Nature, Not Human Activity, Rules the Climate

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19 South LaSalle Street #903
Chicago, Illinois 60603 U.S.A.
phone 312/377-4000
fax 312/377-5000
www.heartland.org

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Nature, Not Human Activity, Rules the Climate

Summary for Policymakers of the Report of the Nongovernmental International Panel on Climate Change

Edited by S. Fred Singer

Contributors

Warren Anderson
United States

Dennis Avery
United States

Franco Battaglia
Italy

Robert Carter
Australia

Richard Courtney
United Kingdom

Joseph d'Aleo
United States

Fred Goldberg
Sweden

Vincent Gray
New Zealand

Kenneth Haapala
United States

Klaus Heiss
Austria

Craig Idso
United States

Zbigniew Jaworowski
Poland

Olavi Karner
Estonia

Madhav Khandekar
Canada

William Kininmonth
Australia

Hans Labohm
Netherlands

Christopher Monckton
United Kingdom

Lubos Motl
Czech Republic

Tom Segalstad
Norway

S. Fred Singer
United States

Dick Thoenes
Netherlands

Anton Uriarte
Spain

Gerd Weber
Germany

Published for the Nongovernmental International Panel on Climate Change

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Foreword

In his speech at the United Nations' climate conference on September 24, 2007, Dr. Vaclav Klaus, president of the Czech Republic, said it would most help the debate on climate change if the current monopoly and one-sidedness of the scientific debate over climate change by the Intergovernmental Panel on Climate Change (IPCC) were eliminated. He reiterated his proposal that the UN organize a parallel panel and publish two competing reports.

The present report of the Nongovernmental International Panel on Climate Change (NIPCC) does exactly that. It is an independent examination of the evidence available in the published, peer-reviewed literature – examined without bias and selectivity. It includes many research papers ignored by the IPCC, plus additional scientific results that became available after the IPCC deadline of May 2006.

The IPCC is pre-programmed to produce reports to support the hypotheses of anthropogenic warming and the control of greenhouse gases, as envisioned in the Global Climate Treaty. The 1990 IPCC Summary completely ignored satellite data, since they showed no warming. The 1995 IPCC report was notorious for the significant alterations made to the text *after* it was approved by the scientists – in order to convey the impression of a human influence. The 2001 IPCC report claimed the twentieth century showed 'unusual warming' based on the now-discredited hockey-stick graph. The latest IPCC report, published in 2007, completely devaluates the climate contributions from changes in solar activity, which are likely to dominate any human influence.

The foundation for NIPCC was laid five years ago when a small group of scientists from the United States and Europe met in Milan during one of the frequent UN climate conferences. But it got going only after a workshop held in Vienna in April 2007, with many more scientists, including some from the Southern Hemisphere.

The NIPCC project was conceived and directed by Dr. S. Fred Singer, professor emeritus of environmental sciences at the University of Virginia. He should be credited with assembling a superb group of scientists who helped put this volume together.

Singer is one of the most distinguished scientists in the U.S. In the 1960s, he established and served as the first director of the U.S. Weather Satellite Service, now part of the National Oceanographic and Atmospheric Administration (NOAA), and earned a U.S. Department of Commerce Gold Medal Award for his technical leadership. In the 1980s, Singer served for five years as vice chairman of the National Advisory Committee for Oceans and Atmosphere (NACOA) and became more directly involved in global environmental issues.

Since retiring from the University of Virginia and from his last federal position as chief scientist of the Department of Transportation, Singer founded and directed the nonprofit Science and Environmental Policy Project, an organization I am pleased to serve as chair. SEPP's major concern has been the use of sound science rather than exaggerated fears in formulating environmental policies.

Our concern about the environment, going back some 40 years, has taught us important lessons. It is one thing to impose drastic measures and harsh economic penalties when an environmental problem is clear-cut and severe. It is foolish to do so when the problem is largely hypothetical and not substantiated by observations. As NIPCC shows by offering an independent, non-governmental 'second opinion' on the 'global warming' issue, we do not currently have any convincing evidence or observations of significant climate change from other than natural causes.

Frederick Seitz
President Emeritus, Rockefeller University
Past President, National Academy of Sciences
Past President, American Physical Society
Chairman, Science and Environmental Policy Project

February 2008

Preface

Before facing major surgery, wouldn't you want a second opinion?

When a nation faces an important decision that risks its economic future, or perhaps the fate of the ecology, it should do the same. It is a time-honored tradition in science to set up a 'Team B,' which examines the same original evidence but may reach a different conclusion. The Nongovernmental International Panel on Climate Change (NIPCC) was set up to examine the same climate data used by the United Nations-sponsored Intergovernmental Panel on Climate Change (IPCC).

On the most important issue, the IPCC's claim that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations," (emphasis in the original), NIPCC reaches the opposite conclusion – namely, that natural causes are very likely to be the dominant cause. Note: We do not say anthropogenic greenhouse (GH) gases cannot produce some warming. Our conclusion is that the evidence shows they are not playing a significant role.

Below, we first sketch out the history of the two organizations and then list the conclusions and responses that form the body of the NIPCC report.

A Brief History of the IPCC

The rise in environmental consciousness since the 1970s has focused on a succession of 'calamities': cancer epidemics from chemicals, extinction of birds and other species by pesticides, the depletion of the ozone layer by supersonic transports and later by freons, the death of forests ('Waldsterben') because of acid rain, and finally, global warming, the "mother of all environmental scares" (according to the late Aaron Wildavsky).

The IPCC can trace its roots to World Earth Day in 1970, the Stockholm Conference in 1971-72, and the Villach Conferences in 1980 and 1985. In July 1986, the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) as an organ of the United Nations.

The IPCC's key personnel and lead authors were appointed by governments, and its Summaries for Policymakers (SPM) have been subject to approval by member governments of the UN. The scientists involved with the IPCC are almost all supported by government contracts, which pay not only for their research but for their IPCC activities. Most travel to and hotel accommodations at exotic locations for the drafting authors is paid with government funds.

The history of the IPCC has been described in several publications. What is not emphasized, however, is the fact that it was an activist enterprise from the very beginning. Its agenda was to justify control of the emission of greenhouse gases, especially carbon dioxide. Consequently, its scientific reports have focused solely on evidence that might point toward human-induced climate change. The role of the IPCC "is to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of *the risk of human-induced climate change,* its observed and projected impacts and options for adaptation and mitigation" (emphasis added) [IPCC 2008].

The IPCC's three chief ideologues have been (the late) Professor Bert Bolin, a meteorologist at Stockholm University; Dr. Robert Watson, an atmospheric chemist at NASA, later at the World Bank, and now chief scientist at the UK Department of Environment, Food and Rural Affairs; and Dr. John Houghton, an atmospheric radiation physicist at Oxford University, later head of the UK Met Office as Sir John Houghton.

Watson had chaired a self-appointed group to find evidence for a human effect on stratospheric ozone and was instrumental in pushing for the 1987 Montreal Protocol to control the emission of chlorofluorocarbons (CFCs). Using the blueprint of the Montreal Protocol, environmental lawyer David Doniger of the Natural Resources Defense Council then laid out a plan to achieve the same kind of control mechanism for greenhouse gases, a plan that eventually was adopted as the Kyoto Protocol.

From the very beginning, the IPCC was a political rather than scientific entity, with its leading scientists reflecting the positions of their governments or seeking to induce their governments to adopt the IPCC position. In particular, a small group of activists wrote the all-important Summary for Policymakers (SPM) for each of the four IPCC reports [McKitrick et al. 2007].

While we are often told about the thousands of scientists on whose work the Assessment reports are based, the vast majority of these scientists have no direct influence on the conclusions expressed by the IPCC. Those are produced by an inner core of scientists, and the SPMs are revised and agreed to, line-by-line, by representatives of member governments. This obviously is not how real scientific research is reviewed and published.

These SPMs turn out, in all cases, to be highly selective summaries of the voluminous science reports – typically 800 or more pages, with no indexes (except, finally, the Fourth Assessment Report released in 2007), and essentially unreadable except by dedicated scientists.

The IPCC's First Assessment Report [IPCC-FAR 1990] concluded that the observed temperature changes were "broadly consistent" with greenhouse models. Without much analysis, it gave the "climate sensitivity" of a 1.5 to 4.5º C temperature rise for a doubling of greenhouse gases. The IPCC-FAR led to the adoption of the Global Climate Treaty at the 1992 Earth Summit in Rio de Janeiro.

The FAR drew a critical response [SEPP 1992]. FAR and the IPCC's style of work also were criticized in two editorials in *Nature* [Anonymous 1994, Maddox 1991].

The IPCC's Second Assessment Report [IPCC-SAR 1995] was completed in 1995 and published in 1996. Its SPM contained the memorable conclusion, "the balance of evidence suggests a discernible human influence on global climate." The SAR was again heavily criticized, this time for having undergone significant changes in the body of the report to make it 'conform' to the SPM – *after* it was finally approved by the scientists involved in writing the report. Not only was the report altered, but a key graph was also doctored to suggest a human influence. The evidence presented to support the SPM conclusion turned out to be completely spurious.

There is voluminous material available about these text changes, including a *Wall Street Journal* editorial article by Dr. Frederick Seitz [Seitz 1996]. This led to heated discussions between supporters of the IPCC and those who were aware of the altered text and graph, including an exchange of letters in the *Bulletin of the American Meteorological Society* [Singer et al. 1997].

SAR also provoked the 1996 publication of the Leipzig Declaration by SEPP, which was signed by some 100 climate scientists. A booklet titled "The Scientific Case Against the Global Climate Treaty" followed in September 1997 and was translated into several languages. [SEPP 1997. All these are available online at www.sepp.org.]

In spite of its obvious shortcomings, the IPCC report provided the underpinning for the Kyoto Protocol, which was adopted in December 1997. The background is described in detail in the booklet "Climate Policy – From Rio to Kyoto," published by the Hoover Institution [Singer 2000]. The Kyoto Protocol also provoked the adoption of a short statement expressing doubt about its scientific foundation by the Oregon Institute for Science and Medicine, which attracted more than 19,000 signatures from scientists, mainly in the U.S. [The statement is still attracting signatures, and can be viewed at www.oism.org.]

The Third Assessment Report of the IPCC [IPCC-TAR 2001] was noteworthy for its use of spurious scientific papers to back up its SPM claim of "new and stronger evidence" of anthropogenic global warming. One of these was the so called 'hockey-stick' paper, an analysis of proxy data, which claimed the twentieth century was the warmest in the past 1,000 years. The paper was later found to contain basic errors in its statistical analysis. The IPCC also supported a paper that claimed pre-1940 warming was of human origin and caused by greenhouse gases. This work, too, contained fundamental errors in its statistical analysis. The SEPP response to TAR was a 2002 booklet, "The Kyoto Protocol is Not Backed by Science" [SEPP 2002].

The Fourth Assessment Report of the IPCC [IPCC-AR4 2007] was published in 2007; the SPM of Working Group I was released in February; and the full report from this Working Group was released in May – after it had been changed, once again, to 'conform' to the Summary. It is significant that AR4 no longer makes use of the hockey-stick paper or the paper claiming pre-1940 human-caused warming.

AR4 concluded that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations" (emphasis in the original). However, as the present report will show, it ignored available evidence *against* a human contribution to current warming and the substantial research of the past few years on the effects of solar activity on climate change.

Why have the IPCC reports been marred by controversy and so frequently contradicted by subsequent research? Certainly its agenda to find evidence of a human role in climate change is a major reason; its organization as a government entity beholden to political agendas is another major reason; and the large professional and financial rewards that go to scientists and bureaucrats who are willing to bend scientific facts to match those agendas is yet a third major reason.

Another reason for the IPCC's unreliability is the naive acceptance by policymakers of 'peer-reviewed' literature as necessarily authoritative. It has become the case that refereeing standards for many climate-change papers are inadequate, often because of the use of an 'invisible college' of reviewers of like inclination to a paper's authors. [Wegman et al. 2006] Policy should be set upon a background of demonstrable science, not upon simple (and often mistaken) assertions that, because a paper was refereed, its conclusions must be accepted.

Nongovernmental International Panel on Climate Change (NIPCC)

When new errors and outright falsehoods were observed in the initial drafts of AR4, SEPP set up a 'Team B' to produce an independent evaluation of the available scientific evidence. While the initial organization took place at a meeting in Milan in 2003, 'Team B' was activated after the AR4 SPM appeared in February 2007. It changed its name to NIPCC and organized an international climate workshop in Vienna in April 2007.

The present report stems from the Vienna workshop and subsequent research and contributions by a larger group of international scholars. For a list of those contributors, see page ii.

What was our motivation? It wasn't financial self-interest: No grants or contributions were provided or promised in return for producing this report. It wasn't political: No government agency commissioned or authorized our efforts, and we do not advise or support the candidacies of any politicians or candidates for public office.

We donated our time and best efforts to produce this report out of concern that the IPCC was provoking an irrational fear of anthropogenic global warming based on incomplete and faulty science. Global warming hype has led to demands for unrealistic efficiency standards for cars, the construction of uneconomic wind and solar energy stations, the establishment of large production facilities for uneconomic biofuels such as ethanol from corn, requirements that electric companies purchase expensive power from so-called 'renewable' energy sources, and plans to sequester, at considerable expense, carbon dioxide emitted from power plants. While there is absolutely nothing wrong with initiatives to increase energy efficiency or diversify energy sources, they cannot be justified as a realistic means to control climate.

In addition, policies have been developed that try to hide the huge cost of greenhouse gas controls, such as cap and trade, a Clean Development Mechanism, carbon offsets, and similar scams that enrich a few at the expense of the rest of us.

Seeing science clearly misused to shape public policies that have the potential to inflict severe economic harm, particularly on low-income groups, we choose to speak up for science at a time when too few people outside the scientific community know what is happening, and too few scientists who know the truth have the will or the platforms to speak out against the IPCC.

NIPCC is what its name suggests: an international panel of *nongovernment* scientists and scholars who have come together to understand the causes and consequences of climate change. Because we are not predisposed to believe climate change is caused by human greenhouse gas emissions, we are able to look at evidence the IPCC ignores. Because we do not work for any governments, we are not biased toward the assumption that greater government activity is necessary.

Looking Ahead

The public's fear of anthropogenic global warming seems to be at a fever pitch. Polls show most people in most countries believe human greenhouse gas emissions are a major cause of climate change and that action must be taken to reduce them, although most people apparently are not willing to make the financial sacrifices required [Pew 2007].

While the present report makes it clear that the scientific debate is tilting away from global warming alarmism, we are pleased to see the political debate also is not over. Global warming 'skeptics' in the policy arena include Vaclav Klaus, president of the Czech Republic; Helmut Schmidt, former German chancellor; and Lord Nigel Lawson, former United Kingdom chancellor of the exchequer. On the other side are global warming fearmongers, including UK science advisor Sir David King and his predecessor Robert May (now Lord May), and of course Al Gore, former vice president of the U.S. In spite of increasing pressures to join Kyoto and adopt emission limits on carbon dioxide, President George W. Bush in the United States has resisted – so far.

We regret that many advocates in the debate have chosen to give up debating the science and now focus almost exclusively on questioning the motives of 'skeptics,' name-calling, and *ad hominem* attacks. We view this as a sign of desperation on their part, and a sign that the debate has shifted toward climate realism.

We hope the present study will help bring reason and balance back into the debate over climate change, and by doing so perhaps save the peoples of the world from the burden of paying for wasteful, unnecessary energy and environmental policies. We stand ready to defend the analysis and conclusion in the study that follows, and to give further advice to policymakers who are open-minded on this most important topic.

S. Fred Singer
President, Science and Environmental Policy Project
Distinguished Research Professor, George Mason University
Professor Emeritus of Environmental Science, University of Virginia

February 2008

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Nature, Not Human Activity, Rules the Climate

Summary for Policymakers of the Report of the Nongovernmental International Panel on Climate Change

1. Introduction

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change's Working Group-1 (Science) (IPCC-AR4 2007), released in 2007, is a major research effort by a group of dedicated specialists in many topics related to climate change. It forms a valuable compendium of the current state of the science, enhanced by having an index, which had been lacking in previous IPCC reports. AR4 also permits access to the numerous critical comments submitted by expert reviewers, another first for the IPCC.

While AR4 is an impressive document, it is far from being a reliable reference work on some of the most important aspects of climate change science and policy. It is marred by errors and misstatements, ignores scientific data that were available but were inconsistent with the authors' pre-conceived conclusions, and has already been contradicted in important parts by research published since May 2006, the IPCC's cut-off date.

In general, the IPCC fails to consider important scientific issues, several of which would upset its major conclusion – that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations" (emphasis in the original).

The IPCC does not apply generally accepted methodologies to determine what fraction of current warming is natural, or how much is caused by the rise in greenhouse (GH) gases. A comparison of 'fingerprints' from best available observations with the results of state-of-the-art GH models leads to the conclusion that the (human-caused) GH contribution is minor. This fingerprint evidence, though available, was ignored by the IPCC.

The IPCC continues to undervalue the overwhelming evidence that, on decadal and century-long time scales, the Sun and associated atmospheric cloud effects are responsible for much of past climate change. It is therefore highly likely that the Sun is also a major cause of twentieth-century warming, with anthropogenic GH gases making only a minor contribution. In addition, the IPCC ignores, or addresses imperfectly, other science issues that call for discussion and explanation.

The present report by the Nongovernmental International Panel on Climate Change (NIPCC) focuses on two major issues – the very weak evidence that the causes of the current warming are anthropogenic (Section 2) and the far more robust evidence that the causes of the current warming are natural (Section 3) – and then addresses a series of less crucial topics:

- Computer models are unreliable guides to future climate conditions (Section 4);
- Sea-level rise is not significantly affected by rise in GH gases (Section 5);
- The data on ocean heat content have been misused to suggest anthropogenic warming. The role of GH gases in the reported rise in ocean temperature is largely unknown (Section 6);
- Understanding of the atmospheric carbon dioxide budget is incomplete (Section 7);
- Higher concentrations of GH gases are more likely to be beneficial to plant and animal life and to human health than lower concentrations (Section 8); and

- **Conclusion:** Our imperfect understanding of the causes and consequences of climate change means the science is far from settled. This, in turn, means proposed efforts to mitigate climate change by reducing GH gas emissions are premature and misguided. Any attempt to influence global temperatures by reducing such emissions would be both futile and expensive (Section 9).

2. How Much of Modern Warming Is Anthropogenic?

The basic question is: What are the sources of twentieth-century warming? What fraction is of natural origin, a recovery from the preceding Little Ice Age (LIA), and what fraction is anthropogenic, e.g., caused by the increase in human-generated GH gases? The answer is all-important when it comes to policy.

AR4 [p. 10] claims "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations" (emphasis in original). AR4's authors even assign a better-than-90 percent probability to this conclusion, although there is no sound basis for making such a quantitative judgment. They offer only scant supporting evidence, none of which stands up to closer examination. Their conclusion seems to be based on the peculiar claim that science understands well enough the natural drivers of climate change to rule them out as the cause of the modern warming. Therefore, by elimination, recent climate changes must be human-induced.

- *Evidence of warming is not evidence that the cause is anthropogenic.*

It should be obvious, but apparently is not, that such facts as melting glaciers and disappearing Arctic sea ice, while interesting, are entirely irrelevant to illuminating the *causes* of warming. *Any* significant warming, whether anthropogenic or natural, will melt ice – often quite slowly. Therefore, claims that anthropogenic global warming (AGW) is occurring that are backed by such accounts are simply confusing the consequences of warming with the causes – a common logical error. In addition, fluctuations of glacier mass depend on many factors other than temperature, and thus they are poor measuring devices for global warming.

- *The so-called 'hockey-stick' diagram of warming has been discredited.*

Another claimed piece of 'evidence' for AGW is the assertion that the twentieth century was unusually warm, the warmest in the past 1,000 years. Compared to IPCC's Third Assessment Report [IPCC-TAR 2001], the latest IPCC report no longer emphasizes the 'hockey-stick' analysis by Mann (Figure 1), which had done away with both the Medieval Warm Period (MWP) and the Little Ice Age (LIA).

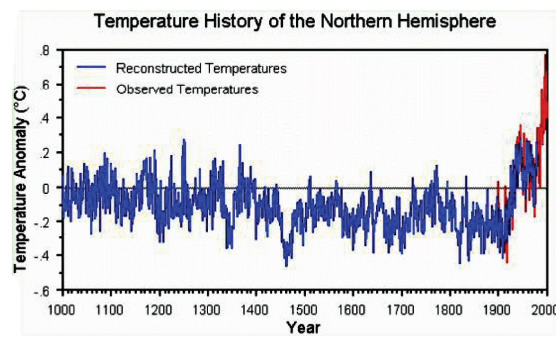


Figure 1: The 'hockey stick' temperature graph was used by the IPCC to argue that the twentieth century was unusually warm [IPCC-TAR 2001, p.3].

'Reconstructed temperatures' are derived from an analysis of various proxy data, mainly tree rings; surprisingly, they do not show the Medieval Climate Optimum and the Little Ice Age, both well-known from historic records. The 'observed temperatures' (in red) are a version of the thermometer-based temperature record since the end of the nineteenth century.

The hockey-stick analysis was beset with methodological errors, as has been demonstrated by Steven McIntyre and Ross McKitrick [2003, 2005] and confirmed by statistics expert Edward Wegman [Wegman et al. 2006]. A National Academy of Sciences report [NAS 2006] skipped lightly over the errors of the hockey-stick analysis and concluded that it showed only that the twentieth century was the warmest in 400 years. But this conclusion is hardly surprising, since the LIA was near its nadir 400 years ago, with temperatures at their lowest.

Independent analyses of paleo-temperatures that do not rely on tree rings have all shown a Medieval Warm Period (MWP) warmer than current temperatures. For example, we have data from Greenland borehole measurements (Figure 2) by Dahl-Jensen et al. [1999], various isotope data, and an analysis by Craig Loehle [2007] of proxy data, which excludes tree rings. (Figure 3) Abundant historical data also confirm the existence of a warmer MWP [Moore 1995].

Greenland Ice-Core Bore Hole Record

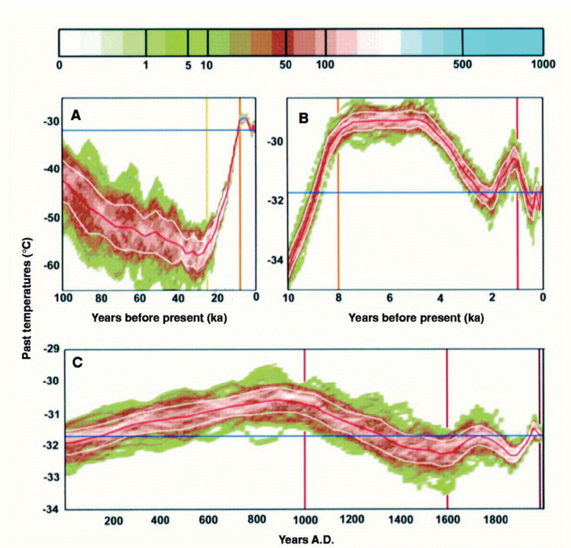


Figure 2: Temperature values from the GRIP ice-core borehole in Greenland. The top left graph shows the past 100,000 years; the dramatic warming ending the most recent glaciation is clearly visible. The top right graph shows the past 10,000 years (the interglacial Holocene); one sees the Holocene Climate Optimum, a pronounced Medieval Warm Period and Little Ice Age, but an absence of post-1940 warming [Dahl-Jensen et al. 1999].

- *The correlation between temperature and carbon dioxide levels is weak and inconclusive.*

The IPCC cites correlation of global mean temperature with increases in atmospheric concentrations of carbon dioxide (CO_2) in the twentieth century to support its conclusion. The argument sounds plausible; after all, CO_2 is a GH gas and its levels are increasing. However, the correlation is poor and, in any case, would not prove causation.

Prehistoric Temperatures from Proxy Data

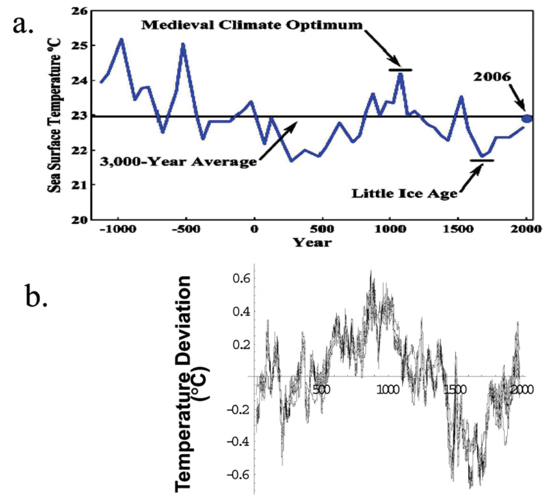


Figure 3a: Surface temperatures in the Sargasso Sea (a two million square-mile region of the Atlantic Ocean) with time resolution of 50 to 100 years and ending in 1975, as determined by isotope ratios of marine organism remains in deep-sea sediments [Keigwin 1996]. The horizontal line is the average temperature for this 3,000-year period. The Little Ice Age and the Medieval Climate Optimum were naturally occurring, extended intervals of climate departures from the mean. A value of 0.25 degrees C, which is the change in Sargasso Sea temperature between 1975 and 2006, has been added to the 1975 data in order to provide a 2006 temperature value [Robinson et al. 2007].

Figure 3b: Paleo-temperatures from proxy data (with tree rings eliminated). Note the Medieval Warm Period is much warmer than the twentieth century [Loehle 2007].

The climate cooled from 1940-1975 while CO_2 was rising rapidly (Figures 4a,b). Moreover, there has been no warming trend apparent, especially in global data from satellites, since about 2001, despite a continuing rapid rise in CO_2 emissions. The UK Met Office issued a 10-year forecast in August 2007 in which they predict further warming is unlikely before 2009. However, they suggest at least half the years between 2009 and 2014 will be warmer than the present record set in 1998 [Met Office 2007].

- *Computer models don't provide evidence of anthropogenic global warming.*

The IPCC has called upon climate models in support of its hypothesis of AGW. We discuss the shortcomings of computer models in greater detail below. Here we address the specific claim that the global mean surface temperature of the twentieth

Global and U.S. Mean Surface Temperatures

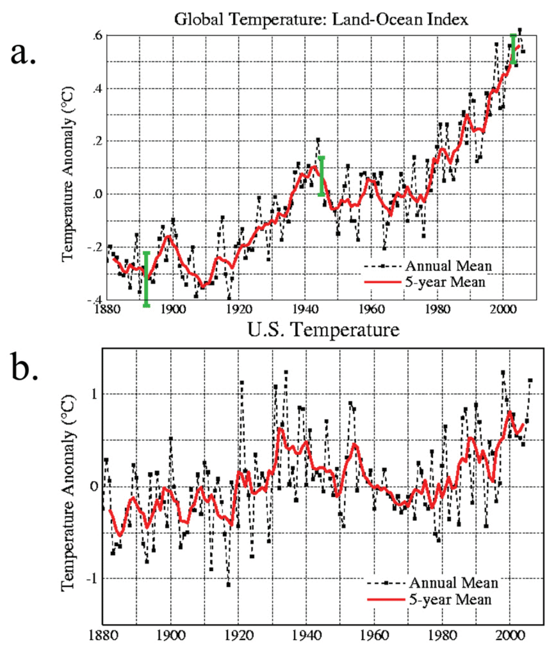


Figure 4a: The global mean surface temperature (GMST) of the twentieth century. Note the cooling between 1940 and 1975. [NASA-GISS, http://data.giss.nasa.gov/gistemp/graphs/]. GMST is subject to uncertain corrections; see text for a discussion of the problems of land and ocean data. The recent rise in temperatures shown here is suspect and does not agree with the measured tropospheric temperature trend (see Figure 13) or with the better-controlled US data, shown in Figure 4b.

Figure 4b: The 2007 discovery of an error in the handling of U.S. data has led to a greater amplitude of pre-1940 warming, which now exceeds the 1998 peak. The Arctic data exhibit a higher temperature in the 1930s than at present and correlate well with values of solar irradiance [Soon 2005]. Note the absence of recent warming and of any post-1998 temperature trend.

century can be adequately simulated by combining the effects of GH gases, aerosols, and such natural influences as volcanoes and solar radiation. Closer examination reveals this so-called agreement is little more than an exercise in 'curve fitting' with the use of several adjustable parameters. (The famed mathematician John von Neumann once said: "Give me four adjustable parameters and I can simulate an elephant. Give me one more and I can make his trunk wiggle.")

Current climate models can give a Climate Sensitivity (CS) of 1.5 to 11.5 C for a doubling of atmospheric CO_2 [Stainforth et al. 2005; Kiehl 2007]. The wide variability is derived mainly from choosing different physical parameters that enter into the formation and disappearance of clouds. For example, the values for CS, as given by Stainforth, involve varying just six parameters out of some 100 listed in a paper by Murphy et al. [2004]. The values of these parameters, many relating to clouds and precipitation, are simply chosen by 'expert opinion.' In an empirical approach, Schwartz [2007] derives a climate sensitivity that is less than the lowest value quoted by the IPCC, as does Shaviv [2005] by using a different empirical method.

Cloud feedbacks can be either positive (high clouds) or negative (low clouds) and are widely considered to be the largest source of uncertainty in determining CS [Cess 1990, 1996]. Spencer and Braswell [2007] find that current observational diagnoses of cloud feedback could be significantly biased in a positive direction.

The IPCC undervalues the forcing arising from changes in solar activity (solar wind and its magnetic effects) – likely much more important than the forcing from CO_2. Uncertainties for aerosols, which tend to cool the climate and oppose the GH effect, are even greater, as the IPCC recognizes in a table on page 32 of the AR4 report (Figure 5).

An independent critique of the IPCC points to the arbitrariness of the matching exercise in view of the large uncertainties of some of these forcings, particularly for aerosols [Schwartz, Charlson, Rodhe 2007]. James Hansen, a leading climate modeler, called attention to our inadequate knowledge of radiative forcing from aerosols when he stated, "the forcings that drive long-term climate change are not known with an accuracy sufficient to define future climate change" [Hansen 1998].

- *Observed and predicted 'fingerprints' don't match.*

Is there a method that can distinguish AGW from natural warming? The IPCC [IPCC-SAR 1996, p. 411; IPCC-AR4 2007, p. 668] and many scientists believe the 'fingerprint' method is the only reliable one. It compares the observed pattern of warming with a pattern calculated from GH models. While an agreement of such fingerprints cannot *prove* an anthropogenic origin for warming, it would be consistent with such a conclusion. A mismatch would argue strongly against any significant contribution from GH forcing and support the conclusion that the observed warming is mostly of natural origin.

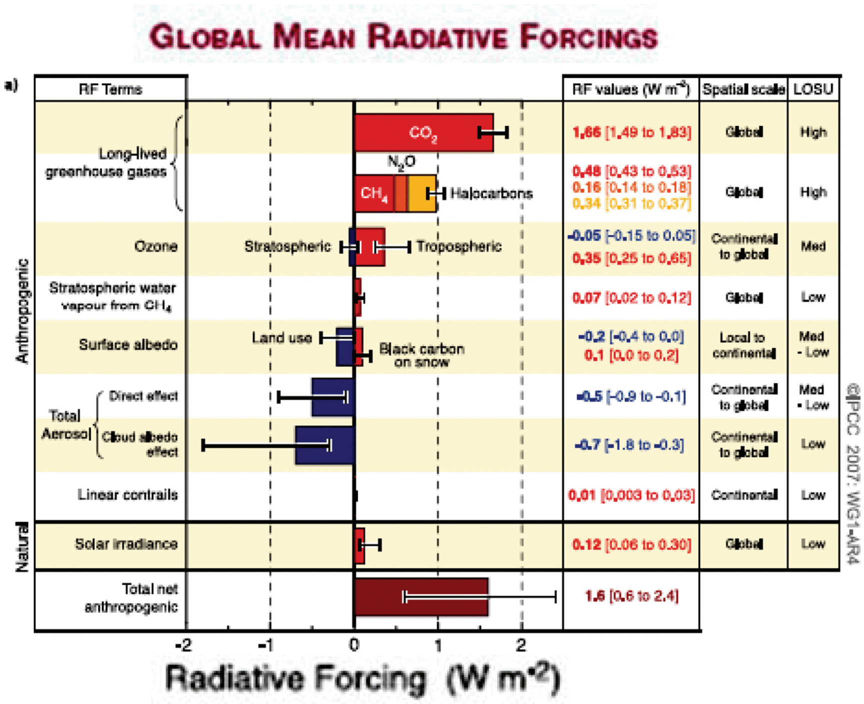


Figure 5: Climate forcings from various sources [IPCC-AR4 2007, p. 32]. Note the large uncertainties for aerosol forcing, exceeding the values of greenhouse gas forcing. Note also that solar forcing is based only on total solar irradiance changes and does not consider the effects of solar wind, solar magnetism, or UV changes.

Climate models all predict that, if GH gases are driving climate change, there will be a unique fingerprint in the form of a warming trend increasing with altitude in the tropical troposphere, the region of the atmosphere up to about 15 kilometers (Figure 6A). Climate changes due to solar variability or other known natural factors will not yield this characteristic pattern; only sustained greenhouse warming will do so.

The fingerprint method was first attempted in the IPCC's Second Assessment Report (SAR) [IPCC-SAR 1996, p. 411]. Its Chapter 8, titled "Detection and Attribution," attributed observed temperature changes to anthropogenic factors – GH gases and aerosols. The attempted match of warming trends with altitude turned out to be spurious, since it depended entirely on a particular choice of time interval for the comparison [Michaels & Knappenberger 1996]. Similarly, an attempt to correlate the observed and calculated geographic distribution of surface temperature trends [Santer 1995] involved making changes on a published graph that could and did mislead readers [Singer 1999 p. 9; 2000 pp. 15, 43-44]. In spite of these shortcomings, IPCC-SAR concluded that "the balance of evidence" supported AGW.

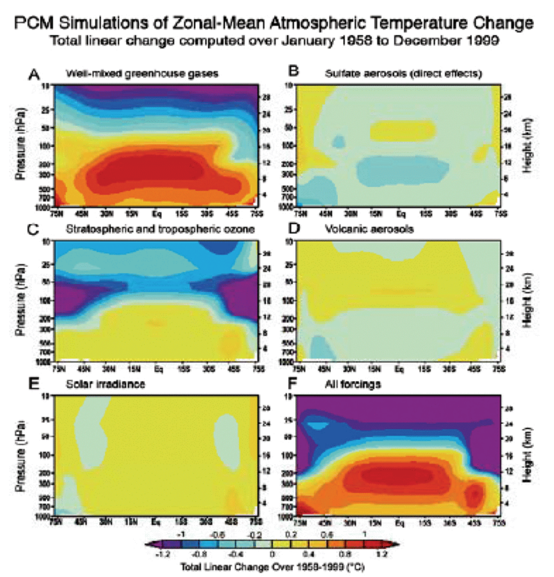


Figure 1.3. PCM simulations of the vertical profile of temperature change due to various forcings, and the effect due to all forcings taken together (after Santer et al., 2000).

Figure 6: Model-calculated zonal mean atmospheric temperature change from 1890 to 1999 (degrees C per century) as simulated by climate models from [A] well-mixed greenhouse gases, [B] sulfate aerosols (direct effects only), [C] stratospheric and tropospheric ozone, [D] volcanic aerosols, [E] solar irradiance, and [F] all forcings [U.S. Climate Change Science Program 2006, p. 25]. Note the pronounced increase in warming trend with altitude in figures A and F as a 'fingerprint' of greenhouse forcing.

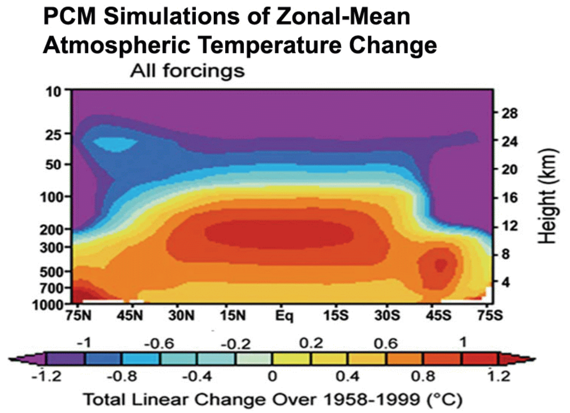


Figure 7: Greenhouse-model-predicted temperature trends versus latitude and altitude; this is figure 1.3F from CCSP 2006, p. 25, and also appears in Figure 6 of the current report. Note the increased temperature trends in the tropical mid-troposphere, in agreement also with the IPCC result [IPCC-AR4 2007, p. 675].

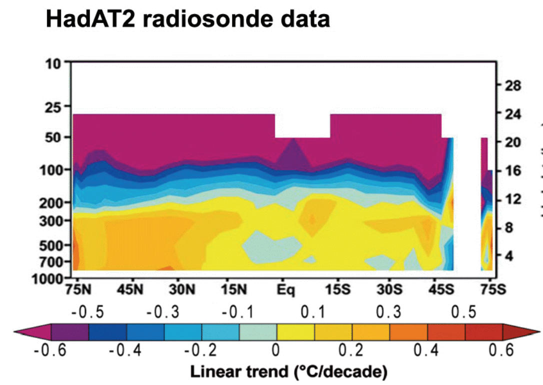


Figure 8: By contrast, observed temperature trends versus latitude and altitude; this is figure 5.7E from CCSP 2006, p. 116. These trends are based on the analysis of radiosonde data by the Hadley Centre and are in good agreement with the corresponding US analyses. Notice the absence of increased temperature trends in the tropical mid-troposphere.

With the availability of higher-quality temperature data, especially from balloons and satellites, and with improved GH models, it has now become possible to apply the fingerprint method in a more realistic way. This was done in a report issued by the U.S. Climate Change Science Program (CCSP) in April 2006 – making it readily available to the IPCC for its Fourth Assessment Report – and it permits the most realistic comparison of fingerprints [Karl et al. 2006].

The CCSP report is an outgrowth of an NAS report "Reconciling Observations of Global Temperature Change" issued in January 2000 [NAS 2000]. That NAS report compared surface and troposphere temperature trends and concluded they cannot be reconciled. Six years later, the CCSP report expands considerably on the NAS study. It is essentially a specialized report addressing the most crucial issue in the GW debate: Is current GW anthropogenic or natural?

The CCSP result is unequivocal. While all GH models show an increasing warming trend with altitude, peaking around 10 km at roughly two times the surface value, the temperature data from balloons give the opposite result: no increasing warming, but rather a slight cooling with altitude in the tropical zone. See Figures 7 and 8 above, taken directly from the CCSP report.

The Executive Summary of the CCSP report inexplicably claims agreement between observed and calculated patterns, the opposite of what the report itself documents. It tries to dismiss the obvious disagreement shown in the body of the report by suggesting there might be something wrong with both balloon and satellite data. Unfortunately, many people do not read beyond the summary and have therefore been misled to believe the CCSP report supports anthropogenic warming. It does not.

The same information can also be expressed by plotting the difference between surface trend and troposphere trend for the models and for the data [Singer 2001]. As seen in Figure 9a and 9b, the models show a histogram of negative values (i.e. surface trend less than troposphere trend) indicating that atmospheric warming will be greater than surface warming. But contrast, the data show mainly positive values for the difference in trends, demonstrating that measured warming is occurring principally on the surface and not in the atmosphere.

The same information can be expressed in yet a different way, as seen in research papers by Douglass et al. [2004, 2007], as shown in Figure 10. The models show an increase in temperature trend with altitude but the observations show the opposite.

This mismatch of observed and calculated fingerprints clearly falsifies the hypothesis of anthropogenic global warming (AGW). We must conclude therefore that anthropogenic GH gases can contribute only in a minor way to the current warming, which is mainly of natural origin.

The IPCC seems to be aware of this contrary evidence but has tried to ignore it or wish it away.

Model-Observations Disparity of Temperature Trends

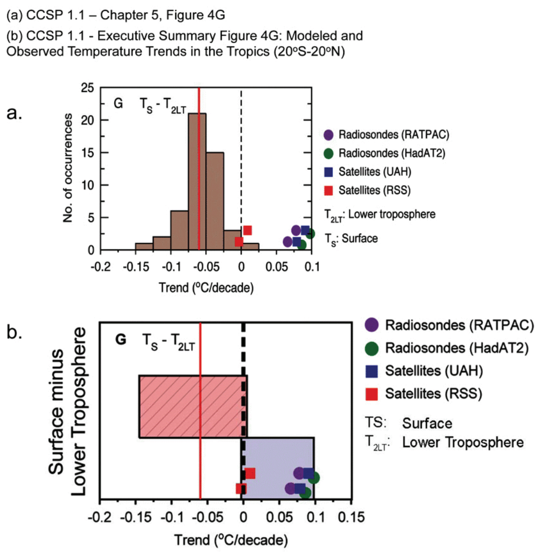


Figure 9a: Another way of presenting the difference between temperature trends of surface and lower troposphere; this is figure 5.4G from CCSP 2006, p. 111. The model results show a spread of values (histogram); the data points show balloon and satellite trend values. Note the model results hardly overlap with the actual observed trends. (The apparent deviation of the RSS analysis of the satellite data is as yet unexplained.)

Figure 9b: By contrast, the executive summary of the CCSP report presents the same information as Figure 9a in terms of 'range' and shows a slight overlap between modeled and observed temperature trends [Figure 4G, p. 13]. However, the use of 'range' is clearly inappropriate [Douglass et al. 2007] since it gives undue weight to 'outliers.'

The SPM of IPCC-AR4 [2007, p. 5] distorts the key result of the CCSP report: "New analyses of balloon-borne and satellite measurements of lower- and mid-tropospheric temperature show warming rates that are similar to those of the surface temperature record, and are consistent within their respective uncertainties, largely reconciling a discrepancy noted in the TAR." How is this possible? It is done partly by using the concept of 'range' instead of the statistical distribution shown in Figure 9a. But 'range' is not a robust statistical measure because it gives undue weight to 'outlier' results (Figure 9b). If robust probability distributions were used they would show an exceedingly low probability of any overlap of modeled and the observed temperature trends.

If one takes GH model results seriously, then the GH fingerprint would suggests the *true* surface trend should be only 30 to 50 percent of the observed balloon/satellite trends in the troposphere. In that case, one would end up with a much-reduced surface warming trend, an insignificant AGW effect, and a minor GH warming in the future.

- *The global temperature record is unreliable.*

It is in fact more likely that the surface data themselves are wrong or that the computer models are wrong – or both. Several researchers have commented on the difficulty of getting access to original data, which would permit independent

A more detailed view of the disparity

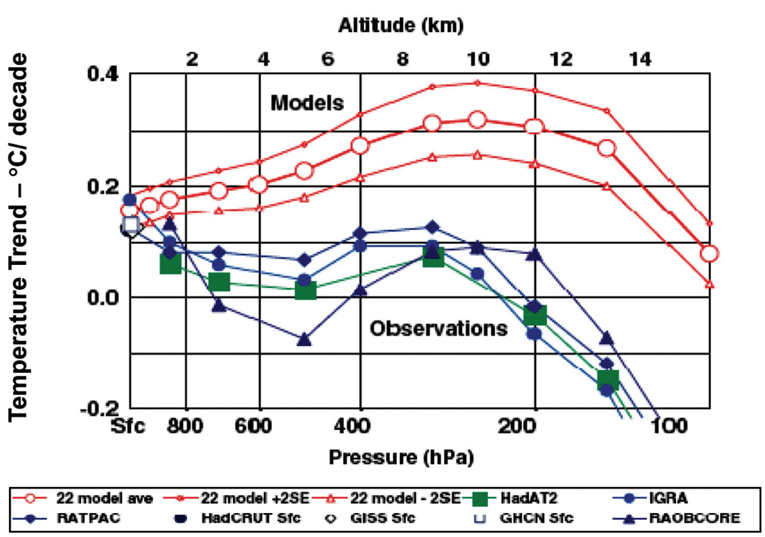


Figure 10: A more detailed view of the disparity of temperature trends is given in this plot of trends (in degrees C/decade) versus altitude in the tropics [Douglass et al. 2007]. Models show an increase in the trend with altitude, but observations from balloons and satellites do not.

verification of the IPCC's analysis of land surface temperatures.

Objections to the surface data are too numerous to elaborate here in detail [see Lo, Yang, Pielke 2007; McKitrick and Michaels 2006]. They have been vigorously criticized for failing to sufficiently control for urban heat-island effects – the fact that asphalt, buildings, air conditioning units, and other parts of urban life cause warming of urban areas that has nothing to do with greenhouse gases. One study of temperature stations in California found no warming in rural counties, a slight warming in suburban counties, and rapid warming in urban counties (Figure 11). [Goodridge 1996]

Another criticism of the temperature record is poor geographic distribution and sampling. The number of stations has varied greatly over time and has decreased markedly from the 1970s, especially in Siberia, affecting the homogeneity of the dataset (Figure 12). Ideally, the models require at least one measuring point for each 5 degrees of latitude and longitude—2,592 grid boxes in all. With the decline in stations, the number of grid boxes covered also declined—from 1,200 to 600, a decline in coverage from 46 percent to 23 percent. Further, the covered grid boxes tend to be in the more populated areas.

Urban Heat Island Effect

Temperature Trends at 107 Californian Stations 1909 to 1994
Stratified by 1990 population of the county where station is located

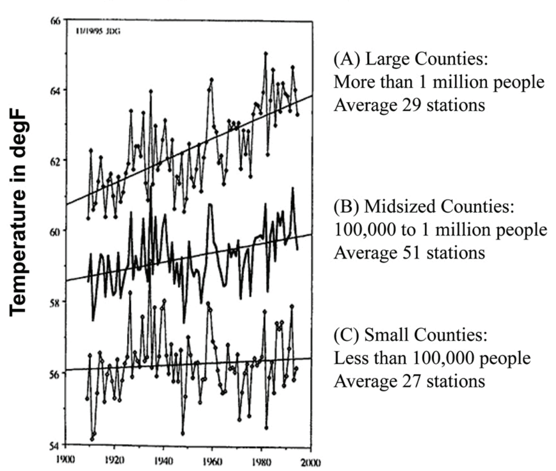


Figure 11: A demonstration of the 'urban heat island' effect: Observed (surface) temperature trends from California weather stations are shown to depend on population density: (A) Counties with more than 1 million people, (B) 100k to 1 million, (C) less than 100k people, respectively [Goodridge 1996]. But note that all three [High, Medium, and Low density] show a temperature rise up to 1940, followed by a pronounced cooling.

NUMBERS OF WEATHER STATIONS AND GRID BOXES

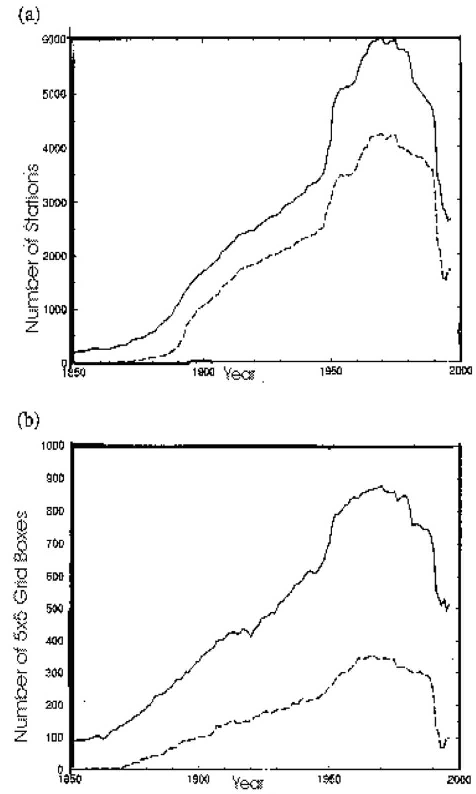


Figure 12: The number of (a) global weather stations and (b) grid boxes [Peterson and Vose 1997]. The top curve (solid) shows stations providing 'mean values'; the dashed curve shows stations supplying 'max-min' values. The rise and fall of covered grid boxes (of 5º x 5º) supplying 'mean values' (solid) and 'max-min' values (dashed). Coverage is seen to be rather poor since the possible number of global grid boxes is 2,592.

An error in the analysis of the NASA-GISS surface data for the U.S. was discovered recently by Stephen McIntyre [2007]. As a result, the year 1934 has emerged as the warmest of the twentieth century for the U.S., and the 1930s the warmest decade.

Data on sea-surface temperatures (SST) have increasingly been obtained from buoys and satellites rather than ships – raising a different set of problems stemming from inhomogeneous data sources. Balloon data can overcome some of these problems, but only satellites provide true global coverage and a homogeneous dataset for the Earth's atmosphere.

Finally, there is a general question of how to define a trend in view of its dependence on the choice of an appropriate time interval. This problem is made more difficult by the occurrence of frequent El Niño warmings and volcanic coolings.

For example, it is often stated that the climate has warmed in the twentieth century – but without mentioning that the warming up to 1940, compared to the cool LIA, was almost certainly of natural origin and that there was cooling from 1940 to 1975 (Figure 4a) when atmospheric CO_2 levels were rapidly increasing. Even the late twentieth-century warming trend may not be real. The global trend, derived since 1979 from satellite data, depends very much on the choice of ending date. Figure 13 shows the complete satellite data record. One can legitimately conclude there was no warming trend prior to 1997, then a small but sudden jump in 1998, followed by another interval of almost no warming since 2001.

Global Lower Tropospheric Temperature, 1978-2007

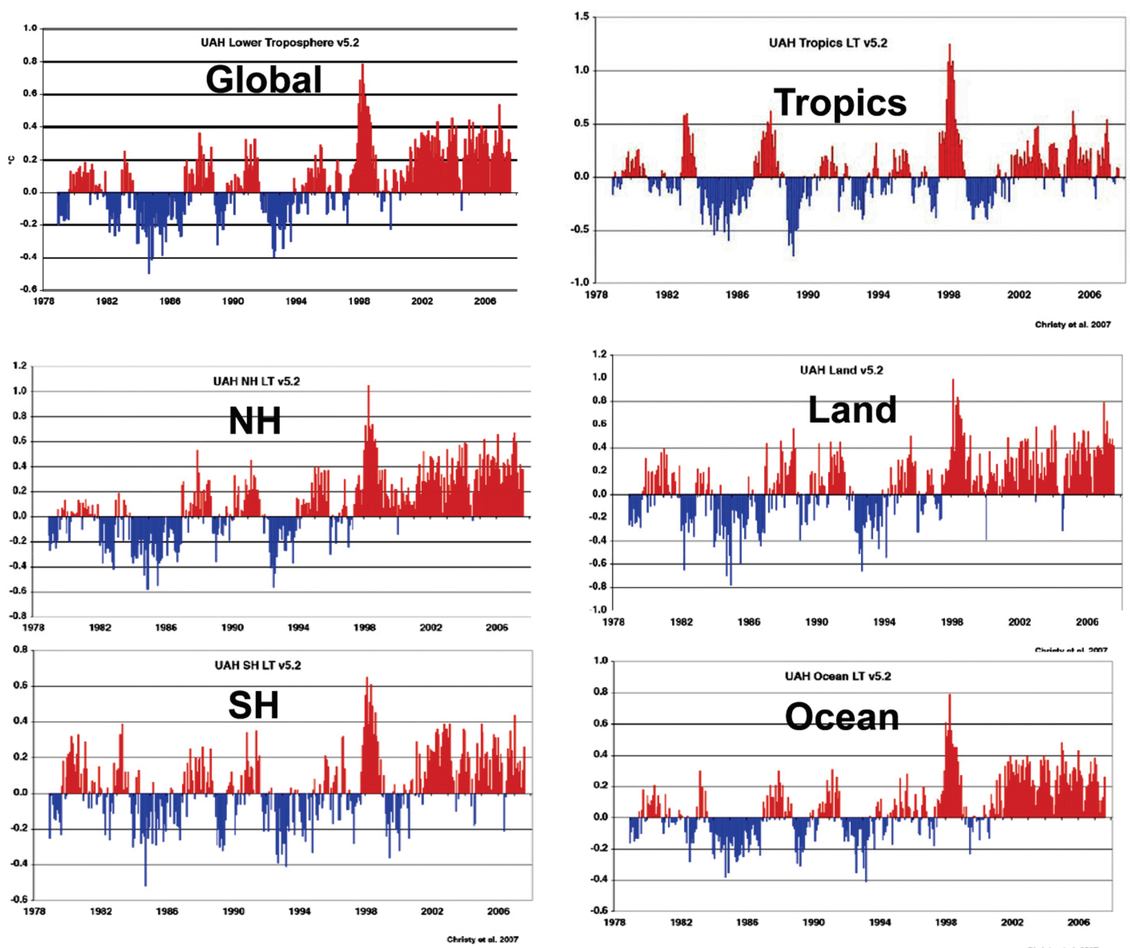


Figure 13: Lower troposphere temperatures versus time from MSU-UAH satellite data. (a) Global; (b) Northern Hemisphere; (c) Southern Hemisphere; (d) Tropics [20 N-20S]; (e) Land; and (f) Ocean [Christy 2007]. Note the absence of a significant trend before 1997 and after 1998. Evidently, the calculated linear trend values (in degrees C per decade) depend on the choice of time interval.

- *Global warming prior to 1940 was not anthropogenic.*

Most agree that the pre-1940 warming signals a recovery from the Little Ice Age and was not caused by GH gases but by natural factors, amongst which solar variability was probably most important. Yet the IPCC in 2001 [IPCC-TAR, p. 716] still quoted a paper that maintains the cause was anthropogenic. That analysis [Wigley 1998] was based on an idiosyncratic statistical approach that has been criticized as spurious. [Tsonis and Elsner 1999]

Another way to show that this analysis is wrong is to divide the data into pre-1935 and post-1935 periods, and then apply Wigley's statistical method. The results for post-1935 correspond to those derived from an unforced (i.e., no increase in GH gases) model calculation. This is contrary to expectation and also suggests the pre-1935 warming is not anthropogenic.

Conclusion: The claim that man is the primary cause of the recent warming is not supported by science. The scientific evidence cited by the IPCC is largely contradicted by observations and analysis.

3. Most of Modern Warming Is Due to Natural Causes

If human influences on global climate are minor, what are the major influences? There are many causes of global climate change, each one prominent depending on the time scale considered. On a time scale of decades to centuries, solar variability may be the most important factor. There are also natural oscillations of internal origin, especially on a regional scale, that do not appear to be connected to human causes either.

- *Internal oscillations play a major role in climate change, yet cannot be forecast.*

The most prominent natural climate oscillations are the North Atlantic Oscillation (NAO), Atlantic Multi-Decadal Oscillation (AMO), Pacific Decadal Oscillation (PDO), and the El Niño-Southern Oscillation (ENSO). The IPCC report describes them well and assigns them to internal oscillations of the atmosphere-ocean system. It is significant, however, that they cannot be forecast by conventional climate models although attempts are being made to incorporate them into climate forecasts to improve forecasting skill [Smith 2007; Kerr 2007]. On the other hand, these may be merely attempts to provide 'band-aid' solutions to explain the absence of a warming trend since 1998.

- *The role of solar influences on the climate can no longer be neglected.*

The IPCC has been disingenuous about solar influences on the climate. Their first report completely ignored solar variability. The IPCC began to take notice only after the pioneering work of Baliunas and Jastrow [1990] and the startling correlation between twentieth-century temperature and solar-cycle length, published by Friis-Christensen and Lassen [1991]. Even then, IPCC reports have persisted up until now in concentrating on solar-cycle changes in total solar irradiance (TSI), which are quite small, of the order of 0.1 percent [Lean 1995; Willson and Mordvinov 2003]. By disregarding or ignoring the very much larger changes of solar ultraviolet [Haigh 1996, 2003] or of the solar wind and its magnetic-field effect on cosmic rays and thus on cloud coverage [Svensmark 2007a], the IPCC has managed to trivialize the climate effects of solar variability.

The AR4 report reduced the IPCC's already-too-low solar impact by about a factor of three so that it became a mere ~1/13 of the anthropogenic influence. The IPCC does not discuss or even reference basic research papers in this field (by Veizer, Shaviv, and, to some extent, Svensmark). Such an omission is difficult to justify in a report that claims to be the most definitive and inclusive assessment of knowledge on climate change.

However, this neglect may no longer be acceptable. The demonstration of solar influence on climate is now overwhelming. One of the prize exhibits is seen in Figure 14 [Neff 2001], which summarizes data obtained from a stalagmite from a cave in Oman. The carbon-14 variations are a clear indication of corresponding changes in galactic cosmic rays (GCR), which are modulated by variations in solar activity. The oxygen-18 values are proxies for a climate parameter, like temperature or precipitation, from a shift in the Intertropical Convergence Zone (ITCZ). The correlation extends well over 3,000 years, with amazingly detailed correspondence. The bottom graph shows the central 400 years expanded and is accurate on almost a yearly basis, making a cause-effect relationship very likely.

The best explanation for these observations, and similar ones elsewhere, is that – as has long been recognized [Singer 1958] – GCR intensity is modulated by the strength of the solar wind and its magnetic field. More recently, a detailed mechanism whereby cosmic rays can affect cloudiness and therefore climate has been suggested and verified experimentally by Henrik Svensmark [2007a,b]. More detailed work is to take place under the CLOUD project proposed by a group of scientists at CERN.

There now is little doubt that solar-wind variability is a primary cause of climate change on a decadal time scale. Once the IPCC comes to terms with this finding, it will have to concede that solar variability provides a better explanation for 20th Century warming than GH effects.

Solar Activity and Climate (as seen by proxies)

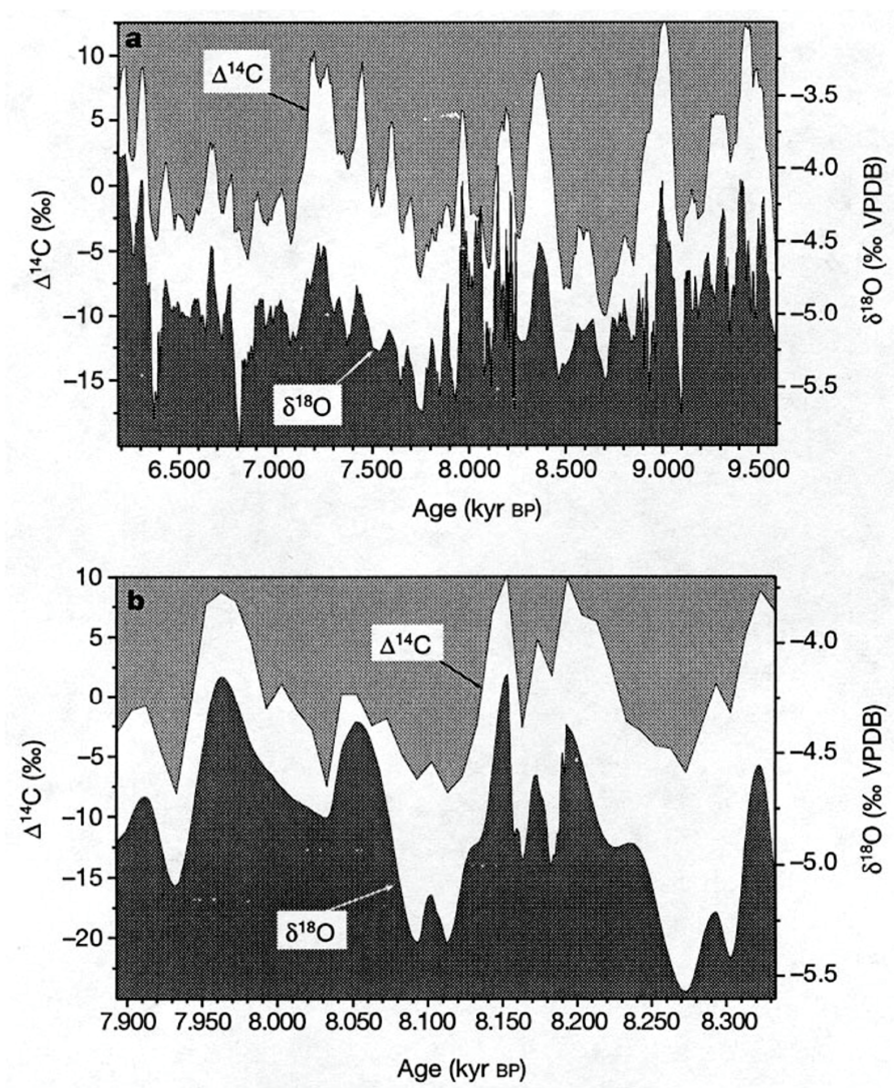


Figure 14: Values of carbon-14 (produced by cosmic rays – hence a proxy for solar activity) correlate extremely well with oxygen-18 (climate proxy); data are from a stalagmite in Oman [Neff 2001]. The time interval covers more than 3,000 years, from about 9,600 to 6,200 years before present (BP). The lower graph shows a particularly well-resolved time interval from 8,350 to 7,900 years BP. It would be difficult to explain this detailed correlation except through the modulation of galactic cosmic rays by changes in the solar wind and solar magnetic activity [Singer 1958]. The mechanism whereby cosmic rays influence terrestrial climate is most likely a change in cloudiness, as suggested by Svensmark [2007a, 2007b].

Indeed, solar variability may explain the pre-1940 warming and subsequent cooling period, the MWP and LIA – and other quasi-periodic climate oscillation with a period of roughly 1,500 years, going back a million years or more [Singer and Avery 2007].

4. Climate Models Are Not Reliable

In its 2001 report the IPCC admitted, "In climate research and modelling, we should recognise that we are dealing with a coupled non-linear chaotic system, and therefore that the long-term prediction of future climate states is not possible" [IPCC-TAR 2001, p. 774] Further, as demonstrated in Section 3, the Earth's climate system is subject to significant, changing influences beyond the Earth itself that are not well understood and cannot be controlled.

Computer models undoubtedly have their place as a way of projecting possible consequences when one or more variables are changed. However, models do not represent reality, yet the IPCC persists in treating them as if they do. The IPCC and its predecessors have adopted climate sensitivities (for a doubling of CO_2) of 1.5 to 4.5 C. But actual model results exceed these 'canonical' limits in both directions.

- ***Computer models do not consider solar dimming and brightening.***

Current models do not consider the observed solar 'dimming' and post-1985 'brightening' [Wild 2005b; Stanhill 2007]. Existing models do not take account of the existence of water vapor (WV) 'dimers' (double H_2O molecules) [Paynter 2007] and their atmospheric absorption of incoming solar radiation in the near-infrared, which may lead to a negative climate feedback as WV concentration increases in the lower troposphere.

- ***Computer models do not accurately model the role of clouds.***

The differences among model results are large and arise mostly from the treatment of clouds and the somewhat arbitrary choices of cloud-related parameters, notably, the droplet-size distribution [Senior and Mitchell 1993], which strongly affects the cloud albedo. Most of the effects of parameter variation are caused by a small subset of parameters; for example, the choice of entrainment coefficient in clouds is associated with 30 percent of the variation seen in climate sensitivity [Knight 2007].

Special problems arise from the chaotic nature of climate. Small changes in initial conditions lead to vastly different outcomes. To overcome this well-recognized feature, modelers resort to multiple runs ('simulations'), which are later averaged into an 'ensemble.' The problem then becomes one of convergence, especially when the outcomes differ greatly from each other [Lucarini 2007]. An additional problem arises when trying to average over different model ensembles, some based on as many as 10 runs, some only on one run.

As previously observed, current GH models do not match the observed latitude distribution of temperature trends. In particular, one would expect that the production of sulfate aerosols in the Northern Hemisphere should create a reduced warming trend there – or even cooling. The observations show the opposite.

In general, models do not consider realistically the lack of geographic homogeneity of forcing, especially for aerosols. Polar trends do not agree with model expectations and can more easily be explained with solar forcing [Soon 2005]. Models reviewed by the IPCC do not employ realistic growth figures for the GH gas methane [Dlugokencky 1998] and do not consider the resultant forcings caused by future changes in the stratosphere from increases in water vapor and ozone depletion [Singer 1971; Shindell 2001].

Held and Soden [2006] clearly show that, for the computer models used in AR4, atmospheric WV increases with surface temperature according to the Clausius-Clapeyron (CC) equation; precipitation and evaporation increase at a rate significantly less than the CC relationship. However, satellite observations suggest that actual precipitation increased twice as fast as models predict [Wentz 2007], indicating the potential of global warming to cause drought may be less than has been feared.

- ***Computer models do not simulate a possible negative feedback from water vapor.***

The models also have problems describing the latitude and altitude distribution of water vapor. In particular, the values of upper-troposphere (UT) water vapor control the heat loss to space and thereby exert an all-important control on the Earth's surface temperature. Measurements may give mean values of UT water vapor; but since emission varies as the fourth power of temperature, one cannot thereby deduce the average value of outgoing long-wave radiation (OLR).

Since water vapor (WV) is the most important atmospheric greenhouse gas, it is difficult to explain in simple terms how it can also act to produce a negative feedback, i.e., to reduce the presumed warming effects of CO_2. In fact, current GH models all incorporate a positive feedback from an increase in WV.

However, Richard Lindzen [1990] and others [Ellsaesser 1984] have pointed to ways whereby WV can produce a negative rather than a positive feedback. It requires a mechanism for reducing the concentration of WV in the upper troposphere (UT). Empirical evidence seems to support such a distribution of UTWV [Spencer et al. 2007].

The negative feedback mechanism works as follows [see Figure 15]: With normal values of UTWV, IR emission into space (called the outgoing long-wave radiation—OLR) takes place at the low temperature of the UT. But if the UT is dry, then the OLR emission from WV bands originates from the much warmer boundary layer in the lower troposphere (LT). The emission from the surface takes place in the atmospheric window (between 8 to 12 microns) and depends on the temperature of the surface, which radiates as a black body.

Note, however, that the total value of OLR must roughly balance the incoming absorbed solar radiation. In the case of a moist UT, more of the OLR radiation will originate from the Earth's surface; in the case of a dry UT the opposite is true. Therefore, a dry UT corresponds to a warmer surface; a moist UT corresponds to a cooler surface: Hence the distribution of WV can produce a negative feedback—provided the increasing CO_2 causes a particular distribution of WV.

- *Computer models do not explain many features of the Earth's observed climate.*

Models overestimate the land surface insolation, (the amount of solar radiation striking the surface) when compared to a dataset of 760 worldwide-

Negative Feedbacks from Water Vapor

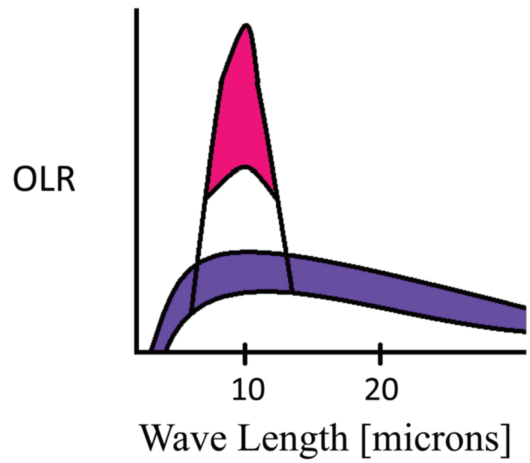


Figure 15: The cartoon suggests that drying of the upper troposphere would lead to a negative feedback reducing the effects of increasing CO_2. The (purple) broad band shows the atmospheric infrared emission into space (outgoing long-wave radiation—OLR). The upper boundary corresponds to a dry upper troposphere (UT); the lower boundary corresponds to a moist UT. The peaked red band shows emission from the surface into space through the atmospheric window (8 to 12 microns). To keep total OLR constant, the lower boundary of this band would correspond to a dry UT, while the upper boundary would correspond to a moist UT. This change in infrared emission from the surface suggests a corresponding temperature change—which ultimately reduces the warming from increased levels of CO_2.

distributed surface stations from the Global Energy Balance Archive [Wild 2005a]. The discrepancy is 9 watts per square meter (W/m2) on average, several times the estimated GH forcing. It suggests uncertainties in partitioning of solar energy between surface and atmospheric absorption.

Beyond this, the GH models do not explain many other features of Earth's observed climate. For instance, the history of polar temperatures, the cooling trend of the Antarctic, the seesaw effect of Northern Hemisphere/Southern Hemisphere linked to ocean circulation, and features such the observed Madden-Julian Oscillation in the tropics, the North Atlantic Oscillation, the Atlantic Multi-decadal Oscillation [Schlesinger and Ramankutty 1994], the Pacific Decadal Oscillation [Mantua 1997], and El Niño occurrences.

In general, climate models do rather poorly in predicting precipitation, particularly on a regional level (see, for example, Figure 16). Nor have they been successful in predicting such major climate phenomena as ENSO or the Indian Monsoon.

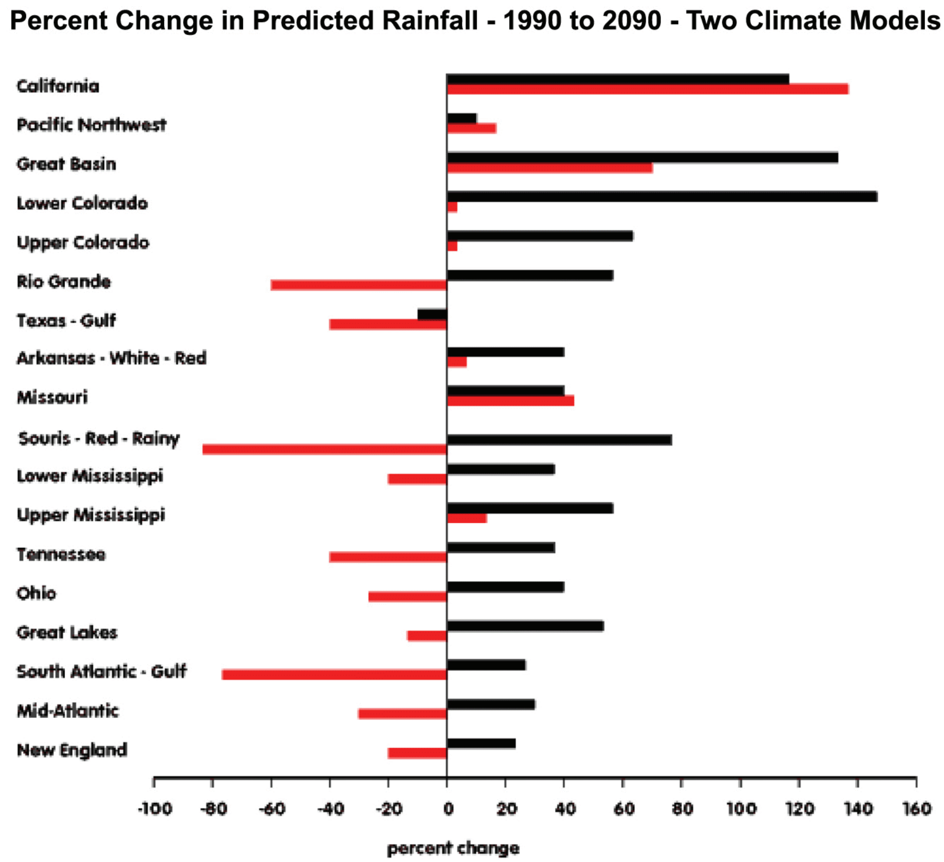


Figure 16: A result from the U.S. National Assessment of Climate Change [NACC 2000]: Expected precipitation for 18 regions of the United States, according to the Hadley model and Canadian model. Note the huge differences between the two model results in magnitude and even in sign. For example, the Dakotas (Souris - Red - Rainy) can turn either into a swamp or into a desert, depending on which climate model is used.

"Climate models are woefully inadequate to simulate and predict Asian summer Monsoon precipitation. The Asian summer Monsoon is the largest single abnormality in the global climate system" [Shukla 2007]. Kriplani et al. [2005] conclude that the Indian Monsoon shows decadal variability with about 30-year cycles of above-and-below-normal rainfall and is not affected by global warming at this time.

- *Computer models cannot produce reliable predictions of regional climate change.*

Computer models are notoriously inadequate in simulating or projecting regional effects, particularly when it comes to precipitation. This fact can be demonstrated most clearly in the U.S.-National Assessment of Climate Change report [NACC 2000] that used both the Hadley model and Canadian model to project future changes for 18 regions of the United States. As can be seen from Figure 16, in about half the regions the two models gave opposite results. For example, the Dakotas would become either a desert or a swamp by 2100, depending on the model chosen. It is significant that the U.S.-NACC report failed to meet the tests of the Information Quality Act [2004] and was withdrawn from official government report status.

While useful in experiments to study the sensitivity of changes in climate parameters, computer models are unsuited for predictions of future climate. Kevin Trenberth, a lead author of the IPCC-TAR report, recently wrote [Trenberth 2007]:

> In fact there are no predictions by IPCC at all. And there never have been. The IPCC instead proffers 'what if' projections of future climate that correspond to certain emissions scenarios. There are a number of assumptions that go into

these emissions scenarios. They are intended to cover a range of possible self consistent 'story lines' that then provide decision makers with information about which paths might be more desirable. But they do not consider many things like the recovery of the ozone layer, for instance, or observed trends in forcing agents. There is no estimate, even probabilistically, as to the likelihood of any emissions scenario and no best guess. Even if there were, the projections are based on model results that provide differences of the future climate relative to that today.

There is neither an El Niño sequence nor any Pacific Decadal Oscillation that replicates the recent past; yet these are critical modes of variability that affect Pacific Rim countries and beyond. The Atlantic Multidecadal Oscillation, that may depend on the thermohaline circulation and thus ocean currents in the Atlantic, is not set up to match today's state, but it is a critical component of the Atlantic hurricanes, and it undoubtedly affects forecasts for the next decade from Brazil to Europe.

The starting climate state in several of the models may depart significantly from the real climate owing to model errors. I postulate that regional climate change is impossible to deal with properly unless the models are initialized.

The 'nuclear winter' episode of 1983-84 represents a good example of how global climate models can give false results and mislead the public and even many experts. Ideologically driven, the 'nuclear-winter' hypothesis relied on a model calculation that used artificial assumptions designed to give the desired result, incomplete physics that neglected important atmospheric processes, and also some physics that was plain wrong. The 'phenomenon' was hyped by the popular press, endorsed by a National Academy of Sciences panel, and taken quite seriously by government agencies, including the Pentagon. It is now being resurrected in an 'improved' form [Robock 2007], but with the same problems as the original version.

Conclusion: The climate models used by the IPCC do not depict the chaotic, open-ended climate system. They cannot make reliable predictions and should not be used in formulating government policy.

5. The Rate of Sea-Level Rise Is Unlikely to Increase

Sea level (SL) rise is one of the most feared impacts of any future global warming, but public discussion of the problem is beset by poor data and extremely misleading analysis.

Eminent practitioners in the field have termed current estimates of SL rise a "puzzle' [Douglas and Peltier 2002], an "enigma" [Munk 2002], and even "fiction" [Mörner 2004].

- *Estimates of recent sea-level rise are unreliable.*

Most discussion, including that of the IPCC, is formulated in terms of global average sea level. Even assuming this statistic can be estimated accurately (see further comments below), it has little practical policy value. Local relative sea-level (LRSL) change is all that counts for purposes of coastal planning, and this is highly variable worldwide, depending upon the differing rates at which particular coasts are undergoing tectonic uplift or subsidence. There is no meaningful global average for LRSL [Douglas 2001].

At one of the allegedly most endangered sites, the Maldives, condemned to disappear soon into the sea, both satellite altimetry and tide-gauge records have not registered any significant SL rise. Contrary to IPCC expectations, sea level there fell by 20 to 30 cm in the past 30 years [Mörner 2004].

Certain observational features stand out. According to abundant and varied geological data, sea level has risen by about 120 meters since the Last Glacial Maximum (LGM) 18,000 years ago [e.g., Fairbanks 1989]. Coral data also show a roughly uniform rate of rise during past centuries [Toscano & Macintyre 2003] (Figure 17). The best tide-gauge data show a fairly uniform rate of rise of about 1.8 mm per year during most of the past century [Trupin and Wahr 1990, Douglas 2001] in spite of warming and cooling (Figure 18). Satellite data have shown a higher rate of rise in the past 20 years [Cazenave and Nerem 2004], but the temporal and geographic variability is so large that the applicability of the data has not been generally accepted.

Sea Level Since Last Glacial Maximum

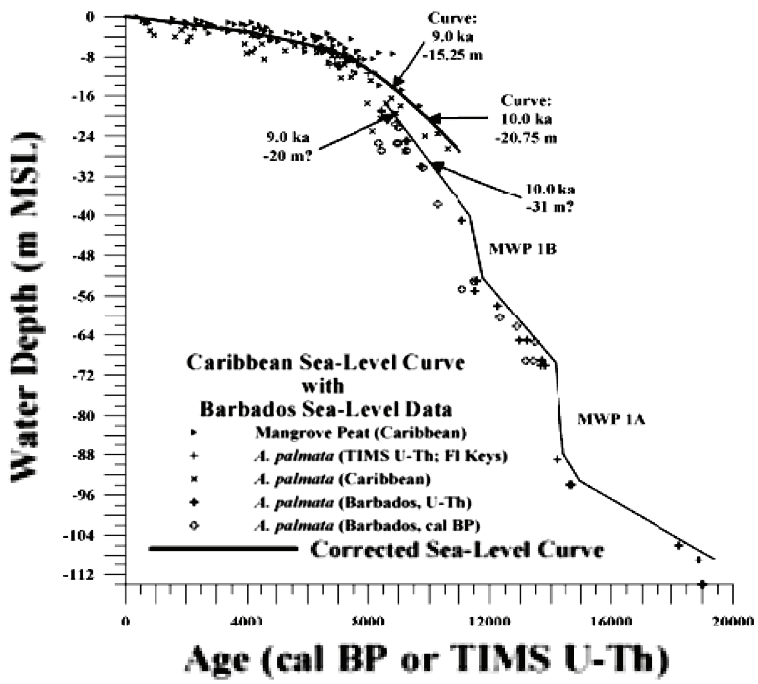


Figure 17: Sea-level rise since the Last Glacial Maximum, as deduced from coral and peat data [Toscano & Macintyre 2003]. The total rise since 18,000 years before present (BP) is about 120 meters. Note the rapid rate of rise as continental ice sheets melted and the more modest and nearly constant rate of rise in the past several millennia – irrespective of global temperature fluctuations.

Sea Level 1900-1980

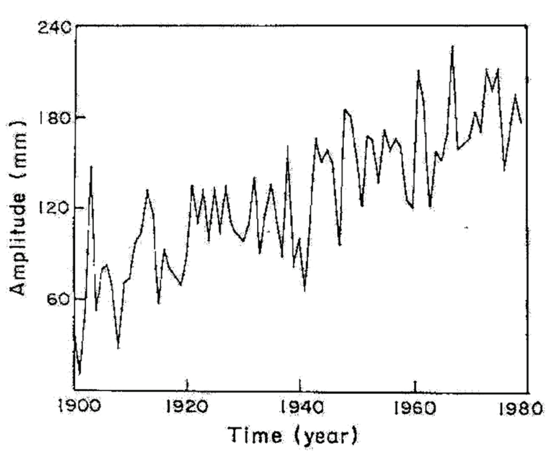


Figure 18: Sea-level (SL) values for 84 tidal-gauge stations with more than 37 years of data [Trupin and Wahr 1990]. They have been corrected for post-glacial rebound. The average rate of rise is ~18 cm per century. Note absence of any acceleration in SL rise during warming intervals. While satellite data [Cazenave and Nerem 2004] suggest a higher rate of rise, an analysis by Holgate [2006] shows a lower rate in recent years.

Some analyses [Holgate 2006] even suggest a slowdown in the rate of SL rise during the latter half of the twentieth century. We may conclude, therefore, that there has been an insignificant amount of acceleration, if any, in SL rise since 1900 – in spite of temperature changes. This conclusion is completely at variance with that of the IPCC, yet it is supported by many independent researchers [Douglas 2001].

- *'Bottoms-up' modeling of future sea levels does not uniformly predict rising sea levels.*

The four IPCC reports have all used a 'bottoms-up' modeling analysis of global average change in sea level. They estimate separately the positive contribution to SL rise from melting mountain glaciers (eustatic) and thermal expansion of a warming ocean (steric). Obviously, this holds only for the upper ocean layer as icy-cold deep-sea water is neither increasing in temperature nor would expand if warmed. They then add the estimated net values (ice loss minus ice accumulation) for the Greenland and Antarctic ice sheets.

The observed lack of acceleration of SL (Figures 17 and 18) may indicate a fortuitous yet plausible balance, in which ice accumulation on the Antarctic plateau roughly balances the effects of expanding ocean and melting glaciers for short-lived (decades-long) global temperature changes [Singer 1997, p. 18]. This is plausible since a warming ocean releases more moisture into the atmosphere, which increases precipitation and ice accumulation, mainly over the Antarctic continent. If true, sea level would continue to increase at about the same rate – roughly 18 cm per century – in spite of temperature changes of short duration, measured in decades, whether warming or cooling.

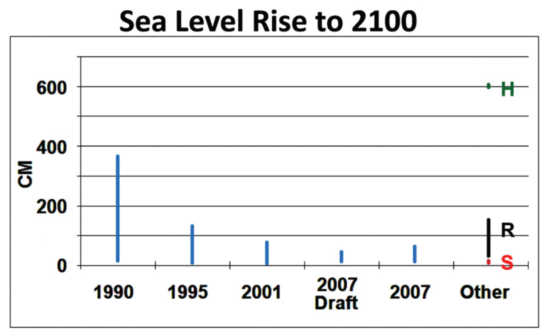
- *Each successive IPCC report forecasts a smaller sea-level rise.*

Successive IPCC reports have reduced their estimates of projected sea-level rise, as shown in Figure 19, and are coming closer to a value of 18 cm per century. Since this is also close to the ongoing rate of rise, this is equivalent to saying there will be no acceleration by AGW, i.e., *no additional sea-level rise due to warming.*

There is, however, another problem: The IPCC figures do not match the observed rate of rise [IPCC-AR4 2007, Table TS.3, p. 50]. Most of the ongoing SL rise may therefore be due to the slow melting of the West Antarctic Ice Sheet (WAIS) [Conway 1999]. It has been slowly melting since the LGM of 18,000 years ago. If it continues at this rate, it will disappear in about 7,000 years [Bindschadler 1998] – unless another ice age commences.

- *Forecasts of more rapid sea-level rise are not credible.*

Recently, Stefan Rahmstorf [2007] has published a 'top down' approach to SL-rise prediction that exceeds the current IPCC estimates about threefold. He simply assumes the rate of rise is proportional to global mean temperature. There is no theoretical basis to support this assumption – and indeed, it is contradicted by observational evidence: SL rise continued at the same rate even when the climate was cooling from 1940 to 1975. As Nobel physicist Wolfgang Pauli once said when confronted with a similar silliness, "This theory is worthless; it isn't even wrong."



	IPCC 1990	IPCC 1995	IPCC 2001	2007 Draft	IPCC 2007	Hansen (H)	Rahmst. (R)	Singer (S)
Max	367	124	77	43	59	600	140	20
Min	10	3	11	14	18	600	50	18

Figure 19: Estimates of sea-level rise to Year 2100 from IPCC reports of 1990, 1995, 2001, and 2007. Note the strong reduction in estimated maximum rise, presumably based on better data and understanding. Also shown are the published seal level rise values of Hansen (H) [2006], Rahmstorf (R) [2007], and Singer (S) [1997]. Both H and R are well outside of the maximum IPCC values. The ongoing rate of rise in recent centuries has been 18 cm per century; therefore, the incremental rate of rise for IPCC 2007 would be 0 to 41 cm, and about 0 to 2 cm for Singer.

James Hansen [2006] has suggested even more extreme estimates of future SL rise – nearly 15 (or even 60) times the mean IPCC value and 30 (or even 120) times that of Singer. His 20-feet estimate is based on speculation about the short-term fate of polar ice sheets, assuming a sudden collapse and melting; his 80-feet estimate is derived by comparison with previous interglacials. However, the MWP and the much greater warmings during the earlier Holocene showed no evidence of such imagined catastrophes. Hansen and Rahmstorf can therefore be considered 'contrarians' on this issue.

It is likely that actual SL observations within the next few years will show such extreme estimates to be wrong. It is ironic that Hansen, Rahmstorf, and some others have attacked the IPCC as being too conservative [Rahmstorf et al. 2007] and relying on consensus [Oppenheimer et al. 2007].

6. Do Anthropogenic Greenhouse Gases Heat the Oceans?

In 2005, Hansen announced he had found the 'smoking gun' for anthropogenic warming by comparing the published increasing rate of ocean heat storage (during a selected time period) with an assumed energy imbalance at the top of the atmosphere [Hansen 2005]. There are many things wrong with this analysis.

Obviously, sea surface temperature (SST) has to increase before heat can be stored in the deep ocean. We know SST increased pre-1940, thus presumably adding stored heat to the ocean, yet few really believe the cause of that warming was anthropogenic, since it occurred well before the large-scale use of fossil fuels. Hansen's analysis has been additionally invalidated by the finding that the heat storage data are over-estimated by a large factor [Gouretski 2007] and by recent observations that heat storage stopped increasing in the past few years [Lyman 2006, Willis 2007].

A more fundamental issue is the degree to which greenhouse effects contribute to SST. According to basic physics, the 'complex refractive index' of water in the infrared (IR) region results in IR radiation being absorbed within a thickness of the order of only 10 microns. However, the GH effect depends on IR radiation, downwelling from the atmosphere towards the surface, being absorbed, and then adding to the normal heating by the Sun's visible radiation (Figure 20). But if this downwelling radiation (DWR), emanating from atmospheric GH gases and from clouds, is completely absorbed in the 'skin' of the ocean, what happens to the absorbed energy? How much is re-radiated? How much is used to increase evaporation?

The problem is to find out how much of the energy is transmitted to the bulk layer beneath the skin in order to help warm the ocean [Singer 2005a, b; Singer 2006]. Peter Minnett [2006] believes his data show that all of the DWR energy contributes to sea surface temperature (SST); others are less sure. One doesn't see any way of answering these questions definitively, except perhaps by direct measurements under different conditions of sea state and surface ripples.

One would measure the DWR, the upwelling IR from the skin, and the detailed temperature distribution just below the skin, and record the changes as the amount of DWR varies. Since we cannot wait for a change in CO_2, we could measure the effect of a cloud or other IR-emitting surface on our experimental setup.

Energy Inputs to Sea Surface

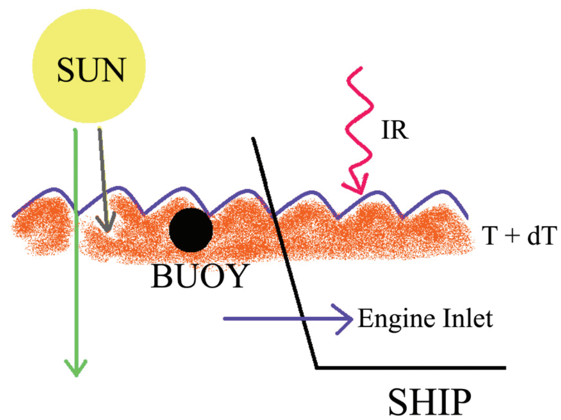


Figure 20: Cartoon showing the absorption of downwelling infrared radiation (from greenhouse gases and clouds) within a ~10-micron 'skin' of the ocean. It is not known how much of this greenhouse energy contributes to sea surface temperature, and how much goes into re-radiation and evaporation. Note the buoys are located in the warmest part of the 'mixed layer' of the ocean; therefore, the increasing admixture of buoy data since 1980 could result in a calculated rise of sea surface temperature that is an artifact of the data handling procedure.

In response to the claim that the observed rise in ocean temperatures provides an empirical solution to this problem, we must consider the possibility that the observed temperature rise is partly an artifact of the method of measurement. As previously observed, in the past 25 years, drifter buoys have become predominant in supplying SST data. But they measure temperatures within a few centimeters of the surface, where solar heating is a maximum (during the day) whereas ships (the previous method of measuring ocean temperatures) measure temperatures a few meters below the surface, where it is colder. (See Figure 20 for an illustration of the different measurement techniques in use.) One can readily show that combining ship data with a *growing* amount of buoy data likely leads to a fictitious temperature rise.

Finally, we must deal with the fact that as SST increases, evaporation increases even more rapidly – setting effective upper limits to SST values [Priestley 1996, Held & Soden 2006, Wentz et al.

2007]. But which temperature should one use: SST (as climate models calculate) or the generally cooler 'skin'? Empirically, the situation is complicated since rate of evaporation depends also on the relative humidity of the overlying atmosphere, surface winds and sea state, and the occurrence of precipitation.

Nowhere does the IPCC discuss these problems in any detail or offer any suggestions for their solution. Yet it is clearly of fundamental importance to know what fraction of the greenhouse effect contributes to ocean heating – not least because oceans cover 70 percent of the Earth's surface.

7. How Much Do We Know About Carbon Dioxide in the Atmosphere?

What fraction of carbon dioxide from human activities contributes to the observed increase in carbon dioxide in the atmosphere and how much ends up in poorly understood sinks? What fraction is contributed by a warming ocean and absorbed by an expanding biosphere?

Unknown outgassing associated with a warmer ocean, changing exchange between the surface layers and the deep ocean (where carbon is locked up for thousands of years), unknown biosphere uptake in a warmer climate – all contribute uncertainties as to future scenarios of atmospheric CO_2 concentration.

The real policy question, then, is this: Can the rate of increase in atmospheric CO_2 concentration be explained with sufficient accuracy, taking account of the various sources and sinks and the uncertainties associated with them, to predict the effects of mandated reductions in anthropogenic GH emissions?

- *Past trends in atmospheric levels of CO_2 are poorly understood and controversial.*

Zbigniew Jaworowski [1994, 1992] has repeatedly pointed to the unreliability of ice-core data to establish pre-1958 CO_2 concentrations, thus creating doubt about the magnitude of the human contribution to the current atmospheric CO_2 concentration.

Ernst-Georg Beck, by assembling more than 90,000 pre-1958 measurements of atmospheric CO_2 dating back to the nineteenth century, has shown rather large variations, including a major increase roughly coincident with a rise in ocean temperatures from 1920 to 1940 [Beck 2007]. Others have disputed the significance of these measurements; the issue has not yet been fully resolved.

On the other hand, the observed latitudinal distribution of CO_2, and its development over time, as seen by CO_2 monitoring stations around the world, provide important evidence for a substantial human component of CO_2 growth. Figure 21 shows CO_2 concentrations are highest in the Northern Hemisphere, with the seasonal cycle diminishing in amplitude in the Southern Hemisphere, as would be expected. But the secular increase of the amplitude points to an expansion of the biosphere – presumably as the result of CO_2 fertilization.

Measurements of increased ocean acidity give us little additional information about the sources of CO_2 increases. Although higher concentrations of carbon dioxide reduce the pH of the ocean to some degree, it still remains slightly alkaline; pH values range from 8.2 (in the Norwegian Sea of the North Atlantic) to 7.9 (in the Eastern Pacific and Arabian Sea) [Doney 2006]. There seems no imminent danger of impact on shell formation by marine creatures. The much-feared effects on coral growth are not supported by actual data. [Lough & Brnes 1997; Fine & Tchernov 2007]

The observed increase over time in the amplitude of the seasonal CO_2 cycle suggests that CO_2 fertilization is expanding the biosphere and thus creating a negative feedback, as will be discussed below. The IPCC report also lacks a thorough discussion of the data necessary to analyze this issue. It mentions [IPCC-AR4, p. 139] the great uncertainty (between 6 percent and 39 percent) in the contribution from land-use changes to CO_2 growth rate.

Isotopic information on carbon-13 appears to be adequate to resolve the problem [Marchitto 2005, Boehm 2002]. Similarly, the measured decrease in atmospheric oxygen over time [Keeling 1992, 1996] not only verifies that fossil fuels have been burned but clarifies some of the details of the CO_2 budget.

Figure 22 shows trends in global emissions of CO_2 from use of fossil fuels from 1850 to 2000. Emissions grew at an annual rate of 4.4 percent from 1850 to 1915, slowed to 1.3 percent from 1915 to 1945 (reflecting the global economic depression), rose to 4.3 percent during the recovery from 1945 to

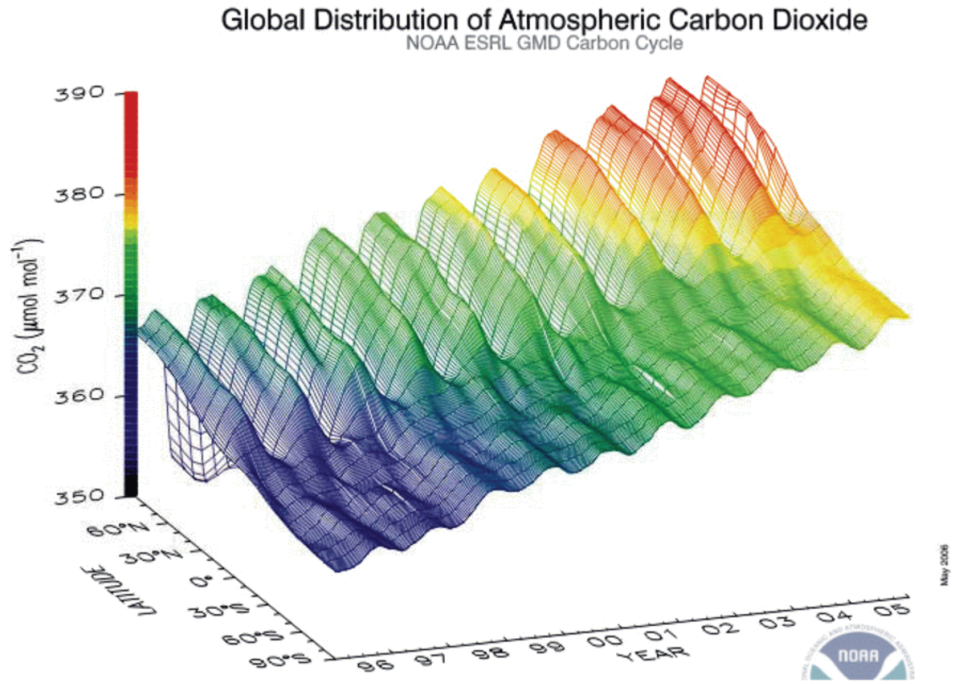


Figure 21: CO_2 levels versus latitude and time [http://www.cmdl.noaa.gov/ccgg]. The level of atmospheric CO_2 is color-coded to the ordinate scale. Data come from the marine boundary layer. Note the latitude variation, indicating a CO_2 source in the Northern Hemisphere. Note the increase in the amplitude of the seasonal variation, suggesting an increase in terrestrial biomass.

1975, and finally slowed once again to 1.2 percent a year in the period from 1975 to 2000, reflecting the spread of more energy-efficient technologies.

Figure 23 compares changes in human CO_2 emissions to changes in atmospheric CO_2 since 1960. The fraction of emissions retained in the atmosphere varies considerably and seems to correlate with ocean temperature, El Niño warmings, and the coolings from volcanic eruptions, not to human emission of CO_2.

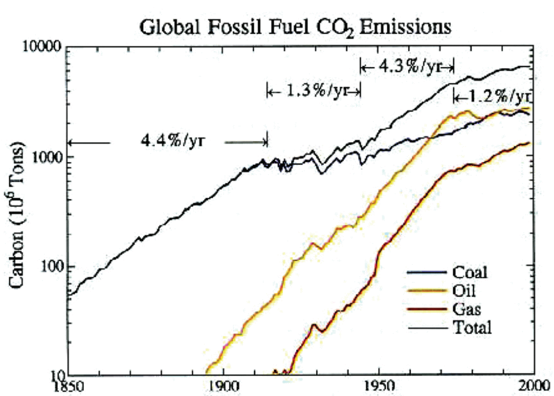


Figure 22: Growth of CO_2 emissions (in megatons per year of carbon) from fossil fuels [Marland 2007]. The top curve gives the total values and growth rates as shown. Note the rapid rise of oil use and then natural gas. Note also that the vertical scale is logarithmic; an exponential rise in emission therefore will appear to be 'linear.'

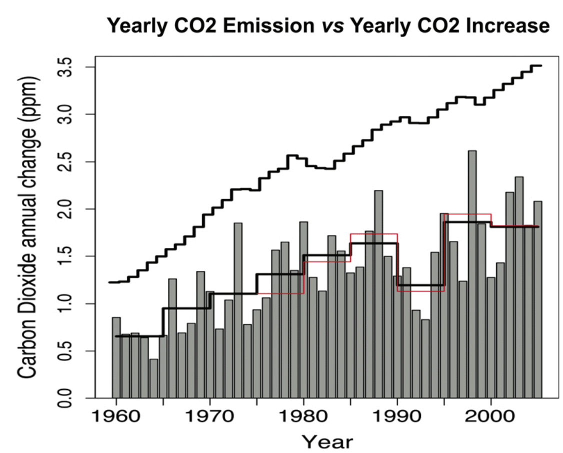


Figure 23: The year-to-year increase of CO_2 vs. time. The bar graph shows an increase in the atmospheric levels, an irregular pattern that correlates well with El Niño warming events and volcanic cooling events. Yet the release of CO_2 from fossil-fuel burning (upper curve) increases smoothly [IPCC 2007, p. 516]. Presumably, there are strong temperature-dependent variations in the CO_2 absorption of the ocean.

- ***Carbon dioxide sources and sinks are poorly understood.***

Present carbon-cycle models rely on unknown sinks to explain recent trends. Presumably, these additional sinks were not operating prior to industrialization and have emerged as a consequence of the increasing atmospheric concentration. In the future, will these 'missing sinks' amplify or diminish the human contribution to atmospheric CO_2?

It is conventionally assumed that the difference between emitted anthropogenic CO_2 and the measured increase must be absorbed in ocean, soils, and biosphere or partly buffered in the upper mixed ocean. Yet there are few data to support this and the literature talks about an unidentified 'carbon sink' – renamed as 'residual land sink' [IPCC-AR4 2007, p. 26]. Recent speculation assigns this sink to tropical forests.

The observed increase in the seasonal change of CO_2 concentration suggests increasing uptake by an expanding biosphere and the upper mixed ocean buffer. Unknown outgassing associated with a warmer ocean, changing exchange between the surface layers and the deep ocean (where carbon is locked up for thousands of years), unknown biosphere uptake in a warmer and wetter climate, increasing decay of biomass, as well as some outgassing of (permafrost) soils, etc., all lead to uncertainties in future values of atmospheric CO_2 concentration.

Less than half of the CO_2 emitted by fossil-fuel burning remains in the atmosphere; the rest is absorbed by the ocean or incorporated by the terrestrial biosphere in roughly equal measures [Baker 2007]. In order to understand the relative role of different parts of the terrestrial biosphere as carbon sinks, global measurements of atmospheric CO_2 concentration must be interpreted by 'inversion' models to determine how uptake, emission, and transport contribute to the seasonal and regional differences.

Previous studies [IPCC-AR4 2007, p. 522] have suggested there must be a strong carbon sink in the Northern Hemisphere, and that the tropics are a net carbon source. There is some evidence, considered controversial, from detailed CO_2 data [Fan 1998] that North America is a net carbon sink [IPCC-AR4 2007, p. 523]. However, Stephens [2007] reports that global vertical distributions of CO_2 in the atmosphere are not consistent with that interpretation but are more consistent with models that show a smaller NH carbon sink and possibly strong carbon uptake in the tropics.

- ***The role of oceans as CO_2 sources and sinks is a major source of uncertainty.***

The role played by a warming ocean seems to be unquestioned. The solubility of CO_2 in water decreases with increasing temperature – roughly by 4 percent per degree C. Therefore, the ability of a warming ocean to absorb CO_2 diminishes – or conversely, a warming ocean will give up CO_2 to a warming atmosphere. Observationally, ice-core data show that atmospheric CO_2 increases *followed* (did not precede) the rapid warmings of past deglaciations [Fischer 1999] by many centuries – although the increased CO_2 may well operate in a feedback loop and contribute to further warming.

The details of this process are rather complicated. The IPCC does not discuss it beyond mentioning that CO_2 is absorbed in the colder parts of the ocean and may be released from upwelling water in the warmer parts. A proper treatment requires knowing the detailed temperature distribution of the ocean in latitude and longitude. It must take into account ocean circulation and how this brings CO_2-rich colder water to the surface. It also involves knowing the degree of saturation of ocean masses as a function of time and the thickness of the mixed layer, likely a function of surface winds and sea state.

The rate of CO_2 uptake by the ocean depends on the difference between the partial pressure of CO_2 in the atmosphere and the pressure that would exist if the ocean and the atmosphere were at equilibrium. Le Quere [2007] reports that the rate of uptake by the Southern Ocean, one of the most important CO_2-absorbing regions, has slowed relative to what would be expected based solely on how fast the concentration of atmospheric CO_2 has risen since 1981. They attribute this shortfall to an increase in windiness over the Southern Ocean, conveniently blamed on global warming. The authors predict this relative trend will continue.

8. The Effects of Human Carbon Dioxide Emissions Are Benign.

Answers to questions regarding where CO_2 comes from and where it goes are of obvious importance in predicting more accurately the effectiveness of controls on human CO_2 emissions. But they are not nearly as important as knowledge of future consumption of fossil fuels or the likely effects of higher CO_2 concentrations on the planet's plants and wildlife.

Regarding the former, there is reason to believe the IPCC has exaggerated future emission trends, invalidating the temperature projections that rest on the accuracy of those emission scenarios. Regarding the latter, there is clear and compelling evidence that higher levels of CO_2, even if accompanied by higher temperatures and changes in precipitation, would be more beneficial than harmful.

- *The IPCC's estimates of future anthropogenic CO_2 emissions are too high.*

The IPCC used essentially the same methodology for producing emission scenarios in its AR4 as it did for TAR, a methodology that was vigorously critiqued by Ian Castles and David Henderson in 2003 for containing basic errors in economics and the handling of economic statistics, excluding from consideration relevant published sources, and excluding economists from its writing and peer review processes [Castles and Henderson 2003; Henderson 2005].

For AR4, the IPCC ran computer simulations for one scenario that appeared in TAR (A2) and two new scenarios (B1 and A1B) [IPCC-AR4 p. 761]. The IPCC frankly admits in the body of AR4, though not in the SPM, that there is considerable uncertainty about the reliability of all of these scenarios and their possible effects on climate:

> Uncertainty in predictions of anthropogenic climate change arises at all stages of the modelling process described in Section 10.1. The specification of future emissions of greenhouse gases, aerosols and their precursors is uncertain (e.g. Nakicenovic and Swart, 2000). It is then necessary to convert these emissions into concentrations of radiatively active species, calculate the associated forcing and predict the response of climate system variables such as surface temperature and precipitation (Figure 10.1). At each step, uncertainty in the true signal of climate change is introduced by errors in the representation of Earth system processes in models (e.g., Palmer et al. 2005) and by internal climate variability (e.g., Selten et al., 2004). ... Such limitations imply that distribution of future climate responses from ensemble simulations are themselves subject to uncertainty... [p. 797]

The IPCC grossly exaggerates the long-term (though not the short-term) increase in emissions from poor countries. It does so by converting Gross Domestic Product estimates for wealthy and poor countries into a common currency (U.S. dollars) using market exchange rates instead of purchasing power parity. This method overstates the baseline income disparity. Because the IPCC projects that poor nations will catch up to or even surpass wealthy nations in per-capita income by the end of the century, the inflated disparity in starting positions means much greater economic activity must take place, and more greenhouse gas emissions would be released into the atmosphere.

The assumption that poor countries would grow as fast as the IPCC predicts is entirely implausible and would be unprecedented in the history of the world. For example, the IPCC predicts all of Asia would increase real incomes by a factor of 70 to 1, whereas incomes even in fast-growing Japan increased by 'only' a factor of 20 to 1 in the twentieth century. According to even the most conservative story lines used by the IPCC, per-capita GDP in the U.S. in 2100 would be surpassed by Estonia, Latvia, Lithuania, North Korea, Malaysia, Singapore, Hong Kong, Libya, Algeria, Tunisia, and Argentina [Castles and Henderson 2003].

- *Higher concentrations of CO_2 would be beneficial to plant and animal life.*

An extensive scholarly literature documents the fact that increases in CO_2 give rise to many changes that are beneficial. In the geologic past, CO_2 levels have been many times higher than present values (Figure 24) and have sustained a large flora and fauna [Berner 1997;Berner and Kothaualla 2001; IPCC-AR4 2007, p. 441].

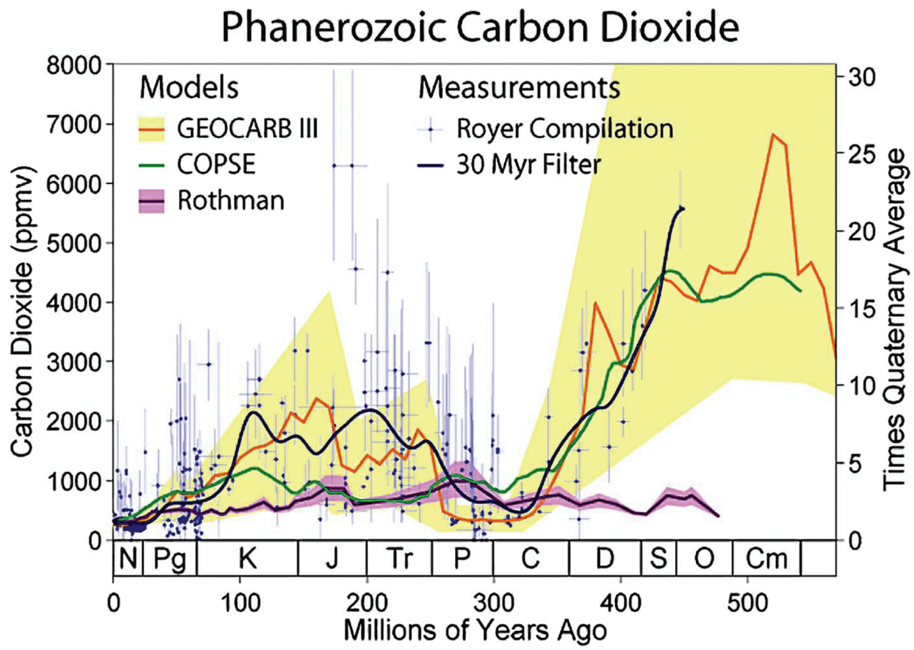


Figure 24: Phanerozoic CO_2: CO_2 concentrations for the past 600 million years, in parts per million (left) and as multiples (up to a factor ~20) of current concentration (right). The past 400,000-year period is squeezed into a thin sliver on the left. Dots represent data, and lines represent various models [Hayden 2007]. Note the significant downard trend in CO_2 levels in the past 200 million years.

Plants use CO_2 to produce the organic matter out of which they construct their tissues. Higher levels of CO_2 in the air enable plants to grow bigger, produce more branches and leaves, expand their root systems, and produce more flowers and fruit [Idso 1989]. Laboratory experiments show that a 300 ppm increase in the CO_2 content typically raises the productivity of most herbaceous plants by about one-third [Kimball 1983; Idso 1992]. Some 176 experiments on trees and other woody plants reveal a mean growth enhancement of 48 percent for a 300 ppm increase in atmospheric CO_2 content [Poorter 1993; Ceulemans and Mousseau 1994; Wullschleger et al. 1995, 1997].

Higher levels of CO_2 cause plants to produce fewer leaf stomatal pores per unit area of leaf surface, and to open those pores less widely [Woodward 1987; Morison 1987]. Both of these changes tend to reduce most plants' rates of water loss by transpiration, making them better able to withstand drought conditions [Tuba et al. 1998], enabling terrestrial vegetation to begin to win back lands previously lost to desertification [Idso and Quinn 1983].

Atmospheric CO_2 enrichment, finally, helps plants cope with the negative effects of a number of other environmental stresses, including high soil salinity, high air temperature, low light intensity, low levels of soil fertility [Idso and Idso 1994], low temperature stress [Boese et al. 1997], oxidative stress [Badiani et al. 1997], and the stress of herbivory (insect and animal grazing) [Gleadow et al. 1998].

Concerns have been raised that coral reefs could be harmed by rising CO_2 emissions through a CO_2-induced acidification of the world's oceans. But a study of calcification rates of Porites coral colonies on Australia's Great Barrier Reef (GBR) found "the 20th century has witnessed the second highest period of above-average calcification in the past 237 years" [Lough and Barnes 1997]. Research by the same authors has found GBR calcification rates were linearly related to average annual sea surface temperature, such that "a 1ºC rise in average annual SST increased average annual calcification by 0.39 g $cm^{-2}year^{-1}$."

Warmer ocean temperatures are likely to increase coral reef calcification "due to an enhancement in coral metabolism and/or increases in photosynthetic rates of their symbiotic algae" [McNeil et al. 2004]. This biologically driven process may account for the ability of coral to survive major changes in temperature over the course of millions of years.

The evident survival of polar bears and other species, of polar ice sheets and glaciers, and of corals, all demonstrate that warmer temperatures have not been catastrophic, as many seem to fear. In contrast, a markedly colder climate would certainly be harmful. Were a warmer climate also to be harmful, then logic would seem to dictate that the present climate is optimal – an unlikely occurrence.

- *Higher concentrations of CO_2 are not responsible for weather extremes, storms, or hurricanes.*

According to the IPCC, “It is very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent” [IPCC-AR4 2007, SPM, p.12]. This argument is expanded on in the main report. The phrase “continue to become more frequent” implies that these events have already become more frequent. But have they?

Bruce Hall [2007] has reviewed climate data for the 50 U.S. states; his chart of the number of record-high temperatures by year goes back to 1884 (Figure 25). The chart shows 25 extreme high temperature records set in 1934 and 29 in 1936, but none in 2001, 2003, 2004, or 2005. There is no evidence from U.S. records that extreme high temperatures are on the increase.

Heat waves in Europe can almost entirely be explained by more frequent occurrence of circulation anomalies (more southerly flow). The role of CO_2 in causing those circulation anomalies is poorly understood, making attribution impossible at this time.

There has been an intense debate also whether a warmer climate will lead to more severe storms and to more frequent and/or more intense tropical cyclones. Regarding storms, claims that heavy precipitation events in the U.S. increased between 1900 and 1990 [Karl and Knight 1998] fails to provide evidence that the increase has anything to do with greenhouse gases or temperature, particularly since there was a slight decline in temperatures during that period. Increases in maximum annual 24-hour precipitation amounts have not been observed in Germany in the past 50 years [DWD, German National Weather Service], the Iberian Peninsula [Gallego et al. 2006] or in parts of China [Wu et al. 2007].

It seems quite plausible that higher values of

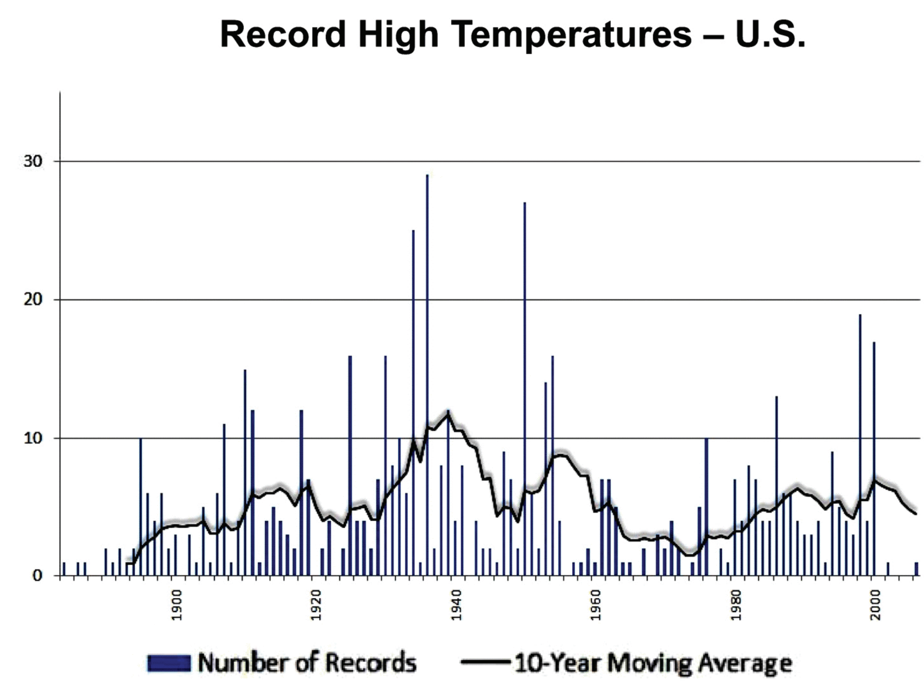


Figure 25: Extreme high-temperature values recorded, by state, in the United States since 1880 [Hart 2007]. Note the peaking around 1940 but not during recent decades; it suggests that the 1930s – not the 1990s – were the warmest decade of the twentieth century.

SST would produce stronger hurricanes [Emanuel 2005; Emanuel and Mann 2006]. But historic records of Atlantic hurricanes do not bear out such a prediction [Goldenberg et al. 2001; Landsea 2005, 2006, 2007]. Recent work by Vecchi and Soden [2007] suggests a warmer climate would lead to increased vertical wind shear, which would impede the development of tropical cyclones (hurricanes). And regarding mid-latitude storms, a global warming will lead to a lessening of temperature gradients between the equator and the poles and therefore to fewer and/or less intense storms [Legates 2004, Khandekar 2005].

9. The Economic Effects of Modest Warming Are Likely to be Positive

Concern that anthropogenic global warming might result in harm to human health and welfare asserts connections between modest increases in temperature and increased morbidity and mortality due to heat stress, the spread of tropical diseases such as malaria and dengue fever, and the negative effects of warming on some industries. There is little evidence to support these claims, and considerable evidence in support of the opposite conclusion, that warmer temperatures benefit human health and prosperity.

- *Human health benefits from warmer temperatures.*

In temperate regions, human mortality and morbidity tend to show clear maxima in the winter and secondary maxima in the summer. While the secondary maxima are more pronounced in regions with warmer summer climates, as in the southern U.S. and southern Europe, even in those regions the secondary maxima are smaller than the winter maxima. A warming of even 3ºC in the next 100 years would, on balance, be beneficial to humans because the reduction of wintertime mortality/morbidity would be several times larger than the increase in summertime heat stress-related mortality/morbidity [Laaidi et al. 2006, Keatinge et al. 2000].

The claim that malaria would spread under a warmer climate has been severely critiqued by Paul Reiter, professor, Institute Pasteur, Unit of Insects and Infectious Diseases, Paris, France, who points out that the incidence of malaria depends on a number of factors, few of them related to climate or temperature. Historically, malaria was widespread throughout many areas in the temperate or even colder regions of the mid-latitudes [Reiter 2005].

- *Economic benefits from global warming*

Beneficial economic effects of warmer temperatures include longer growing seasons in temperate climates, benefitting agriculture and forestry industries, lower heating bills, and lower construction costs. Robert Mendelsohn and James E. Neumann [1999] presented a synthesis of previous studies on the costs and benefits of global warming, which is summarized in Figure 26.

Estimated Annual Impact on U.S. of Doubling of CO_2 (billions of 1990$)

Sector	2060 economy	1990 economy
Market sector impact estimates		
Agriculture	+$41.4	+$11.3
Timber	+$3.4	+$3.4
Water resources - market only	- $3.7	-$3.7
Energy	-$4.1	-$2.5
Coastal structures	-$0.1	-$0.1
Commercial fishing	-$0.4 to +$0.4	-$0.4 to +$0.4
Total (market sectors)	+$36.9 (+0.2% of 2060 GDP)	+$8.4 (+0.2% of 1990 GDP)
Nonmarket sector impact estimates		
Water quality	-$5.7	-$5.7
Recreation	+$3.5	+$4.2

Figure 26. The net effects of the modest warming caused by a doubling of carbon dioxide concentrations are likely to be positive in the U.S., with benefits exceeding costs by some $36.9 billion a year in 2060 (+0.2 percent of 2060 GDP. Adapted from Mendelsohn and Neumann 1999, Table 12.2, page 320.

Mendelsohn and Neumann assumed an increase in temperature of 2.5°C, a 7 percent increase in precipitation, and an increase to 530 ppm atmospheric carbon dioxide by 2060, which they admit "may be somewhat more severe than the most recent scientific assessment in IPCC (1996a)." They found the net impact of global warming on the U.S. economy in the year 2060, if no action were taken to slow or stop emissions, would be *positive*, to the tune of $36.9 billion, or about 0.2 percent of projected GDP. In 2001 dollars this would be about $11.5 billion. The benefits of global warming to the agricultural and timber industries more than outweigh losses to the energy industry or damage to coastal structures.

Economist Thomas Gale Moore [1998]also found that earlier estimates exaggerated the costs of warming. Moore used historical data to calculate that if temperatures were 4.5ºF warmer in the U.S., 41,000 fewer people would die each year from respiratory and circulation diseases. The annual benefits of global warming to the U.S., he estimates, would exceed costs by $104.8 billion in 1990 dollars.

10. Conclusion

The central problems for policymakers in the debate over global warming are (a) is the reported warming trend real and how significant is it? (b) how much of the warming trend is due to natural causes and how much is due to human-generated greenhouse gases? and (c) would the effects of continued warming be harmful or beneficial to plant and wildlife and to human civilization?

In this NIPCC report we have presented evidence that helps provide answers to all three questions. The extent of the modern warming – the subject of the first question – appears to be less than is claimed by the IPCC and in the popular media. We have documented shortcomings of surface data, affected by urban heat islands and by the poor distribution of land-based observing stations. Data from oceans, covering 70 percent of the globe, are also subject to uncertainties. The only truly global observations come from weather satellites, and these have not shown any warming trend since 1998, for the past 10 years.

This report shows conclusively that the human greenhouse gas contribution to current warming is insignificant. Our argument is based on the well-established and generally agreed-to 'fingerprint' method. Using data published by the IPCC and further elaborated in the U.S.-sponsored CCSP report, we have shown that observed temperature-trend patterns disagree sharply with those calculated from greenhouse models.

It is significant that the IPCC has never made such a comparison, or it would have discovered the same result – namely that the current warming is primarily of natural origin rather than anthropogenic. Instead, the IPCC relied for its conclusion (on AGW) on circumstantial 'evidence' that does not hold up under scrutiny. We show that the twentieth century is in no way unusual and that warming periods of greater magnitude have occurred in the historic past – without any catastrophic consequences. We also discuss the many shortcomings of climate models in trying to simulate what is happening in the real atmosphere.

If the human contribution to global warming due to increased levels of greenhouse gases is insignificant, why do greenhouse gas models calculate large temperature increases, i.e., show high values of 'climate sensitivity'? The most likely explanation is that models ignore the negative feedbacks that occur in the real atmosphere. New observations reported from satellites suggest it is the distribution of water vapor that could produce such strong negative feedbacks.

If current warming is not due to increasing greenhouse gases, what are the natural causes that might be responsible for both warming and cooling episodes – as so amply demonstrated in the historic, pre-industrial climate record? Empirical evidence suggests very strongly that the main cause of warming and cooling on a decadal scale derives from solar activity via its modulation of cosmic rays that in turn affect atmospheric cloudiness. According to published research, cosmic-ray variations are also responsible for major climate changes observed in the paleo-record going back 500 million years.

The third question concerns the effects of modest warming. A major scare associated with a putative future warming is a rapid rise in sea level, but even the IPCC has been scaling its estimates. We show here that there will be little if any acceleration, and therefore no additional increase in the rate of ongoing sea-level rise. This holds true even if there is a decades-long warming, whether natural or manmade.

Other effects of a putative increase in

temperature and carbon dioxide are likely to be benign, promoting not only the growth of crops and forests but also benefitting human health. Ocean acidification is not judged to be a problem, as indicated by available data. After all, CO_2 levels have been up to 20 times the present value during the Phanerozoic Period, the past 500 million years. During this time Earth's climate has been remarkably stable, with no 'run-away' greenhouse effects – indicating strong negative feedbacks.

If, for whatever reason, a modest warming were to occur – even one that matches temperatures seen during the Medieval Warm Period of around 1100 AD or the much larger ones recorded during the Holocene Climate Optimum of some 6,000 years ago – the impact would not be damaging but would probably be, on the whole, beneficial. [Table 1]

- *Policy Implications*

Our findings, if sustained, point to natural causes and a moderate warming trend with beneficial effects for humanity and wildlife. This has obvious policy implications: Schemes proposed for controlling CO_2 emissions, including the Kyoto Protocol, proposals in the U.S. for federal and state actions, and proposals for a successor international treaty to Kyoto, are unnecessary, would be ineffective if implemented, and would waste resources that can better be applied to genuine societal problems [Singer, Revelle and Starr 1991].

Even if a substantial part of global warming were due to greenhouse gases – and it is not – any control efforts currently contemplated would give only feeble results. For example, the Kyoto Protocol – even if punctiliously observed by all participating nations – would decrease calculated future temperatures by only 0.02 degrees C by 2050, an undetectable amount.

In conclusion, this NIPCC report falsifies the principal IPCC conclusion that the reported warming (since 1979) is very likely caused by the human emission of greenhouse gases. In other words, increasing carbon dioxide is not responsible for current warming. Policies adopted and called for in the name of 'fighting global warming' are unnecessary.

It is regrettable that the public debate over climate change, fueled by the errors and exaggerations contained in the reports of the IPCC, has strayed so far from scientific truth. It is an embarrassment to science that hype has replaced reason in the global debate over so important an issue.

About S. Fred Singer

S. Fred Singer, an atmospheric and space physicist, is founder and president of the Science and Environmental Policy Project, a nonprofit research and education organization based in Arlington, Virginia. He is also distinguished research professor at George Mason University and professor emeritus of environmental sciences at the University of Virginia.

Singer is the author or coauthor of many books and scholarly articles. Recently he coauthored, with Dennis Avery, *Unstoppable Global Warming – Every 1,500 Years* (Rowman & Littlefield, 2007), which was on the *New York Times* bestsellers list. Singer's previous books include *The Greenhouse Debate Continued: An Analysis and Critique of the IPCC Climate Assessment* (ICS Press, 1992), *Climate Policy – From Rio to Kyoto* (Hoover Institution, 2000), and *Hot Talk Cold Science – Global Warming's Unfinished Debate* (Independent Institute, 1997, 1999).

Singer has been a pioneer in many ways. At the Applied Physics Laboratory of Johns Hopkins University, he participated in the first experiments using high-altitude research rockets, measuring the energy spectrum of primary cosmic rays and the distribution of stratospheric ozone; he is generally credited with the discovery of the equatorial electrojet current flowing in the ionosphere. In academic science during the 1950s, he published the first studies on subatomic particles trapped in the Earth's magnetic field – radiation belts, later discovered by James Van Allen. He was the first to make the correct calculations for using atomic clocks in orbit, contributing to the verification of Einstein's General Theory of Relativity, and now essential in the GPS system of satellite navigation. He also designed satellites and instrumentation for remote sensing of the atmosphere and received a White House Presidential Commendation for this work.

In 1971 he calculated the anthropogenic contribution to atmospheric methane, an important greenhouse gas. He also predicted that methane, once reaching the stratosphere, would transform into water vapor, which could then deplete stratospheric ozone. A few years later, methane levels were indeed found to be rising, and the increase in stratospheric water vapor was confirmed in 1995.

Singer has served as chief scientist, U.S. Department of Transportation (1987- 89); deputy assistant administrator for policy, U.S. Environmental Protection Agency (1970-71); deputy assistant secretary for water quality and research, U.S. Department of the Interior (1967- 70); founding dean of the School of Environmental and Planetary Sciences, University of Miami (1964-67); first director of the National Weather Satellite Service (1962-64); and director of the Center for Atmospheric and Space Physics, University of Maryland (1953-62).

In the 1980s, Singer served for five years as vice chairman of the National Advisory Committee for Oceans and Atmosphere (NACOA). He currently directs the nonprofit Science and Environmental Policy Project, which he founded in 1990 and incorporated in 1992 after retiring from the University of Virginia.

For more information, visit the Web site of the Science and Environmental Policy Project at www.sepp.org.

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Acronyms

AGW	Anthropogenic Global Warming
AMO	Atlantic Multi-Decadal Oscillation
AR4	Fourth Assessment Report of IPCC (2007)
CCSP	Climate Change Science Program (U.S. Government)
CS	Climate Sensitivity
DWR	Downwelling Radiation (IR)
ENSO	El Niño-Southern Oscillation
FAR	First Assessment Report of IPCC (1990)
GCR	Galactic Cosmic Rays
GH	Greenhouse
GISS	Goddard Institute of Space Science (NASA)
GW	Global Warming
HTCS	*Hot Talk Cold Science* book (1997, 1999)
IPCC	Intergovernmental Panel on Climate Change (UN)
IR	Infrared
ITCZ	Intertropical Convergence Zone
LGM	Last Glacial Maximum
LIA	Little Ice Age
LRSL	Local relative sea level
LT	Lower troposphere
MJO	Madden-Julian (tropical) Oscillation
MSU	Microwave Sounding Unit (carried on weather satellites)
MWP	Medieval Warm Period
NACC	National Assessment of Climate Change (U.S.)
NAO	North Atlantic Oscillation
NAS	National Academy of Sciences
NH	Northern Hemisphere
NIPCC	Non-governmental International Panel on Climate Change
OLR	Outgoing Long-wave (IR) Radiation
PDO	Pacific Decadal Oscillation
SAR	Second Assessment Report of IPCC (1995)
SH	Southern Hemisphere
SL	Sea Level
SPM	Summary for Policymakers (of IPCC reports)
SST	Sea Surface Temperature
TAR	Third Assessment Report of IPCC (2001)
TSI	Total Solar Irradiance
UAH	University of Alabama – Huntsville
UTWV	Upper troposphere water vapor
WAIS	West Antarctic Ice Sheet
WV	Water vapor

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