

Understand Climate Science Before Making Climate Policy

George C. Marshall Institute

Roger W. Cohen, May 14, 2010

One of the most remarkable dynamics in the global warming debate is the response to the question: “Tell me, what is the case for significant anthropogenic global warming?” The responses tend to fall into three categories:

One is appeal to authority: “All scientific societies agree that carbon dioxide emissions are causing (fill in the blanks)”

Second is the “It doesn’t matter” response: “Even if the science is wrong, it is still important to do something about it” (that “something” is always big and expensive). I’m going to call this the “Precautionary Principle” response – the idea that if there is any risk at all, we need to do something heroic to reduce it.

Third is out-and-out anger: Something to the effect, “You denier (or some other ad hominem). How dare you try to tell me there won’t be a catastrophe.” This is a favorite of even otherwise dignified groups such as the National Academy of Sciences.

A Debate Dynamic

Question: “What is the case for significant anthropogenic global warming?”

Answer #1: Appeal to Authority, E.g.,

“Well, all scientific societies agree that carbon dioxide emissions are causing *(fill in the blank)*.”

Answer #2: The “Precautionary Principle,” E.g.,

“It doesn’t matter. Even if the science is wrong, it is still important to do *(something big and expensive)* about it.”

Answer #3: Anger, E.g.,

“You *(denier, tool of special interests, dogmatic #@\$%...)*!

How dare you tell me there will *not* be a climate catastrophe!”

Notably, you don't get an answer to the question. Today I want to share some thoughts about this dynamic, because maybe if we understand it, we may have a better chance of following a wise course.

First, we need to answer the question, "What *is* the case?" It has nothing to do with the literally hundreds of alleged *effects* of global warming that have been claimed and reported in the media -- from shrinking ice caps to shrinking sheep. Those effects may or may not be happening; and those that are happening may or may not be due to global warming; and those that are due to past global warming may or may not have been caused by human activity. The case for "attribution" boils down to two assertions. First is that the warming observed during the 20th century was exceptional when compared with previous climate change. Therefore, we must have caused it, and it was mostly our CO2 emissions that did it. Second is the prediction from climate models that things will get much worse in the future.

The Case for Attribution to Human Activity

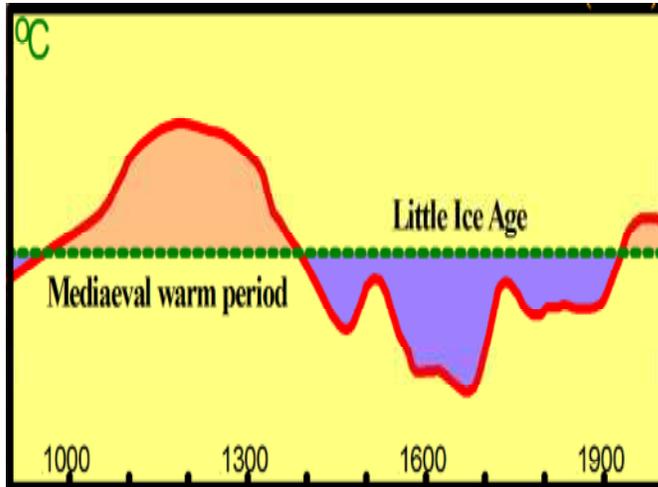
1. Evidence That Twentieth Century Warming Was Exceptional
2. Models Say Future Warming Will Be Much Worse

Slide 2

If 20th century warming was indeed exceptional, then previous warming episodes and all natural variations must have been smaller. Interestingly, in the first IPCC report of 1990, we saw this graphic

of global temperature since about the year 1000. There is a strong Medieval Warming Period, a deep Little Ice Age, and a sporadic warming trend since around 1700.

Early IPCC Report Found Current Temperatures Unexceptional



IPCC 1990

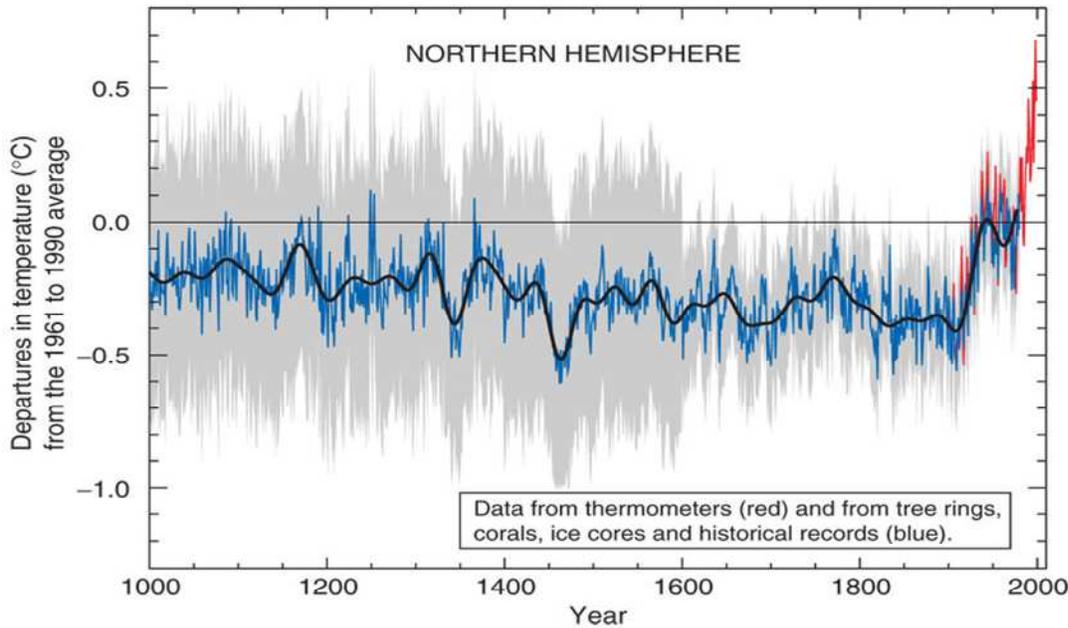
[After Hubert H. Lamb, first Director of CRU, University of East Anglia]

IPCC 1990 Fig 7c

Slide 3

But when we get to the 2001 Report, we are presented with the Hockey Stick. It was based on various proxy “thermometers” such as tree rings. It seems to show that the earth purrs along merrily and constantly until the 20th century, when rapid warming takes off.

IPCC 2001: Hockey Stick as “Smoking Gun”
20th Century Warming Was Exceptional



IPCC 2001 SPM Fig. 1b

Slide 4

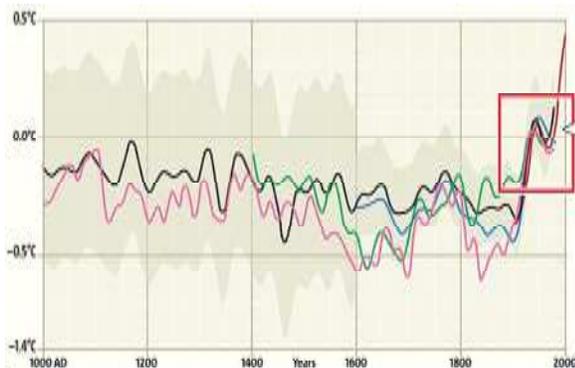
The hockey stick became the poster child of global warming, the most celebrated graph since Descartes invented the *idea* of graphs. We saw it in Gore’s movie. It appeared over and over again in the IPCC report. Let me read from that report, “The rate and duration of warming of the 20th century has been much greater than in any of the previous nine centuries. Similarly, it is likely that the 1990s have been the warmest decade and 1998 the warmest year of the millennium.” End of argument? No. We now know that this statement is baseless; it rests on work laden with technical errors and outright finagling. Climategate told us about the behind-the-scenes manipulations to promote and defend the stick, and to prevent criticisms from being published. But even before Climategate, the work of Steve McIntyre, Ross McKittrick, Hans Von Storch, and others had disposed of it from a science perspective. There are many documented serious problems with the stick. The early statistical methods were found to be flawed; they would produce an upward “blade” even from bogie proxies with no trend. Other research indicated that the method itself inherently underestimates past temperature changes by a factor of two or more. There is deliberate cherry-picking: the consistent and repeated inclusion of certain favorable proxies, while excluding many others from nearby locations that don’t show stick behavior. There is the addition of fictional data to create the appearance of warming when the real data don’t show any. There is even an example of contrary data entered upside down so as to contribute to stick behavior.

The most notorious issue involves a widely publicized e-mail string that has scientists discussing a so-called “trick” to “hide the decline.” They were talking about how to deal with a problem in showing how tree ring proxies stack up to the actual temperature record. The problem is that tree rings showed a decline in their inferred temperature after around 1960-1980, while the actual temperature is believed to have increased. This is called the “divergence problem.” At issue is whether tree rings can be trusted as proxy “thermometers” going back 1,000 years or more if they can’t reproduce the last 40 years. The divergence problem was known before the revelations. What is new is that we now know there was deliberate deception to mask the discrepancies.

So in this graph from IPCC 2001, you see four proxy reconstructions wiggling along pretty flat for centuries, then starting up, but if you look close, they mysteriously end around 1960 or soon after. The actual instrumental record is spliced on to the proxies to create an upward sweeping blade, and the eye loses track of the proxies. In fact proxy data disappear. The part left out for one proxy is shown in the lower right. It decreases while the instrumental temperature goes up; in fact it drops all the way down to the baseline level of all proxies over the last 400 years.

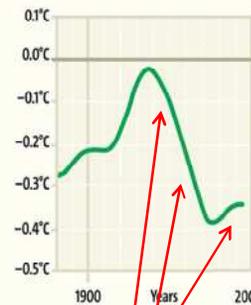
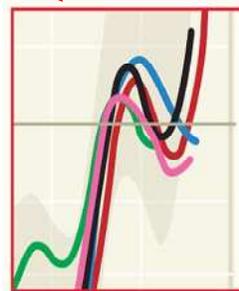
“Hide the Decline”

Proxies Do Not Agree With Instruments Post 1960 – But Data Deleted in IPCC 2001



IPCC 2001 WG1
Fig 2.21

Remove proxy data and splice on
← temperature data; steepen the “blade”



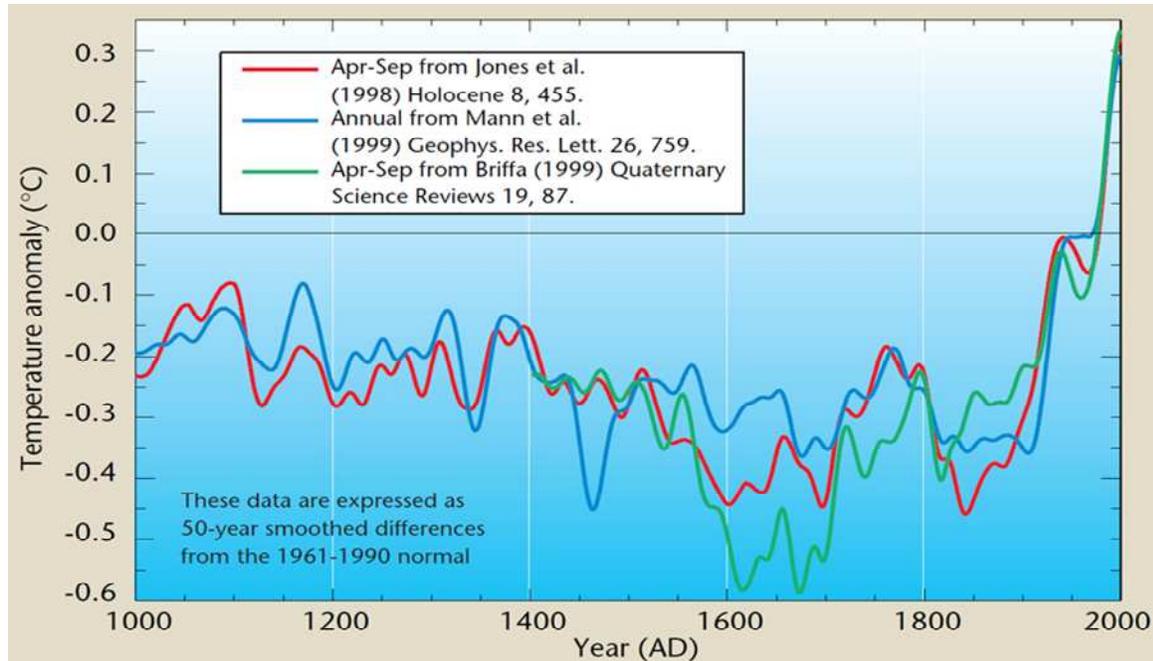
Mask the end points →

The “decline” is left out

“A proxy diagram of temperature change is a clear favourite for the Policy Makers’ summary...But the current diagram with the tree ring only data ...dilutes the message rather significantly...” – CRU email

In the UN WMO Anniversary Report, the trick is complete. We are shown continuous proxy curves as if there are real data after 1960. No one can tell that the last forty years are really instrumental data grafted on because the proxies don't work. As a touch of irony, the Forward to that report reads in part, "The WMO stands ready to maintain its role as the authoritative international scientific voice on weather and climate."

*World Meteorological Organization Report:
All Mention of Splicing of Proxy and Instrumental Record Is Gone*



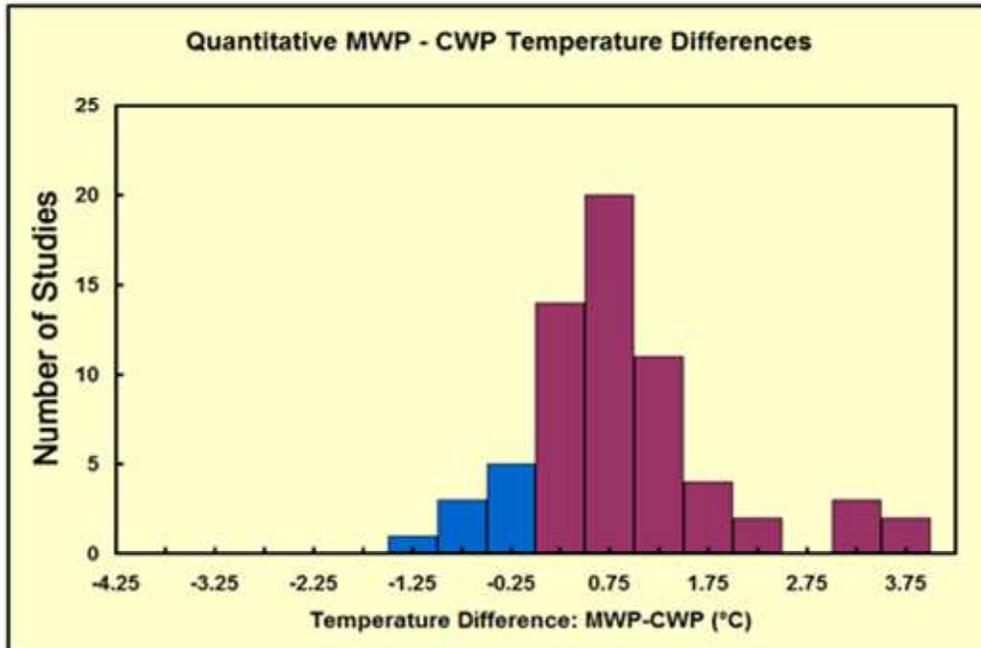
WMO Report 2000 Cover

Slide 6

Then there is the revelation that much raw data used to construct the thermometer temperature record itself from stations around the world have been lost or deleted. It means that other scientists cannot check basic calculations appearing to show a long-term rise in temperature over the past 150 years. Destroying data is scientific unacceptable, made doubly damning because of the importance of the instrumental record and its role in climate modeling – more on this later.

We may never know with certainty how 20th century warming stacks up against the Medieval . The 2006 Wegman Report to Congress concluded that the data just aren't good enough. But it is a fact that by latest count, 56 proxy studies – shown below in purple -- have the Medieval Period warmer than today, while only 9 – shown here in blue -- have it cooler. And those nine are not independent. They are produced by the same researchers, reviewed by the same incestuous set of reviewers, who use a core of a few proxies again and again to get the hockey stick result. The weight of evidence from proxy studies is that the 20th century was not exceptionally warm after all.

Most Proxy Studies Show Medieval Warm Period
Was Warmer than Today

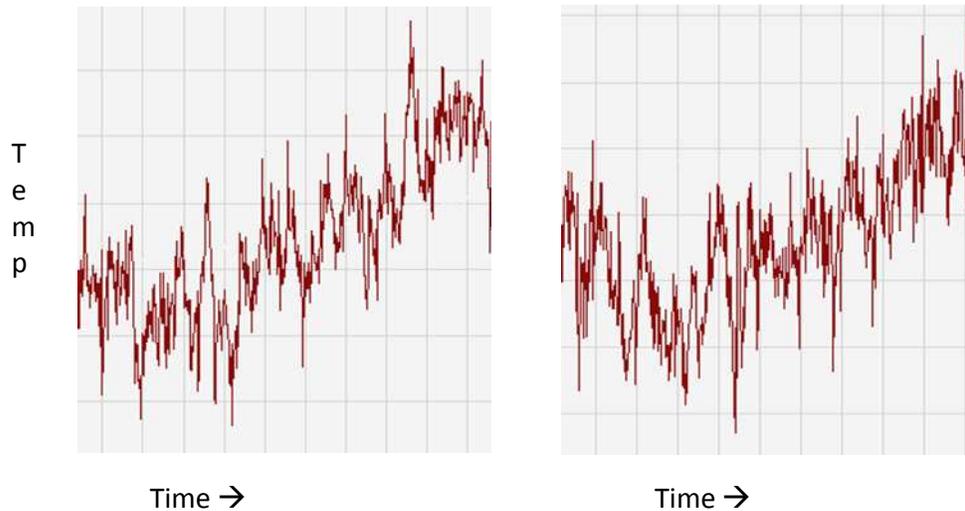


Center for the Study of Carbon Dioxide and Global Change

Slide 7

There are other problems with the assertion that 20th century warming was exceptional. One stems from the fact that it occurred in two bursts – one from about 1910 through about 1940 and one from about 1970 to 2000. Those two bursts are shown below in separate graphs of global average temperature versus time over a 51-year period – one is from 1895 through 1946; the other is from 1957 through 2008. The scales are the same for both graphs. The earlier one is ascribed to natural causes because human emissions then were insignificant compared to later in the century. The later one is blamed on us. The problem is that the first burst was just as fast as the second. Quiz: which is which? Answer: The one blamed on us is on the left. If the first was natural, why is the second unnatural?

Global Average Temperature in Two Half Century Periods:
Which is 1895-1946 (Nature); Which is 1957-2008 (Us?)



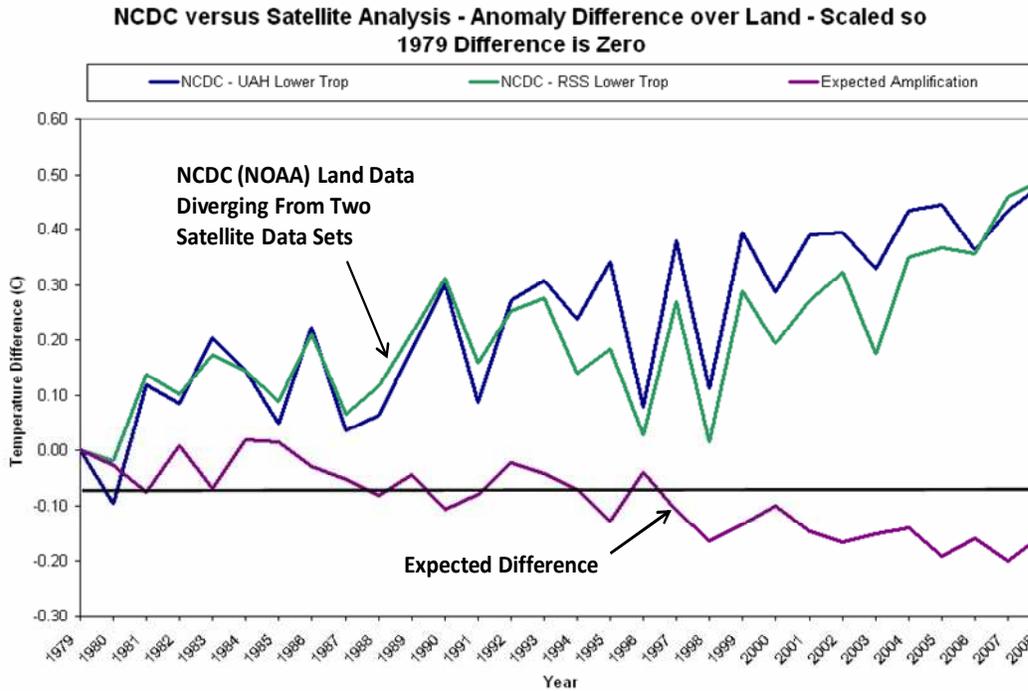
Global average temperature and time scales are identical

Hadley CRUT3 global average temperature record

Slide 8

Another problem is that there is now serious discomfort with the surface instrumental data themselves. For example, we observe a steady divergence of satellite data from land-based data since the satellite measurement era began in 1979. The graph below is from a recent publication plots the difference between land data from the National Climate Data Center and the satellite data sets from the University of Alabama at Huntsville and the Remote Sensing Systems company. We expect the track indicated by the purple. The expanding difference points to highly exaggerated warming trends in land-based data, by about $1\frac{1}{2}$ degrees Celsius per century. This instrumental difference is much more than the entire 20th century warming trend. Quiz Number 2: Which data streams are *not* in the IPCC reports?

Satellite Measurements Show Much Less Warming Than Land-Based Data



P. J. Klotzbach et al, *An alternative explanation for differential temperature trends at the surface and in the lower troposphere*, Journal of Geophysical Research 2009

Slide 9

We now know that published land temperature trends are highly correlated with socioeconomic variables such as urban heat island effects, land use, and preferential cool-station drop out, so much so that the published trend may be exaggerated by a factor of two.

And then there is the constant back-correcting of past trends. These corrections consistently make the past look cooler, whereas unbiased corrections should equally favor warming and cooling. When you see a published graph of temperature trend, the odds are good that it is steeper than it was a few years ago – because past data have been adjusted to make it look steeper.

The problem of data quality and integrity is huge and is just beginning to be unraveled, thanks to the Climategate disclosures and information becoming available in this country through the Freedom of Information Act.

The real backbone of the case is the climate models. These very complex computer models are first calibrated against the observed warming of the 20th century and then used to forecast climate for future emissions scenarios. This calibrating or “hindcasting” is where the exaggeration of past trends gets to be important. The steeper the warming, the harder to account for it with just natural variations. Indeed, models cannot reproduce past warming with just natural variations, so it is assumed it was caused mostly by greenhouse gases, mainly CO₂.

Using the models, the IPCC says that doubling of atmospheric CO₂ relative to the preindustrial era – the mid 1800s -- will warm the earth on average by 2 to 4 ½ degrees C, with a most likely value of 3 degrees. That doubling should occur sometime in the second half of the century. But the whole edifice rests on whether those natural variations and the so called “feedbacks” in the climate system are modeled correctly. Feedbacks are physical and chemical changes in the climate that add to or subtract from the warming effect of CO₂ just by itself. They are very hard to get right, and it is not a matter of raw computing power. Without any feedbacks, the effect of doubling atmospheric CO₂ is only about 1 degree. To get serious global warming, there must be large amplifying feedbacks to turbocharge the warming.

“It’s the Feedbacks, Stupid”

Global Warming From Doubling of CO₂ = 1 Degree C / (1 – f)

F is called the “Feedback Factor”

No Feedback: f = 0 → Global Warming = 1 Degree C

Strongest Possible Feedback: f = 1 → Climate is unstable

Negative Feedback: f is negative → Global Warming Less Than 1 Degree C

IPCC Models: f = 0.5 to 0.8 → Global Warming is 2 to 4.5 Degrees C

“Most likely:” 3 Degrees C

Slide 10

In Slide 10, my one equation says that the global warming we get for doubling of atmospheric CO₂ is that naked one degree for CO₂ all by itself, divided by (1-f). f is called the feedback factor. If all the feedbacks add up to zero, global warming is 1 degree C. But at one extreme is large positive reinforcing feedback, when f equals 1. Then climate is unstable: adding a single molecule of CO₂ would set off runaway warming. To see this, insert for example f=0.99 in the equation, then global warming would be 100 degrees. But f could also be less than 0, corresponding to negative feedback. Then

global warming would be *less than 1 degree* for doubling. The climate models on which the IPCC relies say that feedback is strongly positive; f is between about 0.5 and 0.8, creating the serious warming they warn us about. This large positive feedback is itself troubling, because the geological history of the earth suggests that the climate is inherently stable.

The most important feedback is called the cloud-water vapor feedback. Add a little more CO₂ in the air, and the earth will warm slightly. Surface evaporation will increase, giving more water vapor – the daddy of all greenhouse gases. Water vapor forms clouds, and much depends on the clouds. There are well documented problems with the way the climate models deal with clouds. Colorado State Distinguished Professor of Atmospheric Science Graeme Stephens writes in an extensive review of the cloud feedback issue that, “Different assumptions ... produce very different conclusions about the *magnitude and sign* of feedbacks.” And further, “The lack of maturity of feedback analysis methods also suggests that progress in understanding climate feedback will require development of *alternative methods of analysis*.”

*Clouds Are the Key Feedback Lever:
Models’ Reliability Questioned*

Graeme L. Stephens (Colorado State University,
Distinguished Professor of Atmospheric Science):

“...different assumptions about the [cloud] system produce very different conclusions about the magnitude and sign of feedbacks.”

“The lack of maturity of feedback analysis methods also suggests that progress in understanding climate feedback will require development of alternative methods of analysis.”

G. L. Stephens, *Cloud Feedbacks in the Climate System: A Critical Review*, J. Climate (2005)

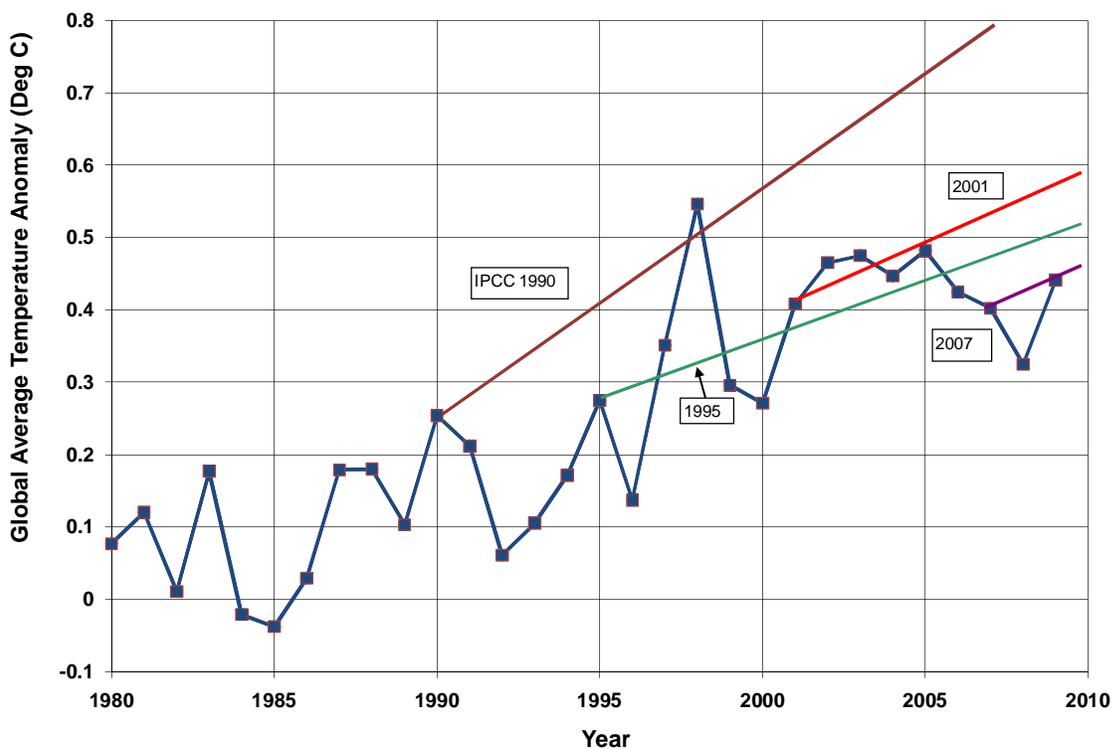
Slide 11

In addition to *theoretical* problems, there are major *observational* issues. Recent empirical studies by Richard Lindzen of MIT, Roy Spencer of the University of Alabama, Stephen Schwartz of Brookhaven National Labs and others provide evidence that the feedback factor is in fact small and may even be net negative so as to dampen global warming. There is also a large body of work that strongly

implicates natural variations such as solar variability and unforced changes in ocean cycles in 20th century warming. Indeed, the weight of *empirical* evidence points to a global temperature rise of only *about* 1 degree C for doubling of CO₂, with about half of it already in the bank because of past emissions. The links provided allow access to a number of papers, reports, and reviews indicating low feedback and therefore a warming of only around a degree.

Whatever the problems with models, real science predicts real things that really happen. The most fundamental tenet of science is the notion that it must be tested by prediction. If it is successful, we keep it around tentatively; if not, we show it the door. The climate models have failed to predict the course of global temperature or to identify an observed greenhouse gas fingerprint. The temperature projections in earlier IPCC reports have greatly overstated subsequent measured temperature trends. Slide 12 compares the central projections of global average temperature from each of the four IPCC reports to the actual temperature trend, starting in each report year. The models keep calling for a rate of warming that just doesn't happen. Indeed, counter to model predictions and despite steady increases in atmospheric CO₂, there has been no statistically significant global warming since around 1995, and the oceans down to a depth of 700 meters have actually cooled slightly since 2004 when the Project Argo deep diving buoys were deployed.

Surface Global Temperature And IPCC Projections Compared
(HadCRUT3 Data Set)



That is the case for attribution of global warming to human emissions. It rests on the climate models and the hockey stick, neither of which holds up well to hardnosed scientific scrutiny. So what about that appeal to authority, “All scientific societies agree...” It is the show stopper to engaging any lay person on the issue. Indeed the societies have become yet more important as IPCC credibility has declined, and National Academy of Sciences leadership has announced its intention to provide science advocacy for what it thinks is needed societal change.

So a small group of physicists set out in early 2009 to try to moderate the 2007 Policy Statement of the American Physical Society, the world’s second largest society of physicists. The key point of concern has been the excerpt from the Statement shown below.

American Physical Society Statement on Climate Change (2007)

“The evidence is incontrovertible: Global warming is occurring. If no mitigating actions are taken, significant disruptions in the Earth's physical and ecological systems, social systems, security and human health are likely to occur. We must reduce emissions of greenhouse gases beginning now.”

Slide 13

The passage is laden with problems: *Nothing* in science is incontrovertible; Global warming is *not* occurring, at least for more than ten years; but worst of all is the simple fact that none of this is based on a scientific assessment undertaken by the Society itself. It simply parrots the posture of the IPCC and its derivatives. It has angered many members. Even those unfamiliar with the science disliked its definitiveness, its successive non sequiturs, and its alarmist nature.

With Climategate and other disclosures casting doubt over the integrity of climate science and eroding public trust invested in science and scientists, we petitioned the Society to conduct an independent and objective study of the global warming issue. So far 265 physicists have endorsed the call for a new look at the science, and as you can see from the samples below, some highly experienced and distinguished physicists think we need that look.

**Regarding the National Policy Statement on Climate Change of the American Physical Society Council:
A Petition to the Council of the American Physical Society.....**

As current and past members of the American Physical Society, we the undersigned petition the APS Council to commission an independent, objective study and assessment of the science relating to the question of anthropogenic global warming. The assessment should consider findings representing the full scope of available scientific sources.

Harold M. Agnew
President, General Atomics Corporation (1979 -1984)
White House Science Councilor (1982 -1989)
Director, Los Alamos National Laboratory (1970 -1979)
E.O. Lawrence Award 1966, Enrico Fermi Award 1978, Los Alamos Medal (with H.A. Bethe) 2001
Member National Academy of Sciences, National Academy of Engineering; Fellow APS, Fellow AAAS

Ralph B. Alexander
Former Associate Professor of Physics
Wayne State University
President, R.B. Alexander & Associates
Technology and market analysis in environmentally friendly materials and coatings
Author, *Global Warming False Alarm (Canterbury)*

Louis J. Allamandola
Director, Astrochemistry Laboratory
NASA Ames Research Center
Fellow APS, Fellow AAAS
Member American Chemical Society, American Astronomical Society, International Astronomical Union

Arthur G. Anderson
Vice President and former Director of Research
IBM (retired)
Fellow APS, Fellow IEEE, Member National Academy of Engineering

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Kenneth A. Jackson
President, Materials Research Society (1976-1977)
President, American Association for Crystal Growth (1970-1976)
Chalmers Award (Materials Society of the AIME) 2003
Award of the American Association for Crystal Growth 1993; Matthewson Gold Medal (AIME) 1966
Member National Academy of Engineering; Fellow APS, AAAS, The Metallurgical Society

H. Richard Johnson
Co-Founder and Former CEO
Watkins-Johnson Company (retired)
Life Fellow IEEE, Member National Academy of Engineering

James R. Johnson
3M Company (retired)
Member Carlton Society (3M Hall of Fame)
Member National Academy of Engineering

Alexander E. Kaplan
Professor, Department of Electrical and Computer Engineering
The Johns Hopkins University
Max Born Award (Optical Society of America) 2005
Alexander von Humboldt Award (von Humboldt Foundation) 1996
Fellow Optical Society of America

Thomas J. Karr
Director, DARPA & Strategic Projects, Advanced Concepts & Technology Division
Northrop Grumman Electronic Systems
Lawrence Livermore National Laboratory (1984-1996)
Editor, Applied Optics (1991-1994)
Member Optical Society of America, AAAS; Senior Member IEEE

Slide 15

The signatories come from diverse academic, government, and industrial backgrounds. There are 100 Fellows and members of the National Academies of Sciences and Engineering. Many have authored important books on various physics topics, and many have won significant prizes and awards, including a Nobel. A number have published major research on the global warming issue, authored books on it, or worked in contiguous areas of meteorology and climate. Nearly all have backgrounds in key science areas that underlie the global warming issue.

But backing off does not come easily or happily to large organizations that are invested in a position, especially one strongly conducive to continued research funding. To date, the APS Statement remains intact, but a long explanatory note has been added; the original 157 word Statement is retained but appended with 827 words of explanation. There is a problem when you need a group of physics monks to expend more than 5 times the number of words to explain what the original words meant. But grudging progress is being made. The Society is still considering a study. But we are not waiting around. I want to use this occasion to announce our plans to start a Forum on Climate Physics within the APS, under terms specified in the Society Constitution. It will be a way for physicists with all points of view to meet, learn about and debate the science, and present research insights, independent of the posture of the physics monks. Every scientist, climate expert or no, has a dog in this fight that is literally to preserve the scientific method, so painfully assembled over the past 400 years.

We come now to the, "It doesn't matter," response. The Precautionary Principle warns that no matter how small the risk, we have to drive it as close to zero as we can. Not so fast. We need to include economic risk in the equation as well as risk of environmental damage. And when we do, things get more complicated. Here I will put on my strategic planning hat. I spent a good part of my career sorting out the economic benefits, costs, and risks of various technology policies and specific technologies.

First understand that in any serious emissions reduction scenario, we are talking about diverting huge amounts of capital from the economy. Marty Hoffert of NYU and colleagues and Tom Wigley of NCAR and his colleagues have independently calculated how much new emissionless energy the world will need to deploy in order to stabilize the atmosphere at various levels of CO₂. They estimated that by 2050, 10 to 30 trillion watts of emissionless primary energy production would be needed to stabilize at twice the pre-industrial level. With renewables costing about \$5-\$10 per average watt above and beyond hydrocarbon-based energy, the additional capital could easily exceed \$50 trillion over 40 years. Even in this era of mega spending and hyper deficits, this is real money. Such a capital investment would be equivalent to devoting the entire current U.S. private nonresidential capital investment over 40 years to the extra cost of emissionless energy. It would suck capital from all other investments that would otherwise go to advancing the quality of life for everyone on earth, with the most severe impact on the poorest people in the less developed world.

But we can say more about the economic impact besides its huge magnitude. Using models, environmental economists have explored the benefits and costs of various policy options. An integrated assessment model is the mother of all models. Think of it as a carbon cycle model, climate

model, and economic model ganged together. A leading practitioner of such models is Economics Professor William Nordhaus, Sterling Professor of Economics at Yale University. He is a Fellow of the American Academy of Arts and Sciences. He serves on the Congressional Budget Office Panel of Economic Experts. In 2005, the Association of Environmental and Resource Economists presented him with the Publication of Enduring Quality Award. This is considered the “Nobel” of environmental economics, and Nordhaus is generally believed to be on the short list for the actual Nobel.

Here is an excerpt of results from his 2008 book. Slide 16 lists ratios of the present value of benefits from avoided climate change damage to the present value of the costs for various policies – assuming the IPCC’s most likely value of climate sensitivity: 3 degrees C for doubling of CO₂. There are some interesting things here. First, the optimum policy under this scenario is a gradually implemented carbon tax. It returns a benefit of nearly 2½ times costs. But a 50-year delay before doing anything is very close to optimal. It affords time for economies to grow so they can better afford the costs of abatement. A strengthened Kyoto – which stresses cap-and-trade – just about breaks even. Constraining global temperature rise to 2 degrees C, a favorite for EU flag waving, gets us into negative return territory. And the truly draconian Gore proposal returns only 50 cents on the dollar. Interestingly, the model says that if IPCC is right, we are going to endure a large percentage of damage no matter what we do, and the more aggressively we try to avoid it, the less attractive the investment becomes. But now the real punch line: From what we know, the IPCC’s value of 3 degrees C for doubling is almost certainly much too high, so these benefit to cost ratios and the climate damage are also too high.

Abatement Costs Skyrocket and Benefit/Cost Ratios Plummet As Policies Become More Aggressive

For 3 Degrees C Global Warming From Doubling of CO₂ (per IPCC)

<u>Policy</u>	<u>Benefit/Cost Ratio</u>	<u>% Damage Saved</u>
Optimal*	2.4	23%
50- year Delay	2.4	16%
Strengthened Kyoto (Cap-And-Trade)	1.1	29%
Limit Temperature Rise to 2 Degrees C	0.8	42%
Gore Proposal	0.5	56%

* Gradually increasing carbon tax set to maximize value of net economic consumption; assumes complete participation and compliance

W. D. Nordhaus, *A Question of Balance: The Economic Modeling of Global Warming* (Yale University Press, 2008)

If you run the Nordhaus model for the more likely 1 degree C temperature rise for doubling, you get a very different picture, as shown in the last slide.

But the IPCC Is Very Likely Much Too High...
Science Impacts Economics

<u>If Global Warming for Doubled CO₂ Is:</u>	<u>Temperature Rise For 2005-2055 Is:</u>	<u>Benefit/Cost Ratio For Optimal Policy Is:</u>
3 Degrees C	1.2 degrees C	2.4
1 Degrees C	0.4 degrees C	0.5

Slide 17

For example, in the year 2055, if the IPCC were right, temperature would have risen another 1.2 degrees Celsius, assuming natural variations cancel out. As we've seen, benefits under the optimum policy run nearly 2½ times costs. But for a 1 degree warming for doubling, temperature is up less than 0.4 degree, and 80 percent of the climate damage never happens. The return for the optimum policy is then well into negative territory. We are paying for an insurance policy whose premium is much larger than the risk. And since none of us can recall an optimum worldwide economic policy, the economic results would actually be much worse than this. Enacting any abatement policy would literally and unnecessarily throw away future wealth.

So the Precautionary Principle is hazardous to our future economic health. The science and the economics are coupled, and it makes a great deal of difference whether we follow the IPCC case or the body of empirical evidence. Indeed following the Precautionary Principle would logically lead us to spend trillions on other improbable events such as the next large asteroid collision, and we *know that* will happen someday.

One purpose of science is to *reduce* uncertainty so as to facilitate wise decisions to promote human progress. The Precautionary Principle claims that one special brand of uncertainty *is itself* a reason to make decisive economic changes. But the science simply does not support any kind of economic intervention. Beware of the "It doesn't matter" response. It does matter, and it matters a great deal.

To wrap up, I want to talk a little about the anger response: “You denier! How dare you tell me there won’t be a catastrophe.” Here I rely largely on my son Geoff, the academic social psychologist in the family. As contrary evidence has accumulated, proponents of global warming have shown signs of cognitive dissonance. The idea is that when presented with information that is dissonant from long held beliefs or strong beliefs that people have invested in, the easiest way to deal with it is to ignore it, refuse to accept it, or simply avoid that type of information. This helps explain why people can be resistant to new information that on a rational basis should be good news. Why would you get angry if someone tells you, “There won’t be a climate catastrophe.”

More than a half century ago, Leon Festinger developed the concept of cognitive dissonance and conducted early studies referred to even today. One study looked at people who bought bomb shelters during the Cold War. It found that they tended to exaggerate the threat of nuclear war and to discount prospects for tension-reducing proposals, almost as if they were invested in nuclear war. Festinger’s book, *When Prophecy Fails*, tells of a doomsday cult that predicted the end of the world on a particular date. When the day came and went, paradoxically the believers became even more determined they were right. They became louder and proselytized even more aggressively.

So we can expect ever more strident, extreme, and opaque defenses from proponents. Here for example is an excerpt from a recent letter signed by National Academy of Sciences members: “Many recent assaults on climate science and, more disturbingly, on climate scientists by climate change deniers, are typically driven by special interests or dogma, not by an honest effort to provide an alternative theory that credibly satisfies the evidence.” We are told that warming is accelerating when there has been none. Bizarre warnings of completely speculative “tipping points” abound. We are told that even cooling is consistent with global warming, and indeed global warming has morphed into *Climate Change*, allowing it to embrace anything that happens, much like astrology.

The global warming issue will limp on, and evidence against a serious human contribution will continue to mount. So as our elected representatives consider burdensome regulations and legislation, they should know that it will not make a whit of difference to the climate and will cause unnecessary economic hardship for all of us, especially the world’s poorest who might otherwise aspire to finally make great strides this century.

Links to a Sampling of Scientific Literature, Reports, Presentations, and Other Material

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A. W. Montford, *The Hockey Stick Illusion: Climategate and the Corruption of Science*, (Independent Minds, 2010) <http://www.bookdepository.com/book/9781906768355/The-Hockey-Stick-Illusion>

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- R. S. Lindzen, *Deconstructing Global Warming*, Presentation to the Competitive Enterprise Institute, 10-26-2009 http://www.youtube.com/watch?v=sHg3ZztDAw&feature=PlayList&p=7500E5102EAF00B5&playnext_from=PL&playnext=1&index=3
- R. S. Lindzen and Y-S Choi, *On the Determination of Climate Feedbacks from ERBE Data*, Geophysical Research Letters, 36, L16705, doi:10.1029/2009GL039628 (2009) <http://www.mit.edu/~ysc/index.files/Lindzen&Choi2009GRL.pdf>
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American Physical Society Petition: Signatories, Comments, and Other Information <http://www.openletter-globalwarming.info/Site/HOME.html>

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