Science Hearing Watch

Science-based analyses of America's key environmental issues

Center for Science & Public Policy

www.ff.org

Scientific Hearing Watch is a service of the *Center for Science & Public Policy*

Contact Information

209 Penn. Ave., SE
Washington, DC 20003

Tel: 202-454-5249

Fax: 202-454-5223

bferguson@ff.org

Personnel

Bob Ferguson
Executive Director

Senate Environment and Public Works full committee hearing.

To examine climate history and its implications

Tuesday, July 29, 2003
SD-406 (Hearing Room)
9:00 am

Opening Statements:

Sen. James M. Inhofe of Oklahoma
Sen. George V. Voinovich of Ohio
Sen. John Cornyn of Texas
Sen. Wayne Allard of Colorado
Sen. James M. Jeffords of Vermont

Witnesses:

Panel I: Climate history and its implications

Dr. David R. Legates
Director, Center for Climatic Research
University of Delaware

Dr. Michael E. Mann
Associate Professor
University of Virginia
Department of Environmental Sciences

Dr. Willie Soon
Astrophysicist
Harvard-Smithsonian Center for Astrophysics

Executive Summary

On Tuesday, July 29, 2003 the Senate Environment and Public Works Committee held a hearing to examine climate history and its implications.

Below is scientific commentary on excerpts from the hearing, prepared by the non-profit, non-partisan Center for Science and Public Policy.

This hearing was prompted by two academic studies about the nature of past and recent climate variability, an issue that bears on the larger debate on human-induced climate change. Astrophysicist Dr. Willie Soon led two studies (one of which included witness Dr. David Legates), and climate statistician Dr. Michael Mann led a short series of others. The hearing attempted to clarify answers to some important questions about the nature of long-term changes in the Earth's climate: Was 20th century warming unusual? Could it have been natural or by human-made greenhouse gas emissions, or both, how can we know that?

Key facts relating to issues covered in the hearing include:

1. **Apparent fundamental defects in the Mann et. al paper would render it unreliable for public policy decision making.** A forthcoming peer reviewed paper audits aspects of the Mann analysis and finds it flawed. The new paper documents and corrects mistakes and errors found in the database on which Mann and coauthors relied. The temperature index using the correct data was recalculated using Mann's own methodology. The corrected results (see Figure 1) find the 20th century is **not** uniquely warm**, contradicting** the conclusions of the U.N. IPCC Third Assessment Report (TAR) and of Mann et al. upon which it relied.

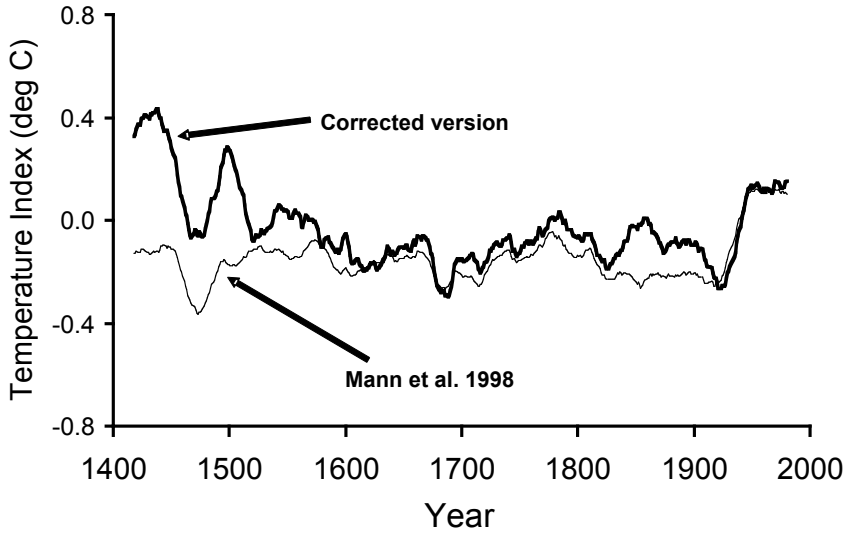

Figure 1 –Past temperature change, estimated from environmental indicators and thermometer records. The U.N. I.P.C.C.-related curve (drawn with a light line) is based on incorrect information. When corrected (darker line), the 20th century temperatures seem to show neither unusual warmth nor an unusual rate of warming over the last 600 years.

2. The purported flaws in the Soon papers are largely misunderstandings and misrepresentations of what the papers do and say.

3. The claim that there exists a **consensus** of scientists that catastrophic man-made global warming is occurring is **refuted** by overwhelming evidence to the contrary:

- A petition signed by more than 17,000 U.S. scientists, many with climate expertise.
- An open letter to Canadian government officials signed by 46 leading climate experts.
- 89 percent of respondents to a survey of the authoritative American Association of State Climatologists.
- Nearly 100 scientists who signed the 1996 Leipzig Declaration.
- Statement of a leading author of the National Academy of Sciences 2001 report on global warming.
- Statements of Russian climate experts at the September 30, 2003 U.N. World Climate Change Conference in Moscow.

4. **Challenges** by Mann to the validity of the satellite data compiled by Dr. John Christy (that show a small warming trend in the upper atmosphere for the northern hemisphere and a slight cooling trend in the southern hemisphere, in contradiction to the output of computer simulations of climate) **are without scientific foundation**.

5. **Efforts to discredit and silence** so-called "skeptics" of human-made global warming serve to undermine science by suppressing important debate.

Background

> The fallibility of methods is a valuable reminder of the importance of skepticism in science. Scientific knowledge and scientific methods, whether old or new, must be continually scrutinized for possible errors. Such skepticism can conflict with other important features of science, such as the need for creativity and for conviction in arguing a given position. But organized and searching skepticism as well as openness to new ideas are essential to guard against the intrusion of dogma or collective bias into scientific results. ("On Being a Scientist: Responsible Conduct in Research," pamphlet published by the National Academy of Science in 1995)

The disagreements evidenced in this hearing are over the so-called "Medieval Warm Period" (MWP) and "Little Ice Age" (LIA). For over thirty years past climate experts have been examining evidence from across the world on the MWP, which tended to produce unusual climate conditions in parts of the world (although not synchronously) sometime in the period from roughly the year 800 to 1300, and the LIA, which tended to produce opposite extremes within the period from approximately 1300 to 1900.

The debate turns on whether the Medieval Warm Period and Little Ice Age actually existed regionally and, if so, if they were global phenomena. Whether they are regional or global phenomena, or both, they would define patterns of natural climate change, and are important background information for assessing the reliability of computer simulations and the causes of 20^{th}-century warmth.

Dr. Mann: Twentieth Century warming unprecedented

Mann and his colleagues report no evidence of that the unusual periods of either the Little Ice Age or the Medieval Warm Period when thermometer records and indicators of environmental change are combined by statistical methods to yield large geographical-scale averages over the Northern Hemisphere or the world. They further report that the 20^{th}-century warming is unusual, and with comparisons to computer simulations, due mostly to human

influence at the end of the 20th century. Over the past several years they have produced several studies to support their claims.

Despite its uncertainties (addressed below in detail), the Mann study was central to the 2001 Third Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC), when the IPCC concluded most of the late 20th century warming was probably due to human influence.

Dr. Soon: Compelling evidence of regional existence of Medieval Warm Period and Little Ice Age

Soon and colleagues published recent literature reviews of roughly 250 paleoclimate studies, concluding the Medieval Warm Period and Little Ice Age were both real and widespread, albeit with significant regional variations, and not synchronous. They wrote:

> "The Medieval Warm Period of 800 to 1300 A.D. and the Little Ice Age of 1300 to 1900 A.D. were worldwide phenomena not limited to the European and North American continents. While 20th century temperatures are much higher than in the Little Ice Age period, many parts of the world show the medieval warmth to be greater than that of the 20th century."

In other words, the warming observed during the twentieth century is **not unprecedented** when individual regions sampled by the environmental evidence is considered. There have been earlier periods of warming, taking place before the industrial revolution and thus long before humans began emitting greenhouse gases into the atmosphere. Together with the unusual climate of the Little Ice Age, both unusual periods suggest large climate changes that would require explanation. Were they caused by changes in the sun, or ocean currents, or the frequency and intensity of volcanic eruptions? At this point, no one knows for sure; the regional variations are in the process of being documented by paleoclimate experts with advanced instruments and techniques. Resolving causes of past climate would help the field to progress.

Importance and relevance of the debate

This generally accepted account of climatic history (as reviewed by Soon) contains two serious implications not made by Soon in the review papers for the notion of significant human-made global warming effects:

1) If the Medieval Warm Period were warmer than today, with no human greenhouse gas contribution, what would be so unusual about modern warming?
2) If the causes of past warming are poorly understood, how can computer simulations give accurate forecasts for future human-made warming trends?

Both propositions question the reliability of computer simulations of future catastrophic climate. Seen as supporting alarmist views, the Mann analysis is being promoted by the U.N. IPCC and governments world-wide as a cornerstone of their rationale for mandating significant and immediate regulation of energy use, with tremendous social, political and economic consequences.

The following is a science-based commentary upon statements excerpted from the hearing report.

Excerpts and commentary on the opening statement of Dr. Mann

Academic qualifications

Dr. Mann: In my testimony here today, I will explain, one, how mainstream climate researchers have come to the conclusion that late 20th century warmth is unprecedented in a very long- term context and that this warmth is likely related to the activity of human beings; and two, why a pair of recent articles challenging these conclusions by astronomer Willie Soon and his coauthors are fundamentally unsound.

> **Comment:** Climatology contains many branches of Science which have to do with climate and weather and the tools to better understand them; e.g. meteorology, geology, oceanography, ecology, biology, chemistry, physics, astrophysics, history, mathematics, statistics, and more.
>
> Dr. Willie Soon's academic training is in atmospheric, space and astrophysics. He has been studying the relationship between solar activity and the earth's climate for nearly a decade, thus he is well experienced in topics related to terrestrial climate change. The value of research should not be judged by the background of the researcher, but in the merit of the results. *Ad hominen* labeling of others (as done repeatedly in Dr. Mann's testimony and comments) as merely astronomers, "outside the mainstream" or "illegitimate scientists" appears not useful. It is interesting to note that another prominent climate researcher, NASA's Dr. James Hansen, also holds academic degrees in astronomy and physics (and none in climatology).

Is there scientific consensus?

Dr. Mann: It is the consensus of the climate research community that the anomalous warmth of the late 20th century cannot be explained by natural factors, but instead indicate significant anthropogenic, that is human influences. This conclusion is embraced by the position statement on climate change and greenhouse gases of the American Geophysical Union, by the 2001 report of the IPCC, the Intergovernmental Panel on Climate Change, and by a National Academy of Sciences' report that was solicited by the Bush Administration in 2001.

> **Comment:** This appears as an open attempt to include political criteria in forming scientific statements, and to limit the freedom necessary for science. **There is no "consensus" in science.** The existence of such a "consensus" would be the end of the scientific method, and would be a return to orthodoxy belief systems like those of the Middle Ages.
>
> Two parts of the **IPCC** report are a large science section (the main report) that describes research activities in climate science, and a politicized *Summary for Policymakers* (SP). The SP is what is commonly quoted in the media and by those supporting the Kyoto Protocol. The SP is misleadingly presented as the consensus of thousands of the world's foremost climate scientists, but no such number participated in the preparation of the voluminous science document, much less the SP. Instead, the SP only represents a consensus of government representatives (many of whom are also their nations' Kyoto representatives), NGO's and

business, rather than of scientists. The SP has a strong tendency to **forego discussion of uncertainty** while presenting extreme, physically implausible **scenarios**. Even the science part of the IPCC report has drawbacks. "It is absolutely remarkable how inferior and one-sided this report is," said Dr. Nils Axel-Mörner, Professor of Paleogeophysics and Geodynamics at Stockholm University. "Where are all the real sea level specialists from our Commission [NB: INQUA] and from IGCP? They have had little or nothing to say in this report. **If science is treated in this way, it is bound to go wrong."** (emphasis added)

MOREOVER THE ORIGINAL TEXT OF THE SPM DID NOT CONTAIN WHAT IS NOW THE MOST FAMOUS QUOTE. THE VERSION CIRCULATED AT THE END OF SCIENTIFIC REVIEW (DATED APRIL 2000) READ AS FOLLOWS:

17
18 • *From the body of evidence since IPCC (1996), we conclude that there has been a discernible human influence on*
19 *global climate*. Studies are beginning to separate the contributions to observed climate change attributable to
20 individual external influences, both anthropogenic and natural. This work suggests that anthropogenic greenhouse
21 gases are a substantial contributor to the observed warming, especially over the past 30 years. However, the accuracy
22 of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and
23 anthropogenic forcing, and the climate response to external forcing.
24

The version published 9 months later (IPCC 2001) READ AS FOLLOWS:

In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely[7] to have been due to the increase in greenhouse gas concentrations.

THE OFFICIALS RESPONSIBLE FOR THIS CHANGE IN WORDING WERE NOT IDENTIFIED ON THE SPM.

The claim of scientific consensus for man-made global warming has become a staple assertion without foundation, and is widely contradicted:

1. A petition compiled by a past president of the National Academy of Sciences has attracted the signatures of more than **17,000** American scientists (http://www.oism.org/pproject/). (In an effort to discredit the petition, the name of popular singer was forged and fraudulently submitted as a scientist. When the fraud was revealed by an activist group, all the names on the list were re-checked, and the one fraudulent name removed.) Nearly all of the initial 17,000 scientist signers have technical training suitable for the evaluation of the relevant research data, and many are trained in relevant fields. Signers of this petition include 2,660 physicists, geophysicists, climatologists, meteorologists, oceanographers, and environmental scientists (http://www.oism.org/pproject/a_sci.htm) who are especially well qualified to evaluate the effects of carbon dioxide on the Earth's atmosphere and climate. Signers also include 5,017 scientists whose fields of

specialization in chemistry, biochemistry, biology, and other life sciences make them especially well qualified to evaluate the effects of carbon dioxide upon the Earth's plant and animal life. All agree the science of climate change, and man's role in it, is uncertain.

The Petition reads: "We urge the United States government to reject the global warming agreement that was written in Kyoto, Japan in December, 1997, and any other similar proposals. The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind.

"There is **no convincing scientific evidence** that human release of carbon dioxide, methane, or other greenhouse gasses is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth." (emphasis added)

2. Forty-six leading climate experts wrote an open letter to Canada's National Post June 4, 2003) claiming that the Kyoto Protocol "lacks credible science." In the letter, they wrote: "Many climate science experts from Canada and around the world, while still strongly supporting environmental protection, equally strongly disagree with the scientific rationale for the Kyoto Accord.

3. Fully 89 percent of respondents to a survey of state climatologists agreed that "current science is unable to isolate and measure variations in global temperatures caused only by man-made factors."

4. An independent organization, The European Science and Environmental Forum, has published two monographs, in which a few dozens of scientists present studies **contradicting** the conclusions of the IPCC.

5. Nearly one hundred scientists signed the 1996 Leipzig Declaration, protesting the alleged IPCC consensus and the implementation of the Rio de Janeiro treaty. The Leipzig Declaration termed the provisions of this treaty "drastic policies **lacking credible support from the underlying science**...ill-advised, wrought with economic danger, and likely to be counter-productive." (emphasis added)

6. MIT professor Richard Lindzen, Ph.D., one of 11 scientists who prepared the National Academy of Sciences 2001 report on global warming has stated repeatedly that there were **a wide variety of scientific views** presented in that report, and that the full report made clear that there is **no consensus**, unanimous or otherwise, about long-term climate trends and what causes them.

7. AP wire stories for September 30, 2003 reported that at the **U.N. World Climate Change Conference in Moscow** Russian scientists and officials rejected the Kyoto Protocol and the illusion of scientific consensus. They expressed **skepticism about the science behind Kyoto**. Dr. Yury Izrael, chair of the organizing committee for the conference, sums it up: "The most important issue is whether ratifying the Kyoto Protocol would improve the climate, stabilize it or make it worse. This is not very clear." Andrei Illarionov, chief economic adviser to President Putin said that the **science backing Kyoto is far from settled**, and

Russia would not sign on. Russia's Natural Resources Minister cited scientific critics of the Kyoto Protocol who said that the adverse effects of greenhouse gas emissions were probably **overestimated**. Top Russian researcher, Valentin Dymnikov, said that that **existing models of atmospheric change lack accuracy and aren't reliable**. Professor Kirill Kondratyev, an influential global climate expert with the Russian Academy of Sciences, said that theories linking global warming to greenhouse gas emissions ignored numerous other factors. **"The only people who would be hurt by abandoning the Kyoto Protocol would be several thousand people who make living attending conferences on global warming,"** said Kondratyev. (emphasis added)

As for Mann's appeal to the position statement by the American Geophysical Union, this is what it actually stated: "It is clear from these [climate proxy] records and from many other studies of paleoclimate evidence throughout the geologic record, that the global climate system has been influenced by many factors in addition to greenhouse gases." (This is precisely what the authors of the Harvard-Smithsonian study emphasize in their study of climate over the past 1,000 years.) Further, the AGU: "In principle, empirical inferences of climate sensitivity would be of great value, but development of such inferences is **confounded by the natural variability** of the climate system, by local or regional effects that can be different from the global effects, and by the simultaneous working of multiple transient forcings and responses." In other words, Mann's assertion that humans are responsible for global warming is not the overwhelming consensus of the AGU study. (emphasis added)

Finally, Mann also misrepresents the National Academy of Sciences report. The NAS clearly stated: "Because of the large and still uncertain level of natural variability inherent in the climate record and the uncertainties in the time histories of various forcing agents (and particularly aerosols), a causal linkage between the buildup of greenhouse gases in the atmosphere and the observed climate changes in the 20th Century cannot be unequivocally established."

Unprecedented warming – a flawed analysis

Dr. Mann: More than a dozen independent research groups have now reconstructed the average temperature of the northern hemisphere in past centuries, both by employing natural archives of past climate information or proxy indicators such as tree rings, corals, ice cores, lake sediments and historical documents, and through the use of climate model simulations. If I can have the first exhibit here, as shown in this exhibit, the various proxy reconstructions agree with each other, as well as with the model simulations, all of which are shown, within the estimated uncertainties. That is the gray-shaded region.

The proxy reconstructions, taking into account these uncertainties, indicate that the warming of the northern hemisphere during the late 20th century, that is the northern hemisphere, not the globe, as I have sometimes heard my study incorrectly referred to, the northern hemisphere during the late 20th century, that is the end of the red curve, is unprecedented over at least the past millennium and it now appears based on peer-reviewed research, probably the past two millennia.

Comment: A forthcoming peer reviewed paper audits aspects of the Mann

analysis and finds it internally flawed (S. McIntyre and R. McKitrick, 2003, Energy & Environment, in press, Nov. 15, 2003). The authors document and correct mistakes and errors found in the database on which Mann relied, and recalculate the temperature index using Mann's own methodology. Their results SHOW the 20th century is not uniquely warm, contradicting the conclusions of the U.N. IPCC Third Assessment Report (TAR) and of Mann et al. upon which the IPCC report partly relied (see Figure 1).

The authors conclude (emphasis added):

The MBH98 hockey stick-shaped NH temperature INDEX discussed here has been extremely influential in discussions of 20th century global warming. Together with a pre-1400 extension derived in Mann et. al. (1999) and a spliced instrumental temperature series, this index figured prominently in the IPCC Third Assessment Report (IPCC 2001) and numerous other publications. However, the dataset used to make this construction contained collation errors, unjustified truncation or extrapolation of source data, obsolete data, incorrect principal component calculations, geographical mislocations and other serious defects. These errors and defects substantially affect the temperature index.

Although not all of the dataset could be audited, it was possible to prepare a data base with substantially improved quality control, by using the most recent data and collating it correctly, by avoiding arbitrary filling in or truncation of data and by computing principal components using standard algorithms. Without endorsing the MBH98 methodology or choice of source data, we were able to apply the MBH98 methodology to a database with improved quality control and found that their own method, carefully applied to their own intended source data, yielded a Northern Hemisphere temperature index in which the late 20th century is unexceptional compared to the preceding centuries, displaying neither unusually high mean values nor variability. More generally, the extent of errors and defects in the MBH98 data means that the indexes computed from it are unreliable and cannot be used for comparisons between the current climate and that of past centuries, including claims like "temperatures in the latter half of the 20th century were unprecedented," and "even the warmer intervals in the reconstruction pale in comparison with mid-to-late 20th-century temperatures" (see press release accompanying Mann et al 1999) or that the 1990s was "likely the warmest decade" and 1998 the "warmest year" of the millennium (IPCC 2001).

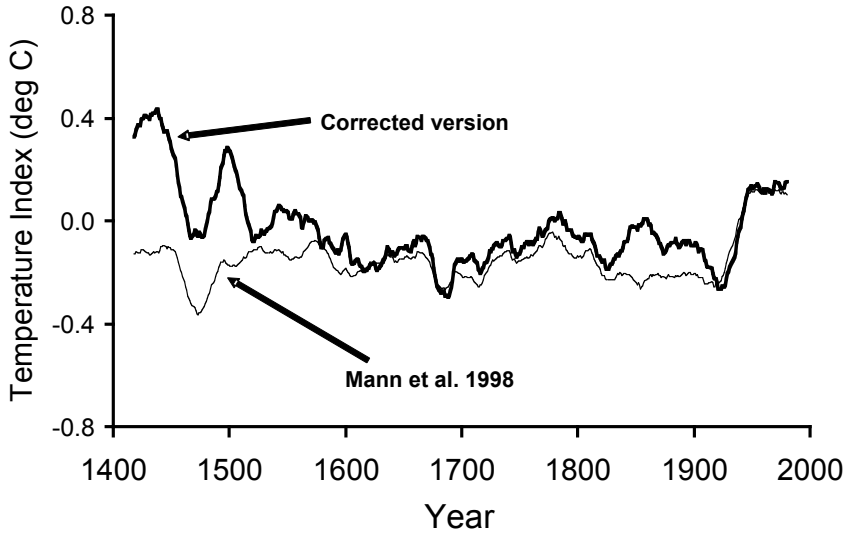

Figure 1 – Temperature INDEX estimated from thermometer records and PROXY indicators of environmental change, SMOOTHED WITH 20-YEAR MOVING AVERAGES. The IPCC-related work (drawn with a light line) has errors that have recently been corrected (heavy line). The corrected results show that the 20th century is not unusually warm compared to periods in the last 600 years (see S. McIntyre and R. McKitrick, *Energy & Environment*, in press, Nov. 15, 2003).

Given the fundamental defects in the Mann paper, it should not be relied upon for making public policy decisions.

Secondly, Mann himself purports that his recent study has **"global" significance**, giving it title in his paper. Mann and Jones say their temperature reconstructions indicate that "late 20th century warmth is unprecedented for at least roughly the past two millennia for the Northern Hemisphere." They also say their data and analysis "suggest a similar, but less definitive conclusion, for the **global mean**" (Mann, M.E. and Jones, P.D. 2003. Global surface temperatures over the past two millennia. *Geophysical Research Letters* 30: 10.1029/2003GL017814.) (emphasis added)

Third, it can readily be seen from the graph (see Figure 2, below) of Mann's own results that the end point of his **reconstructed** global mean temperature history is **not** the warmest period of the prior 1800 years. In fact, his treatment of the data depicts **three earlier warmer** periods: one just prior to AD 700, one just after AD 700 and one just prior to AD 1000.

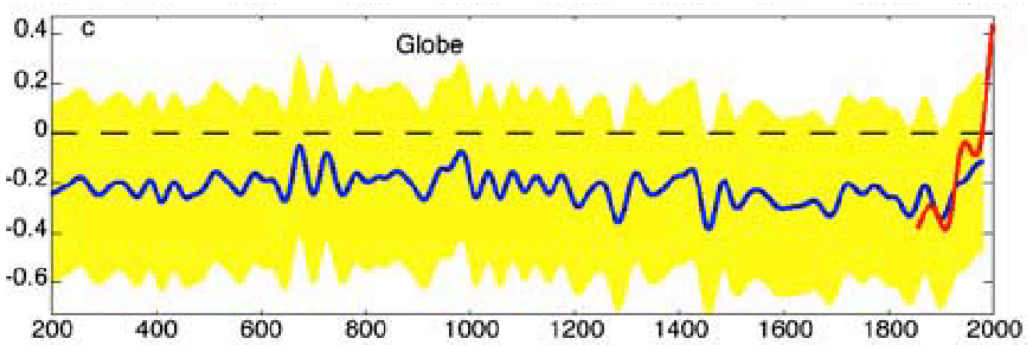

Figure 2 – Proxy reconstruction of global temperatures (blue curve, from A.D. 200 to 1980) and instrument records (red curve, approximately A.D. 1850 to present). The shaded area represents an estimate of uncertainty. Note that within the proxy information alone (blue curve), the 20th century warmth is not unusual. From Mann and Jones (2003).

The globe only becomes warmer in the 20th century when its measured ground temperatures are substituted for its reconstructed temperatures. This approach is like comparing apples and oranges. Many scientists and statisticians believe it is **improper** practice (and therefore **unreliable**) to synthesize a composite graph from two fundamentally different types of measurement. If one has only reconstructed temperatures from the distant past, one can only validly compare them with reconstructed temperatures from the recent past.

Finally, in his comments on the temperature curve illustrated above ("hockey stick") in his 1999 paper Mann states that the 20th century is **nominally** the warmest of the millennium, but enters this **critical caveat**: "Expanded uncertainties in centennial means prior to AD 1600 and warmer conditions during the earlier centuries of the millennium, however, **preclude a definitive statement** prior to AD 1400. The 11th and 12th centuries are within a (centennial) standard error of the 20th century. The late 11th, late 12th, and late 14th centuries rival mean temperature levels. **Our reconstruction thus supports the notion of relatively warm conditions earlier in the millennium**, while cooling following the 14th century could be viewed as the onset of the **Little Ice Age** sensu lato." (emphasis added) **In other words, the error bars in the Mann study are so large, one cannot rule out the 11th and 12th centuries being warmer than the 20th. This not only confirms the likeliness of the Medieval Warm Period but also the Little Ice Age.**

The IPCC Summary for Policy Makers did not carry this critical caveat, nor did Dr. Mann mention it in his testimony. Instead, he proclaimed **absolute** evidence that the 20th century is the warmest in the last 1000 or even 2000 years, though there is irrefutable evidence – for one example, based on borehole temperature measurements covering much of the northern hemisphere - that the **temperature in the Medieval Warm Period was about 2° higher than in the recent past**.

Even the subsequent Mann et al. analysis, which may still contain the flawed data found in the early paper, speak for themselves in clearly demonstrating that **20th century global warmth was not unprecedented** over the past two millennia.

Reference:

Mann, M.E., Jones, P.D., 2003. Global surface temperatures over the past two millennia. *Geophys. Res. Lett*, doi:10.1029/2003Gl017814.

Dr. Mann misrepresents the Soon papers

Dr. Mann: Astronomers Soon and Baliunas have attempted to challenge the scientific consensus based on two recent papers, henceforth collectively referred to as SB, that completely misrepresent the past work of other legitimate climate researchers and are deeply flawed for the following reasons.

Comment: Dr. Mann repeatedly resorts to "straw man" arguments,

misrepresenting the work of Soon et al., and then attacking it. (Specific examples will be examined below.) It is Mann himself, not Soon who presumes to challenge the scientific consensus. Mann's papers present an entirely new perspective on earth's climatic history over the past thousand years, which was different from what had previously been – and still is – generally accepted by the science community.

The Medieval Warm Period and subsequent Little Ice Age - which followed hard on the heels of the Roman Warm Period and Dark Ages Cold Period (McDermott et al., 2001) - were long considered to be **classic examples** of the warm and cold phases of a millennial-scale climate oscillation that has reverberated seemingly endlessly throughout glacial and interglacial periods alike (Oppo et al., 1998; McManus et al., 1999). An **extremely large collection** of scientific papers have been published over the course of the last several decades which have found evidence for the existence of the Little Ice Age and the Medieval Warm Period. As such, the true scientific judgment is that these climate events did occur. Papers continue to appear in scientific journals verifying that **Mann's results are outside the mainstream**. Until the publication of Mann's paper, even the **IPCC** documents up to at least 1995 had faithfully depicted the existence of both the Medieval Warm Period and Little Ice Age.

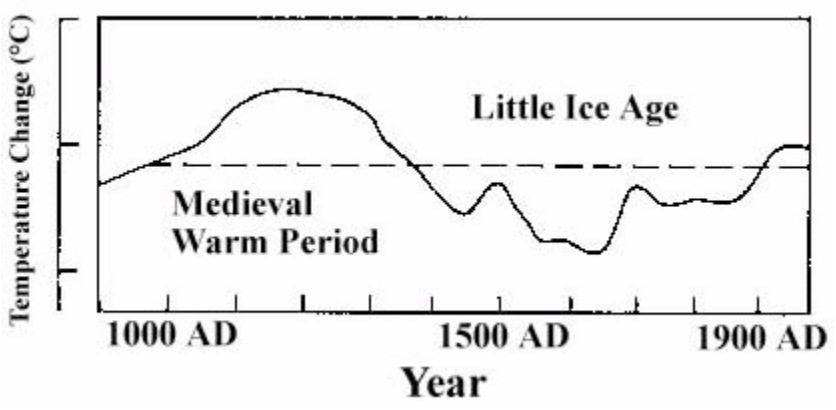

Figure 3 – Estimate of global temperature change since AD 900 from IPCC 1990 report (Houghton et al. 1990).

Furthermore, as can be seen in the Mann and Jones (2003) temperature estimate reproduced in Figure 2, there were several periods in the past, including a time during the Medieval Warm Period (just prior to the year 1000AD), that were warmer than the late-20th century **as depicted in the proxy record**. This is one of the primary conclusions reached by Soon et. al. Essentially, Mann and Jones (2003) **confirm** the conclusions of Soon.

References:

Houghton, J.T., Jenkins, G.J. and Ephraums, J.J. (Eds.). 1990. *Climate Change: The IPCC Scientific Assessment.* Cambridge University Press, Cambridge, UK.

Mann, M.E., Jones, P.D., 2003. Global surface temperatures over the past two millennia. *Geophys. Res. Lett*, doi:10.1029/2003Gl017814.

McDermott, F., Mattey, D.P. and Hawkesworth, C. 2001. Centennial-scale Holocene climate variability revealed by a high-resolution speleothem _18O record from SW Ireland. *Science* 294: 1328-1331.

McManus, J.F., Oppo, D.W. and Cullen, J.L. 1999. A 0.5-million-year record of millennial-scale climate variability in the North Atlantic. *Science* 283: 971-974.

Oppo, D.W., McManus, J.F. and Cullen, J.L. 1998. Abrupt climate events 500,000 to 340,000 years ago: Evidence from subpolar North Atlantic sediments. *Science* 279: 1335-1338.

Soon, W., Baliunas, S., 2003. Proxy climate and environmental changes of the past 1000 years. *Clim. Res*., 23, 89-110.

Dr. Mann: One, SB make the fundamental error of citing evidence of either wet or dry conditions as being in support of an exceptional Medieval Warm Period. Such an ill-defined criterion could be used to define any period of climate as either warm or cold.

Comment: This statement misrepresents the Soon and Baliunas ("Soon" hereafter) method, which correctly considers climate to be more than temperature alone. In their method each proxy is assessed relative to itself. A proxy may be in terms of an environmental variable that cannot readily be transformed to temperature. An example is the depth of Lake Naivasha in eastern Africa. The depth of Lake Naivasha is related to precipitation, but its association with temperature is not accurately known. In this case, Soon relies on the expert researchers, who note that the lake depth climate proxy shows "significantly drier climate than today during the `Medieval Warm Period' (~AD 1000-1270) and a relatively wet climate during the `Little Ice Age' (~ AD 1270-1850) which was interrupted by three prolonged dry episodes." (Vershuren et. al 2000). This particular climate proxy, notes Soon, shows evidence for a climate anomaly (namely, extreme dryness) in eastern Africa during the period called the Medieval Warm Period, and its opposite anomaly (extreme wetness) during the period called the Little Ice Age. Further, Soon notes that the proxy's 20th century values are not the most extreme in the record. Soon assesses the existence of climate anomalies, not just temperature, as part of a broader picture of climate change over the last 1,000 years.

Reference: Verschuren, D., et al. 2000. Rainfall and Drought in Equatorial East Africa during the past 1,100 Years, *Nature*, 403 410-414.

Dr. Mann: It is pure nonsense. Experienced paleoclimate researchers know that they must first establish the existence of a temperature signal in a proxy record before using it to try to reconstruct past temperature patterns.

Comment: "Pure nonsense" is a bit strong to describe a concept that Mann himself incorporated to create his proxy temperature reconstruction. Of the 112 original records that go into his original proxy reconstruction back to the year 1780, at least one-quarter of them come from indicators that are sensitive primarily to precipitation variations (Mann et al., 1998, supplemental

information). Obviously, Mann feels that some precipitation records are useful in reconstructing temperature histories. Soon on the other hand, does not bias the study of climate and environmental change by trying to reconstruct past temperature from proxies primarily sensitive to precipitation. Thus, Mann attempts to equate the precipitation and temperature fields, the assumption that he himself calls "patently invalid" (Mann et al., 2003) and Soon avoids this potential pitfall because they focus on climate and environmental, not just temperature, proxies.

Reference: Mann, M.E., et al., 2003. On past temperatures and anomalous late-20th century warmth. *EOS*, Trans. Amer. Geophys. Union, 84, 256-258.

Dr. Mann: Two, it is essential to distinguish between regional temperature changes and truly hemispheric or global changes. Average global or hemispheric temperature variations tend to be far smaller in their magnitude than those for particular regions. This is due to a tendency for the cancellation of simultaneous warm and cold conditions in different regions, something that anybody who follows the weather is familiar with, in fact.

Comment: This is one reason why Soon chooses to analyze and retain the local information recorded by proxies. Another reason is that it is often difficult to determine the spatial extent of a proxy's climate response, making a large-scale spatial reconstruction (especially from different types of proxies) highly uncertain (see Soon and Baliunas, 2003, p. 97).

Reference: Soon, W. and Baliunas, S., 2003. Proxy climate and environmental changes of the past 1000 years. *Clim. Res*., 23, 89-110.

Dr. Mann: As shown by exhibit three, if I can have that up here as well now, thank you, this exhibit plots the estimated temperature for various locations shown in the previously displayed map. As you can see, the specific periods of relatively cold and warm, blue and red, differ greatly from region to region. Climatologists, of course, know this. What makes the late 20th century unique is the simultaneous warmth indicated by nearly all the long-term records. It is this simultaneous warmth that leads to the anomalous late-20th century warmth evident for northern hemisphere average temperatures.

The approach taken by SB does not take into account whether warming or cooling in different regions is actually coincident, despite what they might try to tell you here today.

Comment: Soon **does not** say that those periods are coincident. Soon (2003) writes, "The goal of [this] study is to deduce the geographical nature of climatic and environmental conditions during [the Medieval Warm Period and Little Ice Age] (p. 90)." And "...[T]he Medieval Warm Period and the Little Ice Age are **not expected to be homogeneous** and sustained (p. 91)." (emphasis added)

Patterns of climate change across the globe are an extremely important aspect of climate, so Soon deliberately retains this important information in their method, instead of eliminating it with a broad spatial average that reduces the complex climate system to a simplistic, one-dimensional temperature characterization.

Reference: Soon, W. and Baliunas, S., 2003. Proxy climate and environmental changes of the past 1000 years. *Clim. Res*., 23, 89-110.

Dr. Mann: Three, as it is only the past few decades during which northern hemisphere temperatures have exceeded the bounds of natural variability, any analysis such as SB that compares past temperatures only to early or mid-20th century conditions; you repeatedly hear Dr. Soon refer to the 20th century; climatologists do not consider that a meaningful baseline because there has been a dramatic warming during the 20th century and the early 20th century and the late 20th century are almost as different as the late 20th century and the other period during the past 1,000 years at least. So a study that refers only to early or mid-20th century conditions or generic 20th century conditions and does not specifically address the late 20th century, cannot address the issue of whether or not late-20th century warmth is anomalous in a long-term context.

Comment: Soon includes the **latest period available** in the proxies; the endpoint of each proxy is set by the expert researchers' record. Soon also distinguishes between early and late 20th century warming where such information is available (see p. 90 and Fig. 3 of Soon and Baliunas 2003).

Reference: Soon, W. and Baliunas, S., 2003. Proxy climate and environmental changes of the past 1000 years. *Clim. Res*., 23, 89-110.

Dr. Mann: To summarize, late-20th century warming is unprecedented in modern climate history at hemispheric scales. A flawed recent claim to the contrary by scientists lacking expertise in paleoclimatology is not taken seriously by the scientific community. The anomalous recent warmth is almost certainly associated with human activity and this is the robust consensus view of the legitimate climate research community.

Comment: In **none** of Mann's studies (Mann et al., 1998; Mann et al., 1999; Mann et al., 2003; Mann and Jones, 2003) is the late-20th century covered by his **proxy reconstructions**. In each of his studies, the proxy record ends in 1980. Therefore, he is unable to make any statements from his proxy reconstructions as to the temperature behavior during the last two decades of the 20th century. The only basis for his conclusions that the temperatures in late-20th century are anomalous is when he compares the instrument record with his proxy reconstructions—a comparison that is not statistically justified in that only a small fraction of the variability in the instrument record is accurately contained in the proxy reconstructions. This means that the proxy record does not mimic the large temperature swings that are present in the instrumental record. This being the case, it is not good scientific practice to extend the proxy record using the instrument record. One cannot nor should not draw any conclusions about the rarity of a temperature event that is present in the instrumental record in comparison with the proxy record—it is especially **egregious** to assign such a conclusion during a period when the instrument and proxy records do not even overlap (the late 20th century).

Mann demonstrates no support for his claim that the "scientific community" does not take seriously the conclusions of Soon that the late-20th century warming is

not unprecedented in modern climate history. The fact the Soon's research was published in two separate peer-reviewed scientific journals (Climate Research and Energy and Environment) indicates that someone at least took it seriously. There were, in addition to Soon and Baliunas, three other co-authors on the Energy and Environment article that are prominent members of the scientific community (Dr. David Legates, Dr. Sherwood Idso, and Dr. Craig Idso). In order to make such a claim, Mann would have to survey the scientific community of climatologists, and he has provided no such data. Dr. Mann's group of friends and co-authors does **not** generally represent the scientific community.

References:

Mann, M.E., Bradley, R.S., Hughes, M.K., 1998. Global-scale temperature patterns and climate forcing over the past six centuries, *Nature*, 392, 779-787.

Mann, M.E., Bradley, R.S., Hughes, M.K., 1999. Northern Hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations, *Geophys. Res. Lett*., 26, 759-762.

Mann, M.E., et al., 2003. On past temperatures and anomalous late-20th century warmth. *EOS*, Trans. Amer. Geophys. Union, 84, 256-258.

Mann, M.E., Jones, P.D., 2003. Global surface temperatures over the past two millennia. *Geophys. Res. Lett.*, doi:10.1029/2003Gl017814.

Soon, W., Baliunas, S., 2003. Proxy climate and environmental changes of the past 1000 years. *Clim. Res.*, 23, 89-110.

Excerpts and commentary from discussions following the opening statements:

Journal of Climate Research *controversy*

Senator Jeffords. As you may know, this is to all of you, the editor-in-chief of the magazine Climate Research resigned the position yesterday over problems with Dr. Soon's paper. In an e-mail sent to my staff, he said "My view, which is shared by many, but not all editors and review editors of Climate Research, is that the review of the Soon et al paper failed to detect significant methodological flaws in the paper. The critique published in the Eos journal by Mann et al is valid. The paper should not have been published in this forum, not because of the eventual conclusion, but because of the insufficient evidence to draw this conclusion."

Comment: What Senator Jeffords staff neglected to inform him was that three other editors at the magazine Climate Research (including the review editor of the original Soon/Balinuas paper) themselves **threatened to resign** if the remarks of editor-in-chief were improperly rushed into print by their journal.

According to Dr. Legates, the referred to "critique" in the Journal Eos was viewed by other scientists as little more than a continuation of Dr. Mann's orchestration of public attacks on his colleagues, Soon and Baliunas, and appeared only in the "Opinion" section of Eos. Dr. Mann's characterization of this opinion piece as

"peer-reviewed" is a **misrepresentation** of that term's common use. Co-author of the Soon-Baliunas papers, Dr. David Legates wrote a response op-ed piece in the Washington Times in which he describes **an effort to silence** so called "climate skeptics." (Emphasis added)

Global warming smear targets
By David R. Legates
THE WASHINGTON TIMES
Published August 26, 2003

While most of official Washington was captivated with the fight on the Senate floor to pass an energy bill before Congress left town for its August vacation, a vicious campaign was under way behind the scenes to smear two leading scientists for pointing out serious flaws in the science behind the theory of human-caused climate change.

The targets were Willie Soon and Sallie Baliunas, both astrophysicists at Harvard, who were characterized as fringe scientists whose work should be ignored. What did they do to attract such characterizations? They had the audacity to pull back the curtain on the wizard of global warming.

The issue focuses on a paper by them that supports the widely held view that the climate of the last millennium has been quite variable and includes a Medieval Warm Period and subsequent Little Ice Age. This is only controversial because it, and the wider body of scientific literature that exists, directly contradicts recent research by Michael Mann, a leading global warming proponent. Mr. Mann argues global air temperatures have been stable over the last 1,000 years, with the exception of the last 100. It is the "Mann-made" warming to which Mr. Soon and Ms. Baliunas have objected.

While most of these arguments are confined to academic discussions that the general public would find less than boring, this fight played out recently in front of the U.S. Senate Committee on the Environment and Public Works. It has also been echoed in several news accounts from academic journals to the New York Times.

Mr. Mann testified before the Senate committee that his research is the "mainstream view" because it is featured in a chapter of the U.N. Nations Intergovernmental Panel on Climate Change (IPCC) report, of which Mr. Mann was a lead author. Mr. Soon and Ms. Baliunas challenged Mr. Mann's claim by reviewing the large body of literature that shows his claims to be unsubstantiated and his research to be fatally flawed. In truth, Mr. Mann's work is the scientific outlier — the one study that does not fit with the wealth of scientific evidence.

Mr. Soon and Mr. Baliunas argue that Mr. Mann's conclusions rest on a dubious manipulation of data. While many of the problems in Mr. Mann's work require scientific expertise to understand, one flaw is so basic that everyone can understand it. Mr. Mann and his colleagues compiled a historical climate reconstruction — called the "hockey stick" because of its shape — primarily using tree ring records to infer air temperature trends. Their use of proxy data is not novel, but the methods they used and thus the results, certainly are. For example, Mr. Mann and his colleagues simply attached the surface temperature record of the 20th century to the end of the proxy record. This is an apples-to-oranges comparison as air temperature readings are not directly comparable to proxy records. However, putting the two different sets of data together in this way makes a stunning visual display for the average reader.

Also, in his analysis for the Northern Hemisphere prior to 1400, Mr. Mann uses data from nine locations in addition to statistical summaries derived from data for the Western United States only. Four of these additional locations are in the Southern Hemisphere, including Tasmania and Patagonia.

The widespread acceptance of this revisionist history was possible because the global-warming community was eager to accept the "hockey stick" as proof of human-caused climate change.

If it remained merely a disagreement about science and research methods, there wouldn't be much of a story — or reason for concern. Unfortunately, it turned into a scientific lynching of Mr. Soon and Ms. Baliunas and anyone associated with them. For example, Chris de Freitas, the editor of Climate Research that published the paper, was criticized for having failed in his responsibilities of quality control, even though the paper passed an extensive peer-review process and the publisher defended Mr. de Freitas' handling of the paper. It was argued Mr. de Freitas should be removed from his position simply for having published it. Even Mr. Mann, in his Senate testimony, dismissed Mr. de Freitas' credentials solely because he "frequently publishes op-ed pieces in newspapers attacking IPCC and attacking [the] Kyoto [protocol]."

Why is all this important? Global warming alarmists would have governments impose significant regulations with tremendous economic implications. The Bush administration is under attack simply for stating that the science is uncertain whether human-induced global warming is occurring. At the same time, scientists that add credence to that assertion are being silenced.

Yet if recent global warming is largely a result of natural climate variability, policies to reduce global warming would be unnecessary, costly and ineffective. Before we are asked to incur the pain, we should better understand whether there would be any gain.

"Methodological flaws" in Soon paper?

Senator Jeffords: What methodological flaws does he mean? Dr. Mann?

Dr. Mann. Well, I have tried to outline the most severe of those methodological flaws. I believe it is the mainstream view of just about every scientist in my field that I have talked to that there is little that is valid in that paper. They got just about everything wrong. They did not select the proxies properly. They did not actually analyze any data. They did not produce a reconstruction. They did not produce uncertainties in a reconstruction. They did not compare to the proper baseline of the late-20th century in trying to make conclusions about modern warmth.

So I think it is the collective view of our entire research community that that is one of the most flawed papers that has appeared in the putative peer-reviewed research in recent years.

Comment: First, Dr. Mann's persistent presumption of speaking for the "entire research community" or "every scientist in my field," coupled with his persistent and unprofessional public denigrations and misrepresentations of the work of other scientists seems suspicious. The true measure of a good scientist is self-criticism and the welcome examination by others through making his methods as transparent and available as possible for replication and validation checks by his peers.

Secondly, Dr. Mann here engages a classical "straw man" argument ("methodological flaws") by accusing Soon and Baliunas of doing something they did not and then attacking. Thus, Dr. Mann seems to misunderstand that Soon and Baliunas (2003) wrote what is known as a review paper—that is, a paper which serves to survey the available literature and consolidate the general findings. Review papers are common in the scientific literature in that they serve to summarize the state of the science on a particular topic. There is very little analysis that goes into them, but instead, a lot of contrasts and comparisons of the

various methods and results among a large group of researchers. This is precisely what Soon and Baliunas did. What they found was that, in a large majority of the over 200 research papers using proxies to represent past climates that they examined, there was evidence that the climate of the 20th century was not the most extreme during the period of record. Their conclusions follow directly from their literature survey and thus do not represent any "methodological flaws" in their approach.

Trashing the satellite record and Dr. John Christy

Dr. Mann. Yes. It is unfortunate to hear comments about the supposed inconsistencies of the satellite record voiced here, years after that has been pretty much been debunked in the peer-reviewed literature, in Nature and Science. Both journals have in recent years published several rigorously peer-reviewed articles indicating that in fact the original statement that the satellite record showed cooling was flawed because the original author, John Christy, did not take into account a drift in the orbit of that satellite, which actually leads to a bias in the temperatures from the satellite.

Christy and colleagues have claimed to have gone back and fixed that problem, but just about every scientist who has looked at it says that their fix is not correct. And if you fix it correctly, then the satellite record actually agrees with the surface record, indicating fairly dramatic rates of warming in the past two decades.

Comments. Dr. Mann once again resorts to **false alliance** with "just about every scientist" for a statement that is clearly unsupported by the scientific literature with which he should be familiar.

Because the satellite-measured lower atmosphere temperature record complied by University of Alabama-Huntsville (UAH) scientists John Christy and Roy Spencer continues to expose the inability of climate models to correctly simulate observed atmospheric temperature trends, both *Science* and *Nature* have amassed a small squad of troops along its flanks in hopes of being first to publish a paper that can successfully invalidate the data and destroy its credibility. The few attempts to date have been slight, transparent and largely irrelevant (http://www.co2science.org/edit/v6_edit/v6n19edit.htm).

Dr. Mann's attack on the work of Dr. Christy appears contextually **gratuitous** and was described by Dr. Christy as "**blatantly erroneous**." (emphasis added) It ignores a huge body of evidence that supports the veracity of the satellite temperature records that John Christy and others have carefully developed and maintained. A count of articles that have demonstrated an excellent level of agreement between the satellite temperature record of Christy et al. and those made independently by weather balloon observations tops 18 (see references below). None of these 18 studies suggest a "dramatic rate of warming" in the globally averaged troposphere during the past two decades. There is, to date, only 1 study which suggests that the Christy record is flawed, and that is one which arrives at its conclusion through comparison of the Christy et al. satellite record to climate models which show a strong warming instead of actual observations as each of the other 18 studies did.

References on Christy work:

Angell, J.K., 2000: Difference in radiosonde temperature trend for the period 1979-1998 of MSU data and the period 1959-1998 twice as long. *Geophys. Res. Lett.*, 27, 2177-2180.

Basist, A. N., and M. Chelliah, 1997: Comparison of tropospheric temperatures derived from the NCEP/NCAR reanalysis, NCEP operational analysis and the Microwave Sounding Unit. *Bull. Amer. Meteor. Soc*., 78, 1431-1447.

Brown, S.J., D.E. Parker, C.K. Folland and I. Macadam, 2000: Decadal variability in the lower-tropospheric lapse rate. *Geophys. Res. Lett*., 27, 997-1000.

Chase, T.N., R.A. Pielke, J.A. Knaff, T.G.F. Kittel, and J.L. Eastman, 2000: A comparison of regional trends in 1979-1997 depth-averaged tropospheric temperatures. *Int. J. Climatology*, 20, 503-518.

Chase, T.N., R.A. Pielke Sr., B. Herman, and X. Zeng, 2003: On the likelihood of rapidly warming surface temperatures unaccompanied by strong warming in the free troposphere in observations and climate model simulations. *Climate Res*., accepted.

Christy, J.R. , 1995: Temperature above the surface layer. *Climatic Change* , 30, 455-474.

Christy, J.R. and R.W. Spencer, 1995: Assessment of precision in temperatures from the Microwave Sounding Units. *Climatic Change*, 30, 97-102.

Christy, J.R., R.W. Spencer, and D. Braswell, 1997: How accurate are satellite 'thermometers'?, *Nature*, 389, 342-3.

Christy, J.R., R.W. Spencer and E.S. Lobl, 1998: Analysis of the merging procedure for the MSU daily temperature time series. *J. Climate*, 11, 2016–2041.

Christy, J.R., R.W. Spencer, and W.D. Braswell, 2000: MSU Tropospheric temperatures: Data set construction and radiosonde comparisons. *J. Atmos. Oceanic Tech.* 17,1153-1170.

Christy, J.R., R.W. Spencer, W.B. Norris, W.D. Braswell and D.E. Parker, 2003: Error estimates of Version 5.0 of MSU/AMSU bulk atmospheric temperatures. *J. Atmos. Oceanic Tech.* 20, 613-629.

Gaffen, D.J., B.D. Santer, J.S. Boyle, J.R. Christy, N.E. Graham, R.J. Ross, 2000: Multidecadal changes in the vertical structure of the tropical troposphere. *Science*, 287, 1242-1245. (selected as a NOAA Research Outstanding Scientific Paper Award 2001).

Hurrell, J., S.J. Brown, K.E. Trenberth and J.R. Christy, 2000: Comparison of tropospheric temperatures from radiosondes and satellites: 1979-1998. *Bull. Amer. Met. Soc.,* 81, 2165-2177.

Lanzante, J.R., S.A. Klein and D.J. Seidel, 2003: Temporal homogenization of radiosonde temperature data. Part II: Trends, sensitivities and MSU comparison. *J. Climate*, 16, 241-262.

National Research Council: NRC 2000, Reconciling Observations of Global Temperature Change. National Academy Press, Washington DC, 85 pp.

Parker, D.E., M. Gordon, D.P.N. Cullum, D.M.H. Sexton, C.K. Folland and N. Rayner, 1997: A new global gridded radiosonde temperature data base and recent temperature trends. *Geophys. Res. Lett*., 24, 1499-1502.

Pielke Sr., R.A., J. Eastman, T.N. Chase, J. Knaff and T.G.F. Kittle, 1998: 1973-1996 Trends in depth-averaged tropospheric temperature. *J. Geophys. Res*., 16,927-16,933.

Santer, B.D., et al., 2003. Influence of Satellite Data Uncertainties on the Detection of Externally Forced Climate Change, *Science*, 300: 1280-1284.

Stendel, M., J.R. Christy and L. Bengtsson, 2000: Assessing levels of uncertainty in recent temperature time series. *Climate Dynamics*, 16(8), 587-601.

Sterin, A.M., 1999: An analysis of linear trends in the free atmosphere temperature series for 1958-1997. *Meteorologiai Gidrologia*, 5, 52-68.

In response to the Mann remarks, **Dr. John Christy** wrote the following to Chairman Inhofe:

> Aug. 18, 2003
> Dear Mr. Chairman:
>
> Thank you for offering me the opportunity to respond to certain comments that were made in the EPW committee hearing on Tuesday, July 29, of this year. I hope I can clear up any confusion that might have been caused by incomplete, misleading or erroneous testimony that day.
>
> The testimony in question by Dr. Michael Mann stated:
>
> "It's unfortunate to hear comments about the supposed inconsistencies of the satellite record voiced here years after that has been pretty much debunked in the peer-reviewed literature in Nature and Science. Both journals have, in recent years, published … articles indicating that in fact, the original statement that the satellite record showed cooling was flawed because … the original author, John Christy, did not take into account a drift in the orbit of that satellite, which actually leads to a bias in the temperatures … Christy and colleagues have claimed to have gone back and fixed that problem. But just about every scientist who has looked at it says that this fix isn't correct and that if you fix it correctly then the satellite record actually agrees with the surface record, indicating fairly dramatic rates of warming in the past two decades."
>
> Virtually all of this testimony is misleading or incorrect. I will touch on the major problems, point-by-point, and I will try to be brief.
>
> 1. Certainly no one has "debunked" the accuracy of the global climate dataset that we built at The University of Alabama in Huntsville (UAH) using readings taken by microwave sensors aboard NOAA satellites. This dataset has been

thoroughly and rigorously evaluated, and has been published in a series of peer-reviewed papers beginning in Science (March 1990). The most recent version of the dataset was published in May 2003 in the Journal of Atmospheric and Oceanic Technology after undergoing a strenuous peer review process.

2. We, and others, are constantly scrutinizing our techniques to find ways to better analyze the data. In every case except one we discovered needed improvements ourselves, developed a method for correcting the error, and published both the error and the correction in peer-reviewed journals. When Wentz, et al. (1998) published their research on the effects of orbital decay (the one exception) they explained an effect we immediately recognized but which was partially counterbalanced by other factors we ourselves discovered. Since that time we have applied the corrections for both orbital decay and the other factors, and have published the corrected data in peer-reviewed journals.

3. The UAH satellite record does not show cooling in the lower troposphere and hasn't shown a long-term cooling trend since the period ending in January 1998. I cannot say where this chronic cooling misconception originated. Our long-term data show a relatively modest warming in the troposphere at the rate of 0.133°? Fahrenheit per decade (or 1.33°? Fahrenheit per century) for the period November 1978 to July 2003.

4. There is no credible version of the satellite dataset that "actually agrees" with the surface temperature record for the past 25 years, nor one that shows "fairly dramatic rates of warming." The as-yet-unexplained differences between the surface and satellite data are at the heart of the controversy over the accuracy of the satellite data.

While much of the surface data remains uncalibrated and uncorroborated, we have evaluated our UAH satellite data against independent, globally-distributed atmospheric data from the U.S. and the U.K. (Hadley Centre) as shown in the figure (enclosure 1). We published the results of those comparisons in numerous peer-reviewed studies (enclosure 2). In each case we found excellent consistency between the satellite data and the atmospheric data. One should note that such independent corroboration has not been performed on the other satellite temperature datasets alluded to in the quoted testimony.

This consistency between two independent datasets gathered using very different techniques gives us a high level of confidence that the UAH satellite dataset provides a reliable measure of global atmospheric temperatures over more than 90 percent of the globe. (By comparison, one of the most often quoted surface temperature datasets achieves partial-global coverage only by claiming that certain isolated thermometer sites provide representative temperatures for an area roughly equaling two-thirds of the contiguous 48 states, an area that would reach from about Brownsville, Texas, to Grand Forks, North Dakota.)

5. A final point relates to numerous comments elsewhere in the testimony in which an appeal to a nebulous "mainstream climate community" was made to support what was stated. First, the notion that "thousands" of climate scientists agreed on the IPCC 2001 text is an illusion. I was a lead author of IPCC 2001, as was Dr. Mann. There were 841 lead authors and contributors, the majority of whom were not climatologists and who provided input in the area in which they have expertise only to their tiny portion of the 800+ page document. These 841 were not asked to approve nor where they given the opportunity to give a stamp of approval on what was finally published.

Although I might be outside the "mainstream," according to Dr. Mann's perspective, I have never thought a scientist's goal was to achieve membership in the "mainstream." My goal is to produce the most reliable climate datasets

for use in scientific research. Whether they show warming or cooling is less important to me than their reliability and accuracy. That these datasets have been published in numerous peer-reviewed venues is testimony to accomplishing this goal and, by inference, would place me inside the mainstream climate community. In addition to being an IPCC lead author, significant achievement awards from NASA and the American Meteorological Society along with my recent election as a Fellow of the AMS are evidence of my impact on the community of scientists.

I hope this clears up any confusion you or your committee members might have had about the UAH global temperature data. If you or any of your committee members have any questions, I will be delighted to answer them to the best of my ability.

Thank you again for offering me this opportunity. I remain,

Sincerely,
John Christy, Ph.D.

More on the satellite data and* Journal of Climate Research *controversy

Dr. Legates. If I may add something, one of the things I have heard is that science has been debunked and, for example, we pointed to Dr. Christy's curve up here and said that because one paper has been written, that curve is now called into question. We have talked about, you mentioned von Storch's resignation from *Climate Research* because apparently he has admitted that this paper never should have been published.

I want to point out that science debate goes on and on. In particular, Dr. Christy has had some very important contributions to indicate that his curve is not incorrect. That is part of scientific debate. Furthermore, I will say with respect *to Climate Research*, Otto Kinne, who is director of Inter-Research, the parent organization of *Climate Research*, asked Chris de Freitas who was the editor who served on the Soon and Baliunas papers, and I can relay this because I am a review editor of *Climate Research* so I am familiar with what has been taking place.

There were several people complaining that Chris de Freitas should be removed simply because he published the Soon and Baliunas paper. That question was brought to Otto Kinne. He asked for Chris de Freitas to provide him with the reviews, the changed manuscripts and so forth. He provided a letter in late June to all of us in which he said, I have reviewed the evidence and I have indicated that the reviews, four for each manuscript, in fact there was a second or an earlier Soon and Baliunas article on another topic that was also called into question by these people leveling charges.

Essentially what he concluded was that the reviewers provided good and appropriate comments; that Doctors Soon and Baliunas provided an appropriate dressing or incorporation of these concerns; and that Chris de Freitas had in fact provided analysis appropriately.

Towards that end, Dr. von Storch was approached. *Climate Research* was putting in an editorial stating essentially this article should never have been published. Otto Kinne was informed and he has asked him not to submit that because it is not founded, and as a result Dr. von Storch, I now understand, has said he would resign.

Senator Jeffords. Dr. Mann?

Dr. Mann. Yes, just a very short comment. It is unprecedented in my career as a scientist to hear of a publisher of a journal going in and telling the editor-in- chief that he cannot publish an editorial. I find that shocking and a bit distressing. I do not know what the circumstances are behind it, but it is disturbing.

Dr. Legates. It is also unprecedented to find an editor being attacked, and this has also happened with the editorial staff of Energy and Environment, which is the other paper, to find an editor attacked for simply publishing an article that has been peer-reviewed and approved by reviewers.

Senator Inhofe. All right. The time has expired. We are four minutes over.

Senator Jeffords. I think that my witness should have the last word on my question, if I could. Dr. Mann, do you have any response to that?

Dr. Mann. Actually, my understanding is that Chris de Freitas, the individual in question, frequently publishes op/ed pieces in newspapers in New Zealand attacking IPCC and attacking Kyoto and attacking the work of mainstream climatologists in this area. So this is a fairly unusual editor that we are talking about.

> **Comment:** This statement again points to the depths of **Mann's bias**, and suggests that it might inhibit him from a fair view of reality. With this logic virtually every person alive would not be qualified to be a journal editor because surely they have some opinion on a topic that is related to their particular field of interest. He suggest that de Freitas is acting in an unusual way by publicly expressing his opinions about climate change, but totally ignores the fact, that one of the co-editors of each of the three IPCC reports of the state of climate change—John Houghton—recently had an op/ed in The Guardian in which he was harshly critical of President Bush for pulling out of the Kyoto Protocol and in which he described global warming as being a "weapon of mass destruction."

CO2 and plant growth

Senator Allard. I guess the question that I would have, now, you know you have increased CO2. So how is the environment in the Earth going to respond to increased CO2? Have any of you talked to a botanist or anything to give you some idea of what happens when CO2 increases in the atmosphere? Plants utilize CO2, extract oxygen. We inhale oxygen and extract CO2. Will plants be more prosperous with more CO2? How does that impact the plant life? Can that then come back on the cycle and some century later mean more O2 and less CO2?

So I am wondering if any of you have reviewed some of these cycles with botanists and see if they have any scientific data on how plants respond to CO2 when that is the sole factor. I am not sure I have ever seen a study. There is moisture and other things that affect plant growth, but just CO2 by itself. Have any of you seen any scientific studies in that regard?

Dr. Soon. I have seen of that. In fact, I have written also a small paper that has a small

section regarding that.

Senator Allard. And what was their conclusion?

Dr. Soon. Their conclusion is that in general, of course, under enrichment of the CO2 in the free air, that yes, plant growth, for example being put up as a crop here, the crop yield will be 30 percent higher, for example. And all these examples are very well known and well verified in the field of botany.

Senator Allard. My time has run out. Would the other two agree with what he said?

Dr. Mann: Not quite.

Senator Allard. What is your modification?

Dr. Mann. In fact, a number of studies have been done, what are called "FACE" experiments. They are open canopy experiments in which CO2 is elevated in the forest and scientists examine the changes in the behavior of that forest. And what scientists at Duke University are finding is that while there is a tendency for an uptake of CO2 by the plants in the near term, what happens is eventually those plants will die. They will rot. And when that happens, this happens on generational time scales.

> **Comment:** Mann fails to acknowledge the **1,000s of journal articles** that have conclusively demonstrated a beneficial effect from carbon dioxide enhancement. These studies have not only established enhanced plant growth in controlled laboratory conditions, but also in real world situations. In fact, the largest examination—that of global vegetation, has shown a remarkable enhancement of the global vegetative ecosystem during the past 20 years in response to growing atmospheric levels of carbon dioxide and the global climate conditions (Nemani et al., 2003).
>
> Reference: Nemani, R.R., et al., 2003. Climate-driven increases in global terrestrial net primary production from 1982 to 1999. Science, 300, 1560-1563.

Benefits of atmospheric CO2

Senator Inhofe. I quoted Dr. Frederick Seitz, the past president of the National Academy of Sciences yesterday, and professor emeritus at Rockefeller University, who compiled an Oregon petition which says there is no convincing scientific evidence that human release of carbon dioxide, methane and other greenhouse gases is causing, or will in the foreseeable future cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate.

Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth. Does each of the three of you agree or disagree with his statement?

Dr. Soon. I agree.

Dr. Legates. I would tend to agree.

Dr. Mann. I find little in there to agree with.

> **Comment:** Mann again refuses even to acknowledge the thousands and thousands of articles that have demonstrated without a doubt the beneficial role of carbon dioxide on plant growth.

Senator Inhofe. All right, thank you.