

# Climate Change Q&A Seminar #1

## Is the Earth really **warming**?

Professor Barry W. Brook

*Sir Hubert Wilkins Chair of Climate Change*

Director, Research Institute for Climate Change and Sustainability

School of Earth and Environmental Sciences

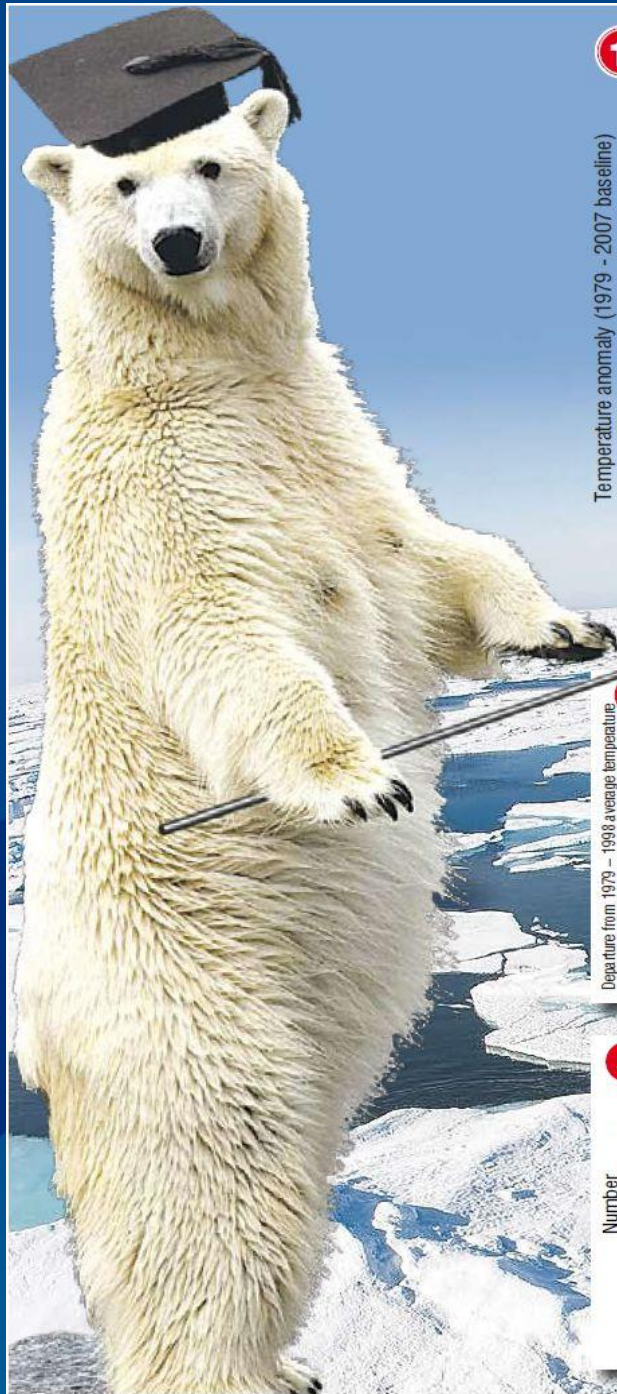
The University of Adelaide

Email: [barry.brook@adelaide.edu.au](mailto:barry.brook@adelaide.edu.au)

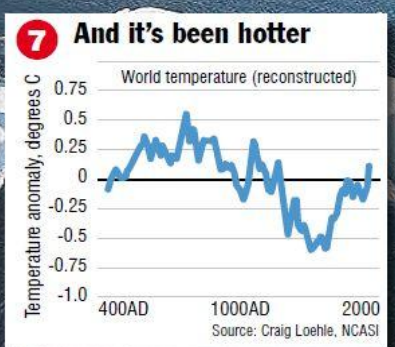
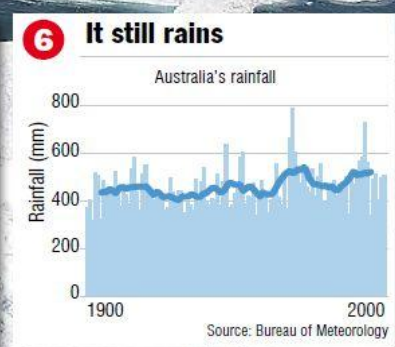
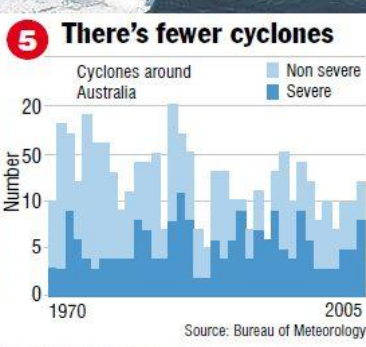
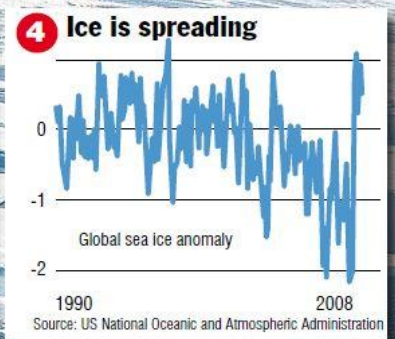
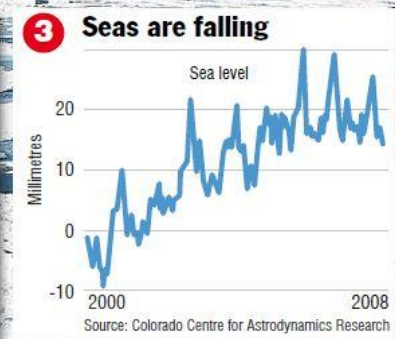
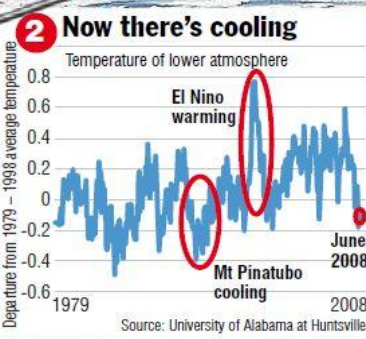
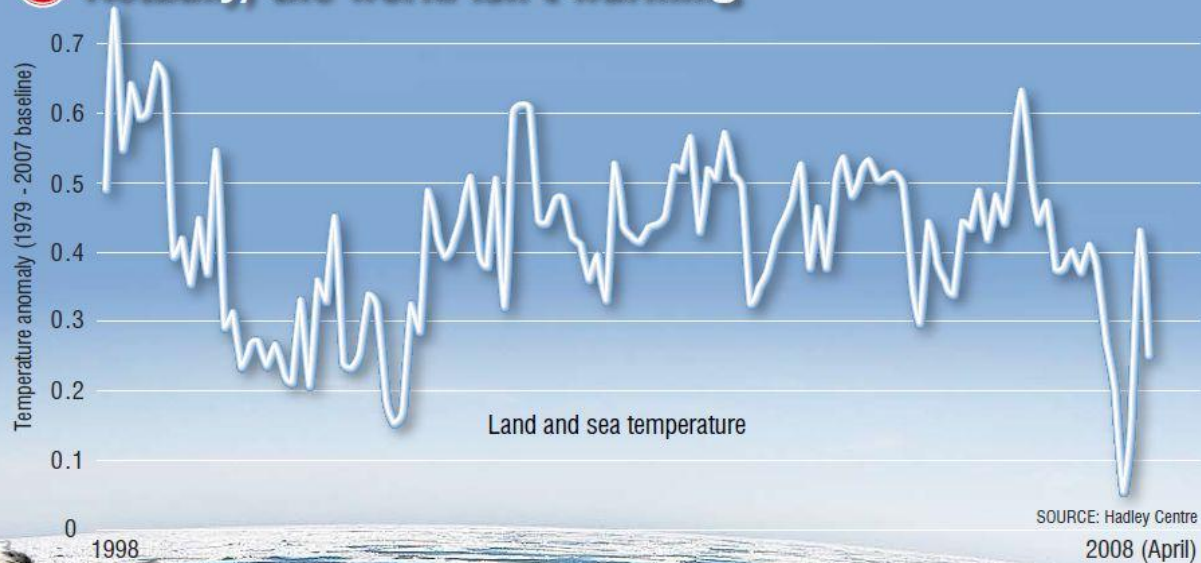
# Climate Change Q&A

*6 lectures – step-by-step guide to the key questions*

- **8 Aug: Is the Earth really warming?**
- **22 Aug: Natural vs Human-caused climate change?**
- **5 Sept: Future climate change scenarios?**
- **19 Sept: Are impacts being overstated?**
- **10 Oct: Will it cost the Earth to avoid this?**
- **24 Oct: Greenhouse denial: the ‘pretend debate’**

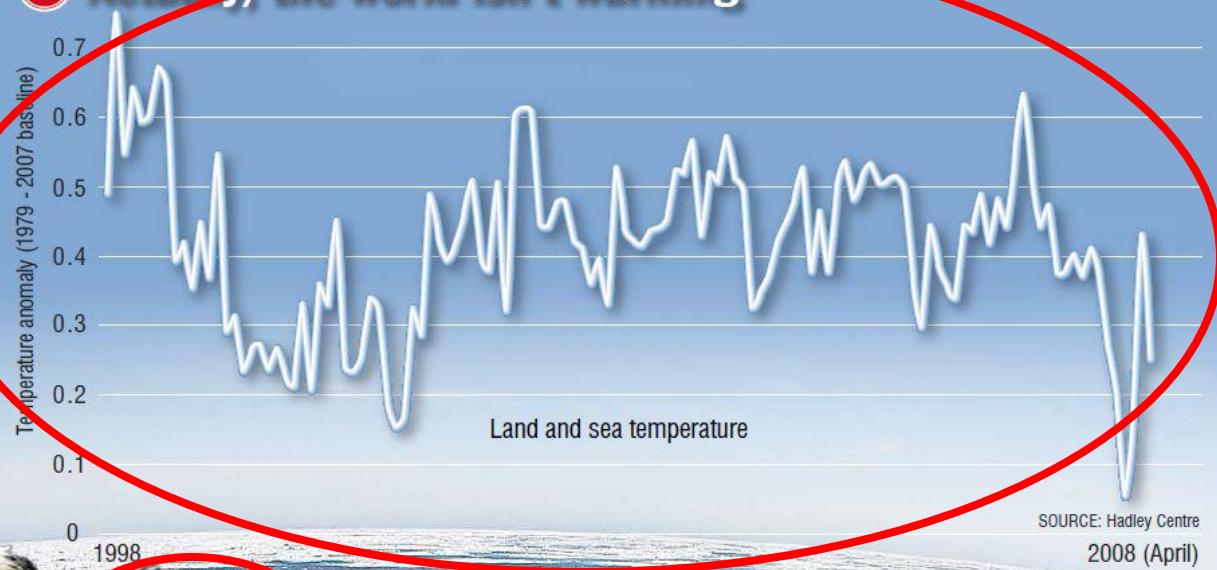


# 1 Actually, the world isn't warming

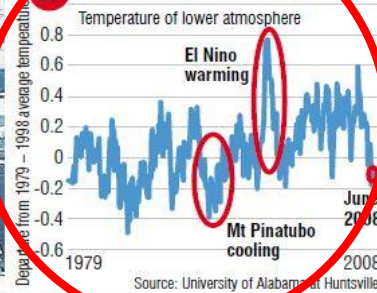




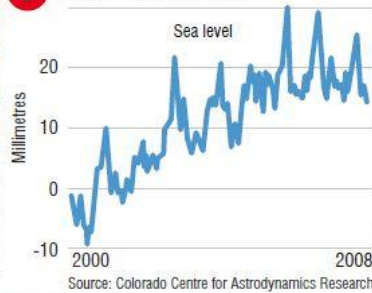
# 1 Actually, the world isn't warming



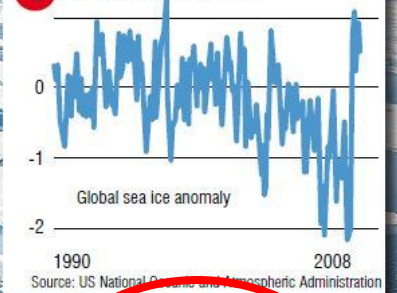
## 2 Now there's cooling



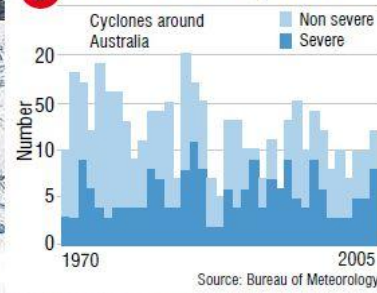
## 3 Seas are falling



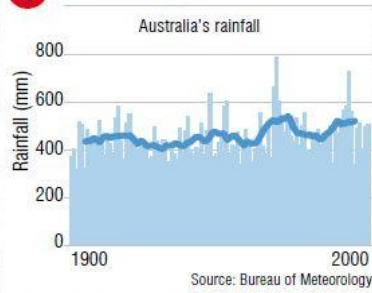
## 4 Ice is spreading



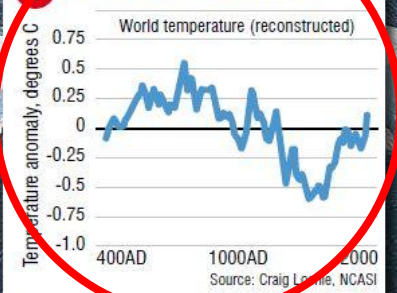
## 5 There's fewer cyclones



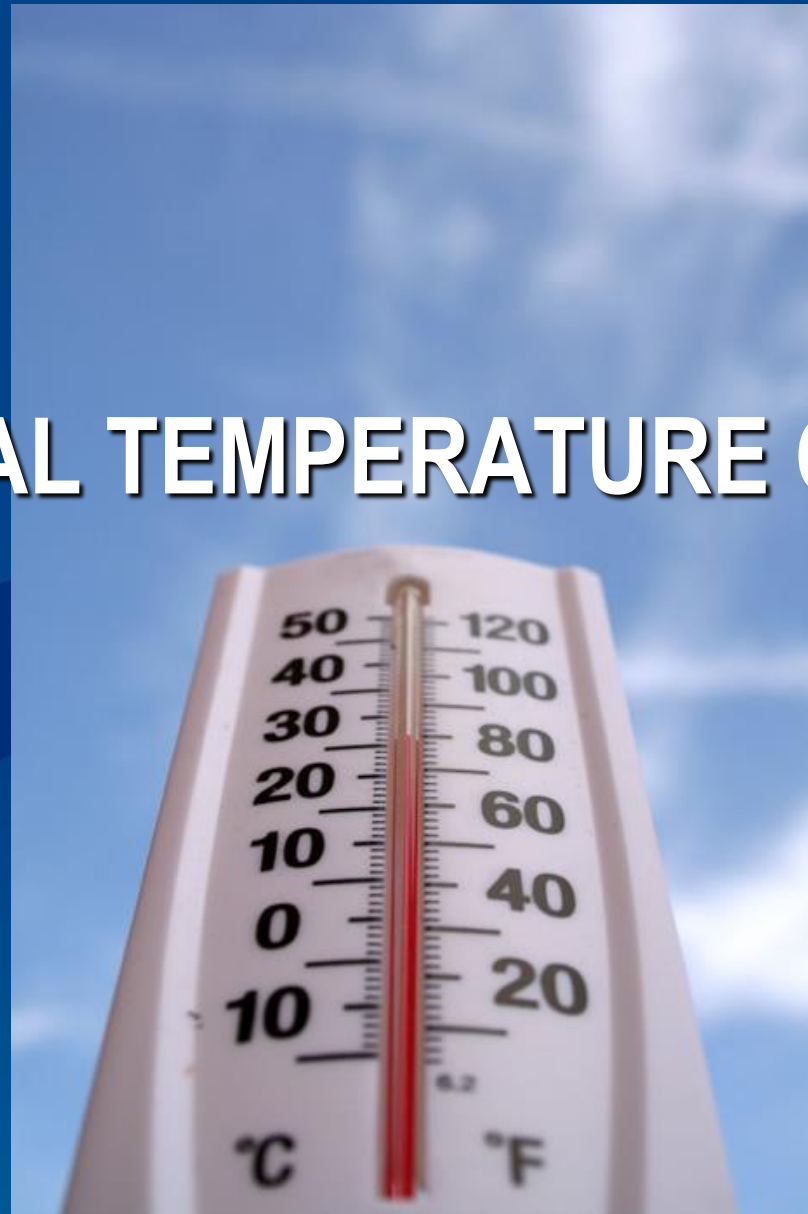
## 6 It still rains



## 7 And it's been hotter



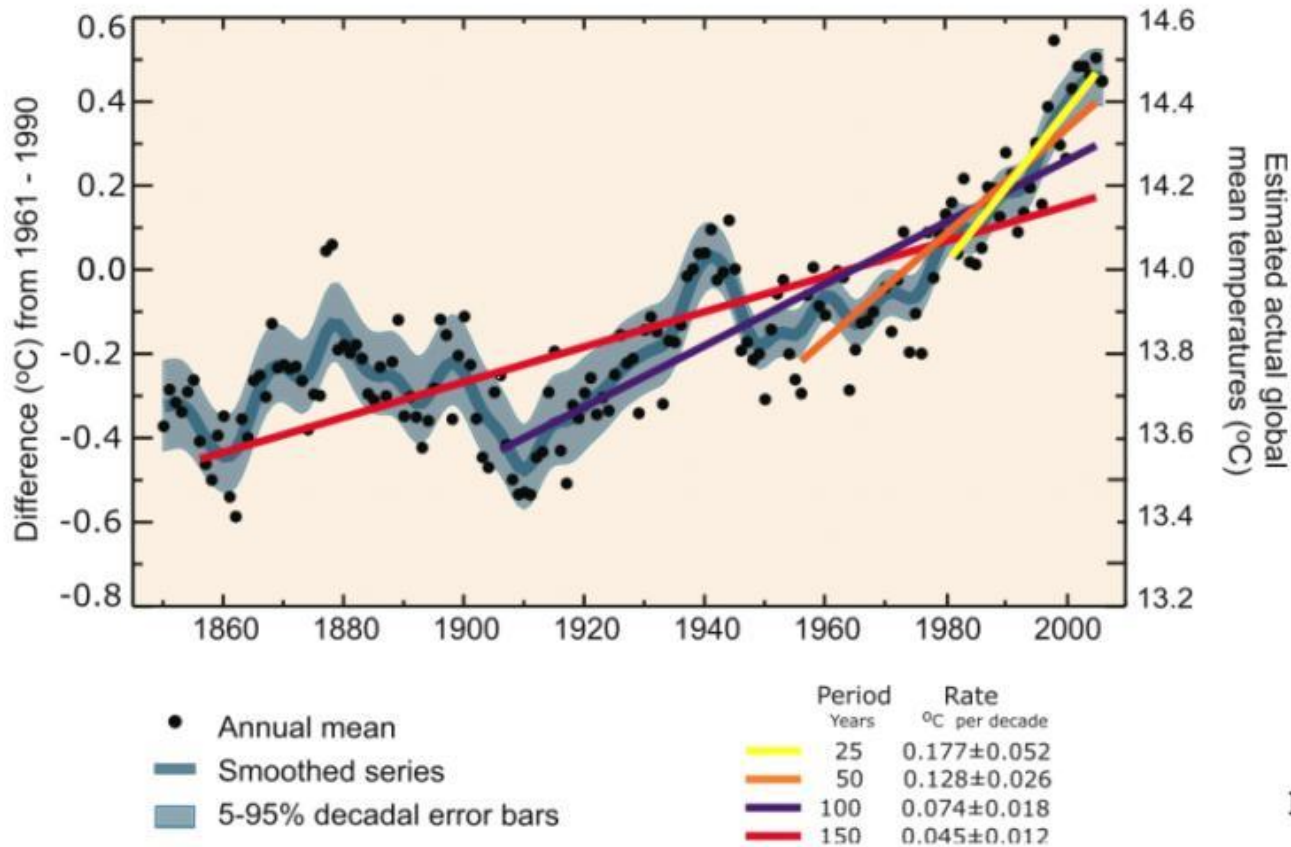
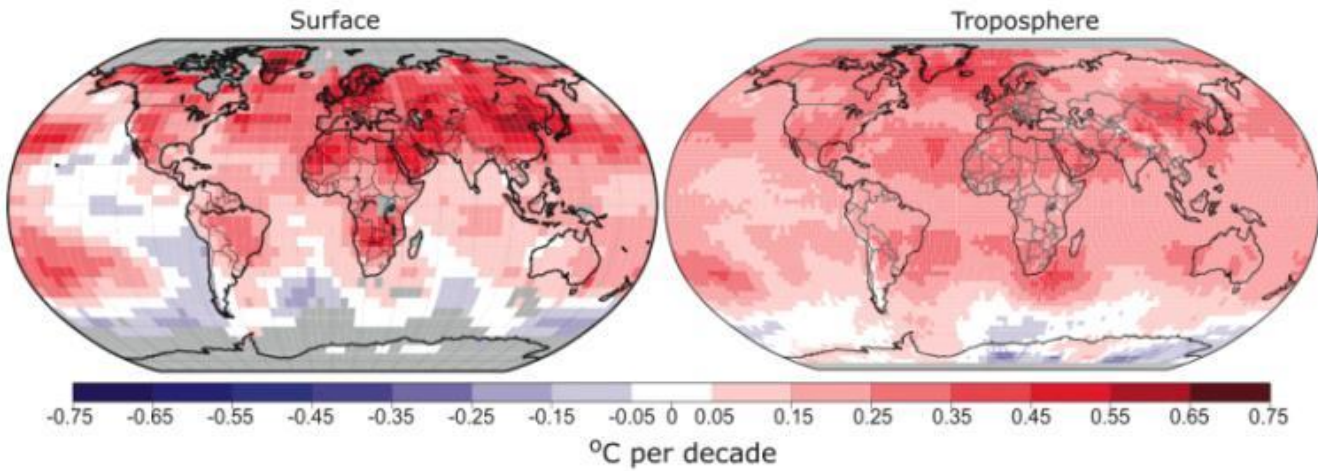
# GLOBAL TEMPERATURE CHANGE





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AUSTRALIA



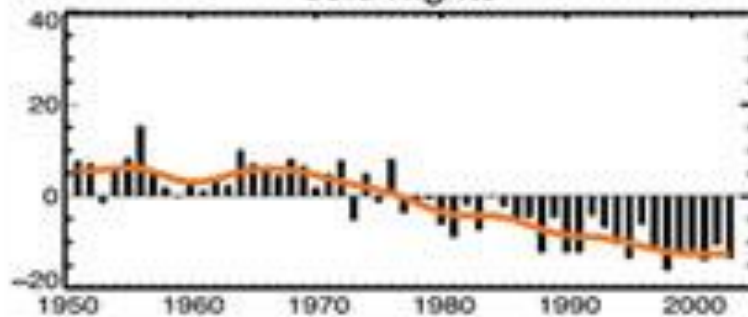


## Frequency of cold and warm days and nights

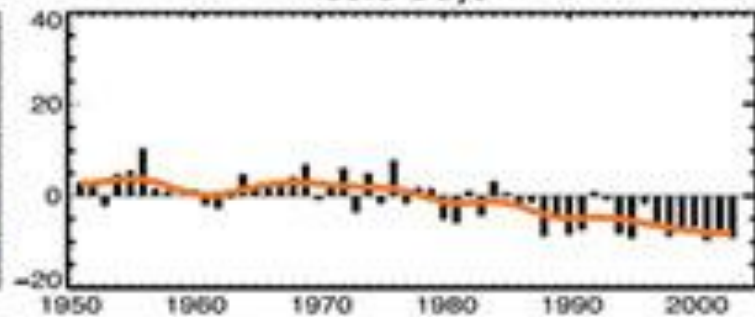
cold = bottom 10th percentile, warm = top 10th percentile

1961 - 1990 base period

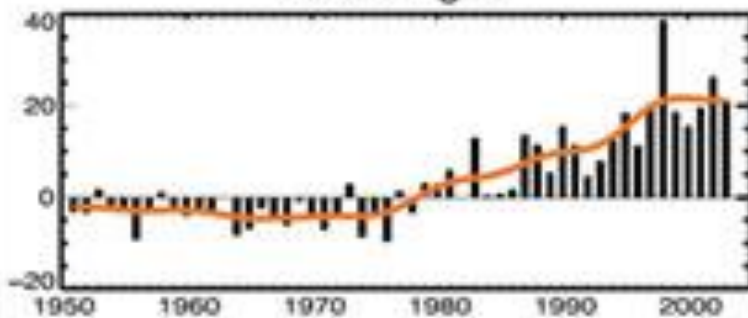
### Cold Nights



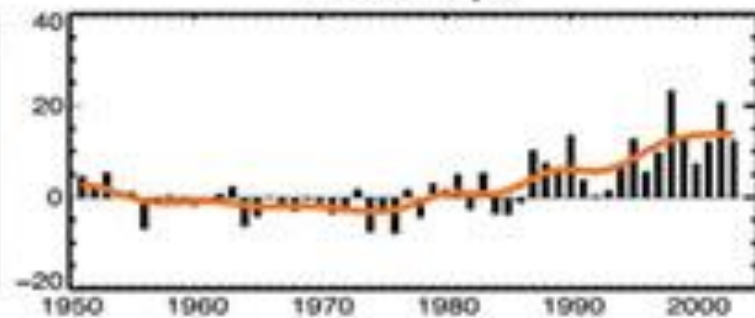
### Cold Days



### Warm Nights

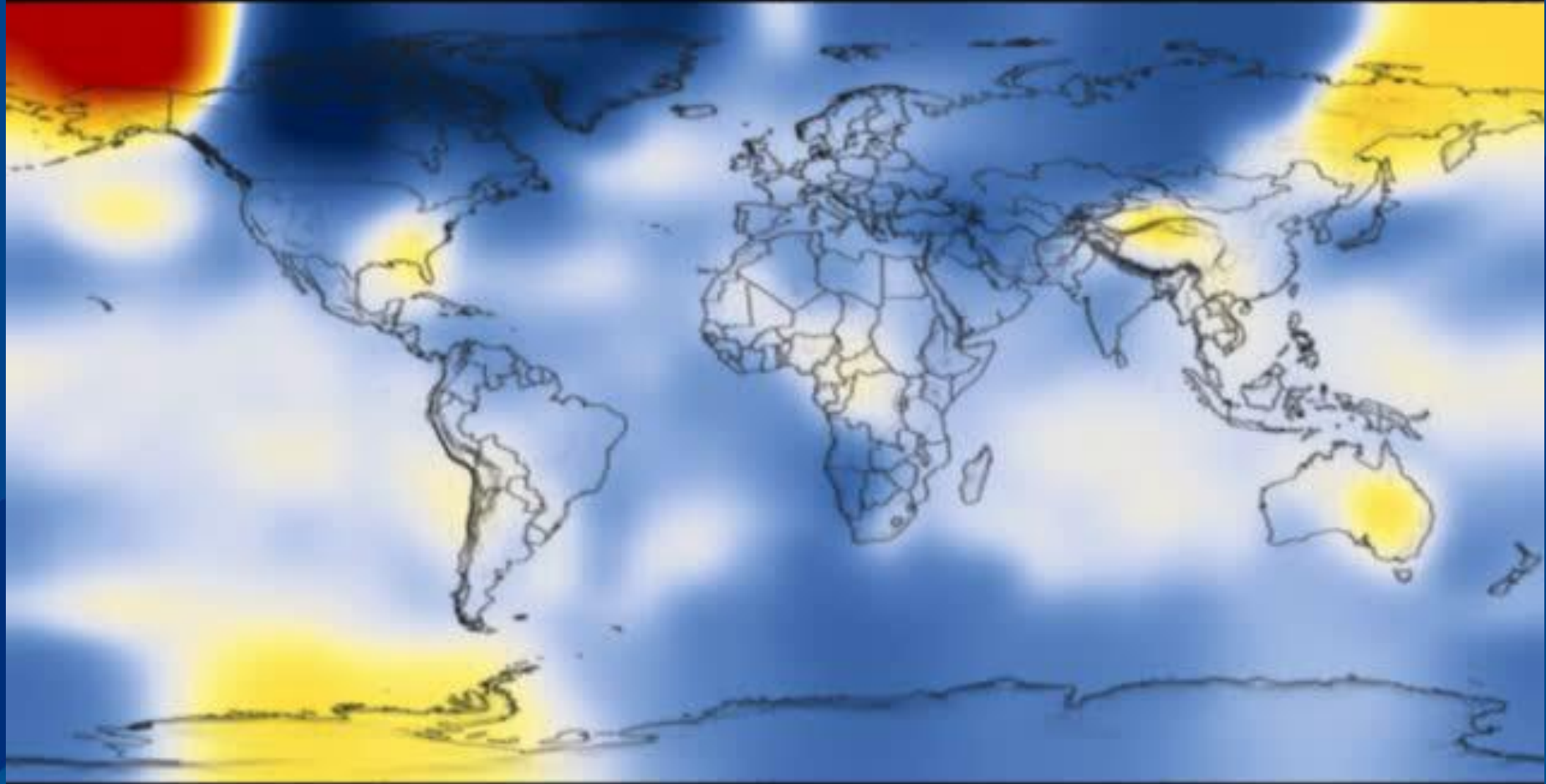


### Warm Days



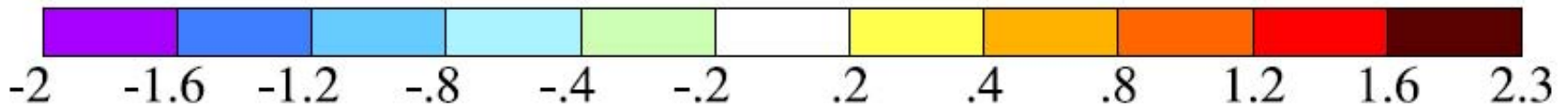
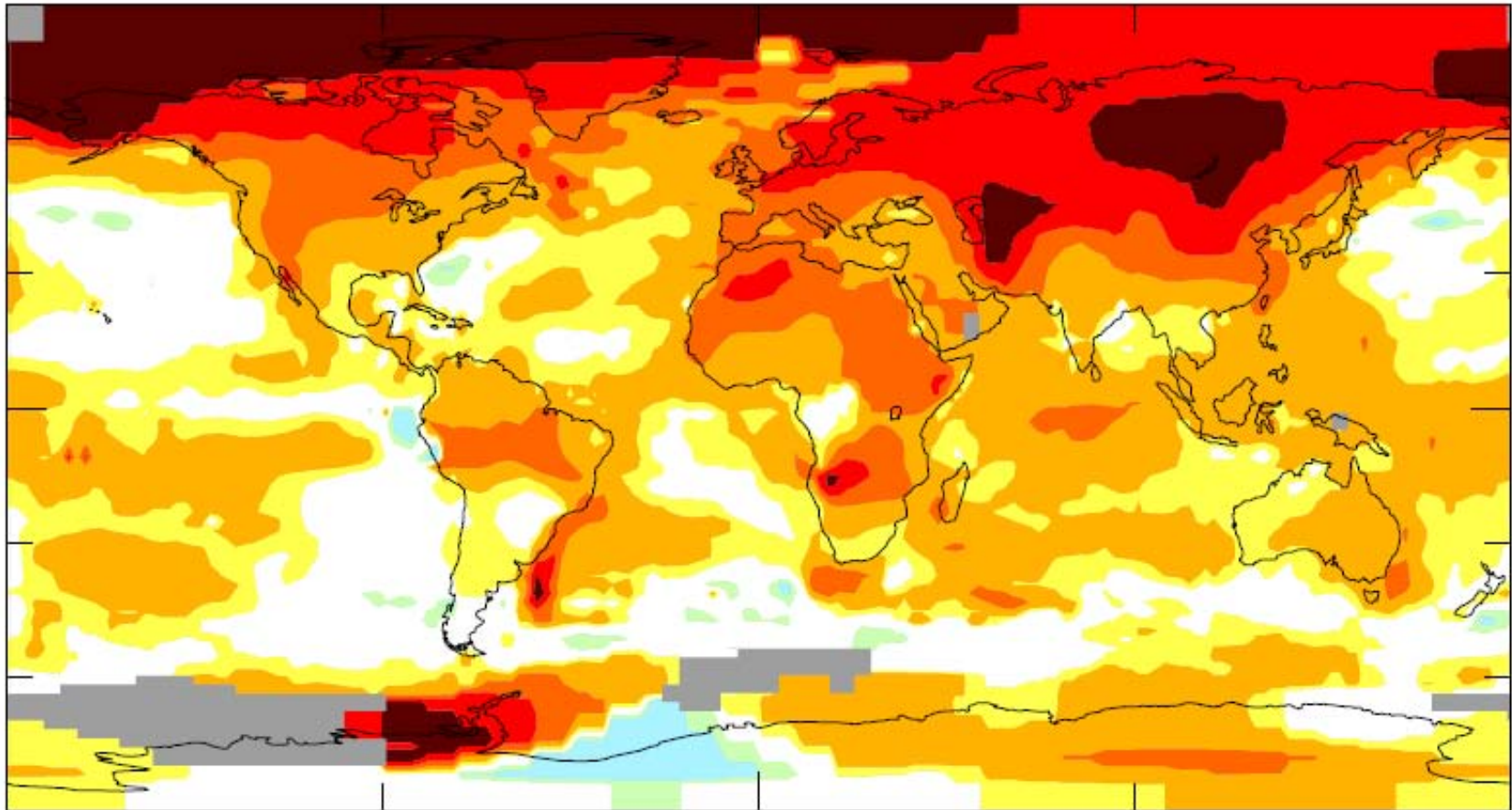


1884

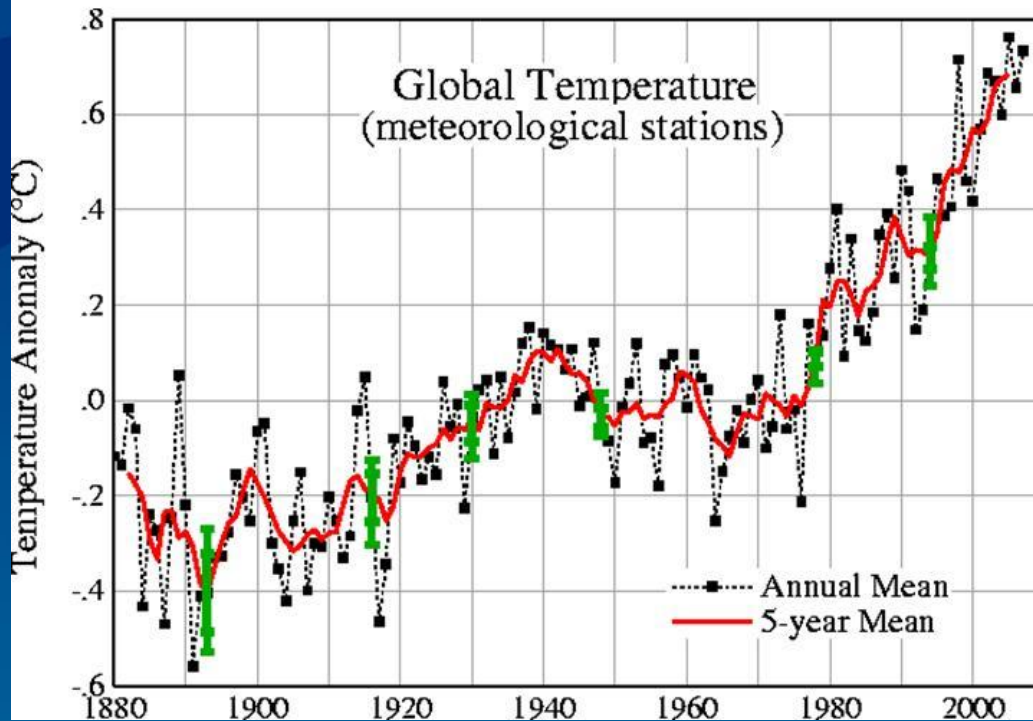
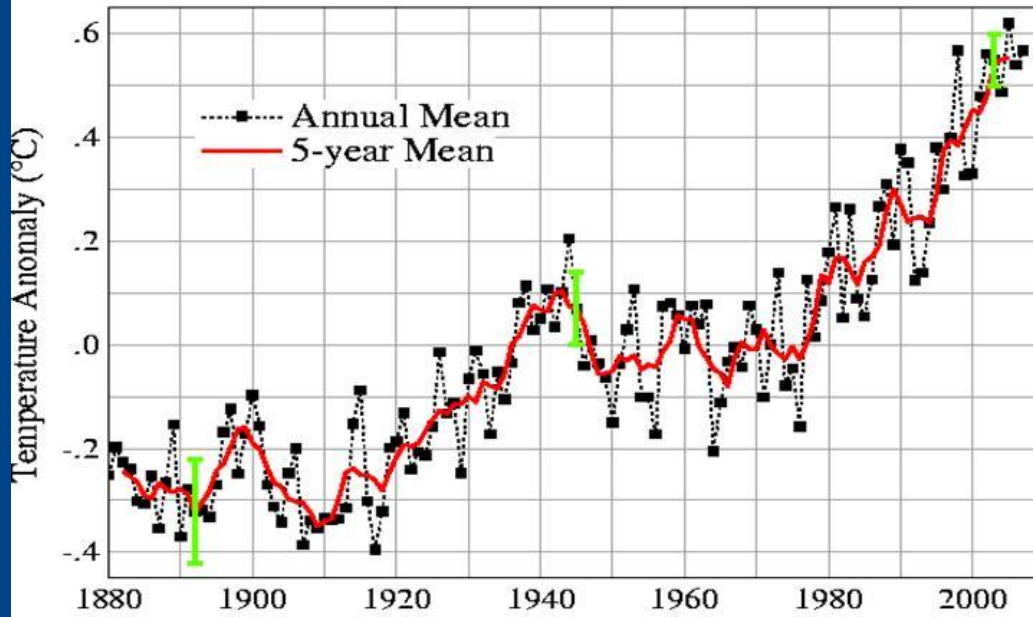


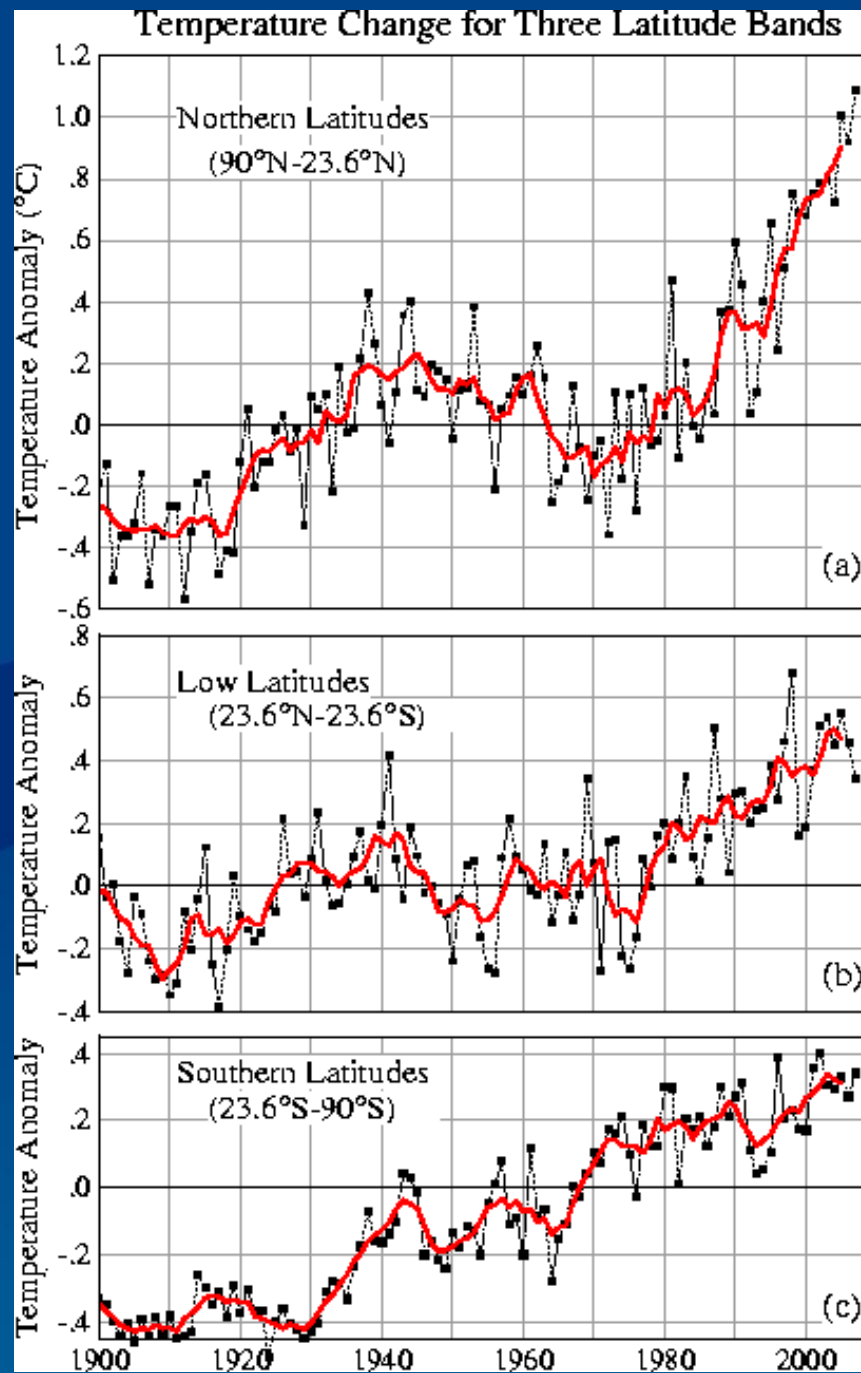
# 2001-2007 Mean Surface Temperature Anomaly ( $^{\circ}\text{C}$ )

Base Period = 1951-80, Global Mean Anomaly =  $+0.54$

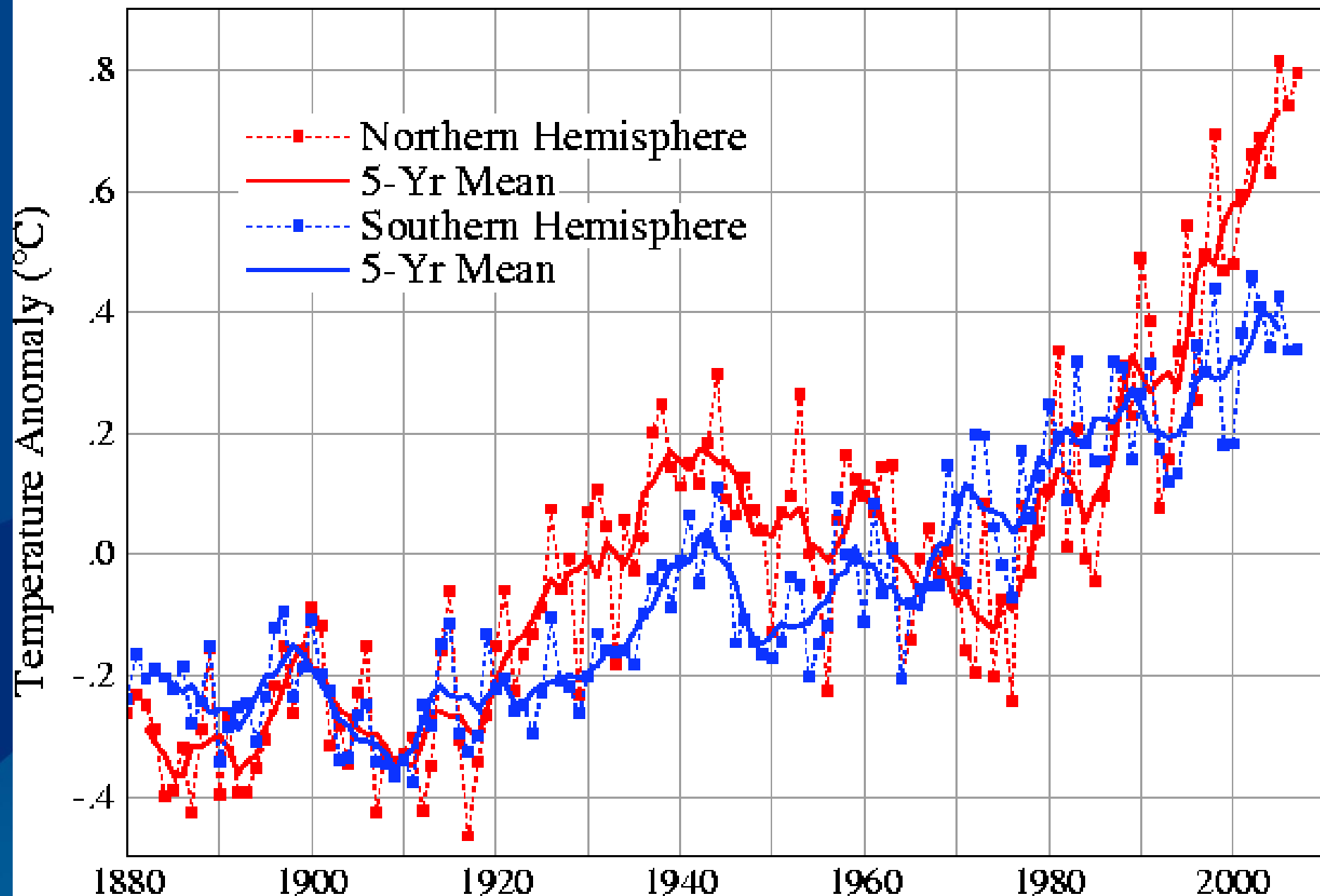


# Global Temperature Land-Ocean Index

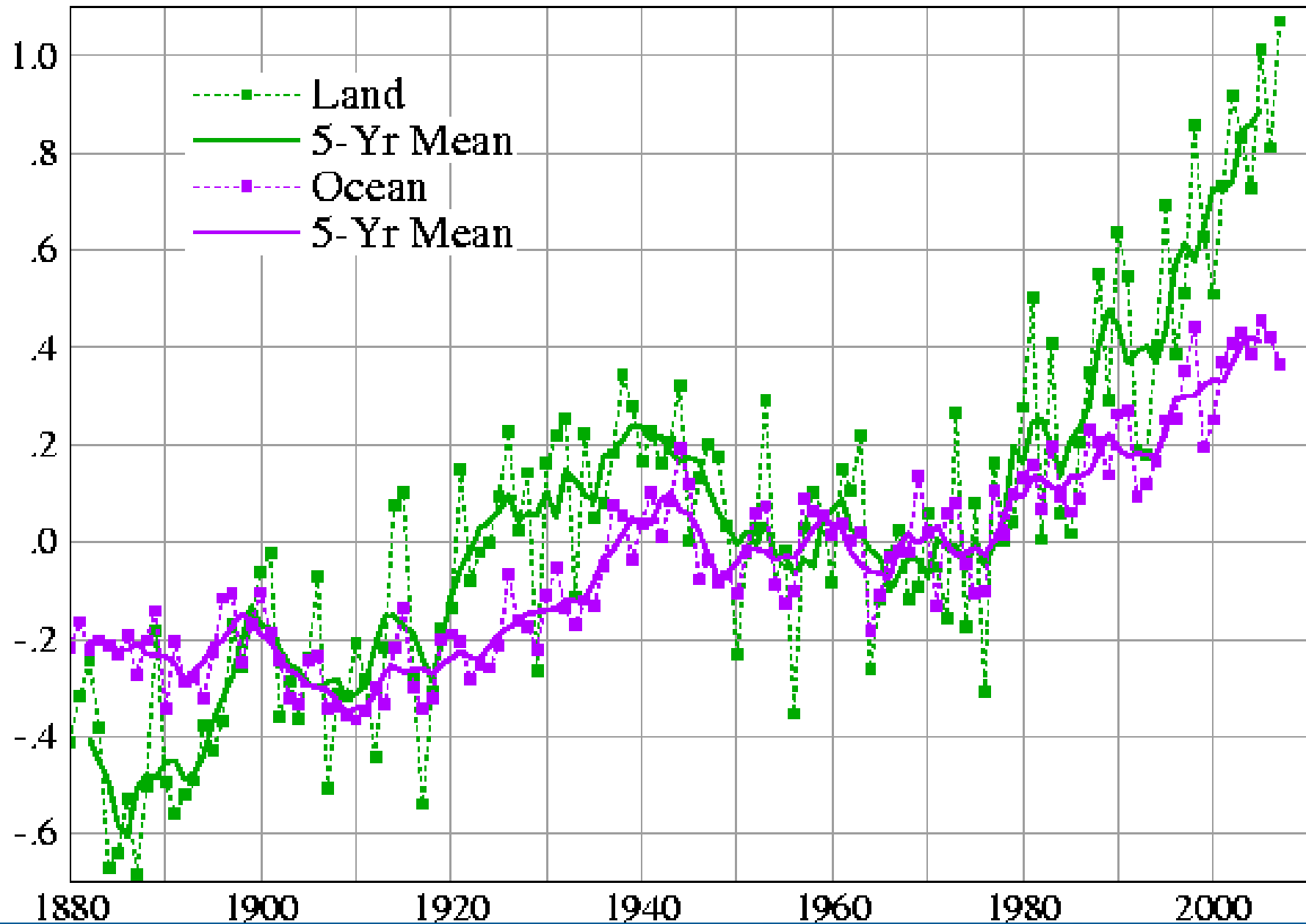




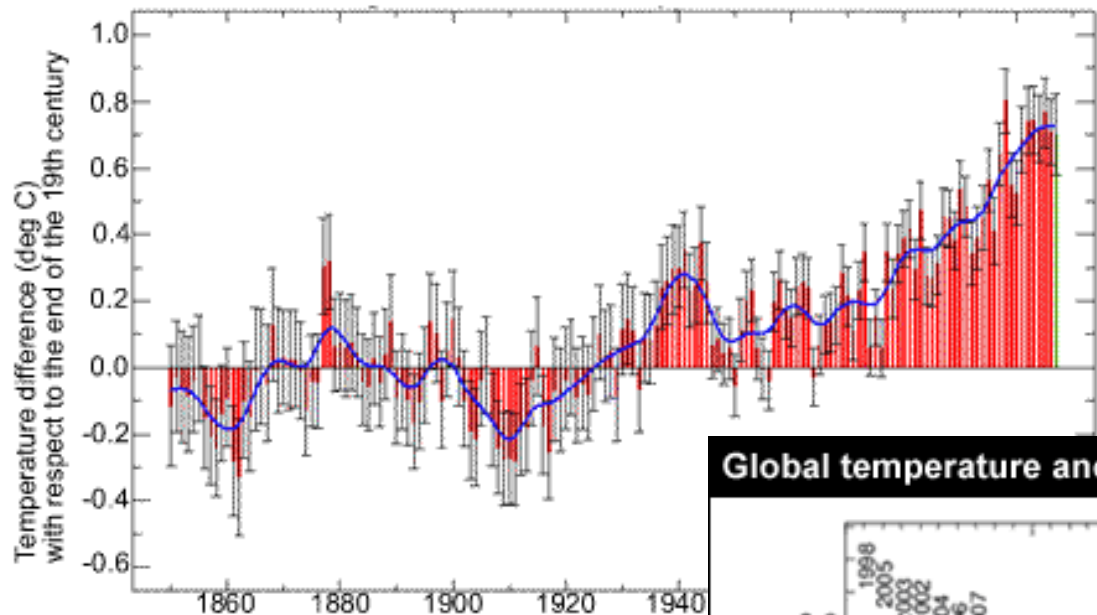
# Hemispheric Temperature Change



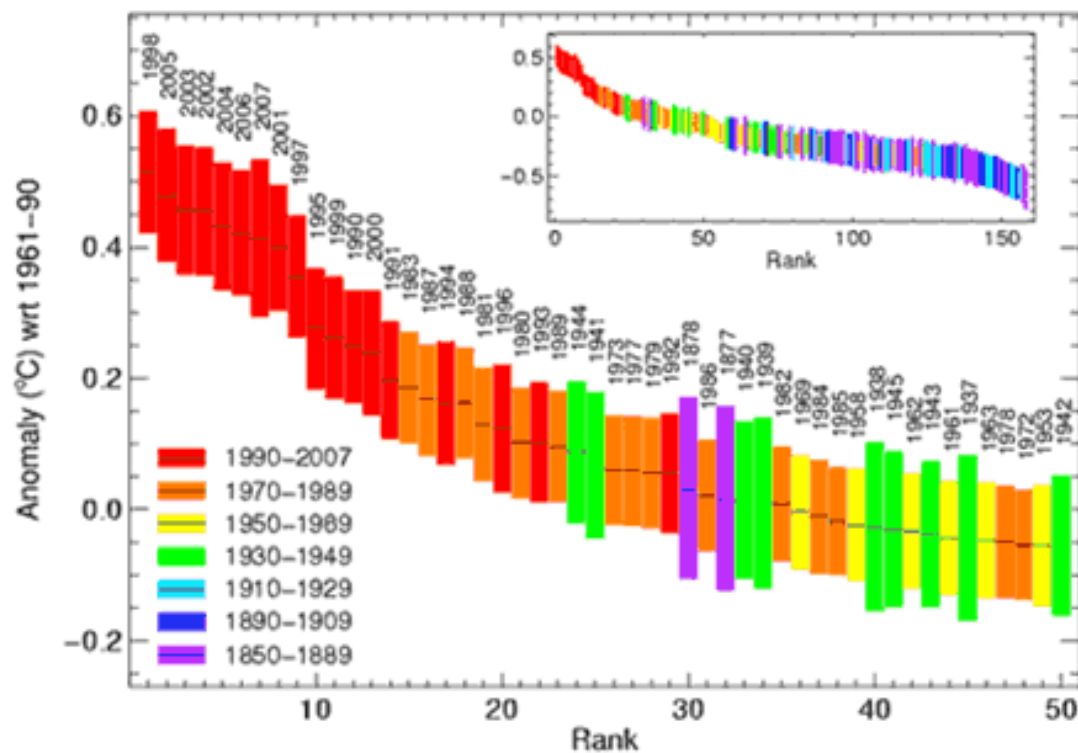
# Land and Ocean Temperature Changes



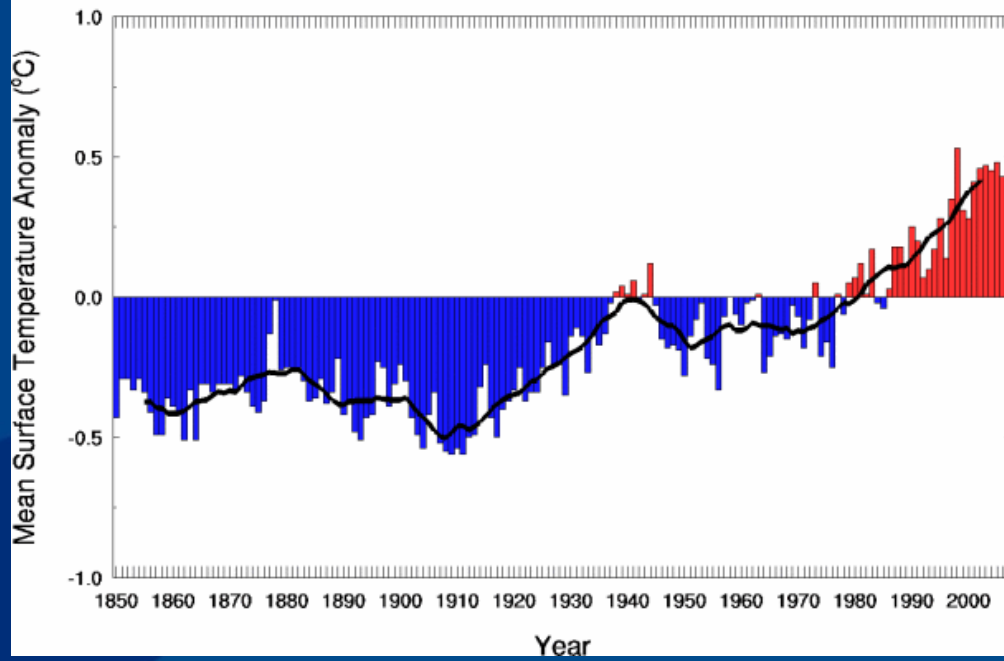
# Global temperature, 1850-2007



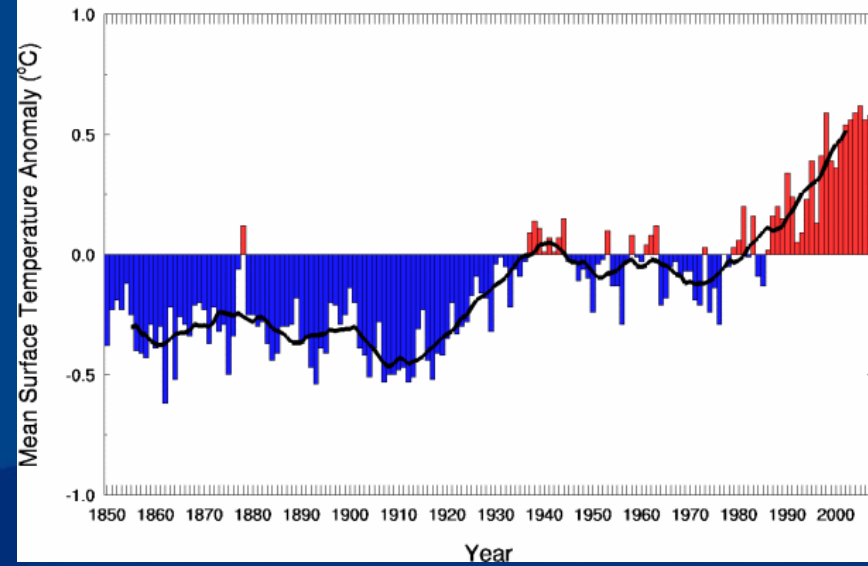
# Global temperature anomaly, 1850-2007



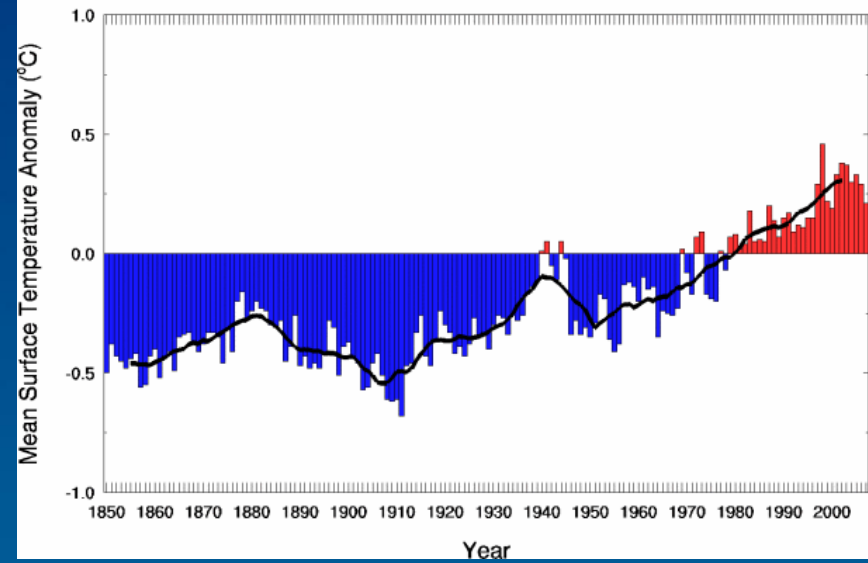
Global Annual Mean Surface Temperature Anomaly (base 1961-90)



NH Annual Mean Surface Temperature Anomaly (base 1961-90)

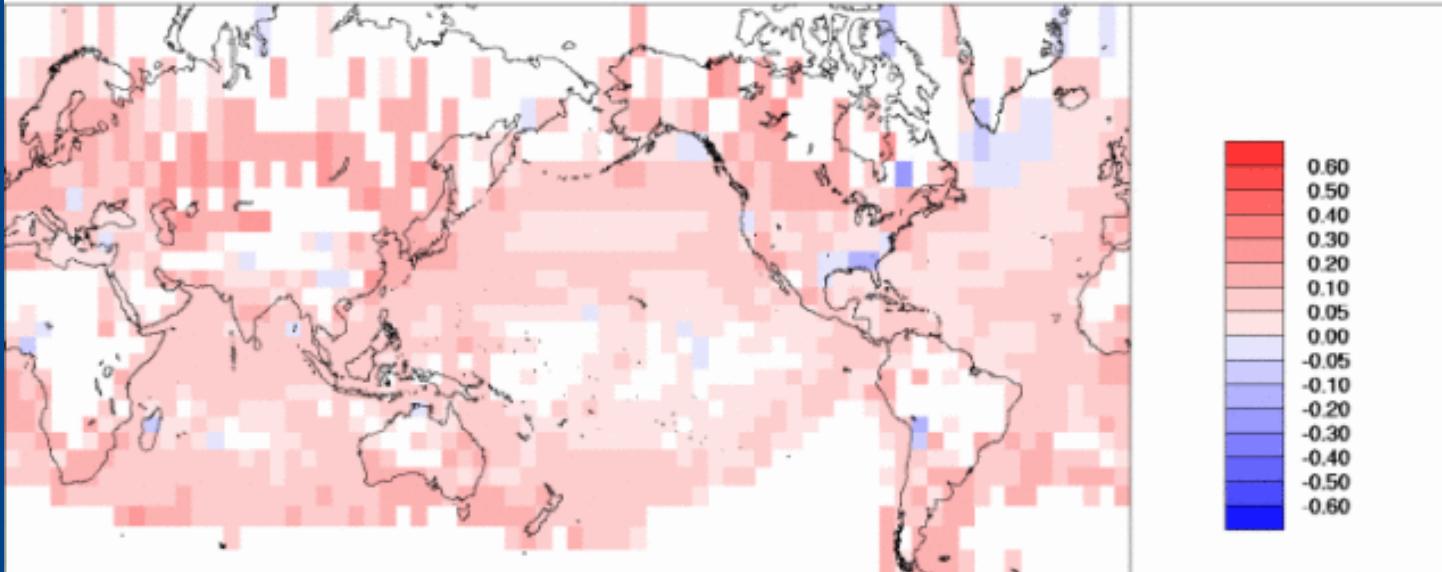


SH Annual Mean Surface Temperature Anomaly (base 1961-90)

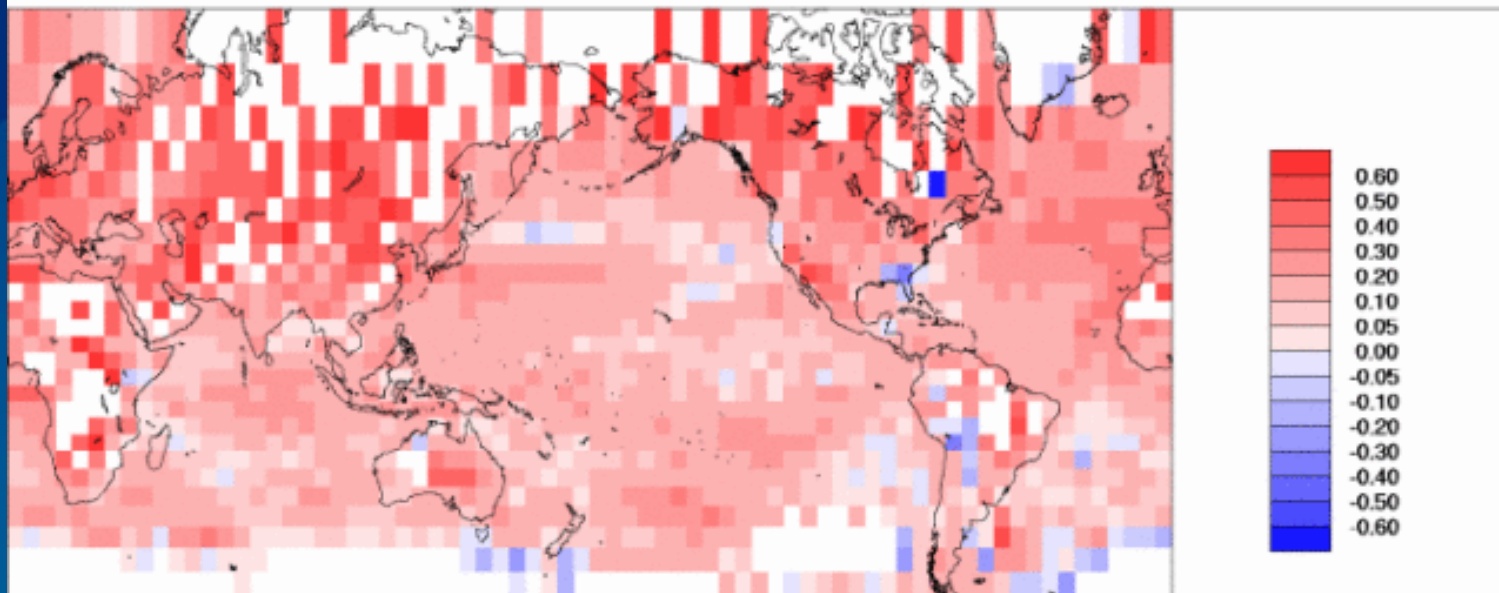


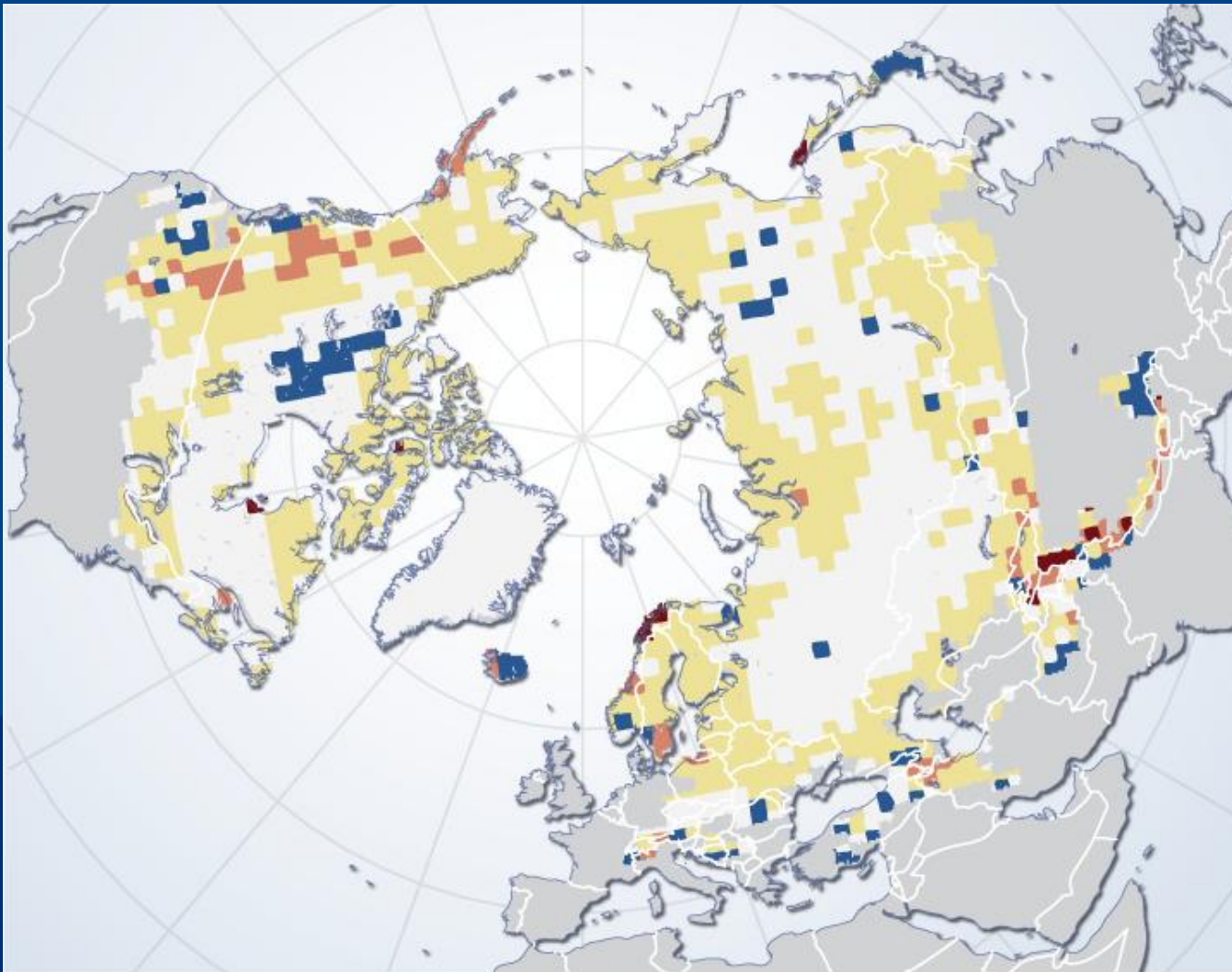


Trend in Global Annual Temperature ( $^{\circ}\text{C}/10$  yrs) 1900-2008



Trend in Global Annual Temperature ( $^{\circ}\text{C}/10$  yrs) 1970-2008

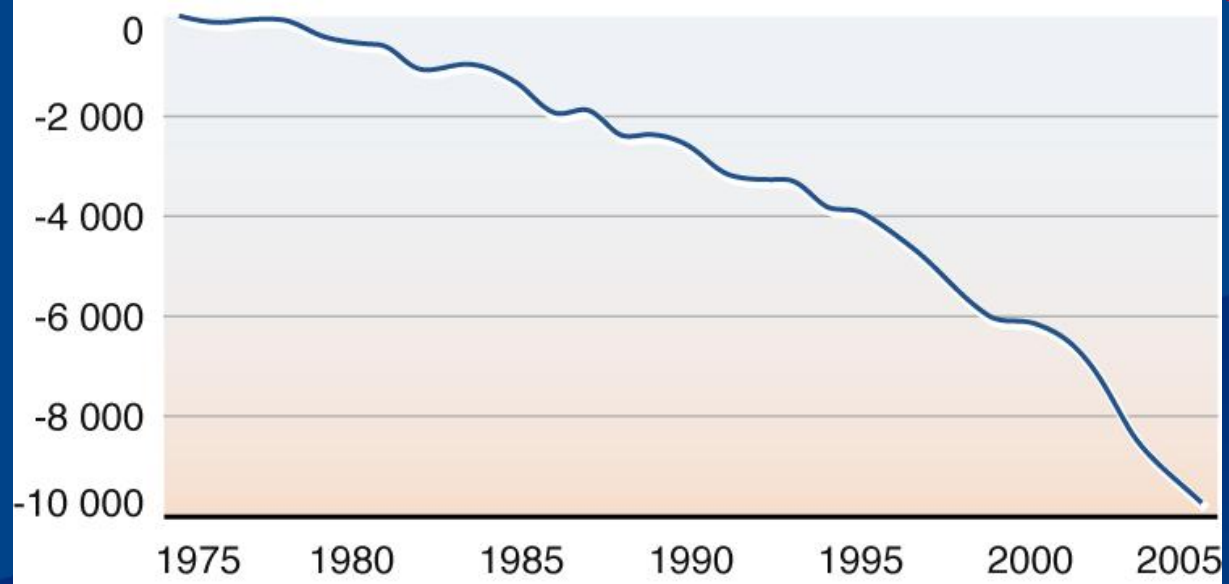




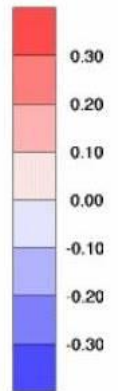
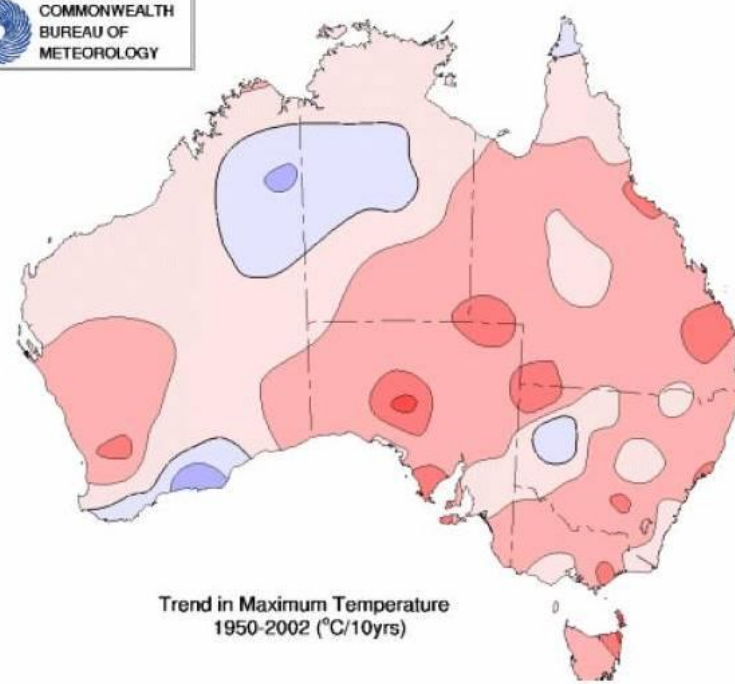
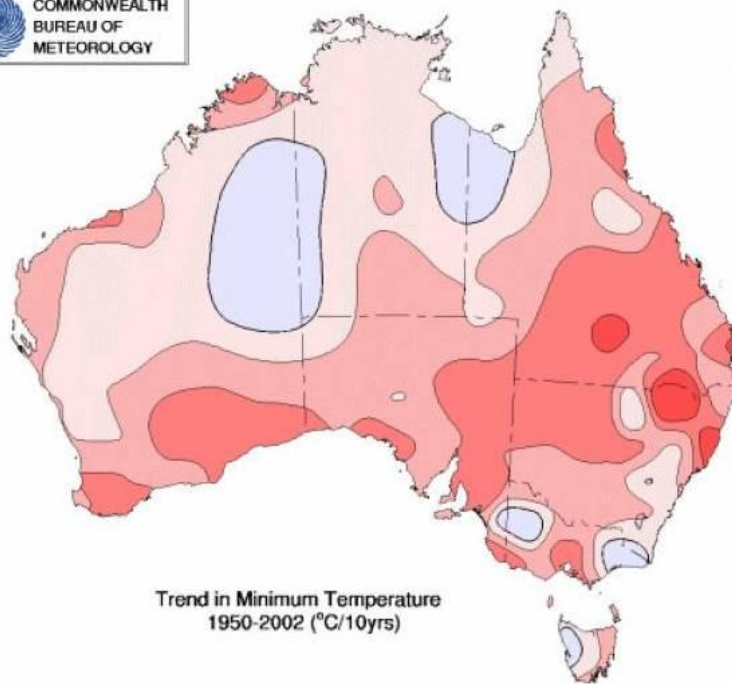
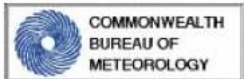
Observed change in spring snow cover  
duration 1970-2004 (days/yr)



Cumulative mean  
annual ice loss  
(mm w.e.)

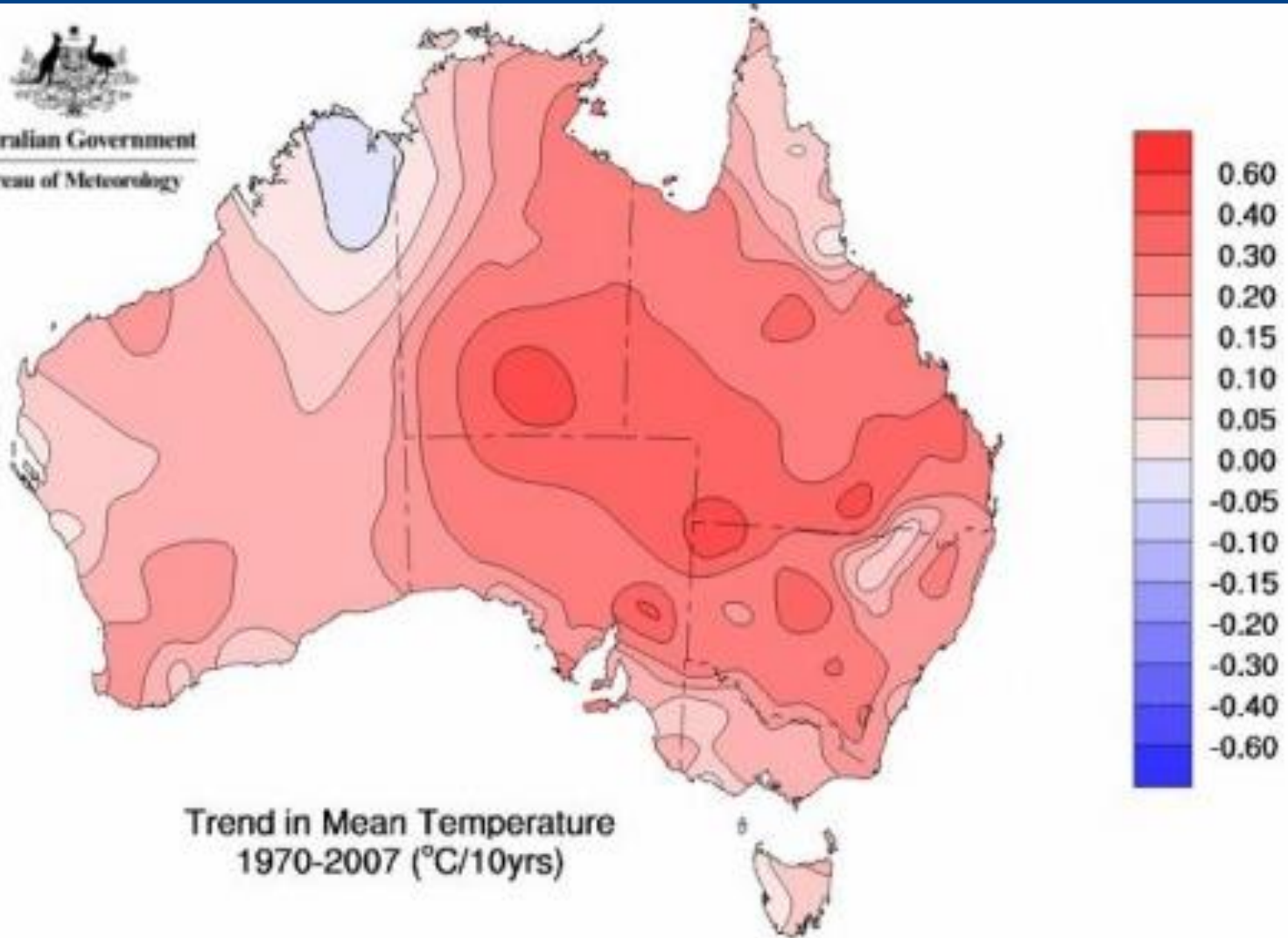


# Trends in minimum and maximum temperature

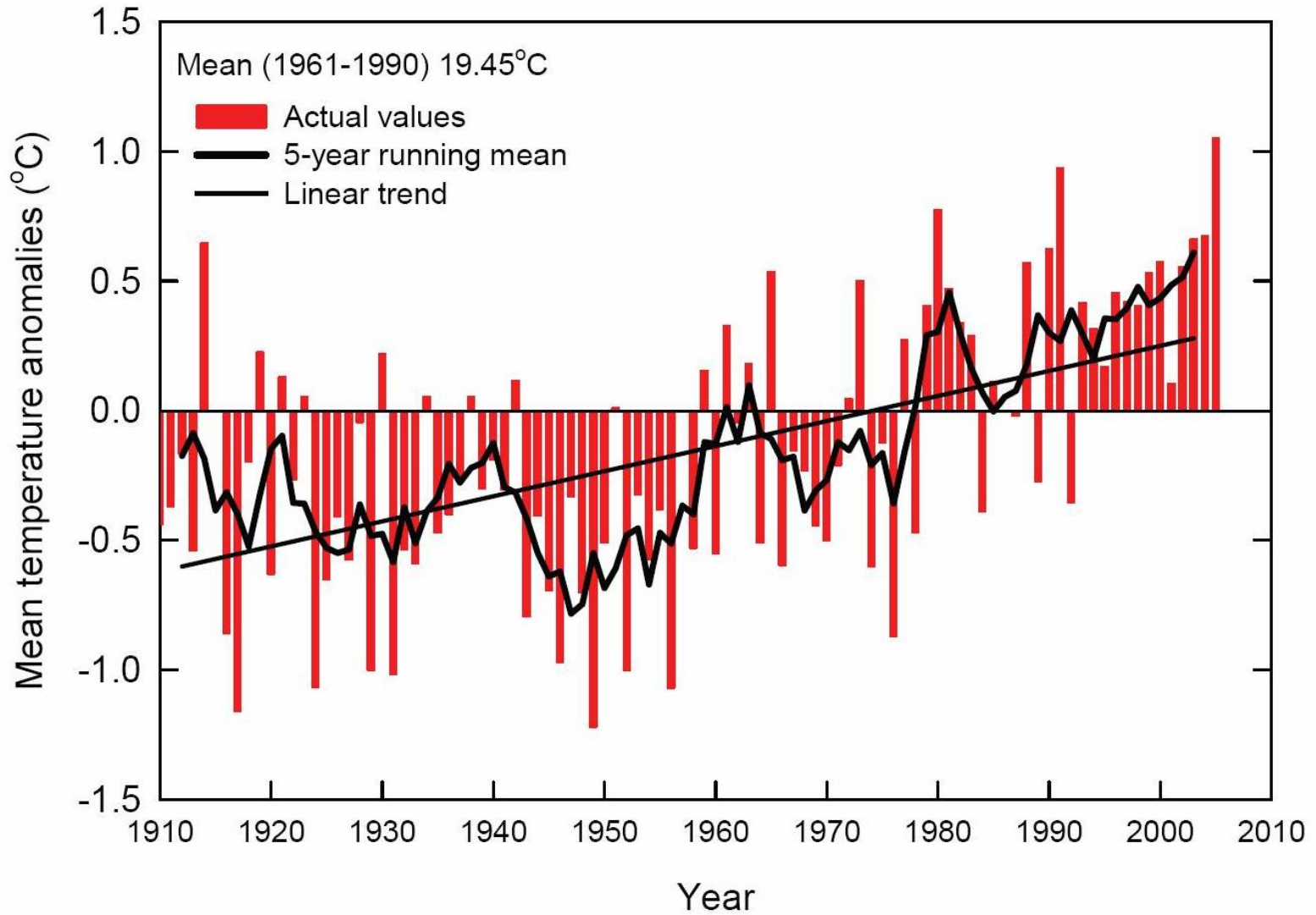




Australian Government  
Bureau of Meteorology

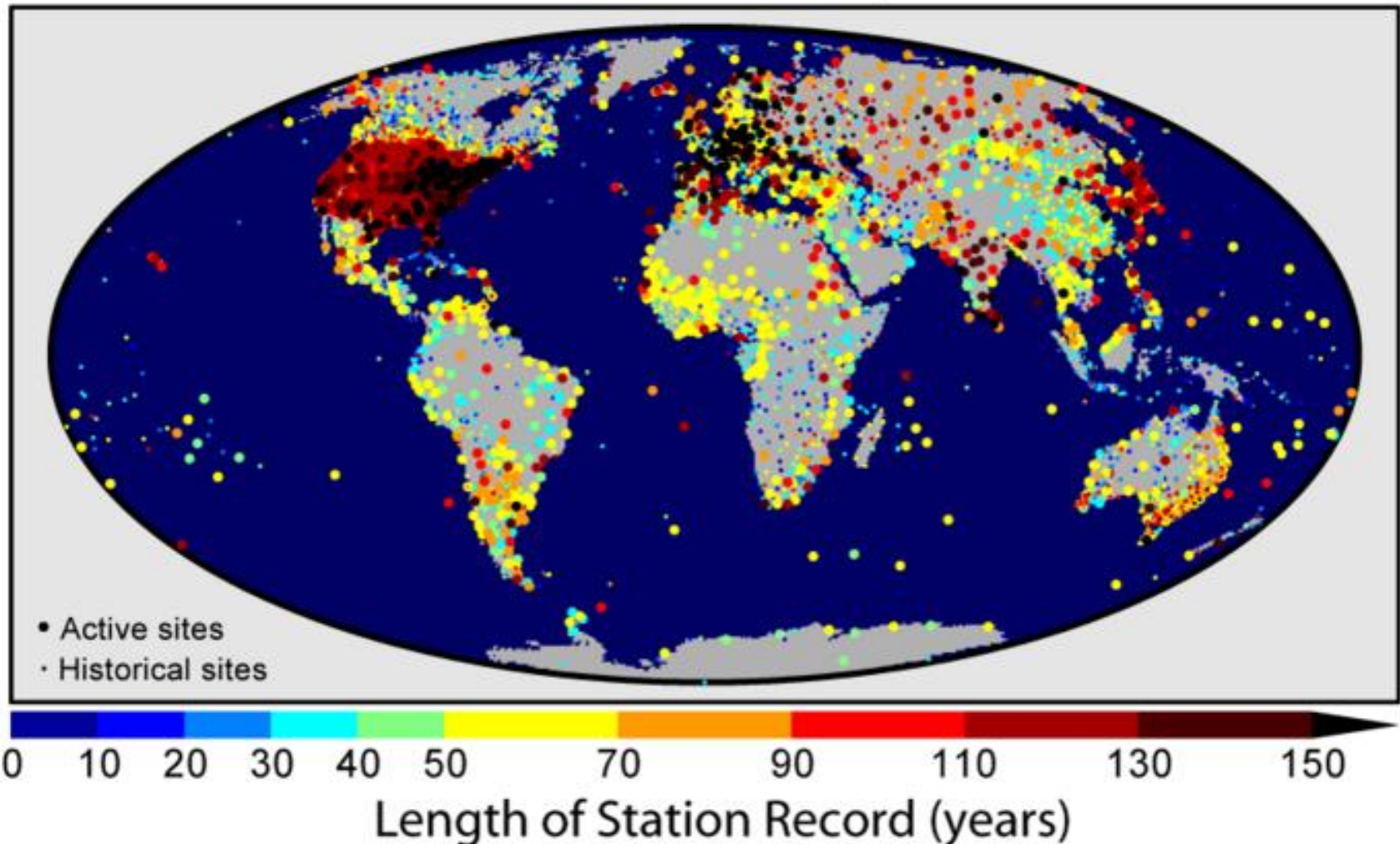


Trend in Mean Temperature  
1970-2007 ( $^{\circ}\text{C}/10\text{yrs}$ )



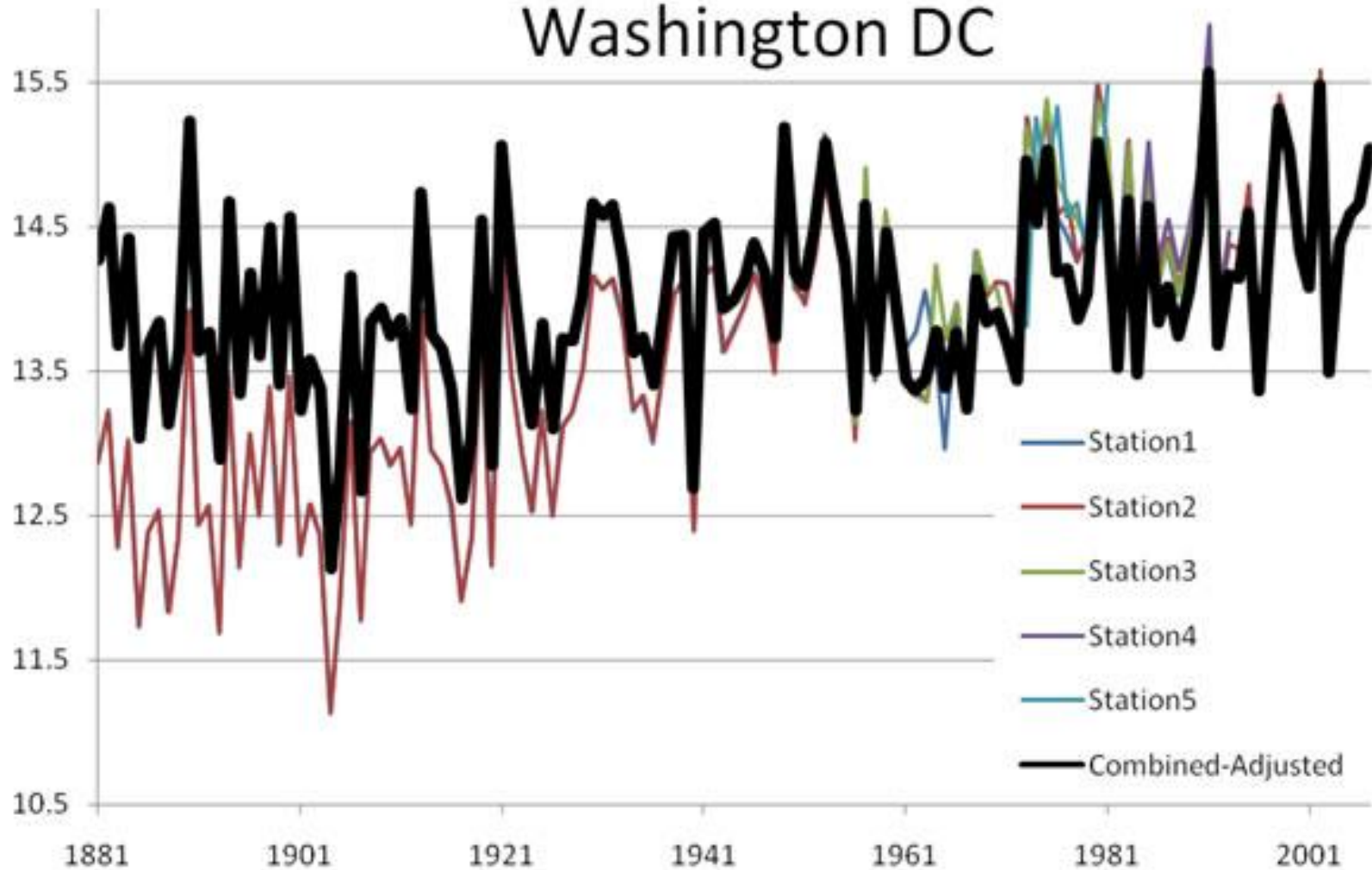
# Instrumental records are biased

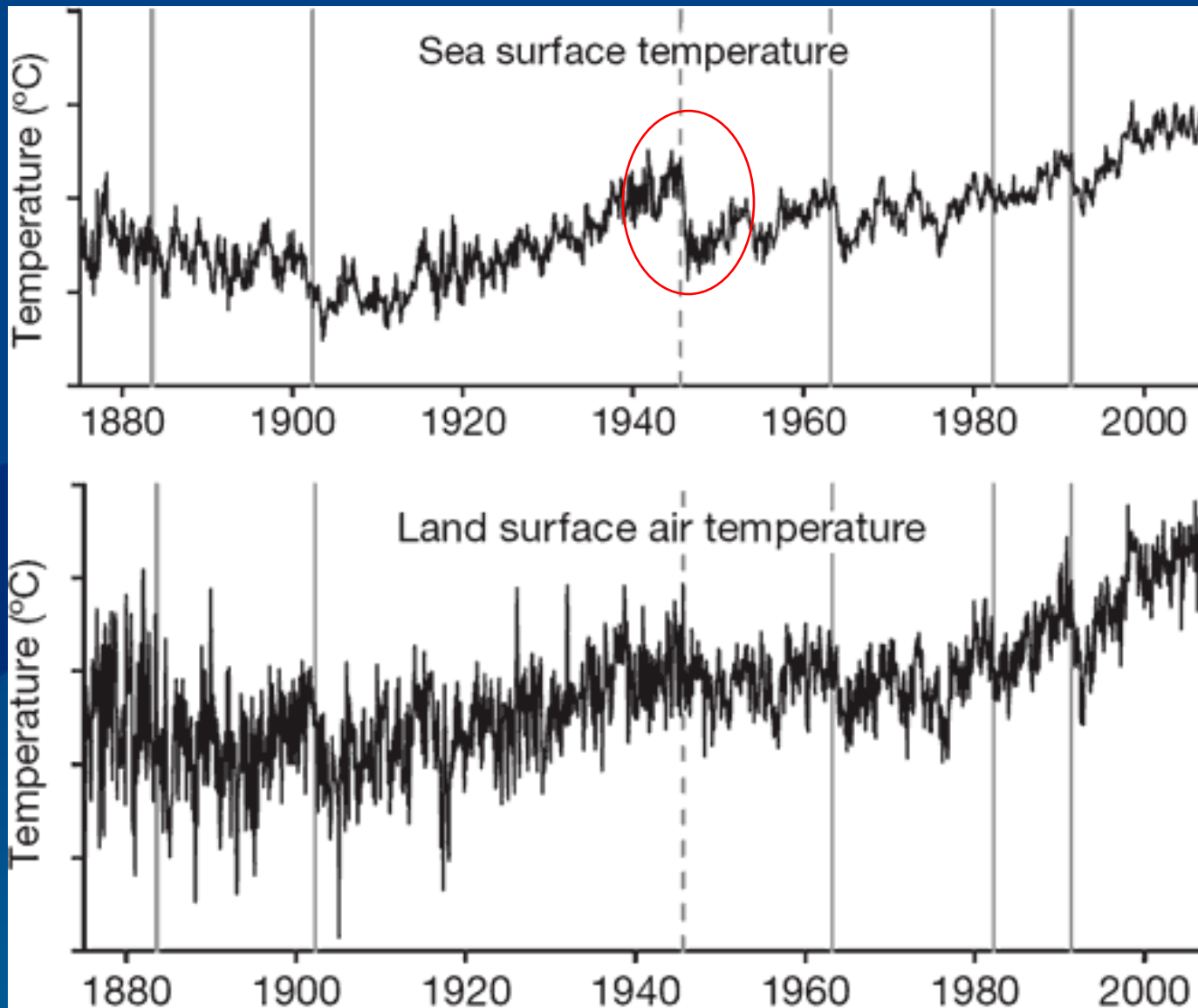
# Global Climate Network Temperature Stations



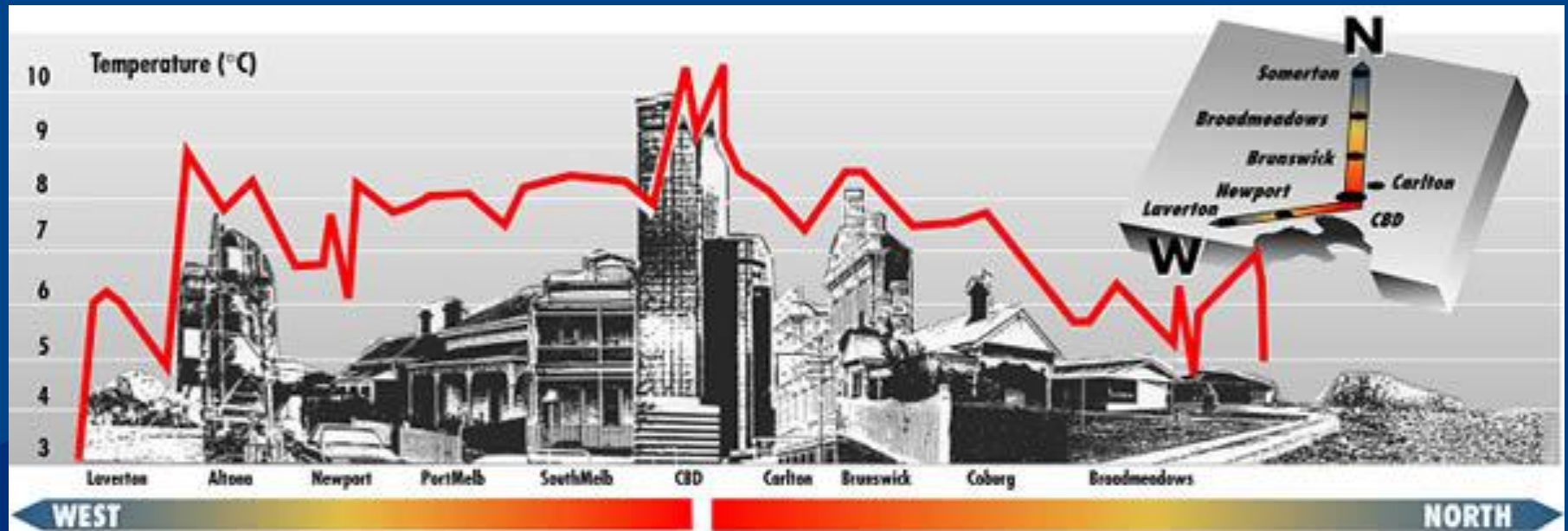


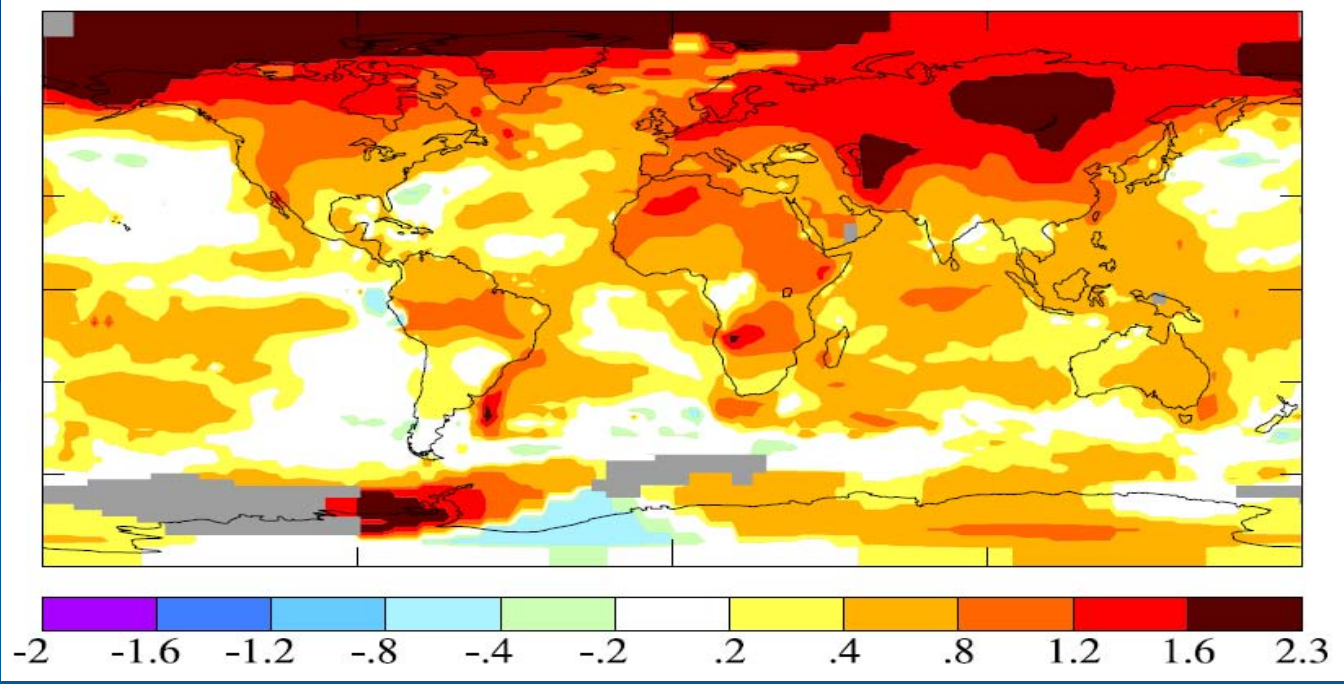
# Washington DC



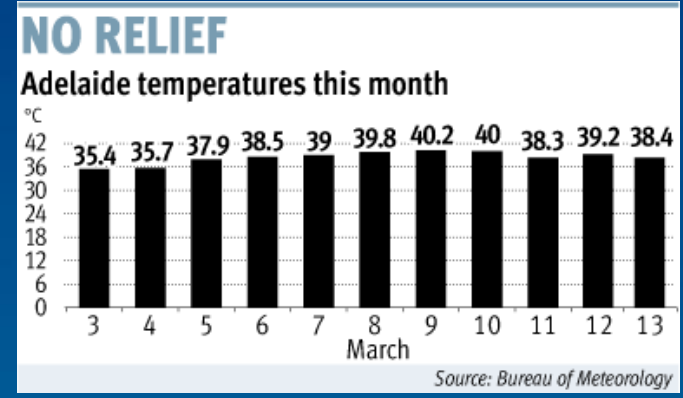
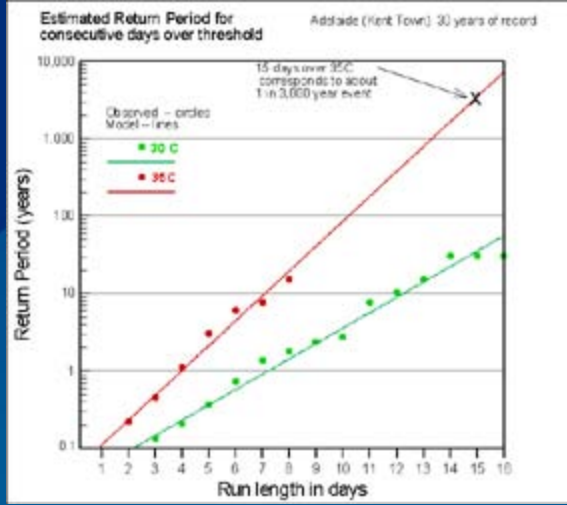
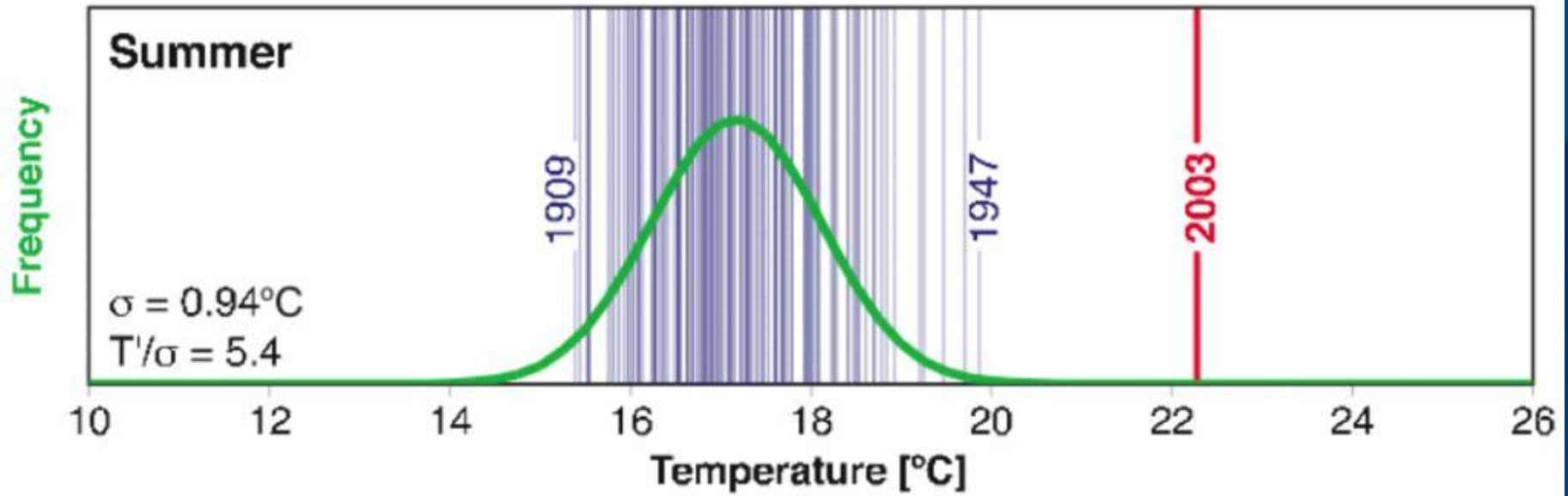


**It's the urban heat island effect**





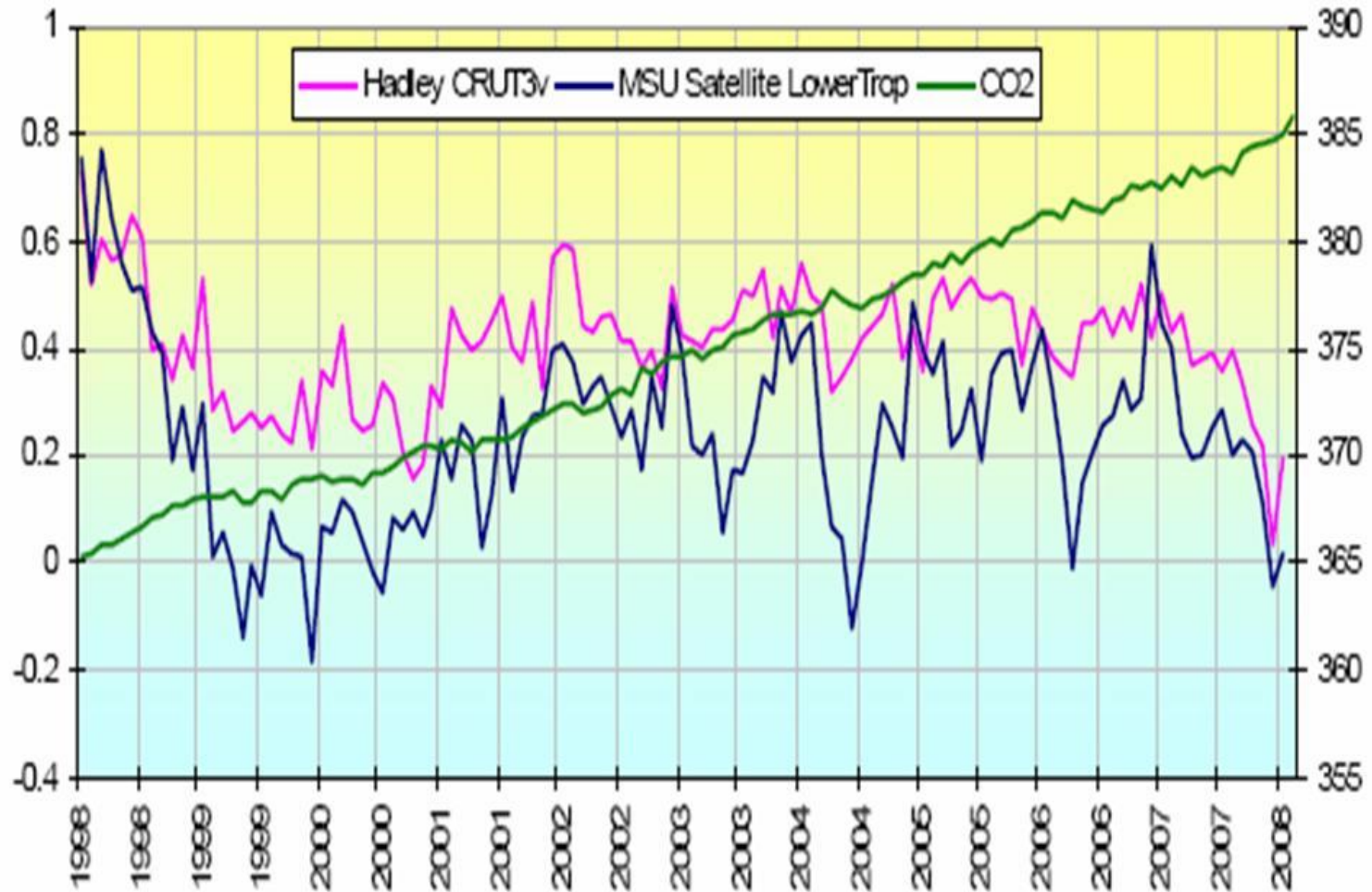
**We've always had heatwaves**

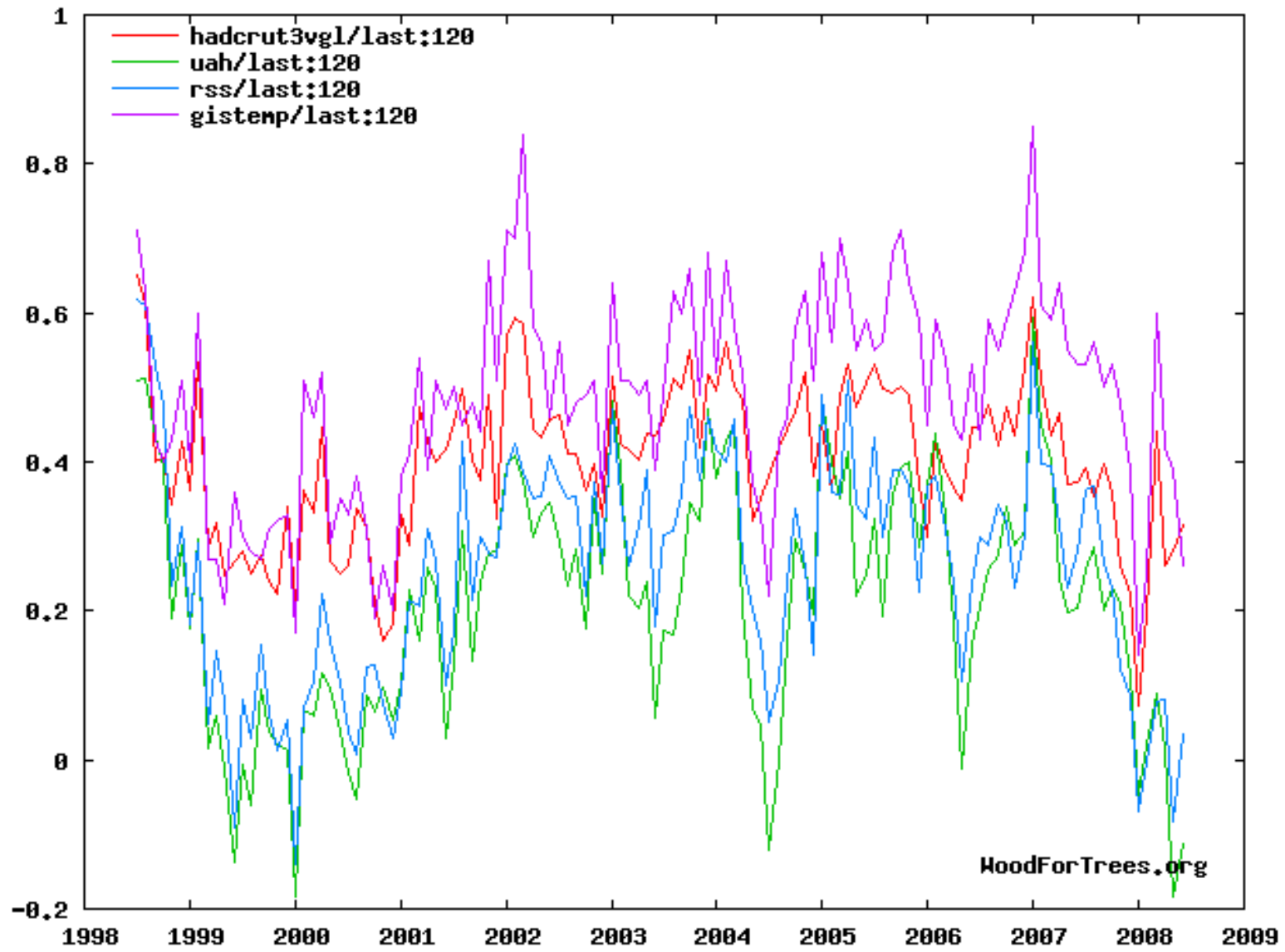


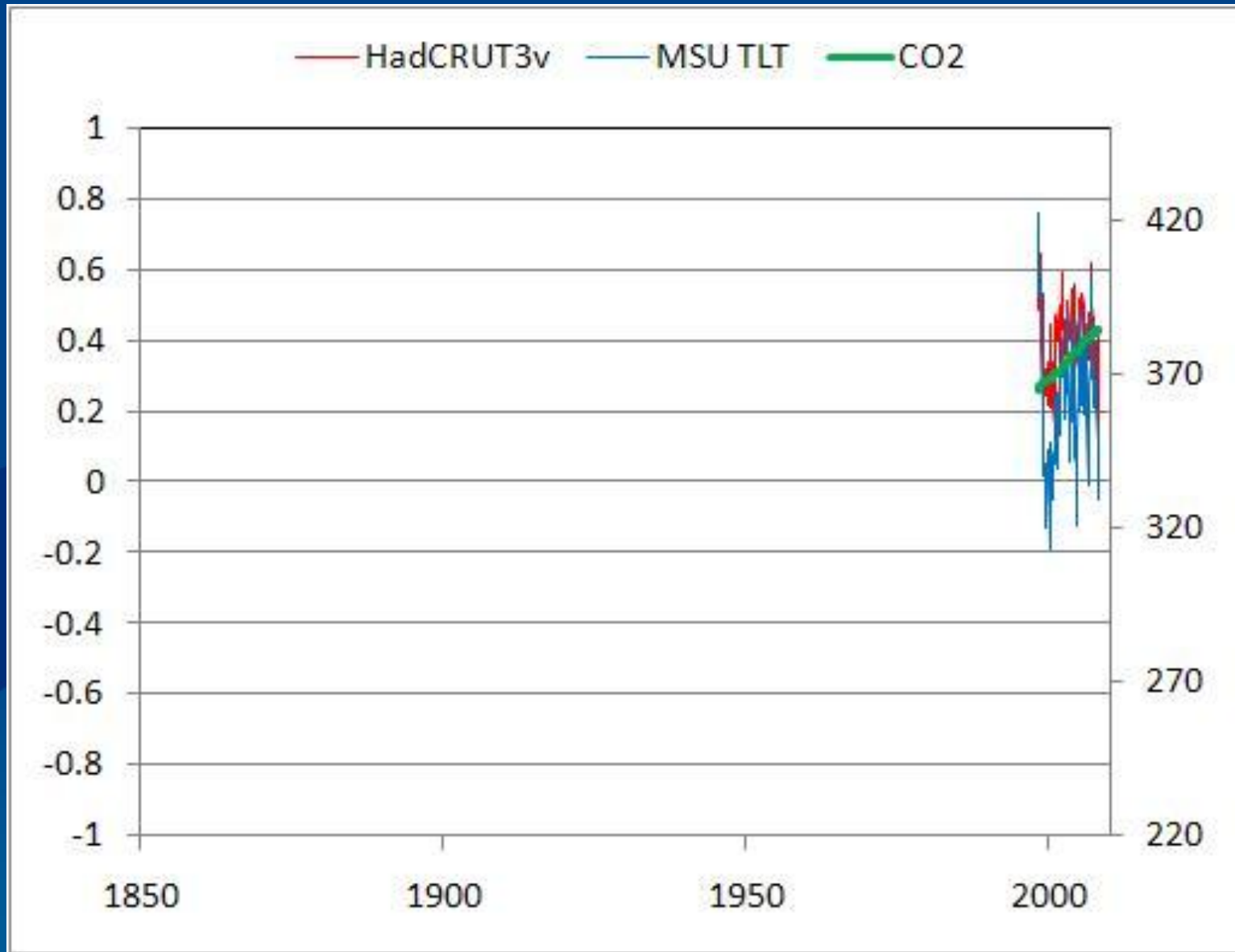
# Global warming stopped in 1998

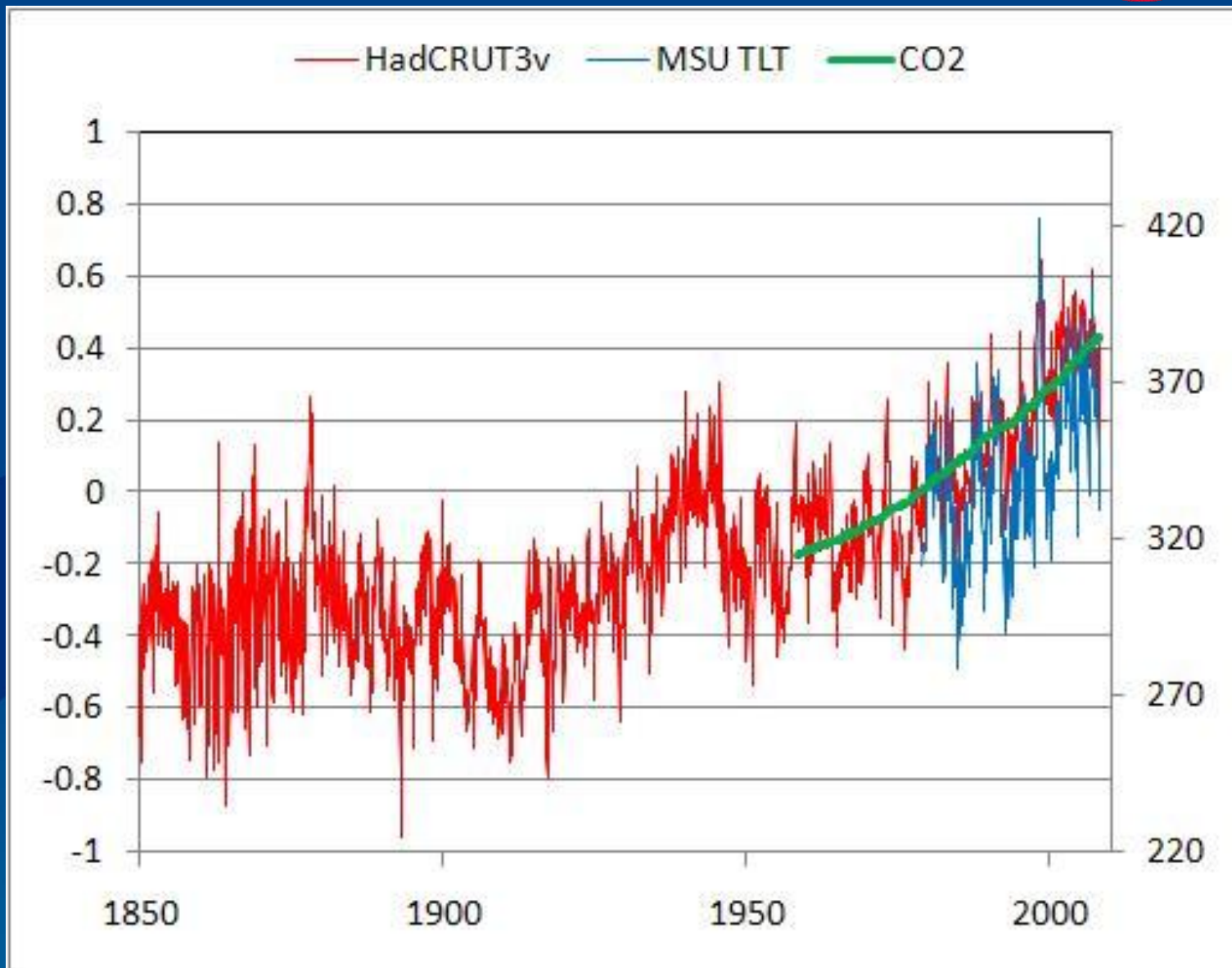


## Hadley and MSU Temps vs CO2

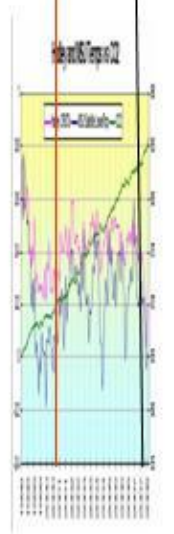
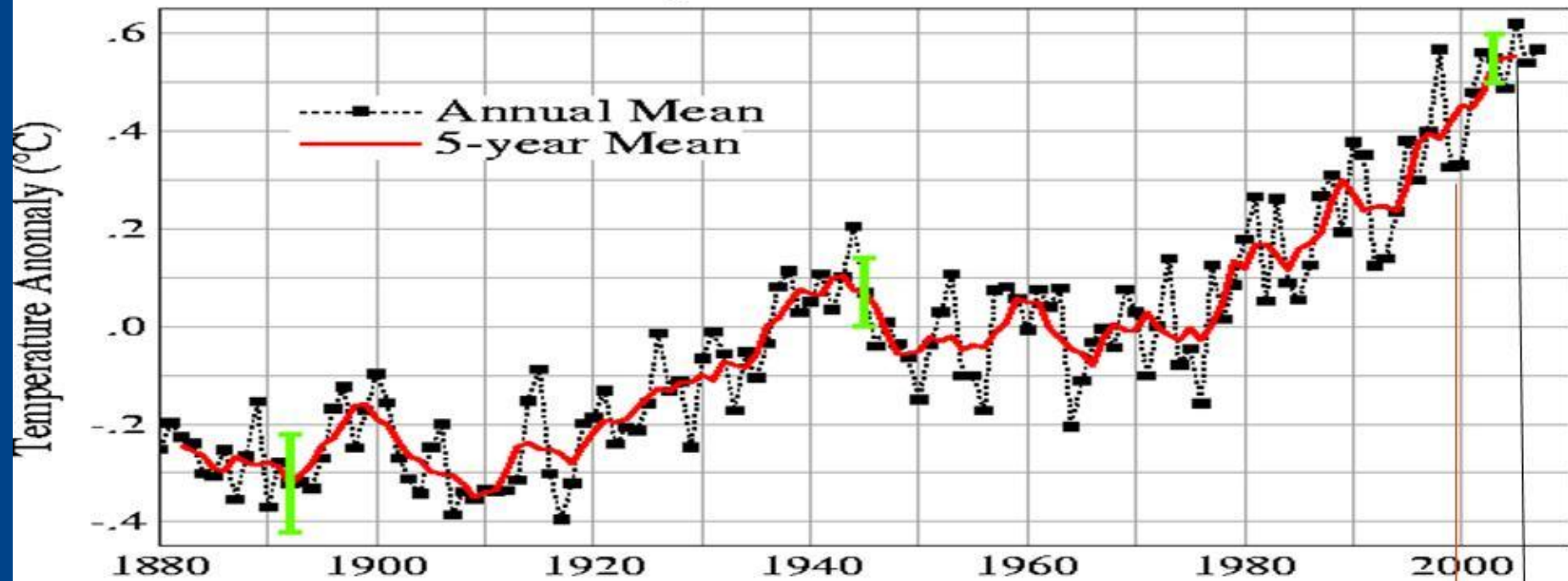


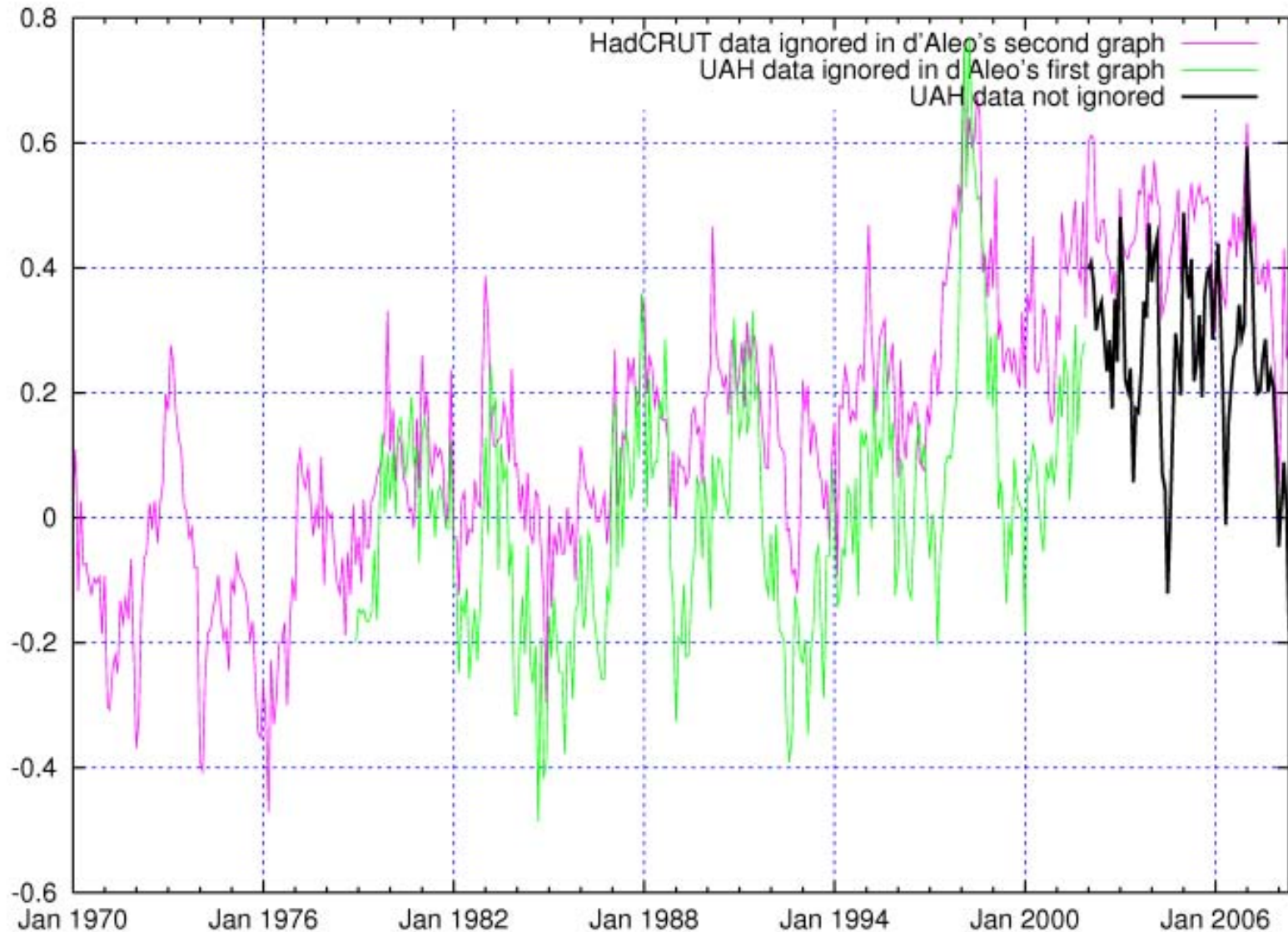


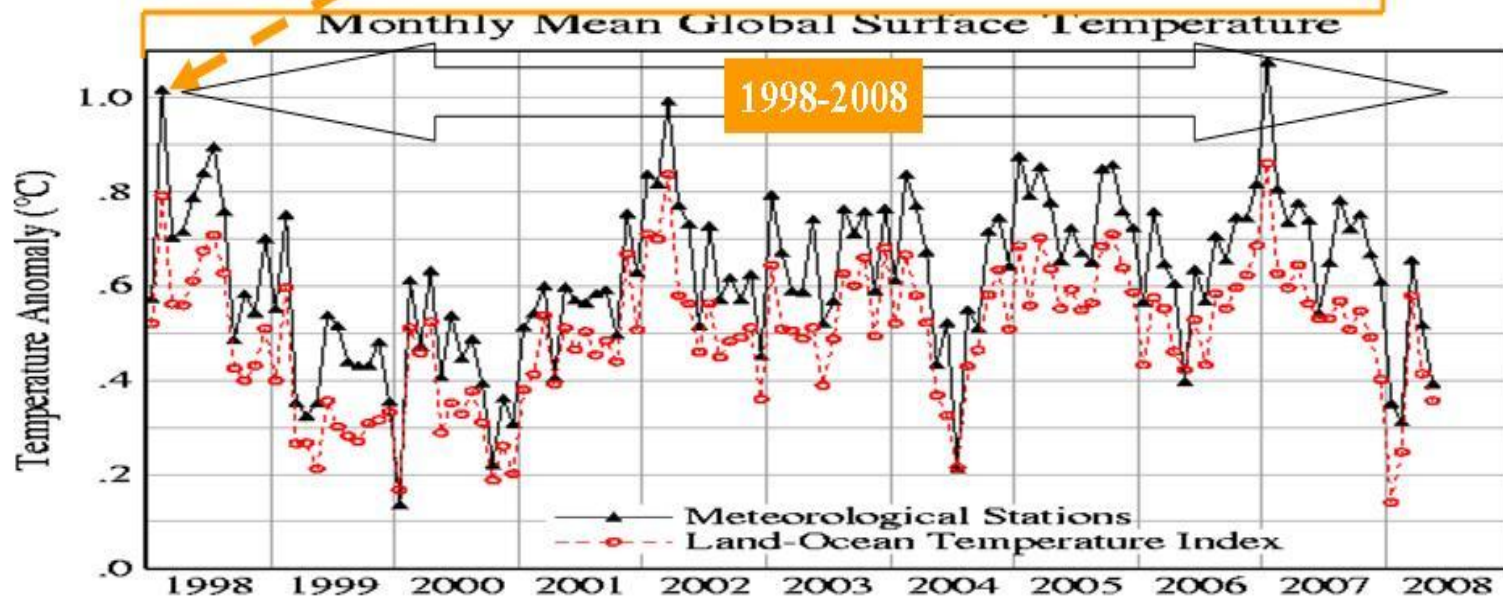
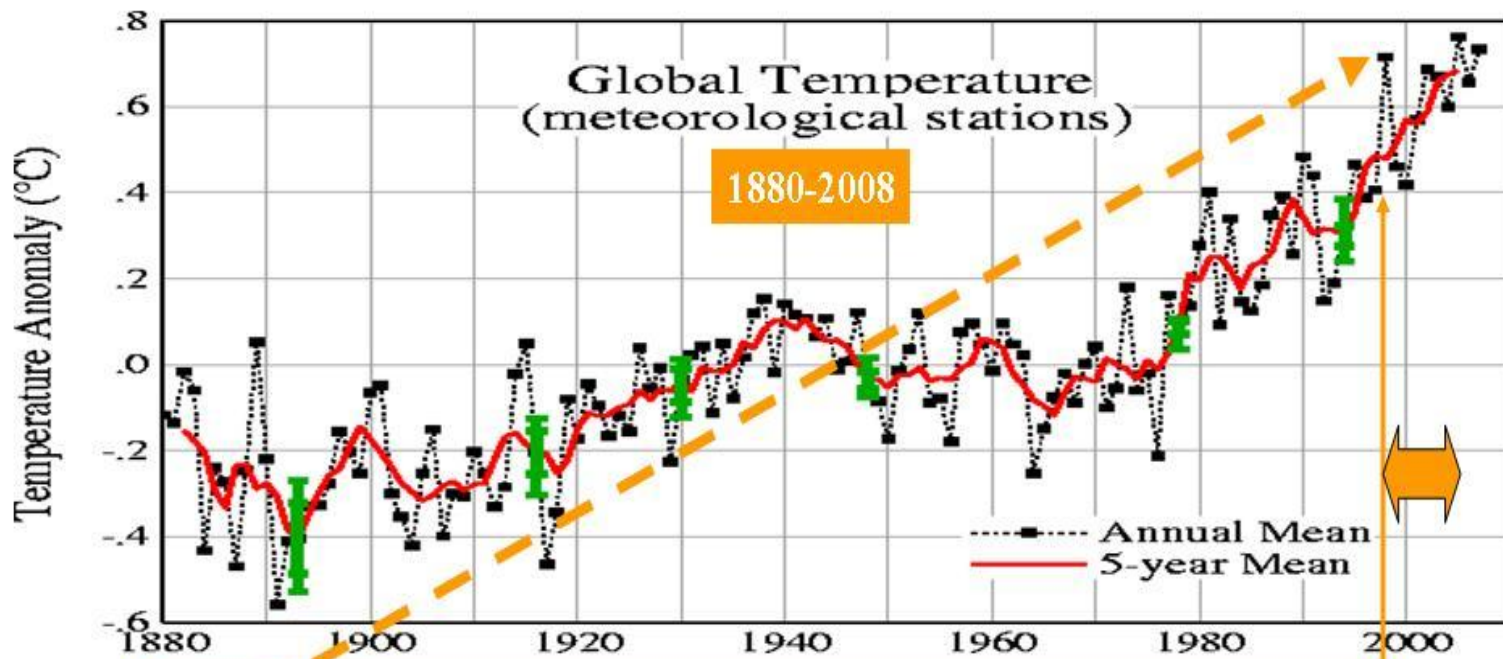




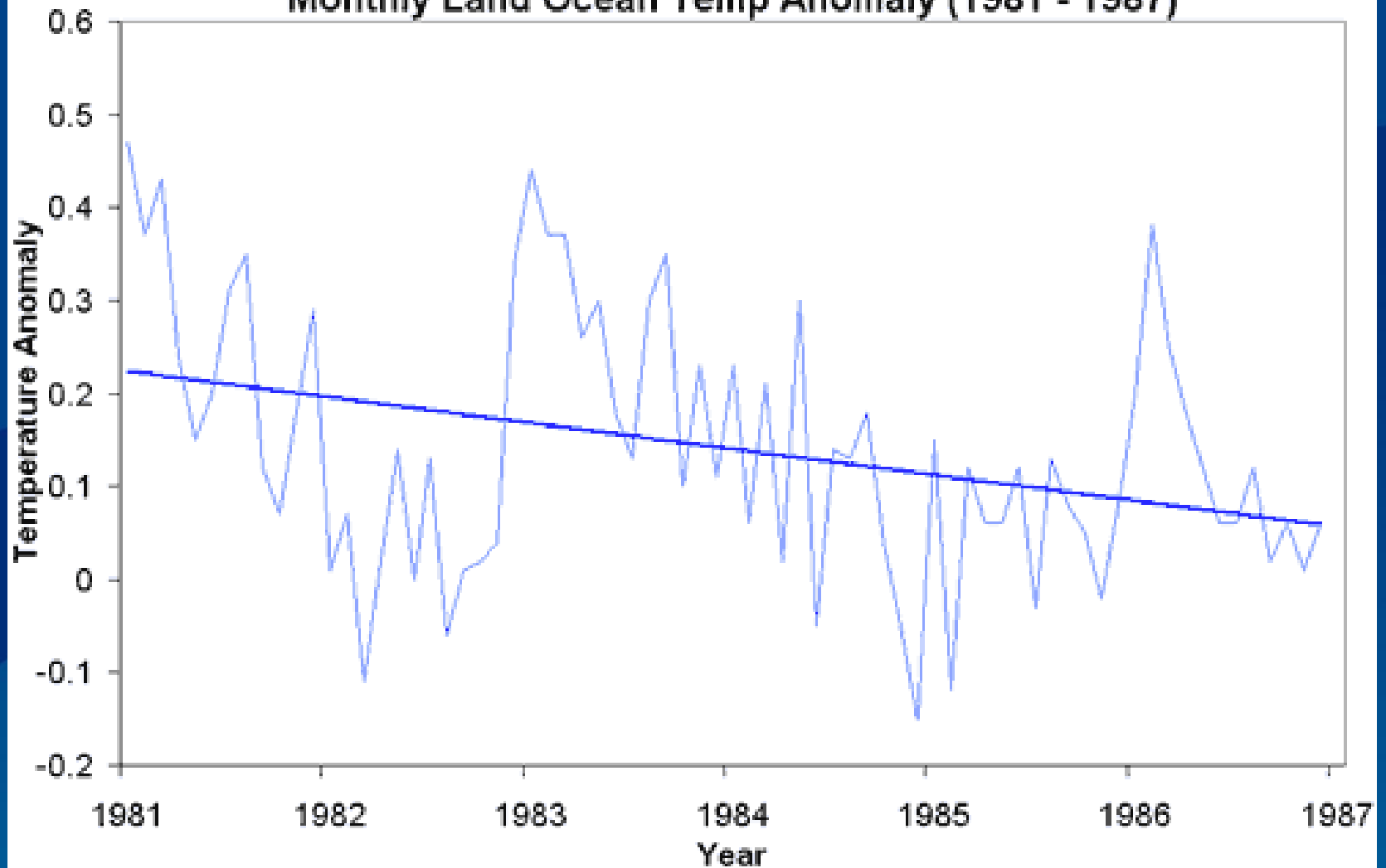
# Global Temperature Land-Ocean Index





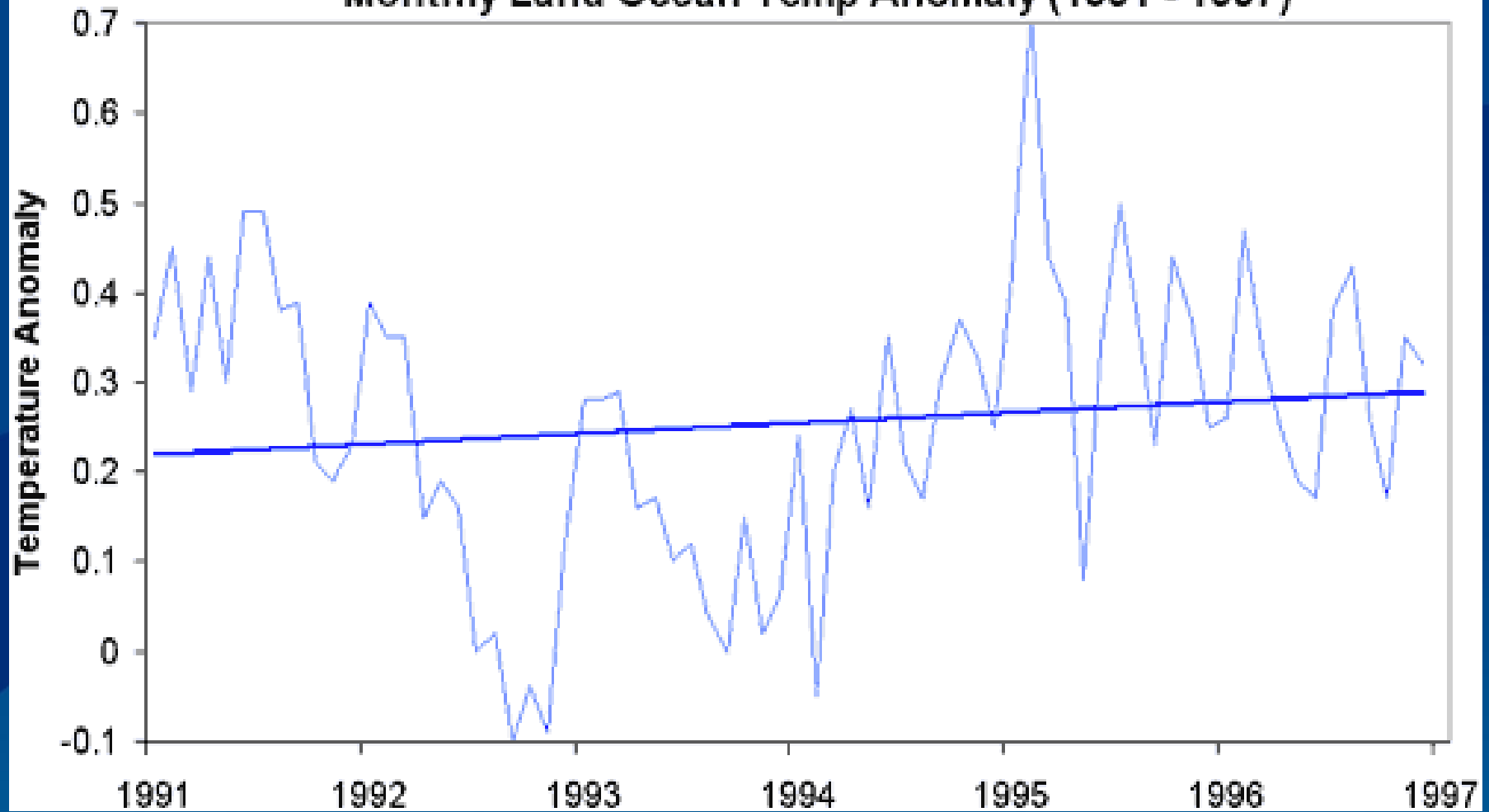


### Monthly Land Ocean Temp Anomaly (1981 - 1987)

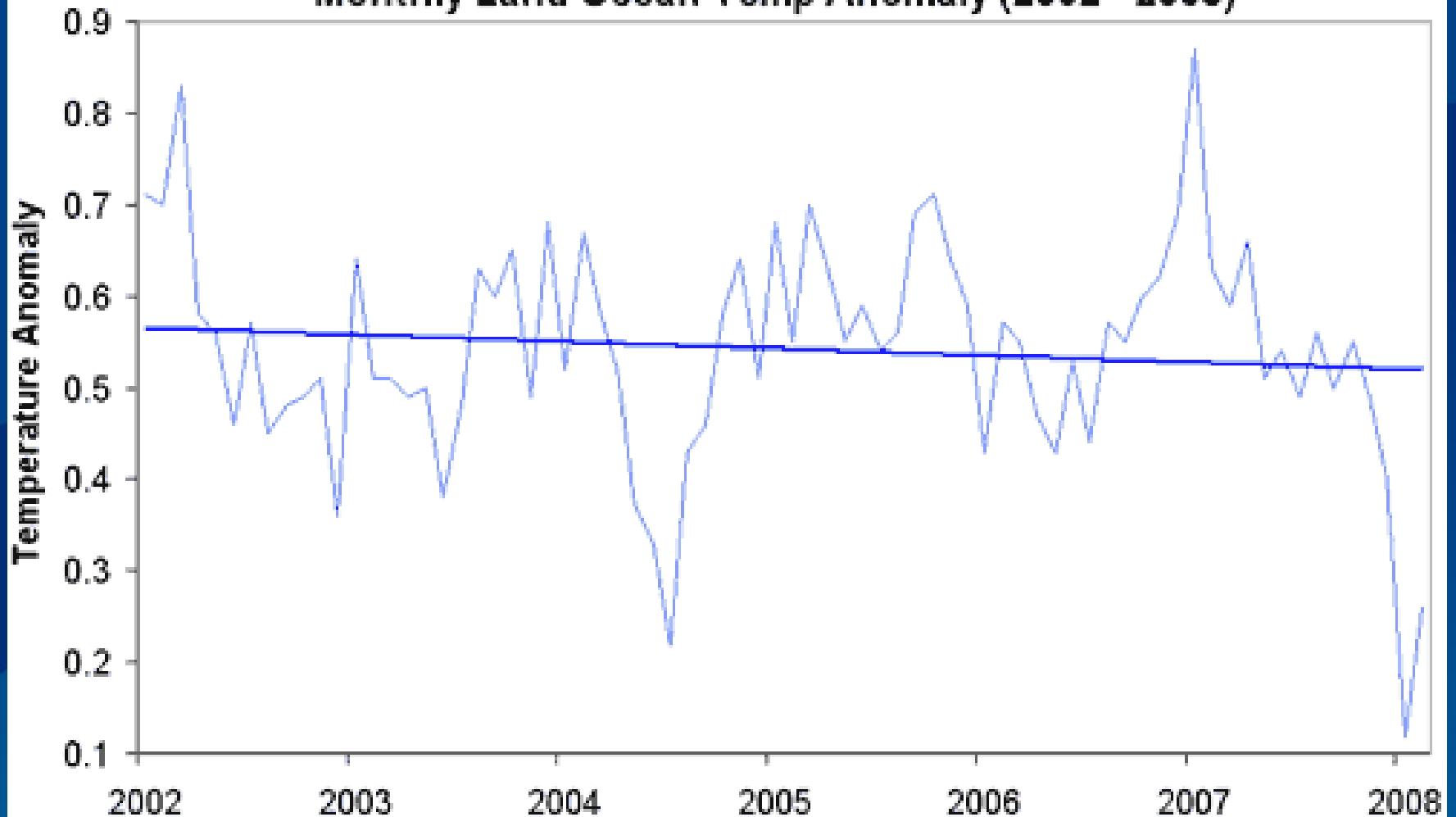


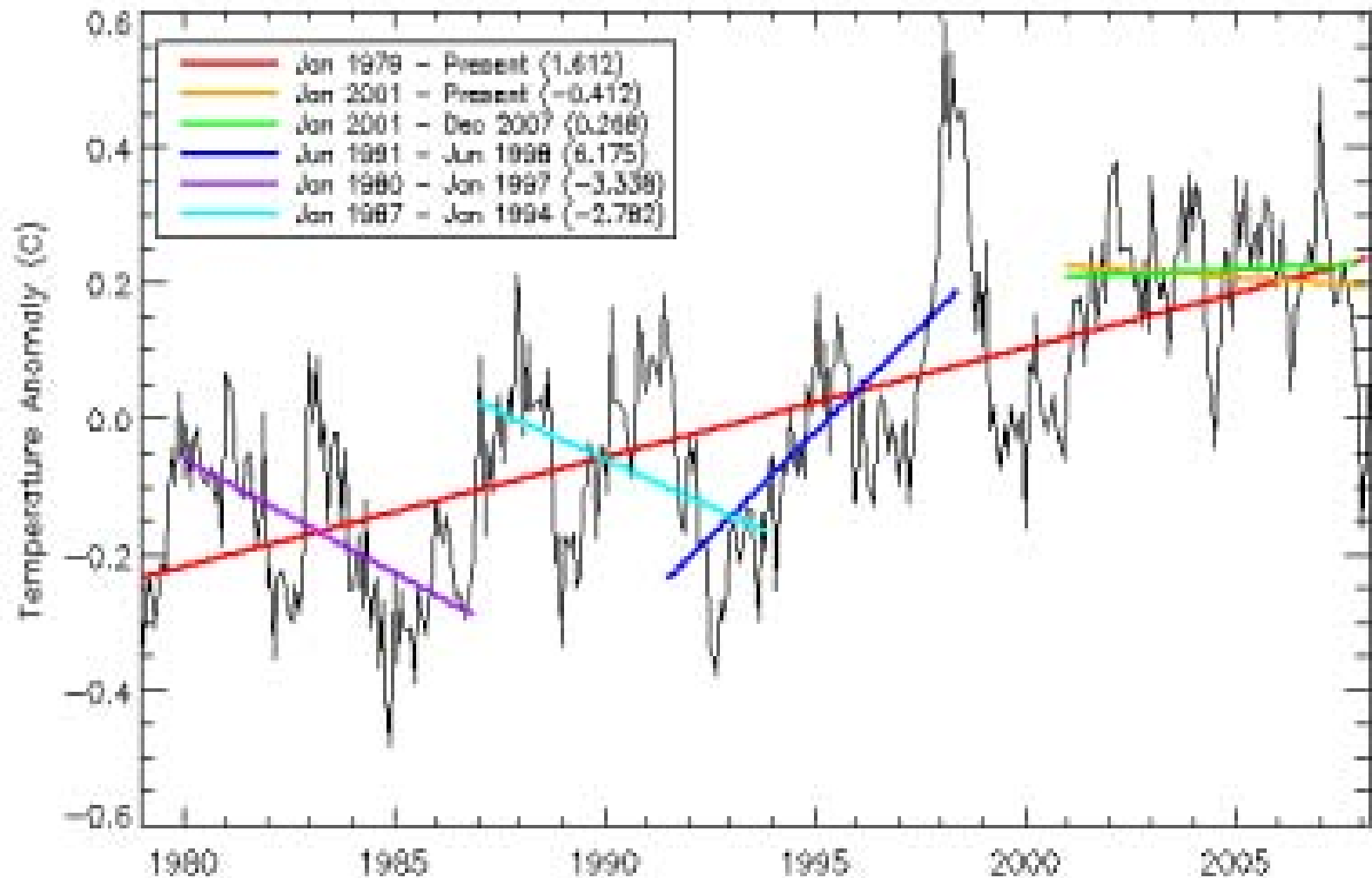


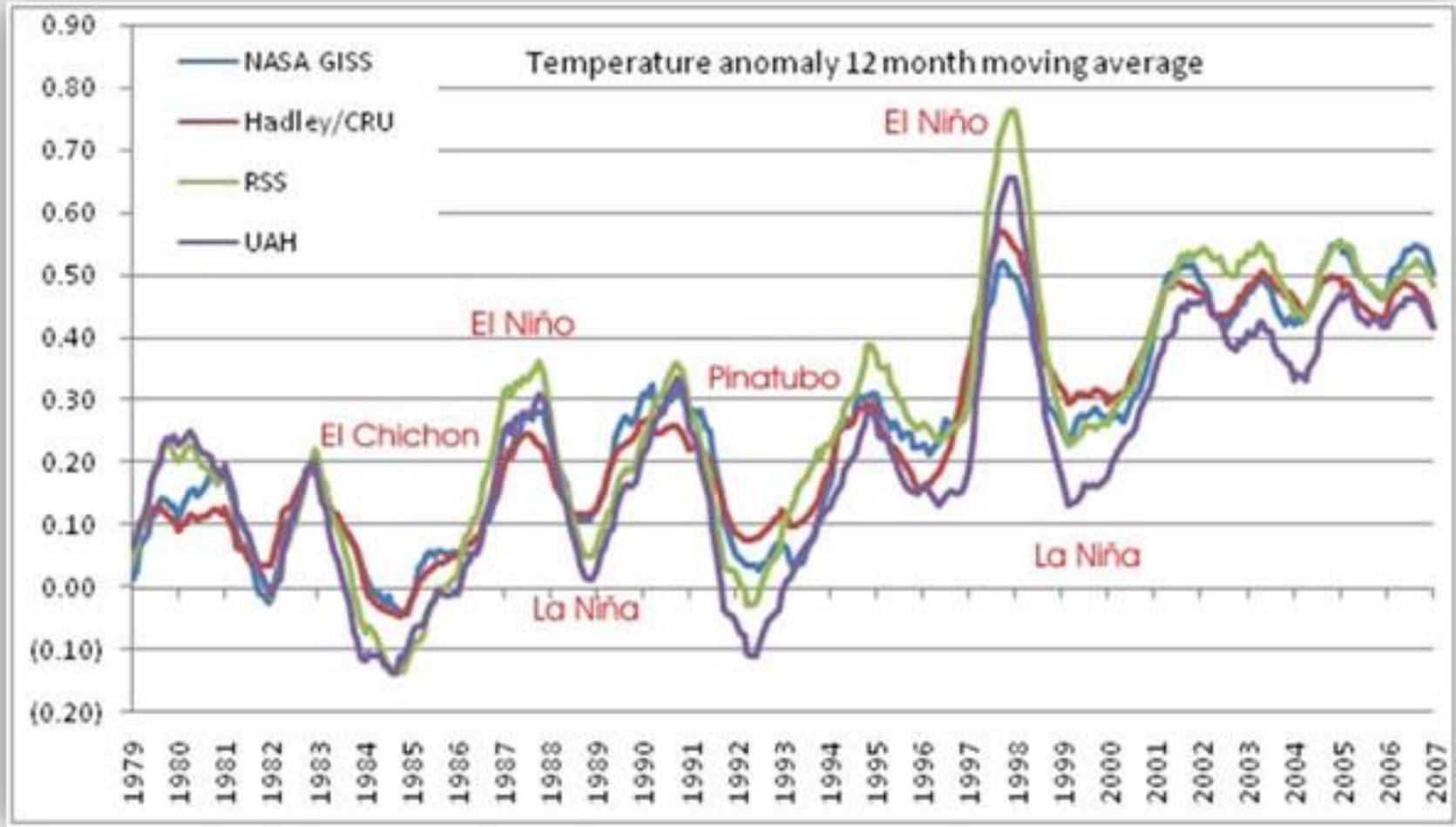
## Monthly Land Ocean Temp Anomaly (1991 - 1997)



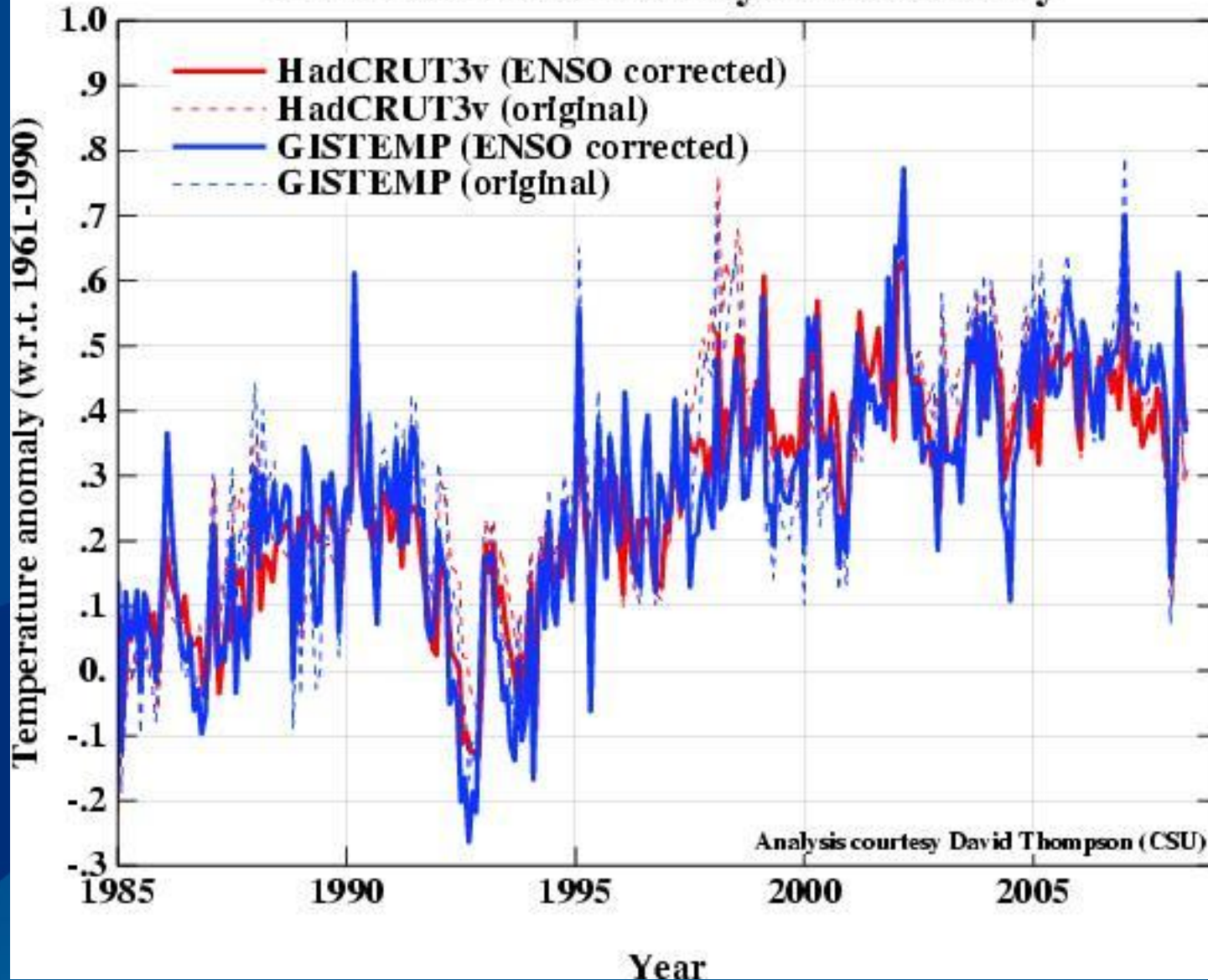
### Monthly Land Ocean Temp Anomaly (2002 - 2008)



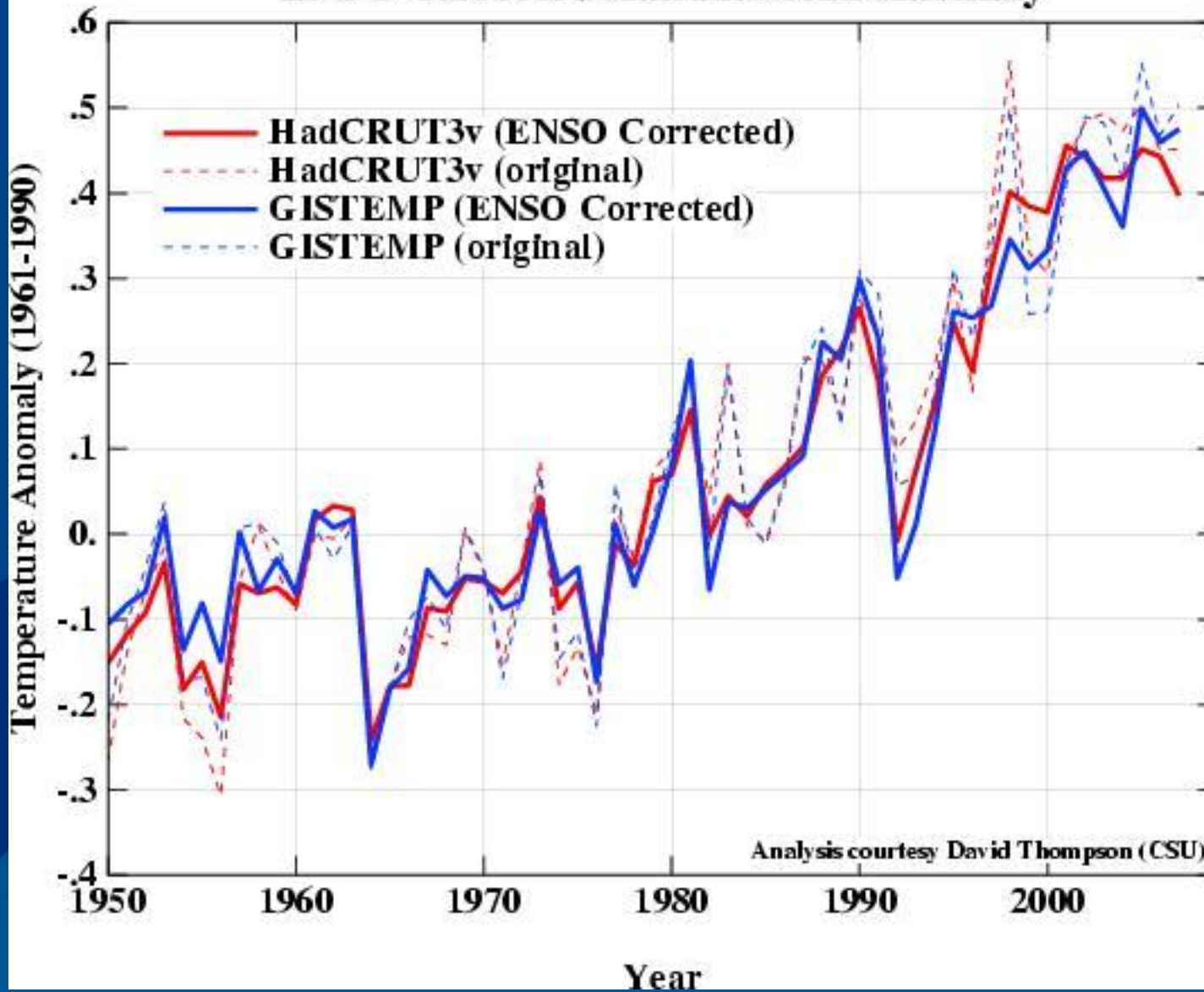


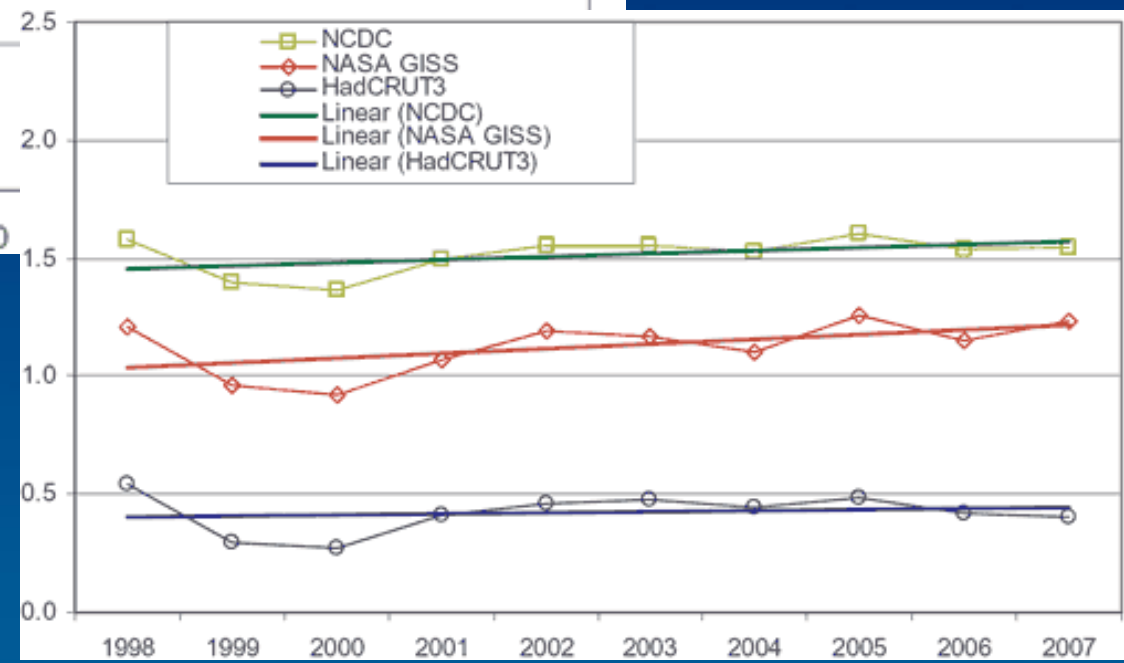
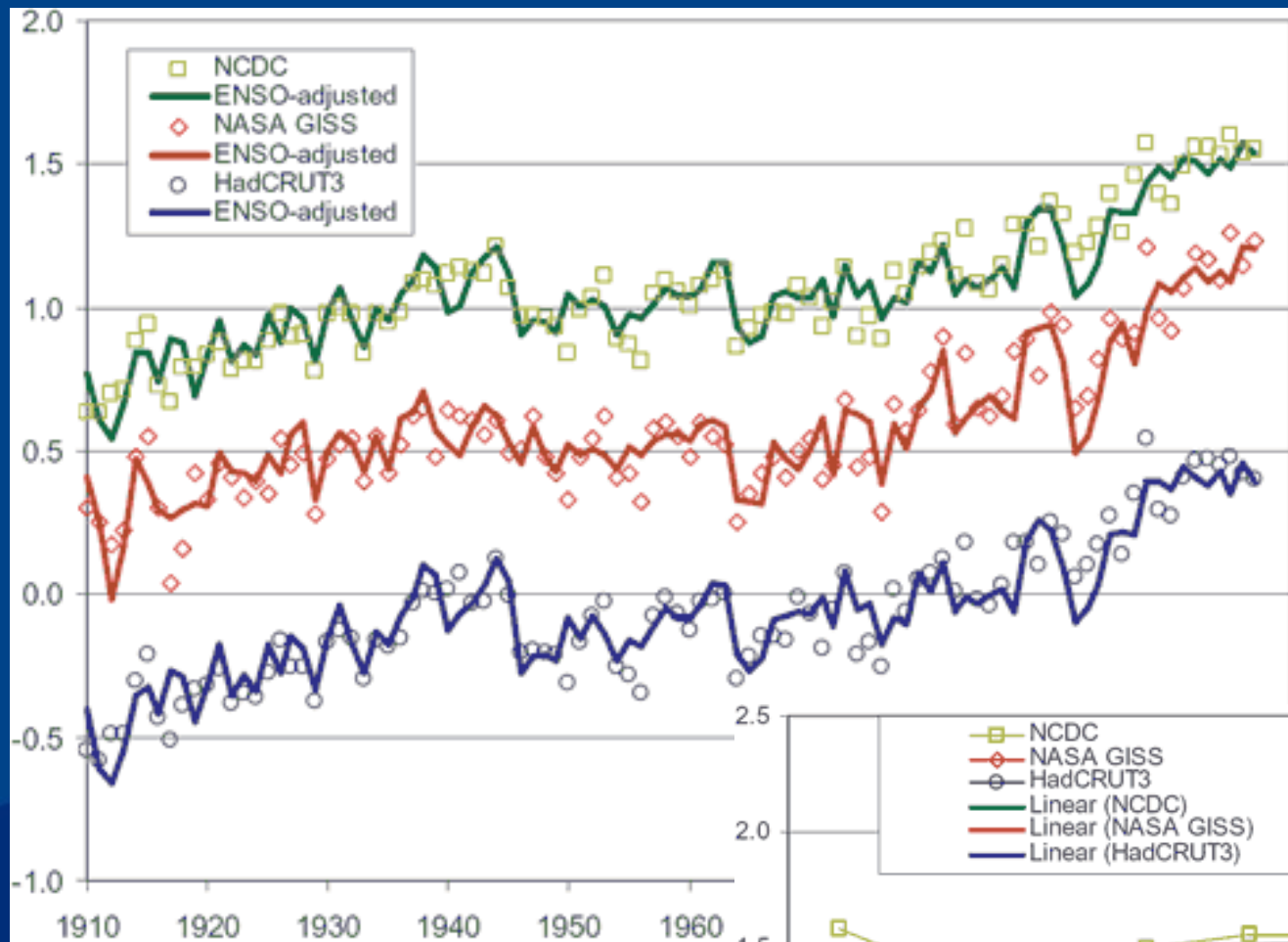


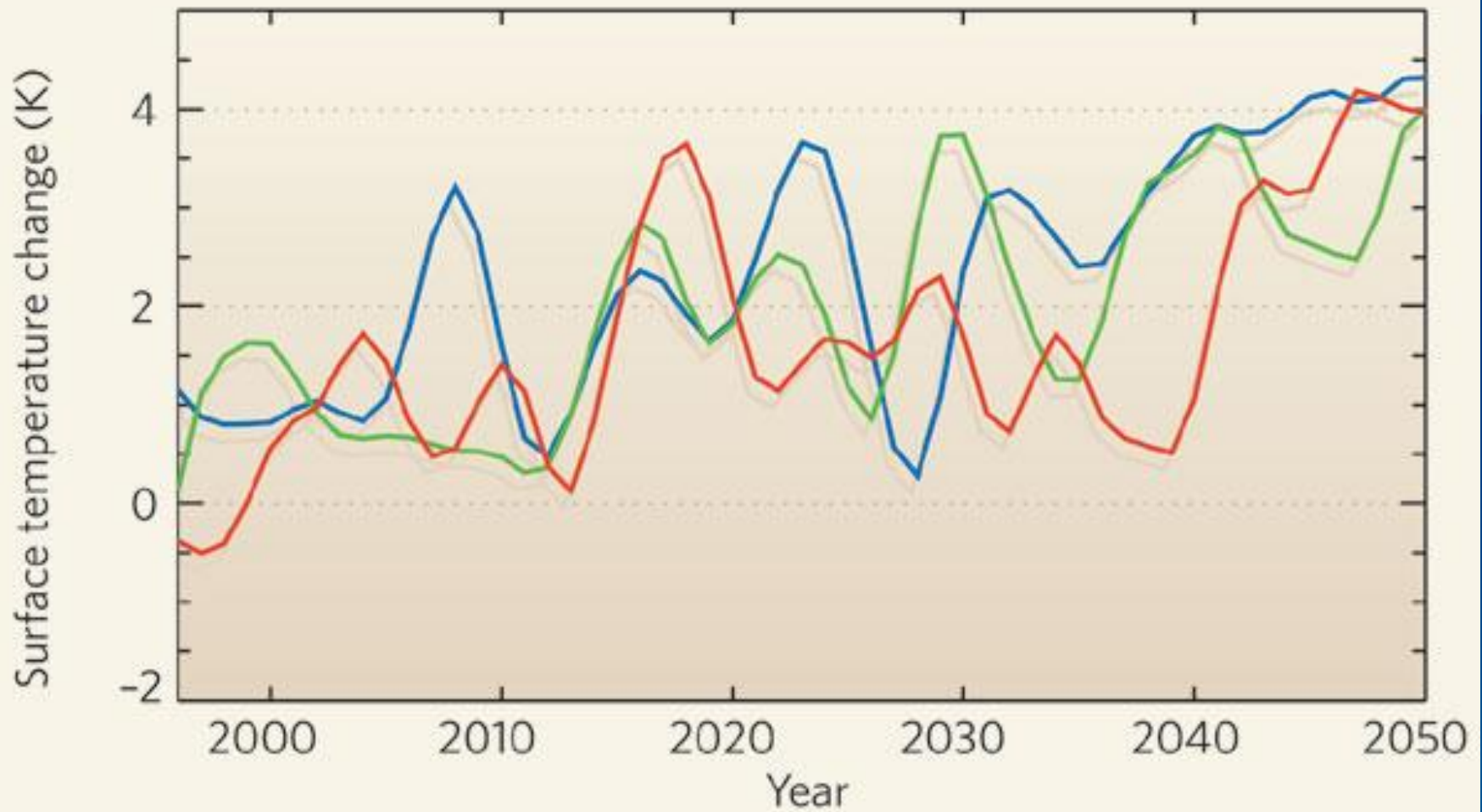
## ENSO-corrected Monthly Mean Anomaly



## ENSO-corrected Annual Mean Anomaly





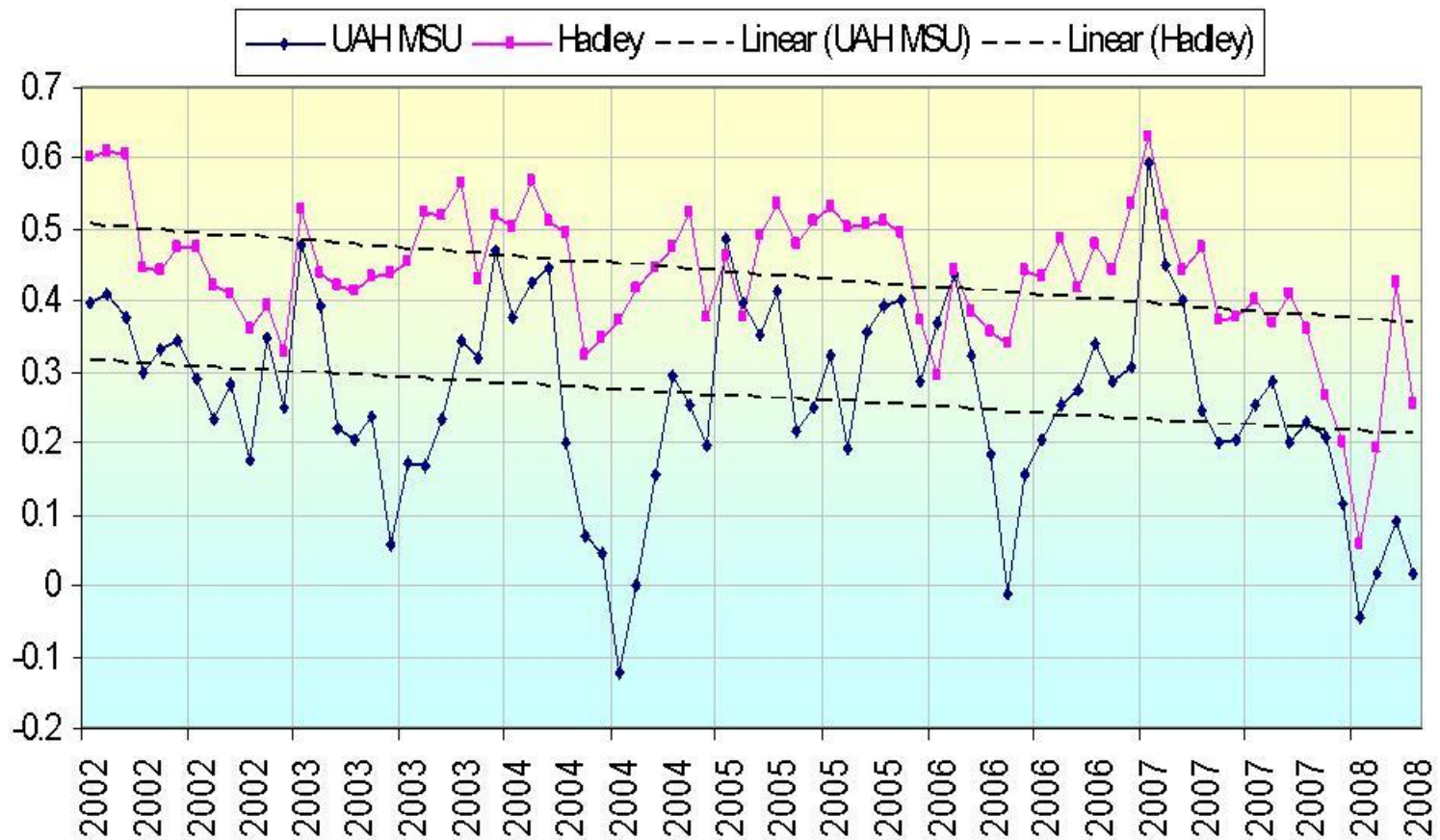




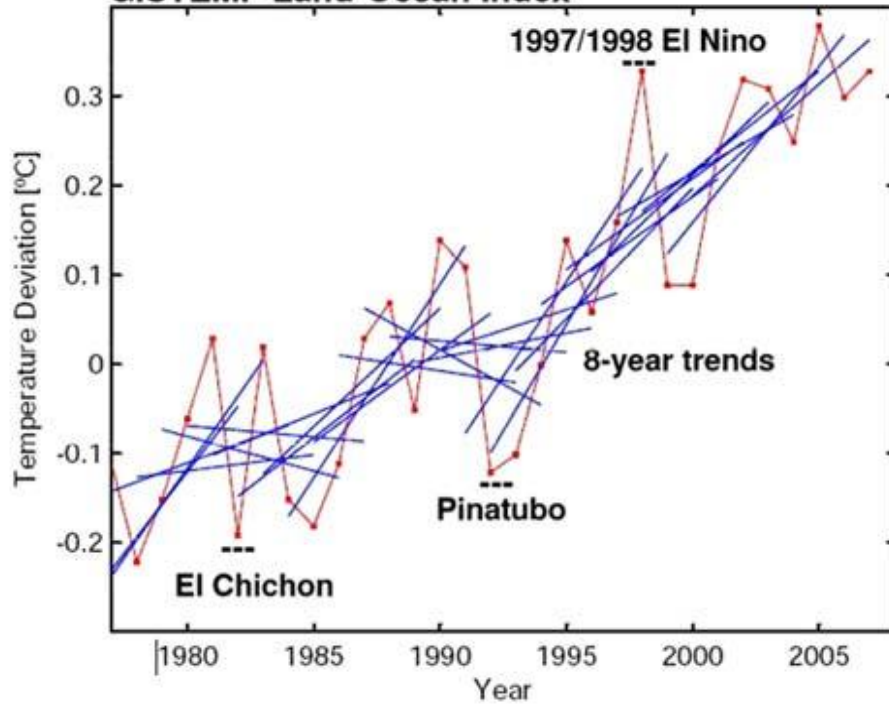
**The Earth has been cooling since 2002**

**(We are entering a new Ice Age)**

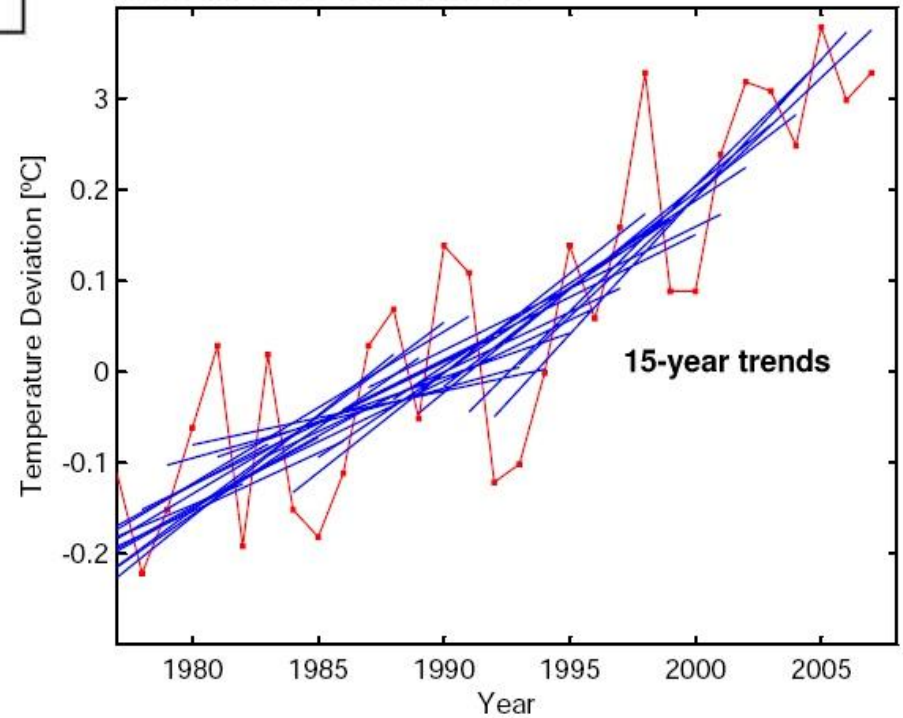
## UAH MSU and Hadley Monthly Temperatures

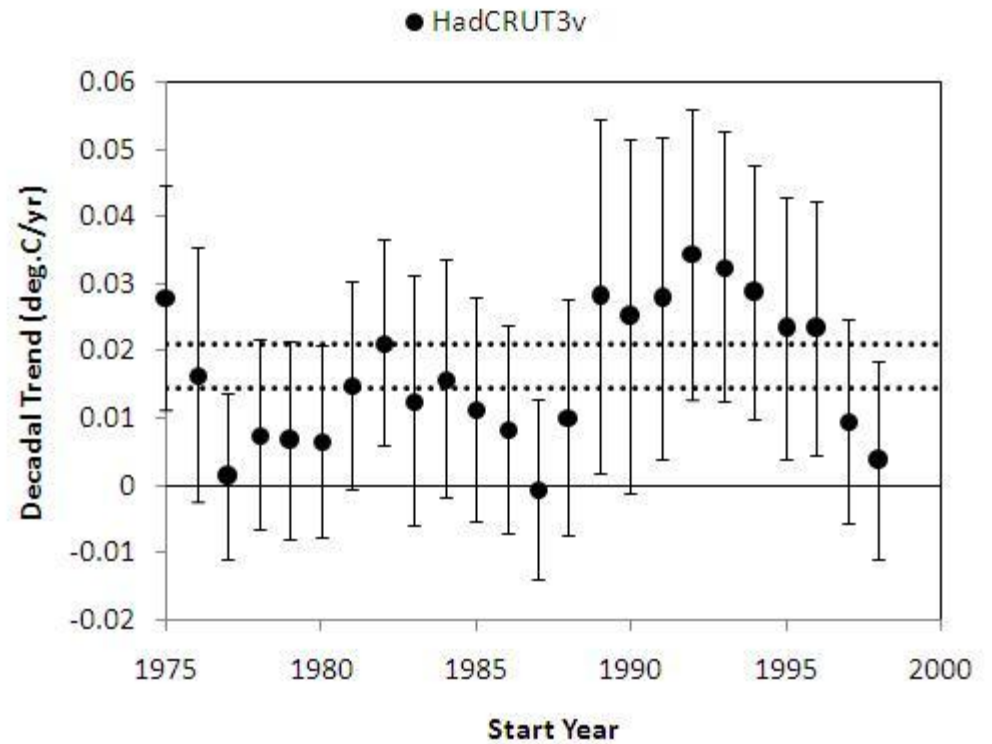
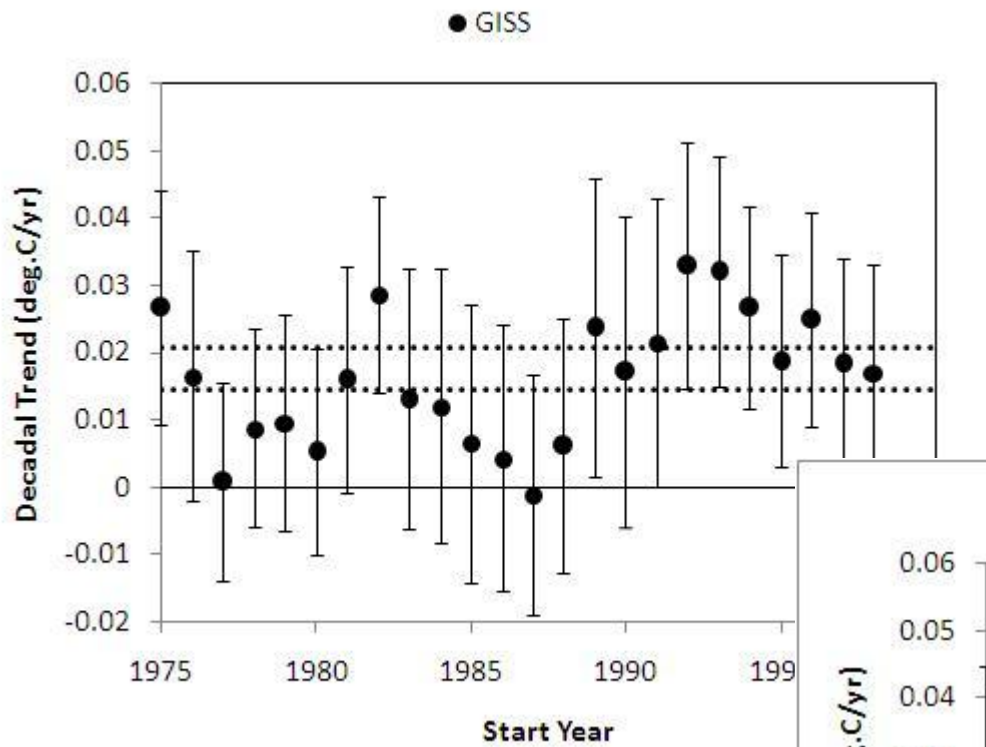


### GISTEMP Land-Ocean Index

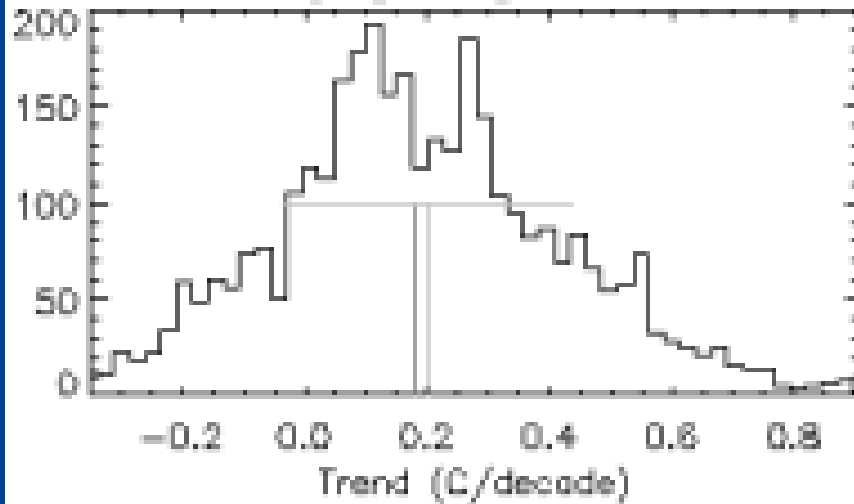


### GISTEMP Land-Ocean Index

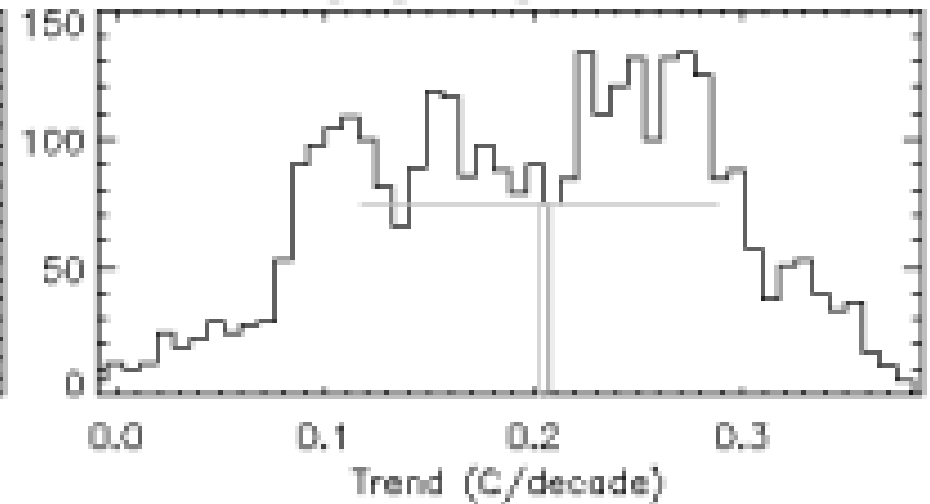




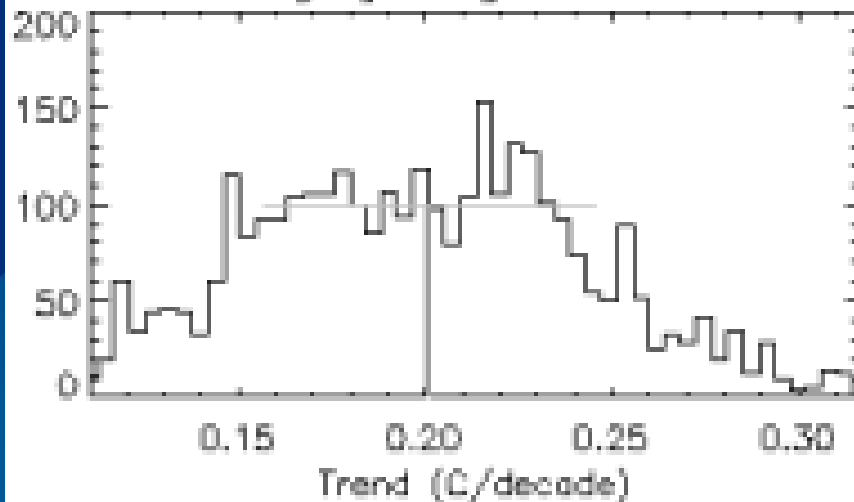
Averaging Length: 7 Years



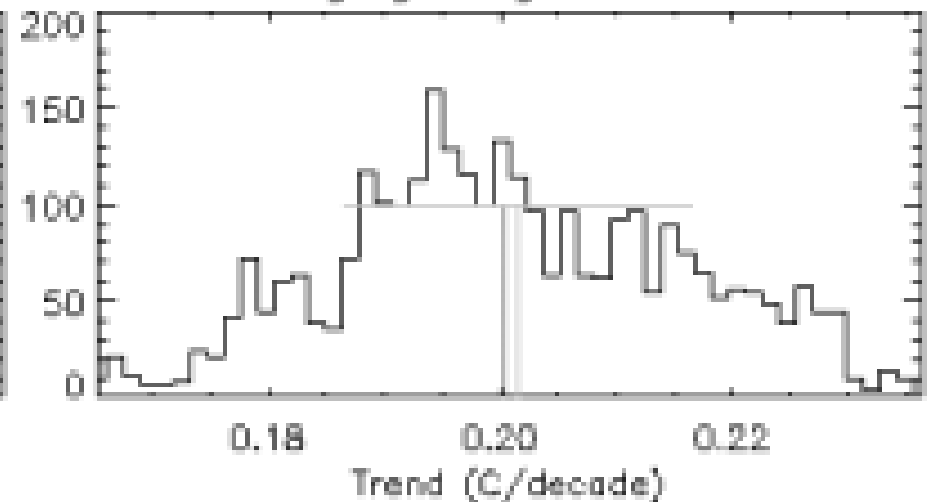
Averaging Length: 14 Years

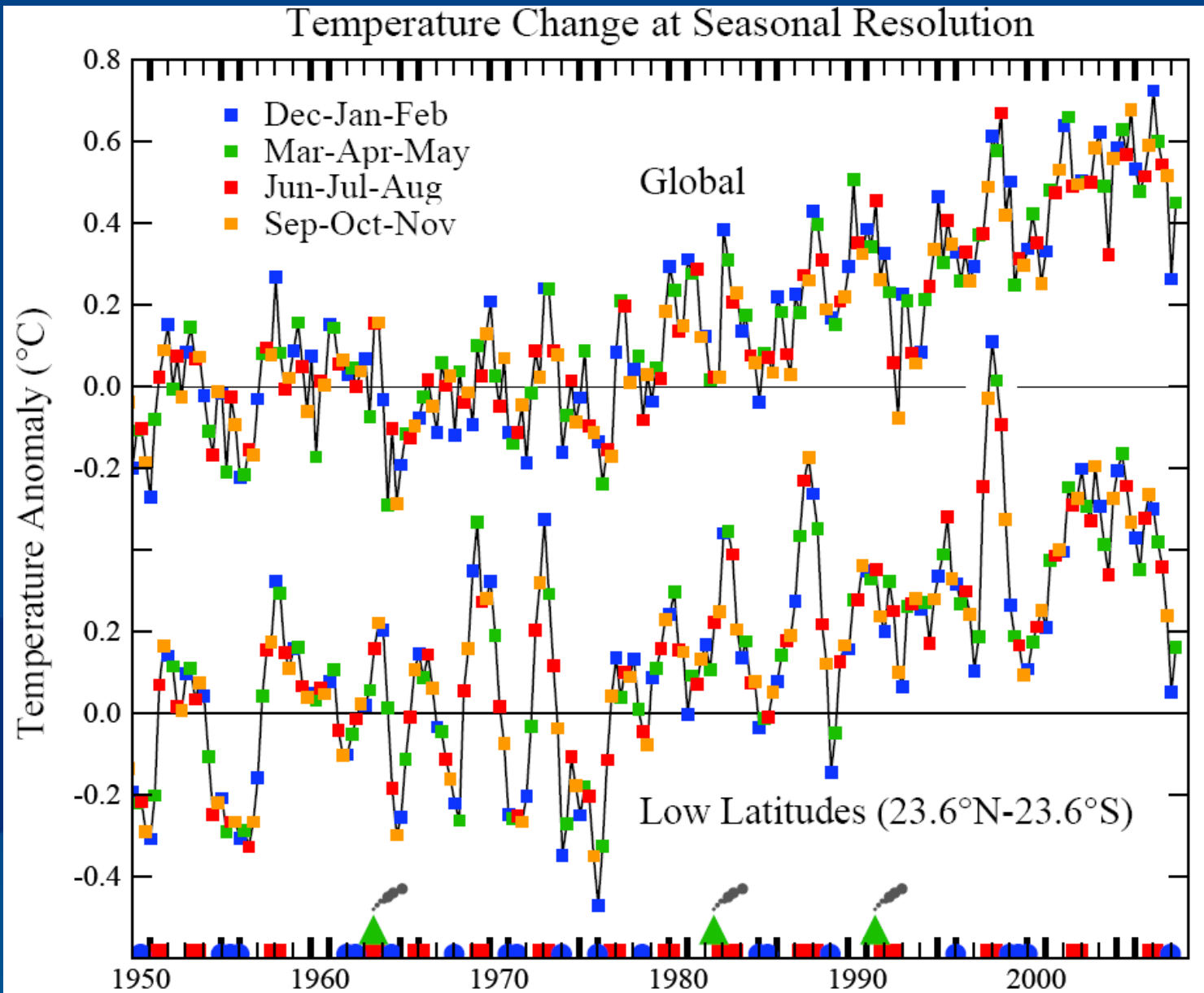


Averaging Length: 21 Years

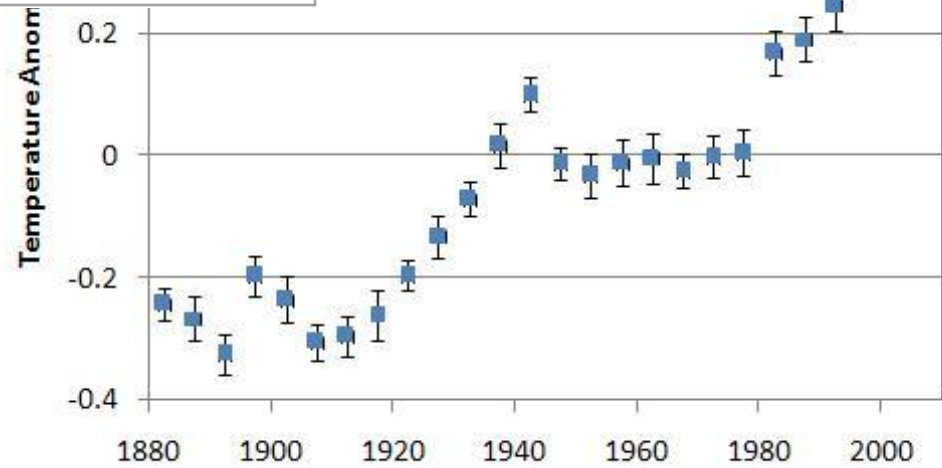
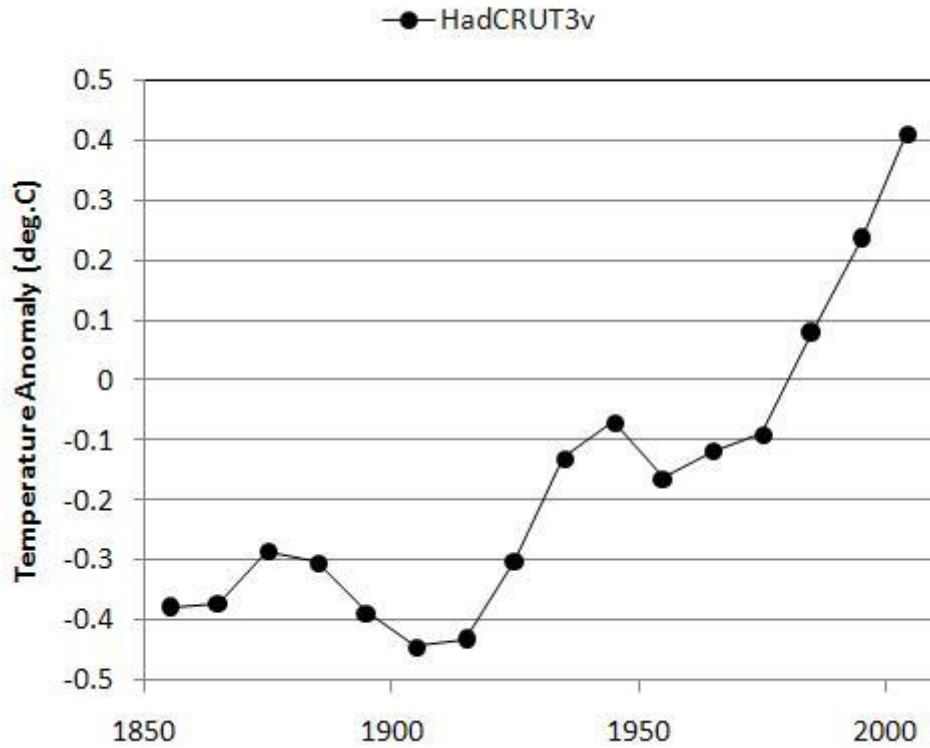


Averaging Length: 43 Years

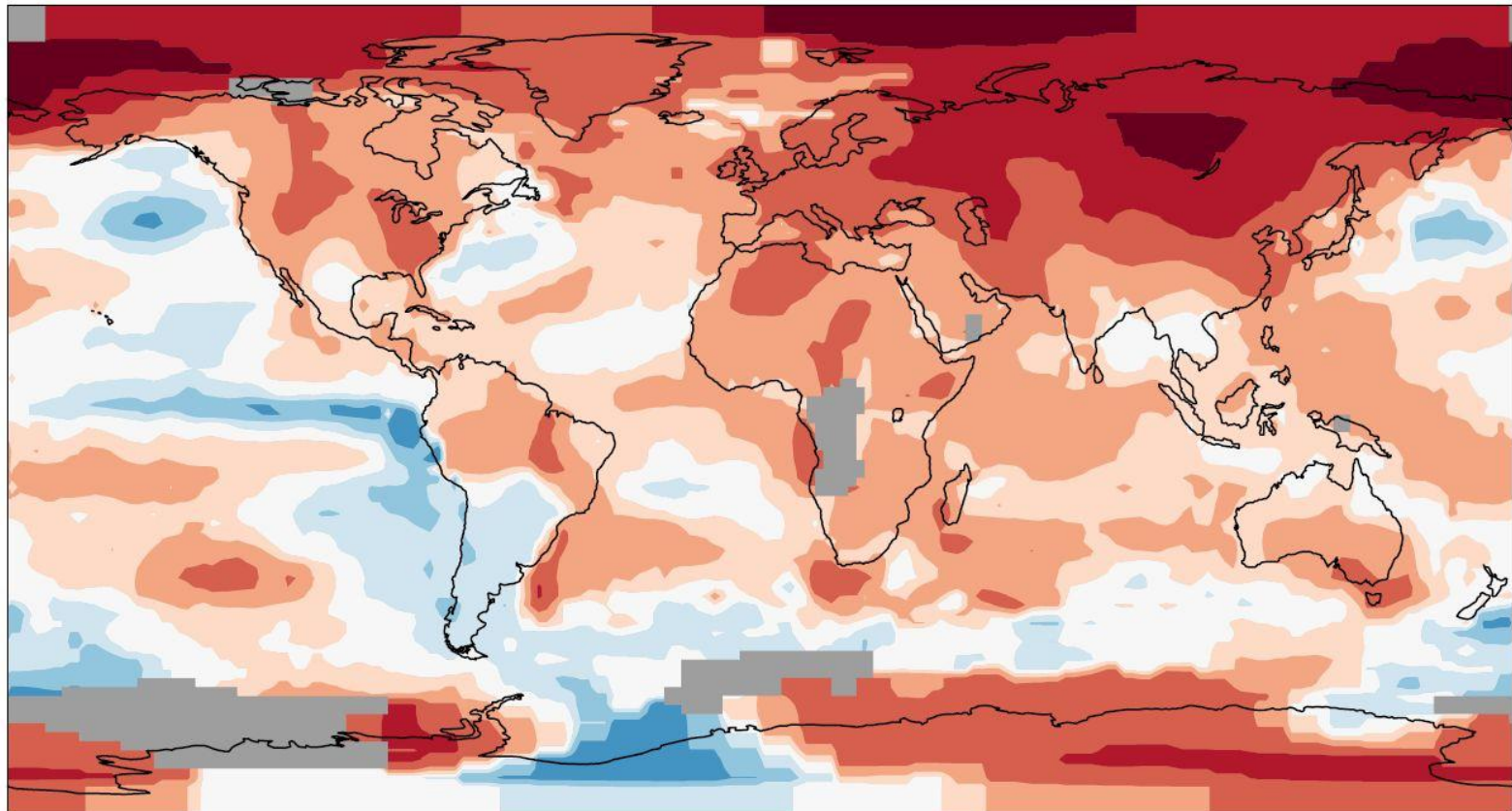




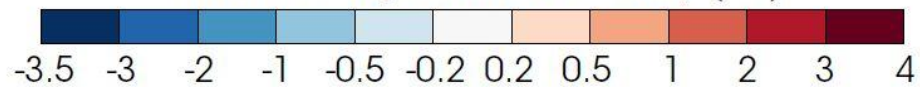
Green Triangle = Volcano; Red Box = El Niño; Blue Semicircle = La Niña



## Global Surface Temperature Anomaly (2007)



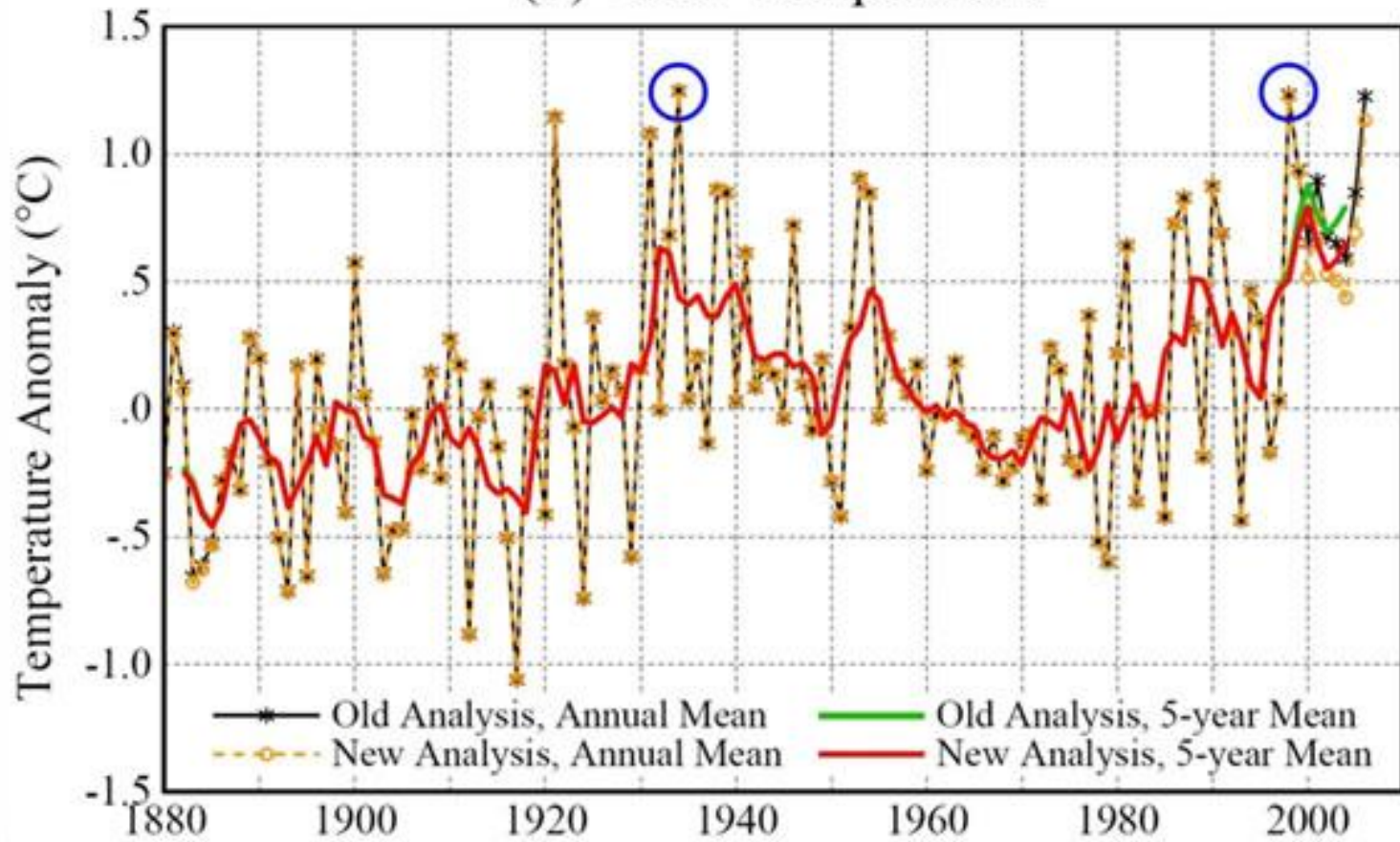
Surface Temperature Anomaly ( $^{\circ}\text{C}$ )



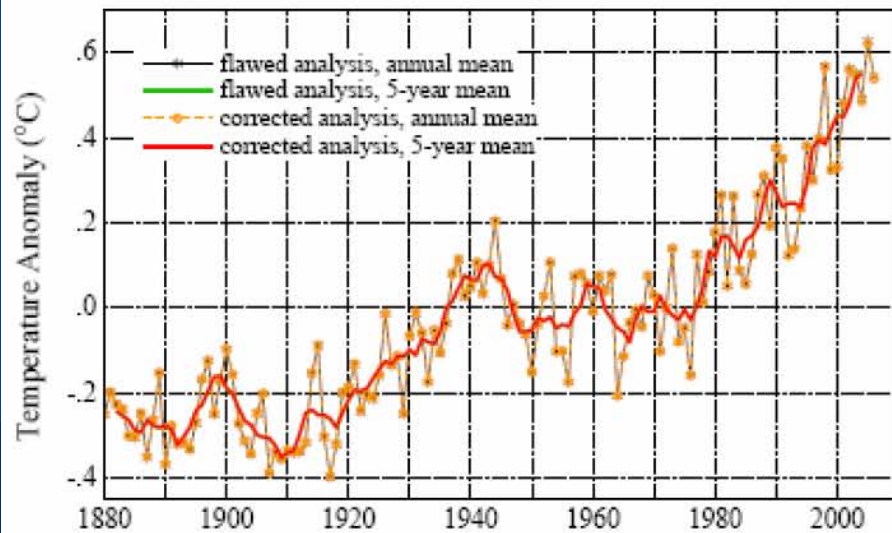


**1934 was the hottest year on record**

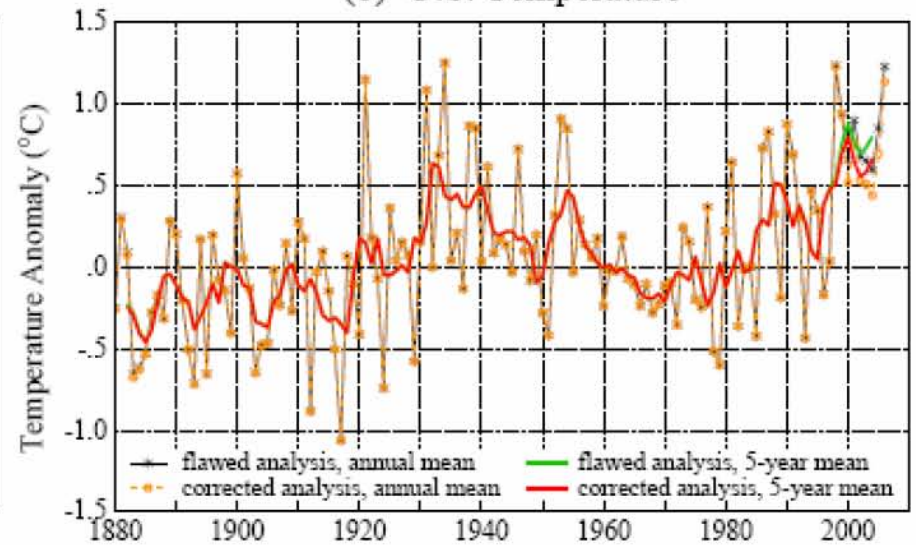
(b) U.S. Temperature

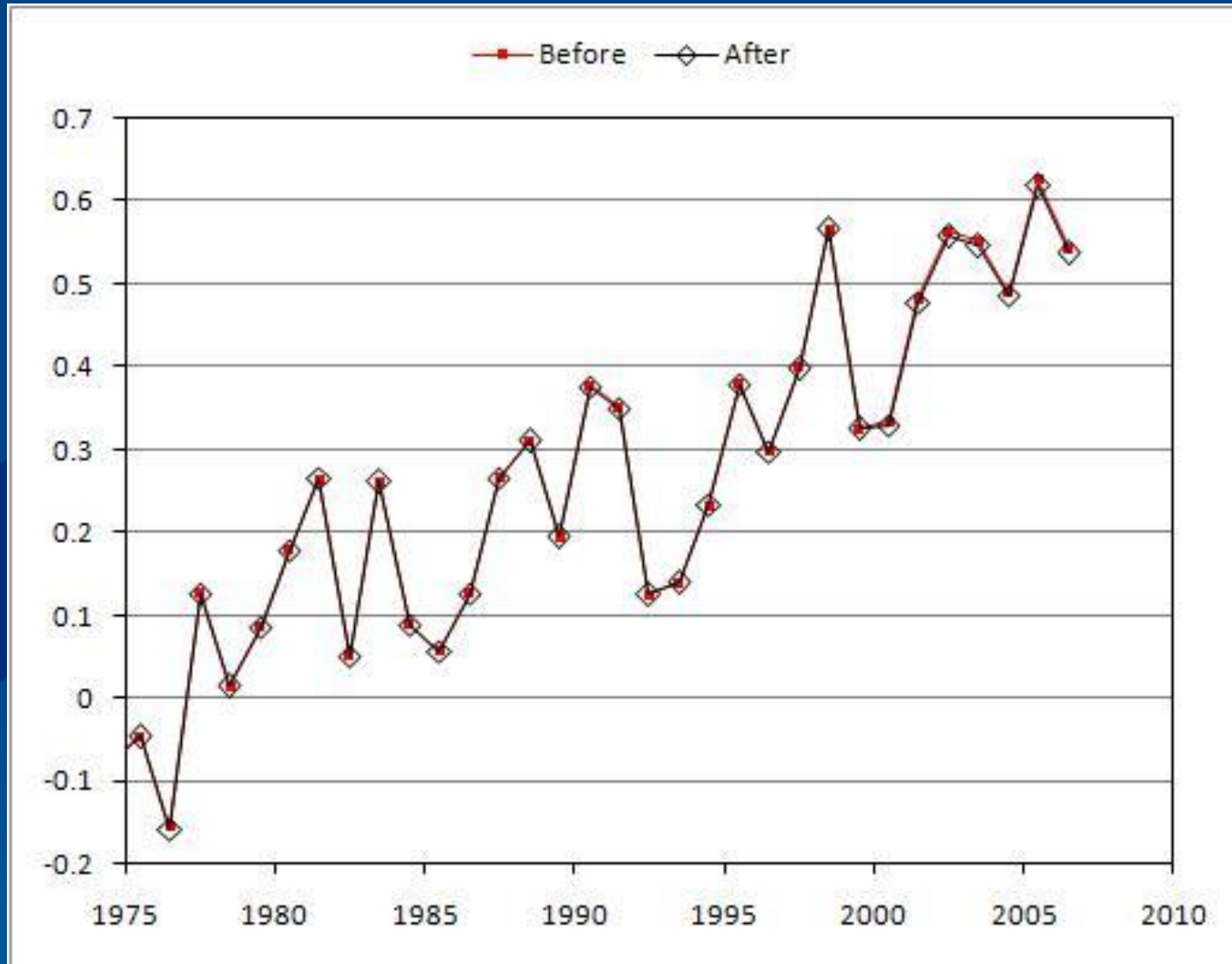


(a) Global Temperature (Land-Ocean Index)

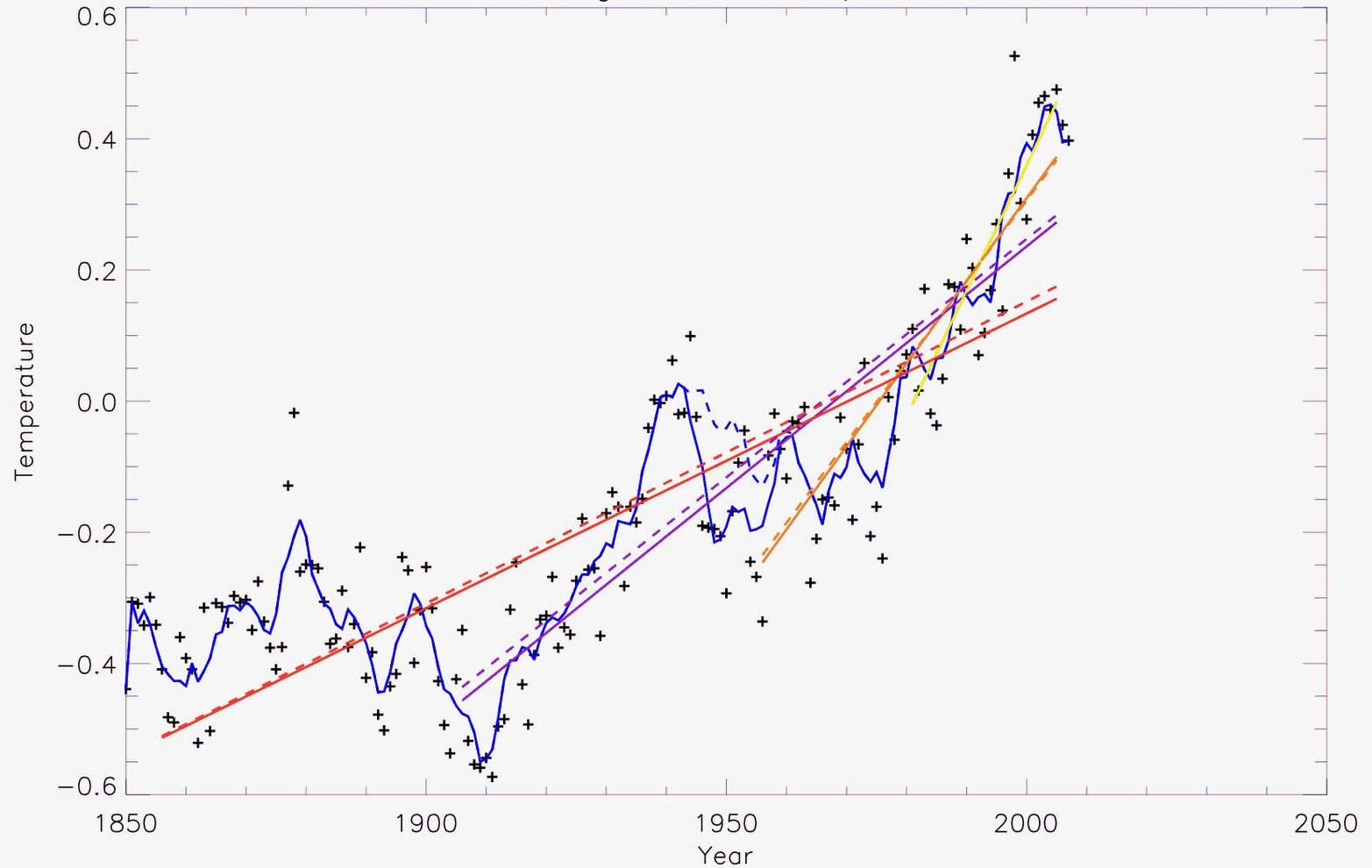


(b) U.S. Temperature





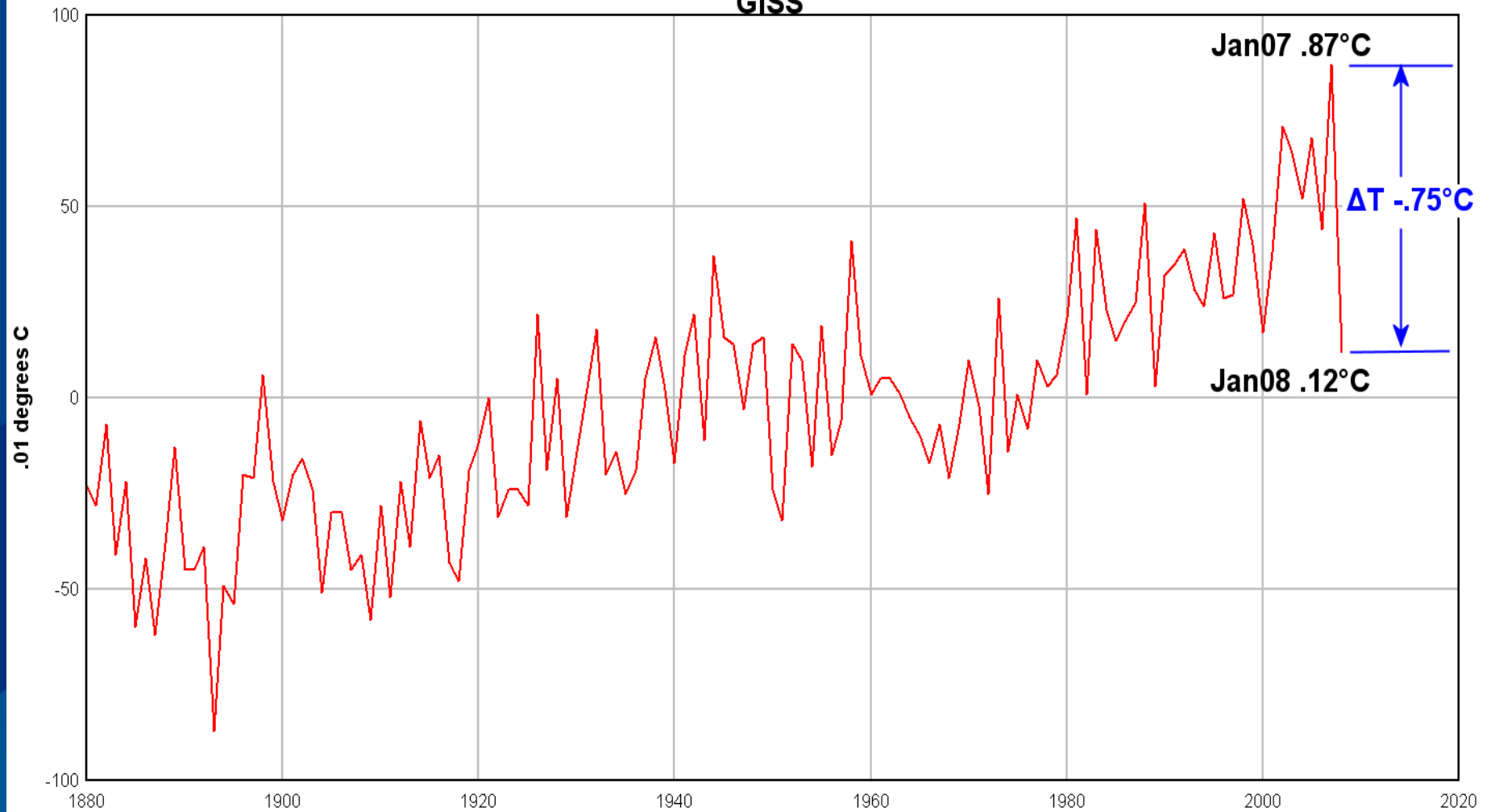
Effect of Changes to the temperature record

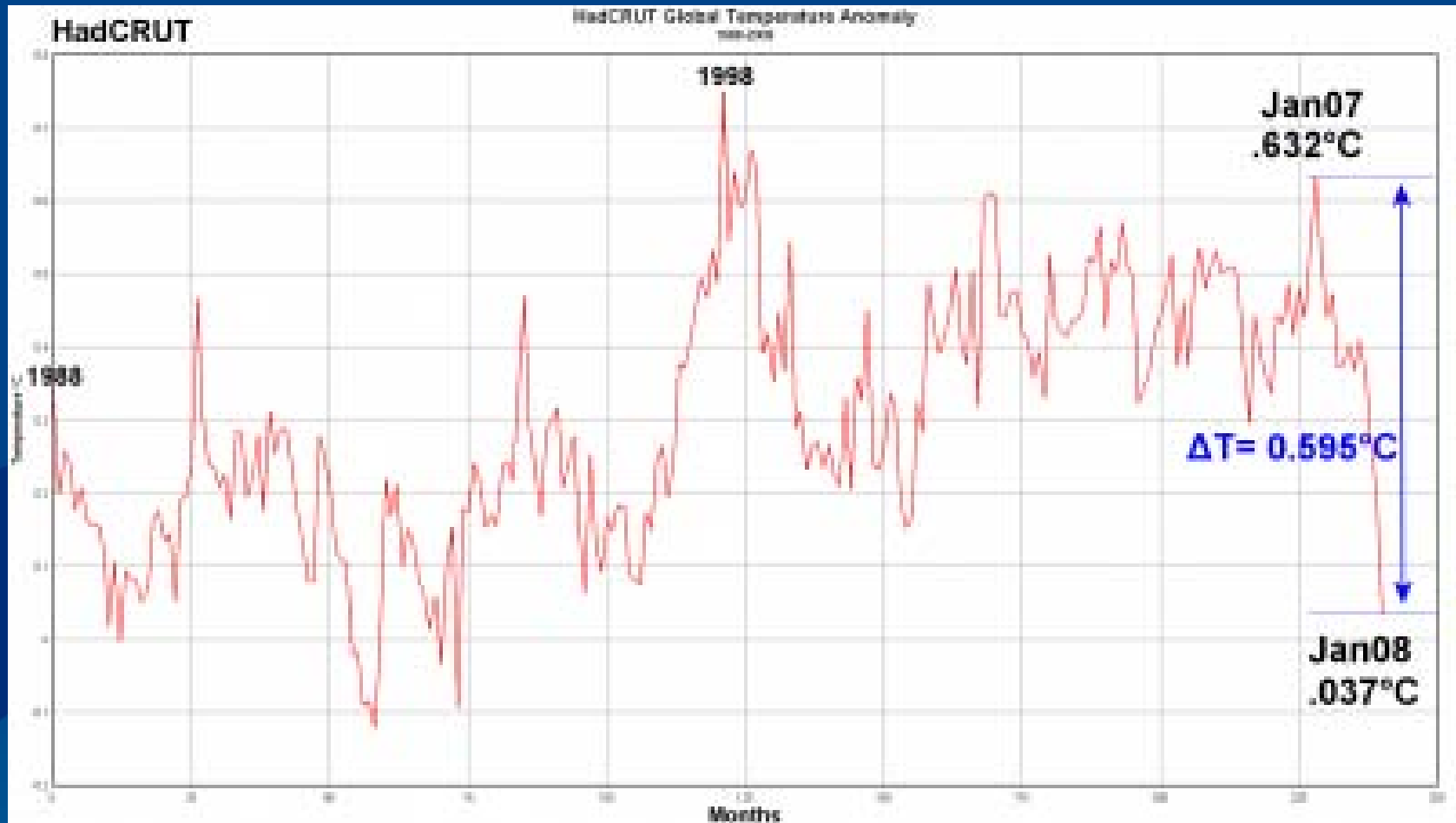


**It's cold!**

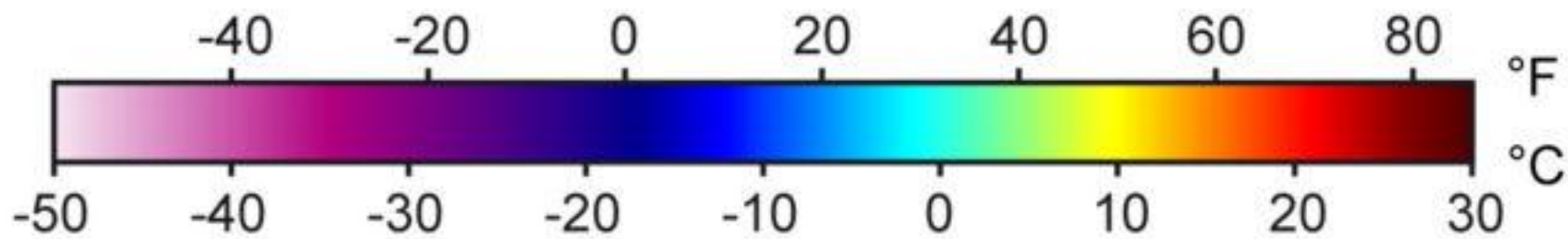
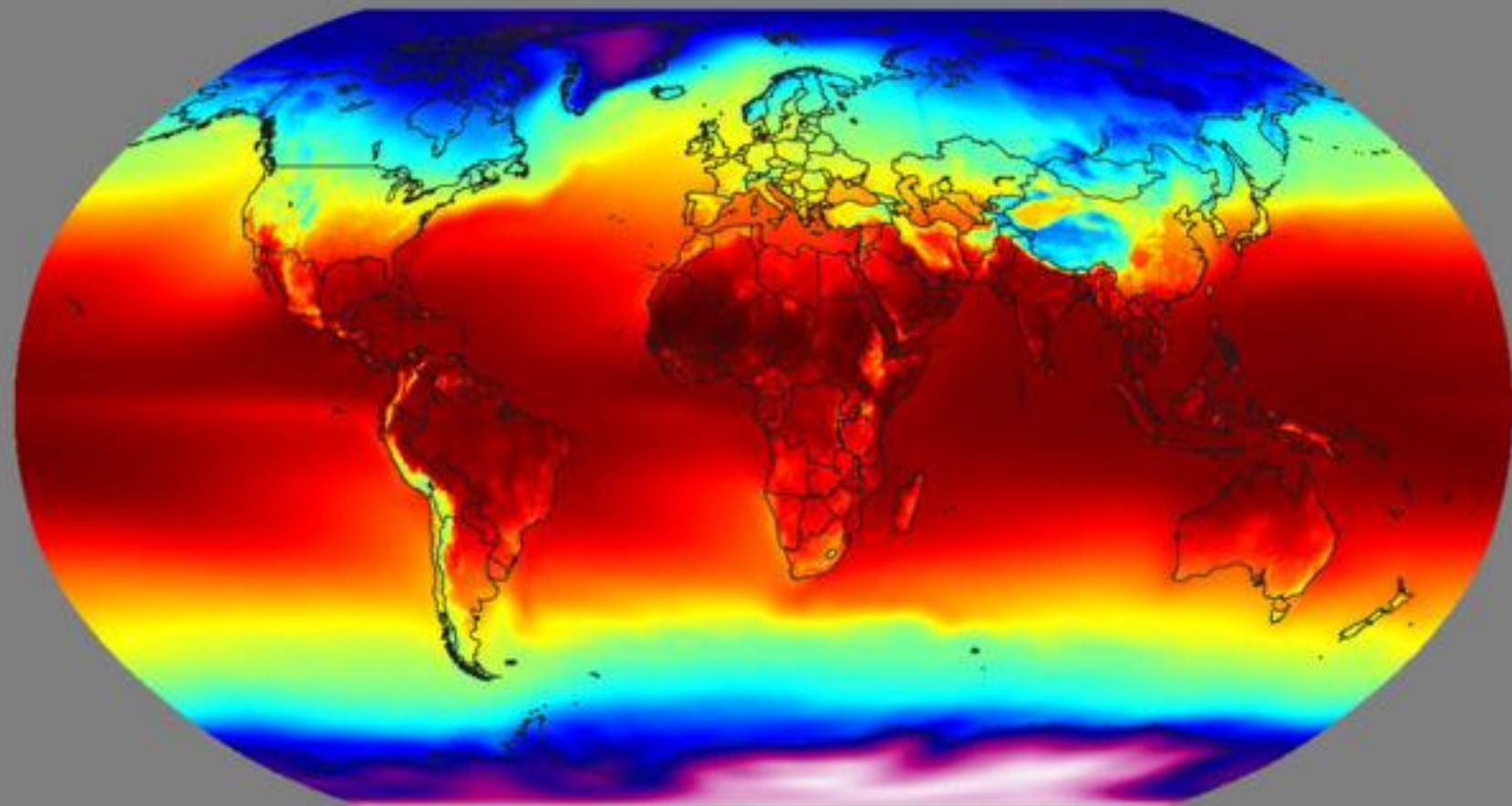
**Jan 2008 wiped out a century of warming**

GLOBAL Land-Ocean Temperature Index in .01 C base period: 1951  
Month of January  
GISS



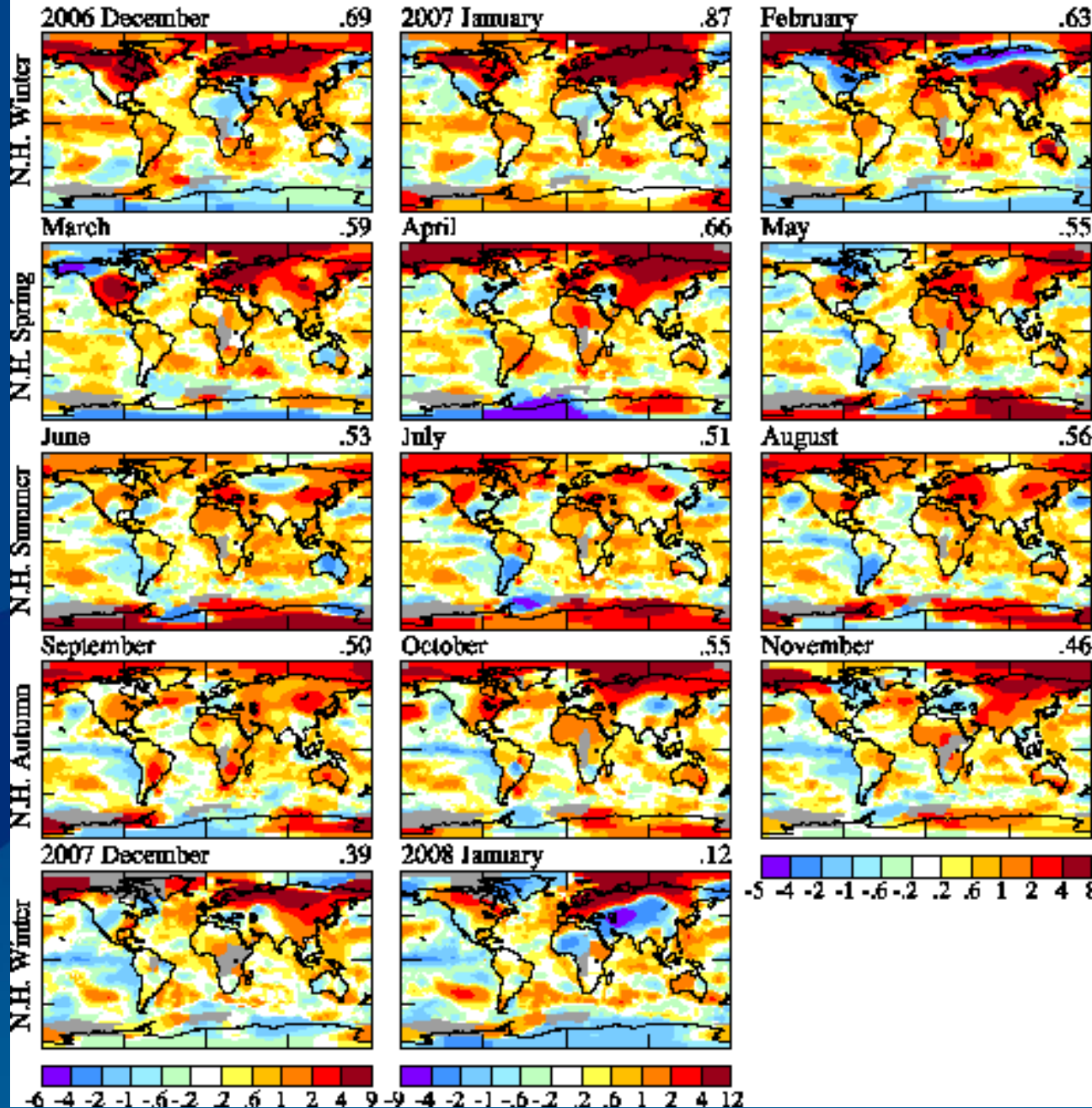






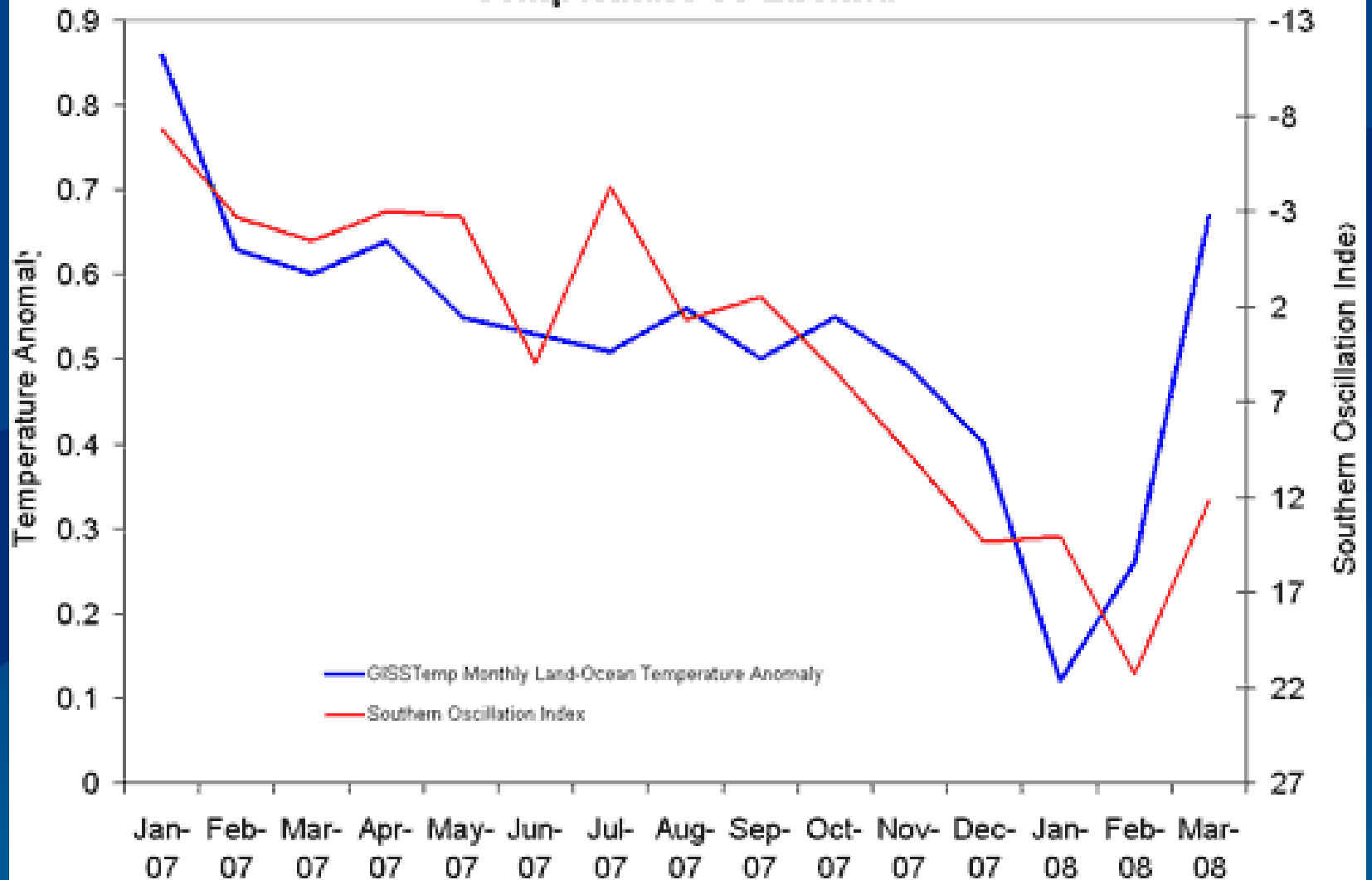
**Annual Mean Temperature**

# Surface Temperature Anomalies (°C) [Base Period 1951-80]

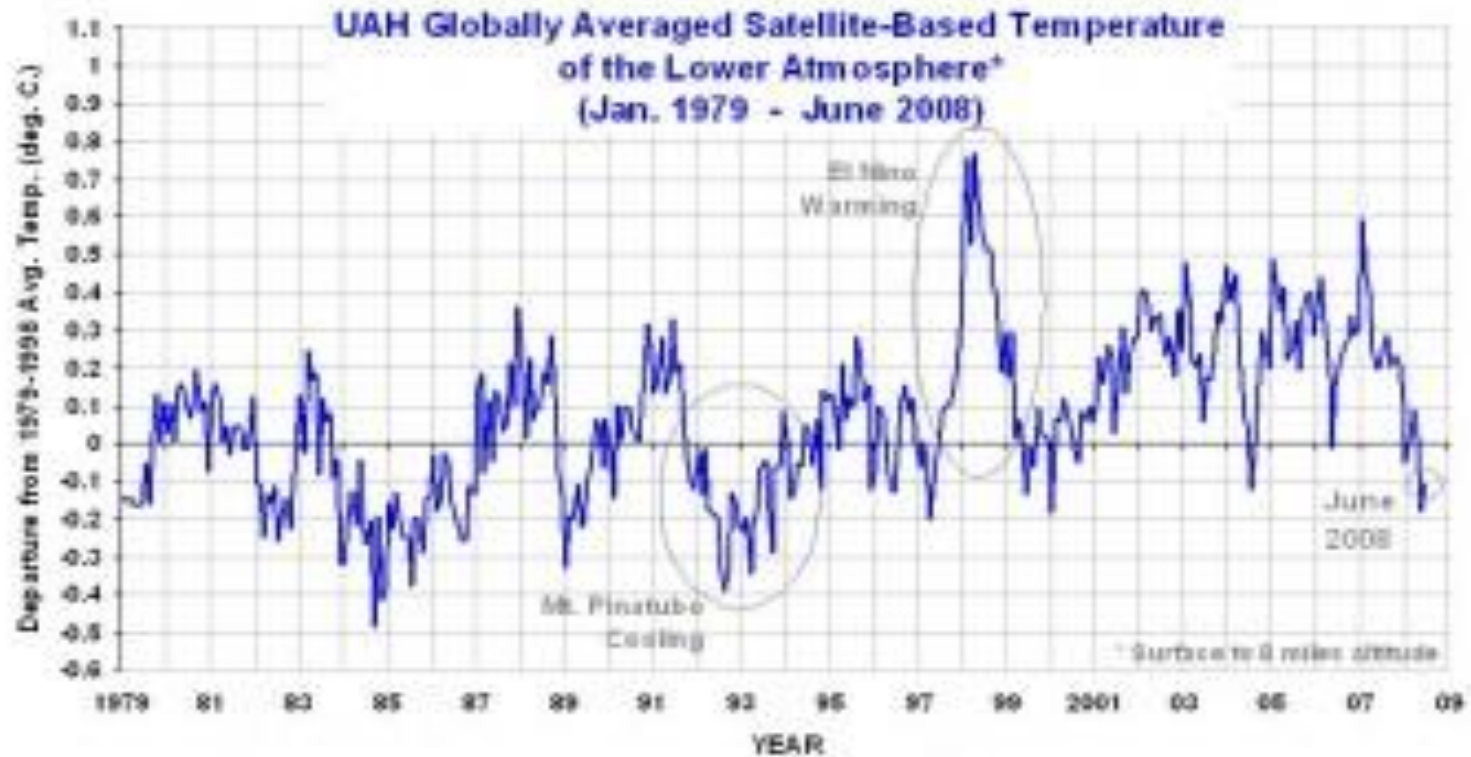


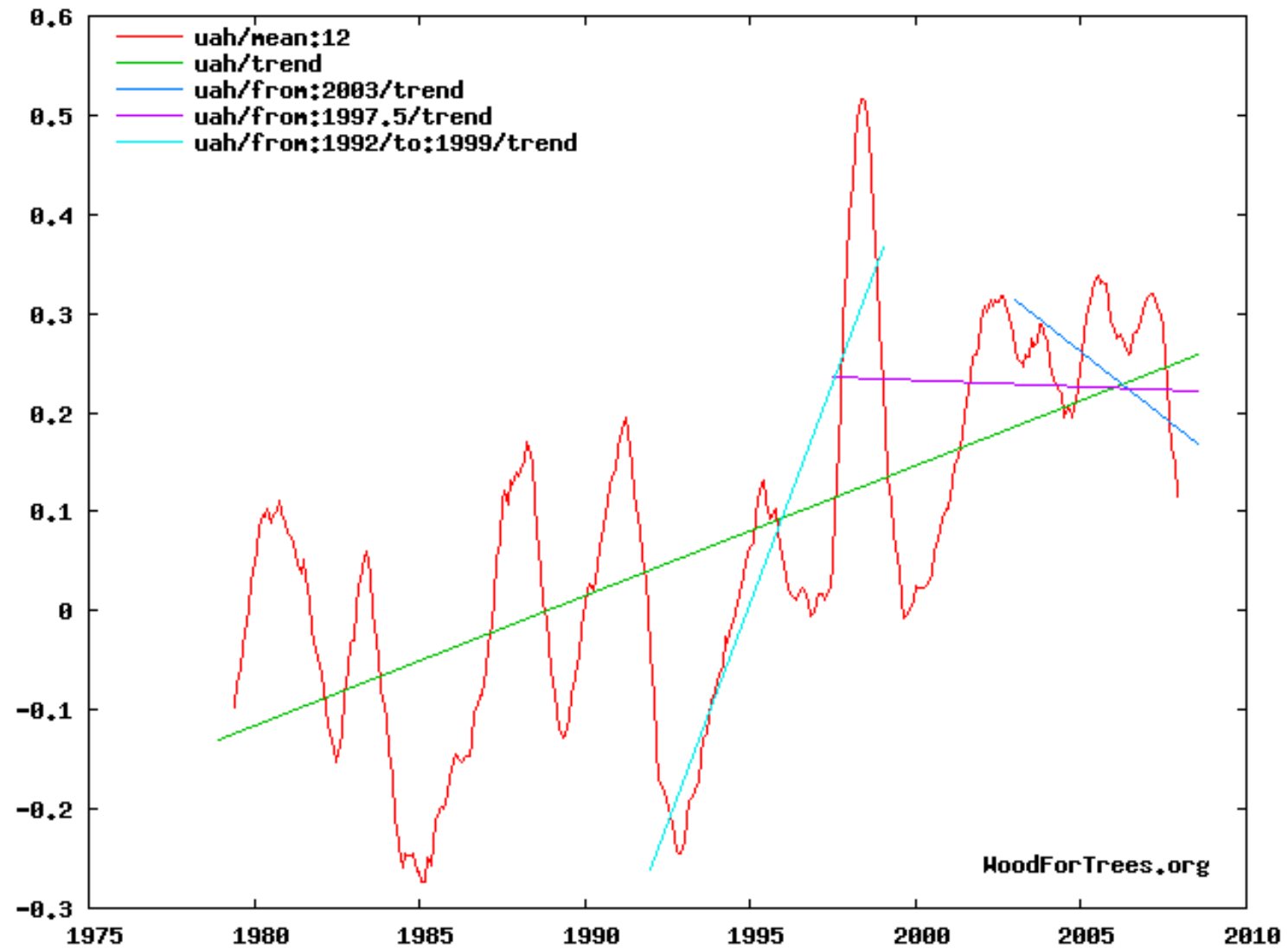
N.H. Winter  
N.H. Spring  
N.H. Summer  
N.H. Autumn  
N.H. Winter

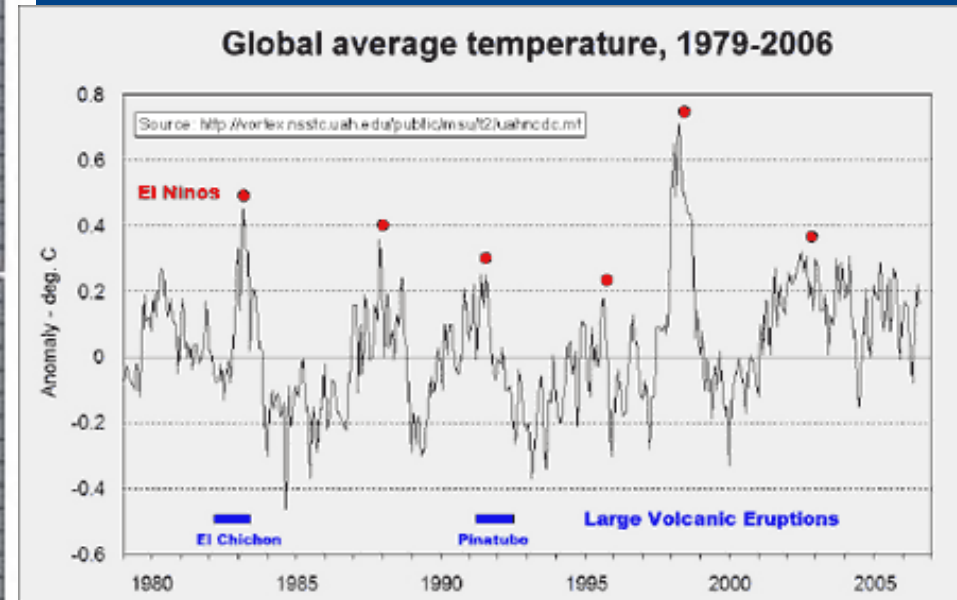
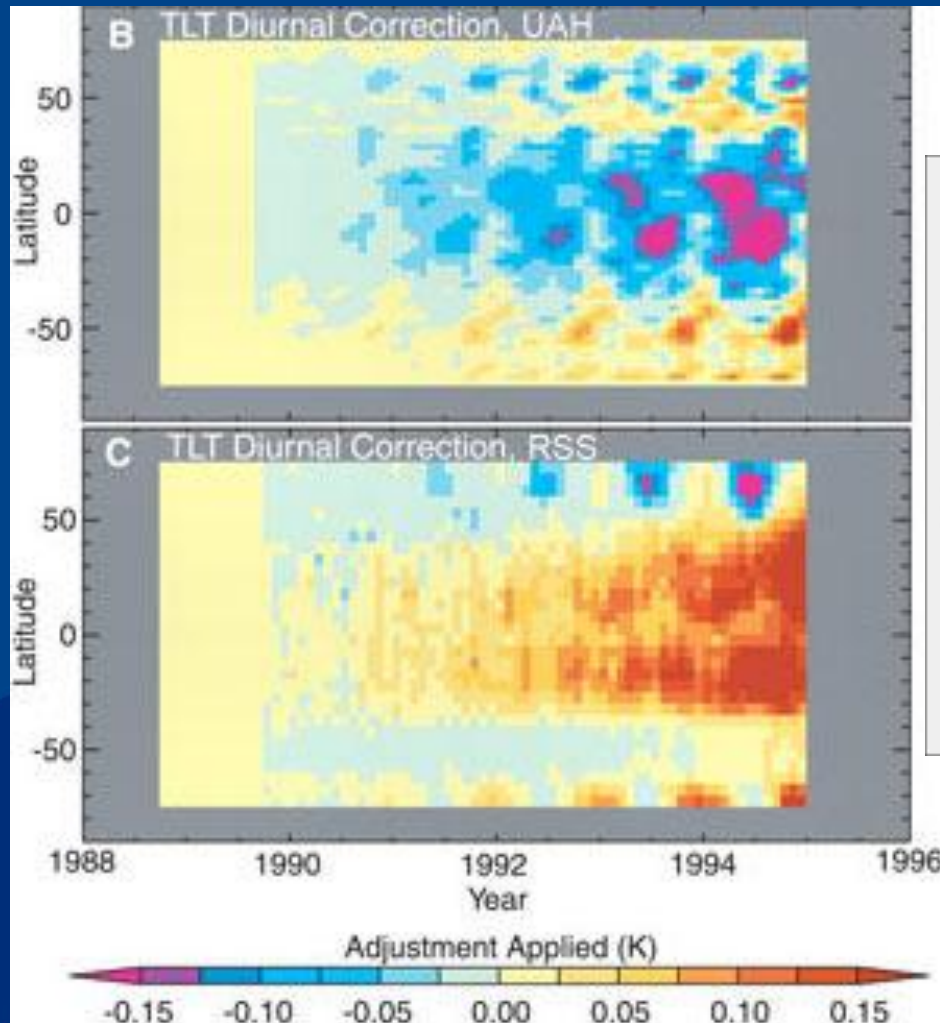
## Temperature vs La Nina

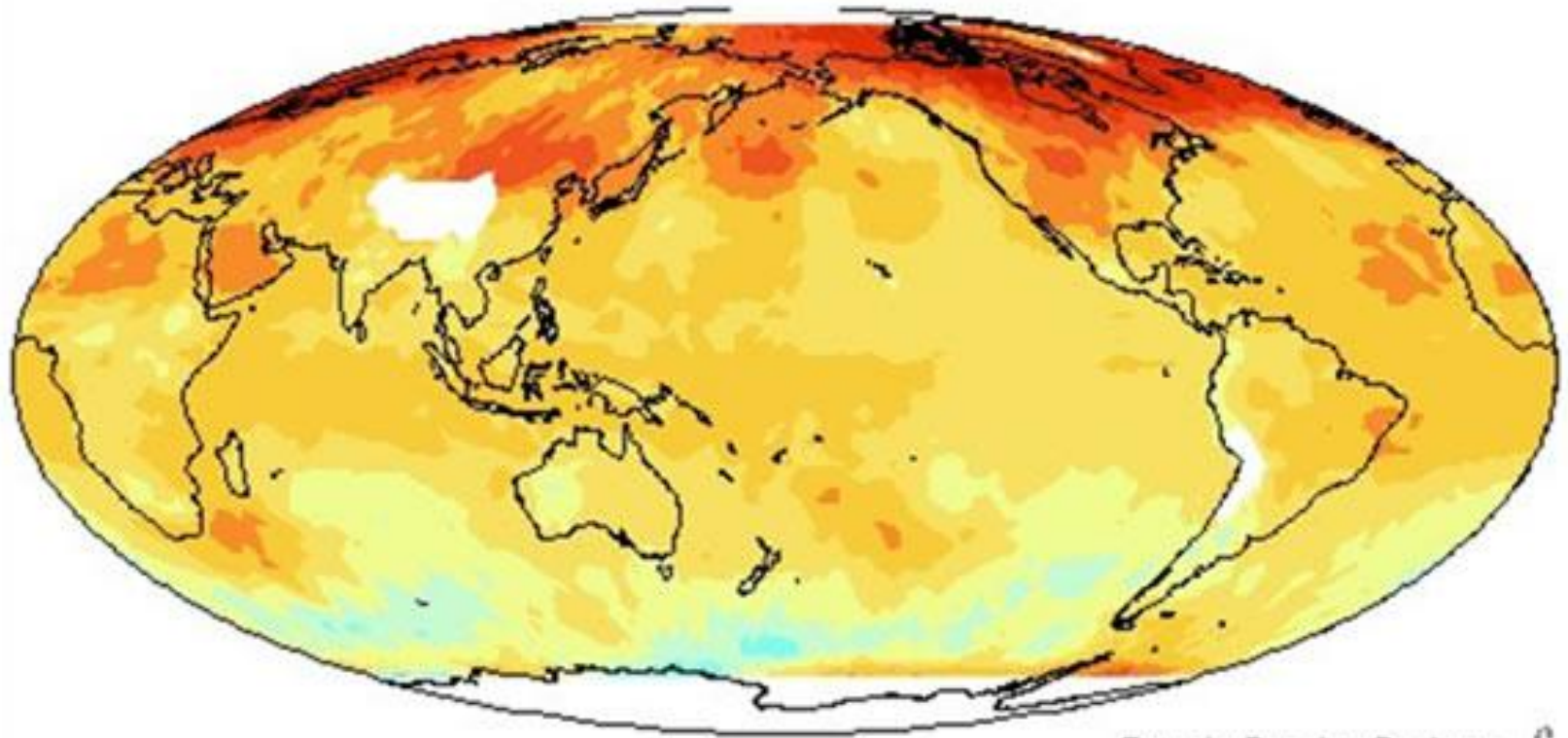


# Satellite temperatures show no warming





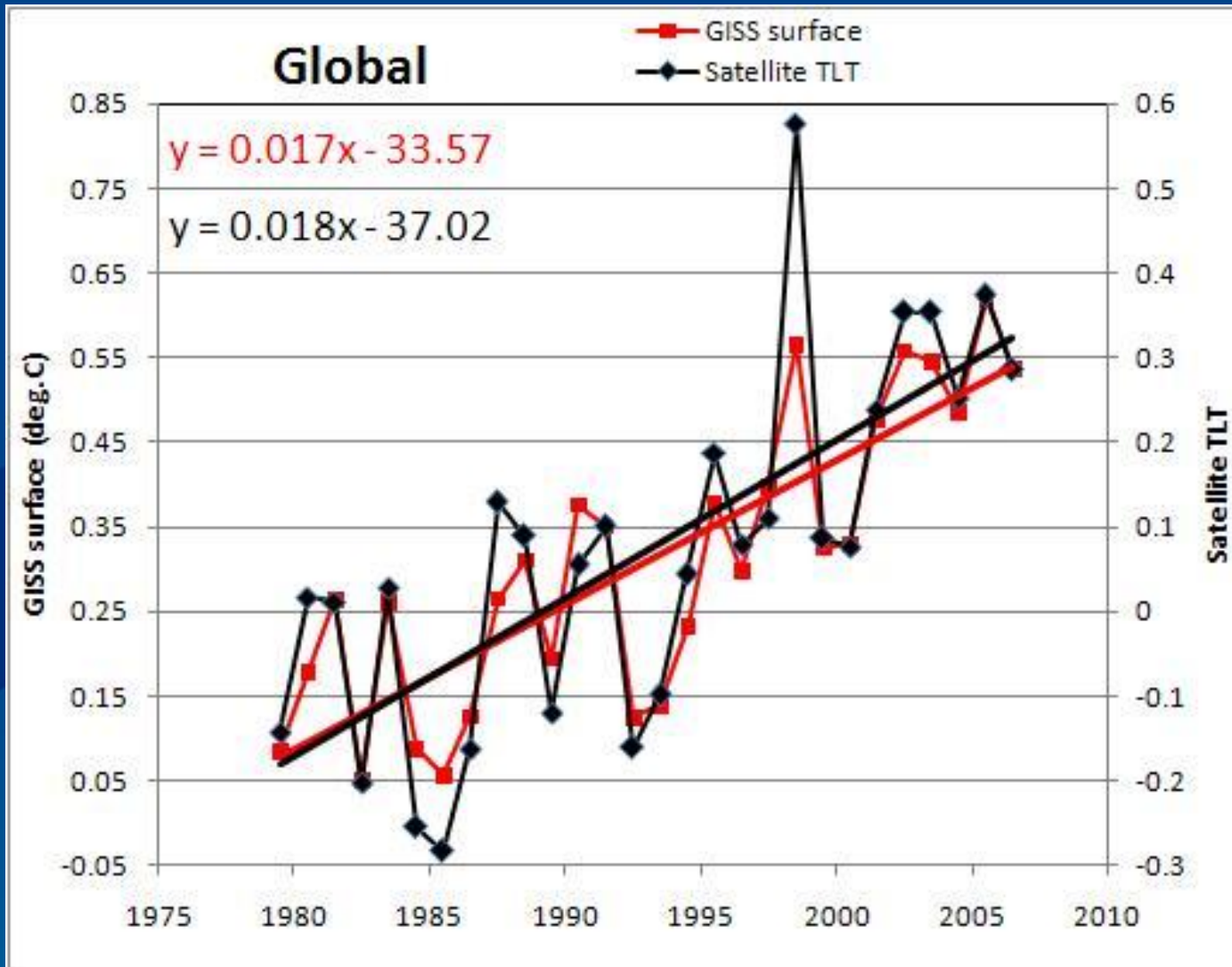


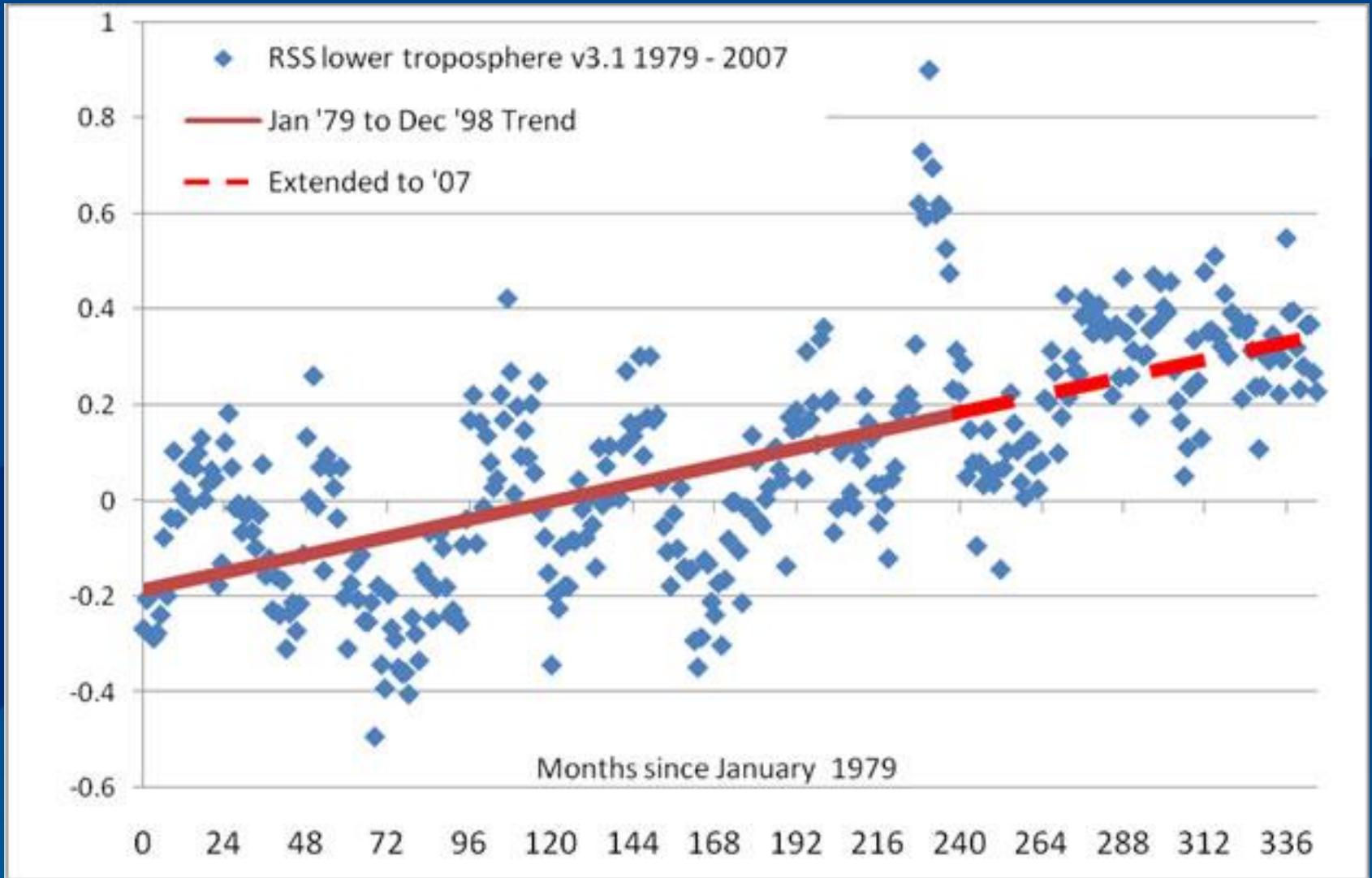


Remote Sensing Systems  
[www.remss.com](http://www.remss.com)

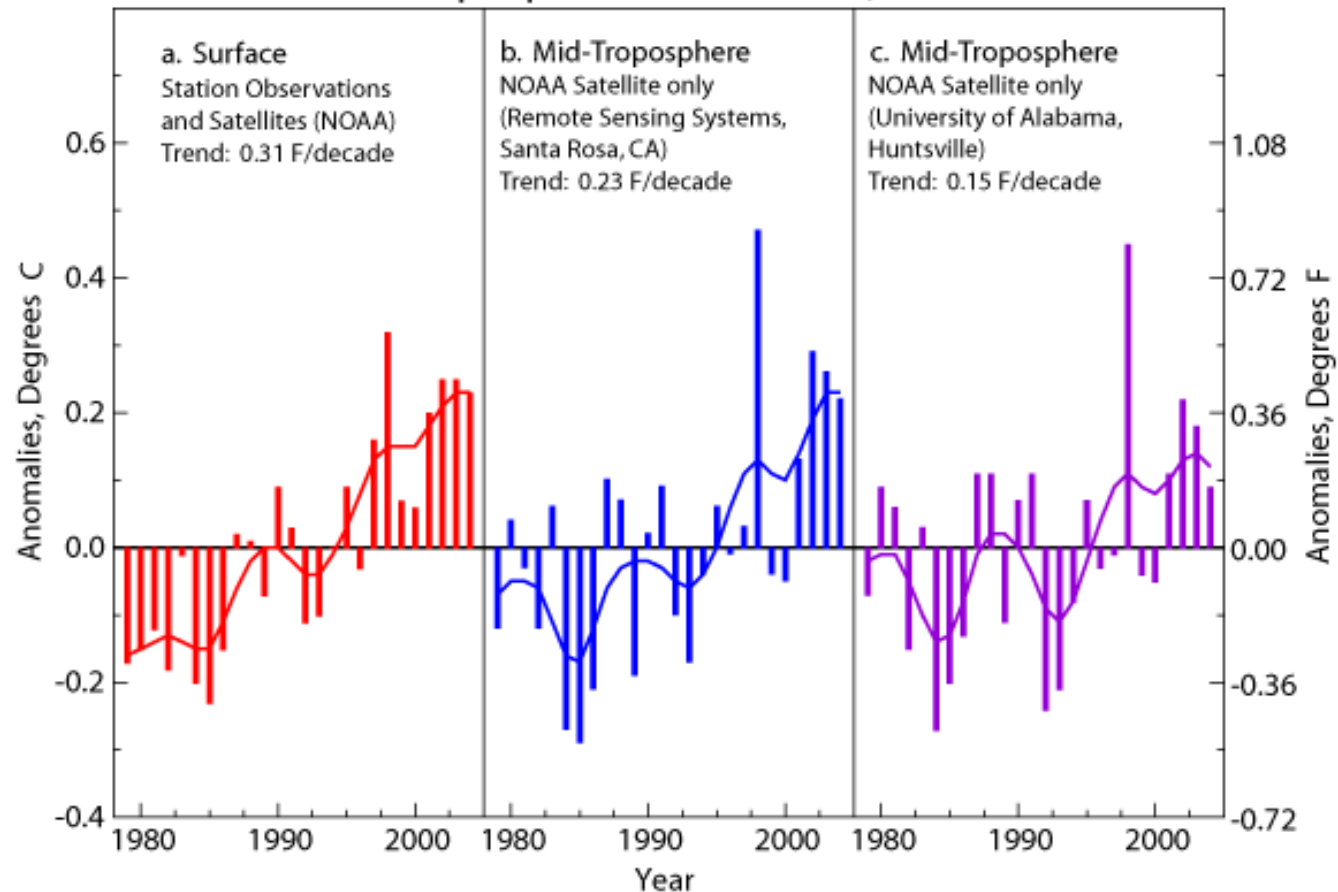


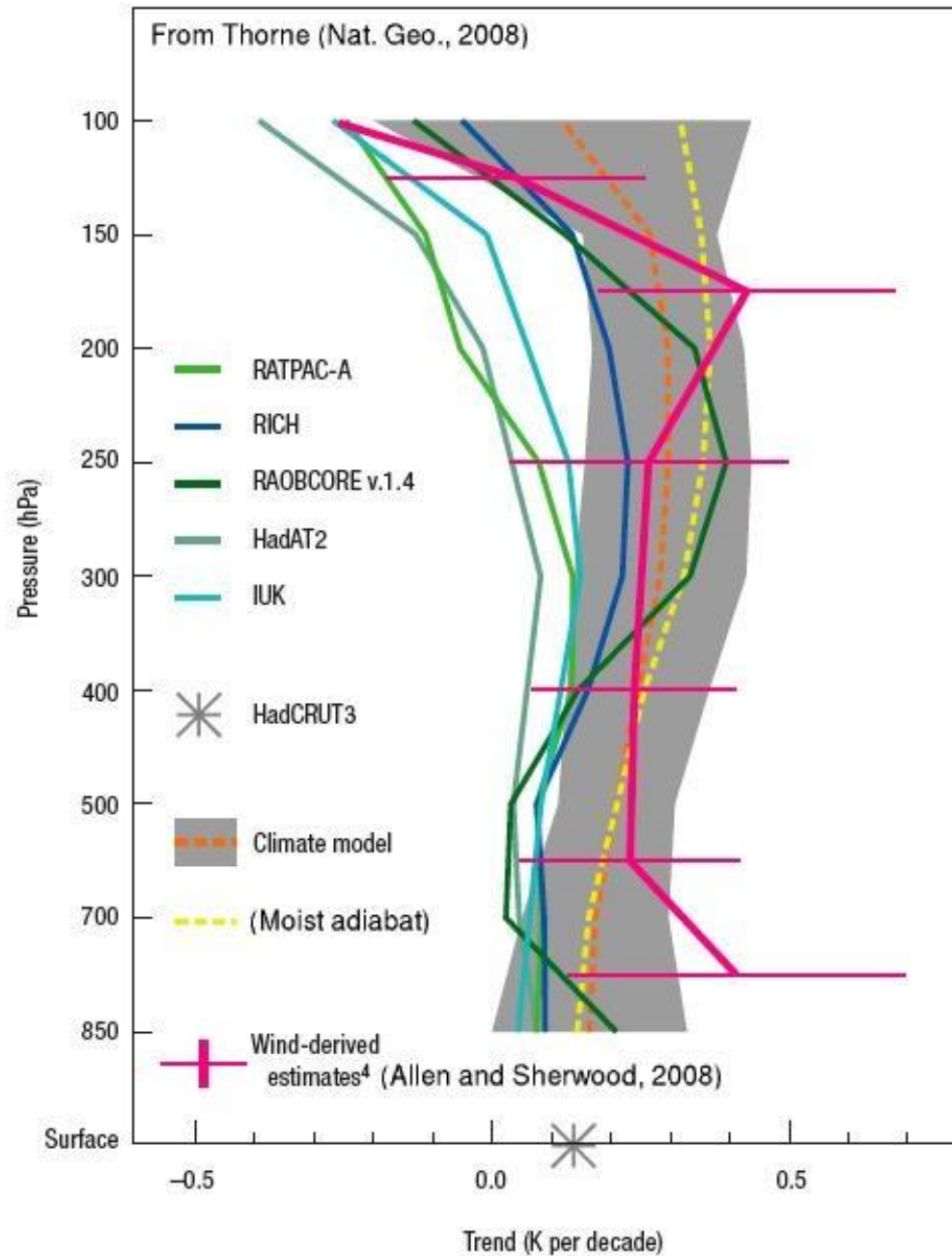






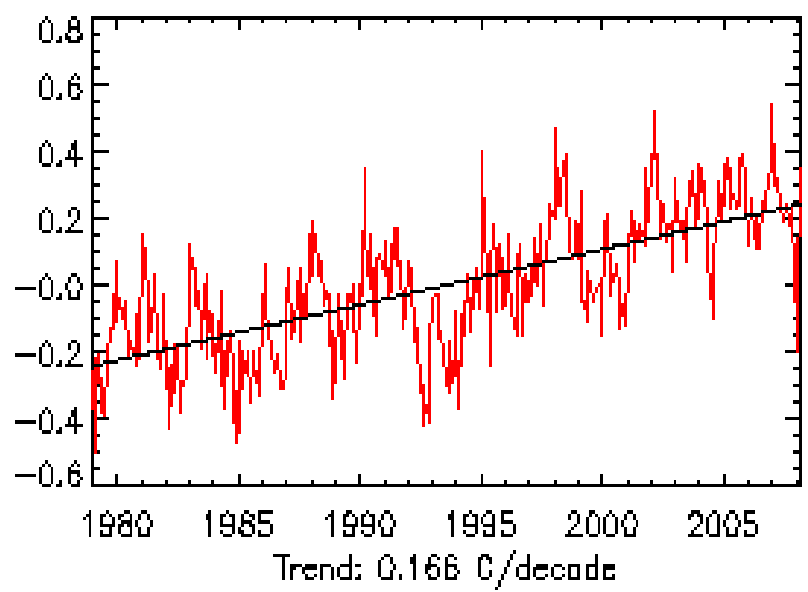
## Annual Temperature Anomalies: Mid-Troposphere and Surface, 1979-2004



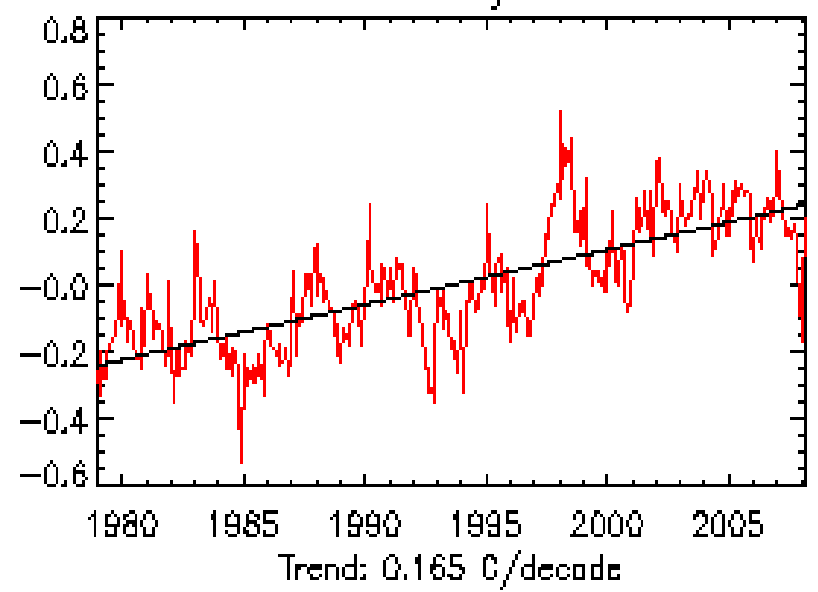


# Different measures of global temperature disagree

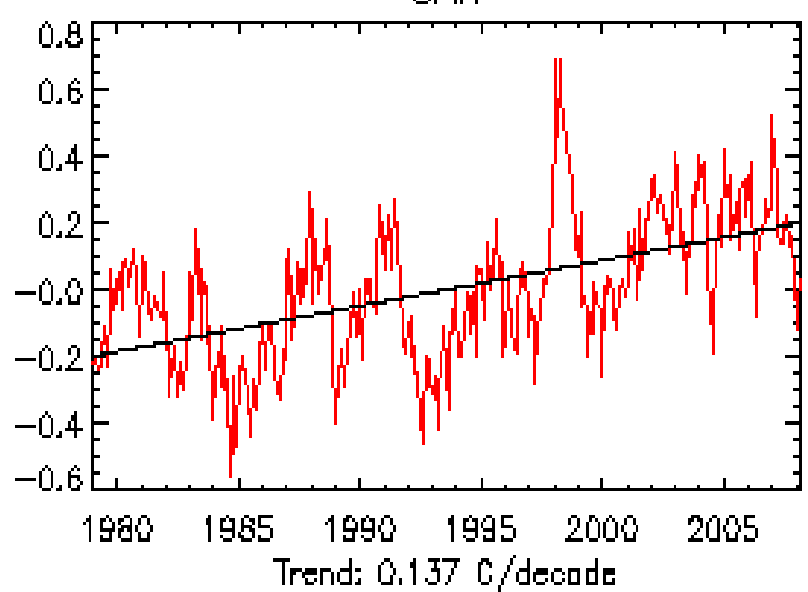
GISS



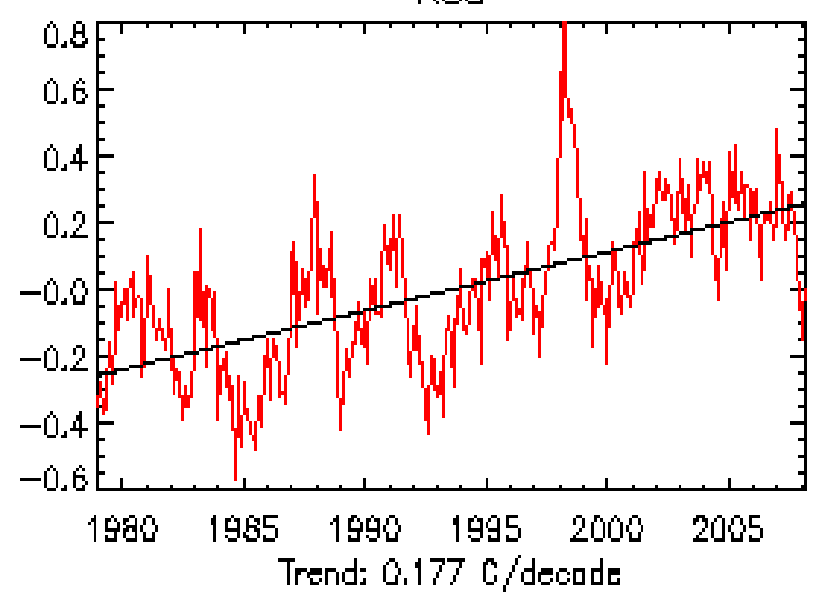
Hadley

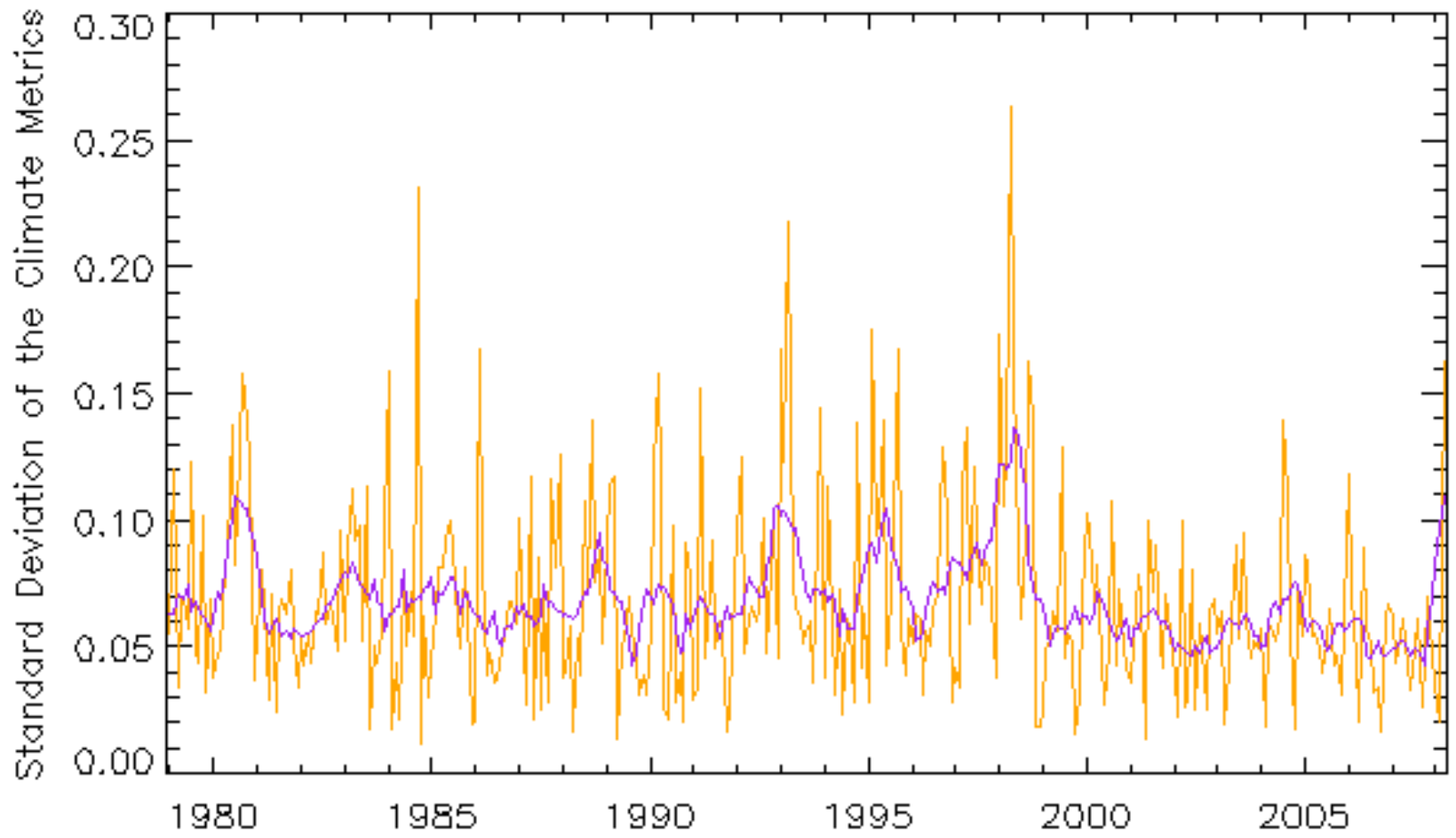


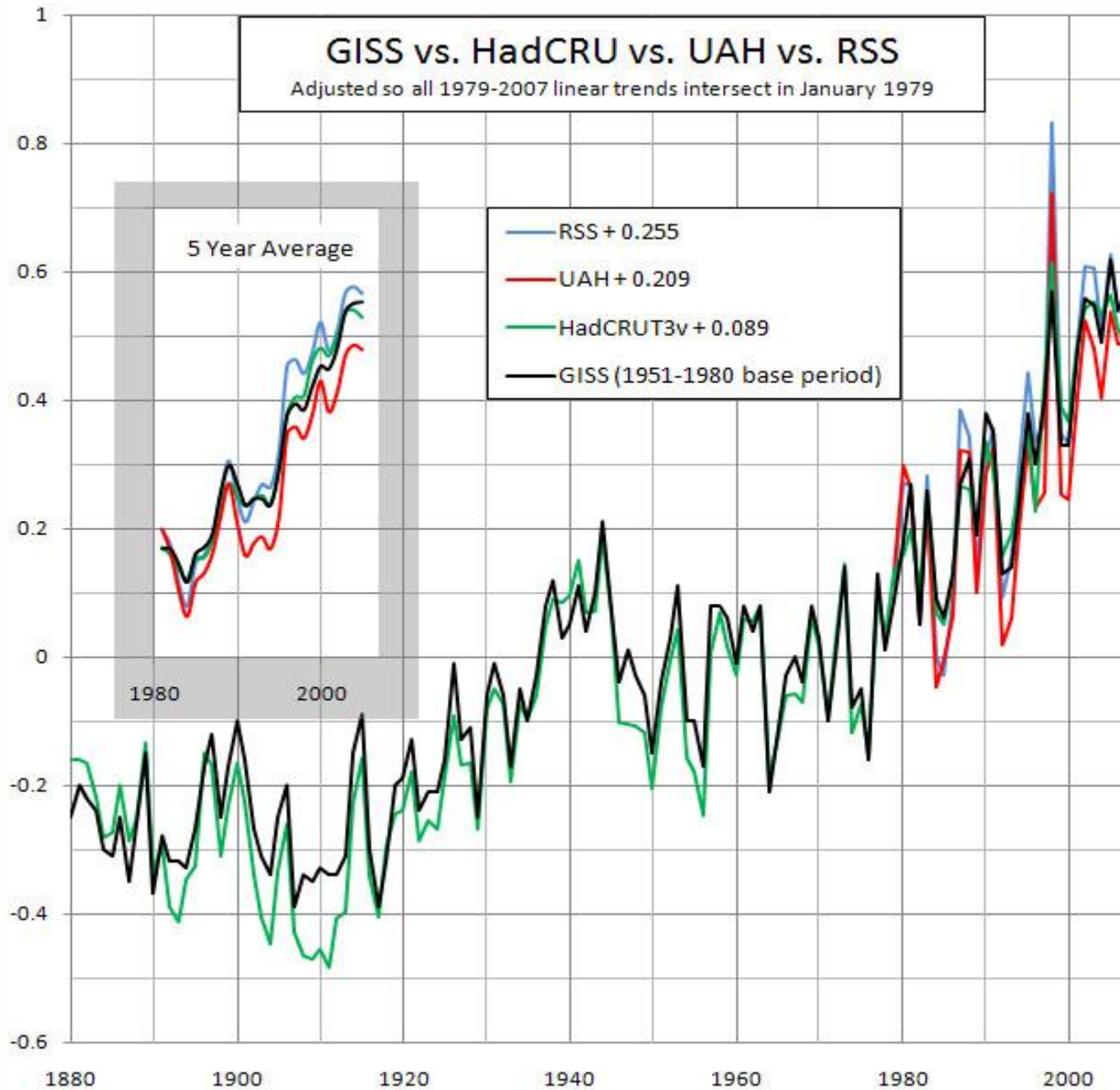
UAH



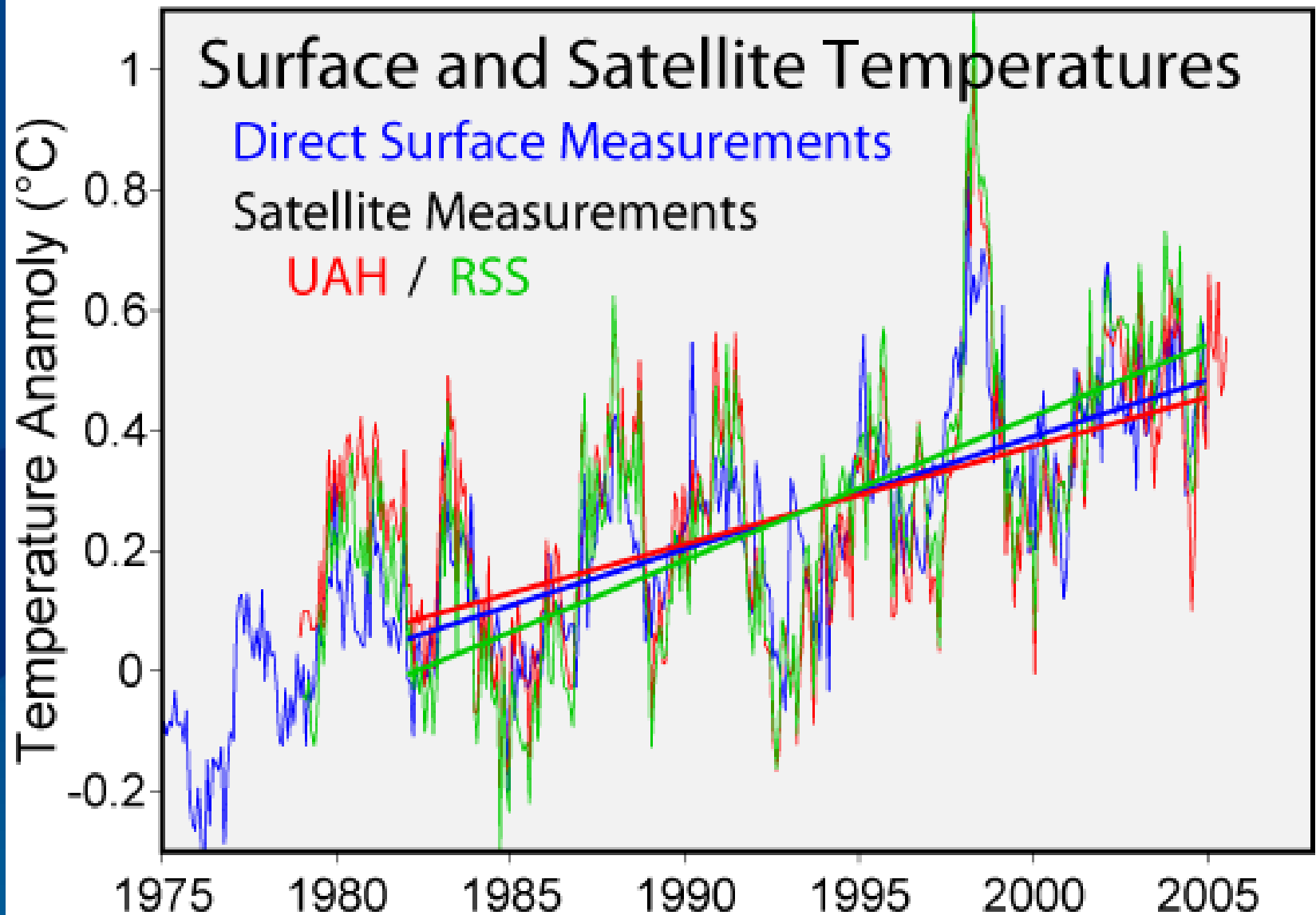
RSS

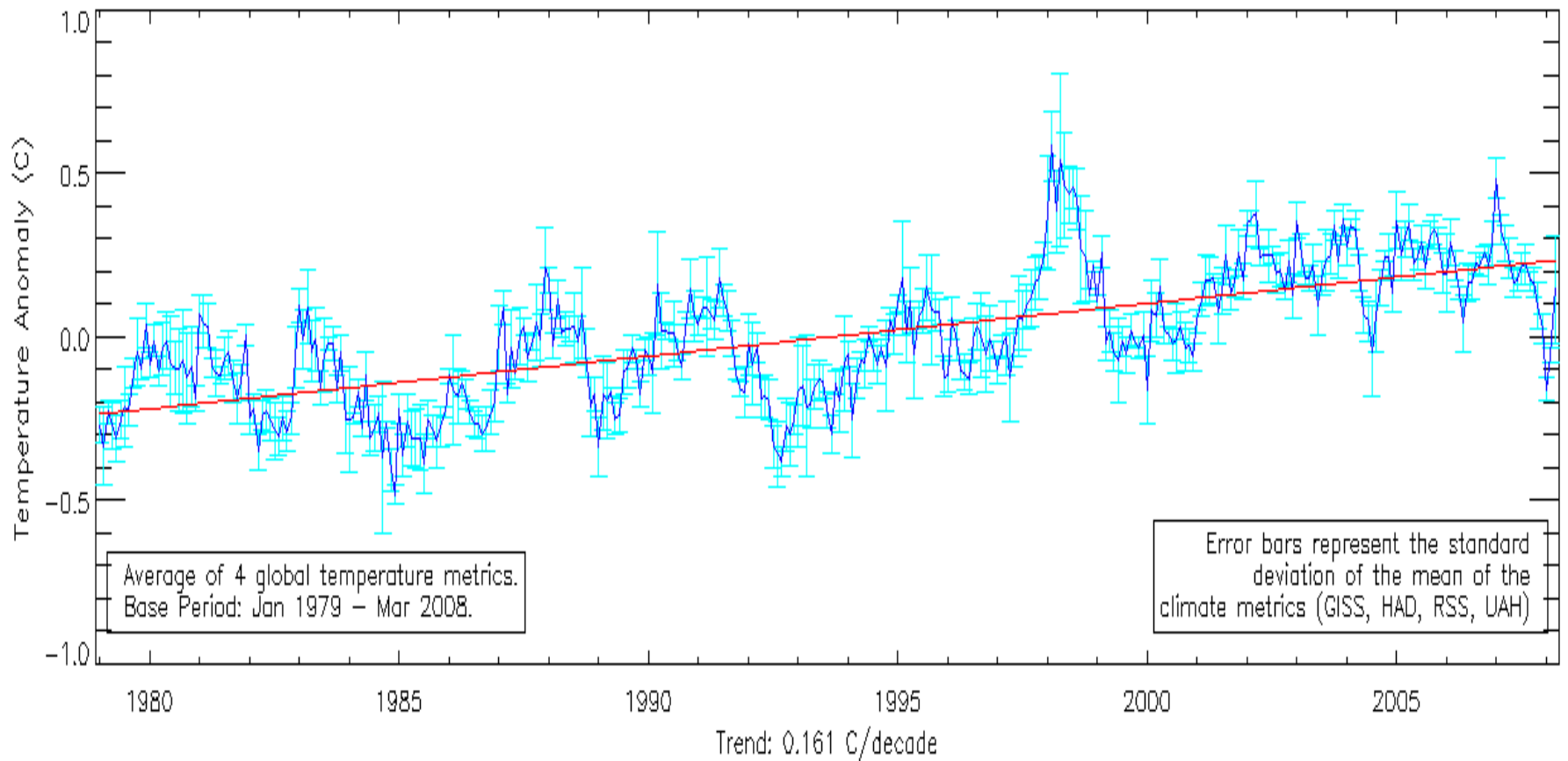




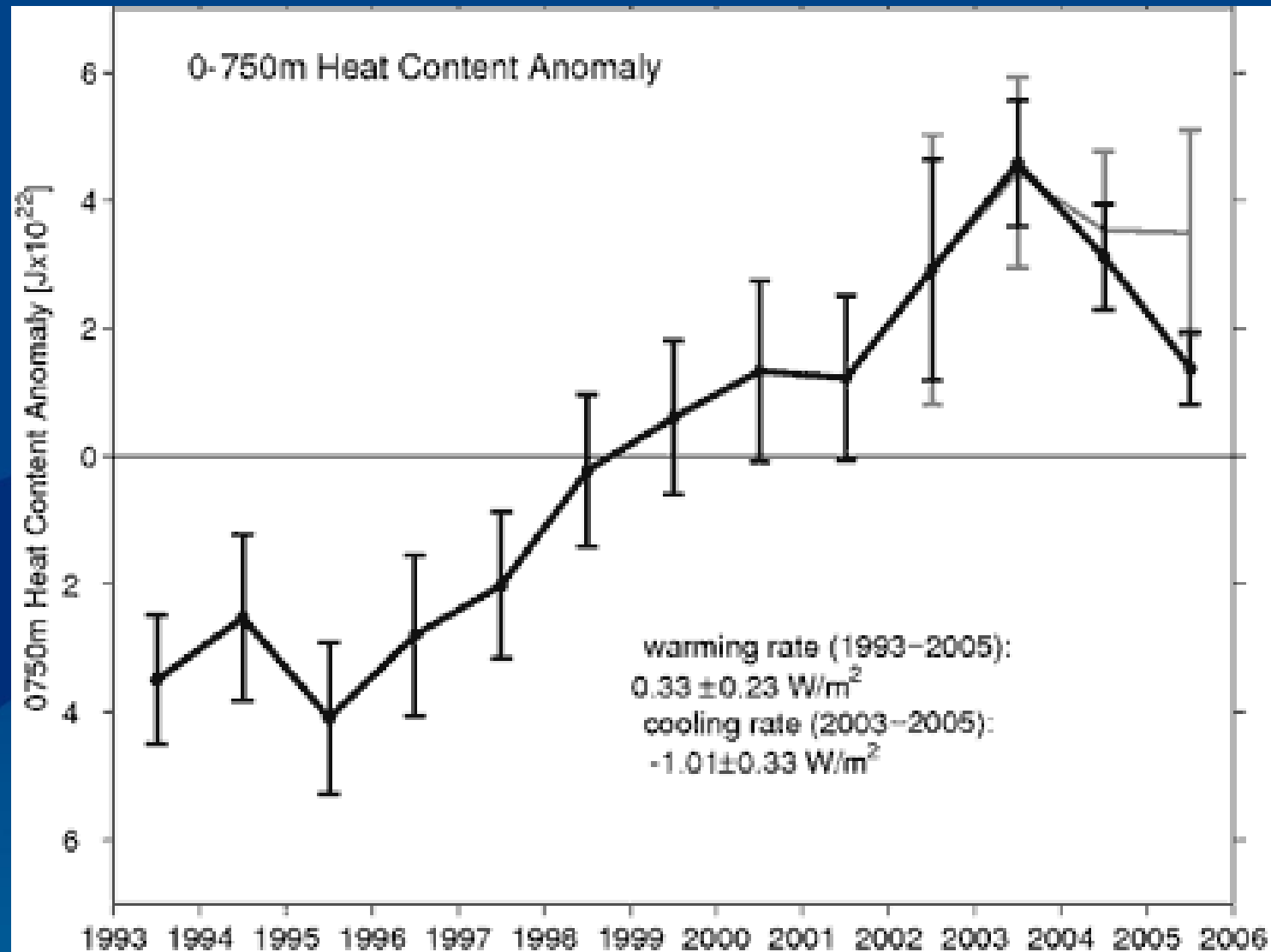


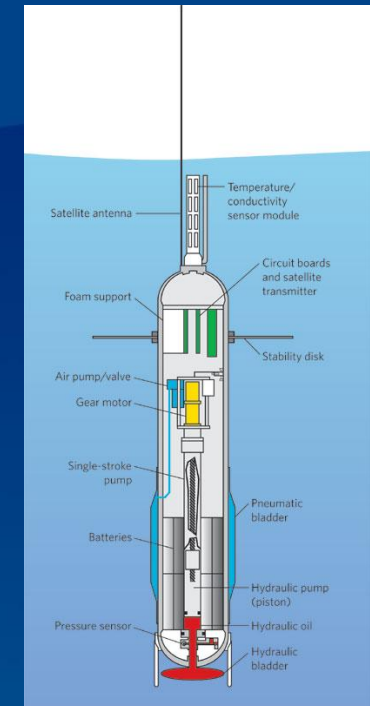
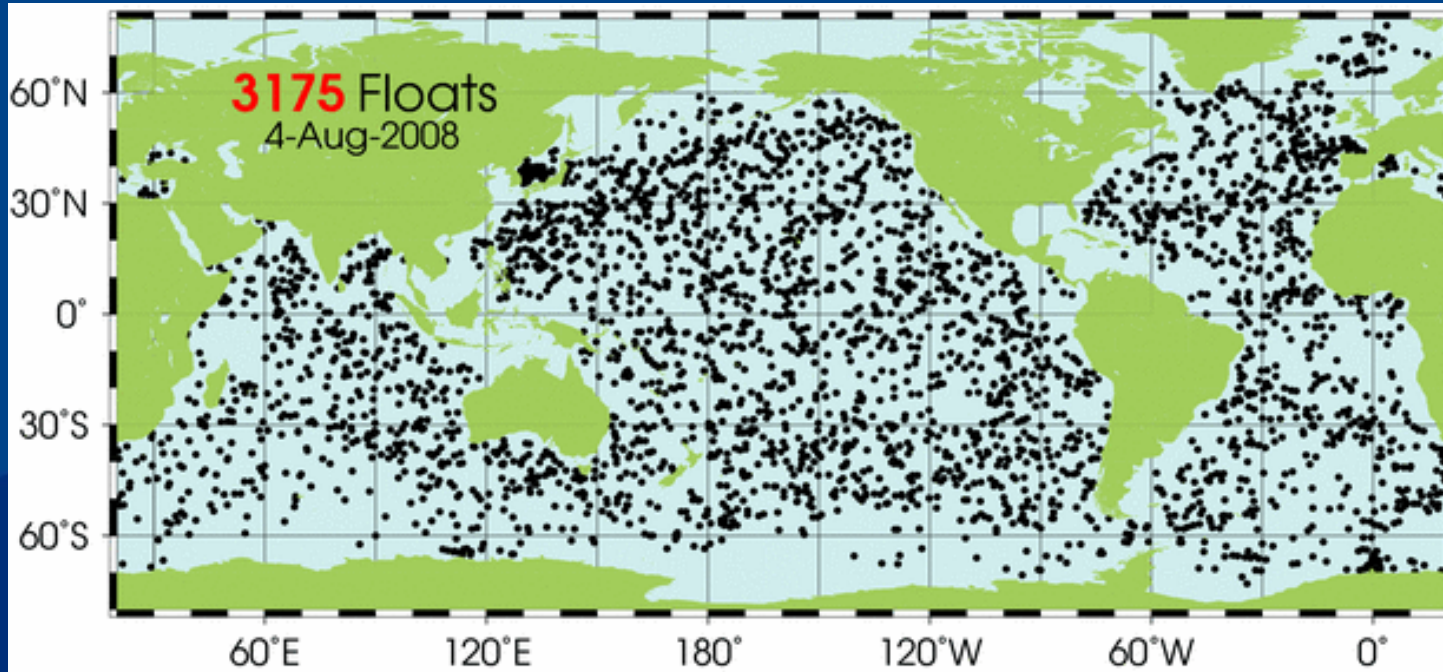




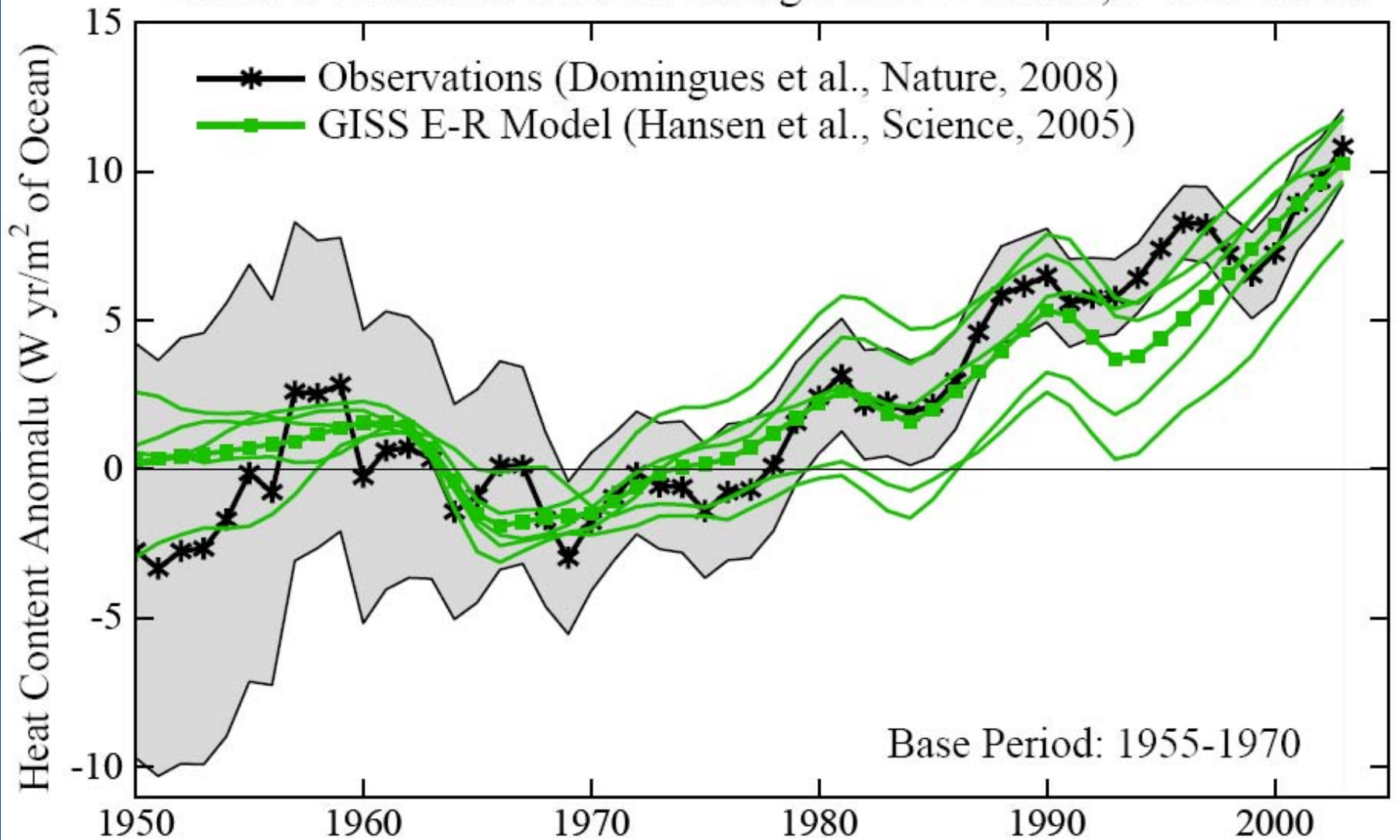


# Ocean temperatures have declined



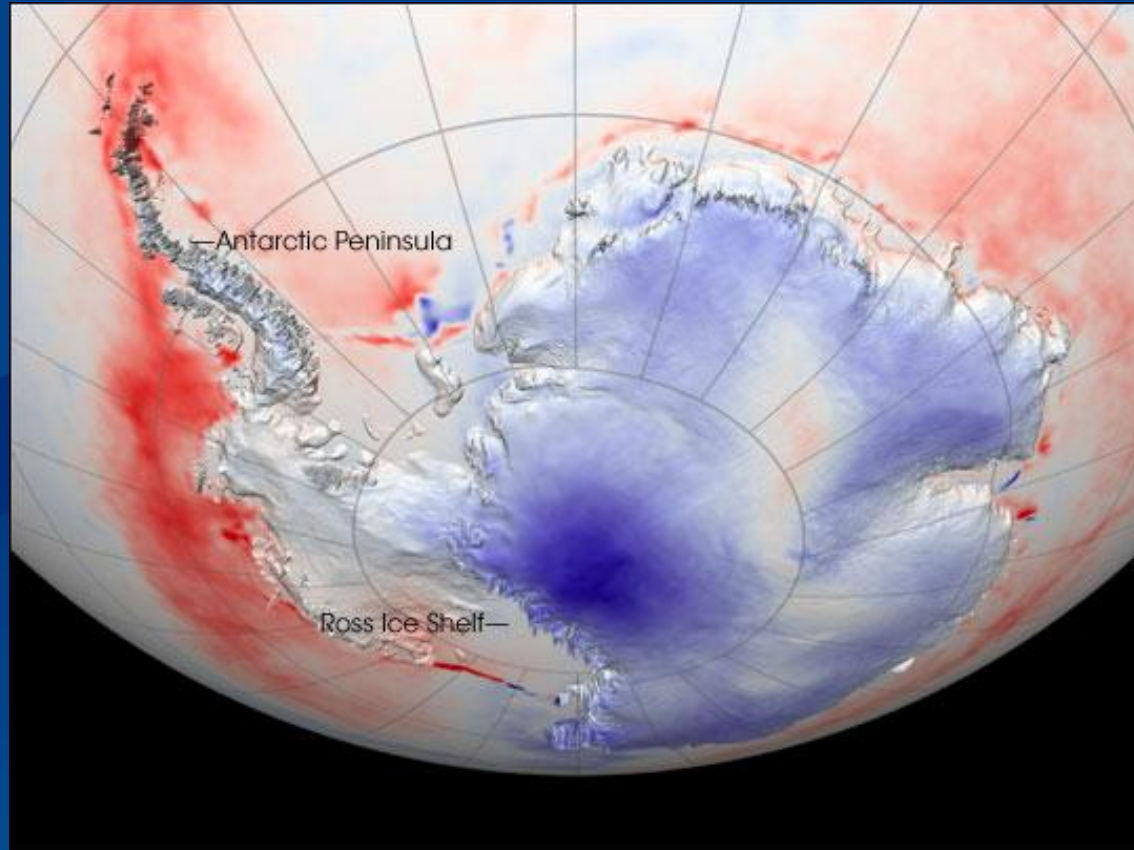
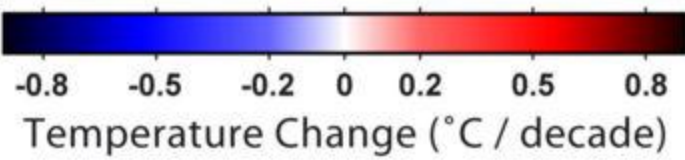
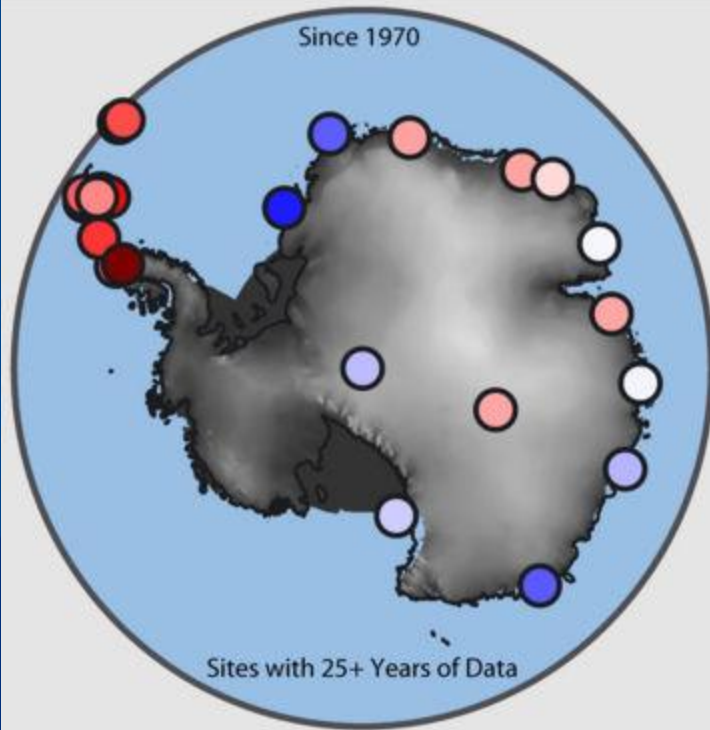


## Global Ocean Heat Content Chnage: Above 700 m, 3-Year Mean

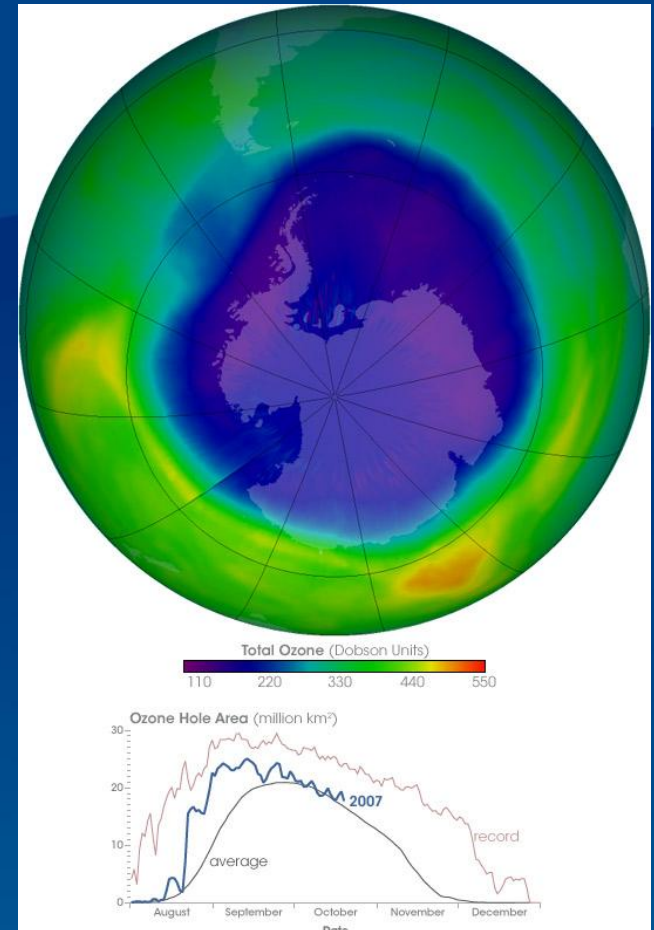
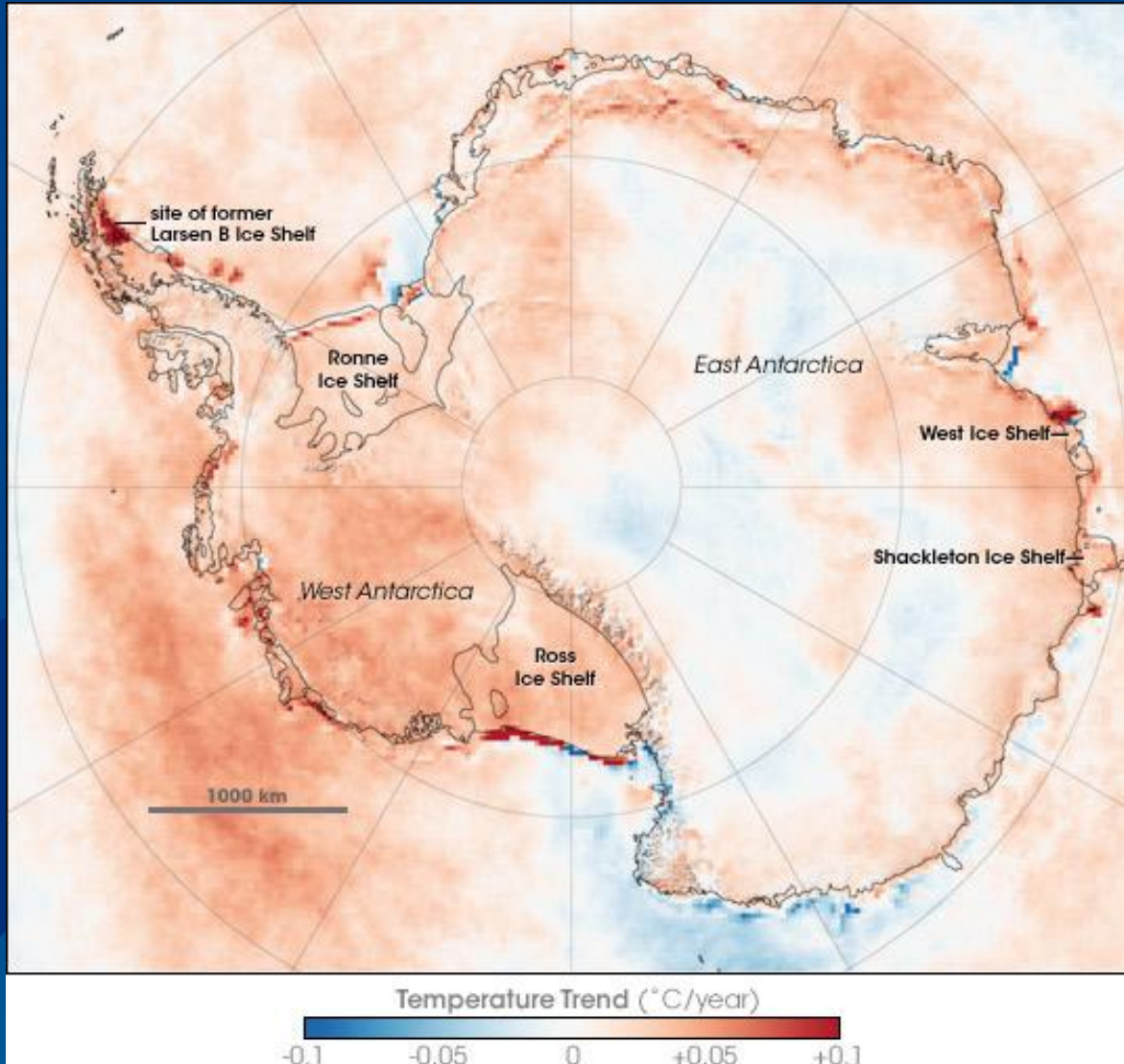


**Antarctica is cooling, not warming**

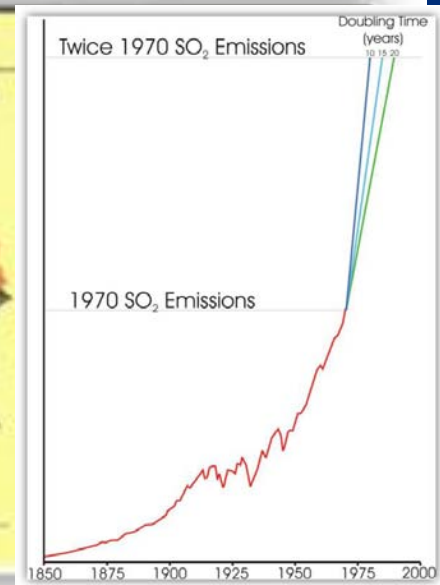
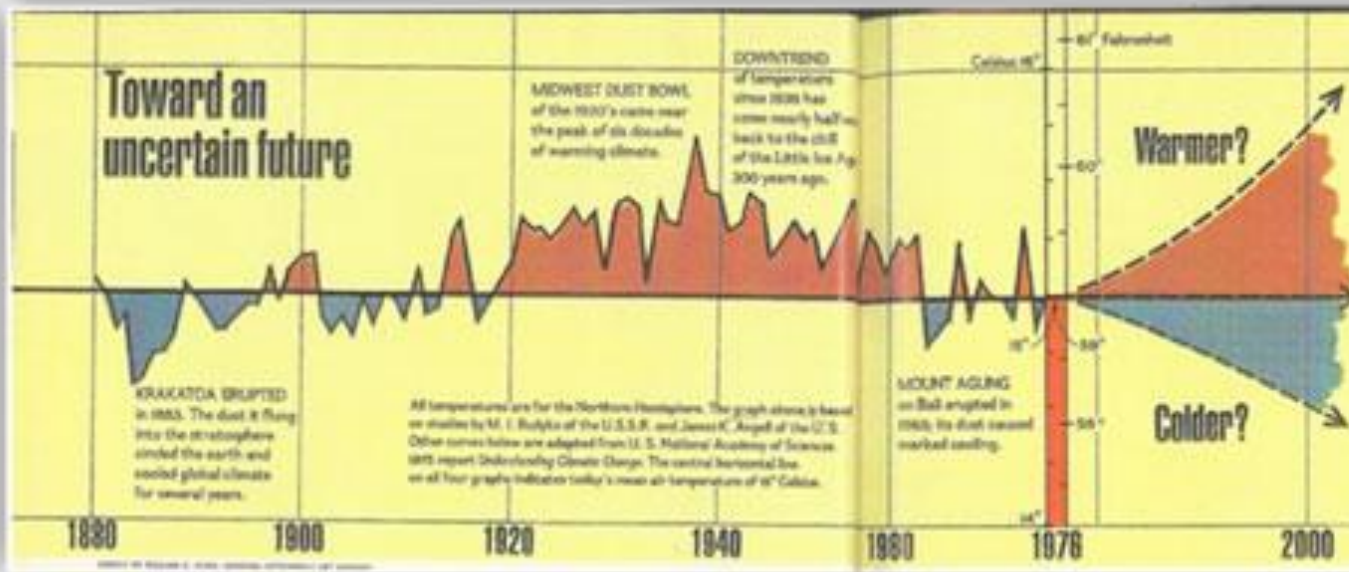
## Climate Change in Antarctica

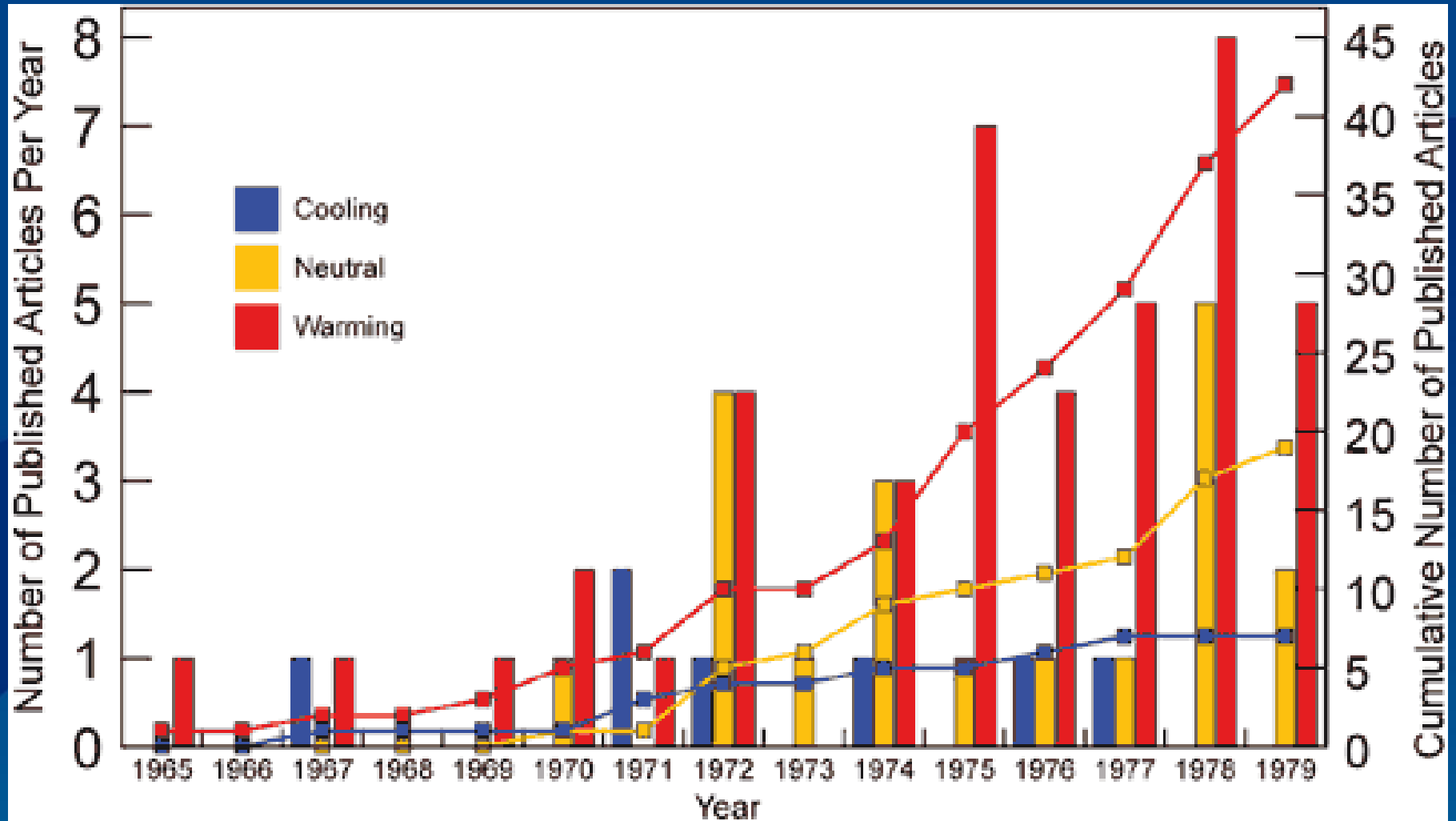






**In the 1970s they said we were heading  
into a new Ice Age**



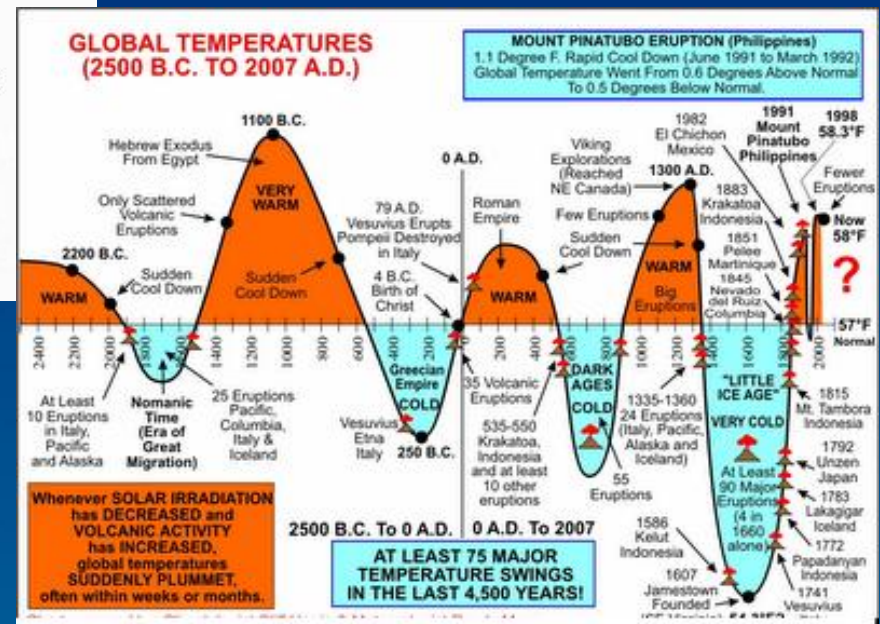
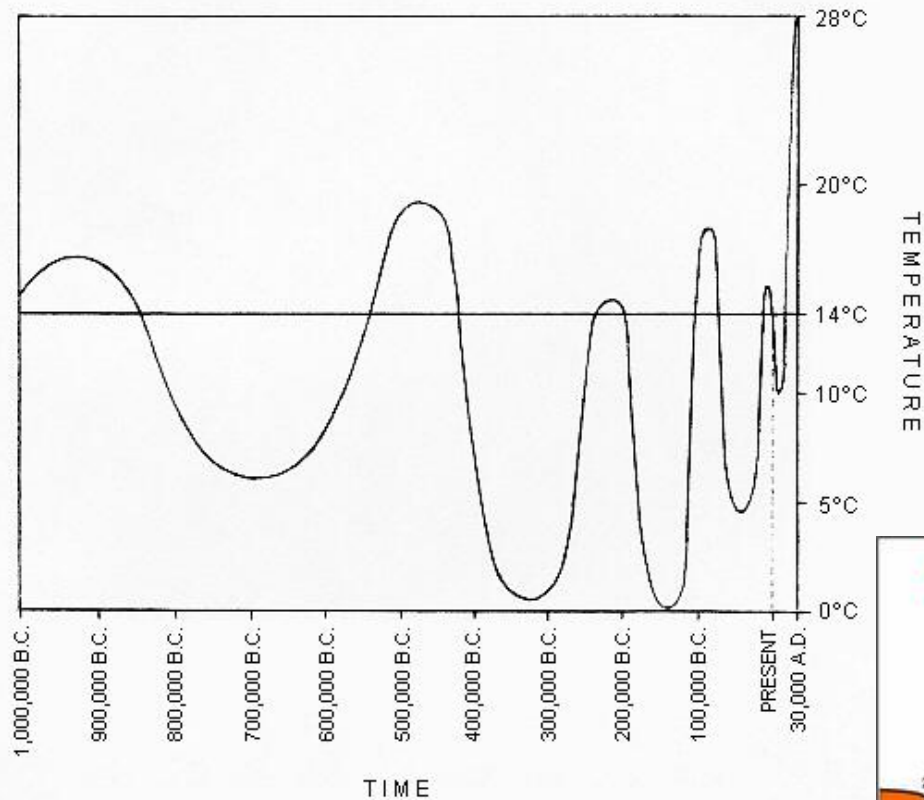


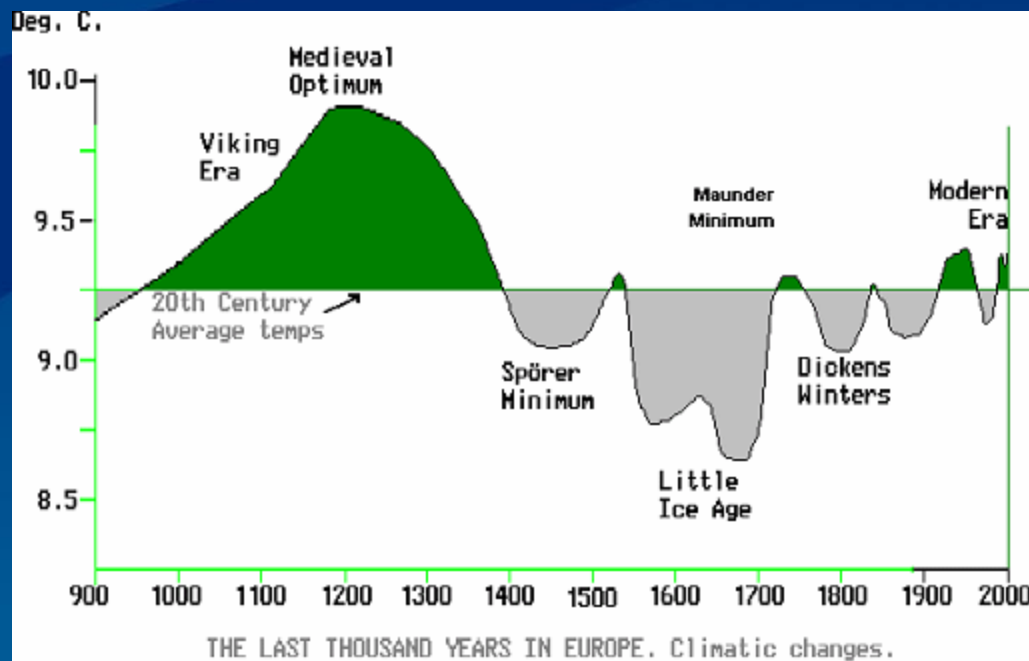
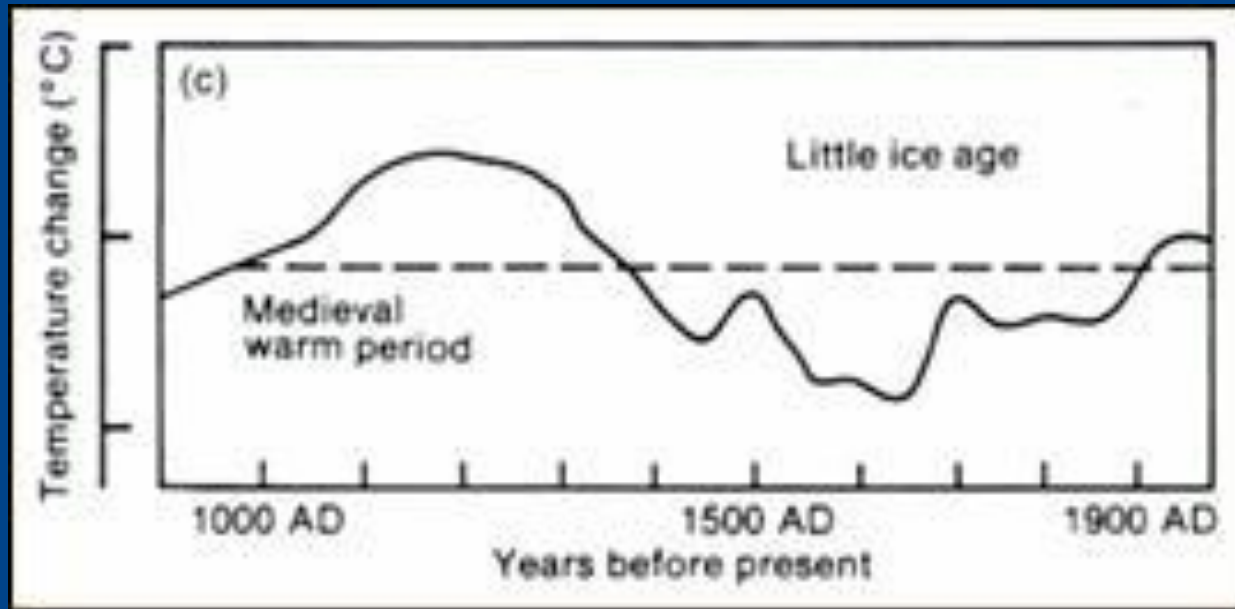
**It was warmer in medieval times**

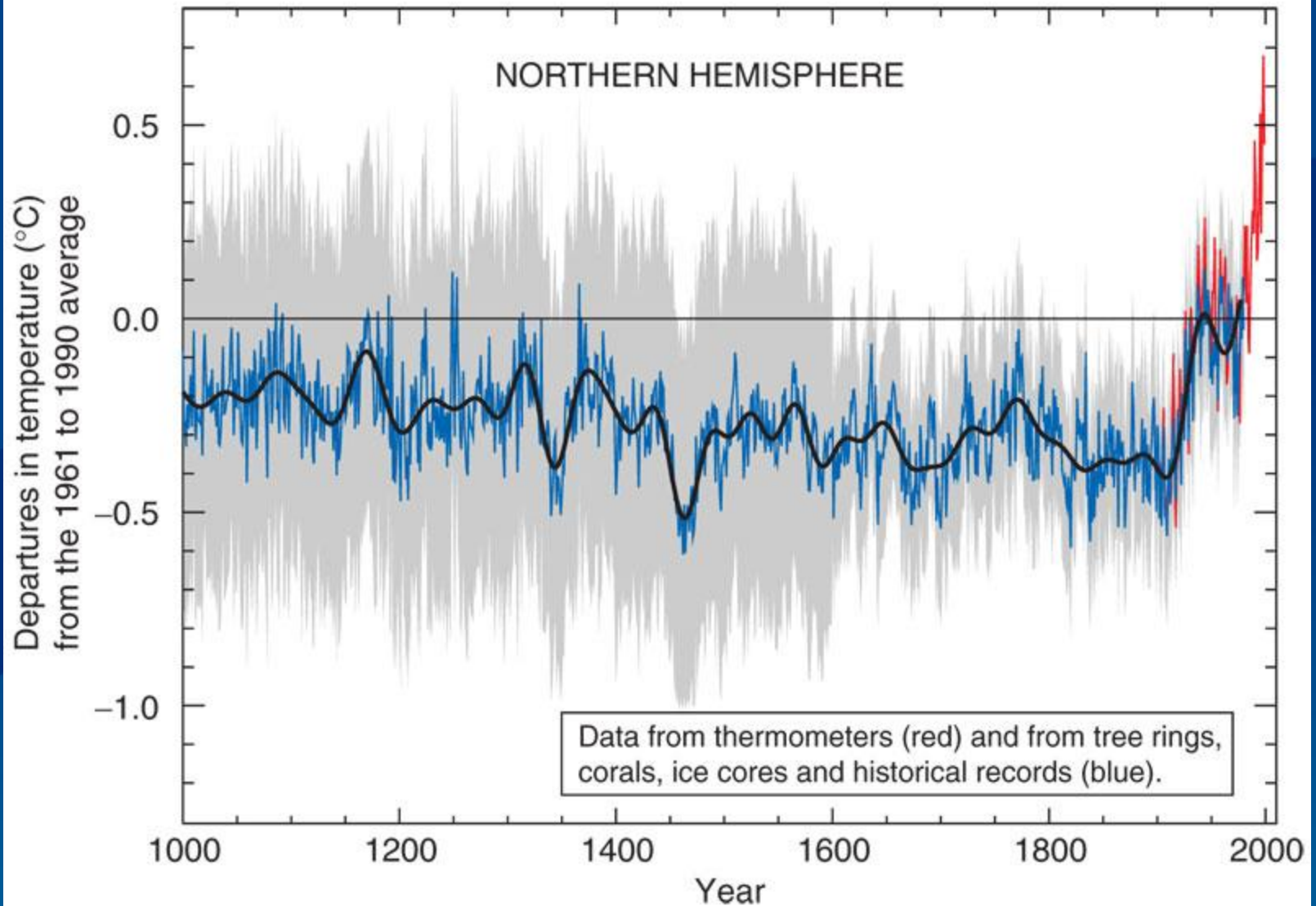
**The 'hockey stick' graph was debunked**



Global Mean Temperatures  
1,000,000 B.C. To 30,000 A.D.





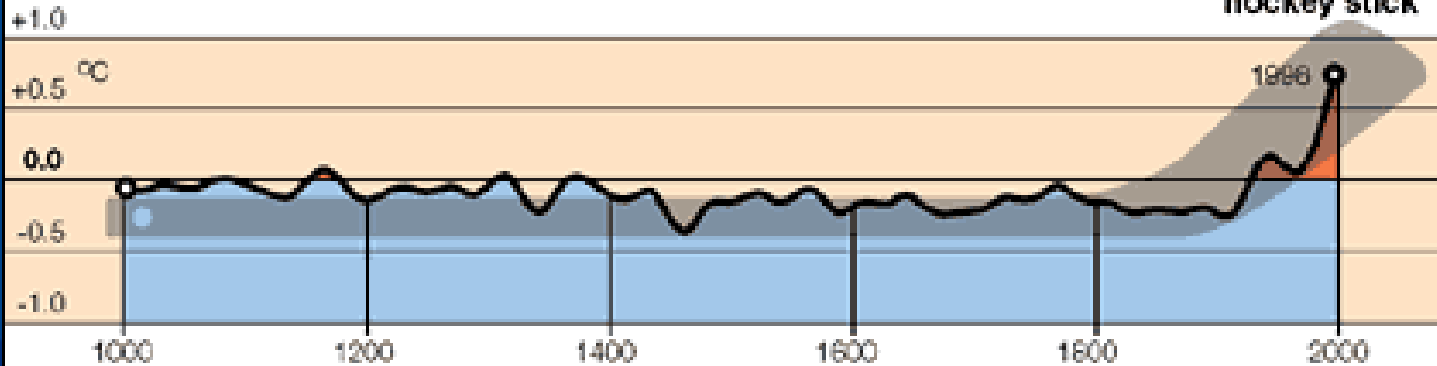




# Battle of the graphs

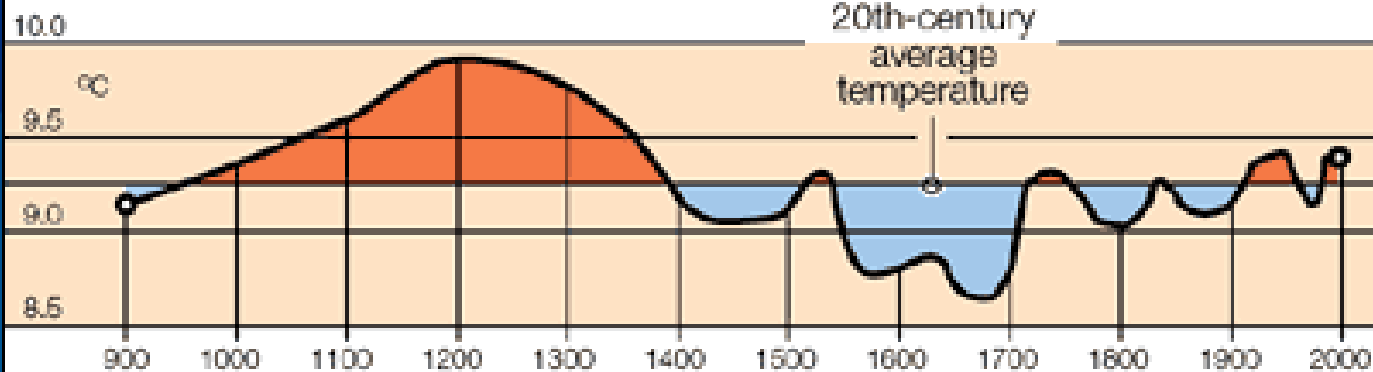
## Temperature anomaly

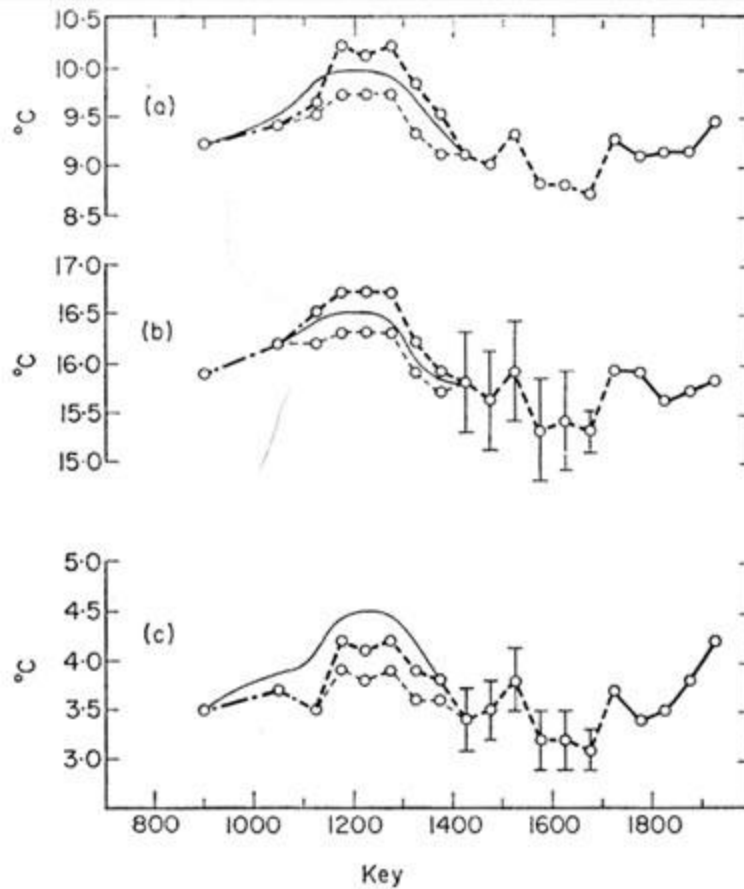
Relative to 1960-1990



## Climatic changes in Europe

Over the past thousand years



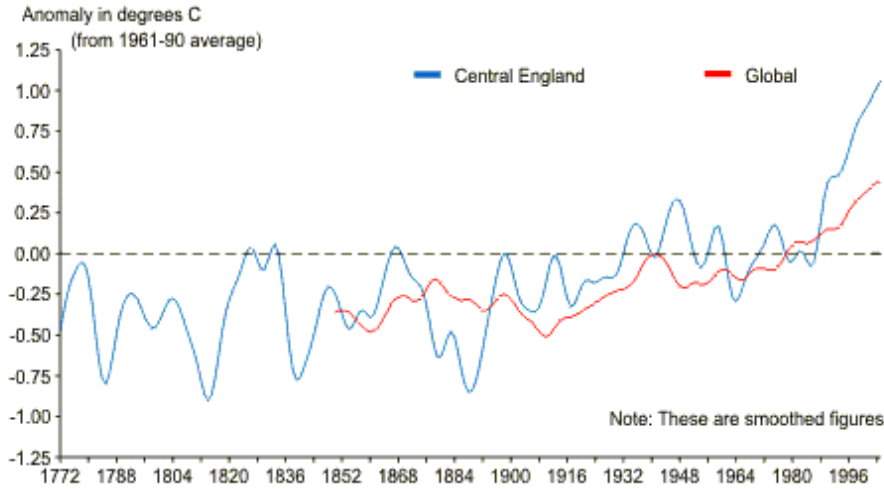


- Observed values
- - - Unadjusted values based on purely meteorological evidence (see text)
- - - Preferred values including temperatures adjusted to fit botanical indications (see text)
- - - Connects points corresponding to 100-200 year means indicated by sparse data
- Analyst's opinion (see text)

FIG. 7. Derived temperature values (°C) in central England, 50-year averages: (a) year; (b) high summer (July and August); (c) winter (December, January and February). The vertical lines indicate three times the standard error.

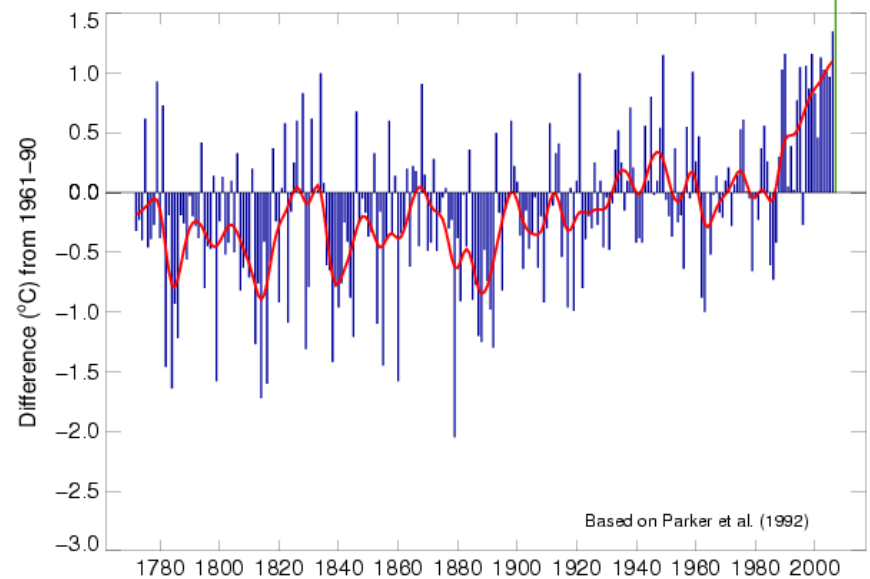


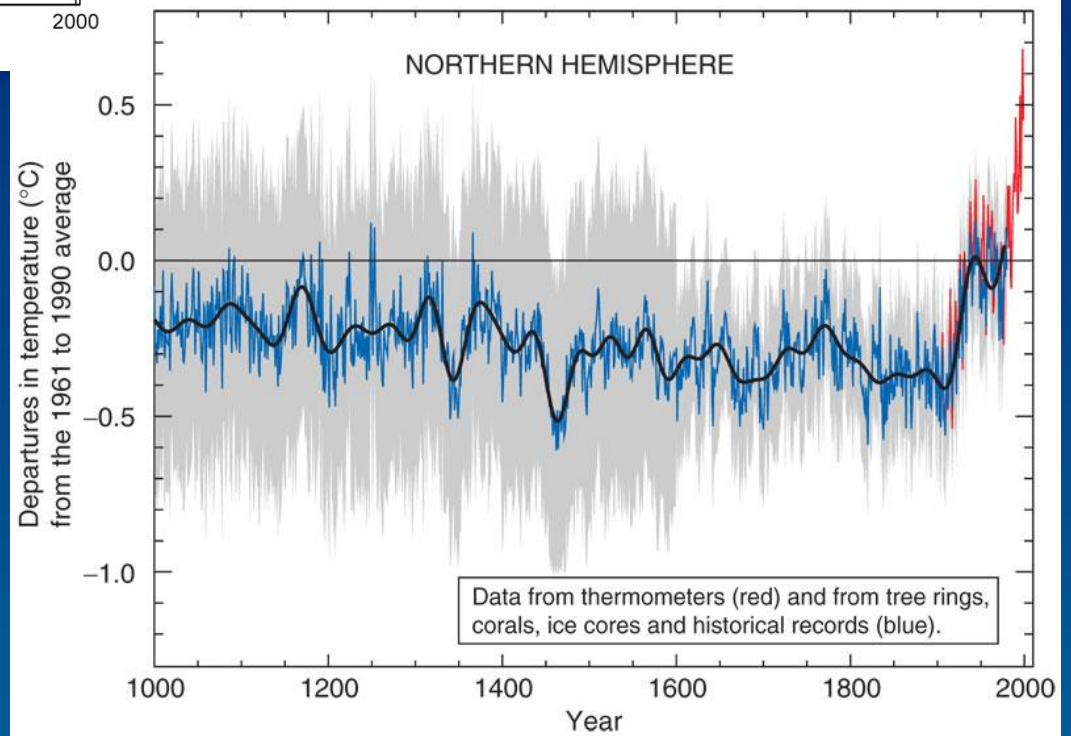
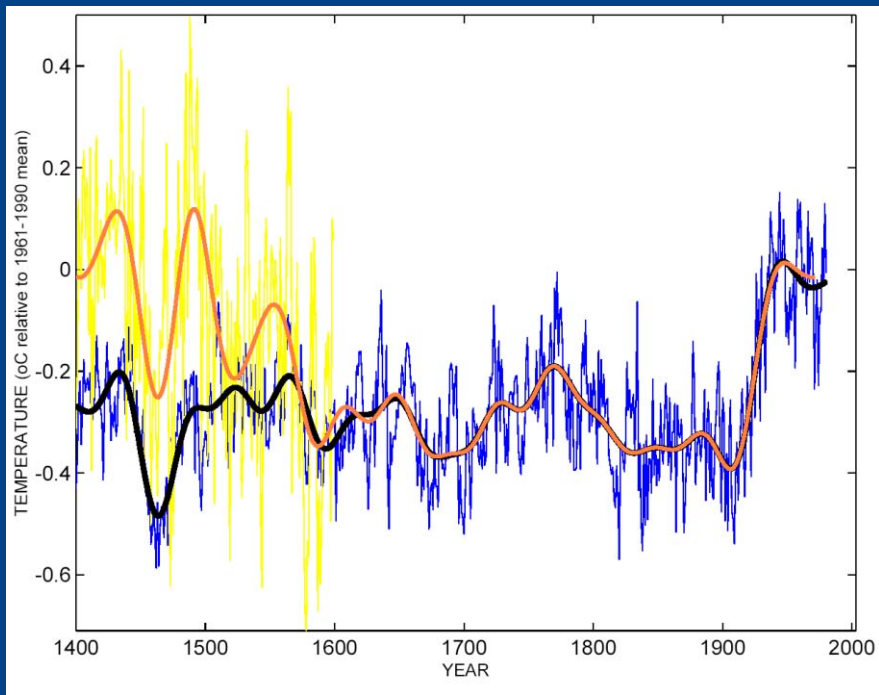
### Global and Central England surface temperature anomalies: 1772-2006

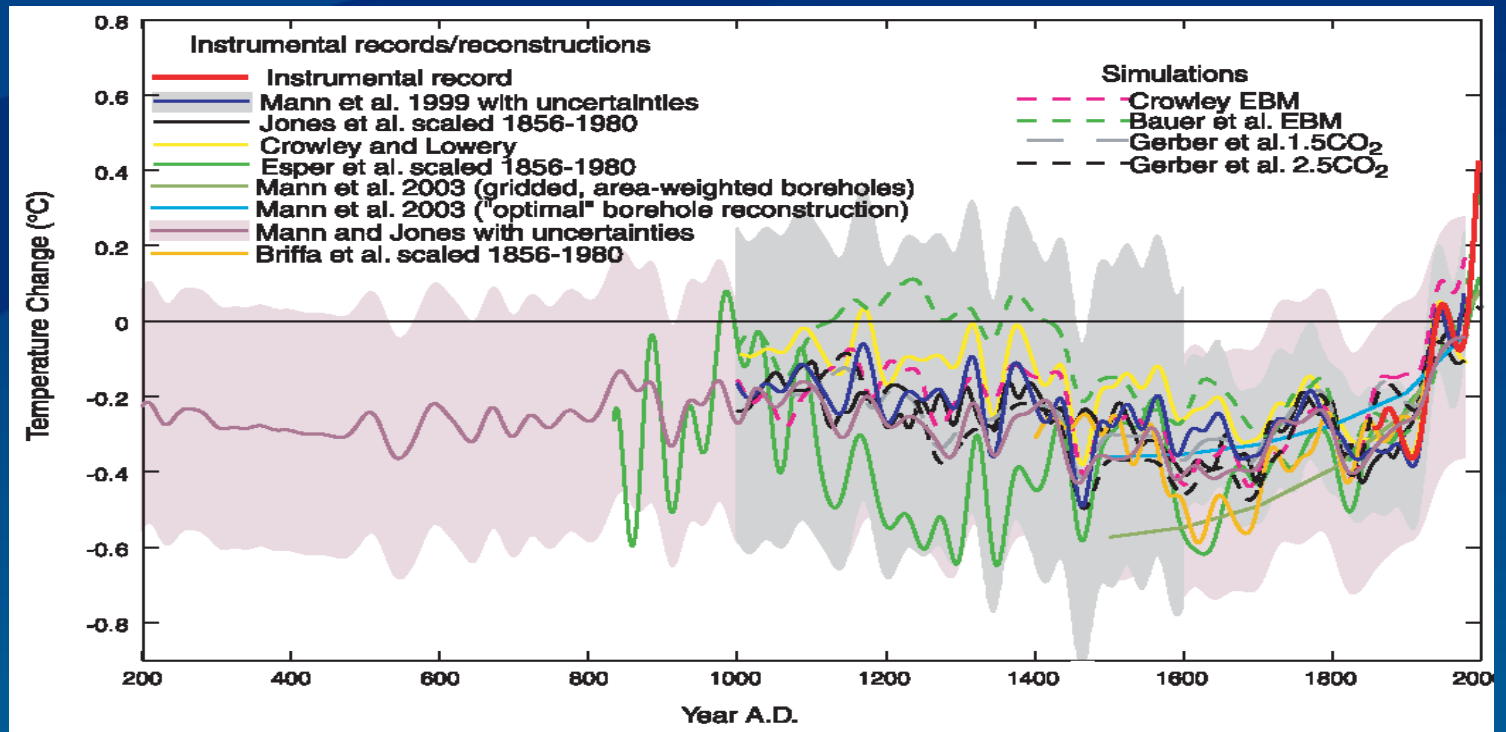
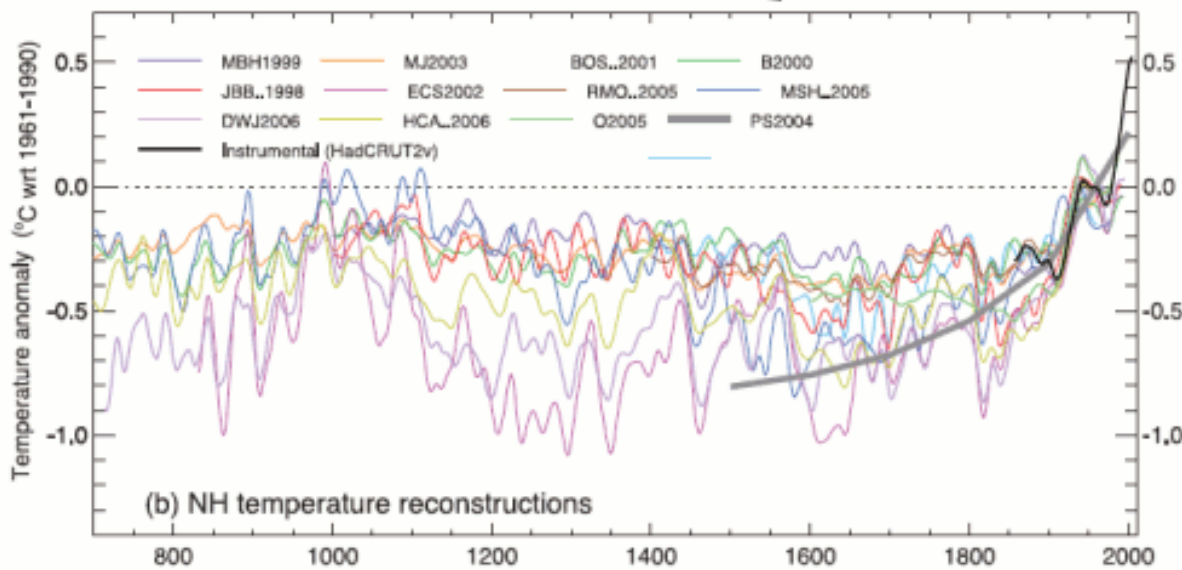


Source: Met Office, Hadley Centre for Climate Prediction and Research

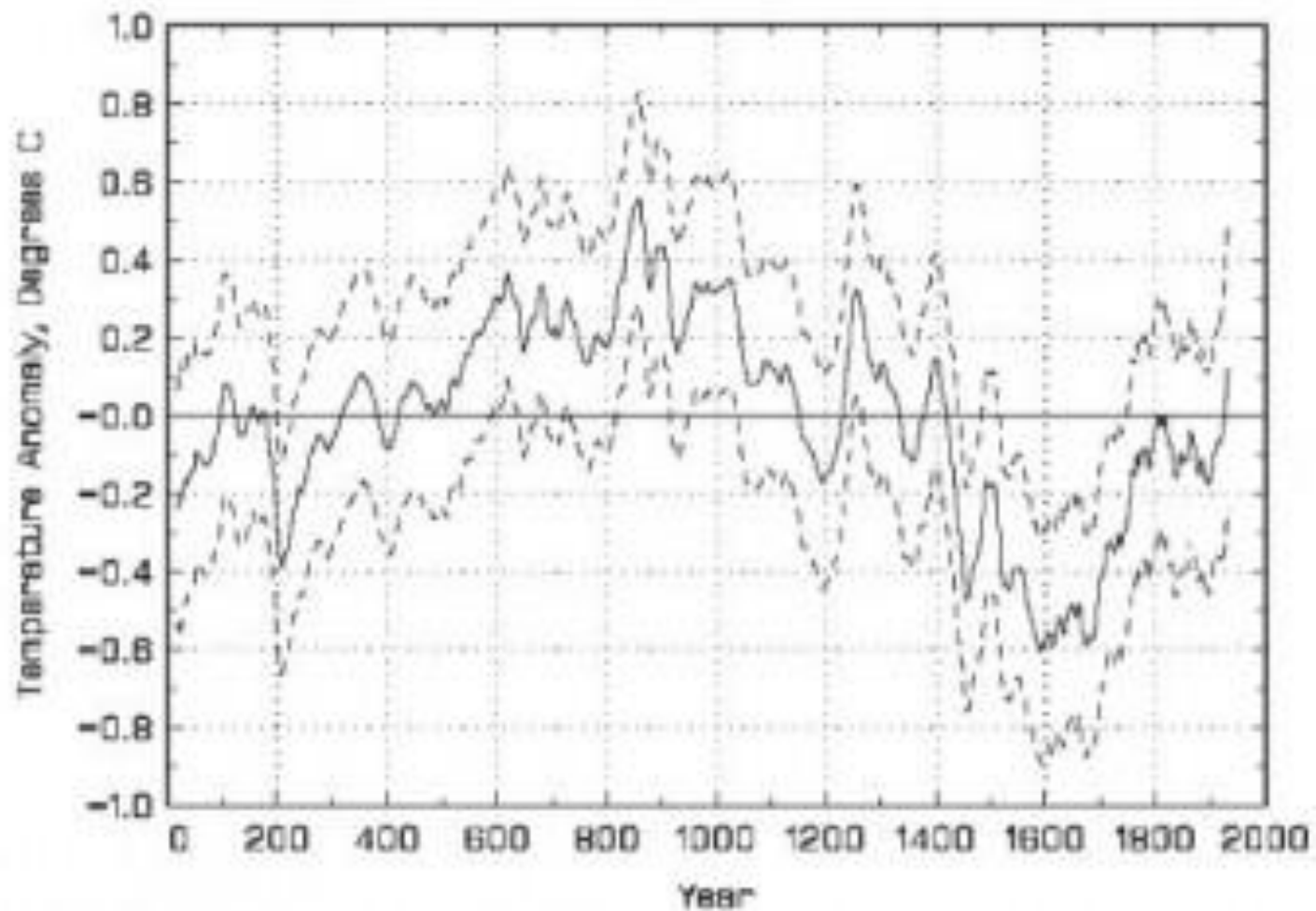
### Mean Central England Temperature Annual anomalies, 1772 to 5<sup>th</sup> Jul 2007



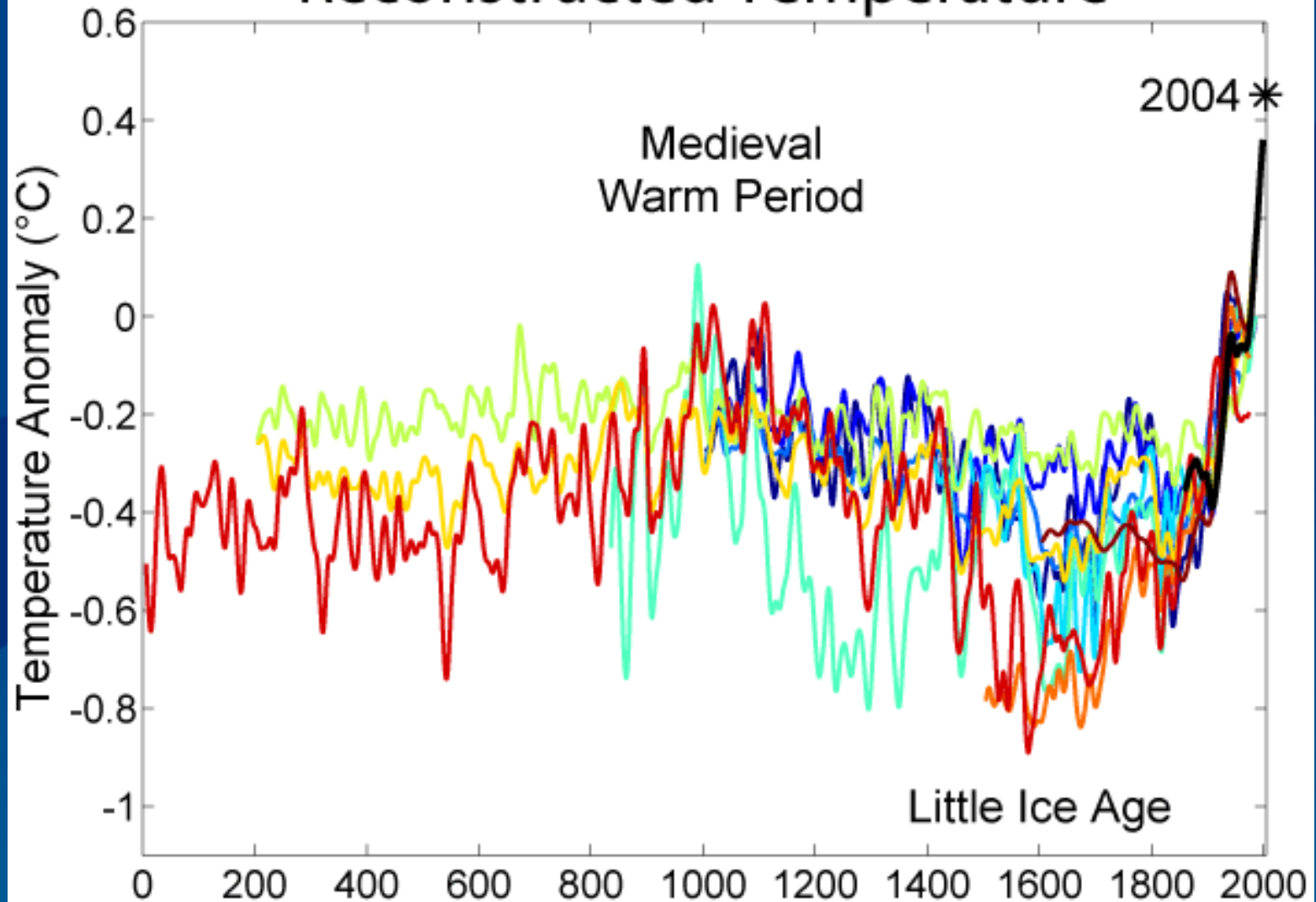




Corrected Global Temperature Reconstruction, 95% CI

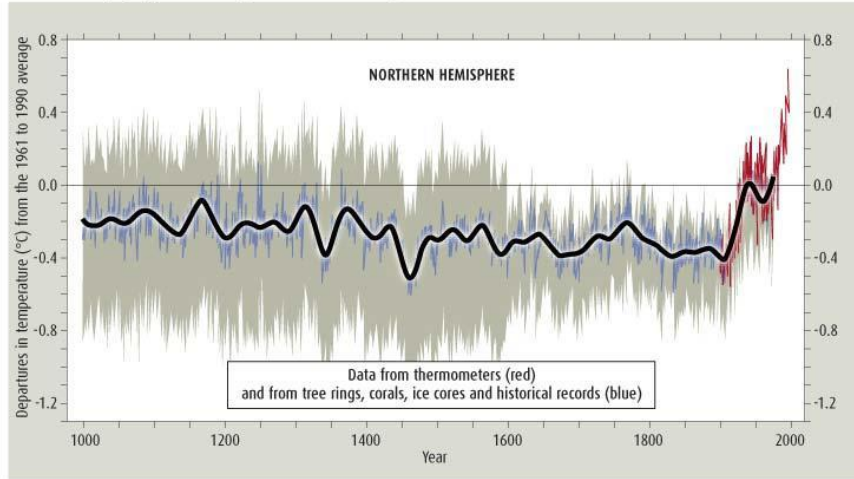


# Reconstructed Temperature



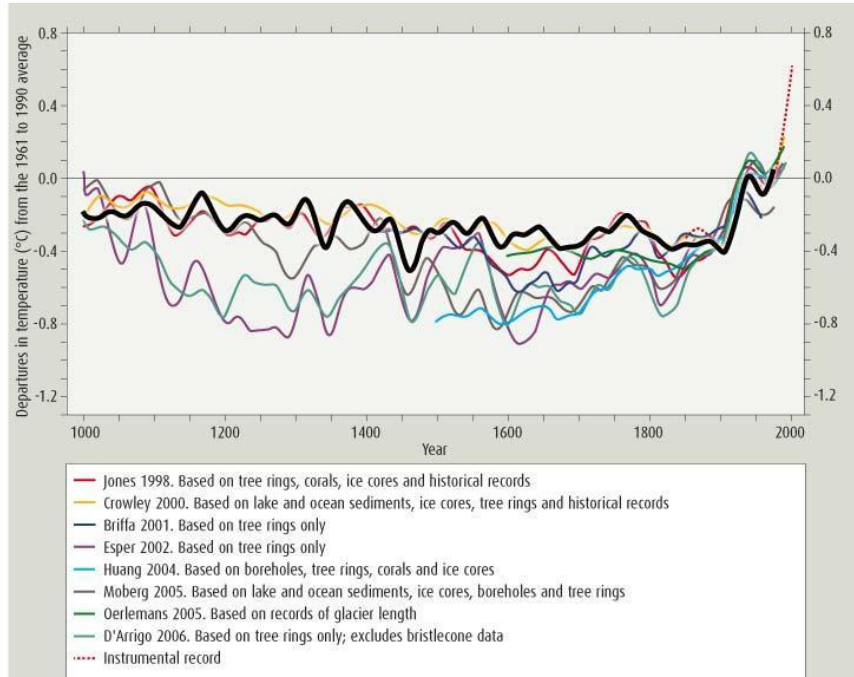
## THE HOCKEY STICK: THE ORIGINAL AND LATER VERSIONS

The 2001 IPCC version: "Variations of the Earth's surface temperature over the past 1000 years"  
The error bars (in grey) show the 95 per cent confidence range



SOURCE: IPCC, MANN 1999

The IPCC version compared with some other northern hemisphere temperature reconstructions\*

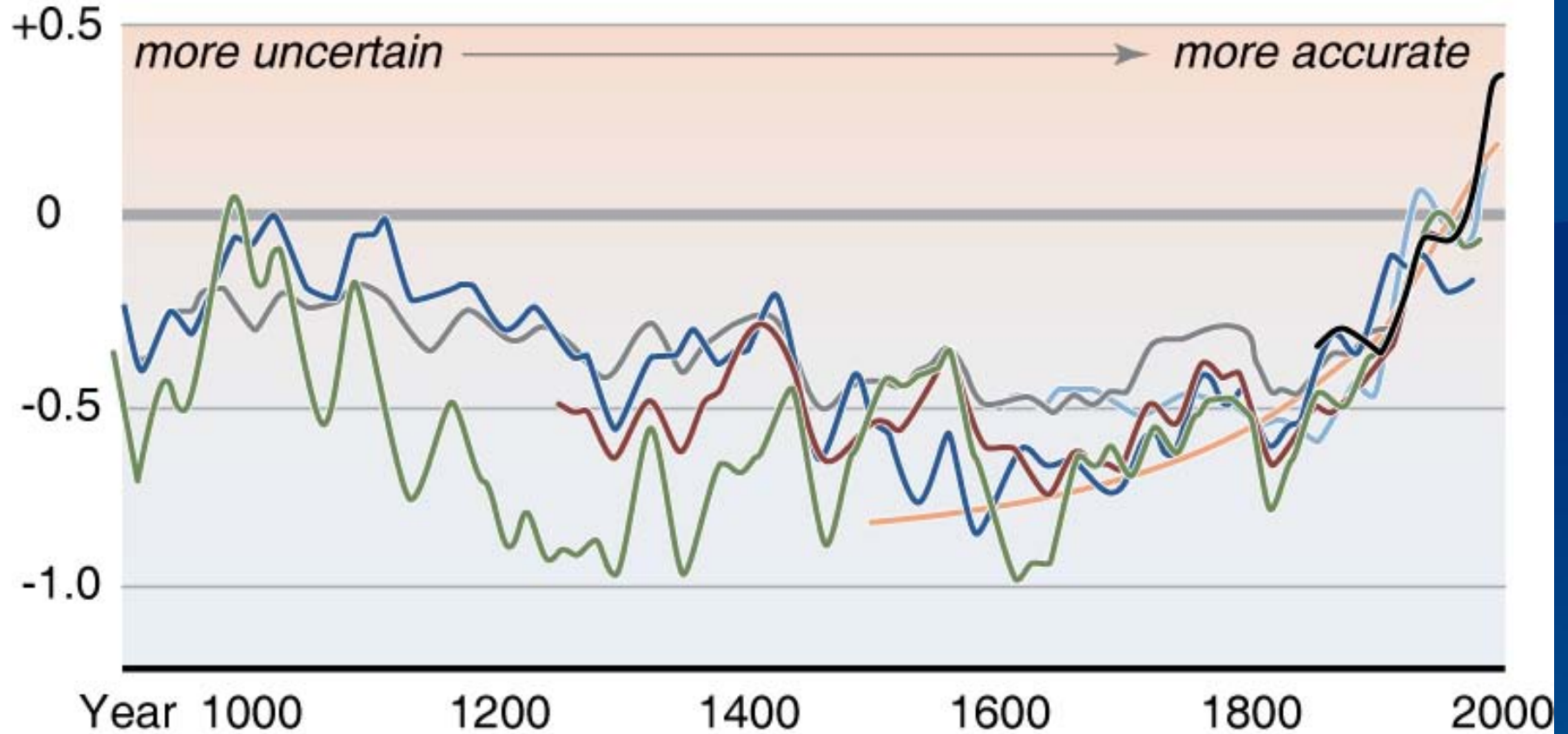


\*Compiled for *New Scientist* by Rob Wilson of the University of Edinburgh, UK.

For each reconstruction, the original raw measurements were decadal smoothed with a 50-year splicing spine. Each reconstruction is aligned so that its mean during the period of overlap, 1856 to 1979, matches that of the instrumental record (apart from Briffa 2001, which extends only to 1960). The mean and variance of the Esper 2002 series has been adjusted.



# Temperature anomaly (°C)



Tree rings

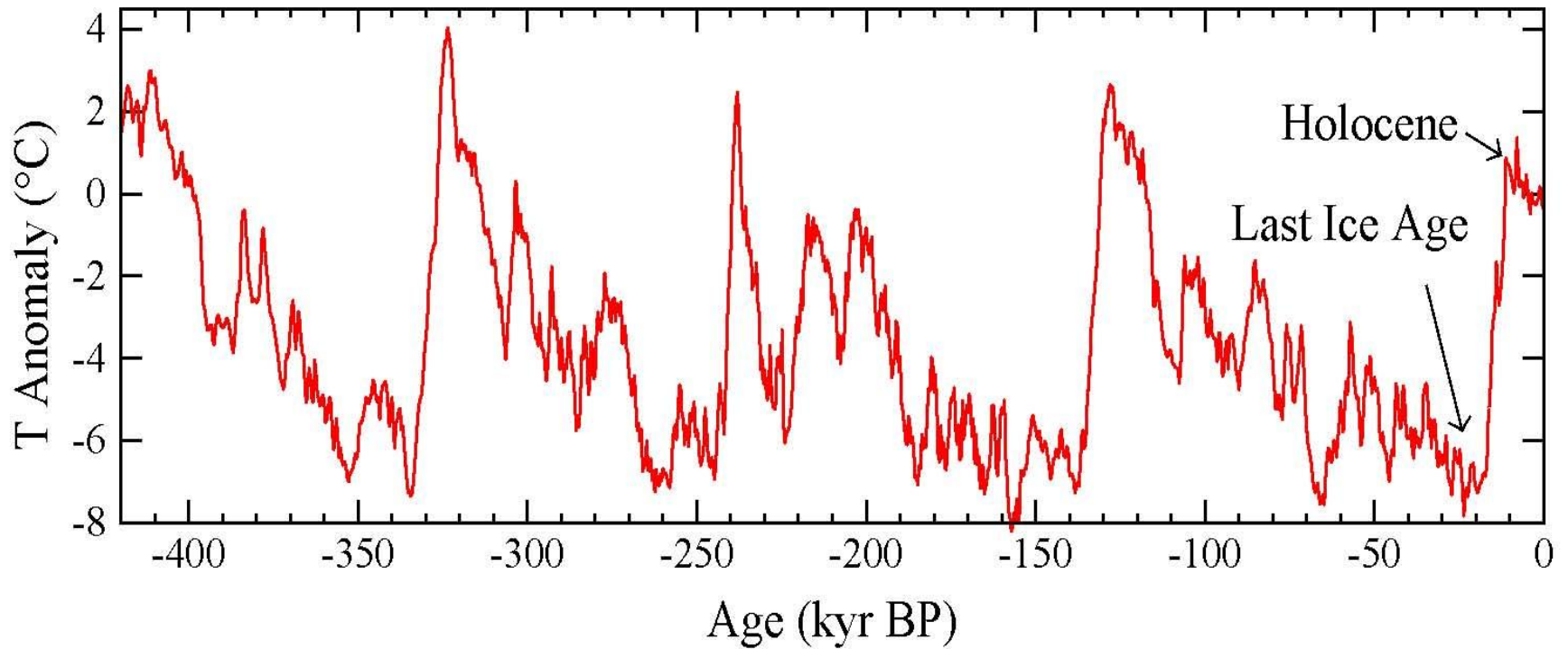
Glacier lengths

Multiple proxies  
(combination)

Borehole temperatures

Instrument record

## Antarctic (Vostok) Temperature



**Discussion Forum:**  
**[www.bravenewclimate.com](http://www.bravenewclimate.com)**



**Climate Q&A slide sources include:**

<http://www.grist.org/news>  
<http://n3xus6.blogspot.com>  
<http://tamino.wordpress.com>  
<http://www.realclimate.org>  
<http://www.skepticalscience.com>  
<http://www.aussmc.org>  
<http://www.bom.gov.au/climate>  
<http://arctic.atmos.uiuc.edu/cryosphere>  
<http://sealevel.colorado.edu>  
<http://cce.890m.com>  
<http://www.ipcc.ch>  
<http://data.giss.nasa.gov/gjstemp>  
<http://nsidc.org/arcticseaicenews>  
<http://environment.newscientist.com/channel/earth/dn11462>  
<http://www.woodfortrees.org>  
<http://blogs.news.com.au/heraldsun/andrewbolt>  
<http://www.globalwarmingart.com>  
<http://cdiac.esd.ornl.gov>  
<http://nature.com/nature>  
<http://sciencemag.com>  
<http://pnas.org>  
<http://www.unep.org/Themes/climatechange>  
<http://www.columbia.edu/~jeh1>  
<http://www.metoffice.gov.uk>  
<http://www.cru.uea.ac.uk/cru/data/temperature>  
<http://www.woodfortrees.org>  
<http://en.wikipedia.org>  
<http://www.yaleclimatemediaforum.org>  
<http://www.global-greenhouse-warming.com>  
<http://www.remss.com/msu>  
<http://climate.uah.edu>  
<http://atmoz.org/blog>  
<http://climateprogress.org>  
<http://forecast.uchicago.edu>  
<http://geosci.uchicago.edu/~rtp1/ClimateBook>  
<http://www.ccpo.odu.edu/SEES>  
<http://www.eoearth.org>  
<http://www.cpc.noaa.gov>  
<http://earthobservatory.nasa.gov>  
<http://www.climateprediction.net>  
<http://scitizen.com>  
<http://www.desmogblog.com>  
<http://www.climatedenial.org>  
<http://www.psie.psu.edu>  
<http://www.agu.org/journals>  
<http://www.esa.org>  
<http://www.aps.org>  
<http://publishing.royalsociety.org>  
<http://flood.firetree.net>  
<http://www.climateaudit.org>  
<http://julesandjames.blogspot.com/>  
<http://icecap.us>  
<http://www.abc.net.au/news/tag/climate-change>  
<http://www.aip.org/history/climate/>  
<http://ams.allenpress.com>  
<http://climatespin.blogspot.com>  
<http://wattsupwiththat.wordpress.com>  
<http://hot-topic.co.nz>  
<http://www.ukcip.org.uk>  
<http://climatesci.org>  
<http://blogs.nature.com/climatefeedback>  
<http://stephenschneider.stanford.edu>  
<http://scienceblogs.com>  
<http://www.wmo.int>  
<http://chriscolose.wordpress.com>  
<http://aerosols.blogspot.com>  
<http://moregrumbinescience.blogspot.com>  
<http://www.ametsoc.org>  
<http://www.theoil drum.com>  
<http://dotearth.blogs.nytimes.com>  
<http://frankbi.wordpress.com>  
<http://www.layscience.net>  
<http://www.energybulletin.net>  
<http://www.daf.gov.au>  
<http://www.climatechange.gov.au>  
<http://csiro.au>  
<http://www.worldviewofglobalwarming.org>  
<http://www.ncdc.noaa.gov/oa/climate>