2022

The Honest Broker Newsletter

@RogerPielkeJr





## Issue #14

# UN IPCC Charter Limits It To Identifying Only Human Causes of Global Warming



# UN IPCC Charter



The [Intergovernmental Panel on Climate Change] IPCC's charter

from the outset has been "to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. IPCC reports should be neutral with respect to policy. ... may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies."



# UN IPCC Reports

- Report #1 in 1990: Ignored satellite data (showed no warming)
- Report #2 in 1995: Significant alterations after approval by scientists
- Report #3 in 2001: Claimed 20<sup>th</sup> century showed “unusual warming”
- Report #4 in 2007: Completely devaluated climate changes in solar activity
- Report #5 in 2014: Confidence increased to 90-95% despite no global warming for 15 years
- Report #6 in 2021-3: Science, Impacts, Vulnerability, Mitigation, Synthesis, Assessment



## Issue #15

UN IPCC Officials Admit That  
Its Real Agenda Is To  
Redistribute Wealth



# UN IPCC Reality



***“We (**UN-IPCC**) redistribute de facto the world’s wealth by climate policy...”***

***“One has to free oneself from the illusion that international climate policy is environmental policy. This has almost nothing to do with environmental policy anymore...”***

**-Dr. Ottmar Endenhofer, **IPCC** co-chair of Working Group 3, November 13, 2010 interview [H/t Dr. Charles Battig]**

# Redistribution of Wealth





# Climate policy used to impose Marxism



"But one must say clearly that we redistribute de facto the world's wealth by climate policy. Obviously, the owners of coal and oil will not be enthusiastic about this. One has to free oneself from the illusion that international climate policy is environmental policy. This has almost nothing to do with environmental policy anymore, with problems such as deforestation or the ozone hole."

Ottmar Edenhofer, Interview with Bernard Potter in *Neue Zürcher Zeitung* (New Zurich Times), 14 Nov 2010.





## Issue #16

The Alleged “97 % Consensus  
of Scientists” Is Bogus

# The 97% Claim – False!

- “Probably the most widely repeated claim in the debate over global warming is that “97 percent of scientists agree” that climate change is man-made and dangerous. This claim is not only false, but its presence in the debate is an insult to science.”
  - *Why Scientists Disagree About GW*, pg. 1 [Introduction].
- “In May 2014, Secretary of State John Kerry warned graduating students at Boston College of the “crippling consequences” of climate change. “Ninety-seven percent of the world’s scientists tell us this is urgent,” he added (Kerry, 2014). Three days earlier, President Obama tweeted that “Ninety-seven percent of scientists agree: #climate change is real, man-made and dangerous” (Obama, 2014). What is the basis of these claims?”
  - *Why Scientists Disagree About GW*, pg. 8.



# Consensus on Consensus – Cook, 2016

Studies into scientific agreement on human-caused global warming

- Seven climate consensus studies

- Oreskes 2004, **Doran 2009**,  
Anderegg 2010, Cook 2013,  
Verheggen 2014, Stenhouse 2014,  
Carlton 2015



- Two key conclusions:

- 1) Depending on exactly how you measure the expert consensus, it's somewhere between 90% and 100% that agree humans are responsible for climate change, with most of our studies finding 97% consensus among publishing climate scientists.
- 2) The greater the climate expertise among those surveyed, the higher the consensus on human-caused global warming.



*Why Scientists Disagree on GW, pg. 8ff*



# e.g. Doran Survey Bias

## ■ Doran/Zimmerman 2009 two-question survey:

- “Q1. When compared with pre-1800s levels, do you think that mean global temperatures have generally **risen**, fallen, or remained relatively constant?”
- Q2. Do you think human activity is a **significant** contributing factor in changing mean global temperatures?”

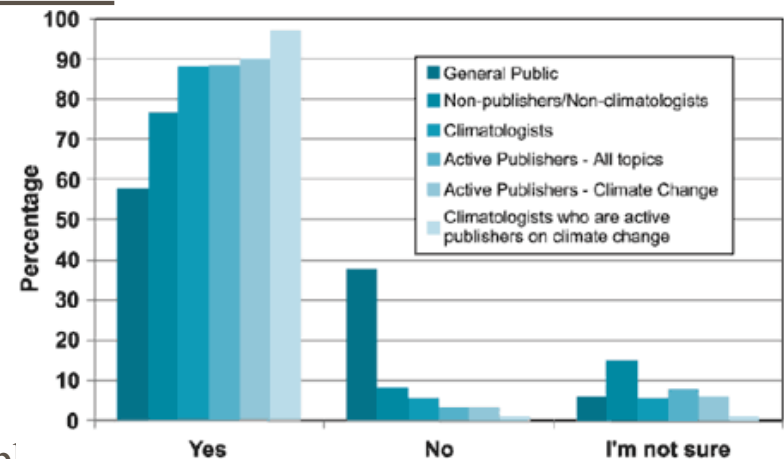
## ■ Survey sent to 10,257 Earth scientists

*Why Scientists Disagree on GW, pg. 13-14*

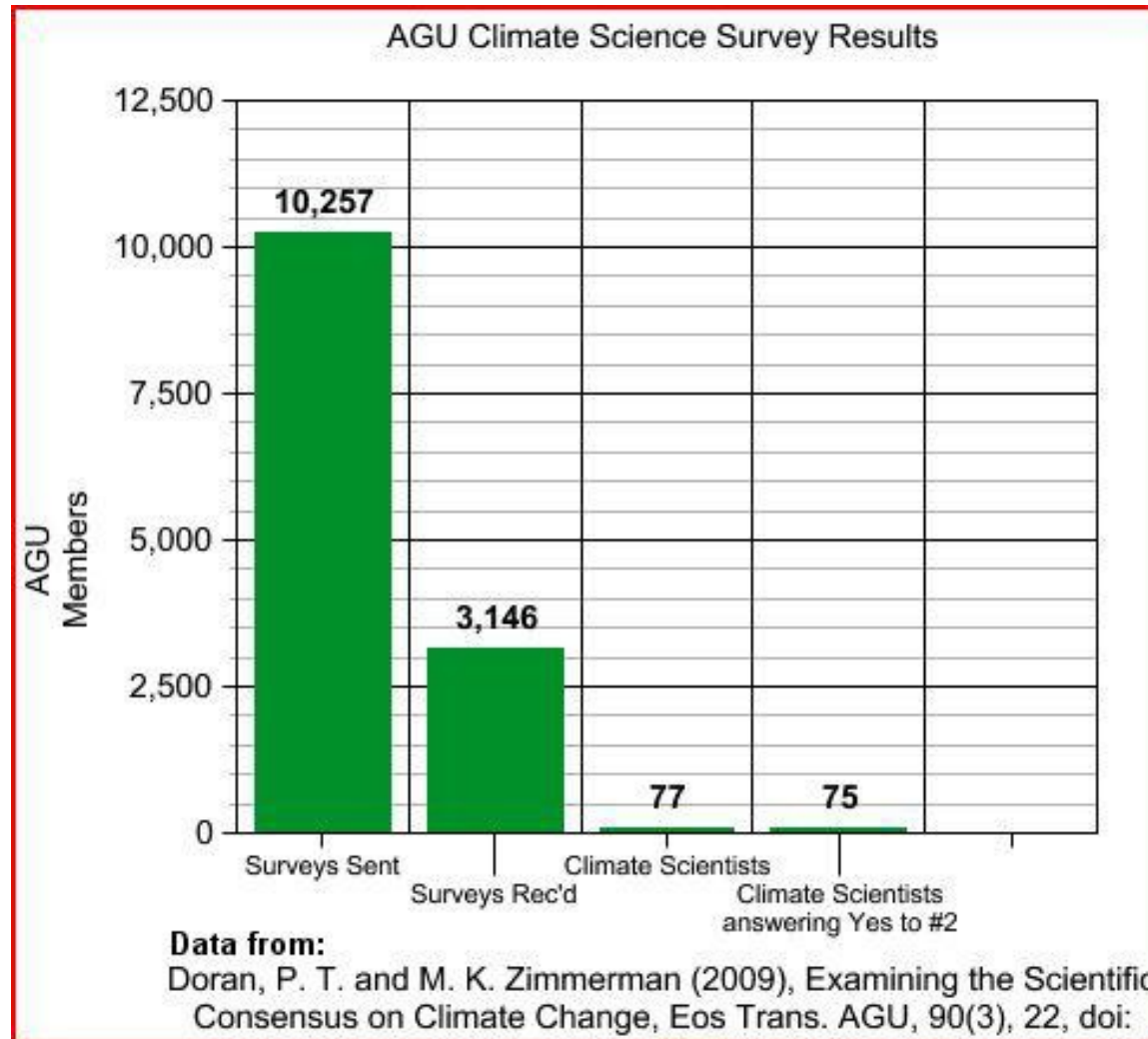
- Limited to academic, government workers
- **Solar scientists & meteorologists excluded**
- Responses from 3,146
- Q1 – risen 90+
- Q2 – yes 82

## ■ Survey results considered

- 79 who listed climate science as their area of expertise, and 50%+ of recent papers on climate science
- Asked wrong questions of wrong people



# Doran GW Survey Results





# Benefits of Warming & More CO2

- Fewer natural disasters and disaster deaths
- Global warming saves lives
- Declining droughts benefit humanity
- Reduced wildfires
- Increased food production
- A greener planet
- Reduced extinctions
- Adaptation rather than expensive mitigation

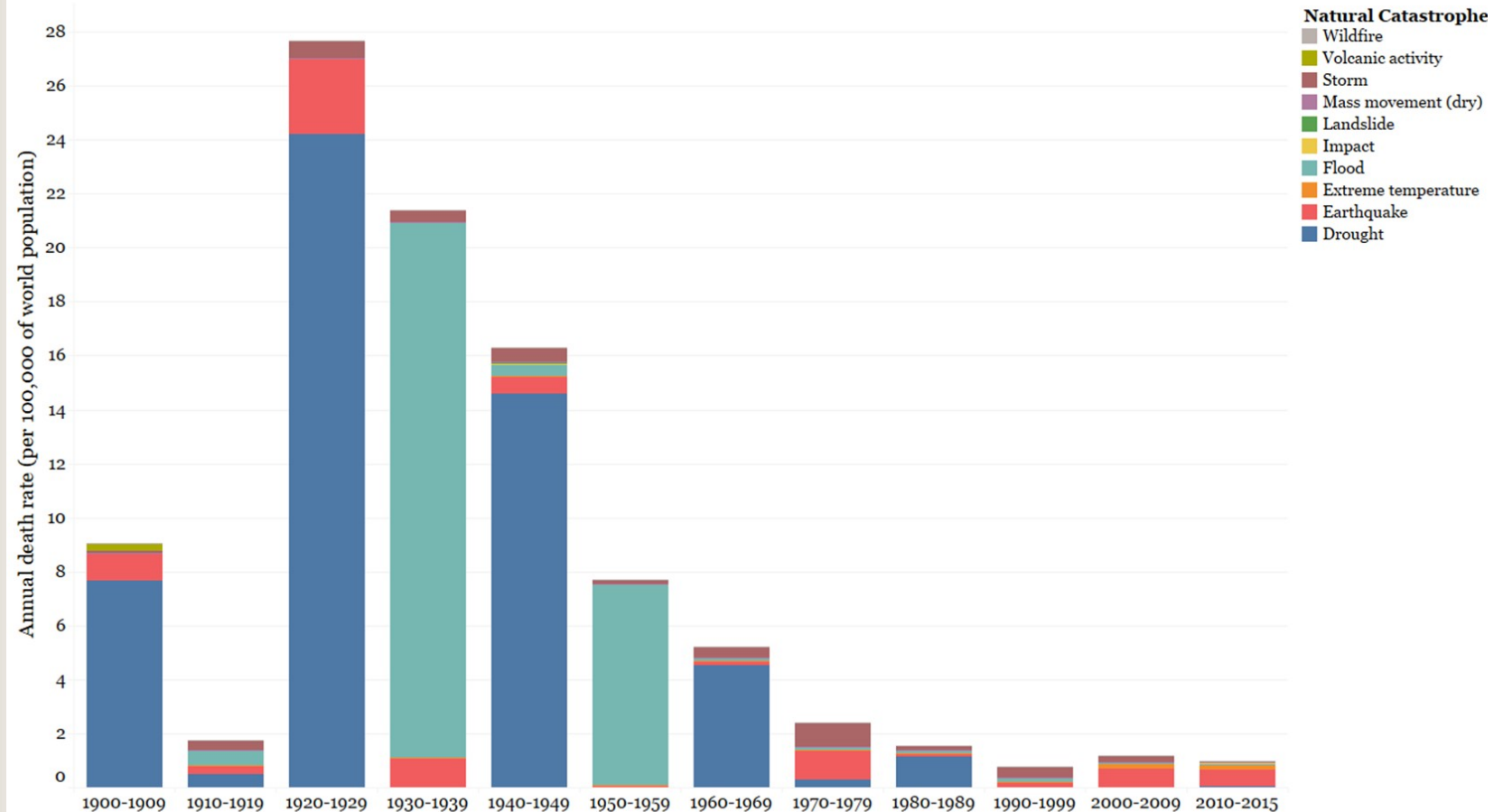


# Global Annual Death Rate From Natural Disasters

## Global annual death rate from natural disasters

Global death rate measured as the number of deaths per 100,000 of the world population  
(by decade 1900s to 2000s; and six years from 2010)

Our World  
in Data



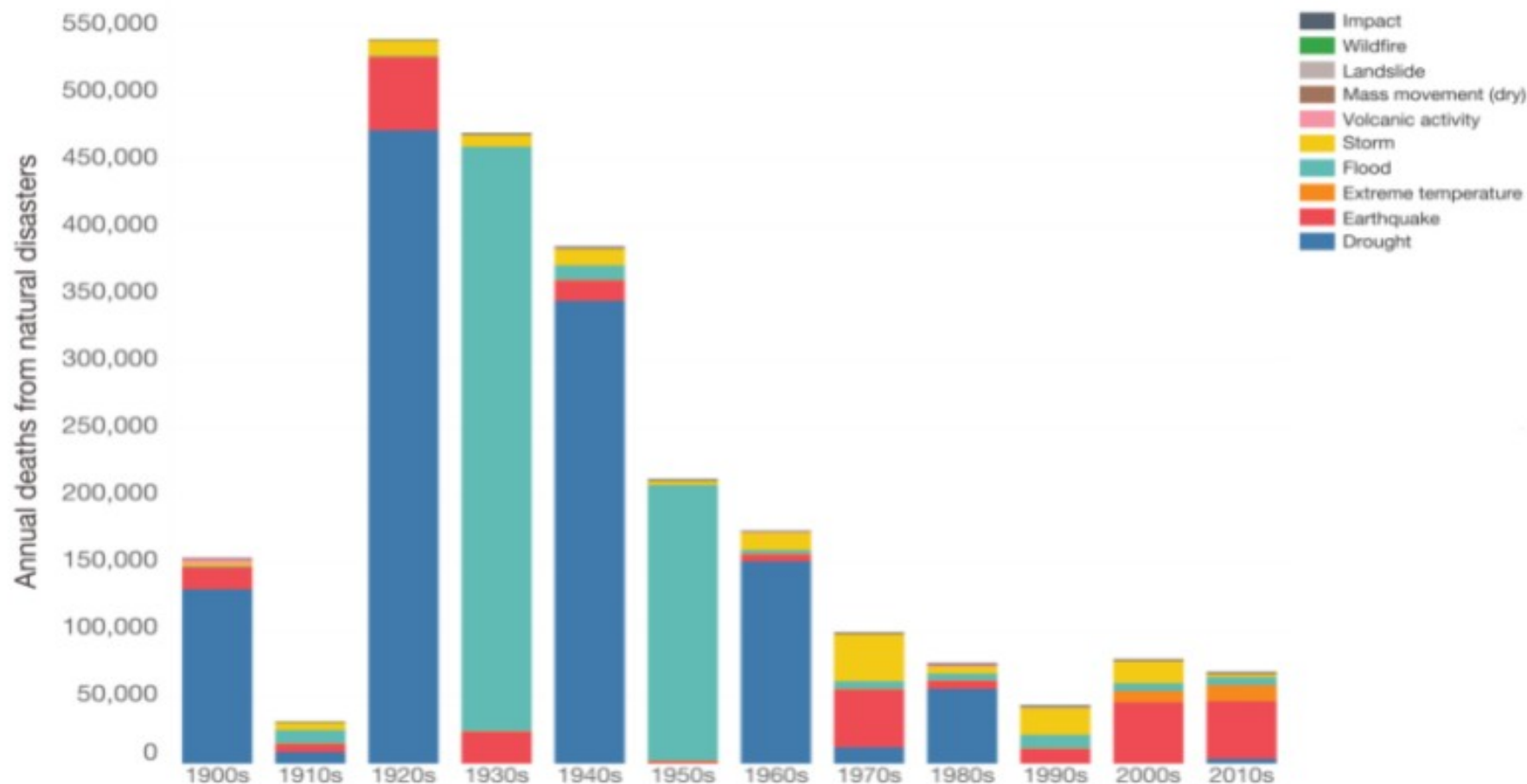
Data source: OFDA/CRED International Disaster Database – [www.emdat.be](http://www.emdat.be) – Université Catholique de Louvain – Brussels – Belgium.

The author Max Roser licensed this visualisation under a CC-BY-SA licence. You are welcome to share but please refer to its source where you find more information: <https://ourworldindata.org/natural-catastrophes/>

# Global annual deaths from natural disasters, by decade

Absolute number of global deaths from natural disasters, per year.

This is given as the annual average per decade (by decade 1900s to 2000s; and then six years from 2010-2015).



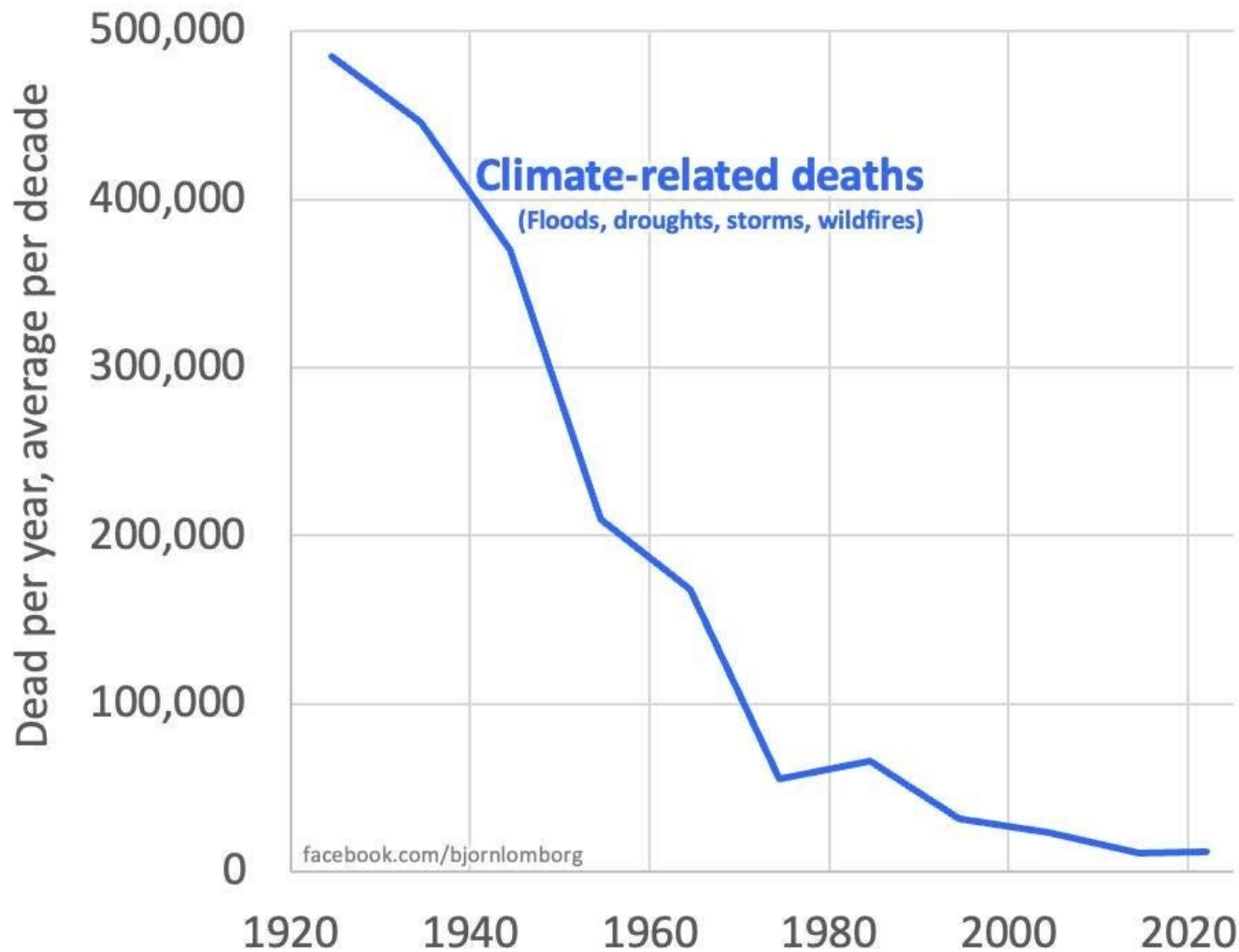
Source: EMDAT (2017): OFDA/CRED International Disaster Database, Université catholique de Louvain – Brussels – Belgium.  
The data visualization is available at [OurWorldinData.org](https://www.ourworldindata.org). There you find research and more visualizations on this topic.

Licensed under CC-BY-SA by the authors Hannah Ritchie and Max Roser.

Average annual global deaths from natural disasters by decade, 1900-2015<sup>2</sup>

# Climate-related Deaths: 1920-2023

Deaths have declined 97+% because richer, smarter and more resilient societies reduce disaster deaths. This swamps any potential climate signal

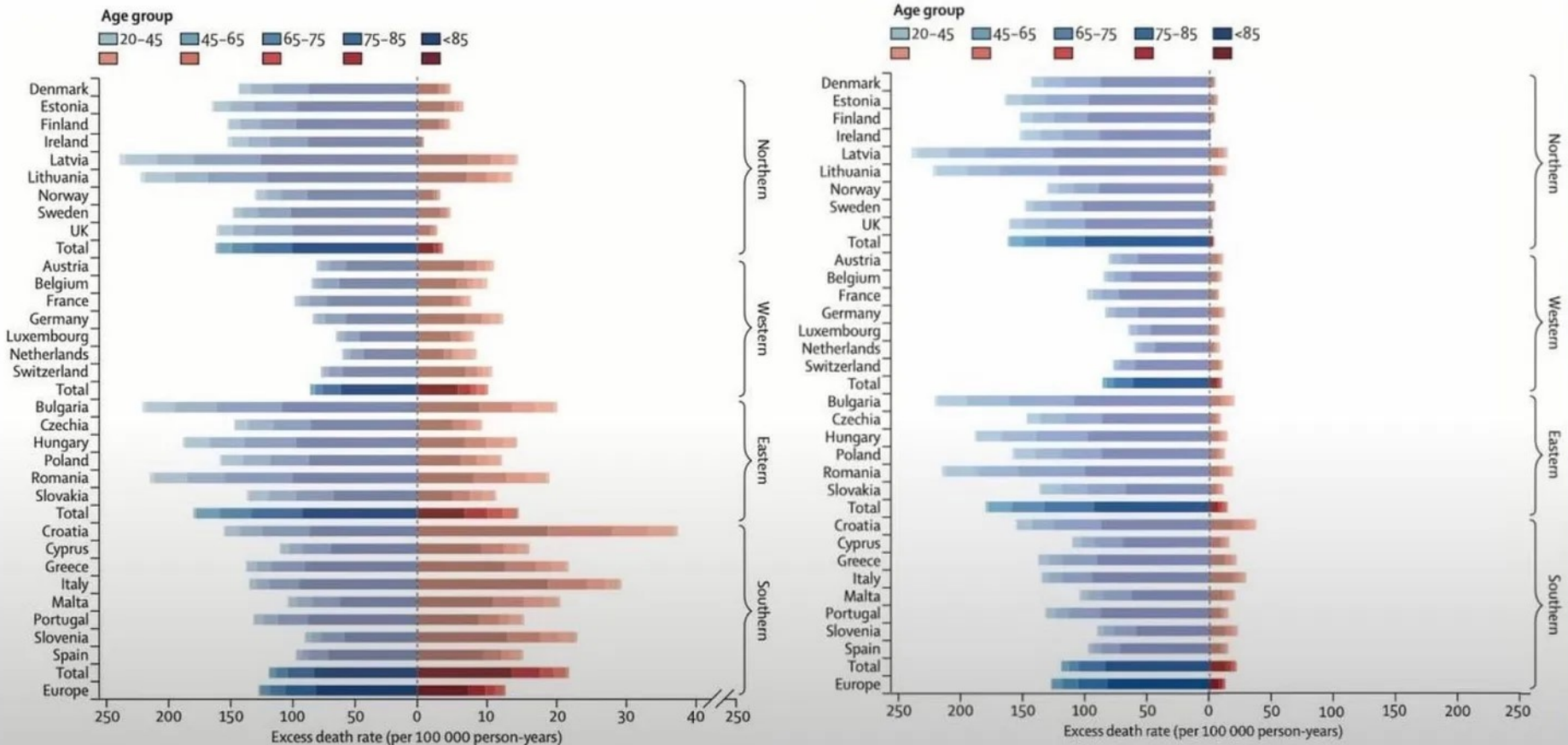


OFDA/CRED International Disaster Database Jan 1, 2024, <https://public.emdat.be>, deaths averaged over decades 1920-29, 1930-1939, ... 2010-2019 placed at decadal midpoints (1924.5, 1934.5 etc), with average data for 2020-23 placed at 2022. Update of Fig. 17 from <https://www.sciencedirect.com/science/article/pii/S0040162520304157>.



# 10x more Cold Deaths than Heat Deaths in Europe

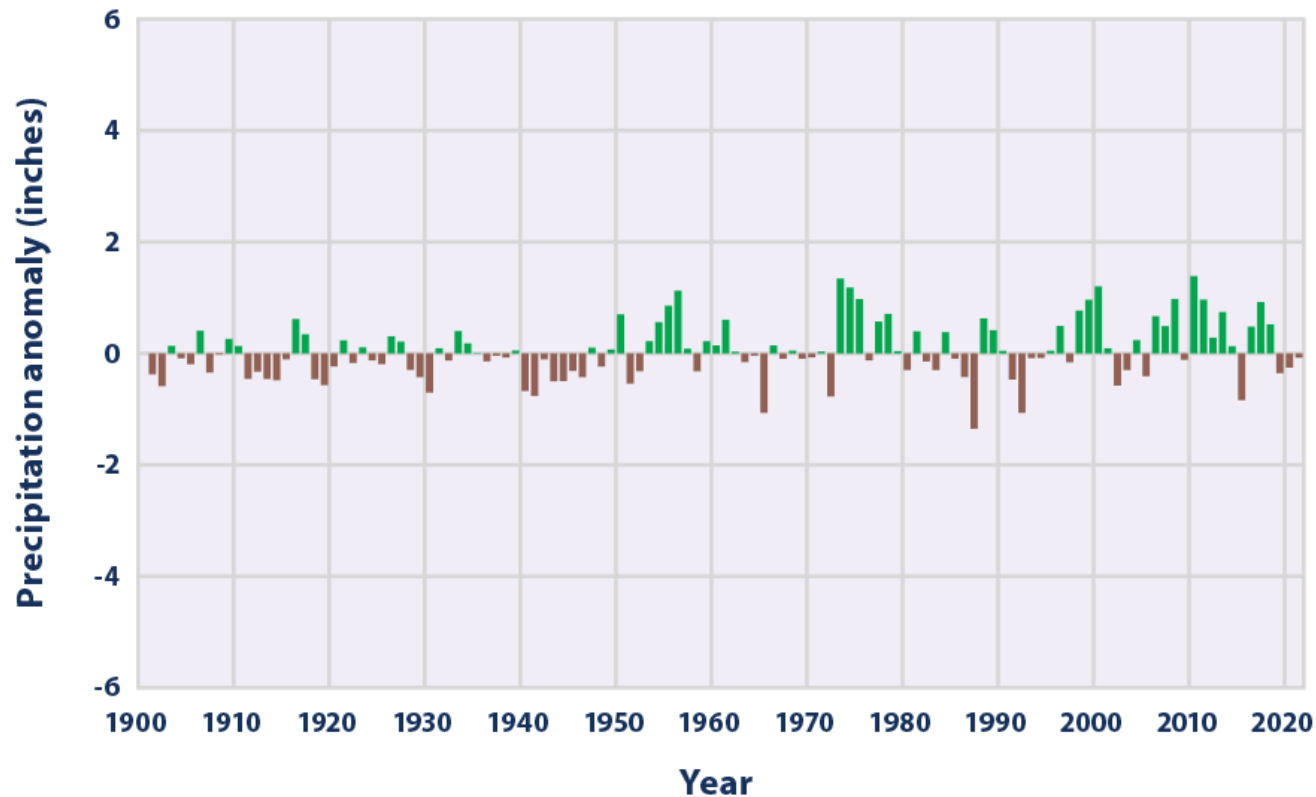
*On the left, how it is presented, on the right with equal axes*



2023 paper: "Excess mortality attributed to heat and cold: a health impact assessment study in 854 cities in Europe" based on 2000-19 data, [www.thelancet.com/journals/lanph/article/PIIS2542-5196\(23\)00023-2/fulltext](http://www.thelancet.com/journals/lanph/article/PIIS2542-5196(23)00023-2/fulltext), Figure 3 left, Figure 3 with equal axes for rates of heat deaths (red) and cold death (blue) on right. [twitter.com/bjornlomborg](https://twitter.com/bjornlomborg)

# Globally Increasing Precipitation

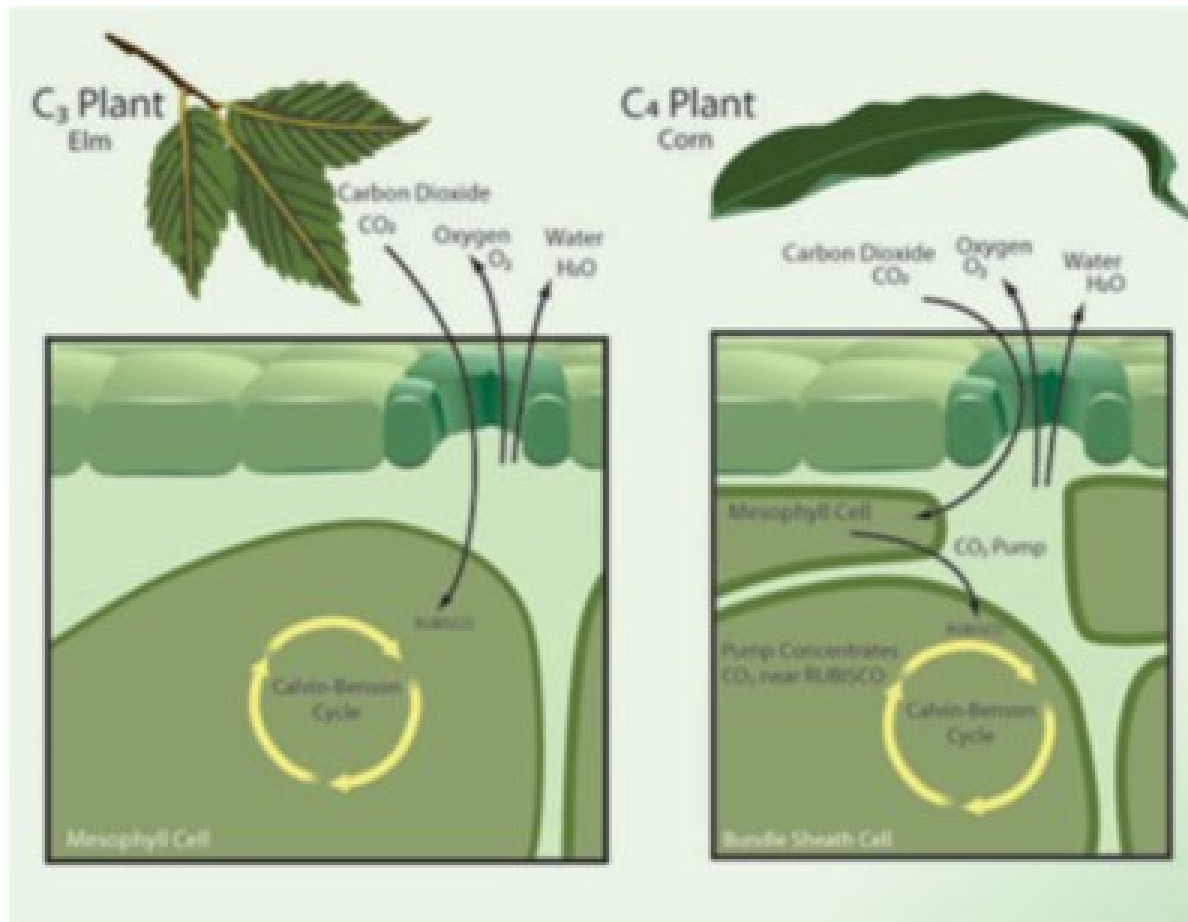
Precipitation Worldwide, 1901–2021



Data source: NOAA (National Oceanic and Atmospheric Administration). 2022. Extended version of GPCC dataset originally published in: Blunden, J., and T. Boyer (eds.). 2021. State of the climate in 2020. *B. Am. Meteorol. Soc.* 102(8):Si–S475. <https://doi.org/10.1175/2021BAMSStateoftheClimate.1>.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators).

# How CO<sub>2</sub> As Plant Food Works

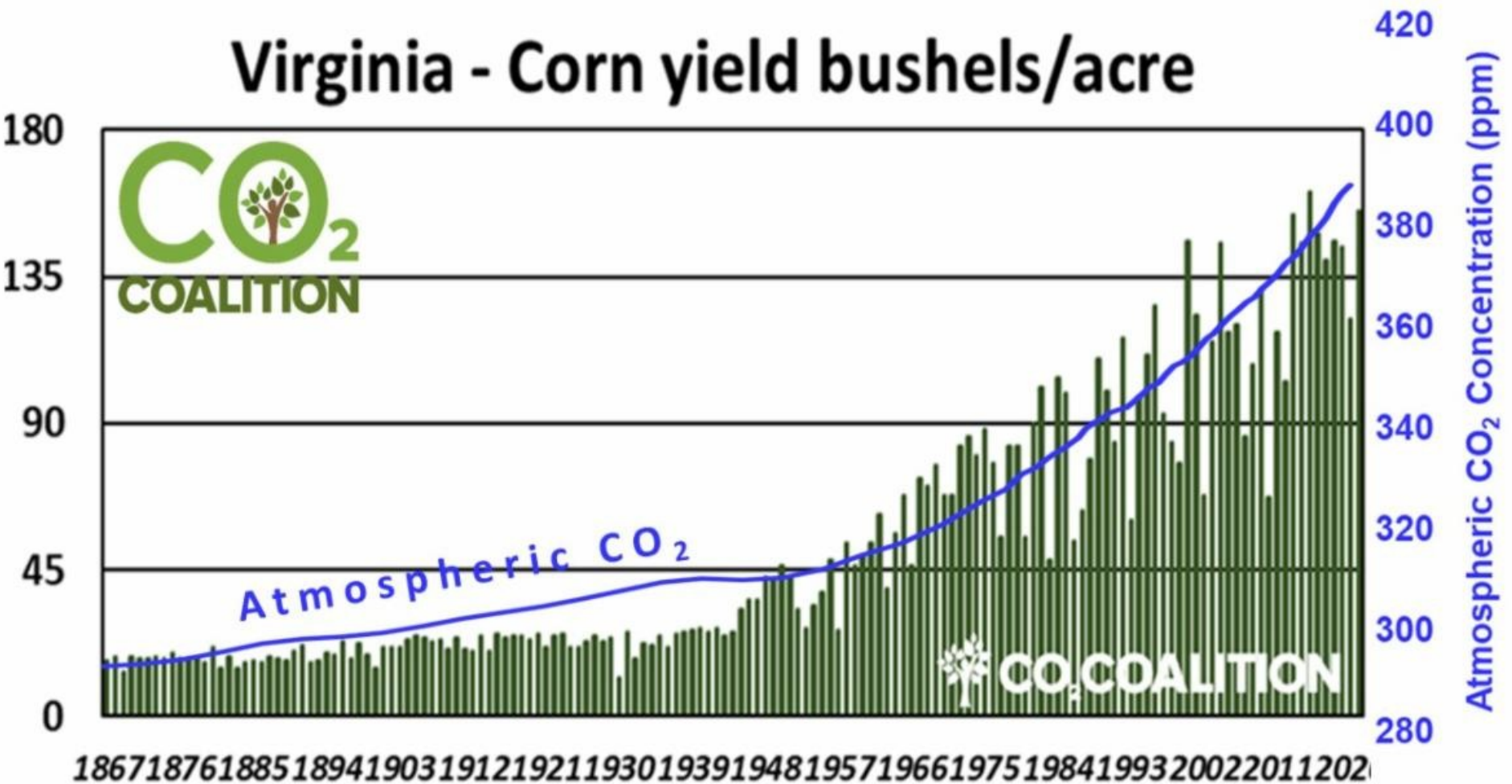


**More CO<sub>2</sub> greatly benefits plants because:**

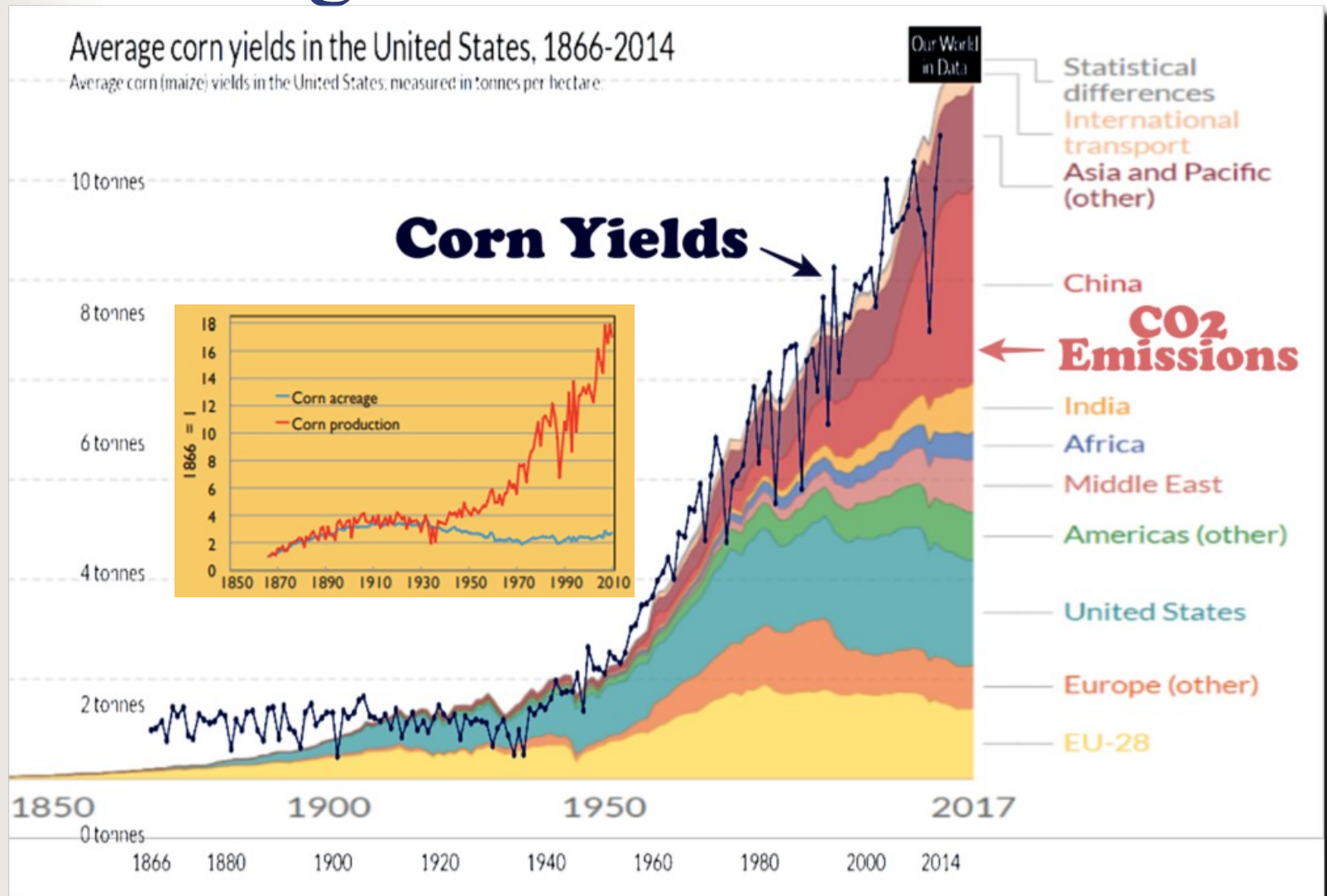
- 1. They need less water if there is more CO<sub>2</sub>.**
- 2. More CO<sub>2</sub> suppresses harmful photorespiration.**



# Virginia - Corn yield bushels/acre



# Average Corn Yields in the US





# Here is what happens with more CO2



385 ppm



535 ppm

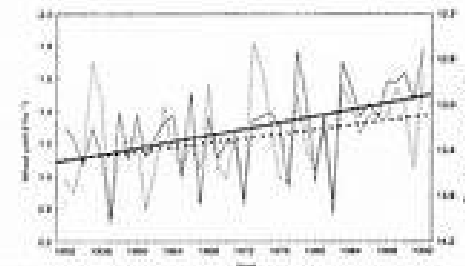


685 ppm



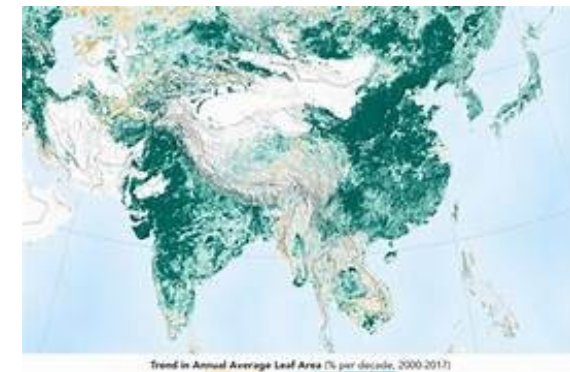
835 ppm





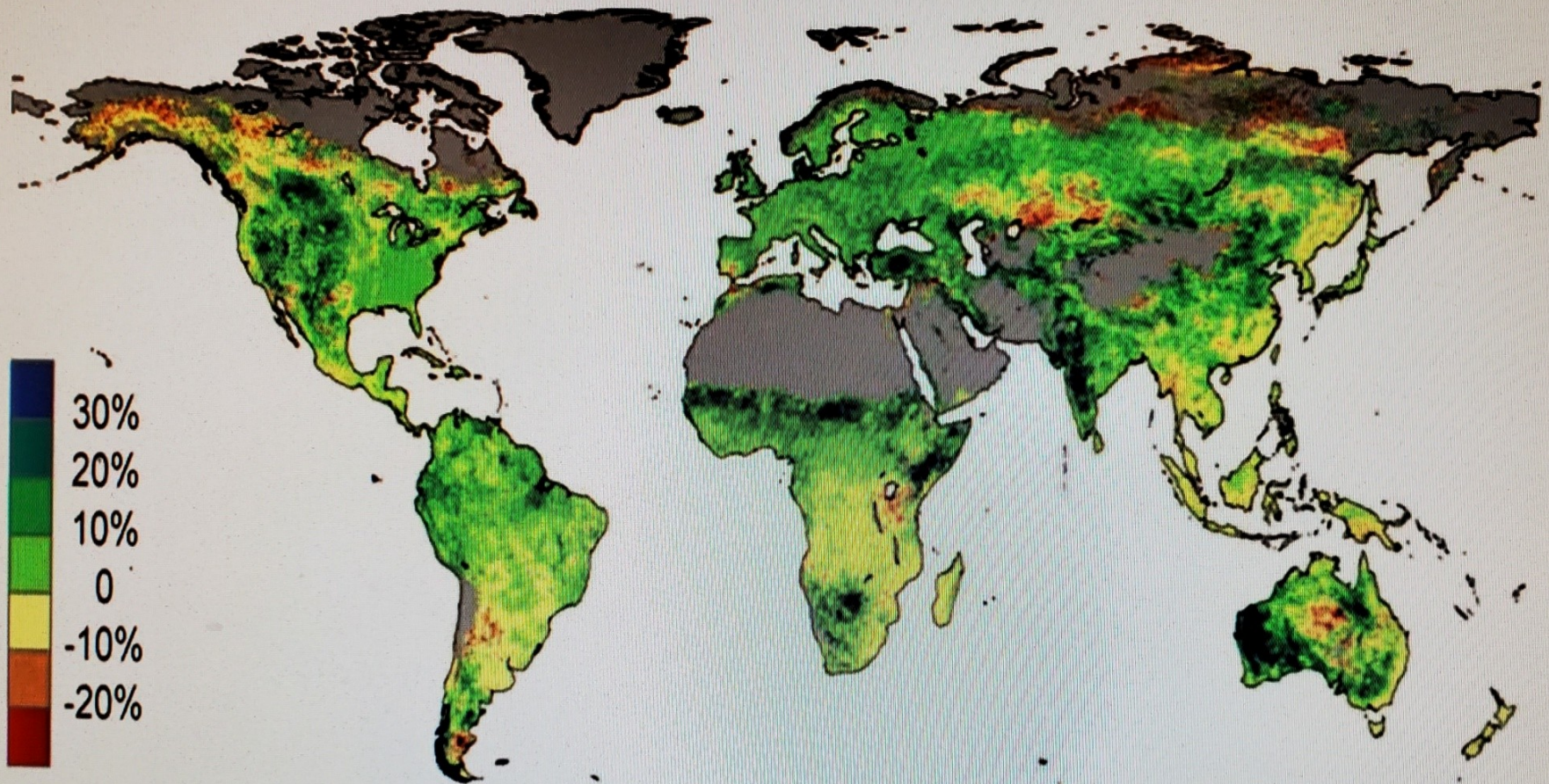
In Australia, climate change appears to have increased wheat yield by about 10 to 20% since 1952 (Nicholls, 1997)

### Observed Increase in Frost-Free Season Length





# Global Greening From CO2 Fertilization: 1982-2010



**Increase = 11% in areas studied**

Donohue et al, GRL (June 2013) DOI: 10.1002/grl.50563



# CO2 and Human Welfare

**Figure 16: Carbon dioxide and human welfare.**

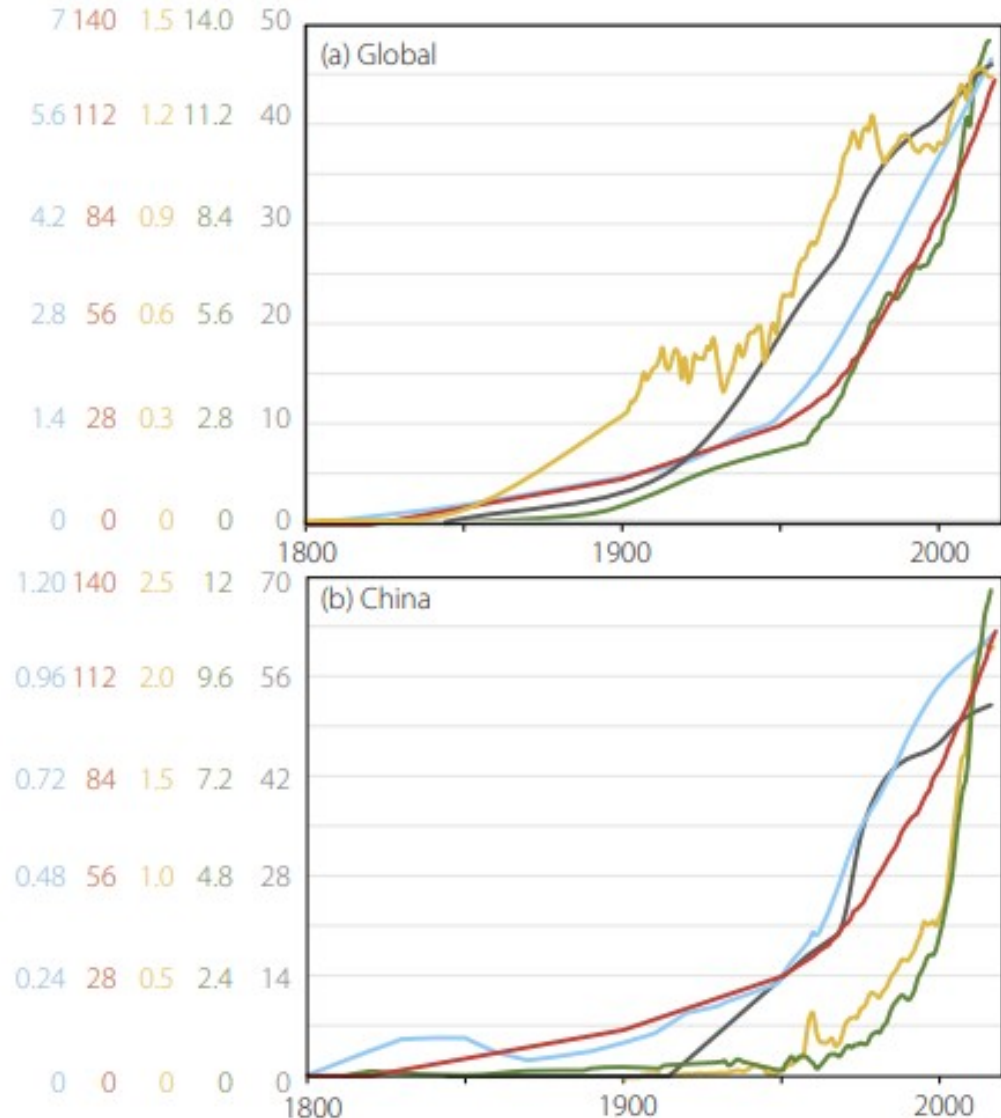
(a) World and (b) China. Updated from Goklany (2012a). Indicators of human welfare are: changes in GDP (per capita at PPP in 2011 USD), population and life expectancy. Carbon dioxide is represented by changes in emissions per capita and global concentration. All changes versus 1800 value, or nearest alternative date. Note that in 1800, emissions per capita were negligible. Sources citation in main text.

**Changes in carbon dioxide:**

- Concentration (ppm)
- Emissions per capita (t carbon)

**Changes in human welfare:**

- Life expectancy
- Per-capita GDP (000 2011 \$)
- Population (billions)





# What Do The Experts Say?



**More CO<sub>2</sub> actually benefits the world.**

**It is not a pollutant at all, and we should have the courage to do nothing about CO<sub>2</sub> emissions**

**--Dr. William Happer**



# CO2 Coalition

- Established in 2015 for the purpose of educating thought leaders, policy makers, and the public about the important contribution made by carbon dioxide to our lives and the economy.
- Prominent members include:
  - William Happer, PhD in Physics from Princeton
  - John Clauser, **PhD & Nobel Prize in Physics in 2022**
  - Patrick Moore, Co-Founder Greenpeace
  - Gregory Wrightstone, MS in Geology – Exec. Director
  - Richard Lindzen, PhD in Physics from Harvard
  - Roy Spencer, PhD in Meteorology
  - William van Wijngaarden, PhD in Physics



# Dr. William Happer's View

- Basic science shows **increasing levels of CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub>** will not cause a “climate emergency.” This is another “extraordinary popular delusion and madness of crowds” in the sad history of human lust for money and power, folly and cowardice.
- More **CO<sub>2</sub>** will **benefit life on Earth** because of its value to agriculture, forestry and photosynthetic life.
- More **N<sub>2</sub>O** and **CH<sub>4</sub>** will have **negligible effects** on Earth's climate.
- Rational people need to push back against climate fanaticism, which is not based on science at all. Appeasement will not work.





# Dr. William Happer — 1/25/25

*“Those who think that way, in many cases, mean very well. But they have been misled. As a scientist who actually knows a lot about climate (and I set up many of our climate research centers when I was at the Department of Energy in the early 1990s) I can assure you that there is no climate emergency. There will not be a climate emergency. ... Policies to address this phony climate emergency will cause great damage to American citizens and to their environment.”*



# Dr. William Happer — 1/25/25

- By far, water vapor is the dominant greenhouse gas. Carbon dioxide is secondary and decidedly minor. Happer illustrates that each primary greenhouse gas prevents certain wavelengths from freely escaping to space. He adds that:
- *“This keeps Earth’s surface temperature warmer than it would be (by about 20 or 30 degrees). [C or about 35 to 55°F] The Earth would be an ice cube if it were not for water vapor and CO<sub>2</sub>; and when I say water vapor, you should understand that I really mean water vapor and clouds, the condensed form of water. Clouds are at least as important as greenhouse gases, and they are very poorly understood to this day.”*



# Climate Regulations Based on a “Hoax”

- Two prominent climate scientists have taken on the EPA new rules to cut CO<sub>2</sub> emissions in electricity generation, arguing that the regulations “will be disastrous for the country, for no scientifically justifiable reason.”
- **William Happer** and **Richard Lindzen** argued that the claims used by the EPA to justify the new regulations are based on political opinions and speculative models that have consistently proven to be wrong.
- “The scientific method proves there is no risk that fossil fuels and carbon dioxide will cause catastrophic warming and extreme weather.”





# Steve Koonin, PhD Physics — 1/18/25

- Koonin then shows that 73 models overestimate the warming of the globe. These models are the ones cited by the UN Intergovernmental Panel on Climate Change and its collaborators as proof of human caused global warming. One problem that Koonin discusses is the **failure of the models to correctly forecast clouds**. As Koonin states:
- *“Natural fluctuations in the height and coverage of clouds have at least as much of an impact on the flows of sunlight and heat as do human influences. But how can we possibly know global cloud coverage say 10, let alone 50 years from now? Obviously, we can’t. But to create a climate model, we have to make assumptions. That’s a pretty shaky foundation on which to transform the world’s economy.*



# Kees de Lange, Amsterdam Vrije Universiteit, Prof Emeritus - Climate Change Conclusions

There is no climate crisis due to Greenhouse gases

CO<sub>2</sub> is harmless, beneficial, causes global greening and increased agricultural production, essential for feeding a growing world population

Net zero goals are unnecessary, impossible and economically harmful

Renewables and their necessary back up are unsuitable to provide a growing world population with the reliable and affordable energy required to live in some comfort

To take care of energy requirements on a global scale, nuclear energy (fission first, fusion hopefully later) is unavoidable



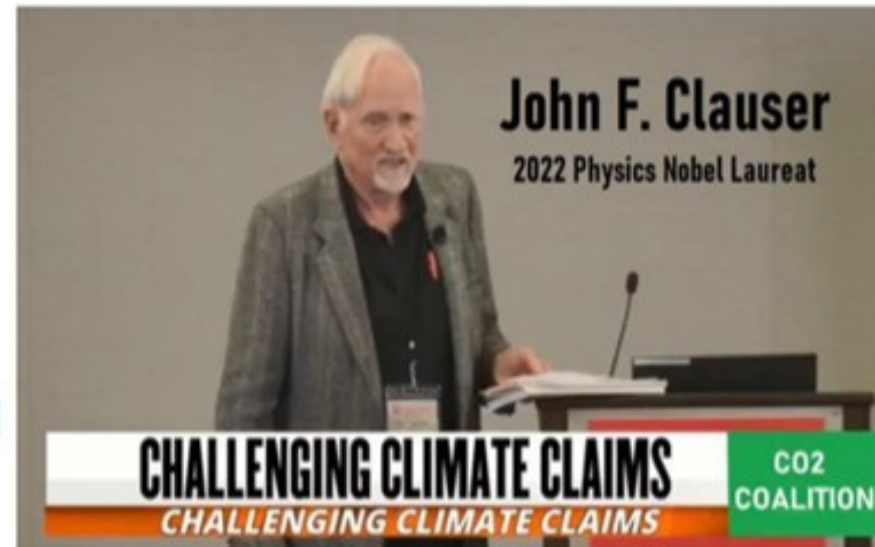
# Dr. John Clauser – 2022 Physics Nobel Laureate

## “Clouds are the Thermostat for Earth’s Climate”

Climate Change Science, Climate Initiatives,  
Society in General  
Clauser's Case: GHG Science Wrong, Clouds  
the Climate Thermostat

This post provides a synopsis of Dr. John Clauser's Clintel presentation last May. Below are the texts from his slides gathered into an easily readable format. The two principal takeaways are:

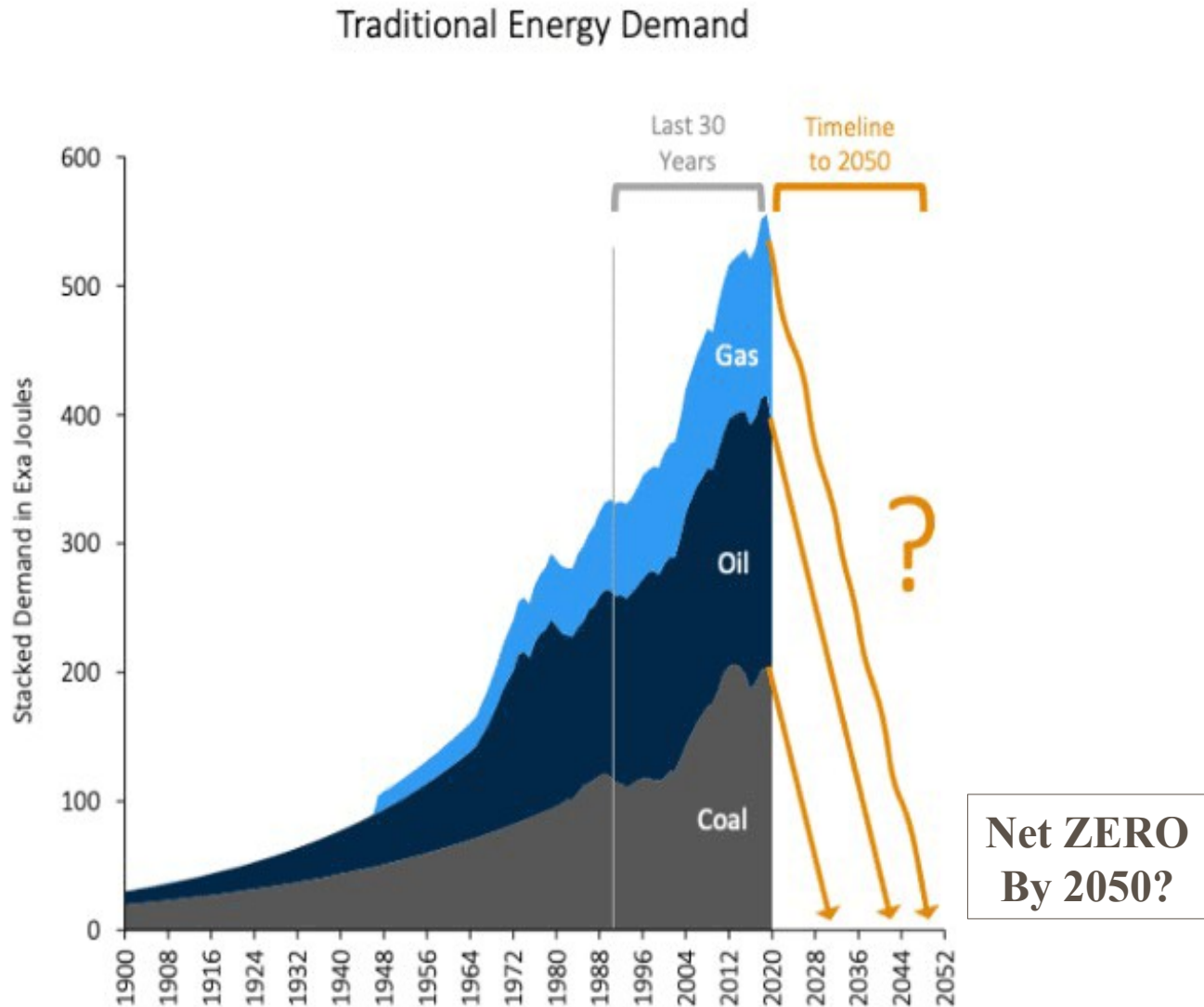
- A. IPCC's Green House Gas Science is Flawed and Untrustworthy**
- B. Clouds are the Thermostat for Earth's Climate, Not GHGs.**



**I confidently assert that the climate crisis is a colossal trillion-dollar hoax.**



# Global Energy Needs Won't Disappear Overnight





# In Conclusion

- UN IPCC CC models have failed miserably
- **Man-made causes** are insufficient
  - CO<sub>2</sub> & CH<sub>4</sub> components of GHG have small effect
- **Natural causes** of CC are more credible
  - Sun energy alone is insufficient
  - Cosmic radiance with sunspots can explain CC
  - Pacific Decadal Oscillation may explain CC
- Paris Climate Agreement **NOT** a solution for a **non-existent problem**
- Clouds are the thermostat for earth's climate, not GHSs
- Benefits of Warming and More CO<sub>2</sub>



# What News Media Isn't Telling You

- Global Warming from 1978 to 1998 has been replaced by Global Cooling (~20 years)
- The Antarctic ice sheet is growing, not melting
- Sea level is rising 7" per century, not 20 ft.
- Some snowfall records set in the past 10 years
- CO<sub>2</sub> & CH<sub>4</sub> **cannot** cause much global warming
- Clouds, sun cycles, ocean currents, volcanoes (all natural) **can and do** control climate change
- Severe storms **are not** more frequent than normal



# What Should the Church Do About GW?

- Commit to viewing the world from God's perspective
- Understand and rely on Scripture as a foundation for life
- Use the Bible to understand the world and evaluate all problems
- Help inform other believers
- Promote the truth and oppose false beliefs with gentleness and respect



**Gen. 8:22**, *While the earth remains, seedtime and harvest, cold and heat, summer and winter, day and night, shall not cease.*

Climate Change is **NOT** a Crisis  
Let's Not Panic!

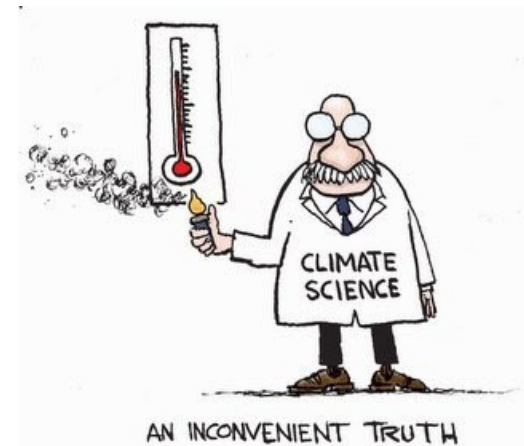
**Thank you  
for your  
attention!**

Dr. Heinz Lycklama

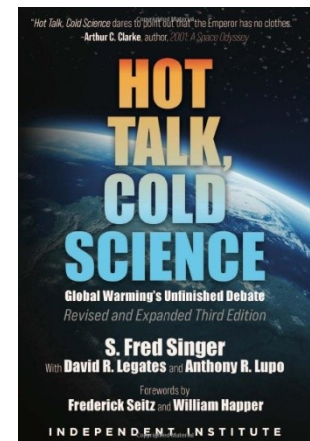
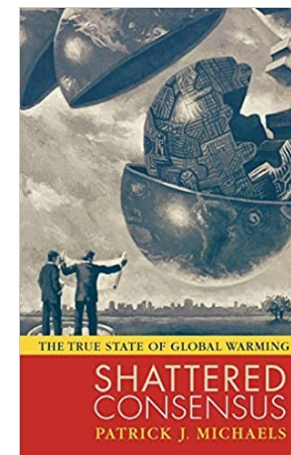
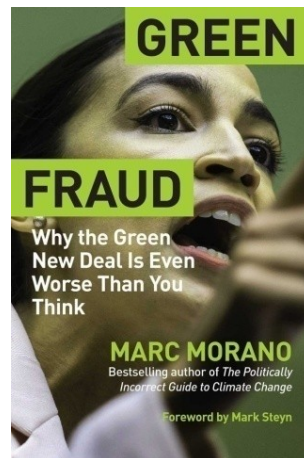
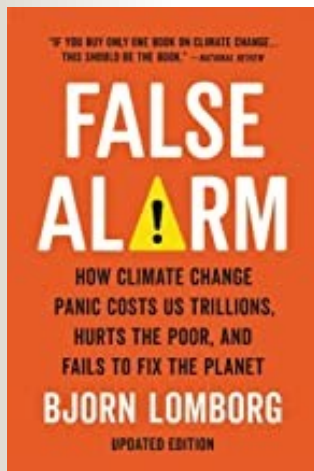
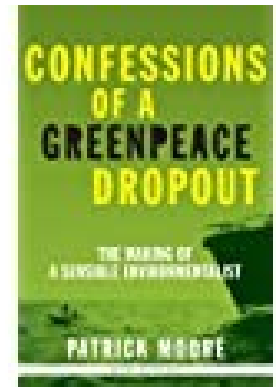
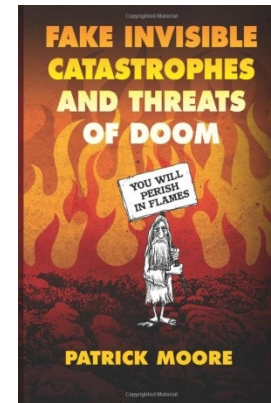
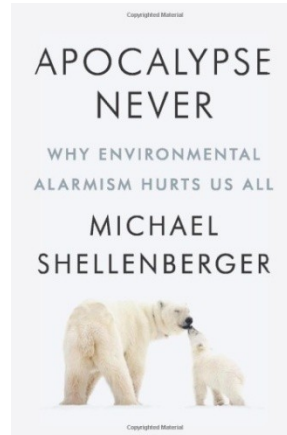
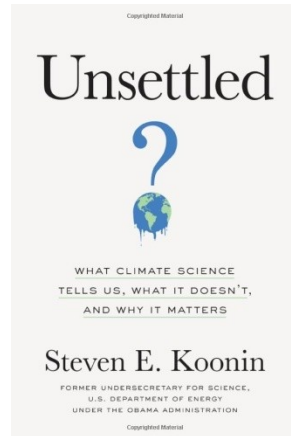
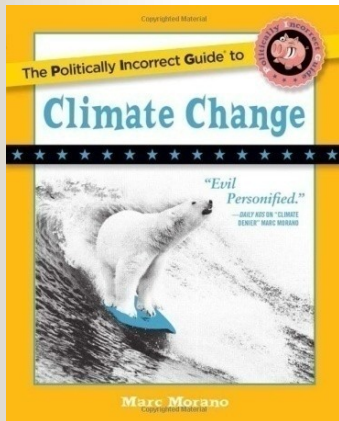
[heinz@osta.com](mailto:heinz@osta.com)

[HeinzLycklama.com](http://HeinzLycklama.com)

[HeinzLycklama.com/RefutingGWA](http://HeinzLycklama.com/RefutingGWA)



# 60+ Books Refuting GWA







# References

- Easterbrook/280.ppt
- Easterbrook/WAStateSenatePPT-032613.ppt
- PhoenixClimatePresentation.ppt
- History of CC in Greenland (DVD)
- The Great GW Debate by Michael Oard (DVD)
- Global Warming by Coral Ridge (DVD)
- Articles by Dr. Larry Vardiman, Climate Scientist at ICR
  - Does CO2 Drive Global Warming?
  - A New Theory of Climate Change



# More References

- The Great Global Warming Blunder, Dr. Roy Spencer
- The Skeptic's Handbook, Joanne Nova 2009
- Climate Change Reconsidered II Series (NIPCC)
  - **Physical Science** - Full Report.
  - **Physical Science** - Summary for Policymakers
  - **Biological Impacts** - Full Report.
  - **Biological Impacts** - Summary for Policymakers
- Nature, Not Human Activity, Rules the Climate (SEPP)
- Why Scientists Disagree About GW (NIPCC)



# Reasons Secular Scientists Think Earth's Climate is Unstable

1. Faulty computer climate models
  - Feedback – positive or negative?
2. Fraudulent politicized research
  - Use of surface vs. satellite temperature measurements
  - Cherry-picked data
  - Manipulated data
3. Dependence on the Milankovitch theory



# All 4 US Drought Cycles in Sync

**All 4 US Drought Cycles are in Synchronization for the First Time Since 1934:**

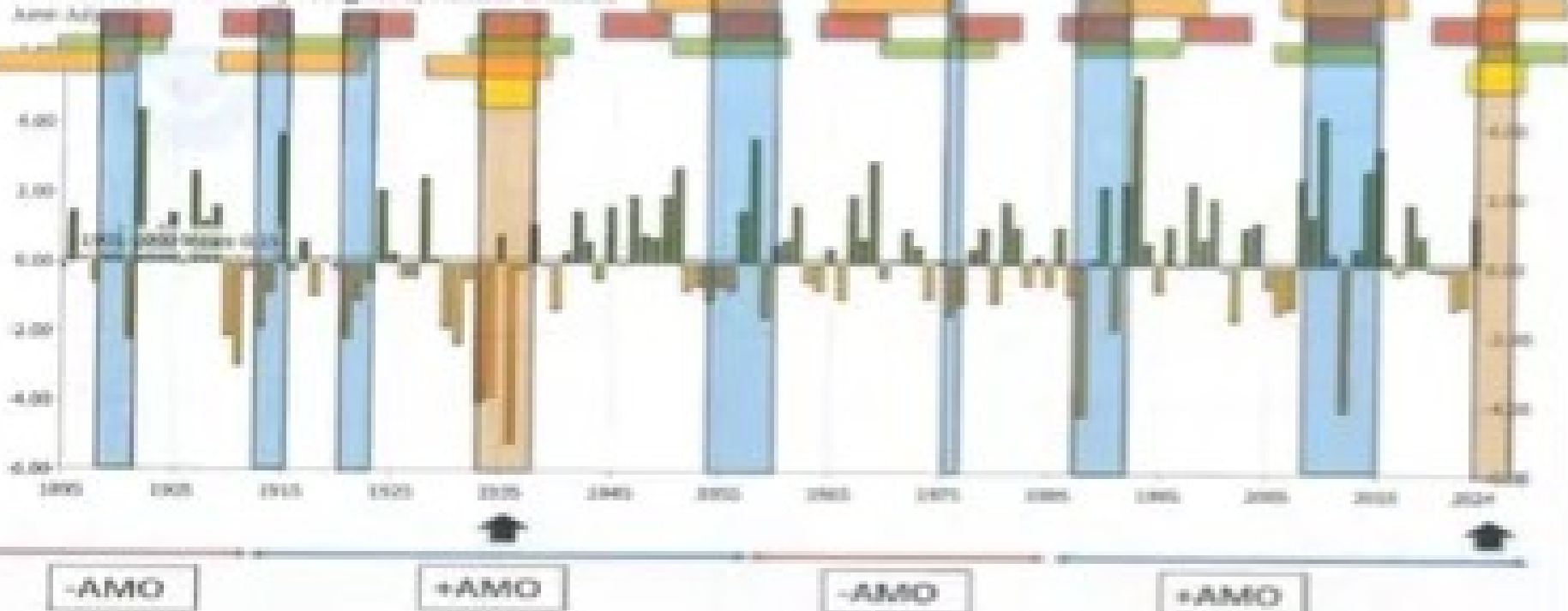
Yellow = 89-Year Gleissberg Drought Cycle

Orange = 11.8-Year Jupiter/Neptune Synodic Cycle

Green = 18.6-Year Lunar Rotation Cycle

Red = 11-Year Trough to Peak Solar Cycle

**Core Belt (Productivity Weighted) Palmer Z-Index**

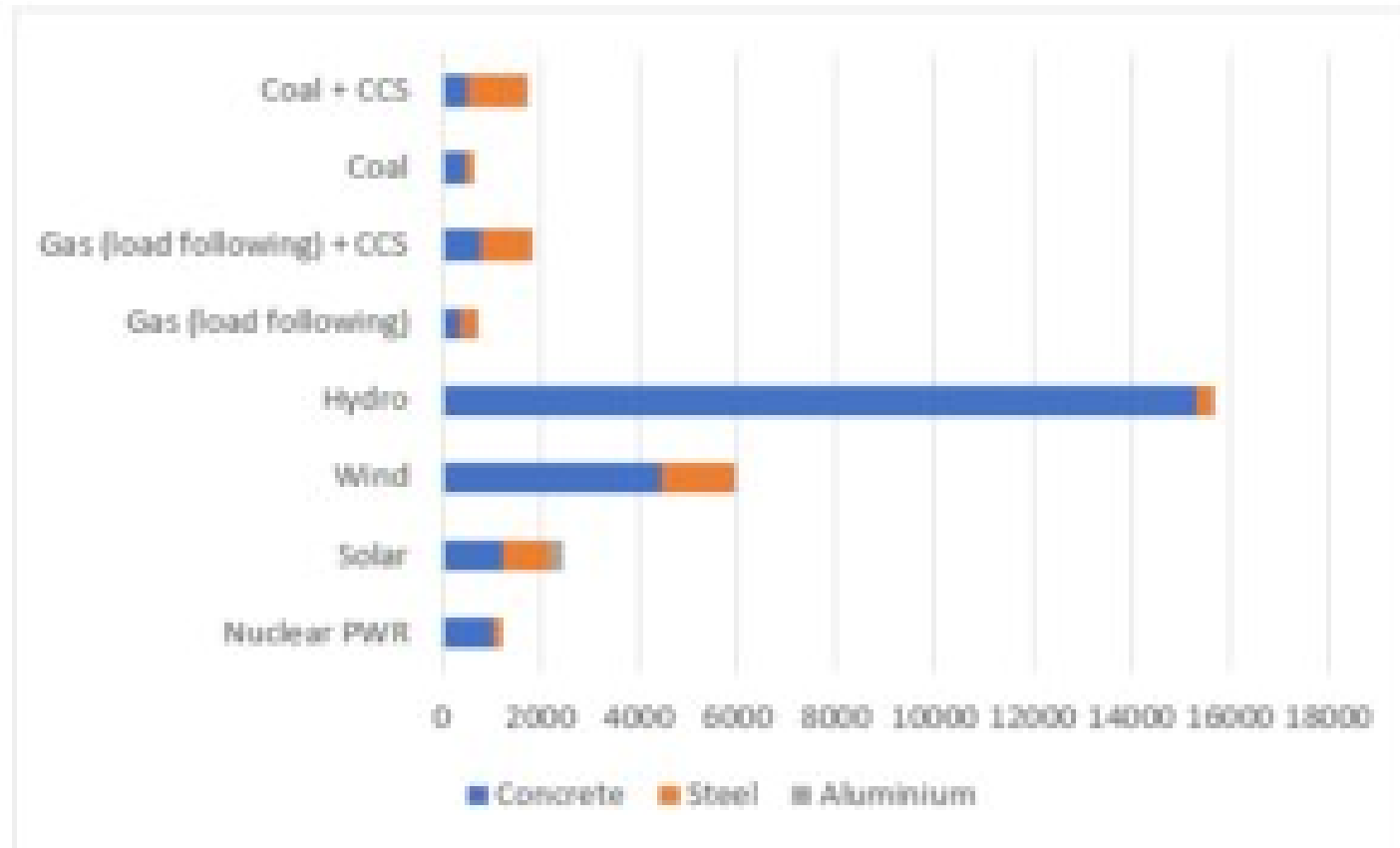




# Five Key Climate Questions

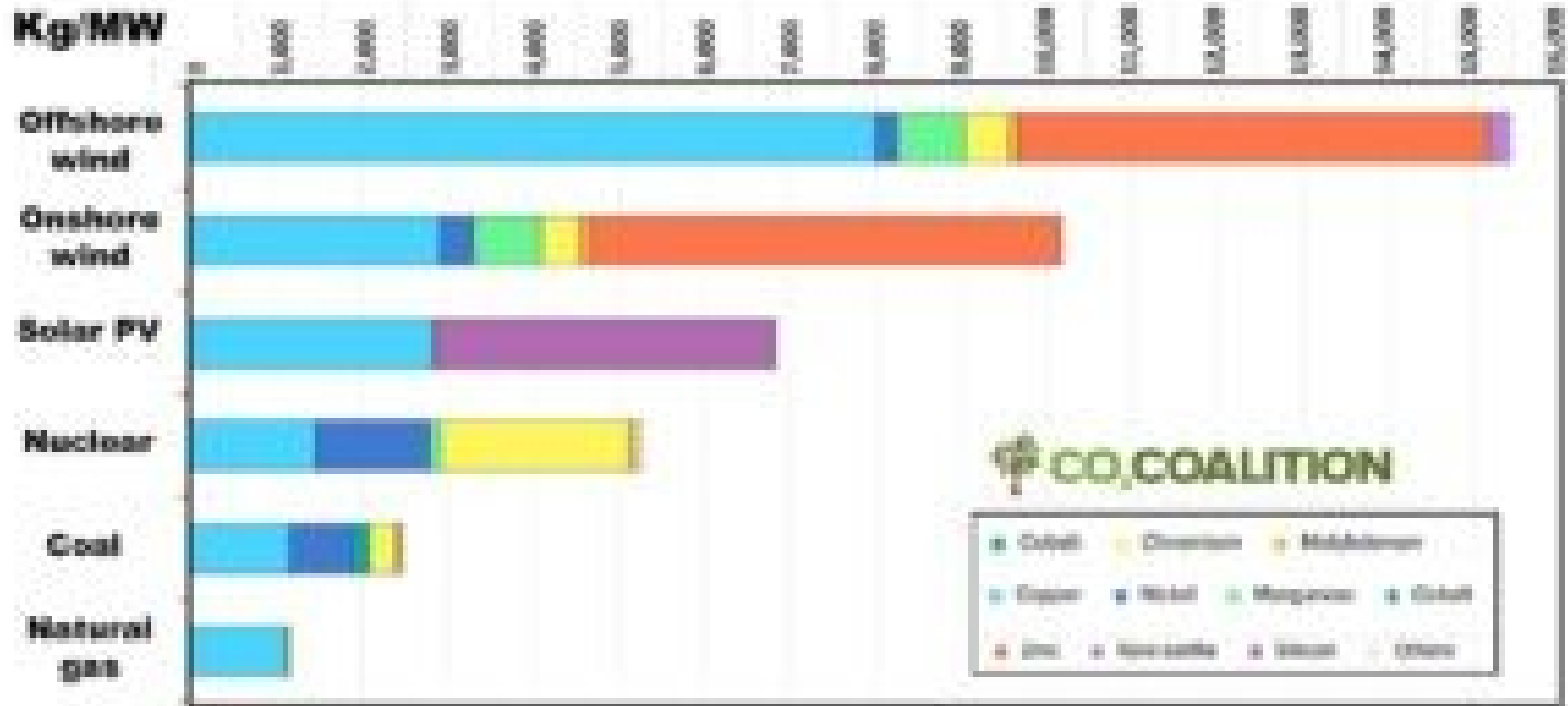
- Is the world warming?
  - *Yes, but historic record likely overstated, and there has been no warming in last 10 years*
- Is that warming due to man's CO<sub>2</sub>?
  - *Likely “some,” but probably not “most”*
- Will future man-made warming be substantial?
  - *Perhaps a degree, at most, over the next century*
- Will we see catastrophic effects from warming?
  - *Likely not – we have not seen them so far*
- Do CO<sub>2</sub> abatement laws like cap-and-trade make sense?
  - *Costs far more than it helps. Many more important priorities. Carbon tax better than cap-and-trade.*

# Metals Demand 2022





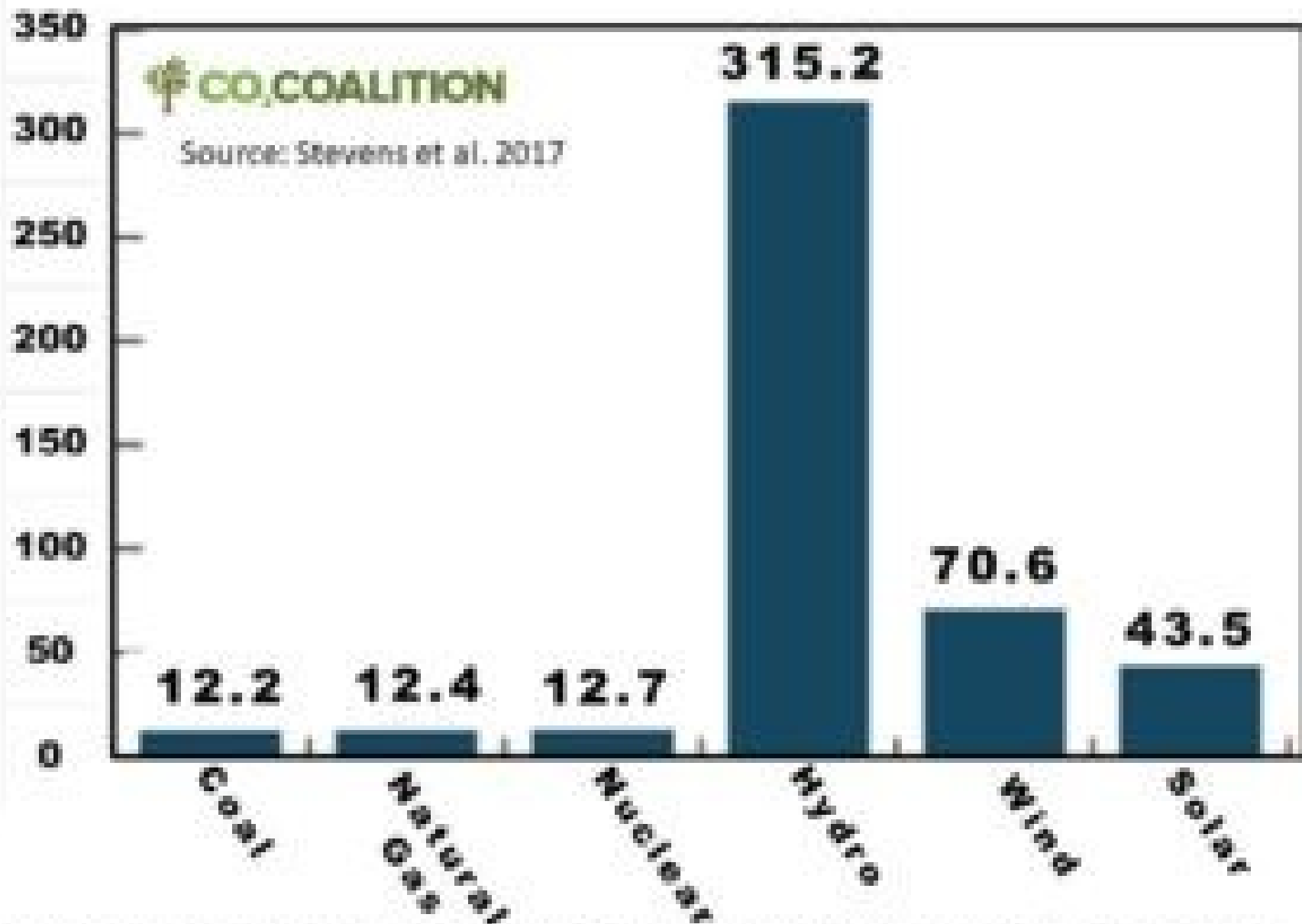
# Metals Demand for Clean Energy



***Metals demand for clean energy technologies compared to other power generation sources***

Source: IEA 2012, [The Role of Critical Minerals in Clean Energy Transitions](#)

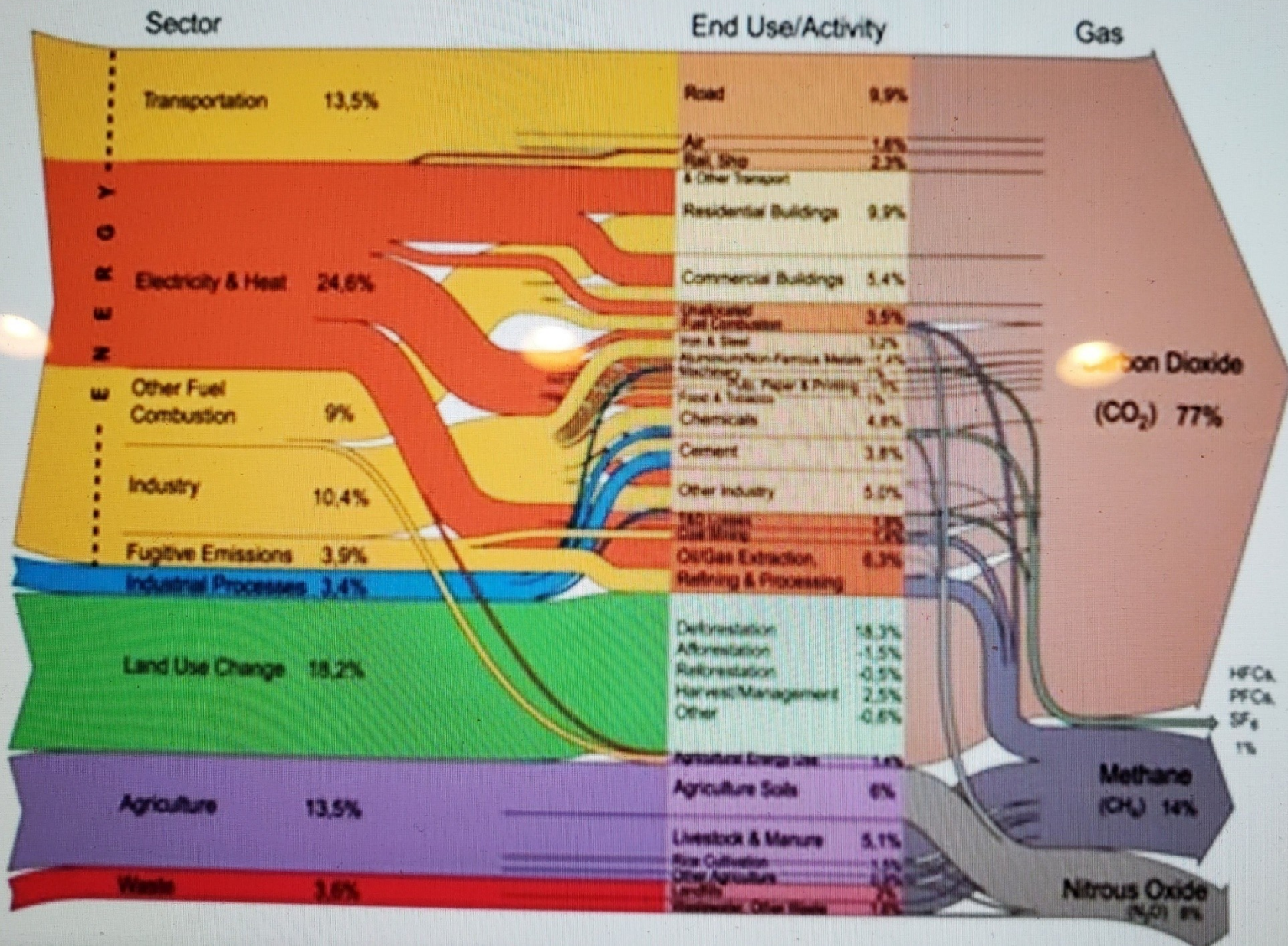
**Total Acres per Megawatt**



**Physical footprint per megawatt of energy produced using various energy technologies**



# Mitigation = Reducing GHGs

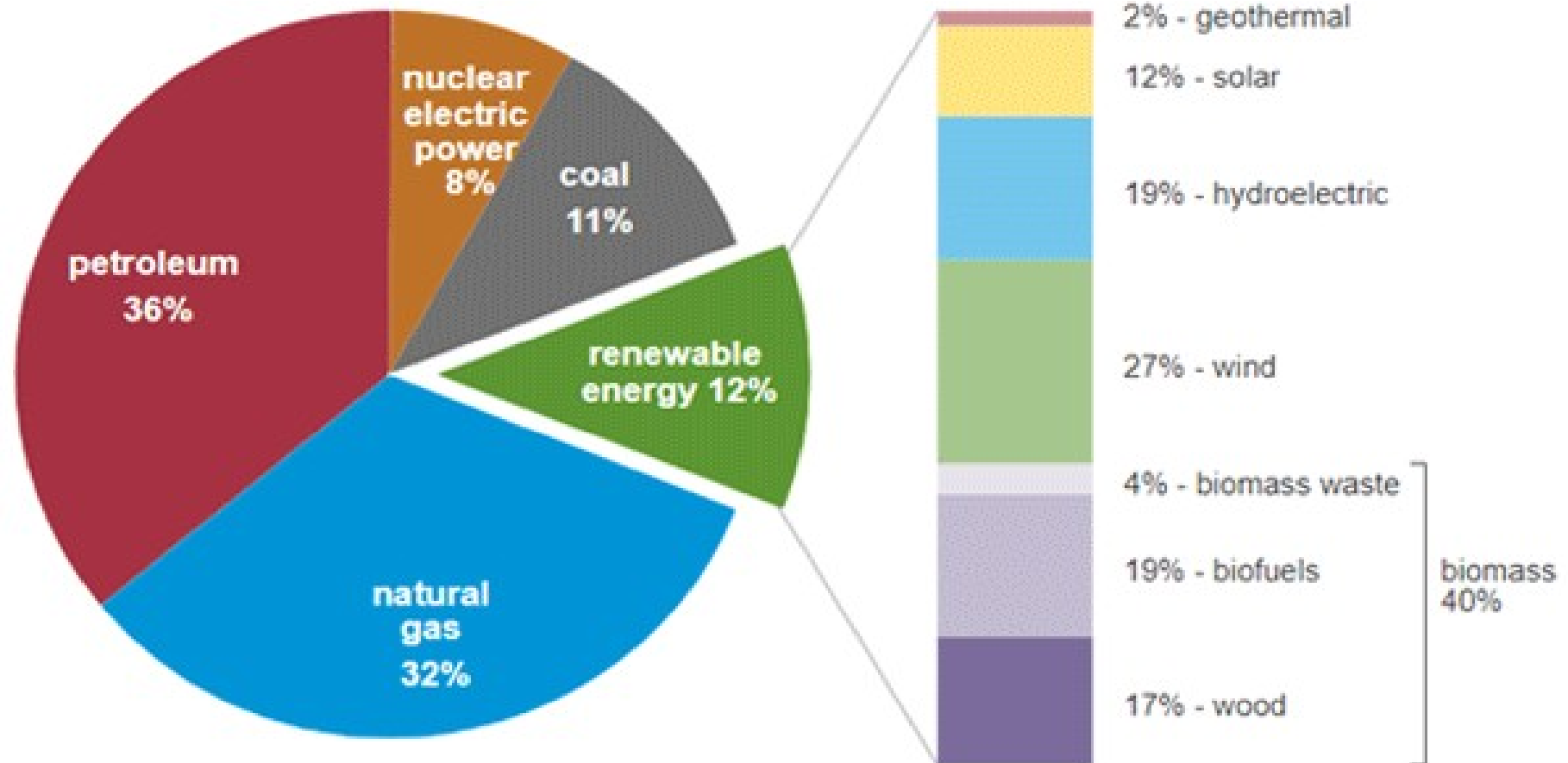




# U.S. primary energy consumption by energy source, 2021

total = 97.33 quadrillion  
British thermal units (Btu)

total = 12.16 quadrillion Btu



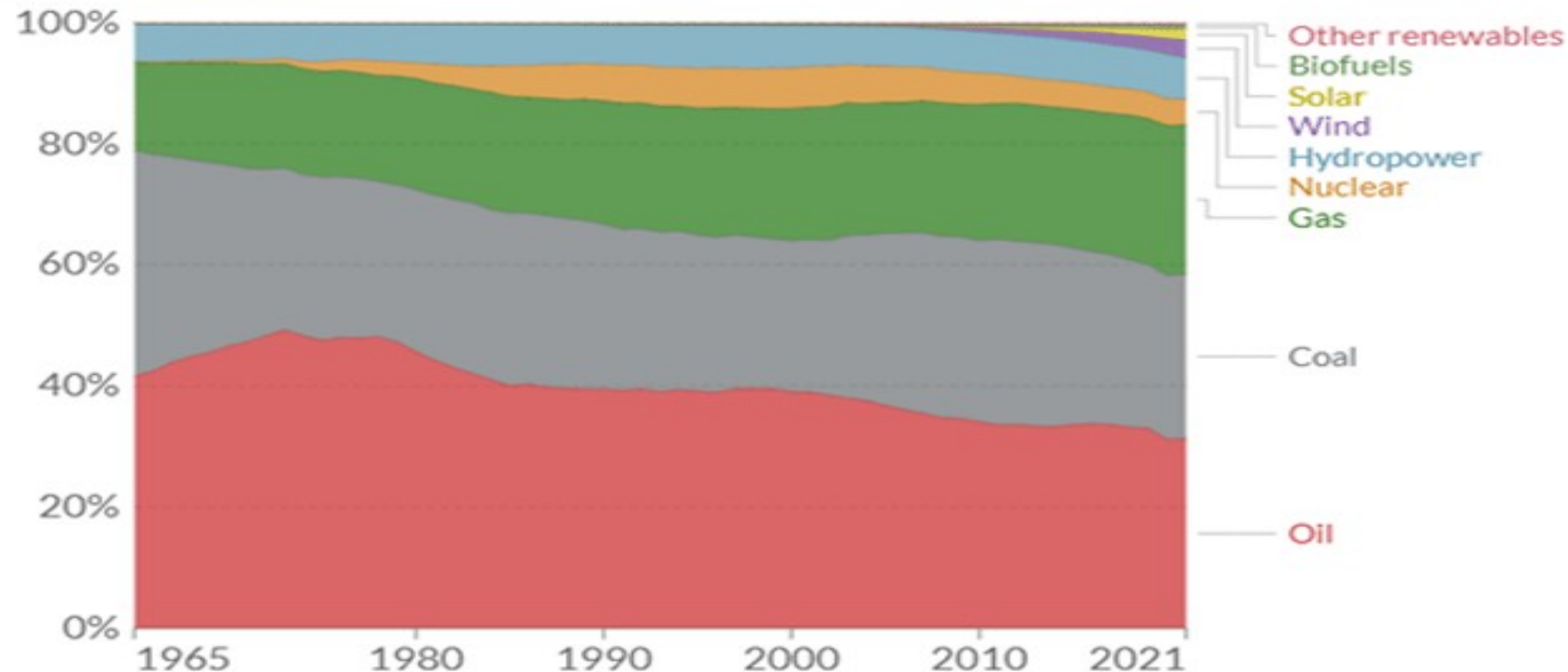
Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2022, preliminary data

Note: Sum of components may not equal 100% because of independent rounding.

# Energy consumption by source, World

Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.

↔ Change region ☒ Relative



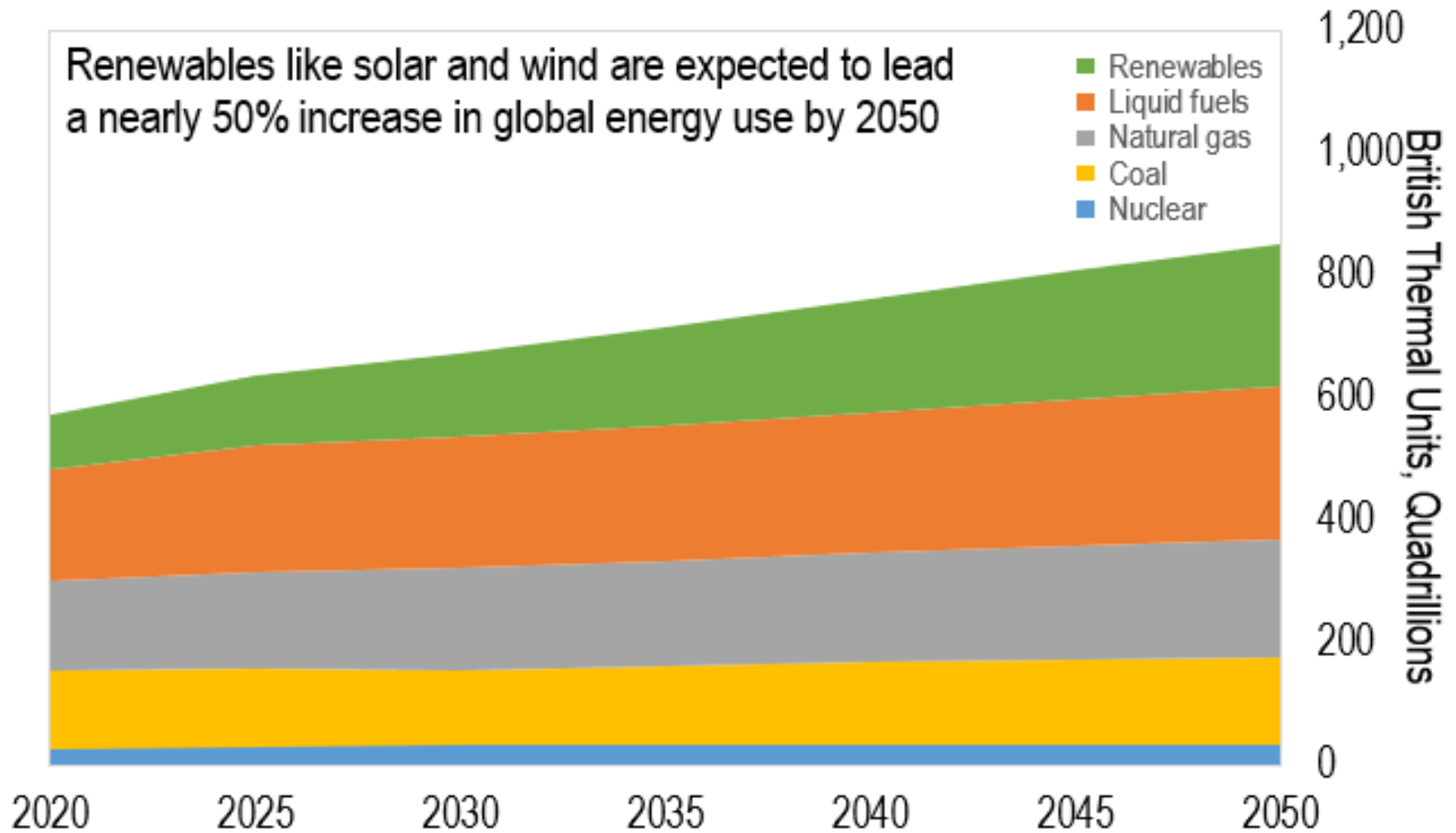
Source: BP Statistical Review of World Energy

OurWorldInData.org/energy • CC BY

Note: 'Other renewables' includes geothermal, biomass and waste energy.

▶ 1965  2021

# Global Primary Energy Consumption by Energy Source

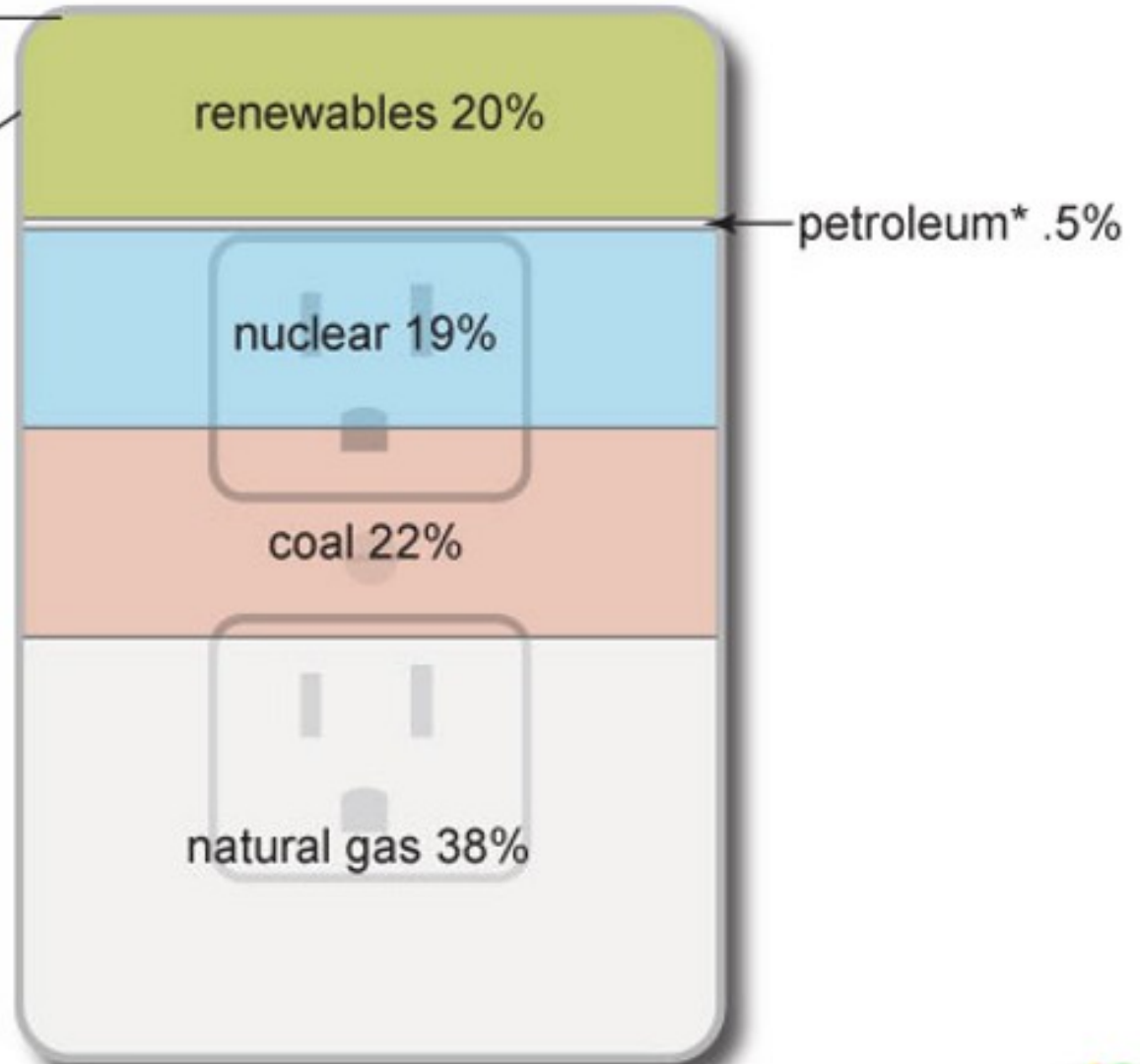




# Sources of U.S. electricity generation, 2021

Total = 4.12 trillion kilowatthours

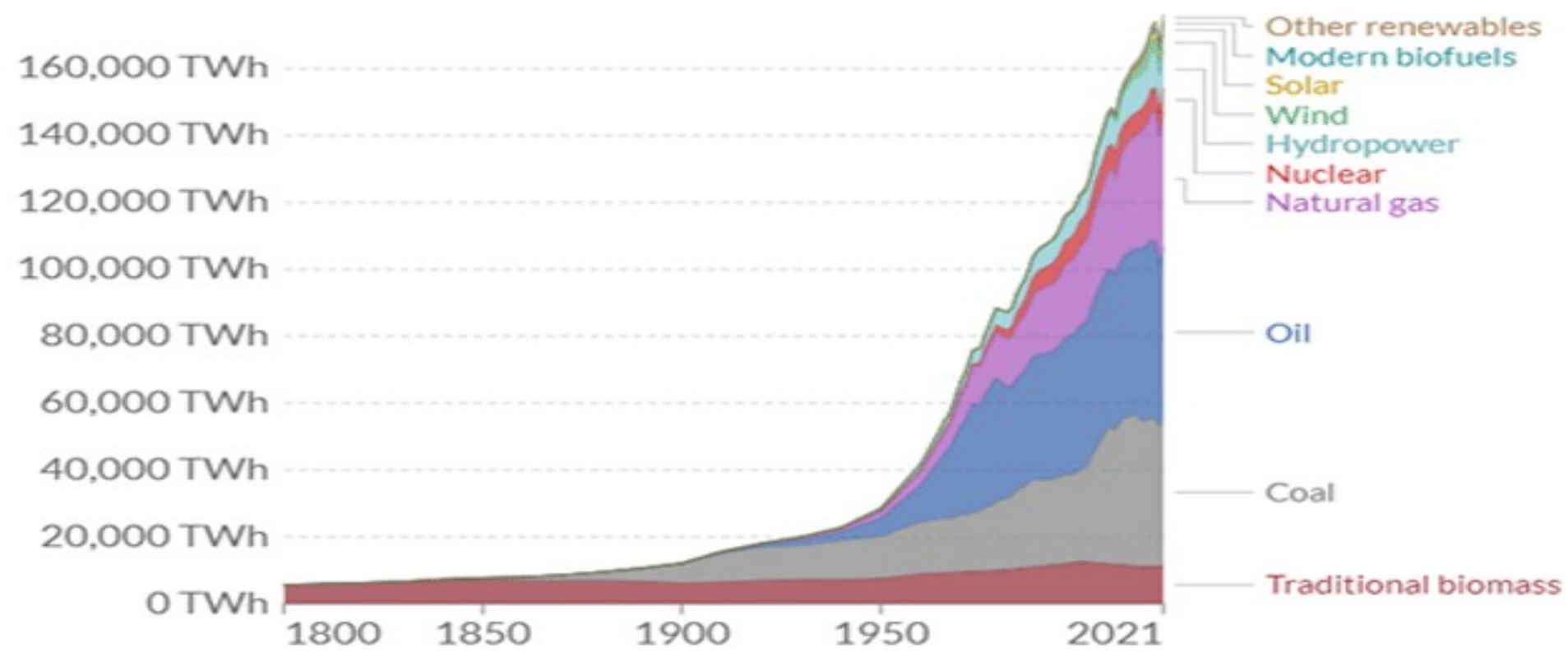
wind	9.2%
hydro*	6.3%
solar	2.8%
biomass	1.3%
geothermal	0.4%



# Global primary energy consumption by source

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.

□ Relative

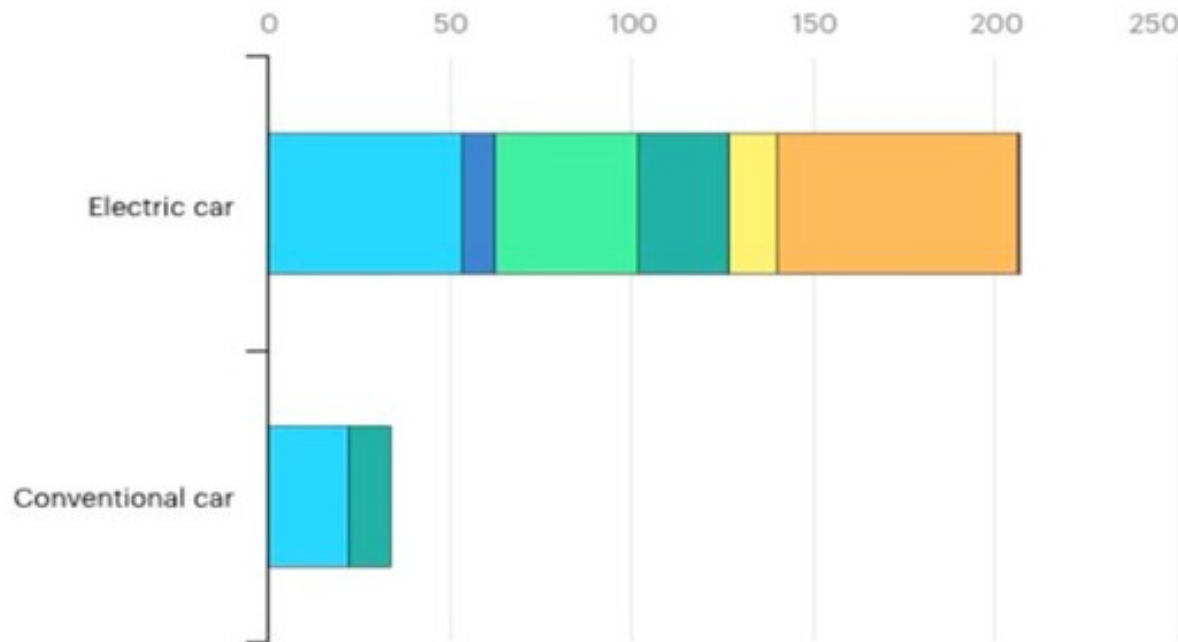


Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy  
OurWorldInData.org/energy • CC BY



# Minerals Used in Electric Cars

kg/vehicle



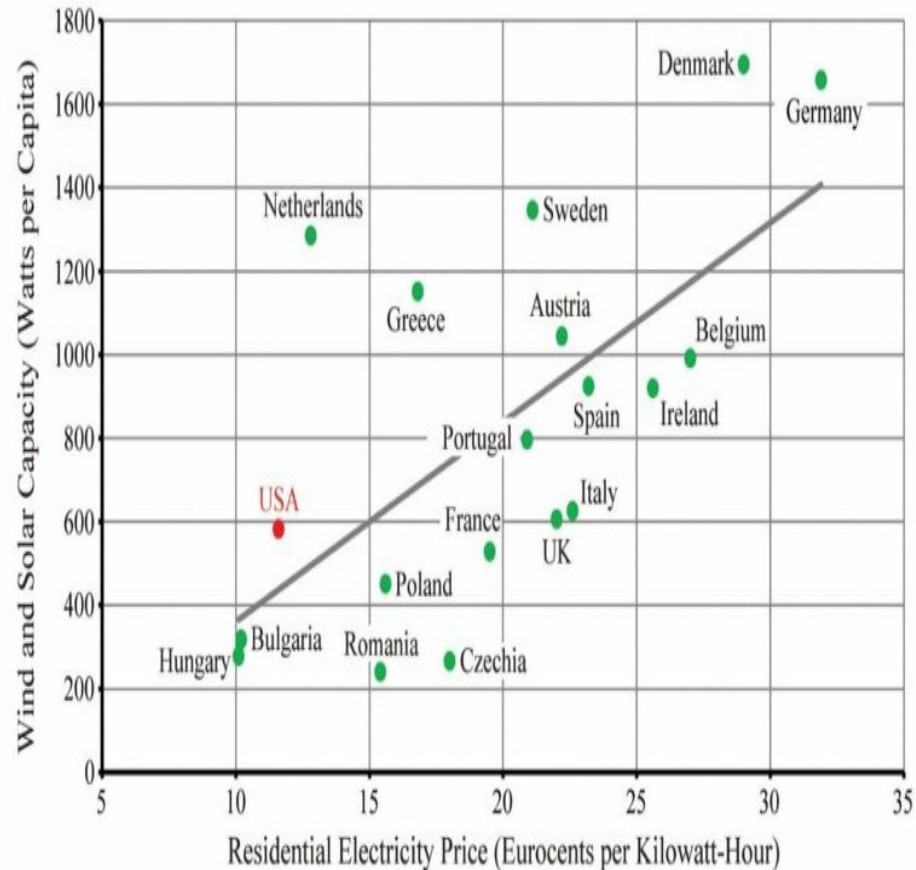
IEA. All Rights Reserved

Copper Lithium Nickel Manganese Cobalt Graphite Zinc  
Rare earths Others



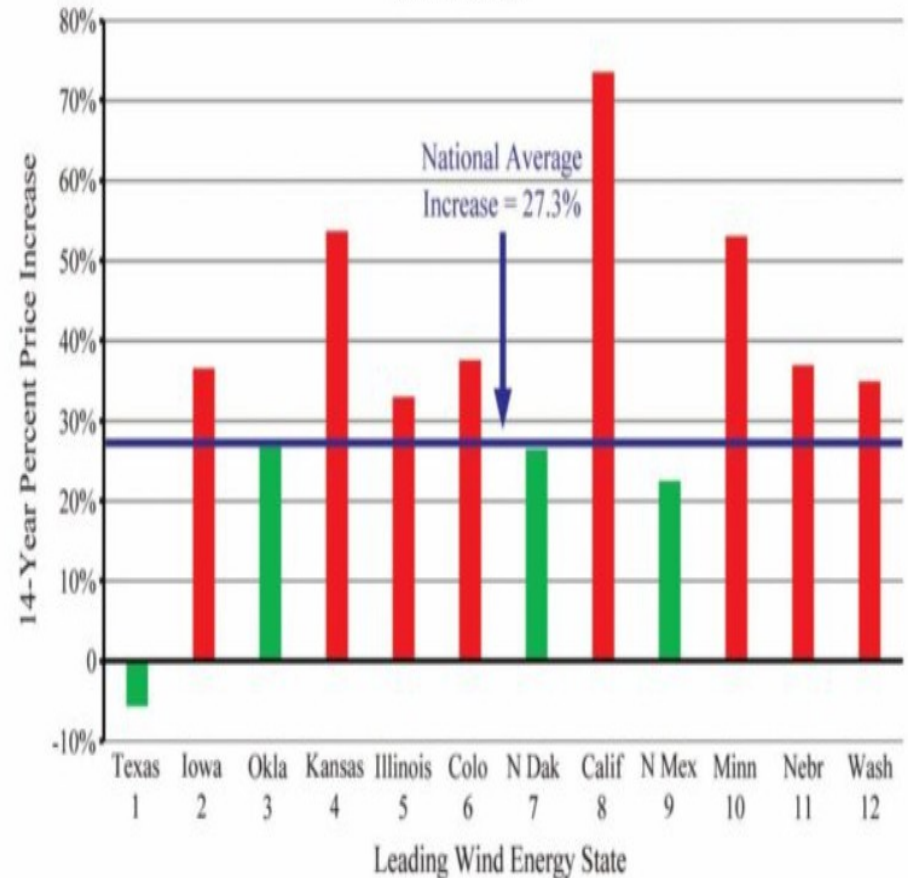
# Energy prices on the rise

Wind and Solar Capacity and Electricity Prices in Europe, 2021



Eurostat, EurObserv'ER, World Bank, EIA (2022)

Electricity Price Rise in Leading US States for Wind Usage  
2008-2022



US Energy Information Administration (2009, 2023)

# Compliance Market Carbon Price Forecast

