

~~Global Warming~~
~~Global Climate Change~~
Climate Disruption
- A Skeptic's View

“Fewer scientific problems are so often discussed, yet so rarely decided by proofs, as whether climatic relations have changed over time.”

Joachim von Schouw, 1826.

“Skeptical scrutiny is the means, in both science and religion, by which deep insights can be winnowed from deep nonsense.”

Carl Sagan

Stipulations

- Scientists have unanimous agreement about a few things:
 - Temperatures may be rising
 - the planet's climate is a complex and dynamic system with countless variables
 - ie. climate changes.
 - CO₂ levels are increasing.
 - The “greenhouse effect” is real.

The Skeptic's Position

- CO₂ concentrations are increasing due to the burning of fossil fuels
- Temperatures may be rising
 - But we really don't know for certain
 - We really don't know why
 - Increased CO₂ should cause an increase in temp.
- Our knowledge of Climate is poor
 - Predictability is poor
 - Huge differences between models and reality
- Claims of disaster are unwarranted
- Proposed solutions are ill-advised

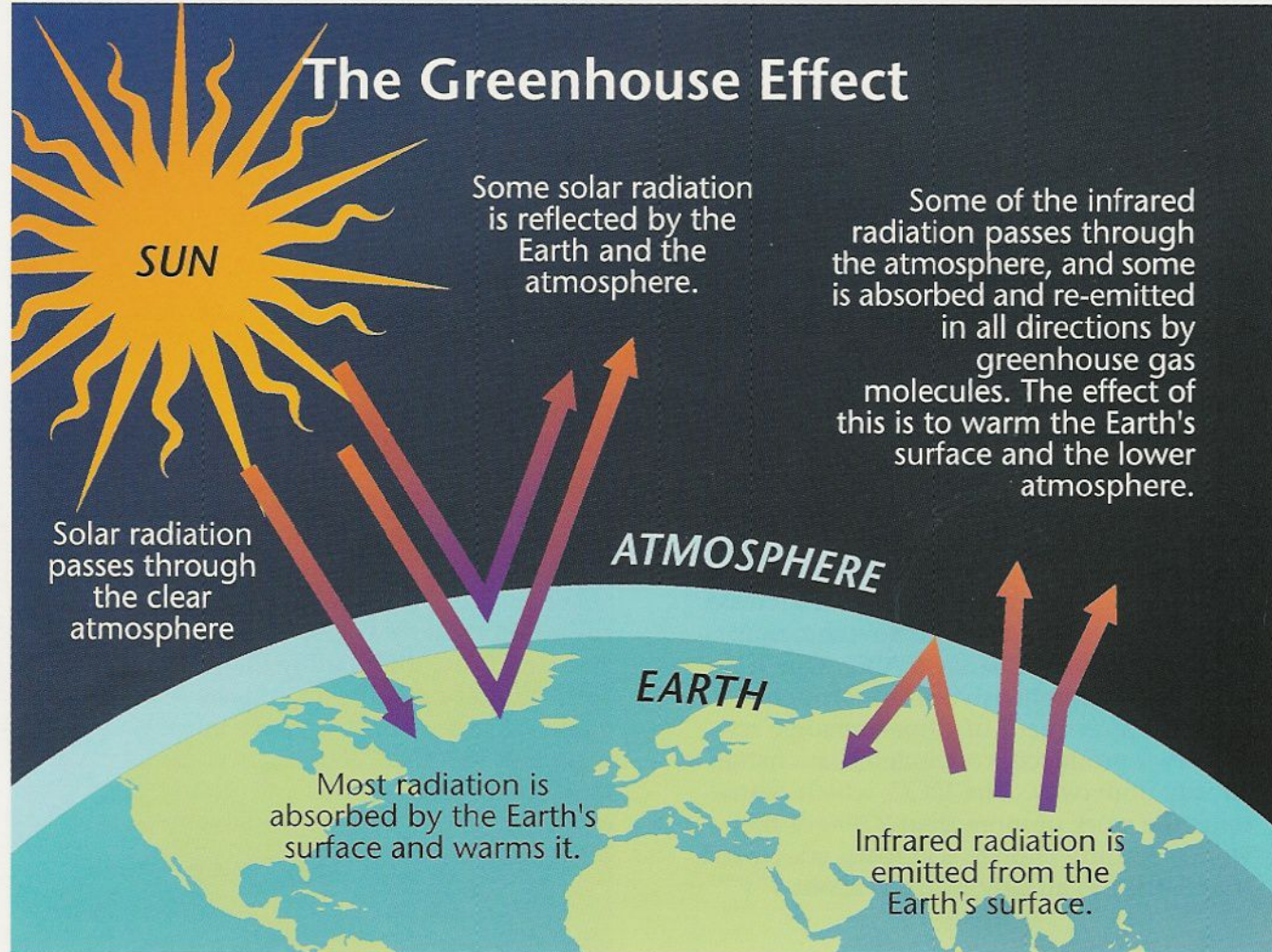


Figure 1. The greenhouse effect naturally warms the Earth's surface. Without it, Earth would be 60° F cooler than it is today – uninhabitable for life as we know it.

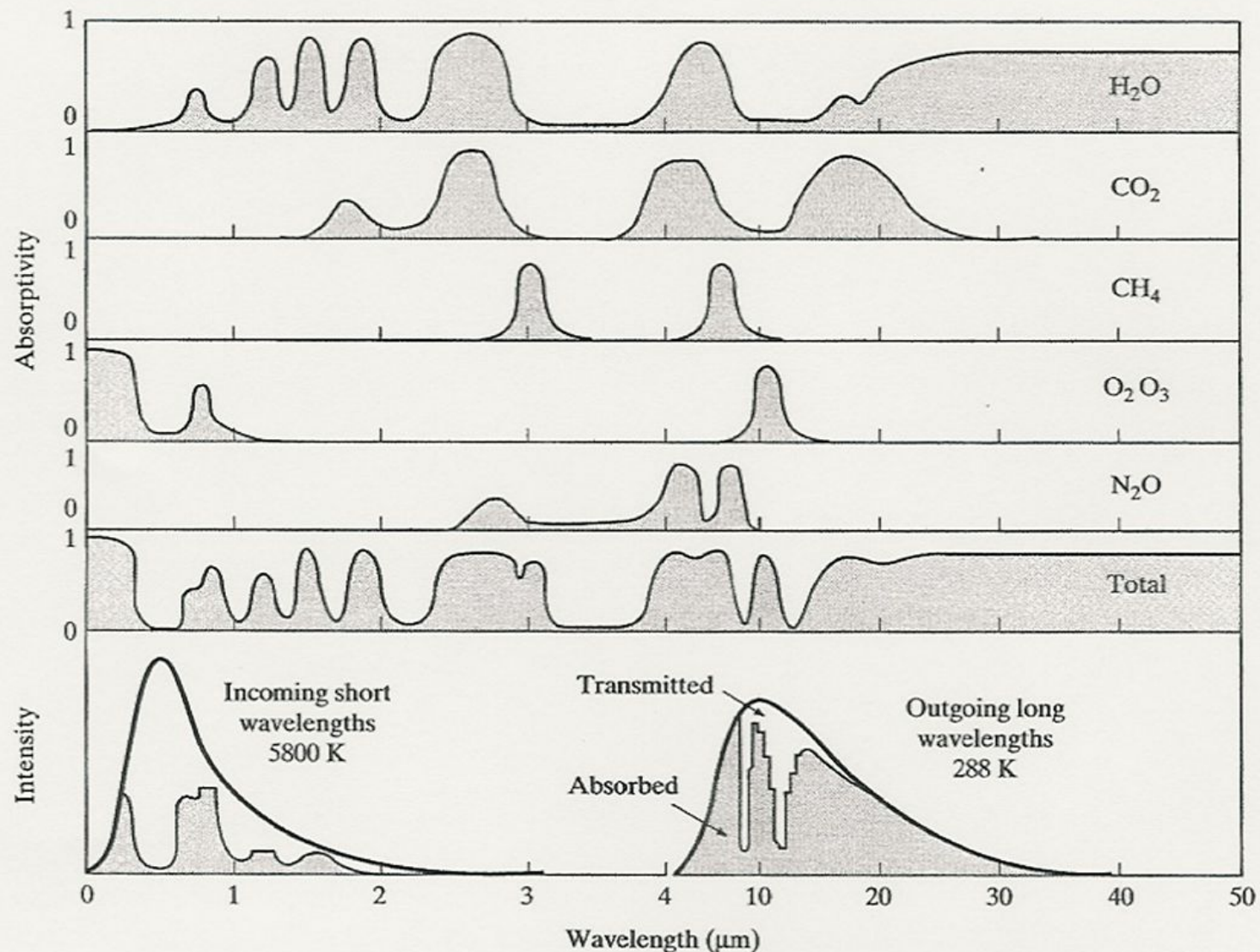


FIGURE 8.11 Absorptivity as a function of wavelength for water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), oxygen and ozone (O_2 , O_3), and nitrous oxide (N_2O), and the total absorptivity of the atmosphere. Shown here are the spectra for incoming solar energy and outgoing thermal energy from the 288 K surface of the earth. Note the wavelength scale change at 4 μm .

Increase in CO₂ Concentrations

Carbon Dioxide Concentrations

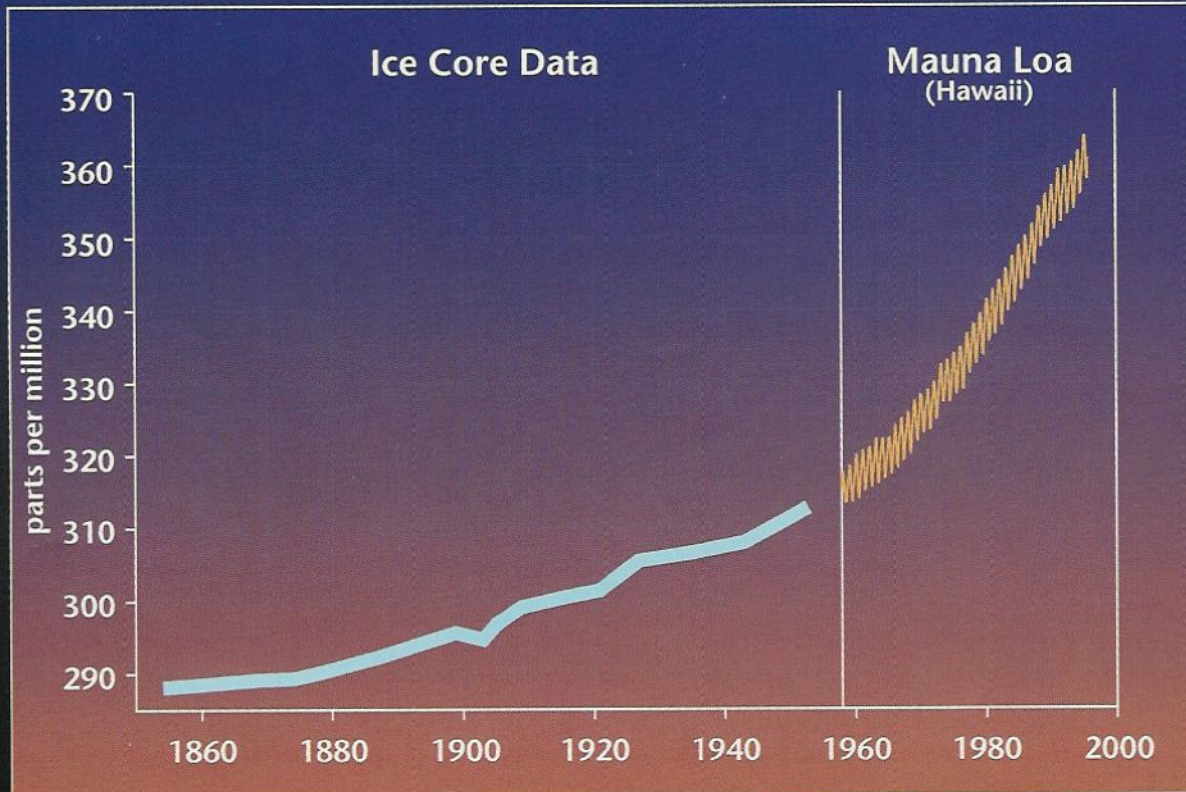
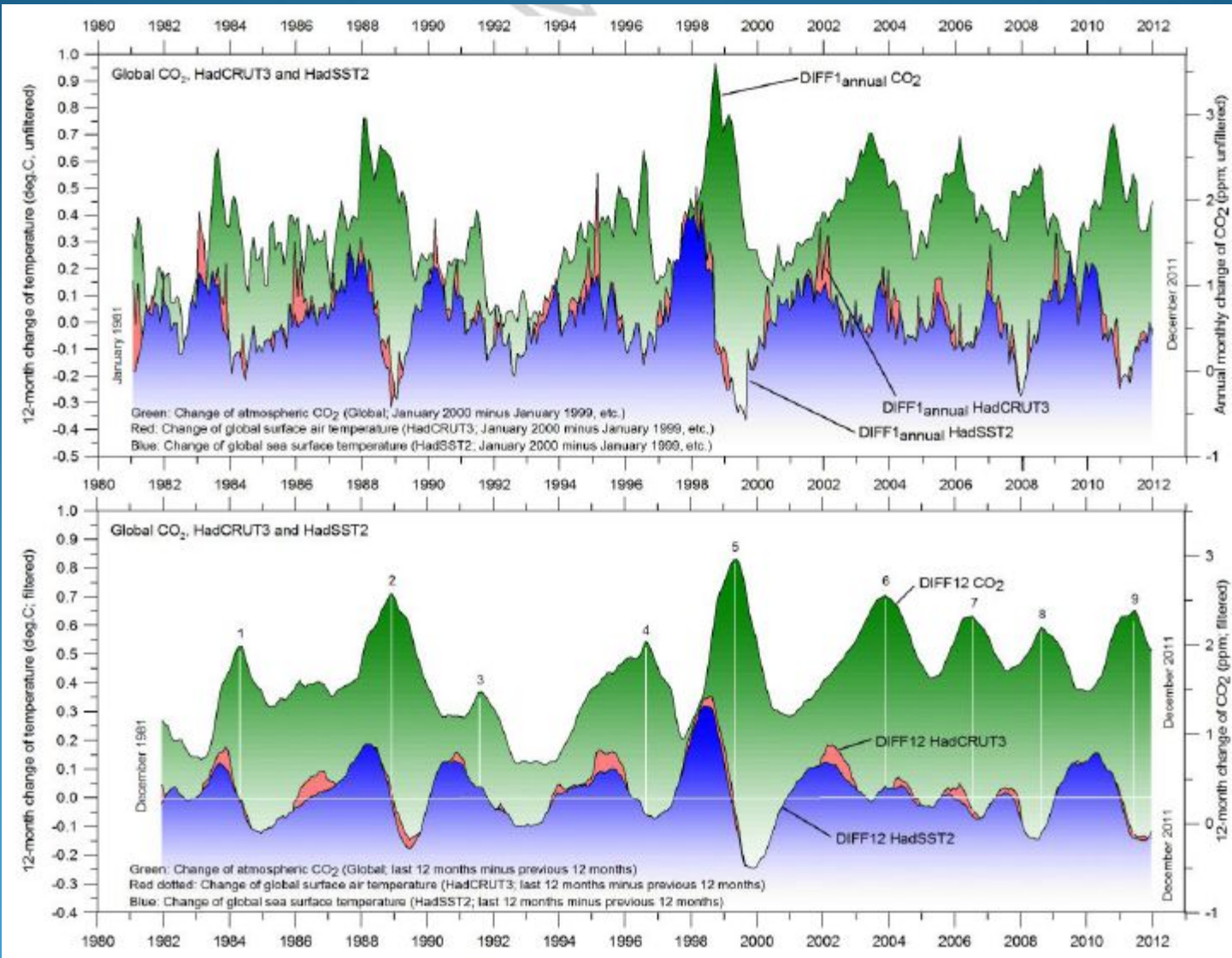
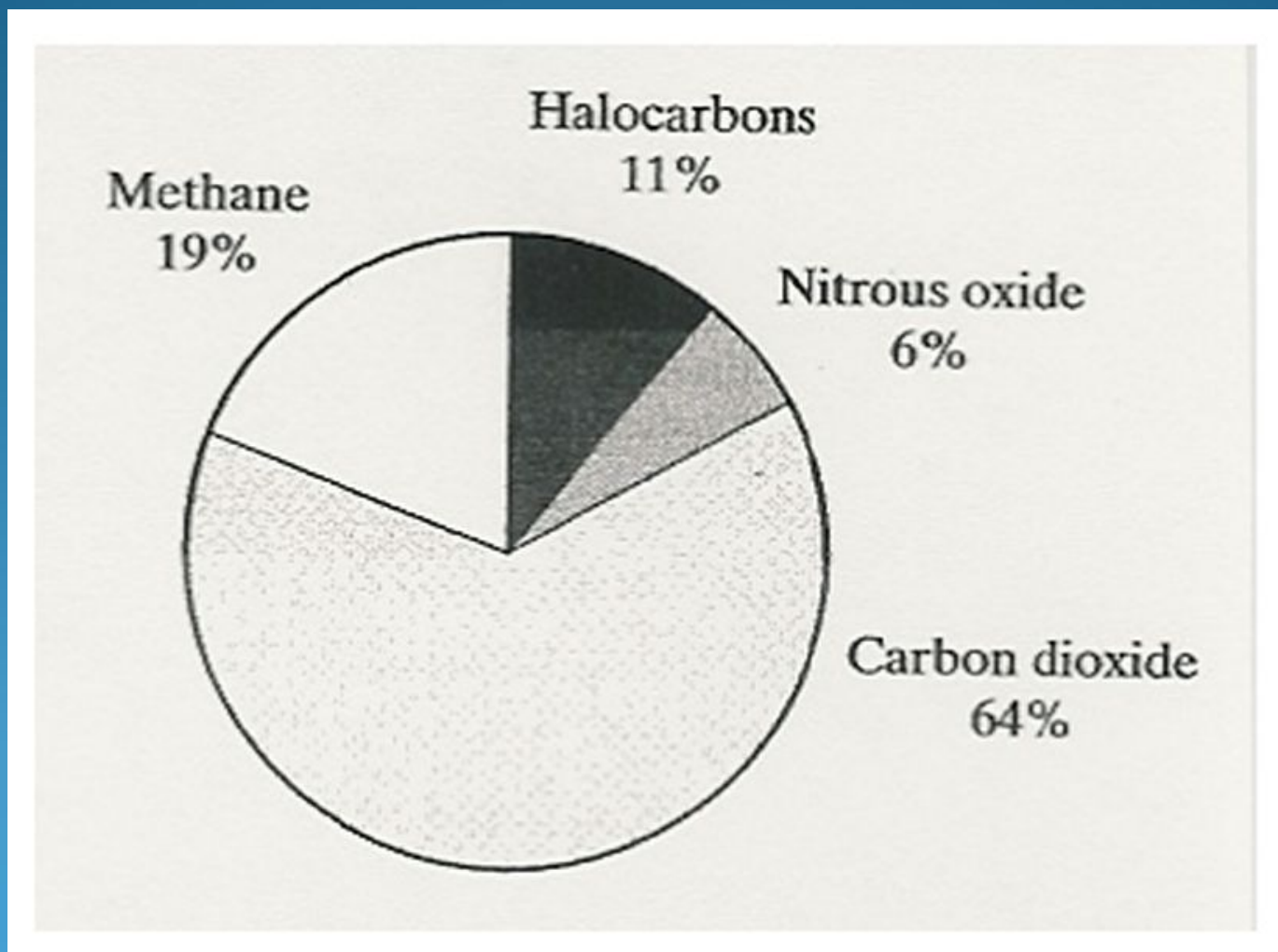


Figure 4. Since the beginning of the Industrial Revolution in the middle of the 19th century, the concentration of carbon dioxide (CO₂) in the atmosphere has steadily increased. Beginning in 1957, continual measurements of atmospheric CO₂ concentrations have been made by scientists at an observatory in Mauna Loa, Hawaii. The seasonal cycle of vegetation in Northern latitudes can be seen in this record: each spring the vegetation "inhales" and absorbs CO₂, and each autumn most of that CO₂ is released back to the atmosphere.

Phase Relationship Between CO₂ and Temperature



Relative Contributions to Global Warming



GREENHOUSE WARMING POTENTIAL of some greenhouse gases, 100 year horizon

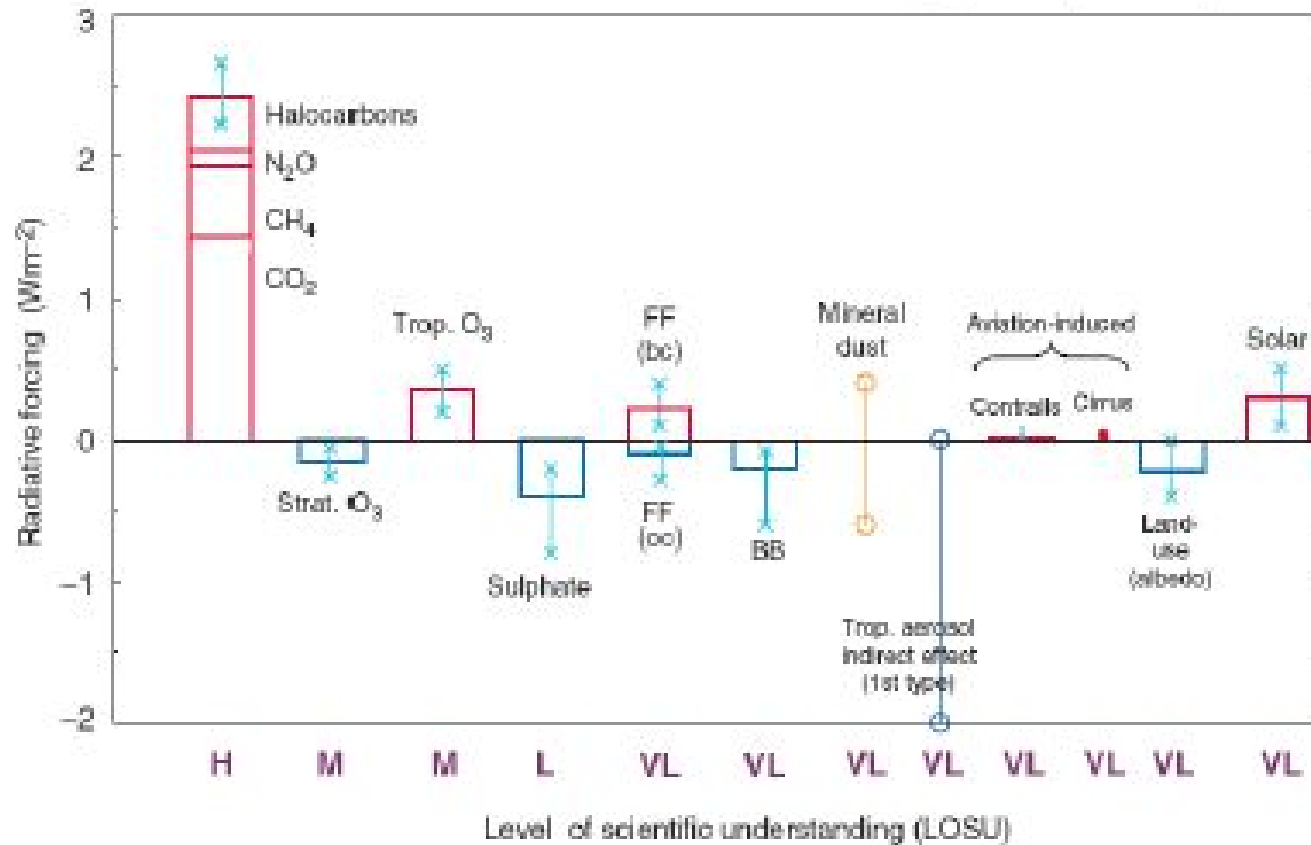
Source: IPCC

carbon dioxide	1
methane	21
nitrous oxide	310
CFC12	8 100
HCFC22	1 500
HFC134a	420
sulphur hexafluoride	34 900

Note that downwelling longwave radiation (due almost entirely to water vapor) is $\sim 150\text{-}250 \text{ W/m}^2$ (i.e. it is $> 100\text{x}$ the total effect of CO_2)

Gas	Abundance (Year 1750)	Abundance (Year 1998)	Radiative forcing (Wm^{-2})
Gases relevant to radiative forcing only			
CO_2	278	365	1.46
CH_4	700	1745	0.48
N_2O	270	314	0.15
CF_4	40	80	0.003
C_2F_6	0	3	0.001
SF_6	0	4.2	0.002
HFC-23	0	14	0.002
HFC-134a	0	7.5	0.001
HFC-152a	0	0.5	0.000
Gases relevant to radiative forcing and ozone depletion			
CFC-11	0	268	0.07
CFC-12	0	533	0.17
CFC-13	0	4	0.001
CFC-113	0	84	0.03
CFC-114	0	15	0.005
CFC-115	0	7	0.001
CCl_4	0	102	0.01
CH_3CCl_3	0	69	0.004
HCFC-22	0	132	0.03
HCFC-141b	0	10	0.001
HCFC-142b	0	11	0.002
Halon-1211	0	3.8	0.001
Halon-1301	0	2.5	0.001

Global and annual mean radiative forcing (1750 to present)



- Where is water vapor? Clouds?

Rates of Forcing

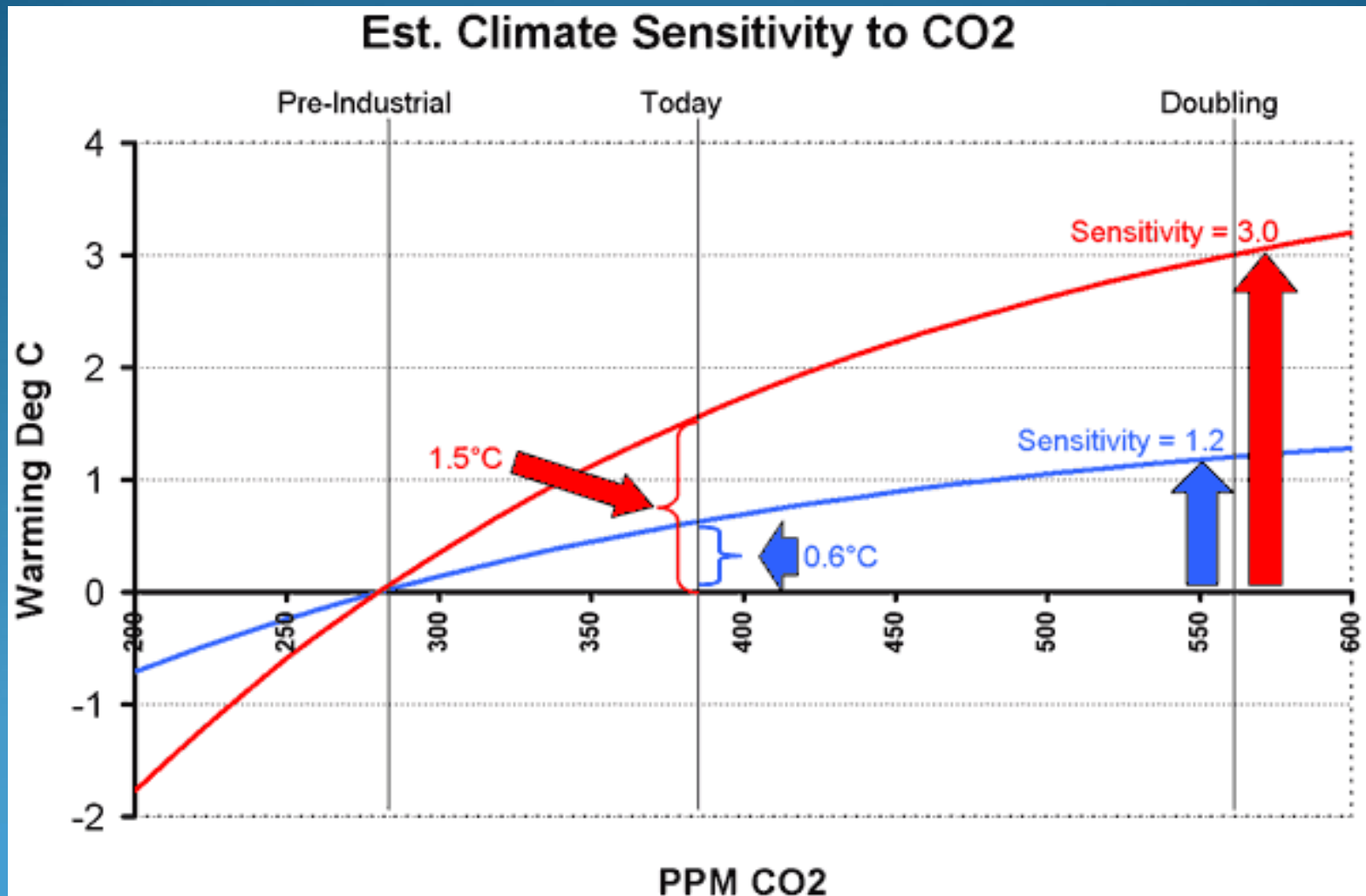
$$E = \varepsilon \sigma T^4$$

E is radiant energy in watts per square metre per second ($\text{wm}^{-2} \cdot \text{s}^{-1}$; hereafter “ wm^{-2} ”);
 ε is emissivity, $1 \geq \varepsilon \geq 0$, equivalent by Kirchhoff's Law to absorptivity;
 σ is the Stefan-Boltzmann constant, $5.67 \times 10^{-8} = ac/4$ | a the radiation constant, c light-speed;
 T is absolute temperature in degrees Kelvin ($^{\circ}\text{C} + 273.15$).

1900-1998	λ	δT	Excess δT	
Base ($\varepsilon = 1.0000$)	0.223			
Actual ($\varepsilon = 0.6135$)	0.303	0.60C	0.00C	1.00
UN 1996 (implicit) and 2001:	0.500	0.99C	0.39C	1.65
Implicit in Houghton, 2002:	0.545	1.08C	0.48C	1.80
Forcings x2 (UN, 2001):	0.606	1.20C	0.60C	2.00
Hansen, 2006 ₁ :	0.670	1.33C	0.73C	2.21
Hansen, 2006 ₂ :	0.750	1.49C	0.89C	2.48
Implicit in Houghton, 2006:	0.809	1.60C	1.00C	2.67
Hansen, 2006 ₃ , and GCMs:	1.000	1.98C	1.38C	3.30
Implicit in Stern, 2006:	1.890	3.75C	3.15C	6.25

The base and actual values of $\lambda = \delta T / \delta E$ are compared with various estimates of λ from the UN, from the chairman emeritus of its scientific assessment working group (Houghton, 2002, 2006), from the scientist who first brought climate change to public notice (Hansen, 2006), and from the Stern report (Stern, 2006). Observed temperature over the past century rose in line with the calculated actual value of λ , but should have risen much further if the various higher values for λ had been appropriate.

Rates of Forcing



Climate Change Controversy

Increased CO₂ will lead to higher temperatures

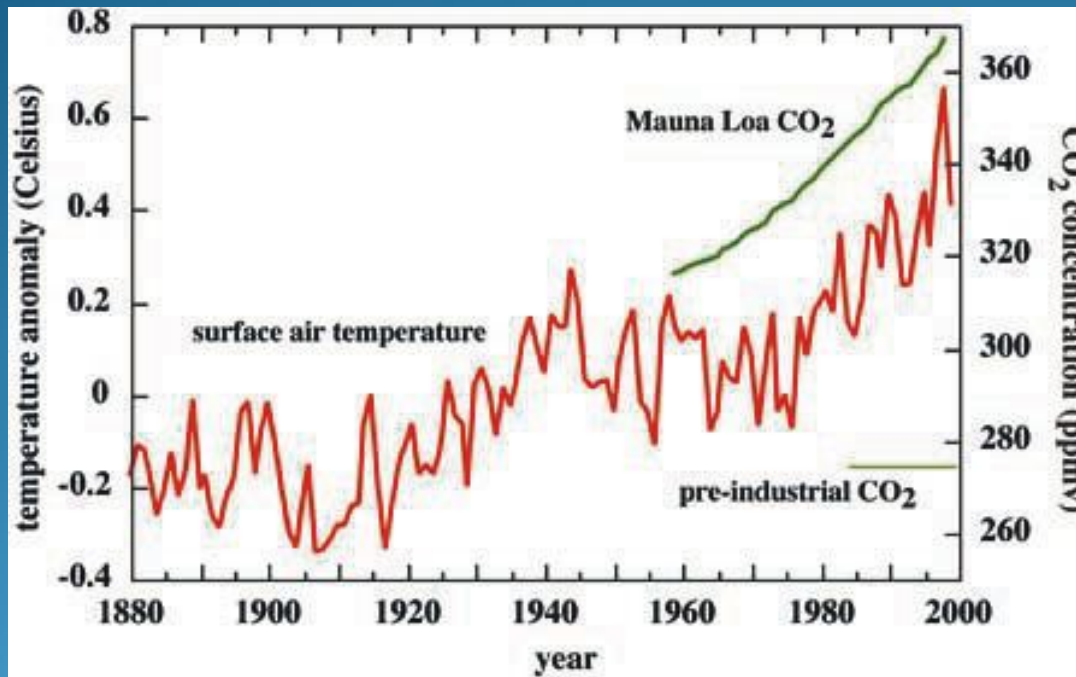
- Undisputed fact
- What is disputed is: By how much?
- Truth is: We haven't a clue

The

Temperature

Record

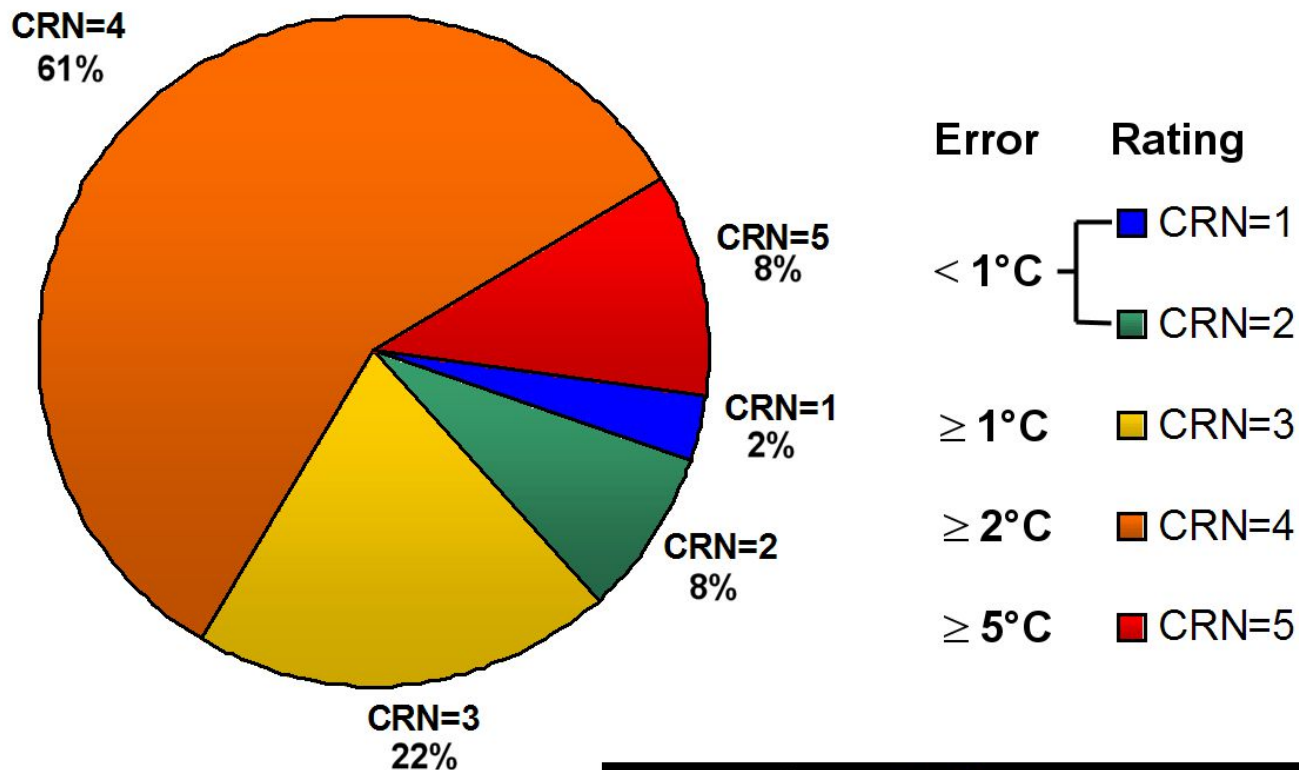
Global Average Temperature



This plot is commonly used to prove global warming is real. It clearly shows about a 1 degree rise per century. It also associates the temp. with CO2 concentrations.

Uncertainty in the Temperature Measurements

USHCN - Station Site Quality by Rating



948 of 1221 stations rated as of 5/31/09
78% of the total

Comparison

All Rated Stations in the CONUS

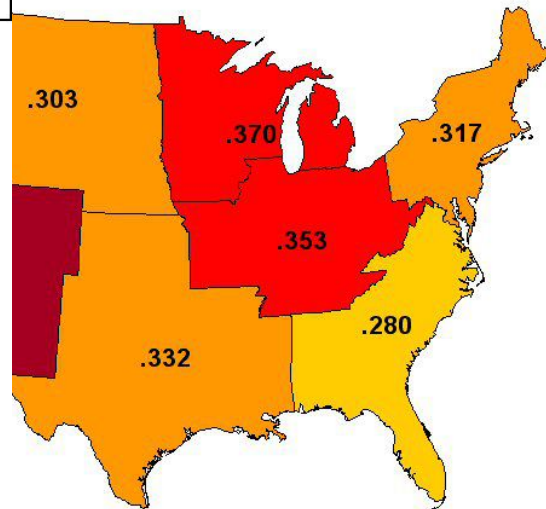
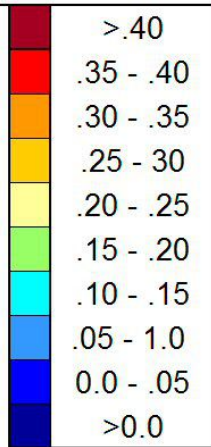
What the compliant thermometers (Class 1&2) say: **$+0.155^{\circ}$ C/decade**

What the non-compliant thermometers (Class 3,4,5) say: **$+0.248^{\circ}$ C/decade**

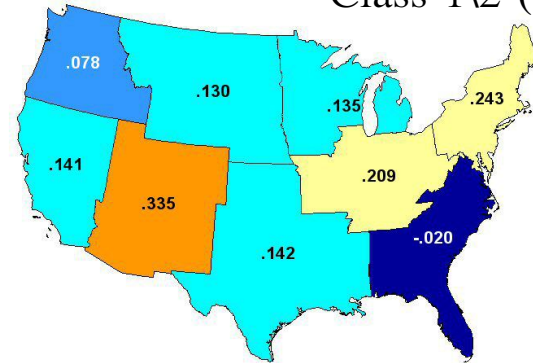
What the NOAA final adjusted data says: **$+0.309^{\circ}$ C/decade**

All stations, Class 1-5 (Final data after NOAA Adjustments)

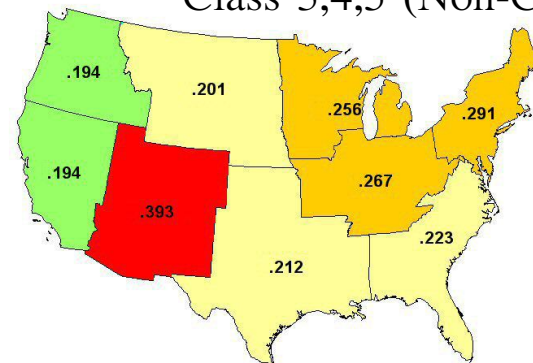
Average Trend
1979 - 2008
 $^{\circ}$ C/decade



Class 1\2 (Compliant)



Class 3,4,5 (Non-Compliant)



Comparison

Airports vs. Non-Airports

Compliant Stations, Non-Airports: **.124**

Compliant Stations, Airports: **.251**

Class 1\2 (Compliant)
AIRPORTS REMOVED



Class 1\2 (Compliant)
AIRPORTS ONLY



Comparison

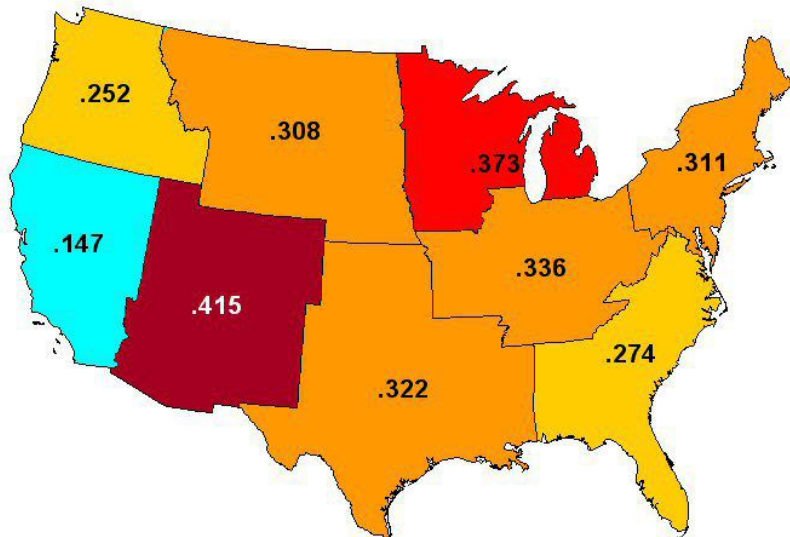
Rural Only

What the compliant thermometers actually say: **+0.123**

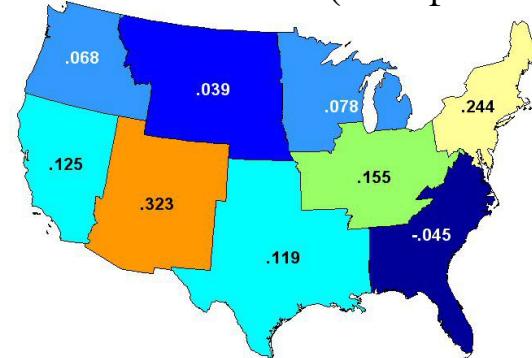
What the non-compliant thermometers say: **+0.228**

What NOAA says: **+0.304**

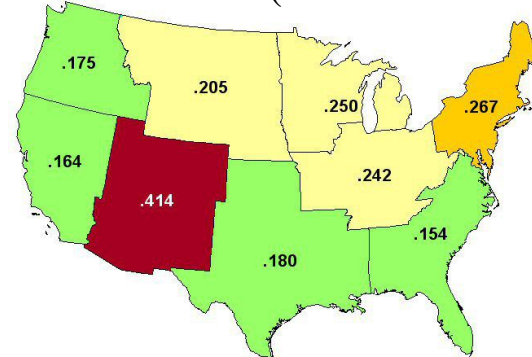
Class 1-5 (After NOAA Adjustments)



Class 1\2 (Compliant)



Class 3\4\5 (All Non-Compliant)



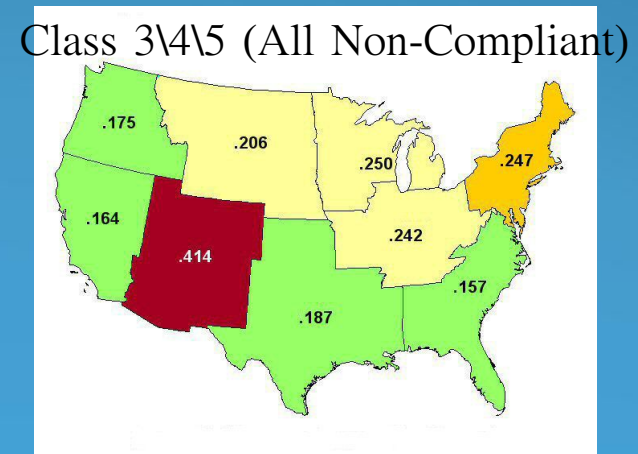
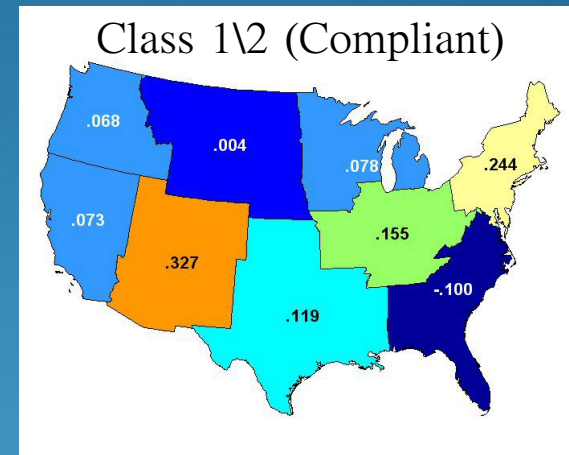
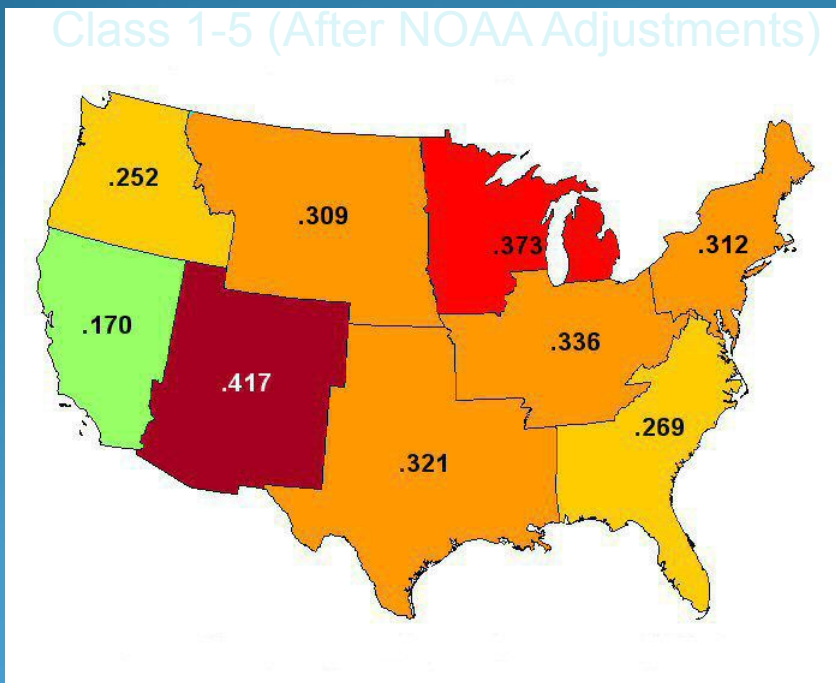
Comparison

Rural, no Airports

What the compliant thermometers actually say: **+0.108**

What the non-compliant thermometers say: **+0.228**

What NOAA says: **+0.307**



Comparison

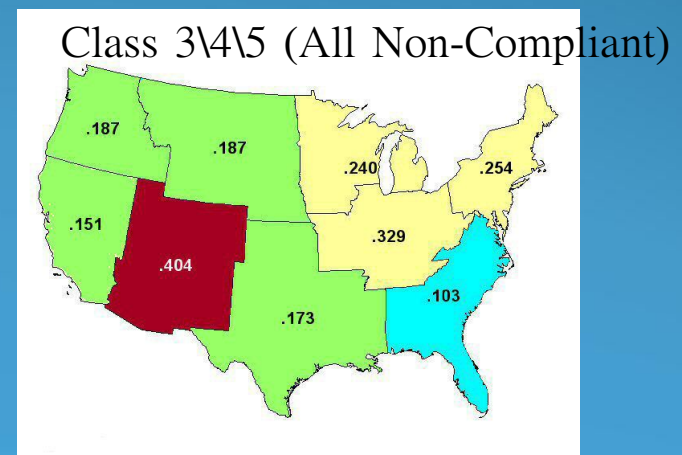
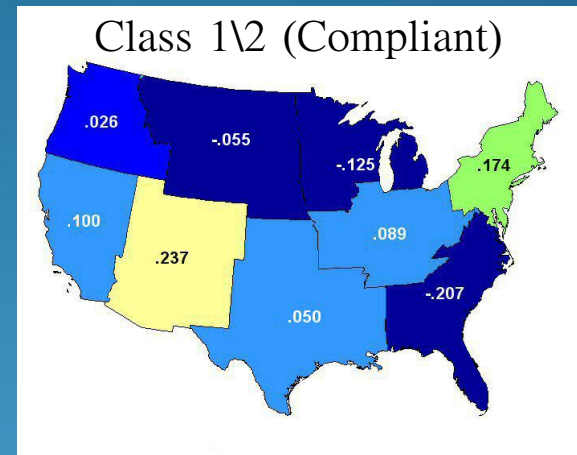
Rural MMTS, no Airports

What the compliant thermometers actually say: **+0.032**

What the non-compliant thermometers say: **+0.183**

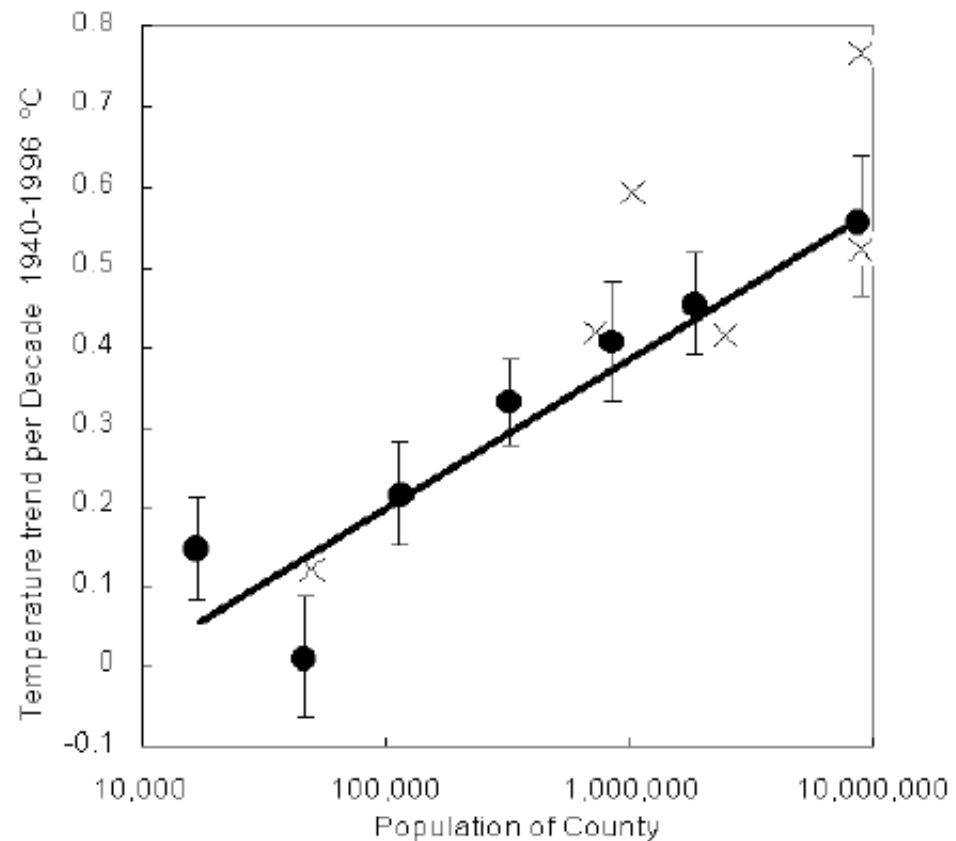
What NOAA says: **+0.300**

Class 1-5 (After NOAA Adjustments)



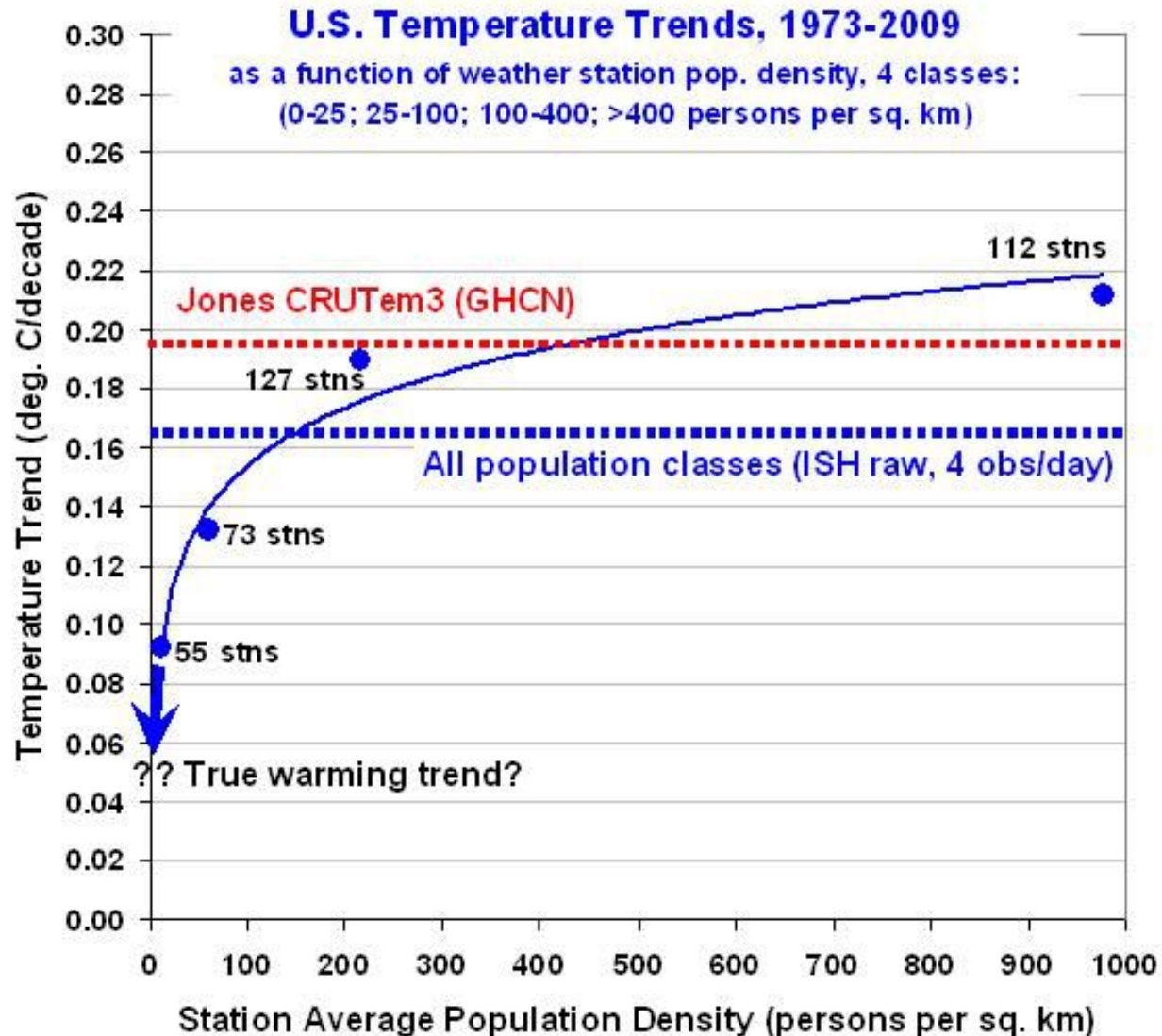
Problems
with the
Data Sets

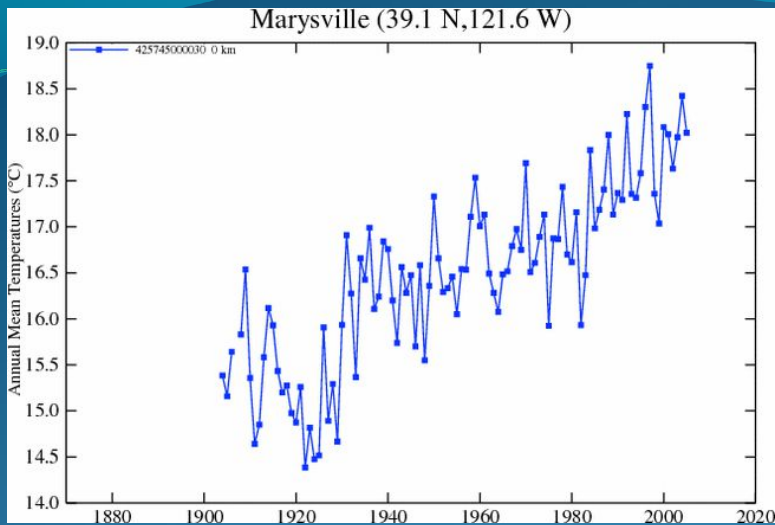
The Effect of Where We Measure



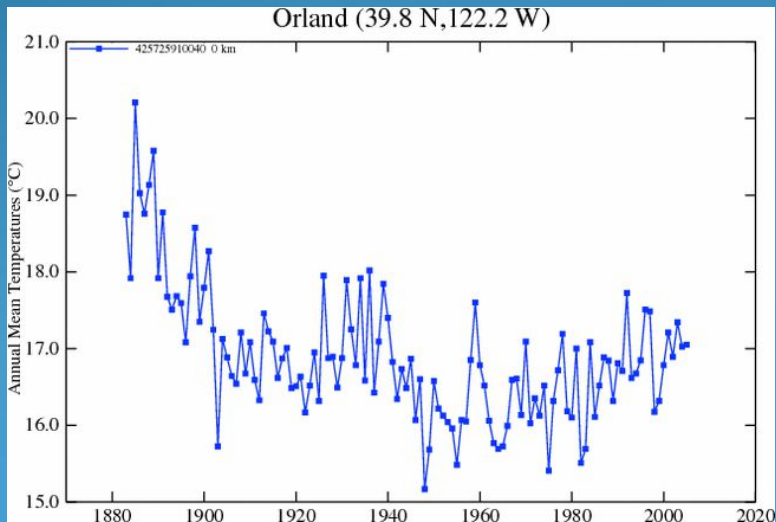
Surface temperature trends for the period of 1940 to 1996 from 107 measuring stations in 49 California counties (39, 40). After averaging the means of the trends in each county, counties of similar population were binned and plotted as closed circles along with the standard errors of their means

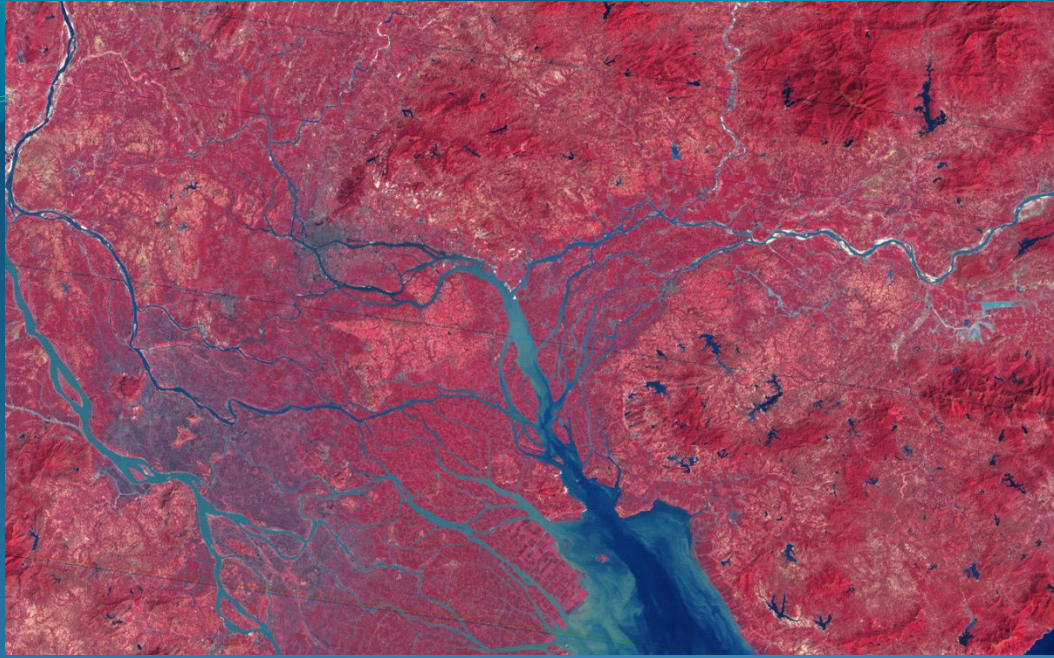
The Effect of Where We Measure





Urban Heat Island Effect
 These two stations are 67 miles apart.





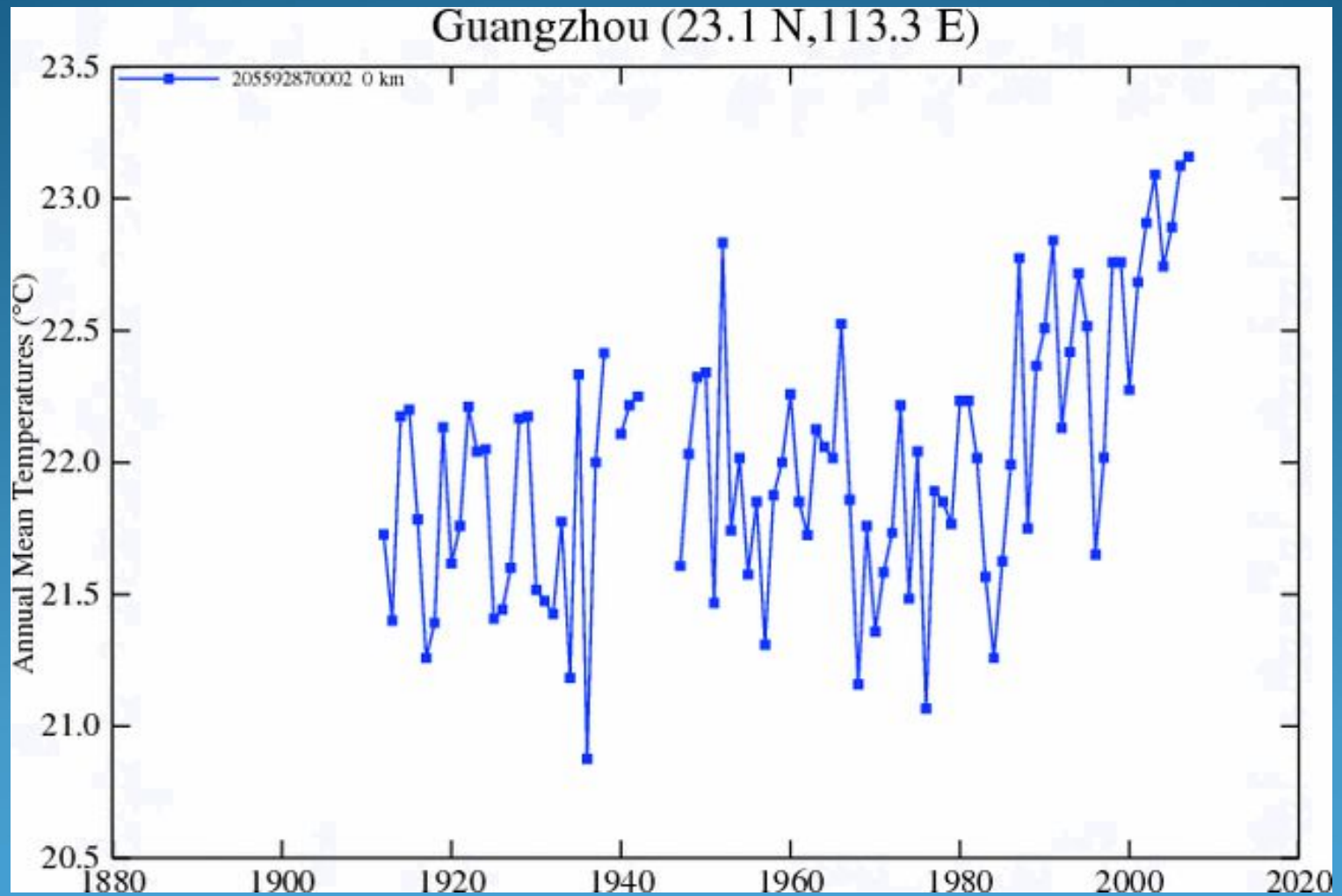
Pearl River Delta

Oct 19, 1979



Jan 10, 2003

Pearl River Temperature



The Effect of Where We Measure

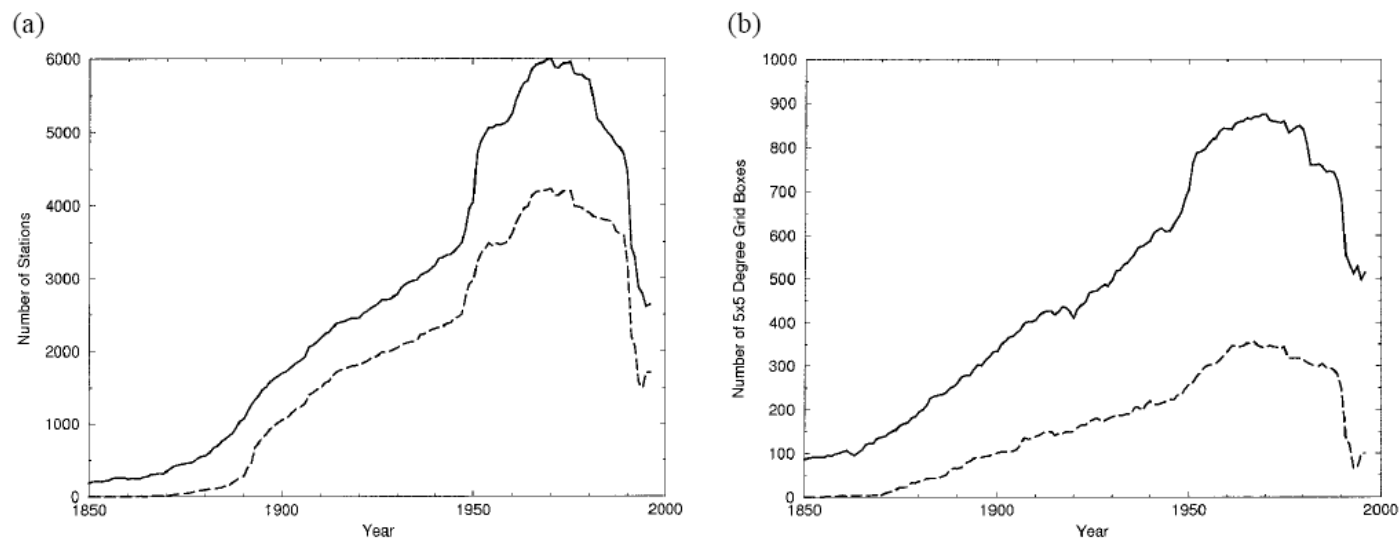


FIG. 2. Time series of the number of stations (a) and the number of $5^\circ \times 5^\circ$ boxes (b) for mean temperature (solid) and maximum and minimum temperature (dashed). The graphs start in 1850, but the earliest mean temperature datum is for January 1701 from Berlin, Germany, and the earliest mean maximum and minimum temperature data in GHCN are for March 1840 from Toronto, Canada. The reasons why the number of stations in GHCN drop off in recent years are because some of GHCN's source datasets are retroactive data compilations (e.g., World Weather Records) and other data sources were created or exchanged years ago. Only three data sources are available in near-real time. The rise in maximum and minimum temperature stations and grid boxes in 1995 and 1996 is due to the World Meteorological Organization's initiation of international exchange of monthly CLIMAT maximum and minimum temperature data over the Global Telecommunications System in November 1994.

Problem: Where are the new stations, and which are being discontinued

Temperature Trends

- Number of Stations

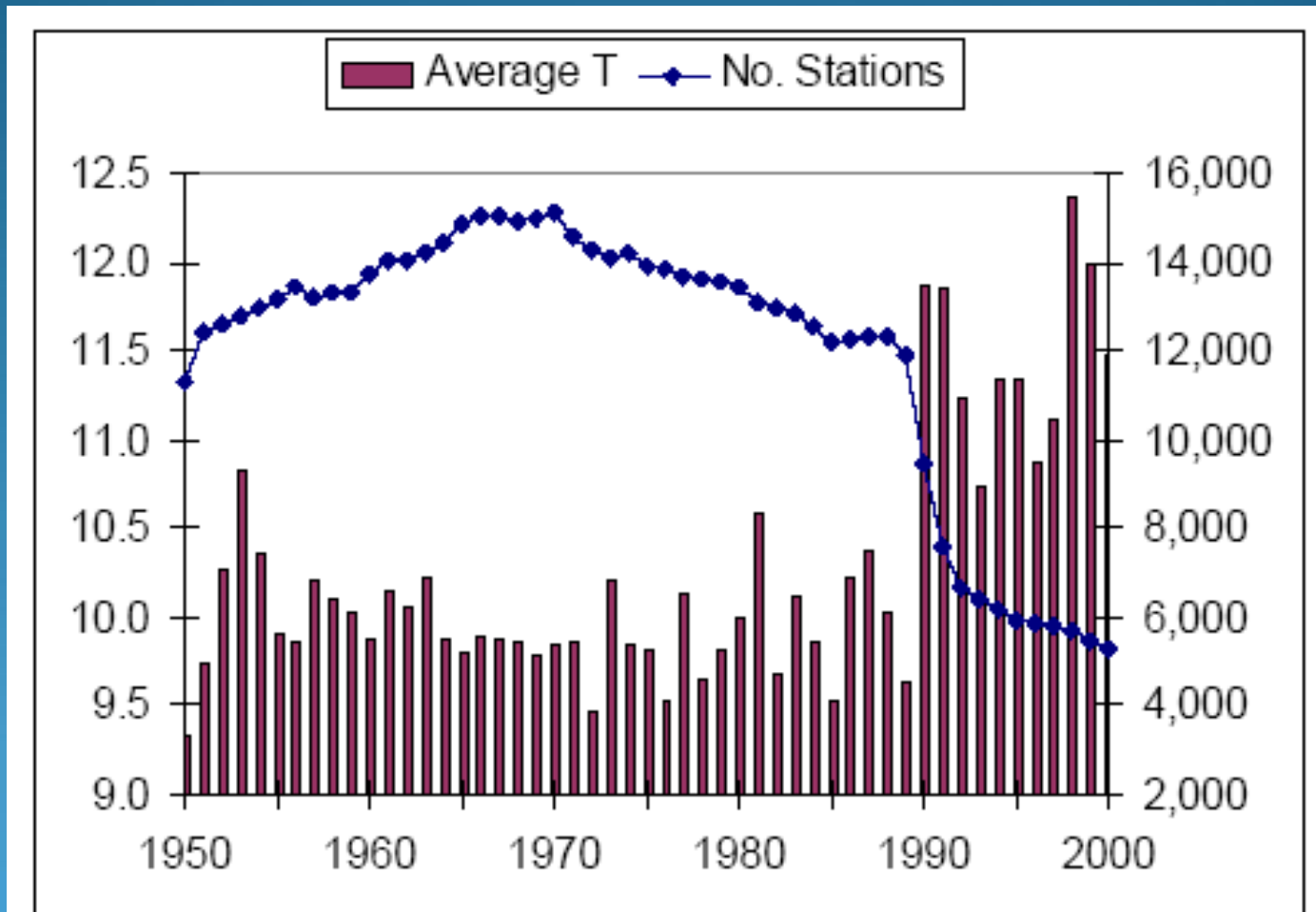
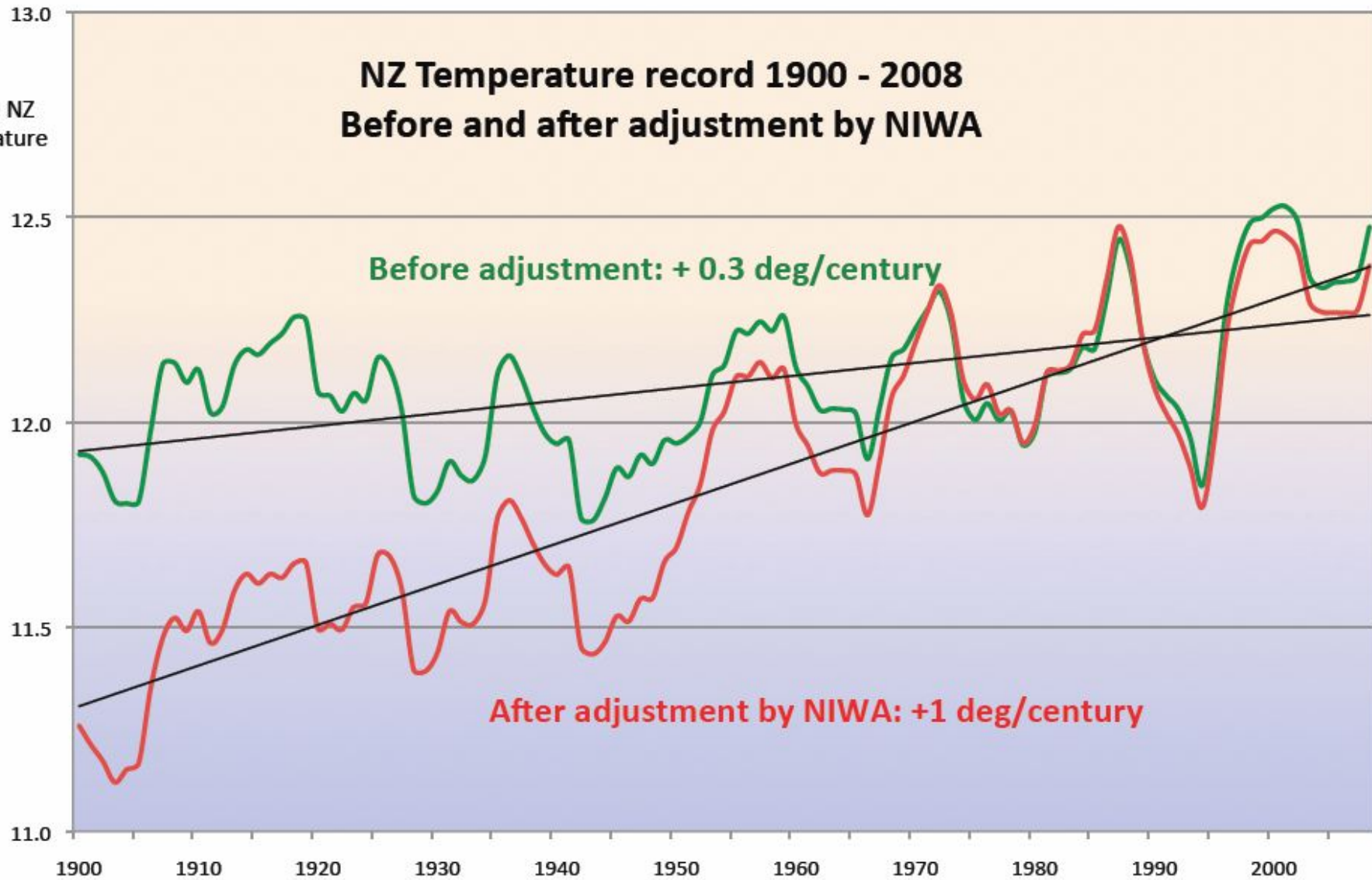


Figure 3. Number of stations in GHCN collection (diamonds, right axis).

Adjustments
to the
Data

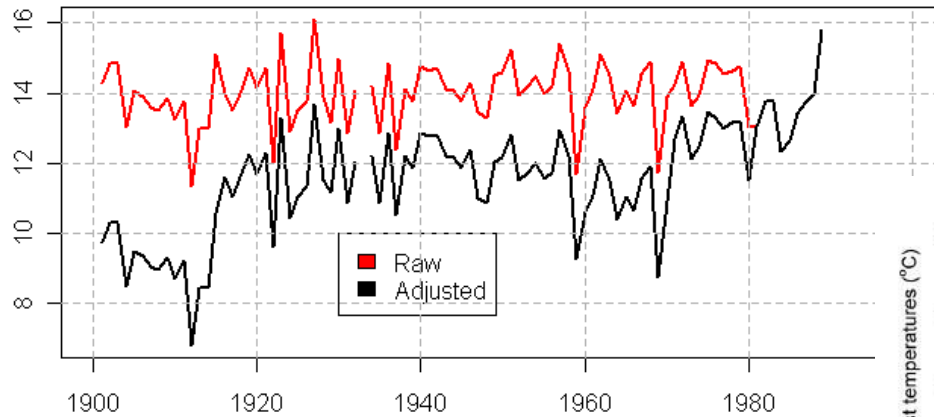
Average NZ temperature

NZ Temperature record 1900 - 2008 Before and after adjustment by NIWA

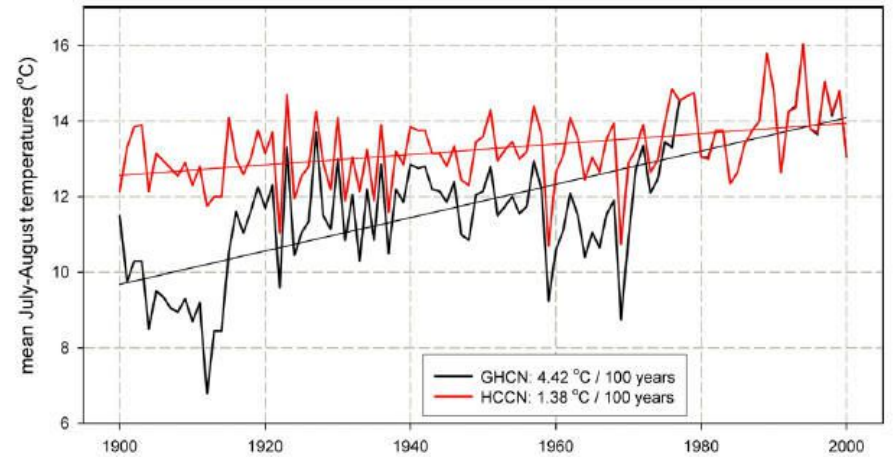
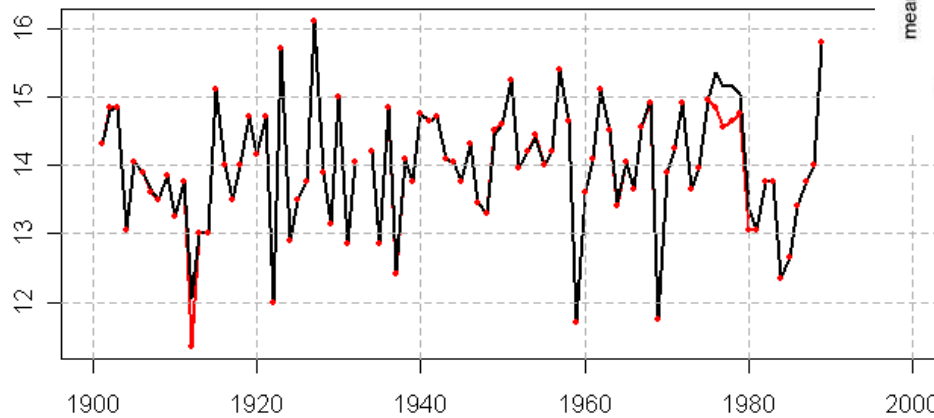


Which is the Correct Record?

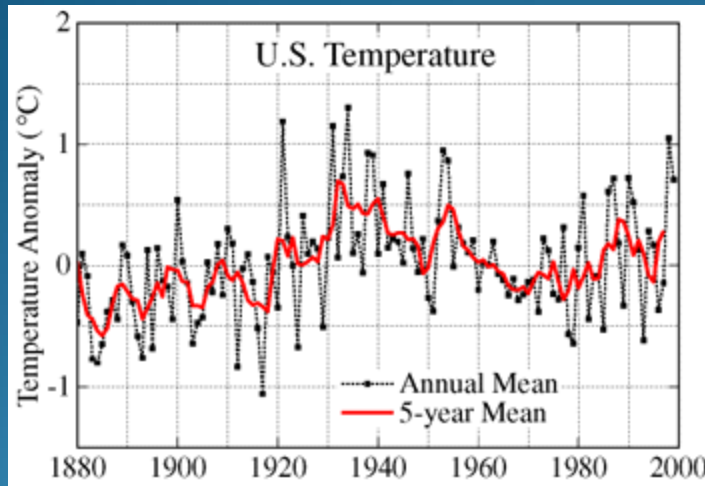
GHCN Versions- Dawson, Yukon



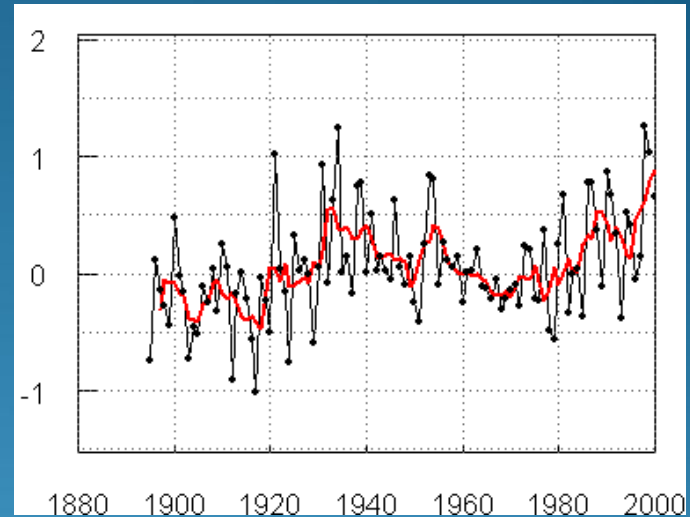
GISS Versions- Dawson, Yukon



Adjusting the Data

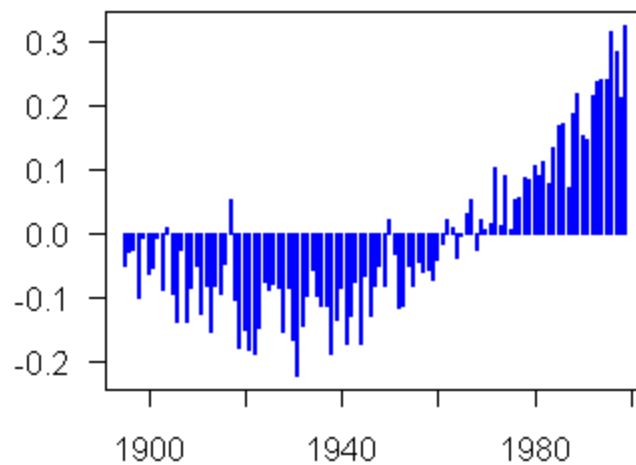


USHCN Version 2000



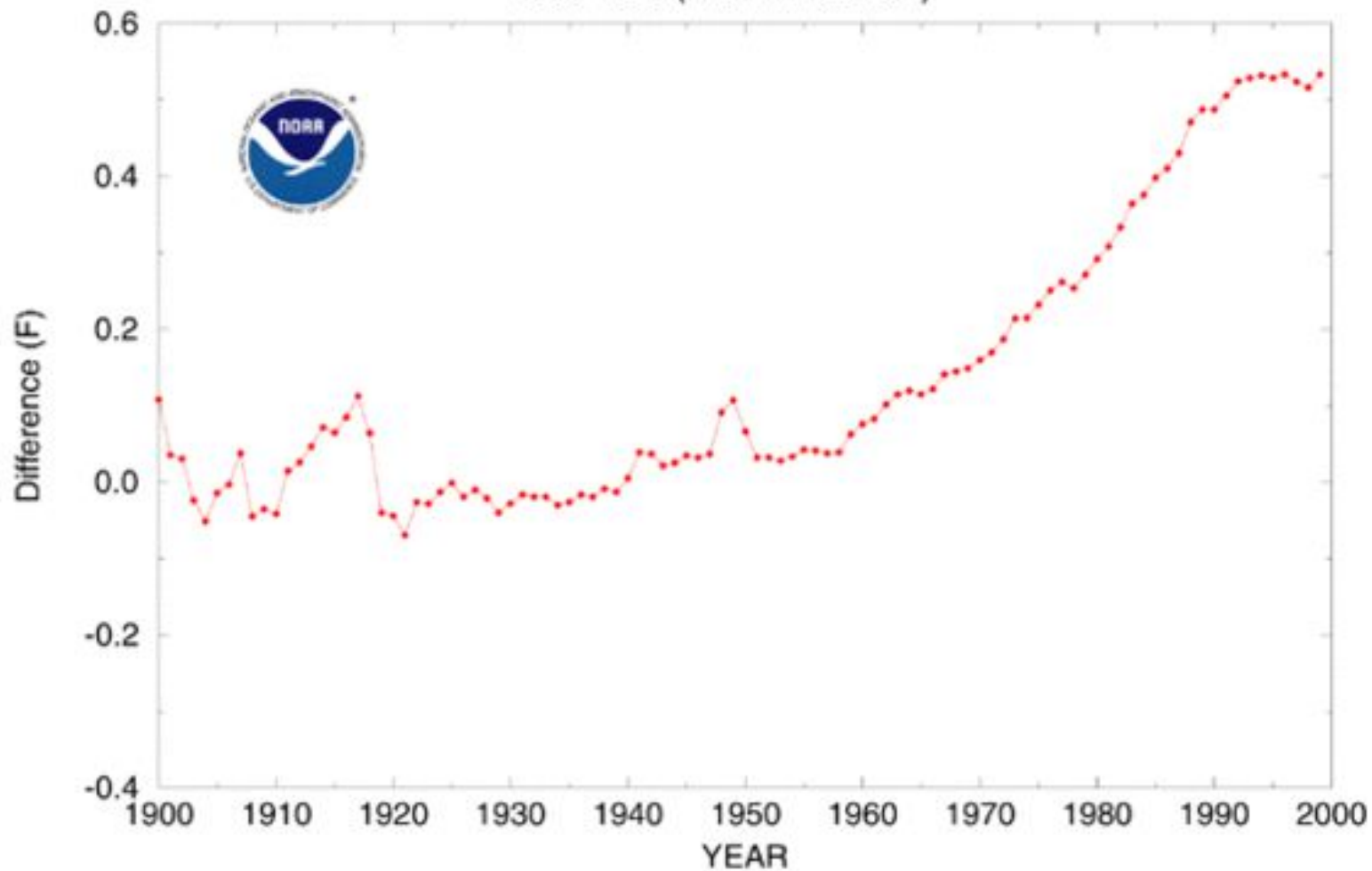
USHCN Version 2007

Difference

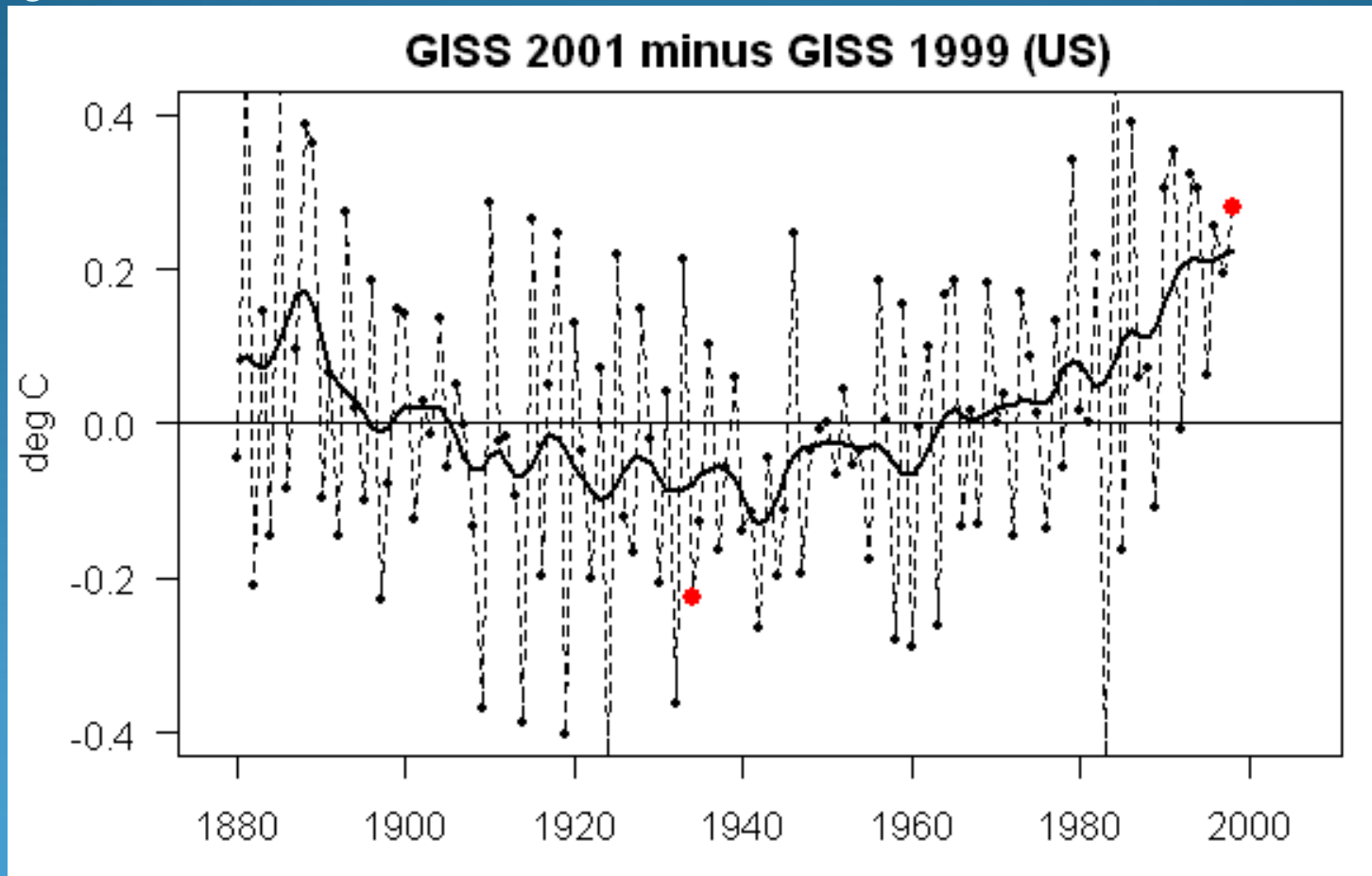


DIFFERENCE BETWEEN RAW AND FINAL USHCN DATA SETS

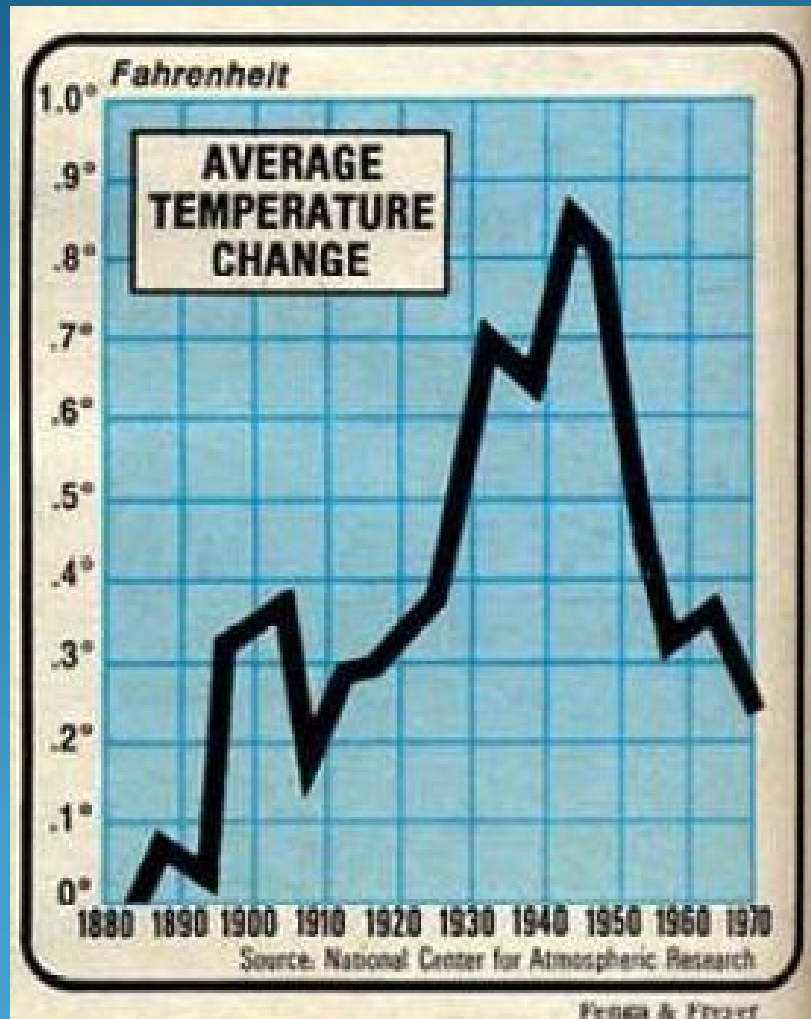
1900-1999 (Final minus Raw)



Undocumented Change in Temperature Adjustment discovered in 2001



Adjusting the Data

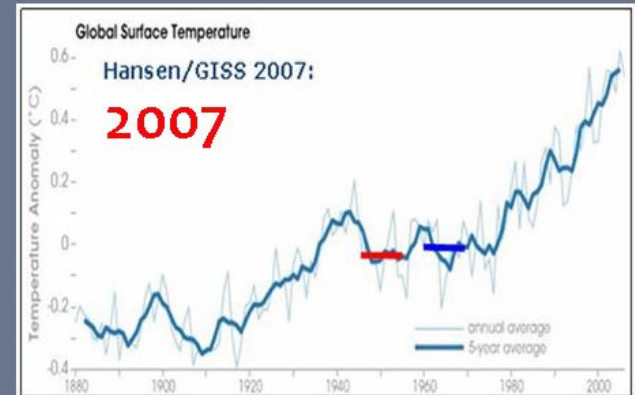
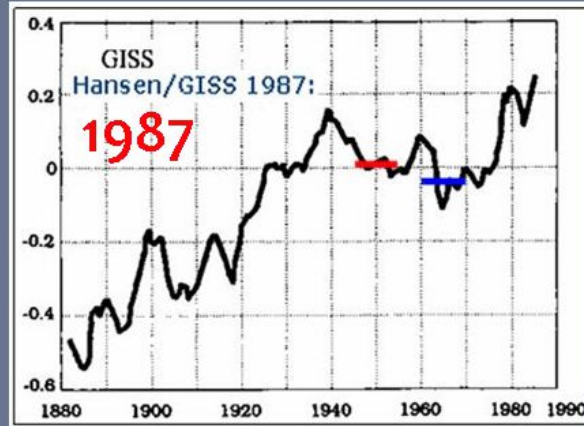
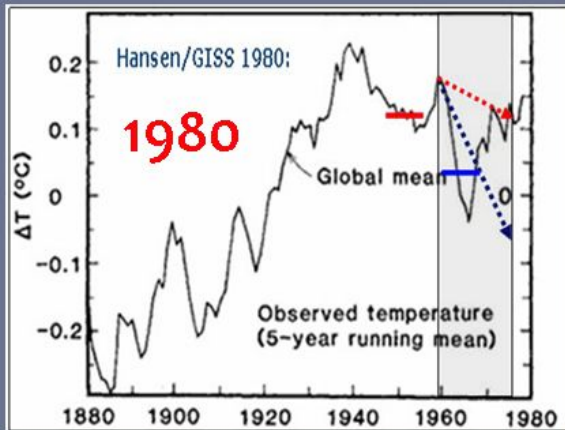


NCAR 1970 Data

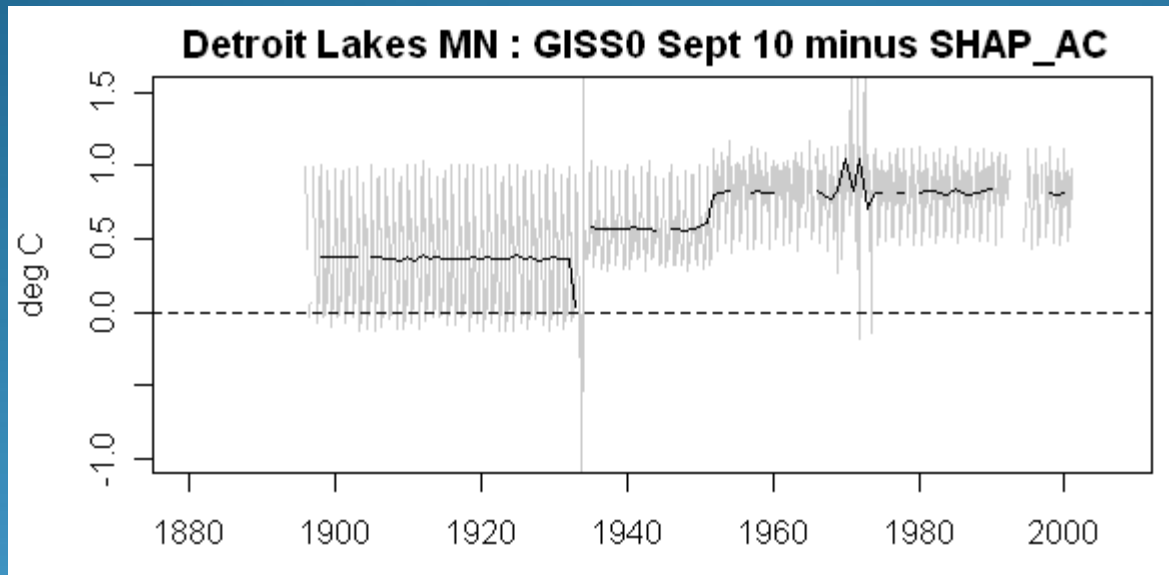
Note the Difference
Between 1945 temperature
And 1970 temperature

“Adjusting” the Data

Watch how the red and blue periods progressively “realign” as GISS reinterprets the temperature from decades long gone

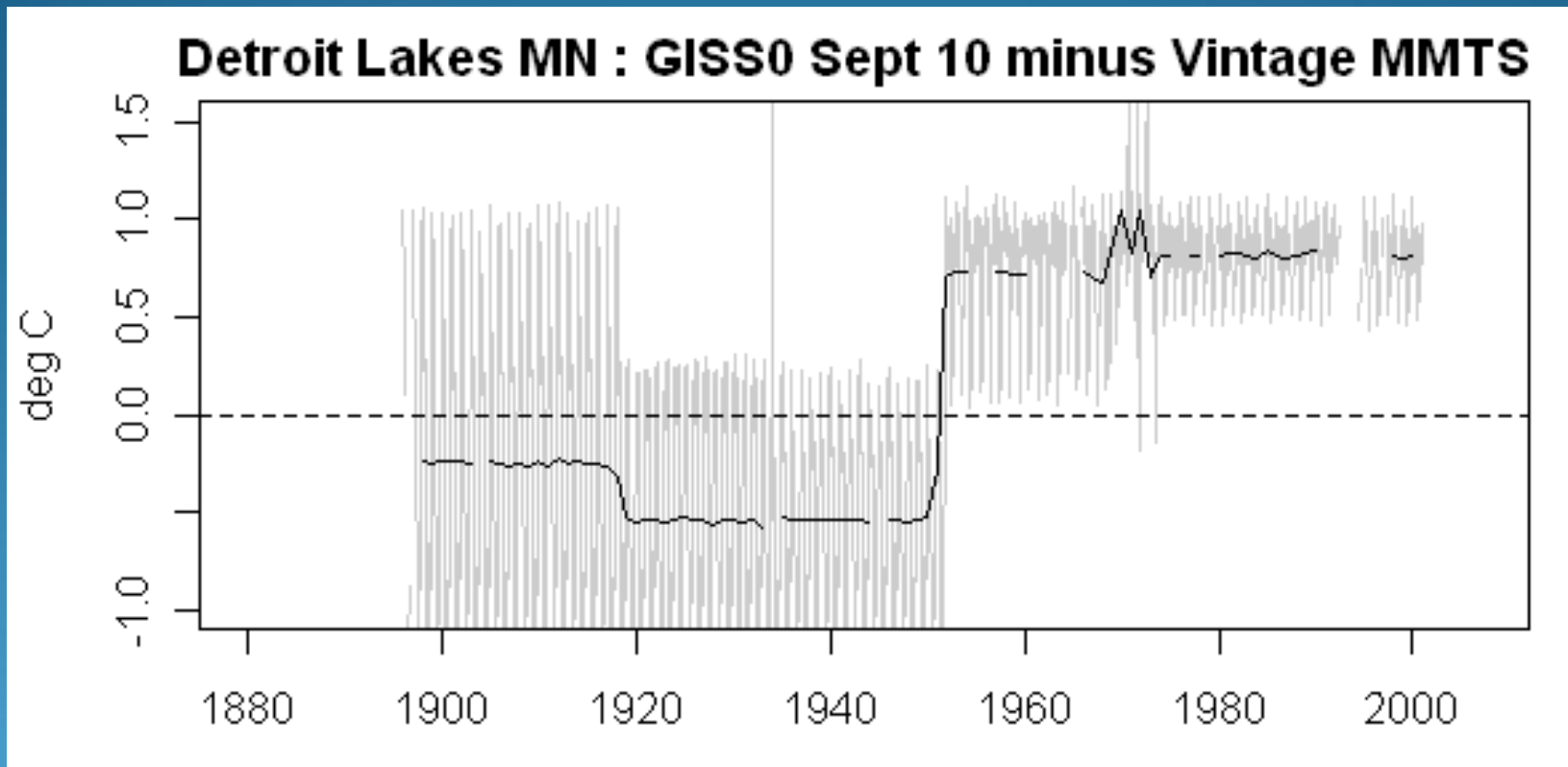


An Undocumented Change in Temperature Adjustment

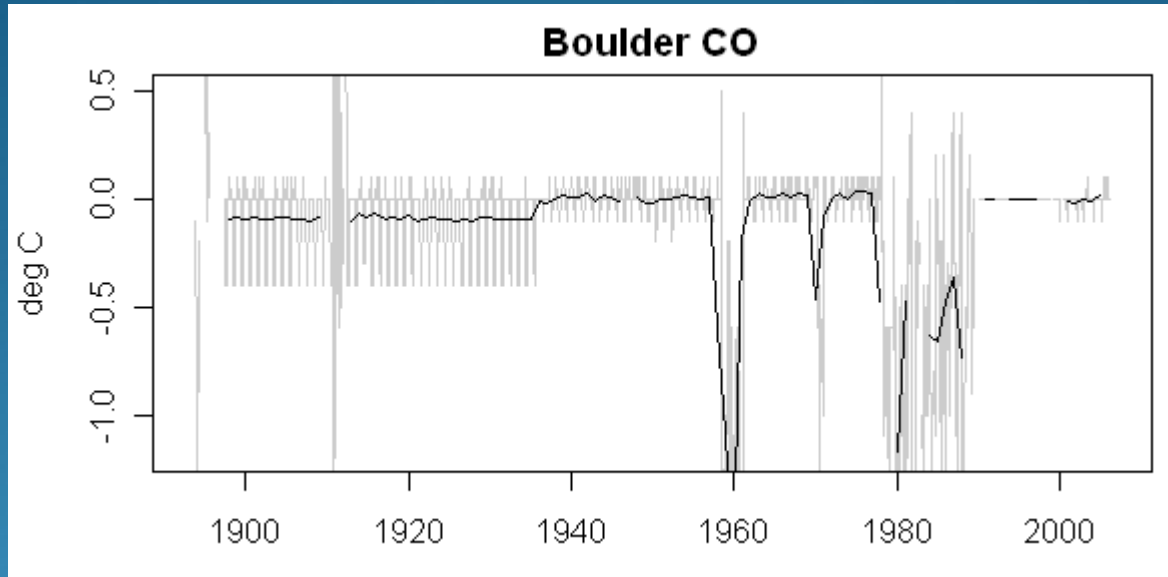


- Difference between Sep 10, 2007 version of Detroit Lakes MN and Aug 25, 2007 version.

Not the First Time it was Adjusted

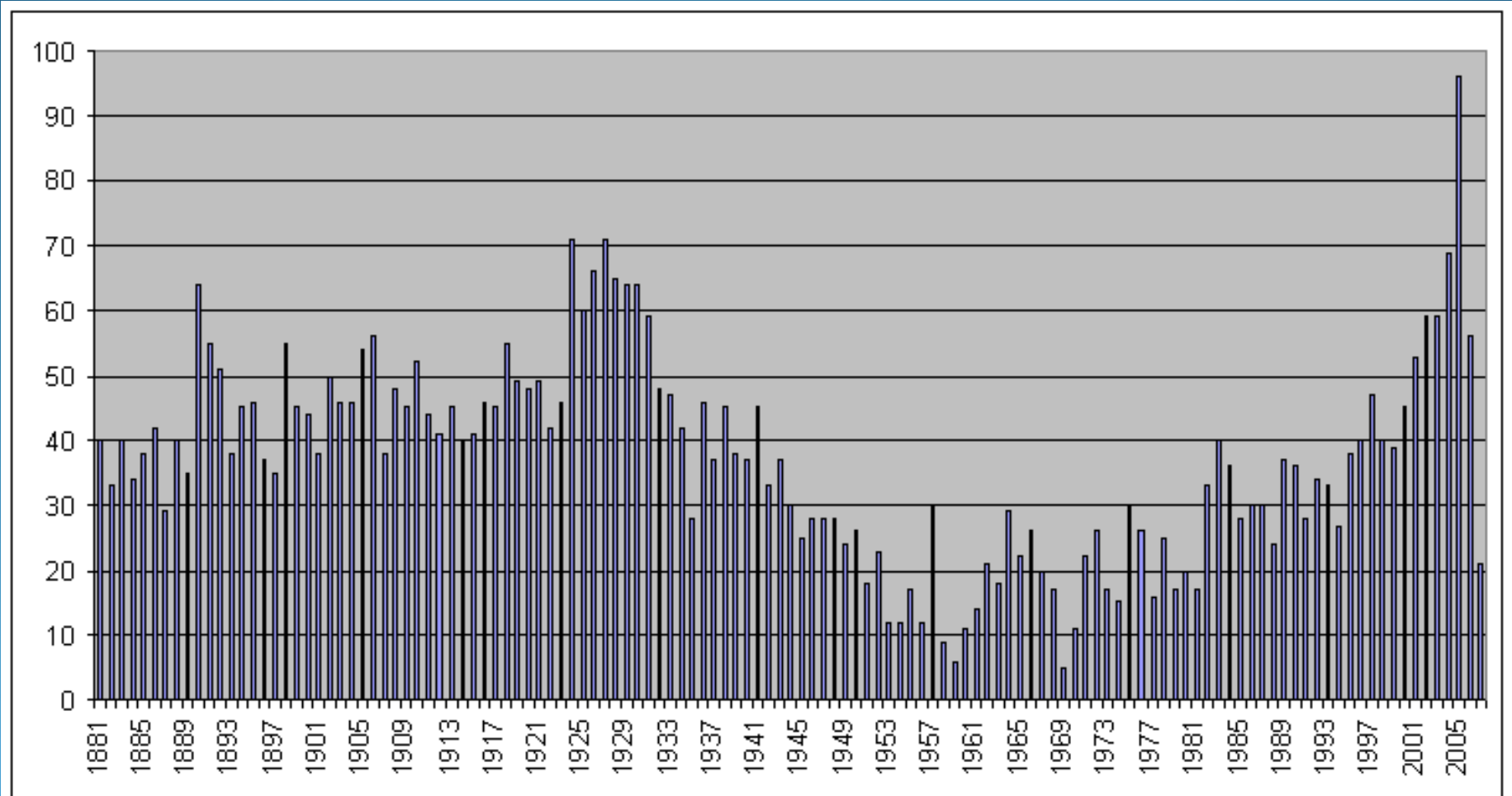


NASA (GISS)Temperature Aug 25th - Sept 10th 2007

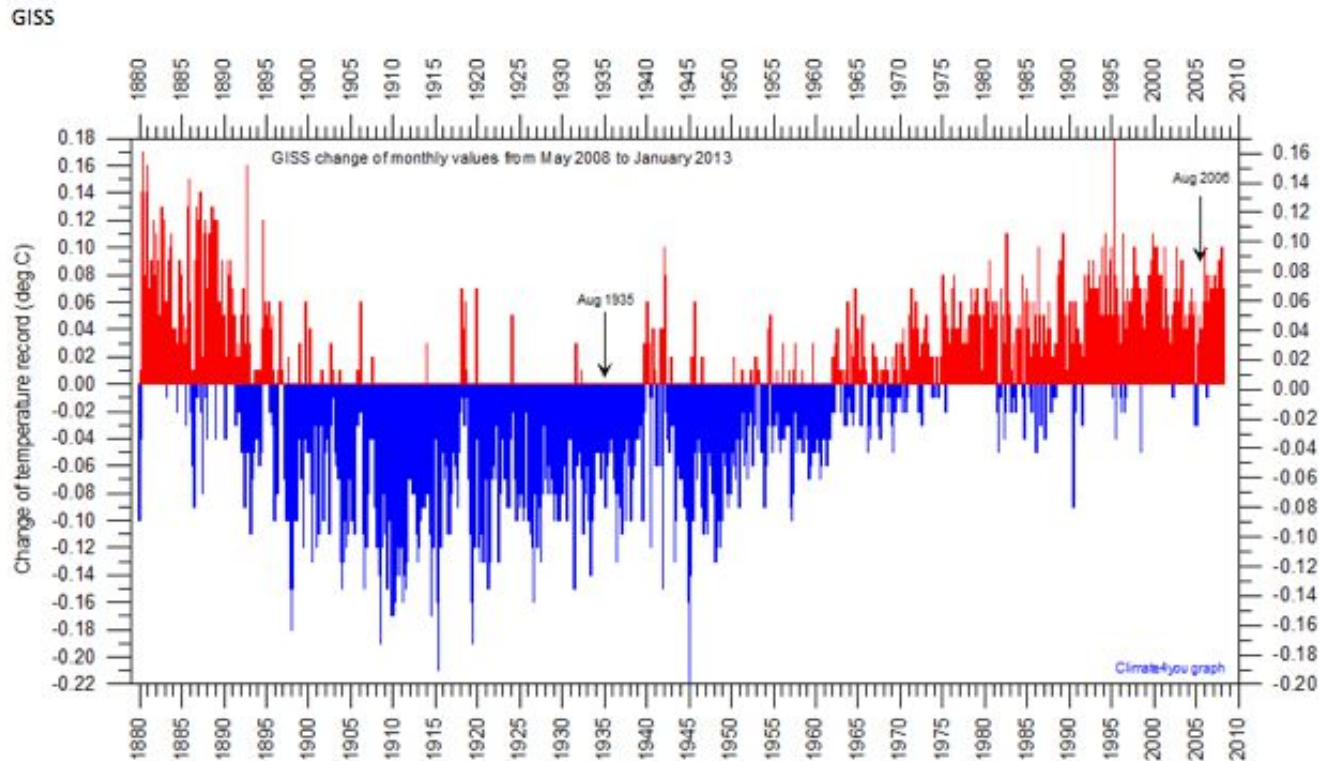


-within the last 2 weeks, NASA now believes that the temperature increase in Boulder since the 1980s is about 0.5 deg more than they believed only a couple of weeks ago.
- Boulder is the home of IPCC Working Group 1, the site of UCAR's world headquarters, NCAR's site and home to hundreds, if not thousands of climate scientists. You'd think that they'd have known the temperature in Boulder in the early 1980s to within 0.5 degree.

Number of times each Temperature Record has been changed in the last 5 years



Recent GISS Adjustment



Maturity diagram showing net change since 17 May 2008 in the global monthly surface air temperature record prepared by the [Goddard Institute for Space Studies \(GISS\)](#), at Columbia University, New York City, USA. This temperature estimate extends back to January 1880. [Click here](#) to see a graph showing the most recent version of the GISS global temperature estimate. The net effects of the adjustments made since May 2008 are to generate a more smoothly increasing global temperature since 1880. Discussions on the background for the lack of temporal stability for the GISS temperature record can be read [here](#), [here](#) and [here](#). Arrows indicate two months where the adjustments over time are illustrated in [the figure below](#). Last diagram update: 25 February 2013.

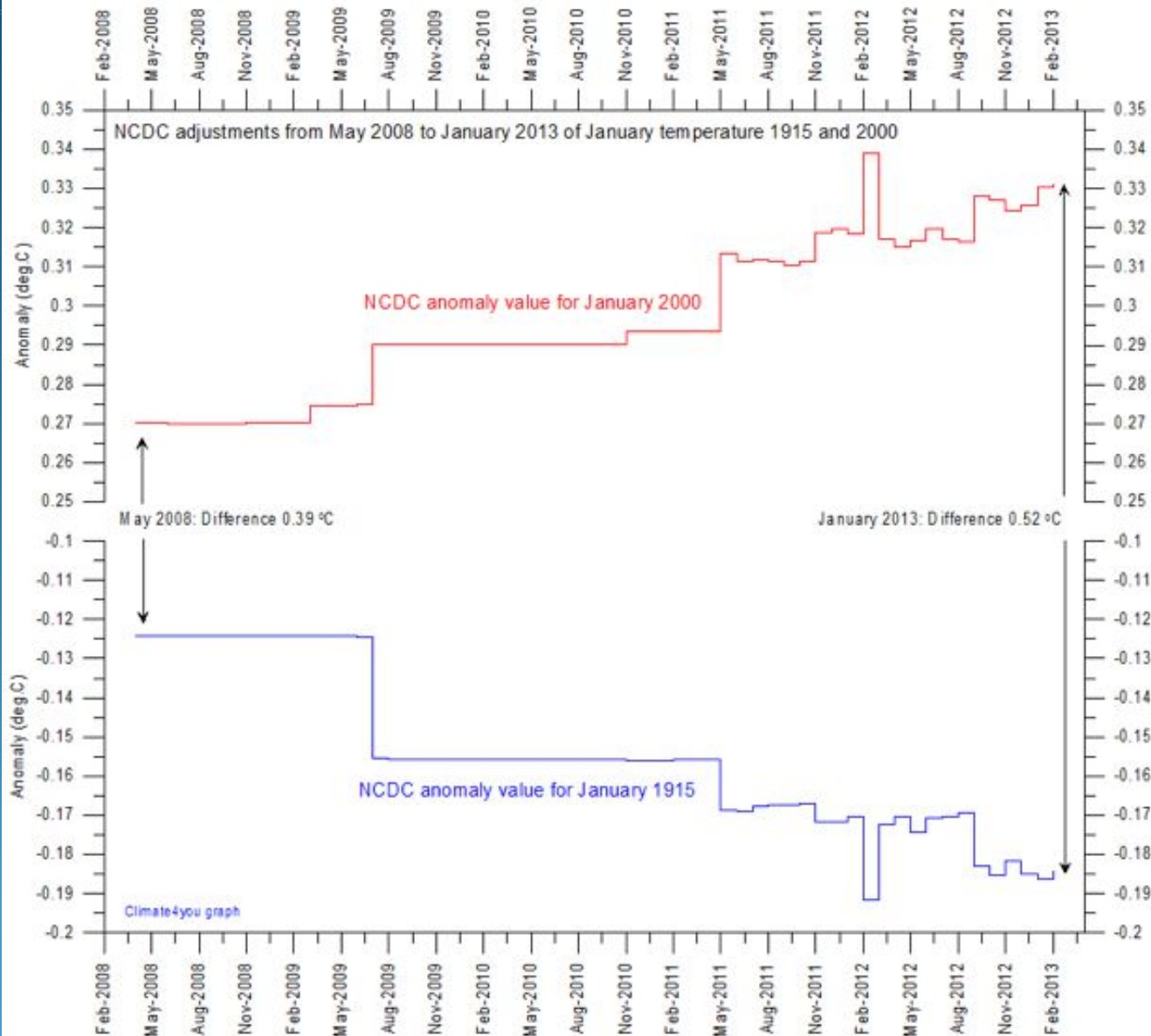


Diagram showing the adjustment made since May 2008 by the [National Climatic Data Center](#) (NCDC) in the anomaly values for the two months January 1915 and January 2000. See also [this diagram](#). Last update 16 February 2013.

Adjustments to the Data

HadleyCRU data set was the subject of the Email scandal

There is discussion in the emails about adjusting the 1945 peak to be only 0.15C

CRU Director admitted that they neither had the original data nor did they know what “corrections” had been applied to the data.

There is no climate data set for which

the data used is completely known,

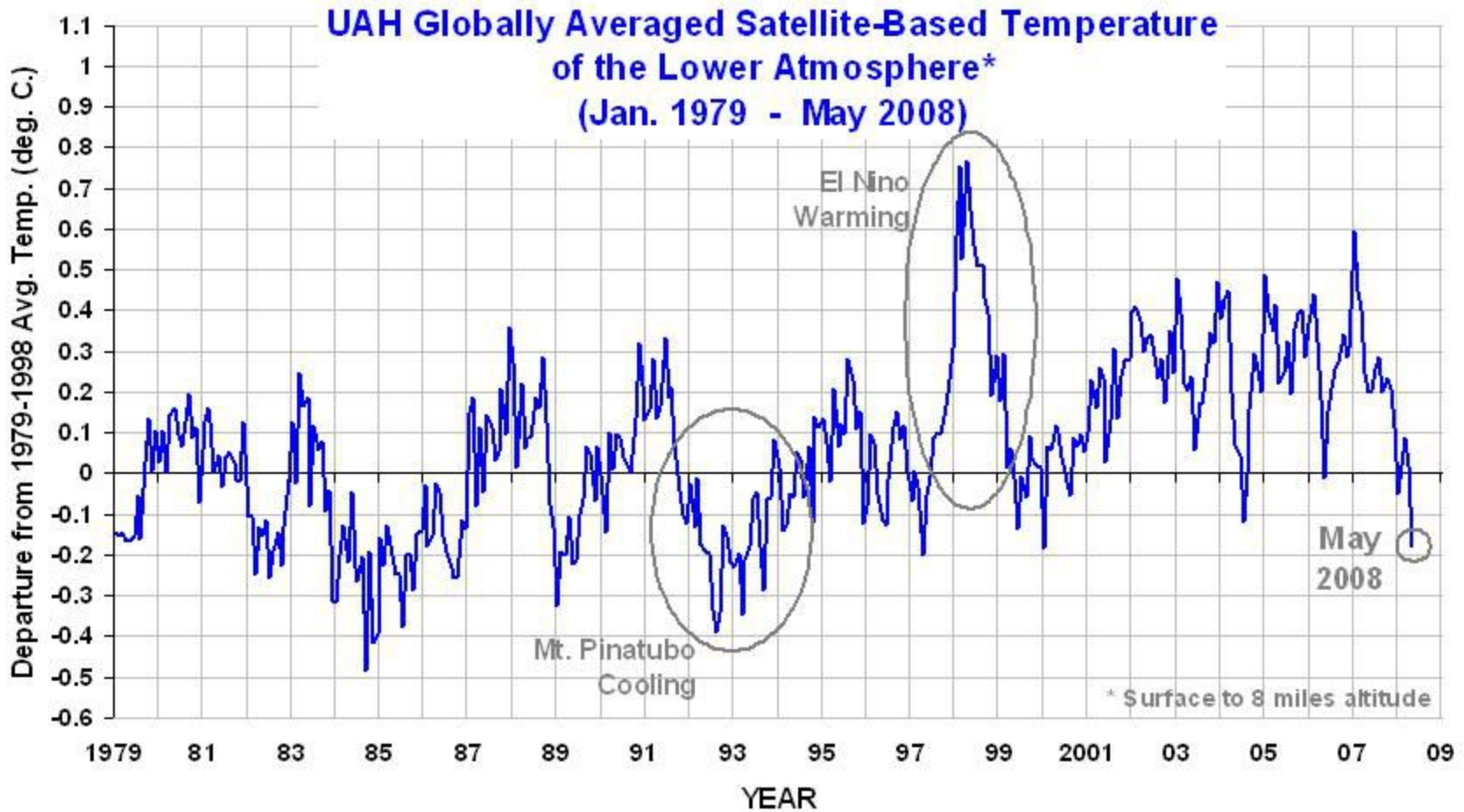
the raw data is freely available

it is known what corrections have been applied

the computer code used to adjust the data is public

- "When all the errors are in the bank's favor, you can be forgiven for thinking there's more at work than sloppy arithmetic."

Is the World Warming?



What does this mean?

The published temperature records are compromised

This does not mean that the earth is not warming.

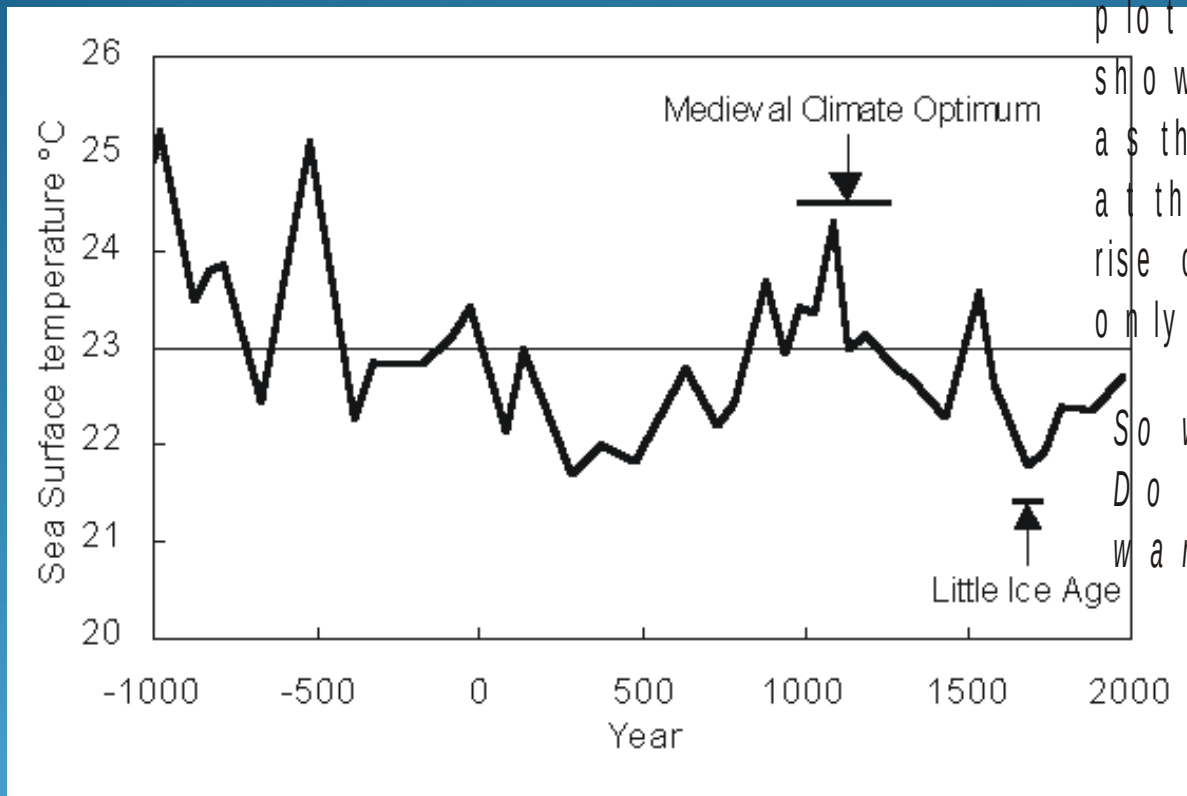
probably is: 0.1-0.3 C/century

What is needed is a bit of perspective. Where are we climate-wise?

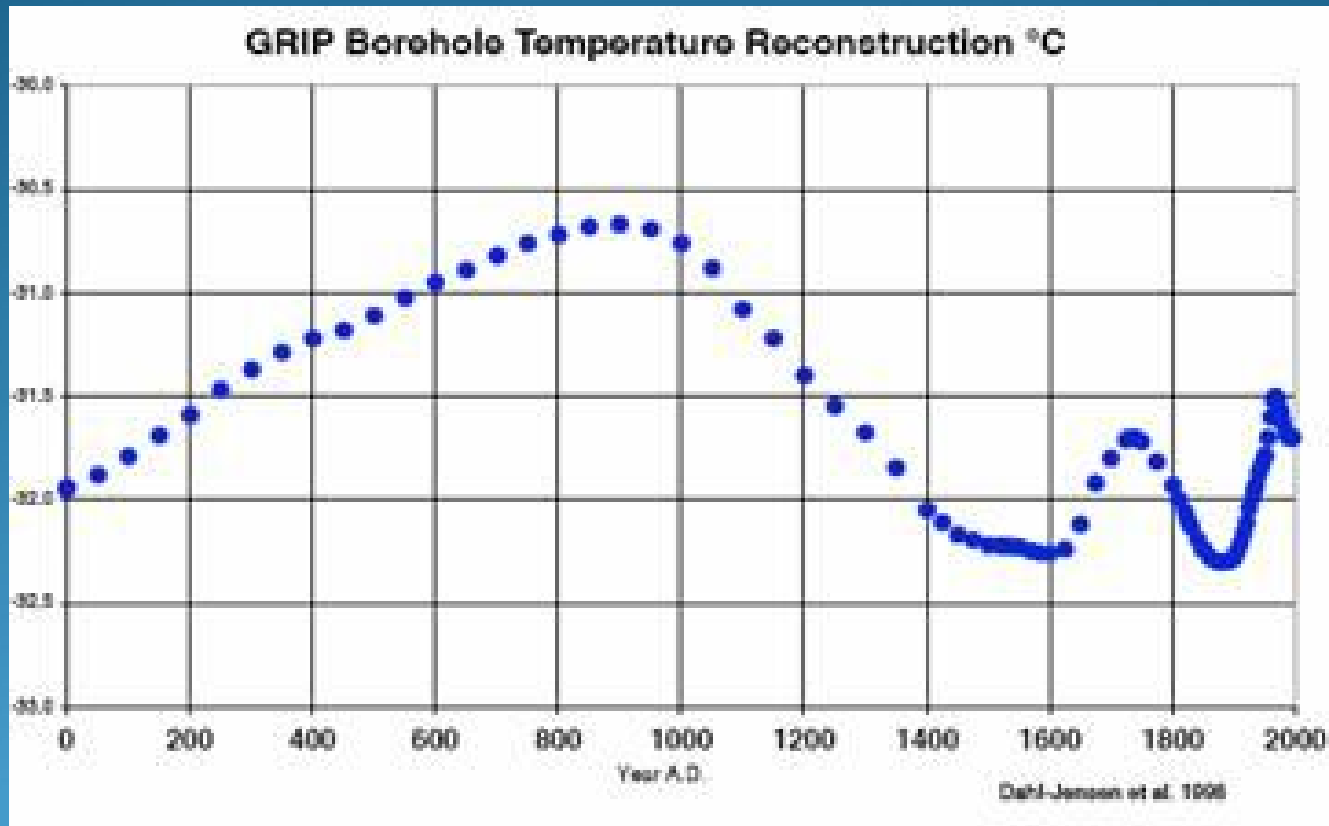
Global Average Temperature

This is a long term plot of temperature. It shows the same trends as the previous plots, but at this scale, the dramatic rise over the past century only restores the mean.

So what is the "truth"?
Do we worry about global warming or not?

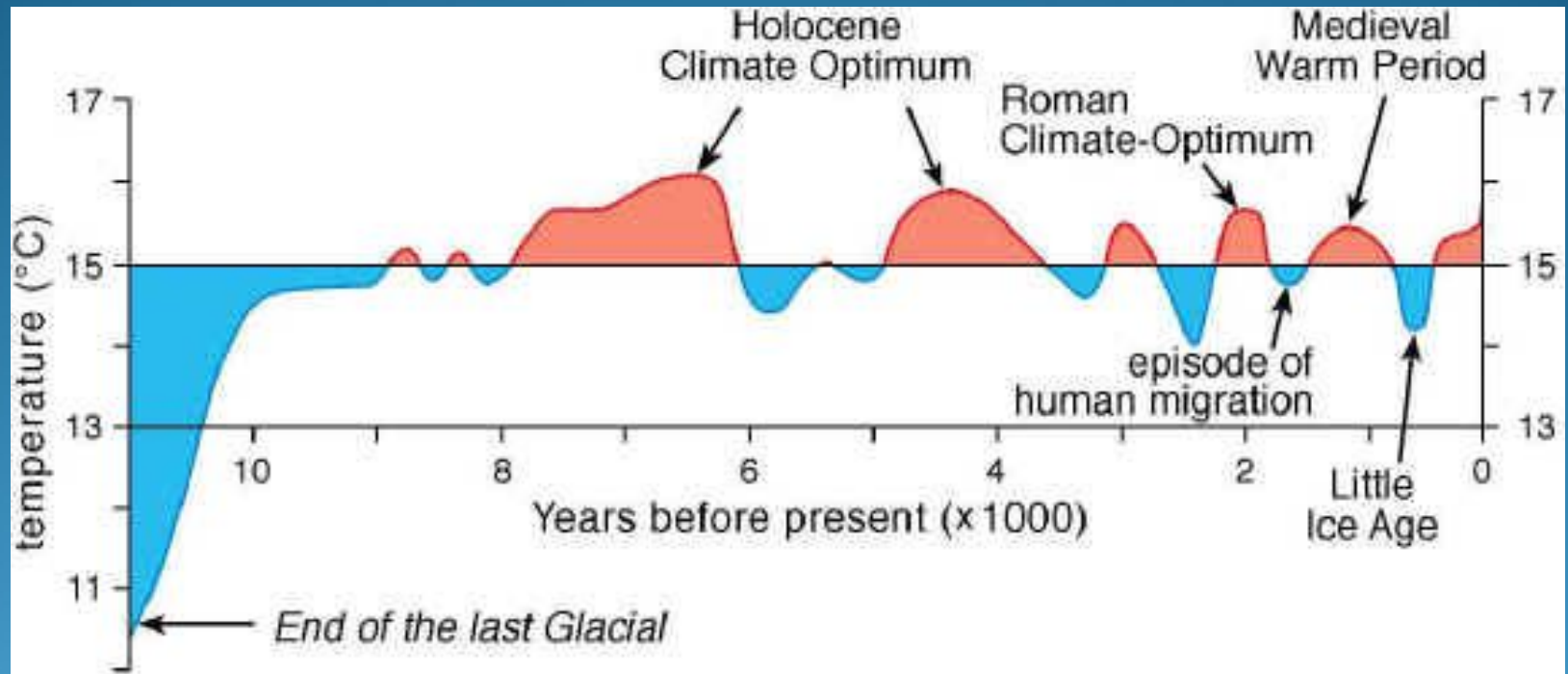


Other Temperature Records



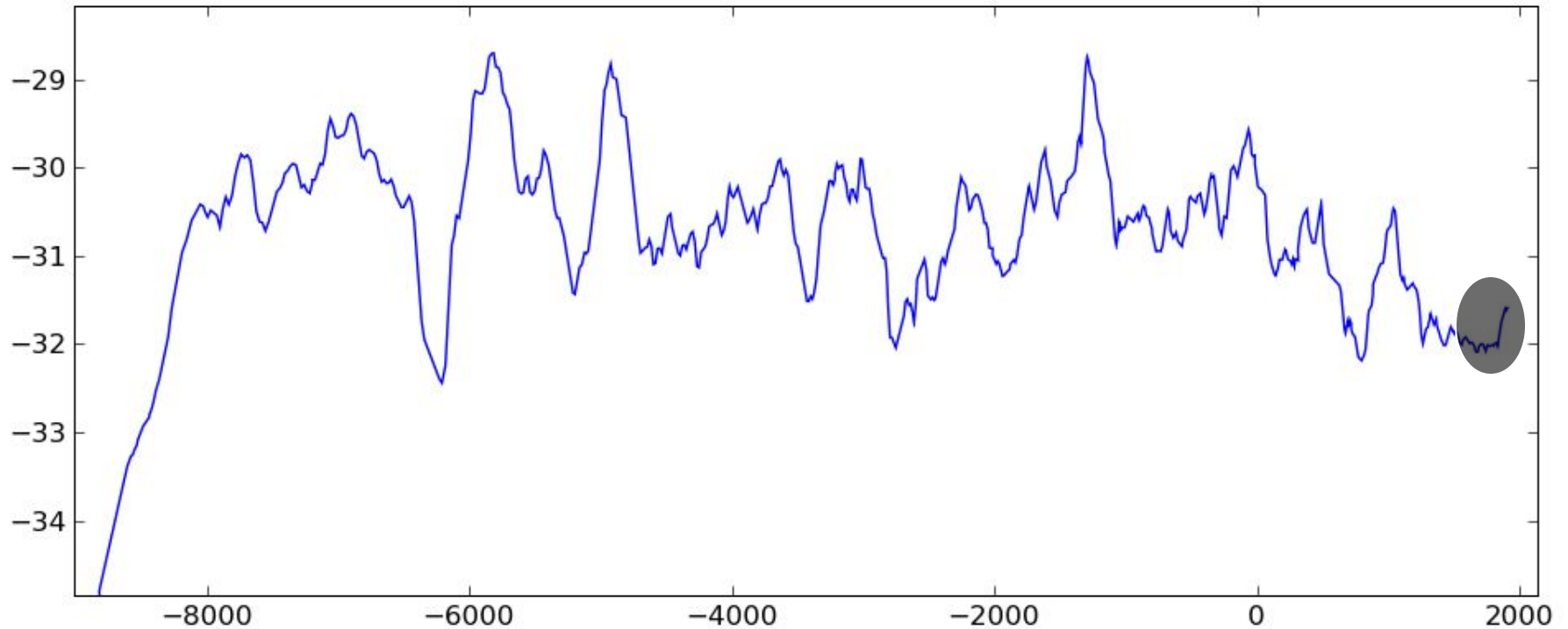
The Greenland borehole record is a measure of temperature. Shown are the last 2000 years. (Dahl-Jensen et al. 1998, *Science*, 282, 268-271 "Past Temperatures Directly from the Greenland Ice Sheet"). A similar plot can be made from boreholes in Siberia.

Long Term Temperature Evidence



Average near-surface temperatures of the northern hemisphere during the past 11,000 years (after Dansgaard et al., 1969, and Schönwiese, 1995)

Long Term Temperature Evidence



The Greenland ice borehole record is a measure of temperature. Shown are the last 10,000 years.

What does this mean?

We are coming out of a long term cold spell. Temperatures might be expected to rise slightly long term

The 1945 peak and the medieval warm period (MWP) present a problem for AGW. The models cannot explain how climate can change $> 0.5\text{C}$ without an increase in CO_2

Both climate events have been the subject of efforts to erase their existence from the record.

This is what the controversy over the “Hockey Stick” is about.

Climate
Change
Model
Predictions

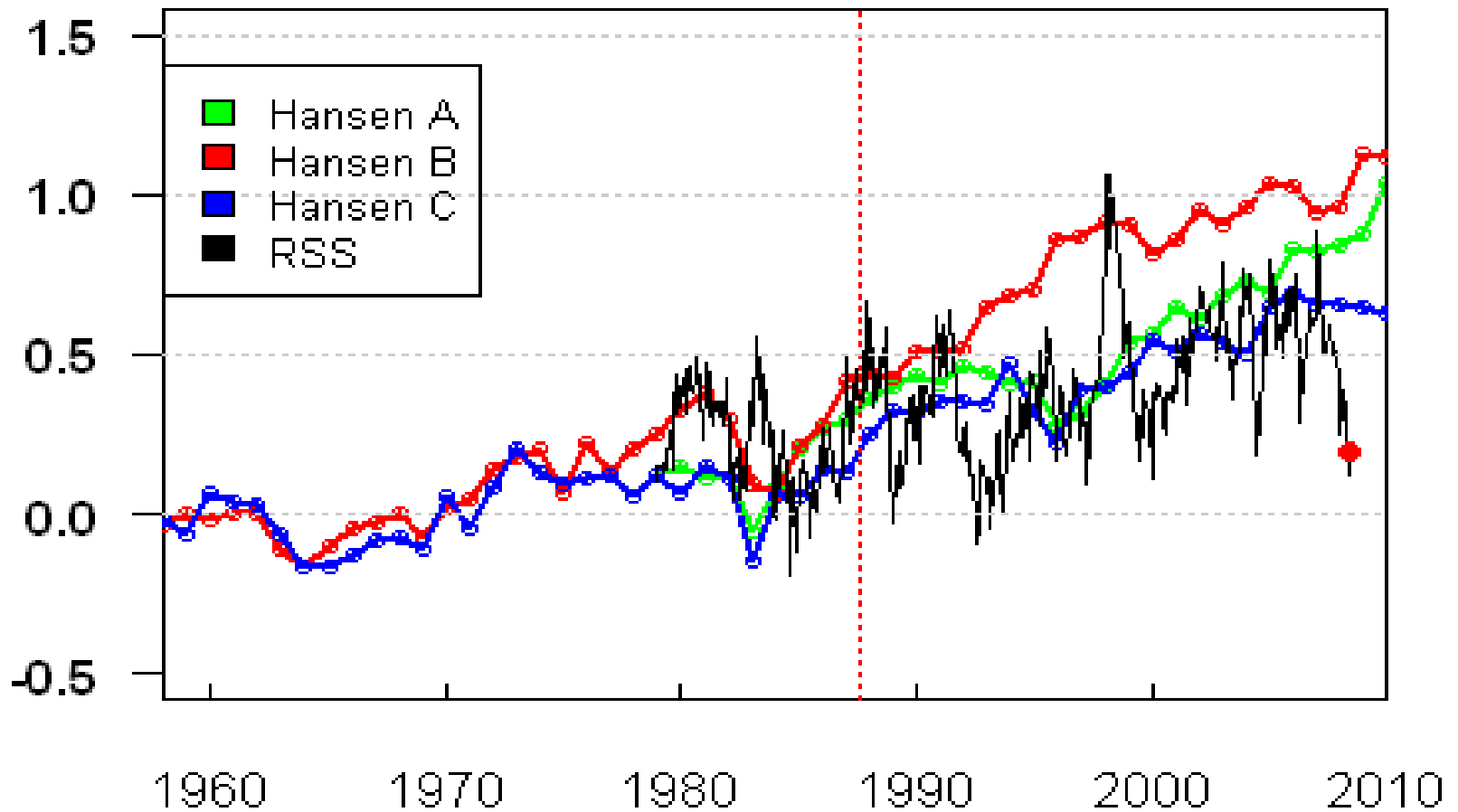
Issues with Models

Current disagreements: Measurements and AWG theory

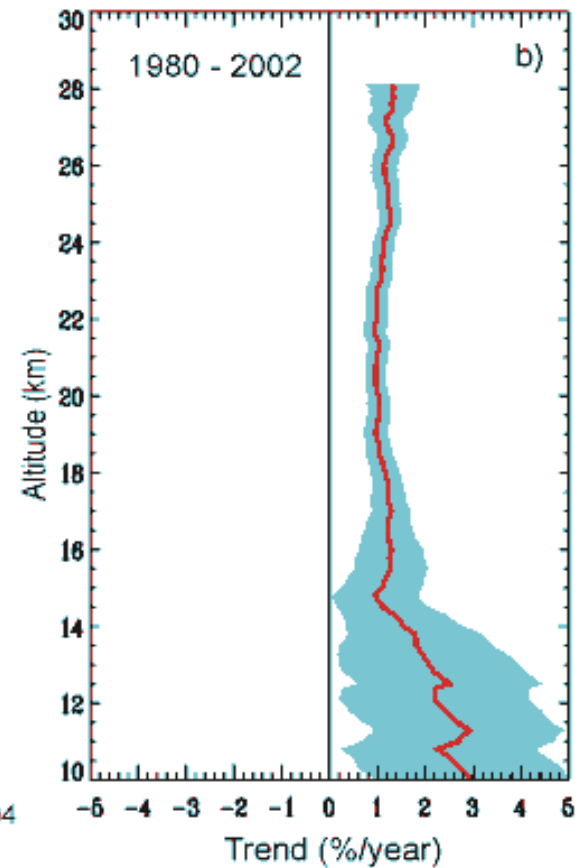
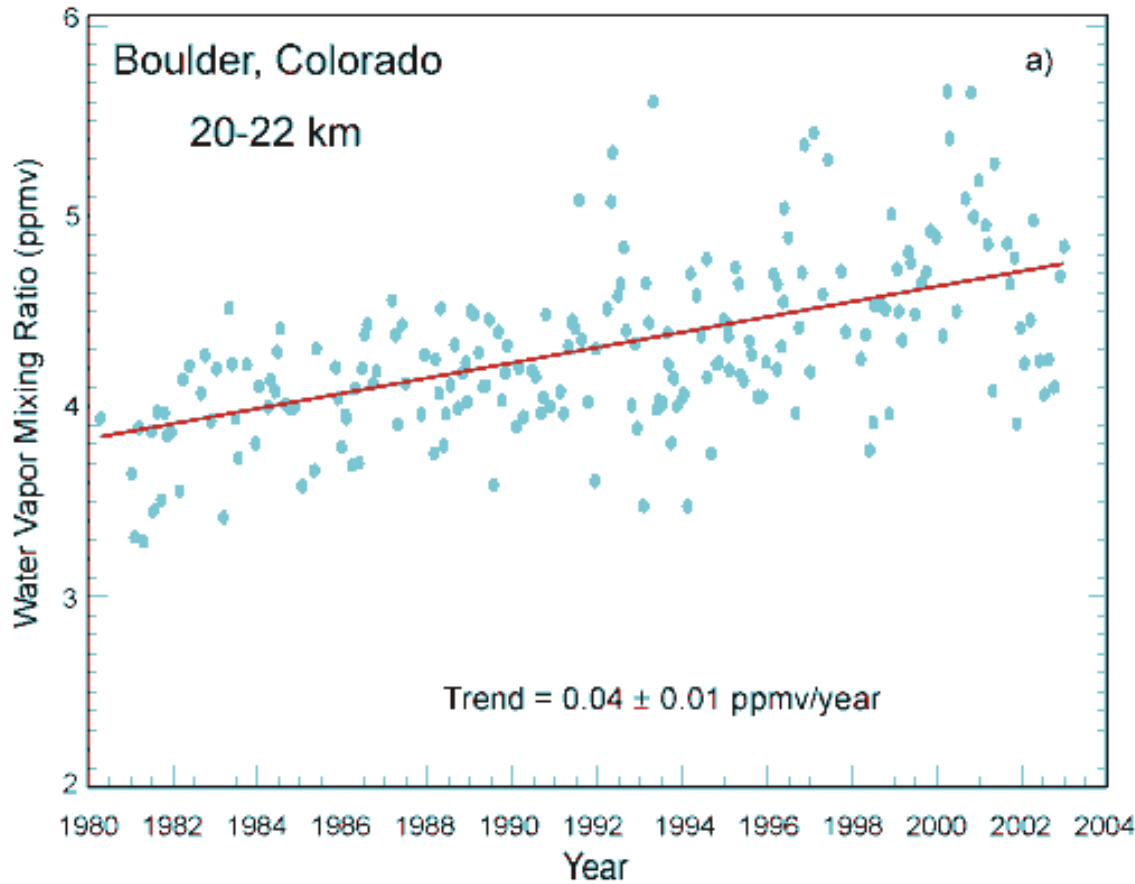
- 1) Temperature Projections
- 2) Water Vapor Feedback
- 3) “Hot Spot” in the tropical troposphere
- 4) Oceans are not warming eg ARGOS
- 5) Stratosphere is warming
- 6) 15+ years of non-warming
- 7) Antarctica is not warming
- 8) Global Cloudiness
- 9) Increase in Storms / Extreme weather events

Model Temperature Projections

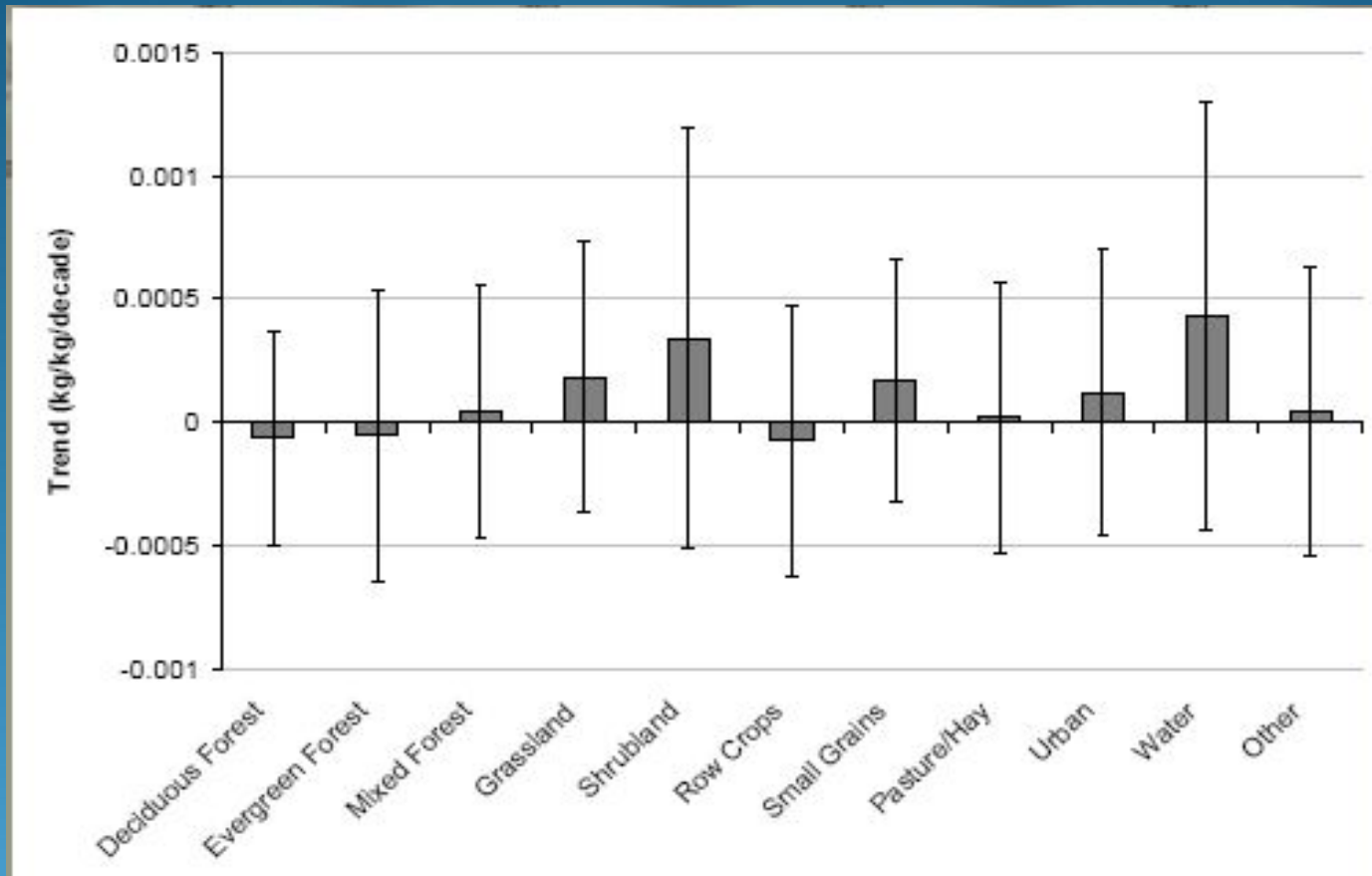
Hansen et al 1988 Projections + RSS



Model Water Vapor Predictions



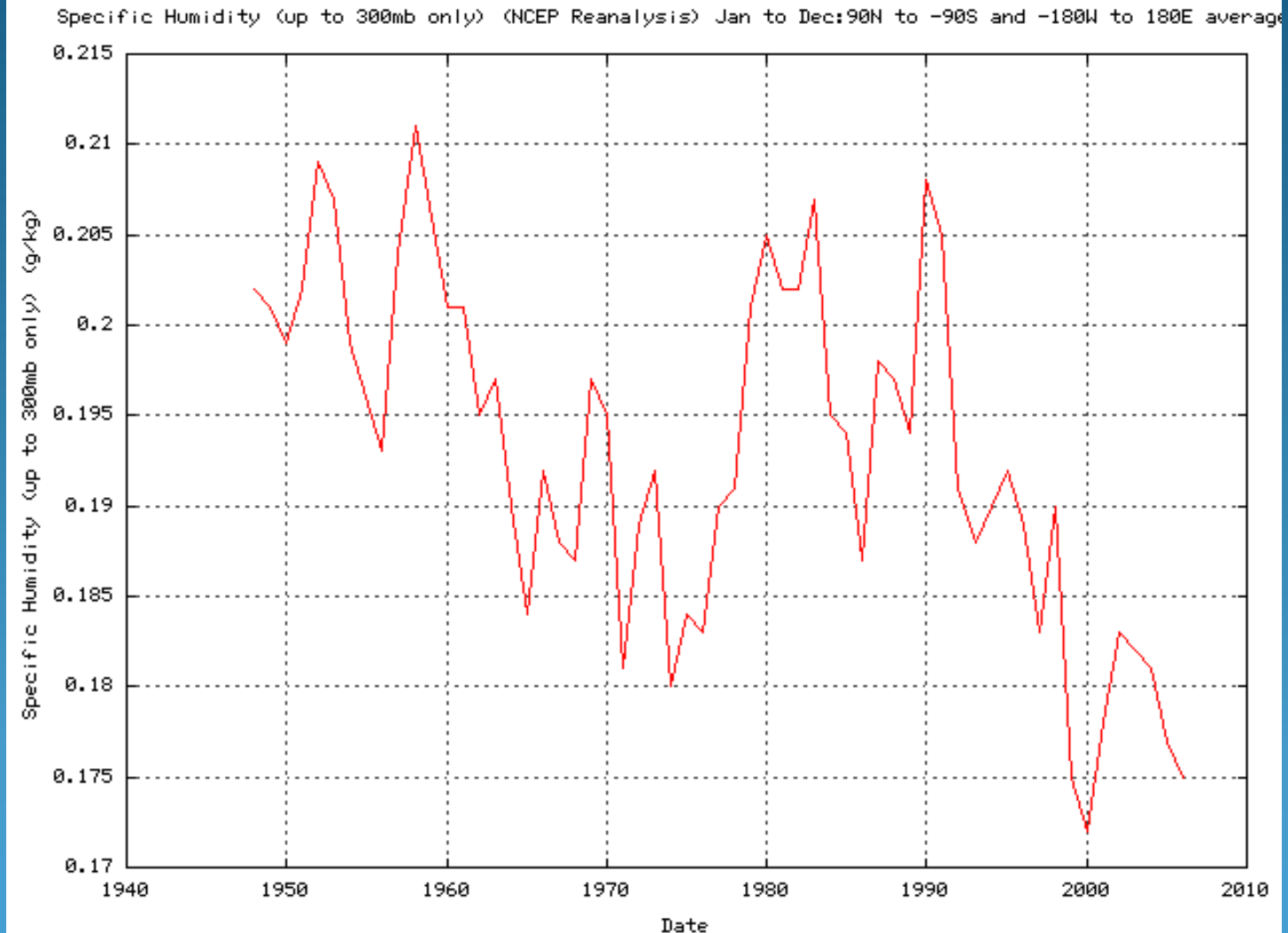
Water Vapor Trends



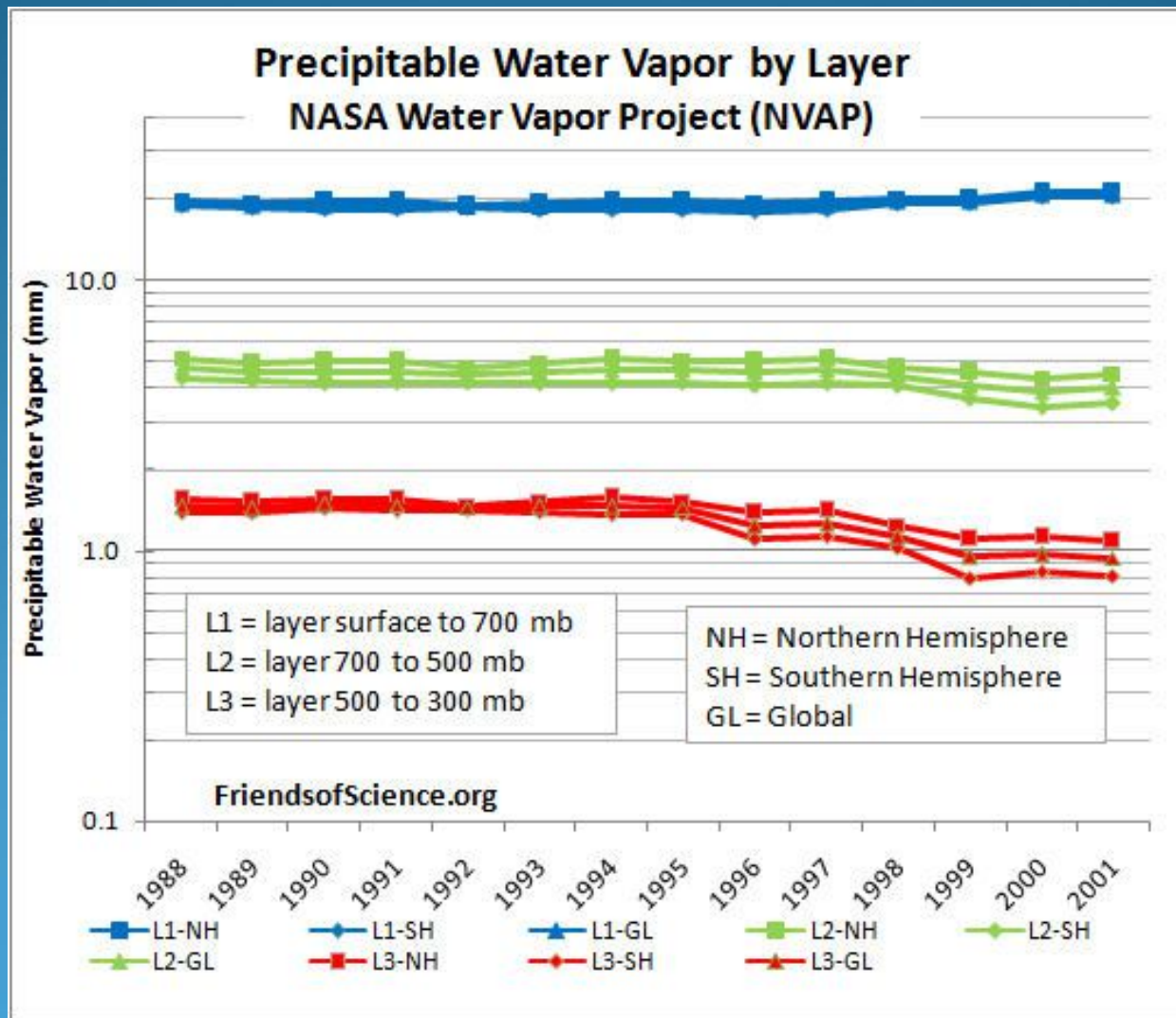
Annually - averaged q trends for 1982-1997, as a function of land-cover cover class. All individual trends are weighted equally.

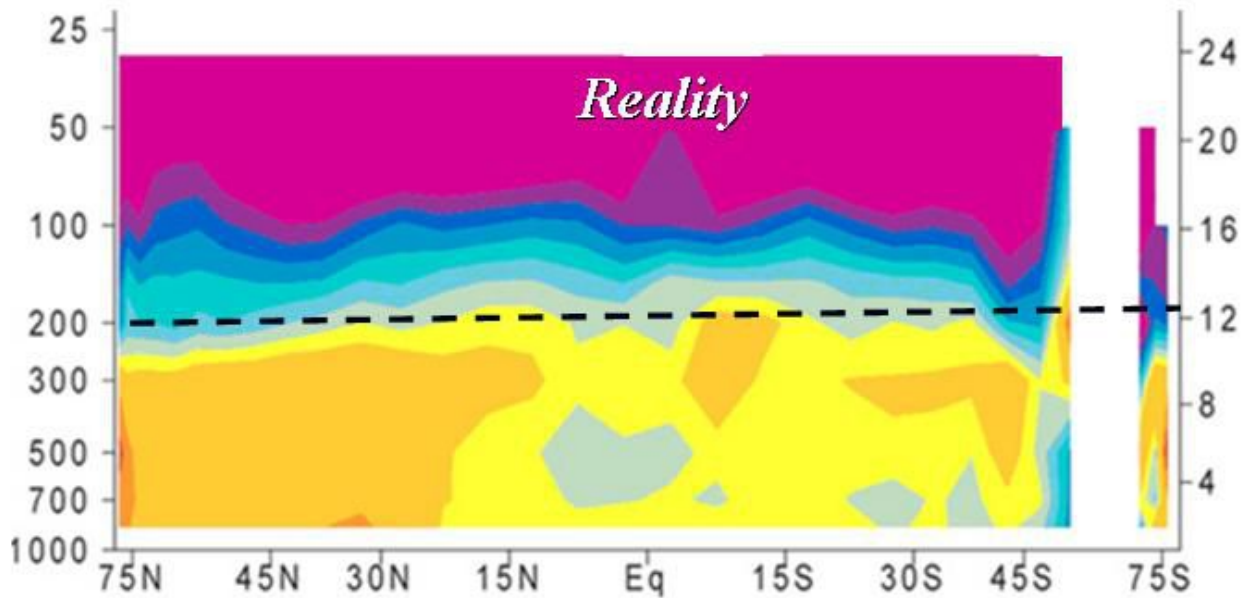
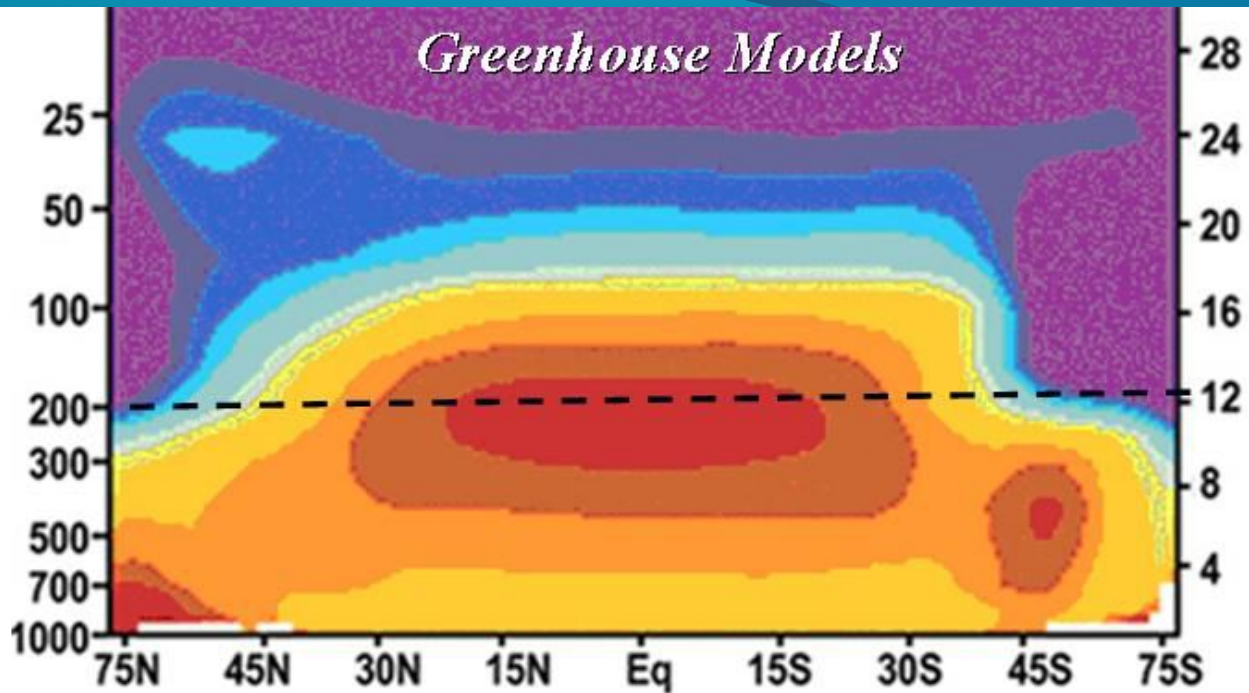
Davey, C.A., R.A. Pielke Sr., and K.P. Gallo, 2006

Water Vapor Trends

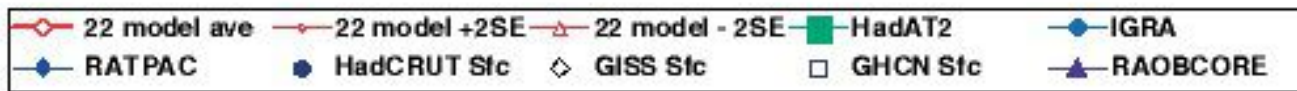
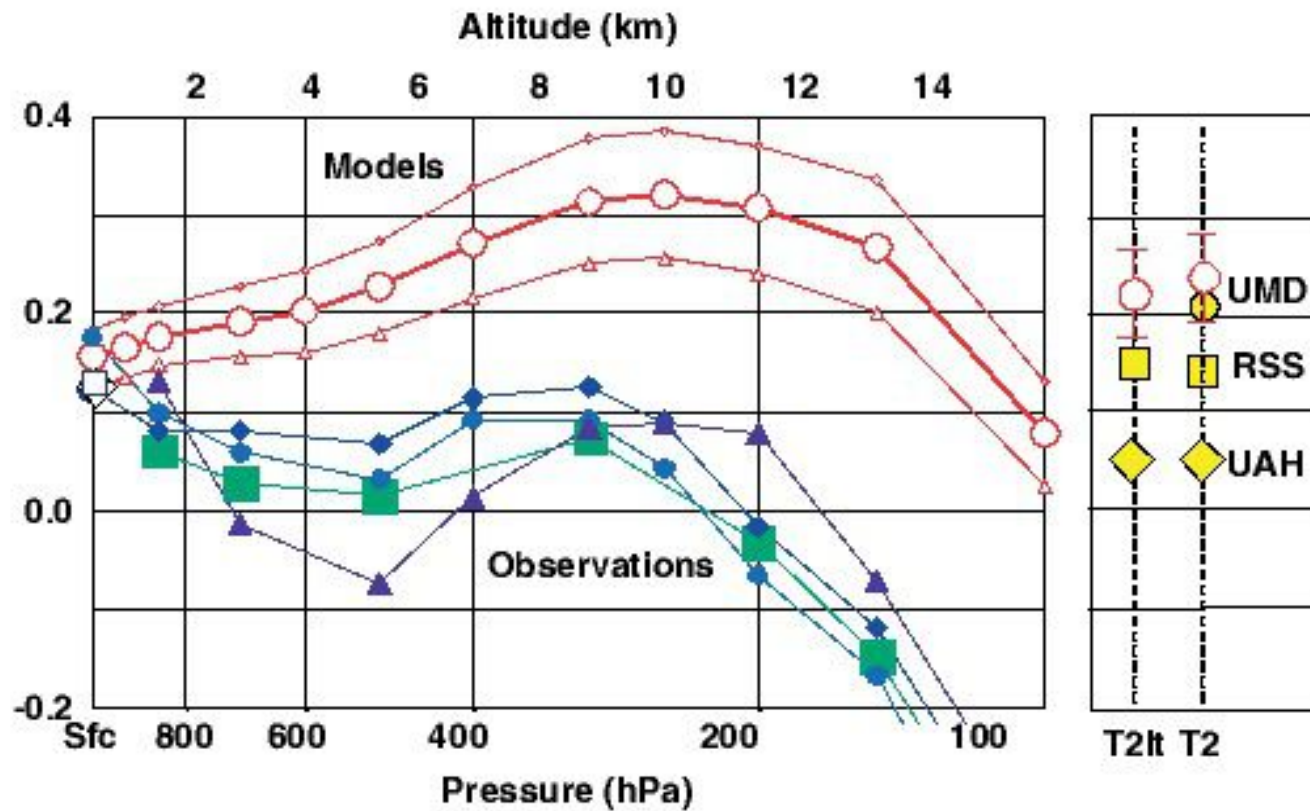


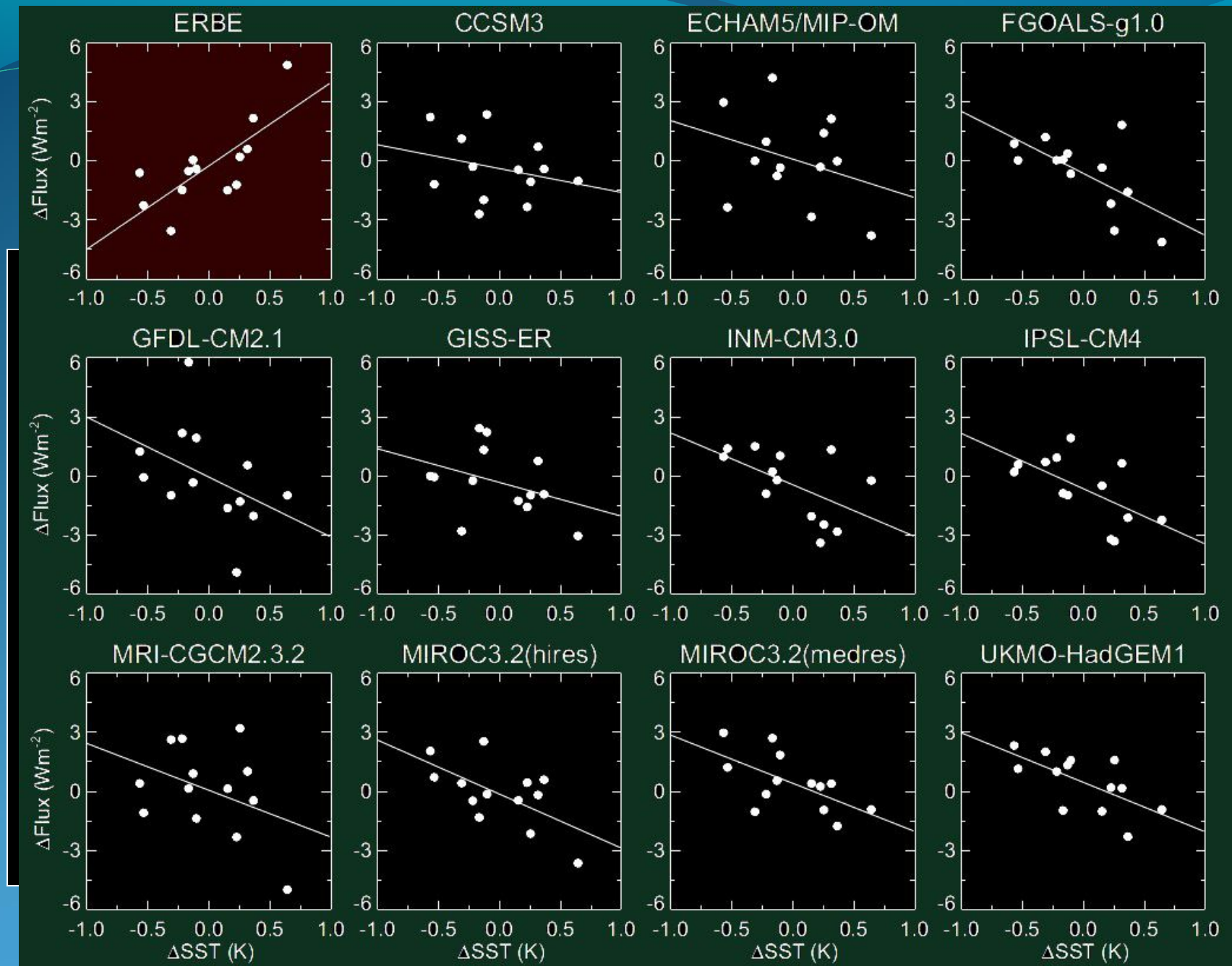
Water Vapor Trends



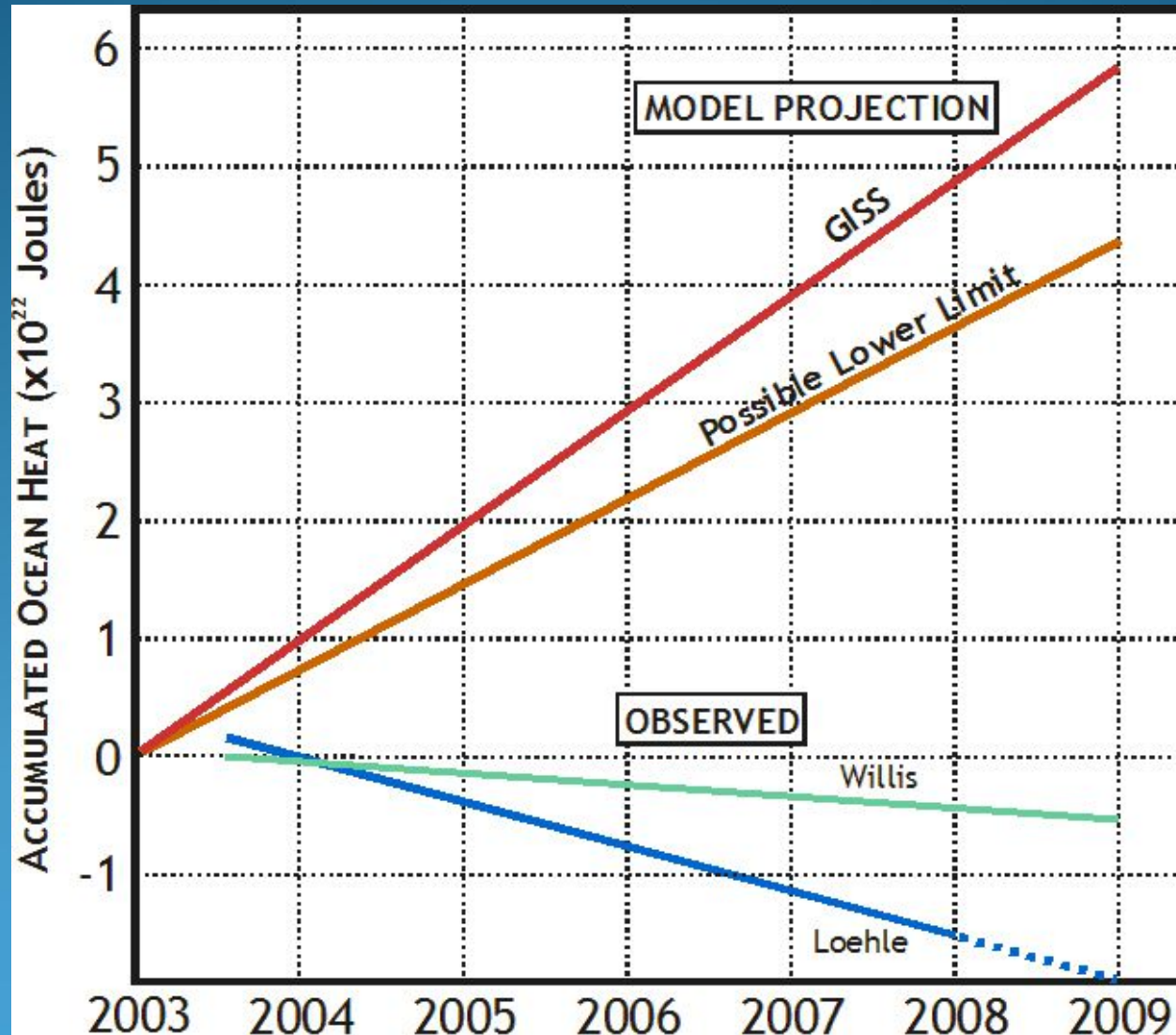


Models Predict Warming of Upper Troposphere at the Equator



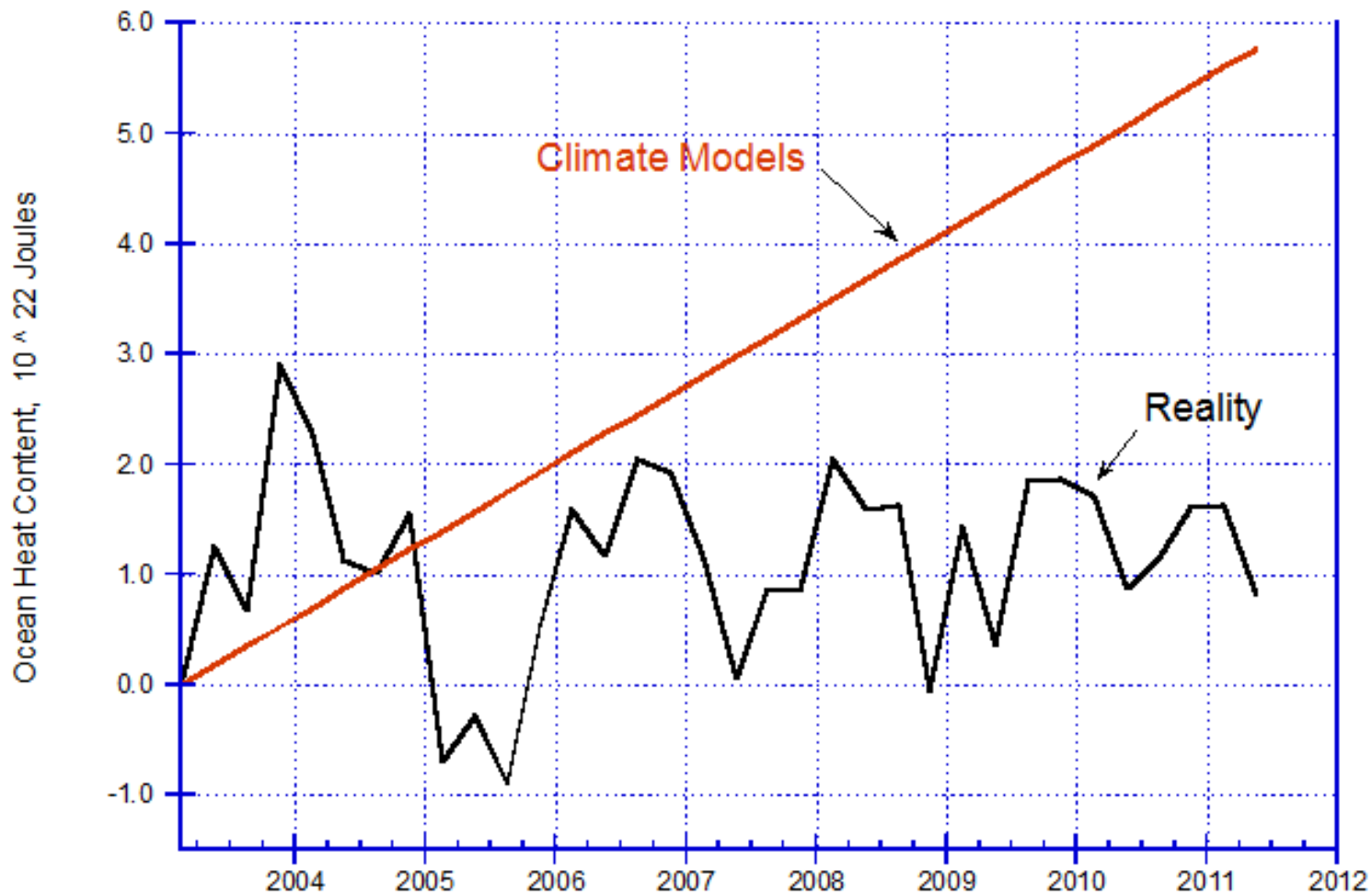


Model Ocean Heat Content Predictions



Ocean Temperature as Measured by ARGO, 0-700 meters

Data source = National Oceanographic Data Center (NODC), USA

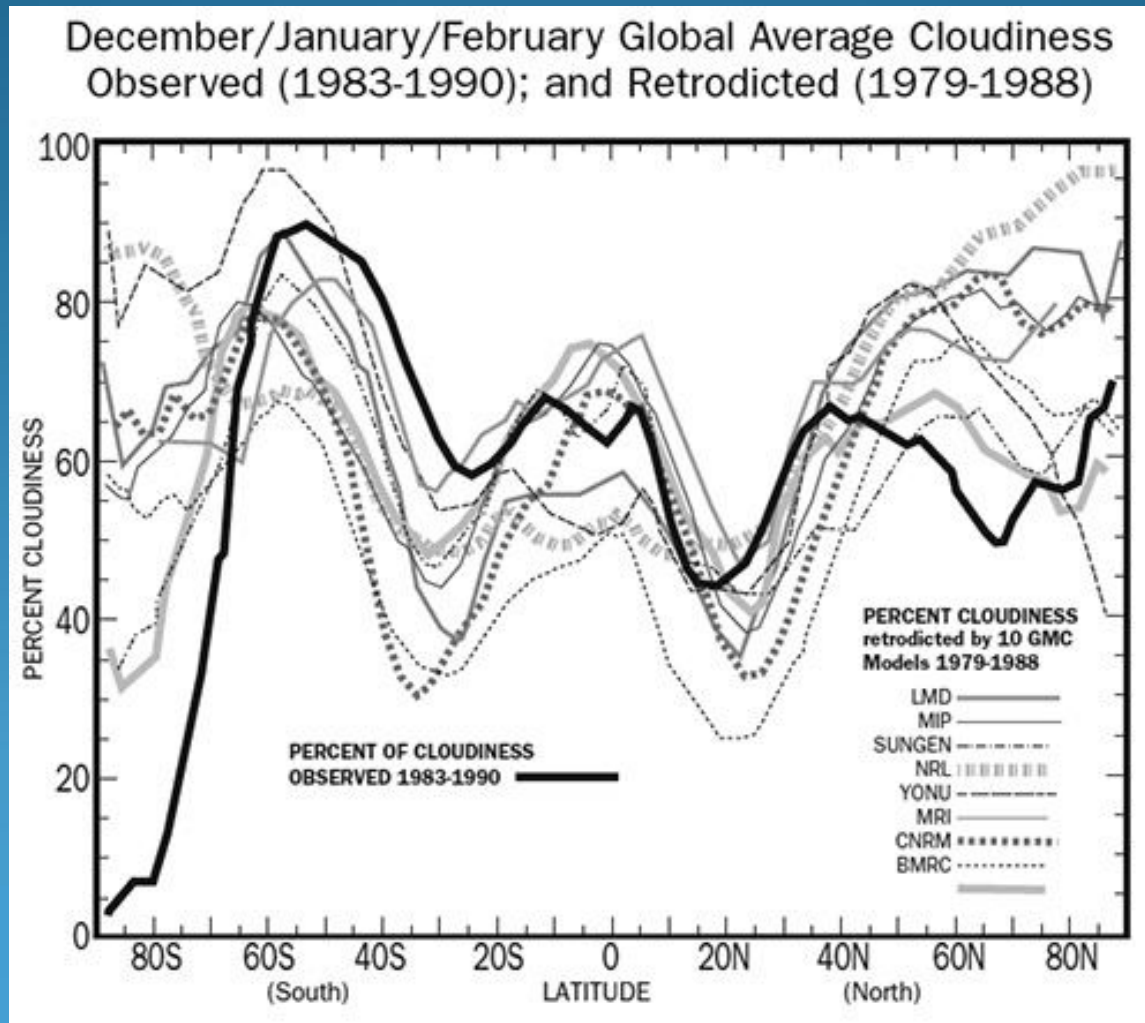


Oceans have only been properly measured by ARGO. Prior data prior has huge uncertainties and overly sparse ocean coverage.

Both datasets zeroed to first quarter 2003. GISS projection of 0.7×10^{22} Joules per year, from Hansen et al, "Earth's Energy Imbalance: Confirmation and Implications" 2005.

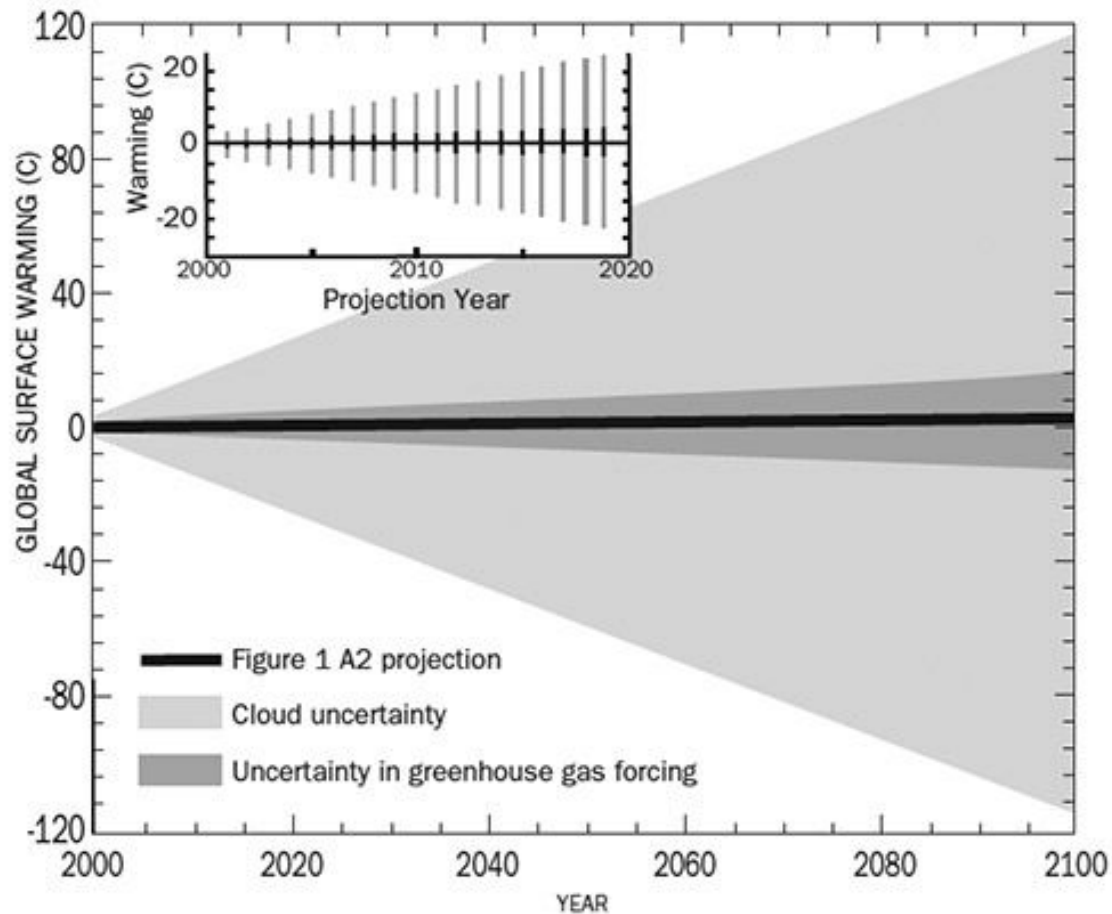
Data: ftp://ftp.nodc.noaa.gov/pub/data.nodc/woa/DATA_ANALYSIS/3M_HEAT_CONTENT/DATA/basin/3month/ohc_levitus_dimdash_seasonal.csv

Measured & Modeled Cloud Amounts

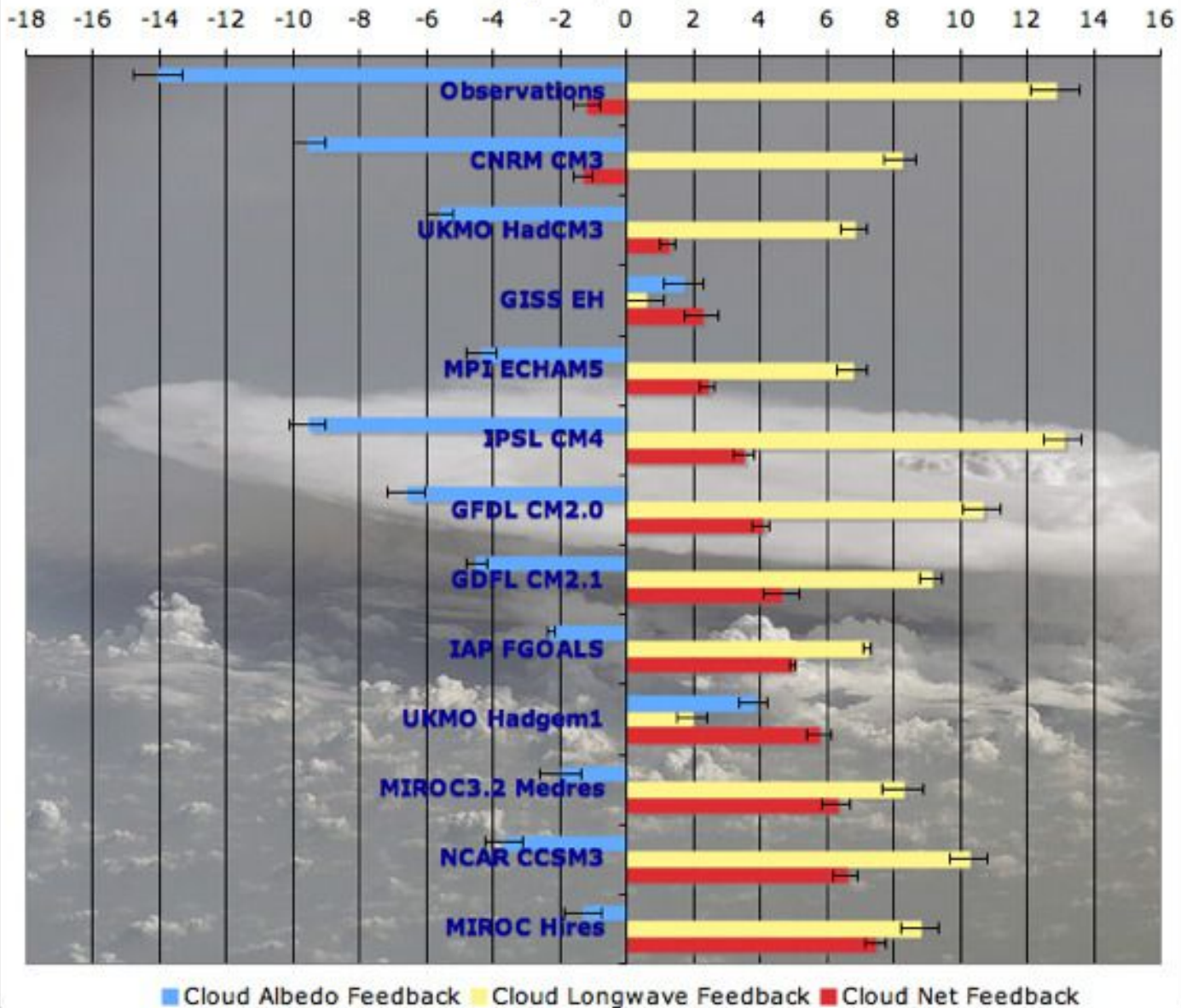


Effect of Cloud Uncertainty

Accumulation of Projection Uncertainty in the Climate Impact of Clouds or of Greenhouse Gas Forcing

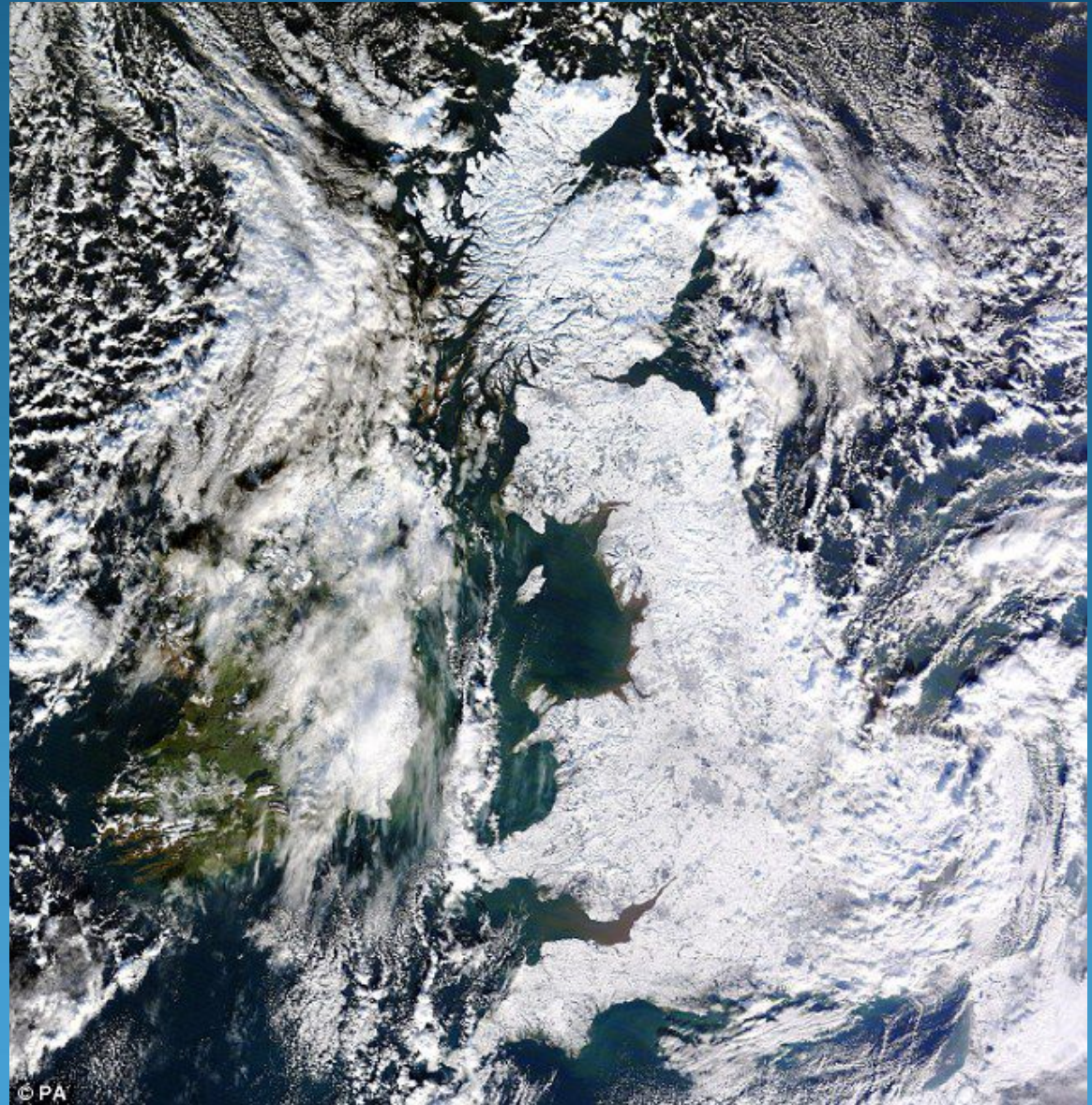


Cloud Albedo, Cloud Longwave, and Net Cloud Feedback in Observations and Models, 1983-2004 (W/m² per °C)



In 2001,
Climate Change
Modelers predicted
England would never
again have snow in
winter.

MODIS photo,
December, 2009



Problem of Falsifiability

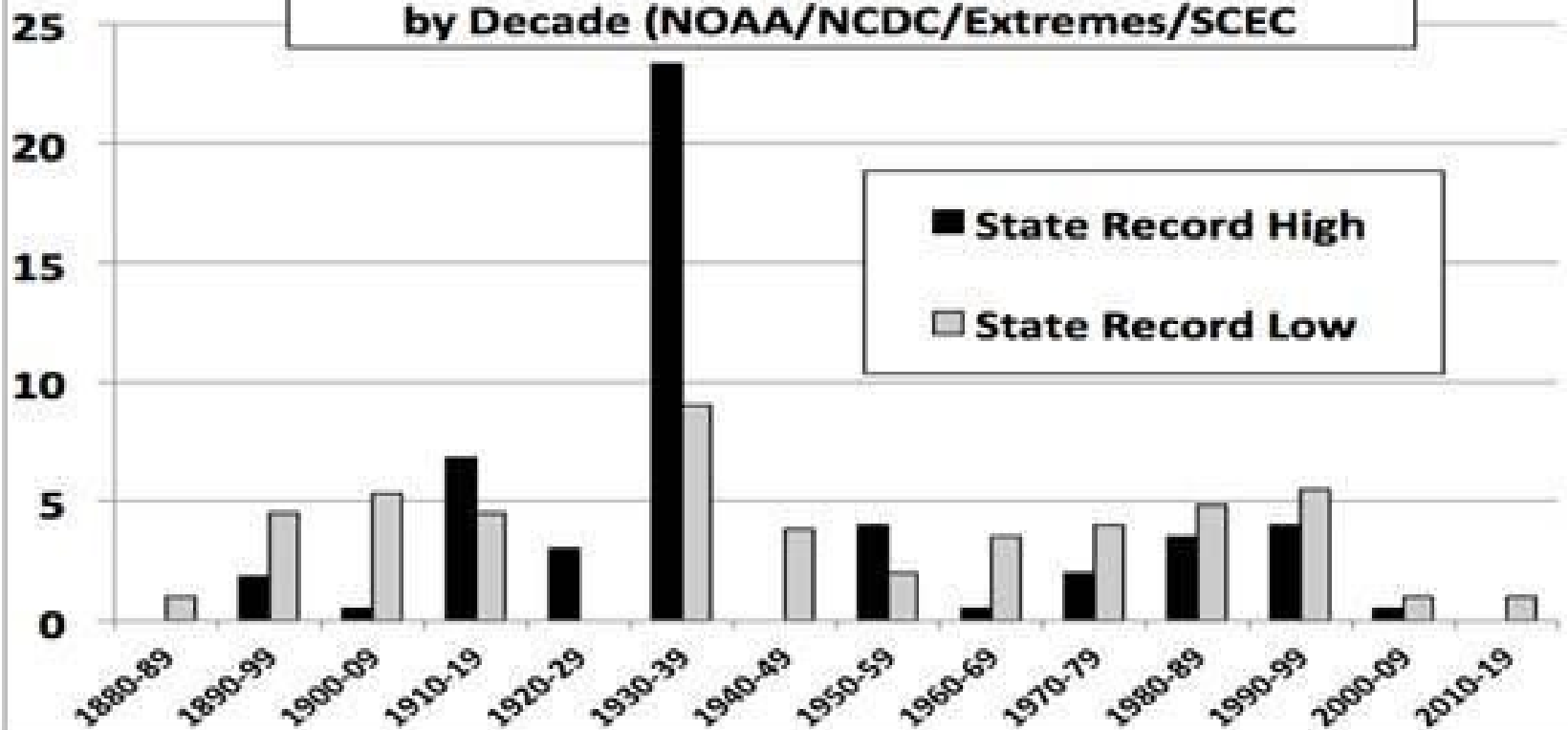
Normally, if a theory predicts “X” and “X” doesn’t happen, then the theory is considered not proven.

If it doesn’t snow, it is proof of climate change, if it does snow, it is proof of climate change.

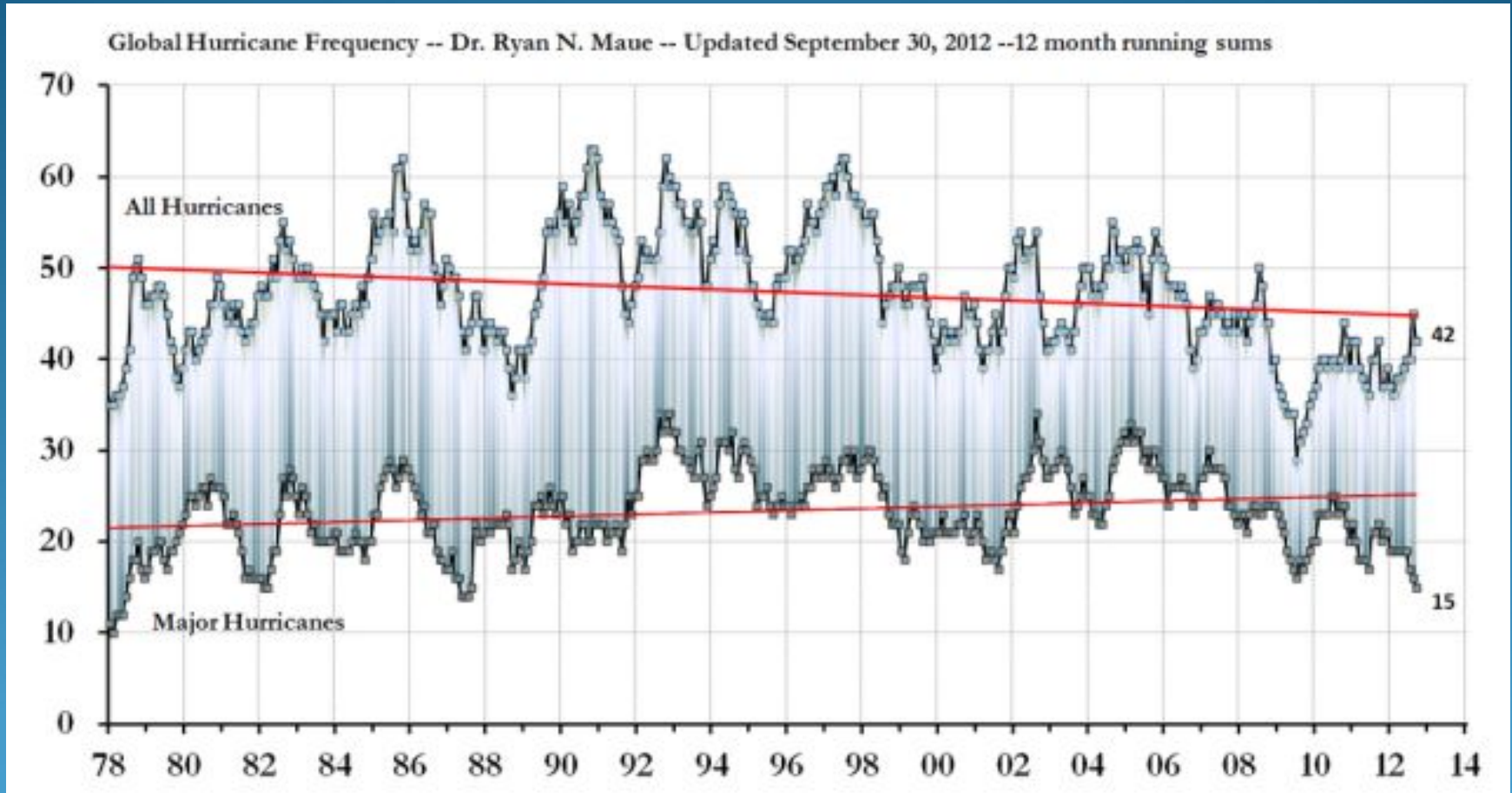
Extreme Weather Events

Record Temperatures

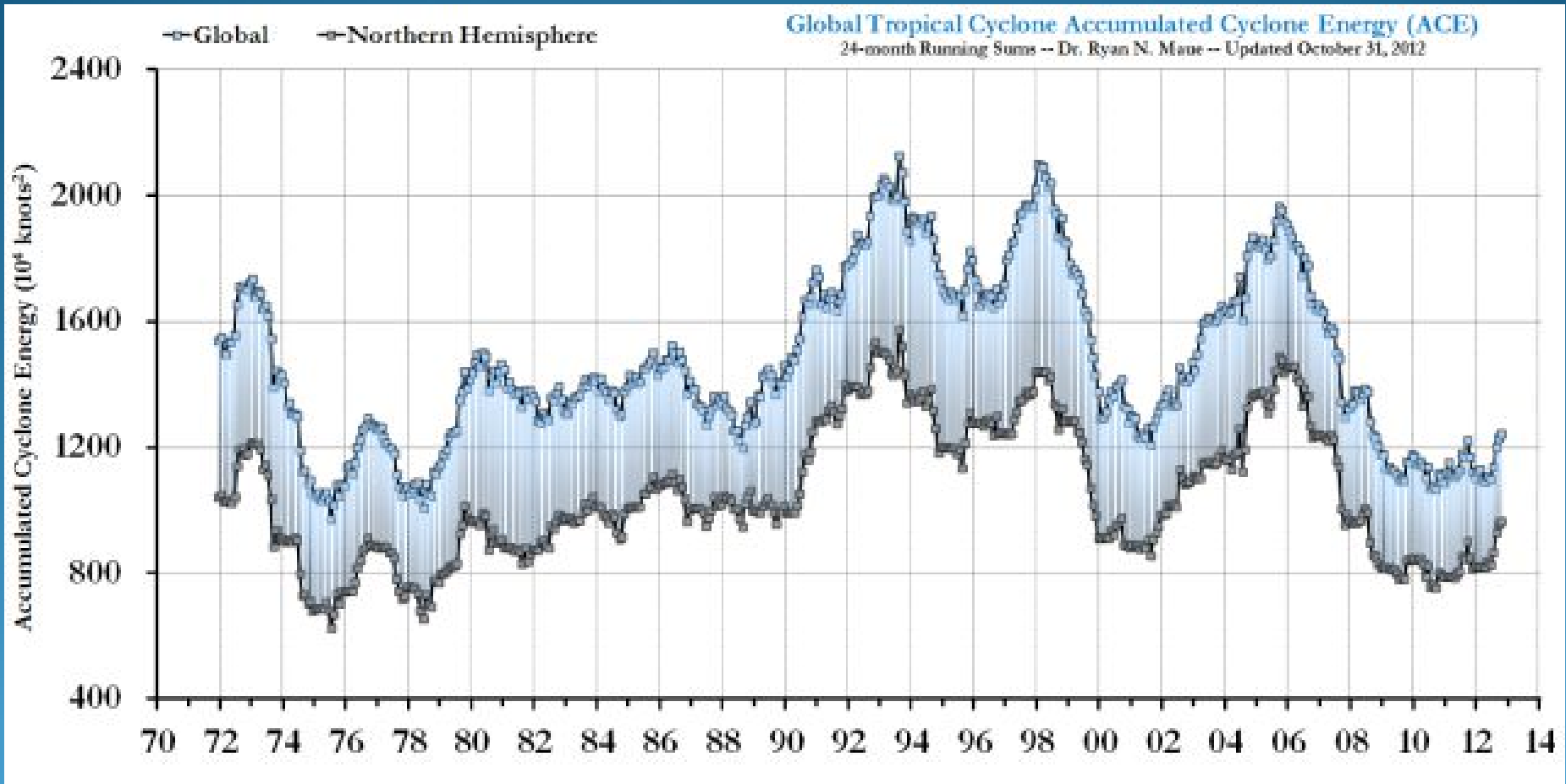
FIGURE 1.1 Number of State Record High and Low Temperatures by Decade (NOAA/NCDC/Extremes/SCEC)



Hurricane Events



Hurricane Events

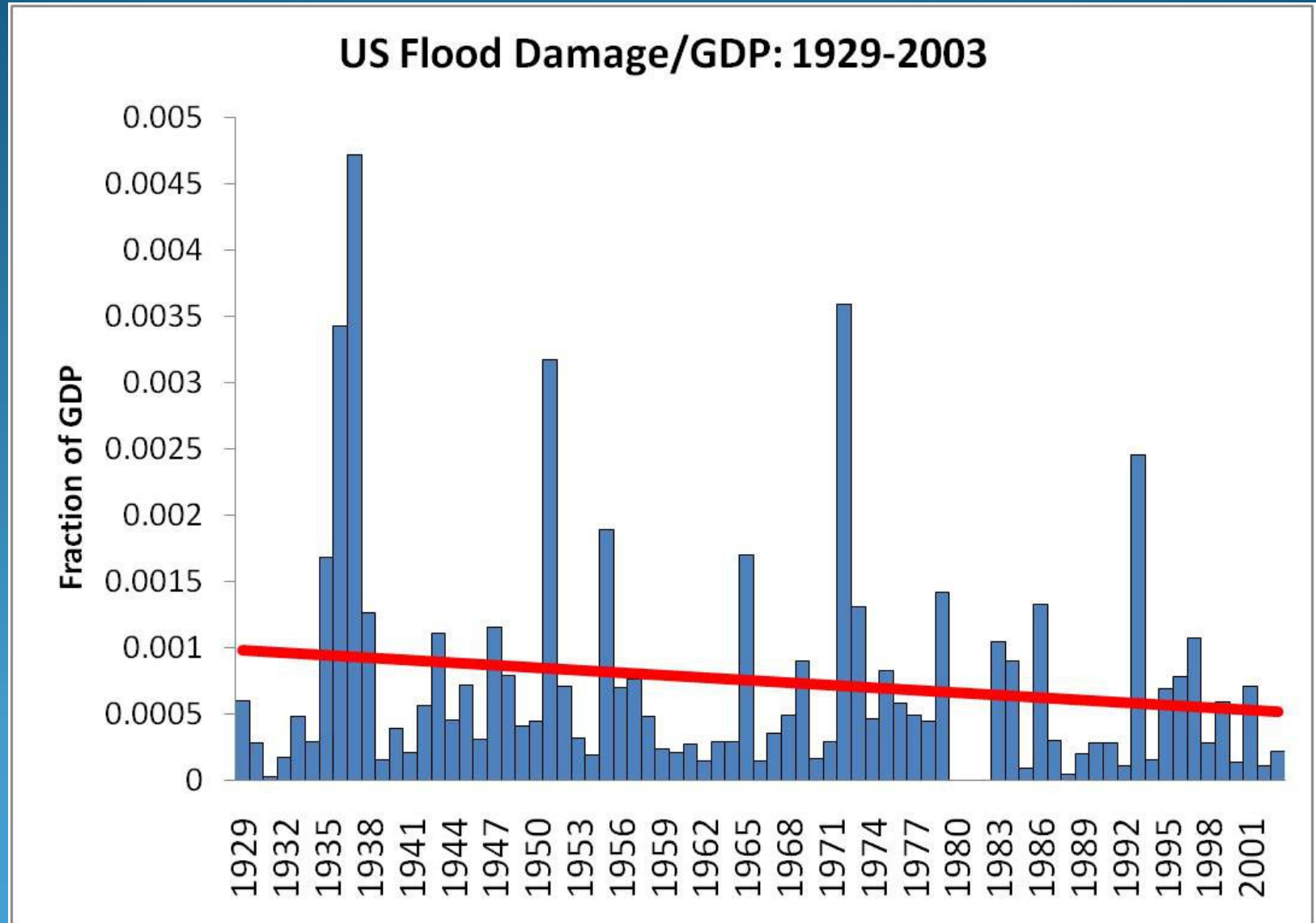


Extreme Weather Events

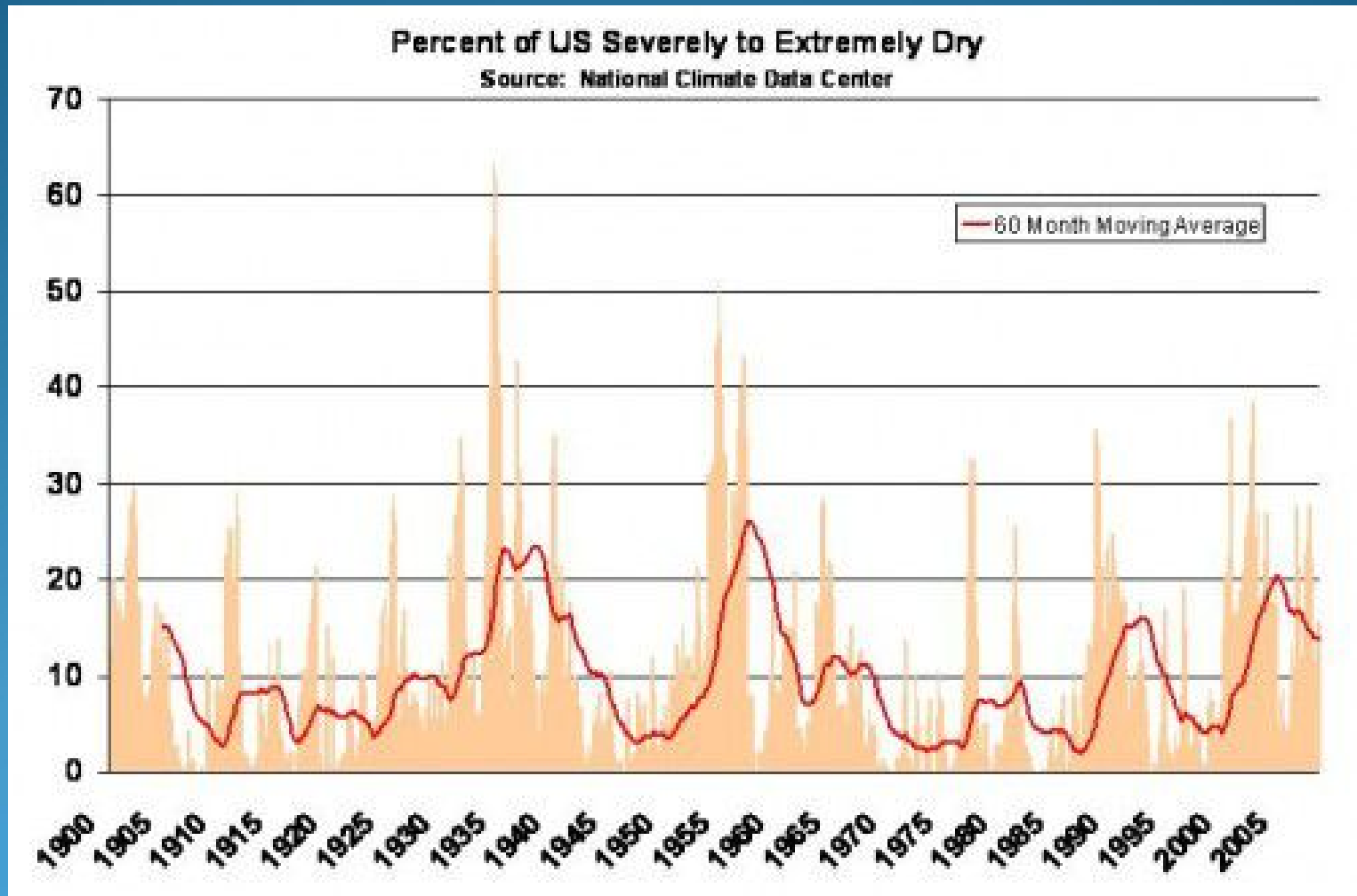
Table 2: Number of Years With Extremely High Hurricane Damage
(Adjusted for inflation, wealth and population increases)

	>\$1 Billion	>\$5 Billion	>\$10 Billion	Per Year (Billions)
1925-29	2	2	2	17.7
1930s	4	1	1	2.6
1940s	8	4	2	5.6
1950s	4	2	2	3.7
1960s	6	5	3	5.2
1970s	5	2	1	2.7
1980s	3	2	1	2.2
1990s	4	1	1	6.6

Damage Due to Extreme Events



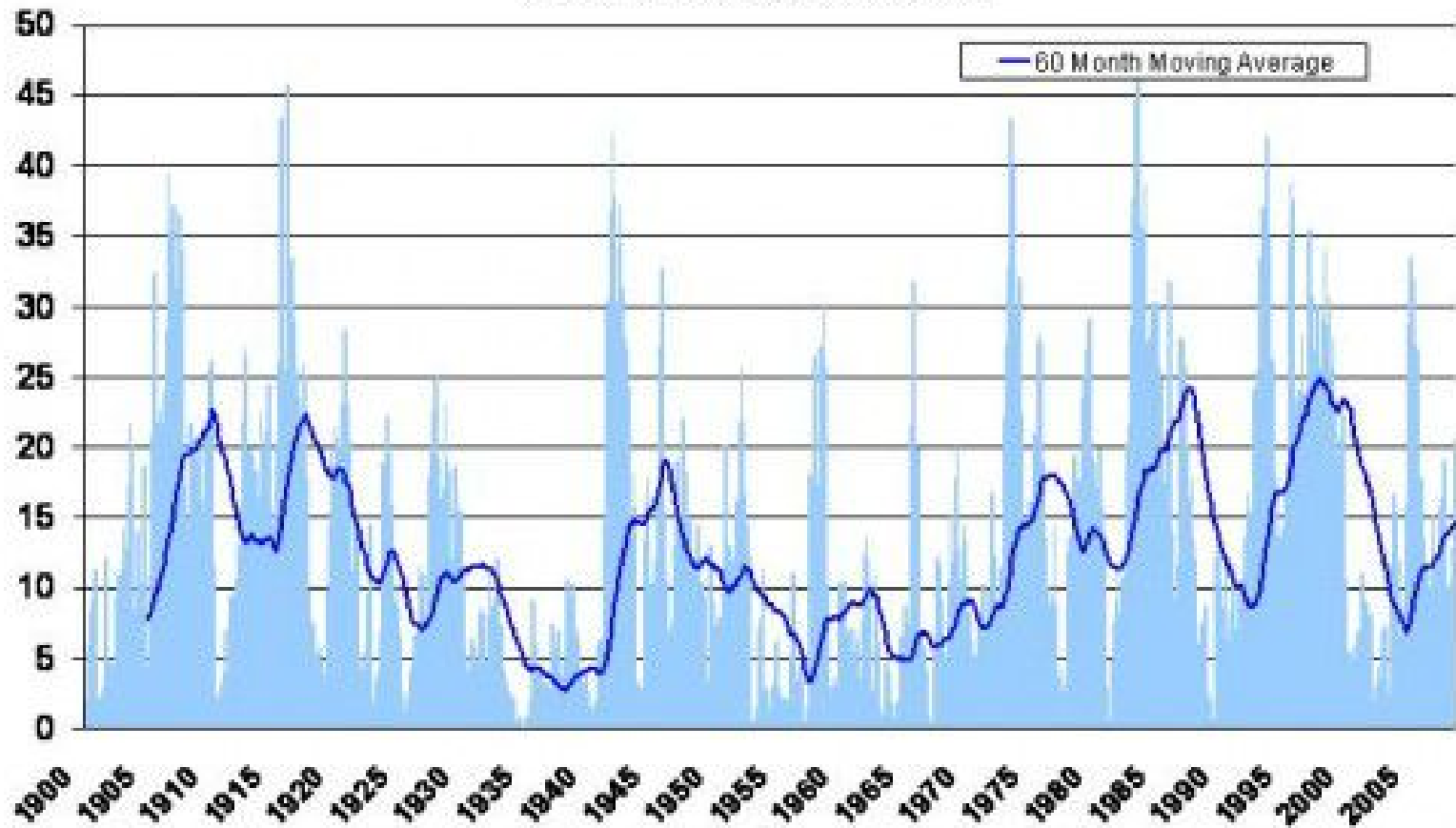
Extreme Drought Events



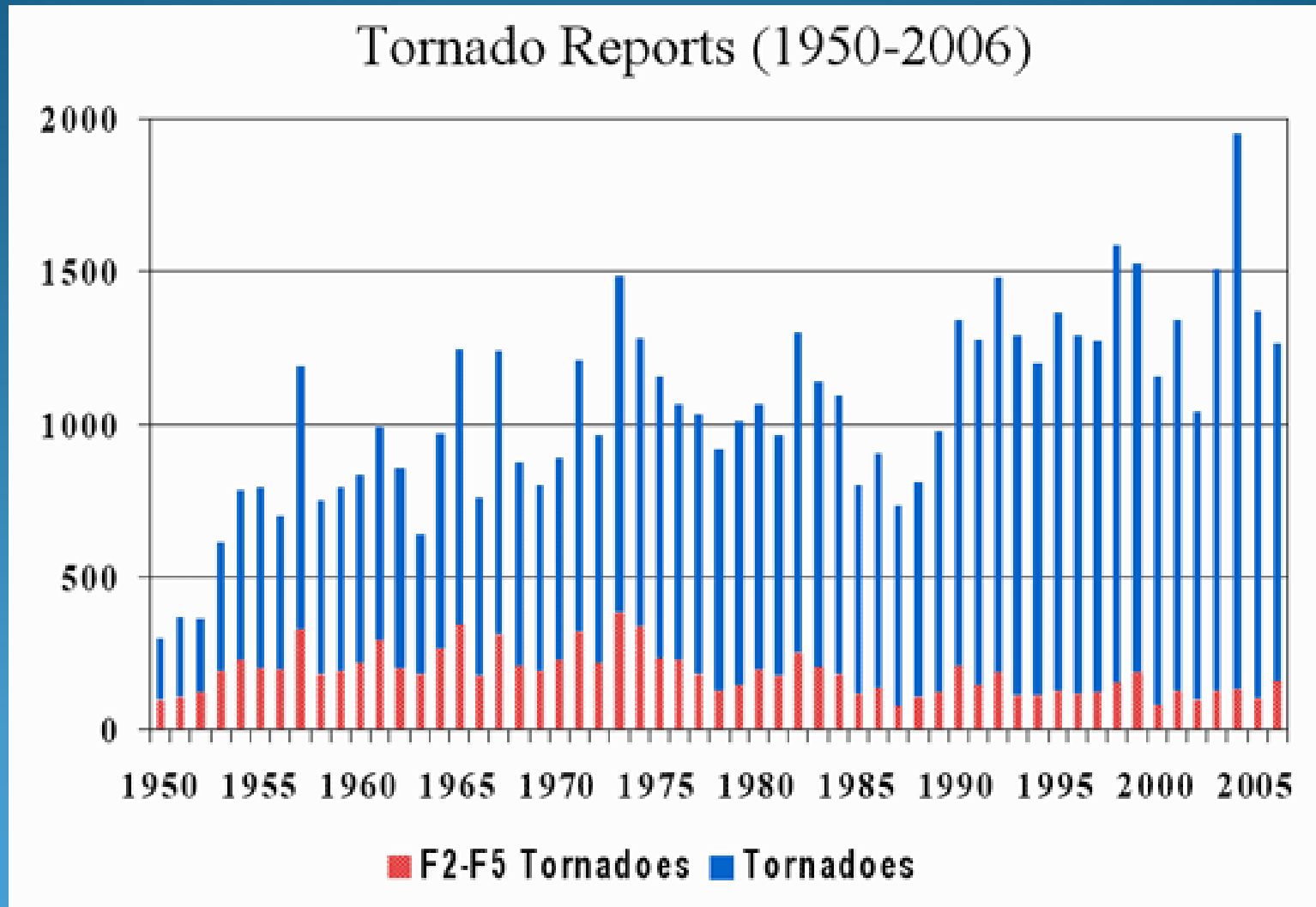
Extreme Wet Events

Percent of US Severely to Extremely Wet

Source: National Climate Data Center



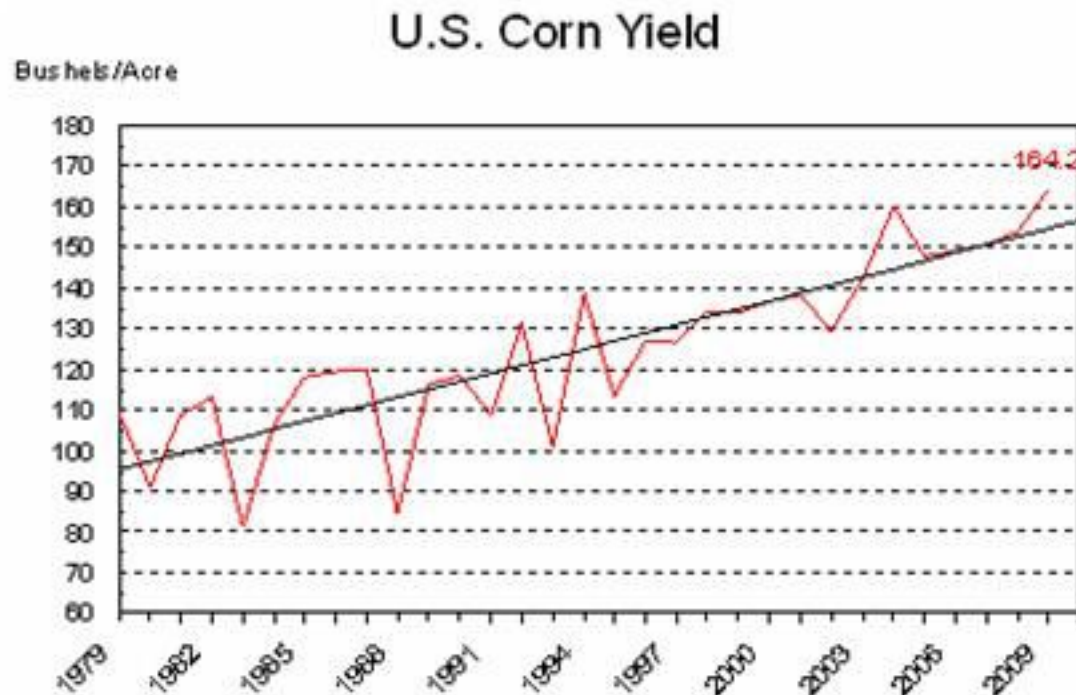
Extreme Events - Tornadoes



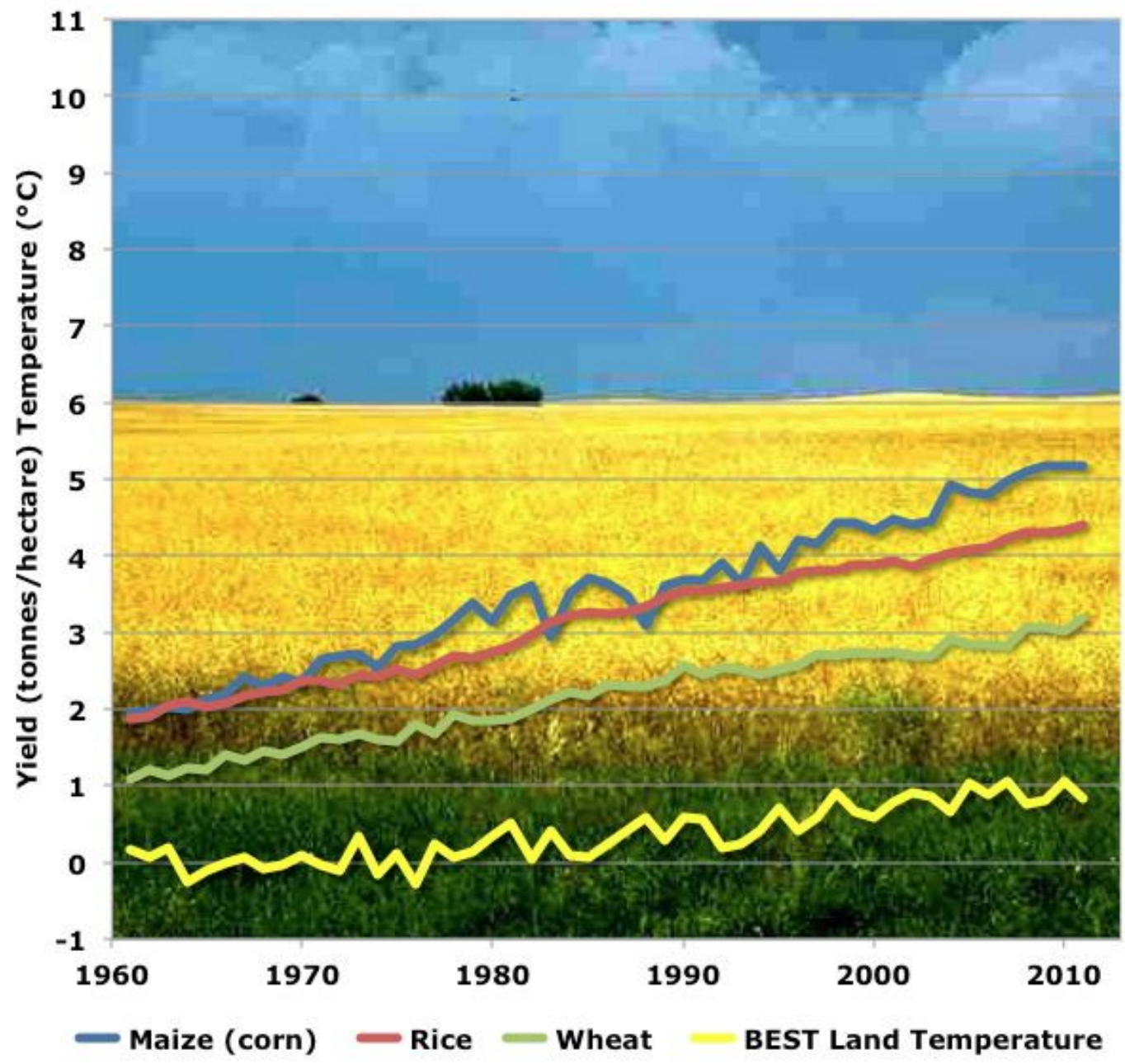
Effects on Crops

"Corn likes it cool, but global warming is raising temperatures across the nation," said Environment America Global Warming Advocate Timothy Telleen-Lawton. "Hotter fields will mean lower yields for corn, and eventually, the rest of agriculture."

-- April, 2009



Grain Yields And Temperature



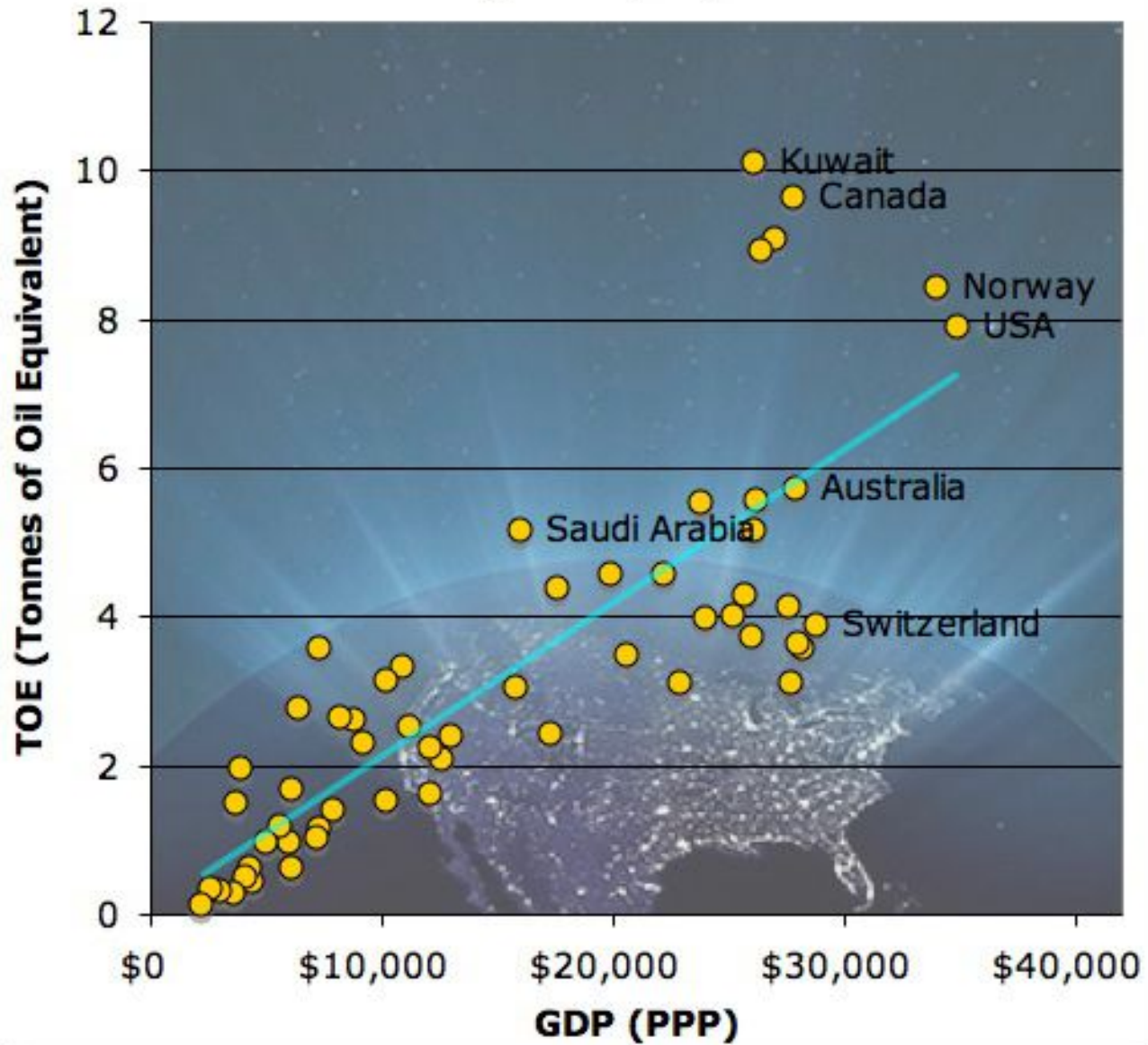
Richard Feynman

- “If a hypothesis disagrees with observations and data, it is wrong. It doesn’t make any difference how beautiful the hypothesis is, how smart the author is, or what the author’s name is, if it disagrees with data or observations, it is wrong” .

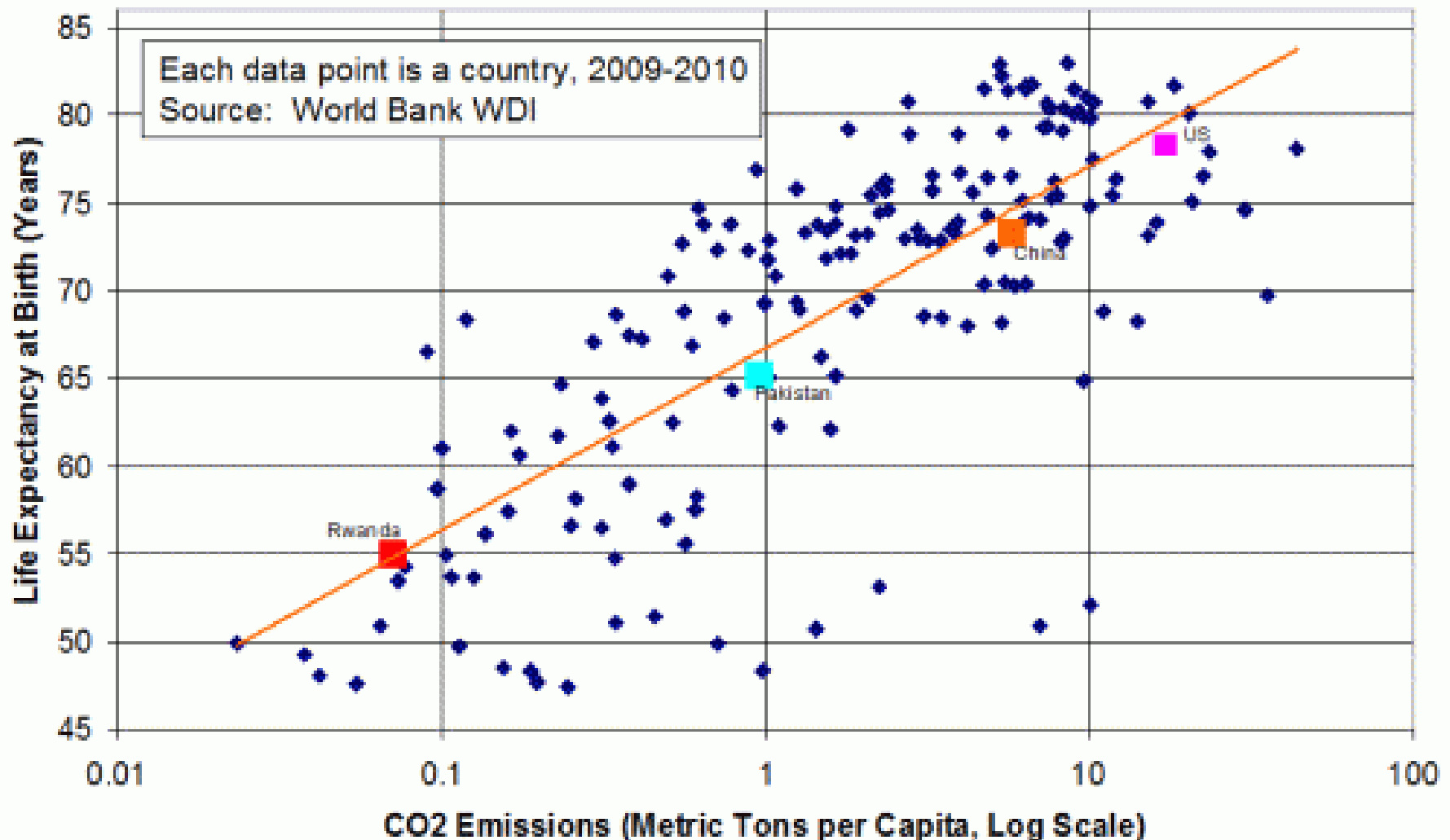
Question

- Even if one completely dismisses a human role in global warming, does it make sense to continue to dump greenhouse (and other) pollutants into the atmosphere?
- The difference is one of urgency and the need to destroy one's economy and way of life for an uncertain and possibly negligible effect.

Energy Consumption vs GDP (per capita)



Each Increase by 10x in CO2 Emissions Correlates to a 10-Year Increase in Life Expectancy



Dominant Factors Influencing Climate Change

Three Hypotheses
by R.A. Pielke Sr.



EXPLANATION

ONLY ONE HYPOTHESIS CAN BE TRUE

Hypothesis 1: Human influence on climate variability and change is of minimal importance, and natural causes dominate climate variations and changes on all time scales. In coming decades, the human influence will continue to be minimal.

Hypothesis 2a: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first order climate forcings, including, but not limited to, the human input of carbon dioxide (CO₂). Most, if not all, of these human influences on regional and global climate will continue to be of concern during the coming decades.

Hypothesis 2b: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and are dominated by the emissions into the atmosphere of greenhouse gases, the most important of which is CO₂. The adverse impact of these gases on regional and global climate constitutes the primary climate issue for the coming decades.

Artwork: Bill DiPuccio

Ethical Considerations

- Data Manipulation
- Concealment of data & analysis methods
- Fraud / Misrepresentation

- Scientific Societies aid, abet, and reward such behavior.
- Scientists tolerate, accept such behavior
- Violation of our common sense.

Proof of Global Warming



Parting Thought

- A lone amateur, against the consensus built the Ark.
- The consensus of a large group of professionals who built the Titanic was that it would not sink.
- In nearly every case in history in which the “consensus” has been invoked, the consensus was wrong.
(Galileo, “ether” , Gondwanaland, ulcers, ...)

Proposed
Solution to
the Problem

Proposed Solutions

would reduce US per capita CO₂ use to levels not seen since
~1880

No amount of conservation could produce such reductions
“Renewable” energy is incapable of producing the amount
of power required.

“Green” economy is not sustainable

Involves massive transfers of capital out of developed
countries to others.

All to produce a negligible difference in the temperature 100
years from now

What does this mean?

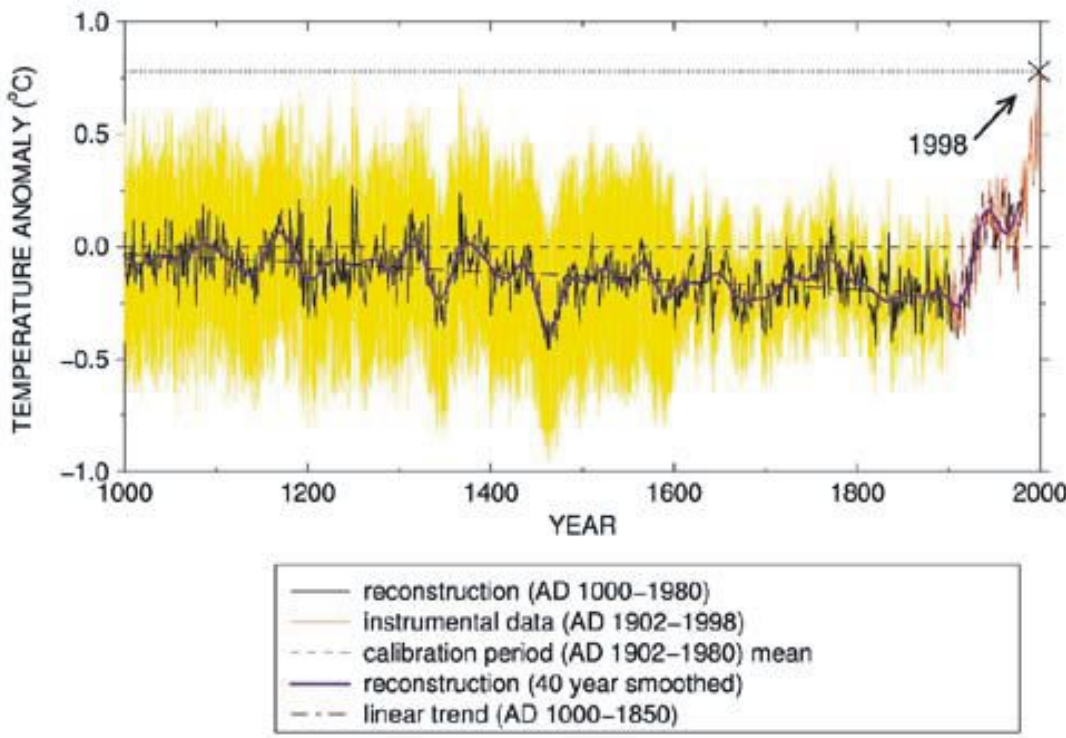
We are coming out of a long term cold spell. Temperatures might be expected to rise slightly long term

The 1945 peak and the medieval warm period (MWP) present a problem for AGW. The models cannot explain how climate can change $> 0.5\text{C}$ without an increase in CO_2

Both climate events have been the subject of efforts to erase their existence from the record.

This is what the controversy over the “Hockey Stick” is about.

Global Average Temperature

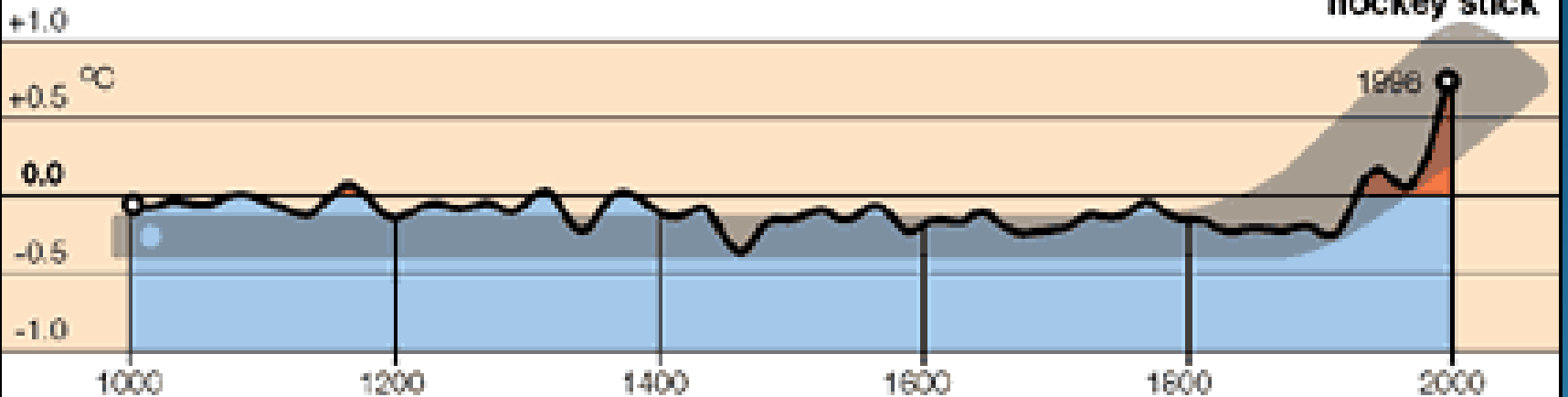


This plot, sometimes referred to as the “hockey stick” is also used to show the seriousness of global warming. It shows a long term drop followed by a precipitous rise.

Battle of the graphs

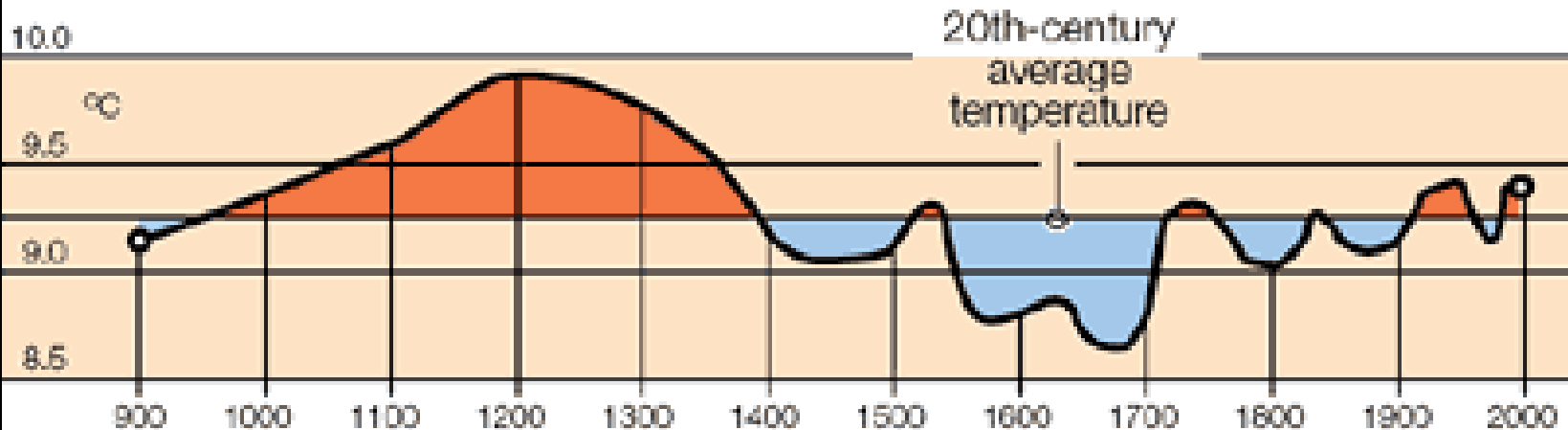
Temperature anomaly

Relative to 1960-1990

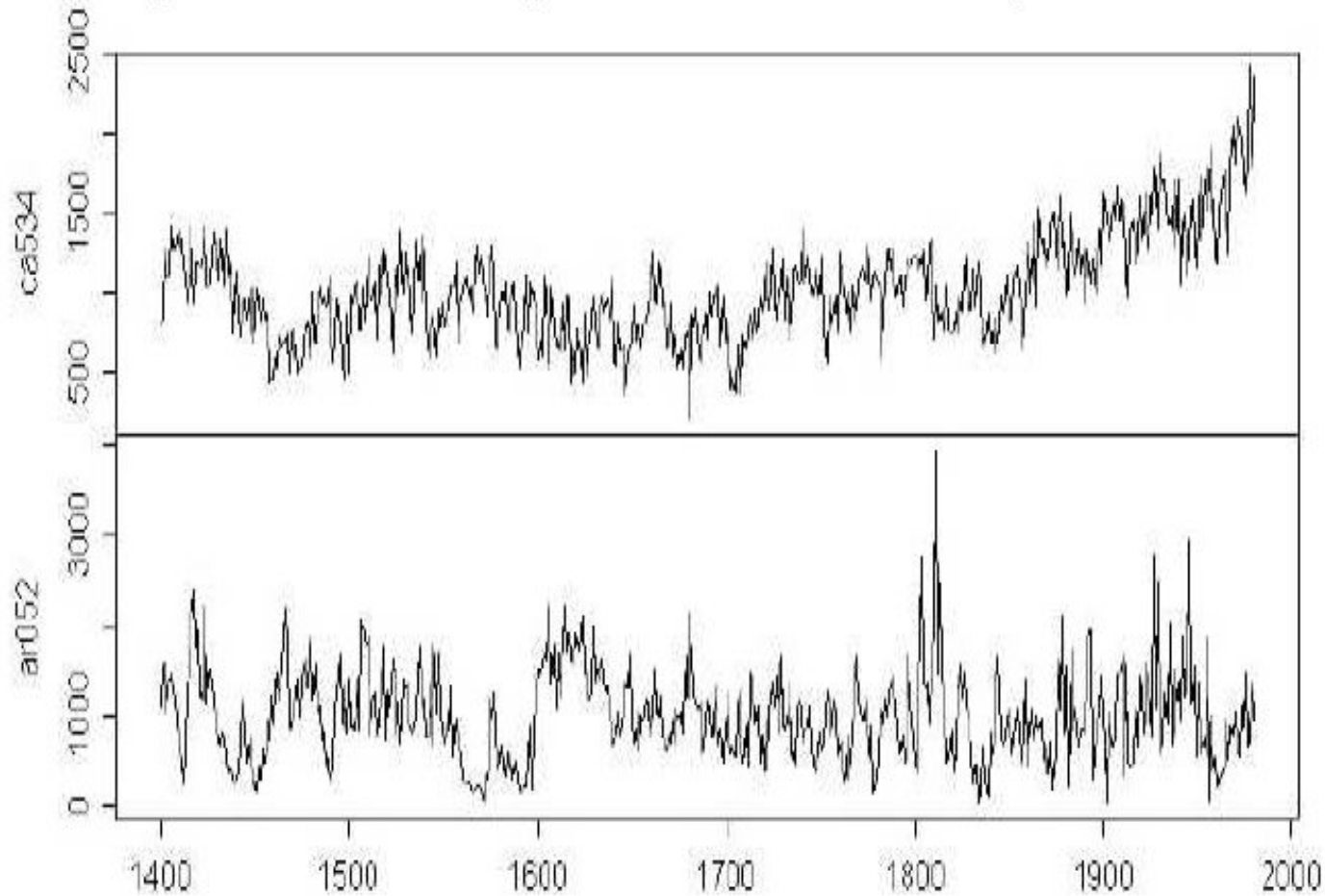


Climatic changes in europe

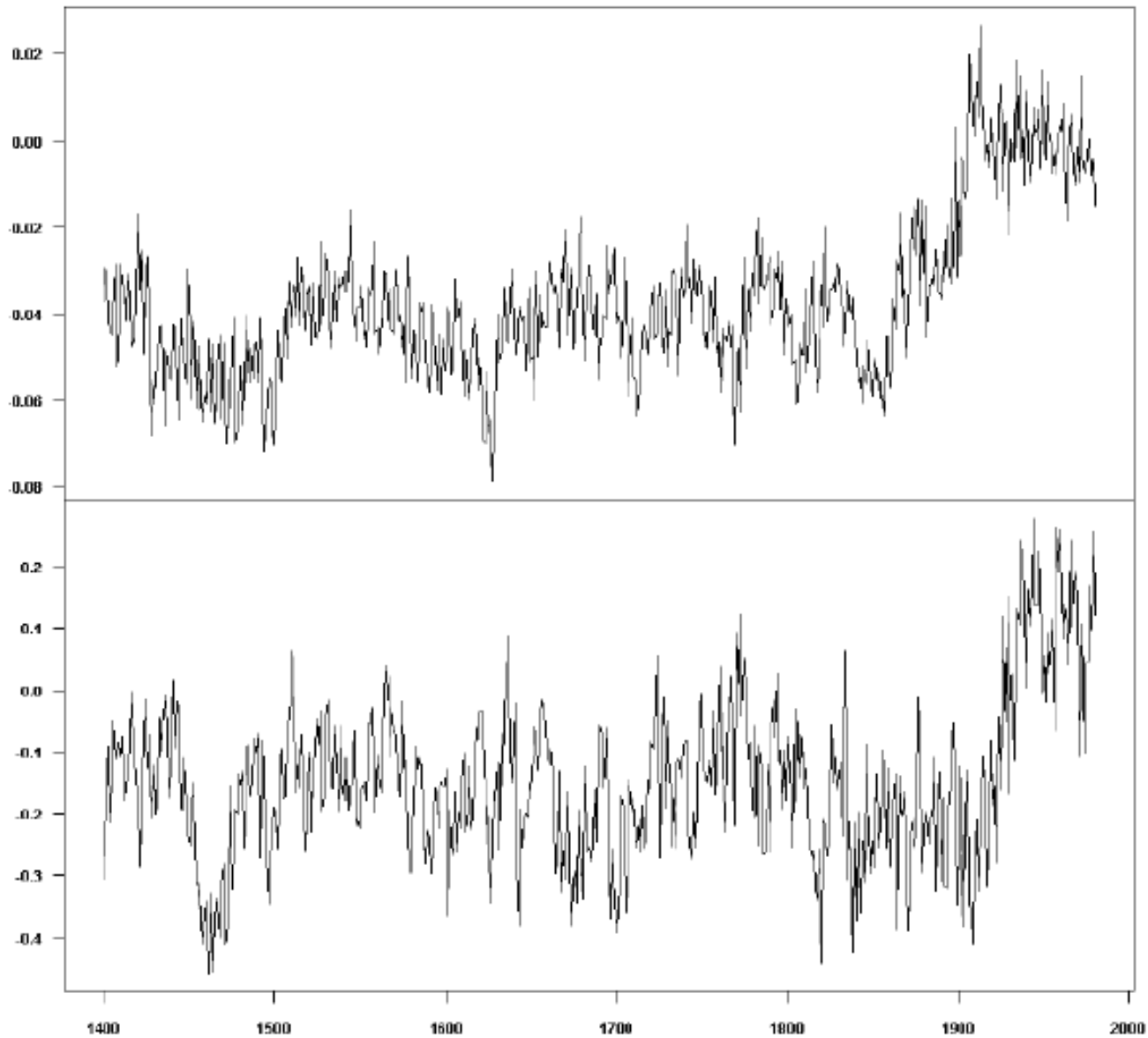
Over the past thousand years



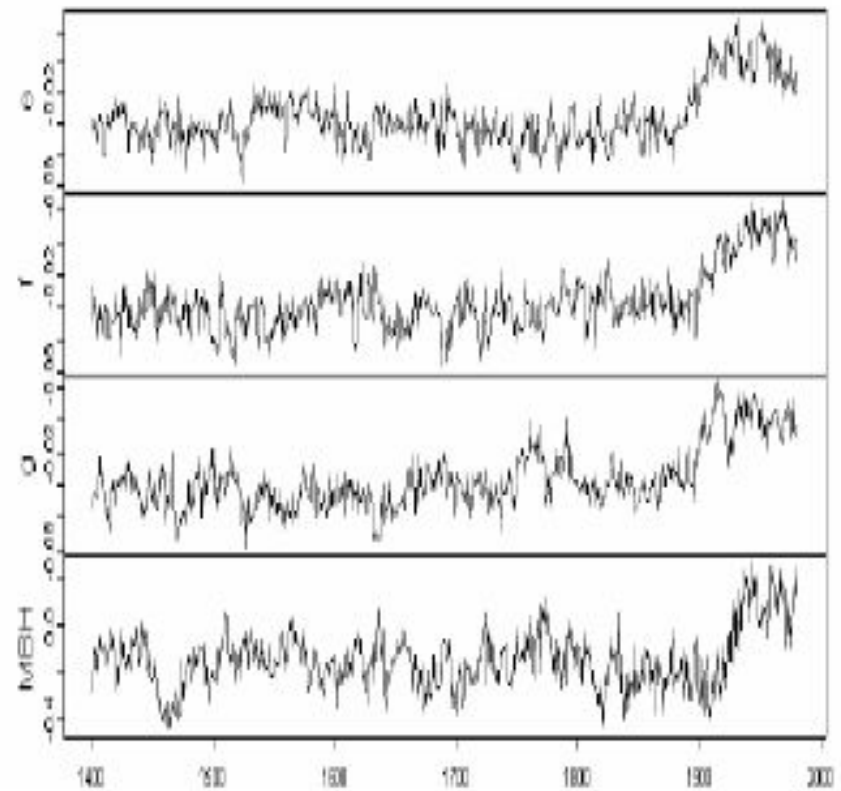
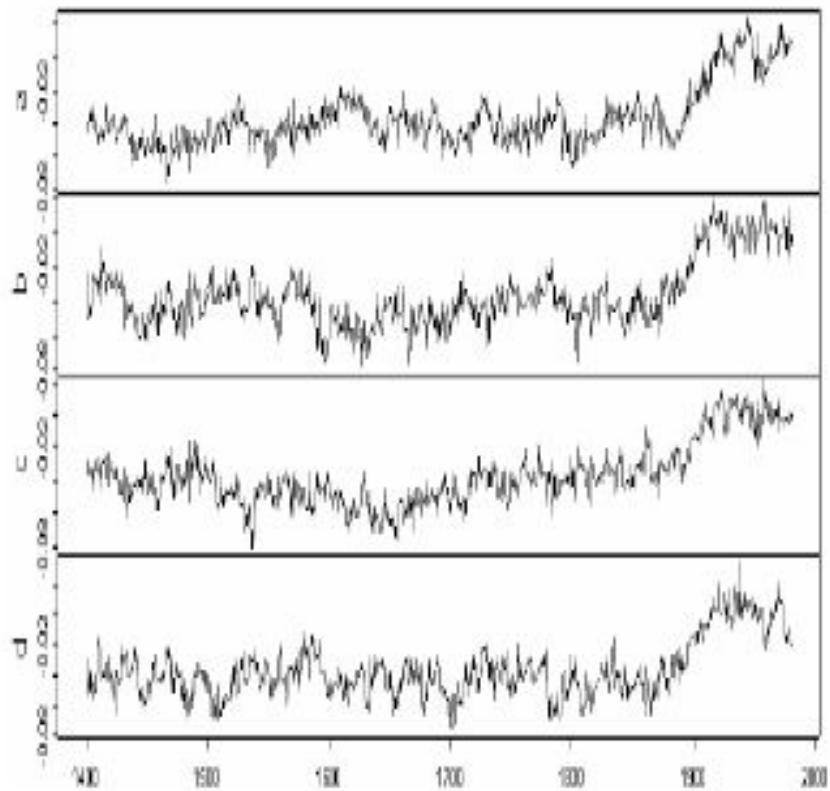
Tree ring records were searched for ones for which the 1900-1960 period



*Two tree ring chronologies from the dataset relied upon by Mann et al (1998). **Upper panel:** Sheep Mountain, California, USA. **Lower panel:** Mayberry Slough, Arizona, USA. Both series are the same length, but Mann's algorithm gives the Sheep Mountain chronology 390 times the weight of the other series.*

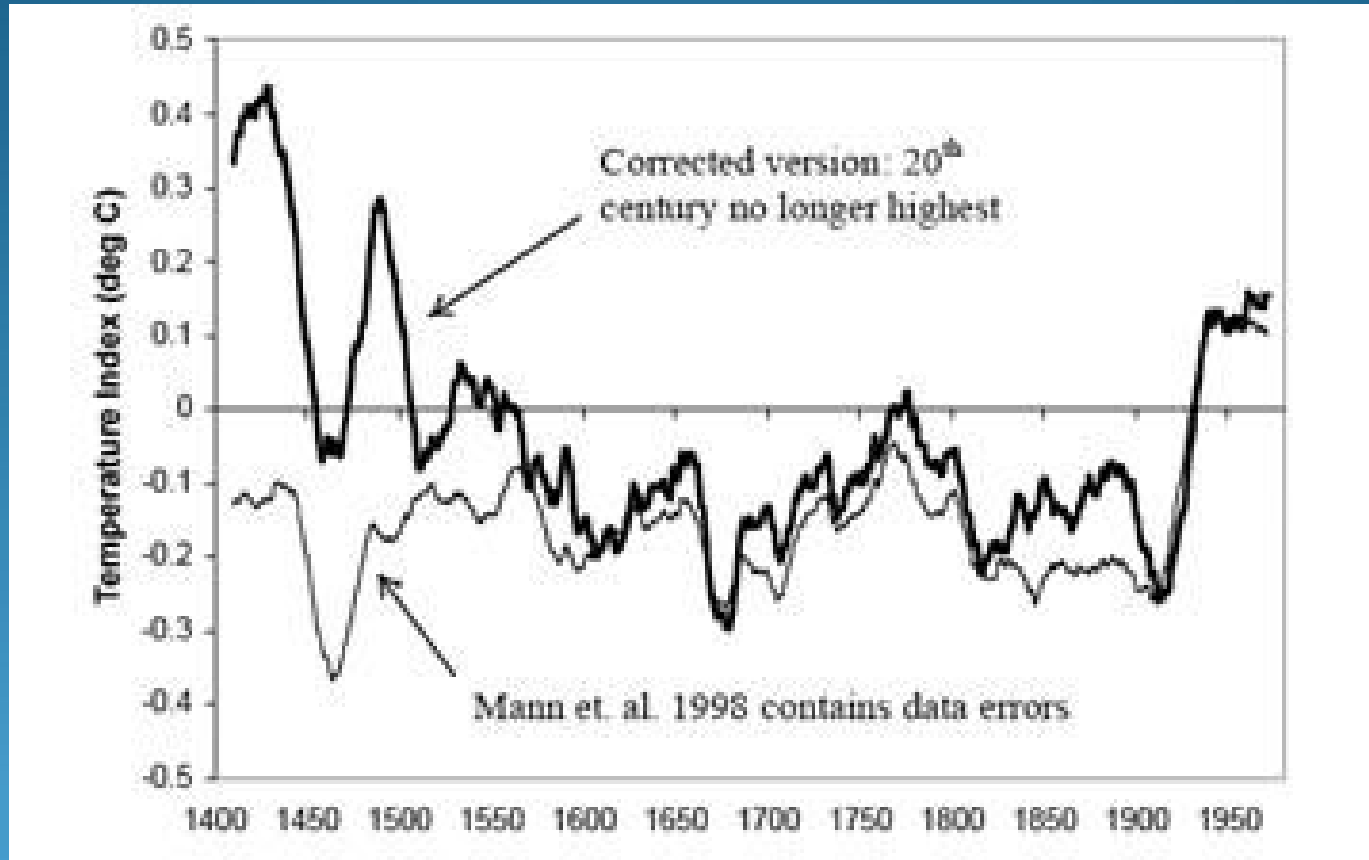


*Upper: Graph by McIntyre et al. (2003), with random noise in the model of Mann et al.
Lower: Temperature reconstruction using Mann et al. proxy data in the same model.*



“Numbers are like people, torture them enough and they’ll tell you whatever you want to hear.”

Corrected Version of the Hockey Stick



A recalculation of the temperature reconstruction of Mann et al. as done by McIntyre et al.

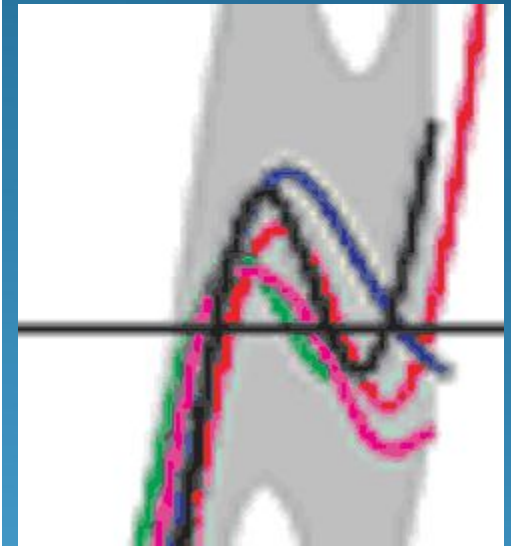
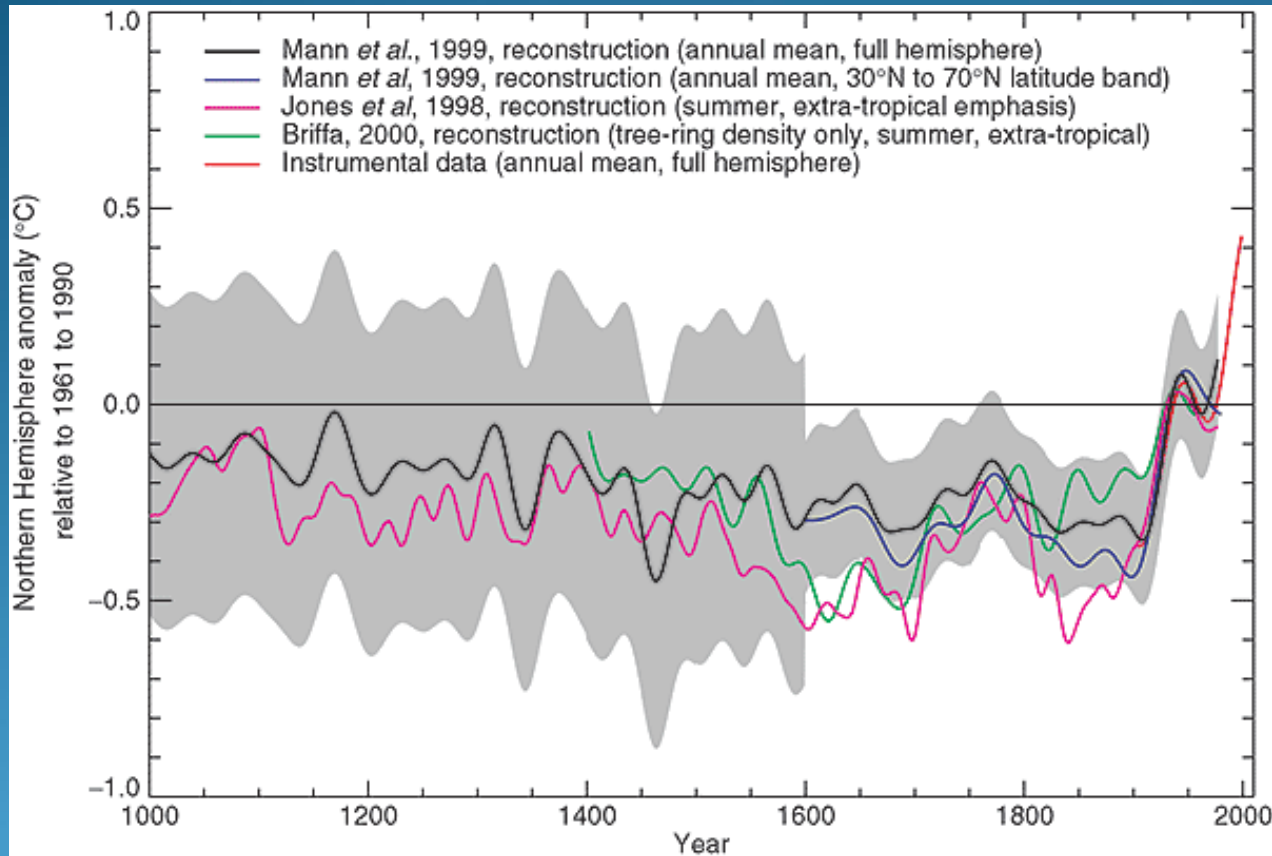
What does this mean?

The inclusion of data sets in the “censored” data set and using correct statistical processes result in a MWP.

But it gets worse.

Note that the hockey stick data ends in 1960. This is the origin of the “Hide the decline” trick in the email scandal

Fiddling with the Data



What It Should Look Like

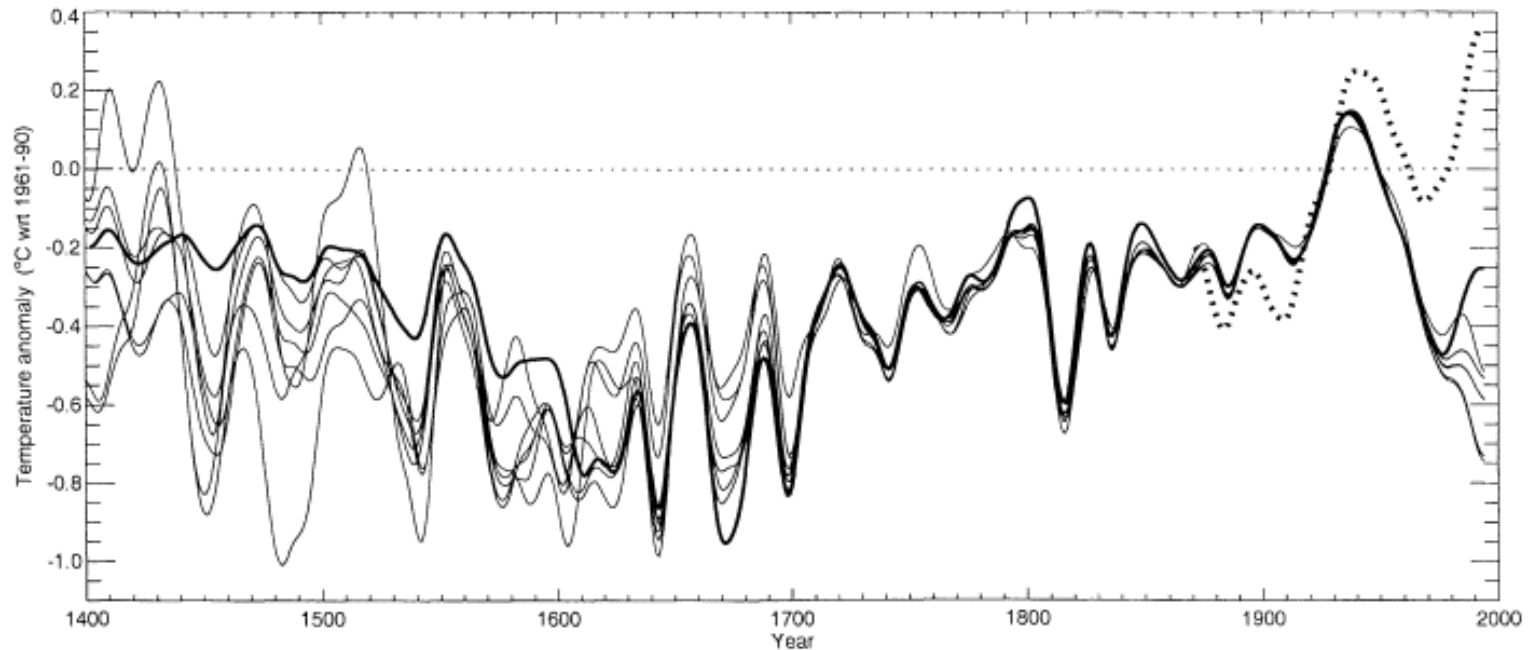


Figure 4. Eight alternative reconstructions of the mean temperature over all land north of 20°N (observations shown by dotted line for 1871-1994). All curves are smoothed with a 25-year filter. See text for explanation of the eight reconstruction methods. The preferred reconstruction based on principal components regression is shown by the thick line for 1402-1994.

What does this mean?

If tree rings are good proxy data for 1900 to 1960 and thus from 1900 back in time, why are they not a good proxy for temperature from 1960 to 2000?

To hide the issue, the IPCC hid the data from 1960 on.

This is done to preserve the hockey stick.

How Does This Happen?

- “The Reason for the Lack of Recognition of the Problems with the Surface Temperature Trend Data is Due to the Conflict of Interest in Preparing such Climate Assessments”

Roger Pielke



Santer, B.D., T.M.L. Wigley, C. Mears, F.J. Wentz, S.A. Klein, D.J. Seidel, K.E. Taylor, P.W. Thorne, M.F. Wehner, P.J. Gleckler, J.S. Boyle, W.D. Collins, K.W. Dixon, C. Doutriaux, M. Frey, Q. Fu, J.E. Hansen, G.S. Jones, R. Fuedy, T.R. Karl, J.R. Lanzante, G.A. Meehl, V. Ramanammy, G. Russel, and G.A. Schmidt, 2005: Amplification of surface temperature trends and variability in the tropical atmosphere. *Science*, 309, 1551-1556. DOI:10.1126/science.1114867.

Sherwood, S.C., J.R. Lanzante, and C.L. Meyer, 2005: Radiosonde daytime biases and late-20th century warming. *Science*, 1556-1559. doi:10.1126/science.1115640.

Mears, C.A., and F.J. Wentz, 2005: The effect of diurnal correction on satellite-derived lower tropospheric temperature. *Science*, 1548-1551. doi:10.1126/science.1114772.

CCSP REPORT

Preface. Report Motivation and Guidance for Using this Synthesis/Assessment Report by Karl, T.R., C. D. Miller, and W. L. Murray, editor

Executive Summary by Wigley, T.M.L., V. Ramaswamy, J.R. Christy, J.R. Lanzante, C.A. Mears, B.D. Santer, C.K. Folland

Chapter 1. Why do temperatures vary vertically (from the surface to the stratosphere) and what do we understand about why they might vary and change over time? by Ramaswamy, V., J.W. Hurrell, G.A. Meehl

Chapter 2. What kinds of atmospheric temperature variations can the current observing systems measure and what are their strengths and limitations, both spatially and temporally? by Christy, J.R., D.J. Seidel, S.C. Sherwood

Chapter 3. What do observations indicate about the changes of temperature in the atmosphere and at the surface since the advent of measuring temperatures vertically? by Lanzante, J.R., T.C. Peterson, F.J. Wentz, K.Y. Vinnikov

Chapter 4. What is our understanding of the contribution made by observational or methodological uncertainties to the previously reported vertical differences in temperature trends? by Mears, C.A., C.E. Forest, R.W. Spencer, R.S. Vose, R.W. Reynolds

Chapter 5. How well can the observed vertical temperature changes be reconciled with our understanding of the causes of these temperature changes? by Santer, B.D., J.E. Penner, P.W. Thorne

Chapter 6. What measures can be taken to improve our understanding of observed changes? by Folland, C.K., D. Parker, R.W. Reynolds, S.C. Sherwood, P.W. Thorne

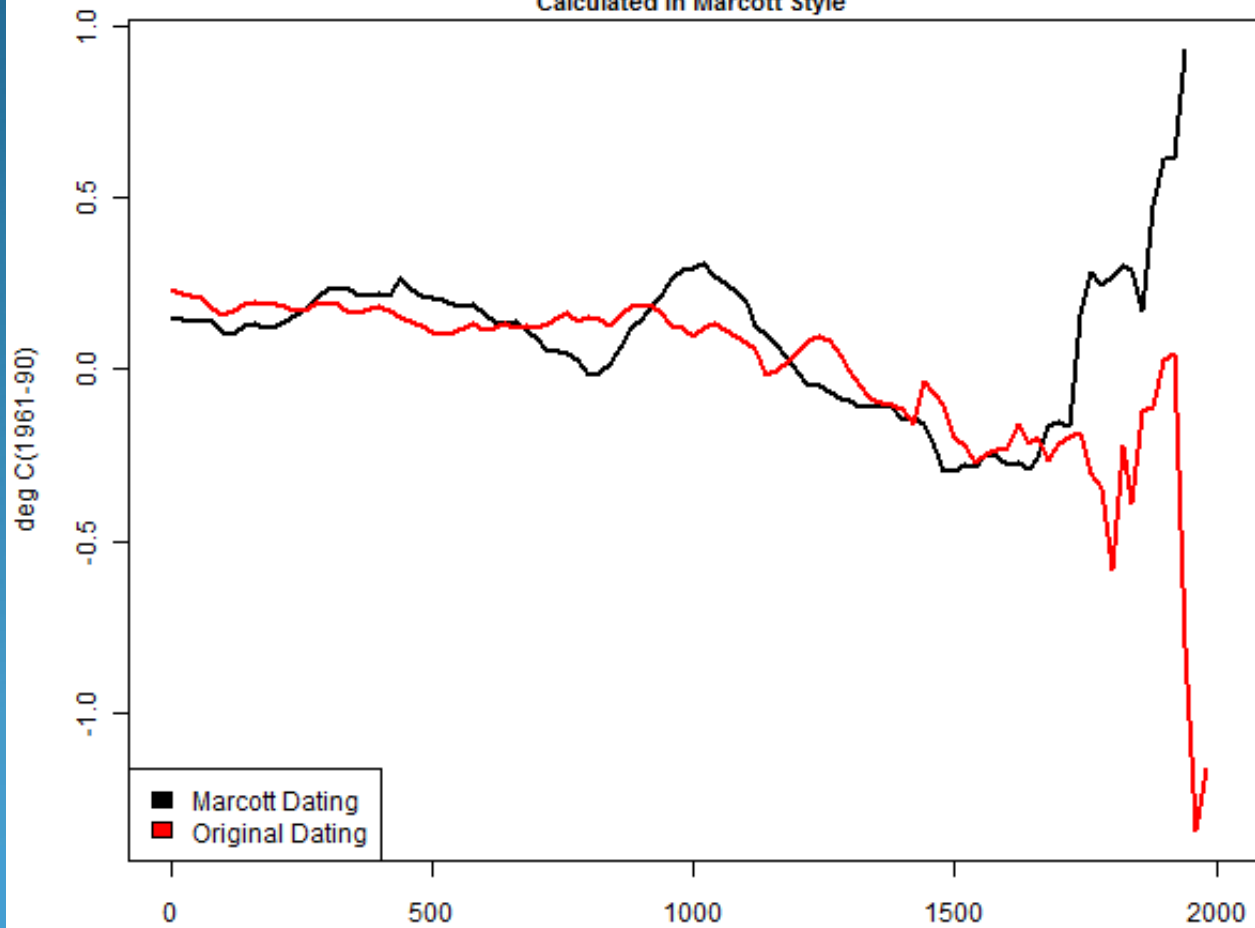
Appendix A. Statistical Issues Regarding Trends. by Wigley, T.M.L.

- we show clearly that adjustments made to the USHCN produce highly significant warming trends at various temporal scales. We find that the trends in the unadjusted temperature records are not different from the trends of the independent satellite-based lower-tropospheric temperature record or from the trend of the balloon-based near-surface measurements.
- Given that no substantial time of observation bias would be contained in either the satellite-based or balloon-based measurements, and given that the time of observation bias is the dominant adjustment in the USHCN database, our results strongly suggest that the present set of adjustments spuriously increase the long-term trend.

Balling and Idso, 2002, Analysis of adjustments to the United States Historical Climatology Network (USHCN) temperature database, Geophys Res Let, 29, 10.1029/2002GL014825

Alkenone Reconstructions

Calculated in Marcott Style



Concerns about Global Warming come from two assumptions:

"the false assumption not only that we live in a perfect world, temperaturewise"

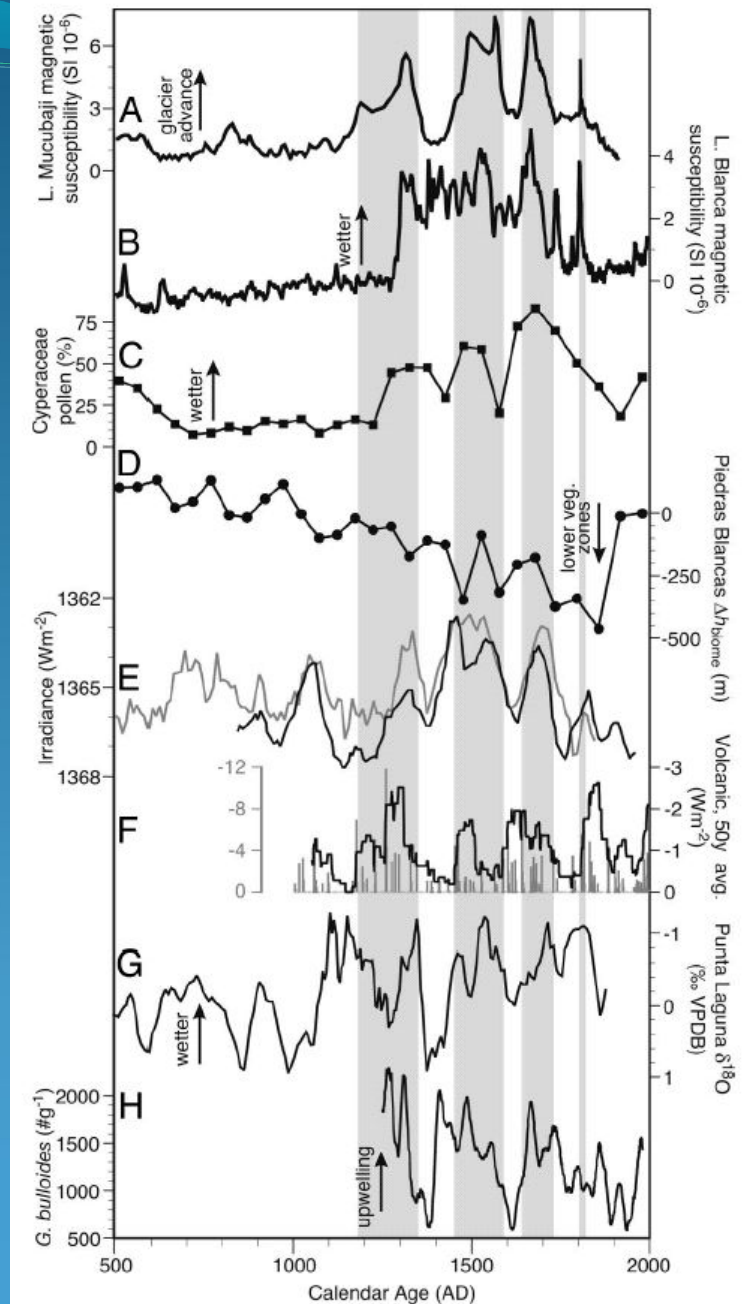
and

"that our warming forecasts for the year 2090 are somehow more reliable than the weatherman's forecast for next week."

Richard Lindzen

Oxygen isotope time series for the last 5000 years, GISP2
Greenland ice core (light line; same dataset as Figure 7), fitted
with a moving average (dark line; after a slide by Andre
Illarianov, 2004

- This figure shows a variety of proxy records. The two sediment series are the top two series. Note the sharpness of Series B (Lago Blanca), which can be interpreted as glacier presence/absence, with onset in the 13th century and ending in the 19th century. The non-existence of the glacier in the MWP is very distinct in this record. Series B shows its maximum extent in the late 17th century, the period of greatest North Atlantic chill in Lamb's view of the world.
- Lake-sediment records from the Venezuelan Andes compared with indices of solar activity and additional tropical paleoclimate proxies. (A–C) Glacial advances, indicated by increases of sediment MS in L. Mucubají (A) (vertical gray shading), coincide with an increase in precipitation, shown by higher MS in L. Blanca (B) and higher abundances of Cyperaceae (sedge) pollen in the Piedras Blancas peat bog located near to L. Mucubají (C) (13). (D) Lowering of ecological zones and colder-wetter climate during the LIA is indicated by the hbiome (equivalent to the minimum estimated departure in ref. 15) from the Piedras Blancas site. (E) Minima in reconstructed solar irradiance (black line) (16) using the scaling of ref. 17 or maxima in 14C (gray line, inverted scale) (18) are coeval with glacier advances. The 14C record reflects solar modulation of the 14C production rate and is scaled to the reconstructed irradiance curve of ref. 16. (F) Annual record of latitude-weighted volcanic aerosol forcing (gray bars and left axis) (4) and 50-yr averages (line and right axis, multiplied by 4 to scale with the reconstructed solar irradiance and plotted at youngest age of the 50-yr window). (G) Wetter conditions are supported by the Punta Laguna, Mexico, $\delta^{18}O$ record of higher P/E during Mucubají glacial advances (19). (H) Abundances of the foraminifer *Globigerina bulloides* in Cariaco Basin sediments are higher during glacial advances indicating stronger trade winds (20).



- I doubt that that exposure will mean much to the general public, but to those of us with a closer interest there are several revelations about US and global temperature measurements (in their final and adjusted forms), that remain a bit puzzling to me:
- That adjustments are relegated to the US.
- That the amount of the adjustment in the US is comparable to the warming anomaly.
- That the details of the means to make adjustments are not known outside those doing it.
- That the assumptions of station quality control, or a lack thereof, are not revealed or apparent.
- Why, if adjustments are required and carried out for US measurements and are a significant portion of the warming trend, they are not considered necessary for other nations?

In More Detail

Temperature Record

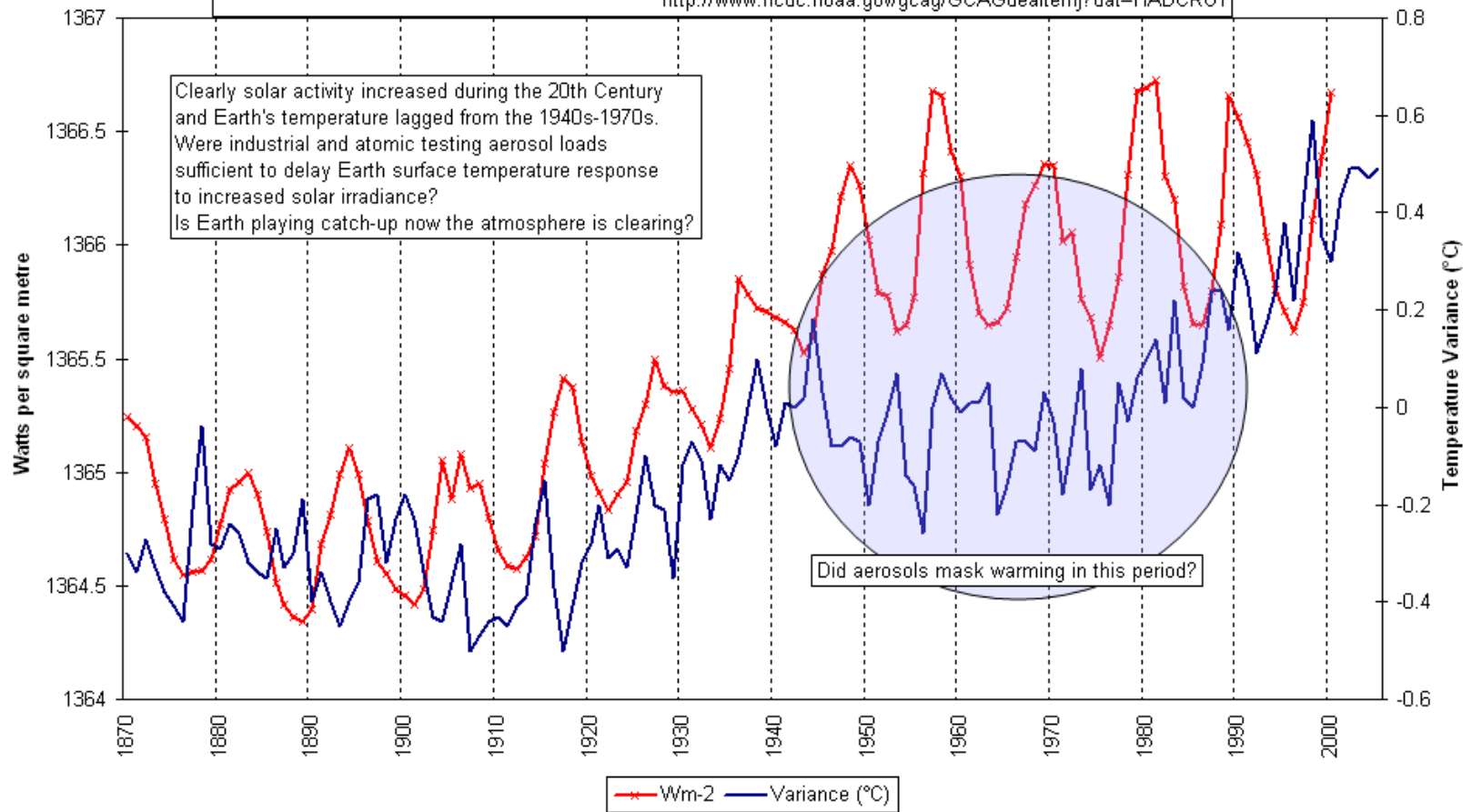
- Global Surface Temperature seems to have risen $\sim 1^{\circ}\text{C}$ in last 100 years
- Tree ring data indicates temperature decreases from 1000-1900 and then started to rise.
- Record high temperatures recorded in 1997 and 1998
- Details of the long term temperature record are uncertain.

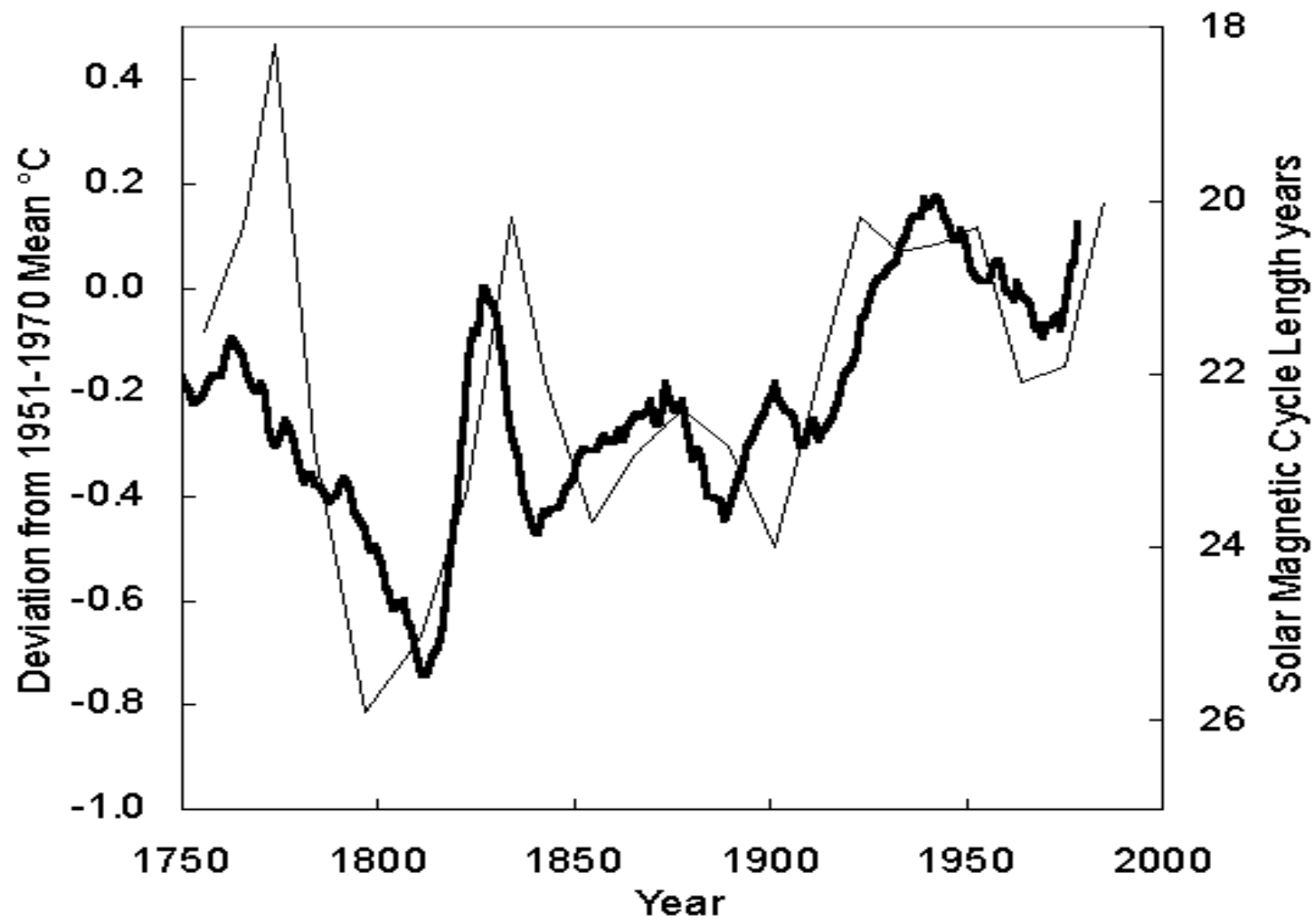
Solar Contribution

- Some have suggested that changes in the brightness of the sun is driving climate change

Solar Irradiance vs Near-Surface Temperature Variance

Data sources: http://www1.ncdc.noaa.gov/pub/data/paleo/climate_forcing/solar_variability/lean2000_irradiance.txt
<http://www.ncdc.noaa.gov/gcag/GCAGdealtemj?dat=HADCRUT>

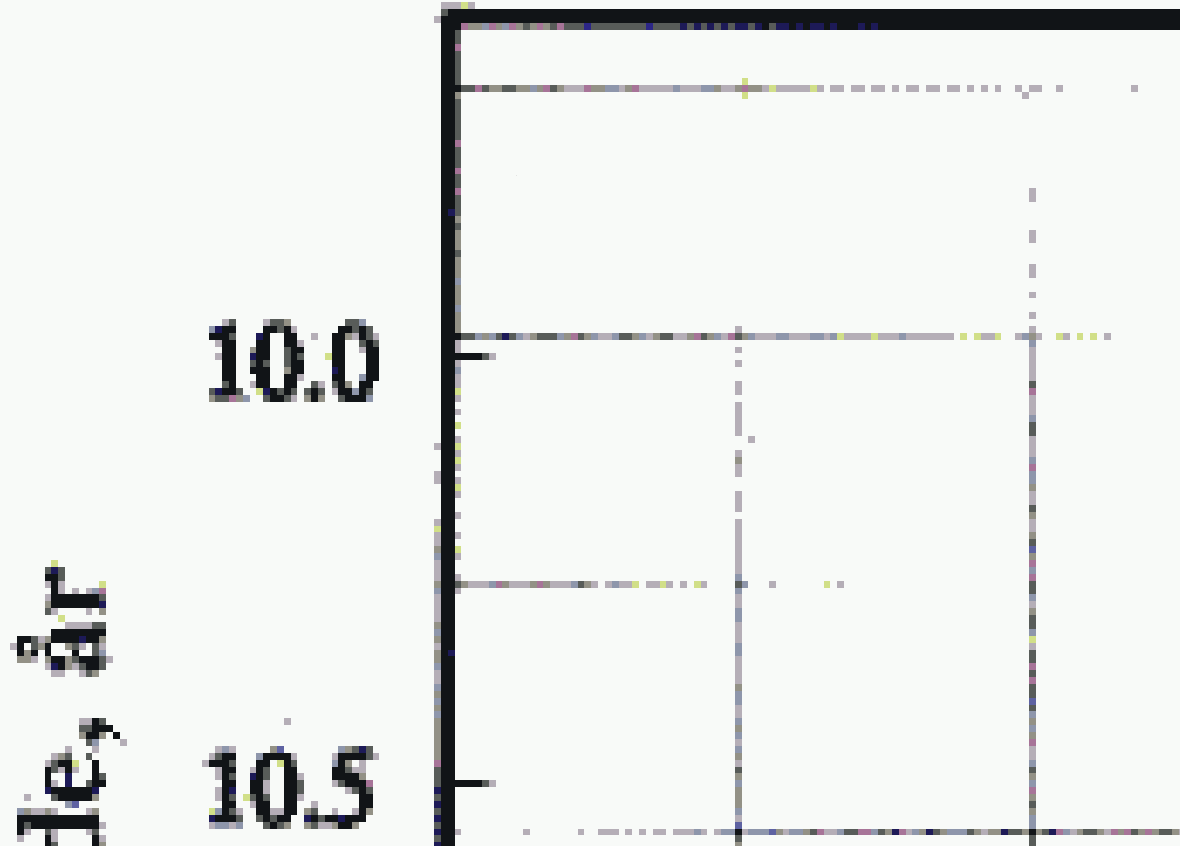


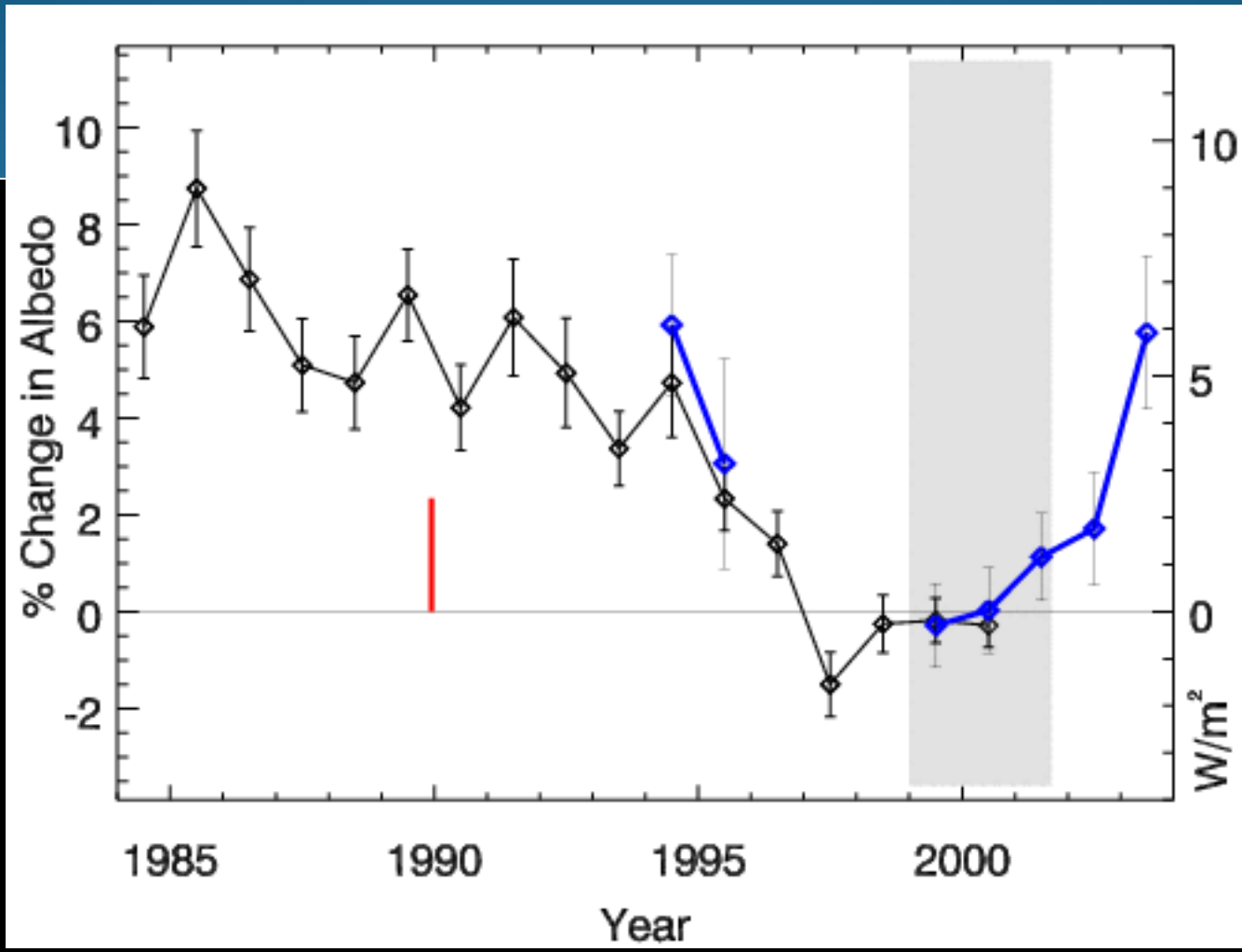


Sunspots and Temperature

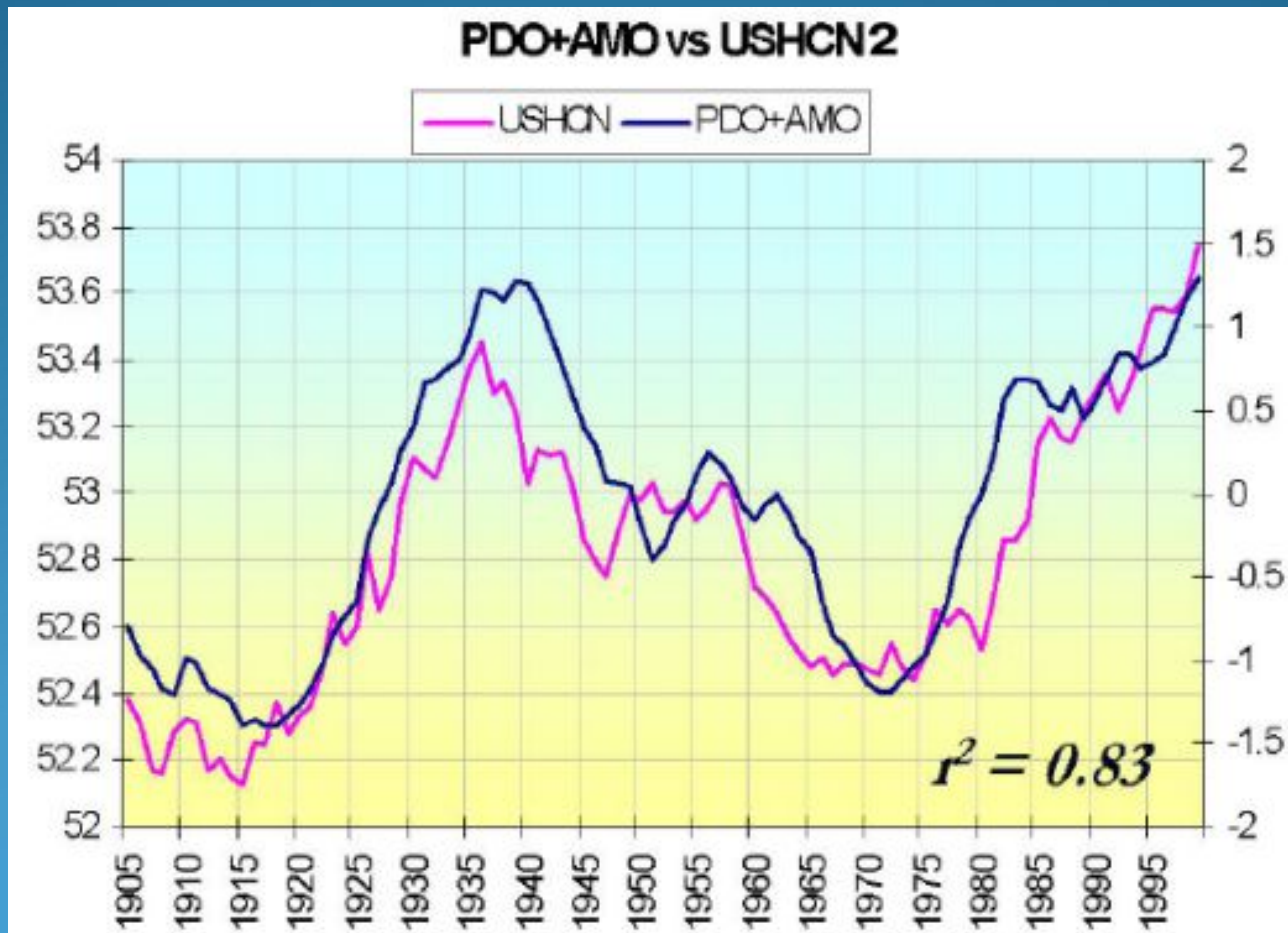
Sunspot Cycle and Temperature

SOLPLET PERIODERS



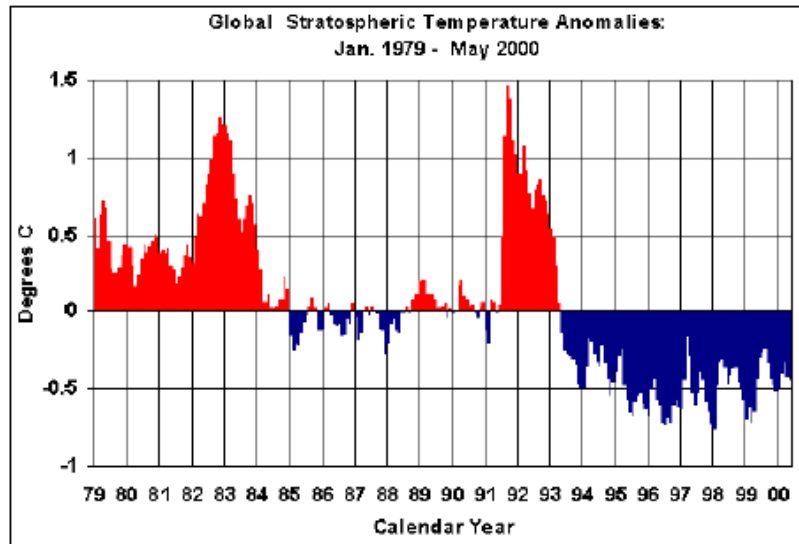
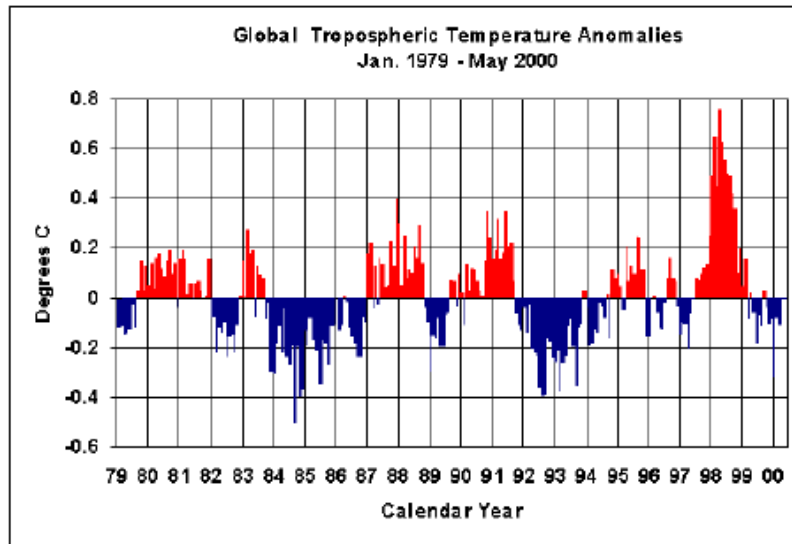


Pacific Decadal Oscillation and Temperatures



Note this data set started in 1905 because the PDO and AMO was only available from 1900.

Upper Atmosphere Trends



Relevant Question

What is the optimum temperature for the planet?

What is the optimum amount of variation?

- **Tropical regions have sparse coverage of surface temperature data.**
- **Until further information can be obtained in these regions, the robustness of warming estimates in this region should be questioned. Thus the CCSP (2006) finding that the**

“the majority of observational data sets show more warming at the surface than in the troposphere,”

while

“ all model simulations show more warming in the troposphere than at the surface”

- **may be a result of the inadequate sampling of the tropical land areas.**

In More Detail

Greenhouse Gasses

- CO₂ has gone from ~274 ppm in 1800 to ~355 ppm today. Deforestation and fossil fuel burning would seem to be the reason. About half of the contribution has been absorbed by the ecosystem.
- Halting the buildup of CO₂ would require reductions in CO₂ emissions of 60-80% below current levels. (Contrast to the 5-10% reduction mandated by the Kyoto Accords.)
- There is evidence that past warming preceded increases in CO₂ concentrations.
- Water vapor is present in concentrations 300 times greater than CO₂ and is responsible for ~98% of the greenhouse effect. Yet water acts to both cool and to warm. The net effect is not known.

The Greenhouse Effect

- The greenhouse effect keeps our planet about 34°C warmer than it would otherwise be.
- Solar energy is more short-wavelength radiation, while energy radiated from the earth is longer range radiation.
- This is shown on the following figure.

Greenhouse Gases

- A wide variety of activities contribute to greenhouse gases.
 - Burning of coal, oil and natural gas releases about 6 billion metric tons annually.
 - Deforestation contributes 1 to 2 billion tons of carbon annually by burning and reducing that part of the earth's biomass that removes (sequesters) CO₂.

Greenhouse Gases

- Methane is increasing in concentration as a result of human food production and landfill emissions as well as other causes.
- Methane has increased from pre-industrial levels of 700 ppb to 1,714 ppb in 1992, an increase of 250%.
- However, concentrations of methane have been falling in the past 5 years.
- Nitrous oxide is also increasing as a result of human activities such as clearing forests, agricultural fertilizer use and vehicle emissions (275 ppb to 312 ppb).

Greenhouse Gases

- Halocarbons, including the subcategory, chlorofluorocarbons (CFCs) which do not contain hydrogen, are all man made.
- They are not only greenhouse gases but also contribute chlorine and bromine atoms to the atmosphere that destroy ozone. (they absorb in the 9 micron range)
- CFCs were and are used as refrigerants, aerosol propellants and in foamed plastics.

Impacts of Global Climate Change

- Environmental refugees
- Flora and Fauna
- Ozone depletion and UV radiation

Global Warming

- The overall emissions of greenhouse gases are growing at the rate of about 1% per year.
- There appears to be a correlation between CO₂ levels and published global temperatures.

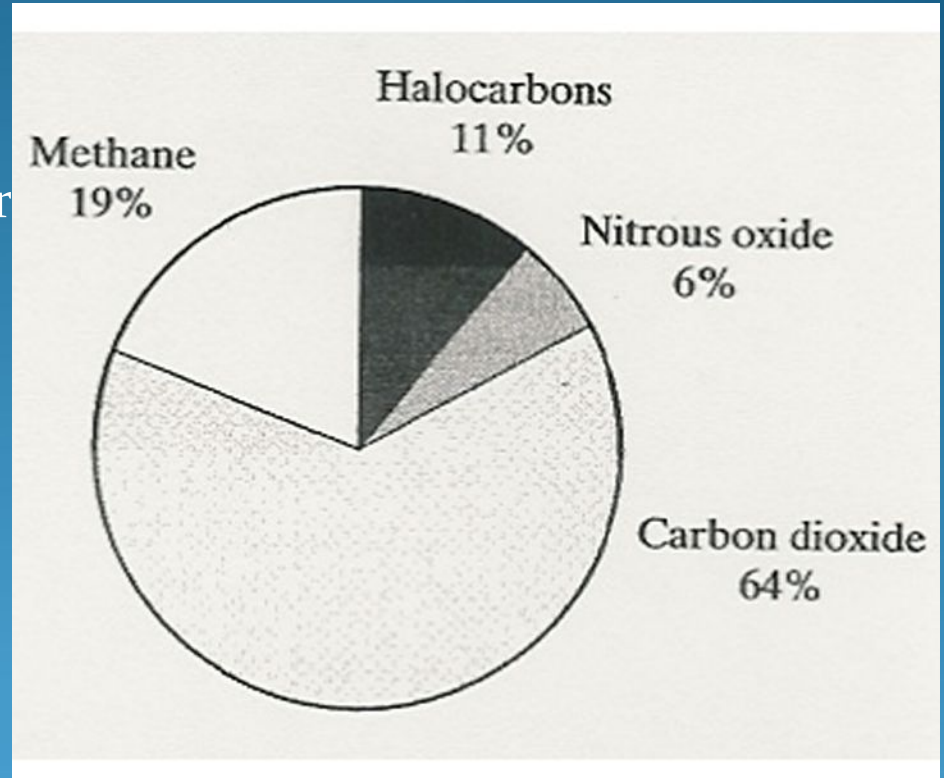
Potential Impacts of Global Climate Change

- Human health
- Rising sea levels
- Disruption of the water cycle
- Extreme weather events
- Changing forests
- Agriculture and food supply

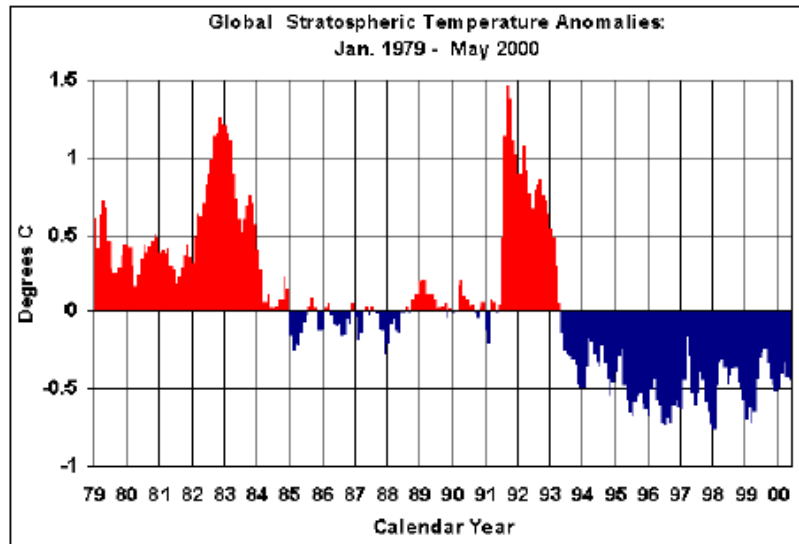
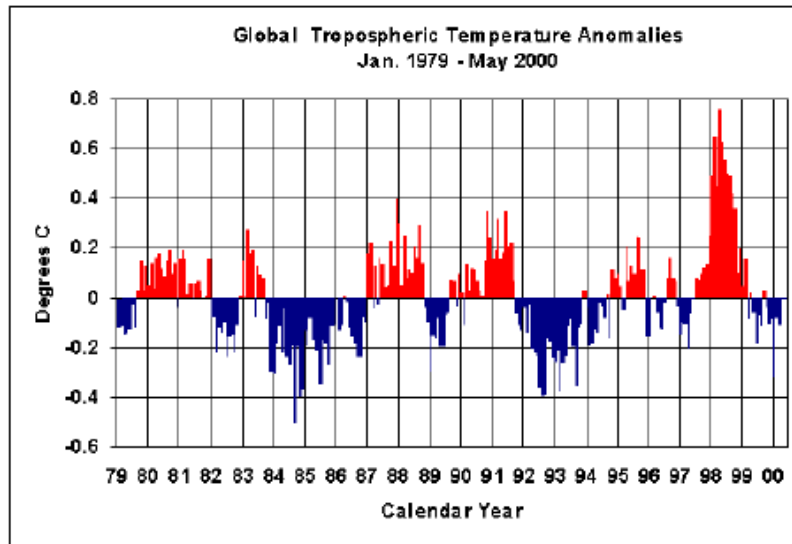
In More Detail

Basic Assumptions

- 95 - 98% of Greenhouse effect is due to water vapor
- Doubling the CO₂ content of the atmosphere makes only a 1-2% effect.
- There is evidence that past warming preceded increases in CO₂ concentrations



Upper Atmosphere Trends



Anecdotal Evidence

In More Detail

Ocean Effects

- Zooplankton is only 70% of 1950's levels.
- Coral reefs may be dying. Some species of birds are dying as are some species of sea lions. Some fish and invertebrates have relocated northward.
- Evidence that fresh water from glaciers disrupts the thermohaline circulation.
- Depending on where you measure, the sea level is or is not rising.
- “Glaciers all over the world are receding”. However, there is contradictory evidence on what is happening with polar ice caps and Greenland. Antarctic seems to be increasing.

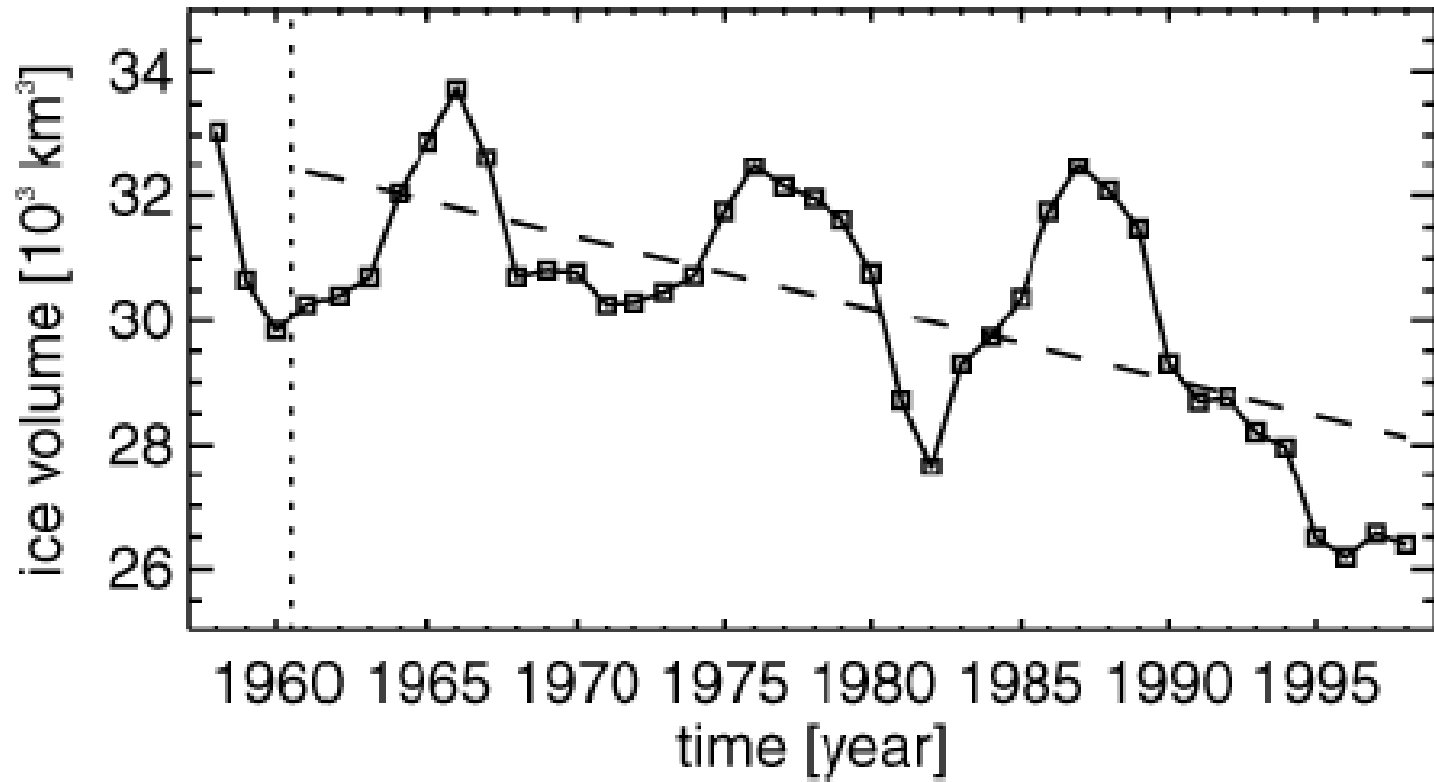
Sea Level Changes

Johnston Island:	no sea level rise for 50 years
Tuvalu:	no sea level rise for 48 years
Tarawa, Kiribati:	no sea level rise for 24 years
Kanton Island:	no sea level rise for 28 years
Nauru:	no sea level rise for 26 years
Honiara, Solomons:	no sea level rise for 26 years
Saipan:	no sea level rise for 22 years

Sea Level Changes



Arctic Ice Volume



However, arctic temperatures have fallen in the last 15 years!!

In More Detail

Weather

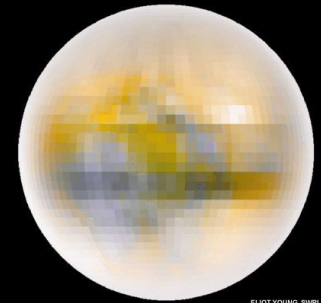
Atmospheric Effects

- The height at which temperature reaches zero has risen about 4 m/year since 1970.
- Global Warming should cause increased precipitation. This in turn is expected to cause an increase in “extreme events” violent storms.
- *In 1989, the Alps endured a virtually snowless winter. Alp Action, wrote in 1991 that global warming would put an end to winter sports in the Alps by 2025 due to lack of snow. In 1999, the Alps had their greatest snowfall in 40 years. Greenpeace blamed global warming.*

One should always remember that the plural of anecdote is not data.

Are these Clues or Irrelevant?

- Pluto has warmed ~2 degrees between 1988 and 2002.
- The south polar CO₂ “icecap” on Mars has decreased in size in the past decade.
- Neptune’s moon, Triton has experienced a 3 C increase in temperature between 1989 and 1998.
- The size and number of storms on Jupiter has increased and the temperature increased by 4 C in the last ten years.



Climate Change Prediction

- Increased CO₂ leads to warming
- Increased warming leads to increased evaporation
- Increased atmospheric water leads to more warming
- Increased warming leads to increased evaporation
- Runaway

Climate Change Prediction

- Runaway greenhouse effect has not happened
- Why?
- Feedbacks are complex; for example
 - More water leads to more clouds - reflects sunlight
 - More water leads to more snow - reflects sunlight
- We don't even know the SIGN of the net effect of an increase in water vapor
- Climate models have mostly positive feedbacks

Media Hysteria

A Time Magazine Time-line

"The discoveries of changes in the sun's heat and the southward advance of glaciers in recent years have given rise to conjectures of the possible advent of a new ice age."

Sept. 10, 1923

"Gaffers who claim that winters were harder when they were boys are quite right... weather men have no doubt that the world at least for the time being is growing warmer."

Jan. 2, 1939

"Climatological Cassandras are becoming increasingly apprehensive, for the weather aberrations they are studying may be the harbinger of another ice age."

June 24, 1974

"[S]cientists no longer doubt that global warming is happening, and almost nobody questions the fact that humans are at least partly responsible."

April 9, 2001

A New York Times-line

"MacMillan Reports Signs of New Ice Age"

Sept. 18, 1924

"America in Longest Warm Spell Since 1776; Temperature Line Records a 25-Year Rise"

March 27, 1933

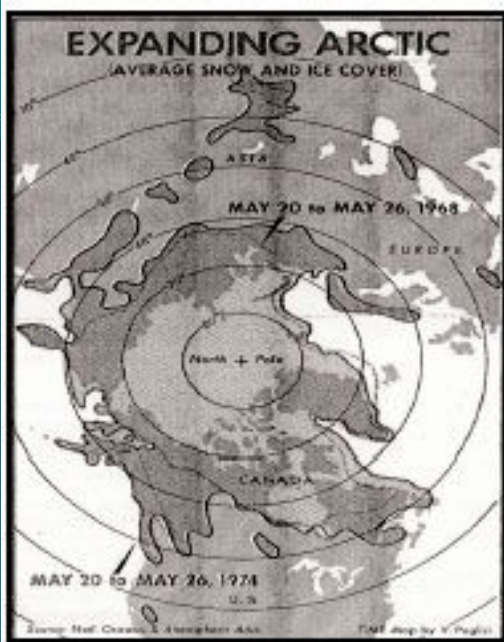
"Scientists Ponder Why World's Climate is Changing; A Major Cooling Widely Considered to Be Inevitable"

May 21, 1975

"Past Hot Times Hold Few Reasons to Relax About New Warming"

Dec. 27, 2005

Media Hysteria



Time magazine's June 24, 1974, story showed how Arctic snow and ice had grown from 1968 to 1974.



The future looked cold and ominous in this Science News depiction from March 1, 1975.



This headline from the May 31, 1976, U.S. News & World Report is a reminder that it hasn't been very long since global warming wasn't a concern.

“...the results indicate that the long term trend over the next 20,000 years is toward extensive Northern Hemisphere glaciation and cooler climate.”

Hays et al., 1976, Science,
194:1121-1132

