

# The Hockey Stick Debate:

*Lessons in Disclosure and Due Diligence*

Stephen McIntyre

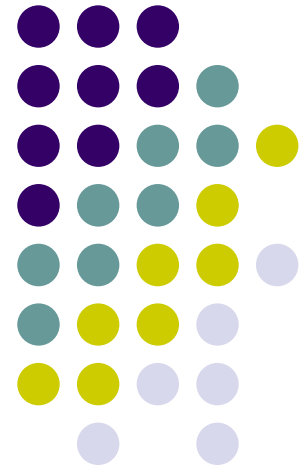
Toronto Ontario

Ross McKittrick

Associate Professor of Economics

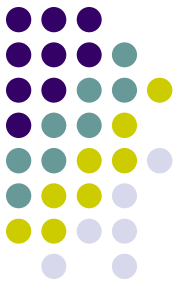
University of Guelph

Guelph Ontario, Canada

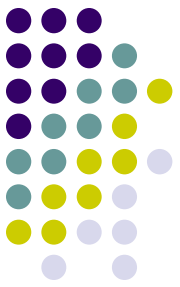


# The Hockey Stick Debate:

## *Lessons in Disclosure and Due Diligence*

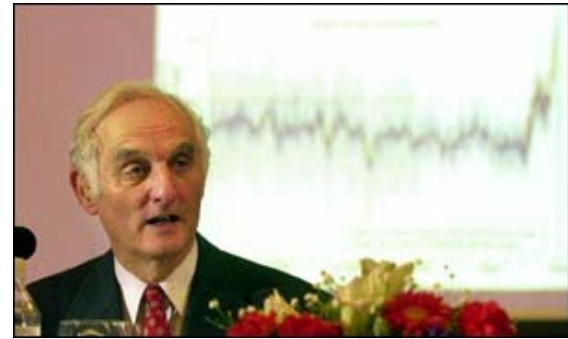


- Summary:
  - Explanation and Update of Hockey Stick Debate,
  - Widen coverage to include ‘Hockey Team’
  - Comments on need for higher standards of disclosure (by authors) and due diligence (by users) when science drives policy



# The IPCC & the Hockey Stick

- 2001: Third Assessment Report



- Concluded that humans are causing climate change of a magnitude exceeding that observed in the past 1000 years

# The importance of the hockey stick graph to the IPCC



Technical Summary of the Working Group I Report

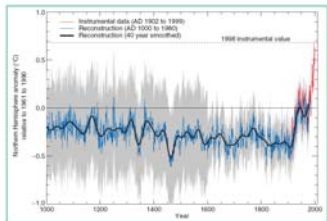


Figure 2. Millennial Northern Hemisphere 2000 temperature reconstruction. Data are from instrumental data, tree rings, ice cores, and historical records and modern instrumental data (and from AD 1000 to 1999, broader version of 100 years (black), and from standard tree-ring (grey shaded) are shown. (Based on Figure 2.10)

It is clear that large, rapid, abrupt temperature changes occurred along the last 1000 years in a region where instrument data are not available. This is the first time that such temperature variability is shown. Several conditions can be identified using long-term tree-ring, ice-core, corals, and other naturally occurring proxy data. Because tree-ring data are available, tree-ring data are used to reconstruct the temperature of the last 1000 years. Tree-ring data are available for the last 1000 years, but are missing in other regions. The tree-ring data are used to reconstruct the temperature of the last 1000 years, but are missing in other regions. The tree-ring data are used to reconstruct the temperature of the last 1000 years, but are missing in other regions.

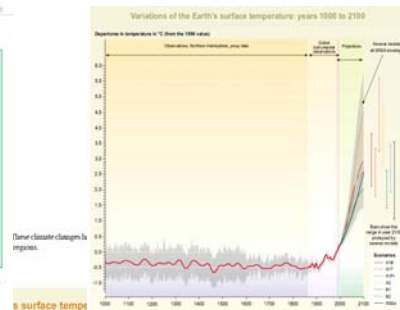


Figure 3. Variations of the Earth's surface temperature years 1000 to 2100. One by period 1000 to 1980, reconstruction of the surface temperature (reconstruction) is shown. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records.

Figure 2.3: The Earth's surface temperature has increased by about 0.6°C over the record of direct temperature measurements (1900-2000, top panel) - it is not unprecedented, at least based on proxy temperature data for the Northern Hemisphere, over the last millennium (bottom panel). In the top panel the global mean surface temperature is shown year-by-year (red bars with grey shading) and approximately decadal-by-decade (interannual and low). Analyses take into account data gaps, random instrumental errors and uncertainties, uncertainties in tree-ring data, and also in adjustments for urbanization over the land. The linear panel margin proxy data (year-by-year blue line with grey shading) are grey shaded. 50-year average (purple line) and the direct temperature measurements (red line) for the Northern Hemisphere. The proxy data consist of tree rings, corals, ice cores, and historical records that have been calibrated against thermometer data. Insufficient data are available to assess such changes in the Southern Hemisphere.

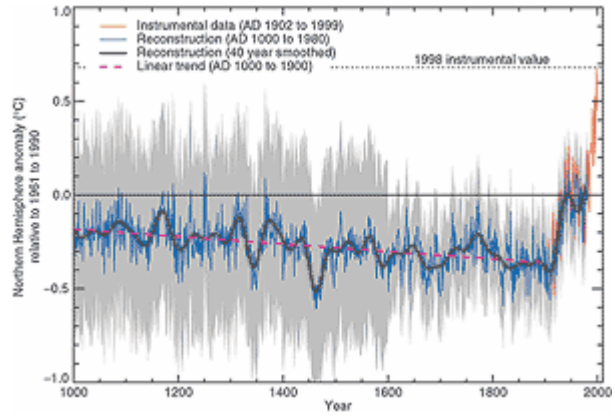


Figure 4. Northern Hemisphere anomaly (°C) relative to 1961 to 1990. One by period 1000 to 1980, reconstruction of the surface temperature (reconstruction) is shown. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records.

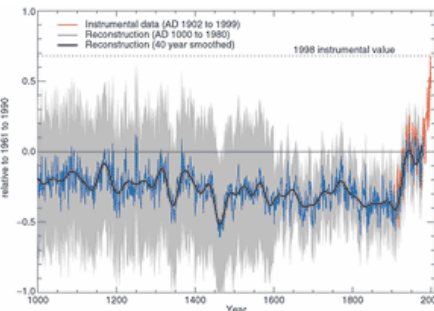


Figure 5. Northern Hemisphere anomaly (°C) relative to 1961 to 1990. One by period 1000 to 1980, reconstruction of the surface temperature (reconstruction) is shown. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records. The reconstruction is based on instrumental data, tree rings, ice cores, and historical records.

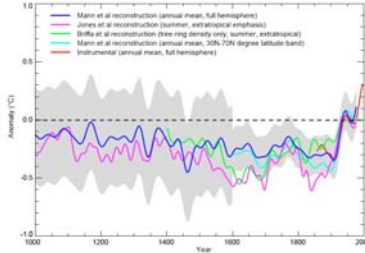
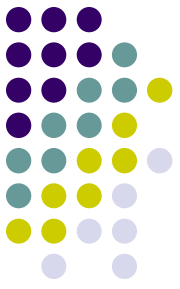


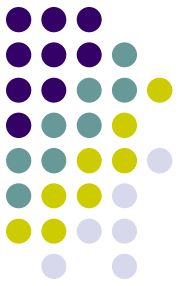
Figure 12.1. Comparison of warm-winter (Joachim et al., 1998) and annual mean (Mann et al., 1998, 1999) multi-proxy-based and warm-winter low-pass filtered (Joachim et al., 1998) annual Northern Hemisphere temperature reconstructions. The annual instrumental mean data (Northern Hemisphere temperature record) is shown for comparison. Also shown is an instrumental sampling of the Mann et al. (1998) warm-winter reconstruction near the 1961-1990 winter period mean temperature. All the series were smoothed with a 30 year running-mean (grey line, with boundary) - contours are shown by plotting the series with its series values along the first and last 25 years.

# The importance of the hockey stick graph to the IPCC



- Used in IPCC Report (2001):
  - Summary for Policymakers
  - Technical Summary
  - Chapter 2, Assessment Report Figs 2.20 and 2.21
  - Synthesis Report (twice)
- Basis for claim that “temperatures in the latter half of the 20th century were unprecedented”

# The importance of the hockey stick graph to the IPCC



## Technical Summary of the Working Group I Report

good agreement, as shown in Figure 4a, with a warming of about 0.1°C per decade. However, since the beginning of the satellite record in 1979, the temperature data from both satellites and weather balloons show a warming in the global middle-to-lower troposphere at a rate of approximately  $0.05 \pm 0.10^\circ\text{C}$  per decade. The global average surface temperature has increased significantly by  $0.15 \pm 0.05^\circ\text{C}$ /decade. The difference in the warming rates is statistically significant. By contrast, during the period 1958 to 1978, surface temperature trends were near zero, while trends for the lowest 8 km of the atmosphere were near  $0.2^\circ\text{C}$ /decade. About half of the observed difference in warming since 1979 is likely<sup>4</sup> to be due to the combination of the differences in spatial coverage of the surface and tropospheric observations and the physical effects of the sequence of volcanic eruptions and a substantial El Niño (see Box 4 for a general description of ENSO) that occurred within this period. The remaining difference is very likely real and not an observing bias. It arises primarily due to differences in the rate of temperature change over the tropical and sub-tropical regions, which were faster in the lowest 8 km of the atmosphere before about 1979, but which have been slower since then. There are no significant differences in warming rates over mid-latitude continental regions in the Northern Hemisphere. In the upper troposphere, no significant global temperature trends have been detected since the early 1960s. In the stratosphere, as shown in Figure 4b, both satellites and balloons show substantial cooling, punctuated by sharp warming episodes of one to two years long that are due to volcanic eruptions.

### Surface temperatures during the pre-instrumental period from the proxy record

It is likely that the rate and duration of the warming of the 20th century is larger than any other time during the last 1,000 years. The 1990s are likely to have been the warmest decade of the millennium in the Northern Hemisphere, and 1998 is likely to have been the warmest year. There has been a considerable advance in understanding of temperature change that occurred over the last millennium, especially from the synthesis of individual temperature reconstructions. This new detailed temperature record for the Northern Hemisphere is shown in

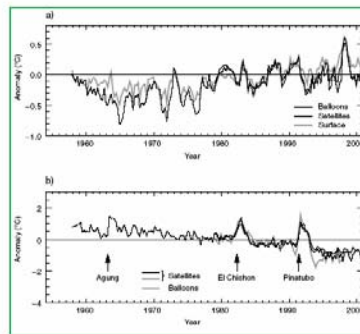


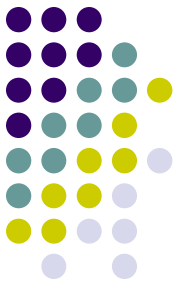
Figure 4: (a) Time-series of seasonal temperature anomalies of the troposphere based on balloon and satellites in addition to the surface. (b) Time-series of seasonal temperature anomalies of the lower stratosphere from balloons and satellites. [Based on Figure 2.12]

Figure 5. The data show a relatively warm period associated with the 11th to 14th centuries and a relatively cool period associated with the 15th to 19th centuries in the Northern Hemisphere. However, evidence does not support these "Medieval Warm Period" and "Little Ice Age" periods, respectively, as being globally synchronous. As Figure 5 indicates, the rate and duration of warming of the Northern Hemisphere in the 20th century appears to have been unprecedented during the millennium, and it cannot simply be considered as a recovery from the "Little Ice Age" of the 15th to 19th centuries. These analyses are complemented by sensitivity analysis of the spatial representativeness of available palaeoclimatic data, indicating that the warmth of the recent decade is outside the 95% confidence interval of temperature uncertainty, even during the warmest periods of the last millennium. Moreover, several different analyses have now been completed, each suggesting

<sup>4</sup> In this Technical Summary and in the Summary for Policymakers, the following words have been used to indicate approximate judgmental estimates of confidence: *virtually certain* (greater than 99% chance that a report is true); *very likely* (90–99% chance); *likely* (65–80% chance); *medium likelihood* (33–66% chance); *unlikely* (10–33% chance); *very unlikely* (1–10% chance); *exceptionally unlikely* (less than 1% chance). The reader is referred to individual chapters for more details.



# The importance of the hockey stick graph to the IPCC



## Technical Summary of the Working Group I Report

good agreement, as shown in Figure 4a, with a warming of about  $0.1^{\circ}\text{C}$  per decade. However, since the beginning of the satellite record in 1979, the temperature data from both satellites and weather balloons show a warming in the global middle-to-lower troposphere at a rate of approximately  $0.05 \pm 0.10^{\circ}\text{C}$  per decade. The global average surface temperature has increased significantly by  $0.15 \pm 0.05^{\circ}\text{C}$ /decade. The difference in the warming rates is statistically significant. By contrast, during the period 1958 to 1978, surface temperature trends were near zero, while trends for the lowest 8 km of the atmosphere were near  $0.2^{\circ}\text{C}$ /decade. About half of the observed difference in warming since 1979 is likely<sup>4</sup> to be due to the combination of the differences in spatial coverage of the surface and tropospheric observations and the physical effects of the sequence of volcanic eruptions and a substantial El Niño (see Box 4 for a general description of ENSO) that occurred within this period. The remaining difference is very likely real and not an observing bias. It arises primarily due to differences in the rate of temperature change over the tropical and sub-tropical regions, which were faster in the lowest 8 km of the atmosphere before about 1979, but which have been slower since then. There are no significant differences in warming rates over mid-latitude continental regions in the Northern Hemisphere. In the upper troposphere, no significant global temperature trends have been detected since the early 1960s. In the stratosphere, as shown in Figure 4b, both satellites and balloons show substantial cooling, punctuated by sharp warming episodes of one to two years long that are due to volcanic eruptions.

### Surface temperatures during the pre-instrumental period from the proxy record

It is likely that the rate and duration of the warming of the 20th century is larger than any other time during the last 1,000 years. The 1990s are likely to have been the warmest decade of the millennium in the Northern Hemisphere, and 1998 is likely to have been the warmest year. There has been a considerable advance in understanding of temperature change that occurred over the last millennium, especially from the synthesis of individual temperature reconstructions. This new detailed temperature record for the Northern Hemisphere is shown in

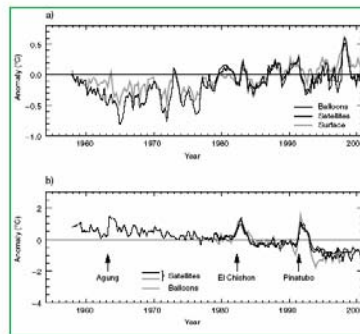


Figure 4: (a) Time-series of seasonal temperature anomalies of the troposphere based on balloons and satellites in addition to the surface. (b) Time-series of seasonal temperature anomalies of the lower stratosphere from balloons and satellites. [Based on Figure 2.12]

Figure 5. The data show a relatively warm period associated with the 11th to 14th centuries and a relatively cool period associated with the 15th to 19th centuries in the Northern Hemisphere. However, evidence does not support these “Medieval Warm Period” and “Little Ice Age” periods, respectively, as being globally synchronous. As Figure 5 indicates, the rate and duration of warming of the Northern Hemisphere in the 20th century appears to have been unprecedented during the millennium, and it cannot simply be considered as a recovery from the “Little Ice Age” of the 15th to 19th centuries. These analyses are complemented by sensitivity analysis of the spatial representativeness of available palaeoclimatic data, indicating that the warmth of the recent decade is outside the 95% confidence interval of temperature uncertainty, even during the warmest periods of the last millennium. Moreover, several different analyses have now been completed, each suggesting

<sup>4</sup> In this Technical Summary and in the Summary for Policymakers, the following words have been used to indicate approximate judgmental estimates of confidence: *virtually certain* (greater than 99% chance that a report is true); *very likely* (90–99% chance); *likely* (65–90% chance); *medium likelihood* (33–66% chance); *unlikely* (10–33% chance); *very unlikely* (1–10% chance); *exceptionally unlikely* (less than 1% chance). The reader is referred to individual chapters for more details.

## Technical Summary of the Working Group I Report

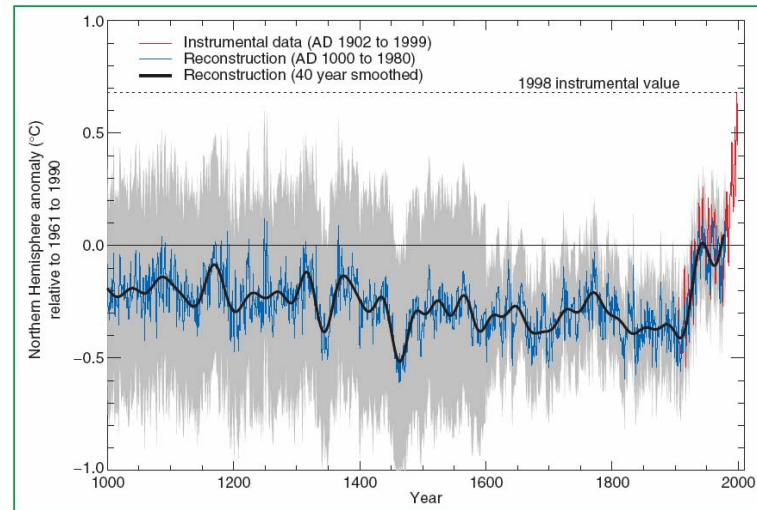


Figure 5: Millennial Northern Hemisphere (NH) temperature reconstruction (blue – tree rings, corals, ice cores, and historical records) and instrumental data (red) from AD 1000 to 1999. Smoother version of NH series (black), and two standard error limits (gray shaded) are shown. [Based on Figure 2.20]

that the Northern Hemisphere temperatures of the past decade have been warmer than any other time in the past six to ten centuries. This is the time-span over which temperatures with annual resolution can be calculated using hemispheric-wide tree-ring, ice-cores, corals, and other annually-resolved proxy data. Because less data are available, less is known about annual averages prior to 1,000 years before the present and for conditions prevailing in most of the Southern Hemisphere prior to 1861.

It is likely that large rapid decadal temperature changes occurred during the last glacial and its deglaciation (between about 100,000 and 10,000 years ago), particularly in high latitudes of the Northern Hemisphere. In a few places during the deglaciation, local increases in temperature of 5 to  $10^{\circ}\text{C}$  are likely to have occurred over periods as short as a few decades. During the last 10,000 years, there is emerging evidence of significant rapid regional temperature changes, which are part of the natural variability of climate.

# The importance of the hockey stick graph to the IPCC



“This gives a fairly clear signal that this isn't just a future issue, it's happening now,” Mr. Hengeveld said. ***Among the strongest evidence is the fact that the past century has likely been the warmest in the Northern Hemisphere in the past millennium, he said. Not only that, the 1990s ranked as the warmest decade of the millennium, and 1998 was the warmest year of the millennium*** in the Northern Hemisphere, which is where most of their data have been acquired.

Henry Hengeveld,  
Canada's Chief Climate Science Advisor,  
*Globe and Mail* January 22, 2001 (emph. added)



# Background: The MWP Problem

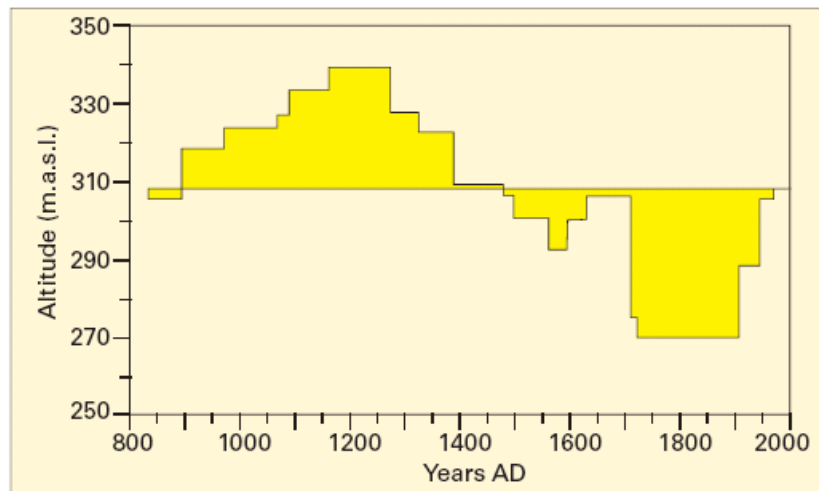
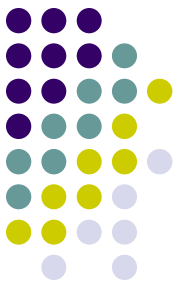
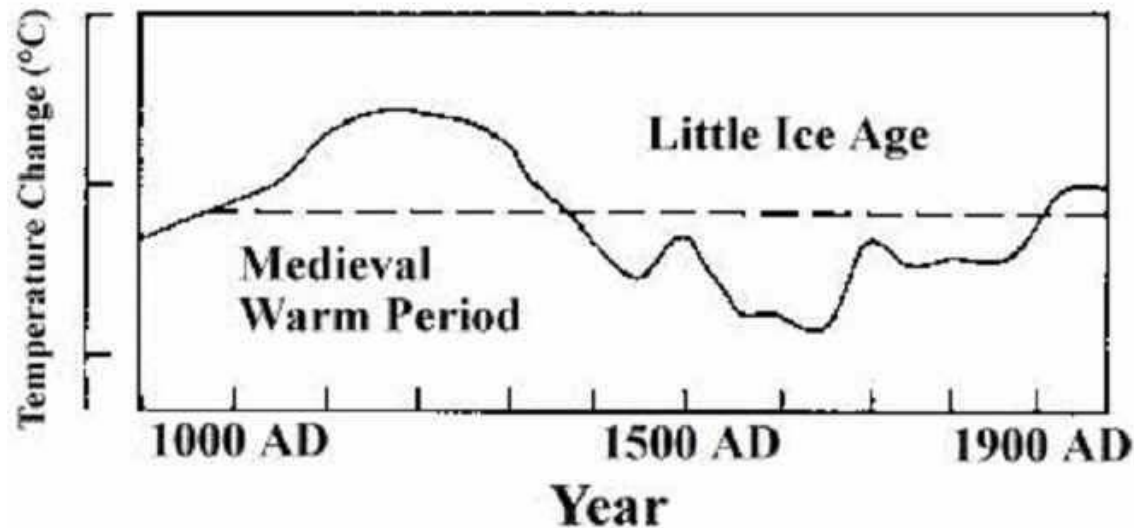


Fig. 1. Altitudinal displacement of the upper treeline in the Polar Ural Mountains during the last 1150 years.



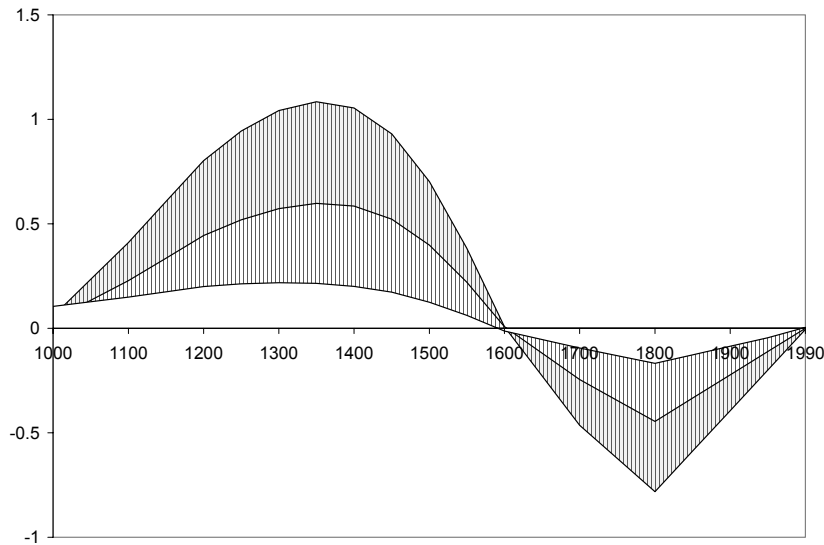
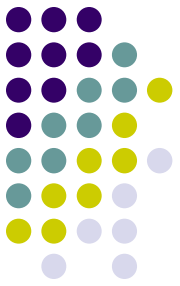
Left: treeline, Polar Urals; right – medieval stump,  
California above present treeline

# Background: The MWP Problem



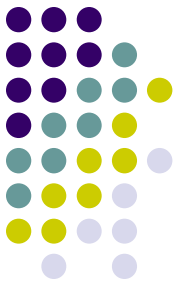
- IPCC 1995

# Background: The MWP Problem



- Boreholes: Huang et al. 1997 (*GRL*)

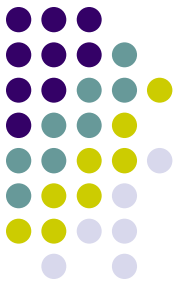
# Background: The MWP Problem



- D. Deming, *Science* 1995

*“With the publication of the article in *Science* [in 1995], I gained significant credibility in the community of scientists working on climate change. They thought I was one of them, someone who would pervert science in the service of social and political causes. So one of them let his guard down. A major person working in the area of climate change and global warming sent me an astonishing email that said **“We have to get rid of the Medieval Warm Period.”**”*

# 1998-1999: Problem Solved!

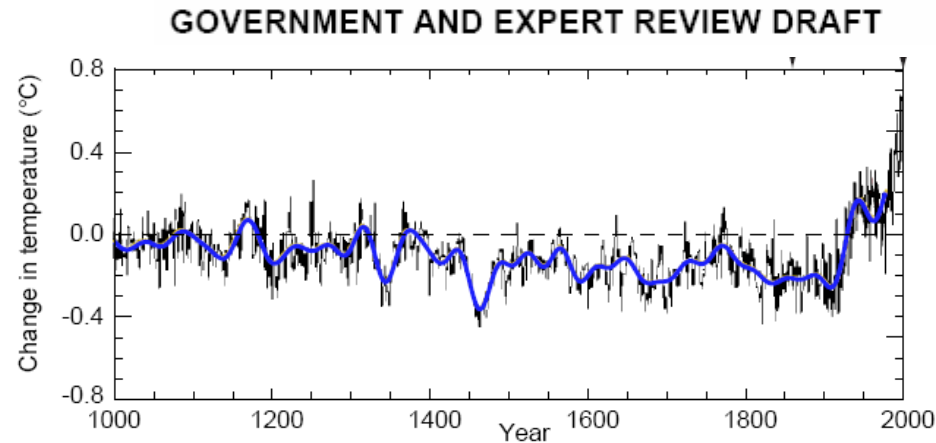


**March. 4, 1999.** Researchers at the Universities of Massachusetts and Arizona who study global warming have released a report strongly suggesting that **the 1990s were the warmest decade of the millennium, with 1998 the warmest year so far...** The latest reconstruction supports earlier theories that temperatures in **medieval times** were relatively warm, but "even the warmer intervals in the reconstruction pale in comparison with mid-to-late 20th-century temperatures," said Hughes.

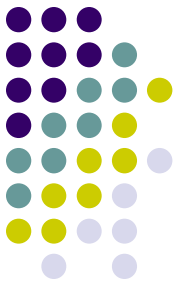
# MBH98: The Instant Consensus



- April 1998: *Nature*
- March 1999: *GRL*
- April 2000: IPCC draft



**Figure 1:** Global mean surface temperatures vary year by year and decade by decade. However, the warming during 20<sup>th</sup> Century has been atypical compared to the rest of the past 1,000 years. The rate and duration of the warming is likely to have been the largest of the period. The 1990s is likely to have been the warmest decade in the millennium in the Northern Hemisphere, and 1998 is likely to have been the warmest year.



# MBH98 Data Structure

- 112 proxy series
- Of these:
  - 71 are individual site records
  - 31 are weighted averages of larger underlying groups
- The weighted averages are called “Principal Components”





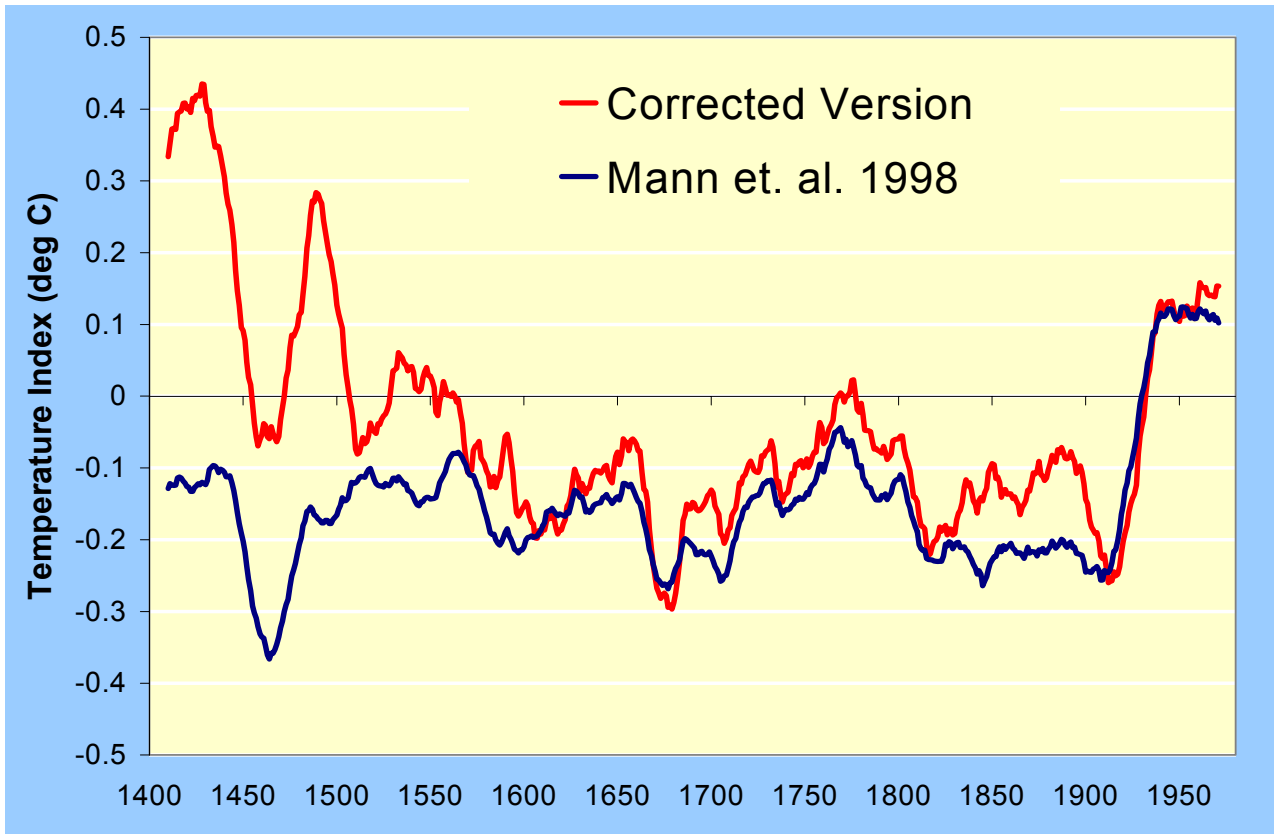
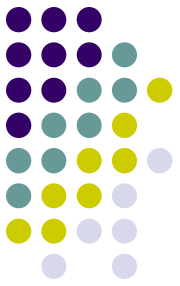
## 1st Period: MM03 (Energy & Env. Nov. 03)



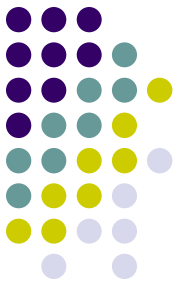
- We found problems:
  - 35 series listed as being used were not used
  - Truncation of sources
  - Obsolete data
  - Duplication of series
  - Series in incorrect geographic locations
  - Problems in the PC calculations



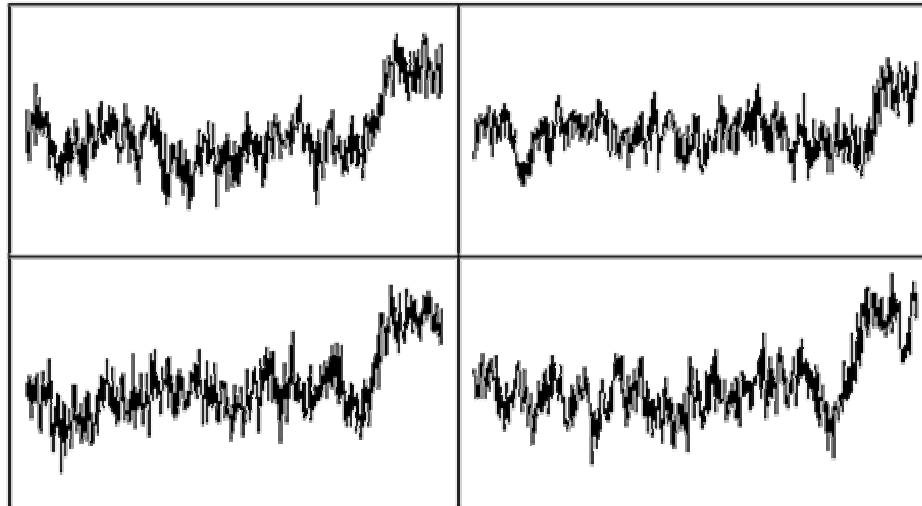
# 1st Period: MM03 (Energy & Env. Nov. 03)



# 2<sup>nd</sup> Period: M&M05a,b



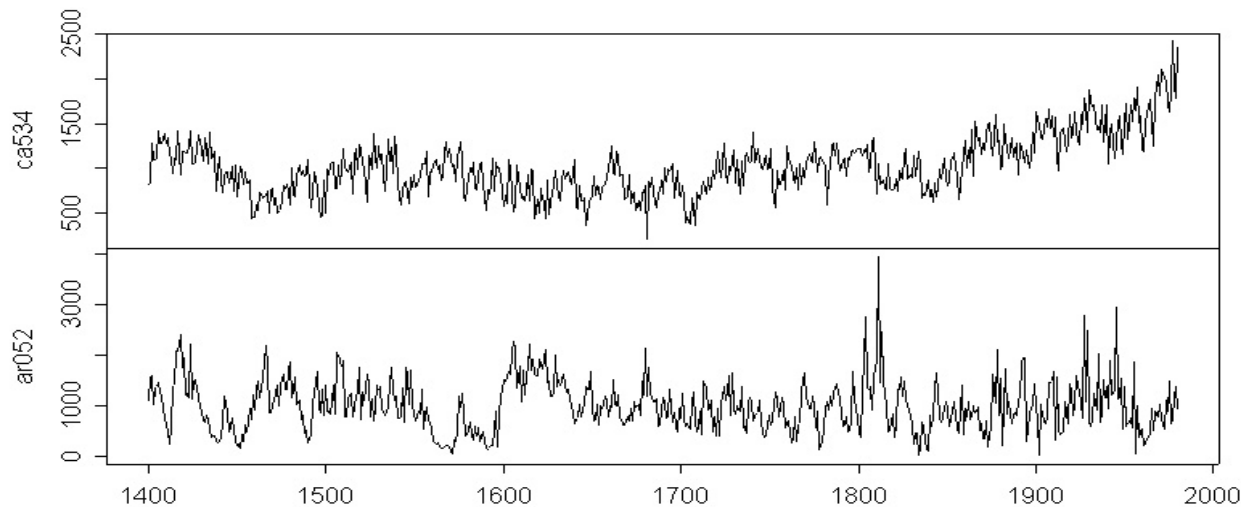
- PC algorithm unravelled
- “Detects” hockey sticks as dominant pattern (PC#1) even in red noise



# 2<sup>nd</sup> Period: M&M05a,b

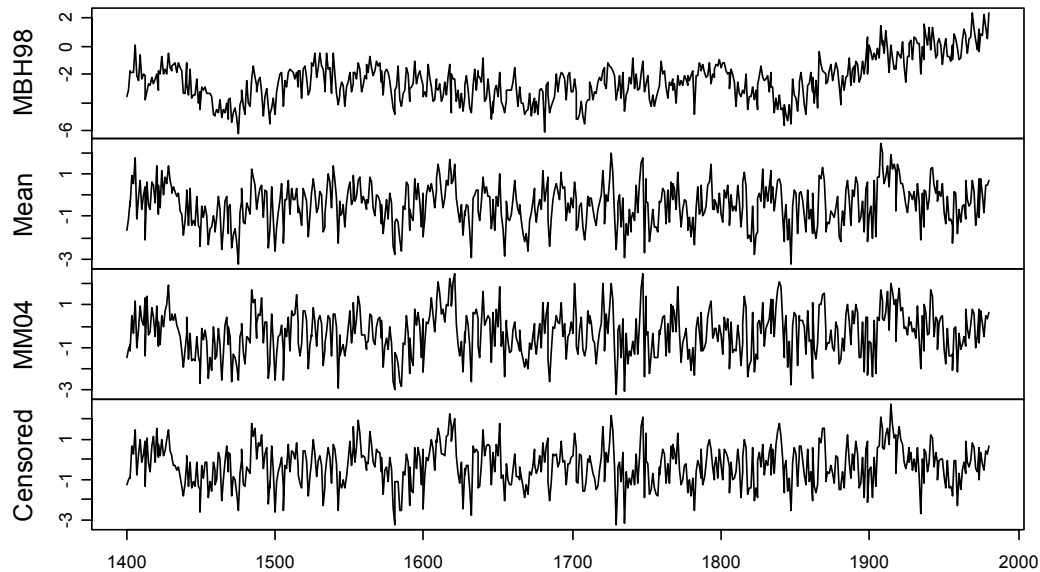


- PC method favours series with 20<sup>th</sup> century growth spurt



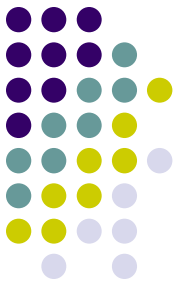
- All top-weighted series are bristlecone pines
- explicitly identified in specialist literature not to be temperature proxies
- Dominant pattern in hockey stick is non-climatic

# 2<sup>nd</sup> Period: M&M05a,b



- **Top panel:** PC1 of the post-1400 NOAMER tree ring network, calculated by MBH98 using short-segment standardization. **Second panel:** simple mean of proxies. **Third panel:** PC1 using standard software without short-segment standardization. **Bottom panel:** Unreported PC1 calculated by MBH after censoring Graybill-Idso high-altitude series. All normalized to 1902-1980.

# 2<sup>nd</sup> Period: M&M05a,b



- Gaspé cedar series used twice
- In one case, missing early years extrapolated
- Start date misrepresented
- Removal of extrapolation has large effect on controversial 15<sup>th</sup> century

# 2<sup>nd</sup> Period: M&M05a,b



- Loss of significance:
  - Validity of historical temperature reconstruction based on “skill” statistics (RE)
  - When PC flaw included in calculations, the claimed “skill” in the RE statistic vanished
  - Related statistics (including R2) that revealed lack of significance not reported in MBH98





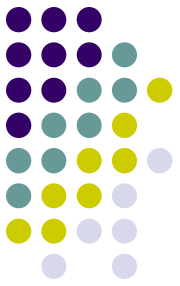
# Intermission: Reactions



- Mann's statistical method “preferentially produces hockey sticks when there are none in the data.”
  - Prof. Francis Zwiers, Canadian Climate Centre
- Our criticism on this point is “entirely valid.”
  - Prof. Hans von Storch, GKSS Research Centre
- “Tree rings with a hockey stick shape dominate the PCA with this method.”
  - Prof. Mia Hubert, Catholic University of Leuven



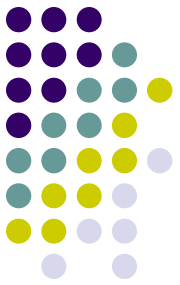
# Intermission: Reactions



- The findings “hit me like a bombshell, and I suspect it is having the same effect on many others.”
  - Professor Richard Muller, University of California at Berkeley
- “It is strange that the climate reconstruction of Mann passed both peer review rounds of the IPCC without anyone ever really having checked it.”
  - Dr. Rob van Dorland, an IPCC Lead Author and climate scientist at the Dutch National Meteorological Agency



# Intermission: Reactions



- He [Climatologist Ulrich Cubasch] discussed with his coworkers - and many of his professional colleagues - the objections, and sought to work them through...Bit by bit, it became clear also to his colleagues: **the two Canadians were right.** ...With that, the core conclusion, and that also of the IPCC 2001 Report, was completely undermined.
  - Das Erste, Feb 16, 2005
- The IPCC review process is fatally flawed... The scientific basis for the Kyoto protocol is grossly inadequate.
  - Dr Hendrik Tenekes, Retired Director, Royal Meteorological Inst., Netherlands, Feb 22, 2005



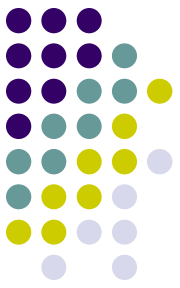
# 3rd Period: Responses by Mann



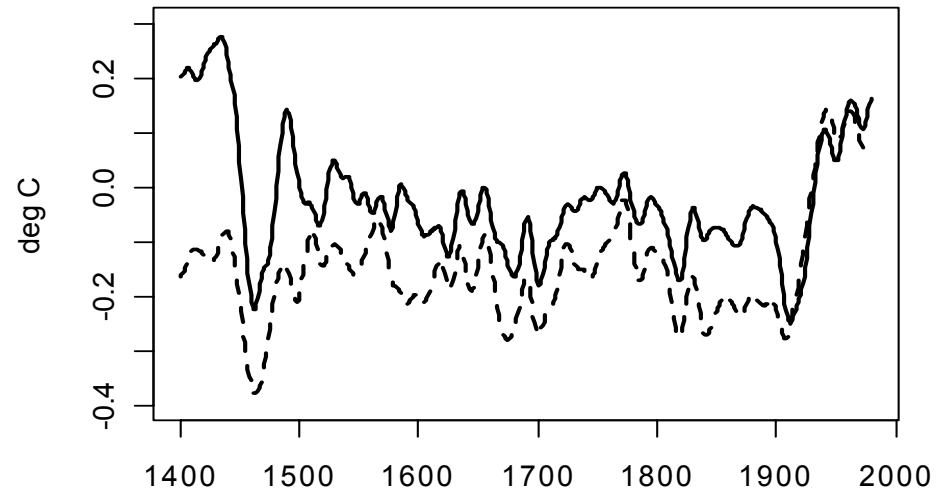
- The hockey stick can be partly recovered by:
  - (A) Using 5 PCs in North America rather than 2
  - (B) Skipping the PC steps and using proxies directly
- The hockey stick is backed up by 10 other independent studies



# 3rd Period: A: Using 5 PCs

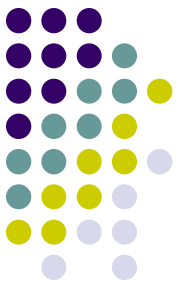


- Irrelevant. Even with 5 PCs:
  - If no bristlecones, no hockey stick
  - If bristlecones retained but CO2 fertilization adjustment applied, no hockey stick





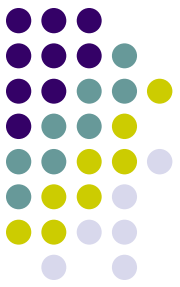
# 3rd Period: B: Skipping PC step



- MBH98(*ff.*) made various robustness claims:
  - Geographical coverage
  - Careful proxy selection
- Skipping PC step wipes out geographical balance
- Allows bristlecones (i.e. worst proxies) to dominate final reconstruction



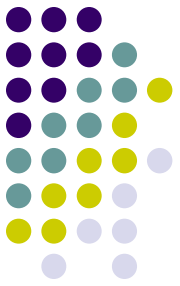
# 3rd Period: A & B



- Reconstruction still fails significance tests
- Alternative methods don't get around this
- We conjecture:
  - If/when Mann releases 15<sup>th</sup> century step calculations the R2 values will be zero
  - Any salvage operation will show the same thing

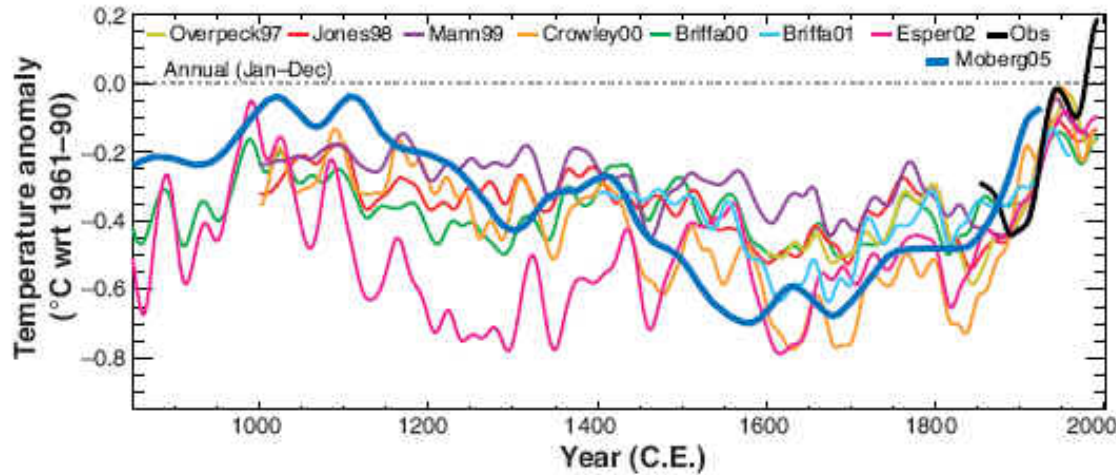


# Missing calculations...?



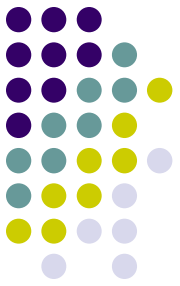
- **Statistics and results for the controversial 15<sup>th</sup> century step (and all other steps except last step)**
  - R-squared test values are key to assessing realclimate counter-arguments, but these have been withheld
- **Source code for final results**
  - Many aspects of MBH98 are not replicable. This does not affect results to date, but there are many remaining puzzles.
  - Mann: ‘Giving them the algorithm would be giving in to the intimidation tactics that these people are engaged in.’ (*Wall Street Journal*, Feb. 14, 2005)

# But isn't it backed up by 10 other independent studies?

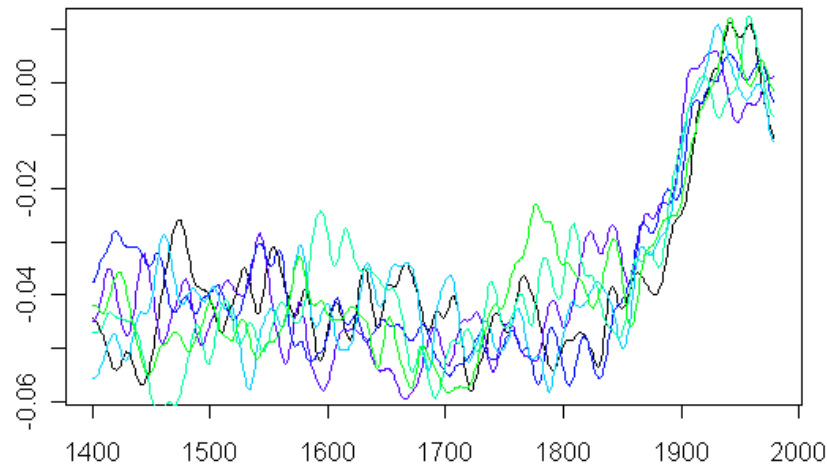


- No:
  - The studies are not independent
  - The proxy data are not independent
  - The other studies need to be checked too.

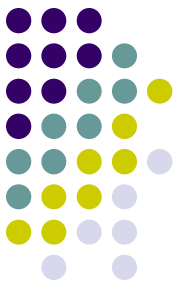
# Spaghetti graphs



- Don't prove anything

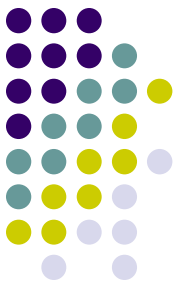


# The studies are not independent



- Bradley and Jones [1993]
- Hughes and Diaz [1994]
- Mann, Bradley and Hughes [1998, 1999]
- Jones, Briffa and others [1998]
- Briffa [2000]
- Briffa, Jones and others [2001]
- Mann and Jones [2003]
- Bradley, Hughes and Diaz [2003]
- Jones and Mann [2004]
- Rutherford, Mann, Bradley, Hughes, Briffa, Jones and Osborn [2005]

# The studies are not independent: MBH



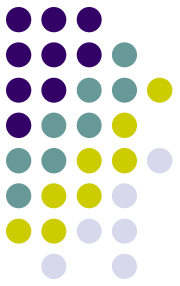
- Bradley and Jones [1993]
- Hughes and Diaz [1994]
- Mann, Bradley and Hughes [1998, 1999]
- Jones, Briffa and others [1998]
- Briffa [2000]
- Briffa, Jones and others [2001]
- Mann and Jones [2003]
- Bradley, Hughes and Diaz [2003]
- Jones and Mann [2004]
- Rutherford, Mann, Bradley, Hughes, Briffa, Jones and Osborn [2005]

# The studies are not independent: MBH J&B



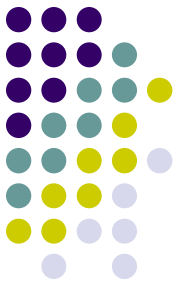
- Bradley and Jones [1993]
- Hughes and Diaz [1994]
- Mann, Bradley and Hughes [1998, 1999]
- Jones, Briffa and others [1998]
- Briffa [2000]
- Briffa, Jones and others [2001]
- Mann and Jones [2003]
- Bradley, Hughes and Diaz [2003]
- Jones and Mann [2004]
- Rutherford, Mann, Bradley, Hughes, Briffa, Jones and Osborn [2005]

# The multiproxy series are not independent



- “An uninformed reader would be forgiven for interpreting the similarity between the 1000-year temperature curve of Mann *et al.* and a variety of others also representing either temperature change over the NH as a whole or a large part of it (see the figure) as strong corroboration of their general validity .... **Unfortunately, very few of the series are truly independent: There is a degree of common input to virtually every one**, because there are still only a small number of long, well-dated, high-resolution proxy records.
  - Briffa and Osborn, *Science* [1999]

# The other studies need to be checked too



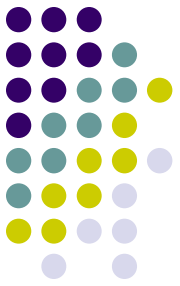
## *Work Under Way*

- Jones
- Jacoby
- Crowley
- Briffa
- Moberg
- Mann





# The other studies need to be checked too



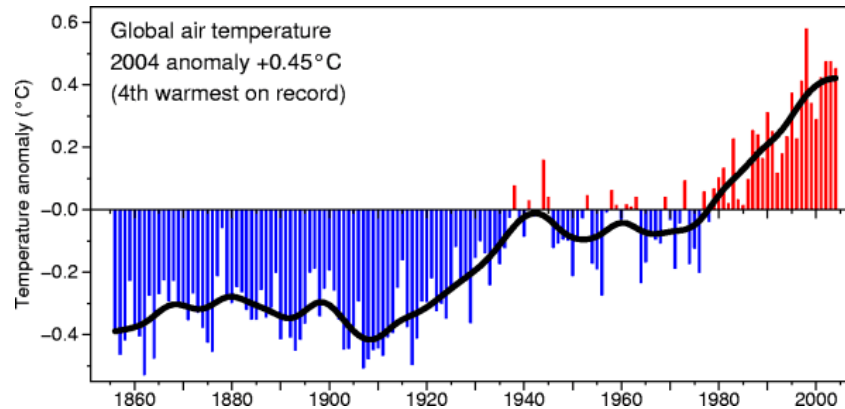
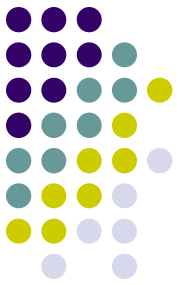
- Persistent issues:
  - Failure to publish or archive data
  - Splicing of different types of records
  - Failure to use updated data series
  - Cherry-picking evidence
  - Failure to address proxy-temperature mismatch (amounts to cherry-picking calibration interval)

# Failure to publish or archive data: Crowley



- Continues to cite results and publicly refers to raw data yet:
  - Couldn't locate original data and "not sure" if he still had it
  - Some smoothed and transformed versions cannot be matched to archived sources
  - Could not recall where discrepant series were obtained
  - Astonished at being expected to be responsible for data that was compiled "5 years ago at another institution"

# Failure to publish or archive data: Jones—CRU Temperature Data

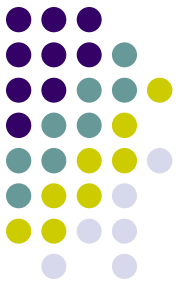


*In response to reader asking to see raw data and processing steps:*

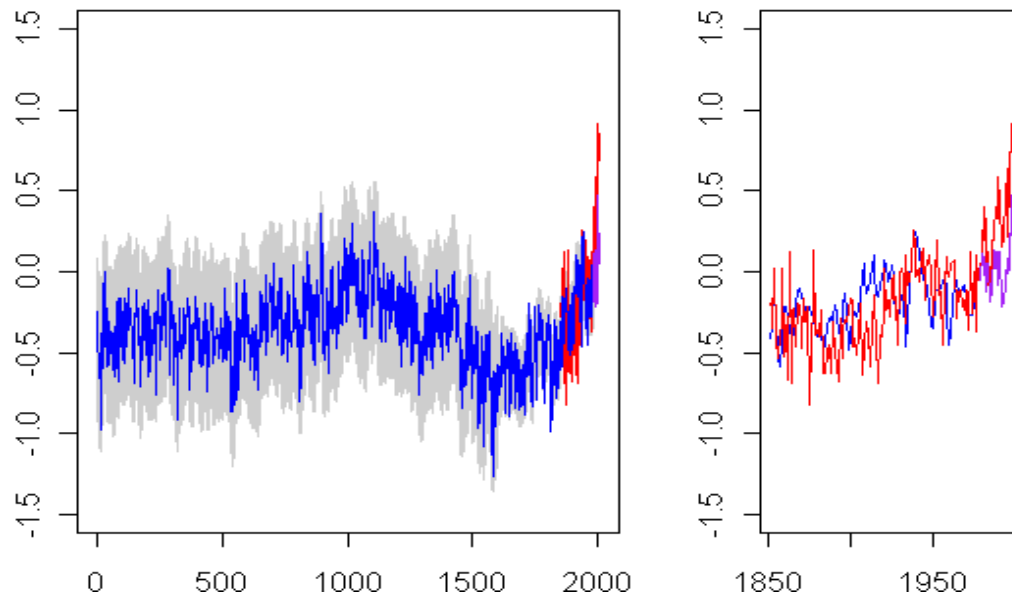
*Jones: We have 25 or so years invested in the work. Why should I make the data available to you, when your aim is to try and find something wrong with it.*

**Jones Funding Sources (U.S.): DOE**

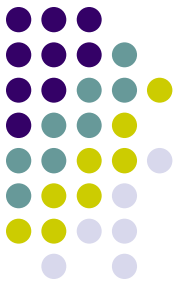
# Splicing of different types of records: Moberg



- Moberg is from 2005, but sometimes uses obsolete data e.g. Uses an obsolete bristlecone series ending in 1962.
- Any vestige of a hockey stick results from splicing the **CRU** instrumental records against proxy records.



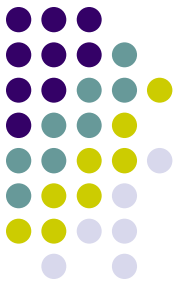
# Failure to use updated data: The Heavy Equipment Excuse



If the proxies are any good, then the warm 1990s should have off-the-chart values. If they don't, how can we be confident that they would have picked up warm MWP decades? **Shouldn't we validate proxies by bringing them up-to-date?**

- *Mann*: Most reconstructions only extend through about 1980 because the vast majority of tree-ring, coral, and ice core records currently available in the public domain do not extend into the most recent decades. While paleoclimatologists are attempting to update many important proxy records to the present, **this is a costly, and labor-intensive activity, often requiring expensive field campaigns that involve traveling with heavy equipment to difficult-to-reach locations** (such as high-elevation or remote polar sites). For historical reasons, many of the important records were obtained in the 1970s and 1980s and have yet to be updated.

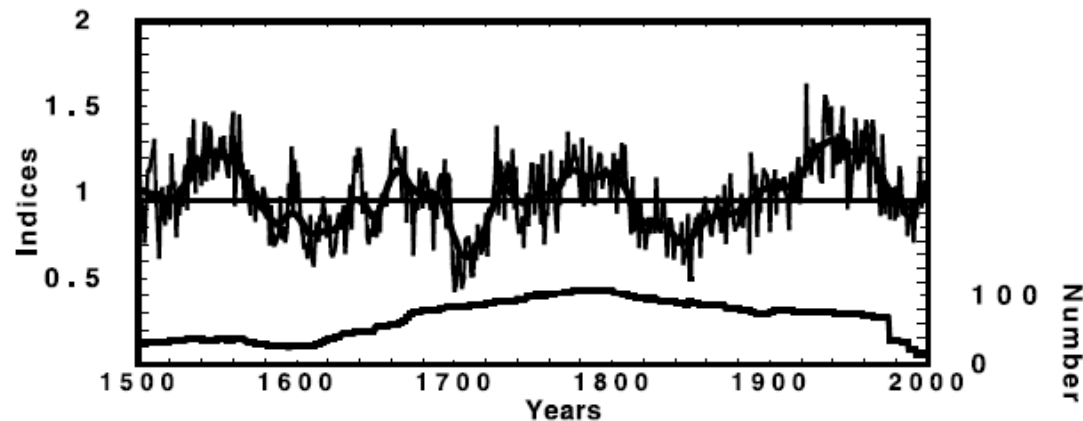
# The Heavy Equipment



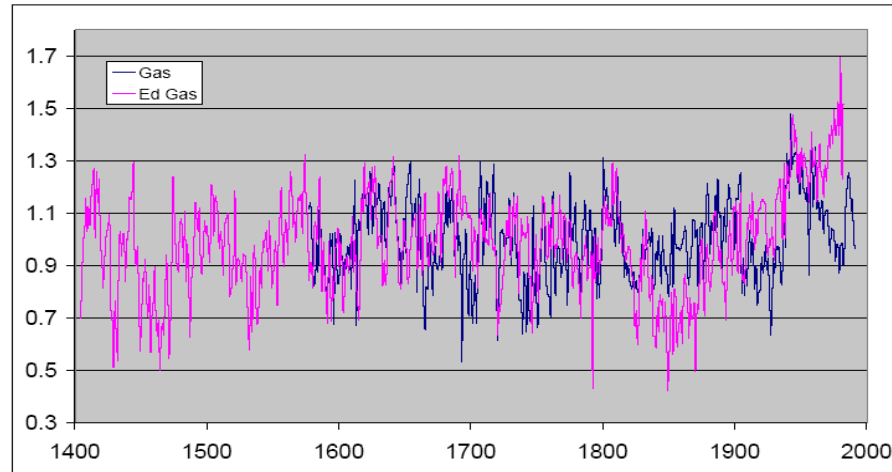


# Failure to use updated data:

- Surely some is available?
  - Yes, but it doesn't show rapid growth post-1980
  - E.g. Twisted Tree Heartrot Hill update to 2002:



# Some key data not archived

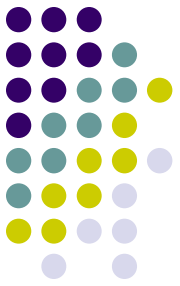


D'Arrigo: “the 1404-1982 version is an older version of the site, and ...[the] updated version is 1577-1991”... “the data you have [the older data] are probably superior with regards to a NH signal.”

Jacoby: “There was an attempt to update this record but the original site was not located. The original sampling was prior to GPS locating. Therefore there is no newer data for this particular site. If we implied this is any published paper, we mispoke.”

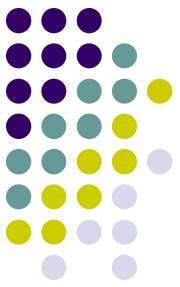


# Cherry-picking Evidence

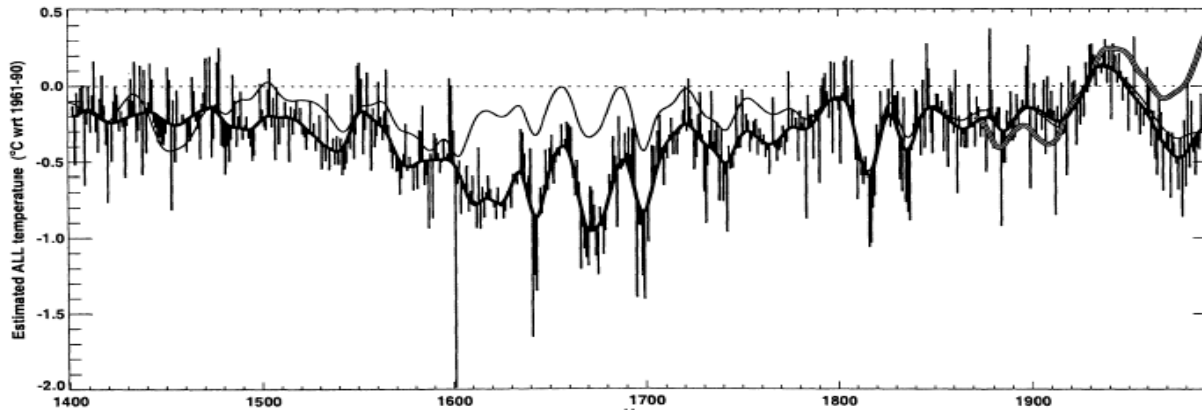
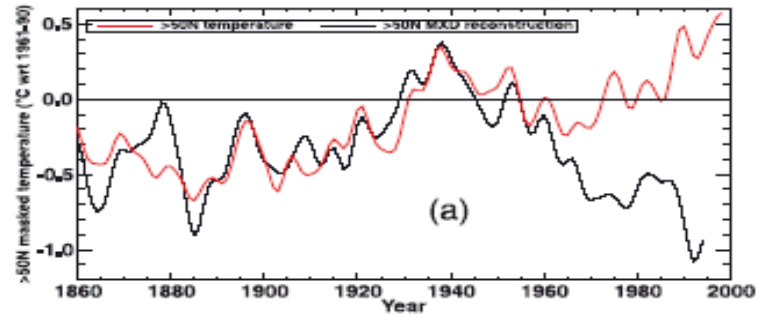


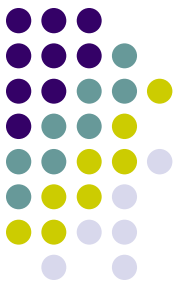
- Even in archiving decisions
- *Jacoby*: “Most of our research has been mission-oriented...If we get a good climatic story from a chronology, we write a paper using it. That is our funded mission... The rejected data are set aside and not archived.... As an examine I refer to the concept of a few good men.”
- *Jacoby*’s northern treeline study used the 10 “most temperature-sensitive” sites out of 36. He refused to provide or archive the other 26 sites.

# Recent proxy-temperature mismatch:

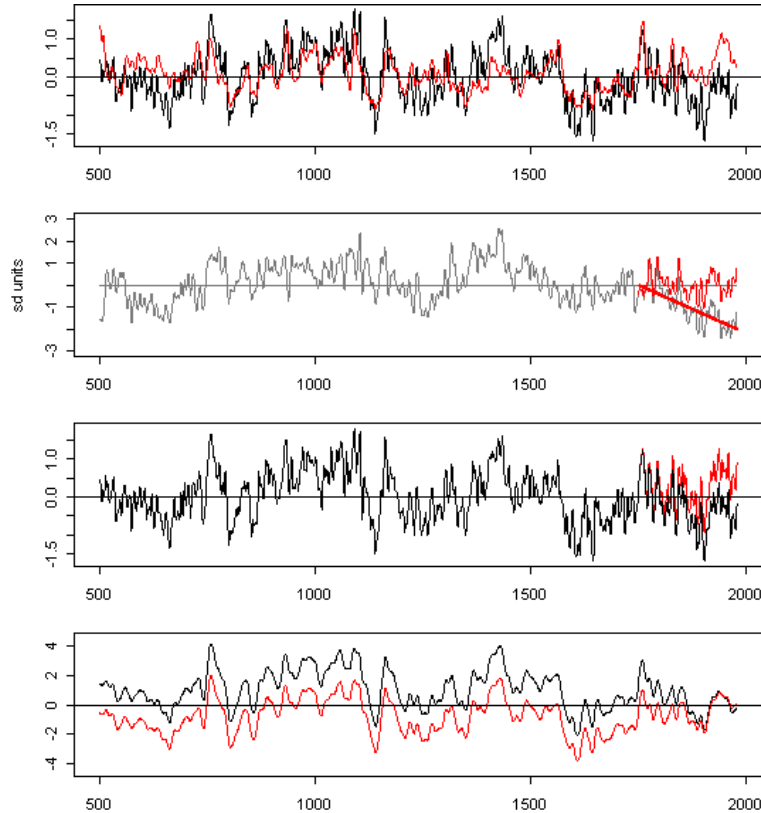


- E.g. MXD Series
- How to “handle”?



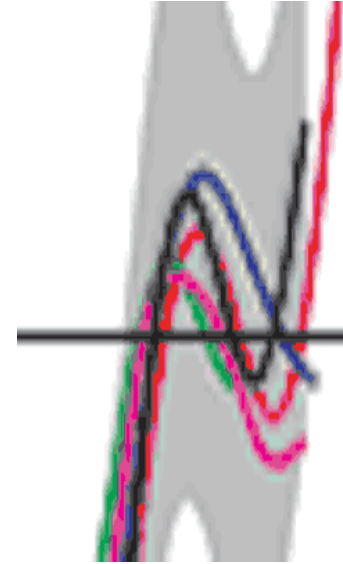
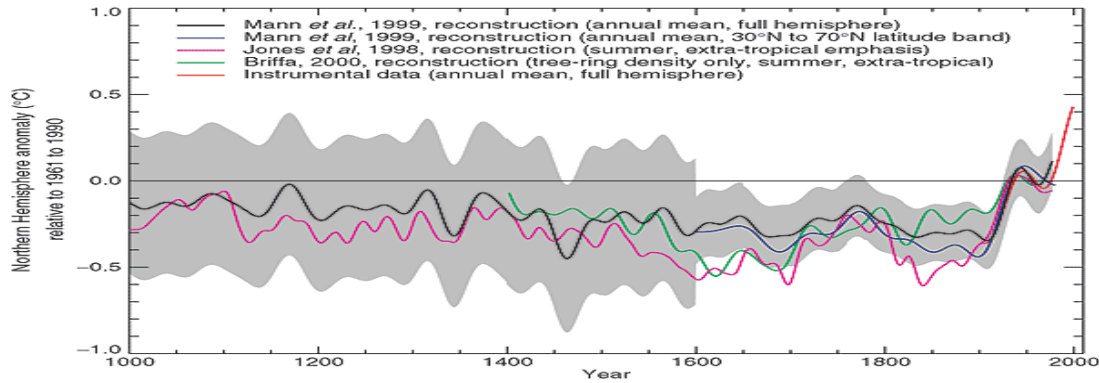
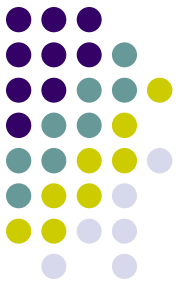


# Hockey Team “method” #1

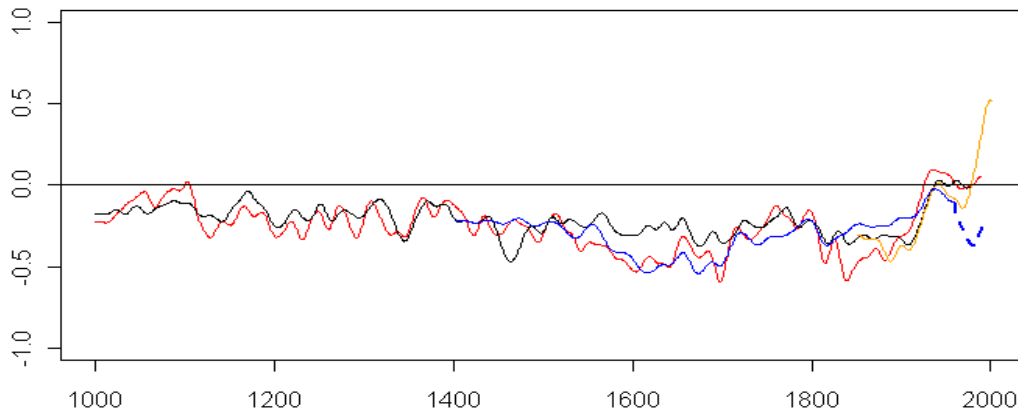
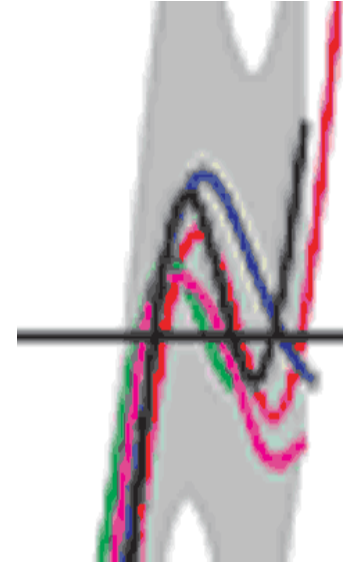
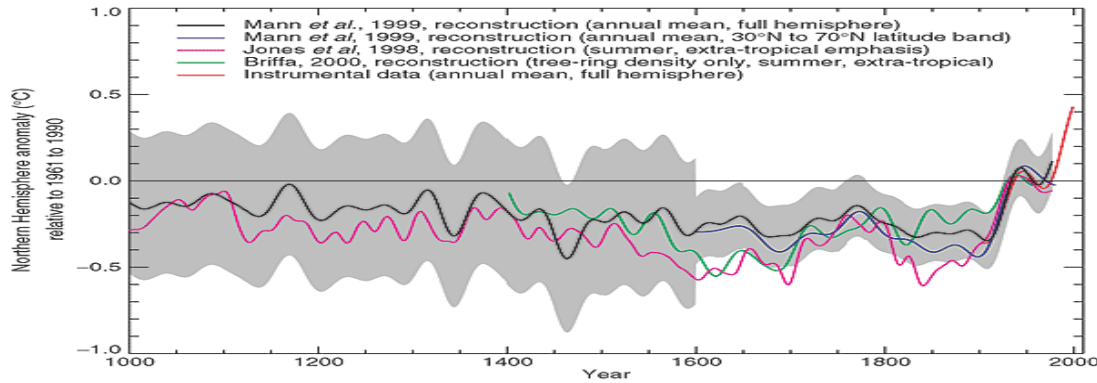


- Tornetrask series “edited” so that a 20<sup>th</sup> century series going down was artificially adjusted
- This series is used in virtually every multiproxy study

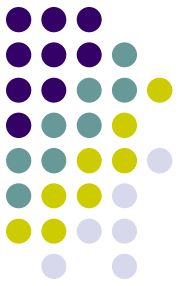
# Hockey Team “method” #2: (IPCC Spaghetti Graph)



# Hockey Team “method” #2: (IPCC Spaghetti Graph)

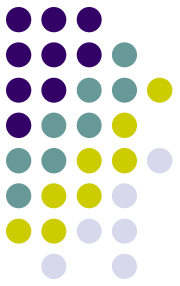


# Closing Thoughts



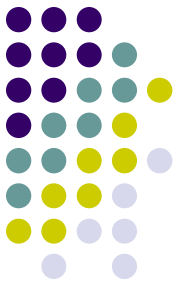
- Government trusted the IPCC
  - The IPCC trusted the journals
    - The journals trusted the referees
      - The referees trusted the authors

# Closing Thoughts



- Government trusted the IPCC
  - The IPCC trusted the journals
    - The journals trusted the referees
      - The referees trusted the authors
        - How do we know the authors are right?

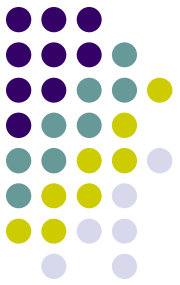
# Closing Thoughts



- Government trusted the IPCC
  - The IPCC trusted the journals
    - The journals trusted the referees
      - The referees trusted the authors
        - How do we know the authors are right?
- Whose job is it to do Due Diligence?



# IPCC?



30. Did IPCC carry out any independent programs to verify the calculations that you made in MBH98 or MBH99? If so, please provide copies of the reports resulting from such studies.

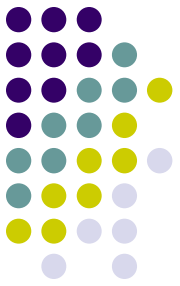
*Mann:* It is distinctly against the mission of the IPCC to "carry out independent programs", so the premise of the question is false. However, the IPCC's author team did engage in a lively interchanges about the quality and overall consistency of all of the papers as the chapter was drafted and revised in the course of review."

# National Science Foundation?



- We requested NSF compel disclosure of MBH98 source code, which they funded.
- Response:
  - Dr. Mann and his other US colleagues are under no obligation ... to provide you with computer programs, codes, etc. His research is published in the peer-reviewed literature which has passed muster with the editors of those journals and other scientists who have reviewed his manuscripts. You are free to your analysis of climate data and he is free to his.

# Journals?

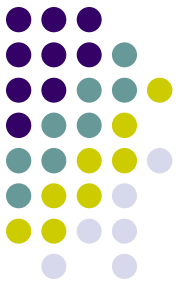


*Schneider*: “I have run the issue by the full Climatic Change Editorial Board since a source code request by a reviewer is unprecedented in the 28 years since I founded the journal.

*Nature*: “we do not take the view that [source codes] are something that in general should automatically be provided on request - the decision of whether or not to do so normally rests with the authors of such codes.” Mann: ‘Giving them the algorithm would be giving in to the intimidation tactics that these people are engaged in,’

*Science*: “Requirements for archiving data seem to focus on the biological and genomic, or at least those areas with prominent public archives. Climatic and geophysical data archives exist, but Science doesn't seem to notice. Also, even the biological requirements are fairly new.

# Government?



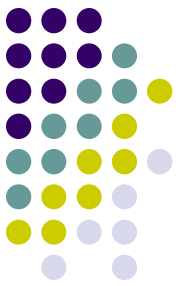
April 6, 2005

Senator the Hon. Ian Campbell

Minister for Environment and Heritage

Senator for Western Australia

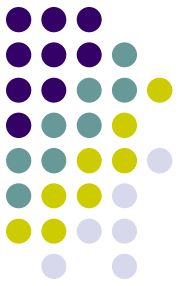
**The Australian Government, together with about 100 other nations, has accepted the findings of the Intergovernmental Panel on Climate Change Third Assessment Report.** This report was prepared by several hundred scientists from all over the world, from various scientific disciplines and with differing opinions on global warming. **The material that went into the report was from scientific research papers that go through a rigorous process of peer review in order to be published. The report itself also goes through a rigorous process of preparation, review, and debate.**



# References

- [www.climateaudit.org](http://www.climateaudit.org) (McIntyre)
- [www.uoguelph.ca/~rmckitri/research/trc.html](http://www.uoguelph.ca/~rmckitri/research/trc.html) (McKittrick)
- [www.realclimate.org](http://www.realclimate.org) (Mann)
- *McIntyre and McKittrick [2005a], Geophysical Research Letters*
- *McIntyre and McKittrick [2005b], Energy & Environment*
- *McIntyre and McKittrick [2003], Energy & Environment*

# End of Presentation

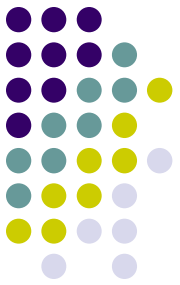


- M&M 2005

# Lessons in Disclosure and Due Diligence



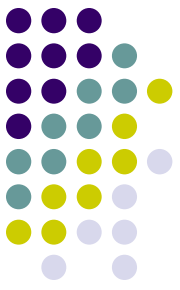
- Paleoclimate Researchers
  - need to take seriously their obligation to disclose data and methodology (Such standards apply in other disciplines.)
  - Especially when science results drive public policy
- Users of research
  - need to begin adopting higher standards of due diligence to compel disclosure
  - Applies to journals, IPCC, NSF, etc.



# PC computational glitch

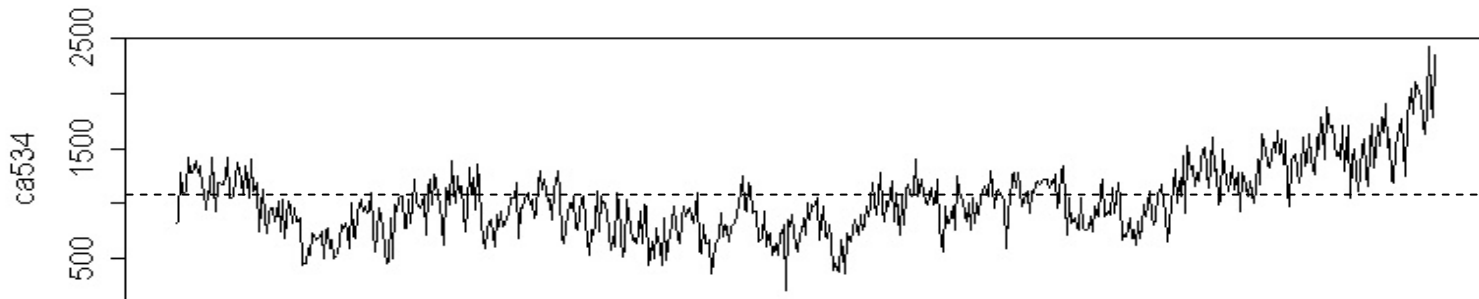
- Standard method:
  - subtract mean, divide by standard deviation
- Yields series with mean=0, variance=1
- PC algorithm then looks for dominant patterns





# PC computational glitch

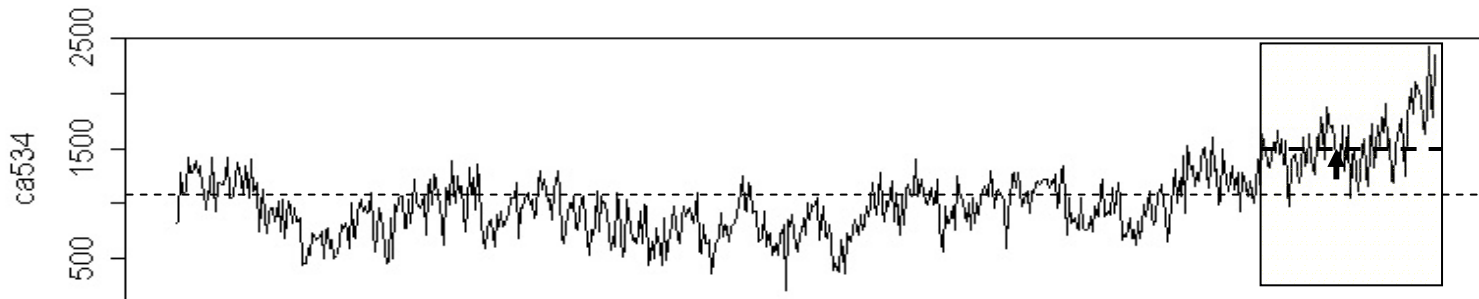
- Mann's method:
  - subtract 1902-1980 mean (rather than series mean), divide by standard error





# PC computational glitch

- Mann's method:
  - subtract 1902-1980 mean (rather than series mean), divide by standard error



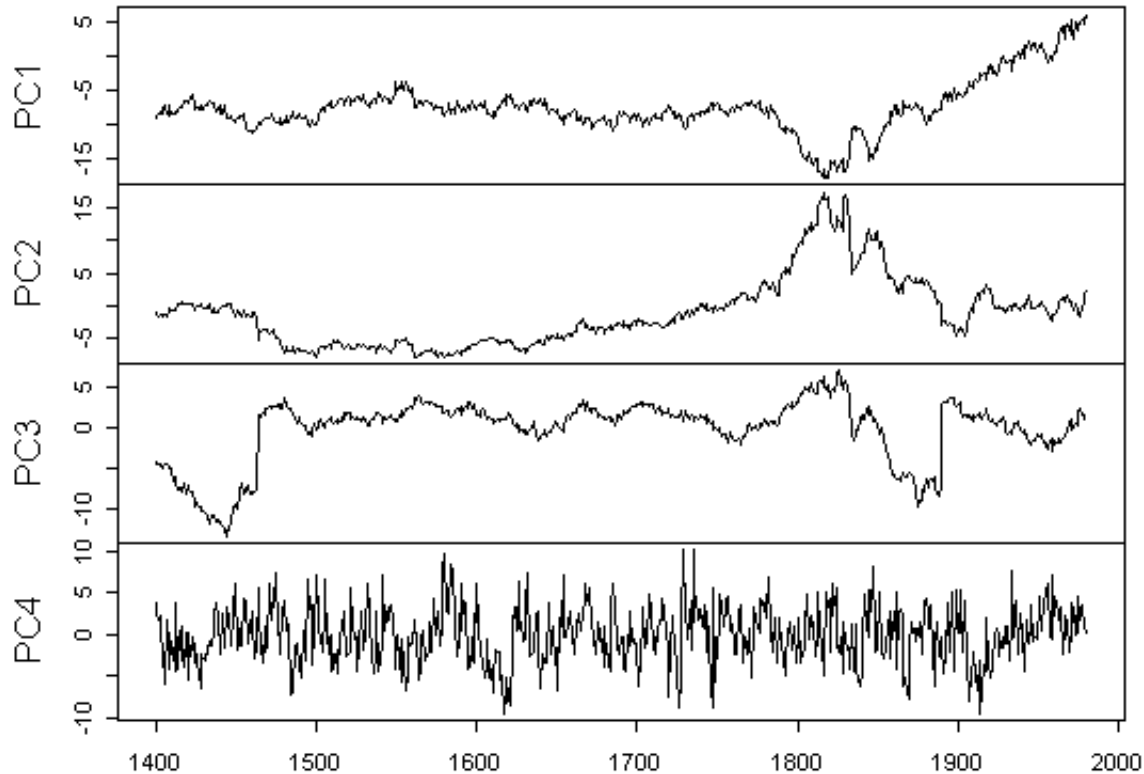
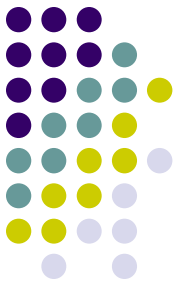


# PC computational glitch

- Result: mean of series which trend up in 20<sup>th</sup> century gets boosted
- PC algorithm picks weights that increase with size of this gap



# “Network” with tech stocks: MBH98



# “Network” with tech stocks: Centered PCs

