

Appendix D

Limitations and Problems with Existing Climate Data and Modeling

This Appendix provides a brief discussion of limitations and problems that have been raised with existing climate data and modeling. These limitations are also important to the work of the IPCC but are not necessarily directly cited in the IPCC 2007 written reports. Only representative literature citations and peer-reviewed references are included. This list, presented in alphabetical order, is not intended to be comprehensive. (Also see Appendix C.)

Alaska Glaciers – For many years environmental advocacy groups such as the World Wildlife Fund have claimed that glaciers are melting worldwide at an alarming rate due to global warming (World Wildlife Fund 2005). Computer models used to predict future warming rely on data such as glacier loss. A peer-reviewed study of Alaska glaciers published January 17, 2010, found that previous studies largely overestimated by 40 percent Alaskan glacier loss for 40 years (Berthier et al. 2010). Reasons for these lower values were attributed to the higher spatial resolution of the glacier inventory as well as the reduction of ice thinning underneath debris and at the glacier margins. Such factors were not resolved in earlier studies. Berthier et al. (2010) suggest that the estimates of mass loss from glaciers and ice caps in other mountain regions could be subject to similar downward revisions.

Bolivia Affect – The “Bolivia” affect is the general name that has been given to describe the fact that when global temperature maps are generated showing actual average temperatures based on surface station measurements across the globe, such maps are created by interpolating between surface stations. Of course, some countries have very few if any surface temperature monitoring stations, and therefore the temperatures across the country must be “filled in.” In the case of Bolivia, for example, there has not been any thermometer data in the Global Historical Climatology Network (GHCN) database since 1990. Therefore, when Bolivia is shown on a global map as having warm (or cold) temperatures, such a determination is based on having little or no current data (See Smith 2010). The same effect can be expected at a smaller geographical scale when surface temperature stations are far apart from the area of interest.

Chinese Weather Stations – Phil Jones, the former CRU director, and collaborator U. Chvung Wang, are accused of making “apparent attempts to cover up data from the Chinese weather stations (IBD 2010).” The location of 42 weather monitoring stations in remote parts of rural China cannot be determined. The data supposedly turned over to American scientists could not be corroborated or confirmed. Therefore, how much of the warming seen in recent decades is due to local effects of spreading cities cannot be determined. *The Guardian* contends that the researchers covered up the missing data for years (Pearce 2010a,b).

Carbon Dioxide Fraction – In making the case that human activities will significantly increase atmospheric CO₂ and drive increases in temperature, assumptions must be made regarding the persistence of CO₂ in the atmosphere. More than 30 studies contradict the IPCC claim that increased carbon dioxide persists in the atmosphere long term (Solomon 2008). Until the percentage contribution to the greenhouse effect from natural causes can be understood and subtracted from the present temperature trend to establish a reliable baseline, it is not possible to determine the greenhouse effect contribution from human activities.

Knorr (2009)¹ re-examines the available atmospheric CO₂ and emissions data including their uncertainties. It is shown that with those uncertainties, the trend in the airborne fraction since 1850 has been $0.7 \pm 1.4\%$ per decade, i.e. close to and not significantly different from zero. The analysis further shows that the statistical model of a constant airborne fraction agrees best with the available data if emissions from land use change are scaled down to 82% or less of their original estimates. Despite the predictions of coupled climate-carbon cycle models, no trend in the airborne CO₂ fraction can be found.

Climate Forcing and Feedback² – Spencer (2010) provides a very readable explanation of forcing and feedback. The energy balance of the Earth is determined by two energy flows: the rate at which solar energy is absorbed, and the rate at which infrared energy is lost to outer space. (The flow of heat from the Earth's core to the surface is very weak.)

- The temperature of the any object (including the Earth) will increase as long as the rate of heat gain exceeds the rate of heat loss by the object.
- The temperature of the any object will decrease as long as the rate of heat loss exceeds the rate of heat gain by the object.

It is generally assumed that the rate of energy flow in (absorbed solar energy) and out (infrared energy) of the Earth have remained the same and in balance for centuries, and therefore the Earth's temperature has remained the same. This type of energy balance is called "radiative energy balance," or "radiative balance." If a "forcing" agent causes the amount of absorbed sunlight to be unequal to the amount of infrared radiation being emitted to outer space, there is radiative forcing present.

- If the amount of sunlight absorbed by the Earth is increased, or if the amount infrared radiation lost to space is decreased, global warming will occur.
- If the amount of sunlight absorbed by the Earth is decreased, or if the amount of infrared radiation lost to space is increased, global cooling will occur.

¹ This summary of Knorr (2009) is adapted from their abstract.

² This basic explanation is summarized from Spencer (2010), which presents a more expanded and definitive explanation of climate forcing and feedback.

The “greenhouse” effect occurs because carbon dioxide absorbs and emits infrared energy, which makes it a “greenhouse gas” (GHG). Carbon dioxide can act like a radiative blanket within the atmosphere, warming the lower atmosphere and cooling the upper atmosphere.

The most important GHG in the atmosphere is water vapor. Water vapor and clouds account for about 90 percent of the Earth’s natural greenhouse effect, CO₂ amounts to about 3.5 percent, and methane contributes even less (Spencer 2010).

The IPCC consensus explanation of manmade global warming is that GHG emissions have caused an increase in the greenhouse effect. Therefore, an energy imbalance has been building up for about 100 years (the industrial period). The IPCC claims that the extra CO₂ emitted to the atmosphere stays in the atmosphere for decades (See Carbon Dioxide Fraction above), and the persistence of the energy imbalance will result in long-term global warming. Computer models are used to forecast this long-term global warming.

Due to its properties, addition of CO₂ to the atmosphere can be reasonably expected to cause some level of warming. There is serious disagreement over whether the IPCC consensus view is even reasonable, and whether the computer code of the models used correspond to the physical phenomenon that is being modeled.

“Feedback” refers to how clouds and other elements of the Earth’s climate system change in response to a temperature change. Such a change could magnify the temperature change (called “positive” feedback) or reduce the temperature change (called “negative” feedback).

- If the sum of all feedbacks in the climate system is positive, then catastrophic global warming can occur. Dramatic changes in climate would also be expected, such as droughts, floods, hurricanes, etc.
- If the sum of all feedbacks is negative, manmade global warming will not be a serious issue. It also would mean that CO₂ in the atmosphere would not adequately explain part warming of the Earth.

All IPCC climate models all exhibit positive feedbacks. The amount of feedback occurring is a key factor in determining whether warming or cooling can be expected. A temperature change can be caused either by a weak forcing that is being amplified by positive feedback, or by a strong forcing that is being reduced by a negative feedback.

- Estimates of past temperature change are better than estimates of the forcings that caused them. If a small temperature change is observed, it is traditionally assumed that it is caused by a tiny forcing being amplified by positive feedback.
- If an observed temperature change is not accompanied by a good estimate of what caused it, then a positive feedback will most likely be diagnosed.
- Ambiguity over observed feedbacks is the largest reason for the large range of global warming projections generated by the IPCC.

- Through peer-reviewed papers (Spencer et al. 2007, Spencer and Braswell 2008), as explained in Spencer (2010), the role of clouds in the climate system are not sufficiently understood. It is not known whether clouds cause temperature to change, or if temperature causes clouds to change.
- Natural cloud fluctuations in the climate system will cause a bias in the diagnosed feedback in the direction of positive feedback. This is the illusion of an overly sensitive climate system.
- Forcing and feedback have been confused in previous interpretations of natural cloud and temperature changes.
- The real climate system looks sensitive to climate modelers. Therefore, the IPCC models are built to be sensitive more than the climate system really is. The models then produce large estimates of global warming in response to increases in CO₂ (assumed to be anthropogenic).
- Spencer (2010) provides evidence that each of the 18 IPCC models show chaotic cloud fluctuations that cause year-to-year changes in global average temperatures. Climate researchers have not properly accounted for clouds causing temperature change (forcing) when trying to estimate how much temperature change causes clouds to change (feedback).
- Thinking that the climate system is sensitive, the IPCC models are coded to be overly sensitive, producing too much warming. By ignoring natural variations, climate modelers have concluded that they can ignore natural variations, resulting in a “consensus” or “group-think” assurance that mankind is causing global warming.
- The IPCC does not address any evidence for natural causes of global warming. Global warming and cooling are not the exceptions, but the rule, and have been occurring for centuries.
- The climate system can generate an energy imbalance all by itself. Natural climate variability is chaotic, poorly understood, and for the most part unpredictable, as Meteorologists well know.
- The IPCC models assume that the climate stays the same indefinitely, until it is forced to change due to some external influence.
- Climate change cannot be understood without first understanding the complexities of weather. Climate is essentially an average of weather. Without understanding what controls variations in weather, an understanding of the potential sources of climate change is not possible.

- Natural variations of only about 1 percent in global average cloud cover would explain most of the climate change observed over the prior 2,000 years.
- Natural fluctuations such as the Pacific Decadal Oscillation have been shown to cause a change in the Earth's energy balance, thereby affecting climate change naturally.

Climate Sensitivity – IPCC scientists like Stratus Consultants's Joel Smith claim that climate is more sensitive than first thought. This means that small increases in CO₂ concentrations will have an even larger impact on global warming and climate change (Snider 2009). Spencer (2010) presents data indicating that the climate system is much less sensitive to GHG emissions than experts claim it to be. That being the case, the measure of a carbon footprint may not be relevant to future global temperatures. Temperatures may be as likely to fall as to rise. (See "Climate Forcing and Feedback" above.)

Schwartz (2007) applied an empirical relationship between trends in surface temperature and ocean heat content, finding that a doubling the CO₂ concentration in the atmosphere would result in a 1.1°C increase in average temperature (0.1–2.1°C, two standard deviation uncertainty range). This result is 63% lower than the IPCC's estimate of 3°C for a doubling of CO₂ (2.0–4.5°C, 2SD range).

Conflicts of Interest – Accusations of conflicts of interest have been raised regarding the head of the IPCC climate change panel, Dr. Rajendra Pachauri. Dr. Pachauri and others (e.g., Al Gore) have a conflict of interest in that they are making a fortune from ties with "carbon trading" companies (North and Booker 2009).

Cooling Trends – In times past cooling trends and predictions of another ice age have been made (Sutton 2009). For example, Newsweek published a cover issue on April 28, 1975 warning of global cooling. From measured data, it is generally acknowledged that global cooling has been occurring in recent years. However, the current climate models do not predict such cooling. A number of scientists in recent years have predicted that we are entering an extended time of global cooling rather than warming. Most recently, Russian scientist Oleg Pokrovsky of the Main Geophysical Observatory says the world should expect cooling – and not warming (Gosselin 2010).

Cosmic Rays and Chlorofluorocarbons (CFCs) – Cosmic rays and chlorofluorocarbons (CFCs) have both been implicated in depleting the Earth's ozone layer. Qing-Bin Lu (2009), a professor of physics and astronomy, analyzed observations from satellite, ground-based and balloon measurements. Applying an established mechanism CFCs and cosmic ray energy particles were shown to be mostly the cause of climate change, rather than CO₂ emissions.

Data Availability and Peer-Review – The British government has determined that someone at East Anglia University committed a crime by refusing to release global warming documents sought in 95 Freedom of Information Act requests. The CRU is one of three international agencies compiling global temperature data. Requests for data have been blocked and/or unnecessarily delayed. For example, in April 2007 Belfast ecologist Doug Keenan requested The Queen's University of Belfast, Northern Ireland, to provide a copy of 40 year's worth of

data on 7,000 years of Irish tree rings. Three years' later, the tree ring data was eventually provided (Pearce 2010c). Not all climate researchers have made their raw data available for independent corroboration of their analytical results.

Debris flow – The IPCC climate scientists predicted that mudslides and landslides, known as debris flow, will increase due to global warming. Matthews et al. (2009) could find no obvious correlation between debris-flow frequency and a relative warm climate. They report that there appears to be no consistent upward trend in debris-flow frequencies over recent decades.

Forecasting methods – Unexpected shifts in a time series of measurements can lead to forecasting errors and model unreliability. Hoffman (2009) reports that

“David R.B. Stockwell and Anthony Cox, in a paper submitted to the *International Journal of Forecasting* entitled “Structural break models of climatic regime shifts: claims and forecasts,”.... In econometrics, the Chow test is commonly used in time series analysis to test for the presence of a *structural break*. A structural break appears when an unexpected shift in a time series occurs. Such sudden jumps in a series of measurements can lead to huge forecasting errors and unreliability of a model in general. Stockwell and Cox are the first researchers I know of to apply this econometric technique to temperature and rainfall data....”

The author's abstract notes that evidence was found for a significant change in the temperature series around 1997, corroborated with evidence of a coincident oceanographic regime-shift. The trends between the significant change points were used to generate a forecast of future flat global temperature changes.

Greenhouse Effect – As mentioned above, CO₂ absorbs space-bound infrared radiation, thereby increasing the energy available at the Earth's surface for warming or increased evaporation. There is disagreement about how powerful the effect is, especially when considered in combination with other factors, various feedback mechanisms both negative and positive, and other influences that might or might not overwhelm the effect of CO₂. (See Climate Forcing and Feedback above).

Gerlich and Tscheuschner (2009) argue that the natural greenhouse effect is not based in physical reality. Roberts (2010) argues that the “greenhouse” effect as an explanation for global warming is not supported by basic thermodynamics, nor by measured atmospheric data. The IPCC has found no specific scientifically measured real-world evidence of any causal relationship between human CO₂ emissions and the Earth's warming.

Greenland Glaciers – Melting of glaciers in Greenland has been pointed to as proof of the detrimental effects of catastrophic long-term global warming. Nick et al. (2009) applied numerical modeling to examine large-scale changes in Greenland outlet glacier dynamics. They conclude that Greenland tidewater outlet glaciers are highly sensitive to changes in their terminous boundary conditions and dynamically adjust extremely rapidly, providing an explanation for their almost synchronous behaviour to short-term fluctuations in climate. These

results imply that the recent rates of mass loss in Greenland's outlet glaciers are transient and should not be extrapolated into the future. (See also World Climate Report 2009.)

Hurricanes – News stories periodically appear suggesting a link between hurricane impacts and global warming (Poor 2008). But Pielke, Jr., et al. (2005, 2008) conclude that linkages between global warming and hurricane impacts are premature. At this time an individual storm simply cannot be definitively linked to global warming.

Early predictions by scientists at the Massachusetts Institute of Technology (MIT) were previously touted as showing the certainty of a link between global warming and stronger hurricanes. The same researchers using a new forecasting technique recently reported different model results. Emanuel et al (2008) predict a reduction in the number of hurricanes around the world over the next two centuries, with increases in intensity in some regions. New simulations have reportedly reproduced past hurricane fluctuations satisfactorily, suggesting that the improved model should generate more accurate future predictions.

More recently, Knutson et al. (2010) examined the relationship between tropical cyclones and climate change. The abstract of this study is provided below:

“Importantly, although some statistical methods project very large increases of about 300% by the late twenty-first century in aggregate Atlantic hurricane activity (power dissipation), such dramatic projected increases are not supported by existing downscaling models or by alternative statistical methods. Moreover, despite some suggestive observational studies, we cannot at this time conclusively identify anthropogenic signals in past tropical cyclone data. A substantial human influence on future tropical cyclone activity cannot be ruled out, however, and could arise from several mechanisms (including oceanic warming, sea-level rise and circulation changes). In the absence of a detectable change, we are dependent on a combination of observational, theoretical and modeling studies to assess future climate changes in tropical cyclone activity. These studies are growing progressively more credible, but still have many limitations, as discussed in this review.”

Recent peer-reviewed studies refute climate models based on the anthropogenic global warming hypothesis (Kuleshov et al. 2010, Zhou et al. 2009). The recent global warming has not caused an increase in severe tropical cyclones. In fact, cyclone activity is basically flat despite the large increase in human CO₂ emissions.

Research Integrity – Errors in the IPCC 2007 report and release of the CRU emails (ClimateGate) have raised serious concerns regarding the integrity of the IPCC and climate science and research. In the U.S., an inquiry was conducted by Pennsylvania State University on the methods used by climate scientist Michael Mann and his construction of the famous “Hockey Stick” graph, which follows:

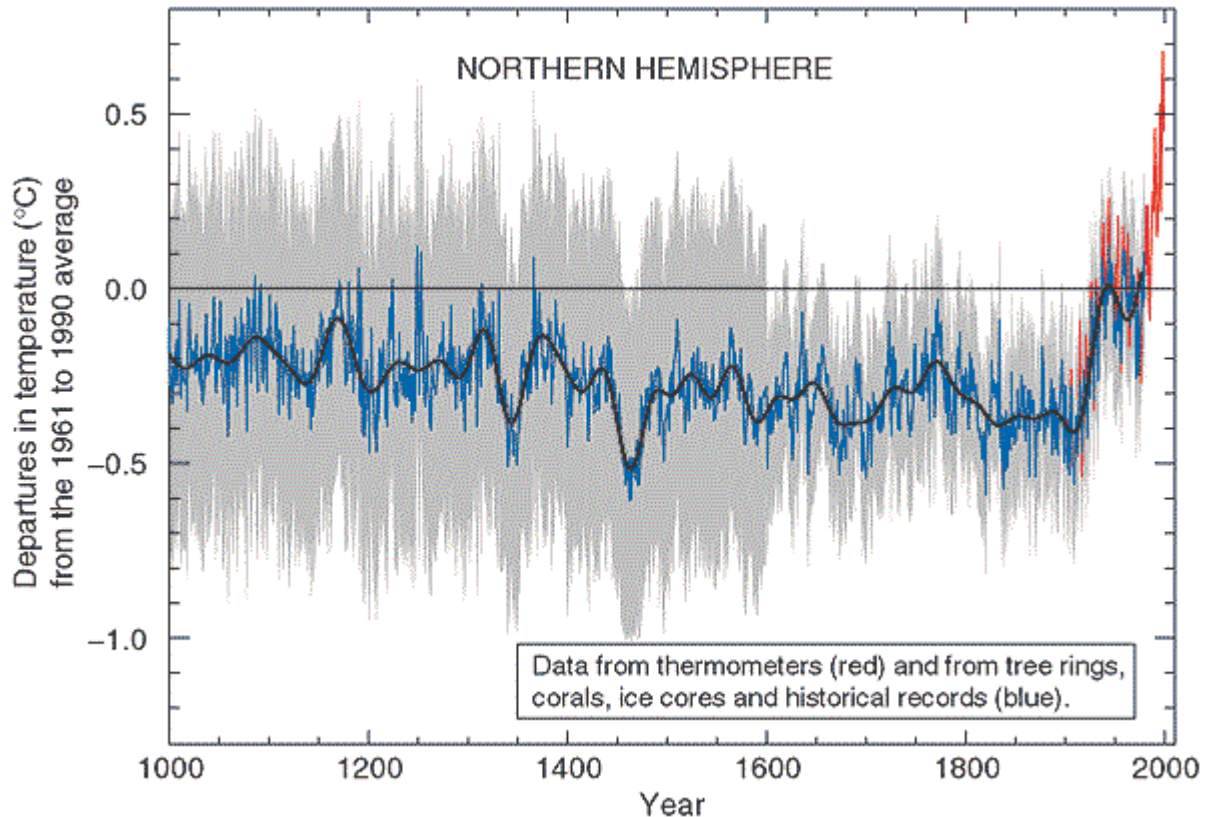


Figure D-1. Last 1000 Years of Temperature Estimation After Dr. Michael Mann.

The temperature graph above (Figure D-1) shows a small temperature variation before 1900. The graph was published in *Nature*, and prominently displayed in several places in the IPCC 2001 report. The graph is also called MBH98 after the three authors Mann, Bradley, Hughes, and from the year it was compiled, 1998.

The figure does not appear in the IPCC 2007 report. The graph does not adequately show the Medieval Warming Period and the Little Ice Age, which correspond to historical records. In addition, the statistical methods used to construct the graph have been questioned³ as inappropriate (Harvey 2010).

The mercury thermometer was invented in 1724 by Gabriel Fahrenheit. To estimate temperature prior to that time, “proxy data” are used – measurements derived from records such as ice cores, tree-rings and growing season dates. Before 1900, temperature estimations are based largely on tree ring data. To estimate tree ring growth in the past, a normalization was made comparing tree ring growth during the 20th century to temperature records. However, tree ring data after 1900 do not correspond well to temperature changes. (See Tree Line discussion below.)

³ Professor David Hand, president of the Royal Statistical Society, has concluded that the statistical methods were inappropriate, as reported in Harvey (2010).

Actual temperature records (the red line in Figure D-1) were used for the more recent period, combined with proxy data reconstruction (the blue line in Figure D-1), to create the overall graph. However, when presented in the IPCC 2001 report, the tree ring data was truncated after 1961 as shown in Figure D-2 below, without explanation (Rose 2010).

Beginning on and about November 22, 2009, The Pennsylvania State University began to receive numerous communications (emails, phone calls and letters) accusing Dr. Michael E. Mann of having engaged in acts that included manipulating data, destroying records and colluding to hamper the progress of scientific discourse around the issue of anthropogenic global warming from approximately 1998. These accusations were based on perceptions of the content of the widely reported theft of emails from a server at the Climatic Research Unit of the University of East Anglia in Great Britain.

The University conducted an internal investigation, and found that there was no credible evidence that Dr. Mann had:

1. Engaged in, or participated in, directly or indirectly, any actions with the intent to suppress or falsify data.
2. Engaged in, or participated in, directly or indirectly, any actions with the intent to delete, conceal or otherwise destroy emails, information and/or data, related to AR4, as suggested by Phil Jones.
3. Engaged in, or participated in, directly or indirectly, any misuse of privileged or confidential information available to you in your capacity as an academic scholar.

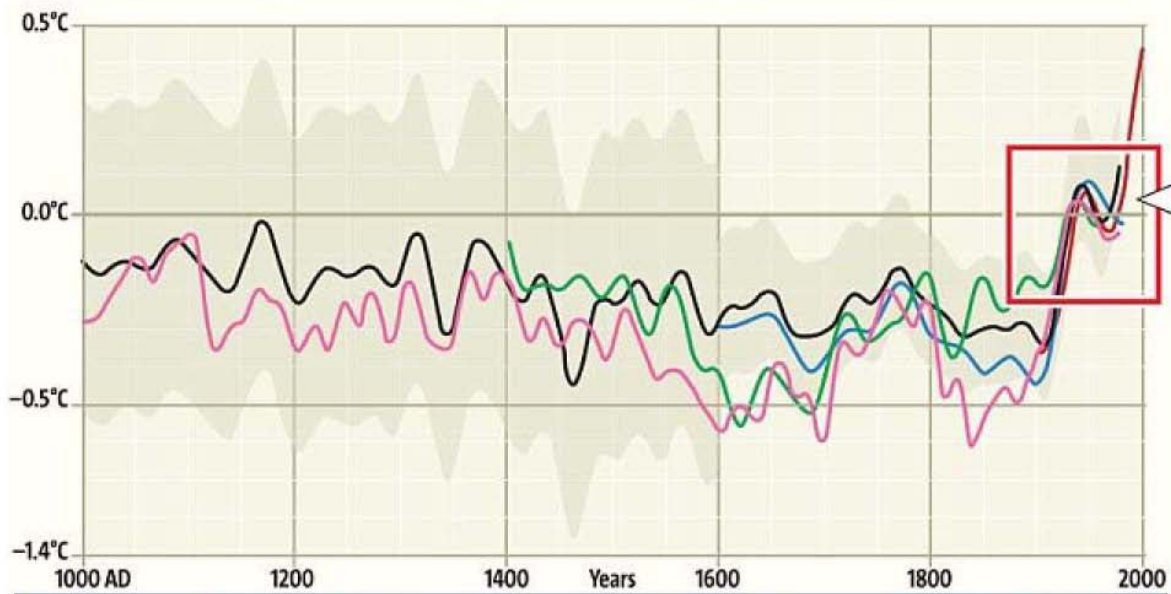
The university could not determine whether any evidence existed regarding the fourth and final accusation below:

4. Engaging in, or participating in, directly or indirectly, any actions that seriously deviated from accepted practices within the academic community for proposing, conducting, or reporting research or other scholarly activities.

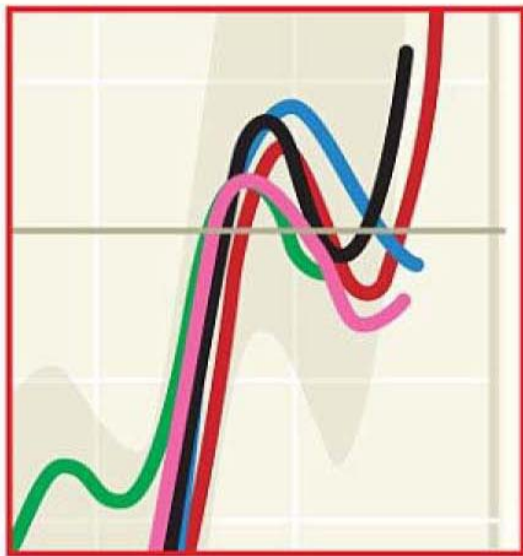
Critics have charged that the University of Pennsylvania internal investigation was a “whitewash” and does not begin to address the issues (Barnes 2010). It is unclear what next steps will be taken, if any.

The IPCC also recognizes that it has an integrity problem, especially with regard to quality control of its reports. To address this, on March 10, 2010, the IPCC requested the UN InterAcademy Council (IAC)⁴ to conduct an independent review of the policies and procedures of the IPCC. Based on this review, the IAC will issue a report with recommended measures and actions to strengthen IPCC’s policies and procedures so as to be better able to respond to future challenges and ensure the quality of its reports. The IAC consists of the Academies of Sciences from 20 countries. Critics charge that a review of the IPCC by another entity that advises the UN branch will not be objective, which may further undermine its credibility (Terrell 2010).

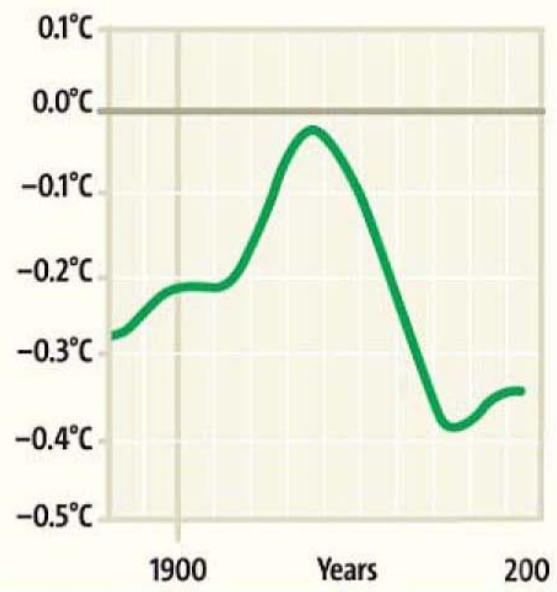
⁴ For more information regarding this review go to: <http://reviewipcc.interacademycouncil.net/>



The IPCC's crucial 'hockey stick' graph shows a dramatic rise in temperatures over the last 40 years of the 20th Century – but what happens to the green line of data from tree rings?



Blowing up the graph shows it disappears in 1961, artfully hidden behind the other colours



The reason? Because this is what it shows after 1961: a dramatic decline in global temperatures ...

Figure 2. Tree Ring Proxy Data Show a Dramatic Decrease in Global Temperatures After 1961 (Source: Rose 2010)

Role of CO₂ – Interglacial periods are thought to be Milankovitch cycles enhanced by rising atmospheric carbon dioxide concentrations. During interglacial periods, global temperature is believed to be primarily controlled by carbon dioxide concentrations, modulated by internal processes such as the Pacific Decadal Oscillation and the North Atlantic Oscillation.

Marsh (undated) has examined the impact of galactic cosmic ray flux and low altitude cloud cover, concluding that carbon dioxide appears to play a very limited role in setting interglacial temperatures.

Russian Data Omission – The Moscow-based Institute of Economic Analysis (IEA) issued a report⁵ that the Hadley Center for Climate Change based at the headquarters of the British Meteorological Office in Exeter (Devon, England) had probably tampered with Russian-climate data. As reported by Delingpole (2009), ... “the IEA believes that Russian meteorological-station data did not substantiate the anthropogenic global-warming theory. Analysts say Russian meteorological stations cover most of the country’s territory, and that the Hadley Center had used data submitted by only 25% of such stations in its reports. Over 40% of Russian territory was not included in global-temperature calculations for some other reasons, rather than the lack of meteorological stations and observations.” D’Aleo and Watts (2010) examine the impact of the omitted Russian data on temperature estimates. (See Appendix J)

Sea Level Predictions – A 2009 paper entitled “Constraints on future sea-level rise from past sea-level change” published in *Nature Geosciences* used fossil coral data and temperature records derived from ice-core measurements to reconstruct how sea level has fluctuated with temperature since the peak of the last ice age. The study claimed that sea levels would rise by up to 82 cm by the end of the century, and confirmed the conclusions of the IPCC 2007 report. The IPCC 2007 report stated that sea level would probably rise by 18cm-59cm by 2100, but stressed this was based on incomplete information about ice sheet melting and that the true rise could be higher.

In February 2010, the authors formally withdrew their paper from *Nature Geosciences* publication. After publication, the authors became aware of two mistakes that impact the detailed estimation of future sea level rise. Therefore, the authors could no longer draw firm conclusions regarding 21st century sea level rise from the study without further work. The authors do not know whether the retracted papers sea level rise estimates are an overestimate or an underestimate. (Adam 2010)

Vermeer and Rahmstorf (2009) project a rise of 0.75 m to 1.9 m by 2100, based on the future global temperature rise scenarios of the IPCC 2007 report.

Temperature Records – Temperature data records used to support the IPCC’s claims about “unprecedented” and catastrophic late 20th century global warming are untrustworthy. The records rely on a dwindling number of weather surface stations whose readings have been skewed either by relocation or by the warming effects of the cities (O’Sullivan 2010).

⁵ The IEA report can be found at <http://en.rian.ru/papers/20091216/157260660.html>

Two American researchers claim that the U.S. National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautic and Space Administration (NASA) Goddard Institute for Space Studies (GISS) have reduced the total number of Canadian weather stations in the database, and have “cherry picked” the ones that remain by choosing sites in relatively warmer places, including more southerly locations, or sites closer to airports, cities or the sea (Foot 2010). In the 1970s, nearly 600 Canadian weather stations fed surface temperature readings into a global database assembled by NOAA. Now NOAA only collects data from 35 stations across Canada.

Tree lines – Summer temperature is widely considered to be the primary control of treeline formation and maintenance. Winter temperatures have previously been considered less critical because of the insulative effects of snow. A recently published study by Harsch et al. (2009) found that treelines are not universally responding to climate warming by advancing. No evidence was found to support the prevailing view that high altitude and latitude treelines are controlled only by summer temperatures. Treelines are more likely to advance at sites that had warmed during the winter months.

U.K 2006 Stern Report – In 2006, a U.K. government-commissioned report known as the Stern Report presented an economic doomsday prediction.⁶ Some predictions had been watered down after publication because the scientific evidence on which they were based could not be verified. Among the original claims deleted were that northwest Australia has had stronger typhoons in recent decades, and that southern Australian lost rainfall because of rising ocean temperatures. (Gray 2010, Pielke 2007). Robert Muir-Wood, a researcher, claims the Stern Report misquoted his work to suggest a firm link between global warming and more-frequent and severe floods and hurricanes. Robert Muir-Wood claims his original research showed no such link, and that the Stern Report went far beyond what was an acceptable extrapolation of the evidence (Leake 2010).

U.S. Data Quality – The U.S. National Climate Data Center has been accused of manipulating weather data (Murray and Abbott 2010). Forty years ago there were 6,000 surface-temperature measuring stations, but only 1,500 by 1990. Most of the deleted stations were in colder regions, resulting in misleading higher average temperatures. The National Aeronautics and Space Administration (NASA) has admitted that its temperature records are inferior to those maintained by both the University of East Anglia's Climatic Research Unit (CRU), the focus of ClimateGate, and the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC). (Snow 2010)

Urban Heat Island Effect – The Urban Heat Island Effect (UHIE) refers to the observation that air temperatures increase in urban areas as compared to rural areas, by virtue of the effects of development. This suggests that man (development) has caused warming in urban locations, which is expected. However, the UHIE has not caused warming in rural locations. Long (2010) has presented a critique of the National Climatic Data Center's (NCDC's) treatment of historical data for the contiguous U.S., finding that the NCDC committed the same data tampering with

⁶ http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/sternreview_index.htm

U.S. data, as the Moscow-based Institute of Economic Analysis (IEA) found the Hadley Center for Climate Change had done with historical temperature data for Russia.

Water vapor – Water vapor is the most important greenhouse gas, yet little research has been done its effect on atmospheric temperature. Solomon et al. (2010) have found that a decrease in water vapor concentration of about 10% since 2000 slowed the rate of increase in global surface temperature over 2000-2009 by about 25%, compared to that which would have occurred due only to CO₂ and other GHGs. Limited data suggest that stratospheric water vapor probably increased between 1980 and 2000, which would have enhanced the decadal rate of surface warming. These findings show that stratospheric water vapor is an important driver of decadal global surface climate change. (See above discussion on “Climate Forcing and Feedback.”)

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