

^{AV}Surface Temperature Reconstructions over the Last 2000 years*

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Abstract

The time dependence of large-scale surface temperatures (hemispheric or global average) over the last millennium provides perspective for understanding present and future states of global climate. To estimate these past temperatures, proxies must be used since the instrumental record only extends back about 150 years. The main technique used in reconstructions by proxies involves utilization of the instrumental record as a means of calibration. As an example, consider tree rings. First the specialist investigates the available sites and decides what factors are controlling the local response to environmental conditions. Once these are identified and if the species and specimens at the site are sensitive to temperature change, one can use the tree ring widths (or other parameters) to design a ‘thermometer’ that can be used for extrapolation. The steps along the way are essentially the methods of statistical regression.

The findings of the 2006 National Academy of Sciences Committee can be summarized as follows:

- 1) There was a warm period in the middle ages and a cool one centered in the 1600s, with an upswing in temperatures after that to the present.
- 2) It can be said with a high level of confidence that the last three decades were warmer than any such interval in the last 400 years.
- 3) It is plausible that the last three decades were the warmest in a thousand years.

While this methodology does not make use of climate models, they are essential to understand the record and to project climate into the next century.

Surface Temperature Reconstructions for the Last 2000 Years

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This Talk:

- Introduction: NRC Report, 2006
- Proxy Indicators of Past Climates
- Some Findings of the Report
- A Few More Recent Findings

Surface Temperature Reconstructions for the Last 2,000 Years

Committee on Surface Temperature Reconstructions for the Last 2,000 Years
Board on Atmospheric Sciences and Climate
Division on Earth and Life Studies

GERALD R. NORTH (*Chair*), Texas A&M University, College Station

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JOHN M. WALLACE, University of Washington, Seattle

12 Referees, two Monitors

Annual Temperature Anomalies

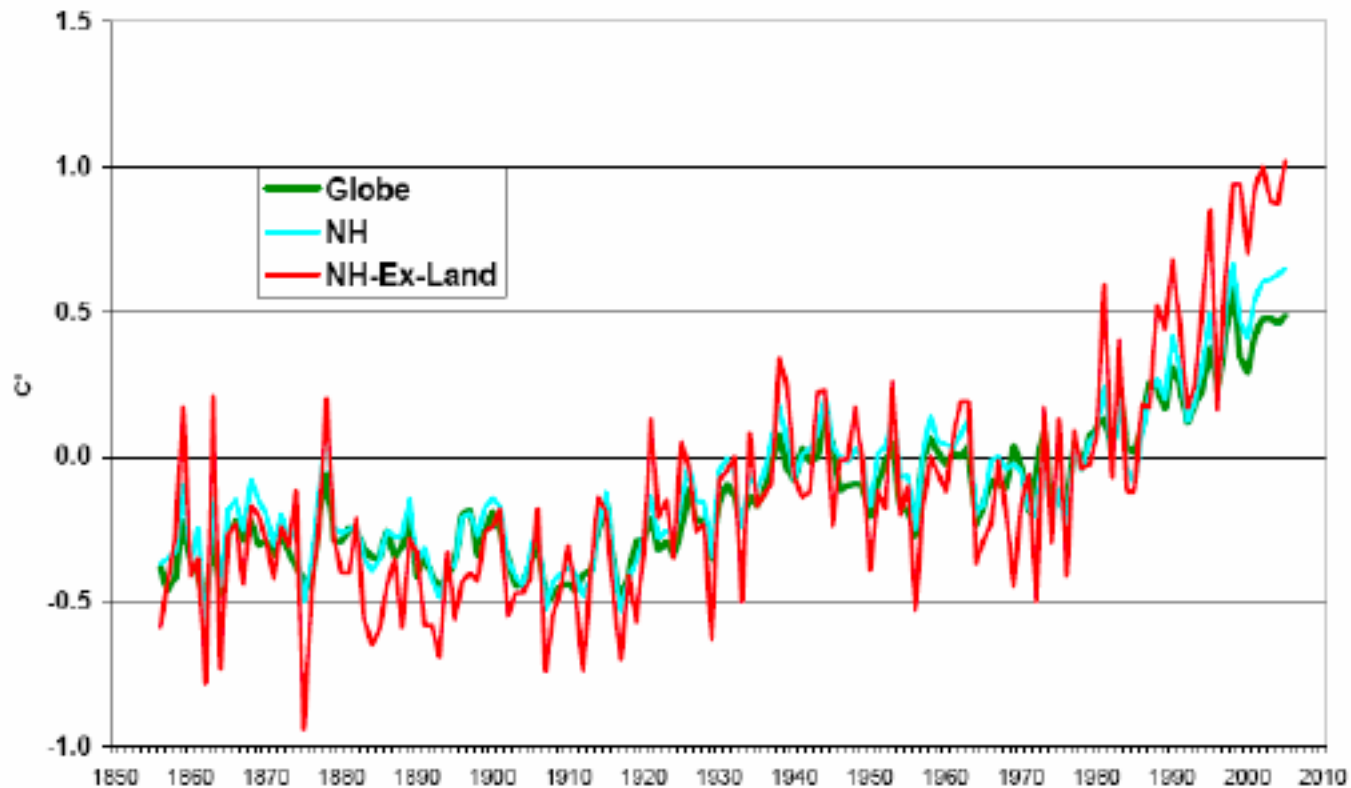
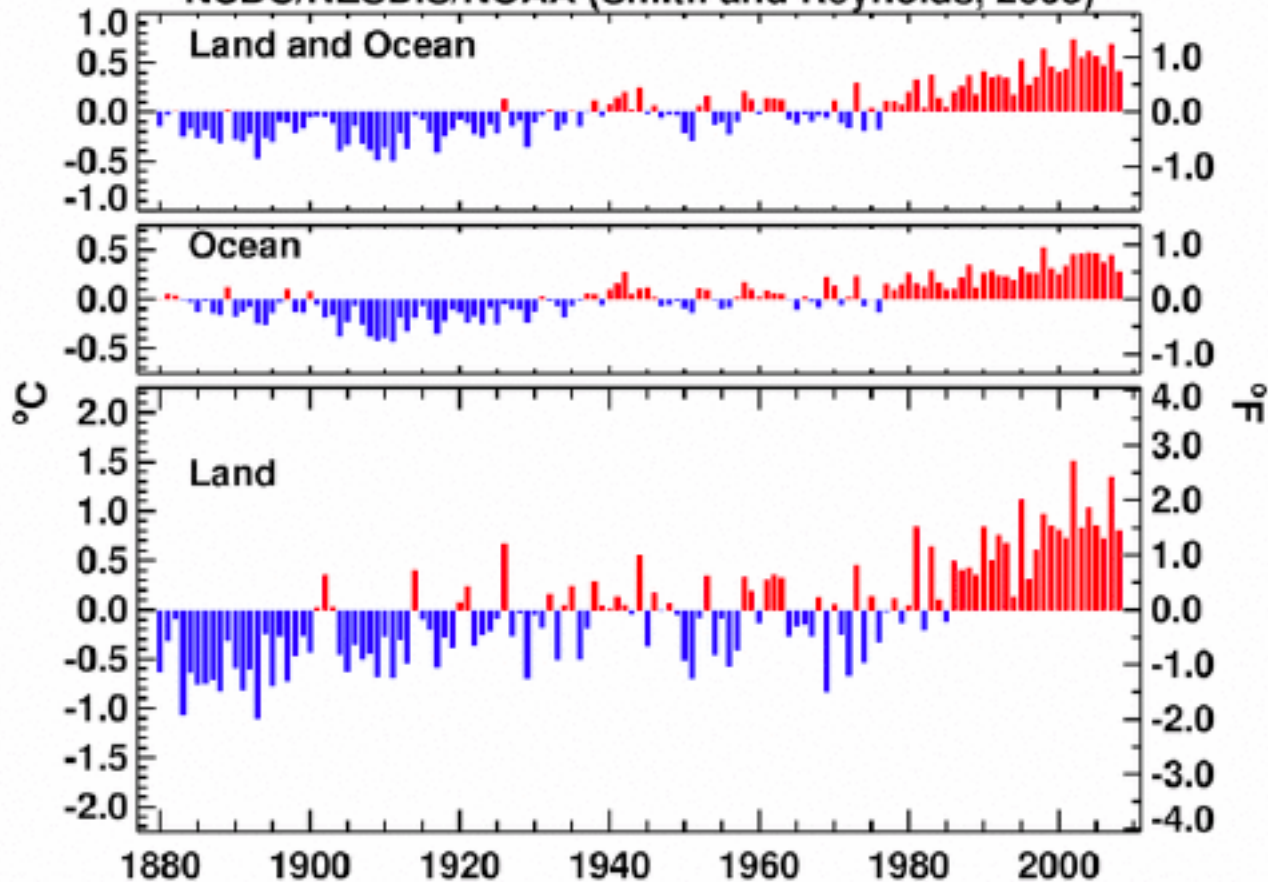


FIGURE 2-1 Global, Northern Hemisphere, and Northern Hemisphere extratropical land area annual temperature anomalies from the HadCRUT2v surface temperature dataset. SOURCE: Jones et al. (2001).

Jan-Mar Global Surface Mean Temp Anomalies

NCDC/NESDIS/NOAA (Smith and Reynolds, 2005)



Is it starting to cool off?

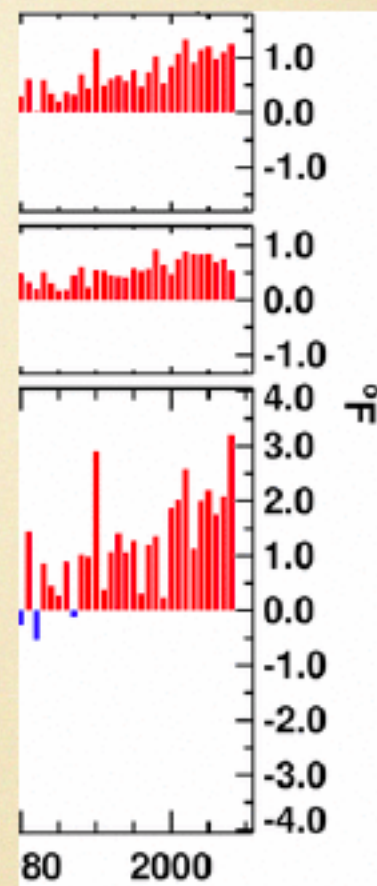
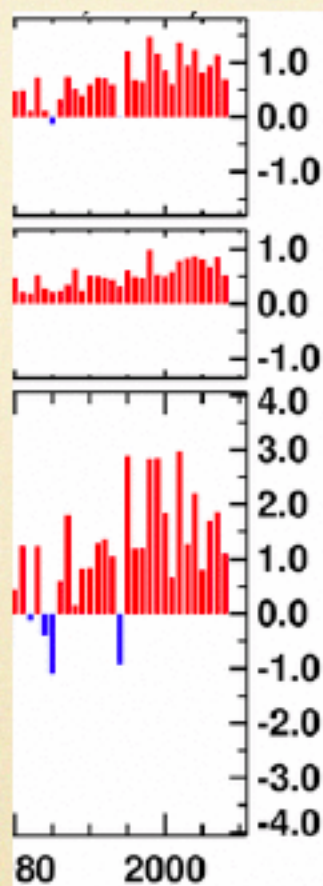
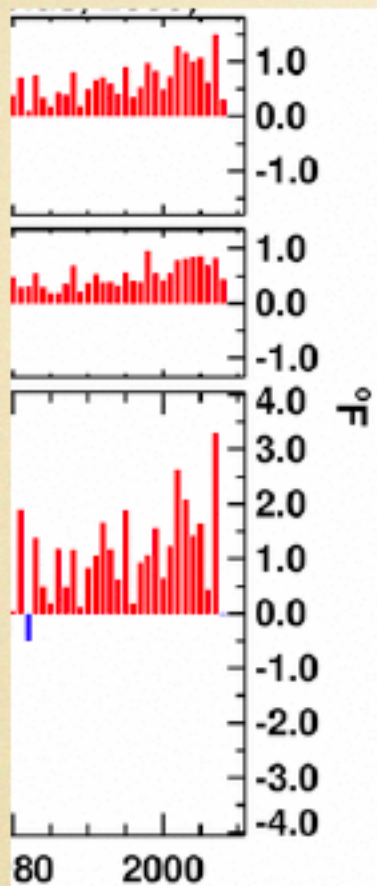
Copyright 2005 American Meteorological Society (AMS) used with permission AMS

Jan 08

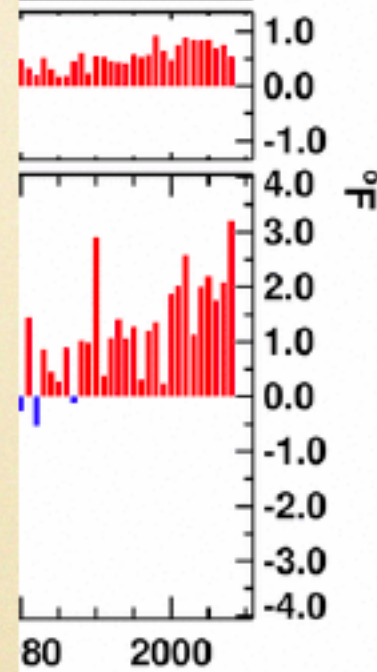
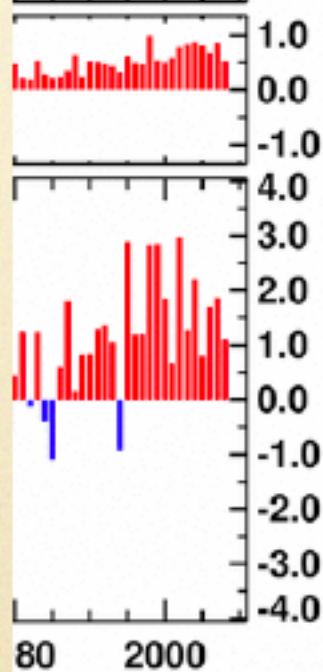
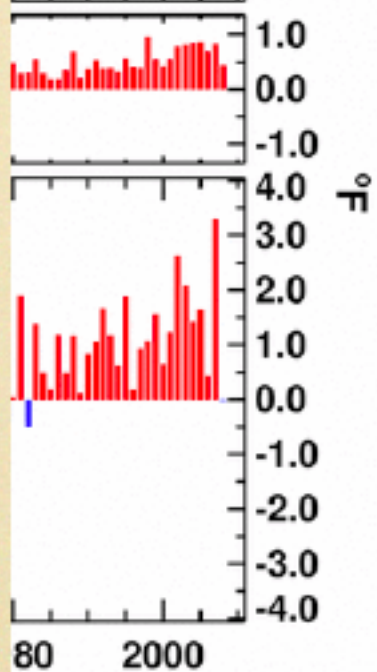
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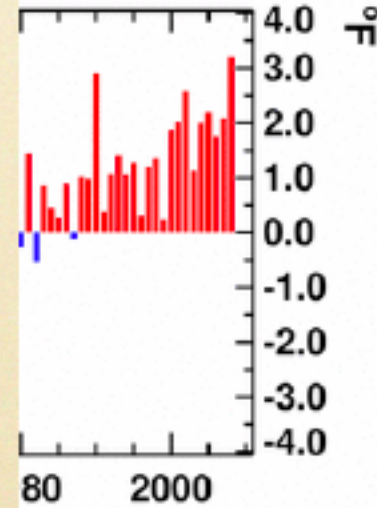
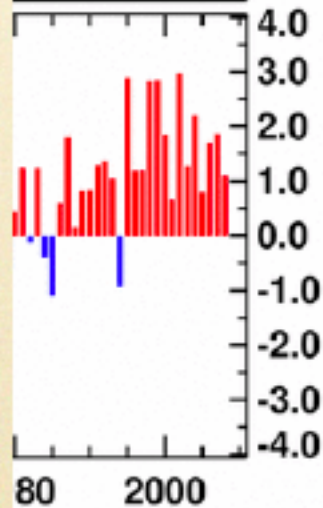
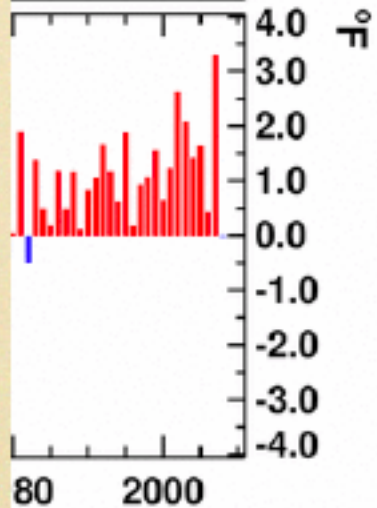
Global



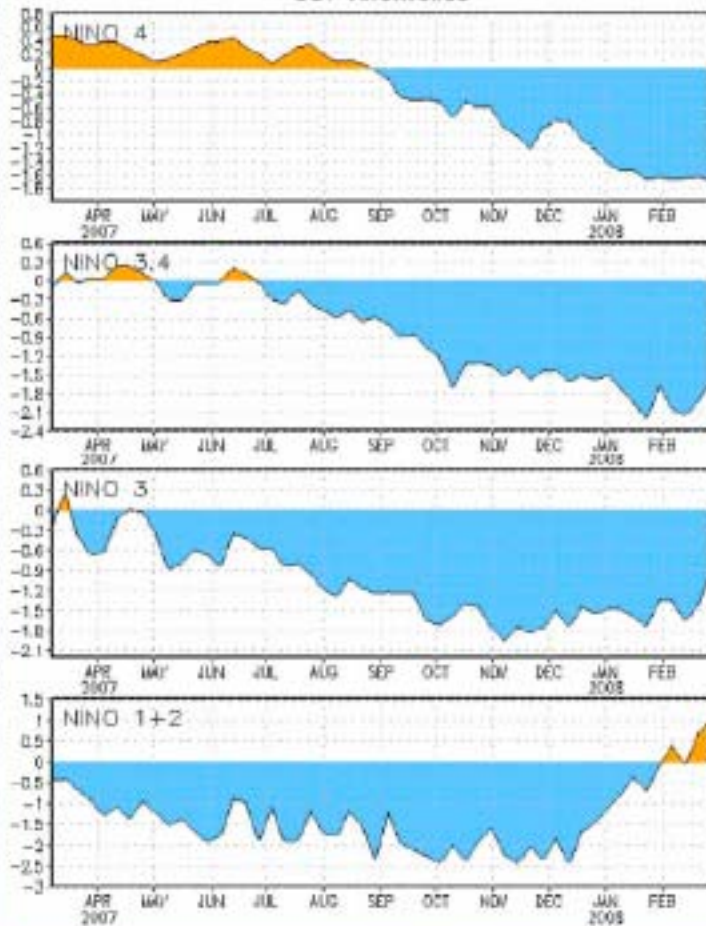
Ocean



Land



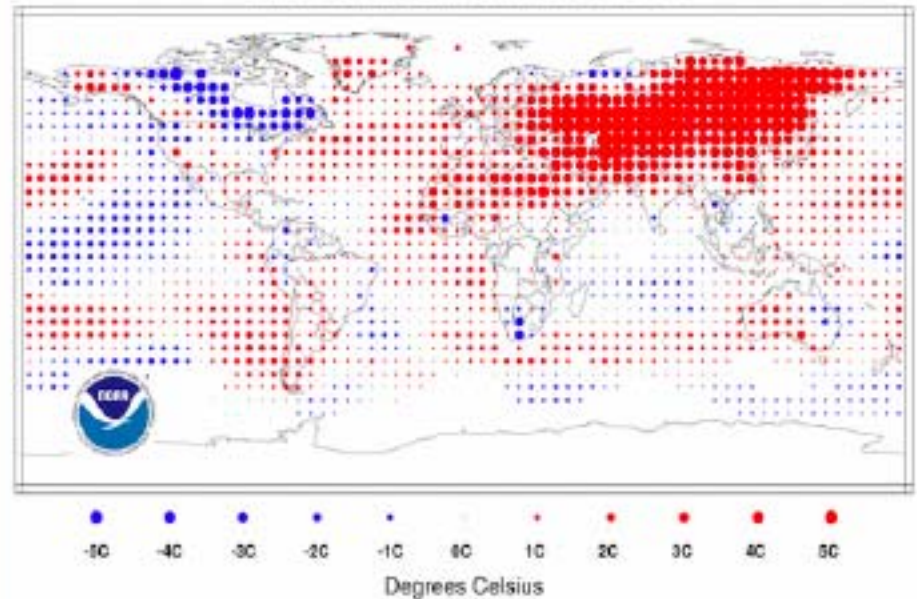
SST Anomalies



Temperature Anomalies March 2008

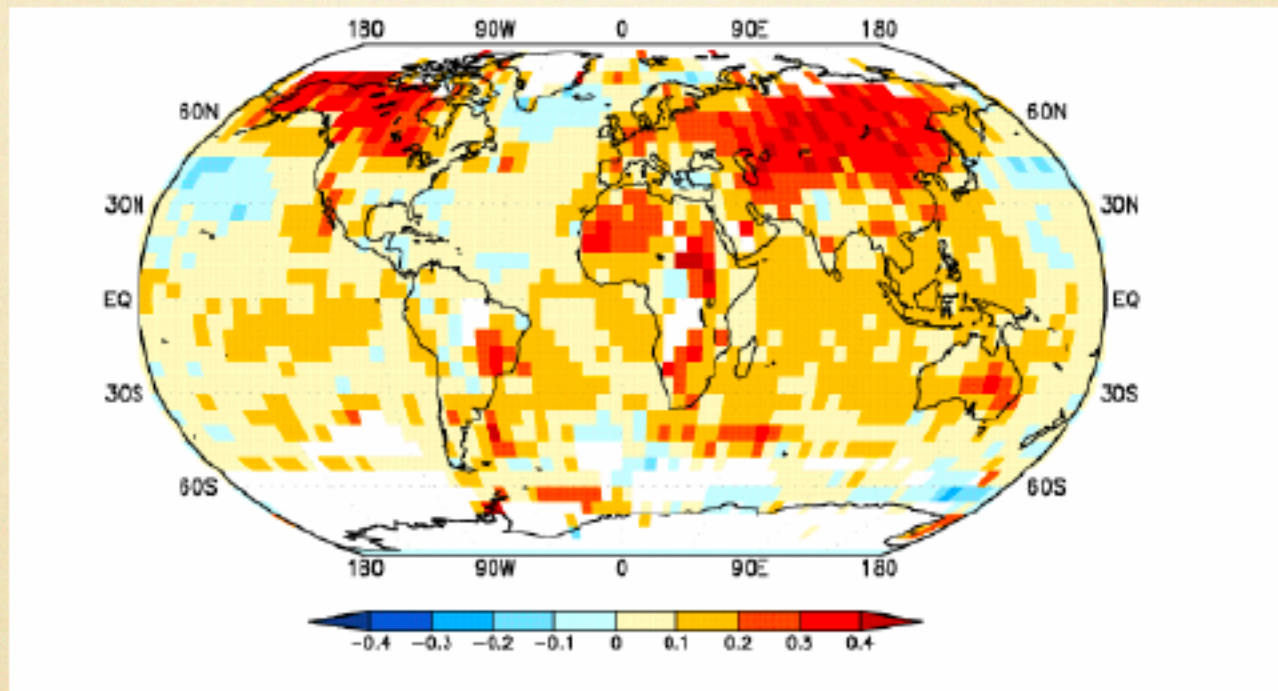
(with respect to a 1961-1990 base period)

National Climatic Data Center/NESDIS/NOAA



La Nina 2007-08

Back to the NRC Report



Temperature Trends – Last 50 years

Reprinted with permission NRC Surface Temperature Reconstruction for the Last 2000 Years ©2006 by the National Academy of Sciences Washington, D.C.

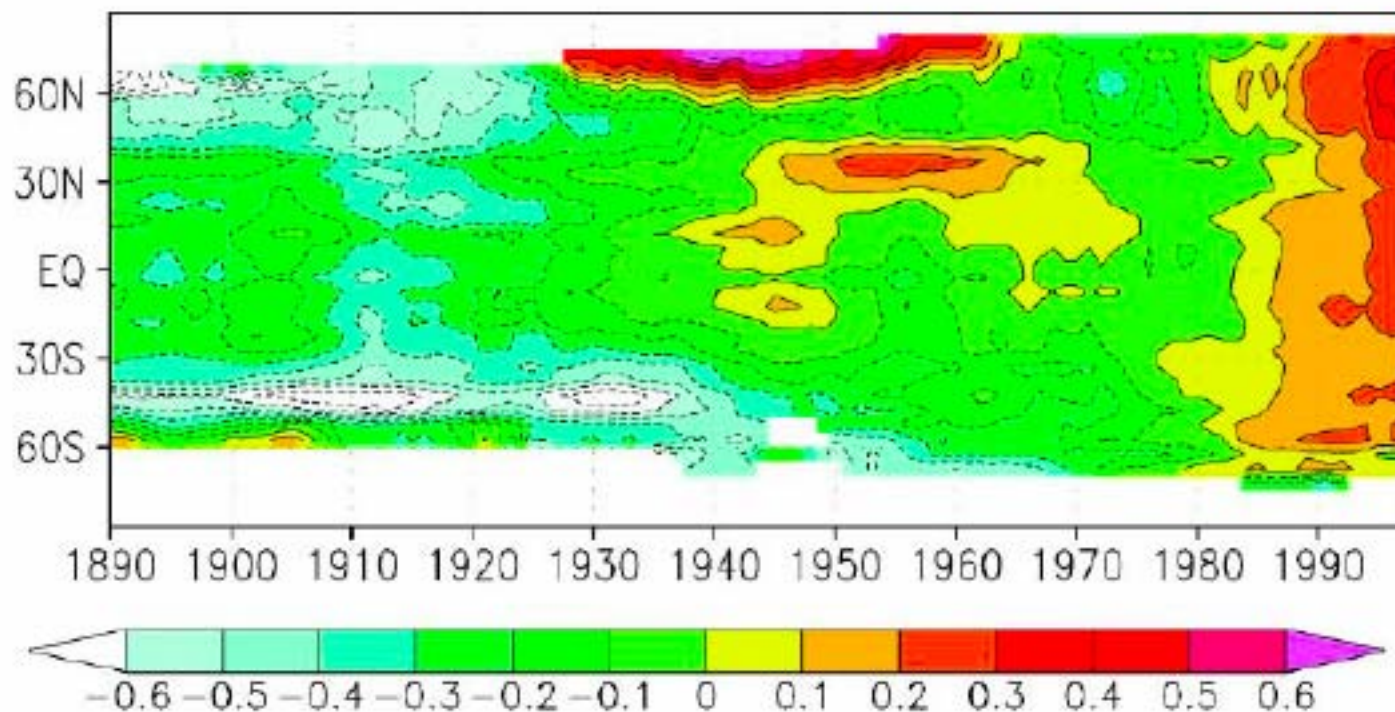
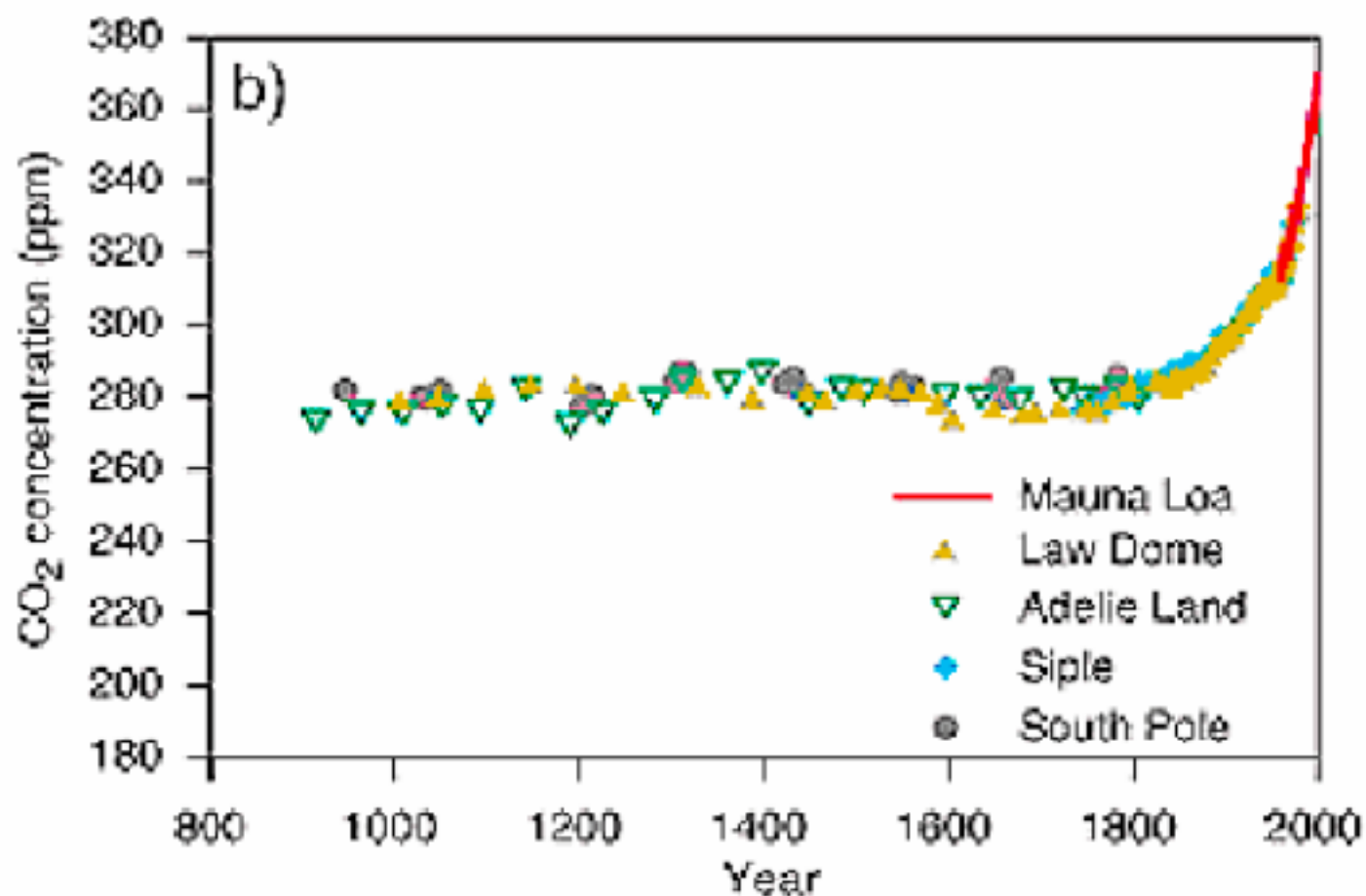


FIGURE 2-5 Smoothed, zonal mean anomalies of surface temperature (in K) for the observations in each latitude band from 1890-1999. Anomalies are relative to the 1961-1990 climatology. SOURCE: Delworth and Knutson (2000).

Carbon Dioxide Changes



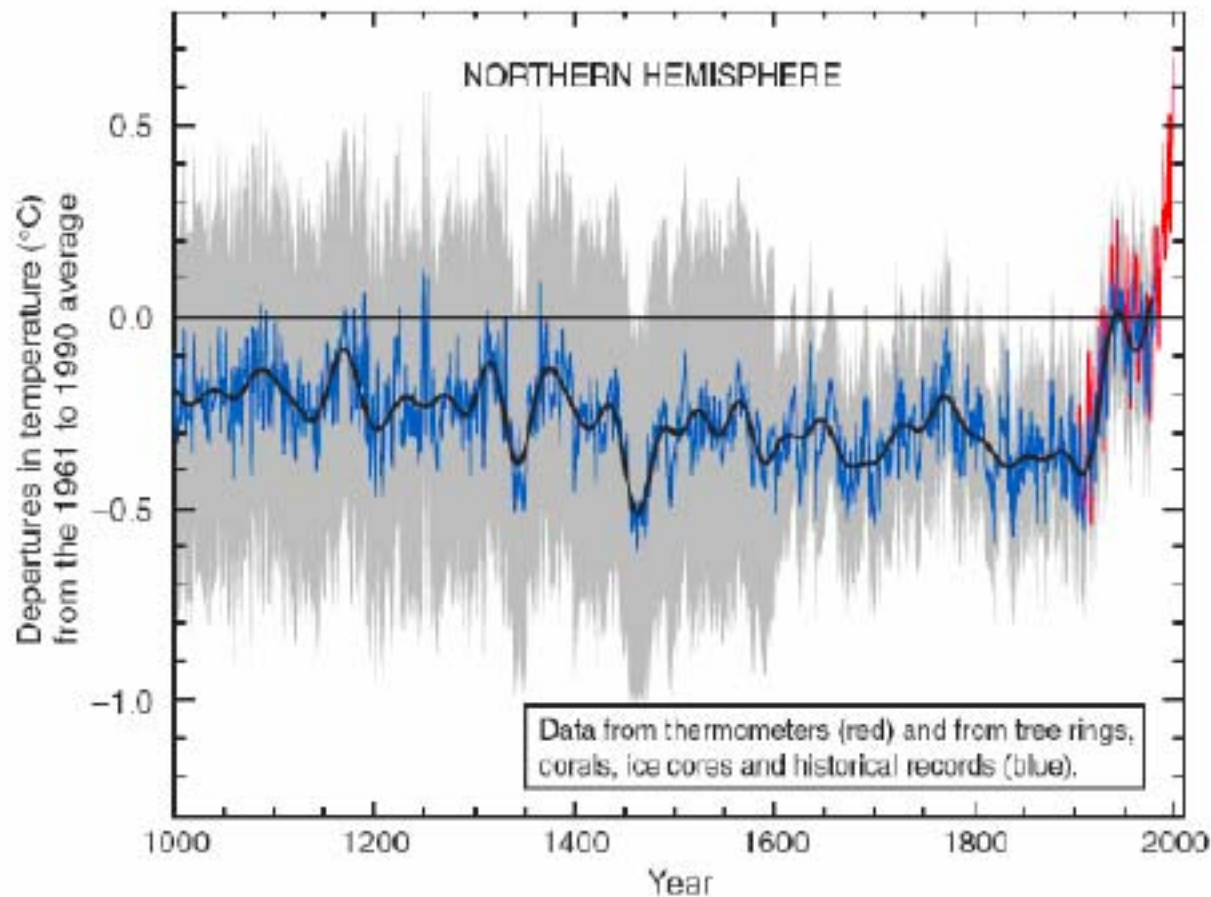


FIGURE O-4 Multiproxy reconstruction of Northern Hemisphere surface temperature variations over the past millennium (blue), along with 50-year average (black), a measure of the statistical uncertainty associated with the reconstruction (grey), and instrumental surface temperature data for the last 150 years (red), based on the work by Mann et al. (1999). This figure has sometimes been referred to as the "hockey stick." SOURCE: IPCC (2001).

Best Guess in 1990 (IPCC Report)

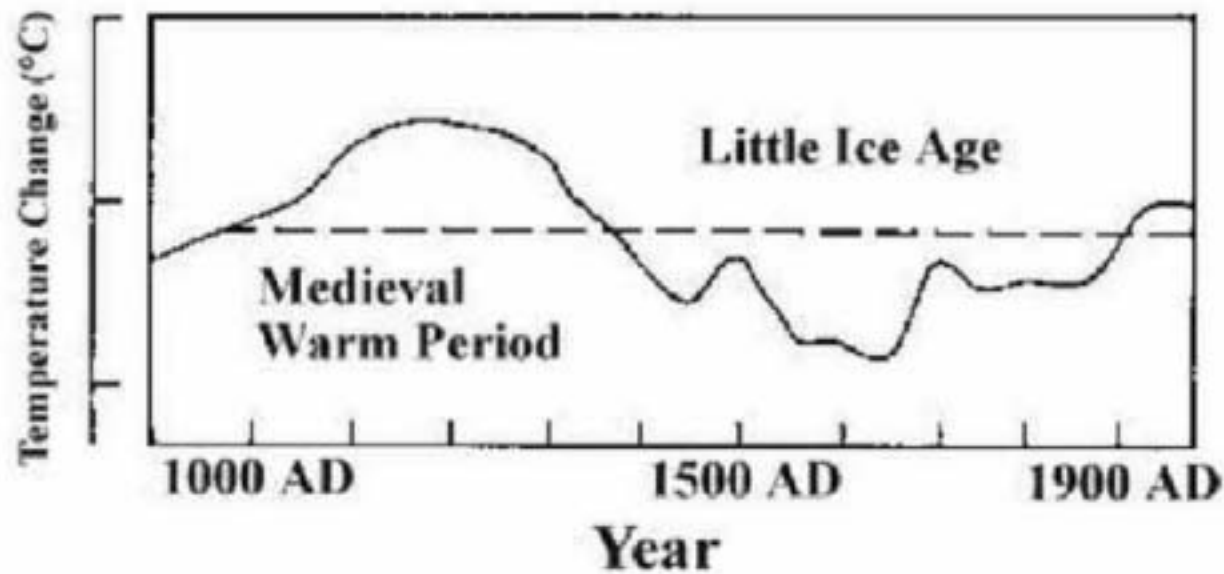


FIGURE O-3 Schematic description of global temperature variations in degrees Centigrade for the last 1 100 years published more than 15 years ago. SOURCE: IPCC (1990)

Lamb gives no
indication of
how got these
graphs

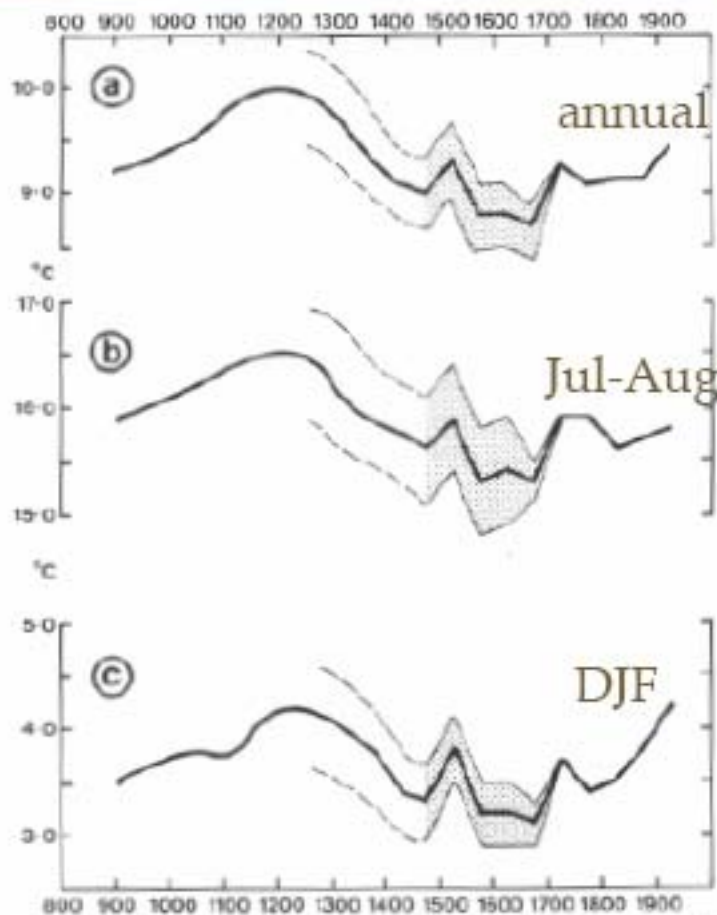
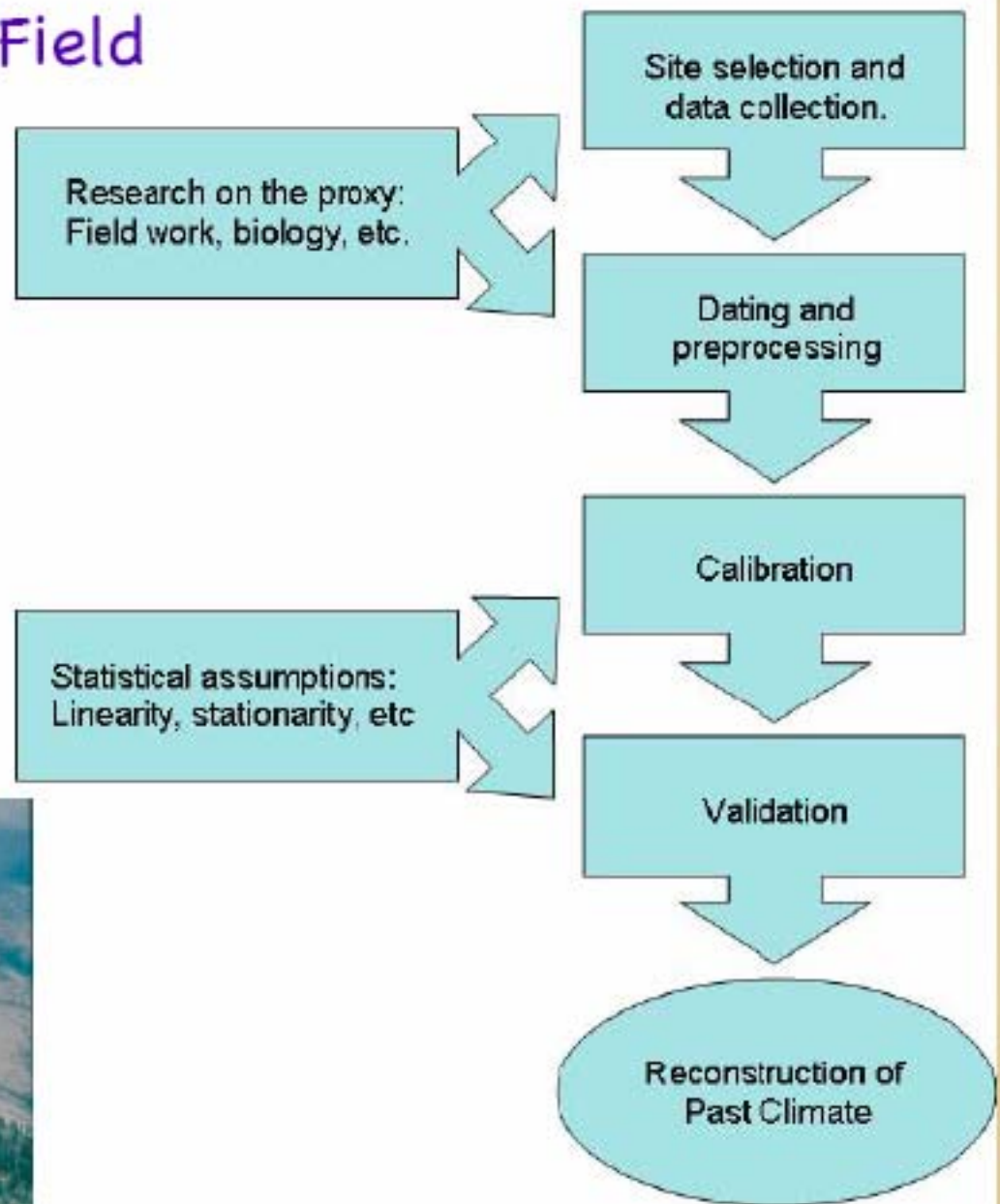


Fig. 30 Estimated course of the temperatures prevailing in central England since AD 800. Probable fifty-year averages: (a) for the whole year; (b) for the high summer months, July and August; (c) for the winter months, December, January and February. The shaded area indicates the range of apparent uncertainty of the derived values.

H. H. Lamb, *Climate History and the Modern World*, Methuen, 1982,
387p.

Reconstructing a Temp Field



Low Latitude Ice Core Record

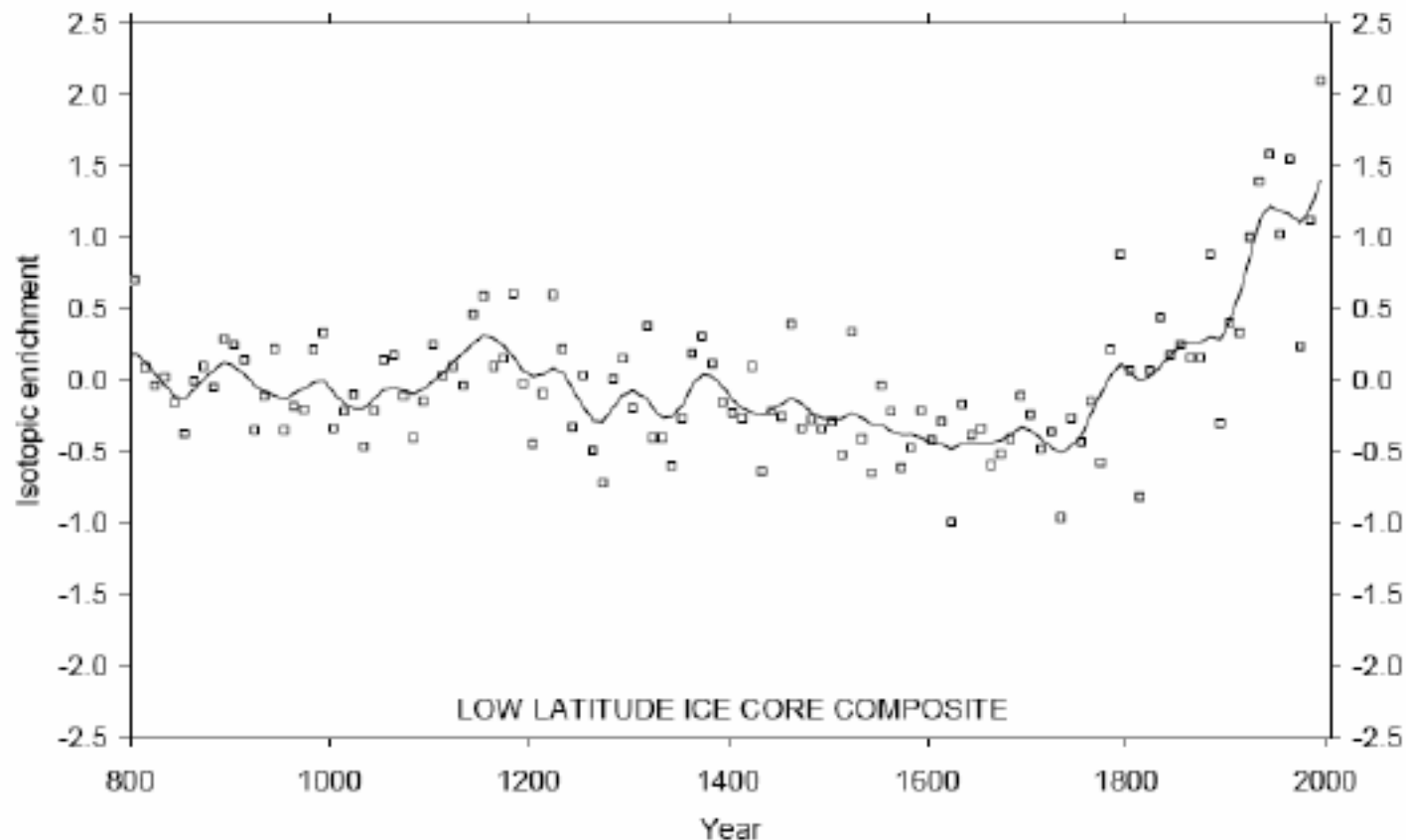
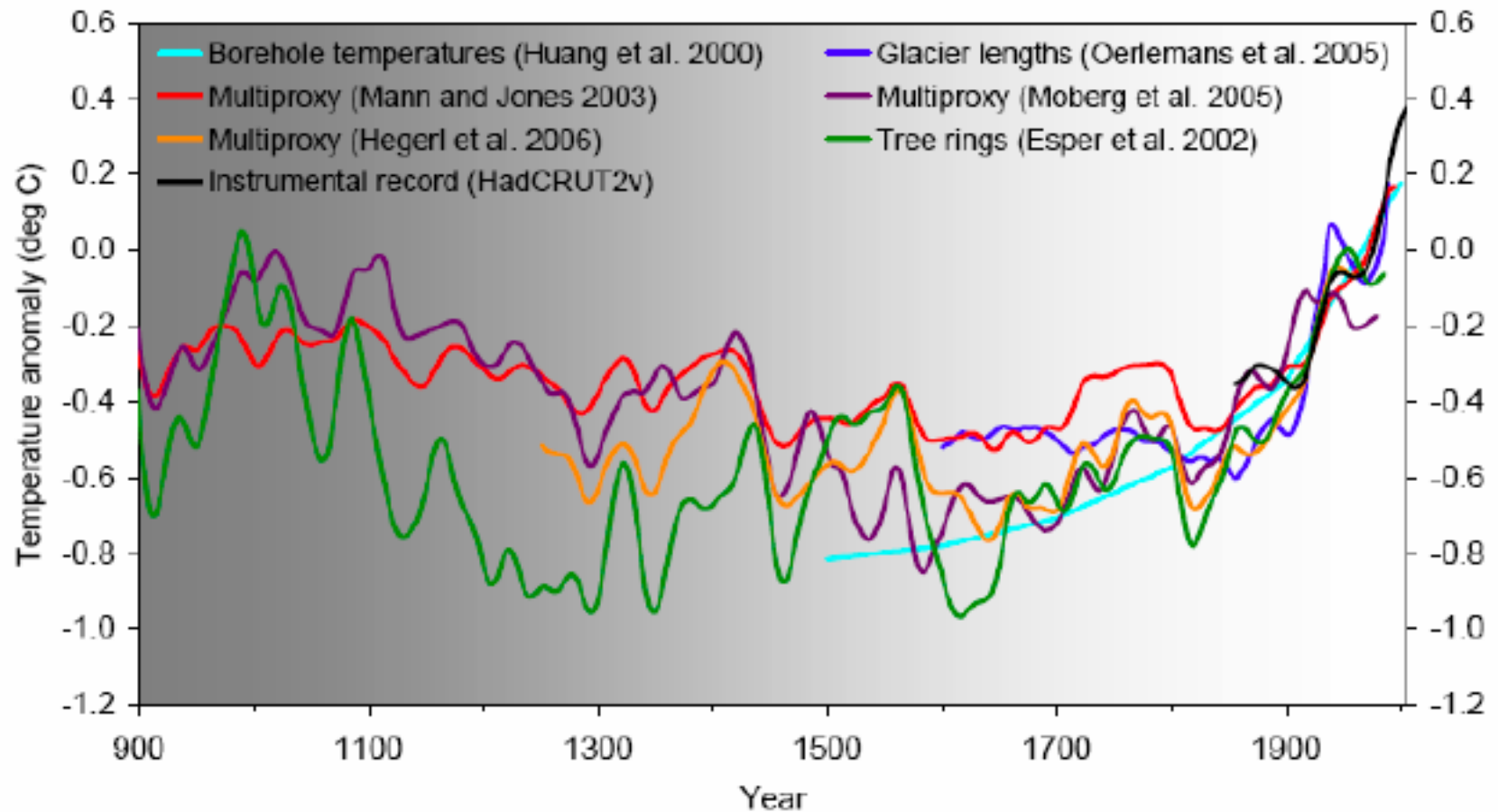
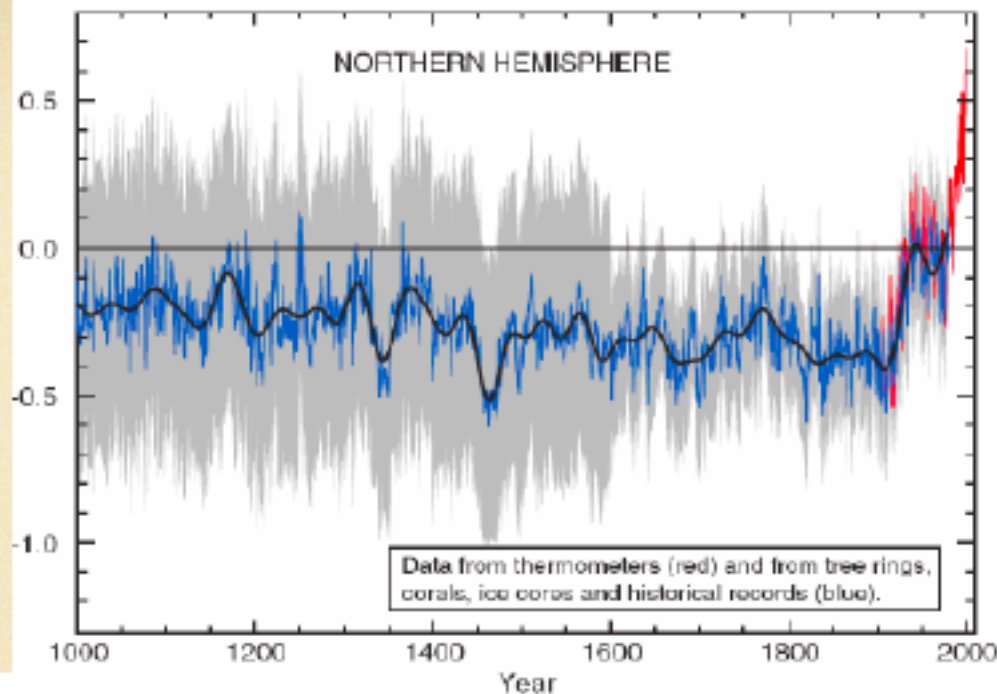


FIGURE 6-3 Composite isotopic record from low latitudes, including four ice cores from Tibet and three from the Andes. The isotope records have been normalized to mean and standard deviation and averaged. The solid line is a smoothed version of the composite record created using a 50 year triangular filter. SOURCE: Thompson et al. (in press).

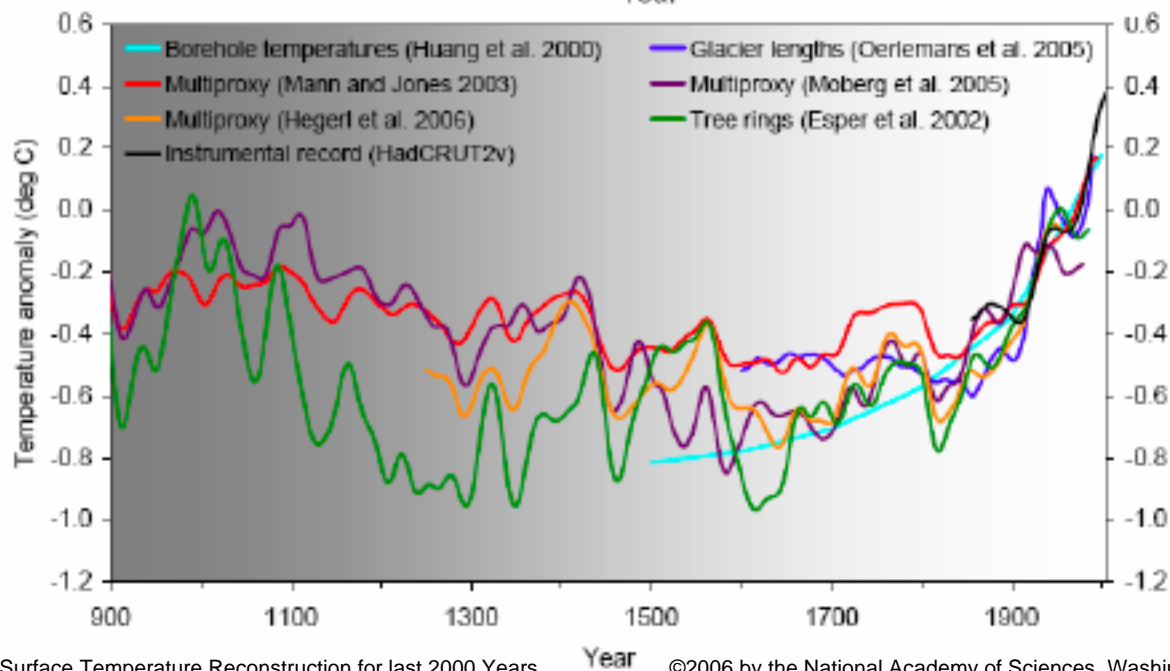
NRC Reconstruction, 2006

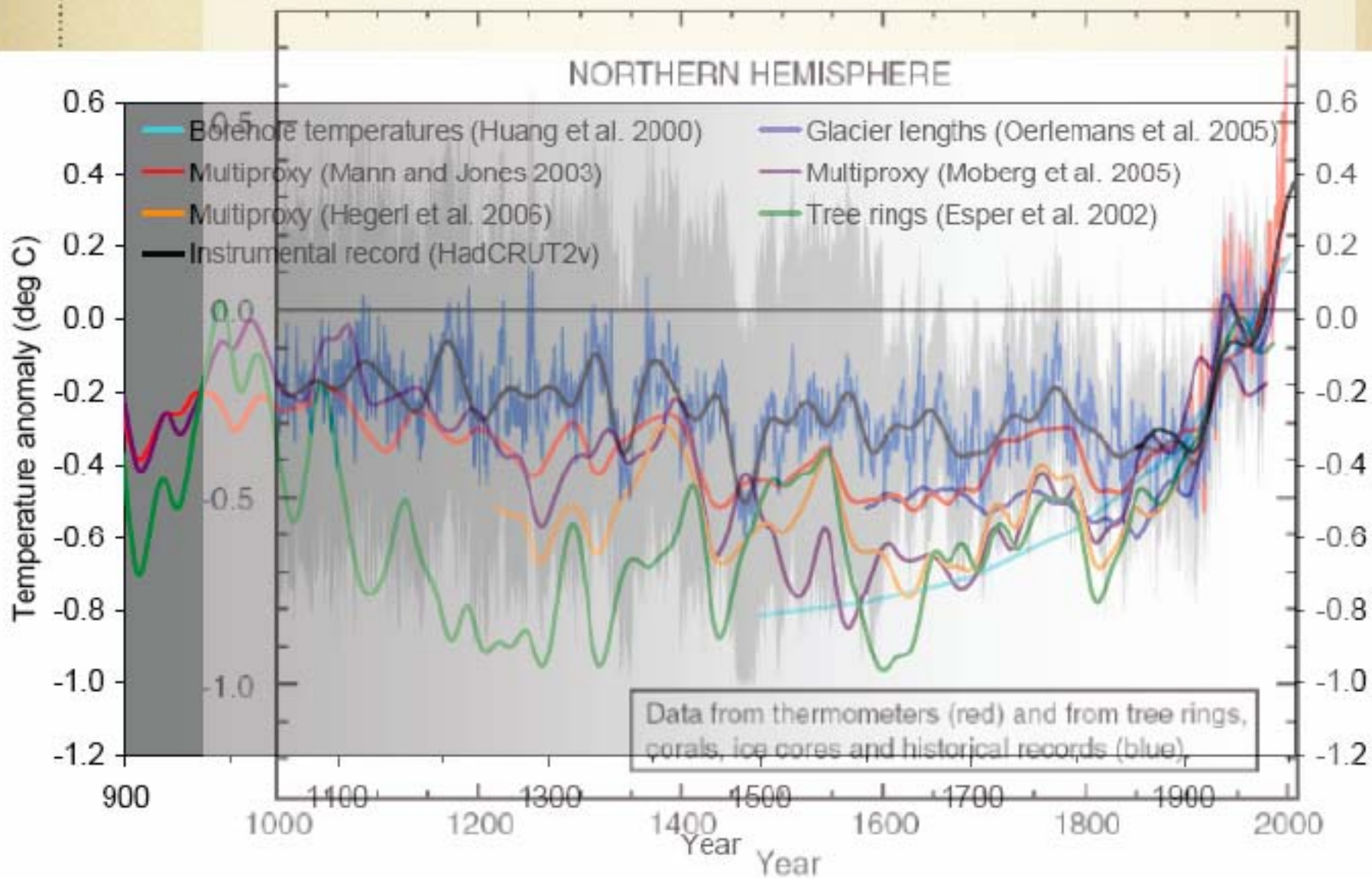


MBH

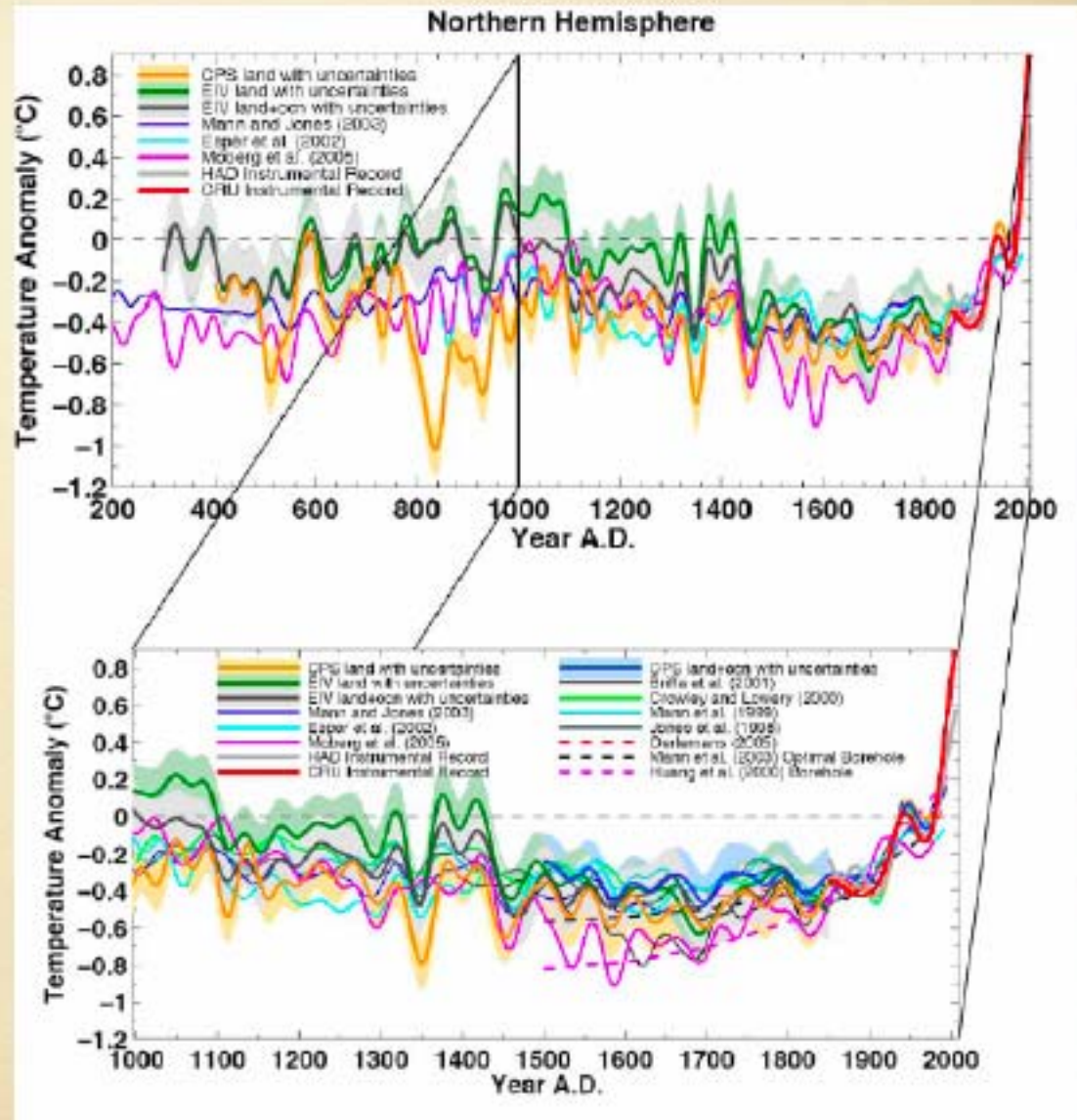


NRC



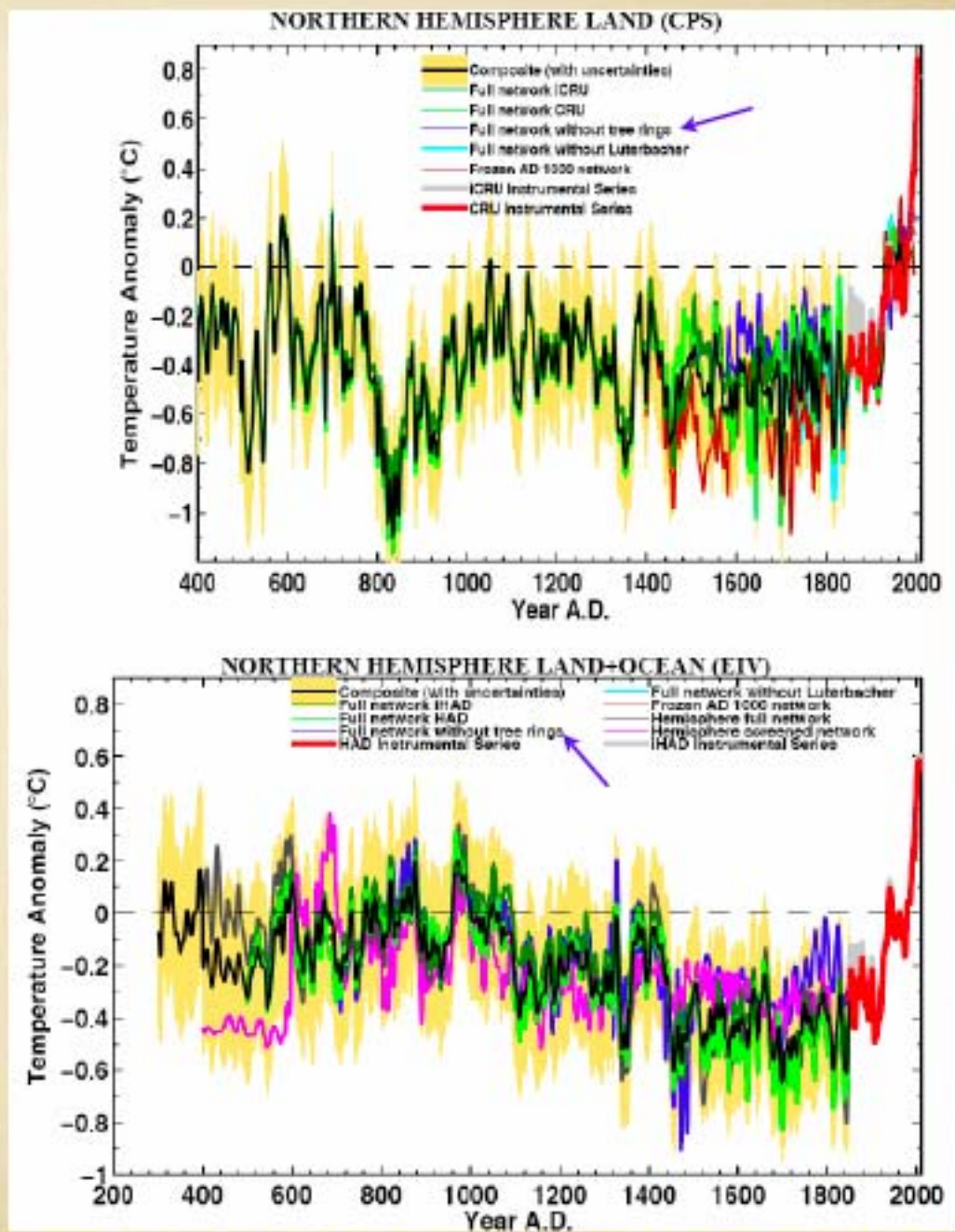


New Results:



Mann et al. manuscript 2008 (with permission)

Analysis with two different
statistical methods and
with/without tree rings



Mann et al. manuscript 2008 (with permission)

My Take on This. . .

- NRC, IPCC, Mann and Colleagues
 - Consistent with each other within reasonable uncertainty bounds
- These last are the warmest decades in at least 400 years and possibly 1000 years.
- Yes, humans are responsible for the dominant portion of the warming (IPCC, AGU, AMS,...)

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