

GLOBAL WARMING **FALSE ALARM**

THE BAD SCIENCE BEHIND THE UNITED
NATIONS' ASSERTION THAT MAN-MADE
CO₂ CAUSES GLOBAL WARMING



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RALPH B. ALEXANDER

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Preface

Much has happened in the global warming arena since this book was first published three years ago. Shortly after the book came out, the Climategate scandal burst into the open and sent shock waves around the world. This was quickly followed by the ending in disarray of the overhyped Copenhagen climate summit, which failed to reach agreement on extending the UN Kyoto Protocol that attempts to limit greenhouse gas emissions.

Since then, a myriad of mistakes and new exaggerations by the IPCC and climate change alarmists have come to light, hysteria over weather extremes supposedly caused by man-made CO₂ has reached new heights, an important experiment on cloud physics has been conducted, and the cooling trend that began in 2001 has shown no signs of letting up.

All these developments and more are covered in this revised edition, which contains approximately 50% new or updated material, including an expanded chapter on alternative explanations to CO₂ as the main source of global warming. The only area where I've cut back is CO₂ data, since there is little dispute over how much the level of CO₂ in the atmosphere is rising.

The biggest change is to the endnotes. There are now more than 400 explanatory notes and scientific references, the majority of references including URLs (Internet addresses) where the paper or article – either the complete document or a summary – can be accessed free of charge. However, URLs are not supplied for references within IPCC reports, which can be accessed online only by the chapter. The few other references that don't include a URL can generally be accessed for a fee, but the fee is often more than the cost of this book!

And, while the less technically inclined may not want to look up every reference, I highly recommend consulting at least the explanatory notes, as these often contain important detail.

I'd like to thank Kevin Walter, who pushed me into embarking on a 2nd edition and gathered most of the background material for the chapter on alternatives (Chapter 5); Roger Cohen, for his constructive comments on the 1st edition and several other insights; Gordon Fulks, for drawing my attention to several current papers in climate science, through his Global Warming Realists email group; and my wife Claudia, for her continued support and tolerance of the incursions my writing has made into our leisure time.

August, 2012

Preface to 1st Edition

I wrote this book because I'm a scientist. Because I'm offended that science is being perverted in the name of global warming – today's environmental cause célèbre. Because the world seems to have lost its collective mind and substituted political belief for the spirit of scientific inquiry.

Science is not a political belief system. Yes, scientists are human and have their biases, but the keystone of science is rational investigation. There's nothing very rational nor investigative about much of the conventional wisdom on global warming, which is characterized more by a near religious zeal than by thoughtful evaluation of the evidence.

It's the abuse of science by global warming alarmists that turned me into a skeptic about CO₂. Until fairly recently, I was a fence sitter and willing to accept the possibility that recent climate change is the result of human activity, though I also had my doubts.

What first changed my view was a college course on physical science that I taught a few years ago and that included a segment on global warming. Despite the fact that the course focused on the scientific method, and on not accepting hypotheses without adequate testing or evidence, the textbook simply presented the alarmist line on man-made global warming without question.

To me, that made a mockery of the history of science presented in the course, which featured several examples of how mainstream scientific thinking has sometimes been wrong in the past. At the very least, I felt that the other side of the global warming debate should have been discussed as well.

The experience induced me to take a second look at global warming. As I delved more deeply into the background material, I found myself steadily moving over to the skeptical camp and becoming more and more annoyed at the strident tone of most alarmist declarations – especially the assertion that “the debate is over”. Such an assertion would have appalled the famous 19th-century British biologist Thomas Huxley, often regarded as one of the founding fathers of modern scientific thought, who once said: “Skepticism is the highest of duties; blind faith the one unpardonable sin”.

This book takes the skeptics’ viewpoint on global warming, but with emphasis on the underlying science rather than the politics. My intention is as much to resurrect the tarnished reputation of scientific endeavor as it is to convince you that CO₂ has little to do with global warming.

Why have I taken it on myself to defend the honor of science?

It’s because I feel so strongly about my chosen profession. I’ve been interested in science since my childhood, when science was held in particularly high regard following the development in only a few years of nuclear power, the transistor (the basis of today’s computer chip), and rockets capable of sending man to the moon – along with advances in the biological sciences such as figuring out the structure of DNA.

Some of the gloss of those heady times later wore off, and there was an understandable backlash when it was realized that science didn’t have all the answers to our problems. Unfortunately, this reaction helped fuel the rise of “junk science”, based on ignorance and fear instead of the traditional scientific method. And all that coincided with the start of the global warming debate about 20 years ago, so perhaps we shouldn’t be surprised that the debate has generated more heat than light.

Much of the book is critical of the UN’s Intergovernmental Panel on Climate Change (IPCC). That’s because the current belief that global warming is caused by man-made CO₂ stems largely from the IPCC’s climate assessment reports, as interpreted by the mass media and swallowed by the public at large.

PREFACE

More than anything else, it is the IPCC reports that have convinced me alarmists are wrong about CO₂.

I'm not saying that the lengthy, detailed reports are full of bad science. They do contain accurate and useful information in places, supplied by well-meaning climate researchers who are genuinely trying to piece together a coherent picture of the Earth's climate system. But these scientists appear to be in the minority within the IPCC, which is dominated by other scientists and bureaucrats who manipulate the data and the reports for their own ends.

All of this is a sad commentary on the state of science today. It has taken more than two millennia to develop and refine the modern scientific method to the point where we've been able to make major technological advances in a relatively short time. But if we continue to debase science as the IPCC and other political bodies do, our wonderful scientific heritage will be lost.

The book is written for both the layman and the scientist, at a level that anyone with a high-school education including some basic science should be able to understand. However, even those who can't comprehend the science in detail should be able to follow the general line of argument.

To convey the essence of global warming science in a readable and informative manner, I've kept technical material and scientific jargon to a minimum in the main text. Scientists, and those nonscientists seeking more detail, will have to dig a little further by consulting the many endnotes (and the appendices) at the back of the book.

There are several people I want to thank. These include my brother Patrick, who first got me seriously interested in global warming and encouraged me to write this book; my colleagues Keith and Hillary Legg, for many discussions on the subject and useful suggestions; Jim Peden, who convinced me to actually start writing; Howard Hayden and Roy Spencer, for answering my questions; and my wife Claudia, for her unwavering support and encouragement as I took on what is still an unpopular cause.

May, 2009

GLOBAL WARMING FALSE ALARM

Chapter 1: Climate Change Delusions

Science is under attack like never before, especially by global warming alarmists. The alarmists would have us believe that doomsday is near, that a catastrophe awaits the Earth unless we stop pumping carbon dioxide (CO₂) into the atmosphere by burning fossil fuels. It's CO₂ that is causing the climate to change, insist the believers. If we don't do something about this pesky gas right now, our planet and our way of life will be destroyed.

This is utter nonsense. Global warming may be real, but there's hardly a shred of good scientific evidence that it has very much to do with the amount of CO₂ we're producing, or even that temperatures have risen as much as warmists say.

Today's climate change hysteria began 25 years ago with United Nations discussions that created the Intergovernmental Panel on Climate Change (IPCC). To climate change alarmists, the climate bible is a series of assessment reports issued by the IPCC about every six years. Based on the collective opinion of several hundred climate scientists, these reports are the source of the widely held belief, promulgated by Al Gore and other alarmists, that higher temperatures are the result of human activity.¹

Unfortunately, nature has not been cooperating. Global temperatures have flat-lined or fallen since about 2001, throwing a monkey wrench into global warming theory that doesn't allow for cooling because the CO₂ level is constantly going upwards.

Not to be put out, the global warming faithful simply changed their tune. Global warming became climate change, despite the fact that the Earth's climate had already been changing for thousands of years, long before industrializa-

tion boosted CO₂. And the telltale sign that CO₂ causes climate change became weather extremes instead of rising temperatures. Widespread wildfires in Russia, severe flooding in Pakistan, deadly tornadoes in the U.S., even harsh winters and record snowfalls – all of these are the result of man-made CO₂, according to the alarmists.

How convenient. Just ignore the current cooling trend and blame every unusual weather event on CO₂ and global warming. That may help drive political action on climate change, but it's not science. True science is based on rigorous logic and evidence, not blind faith in quasi-religious dogma.

The IPCC and global warmists spare no effort in telling us to stop climate change by curtailing or even ending emissions of CO₂. Failure to act will mean even more extreme weather, colossal shifts in rainfall patterns, and thawing of the polar ice caps. But if we care to look back at the 1930s or the 1950s, when the CO₂ level was much lower than now, we'd see that terrible floods² and droughts³ and melting ice caps⁴ are nothing new.

The alarmists have spun such a web of deception that any science contrary to the view of human-induced global warming is either ignored, played down, or deliberately distorted. News releases and scientific papers that don't adhere to the IPCC "party line" on CO₂ are frequently sidelined by a barrage of attacks, sometimes vicious and personal.

Global warming skeptics have very different ideas about the origins of climate change. Unlike alarmists, skeptics believe that humans have little to do with global warming and dispute the notion that our CO₂ emissions have any significant effect on climate. They question the basic science behind the whole case for a human influence on the climate system.

To skeptics, climate change is almost entirely a result of natural causes. Therefore, there's no point in passing legislation on CO₂ emissions arising from the human presence on Earth – at least, no point in doing it to combat global warming.

Both groups defend their views vehemently, although the debate, if it can be called a debate, is mostly conducted out of public sight in the silent world of Internet blogs. Actual debates between the two sides are rare, alarmists repeatedly refusing invitations to publicly discuss the issues, usually on the grounds that their skeptic counterparts are "unqualified" (read: dispute the conventional wisdom) or that there is nothing to discuss.

Until recently, the mainstream media presented the alarmist viewpoint almost exclusively, as if man-made global warming were an established fact, a belief that no longer needed to be questioned or debated. To my amazement, this standpoint has even been adopted by many of the world's most eminent professional scientific societies.

An important part of the belief in global warming orthodoxy is the deeply ingrained misconception that a scientific consensus exists, that the scientific community speaks with one voice on CO₂ and climate change.

Because of this, skeptics have been frequently denigrated and even publicly vilified by alarmists. Even today, alarmists persist in bad-mouthing anyone who doesn't subscribe to their convictions by calling them "deniers" – an attempt to link global warming skeptics with the immorality of Holocaust deniers.⁵

Dr. Rajendra Pachauri, who is the current IPCC chairman, has ridiculed those who question the so-called consensus by comparing skeptics to members of the Flat Earth Society, which he said⁶ probably has about a dozen members in modern times. Former U.S. Vice President Al Gore has made similar statements, claiming that "They [Skeptics] are almost like the ones who still believe that the Moon landing was staged in a movie lot in Arizona."⁷

The tide has turned, however, in the last few years and public opinion has now swung toward climate change skeptics. While the general public was evenly divided between alarmist and skeptical views of global warming when the 1st edition of this book was published three years ago, recent polls indicate that the percentage of skeptics in the public at large is currently around 60%.^{8, 9} National newspapers in several countries now carry regular articles that present skeptical opinions or question the notion that our climate is headed for disaster.

Among scientists, the percentage of skeptics is generally lower, perhaps only 10% to 20% for climate scientists. An opinion poll of several hundred climate scientists worldwide on the origins of global warming was carried out by Dennis Bray and Hans von Storch, first in 1996 and again in 2003 and 2008. The 2008 survey, conducted online, found that approximately 14% of the climatologists polled believe that climate change in general is not due to human activity.¹⁰

A survey of 3,146 earth scientists the same year asked respondents if they thought human activity was contributing significantly to changing temperatures. Some 82% of those surveyed answered yes,¹¹ suggesting that 18% of earth

scientists are global warming skeptics, although a specific question about global warming or climate change was not asked.

It is clear from both polls nevertheless that a substantial number of climate scientists, even if not a majority, are global warming skeptics – over 370 of the earth scientists polled who regard themselves as climatologists (12% of 3,146),¹² for example.

Subsequent studies have pegged the percentage of climate scientist skeptics as high as 16%¹³ and as low as 2-3%.¹⁴ However, the low estimate has been criticized on several grounds by climate scientists themselves, including some who are not global warming skeptics, such as Roger Pielke Jr. On the study minimizing the number of skeptics, Pielke Jr. commented that “... this paper simply reinforces the pathological politicization of climate science in policy debate.”¹⁵

Scientists overall are much more skeptical than climate scientists. In 2007, U.S. Senator James Inhofe held a Senate hearing on global warming and the media, in an effort to balance the media’s one-sided stance in presenting the science of climate change. The hearing’s official report¹⁶ included a list of about 400 scientists from over 20 countries who have voiced strong objections to the assumed consensus on human-caused global warming. The list of dissenting scientists is constantly updated, and had grown to more than 1,000 by December 2010.¹⁷

An ongoing project designed to attract skeptics on climate change is the “Petition Project”.¹⁸ Originally organized in 1998 by the Oregon Institute of Science and Medicine, in order to counter the then-widespread claim that further examination of global warming science was unnecessary, the Oregon petition has now been signed by more than 31,000 U.S. scientists.

However, the petition refers to “catastrophic heating” of the Earth’s atmosphere and “disruption” of the earth’s climate, rather than climate change as such. So, as in the survey of earth scientists that didn’t ask explicitly about global warming or climate change, the exact number of global warming skeptics among the Oregon petition signatories is uncertain. It’s clear though that the number is large.

But does it matter what other scientists or the general public think about global warming? Aren’t the vast majority of climate scientists right? They’re the experts after all, who, in their own words at least, “understand the nuances and scientific basis of long-term climate processes”.¹¹

If climatologists' conclusions and prognostications for the future were based on solid experimental observations – the hallmark of genuine science – there would be good reason to believe them. But, as you'll see shortly, the whole architecture of man-made global warming depends on unbridled faith in deficient computer models. And the poor science is compounded by the all-too-human need of climate scientists to preserve their jobs and research funding by reinforcing the prevailing wisdom on global warming.

Receipt of climate science funding has long depended on being able to affirm that CO₂ controls our climate. This connection has been used to intimidate global warming skeptics, as observed by well-known climate scientist Richard Lindzen, who is Alfred P. Sloan Professor of Atmospheric Science at MIT:

But there is a more sinister side to this feeding frenzy. Scientists who dissent from the alarmism have seen their grant funds disappear, their work derided, and themselves libeled as industry stooges, scientific hacks or worse. Consequently, lies about climate change gain credence even when they fly in the face of the science that supposedly is their basis.¹⁹

As well as skeptical scientists who keep quiet out of fear, there are others who feel no particular need to make their views known in public. I was in that category myself before embarking on this book. What all this means is that any count of scientific skeptics on global warming is bound to be an underestimate.

CORRUPTED SCIENCE

As a scientist, what I personally find most troubling about the climate change debate is the gross misuse of science by those on the alarmist side. The worst public offender is the IPCC, which long ago became the accepted authority for those convinced that global warming has human origins.

In this book, I will expose the most flagrant abuses of normal scientific practice by the IPCC, and draw attention to the questionable assumptions and interpretations of data that the IPCC and its alarmist advocates have used to formulate their position on global warming.

This will involve looking at both the science – which we'll do at a fairly basic level – and the methodology used to interpret the available climate data. Good science is based on what is called the scientific method, a set of procedures estab-

lished over many centuries since the time of the ancient Greeks. In later chapters, we will see where the IPCC has not only gone wrong in its handling of climate data, but has also departed repeatedly from sound scientific methodology – to the point of corruption in many instances.

But first, let's review what the IPCC is and what it has to say about global warming.

THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

The IPCC has always believed that global warming is man-made, ever since it was established in 1988. The organization was founded jointly by the UN Environment Programme and by the World Meteorological Organization (WMO), a group that works to standardize weather-related observations. The IPCC's stated purpose was to assess "the scientific, technical and socioeconomic information relevant for understanding the risk of human-induced climate change".

But despite the implication in this statement that climate change caused by human activity was still in the future, it's no secret that the UN and the IPCC believed it was already happening. Though cloaked in bureaucratic language, this presumption can be clearly seen in the terms of the mandate that included, in addition to wording on filling gaps in our climate knowledge, statements such as:

Review of current and planned national/international policies related to the greenhouse gas issue; Scientific and environmental assessments of all aspects of the greenhouse gas issue and the transfer of these assessments and other relevant information to governments and intergovernmental organisations to be taken into account in their policies ...²⁰

In other words, the whole IPCC effort has always been biased toward the assertion that humans alone have caused the warming we now measure across the globe. This bias is a central part of all the panel's publications and reports. By the IPCC's own admission,²¹ even the first report in 1990 "... made a persuasive, but not quantitative, case for anthropogenic [human-caused] interference with the climate system."

Subsequent IPCC reports have reinforced the original conclusion, adding more and broader arguments for the existence of man-made warming, and putting

TABLE 1.1: PRINCIPAL IPCC ASSERTIONS²²

Assertion	Confidence level
1. Man-made CO ₂ and other greenhouse gases ²³ in the atmosphere have increased markedly since 1750.	100%
2. Most of the global warming in the last 50 years has been caused by these gases.	At least 90%
3. Temperatures in the Northern Hemisphere since 1960 have been the highest of any 50-year period in the last 1,300 years.	At least 66%
4. Even greater warming will occur this century if we continue to emit CO ₂ and other greenhouse gases.	At least 90%

WHAT'S WRONG WITH THIS PICTURE?

- Assertions 2, 3 and 4 are debatable (though assertion 1 is not in dispute) and may not be true at all.
- Confidence levels as high as 90% are totally unjustified, because these three conclusions are based solely on computer models that are only crude approximations to the Earth's climate.

Such high confidence levels have led to the false, unsupported beliefs that there is "scientific consensus" on human-induced climate change and that "the science is settled".

The phrase "global warming gases" has become part of everyday usage, despite the lack of any proven connection between greenhouse gases and global warming.

numbers to this and other assertions (Table 1.1). Each successive report has sounded more and more confident that global warming is largely our own fault. By the time the Fourth Assessment Report was issued in 2007, the IPCC claimed to be up to 90% certain of its conviction that rising temperatures are caused by human activity.

All of that would be unimportant were the IPCC not so powerful: numerous governments around the world, not to mention environmental groups and the general public, regard its word as climate gospel – to be taken as the absolute truth, without question. Its reports on global warming are far more widely read and quoted than most speeches by world leaders on any topic at all. The IPCC itself rightfully claims that its reports immediately become “standard works of reference”. This is an enviable position that most interest groups and professional societies can only dream of.

If the IPCC were simply an organization of climate scientists without any agenda other than to review and understand the many factors affecting the Earth’s climate, its pronouncements might be more believable. But the reality is that the IPCC is mostly made up of bureaucrats and government representatives, intent on validating the panel’s original assumption that global warming is a man-made phenomenon. Indeed, two of its three working groups and an associated task force all focus on the impact and mitigation of global warming, based on the underlying presumption that it *is* a direct result of human activities. The other working group concentrates on the science, but shares the same biased assumption.

The IPCC’s climate scientists consist of working scientists who act as either authors (contributors) or reviewers of the organization’s reports. Writing and reviewing the 2007 report supposedly involved more than 3,750 people,²⁴ of whom an estimated 2,000 were climate scientists according to press reports at the time. But of these, only a small percentage held a PhD degree – the most generally accepted measure of scientific expertise.

In any case, both numbers have been shown to be overestimates, due to duplication of authors and reviewers.²⁵ My best estimate is that less than a half, maybe only a third, of the 3,750 involved in producing the 2007 report were climate scientists.²⁶

Many of those who were not climate scientists were not scientists at all: the academic participants listed by the IPCC include social scientists and geographers, and other contributors include civil engineers and even lawyers. This means that much of the scientific analysis in IPCC reports comes from people who may not have the background to assess the science. No doubt that's why there have been a number of accounts of IPCC climate scientists whose dissenting opinions have been suppressed or ignored. It's not an approach that produces good science.

THE CO₂ GLOBAL WARMING HYPOTHESIS

Carbon dioxide gets a bad rap these days. Although crops and trees need it in order to grow, and it's the gas that gives soft drinks their fizz, we humans are spewing vast quantities of CO₂ into the air by burning coal and natural gas for energy and by driving cars. If you believe the global warming alarmists, all the CO₂ we produce is what's causing the mercury to rise around the world.

How could this be?

To answer that question, we need to examine the scientific observations on which the CO₂ theory is founded. Observations, or data gathering, are at the root of the scientific method that I referred to earlier. But we'll see that these data don't necessarily mean climate change is a human phenomenon.

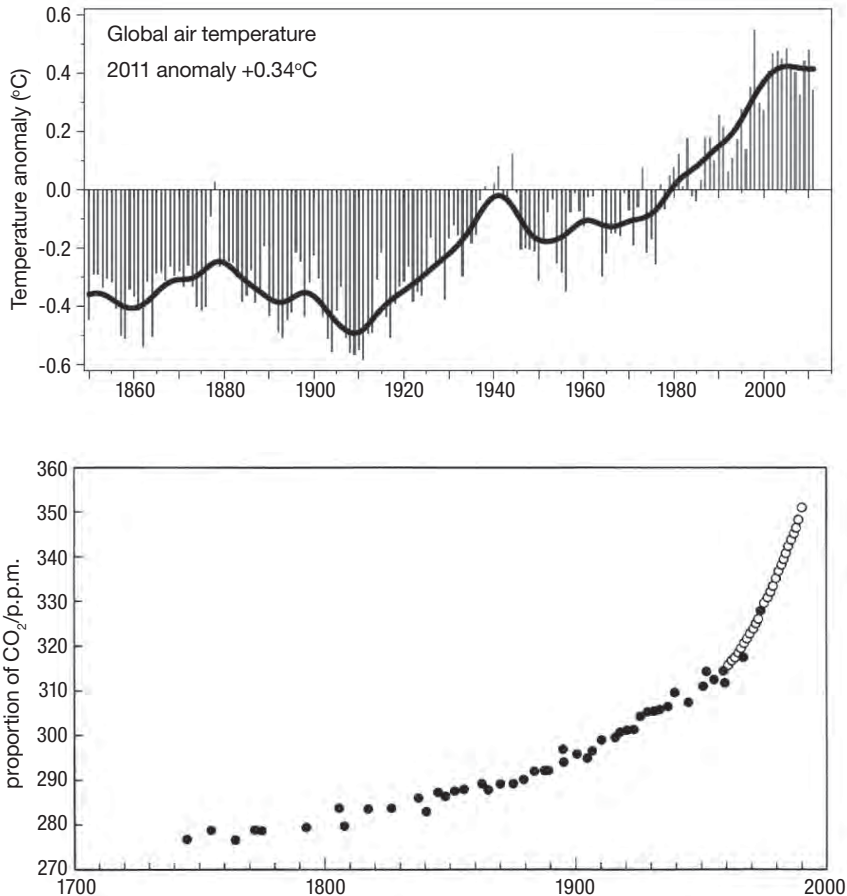
There are two observations that have sparked the debate on global warming, one involving temperatures and the other, CO₂ levels:

1. Worldwide temperatures have been climbing on average since the middle of the 19th century, although they have recently fallen slightly, and
2. The amount of CO₂ in the atmosphere has steadily increased over the same timespan, at an accelerating rate. Much of the extra CO₂ comes from human activities, mainly the burning of coal, oil and natural gas.

If temperature and the CO₂ concentration have both gone up (see Figure 1.1), then it's reasonable to say they must be connected – right? Rising temperatures and higher atmospheric CO₂ are indeed related, but this doesn't necessarily explain global warming. The crucial question is how strongly are they related?

We know that rising CO₂ levels boost the Earth's temperature, but this is only a minuscule effect, not enough to account for the warming that the world has seen. It's entirely possible that higher temperatures are only weakly linked to the elevated CO₂ level and that most of the temperature increase hasn't come from CO₂ at all, but from some other, natural source – many skeptics would say the sun or one of our oceans.

Figure 1.1: The Modern Temperature and CO₂ Record



Sources: Temperature – Climatic Research Unit/Hadley Centre (HadCRU);²⁷ CO₂ (filled circles: Antarctic ice-core data, open circles: Mauna Loa Observatory measurements) – climateprediction.net.²⁸

The climate change debate hinges on this issue, on how the separate observations about the Earth's temperature and the CO₂ content of its atmosphere should be interpreted.

According to the IPCC and global warming alarmists, the only possible interpretation is that the warming we have experienced is caused by the raised level of CO₂. This conclusion is embodied in a scientific hypothesis (Table 1.2), which explains the CO₂-temperature connection in terms of what we call the greenhouse effect.

The greenhouse effect, named (though incorrectly) for the process that ripens tomatoes in a glass hothouse, is a well-understood scientific phenomenon, originally explained by the French mathematician Joseph Fourier in the 1820s. Because it's described at length elsewhere, I won't go into detail here. A simplified explanation is that greenhouse gases in the atmosphere act as a radiative blanket around the Earth, trapping some of the sun's heat that would normally be radiated away.³² This makes the planet warmer than it would be without greenhouse gases.

A possible greenhouse connection between increased CO₂ levels and higher temperatures was first proposed by the Swedish chemist Svante Arrhenius, at the end of the 19th century. He later hypothesized that human activity could result in global warming.³³ But it was not until the IPCC began publishing its climate reports in the 1990s that belief in the CO₂ hypothesis became widespread.

Contrary to popular opinion, however, the major greenhouse gas in the atmosphere is not CO₂, but water vapor (H₂O). Water vapor accounts for about 70% of the Earth's natural greenhouse effect and water droplets in clouds for another 20%, while CO₂ contributes only a small percentage, between 4 and 8%, of the total. The other greenhouse gases are ozone, methane, nitrous oxide and chlorofluorocarbons (CFCs, the gases formerly used in aerosol cans and refrigerators), which all make even smaller contributions to greenhouse warming.

Without the natural greenhouse effect – in the absence of any greenhouse gases at all – life on Earth as we know it would not exist. The globe would be cooler than it is now by about 33° Celsius (60° Fahrenheit), too chilly for most living organisms to survive.

Thus, it's definitely possible in principle that adding to the store of existing greenhouse gases by putting more CO₂ into the atmosphere could increase tem-

TABLE 1.2: THE CO₂ HYPOTHESIS

Observations

- Global surface temperatures have risen by approximately 0.8° Celsius (1.4° Fahrenheit) since 1850.²⁹
- The CO₂ level in the lower atmosphere has gone up as much as 37% in the same period,³⁰ largely due to man-made CO₂ emissions from factories and automobiles.

Hypothesis

Global warming is caused primarily by man-made CO₂ in the atmosphere via the greenhouse effect, which says that greenhouse gases such as CO₂ heat up the Earth.

WHAT'S WRONG WITH THIS HYPOTHESIS?³¹

1. *The CO₂ steady level problem:* The CO₂ level remained steady during previous global warming and cooling periods over the last 2,000 years – neither going up nor down as the average temperature rose and fell.
2. *The CO₂ amplification problem:* The climate change from extra CO₂ is very small. A 37% upswing in CO₂ causes only a tiny temperature increase, unless this increase is amplified by water vapor in the atmosphere and by clouds. But we don't know how big or small this amplification is, or even if it's an amplification and not a diminution.
3. *The CO₂ lag problem:* Historically, gains in atmospheric CO₂ levels occurred several hundred years *after* the temperature went up. This CO₂ lag, in the global warming period following an ice age, can't be reconciled with today's global warming, in which CO₂ and temperature have risen together.

peratures. One place in the solar system where there is an abundance of CO₂ and a pronounced greenhouse effect is the planet Venus.³⁴ But the total amount of CO₂ in the Earth's atmosphere is still only very small: about 390 parts per million, or less than one twentieth of a percent. It takes an awful lot of CO₂ to make an appreciable difference.

The critical issue is whether the extra CO₂ that we've injected into the Earth's atmosphere since industrialization began in the early 1800s is enough to bump up the temperature by the observed 0.8° Celsius (1.4° Fahrenheit).

It is on this question that climate change skeptics and alarmists differ most sharply. Skeptics say there's no good evidence that man-made CO₂ is playing any significant role in global warming. The alarmists, on the other hand, say everything points to the fact that it is.

COMPUTER MODEL FALLACIES

To skeptics, the IPCC's claim that we can be more than 90% certain that global warming is entirely man-made borders on the absurd. As we'll see, every single conclusion and prediction in all the IPCC reports is based on computer models of the Earth's climate, and these theoretical models are far from the tools for accurate climate analysis and projection that the IPCC believes them to be.

I am not saying that computer models can't play a useful role in simulating complex physical phenomena such as climate. It's just that computer simulations are only as accurate as the underlying assumptions in the model.

If the assumptions in a particular computer model are based on established science, the predictions of the model are highly reliable – and a confidence level approaching 100% is warranted. A good example of this is the computer calculations used by the U.S. government to simulate explosions of nuclear weapons in its stockpile.

Back in the days when people worried about dangerous radioactive fallout from atmospheric testing of atomic bombs, worldwide political pressure led to the banning of atmospheric tests and the initiation of underground testing. But because some nuclear fallout occurs even when tests are carried out deep underground, computer simulations are now used as an alternative to conducting actual tests of the warheads. So accurate is the computer model in representing the science of nuclear explosions that the government believes it has an excellent

handle on the capabilities of its nuclear stockpile, and consequently feels no need to resume its previous real-world testing to confirm the strength of its nuclear deterrent.

That's the good news, for both nuclear weapons stewardship and the environment. But not all computer models are as sophisticated as those that mimic nuclear explosions, nor are the underlying physical processes as well understood or even known in many cases. Models that attempt to simulate the behavior of the universe, or of the human brain – both immensely complex systems, on different scales – are only in their infancy today and unable yet to make many useful predictions.

Climate models are in this category too. There's a lot we've learned about the intricacies of the climate on our planet, but there's also a great deal we don't know. Our understanding of clouds and water vapor, of the interaction between the oceans and the atmosphere, and even the details of the sun's effect on the Earth's climate are all still at a primitive stage. These factors can only be modeled crudely, and anything poorly understood is often left out of the models altogether.

It makes no sense at all, therefore, to attach a confidence level of 90% (“very likely” in IPCC terminology) to the statement, for example, that greenhouse gases have caused most of the global warming that we see. A confidence level of a few percent might be closer to the mark. Even in the Bray and von Storch survey in 2008, only 50% of the climate scientists polled thought that the current theoretical understanding of climate change is adequate.³⁵

THE SKEPTICS' EXPLANATION: NATURAL CAUSES

Skeptics about the alarmist belief in human-induced climate change have an alternative explanation that doesn't depend on bad science or demonization of critics to convey its message: the warming is predominantly natural, the result of one of nature's many cycles. We already know there are cycles that have caused the Earth's temperature to fluctuate numerous times in the past.

What are these cycles?

One type of cycle that is definitely *not* the cause of the current warming trend is regular but long-term changes in the Earth's orbit around the sun. We learn in high school that the Earth goes around the sun in an elliptical path, and that it spins on an axis that is tilted. Over time, the elliptical orbit stretches and con-

tracts, the angle of tilt changes – on different timescales – and the Earth also wobbles on its axis, on yet another timescale.

The cumulative effect of all these slow dance moves by the Earth is that the amount of heat and light from the sun goes up and down over long periods of time, especially near the North Pole. This causes extended global warming and global cooling cycles, both of which can last for tens or even hundreds of thousands of years.

Prolonged cooling cycles are known as ice ages because of the massive ice sheets and glaciers that cover a lot of the planet. The next ice age is not expected for at least another 1,500 years, and maybe longer if current global warming persists.

But there are other natural cycles, many of which are shorter than the Earth's orbital cycles, that could be influencing our present climate – notably those associated with our sun. As we've seen, the sun's heat energy, in combination with greenhouse gases (mostly water vapor) in the atmosphere, provides a sufficiently comfortable living environment for us to survive.

Like the Earth's orbit in the solar system, the sun's output is not constant but wiggles in time. However, most solar cycles are much shorter in length than the 10,000-year-plus cycles that the Earth goes through. For example, the number of sunspots³⁶ fluctuates over an interval of about 11 years. A recent sharp decline in sunspot activity has prompted some solar scientists to suggest that we're headed for a chilly period, rather than more warming.

Apart from solar cycles, natural short-term oscillations of the atmosphere and oceans, poorly understood right now, may have a much greater impact on global temperatures than we think. The familiar El Niño and La Niña cycles are already known to have drastic climatic effects in countries bordering the Pacific Ocean.

Solar variability and ocean oscillations are not only tied together, but they also affect the Earth's cloudiness, both directly and indirectly. One indirect effect is the influence of cosmic rays³⁷ that emanate from deep space and constantly bombard our atmosphere, sometimes creating low-level clouds that result in cooling of the planet's surface. The sun can block these cosmic rays, changing the cooling effect. Some climate scientists think that clouds alone may make the single biggest contribution to our climate.

Yet hardly any of these sources of natural variability – the sun, the oceans, and clouds – are considered by the IPCC. The computer models that form the basis for

the IPCC's reports do incorporate solar effects, but only direct effects and only at a fairly rudimentary level.³⁸ Later in the book, we'll examine all of these possible causes of climate change in more detail.

Where I and other skeptics take issue with the IPCC is that, knowing that natural variability has largely been left out of the climate models, the panel then goes on to draw conclusions on global warming that completely ignore the omissions and insists that most of the warming must come from man-made CO₂. And, as we'll see, the IPCC uses bad science to shore up its case.

Chapter 2: Science Gone Wrong

Apart from its bias, the IPCC is hypocritical. In discussing the nature of science in the historical overview of its 2007 report, the IPCC states:

Science may be stimulated by argument and debate, but it generally advances through formulating hypotheses clearly and testing them objectively. This testing is the key to science. ... It is not the belief or opinion of the scientists that is important, but rather the results of this testing. ... Thus science is inherently self-correcting; incorrect or incomplete scientific concepts ultimately do not survive repeated testing against observations of nature.³⁹

This is an accurate and succinct summary of what good science *should* be all about – the essence of the scientific method⁴⁰ that I referred to earlier. But the methodology actually used by the IPCC makes a mockery of the observational testing called for in the statement. The same report goes on to say:

Using traditional approaches, unequivocal attribution of causes of climate change would require controlled experimentation with our climate system. However, with no spare Earth with which to experiment, attribution of anthropogenic climate change must be pursued by ... demonstrating that the detected change is consistent with computer model simulations ...⁴¹

“Must” be pursued by computer simulations? In a single sweeping declaration, the IPCC brushes aside modern science and its dependence on experimental

observation, choosing instead to base all its assertions and projections solely on untested theoretical models of the climate.

The insistence of the IPCC that the notion of human-induced global warming can be validated by computer modeling is where the bad science begins. Unfortunately for science, the IPCC missteps go on. It's not just unquestioning acceptance of computer models that derails the IPCC's conclusions, but a host of other departures from sound scientific practice as well – including data manipulation and outright fabrication.

DATA MANIPULATION

Central to any scientific investigation, such as checking out the validity of the CO₂ global warming hypothesis, are the raw data gathered by observation. Without data there can be no hypotheses, no science.

And the data must be handled according to certain unwritten rules, if inferences drawn from the data are to be regarded as reliable, solid science. These rules include examining all the evidence, eliminating bias⁴² in the measurements, and using multiple sources of data to minimize the influence of any personal quirks of the investigators.

One of the most frequently overlooked rules of the scientific method is that you have to consider *all* the data. What the rule is saying is that you can't ignore any piece of evidence that doesn't fit your theory or verify your hypothesis, simply because it's inconvenient.

I've done scientific research, and I know how tempting it can be to reject data that you don't like for some reason. Maybe you made an observation that conflicts with what everyone else has seen, or maybe you can't draw the trend line that you want through your graphed data points without throwing out some data.

But it's a big no-no in the scientific sphere to ignore or discard any experimental observation, unless there was an obvious mistake that calls for repeating the measurement, or there is bias in the data that can't be corrected for – which is sometimes the case with historical data. All other data must be kept, even if it can't be fully explained.

The rules are really just common sense, but important nonetheless because science strives to understand the physical world through honest investigation

and discovery. No one can hope to gain any insight by playing fast and loose with the data.

Regrettably, the IPCC and its alarmist cheerleaders do just that with the principal pillars of its data edifice, in order to reinforce its contention that climate change is a man-made phenomenon. They do it with the temperature record, both present and past, with sea levels, and with data on natural climate cycles. And not just once, but many times over.

Exaggerated Temperatures

A big part of the IPCC story is the surge in global temperatures from about 1970 to 2001, which is clearly visible if you look back at Figure 1.1. That data, measuring the temperature anomaly – or change from the average temperature – for the period from 1850 to 2011, is based on both land and sea measurements.

But how accurate are these measurements?

I'm not talking about the thermometers used, as thermometers have been around for a long time and we can depend on them to accurately record the temperature. But that doesn't necessarily mean that temperature readings are reliable. The reading will depend on where the thermometer is situated – a thermometer out in the scorching sun will show a different temperature from one nearby in the cooler shade, for example.

So land-based surface temperatures are always taken by thermometers in special white louvered boxes, or by more modern electronic sensors encased in a bellows-like enclosure, about 1.3 meters (4 feet) off the ground. This standardizes the measurement method, but there's still a problem because of what are called urban heat islands.

The term urban heat island refers to the warming generated by people living in cities, which are always significantly warmer than surrounding rural areas because concrete, asphalt and buildings tend to soak up heat. Heat islands introduce bias into temperatures that are averaged over both city and rural land areas, causing average temperatures to be overstated. The influence of urban heat islands on recorded temperatures, even in small cities, is well established.⁴³

Temperature bias can also arise because the thermometer or sensor is in the wrong place. If it's next to a paved parking lot, for instance, heat reflected by the paving and heat generated by the running engines of vehicles will skew the

measured temperature to indicate false warming. Regulations in the U.S. require temperature sensors to be at least 30 meters (100 feet) from artificial heating or reflecting surfaces, but many temperature stations don't meet this requirement.

It was concern that urbanization may have compromised the U.S. temperature record, especially in recent years, that induced prominent meteorologist Anthony Watts to take a close look at the siting of weather stations across the U.S. Watts recruited a team of over 650 volunteers to visually inspect and photographically document more than 860 of these temperature stations.⁴⁴

The results came as a shock to the weather station sleuths:

We found stations located next to the exhaust fans of air conditioning units, surrounded by asphalt parking lots and roads, on blistering-hot rooftops, and near sidewalks and buildings that absorb and radiate heat. We found 68 stations located at wastewater treatment plants, where the process of waste digestion causes temperatures to be higher than in surrounding areas.⁴⁵

The Watts team discovered that a staggering 89% of the inspected stations failed to meet the 100 feet rule, and concluded that the U.S. temperature record is unreliable, as most likely is the global temperature record.

Just how unreliable was investigated in several subsequent analyses of the station siting data. A group of climate scientists together with Anthony Watts found that poorly located sites overestimate trends in the minimum daily temperature, while – perhaps surprisingly – underestimating maximum temperature trends.⁴⁶ Although these two opposing effects cancel when calculating mean temperature *trends* over time, the bias in the *mean* temperature itself averages about 0.13° Celsius (0.23° Fahrenheit) upward.⁴⁷

This implies that measured temperatures, at least in the U.S., need to be corrected downward by approximately 0.13° Celsius (0.23° Fahrenheit).

An earlier analysis of the same station site data was made by another group of climate scientists, this time at the U.S. National Oceanic and Atmospheric Administration (NOAA). Their study claimed that no correction is necessary for poor station siting, because of adjustments routinely made to measured temperatures to compensate for bias.⁴⁸ That the study's conclusion disagreed with the later

analysis should come as no surprise, since NOAA is the gatekeeper for the official U.S. temperature record – and an ally of the IPCC.

Evidence of the need for global temperatures to be pared down because of urban heat islands comes from a study by economist Ross McKittrick and climatologist Patrick Michaels, who investigated the pattern of warming over the Earth's land surface compared to local economic conditions, which are a signature of the human presence. In an extensive statistical and economic analysis of global temperature data, they concluded that the probability that human activities such as industrialization and urbanization do *not* influence local temperature trends is less than 1 in 14 trillion.⁴⁹ That's an incredibly low number, and means that urban living unquestionably creates a net warming bias.

McKittrick and Michaels determined that recently measured global warming rates need to be reduced appreciably to cancel out the bias, sometimes referred to as data contamination by human activity, even though climate scientists supposedly adjust warming rates for urbanization. When properly corrected for the urban heat island effect, the warming rate recorded on land since 1980 falls by about half globally.

The IPCC, however, in its ongoing quest to make all its data conform to the CO₂ global warming hypothesis (Table 1.2), essentially ignores this data contamination. There is of course irony here: on the one hand, the IPCC invokes human industrial activity to explain global warming but, on the other hand, rejects evidence for the influence of man-made cities on the temperature!

Needless to say, the IPCC dismisses the McKittrick and Michaels study in its 2007 Fourth Assessment Report.⁵⁰ The IPCC maintains that the heat island urbanization adjustment is negligible and that there is hardly any bias in uncorrected temperature trends,⁵¹ quoting studies by other climatologists.

This led to McKittrick – who was an external reviewer for the report, and submitted extensive comments critical of the IPCC position – leveling charges of fabrication against the IPCC, which I'll discuss later in the chapter.

Using McKittrick and Michaels' result that the land surface warming rate since 1980 should be sliced in half due to urban heating, the corresponding drop in the post-1980 global warming rate is about one fourth (25%), from approximately 0.17° Celsius (0.31° Fahrenheit) down to 0.13° Celsius (0.23° Fahrenheit) per decade.⁵² The correction to overall global warming is smaller than for land

regions alone, since the oceans are warming at a slower rate and show no heat island effect. Oceans cover 71% of the Earth's surface.

A recent analysis of global temperature data that purports to show different results from what I've just discussed is the Berkeley Earth Surface Temperature (BEST) study. While the study finds that the magnitude of global warming on land is the same as previously estimated by the IPCC, it also claims that the effect of urban heating on land temperature data is almost insignificant, and that poor station siting in the U.S. doesn't bias measured mean temperatures.⁵³ The findings are based on analysis of a much larger database than that used for most climate studies.

However, these preliminary results of the Berkeley study are open to interpretation, and indeed there was a vigorous online debate about their significance when the results were first made public late in 2011.

The main criticism has been that the raw temperature data underpinning the BEST analysis is essentially the same as the data used for most other past analyses, including the NOAA station siting analysis mentioned previously, as has been pointed out by Roger Pielke Sr.⁵⁴ It's therefore not surprising that the BEST study arrives at similar conclusions.

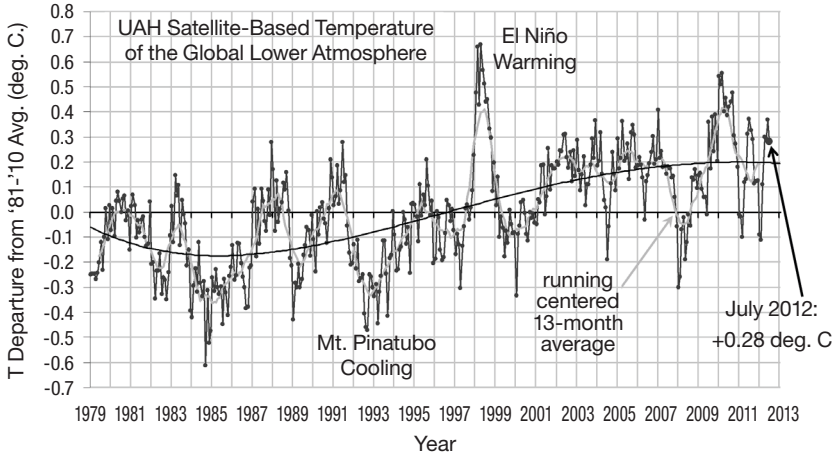
But controversy over whether the Berkeley results reproduce the well-known decline in global temperatures since 2001, a topic I'll return to later in the book, has since been settled by a joint statement from two of the study coauthors, saying that the BEST analysis neither confirms nor denies recent slowing of global warming.⁵⁵ The study website adds that large fluctuations in the average land temperature from year to year make it difficult to extrapolate a short-term trend.⁵⁶

Further evidence for bias in land temperatures comes from satellite data. Satellites in orbit around the Earth can measure temperature accurately over both land and sea, with the exception of small regions near the North and South Poles, by means of microwaves. These measurements are also subject to bias, caused by satellite drift in orbit and other factors, but all these factors are well understood and can easily be corrected for.

Satellites sample global land temperatures uniformly, unlike Earth-based thermometers and sensors that are weighted more toward developed, urban areas. Taking the heat island effect into account, the satellite data therefore shows less warming than the land and sea surface records relied on by the IPCC.

This is no doubt why the IPCC has chosen not to include satellite temperature measurements in its estimate of the recent global warming rate, even though data is available from 1979 (Figure 2.1).

Figure 2.1: The Satellite Temperature Record



Source: Spencer.⁵⁷

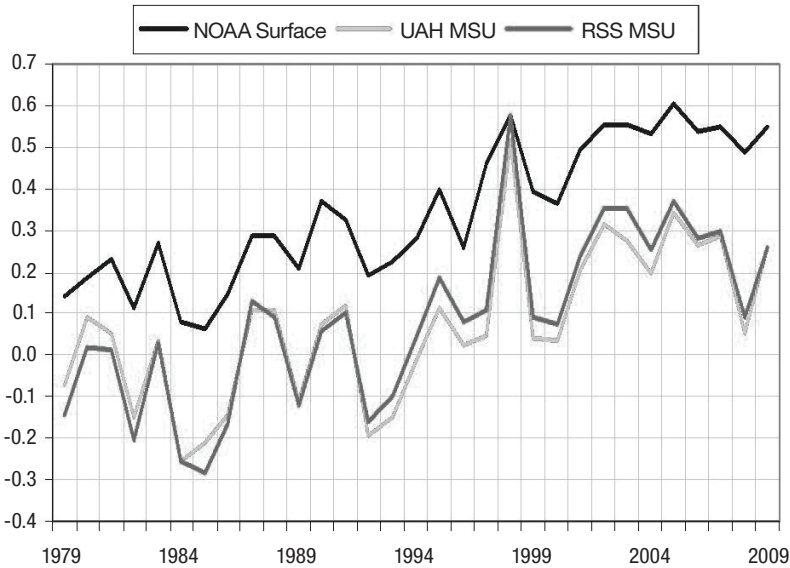
In fact, the current global warming rate of 0.14° Celsius (0.25° Fahrenheit) per decade since 1981 from the satellite measurements⁵⁸ is almost identical to the heat-island corrected warming rate since 1980, based on surface thermometers, deduced from the McKittrick and Michaels study.⁵² So either the satellite data are wrong, which no one – alarmists or skeptics alike – believes, or urban contamination causes bias in the surface data, bias that the IPCC ignores.

Unsurprisingly, the global warming rates reported by the IPCC and its alarmist accomplice NOAA are higher. According to the IPCC, the rate for the period since 1979 has been 0.17° Celsius (0.31° Fahrenheit) per decade,⁵⁹ while NOAA says the warming rate has been 0.16° Celsius (0.29° Fahrenheit) per decade since 1970, based on its surface thermometer data.⁶⁰

There have been numerous instances of NOAA meddling with the surface temperature record, in areas of the globe ranging from the Arctic to Australia to the U.S. Not only does NOAA exaggerate the warming rate, but the exaggeration also grows bigger over time, as can be seen by looking carefully at Figure 2.2

that shows the difference between surface and satellite data constantly stretching – and this despite the fact that NOAA manages both the satellite and surface temperature programs.

Figure 2.2: How NOAA Stretches the Temperature



Source: ICECAP.⁶¹ The global surface temperature record is from NOAA;⁶² NOAA satellite data compiled by the University of Alabama in Huntsville (UAH) is the same as in Figure 2.1. The vertical scale shows the temperature anomaly in °C.

A very recent reanalysis of the U.S. temperature record is a damning indictment of NOAA procedures. Using a new WMO-approved methodology for rating weather station siting, a study led by meteorologist Anthony Watts has found that published U.S. temperature trends from 1979 to 2008 are twice as high as they should be, due mostly to NOAA's erroneous upward adjustments to the data.⁶³

NOAA, as we saw earlier, claims that their temperature adjustments obviate the need to correct for poor station siting. But the Watts study concludes that the corrected U.S. warming rate since 1979 ought to have been 0.16° Celsius (0.29° Fahrenheit) per decade for the best located stations, compared with the adjusted NOAA rate of 0.31° Celsius (0.56° Fahrenheit) per decade.⁶⁴ Although the U.S. is only 2% of the world's surface area, NOAA's recent *global* warming rate – also

0.16° Celsius (0.29° Fahrenheit) per decade – is undoubtedly high as well, as I discussed above.

Because urbanization goes all the way back to the 19th century, although it has accelerated in recent years, it's highly probable that both IPCC and NOAA overestimates of the global warming rate since 1979 apply to the whole period from 1850 as well.

What this means is that the IPCC's estimated global temperature increase of 0.8° Celsius (1.4° Fahrenheit) for the modern period is too high and should be trimmed by 25% – that is, by 0.2° Celsius (0.4° Fahrenheit) – down to 0.6° Celsius (1.1° Fahrenheit). The reduction called for is roughly consistent with the need to lower measured U.S. temperatures by about 0.13° Celsius (0.23° Fahrenheit), based on poor weather station siting, as I indicated before.

But even if reported global land and sea temperatures are inflated by 0.1° Celsius (0.2° Fahrenheit) to 0.2° Celsius (0.4° Fahrenheit), is that such a big deal? An exaggeration of this size in the global temperature uptick may not seem like much, but it's enough to matter. The IPCC argument that natural variability alone cannot explain the observed rise in worldwide temperatures becomes a lot shakier if that rise has been overestimated by a few tenths of a degree, not to mention that the IPCC's climate models then have much less validity.

Even at 0.1° to 0.2° Celsius (0.2° to 0.4° Fahrenheit), the exaggeration is, at the very least, poor science – poor science that has led the IPCC to make numerous unjustifiable predictions of disastrous consequences of global warming that await the Earth. Good science demands intellectual honesty, including correction of data for bias.

Disappearing Temperatures: The Hockey Stick

Much worse than a 0.1° to 0.2° Celsius (0.2° to 0.4° Fahrenheit) exaggeration in the modern temperature increase was the “hockey stick” scandal – an outrageous attempt by the IPCC to distort historical temperature data to suit its political agenda. The episode is well documented elsewhere but bears repeating here.

The scandal arose because of the IPCC's need to validate its hypothesis about the connection between global warming and man-made CO₂. We've seen how this hypothesis is based on similar upward trends in the modern temperature record and the CO₂ level (Figure 1.1). If the hypothesis, and computer climate

models that depend on the hypothesis, are to hold up, then temperature and CO₂ should track one another historically and not just for the last 160 years.

The difficulty with this need is that, over the last 2,000 years, the temperature and CO₂ level *don't* track (Figure 2.3). The temperature has fluctuated, both up and down, but there has been almost no change in the CO₂ concentration until modern times – the CO₂ steady level problem referred to in Table 1.2.

How was this historical data obtained?

Measurement of temperature using scientific thermometers goes back only to the early 18th century, and accurate determination of the CO₂ level has been possible only for the last 55 years or so. Temperature and CO₂ data for earlier periods come from so-called proxy methods, or indirect measurements using sources such as tree rings, ice cores, leaf fossils or boreholes.

Each of these proxy methods has its limitations. Although the most commonly used proxy for temperature is tree-ring data, some paleoclimatologists (climatologists who study the past) believe that tree rings are unreliable indicators. This is because the widths of tree rings respond not only to temperature, but also to other factors such as moisture and CO₂. However, the data in Figure 2.3 were not based on tree rings.

The distinctly noticeable warm spell seen around the year 1000 is known to historians as the Medieval Warm Period, a time when warmer than normal conditions were reported in many parts of the world. The cool period centered around the year 1650 has been labeled the Little Ice Age and is also reported in various historical records. But there is no sign at all of these warming and cooling periods in the CO₂ data for the same timespan, which is based on ice-core proxies.

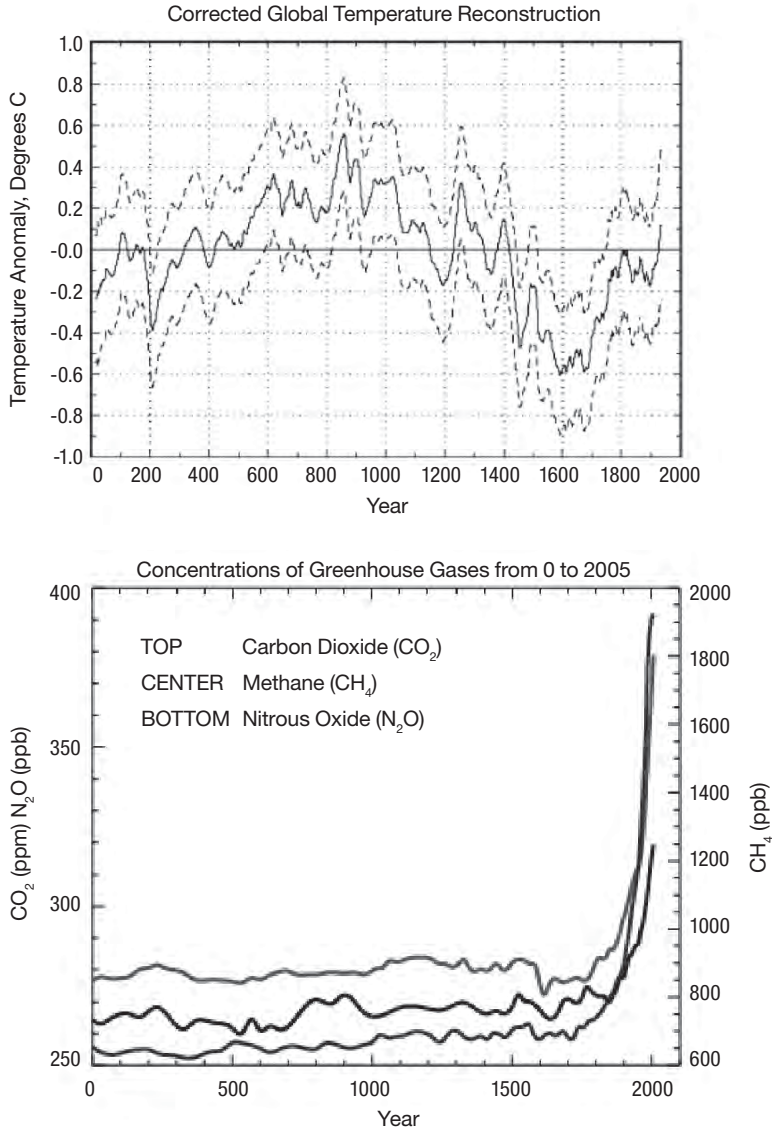
As I said, this mismatch is a problem for the IPCC's view of climate change. For the CO₂ hypothesis to be correct, the temperature and CO₂ level must go hand in hand, for *all* periods of time including the last 2,000 years.

Oddly enough, the IPCC seemed unaware of this problem in its First Assessment Report in 1990 that showed a temperature graph for the last 1,000 years, with both the Medieval Warm Period and the Little Ice Age not only included, but clearly labeled (Figure 2.4).

Yet the Third Assessment Report in 2001 told a radically different story. All of a sudden, the Medieval Warm Period and the Little Ice Age had disappeared! In their place was a fairly flat-looking graph (Figure 2.5) with few temperature ups

and down until the beginning of the present climb around 1900 – a chart that now bore a remarkable resemblance to the modern CO₂ record, looking like the shaft and blade of a hockey stick on its side.

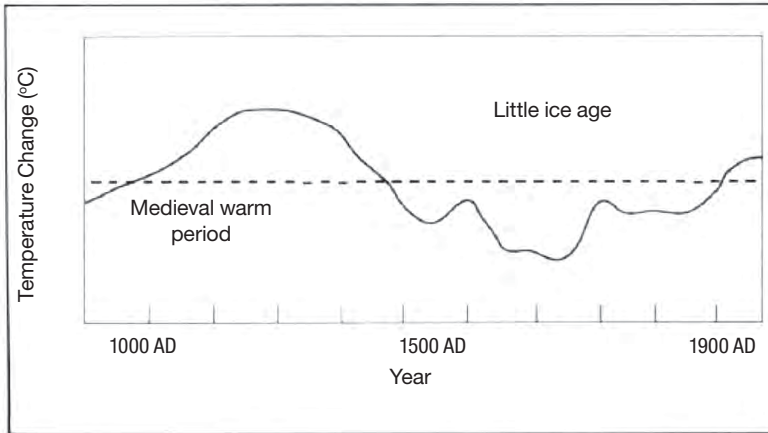
Figure 2.3: The Last 2,000 Years of Temperature and CO₂



Sources: Temperature (showing 95% confidence intervals) – Loehle and McCulloch;⁶⁵ CO₂ – Intergovernmental Panel on Climate Change.⁶⁶

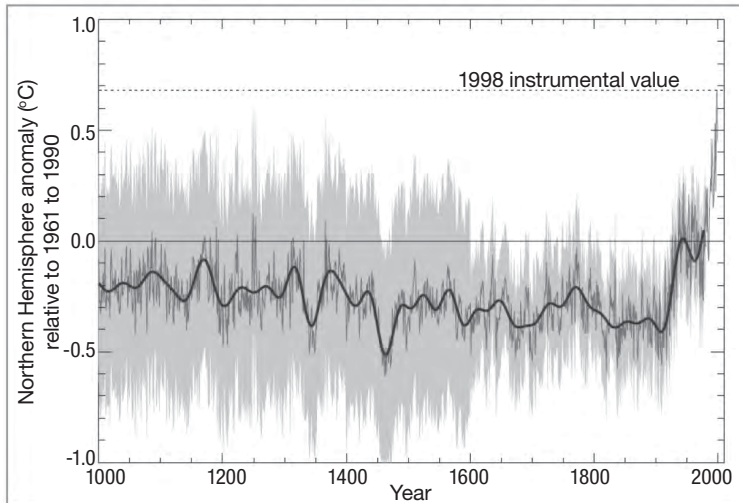
Hey presto! At a stroke, the IPCC solved its problem. The temperature record for the past 2,000 years indeed showed the same behavior as the CO₂ level (and other greenhouse gases), and the IPCC could now proclaim that it was right about

Figure 2.4: The IPCC's View of History, 1990



Source: Intergovernmental Panel on Climate Change.⁶⁹

Figure 2.5: The IPCC's View of History, 2001 – The “Hockey Stick”



Source: Intergovernmental Panel on Climate Change.⁶⁸ Note that the horizontal time scale lines up approximately with Figure 2.4 above.

global warming being human-induced. If the panel was rewriting history at the same time, so be it.

The hockey stick graph was largely the work of Michael Mann, an IPCC author then at the University of Massachusetts, who published two papers in 1998 and 1999 reconstructing historical temperatures for the period from 1000 to 1980, based predominantly on tree-ring data. Intertwined with this pre-1980 proxy record was the 20th century thermometer record.⁶⁷

Mann then conspired with his counterparts in the UK, who had produced similar but less wide-ranging graphs, to combine all the reconstructions into a convincing composite hockey stick for the IPCC's 2001 report.⁶⁸

Never mind that tree rings are considered an inaccurate proxy for past temperatures,⁷⁰ nor that the 20th century thermometer record is exaggerated by the urban heat island effect, as I've just shown. The IPCC graph had an immediate visual and political impact. By doing away with the Medieval Warm Period and the Little Ice Age, the hockey stick not only vindicated what global warming alarmists had been saying, it also gave a boost to governments wavering on adoption of the UN's 1997 Kyoto Protocol, which limits emissions of CO₂.

Yet this apparent triumph for the IPCC's global warming model was about to come crashing down around its ears, with the subsequent revelation that – yes, you guessed it – the IPCC and the hockey stick “team” were guilty of egregious data manipulation, of bending scientific data for an ulterior motive.

Not well-known about the hockey stick is that the splicing together of tree-ring and thermometer data was done simply because much of the tree-ring data indicates a temperature *downturn* after about 1960, contrary to thermometer readings. A reconstruction of historical temperatures up until the present using tree rings alone would therefore not exhibit the characteristic hockey stick shape, since the upturned blade of the stick comes primarily from the modern thermometer data depicted in Figure 1.1.

To produce a hockey stick and get the alarmist message across, Mann and the IPCC deceptively retained the earlier tree-ring data but ignored the recent temperature downtrend in later data, substituting thermometer readings instead.⁷¹

Nonetheless, they did keep a tiny subset of tree-ring data that bucks the post-1960 trend – ring widths from North American bristlecone pines, even though these are widely doubted to be dependable temperature proxies because of an

unexplained 20th century growth spurt. It was highly convenient, of course, that the bristlecone growth surge happened to reinforce the IPCC claim in the 1990s that global warming was accelerating. That claim has turned out to be false.

But even though the mercury was rising in the late 1900s, playing fast and loose with the data isn't acceptable science, as I said at the beginning of the chapter. Either you use *all* the tree-ring data, or none at all.

The Mann studies and the hockey stick were initially debunked in 2003 by Canadian statistician Stephen McIntyre and economist Ross McKittrick (coauthor of the urban heat island studies discussed earlier), who found that, apart from preferential data selection, Mann's conclusions were based on faulty statistical analysis.⁷² In fact, McIntyre and McKittrick showed that they could almost always produce a hockey stick, even from completely meaningless random data. In their words,

The particular "hockey stick" shape derived in the Mann proxy construction ... is primarily an artefact of poor data handling, obsolete data and incorrect calculation of principal components.⁷³

The authors added that Mann's studies were overly dependent on the tree-ring data from bristlecone pines. Omission of the bristlecone pine data, representing just one of over 100 data sets included in the original analysis, reinstates medieval warming and gives the lie to the IPCC's assertion that our present warm trend is exceptional compared to preceding centuries.

In 2006, some five years after the publication of the IPCC's report featuring the hockey stick, a team of statisticians appointed by the U.S. House Committee on Energy and Commerce found Mann's statistical analysis to be "somewhat obscure and incomplete", and the criticisms by McIntyre and McKittrick to be "valid and compelling".⁷⁴ The team also accused the IPCC of politicizing Mann's work.

At almost the same time, the U.S. House Committee on Science, which had been charged by the National Research Council (NRC) of the National Academy of Science to report on temperature data for the last 2,000 years, came to similar conclusions. The NRC report states:

Large-scale surface temperature reconstructions yield a generally consistent picture of temperature trends during

the preceding millennium, including relatively warm conditions centered around A.D. 1000 (identified by some as the “Medieval Warm Period”) and a relatively cold period (or “Little Ice Age”) centered around 1700. The existence and extent of a Little Ice Age from roughly 1500 to 1850 is supported by a wide variety of evidence including ice cores, tree rings, borehole temperatures, glacier length records, and historical documents. Evidence for regional warmth during medieval times can be found in a diverse but more limited set of records including ice cores, tree rings, marine sediments, and historical sources ...⁷⁵

Despite this widespread denouncement of his work, Mann – who is a paleoclimatologist but not a statistician – has continued to argue for the legitimacy of the hockey stick graph. At one stage, he defended the absence of the Medieval Warm Period and the Little Ice Age from his temperature reconstruction by saying that these were local rather than global phenomena, and restricted to small regions of the Northern Hemisphere. The difficulty with this explanation is that there is ample historical evidence from around the world, including the Southern Hemisphere, of the existence of both climate periods.⁷⁶

In 2008, Mann’s group published a new study reconstructing temperatures back to the year 700,⁷⁷ based on a larger number of alternative proxies that weren’t tree rings than they had used in their earlier work.

In an apparent concession to critics, Mann (now at Pennsylvania State University) this time acknowledged the occurrence of medieval warming, although he still insisted that it didn’t come close in magnitude to our modern global warm spell. Mann even claimed in an interview that, far from being bent as the new reconstruction clearly shows, “the hockey stick is alive and well”.⁷⁸

But hockey stick debunkers McIntyre and McKittrick were unsatisfied, finding that the new Mann study contained further statistical flaws, and that the group had failed to follow all the suggestions made by the NRC in its 2006 report.⁷⁹

In an effort to rehabilitate the hockey stick, one of Mann’s UK colleagues published another study in 2008, utilizing Russian tree-ring data that appeared to show temperatures rising recently,⁸⁰ just like thermometer data. Unfortunately, that study too turned out to be flawed, relying heavily on a single freak tree (in

Yamal, Siberia) that doesn't follow the downward trend of most tree-ring temperatures since 1960. This further attempt at deceit prompted McIntyre – who has become a self-appointed auditor of climate change claims – to call the lone tree “the most influential tree in the world”.⁸¹

In contrast, a very recent Chinese study of tree rings over the last 2,485 years shows the occurrence of both the Medieval Warm Period and the Little Ice Age on the Tibetan Plateau, along with several earlier warm periods.⁸² The study is part of a major Chinese research project to better understand millennium-scale climate change.

What the IPCC will make of Mann's recent work remains to be seen. Its 2007 Fourth Assessment Report grudgingly conceded that the hockey stick graph in the 2001 report was controversial, and that a more careful reconstruction of the temperature record does indeed show medieval warmth and chillier conditions during the Little Ice Age.⁸³ But an article published in 2005 by a University of Oklahoma geoscientist, David Deming,⁸⁴ leaves no doubt that in 2001, the IPCC was exploiting the hockey stick for its own ends.

Deming had established credibility with alarmists in the climate science community with an earlier paper, in which his analysis of borehole temperature data appeared to bolster the IPCC's CO₂ theory of climate change, although he concluded that natural variability could not be ruled out as a cause of warming either. The research was enough, nevertheless, to gain Deming admission to the alarmist club:

With the publication of the article in Science ... They thought I was one of them, someone who would pervert science in the service of social and political causes. So one of them let his guard down. A major person working in the area of climate change and global warming sent me an astonishing email that said “We have to get rid of the Medieval Warm Period.”⁸⁵

As we've seen, elimination of the Medieval Warm Period and the Little Ice Age was essential if the IPCC was to match up the temperature record and the CO₂ level over the last 2,000 years (Figure 2.3), and thus substantiate its hypothesis that global warming stems from human activity. So Mann's hockey stick curve, erroneous and deceptive as it is, must have seemed like a gift from God.

TABLE 2.1: BAD IPCC SCIENCE – DATA MANIPULATION

The IPCC take on climate data

- Global warming is about 0.8° Celsius (1.4° Fahrenheit) since 1850.
- The warming rate since 1979 has been 0.17° Celsius (0.31° Fahrenheit) per decade, higher than ever before.
- Temperature and the CO₂ level in the atmosphere have always gone hand in hand, for all periods of time – past as well as present. This is required by the CO₂ hypothesis.

WHAT'S WRONG WITH THIS DATA?

1. *Global warming is exaggerated* by 0.1° to 0.2° Celsius (0.2° to 0.4° Fahrenheit), because the IPCC has ignored a warming bias caused by artificially high temperatures measured in urban areas. The bias is consistent with satellite data showing lower warming.
2. Both the IPCC and NOAA have *inflated the recent warming rate*.
3. NOAA boosts global warming by *stretching the surface temperature record*, which is steadily diverging from the temperature measured by NOAA satellites.
4. GISS magnifies global warming by *contracting past temperatures*, rewriting the U.S. surface temperature record.
5. To match temperature to the CO₂ level over the last 2,000 years, the IPCC *rewrote history* by eliminating the well-established Medieval Warm Period and the Little Ice Age, creating the erroneous hockey stick graph.

Luckily for science, the world woke up to this particular case of IPCC corruption and the hockey stick – which I’ll revisit later in the chapter – is now largely discredited.

Disappearing Temperatures: GISS Rewrites the Past

Now you see it, now you don’t.

I’ve already discussed how far the IPCC and climate alarmists will go to keep alive their myth that man-made CO₂ causes climate change. But the dishonesty goes beyond inflating temperature measurements and being deceitful with tree-ring data. In a blatant extension of the hockey stick saga, one of the major custodians of temperature data has begun tampering with the U.S. temperature record – and it looks like one of the others is following suit with global temperatures.

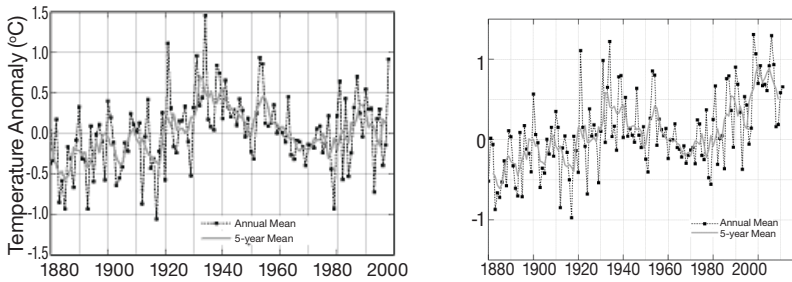
There are three principal guardians of the world’s temperature data, whose duties include analyzing the raw temperature data gathered from global weather stations. The three are NOAA and the NASA Goddard Institute for Space Science (GISS) in the U.S., and the UK collaboration between the Climatic Research Unit at the University of East Anglia and the Met Office’s Hadley Centre (HadCRU).

The three organizations use different analytic approaches, and different subsets of the available temperature data, though there’s a lot of overlap so the three analyses are not completely independent. Nevertheless, the analyses play a key role in estimating how much global warming the planet has undergone.

We’ve previously seen how NOAA boosts present-day global temperatures (Figure 2.2), in order to exaggerate the magnitude of global warming. GISS specializes in doing the same thing, mostly with past U.S. temperatures but in the reverse direction. That is, GISS deliberately tamps down old temperature readings so as to make the past seem cooler than it really was.

Figure 2.6 reveals GISS at work on both fronts. In the period between 1999 and 2011, GISS not only meddled with U.S. temperatures from the 1930s – in particular, diminishing the record heat of 1934 – but also bumped up the readings from 1980 onwards.

Figure 2.6: How GISS Hikes Up Warming



Source: U.S. surface temperature record according to NASA GISS, in 1999 (left)⁸⁶ and revised in 2011 (right).⁸⁷

The net effect, of course, is to make global warming in the U.S. appear more severe than it actually is. And while the original data showed 1934 to be 0.6° Celsius (1.1° Fahrenheit) hotter than 1998, which was another hot year, the revised version has 1998 warmer by about 0.1° Celsius (0.2° Fahrenheit)!⁸⁸ In reality, most record high temperatures were set long ago (Table 2.2).

Table 2.2: Worldwide Record High Temperatures⁸⁹

Continent	All-time high	Place	Date
Africa	136°F	El Azizia, Libya	September 13, 1922
North America	134°F	Death Valley, California	July 10, 1913
Asia	129°F	Tirat Tsvi, Israel	June 21, 1942
Australia	128°F	Cloncurry, Queensland	January 16, 1889
Europe	122°F	Seville, Spain	August 4, 1881
South America	120°F	Rivadavia, Argentina	December 11, 1905
Oceania ⁹⁰	108°F	Tuguegarao, Philippines	April 29, 1912
Antarctica	59°F	Vanda Station, Scott Coast	January 5, 1974

GISS maintains that its recent revision of U.S. temperatures came only from changes to the raw temperature data made by NOAA, which in 2009 adopted a new method for correcting measured temperatures for bias, supposedly to reduce

uncertainty in any climate trends deduced from the data.⁹¹ But it's hard to believe that GISS and NOAA are acting in good faith, when every correction results in a steeper temperature increase from global warming, never a gentler one.

Even the UK's HadCRU collaboration, which previously had the reputation for producing the most reliable temperature record (Figure 1.1) of the three organizations, has now started to play the same game. According to a 2012 report from the CRU, 2010 – and no longer 1998 – was the hottest year on record globally, allegedly based on a recent analysis of land temperatures that includes new data from weather stations in the Arctic.⁹²

I've now looked at three separate examples of how the IPCC and its allies have abandoned any pretense of playing by the scientific rules in arriving at their position that humans have caused global warming – by ignoring bias in the modern temperature record, misrepresenting the historical temperature record, and doctoring temperatures over the last century. If submitted as part of a science thesis by a PhD student in a reputable institution, any one of these efforts alone would be enough to fail the student.

But there's more. We'll see in the next section that the IPCC and climate change alarmists not only thumb their noses at accepted procedures for handling scientific data, but they also stoop to shady and corrupt practices in presenting and publishing that data.

CORRUPTION AND FRAUD

Biased from the beginning toward its belief in man-made global warming, the IPCC – along with CO₂ warmists in the scientific establishment and the media – has spared no effort in attempting to suppress contrary scientific evidence and to stifle the views of critics. This line of attack has extended to brazen dishonesty as we've just seen, and even to making fraudulent claims.

Suppressing Evidence: Climategate

A slew of scandalous revelations, many intimately connected to the infamous hockey stick curve, recently came to light when thousands of embarrassing emails from the Climatic Research Unit (CRU) at the UK's University of East

Anglia were leaked onto the Internet – first in November 2009, then again late in 2011. It's not known to this day whether the incidents, known as Climategate, were the work of an outside hacker or an inside whistle-blower at the CRU.

But the private emails between several of the world's top climate scientists, both at the CRU and in the U.S., reveal numerous instances of the Climategate perpetrators conspiring to suppress evidence, simply to buttress the faulty hypothesis that climate change comes from human activity.

The misdeeds include extensive data manipulation; subterfuge to keep temperature data and computer codes from being released to outside researchers who wanted to perform independent analyses; destruction of records; and interference with the peer review process to prevent contrary scientific papers from being published. All in the name of the CO₂ theory of global warming and its assertion that temperatures today are the highest in more than 1,000 years.

I'll return to the issue of peer review later. Here we'll take a look at just three of the many scientific transgressions committed by the Climategate gang.

Towering over all the revelations is the shameful effort to “hide the decline” in recent global temperatures derived from tree-ring data – an effort that was part of the deceptive reconstruction of historical temperatures involved in creation of the now discredited hockey stick.

The machinations began in September 1999 with the meeting of IPCC lead authors to discuss the first draft of the Third Assessment Report. Shortly after this meeting, in an email to his UK colleagues, hockey stick architect Mann expressed concern about the downturn in temperatures shown by nearly all the tree-ring data after 1960, which didn't fit with the upsweep of the hockey stick:

The key thing is making sure the series are vertically aligned in a reasonable way. I had been using the entire 20th century, but in the case of Keith [Briffa]'s, we need to align the first half of the 20th century with the corresponding mean values of the other series, due to the late 20th century decline.⁹³

Here Mann is talking about the composite temperature reconstruction that was to appear in the IPCC report, based on both the hockey stick and similar reconstructions by his UK associates. His concern over the visibility of the decline in tree-ring temperatures got the others' attention. Only two months later, CRU chief Phil Jones announced to the group:

I've just completed Mike [Mann]'s *Nature* trick of adding in the real temps to each series for the last 20 years (ie from 1981 onwards) and from 1961 for Keith [Briffa]'s to hide the decline.⁹⁴

In no uncertain terms, this email exposes the deliberate deceit behind the hockey stick. The “trick” that Jones refers to – and seems proud of – was originally employed by Mann in his 1998 paper in the journal *Nature*, in which thermometer measurements were substituted for the bulk of the post-1980 tree-ring data, but the earlier tree-ring data was retained.⁶⁷ Although normal scientific practice would have been to draw attention to this procedure in the paper and to justify it, Mann chose to hide the deception by saying nothing.

The silence about hiding the decline continued in the IPCC Third Assessment Report in 2001, just as Jones' email had foreshadowed. And even in the Fourth Assessment Report in 2007, suppression of the post-1960 data⁷¹ is only mentioned in passing, as part of a general discussion on the limitations of tree rings as a proxy.⁸³

The incompatibility of the Medieval Warm Period with the hockey stick concept has been an ongoing thorn in the IPCC's side. This is evident in a 2003 email from Mann, in which he wrote:

I think that trying to adopt a timeframe of 2K [2000 years], rather than the usual 1K [1000 years], addresses a good earlier point that Peck [Jonathan Overpeck] made with regard to the memo, that it would be nice to try to “contain” the putative MWP [Medieval Warm Period], even if we don't yet have a hemispheric mean reconstruction available that far back.⁹⁵

Use of the word “putative” signifies that the Climategate gang was intent on minimizing the Medieval Warm Period, even when there wasn't enough data to back up their craftiness. Climate scientist and IPCC lead author Jonathan Overpeck, who is quoted here, is rumored to be the source of the email mentioned earlier in the chapter on completely eliminating the Medieval Warm Period from the historical record.

You don't need to be a scientist to know that the data manipulation described in these emails is shamelessly dishonest. Although the hockey stick was eventually

debunked, it is only the Climategate emails that have uncovered the true extent of the fraud involved.

A second major transgression concerns the important scientific issue of reproducibility. The scientific method requires that all observations and results of analyses be repeatable by others – a safety measure to guard against bias. Because so much of the hockey stick saga seemed questionable, McIntyre and several other skeptics decided to ask for copies of the proxy data and computer codes used by Mann and his collaborators, so they could perform independent analyses of the same data and thus verify or invalidate the conclusions.

While requests of this type are welcomed in most scientific circles, the Climategate conspirators put up a near impenetrable wall of resistance. Mann's group blocked the move at every turn, making it much more difficult than it should have been for McIntyre and McKittrick, who originally debunked the hockey stick graph in 2003, to obtain all the detailed information they sought on the hockey stick calculations.

Annoyed by McIntyre's persistence, Mann responded to a 2004 email from Jones by stating:

I have no idea what he [McIntyre]'s up to, but you can be sure it falls into the “no good” category. ... I would not give them anything. I would not respond or even acknowledge receipt of their emails. There is no reason to give them any data, in my opinion, and I think we do so at our own peril!⁹⁶

Mann evidently felt they had something to hide, other than the decline.

Concerted efforts by climate change alarmists to discredit McIntyre altogether, such as trying to link him to the fossil fuel industry, a favorite alarmist tactic, failed. Instead, a resolute McIntyre explored how to obtain what he still needed through the U.S. Freedom of Information Act (FOIA), a tool frequently used by investigative reporters. This move greatly rattled Jones in the UK, who wrote to Mann in February 2005, saying:

The two MMs [McIntyre and McKittrick] have been after the CRU station data for years. If they ever hear there is a Freedom of Information Act now in the UK, I think I'll delete the file rather than send to anyone. ... We also have a data protection act, which I will hide behind.⁹⁷

And, just three weeks later, to three others:

I'm getting hassled by a couple of people to release the CRU station temperature data. Don't any of you three tell anybody that the UK has a Freedom of Information Act!⁹⁸

So not only were the Climategate gang scheming to suppress data, but they also felt above the law in concealing their wrongdoing. Despite the CRU being a publicly funded institution and therefore legally obliged to retain records of its work and to make them available for scrutiny, Jones had no qualms about deleting a computer file or doing anything else necessary to prevent CRU records from being released. And this is far from being the only example, either in the UK or the U.S., of files or emails being deleted to prevent their public disclosure.

Above all, the Climategate perpetrators were intent on keeping as much as possible of the hockey stick data and computer codes out of McIntyre and McKittrick's hands. In the end, however, the law prevailed and the hockey stick team was forced to hand over the remaining pieces of data and code.

But, no doubt wondering what additional errors McIntyre and McKittrick would discover in the team's tree-ring analysis, a recalcitrant Mann complained in 2006 that he didn't see "why you should make any concessions for this moron [McIntyre]".⁹⁹ McIntyre had just accused other hockey team members of "juvenile behavior" in obstructing his FOIA requests. As I discussed before, McIntyre and McKittrick did indeed go on to unearth flaws in a further Mann study.^{77,79}

Alarmist apologists have attempted to defend the work of the hockey stick team. However, the science itself aside, secrecy and unwillingness to share data – in both of which the central figures in Climategate excelled – have no place in proper scientific methodology.

A third instance of suppression of evidence that the Climategate emails made public involves allegations of fraud, in connection with the urban heat island effect. The allegations were made from 2007 to 2009 against climate scientist Wei-Chyung Wang, who is a professor at the State University of New York at Albany, by former UK financial analyst Douglas Keenan.¹⁰⁰

The alleged fraud concerns two 1990 research papers coauthored by Wang, in which a comparison was made between temperatures gathered at both urban and rural weather stations in China over the years 1954 to 1983.^{101,102} The lead author on the second paper was none other than the CRU's Jones.

Keenan accused Wang of fabricating more than half the station histories – that is, making up the raw temperature data – as well as lying about changes in station location. A statement in both research papers that there were few station moves, which affect temperature measurements, was shown by Keenan to be false, since many of the stations moved multiple times during the 30 years of the study. One station had five different locations from 1954 to 1983, some of the locations being as much as 41 kilometers (25 miles) apart.¹⁰³

By Keenan's estimate, the station moves could have affected the measured Chinese temperatures that were used in the two studies by as much as 0.4° Celsius (0.7° Fahrenheit),¹⁰⁰ which is a substantial portion of the average temperature increase worldwide from global warming during the study period.

The paper with Jones as lead author concluded, partly from the allegedly fabricated data, that urbanization in China has no significant effect on measured temperatures.¹⁰² This particular study is highly important, as it was cited by the IPCC in its 2007 report as evidence that the urban heat island effect is negligible,¹⁰⁴ along with its own fabricated evidence to be discussed in the next section.

The Climategate emails strongly hint that Jones was complicit in covering up the fraud. Perhaps the most telling sign that he was more than just an innocent coauthor of Wang was a 2010 article about the case in the UK's *The Guardian* – a newspaper known more for attacking climate change skeptics such as Keenan than defending them.¹⁰⁵

In an internal CRU email sent in February 2007, responding to yet another FOIA request from climate auditor McIntyre, asking for the original Chinese data, Jones wrote, "I don't really see this as an FOI request. I am really loath to send them the data even if I could find it."¹⁰⁶ Jones had told McIntyre previously that supplying the data would be "too burdensome". In March 2007, Keenan requested the same Chinese data.

The requests prompted hockey stick creator Mann to weigh in shortly afterwards, advising Jones that:

This is all too predictable. This crowd of charlatans is always looking for one thing they can harp on ... The last thing you want to do is help them by feeding the fire. Best thing is to ignore them completely.¹⁰⁷

The Climategate gang was up to its old tricks again, although the obstruction was once more in vain. After Wang agreed to supply the questionable station data, Jones felt obliged to pass it on to Keenan and McIntyre. But Jones and his colleagues were taken aback when Keenan then made his fraud allegations, which are still unresolved.

However, Jones recently reversed himself. In a new study of Chinese temperatures, he reported not only that a strong urban warming effect does indeed exist in China, but also that urban warming caused the China-wide temperature rise between 1951 and 2004 to be overstated by a whopping two thirds.¹⁰⁸ In an obvious attempt to distance himself from the fraud charges, Jones did not include Wang among his coauthors on the new study.

These three examples of corruption exposed by Climategate are just the tip of the iceberg. Many more can be found in the voluminous emails, which have been dissected in numerous blogs and books. The obstructive behavior has been called “climate tribalism” by Judith Curry, a leading climatologist who is chair of the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology, and one of the few voices of reason among nonskeptics.¹⁰⁹

Because of the public outcry over Climategate, there have been several official investigations into the scientific misconduct exposed by the emails. The official inquiries were conducted in the UK (three separate investigations of the CRU), the U.S. (of Michael Mann), and the Netherlands (of the IPCC).

But just as we might expect, a majority on the investigating panels consisted of either scientists who were advocates of the man-made global warming theory or, in the case of Mann, Pennsylvania State University personnel – who were more interested in protecting Mann for his research funding prowess than in looking into the charges against him. None of the panels interviewed any critics of the Climategate offenders.

So it was no surprise, at least to climate change skeptics, when the official investigations almost completely whitewashed the fraudulent and obstructive behavior being investigated. Even a columnist normally supportive of the alarmist view found the reports “At best ... mealy-mouthed apologies; at worst ... patently incompetent and even wilfully wrong.”¹¹⁰

The only concession made to critics was by one of the UK reviews that chastised the CRU and the University of East Anglia for showing “a consistent pattern of failing to display the proper degree of openness”.¹¹¹

Cooking up Evidence

Beyond the deception, obstruction and cover-ups revealed by the Climategate emails is yet another example of fraud by the IPCC – this time involving the creation of fictional evidence to prop up a fallacious argument about urban heat islands.

As discussed earlier in this chapter, the IPCC’s 2007 report minimizes the influence of urbanization on recorded temperature data. Imagine its astonishment, then, when upstarts McKitrick and Michaels published their detailed statistical study showing that the urban heat island effect accounts for just over a half of the measured temperature increase on land due to global warming.^{51, 112}

Perhaps in the hope of silencing any public comment by McKitrick, the IPCC had made him an external reviewer for that part of the report. Their efforts backfired, however, as McKitrick not only submitted extensive comments in support of the conclusions he and Michaels had reached, but also struck back openly at the IPCC when those comments were passed over.¹¹³

In explaining why he accepted the IPCC’s invitation to serve as a reviewer, McKitrick says:

Contamination of surface climate data is a potentially serious problem for the IPCC. Conclusions about the amount of global warming, and the role of greenhouse gases, are based on the assumption that the adjustment models work perfectly ... the core message of the IPCC hinges on the assumption that their main surface climate data set is uncontaminated. And by the time they began writing the recent Fourth Assessment Report, they had before them a set of papers proving the data are contaminated.¹¹⁴

The IPCC report dismisses the McKitrick and Michaels study with the false statement that most global temperature measurements have already been adequately adjusted for urbanization, and that only a very small additional correction is necessary. McKitrick wrote a lengthy criticism of this opinion, backed

up by strong evidence to the contrary from the study, during the writing of the IPCC report.

What happened next is astounding, but typical of how the IPCC operates. Confronted with published evidence from one of their own reviewers that the heat island effect contaminates global temperatures, they trivialized the evidence with the conjecture that urban warming can be chalked up to entirely natural causes. In publicly available comments on the report's second draft, the IPCC authors state that the urban heat island effect is insignificant and that any urban warming comes from "...strengthening of the Arctic Oscillation and the greater sensitivity of land than ocean to greenhouse forcing owing to the smaller thermal capacity of land."¹⁵

This preposterous claim is complete nonsense. The Arctic Oscillation is a wind circulation pattern that affects long-term weather trends in the Arctic, but has absolutely nothing to do with the heat island effect from urban areas. And the comparison of land to ocean is irrelevant since McKittrick and Michaels only studied temperatures over land.

But the IPCC didn't stop there. Referring to the strong connection that McKittrick and Michaels found between temperatures and local economic activity, the final version of the report declares:

However, the locations of greatest socioeconomic development are also those that have been most warmed by atmospheric circulation changes (Sections 3.2.2.7 and 3.6.4), which exhibit large-scale coherence. Hence, the correlation of warming with industrial and socioeconomic development ceases to be statistically significant.⁵⁰

Here the IPCC acknowledges the correlation between warming trends and socioeconomic development, meaning industrialization and urbanization, but dismisses the correlation as a mere coincidence due to unspecified "atmospheric circulation changes". This is more of the Arctic Oscillation gobbledygook that the IPCC authors invoked earlier in the report writing process, since the two cited sections of the report say nothing at all about industrial or urban development.

However, the most outrageous comment is the second sentence in the excerpt above, maintaining that McKittrick and Michaels' evidence for a definite correlation between elevated temperatures and urbanization is statistically insignificant.

McKittrick has since demonstrated in a further study, which specifically includes four major atmospheric circulatory (wind) patterns, that exactly the opposite is true – that is, the correlation is indeed statistically significant, and measured temperatures are strongly tied to urbanization.¹¹⁶

The IPCC's claim to the contrary is a flagrant abuse of science and scientific methodology. Not only did the UN panel reject perfectly sound scientific evidence in McKittrick and Michaels' previous studies, but they did so on the basis of nonexistent counterevidence from wind patterns. In McKittrick's words, this amounts to "making stuff up" and constitutes a "plain fabrication" by the IPCC.¹¹³

Peer Review as a Weapon

One of the favorite tactics of global warming alarmists is to wield the time-honored tradition of peer review in scientific publishing as a weapon against skeptics. While this may be less outrageous behavior than some of the other abuses I've just described, it's still corrupt.

The tactic takes several forms. In a common line of attack, alarmist climate scientists band together to write negative reviews of a skeptical research paper submitted to a scientific journal, often purely on the grounds that the paper contradicts the status quo, which is dominated by the man-made CO₂ hypothesis, and therefore couldn't possibly be worthy of publication.

Alternatively, when there's little to criticize in the manuscript, alarmist reviewers pressure the journal editor to throw it out because it's not written by a member of the alarmist club. If the editor doesn't comply, and continues to accept papers from skeptics, the alarmists move to have the editor ousted.

The Climategate emails provide ample insights into both these strategies. As a result of the clamor over the hockey stick, paleoclimatologists – the tree-ring folk – went to great lengths in trying to keep contrary papers from seeing the light of day. Many skeptical climate scientists have experienced lengthy delays in publication of their manuscripts, or have had to submit them to obscure journals, because normal publication was thwarted by alarmists.

At the very least, the Climategate gang wanted to exclude skeptics from IPCC reports. Jones confided to Mann in 2004:

I can't see either of these papers being in the next IPCC report. Kevin [Trenberth] and I will keep them out somehow – even if we have to redefine what the peer-review literature is!¹¹⁷

Alarmists have been successful in orchestrating the removal of “offending” journal editors who dare to accept skeptical papers. In a 2003 email to a large group of paleoclimatologists and others, climate scientist Tom Wigley discussed a paper he didn't like that had been published in 2002 by skeptical climatologist Michaels in the journal *Climate Research*. Wigley and another reviewer had written negative reviews of the manuscript and had recommended rejection, but the paper appeared in print because three other reviewers gave it the thumbs-up. Piqued, Wigley wrote:

I suspect that de Freitas [a *Climate Research* editor] deliberately chose other referees who are members of the skeptics camp. I also suspect that he has done this on other occasions. How to deal with this is unclear, since there are a number of individuals with bona fide scientific credentials who could be used by an unscrupulous editor to ensure that ‘anti-greenhouse’ science can get through the peer review process.¹¹⁸

Clearly, Wigley thought – like many other alarmists – that any papers questioning the CO₂ explanation of global warming should never be published, regardless of their scientific merits.

Chris de Freitas stayed on as an editor at *Climate Research*, in spite of an ad hominem campaign by the Climategate gang to have him both removed from his editorial position and even fired from his university job.^{119, 120} Nevertheless, the Climategate conspirators made so much noise about another skeptical paper published in the journal in 2003 that not only was its editor-in-chief forced to resign, but four other editors also left.¹²¹ Among other claims, the paper in question maintained that the Medieval Warm Period was warmer than today.

Intimidation of editors worked again at a different publication two years later, by which time the frustration level among paleoclimatologists had risen further. Shocked that the mainstream scientific journal *Geophysical Research Letters* (GRL), which publishes a large number of alarmist papers on climate change, had

just given the green light to one of McIntyre and McKittrick's studies debunking the hockey stick,⁷² Wigley emailed his colleagues in 2005, saying:

This is truly awful. GRL has gone downhill rapidly in recent years. ... If you think that Saiers [GRL editor] is in the greenhouse skeptics camp, then, if we can find documentary evidence of this, we could go through official AGU [American Geophysical Union] channels to get him ousted. Even this would be difficult.¹²²

Despite Wigley's reservations, the editorship of GRL did indeed change hands later that year. If they couldn't convince everyone that the hockey stick was real, the hockey team could at least control the world of climate science publishing.

Yet another editorial resignation over peer review occurred as recently as 2011, at the relatively new journal *Remote Sensing*. In this case, the journal had published a controversial paper on climate sensitivity (see Chapter 4) by well-known skeptical climatologist Roy Spencer and a coauthor, who used satellite measurements to challenge the reliability of computer climate models.¹²³

Because computer models are at the heart of climate change hysteria, alarmists rose up en masse and complained, both to the journal and in public, about the perceived failure of peer review in allowing a skeptical paper to penetrate alarmist early warning defenses.¹²⁴ Within a month, *Remote Sensing* editor Wolfgang Wagner stepped down in order to appease his critics.

But Wagner's disingenuous resignation editorial, which has been described as "eerily reminiscent of past recantations by political and religious heretics",¹²⁰ makes it clear it was skeptics, and not the peer review process itself, that were the actual alarmist target:

Therefore, from a purely formal point of view, there were no errors with the review process. But, as the case presents itself now, the editorial team unintentionally selected three reviewers who probably share some climate sceptic notions of the authors.¹²⁵

Just keep the skeptics out of the scientific literature and the CO₂ theory can reign supreme.

IPCC Dirty Tricks

The IPCC as an organization is no less corrupt than the Climategate offenders. And nowhere is corruption in the IPCC more visible than in the review process by which the conclusions of its climate scientists become part of the panel's published reports – reports that constitute the bible of climate change alarmists.

But just as bias toward human-induced global warming is built into the IPCC's original mandate, politicization and corruption of the report review process are, amazingly enough, inherent in the panel's working principles. These principles state:

Changes (other than grammatical or minor editorial changes) made after acceptance by the Working Group or the Panel shall be those necessary to ensure consistency with the Summary for Policymakers or the Overview Chapter.¹²⁶

In other words, the science should be modified if needed to conform to the Summary and Overview, which get written first! That's like asking a jury to rubber stamp a verdict that the judge has already decided on. In the financial world, it's called cooking the books.

A disturbing example of corruption in the IPCC reviewing process occurred during preparation of the Second Assessment Report back in 1995, when the IPCC was trying very hard to establish the concept of a “discernible human influence” on climate. This has been described in detail elsewhere, so I'll only dwell on it briefly here.

In order to link global warming with man-made CO₂ and identify a climate change signal, the IPCC attempts to apply a technique called “fingerprinting”, whereby geographic and temporal patterns of higher temperatures are matched to the predictions of computer climate models.

But the 1995 IPCC claim to have successfully identified a human fingerprint on global climate was demonstrably false, because it was based on selective use of temperature data. When all the data were examined as a whole, the case for a human CO₂ signature in our climate was found to be very weak.

That caused a considerable ruckus at the report review stage. In a rare display of honesty by the IPCC, the draft of the report disputed the success of fingerprinting and actually questioned the evidence for any human effect on climate. The draft included as many as 15 statements reflecting these views.

In the final version, all the statements had gone, being replaced by quite different language implicating greenhouse gases such as CO₂ in global warming, and claiming that, for the first time, evidence now existed for a human influence on climate.¹²⁷ This claim was a sea change in the public declarations of the IPCC, which up to then had made only tentative declarations about human-induced climate change, and played a major role in subsequently shifting public opinion toward the alarmist viewpoint.

But the drastic changes from the draft version of the report had all been made surreptitiously, by a small group of about six authors for that particular chapter, including lead author Ben Santer – without the other authors or any reviewers even being consulted. The alarmists had won their first battle against the skeptics, inside the IPCC itself.

Frederick Seitz, an eminent physicist and past president of both the National Academy of Sciences and the American Physical Society, wrote at the time that he had never witnessed “a more disturbing corruption of the peer-review process” than the events that led to the IPCC report, and accused the IPCC of tampering with science for political purposes.¹²⁸

Even the prestigious journal *Nature*, while supportive of the IPCC’s stance on global warming, castigated the panel in an editorial, saying that:

IPCC officials claim ... the revisions [were made] in particular to ensure that it conformed to a ‘policymakers’ summary’ of the full report ... But there is some evidence that the revision process did result in a subtle shift ... that ... tended to favour arguments that aligned with the report’s broad conclusions.¹²⁹

The IPCC, in line with its corrupt working principles, had turned the review process upside down and had replaced perfectly good science with what had already been written in the report summary. One of the authors of the altered chapter basically admitted as much in a later attempt to defend the IPCC’s position, saying that the whole report was unquestionably “fraught with political significance”.¹³⁰

Little has changed at the IPCC since then. However, the recent investigation of the IPCC in the wake of Climategate did address a number of issues, including assessment report review.

TABLE 2.3: BAD IPCC SCIENCE – CORRUPTION AND FRAUD

Areas of IPCC corruption

- The historical temperature record.
- Release of data and computer codes for publicly funded climate research.
- The effect of urbanization on global temperatures: two separate cases, one involving alleged fraud.
- Peer review in climate science publishing, including intimidation of journal editors.
- The IPCC's internal process for reviewing climate assessment reports.

WHAT'S WRONG WITH THIS SCIENCE?

1. IPCC authors dishonestly *conspired to "hide the decline"* in recent temperatures derived from tree-ring data, as part of the deceitful skewing of historical temperatures to produce the discredited hockey stick curve.
2. The Climategate gang *willfully obstructed FOIA requests* for proxy data and computer codes used to create the hockey stick. There is evidence in the Climategate emails that files and email records were destroyed.
3. *Formal charges of fraud* have been made against an IPCC climate scientist in connection with urban warming, for allegedly fabricating Chinese temperature data and lying about weather station histories. The Climategate perpetrators may have been *complicit in a cover-up*.
4. The IPCC dismissed sound statistical evidence that urbanization artificially inflates global temperatures, by using double-talk and by citing nonexistent counterevidence – which led to *accusations of fabrication* against the IPCC by the authors of the statistical study.
5. The Climategate offenders have *interfered with the peer review process, and orchestrated the removal of journal editors*, in order to prevent the publication of scientific papers contrary to the CO₂ theory of global warming.
6. IPCC principles require the science in its reports to conform to the policymakers' summary, a political document that is often written *before* the body of the report. And in the 2007 report, 30% of the scientific sources were *not peer reviewed*.

Among the inquiry's recommendations were that the process for approving the Summary for Policymakers be revised, in order to reduce political interference with the scientific results; and that IPCC review editors should exercise their authority to ensure that "properly documented alternative views" receive due consideration, and that "genuine controversies are adequately reflected in the report".¹³¹

The inquiry also found that the IPCC needs to strengthen and enforce its procedures for citing unpublished and non-peer-reviewed literature in its reports. This recommendation was a response to a survey revealing that a staggering 30% of the so-called scientific sources cited by the alarmist IPCC in 2007 were not peer-reviewed at all,¹³² but included newspaper articles, reports from lobbyists, and brochures – despite the efforts of the Climategate gang to keep any skeptical papers on climate science in the non-peer-reviewed category.

But it remains to be seen how seriously the IPCC will take these findings. The organization's existing review process is highly compromised from years of abuse, and fundamental reforms need to be implemented.

GLOBAL WARMING FALSE ALARM

Chapter 3: Computer Snake Oil

Alarmist climatologists, when attacked by skeptics in other scientific disciplines for promoting belief in man-made global warming, are fond of hiding behind their so-called expertise in climate science. We're the experts, they declare – so only they are qualified to pass an authoritative opinion on climate change.¹²⁰

While not being an expert in a particular field doesn't disqualify a scientist in another field from evaluating the evidence and passing an opinion, you need to ask yourself in this case whether the climate scientists who claim to be experts really are. It's no secret, but it's not widely known that their "expert" opinions are based entirely on theoretical computer models of the climate.

Computer climate models are also the foundation for the gloom and doom about CO₂ and global warming preached by the IPCC. However, as we'll see, the IPCC's computer models are a poor imitation of reality and have made many predictions that have simply turned out to be wrong.

Because computer models are central to the climate change debate, the whole of this chapter is devoted to them.

IT'S ONLY A MODEL

Computer models can be very powerful tools. One area where computational models are particularly useful is the design and engineering of complex technological marvels such as cars, airplanes, or computer chips. For all of these, the underlying science is well known and the assumptions behind the models have been thoroughly tested.

Models don't do as well when the computation is unable to mirror the reality of a complex system. This happens when there are gaps in our knowledge of the model's infrastructure, and we have to use guesswork to fill in the gaps. Now we can no longer be certain about what the model tells us.

Computer climate simulations are only as reliable as the assumptions that the computer model is built on: "garbage in, garbage out", as software engineers like to say. Just as scientific hypotheses need to be verified experimentally before they can be confirmed – a requirement that the IPCC actually recognizes¹³³ – so do any educated guesses made in a computer calculation.

One of the biggest defects in the IPCC's argument for human-caused global warming is that its theoretical climate models are chock-full of *untested* assumptions. They include conjectures about basic elements of the climate system, such as clouds and precipitation; about the contribution, largely ignored, of natural cycles to current high temperatures; and about the physical processes that control the response of the Earth's climate to tiny additions of CO₂, a response much exaggerated in the models.

I'll discuss these and other assumptions as we go through the book. The real problem is that many of the assumptions are undergoing testing right now, in an ongoing experiment that may not be complete for another 50 or 100 years. Alarmists and the IPCC say we can't afford to wait that long for the results, so our only choice is to rely on computer modeling.

Nevertheless, there is abundant evidence that the IPCC's computer models do not accurately simulate even the present-day climate, let alone the future or the past. Many of the predictions made by these models about current climatic conditions have been dead wrong, and the only reason that climate models can "hindcast" the historical record is that they are arbitrarily adjusted to fit the historical data.

Even though computer simulations can be useful, it's easy to become carried away with their possibilities and to inflate the importance of their predictions.

Something I've noticed in my own research is that, while some features of any experimental results obtained in the real world can be reproduced by theoretical computer calculations, other features typically can't. And computational models tend to exaggerate the magnitude of trends in the actual data. The reason is simple: computer models depend on assumptions, and it's next to impossible to

make all the right assumptions. There are just too many unknowns that can't be measured or tested.

It's not very different with climate models. Some of the models are very elaborate and can predict all sorts of climatic variables in great detail – so much so that we can be awed by the model itself, by the sheer calculating power at our fingertips. I've certainly experienced that feeling.

But a model is just a model. Even though the computational power of current supercomputers used for climate modeling is more than a million times greater than what was available in 1970, when computing was in its infancy, that doesn't change the fact that the models are constrained by their underlying assumptions. All the computing speed in the world doesn't make up for lack of understanding.

The 2008 Wall Street meltdown is a painful reminder of this. Although the reasons for the U.S. financial crash and the subsequent Great Recession are numerous, there's no doubt that computer models played a role, since it was computer simulations that had been routinely used to evaluate risk by the investment community. If the models had better represented reality, or if bankers had been more aware of the limitations of computer modeling, perhaps the financial crisis wouldn't have been as bad as it was.

Another notorious example, from the engineering field, is the Millennium Bridge in London. It was only after the footbridge was built, and people walked on it for the first time, that unexpected swaying was felt by walkers, causing the bridge to be promptly closed for design modifications. The engineers realized they had created what is known as a resonant structure, a well-understood phenomenon that could have been avoided if they had made correct assumptions in their computer models of the bridge.

Climatologists defend their theoretical computer models by saying the models are the only handle we have on the climate. That is true, unless we're prepared to wait several decades until we have some more definitive measurements. But that doesn't mean the models are right. I certainly wouldn't want to fly on an airplane designed by the engineering equivalent of a computer climate model.

Remember, it's only a model.

FITTING AN ELEPHANT

Ideally, what one would like in a climate model is an accurate depiction of the most important climatic features – especially those important to humans, such as temperature, precipitation, winds and storms.

That's easier said than done, as the model must not only obey the laws of physics and chemistry, but it must also simulate a host of complex interactions in the Earth's climate system, which couples the atmosphere to the land masses to the oceans to snow and ice.¹³⁴ This complexity includes phenomena as diverse as jet streams in the upper atmosphere, deep ocean currents, clouds, greenhouse gases and climate cycles such as El Niño.

Climate processes span enormous sweeps of distance and time, from a few centimeters to thousands of kilometers, and from several hours to millennia. For a computer simulation, all the processes and their interactions must be expressed as mathematical equations, which are translated into computer codes. Armed with these equations, the computer then simulates how the climate evolves over time.

That may sound straightforward, but there are two big limitations. The first is that even the most powerful computer in the world today is not capable of simulating the climate on a small spatial scale. So a grid is employed, with the grid boxes for the highest resolution atmospheric models being about 80 kilometers (50 miles) square across the Earth's surface, and about 0.6 kilometers (0.4 miles) high vertically; ocean grids are finer.

This means that anything smaller, including cloud formation, falls between the cracks of the grid and can't be modeled accurately. For small-scale processes, simplified pictures of reality involving approximations become essential. Some approximations aren't as good as others.

The second major drawback to computer modeling is that, for all our modern technological prowess, there's plenty we don't understand or don't even know about the large-scale workings of the Earth's climate over long distances. That's where the assumptions come in. And aside from the fact that many assumptions can't be tested, as I've said before, the assumptions require yet more approximations.

All these approximations, large-scale and small-scale, are incorporated in the model in the form of adjustable numerical parameters.¹³⁵

The very existence in computer climate models of so many adjustable parameters, often termed “fudge factors” by scientists and engineers, should be a warning sign in itself. The famous mathematician John von Neumann once said, “With four [adjustable] parameters I can fit an elephant, and with five I can make him wiggle his trunk.”¹³⁶

Some adjustable parameters simply embrace a range of error in a measured quantity, but others are unknown and have to be guessed. To adequately describe fine-scale processes that take place inside one of the 80-kilometer-square grid boxes over the Earth’s surface, almost 30 parameters alone are needed.¹³⁷ With many more required to account for all the coarse-scale assumptions, the total number of parameters in a climate model can run into the hundreds. That’s a lot of elephants!

Climate scientists have come up with several procedures to get a grasp of some of the unknowns in their models. One of these is to use more than one model, each based on slightly different variable parameters, in order to estimate the uncertainty in the parameters. For its 2001 and 2007 reports, the IPCC used up to 34 and 23 different atmosphere-ocean climate models, respectively.^{138, 139}

Another method “tunes” selected adjustable parameters until the model correctly represents known quantities, such as the global energy balance.¹⁴⁰ However, tuning parameters to match a particular quantity can lead to the false conclusion that a cause and effect relationship exists.

Remember, it’s only a model. No fixes to present-day computer models can escape the fact that the models still depend on numerous unverified assumptions and adjustable parameters. Even the very latest models contain biases arising from incorrect assumptions, as pointed out in a recent report to Congress by U.S. climate modelers:

Nonetheless, there are still systematic biases in ocean-atmosphere fluxes in coastal regions west of continents, the spectrum of ENSO [El Niño–Southern Oscillation] variability, spatial distribution of precipitation in tropical oceans, and continental precipitation and surface air temperatures.¹⁴¹

With so many parameters uncertain or just not known, the predictions of any of these models become dubious, to say the very least. Yet the IPCC says it’s 90%

sure of the link between global warming and man-made CO₂ – a prediction based solely on theoretical models. Tweak the parameters differently, and the models will predict little or no warming.

And that's just the present climate (Table 3.1). The IPCC and its alarmist accomplices constantly warn that global warming will get worse and, believe it or not, have actually forecast how hot it will be 90 years from now, using the very same computer models. Talk about stretching the truth.

The IPCC forecasting process¹⁴² has been audited by Scott Armstrong, a marketing professor who is an internationally recognized expert on forecasting methods in general, and a colleague.¹⁴³ The audit included a survey of IPCC authors and reviewers, together with a smaller number of known climate change skeptics. It found that not only did the IPCC's methods violate a majority of standard forecasting principles, but also:

The forecasts in the Report were not the outcome of scientific procedures. In effect, they were the opinions of scientists transformed by mathematics and obscured by complex writing. ... Extensive research has shown that the ability of models to fit historical data has little relationship to forecast accuracy.¹⁴⁴

So much for the IPCC's climate forecasts. Remember, it's only a model.

CLOUDING THE PICTURE

In computer climate models, it is assumptions about two watery entities – clouds and atmospheric water vapor – that underpin the IPCC's conclusions on man-made global warming. According to the models, the normally tiny effect of CO₂ on global temperatures is amplified most by water vapor and clouds.

The two are related, since clouds are born when water evaporates to form water vapor, which later condenses into liquid droplets or ice crystals to produce the clouds. But they aren't the same, clouds being essentially liquid water while water vapor in the atmosphere is a greenhouse gas, so they affect temperature and climate differently. We'll come back to water vapor in the next chapter, which deals with the sensitivity of the Earth's climate system to CO₂.

But the representation of clouds is one of the biggest weaknesses of climate models. In fact, clouds can't be properly modeled at all in present computer simu-

lations. This is partly because we just don't know much about the inner workings of a cloud either during the cloud's formation, or when it rains, or when the cloud is absorbing or radiating heat. The result is a lot of adjustable parameters.¹⁴⁵

The inability to model clouds is also partly because actual clouds are much smaller than the computer grid scale, by as much as several hundred or even a thousand times. Even the coming generation of supercomputers will be able to represent only the largest clouds accurately.¹⁴⁶ So clouds are represented in computer models statistically – that is, by average values of size, altitude, number and geographic location. You know that's not a very good representation just from watching the nightly weather forecast.

Inadequacies in computer simulations of clouds are acknowledged by climate modelers, even though these same modelers insist that the models can be used to make highly reliable predictions about the future. James Hansen, who heads GISS and has carried out computer climate simulations for almost 40 years, admits in a research paper that:

Model shortcomings include ~25% regional deficiency of summer stratus cloud cover off the west coast of the continents with resulting excessive absorption of solar radiation by as much as 50 W/m², deficiency in absorbed solar radiation and net radiation over other tropical regions by typically 20 W/m², sea level pressure too high by 4–8 hPa in the winter in the Arctic and 2–4 hPa too low in all seasons in the tropics, ~20% deficiency of rainfall over the Amazon basin, ~25% deficiency in summer cloud cover in the western United States and central Asia with a corresponding ~5° Celsius excessive summer warmth in these regions.¹⁴⁷

Apart from all the other deficiencies listed, especially for clouds, it's worth noting that this particular model's summer temperature overestimate of 5° Celsius (9° Fahrenheit) in the U.S. and Asia is as large as the drop in global temperatures that accompanied the last ice age! With such massive errors, how can anyone expect models like this to accurately simulate global warming of less than 1° Celsius (1.8° Fahrenheit) to date?

Hansen, who is also one of the shrillest climate change alarmists, talks in the same paper about “dangerous anthropogenic interference” with the Earth's

climate caused by CO₂, a phrase that comes from the UN.¹⁴⁸ It's probably Hansen and his climate model that are the danger to humanity.

Oddly enough, the IPCC seems aware of the limitations of its computer models for clouds. Chapter 8 of its 2007 report states:

Nevertheless, models still show significant errors. ... many important small-scale processes cannot be represented explicitly in models, and so must be included in approximate form ... Significant uncertainties, in particular, are associated with the representation of clouds, and in the resulting cloud responses to climate change.¹⁴⁹

Chapter 8 goes on to say that different computer climate models vary considerably in their estimates of sensitivity to CO₂, mainly because of differences among the models in the way that the warming effect of CO₂ is amplified by clouds.¹⁵⁰ And then Chapter 10 reveals that just the uncertainty alone in the predicted heating and cooling (radiative) effect of clouds is larger than the total modeled warming anticipated from a doubling of CO₂ over its preindustrial level.¹⁵¹

Yet, despite this recognition that its computer simulations are deficient in modeling clouds – which contribute almost as much as water vapor to CO₂ amplification in the models – Chapter 9 of the very same IPCC report claims that global warming over the last 50 years “very likely” comes from CO₂.¹⁵² This is part of an all-too-common syndrome that permeates the IPCC's reports, where the left hand doesn't appear to know what the right hand is doing.

As we'll see shortly, clouds may hold the key to explaining global warming, but for reasons entirely unrelated to CO₂ and human activity.

FAILED PREDICTIONS

The ultimate test of any computer model is how accurately it represents reality. To evaluate its theoretical climate models, and to “validate” them for predicting the future, the IPCC uses the models to simulate past and present climates.

The dangers in this approach have been clearly expressed by NASA climatologist Claire Parkinson:

Success in simulating the past and present does not necessarily translate to success in simulating the future. For simulations of the past and present, we have the possibility

of tuning the model to improve the match with observations, but there are no observations to allow a tuning for the simulated future.¹⁵³

Not only are all predictions of computer climate models for the future unreliable, but predictions for the *present* climate – now, or a few years from now – are often just plain wrong. Since we’re talking about global warming, you’d expect the computer models to correctly predict temperatures if nothing else. Yet the models’ track record is about as impressive as a sports team that fails to score for the whole season.

The Missing Atmospheric Hot Spot

In the last chapter I mentioned the concept of fingerprinting. The concept refers to the matching up of present-day climate patterns with predictions of computer climate models based on the CO₂ global warming hypothesis.

According to climate change alarmists, any observation of a predicted human fingerprint on our climate confirms the CO₂ theory of global warming – or so they insist, even though cause and effect may not really be correlated because of uncertainty in the hundreds of variable parameters used in computer models, as I pointed out before.

One of the most controversial fingerprints is the so-called CO₂ “hot spot” in the lower atmosphere.¹⁵⁴ Computer climate models predict that global warming should heat up the lower atmosphere faster than the Earth’s surface.

For CO₂ greenhouse warming, the warming rate of the air at an altitude of 10 to 12 kilometers (6 to 7 miles) directly above the tropics, where the difference is most conspicuous, should be about twice as large as it is near the ground, according to the models.¹⁵⁵ The predicted effect is much stronger for CO₂ than for other sources of global warming such as the sun.

But the CO₂ hot spot isn’t there. No one can find it.¹⁵⁶

Because satellites can’t measure the temperature at specific heights in the atmosphere, climate scientists rely on weather balloons instead.¹⁵⁷ But weather balloon data is less precise than satellite temperature data, and the uncertainty in a single balloon temperature measurement is big enough to possibly miss the hot spot. Nevertheless, hundreds of balloon measurements have all confirmed that the

TABLE 3.1: COMPUTER CLIMATE MODELS

What the models include

No computer model fully represents an entire climate system, but the most sophisticated models include: atmospheric features such as heat from the sun, clouds and precipitation/evaporation, winds, aerosols, and natural and man-made greenhouse gases; oceanic features such as atmosphere-ocean coupling, salinity, and deep currents; land surface features such as snow cover, rivers and lakes, vegetation and biological processes; and sea ice features such as ice extent and movement.

WHAT'S WRONG WITH THESE MODELS?¹⁵³

1. *It's only a model:* Because important climate processes are approximated using adjustable “fudge factors”, computer models don't come close to simulating the full complexity and interconnectedness of the global climate. The models predict a higher warming rate in the Southern Hemisphere, but the Northern Hemisphere is actually warming most.
2. *Atmosphere:* Climate models predict a CO₂ hot spot in the lower atmosphere over the tropics, but extensive measurements have failed to detect it.
3. *Clouds:* Cloud formation and behavior can't be modeled with confidence. Models can't predict convincingly how clouds will respond as the climate evolves, nor what the full consequences of cloud changes will be.
4. *Precipitation:* The models underestimate heavy rainfall, and don't account for the depletion by precipitation of atmospheric water vapor – the major greenhouse gas. This deficiency can lead to flawed predictions.

5. *Oceans:* Climate models predict warming of both the atmosphere and oceans, but the oceans have stopped heating up since 2003. Simulations of the Southern Ocean are deficient due to systematic biases in the models.
6. *The Poles:* Computer models predict strong warming at the North and South Poles, which is not observed. The models don't incorporate the polar ice caps, and most models don't include any ice sheet calculations.
7. *Natural variability:* Several tropical climate cycles such as El Niño are poorly simulated by present computer models.¹⁶¹
8. *Indirect solar effects:* Indirect effects from the sun, such as shielding of cosmic rays that create cooling clouds, are not included.
9. *"Tuning" of models:* Tuning adjustable parameters to match a specific quantity can lead to mistaken assignment of cause and effect, and to the false impression that the simulated results mean more than they do.
10. *Data limitations:* Lack of adequate raw data is a bigger problem than limitations of the models themselves.

warming rate aloft is not just less than climate models predict, but may even be lower than the warming rate at the surface.¹⁵⁸

The average CO₂ warming rate in the lower atmosphere predicted by the models is approximately 0.21° Celsius (0.38° Fahrenheit) per decade.^{159, 160} Yet satellites measure an actual rate of only 0.13° Celsius (0.23° Fahrenheit) per decade since 1981 (see Chapter 2), and weather balloon data shows the same or even a lesser warming rate.

All the IPCC and global warming alarmists can say in defense of their computer models is that the CO₂ hot spot must be there, but for some reason it can't be seen. In the words of IPCC author Ben Santer, "We may never completely reconcile the divergent observational estimates of temperature changes in the tropical troposphere",¹⁶⁰ implying that uncertainties in the balloon temperatures are too large for any meaningful comparison to be made to climate models. But he fails to mention that the uncertainty in the model predictions could be even larger!

The only reason computer models predict a CO₂ hot spot is that the models are programmed that way. As we'll see in the next chapter, the atmospheric heating wrongly predicted by climate models is closely connected to the phenomenon of water vapor feedback.¹⁶²

The Arctic and Antarctic

One of the predictions of computer climate models is that CO₂-driven global warming should be strongest at the North and South Poles. This is partly because of a chain reaction in which melting snow and ice expose darker surfaces underneath that soak up extra sunlight, causing further melting.¹⁶³

In the Arctic, while the average warming rate for the period from 1875 to 2001 was twice that across the whole Northern Hemisphere, for the 20th century alone the two warming rates were similar. The 20th century warming rate in the Arctic was 0.05° Celsius (0.09° Fahrenheit) per decade, compared to a Northern Hemisphere rate of 0.06° Celsius (0.11° Fahrenheit) per decade.¹⁶⁴ This is not the behavior that computer models reproduce.¹⁶⁵

Temperatures across much of the Arctic were as high around 1940 as they are now, and there was even talk at the time of a new Arctic sea passage being opened up.¹⁶⁶ But the true warming rate at present is uncertain because the major custodians of global temperature data have been fiddling with the records, as we saw in Chapter 2. According to a recent tabulation, 23 out of 26 measured Arctic temperatures for 1940 have just been revised downward, in many cases substantially¹⁶⁷ – to artificially accentuate the warming trend in that part of the globe, and to deceptively bring the trend in line with the predictions of climate models.

Climate change alarmists have made much of shrinking Arctic sea ice, supposedly caused by global warming. However, the shrinkage has recently reversed – a

topic we'll return to later – and, in any case, was most likely due to a natural climate cycle rather than higher CO₂ levels.¹⁶⁴

In the Antarctic, the picture is more complicated. Although West Antarctica and the small Antarctic Peninsula which points toward Argentina are both warming, the remaining 80% of the continent has shown no significant temperature trend since the 1960s, and may even have cooled up until at least 2000.¹⁶⁸

The lack of warming for Antarctica overall, contrary to what models predict, prompted the publication of a 2009 research paper claiming that the whole Antarctic continent, and not just the Western portion, has been warming up for the last 50 years.¹⁶⁹ The contention was based on a statistical analysis, in which temperatures across the continent were reconstructed from the sparse temperature record of Antarctic weather stations, most of which are near the coast, and from satellite data.

You probably won't be surprised that the authors of the paper included Michael Mann of hockey stick infamy. Following criticism by economist Hu McCulloch of the statistical techniques used to reconstruct the Antarctic record,¹⁷⁰ Mann and his coauthors published a correction several months later.

But while the corrected calculation shows that the 50-year temperature trends for the continent as a whole and for East Antarctica may be flat, the revised paper didn't retract the original claim about continent-wide warming. Nonetheless, a 2011 paper, whose authors included climate auditor McIntyre, also faulted the statistical analysis, concluding that Antarctic warming is concentrated in the Peninsula and that the warming trends elsewhere on the continent are less than half the Mann estimates.¹⁷¹

Averaged over all Antarctica, the actual warming rate for the period from 1957 to 2006 is about 0.05° Celsius (0.09° Fahrenheit) per decade,¹⁷² which is the same as the average 20th century warming rate in the Arctic.

Despite any possible warming in East Antarctica, a recent Norwegian study has revealed that very little ice is disappearing from ice shelves in the Eastern part of the continent,¹⁷³ in stark contrast to the predictions of computer ocean models for that region. And, despite the contraction of sea ice in the Arctic, the sea ice around Antarctica as a whole¹⁷⁴ has been steadily expanding for more than 30 years. Since the start of the satellite record in 1979, Antarctic sea ice has gained in extent by about 1% per decade.^{175, 176}

Northern vs Southern Hemisphere

Another temperature prediction that computer models don't get right is that the Southern Hemisphere should be warming more than the Northern Hemisphere. That's because of the net cooling effect of aerosols, which are tiny particles in the atmosphere, mostly sulphates, generally resulting (like CO₂) from the burning of fossil fuels. Aerosols are emitted predominantly in the more industrial Northern Hemisphere, which should therefore get less hot than the Southern Hemisphere, according to the models.¹⁷⁷ But exactly the opposite is true and the warming rate is higher in the Northern Hemisphere, as the IPCC documents in its latest report.¹⁷⁸

The Oceans

As a fourth example of faulty temperature prediction by computer models, the world's oceans have stopped warming since 2003¹⁷⁹ – even though the models say the oceans should be getting warmer along with land surfaces and the atmosphere. Another shortcoming that the IPCC itself admits to is bias in modeled sea surface temperatures, which are too low in some parts of the Northern Hemisphere, and too high on the eastern side of tropical oceans.¹⁸⁰

Further deficiencies in the IPCC's climate models include the modeling of rainfall, particularly in the tropics, the simulation of several natural climate cycles such as the Pacific Decadal Oscillation, and the inability to explain why the amount of the greenhouse gas methane in the atmosphere has suddenly stopped rising.

What a litany of failings! Yet the IPCC relies on these very same models to uphold its assertion that CO₂ emissions are responsible for climate change.

Remember, it's only a model. Until we improve our present rudimentary understanding of many aspects of the Earth's climate, the models will continue to fall short. Computer climate models are like a boat riddled with holes, with the IPCC and its alarmist disciples frantically bailing to keep it afloat.

Chapter 4: CO₂ Sense and Sensitivity

It's all about climate sensitivity.

Both alarmists and skeptics agree that adding extra CO₂ to the Earth's atmosphere causes global temperatures to rise. But the key question is by how much does the temperature go up? The amount of warming that comes from a doubling of the CO₂ level is called the climate sensitivity.

The IPCC's conviction that climate change comes from human CO₂ emissions is closely tied to climate sensitivity – especially those assumptions in its computer models that influence the response of our climate system to CO₂.

The way the IPCC and its alarmist supporters talk, you'd think that the whole CO₂ global warming issue is cut-and-dried, that there's no question about climate sensitivity, and that there's already enough CO₂ in the atmosphere to cause devastatingly high temperatures in the years to come. Nothing could be further from the truth.

Figuring out climate sensitivity from computer climate models relies on a number of questionable, untested assumptions, mostly about the Earth's past climate. So it should be no surprise that the predictions these models make about climate sensitivity are just as unreliable as the models' faulty temperature predictions that I discussed in the previous chapter.

CO₂ FEEDBACK: FALSE POSITIVE?

Climate sensitivity is intricately linked to the important concept of feedback, a technical term borrowed from the field of electronic engineering. It's not a dif-

difficult concept to grasp though, as the word has much the same meaning as in everyday life.

In science, feedbacks result in sustained magnification (called positive feedback) or sustained diminution (negative feedback) of a response to a disturbance of the status quo. A weather-related example of positive feedback is the gaining of strength by tornadoes or hurricanes through amplification processes that cause a self-reinforcing chain reaction.¹⁸¹ The feedback often continues to intensify the storm until some other factor intervenes, such as a hurricane making landfall.

Negative feedback, on the other hand, results in the damping down of a process, so as to bring a system back to where it was before. Negative feedback processes are very common in nature, acting as a safety valve to keep everything from delicate ecosystems to the animal kingdom in balance.

The human body is a remarkable example of many types of negative feedback. Body temperature, blood pressure, blood sugar level and numerous other functions are all controlled by negative feedback mechanisms, which maintain that function within the narrow range necessary for our survival. For example, body temperature is regulated through feedbacks that cause the body to sweat when it's too hot or to shiver when it's too cold, in order to return the temperature to normal.

So why are feedbacks important for global warming? The reason is that without feedback, in fact without net *positive* feedback to enhance the climate sensitivity to CO₂, there wouldn't be anything for the warmists to worry about. Positive feedbacks ratchet up the warming, but negative feedbacks turn it down.

On its own, the 393 parts per million of CO₂ in the atmosphere today is not enough to cause even a 0.8° Celsius (1.4° Fahrenheit) rise in temperature since 1850, if the only explanation is the greenhouse effect that I discussed back in Chapter 1. Man-made global warming, if it exists at all, would be insignificant without positive CO₂ feedback to magnify the Earth's natural greenhouse effect. Climate modelers say this feedback comes primarily from water vapor and from clouds, with a small contribution from snow and ice.¹⁸²

But if there's no feedback, or if the net feedback is *negative* – a distinct possibility, as we'll see shortly – then global warming is not likely to have been caused by CO₂. With negative CO₂ feedback, even a future doubling of CO₂ from its preindustrial level will have little influence on temperatures.

That's not the story you hear from alarmists and the IPCC, who sermonize that the world is already close to disaster and that we need to rein in our CO₂ output immediately. Few people realize that this gloomy prognostication is founded on shaky theoretical computer models that predict positive CO₂ feedback.

Most feedbacks in nature are negative, presumably for good reason – to maintain stability in the natural world. Why should the Earth's climate system be any different, even if the perturbation comes from human activity?

Positive feedback, which amplifies the initial disturbance, can lead to runaway conditions and a system out of control. However, the positive feedback mechanism can be held in check if other processes, some of which involve self-correcting negative feedback, are operating at the same time. The fact that no runaway climate events have occurred in the Earth's past suggests again that climate is governed by negative, rather than positive, feedbacks.

The IPCC concludes from its computer climate models that the major global warming feedbacks are all positive, with just one exception (Table 4.1).¹⁸³ But there's very little observational evidence to justify this conclusion.

For instance, the argument is often made by climate change alarmists that water vapor feedback¹⁸⁴ must be positive, or there would be no way to explain the observed warming. However, this argument is based entirely on computer models that don't allow for any natural sources of global warming apart from the sun, the influence of which is underestimated in any case (Chapter 5). If natural sources were properly accounted for in the models, it's quite possible the models would predict that water vapor feedback is negative.

Even if water vapor feedback is indeed positive, it may not be as strongly positive as the IPCC says. We saw in the last chapter that the hot spot in the lower atmosphere, predicted by IPCC computer models, is missing. But the hot spot is inherently related to water vapor feedback – one can't exist without the other, so the absence of a hot spot means that the feedback must be weak.¹⁸⁵

There's considerable uncertainty too about other feedbacks that can affect global temperatures, such as the carbon cycle feedback, which can pump up the amount of CO₂ retained in the atmosphere.¹⁸⁶ Even the IPCC acknowledges that these feedbacks are poorly understood:

Large differences between models, however, make the quantitative estimate of this [carbon cycle] feedback uncertain.

Other feedbacks (involving, for example, atmospheric chemical and aerosol processes) are even less well understood. Their magnitude and even their sign remain uncertain.¹⁸⁷

Table 4.1: Major CO₂ Feedbacks in IPCC Models

Feedback	Positive or negative
Water vapor ¹⁸⁴	Positive
Clouds	Positive
Temperature/altitude ¹⁸⁸	Negative
Snow and ice	Positive

With few exceptions, we just don't know which climate feedbacks make the most difference nor which ones the least, nor even whether those feedbacks that appear to be positive and destabilizing really are – and not negative and climate-stabilizing instead. Furthermore, many models ignore the fact that different feedbacks are often coupled to one another. The feedbacks deduced from IPCC climate models are no more accurate or reliable than the many adjustable parameters in the models.

Negative Feedback in Satellite Data

Evidence for global warming feedbacks, either positive or negative, is hard to find. So three recent studies of satellite data¹⁸⁹ that appear to show strongly negative cloud feedback are quite astounding. Two of the studies were by researchers at the University of Alabama in Huntsville, and the third by scientists at the University of Auckland in New Zealand.

The first University of Alabama study probed day-to-day changes in climate variables such as cloud cover, rainfall, and temperature, over a two-month period, for a short-term climate cycle in the tropics.¹⁹⁰ The researchers were surprised to find a decrease in high-altitude cloud coverage as the tropical air warms during the cycle, in direct contradiction to IPCC climate models that predict an increase in high-level clouds from such warming.

A reduction in high-level clouds, which are the clouds that cause heating of the Earth's surface (low clouds cool), means negative feedback is operating – the

climate system responds to the natural tropical warming by cooling everything down, trying to restore the climate to its previous state.

As lead author and climatologist Roy Spencer explained,¹⁹¹ the tropical warming cycle serves as a proxy for global warming caused by man-made greenhouse gases such as CO₂. In other words, global warming feedback from high clouds is negative and damping, the very opposite of what the IPCC concludes, which is that CO₂ cloud feedbacks are positive and amplifying. The satellite data also supports an earlier proposal by MIT's Richard Lindzen that high-level clouds near the equator open up, like the iris of an eye, to release extra heat when the temperature rises¹⁹² – also a negative feedback effect.

The University of Alabama study was criticized, however, on the grounds that it applied only to tropical regions, and that feedback effects occurring over a period of weeks may not play a role on the longer timescales associated with global warming. So Spencer and his team undertook a second study, involving analysis of data from another satellite,¹⁹³ which also provides solid evidence for negative cloud feedback.¹⁹⁴

The second study compared cloud feedbacks deduced from five years of satellite data, collected over the global ocean, with the same feedbacks calculated from IPCC climate models. Not only did the new study reveal the same distinctly negative cloud feedback¹⁹⁵ as the original satellite study, but the comparison also showed that none of the IPCC models displayed the negative feedback behavior seen in the satellite data. In fact, the cloud feedbacks from all the climate models were positive, just as the IPCC insists they are (see Table 4.1).

In contrast to the first study, which demonstrated negative feedback from a reduction in high-level clouds that warm the Earth, the second University of Alabama study appears to show negative feedback from an increase in low-level clouds that exert a cooling effect.

The University of Auckland scientists discovered that the Earth's clouds got a little (about 1%) lower during the first decade of the 21st century.¹⁹⁶ Since the drop in average cloud height came mostly from fewer clouds forming at very high altitudes, just as seen in the first University of Alabama study, this observation suggests a totally unexpected negative cloud feedback. The study will be continued until 2020 to see if the decline in cloud height persists.

Interpretation of satellite data on clouds is controversial, because the data intertwines feedback effects with forcings, which are the sources of warming or cooling that produce feedbacks.¹⁹⁷ Intense debate over this issue is what led to the dispute I described in Chapter 2 over Spencer and Braswell's 2011 paper on feedbacks in Remote Sensing,¹²³ and the resulting resignation of the journal editor.

Nevertheless, all three studies described here leave little doubt that the IPCC's conclusions about cloud feedback¹⁹⁸ are wrong.

If indeed cloud feedback is negative rather than positive, and as strongly negative as the University of Alabama studies indicate, then it's entirely possible that combined negative feedbacks in the Earth's climate system dominate the positive feedbacks from water vapor, and from snow and ice (Table 4.1). This would mean that the overall response of the climate to added CO₂ in the atmosphere is to diminish, rather than magnify, the temperature increase from CO₂ acting alone – the reverse of what the IPCC claims is happening. Of course, it also means that global warming must have some other explanation.

Before we examine alternative explanations for global warming, we'll look at how the IPCC's predilection for positive CO₂ feedback leads to overestimation of the effect that human CO₂ emissions have on temperature.

CO₂ OVERSENSITIVITY

To come up with specific numbers for climate response to CO₂, the IPCC and its computer modelers generally go back to the past and use their models to reproduce the historical climate record.¹⁹⁹ This record embraces data for the last 160 years, during which the atmospheric CO₂ level has climbed significantly; proxy data for the last millennium; and ice-core proxies for the long-ago ice ages (the paleoclimate).

The models include adjustable parameters that affect the various feedbacks just discussed, as well as parameters to describe forcings – the actual disturbances that alter climate and give rise to feedback, such as radiation from the sun, greenhouse gases in the atmosphere, and aerosols. Forcings can be positive or negative, depending on whether they produce a heating or cooling effect, respectively.

As I said before, climate sensitivity refers to the warming caused by a doubling of the atmospheric CO₂ level. The usual baseline is taken to be the preindustrial CO₂ level in 1850, which is about when the present period of global warming began (Figure 1.1).

With high climate sensitivity, meaning a climate exceptionally sensitive to CO₂, the temperature increase for doubled CO₂ will be large – as much as 4.5° Celsius (8.1° Fahrenheit) or even more, according to some IPCC models.²⁰⁰ On the other hand, with low climate sensitivity, the temperature rise for twice the CO₂ will be a lot smaller – perhaps 2° Celsius (3.6° Fahrenheit) in the IPCC’s view.²⁰¹ At its present rate of increase, the CO₂ concentration in the atmosphere will double from its 1850 level sometime around 2100.

Table 4.2 shows the temperature gain since 1850 at doubled CO₂, as well as at today’s CO₂ level, as estimated by various climate models (IPCC and Hansen), or calculated from satellite observations (Lindzen and Spencer). Information about the models and calculations can be found in the Appendix. Because the CO₂ concentration hasn’t doubled yet, the predicted temperature increases for today’s climate are modest.

Table 4.2: CO₂ Climate Sensitivity (degrees Celsius)²⁰²

Model or calculation	Predicted temperature increase from CO ₂	
	Today	At doubled CO ₂
IPCC (2001)		3.5°C
IPCC (2007)	0.76°C	3.3°C
Hansen	0.6°C	2.7°C
Lindzen	0.36°C	0.73°C
Spencer	0.22°C	0.45°C
Zero CO ₂ feedback	0.55°C	1.1°C
Positive CO ₂ feedback	above 0.55°C	above 1.1°C
Negative CO ₂ feedback	below 0.55°C	below 1.1°C

The lower part of the table highlights the anticipated temperature increases for different types of feedback in the Earth’s climate system: zero (no net feedback), positive, and negative.

You'll see immediately why feedbacks are central to climate sensitivity (the CO₂ amplification problem in Table 1.2). When we compare the upper and lower parts of Table 4.2, what stands out is that the *only* predicted climate sensitivities that show negative feedback are those based on actual observations, not the estimates from computer climate models. Just remember it's experimental observations and not theoretical computer models that are the essence of good science.

Just as it does with temperature measurements, the IPCC exaggerates climate sensitivity – by three times or more in this case.

A recent analysis by UK mathematician Nicholas Lewis revealed that the exaggeration is inherent in the IPCC's statistical procedures, which greatly skew its predicted climate sensitivities toward higher warming.²⁰³ No wonder so many predictions of computer climate models are wrong!

You can also see from Table 4.2 that the sign (positive or negative) of the net CO₂ feedback dictates how much of today's global warming originates from CO₂, and how much comes from other sources. If the net feedback is positive, as IPCC climate models insist, almost all of the 0.6° Celsius (1.1° Fahrenheit) temperature rise²⁰⁴ can be ascribed to CO₂. However, if the net feedback is negative, CO₂ accounts for only a small portion of the temperature increase to date, and the rest must have other origins.

As discussed in the previous section on satellite data, there is now evidence that cloud feedbacks are negative, instead of positive as concluded by the IPCC. Negative cloud feedback that is sufficiently strong to overcome any positive feedbacks in the climate system will make the overall CO₂ feedback negative – and make the CO₂ climate sensitivity too small to be of any concern.

Negative feedback implies low climate sensitivity, which means small temperature increases, even for lots more CO₂ in the atmosphere. Or minimal global warming from man-made CO₂. It's as simple as that.

Feedbacks aside, there are still several issues with the historical approach to validating computer climate models. By far the biggest issue, and one of the basic weaknesses of the IPCC's models, is the underlying assumption that the Earth's climate sensitivity has remained unchanged throughout history, forever the same.

Past climate conditions were often very unlike today's, with temperature swings up to 10° Celsius (18° Fahrenheit) as the planet switched between frigid ice ages and warmer interglacial periods; temperatures that varied more slowly

with time than now; different levels of CO₂ and other greenhouse gases; vast ice sheets that built up and then disappeared thousands of years later; different types and amounts of vegetation; and more.

Why should the climate sensitivity have stayed the same while the Earth's climate changed so much?

It's possible that climate sensitivity is some sort of universal constant, like the speed of light, but it's much more likely that it varies along with the climate. There's no particular reason that it shouldn't. The IPCC admits as much, even though all its climate predictions are based on the assumption of unaltered climate sensitivity through the ages:

The use of a single value for the ECS [equilibrium climate sensitivity] further assumes that it is constant in time. However, some authors ... have shown that ECS varies in time in the climates simulated by their models. Since results from instrumental data and the last millennium are dominated primarily by decadal-to centennial-scale changes, they will therefore only represent climate sensitivity at an equilibrium that is not too far from the present climate.²⁰⁵

Just how difficult it is to fit the historical climate record, we've already seen in the hockey stick fiasco. So intent was the IPCC on making temperatures for the last 2,000 years mirror the CO₂ record that it ignored historical temperature data showing otherwise, and indulged in deceptive data manipulation.

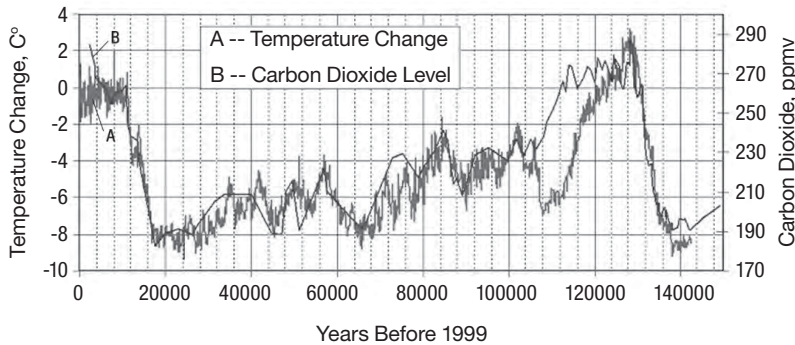
Climate modelers may not have sunk to the same depths, but they can't escape the fact that fitting computer simulations to historical data does not yield a unique number for climate sensitivity. This is because there are so many variable parameters in the models. The only way the climate sensitivity can be deduced at all is by making assumptions about all the other adjustable parameters – assumptions that may not be correct. As you saw in Chapter 3, an elephant can be fitted with only five parameters.

We'll look now at the difficulties that arise in trying to use computer models to simulate the climate record from the ice ages.

TWO-FACED CO₂

As I've already said, climate sensitivity numbers generally come from hindcasting, from matching the output of computer climate models to historical data. Some of that data we've encountered in previous chapters. Figure 4.1 presents data showing the temperature record and CO₂ level in the Earth's atmosphere over the past 150,000 years, including the most recent ice age that lasted about 100,000 years and ended 11,000 years ago.

Figure 4.1: The CO₂ – Temperature Lag



Source: Pangburn.²⁰⁶ Note that time in this chart advances from right to left, with the present on the extreme left of the figure and the distant past on the right.

Something to notice about this data, which is obtained from analysis of Antarctic ice cores,²⁰⁷ is that the CO₂ level closely mimics changes in temperature, but the CO₂ lags behind – with CO₂ concentration changing, up or down, well after the corresponding temperature shift occurred. The lag is about 600 to 800 years,^{208, 209} and may have been even longer hundreds of thousands of years ago.

Most paleoclimatologists believe that CO₂ lagged temperature during the ice ages because it takes several hundred years for CO₂ to come out of, or get into, the world's oceans, which is where the bulk of the CO₂ on our planet is stored.

The oceans can hold much more CO₂ (and heat) than the atmosphere. Warm water holds less CO₂ than cooler water, so the oceans release CO₂ when the temperature goes up, but take it in as the Earth cools down. The lag time is related to what oceanographers call the ocean-mixing time for CO₂.^{209, 210}

TABLE 4.3: CO₂ SENSITIVITY

The IPCC position

- The major CO₂ feedbacks, which control the climate's response to added CO₂ in the atmosphere, are *positive* feedbacks that amplify the effect of CO₂ on its own.
- The climate sensitivity, which measures any global warming from CO₂, has remained unaltered from the time of the ice ages until now.
- Global warming at the end of ice ages was aided by positive CO₂ feedback, though the feedback lagged the temperature by 600 to 800 years.
- Today's global warming is also assisted by positive CO₂ feedback, but the feedback switches on almost immediately.

WHAT'S WRONG WITH THIS PICTURE?

1. Recent satellite observations show strongly *negative feedback from clouds*. If this negative cloud feedback dominates the positive feedbacks from water vapor, and from snow and ice, the net CO₂ feedback is negative – diminishing the warming from CO₂ to an insignificant level.
2. IPCC climate models *greatly exaggerate climate sensitivity*, partly because of assumptions made about atmospheric water vapor, and partly because of faulty statistical analysis.
3. Climate conditions during the ice ages were radically different from today, so it's unlikely that the *climate sensitivity* is still the same, as assumed in most computer climate models.
4. CO₂ lagged temperature during post ice-age warming due to its delayed release from the oceans. But because of the lag, atmospheric CO₂ kept rising for 600 to 800 years after the temperature leveled out. In the modern era since 1850, the CO₂ level and temperature have increased together. This *two-faced CO₂ behavior* makes no sense.

A recent study asserts that increased CO₂ *led*, not lagged, global warming at the end of the most recent ice age, based on a variety of proxy data. Jeremy Shakun and his coauthors postulate that while CO₂ trailed temperature in the Antarctic when the ice age terminated, as you can see by looking carefully at Figure 4.1, higher CO₂ levels preceded warming over the globe as a whole.²¹¹ This conjecture is an extension of earlier proposals by other paleoclimatologists,²¹² on a more rapid timescale.

But a detailed, independent analysis of the same proxy data has found there is so much scatter in the data that whether CO₂ leads or lags the warming can't even be established!²¹³ The study's claim to the contrary is reminiscent of the hockey stick episode (Chapter 2), when the IPCC tried to flatten out the bumps in the historical temperature record to make it conform to the CO₂ record, for the purpose of bolstering its hypothesis that global warming is a direct consequence of human activity.

It's not hard to see what the alarmist authors of the CO₂ lead study were up to. The CO₂ hypothesis requires warming from human CO₂ to follow the rising CO₂ level, not the other way round. So, just as Mann and his colleagues had already done with temperatures over the past millennium, Shakun and his coauthors have deceptively done with the temperature record as the Earth emerged from the last ice age, to make it look like the gain in CO₂ triggered warming.²¹¹ That is, enhanced CO₂ causes global warming, whatever the source of the CO₂ – then and now.

Nonetheless, the observed CO₂ lag does indeed deal a deathblow to the notion of man-made global warming. The reason has to do with the behavior of the temperature and CO₂ level just beyond the cessation of an ice age.

Ice ages are believed to have ended (and begun) because of changes in the Earth's orbit around the sun.²¹⁴ After tens of thousands of years of bitter cold, the temperature suddenly took an upward turn. As we've just seen, warmer conditions make CO₂ less soluble in water, causing the oceans to give up CO₂ to the atmosphere as the temperature increases, a process that takes 600 to 800 years.

According to IPCC climate modelers, the melting of ice sheets and glaciers caused by the slight initial warming could not have continued, unless this temperature rise was amplified by positive feedbacks – including CO₂ feedback, triggered by the surge in atmospheric CO₂ as it escaped from the oceans.²¹⁵ Aided

by the feedbacks, says the IPCC, a period of global warming ensued, with the temperature climbing until it reached a new, higher equilibrium level that signaled the end of the ice age. A similar chain of events, based on CO₂ and other feedbacks, enhanced global cooling as the temperature dropped at the beginning of the ice age.²¹⁶

The problem for believers in the CO₂ global warming hypothesis is that when the ice age was over, the temperature suddenly stopped increasing and leveled out, but CO₂ continued to rise for another 600 or 800 years before plateauing and then decreasing slightly. That's well documented in the historical record (Figure 4.1).²¹⁷

But how can rising CO₂ in the atmosphere be the cause of escalating temperatures today, yet not 11,000 years ago – and at previous ice-age terminations – when the mercury stood still as the CO₂ level kept ascending? If CO₂ from the oceans didn't make the temperature go up during the 600 years or so immediately after the Earth's recovery from an ice age, why should CO₂ from human emissions make it go up now (the CO₂ lag problem in Table 1.2)?²¹⁸ Perhaps some of the present rise in the CO₂ level is the ocean-delayed response to distant medieval warming.

It makes no sense that CO₂ feedback should be dragging the temperature upward in our present climate, and did the same thing as the planet pulled out of past ice ages, but then suddenly turned off for the final 600 to 800 years.

The IPCC, in its 2007 report, implies that this two-sided temperature response to CO₂ occurs because temperature and CO₂ are going up much faster during current global warming than they did at the end of the last ice age.²¹⁹ The atmospheric CO₂ level is indeed growing a lot more rapidly today, but the assertion that the temperature is increasing 10 times faster than in the past is an exaggeration, as you might expect from the IPCC. The warming we've seen since 1850 has in fact been only two to three times faster than post-ice-age global warming.²²⁰ That's not such a big difference.

Other questions also arise. For instance, the IPCC asserts that net CO₂ feedback has always been positive, from the ice ages to the present. I've already discussed the possibility, based on recent satellite observations of clouds, that the net CO₂ feedback in our current climate is negative. How can the IPCC be so sure it wasn't negative instead of positive going into and out of ice ages?

And how certain is it that CO₂ feedback was operating at all in glacial times? Other feedbacks – such as from snow and ice – are believed to have played a role in ice-age temperature swings. Perhaps these other feedbacks could have done the job alone, without any help from CO₂, the atmospheric CO₂ level moving up or down simply in response to the changing solubility of CO₂ in the oceans caused by changing temperatures.

Assuming that there actually was CO₂ feedback to amplify temperature rises and falls, why was the temperature descent at the onset of an ice age so much slower than its rapid climb at the end?

If you're beginning to think there's more uncertainty than certainty in global warming science, you're right. The CO₂ hypothesis and the whole theory of human-induced global warming, for a theory is what it is, are a flimsy house of cards.

Chapter 5: Doing What Comes Naturally

As we've seen in the last few chapters, man-made CO₂ is highly unlikely to be the main cause of climate change. The whole IPCC case for CO₂ warming is shot through with problems, from inconsistencies in the CO₂ hypothesis to overconfidence in computer models to distortion of data to corruption. The science behind the IPCC's reports is so badly flawed that it's hard for me to believe that so many alarmists accept them as an act of faith.

But if it isn't CO₂, what's heating up the planet?

An honest answer to the question would be that we just don't know right now. It's not that we're short of ideas, but we simply don't have enough evidence at the moment to draw any firm conclusions – except that the chances of CO₂ being the number one culprit are very, very slim.

If humans are not to blame, the obvious place to look for an alternative explanation is nature. It's well known that natural cycles have altered the Earth's climate many times in the past, notably the orbital changes that sent the globe into the deep freezes of the ice ages.

Nobody is suggesting that our current warming spell has anything to do with the Earth's orbital cycles, but there are several other candidates in the natural world. One, or a combination, of these natural cycles could well be responsible for global warming. In this chapter, we'll examine two of the main contending alternatives, solar variability and ocean oscillations, along with their effect on clouds.

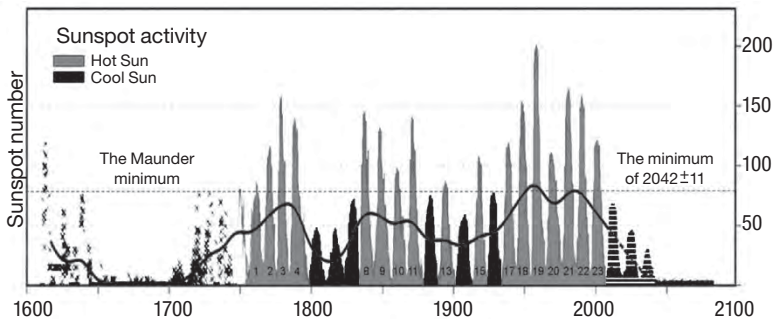
NATURE'S WARMING: THE SUN

It was suspected that the sun is connected to the Earth's climate soon after the invention four hundred years ago of the telescope, which made it possible to see sunspots (and other astronomical quirks) more clearly. Sunspots are small dark blotches on the sun's surface caused by magnetic storms in the solar interior.

During the so-called Maunder Minimum (Figure 5.1), a 70-year period in the 17th and 18th centuries that formed part of the Little Ice Age, there were hardly any sunspots at all. In 1801, British astronomer William Herschel proposed that sunspots were linked to the weather, observing that the price of wheat had been high during that low-sunspot period, which he thought reflected poor harvests because of the cooler conditions.

Although Herschel was not able to prove his case at the time, U.S. astronomer John Eddy almost 200 years later established that sunspot variations have been associated with changes in the Earth's climate for thousands of years. The variation in sunspot number over time is but one of many solar cycles.

Figure 5.1: The Sunspot record from 1611



Source: Abdussamatov.²²¹ The three striated peaks on the right of the figure for solar cycles 24, 25 and 26, and the minimum of 2042, are forecasts.

Rhythms of the Solar System

The solar system is constantly pulsating. As we know, all the planets, including our own, orbit the sun and spin on an axis. But the sun is not motionless either: it too rotates on an axis and, because it's tugged by the gravitational pull of the

giant planets Jupiter and Saturn, orbits in a small but complex spiral around the center of the solar system.²²²

All this pulsation results in a large number of natural cycles tied to the sun, the sunspot count over a year being but one such cycle. The annual sunspot number goes up and down over an interval of about 11 years, and the cycle duration fluctuates as well, from as short as 9 years to as long as 14 years.

Along with the number of sunspots, the sun's heat and light output²²³ waxes and wanes during the solar cycle. Although this variation in itself is too small, at about one part in a thousand, to have any appreciable effect on our climate, the average value of the sun's output changes slowly with time – and these changes can cause warming and cooling of the Earth's surface. The changes in average solar output correspond closely to the pattern shown by sunspot numbers in Figure 5.1.

There are cycles longer than 11 years too. Not only do solar output and the sunspot number repeat every 11 years or so, but their maximum (and minimum) values also make extra big jumps every 87 years and again at 210-year intervals.

The 87-year and 210-year cycles may be associated with a newly discovered climate cycle approximately 1,500 years long, which has manifested itself during both the Earth's ice ages and warmer interglacial periods, including the one we're in today. The 1,500-year (plus or minus 500) cycle is described at length elsewhere,²²⁴ so I won't dwell further on it here.

The 87-year solar cycle has been linked to a number of regional climate fluctuations, exhibited for instance by temperatures in central England since 1700, rainfall in Beijing and flooding of the Nile River in Africa.²²⁵ The 87-year cycle has also been used to predict the future occurrence of a protracted cold stretch around 2030, with temperatures comparable to those experienced during the Maunder Minimum period of the Little Ice Age.²²⁶ Another prediction links the 210-year solar cycle to an upcoming freeze, in the vicinity of 2040-2050.²²¹

Mathematical physicist Nicola Scafetta has developed an astronomical climate model, in which the changing positions of Jupiter and Saturn in the solar system result in a *60-year* climate cycle on Earth.²²⁷ As we'll see later in the chapter, surface temperatures in the Pacific Ocean exhibit a 60-year cycle.

There is also evidence for a 60-year cycle in the rise of global sea levels since 1700 and, says Scafetta, in observed monsoon rainfall cycles as recorded in

ancient Sanskrit texts.²²⁸ He believes that a natural 60-year cycle based on Jupiter and Saturn may even explain traditional Chinese, Tamil and Tibetan 60-year cyclical calendars, remarking to a correspondent that “in the Hindu tradition, the 60-year cycle is known as the cycle of *Brihaspati*, the name of Jupiter”.²²⁹

According to the astronomical model, up to 50% of the global warming between 1970 and 2000 may have come from this natural 60-year cycle.²²⁷ And much of the other 50% can be attributed to the increase in the sun’s average output since the gloomy days of the Maunder Minimum, Scafetta has claimed in earlier papers.^{230, 231}

However, the exact amount of the solar contribution to global warming is critically dependent on how much the sun’s activity has risen from the time of the sunspot-free Maunder Minimum. Scafetta’s estimate of a solar contribution around 50% hinges on satellite measurements^{232, 233} that show a post-Maunder Minimum rise in solar output about one third larger than another set of satellite data.²³⁴

There has been considerable debate over which satellite data set is the more accurate, especially in establishing the current solar activity level; a recent effort to resolve the difference was controversial.²³⁵ Solar physicist Mike Lockwood has argued that the solar activity gain since the Maunder Minimum is more in line with the second, lower set of satellite measurements²³⁶ – in which case the solar portion of current global warming is much less than 50%.

But this applies only to direct connections between the sun and the Earth’s climate. As well as any direct solar influence, indirect solar effects can have an impact on the warming and cooling of our planet. Possible indirect effects include cosmic rays from deep space, the sun’s own ultraviolet (UV) radiation, something called the solar wind,²³⁷ and even other natural climate cycles.

Some sort of amplification mechanism is required, however, for there to be a significant contribution to global warming from any of the solar cycles that I’ve discussed here, or from indirect solar effects.

Nevertheless, despite the attempts by the IPCC in its latest report to minimize the sun’s contribution to global warming,²³⁸ the need for a solar amplification mechanism should not be dismissed lightly. After all, in the IPCC’s computer climate models, it’s primarily amplification by water vapor and cloud feedbacks that boosts the tiny temperature increase caused by CO₂ acting alone.²³⁹

Potential sources of solar amplification include any variation in the Earth's reflectivity (albedo),²²¹ which may or may not be associated with changes in cloud cover, water vapor in the atmosphere, and two other mechanisms to be discussed in the next sections.

Amplification Mechanisms: Cosmic Rays from Outer Space

Fluctuations in the sun's output are small, about a tenth of one percent over the 11 years of the sunspot cycle, and perhaps only as much or a little more during the 300 years since the Maunder Minimum ended in the early 18th century. But this may be enough to explain a substantial part of our current global warming, even though the IPCC wants us to believe otherwise.

How can such small changes in the sun's activity affect our climate at all?

One answer is in indirect solar effects – not the direct effect of the sun's heat, which is absorbed by gases in the atmosphere, by clouds, by the oceans, and by land surfaces;²⁴⁰ but secondary, indirect effects associated with galactic cosmic rays, the sun's UV rays, or maybe one of the Earth's atmospheric circulatory patterns. It's possible that a tiny increase in solar activity could be amplified by one of these indirect effects.

Cosmic rays are super-energetic, electrically charged particles that come mostly from exploded stars in our Milky Way galaxy and continually bombard the upper atmosphere. But the sun's solar wind²³⁷ can deflect these intruders away from the Earth. As the sun becomes more active, the number of cosmic rays hitting the atmosphere falls off; as it quiets down, more cosmic rays get through to the atmosphere.

According to a proposal by Danish physicist Henrik Svensmark, cosmic rays can seed the formation of clouds – especially low-level clouds that cover more than 25% of the Earth's surface and produce cooling.²⁴¹

The idea is that a small increase in the sun's output that decreases the number of cosmic rays can therefore reduce the cooling effect from low clouds, amplifying the direct warming effect from the sun itself through a positive feedback process. In Svensmark's words, the connection between clouds and cosmic rays provides “a mechanism for solar-driven climate change more powerful than changes in solar irradiance”.²⁴²

Svensmark claims that this indirect cloud mechanism can explain not only modern global warming, but also the 1,500-year climate cycle mentioned in the previous section, and even the onset and termination of ice ages in the very distant past. Millions of years ago, the variation of cloudiness induced by cosmic rays had less to do with solar activity, says Svensmark, than with changes in the number of cosmic rays reaching the sun in the first place, which fluctuated as the solar system moved across the spiral arms of our galaxy.²⁴³ Other researchers have found that the number of cosmic rays in the sun's vicinity does indeed vary, over a cycle of about 140 million years.²⁴⁴

It's already well established that the slight flickering in the sun's output regulates the number of cosmic rays that reach the atmosphere today. And Svensmark's comparison of satellite data on clouds with ground-based cosmic ray counts does appear to show a correlation between low cloud cover and galactic cosmic rays, over the last 30 years.²⁴⁵

However, despite the reduction in cosmic ray intensity during the whole 20th century, which would have contributed to global warming according to the Svensmark theory, his far-reaching assertions are still largely speculative at present. Apart from speculation, the only basis for the notion that cosmic rays are related to low cloud cover is laboratory experiments, which may not be a realistic simulation of actual conditions in the Earth's atmosphere.

Preliminary experiments, conducted at the Danish National Space Center in Copenhagen, reproduced real-life conditions only at sea level.²⁴⁶ In 2011, the first of a series of bold, large-scale experiments was completed at the European atom-smashing facility (CERN) in Geneva, using a special "cloud chamber" that can simulate all levels of the atmosphere, together with a high-energy particle beam that mimics cosmic rays at higher altitudes.²⁴⁷

Although the latest experiment appears to support the Svensmark hypothesis of a cosmic ray contribution to global warming, the study has raised new questions that require further investigation – which may take several years.

The proposed mechanism for cloud formation involves cosmic rays breaking air molecules apart to form miniscule quantities of airborne droplets, or aerosol particles, that are made up of tiny clusters of sulfuric acid and water vapor. Atmospheric aerosols are thought to be the building blocks for clouds.²⁴⁸

As anticipated, the CERN results show that sulfuric acid and water vapor can rapidly form small aerosol droplets a kilometer or two up in the atmosphere, and that cosmic rays enhance the formation rate by ten times or more. But the surprise was that, in the lowest layer of the atmosphere, additional vapors are needed to nucleate aerosols.²⁴⁹

So the CERN group is planning future experiments to discover what other vapors are involved, whether they are largely natural or of human origin, and how they influence clouds.²⁵⁰ The group will also study larger aerosol droplets in the chamber, and even hopes to generate artificial clouds.²⁴⁷

In the meantime, whether the correlation between low cloud cover and cosmic rays really exists is the subject of intense debate. As in many other areas of climate science, good quality observational data on clouds is hard to come by. A problem with satellite observations is that low clouds are sometimes obscured by middle-level and high clouds²⁵¹ that respond differently to cosmic rays. The picture is further complicated by possible changes in cloud height as a result of global warming (Chapter 4), which makes it more difficult to distinguish between low and middle clouds.

The analysis of a group of Finnish climatologists has endorsed Svensmark's theory that low cloud cover correlates with cosmic ray intensity, even though the correlation is regional rather than global.²⁵² Although the regional correlation is not restricted to any one area, a global connection is disputed by other researchers, including UK physicists Terry Sloan and Sir Arnold Wolfendale, who maintain that less than 23% of the worldwide decrease in low clouds during solar cycle 22 (see Figure 5.1) was due to the sun's influence on cosmic rays.²⁵³

Sloan's research group also finds that changes in cloud cover, both low and high, correlate better with variations in the sun's UV output – a topic to be discussed in the following section – than with cosmic rays²⁵⁴.

But a recent upsurge in cosmic ray counts around the world may swing the pendulum back toward the Svensmark hypothesis. The intensity of cosmic rays has risen noticeably since the mid-2000s,²⁵⁵ reflecting a slight drop in solar activity that is also seen in declining sunspot numbers (Figure 5.1). This falloff in solar activity may foreshadow future global cooling, such as the big freeze predicted from the 87-year and 210-year solar cycles and discussed earlier in the chapter.

The IPCC is hedging its bets on cosmic rays for now, saying that while “empirical associations have been reported between globally averaged low-level cloud cover and cosmic ray fluxes”, its level of scientific understanding of cosmic ray influences is “very low”.²⁵⁶ This very low understanding has evidently prompted the IPCC to omit all indirect solar effects from its computer models, although its marginally higher “low” understanding of direct solar effects²⁵⁷ hasn’t prevented it from including these in the models.

Amplification Mechanisms: Ozone

A second indirect heating effect of the sun, possibly more important than cosmic rays, implicates the ozone layer.

You’ve probably heard about the holes in the ozone layer, which are a concern because they allow more of the sun’s harmful UV radiation to penetrate the atmosphere and make it to the Earth’s surface in regions of the globe underneath the holes. The ozone layer, which is located in the upper atmosphere,²⁵⁸ normally protects us from nearly all UV rays by absorbing them. Some ozone also resides in the lower atmosphere.¹⁵⁴

As the sun’s output of heat and visible light fluctuates, so too does its production of invisible UV, which varies much more over the 11-year solar cycle than the tenth of a percent change in total solar output.²⁵⁹ A more active sun generates more UV radiation, which creates more ozone in the ozone layer.²⁶⁰ The slightly thicker ozone layer provides a little extra UV protection for humans by absorbing more sunlight.

Absorption of solar UV also warms the ozone layer, since all forms of radiation from the sun (including visible light, UV and infrared) carry heat energy. This in turn heats both the upper and lower atmosphere²⁶¹ and amplifies the direct warming caused by solar activity – a positive feedback process.

The amplification associated with positive feedback can also magnify cooling effects when the sun’s UV output declines. A second positive feedback connected with variations in solar activity involves shifts in atmospheric wind patterns produced by UV changes.²⁶² Lockwood has proposed that the wind shifts may be related to very cold European winters since about 2009 – perturbations of upper atmosphere winds by lower UV levels resulting in “blocking” of the north polar

jet stream,²⁶³ a high-altitude air current that governs much of the weather in Europe and North America.

Meteorologists think a lazy jet stream caused by a downturn in UV from a quieter sun may explain many of the prolonged heating and cooling spells that have become prevalent in the Northern Hemisphere recently.²⁶⁴ Blocking produces unusual holding patterns that can keep a weather system in one place for extended periods.

And there may even be a link between solar UV and cloud cover – a link that can contribute indirectly to global warming, as we’ve just seen with cosmic rays. Two of the studies mentioned in the previous section, which found a correlation between cosmic ray strength and low cloud cover, also noted a correlation of solar UV output with middle cloud cover.^{252, 254} Middle level clouds can either cool like low clouds, or warm like high clouds.

However, the exact amount of indirect warming produced by solar UV acting on the ozone layer is unknown at present. Atmospheric physics researcher Joanna Haigh in 2003 cited several studies, all of which suggest that climate models “may underestimate solar influence by up to a factor of three” because the models omit ozone heating effects.²⁶⁵ But in a later paper, Haigh says her research team’s analysis of recent UV measurements suggests that the sun’s indirect contribution to global warming may in fact have been overestimated.²⁶⁶

Other Planets

If the sun is playing a role in global warming on Earth, we would expect the other planets in our solar system to show signs of warming as well. Planetary global warming may indeed exist, but the evidence is rather thin at the moment and there is an extreme scarcity of both data and scientific studies.

Even with the annual publication of thousands of research papers on the climate of our own planet, there’s plenty of disagreement about what is causing temperatures to rise – despite the constant efforts of the IPCC and climate change alarmists to convince us that CO₂ is the villain. So we shouldn’t pay too much attention to what are just a handful of articles on warming trends elsewhere in the solar system.

An example of how easy it is to be misled by limited data can be found in recent studies of Mars, where dust storms are prevalent.

From darkening of the planet's surface, a team of space scientists calculated that in the 22 years between two NASA missions to Mars, it had warmed by 0.65° Celsius (1.2° Fahrenheit). This is almost as much global warming as we've experienced here on Earth in 160 years. Attributing the apparent warming to changes in sunlight-reflecting surface dust, though not to solar activity, the research team linked the sudden temperature rise to melting of the ice cap near the Martian South Pole over the past few years.²⁶⁷

But a different group of investigators pointed out that the first mission to Mars had come right after a global dust storm there that had made the planet appear much brighter than it looked 22 years later, and concluded that surface brightness doesn't tell us much about Martian warming.²⁶⁸ The melting of the southern ice cap could also have been associated with changes in dust coverage and, in the absence of other data, doesn't make a strong case for global warming on Mars.

Another reason to be skeptical about evidence for global warming on other planets is that most planets have very long "years".

It takes 165 Earth years for Neptune to orbit the sun once, for example, which means we need to wait a long time to ensure that any warming trend we notice isn't just from the changing Neptunian seasons. Possible global warming reported on Neptune,^{269, 270} on Neptune's moon Triton,²⁷¹ and on Pluto²⁷² have all been ascribed, at least partly, to planetary seasonal effects.

One planet where CO₂ has unquestionably caused global warming is Venus, which has a dense atmosphere consisting of 97% CO₂, far above the Earth's current CO₂ level of 393 parts per million (0.039%). The runaway greenhouse effect on Venus produces furnace-like conditions, with a surface temperature around 470° Celsius (880° Fahrenheit). But that's how it's been there for billions of years and the planet isn't currently getting any warmer from the sun.

More IPCC Shenanigans: Solar Warming Minimized

The IPCC has done it again.

As we saw in earlier chapters, the IPCC and its supporters have indulged incessantly in exaggeration, data tampering and deception to bolster their case for man-made climate change.

The same wiliness can be found in the IPCC's treatment of historical data for solar activity, where the goal was to make the contribution of solar variability

to global warming appear lower than it may actually be. The sun's fluctuations probably can't explain all the global warming to date, but the IPCC's Fourth Assessment Report in 2007 minimizes the solar contribution almost to the point of insignificance by cherry-picking the historical record.

Proxy records of solar intensity include both sunspot numbers and so-called cosmogenic isotopes, which are trace amounts of radioactivity left in proxies such as ice cores and tree rings by past cosmic rays from space. As the sun's output varies, the radioactivity levels of these isotopes rise and fall, leaving an imprint of solar activity at the time.²⁷³

The variation in solar activity includes short-term fluctuations during the sun's 11-year cycle, as well as longer-term increases or decreases in the average solar output that can have a significant effect on climate. As we saw earlier in the chapter, how much the sun is contributing to global warming depends on how much the sun's average energy has risen since the Maunder Minimum, the period from 1645 to 1715 when there were almost no sunspots and solar activity was low – the years that coincided with the chilliest episode of the Little Ice Age.

According to the IPCC,²⁷⁴ the sun's output right now has increased only slightly over the 300 years since then. If the IPCC is correct, it means that any solar contribution to global warming today is minimal. However, the IPCC's conclusion about the sun's output is based on a very selective choice of historical data, namely the plucking out of one of the lowest available estimates of the boost in solar output since the Maunder Minimum.

The problem is that actual measurements of solar activity, apart from sunspot counts, date only from the beginning of the satellite era in 1978. To fill in the rest of the gap between the Maunder Minimum and now, we have to rely on theoretical reconstructions of solar output, based on a variety of proxies. Consequently, as stated in a recent review of the sun-climate connection, "...the extent of the positive drift in TSI [solar activity] between the Maunder Minimum and the present day is uncertain".²⁶²

The IPCC's low estimate of the increase in solar activity during the last 300 years is derived from a reconstruction based on recorded sunspot numbers and a computer model.²⁷⁵ While computer simulations of the sun are probably no more reliable than computer climate models, other reconstructions of solar activity using different methods have arrived at similar low estimates.

The 2007 IPCC report actually lists several estimates of the solar activity gain since the Maunder Minimum, the selected high estimate being three times larger than the low one based on sunspot proxies,²⁷⁶ but calculated instead from ice-core radioactivity levels.²⁷⁷

Needless to say, the IPCC then goes on to ignore all but the lowest estimate to calculate the solar contribution to global warming.²⁷⁸ Obviously, a bigger increase in the sun's average output since the end of the 1600s would account for more of our recent global warming than the IPCC wants to admit.

In its 2001 Third Assessment Report, the incorrigible IPCC resorted to a different subterfuge to minimize the sun's effect on global warming.

Most of the estimates in that report weren't based on proxy data from sunspots or ice cores, but on comparisons between the sun and similar stars, a method that is now largely discredited. But these comparisons yielded calculations of the solar activity gain since the Maunder Minimum even larger than the high estimate that the IPCC rejected for its 2007 report. To lower the big difference in solar output between past and present, the IPCC deviously measured the present-day increase only from the year 1750²⁷⁹ – well after the Maunder Minimum was over, and the sun's intensity and the number of sunspots had returned to more normal levels. This ruse cut the solar activity increase since 1700 in half.

Once more, and on two separate occasions, the IPCC has cast aside the rules of science to prop up its unconvincing case for man-made CO₂ as the source of global warming. As I discussed earlier, one of the cornerstones of the scientific method is that you don't ignore or discard data just because it doesn't fit your theory. Properly conducted science examines all the data, without bias.

So determined has the IPCC been to trivialize the role played by the sun in climate change that it doesn't even bother to enumerate the solar contribution in its 2007 report. It appears that the IPCC estimates the solar portion of total global warming at only a few percent.²⁸⁰

But there's plenty of evidence that solar activity has increased considerably over the last 300 years, and that the sun's role in global warming has been underrated in IPCC computer climate models.

NATURE'S WARMING: THE OCEANS

Natural climate variability includes several patterns of cyclic behavior. These come about through changes in wind and ocean circulation over months or years, but reveal themselves as fluctuations in temperature, rainfall and other features of our daily and weekly weather.

The familiar El Niño and La Niña cycles arise from seesaw changes in tropical ocean surface temperatures that cause drastic shifts in climate around the Pacific Ocean,²⁸¹ for periods of a year or more at a time. The 1997-1998 El Niño, one of the strongest on record, raised surface temperatures around the world by 0.17° Celsius (0.3° Fahrenheit)²⁸² – which is an appreciable fraction of the total global warming since 1850 – for a full year. More serious effects of El Niño and La Niña can range from catastrophic flooding in the U.S. and Peru to severe droughts in Australia. The cycles recur on a regular basis, although the intervals between them can vary quite a bit.

Other ocean oscillations that repeat at intervals from years to decades include the Pacific Decadal Oscillation, the North Atlantic Oscillation, the Arctic Oscillation and the Atlantic Multidecadal Oscillation. Although IPCC computer climate models endeavor to simulate the various cycles, the models have been unsuccessful at predicting the timing and climatic effects of several of them.²⁸³

Before we look at one of these cycles (the Pacific Decadal Oscillation) in more detail, we'll pause to examine several examples of a new line of investigation in climate science, involving interconnections between ocean oscillations and solar variability. It's becoming increasingly apparent that the sun, the oceans and even clouds are tied together, as well as to the atmosphere, and it's quite possible that their interactions have a far bigger effect on climate than CO₂.

The Sun-Ocean Connection

In studying the 1,500-year solar cycle discussed at the beginning of this chapter, geologist Gerard Bond and his colleagues suggested two amplification, or positive feedback, mechanisms through which very small drops in solar activity may have triggered substantial climate change many times over the last 9,000 years.²⁸⁴ The changes include abrupt cooling in the Netherlands, glacial advances in Scandinavia and markedly reduced rainfall in the Persian Gulf.

One of the suggested amplification mechanisms involves changes in the ozone layer, which I've already discussed. The other involves the oceans.

The hypothesis is that a slight fall in solar output could have slowed the turning over of deep ocean currents in the North Atlantic by lowering surface salinity. A similar slowing occurred at the end of the last ice age, caused not by the sun but by the sudden melting of ice sheets.²⁸⁵ The overturning of ocean water is part of the ocean conveyor belt that circulates water and heat around the globe, so any phenomenon such as solar variability that alters this circulation can affect global temperatures. In this case, the slowdown of the conveyor belt would have intensified the initial solar cooling, but the slowing could have been triggered equally well by solar warming.

A rather different ocean amplification mechanism has been proposed by a group of climatologists, in trying to explain the pronounced response of the Pacific Ocean climate system to the small variation in solar activity over the 11-year sunspot cycle.²⁸⁶

The explanation involves another "bottom-up" mechanism, in which the additional ocean heating caused by a slightly stronger sun results in increased evaporation. This in turn produces heavier rainfall, stronger winds and fewer low clouds in the Pacific – raising sea surface temperatures, since low clouds cool, and amplifying the original warming via positive feedback. A similar explanation applies to cooling. The combined effect of this bottom-up mechanism with "top-down" ozone amplification is to magnify direct solar heating by four times or more.²⁸⁷

Since oceans can store and transport vast amounts of heat – a characteristic known as thermal inertia – there is a time lag between changes in solar activity and corresponding changes in temperature. The oceans absorb most of the sun's incoming heat near the equator and then transport it north or south, a process that takes about 8 to 12 years.^{226, 288}

Because this time lag is approximately as long as an 11-year solar cycle, global surface temperatures in any particular cycle are determined by the length of the *previous* solar cycle, a recent Norwegian study has found – at least in the North Atlantic. The study also found that the solar contribution to global warming over the last 150 years was about 40% in Norway and up to 70% in nearby locations such as Iceland.²⁸⁹

And, from an analysis of fluctuations in ocean heat content, a topic I'll return to in the next chapter, Israeli physicist Nir Shaviv has concluded that total solar forcing is from five to seven times larger than that associated with direct solar warming. Such a large amplification factor would imply that the Earth's climate is much more sensitive to the sun than to CO₂.²⁹⁰ Of the various possible indirect amplification mechanisms, Shaviv favors cosmic rays.

The Pacific Decadal Oscillation (PDO)

The Pacific Decadal Oscillation (PDO) has characteristics in common with El Niño and La Niña, but the cycle time is much longer – about 60 years for a full PDO cycle, compared with two to seven years between successive El Niño or La Niña events. Although the fluctuations of the PDO can be traced back at least several centuries, its distinctive pattern wasn't recognized until the 1990s, when it was named by a U.S. fisheries scientist trying to explain the connection between Alaskan salmon harvests and the Pacific climate.

The PDO cycle switches between warm and cool phases. During the 30-year warm phase, when more El Niños occur, ocean surface temperatures in the northeastern Pacific are higher than normal, and the southeastern U.S. is cooler and wetter than usual. The 30-year cool phase, marked by an excess of La Niñas, is dominated by correspondingly lower ocean temperatures and warmer, drier conditions inland.

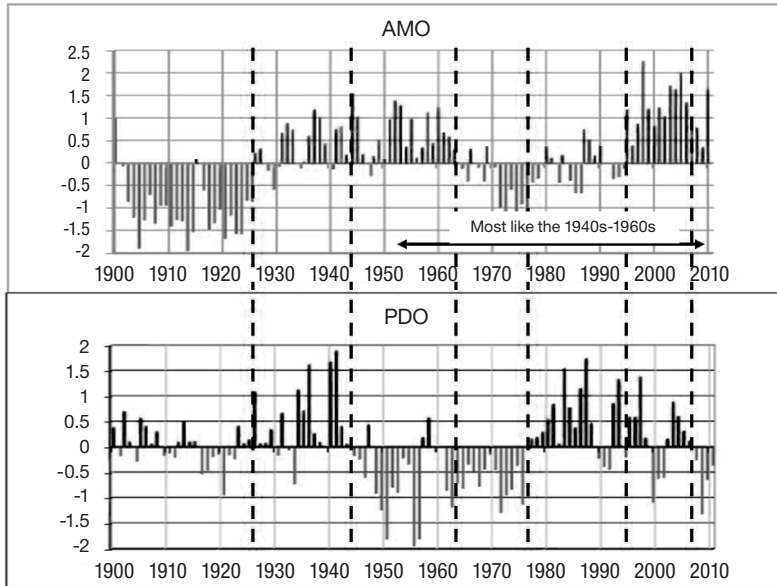
The other major multidecadal ocean cycle is the Atlantic Multidecadal Oscillation (AMO), which has a cycle time of approximately 65 years. Like the slightly shorter PDO, the AMO alternates between warm and cool phases, although the warm phases usually last longer. The two cycles are compared in Figure 5.2.

Because the cycle times for the PDO and AMO are close to 60 years, it's possible that one or both of these ocean oscillations is related to the proposed 60-year solar cycle underpinned by the motions of Jupiter and Saturn,²²⁷ a theory discussed earlier in the chapter. However, the astronomical model on which this theory depends is just a model and, like computer climate models, contains arbitrary adjustable parameters – though fewer of them.

Meteorologist Joe D'Aleo and others have pointed out that the warm and cool phases of the PDO coincided with the major periods of warming and cooling, respectively, in the 20th century.²⁹¹ Even though the overall trend in tempera-

tures since 1850 has been upward, there have been at least two intervals when the mercury took a dive for a decade or more (Figure 1.1). Each time that the PDO mode shifted from warm to cool, or vice versa, global temperatures switched accordingly.

Figure 5.2: The AMO and PDO since 1900



Source: ICECAP.²⁹³ The vertical scale shows the AMO or PDO index – a measure of Atlantic or Pacific surface temperature, respectively. A positive index indicates warming, a negative index cooling.

To some skeptics, this coincidence explains global warming. But while the PDO may be an explanation for global warming, it is not simply because the temperature follows the warm and cool phases of the oscillatory cycle.

Roy Spencer and his research team at the University of Alabama in Huntsville have hypothesized that *cloud* changes associated with the PDO may be able to account for much of measured global warming,²⁹² which the IPCC and climate change alarmists insist on attributing to CO₂. The University of Alabama group is the same one that found evidence in satellite observations for negative CO₂ feedback from clouds, a subject discussed in Chapter 4. The new global warming hypothesis also relies on satellite data.

TABLE 5.1: NATURAL WARMING – ALTERNATIVES TO CO₂

Alternative

1. *Solar variability*

- Solar 11-year, 87-year, 210-year and possibly 60-year cycles.
- An increase in the sun's average output over the 300 years or so since the Maunder sunspot minimum during the Little Ice Age.
- Indirect amplification from the sun's deflection of cosmic rays. This deflection may reduce the cooling from low clouds when the sun is more active.
- Indirect amplification from the sun's UV radiation, which warms the ozone layer and shifts wind patterns in the upper atmosphere, and may affect clouds in the lower atmosphere.

2. *Sun-ocean connections*

- Amplification from the interaction of the sun and oceans, via the slowdown of deep ocean currents caused by reduced surface salinity.
- Amplification from the interaction of the sun and oceans, via a reduction in low cloud formation resulting from heavier rainfall.

3. Cloud fluctuations associated with the *Pacific Decadal Oscillation (PDO)*, a natural climate cycle that switches between warm and cool every 30 years.

WHAT'S WRONG WITH THIS PICTURE?

- The IPCC claims erroneously that nearly all global warming is caused by man-made CO₂, and that natural climate variability plays almost no role.
- The IPCC wrongly assumes that the only natural contribution to the modern warming trend is direct solar effects, and deceptively minimizes even this contribution.
- Potential sources of global warming, such as indirect solar effects, sun-ocean linkages and natural climate cycles like the PDO, are omitted from the IPCC's computer climate models. Most of the models don't allow for time lags caused by ocean thermal inertia.
- Most of the IPCC's efforts go into shoring up its case for the faulty CO₂ hypothesis. Very little attention is paid to investigating alternative explanations for climate change – and only minimal funding is available for studying natural variability.

What Spencer postulates is that the natural variability of the PDO causes changes not only in temperature and precipitation, but also in cloud cover. As you may recall, low-level clouds cool the Earth's surface, while high-level clouds have a heating effect. Warming can originate from either a reduction in low clouds, or an increase in high clouds, or both.

The IPCC, Spencer points out, assumes that this kind of natural cloud variability does not exist and that "the Earth stays in a perpetual state of radiative balance that has only been recently disrupted by mankind's greenhouse gas emissions".²⁹² Disputing this IPCC claim, Spencer says that his group has already shown theoretically that random variations in cloudiness on a *daily* basis can cause ocean temperatures to vary over decades, which is one of the signatures of the PDO.²⁹⁴

The University of Alabama proposal extends this idea to variations in cloud cover that occur not daily, but over timespans of up to 100 years – which might then cause long-term temperature changes such as global warming. Although the PDO is localized in the Pacific Ocean, the mixing of ocean waters around the world over a period of time can result in global cloud fluctuations.

Using a simple climate model with very few assumptions, and with fluctuations in cloud cover directly related to the observed PDO undulations, Spencer simulated global temperatures for the 20th century.²⁹⁵ Astonishingly, this simple PDO model, on its own, can explain up to 75% of the global warming observed for the whole period from 1900 to 2007.

Analysis of the satellite evidence for PDO cloud fluctuations shows strongly negative cloud feedback, just as found in the earlier studies of other cloud data by Spencer's team.²⁹⁶ Negative feedback diminishes the warming caused by atmospheric CO₂ acting alone, to a low or even an insignificant level.

In 2008, the 30-year PDO warm phase that began in 1977 came to an end (Figure 5.2). This ushered in a new cool phase, just as the shift that occurred in the 1940s resulted in global cooling for the 30 years that followed. It's important to note that these cooling spells are also predicted by the PDO cloud fluctuation model, the basic idea being that the PDO causes long-term variability in cloud cover that leads to global warming and cooling.

Of course, a single study doesn't make a compelling case for PDO cloud fluctuations causing 75% or more of the global warming that we've seen so far. But, since the IPCC and climate change alarmists are most likely wrong about CO₂,

the PDO theory is certainly a good candidate for an alternative, natural explanation. Further investigation may well validate this alternative theory.

How very different these natural explanations are from the CO₂ story pushed by the IPCC and climate change alarmists! According to the CO₂ hypothesis that we've examined at length in previous chapters, nearly all the warming measured since 1850 has been caused by human emissions of CO₂.

Natural cycles, such as solar cycles, ocean oscillations and the PDO cloud changes discussed here, have been summarily dismissed by the IPCC – which makes the sweeping assumption that the only source of natural climate variability that contributes to global warming is solar activity.²⁹⁷ And it resorts to deception to minimize even this contribution.

Admittedly, our current understanding of natural variability is poor. But that's no reason to exclude natural causes, other than the sun, from computer climate models.

The IPCC says its computer models are unable to match the measured temperature record for the 20th century if the models include only natural sources of warming.²⁹⁸ That's because the only natural sources simulated by the models are direct solar effects, not to mention the intrinsic limitations of the models themselves. All other natural possibilities, including indirect solar effects such as cosmic rays and ozone, plus sun-ocean connections and climate cycles like the PDO, are omitted.

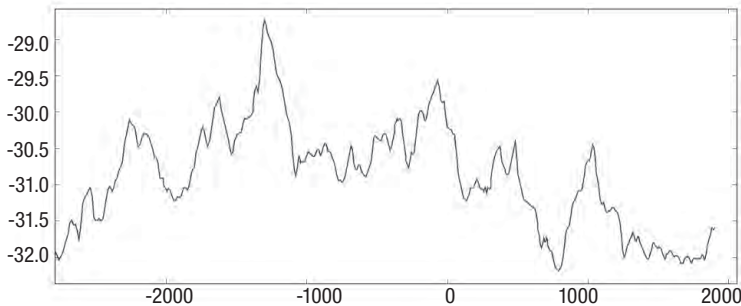
The IPCC makes much of its supposed ability to detect an “anthropogenic signal” in climate data, especially the temperature record, as substantiation of man-made global warming.²⁹⁹

All this means in reality is that computer climate models, with all their assumptions about CO₂ and the climate system, can be adjusted to simulate the climatic record – and that's not at all surprising, with so many variable parameters to play with. The apparently good fit to climate data doesn't validate the models nor authenticate the connection between CO₂ and global warming.

The unlikelihood that CO₂ plays any significant role in climate change is clear from the temperature record for the 11,000 years that have elapsed since the end of the last ice age.

During this long interglacial epoch, when human civilization developed and thrived, there have been several periods of global warmth, all of which were warmer on average than our present climate and occurred long before factories and SUVs began adding CO₂ to the atmosphere. These hot spells included the Medieval Warm Period, the Roman Warming about 1,000 years earlier and the Minoan Warming 1,000 years before that (Figure 5.3), along with others.

Figure 5.3: 5,000 Years of Central Greenland Temperatures



Source: Foresight Institute.³⁰⁰ The horizontal scale shows the year and the vertical scale gives the surface ice temperature in °C. The Medieval Warm Period corresponds to the peak on the right, the Roman Warming to the two peaks immediately to the left, and the Minoan Warming to the highest peak.

But unfortunately, an adequate understanding of natural climate variations is sadly lacking. For the last 25 years, the climate science community in general, and the IPCC in particular, has been obsessed with CO₂. If just a small fraction of the countless hours and weeks of effort that have been wasted trying to justify the CO₂ theory had instead been devoted to studying natural causes of rising temperatures, we might by now have had enough data to properly evaluate the alternative explanations.

Chapter 6: Global Cooling

Alternative explanations aside, climate change alarmists now have to grapple with a big nail in the man-made global warming coffin. To their enormous embarrassment, global temperatures have been falling – slightly – since about 2001. And this despite the fact that humans are continuing to release more and more CO₂ into the atmosphere.

That's right, it's been cooling. As the data comes primarily from NOAA and the UK's HadCRU, both of which manipulate temperatures to exaggerate global warming as we saw in Chapter 2, you can be pretty sure that the modest amount of cooling these two temperature custodians admit has occurred is really an underestimate – and that the actual drop since 2001 is much bigger than they're saying.

Perplexed, global warming alarmists around the world are calling the cooling a “hiatus”. But by 2012, the hiatus was at least 11 years old and counting.³⁰¹ If it persists for another few years, the argument that periods of less than 10 to 15 years are too short to define a climate trend will lose its validity, and a lot of climatologists will have egg on their face.

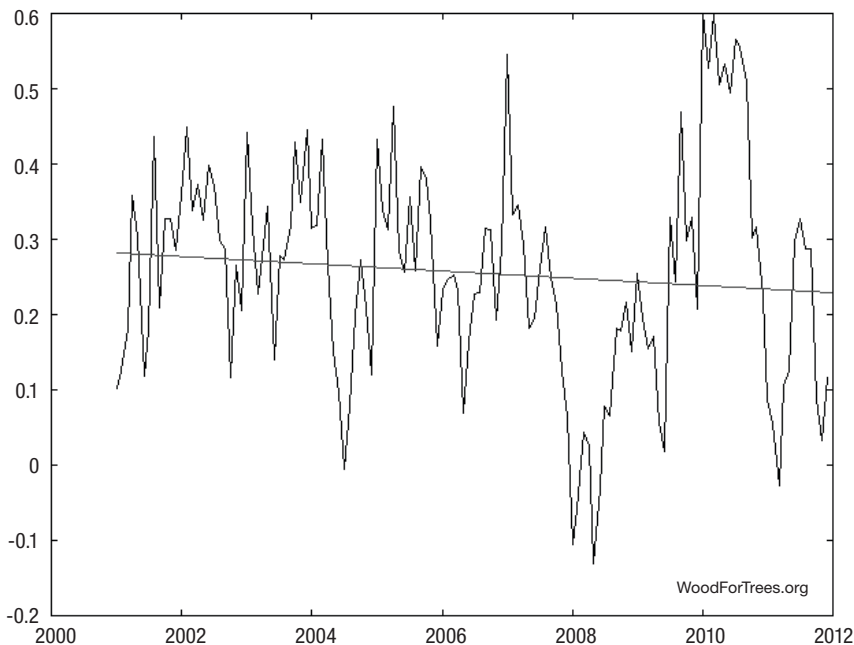
REVERSAL OF FORTUNE

Despite warmist protestations about the veracity of reports on the cooling trend when it first became evident several years ago, the temperature downturn gained credibility in 2009 with the release of a study by two mathematical scientists at the University of Wisconsin-Milwaukee.³⁰²

The study found not only that global temperatures have leveled off and decreased since late 2001, after rising steadily for the previous 30 years (see Figure 6.2), but also predicted that the cooling will continue for several decades. Stating that the cool spell can't be attributed to any particular cause, although it must be natural, coauthor Kyle Swanson remarked, "This is nothing like anything we've seen since 1950".³⁰³

Figure 6.1 displays average global temperatures since 2001, showing the unmistakable dip. Up to 2011, the worldwide average temperature had declined about 0.05° Celsius (0.09° Fahrenheit) from 2001.³⁰⁴ The decline cancels out about 10% of the gain from the warming spurt between 1970 and 2000.

Figure 6.1: The Recent Temperature Record



Source: RSS.³⁰⁶ The connected data points, from the RSS satellite record, show the temperature anomaly in °C at monthly intervals since 2001, while the sloping line is a trend line.

You'll be wondering, no doubt, how the IPCC and climate alarmists are dealing with all this. It certainly came as a shock to the global warming faithful, as a frustrated Kevin Trenberth's Climategate email in 2009 reveals:

GLOBAL COOLING

Well ... where the heck is global warming? ... The fact is that we can't account for the lack of warming at the moment and it is a travesty that we can't. The ... data are surely wrong. Our observing system is inadequate.³⁰⁵

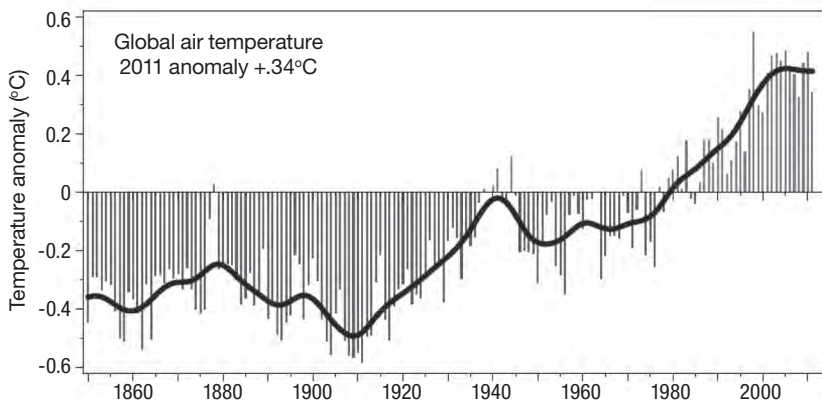
If experimental observations don't match the theory, blame the data or the measurements!³⁰⁷ We'll see another example of this contorted thinking later in the chapter.

Some alarmists at the time declared that cooling was really part of global warming.³⁰⁸ But once the folly of such illogical and farfetched reasoning was exposed, the alarmists adopted a more desperate ploy – that the new signature of CO₂-induced climate change should be extreme weather events, not higher temperatures. However, the general public isn't buying this idea.

Nonetheless, we should recognize that an extended period of cooling – even if it lasts for another 30 years – isn't necessarily the end of global warming. Shown below (Figure 6.2), and also in Chapter 1, is the temperature record from 1850, which is roughly when modern global warming is considered to have begun. As you can see, there have been several cooling stretches over this time, during which the mercury climbed about 0.8° Celsius (1.4° Fahrenheit) overall.

The chart in Figure 6.2 can be divided into five time periods of close to 30 years

Figure 6.2: The Temperature Record from 1850



Source: HadCRU.³⁰⁹

each, in which the temperature alternately rose and fell. From 1850 to 1880 the temperature increased; from 1880 to 1910 it went down again, only to go up once more until 1940; and so on.

Computer climate modelers attribute the cooling that occurred between 1940 and 1970 to aerosol particles in the atmosphere, generated by coal-fired power plants that mushroomed during the period of accelerated industrial development after World War II. According to believers in the CO₂ hypothesis, this cooling effect dominated the warming trend from CO₂ emissions for all those years, but gave way to overall warming in the 1970s as clean air acts in several countries reduced global emissions of sulphate aerosols.³¹⁰

Convenient as this explanation may be, nevertheless, it doesn't readily account for the current cooling trend. Present global aerosol emissions are thought to be well below those of the post-World War II period, despite the rapid industrialization of China and India, where aerosol emissions are rising. And even the alarmist IPCC concedes that its level of scientific understanding of aerosol forcing ranges from "low" to "medium-low".³¹¹

The temperature decline from 1940 to 1970 could equally well be associated with fluctuations in natural cycles, something that computer models ignore. In fact, the alternating pattern in the temperature record shown in Figure 6.2 goes back all the way to 1470, with a cycle time of around 27 years.³¹²

That 30 years is the cycle time for the warm or cool phase of the Pacific Decadal Oscillation and also approximately for the Atlantic Multidecadal Oscillation may be significant, though our knowledge of both natural cycles is too limited at present to draw any definite conclusions from this observation. There may also be a connection to the proposed 60-year solar cycle that I discussed in Chapter 5, the cycle being based on an astronomical model that correctly reproduces the current cooling trend.

What will happen when the recent dip in temperature comes to an end is anyone's guess. Based on the 30-year historical pattern just discussed, we might expect another bout of warming. Indeed, the University of Wisconsin study concludes that the present cooling is "superimposed upon an overall warming presumably due to increasing greenhouse gases".³⁰²

But this assumes that the underlying climate driver is CO₂, an assumption that is very likely incorrect as we've seen. And even though the study authors profess

allegiance to the CO₂ hypothesis, that may be just for the purpose of maintaining their standing in the climate science community.

As discussed in Chapter 4, the sensitivity of the Earth's climate system to added CO₂ is unlikely to be anywhere near as high as the IPCC claims. The very fact that we're currently in a cooling period while CO₂ is still rising attests to low CO₂ sensitivity.

So it's not at all certain that temperatures will resume their previous ascent when the natural source responsible for the present decline switches off in perhaps 20 or 30 years. It's entirely possible that some other source of natural variability will kick in and keep the temperature trending down.

We saw in the previous chapter how the sun's 87-year and 210-year cycles may result in much cooler conditions by 2030 or 2040. In addition, an irregular solar cycle resulting from magnetic changes inside the sun is likely to send it into what is known as a grand solar minimum, within the next 40 years.^{313, 314} And according to the Norwegian study cited in Chapter 5, the 13-year extent of solar cycle 23 (see Figure 5.1) – almost two years longer than normal – already portends a drop in temperature of at least 1.0° Celsius (1.8° Fahrenheit) in Norway and the North Atlantic, during cycle 24 that ends around 2020.²⁸⁸ That's more than the global warming increase for the Northern Hemisphere over the last 160 years!

By analogy to the pattern shown by past warmings (Figure 5.3), astrophysicist Gordon Fulks has suggested that the present bout of cooling may signify a turning point in the modern warming trend, which really began shortly after 1900 (Figure 6.2). Most of the previous interglacial warmings lasted about 200 years, so that the 20th-century upswing should be followed by a 21st-century downswing, each approximately 100 years in length.³¹⁵ If that's the case, the temperature may already be on its way down permanently.

But we just don't have enough knowledge of the climate to make a reliable prediction one way or the other, to say whether it will warm, or cool further, when the present cooling is over. A quick glance at the long-term historical record (Figure 2.3 or Figure 5.3), however, tells us that global temperatures are always going up and down over short periods of time.

CRYING WOLF

Global cooling, even for a limited period, isn't in the IPCC playbook. If not hell on earth, something close to it is projected by the IPCC's most recent report, with global temperatures escalating from now until the end of the 21st century and beyond. Along with the nonstop warming, says the report, will come intensified heat waves, surging sea levels, and prolonged droughts.³¹⁶

All these projections are based on the IPCC's computer climate models – which, as we know, rely heavily on CO₂ (and other greenhouse gases), with a very small contribution from the sun but not from any other natural sources. The predictions encompass a range of futuristic scenarios that embrace varying estimates of CO₂ emissions, global population and economic growth.³¹⁷

While the various scenarios result in different predictions of the assumed temperature leap by century's end, the warming calculated for the first few decades until 2030 is almost the same in all pictures. From 2001 to 2011, the global warming projected by the IPCC was about 0.22° Celsius (0.40° Fahrenheit).³¹⁸

How wrong can one be?

Over these 10 years, average surface temperatures *dropped* by about 0.05° Celsius (0.09° Fahrenheit), as we've seen. This means the IPCC overestimated the temperature for 2011 by close to 0.3° Celsius (0.5° Fahrenheit).³¹⁹ That's about half of the temperature increase since 1970,³²⁰ and around one third of that for the whole period since 1850.

Consumed by recent high temperature readings that were the highest in hundreds of years, the IPCC failed to even notice the cooling downturn. Its 2007 report includes recorded temperature data to as recently as 2005, four years into the slump, and yet its projection graphs show the temperature inching up every year from 2000.³¹⁸ Talk about not having your act together.

The IPCC's temperature estimates for the first decade of the century are so far from reality that it's impossible to give any credence at all to its inflated projections for 2100, projections in which the IPCC claims to have a confidence level of 66%.³²¹

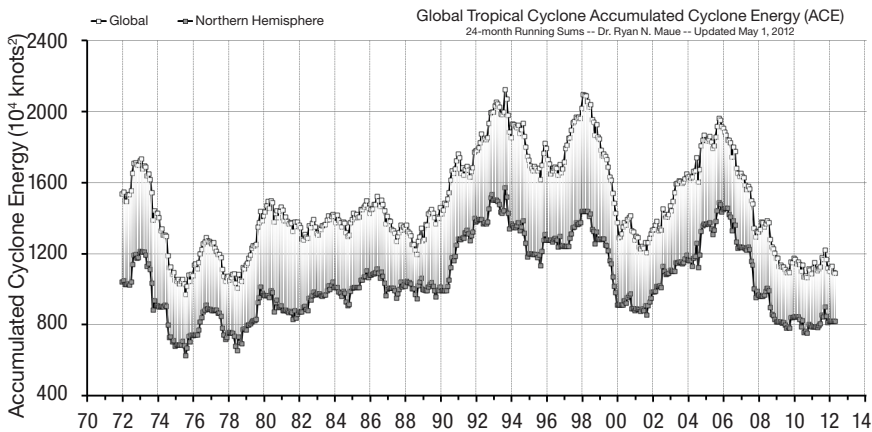
And it's not just temperature predictions on which the IPCC and alarmists in general are crying wolf. The list of highly questionable IPCC projections for our future climate includes heavier rainfall, more intense hurricanes and widespread thawing of permafrost.³²² There's little likelihood that any of these will occur if

the climate is dominated not by CO₂ emissions, but by natural variability that is currently cooling the globe down.

Global warming alarmists made hay of Hurricane Katrina, the deadly hurricane that struck the U.S. Gulf Coast in 2005, causing widespread flooding and devastation. It was all too easy to attribute such a costly disaster to climate change. Indeed, the IPCC maintains that “intense tropical cyclone activity has increased since about 1970”, and that tropical cyclones (which include hurricanes and typhoons) are now much stronger and longer lasting than before, due to global warming.³²³ The IPCC also predicted that future tropical cyclones will become more powerful yet, though the total number is not expected to increase.³²⁴

But in fact, hurricanes and tropical storms are currently becoming less intense, if anything. A commonly used measure of tropical cyclone strength and duration is now at its lowest point since the mid-1970s (Figure 6.3). This almost certainly reflects recent global cooling, just as the previous upward trend in cyclone activity noted by the IPCC, and visible in Figure 6.3, was indicative of the warming surge that ended in 2000.

Figure 6.3: Tropical Cyclone Activity since 1972



Source: Maue.³²⁵

Moreover, attempts to link a 2011 spurt in killer U.S. tornadoes to climate change have recently been debunked, by none other than the National Climatic Data Center (NCDC), which is an arm of NOAA. An NCDC analysis shows

essentially no trend in the incidence of the strongest twisters over the past 55 years.³²⁶

A possibly more pressing issue, often in the news these days, is the extent of Arctic sea ice. For years, those who adhere to the theory that CO₂ causes global warming have been lamenting the retreat of glaciers, the disappearance of snow caps from lofty mountains, and the shrinkage – from the early 1970s to about 2006 – of the ice cap at the North Pole. If only we'd stop loading the atmosphere with more CO₂, they contend, all of this could be reversed.

The shrinking of the polar ice cap has in truth been quite dramatic. Satellite measurements show that Arctic ice cover in the summer months, when the ice is at its minimum extent, contracted at a rate of 7.4% per decade from 1979 to 2005, which is a total reduction of 20% over that period.³²⁷

You don't have to be a rocket scientist (or even a climate scientist) to figure out that, if the same trend continued, the ice cap wouldn't be here much longer. In 2008, an ice scientist declared that Arctic ice was “in a death spiral” and could be completely gone in summer by about 2030.³²⁸ No more ice to fend off the global warming rays of the sun's summer heat,³²⁹ no more habitat for polar bears.

But a funny thing happened on the way to disaster. Since at least 2007, and perhaps a year or two earlier, Arctic ice has been expanding again.³³⁰

The summer ice cap in 2008 was 9% larger than the minimum reached in 2007, the minimum that had sent alarmists into such a frenzy. In other words, the gain in just one year was greater than the loss over a whole decade during the 1980s and 1990s. Although summer ice cover in 2011 was only slightly greater than the 2007 minimum,³³¹ winter ice early in 2012 was well above its extent for the last few years,³³² especially in the Bering Sea.

Of course, the recovery of the ice cap that appears to be underway is probably linked to the cooling trend discussed in the previous section. Climate change alarmists want none of it, however, and insist that the recovery of Arctic ice is merely part of the global warming hiatus mentioned earlier in the chapter. But we've already seen that Antarctic sea ice has been growing for over 30 years, with the result that global sea ice area has remained much the same over the whole period³³³ – a period during which temperatures rose considerably.

Global cooling, it seems, is here to stay for a while. It will be interesting to see what distortions of the truth the IPCC comes up with in its next assessment

TABLE 6.1: GLOBAL COOLING

The IPCC's stand

- Global temperatures will continue to increase steadily through the end of the 21st century, unless we rein in our emissions of CO₂.
- Consequences of global warming such as more intense hurricanes, shrinking of the Arctic ice cap, and retreating glaciers, will get worse without action on CO₂.
- Missing heat from the ever increasing CO₂ level must be hiding in the deep ocean, a conclusion reached since publication of the IPCC's 2007 report.
- The oceans will continue to warm overall, causing sea levels worldwide to rise drastically.

WHAT'S WRONG WITH THIS PICTURE?

1. Man-made CO₂ is highly unlikely to be the primary cause of global warming, as discussed in previous chapters.
2. Since 2001, global temperatures have fallen by about 0.05° Celsius (0.09° Fahrenheit). A recent study predicts that the cooling trend may continue for up to 30 years.
3. The IPCC's most recent report doesn't predict any cooling at all, and overestimated the projected temperature for 2009 by 0.3° Celsius (0.5° Fahrenheit) – which is a third of the total global warming since 1850.
4. Average hurricane strength and duration are currently at exceptionally low levels, reflecting the global cooling trend.
5. Although Arctic sea ice shrank from 1979 to 2005, it has begun to expand again, probably due to global cooling. Antarctic sea ice has been growing for more than 30 years.
6. The missing ocean heat hypothesis is based entirely on computer climate models that overestimate climate sensitivity to CO₂ and have made many failed predictions.
7. A 40-year warming of the world's oceans ended in 2003. Since then, the oceans have cooled, and the rate of increase in sea level has slowed.

report (due in 2014) in order to explain so many failed predictions about global warming.

MISSING OCEAN HEAT

The oceans, as we saw in Chapter 5, play a key role in regulating global temperatures because they can hold a lot more heat – about 1,000 times more – than the atmosphere. Almost 90% of the heat that global warming has added to the Earth’s climate system over the last 50 years is sitting in the oceans.³³⁴ The oceans can also hold much more CO₂ than the atmosphere. Both heat and dissolved gases such as CO₂ are initially stored in the upper layers of the global ocean, where they can be readily exchanged with the air above.

Global warming or cooling shows up in the oceans in two ways. First, sea surface temperatures rise or fall, just as the surface temperature does on land. Second, the total heat stashed away in the ocean depths changes with temperature, more heat being stored as the Earth warms and less as it cools.

The cooling trend that began in 2001 is visible in both land and sea surface temperatures, though these are usually combined to produce records like those in Figures 6.1 and 6.2. The same downturn, delayed by about two years, has been seen as well in ocean heat content – a quantity that is calculated from Argo float observations.³³⁵

The Argo profiling floats are robotic buoys that patrol the world’s oceans, sinking more than a mile deep once every week or so and then bobbing up to the surface, taking the temperature of the water as they ascend. When the floats eventually reach the surface, the data is transmitted to a satellite.³³⁶

Measurements of ocean heat content are important because of its close relationship to global energy balance, which refers to the balance between the amount of sunlight absorbed at the top of the Earth’s atmosphere and the amount of energy that the Earth radiates away to space. Any imbalance in the direction of net sunlight absorption results in global warming.³³⁷

But the diminishing ocean heat content measured from 2003 to at least 2008 is a major conundrum for believers in the CO₂ global warming hypothesis. If the CO₂ level in the atmosphere continued to rise over this period, while global temperatures and ocean heat were falling, then where’s the heat from the CO₂?

According to climatologist Kevin Trenberth and other climate change alarmists, the missing heat is hiding in the deep ocean, where it can't be measured!³³⁸ A new twist on “hide the decline”.

This is strangely reminiscent of Scotland's Loch Ness Monster, supposedly photographed in 1933 but now widely thought to be a myth because of a lack of sightings, and is like telling a child that Santa Claus lives at the North Pole. As there's currently no way to measure the heat content of the deep ocean, what else could be more convenient than claiming that global warming is lurking in Davy Jones's locker?

Maybe the heat isn't really missing at all. You probably won't be surprised that the missing heat conjecture is based solely on computer climate models – models that greatly exaggerate the sensitivity of our climate to CO₂, as I discussed before.

Needless to say, NOAA refuses to recognize the existence of any problem, by ignoring the Argo float data and adhering instead to measurements of ocean heat content founded on out-of-date and less reliable technology.³³⁹ This data shows the heat content increasing relentlessly, in lockstep with CO₂ – despite the admission by NOAA oceanographer Sydney Levitus that the data is biased.³⁴⁰

The true believers maintain that a 2011 study by scientists at the National Center for Atmospheric Research (NCAR) in the U.S. and Australia's Bureau of Meteorology³⁴¹ shows that indeed deep oceans can sequester heat during intervals of respite from global warming. But again, the study relies on computer climate simulations. We've already seen how deficient computer models are in simulating and predicting other aspects of global warming.

According to the study authors, the simulations show that during hiatus periods, deeper ocean layers absorb a disproportionate amount of heat, owing to changes in ocean circulation. Below about 300 meters (1,000 feet), the global ocean supposedly warms 18% to 19% more during hiatuses than at other times. In contrast, the shallower ocean layers above 300 meters purportedly warm 60% less than they do during non-hiatus periods.³⁴²

Nevertheless, not only is this prediction based on a computer climate model with all its shortcomings but, as Roger Pielke Sr. points out, heat that finds its way to the deep ocean must first pass through the upper ocean layers – a phenomenon that has not been observed in the Argo floats.³⁴³

One recent analysis of Argo float data, in which ocean heat content and other variables were measured to a depth of 1500 meters (1 mile), does appear to indicate an increase in heat content over this depth, between 2005 and 2010.³⁴⁴ However, the precision of this analysis has been seriously questioned.³⁴⁵

In any case, it's clear that the oceans have stopped warming.³⁴⁶ This may have happened once before for a short period, in the 1960s, although the overall trend in stored ocean heat from then until 2003 has been upwards.³⁴⁰ While it remains to be seen how long the present interruption in ocean heating will last, every indication is that global warming – of land masses, the oceans, and polar ice – is over for now.

The IPCC had little to say in its 2007 report about ocean cooling, except to mention that after the oceans had warmed by 0.1° Celsius (0.2° Fahrenheit) from 1961 to 2003, there had been “some cooling”.³⁴⁷

Sea Levels

Ocean warming or cooling has important ramifications for sea levels. Since water takes up more volume as it warms, higher ocean temperatures raise the average sea level; conversely, lower temperatures bring the level down. Sea levels also rise as glaciers and ice caps melt, but by far the biggest contribution currently comes from thermal expansion of the oceans.³⁴⁸

Historically, sea levels were measured by a worldwide network of tide gauges, consisting most often of a float inside a protective well. Since 1992, this older method has been replaced by satellite altimetry.

Both methods have their pluses and minuses. The principal problem with tide gauges is shifts in the ground under the gauge, from land subsidence or uplift – subsidence resulting in overestimation of the tide level and uplift resulting in readings that are too low. Satellite observations can make very accurate measurements of sea level but, like other satellite data, are subject to bias that must be corrected for.

The gradual heating of the Earth's oceans over the modern global warming era is reflected in the globally averaged sea level, as documented by the IPCC.³⁴⁹ For the whole 20th century, the rate of sea level rise calculated from tide gauge measurements was about 1.7 mm (about 1/16th of an inch) per year, increasing

to 1.8 mm per year for the period from 1961 to 2003.³⁵⁰ That's 17 to 18 cm (6 to 7 inches) per century.

For the last decade of this period, when global temperatures were escalating rapidly between 1993 and 2003 (see Figure 6.2), satellite altimetry shows an apparently higher rate of sea level rise, of 3.1 mm (about 1/8th of an inch) per year.³⁵¹ However, even the IPCC concedes it doesn't know whether this higher rate is due to "decadal variability" – part of normal oscillations in the rate of rise – or a jump in the longer-term trend.³⁴⁷

But recent satellite and tide gauge data both indicate a slowing down of sea level rise after 2003, and no change at all in the average sea level from early 2010 to early 2012^{352, 353} – suggesting that sea levels are behaving in the same way as ocean heat storage which, as we've just seen, has declined since 2003.

The prospect of massive flooding of low-lying coastal areas and islands, from the IPCC's projected rise in sea levels arising from global warming, has captured the public imagination and the attention of the media like no other potential change in our climate. But as with future warming, the melting of Arctic sea ice, and ocean heat content, the IPCC and other alarmists may once more be crying wolf.

GLOBAL WARMING FALSE ALARM

Chapter 7: Why It Matters

Almost everything in the book so far has been about the *science* of global warming. That's because the IPCC's reports – which have become the manifesto for climate change alarmists – are founded on flawed science and abuse of the well-established scientific method. I've shown just where the IPCC has gone astray scientifically in trying to tie global warming to man-made CO₂.

But, the science aside, why does it matter?

Whether or not climate change comes from CO₂ is important because the human race has embarked on what could become one of the costliest efforts ever undertaken, just in order to curtail CO₂ emissions. The effort could cost the U.S. alone up to \$2 trillion,³⁵⁴ which is half as much as the country spent on World War II.³⁵⁵

Trillions of dollars could be squandered, to fix a problem that doesn't exist. Global warming may be real, but there's next to no evidence that CO₂ has very much to do with it.

Nonetheless, global warmists are pushing hard for measures to shrink our CO₂ output, such as emission caps, carbon taxes, tradable carbon credits, and reduction of fossil fuel subsidies. Legislative bodies around the world have jumped on the carbon bandwagon, beginning with the UN Kyoto Protocol to limit production of CO₂ and other greenhouse gases.

Carbon pricing is already upon us. But as recent experience in several countries has shown, no legislation, whatever its intent, can guarantee lower CO₂ emissions. And even if CO₂ discharges were to drop, it would hardly make any difference to global warming.

THE CARBON PRICING BOONDOGGLE

According to alarmists, human CO₂ emissions are a serious threat to our planet and need to be scaled back before the climate reaches a point of no return. Mistaken though this notion is, the alarmist community long ago realized that curbing CO₂ would require intervention of some kind. The biggest sources of CO₂ are power plants and smokestack industries, neither of which is inclined to take voluntary action on an invisible gas that has no known health effects at its normal atmospheric concentration.³⁵⁶

Because direct regulation is not a very cost-effective approach, given its need for an extensive bureaucracy and an inspection system, interest usually focuses on a market-oriented alternative such as an emissions tax or a trading scheme often known as cap-and-trade. Various forms of taxation and cap-and-trade systems already exist around the world, on a national or regional level, to limit the emission of several genuinely toxic pollutants – of which CO₂ is not one – into the air.

A carbon tax simply penalizes excessive production of CO₂. The general idea behind a CO₂ cap-and-trade system is to lower production by imposing limits or caps, in the form of tradable allowances to emit so many tonnes³⁵⁷ of CO₂ per year. To slow the buildup of CO₂ in the atmosphere, the overall cap can be progressively reduced.

Individual caps can be exceeded by purchasing additional allowances, known as carbon credits, either directly from other emitters that churn out less CO₂ than their allocated amount, or through a financial exchange. In addition to trading carbon credits, participants in the exchange can acquire them by investing in low-emissions projects in developing countries like Indonesia, where it costs less to cut back on CO₂ than in their own backyard.

The first global cap-and-trade scheme for greenhouse gases, including CO₂, was established by the Kyoto Protocol in 1997 and finally took effect in 2005.³⁵⁸

The Kyoto scheme set legally binding targets for the industrialized countries, with the goal of reducing global greenhouse gas emissions by an average of 5.2% of 1990 levels, over the five years from 2008 to 2012. Several countries were allowed to increase their emissions during this period. Altogether, 191 nations had signed the protocol by late 2011. The U.S. signed, but never ratified, the protocol because China and India – who together emit almost a third of the world's CO₂, and more than the U.S.³⁵⁹ – are exempt from its requirements.

It has probably occurred to you, even after the short description above, that a cap-and-trade system is far more cumbersome administratively than a simple emissions tax on CO₂. However, neither method has been universally successful so far in reducing CO₂ emissions.

Norway, which in 1991 enacted a carbon tax covering approximately 65% of the country's CO₂ emissions,³⁶⁰ saw its CO₂ output climb by 18% from 1992 to 2007.³⁶¹ Its neighbors Sweden and Denmark, on the other hand, were able to make modest CO₂ reductions after initiating similar taxes around that time. Among industrialized countries with no carbon taxes, France saw its CO₂ emissions go up about 11% over the same period, while Germany cut its CO₂ production by 8%.³⁶²

The track record for cap-and-trade, which is really a tax in disguise, is even less impressive. The European Union's Emissions Trading Scheme (ETS), started in 2005, is the largest cap-and-trade system in the world and accounts for almost half of Europe's CO₂ emissions.³⁶³ Yet in the two years to 2007, the marginal increase (less than 1%) in European CO₂ output was hardly any different from the increase for North America,³⁶¹ which has not adopted any cap-and-trade plan except in isolated states and provinces.

Of course, since CO₂ has little effect on global temperatures, carbon taxation and CO₂ cap-and-trade are both a massive waste of our time and effort. Carbon pricing is money down the drain.

It's the economic cost of carbon pricing that societies and governments need to take a long, hard look at. The cost is high, because a large proportion of global economic activity depends on carbon through the burning of fossil fuels. In the U.S., around 85% of energy consumption is carbon-based, and energy use underlies nearly every sector of the economy.

What's the cost to society of lowering CO₂ emissions?

The U.S. Congressional Budget Office (CBO) – well known for its impartial and accurate financial analyses of proposed government programs – has examined this question several times, primarily for CO₂ cap-and-trade schemes. In a study conducted in 2000, based on 1998 emission levels, the CBO estimated that a 15% cut in CO₂ emissions would cost the average U.S. household from 2% to 3% of its annual income, across the whole economic spectrum.³⁶⁴

While this may not sound like much, the percentage increase is about the same as the inflation rate in the U.S. during the 2000s. It's common knowledge that those who live on a fixed income, such as seniors, quickly find themselves in a financial squeeze without annual adjustments for inflation – so a cost increase of even a few percent for a cap-and-trade system would unquestionably have a significant impact on all but the very rich.

Indeed, the CBO report points out that the burden of a CO₂ trading plan, which would raise prices for energy and energy-intensive goods and services, would fall more heavily on the poor than on the rich.³⁶⁵ This is because the poor spend a larger percentage of their income on energy costs than those who are better off. So cap-and-trade is equivalent to a regressive tax.

An analysis by the U.S. Environmental Protection Agency (EPA) of a proposed cap-and-trade bill in 2008 predicted that by 2030, electricity prices would be from 35% to 79% above normal.³⁶⁶ Even higher estimates of energy prices came from the U.S. National Association of Manufacturers (NAM), who projected that households would pay between 101% and 129% more for their electricity by 2030 under the proposed legislation.³⁶⁷ It's only the utility companies that stand to gain from a CO₂ trading system.

Advocates of the alternative taxation approach to carbon pricing point out that tax revenues can be used to offset the higher cost of living due to the tax. For example, low-income households and others who bear a disproportionate share of the tax burden can be compensated.

But higher energy costs can cause bigger problems. Although rising energy prices alone are not believed to cause recessions, most economists agree that more expensive energy increases the *risk* of an economic downturn and that, along with other factors, increased energy prices will trigger a recession.

In fact, the very introduction of CO₂ cap-and-trade in the European Union and the subsequent boost in energy prices may have helped set off the current European debt crisis and tipped much of the Union into a new recession. As we are all well aware from recent experience, recessions mean lost jobs as well as other misery.

Global warming alarmists, invoking the precautionary principle, argue that the cost of taking steps to limit CO₂ emissions far outweighs the cost of doing nothing, that the cost of carbon pricing is small compared to the benefits of not

letting our climate get out of control. If there were an established link between CO₂ and global warming, I'd agree with them.

But since there's little, if any, connection, why risk economic disaster?

The irony of the Kyoto Protocol for lowering global CO₂ emissions is that the protocol had its roots in the earlier UN Framework Convention on Climate Change, a treaty adopted in 1992. The treaty's stated objective was to stabilize greenhouse gas concentrations in the atmosphere in order to prevent interference with the Earth's climate, but only in ways that would not disrupt the global economy.³⁶⁸ Ignoring the issue of whether the treaty was right about CO₂, the only mechanism the UN has actually been able to come up with for reducing CO₂ levels is a cap-and-trade plan that may already be contributing to the current economic slump.

Europe's Failed Cap-and-Trade

Twice in seven years, the European Union has failed in its attempts to introduce a viable cap-and-trade system for CO₂.

If anything, Europe's ETS has achieved the opposite of what was intended. Instead of greenhouse gas emissions going down, the amount of CO₂ pumped into European skies has gone up, and the cost of emitting CO₂ has fallen through the floor. It's currently far more profitable for utilities in Europe to burn more carbon-based fossil fuels than ever before, rather than investing in carbon-free alternative energies, as was hoped.

The first CO₂ cap-and-trade market in Europe began in 2005. It included about 11,000 of the larger power plants and industrial facilities that together account for almost half of European CO₂ emissions. The trading price of allowances, after rising initially to a peak of around €30 per metric ton (\$36 per U.S. ton) of CO₂,³⁶⁹ collapsed to under €0.10 per metric ton by the end of 2007.³⁷⁰

What happened essentially is that European governments, who were given the task of allocating the allowances, allocated too many, and gave most of them away free rather than auctioning them to create a more valuable commodity. Some companies, especially electrical utilities, promptly sold their excess free credits, resulting in windfall profits that were never intended as part of the plan.

In addition, over the three years that the scheme was to run, nearly every country sought to *increase* its base CO₂ cap over past emission levels, completely

defeating the purpose of cap-and-trade. Only Germany and the UK asked for carbon caps lower than their past emission histories.

Needless to say, verified CO₂ emissions in Europe increased between 2005 and 2007, by about 2% overall,³⁷¹ and a large number of member states did not meet their emission targets.

These disastrous results prompted the European Union to tighten national caps for the second phase of its trading scheme, scheduled to operate from 2008 to 2012, with total CO₂ allowances being cut 7% below 2005 emission levels.³⁷² The allocation system for allowances was also toughened up and, in 2012, aviation emissions of CO₂ were included.

But the second attempt at regulating CO₂ emissions has fared as poorly as the first. By February 2009, the price of what some traders call “hot air” had fallen below €10 per metric ton (\$12 per U.S. ton) – just as the price of CO₂ had done a year into the original cap-and-trade market, three years earlier. After recovering to around €15 per metric ton during 2010 and 2011, the price dropped to €6 per metric ton in 2012.³⁷³ This price is considered much too low to stimulate low-carbon investment.

The second failure of Europe’s ETS has been blamed on an oversupply of allowances, just like the first. But this time, the reason wasn’t government largesse in giving away too many free credits, but rather economic conditions together with the European renewable energy directive.³⁷⁴

As demand fell and factories trimmed their output during the Great Recession, companies needed fewer CO₂ allowances, so they sold off the surplus – bringing down the allowance price. And the renewable energy directive reduced the need for CO₂ permits even more, without having any effect whatsoever on CO₂ emissions. In fact, the renewables policy combined with the ETS has resulted “in a strange push for wind and coal”.³⁷⁵

Undaunted, the Europeans are planning a third attempt at a CO₂ trading market. In the light of its experience with the first two phases, the European Union is currently mired in debate over “set-asides” – withdrawal of a large fraction of the CO₂ allowances that will be allocated in the third trading period from 2013 to 2020, in order to bolster the CO₂ price.³⁷⁶

In addition, the national carbon caps established from 2005 to 2012 will be replaced by a single cap for the whole Union, with the cap declining annually

to 79% of its 2005 level by 2020. This time, unlike before, approximately half the total allowances allocated each year will be auctioned instead of handed out free.³⁷⁷

Nevertheless, the market's experience with the first two phases of the European scheme demonstrates clearly that CO₂ cap-and-trade is ineffective at holding CO₂ emissions in check. If European Union member states can't agree on set-asides, or conflicting national initiatives such as the UK's carbon price floor – a form of tax – get in the way, the third incarnation is doomed to failure as well. Lots of euros down the drain for a measure that isn't necessary in the first place.

North American Regionalism

While the European Union's cap-and-trade system mimics the Kyoto Protocol, with Union-wide limits on CO₂ emissions, its transatlantic counterpart North America is taking a regional approach to carbon pricing. This is because repeated efforts to introduce national CO₂ trading plans have been singularly unsuccessful in both the U.S. and Canada.

The U.S. Congress has rejected cap-and-trade legislation designed to reduce greenhouse gases, primarily CO₂, on a number of occasions since 2007. The most recent 2009 bill targeted electric utilities, fuel producers and manufacturing, setting a cap of 20% below 2005 emission levels to be attained by 2020, and a far-reaching 83% below 2005 emissions to be achieved by 2050.³⁷⁸

You may not know that the U.S. already has an emissions trading system in place for sulfur dioxide (SO₂), a toxic gas that causes acid rain when released into the atmosphere and, like CO₂, is generated from the combustion of fossil fuels.

But, while the program is often touted as a success, SO₂ emissions in the U.S. have fallen by only 25% since trading began in 1994.³⁷⁹ That's no more than the decrease that occurred previously between 1980 and the program's startup – a period when there was no SO₂ regulation at all, and when power plants and other SO₂ producers took only voluntary steps to cut their emissions. So much for the effectiveness of cap-and-trade.

Despite this unremarkable performance, the SO₂ program was used as a model for a failed 2008 bill to cap CO₂ and other greenhouse gases. Yet the principal reason for that bill's failure was not that Congress thought the plan might not work, but its enormous projected cost.³⁸⁰

In Canada, a similar cap-and-trade measure was first tabled in the federal Parliament in 2006. After dying in 2008 from lack of action and subsequently being defeated in 2010, the bill was reintroduced in 2011, only to languish again.³⁸¹ At the same time, Canada has announced its intention to withdraw from the global Kyoto Protocol, citing potential financial penalties that could be imposed because of its inability to keep a lid on CO₂ emissions.³⁸²

With national schemes completely off the table, several U.S. states and Canadian provinces have decided to go it alone with their very own cap-and-trade plans.

In the U.S., California is the Lone Ranger state when it comes to environmental regulation, having long enacted environmental laws and rules that most other states have barely considered. Of course, in the case of CO₂, the other states are wiser. California's new cap-and-trade regulation, which initially covers 360 businesses and takes effect in 2013, requires CO₂ emitters to turn in sufficient allowances to the state each year to cover their emissions. The goal is to restore emissions to the 1990 level by 2020 via an annually declining cap.³⁸³

In addition to California, nine states in the northeastern U.S. signed on to a regional initiative in 2012, under which CO₂ emissions from only the power sector will be cut 10% by 2018. Nearly all the emission allowances will be auctioned, the auction proceeds to be invested in energy efficiency and so-called clean energy technologies.³⁸⁴

California's cap-and-trade program is to be linked to a similar scheme starting up in 2013 in Canada's maverick province, Québec, the linkage to include combined auctions. Québec emits approximately one-sixth as much CO₂ and other greenhouse gases as California, and will require the same rigorous reductions in emissions.³⁸⁵ The provincial program is to begin with industrial emitters and will be extended to gasoline distributors in 2015.

Canadian province Alberta already has its own plan to reduce CO₂ emissions, based on a cap and on purchase but not trading, significantly, of carbon credits. The program requires large emitters to cut their emissions by 12% of a baseline level by either improving their operations, buying credits, or paying the provincial government for the amount of CO₂ by which they exceed the cap.³⁸⁶ Alberta, a large producer of both oil and natural gas, and the locale of the Canadian oil sands, emits about half as much CO₂ as California.³⁸⁷

On the other hand, Canada's British Columbia, whose CO₂ emissions are comparable to Québec's,³⁸⁸ initiated a carbon tax in 2008. The new revenues collected since then have been returned to consumers and businesses in the form of tax breaks and credits. However, the province is rethinking the tax policy because, it says, the U.S. and other Canadian provinces have not stepped up to the plate in tackling CO₂ emissions, and British Columbia shouldn't be a lone pioneer.³⁸⁹

But all this activity doesn't mean that North America's regional carbon pricing schemes will be any more effective at holding down CO₂ levels than the ETS has been in Europe. And, just like Europe's emissions control program, its North American sister programs will come at a cost.

One of the more immediate effects of controlling CO₂ emissions is that prices for electricity and other forms of energy go up, as utility companies pass on the cost of CO₂ allowances to their customers. Another important consequence is job losses that result from reduced industrial output, due to a combination of higher energy prices, the high cost of complying with the required emissions cuts, and greater competition from overseas manufacturers with access to cheaper energy.

A conclusion of the NAM report that I mentioned before was that between 3 million and 4 million U.S. jobs would disappear in 2030 if a proposed cap-and-trade bill became law.³⁶⁷ Similar estimates have been made by other organizations.³⁹⁰ On this basis, California can expect to lose hundreds of thousands of jobs a year once its cap-and-trade plan comes into being – along with Québec and Alberta in Canada.

And all for nothing, as CO₂ has little to do with global warming. Lots of dollars down the drain.

Other Countries

Japan has had a voluntary emissions trading system since 2006,³⁹¹ and Mexico recently passed climate change legislation that mandates a 50% reduction in CO₂ emissions below 2000 levels by 2050, although carbon pricing is not part of the new law.³⁹² A new cap-and-trade program in South Korea will start in 2015.³⁸⁵ And several smaller countries have carbon pricing schemes, including Australia and New Zealand.

Australia passed a package of laws in 2011 imposing a price on carbon, after several months of vigorous debate. The new laws established a carbon tax on the

nation's 500 largest CO₂ emitters, starting in July 2012, with the goal of cutting emissions by 2020 to 95% of their level in 2000.³⁹³

While the Australian tax prices carbon relatively high compared with the European Union, it will be replaced by an emissions trading scheme similar to Europe's in 2015. Export-focused industries with intensive emissions will be given free carbon permits for the first three years of that scheme. In the meantime, carbon tax revenues will be used to compensate export industries exposed to heavy competition overseas, as well as local steelmakers and 90% of the country's workforce³⁹⁴ – all of whom can expect to pay more for energy once the tax is enacted.

Australia's neighbor New Zealand initiated a CO₂ cap-and-trade system in 2008, featuring staggered entry of various sectors.³⁹⁵ The system appears to have had success in increasing reforestation, forest owners receiving carbon credits because forests absorb greenhouse gases.³⁹⁶

Nonetheless, New Zealand has been forced by the still shaky global economy to ease back on full implementation of its trading scheme. A planned doubling of the carbon price scheduled for 2013 has been postponed, and agriculture's entry into the system has been delayed from 2012 to 2015. Pointing out that half the nation's CO₂ emissions come from agriculture, the New Zealand Prime Minister recently stated: "The global demand for food is great and we want to supply that".³⁹⁷ Cap-and-trade is seen as a burden for New Zealand's agricultural industry.

The tussle between economic well-being and the need promoted by climate change alarmists to scale back CO₂ emissions is what will govern the success or failure of carbon pricing efforts worldwide. It is only slowly becoming apparent to alarmists and environmentalists that our western standard of living is intimately connected to the availability of cheap sources of energy which, up until now at least, have long been fossil fuels.

The Kyoto Protocol to limit greenhouse gas emissions, predominantly CO₂ from fossil fuels, has been a resounding failure, just like the European Union's ETS.

Drawn up with the intent of stabilizing global emissions of greenhouse gases, the protocol set the apparently modest goal of reducing emissions by 5.2% of 1990 levels by 2012. As of 2009, worldwide CO₂ emissions had *increased* by 31% since 1997 (the year of the protocol) and were still going up.³⁹⁸ Most of the increase can

be attributed to China and India, both of which have boosted their emissions considerably.

It's the developing nations, which today account for more than half of global CO₂ production, that will be hurt most by carbon pricing. The standard of living in the industrialized countries may decline because of higher energy prices associated with carbon caps or carbon taxation, but there can be no doubt that the cost of carbon pricing will have devastating economic effects for the Third World.

The overriding problem in the developing world is widespread poverty. It goes without saying that poor nations need the cheapest energy available to bring them into the industrial era and improve their quality of life – even to provide the basics such as clean drinking water and electricity.

But the energy won't be from wind turbines or solar cells that are still too costly for extensive use, even in industrial nations. They'll be conventional power plants burning coal or natural gas, just like those employed in the U.S. to generate well over half of the country's electricity, because coal and natural gas are plentiful and cheap. Coal-fired power stations are the principal energy sources that China and India are exploiting for rapid industrialization.

Alarmists like to argue that the developing world will have to bear the brunt of climate change, in the form of stronger hurricanes and higher sea levels that will flood low-lying nations, so that we need to limit CO₂ emissions for the sake of countries such as Bangladesh and the Maldives.

But as we've seen, CO₂ contributes little to global warming. And we have no control at all of the natural sources that are largely responsible for currently higher temperatures, such as the sun. So cutting back on CO₂ isn't going to do much to help the poorer nations on our planet cope with global warming, and will in fact be a major economic burden on them. That's why they're seeking to have the industrialized countries pay the bill for any action that is taken, something the western world can ill afford.

Lots of money down the drain – money that could be far better spent in adapting to the effects of global warming, if it resumes, on developing countries.

THE FALSE PROMISE OF RENEWABLES

The big hope behind carbon pricing is that it will create incentives for power plants and industrial operations to switch to alternative types of energy that

don't depend on burning fossil fuels, and therefore don't produce CO₂. These alternatives, frequently spotlighted in the media, include nuclear power as well as renewable energy sources, such as biofuels and hydroelectric, wind and solar power.

All these technologies exist today. The world knows how to build reliable wind turbines and solar panels, and to generate electricity from them. But the electricity is very expensive compared to what can be produced from fossil fuels, even if the cost of subsidies is ignored.

That's the rub. Renewable energy sources, and possibly nuclear power as well, are simply too costly at present to make any major inroads into the energy market.

So long as ample supplies of coal, oil and natural gas are available, basic economics dictates that these will continue to be the dominant sources of energy for years to come. The only other option is to make drastic lifestyle changes – and I don't just mean forgoing luxuries, but doing without all the labor-saving machines that are an essential part of our daily lives, and without heating or air-conditioning in all but the most severe climates, because these and other benefits of readily available energy can only be realized if the energy is affordable.

In any case, the game has now changed dramatically, thanks to a recent revolution in natural gas technology known as hydraulic fracturing or fracking.

Fracking unlocks previously inaccessible supplies of natural gas from shale rocks underground.³⁹⁹ The new technology has led to a totally unexpected boom in natural gas production in the U.S. and other countries, with the International Energy Agency predicting that worldwide supplies of shale gas could last more than 250 years.⁴⁰⁰ Large reserves exist in North America, Mexico, Argentina, China and Europe, among other regions.

Although there are possible environmental issues with fracking, it has the potential to make the U.S. a major exporter of natural gas, boost the economy, and even restore the nation's former industrial strength by providing inexpensive energy for steel mills and other manufacturing facilities.⁴⁰¹ The price of natural gas in the U.S. has already fallen drastically, and the shale gas share of the natural gas market is expected to increase from 23% in 2010 to 49% in 2035.⁴⁰²

While natural gas is still a fossil fuel, it's lower in carbon and considerably cleaner than coal, producing only half as much CO₂ when burned. Because it's

so cheap and abundant, it's already being used for electricity generation, as well as heating – and will displace renewables for the foreseeable future.

Don't get me wrong. I'm not opposed to alternative forms of energy generation and, as a former nuclear physicist, am a huge fan of nuclear power. But to think that renewable energy is going to play a significant role within the next 20 or 30 years is fooling ourselves.

It takes time, typically 20 to 25 years, to commercialize new energy technologies.⁴⁰³ That includes refining the technology, building pilot facilities, scaling the process, developing the infrastructure for energy distribution, and getting the cost down to where the technology won't break the bank. And once the technology is commercial, it can take many more years for it to gain an appreciable share of the market.

Even though some of these steps have already been taken for wind and solar energies, the costs of both need to fall a lot more before they will be market ready. In contrast, the basic groundwork on fracking began in the 1940s and the process was commercialized in the 1980s, but the cost only started to drop in the early 2000s.

Failure to understand the commercialization time frame was one of the main reasons for the 2011 bankruptcy of Solyndra, a Silicon Valley-based solar company that was the recipient of a \$535 million loan from the U.S. Department of Energy (DOE) just two years earlier,⁴⁰⁴ and for the collapse of a slew of other publicly funded energy startups.⁴⁰⁵

In the short term, it's highly unrealistic to think that all but a small fraction of the energy we require for electricity and transportation could come from anything but fossil fuels. And renewables will always be supplemental energy sources, since no single source will come close to providing sufficient power for a whole country.

A case in point is wind energy. Wind is currently favored by many environmentalists because the technology is clean, simple – basically a modern version of the old-fashioned windmill – and well established. The principal drawback is that even in windy areas, the wind doesn't blow all the time, so wind energy can only be delivered intermittently.

TABLE 7.1: CARBON PRICING

Control of CO₂ emissions

- The UN Kyoto Protocol mandated the lowering of CO₂ emissions from industrialized countries, by an average of 5.2% of 1990 levels, by 2012.
- To achieve this target, the European Union introduced a CO₂ cap-and-trade system. Trading of the initially free CO₂ allowances began in 2005.
- North America has taken a regional approach to carbon pricing, with emissions trading schemes established in California, nine northeastern U.S. states, Canadian provinces Québec and Alberta, and a carbon tax in British Columbia.
- Several other nations have carbon pricing systems, including Australia, New Zealand and Norway.
- Carbon pricing schemes are expected to speed up development of renewable forms of energy that don't generate CO₂, such as wind power.

WHAT'S WRONG WITH CARBON PRICING?

1. Controlling CO₂ emissions will have little impact on global warming, most of which likely comes from natural causes.
2. Cutting back on CO₂ will cost trillions of dollars – wasted money that could be used instead for adapting to any future effects of climate change.
3. Europe's Emissions Trading Scheme has failed twice in seven years, with the price of CO₂ allowances reaching rock bottom in 2007, and dropping to an unsustainable level in 2012, while European emissions increased.
4. Both the U.S. and Canada have rejected national CO₂ trading plans. Canada is about to withdraw from the Kyoto Protocol, and British Columbia is rethinking its carbon tax.
5. Carbon pricing increases the cost of living by raising energy prices, which can nudge the economy into recession.
6. The cost of carbon pricing falls most heavily on the poor. This cost will be a major economic burden for the developing countries, as well as the less well-off in industrialized nations.

7. It will be decades before renewable energies gain an appreciable share of the energy market, partly because of their high current cost and partly because they are about to be displaced by natural gas from shale. Switching to renewables won't reduce overall CO₂ emissions, since wind and solar power require backup energy from fossil fuels.
8. Carbon pricing schemes cause job losses that outnumber the green jobs created in renewables.

Nevertheless, the DOE, in conjunction with wind turbine manufacturers, utility companies and others, has recently studied the feasibility of supplying 20% of the nation's electricity from wind energy by 2030.⁴⁰⁶

The study concedes that a 20% wind scenario by 2030 is ambitious and will require "significant changes in transmission, manufacturing, and markets".⁴⁰⁷ The largest challenge will be in transmission, since wind energy can't be stored and most of it will be produced in sparsely populated areas of the country, which are also the windiest. The DOE study estimates that construction of the necessary transmission lines will add about 10% to the capital cost of building the extra wind energy capacity, a cost that will be borne by consumers.

But neither technical challenges nor cost are the main issue here. If the purpose of manufacturing enough wind turbines to meet 20% of the U.S. demand for electricity is to get away from burning fossil fuels, then the exercise is another massive boondoggle.

By the study authors' own admission, generating that amount of electricity from wind in 2030 will avoid only about 10% of the CO₂ emissions that would occur without any significant boost in wind power.⁴⁰⁸ Projected CO₂ emissions from all energy sources in 2035, even with all that additional wind energy, will still exceed today's emissions by about 2% from DOE statistics,⁴⁰⁹ the biggest contribution by far to CO₂ reduction coming from the increased use of natural gas.⁴¹⁰

Experience in Denmark – the world's most wind-intensive nation, with more than 5,000 turbines – is unimpressive. Even though the country claims that it generates 20% of its electricity from wind, the reality is that an average of less

than 10% was actually used in Denmark between 2004 and 2009. Because much of the energy is produced at night when demand is low, the rest was exported to nearby countries such as Germany. But despite all this, Danes paid three times more for electricity in 2008 than they did in 2000, when the number of wind turbines was much lower.⁴¹¹

Additionally, several countries have found that extra coal-generated electricity is needed to cover the unpredictability of wind power.⁴¹² On top of all this, turbines are unsightly and noisy, both of which concerns have halted the building of additional onshore turbines in Denmark and elsewhere.⁴¹³

I'm all in favor of developing renewable energies such as wind, in the U.S. and globally. But let's not delude ourselves that taking this path is going to reduce the world's CO₂ emissions or have any noticeable effect on global warming.

Not everyone is as optimistic about the potential for renewables as the authors of the wind scenario study. The DOE's annual report for 2012 predicts that only 4% of U.S. electricity generation in 2030 will come from wind power, not the 20% projected in the study, and that the total contribution from *all* renewable sources will be only 15%.⁴¹⁴

In 2030, coal and natural gas combined will still be providing two thirds of U.S. electricity, down only slightly from today,⁴¹⁵ if we don't want to go back to living in caves. Even the wind study recognizes that "coal power will continue to play a major role in future electricity generation".⁴⁰⁶

So the world will still be putting lots of CO₂ into the atmosphere unless, perhaps, we can develop so-called clean coal technology. This entails capturing the CO₂ generated by burning coal and other fossil fuels, and storing it deep underground. But the technology is unproven and likely to be extremely expensive.

Solar power was once a leading contender for the energy source of the future. However, while solar technologies play an important role in sunny, remote parts of the globe where there is no electric grid, and on satellites, they are still much too costly for grid-connected use in the developed world. Like wind energy, solar energy can't be easily stored and, of course, the sun doesn't shine at night.

The simple truth is that renewables don't, and won't in the future, have the capacity to meet the world's thirst for energy. Currently, the largest source of renewable energy in the U.S. is hydroelectric power, but this won't grow much

beyond its present level because the country has run out of unused reservoirs in the mountains.

An argument often used to justify the anticipated high cost of switching to renewable forms of energy is that they will create jobs – green jobs. But this is an illusion, as countless recent examples illustrate.

The DOE wind scenario study calculates how many jobs would be created by building the turbines needed to achieve the study's goal of 20% wind energy capacity by 2030, using a standard economic impact model. The results wouldn't excite too many economic development departments, with an average of 260,000 new jobs created annually between now and 2030 in manufacturing, construction, turbine operations and related businesses. That's for the whole U.S. In most states, there would be under 10,000 new jobs per year.⁴⁰⁶

Even this is an unrealistically high number, according to a 2011 article in the U.S. newspaper *The New York Times*⁴¹⁶ – a publication that often advocates the alarmist view of climate change. In California's Silicon Valley, which is a hotbed of investment in renewable energy technologies, the article quotes a study by the nonpartisan Brookings Institution as finding that clean-technology jobs actually disappeared from 2003 to 2010 in San Francisco's South Bay area. Many of the jobs that were created are actually in low-wage countries such as China. And of metropolitan areas nationwide, only 53% added clean-technology jobs at a faster rate than other sectors of the economy during the same period.⁴¹⁷

Further evidence of the green jobs fantasy comes from Spain, which is part of the European Union's cap-and-trade system. A Spanish study found that for every new job created in renewables, particularly wind energy, slightly more than two jobs have been lost. Added the study's author: "The loss of jobs could be greater if you account for the amount of lost industry that moves out of the country due to higher energy prices."⁴¹⁸

Although the Spanish study has been criticized for its methodology,⁴¹⁹ it's probably no coincidence that the country's unemployment rate was approaching 25% in early 2012 and its banking system was in crisis. These adverse effects should have been expected, since wind power costs more than conventional sources of energy and, as the U.S. NAM report concluded, millions of jobs can be lost under cap-and-trade.

Creating green jobs is an admirable objective, but not if it destroys existing jobs in traditional industries. Carbon pricing simply doesn't add up.

Furthermore, the negative economic effect of job losses from carbon pricing is compounded by the heavy subsidization of new jobs in renewable energies. According to the DOE, U.S. government subsidies in 2010 amounted to \$52.48 per megawatt hour (5 cents per kilowatt hour) for electricity produced from wind, compared to only 64 cents for coal and \$3.10 for nuclear energy.⁴²⁰ Although the subsidy for wind energy is declining, the present subsidy cost will be passed along to consumers.

That's exactly what has happened in the Canadian province of Ontario, where the provincial government has established electricity feed-in rates for solar and wind energy. The wind-power rates are more than double those for nuclear power and four times higher than hydroelectric power.⁴²¹ Other countries such as Denmark and the UK also subsidize wind power heavily.

Subsidies, insufficient capacity, and job losses – that's what we can expect for renewable energy, if we force the pace of development as carbon pricing will. And while renewables will slow the growth of CO₂ emissions slightly, there's no sign that the CO₂ level will actually fall. Of course, it doesn't matter much if the CO₂ level falls or not anyway, as far as global warming is concerned.

Chapter 8: Reflections

The flawed science behind the IPCC's assertion that global warming is man-made reveals an almost pathological pattern in the behavior of climate change alarmists. It's the alarmists, not skeptics, who are in denial.

The pattern starts innocently enough, with exaggeration. We're surrounded by hype in our lives, in everything from advertising to politics, so it shouldn't be a big surprise that global warmists overstate their case to gain attention, even if the distortion goes beyond the boundaries of good science.

We've seen at least two instances of alarmist exaggeration in this book. In Chapter 2, I discussed how the current global warming rate has been inflated about 25% by the IPCC and its fellow travelers, due to the urban heat island effect. In Chapter 4, I described how the IPCC exaggerates the sensitivity of the Earth's climate to CO₂, thanks to deficient computer climate models.

But hype alone is insufficient for the alarmist crowd. The second, and more sinister, element of the denial pattern goes further than exaggerating measurements or calculations by manipulating the very data itself, in order to make it conform with the CO₂ global warming hypothesis. This is not just dishonest, but fraudulent and flies in the face of everything that science and the time-honored scientific method represent.

There are several examples that I've described of how alarmists have twisted data to fit anthropogenic global warming theory. The most notorious is the conspiracy among the Climategate perpetrators to hide the decline in late 20th century tree-ring temperatures, which were selectively discarded in creating the infamous hockey stick. Splicing tree-ring data from earlier centuries with

modern thermometer readings was a convenient but deceptive ploy to make historical temperature and CO₂ records match up during the Middle Ages, in accordance with the CO₂ hypothesis.

Other glaring examples of egregious data manipulation by alarmists include NOAA stretching the global warming rate as time goes on (Figure 2.2), and GISS inflating the warming rate by tampering with past temperatures (Figure 2.6). And we saw how a recent study, echoing the hockey stick story, manipulated proxy temperature data to make it look like increased CO₂ led global warming at the end of the last ice age – in direct contradiction to ample evidence that CO₂ levels actually lagged ice-age temperatures (Chapter 4).

However, even exaggeration and data manipulation aren't always enough for climate change alarmists to get their message across. The third and final element in the denial pattern, invoked when the observations still don't match theory, is to either pretend that they do or to blame the data.

An apt illustration of alarmists burying their heads in the sand, pretending that their CO₂ theory is alive and well, is use of the word hiatus to describe the current period of global cooling. The word itself suggests the interruption in global warming is only temporary, which it may be – but with nothing except computer models to substantiate the hiatus idea, continued cooling is just as likely.

Faulting the data itself is becoming a favorite alarmist tactic, as more and more predictions of the climate models that underpin the CO₂ theory founder on the rocks of reality.

That the predicted atmospheric hot spot above the tropics is missing has been blamed on imprecision in balloon temperature measurements (Chapter 3), despite the fact that comparable uncertainty exists in computer estimates of climate sensitivity, which form the basis of the whole global warming scare. And the ocean heat that climate models say is missing has been blamed on our inability to measure heat at great ocean depths, where the majority of alarmists insist it must be hiding.

Why do climate change alarmists indulge in so much deception, either consciously or unconsciously? Exploring the answers to this question could take another book, but there can be little doubt that the ever increasing desperation exhibited by many alarmists today stems from the current cooling trend. As more

and more evidence against the CO₂ theory of global warming piles up, the alarmist pronouncements become ever more shrill and ridiculous.

This is a superb example of what psychologists call cognitive dissonance.⁴²² The term usually refers to people's reaction on learning something that conflicts with a strongly held belief – here, that global warming is man-made. In cognitive dissonance, the reaction to the conflicting evidence is to dismiss it, even if that's irrational.

You may be wondering how rational, well-educated climate scientists and others – including the many learned scientific societies that subscribe to the CO₂ theory – can behave this way, how they can't bring themselves to even consider evidence, sometimes overwhelming, that contradicts their beliefs. The explanation may reside in superstition.

Superstition, which is rooted in fear and thought to emanate from the reptilian portion of our brains, has been part of the human psyche ever since the emergence of self-consciousness in early mankind. Since then we humans have learned to speak, write, read, and live together in comparative peace. But we're still superstitious. Superstition about the weather in particular is hardly surprising, given the awesome power of the forces of nature. Witnessing storms, lightning and even the daily rising and setting of the sun must have induced fear and wonder in primitive cultures.

The same fear and wonder are what climate change alarmists exploit today in linking weather extremes, which have occurred from time immemorial, to global warming. Superstition is what lies behind present-day climate hysteria that connects every heat wave, major flood and tornado outbreak to man-made CO₂.

In historical societies, scholars tell us that weather superstition often found expression in ritual human sacrifice. The Mayans, for example, tossed victims into a limestone sinkhole as part of a ritual to appease the rain god Chaac.⁴²³ If seasonal rains came too soon or too late, or if drought took over, crops would fail and both people and livestock would be short of food. The Aztecs and Druids are among other cultures that practiced human sacrifice, although weather concerns were not the only reason.⁴²⁴

Fortunately, climate change alarmists don't advocate human sacrifice, even though there have been occasional alarmist calls to execute or blow up global warming skeptics.⁴²⁵ But it's only a few centuries since superstition over the

climate led to intensive witch hunts and widespread executions, usually by burning, for witchcraft.

After economist Emily Oster demonstrated in 2004 that the most active era of witchcraft trials in Europe coincided with the Little Ice Age,⁴²⁶ other researchers have argued that cold weather may have precipitated the Salem witch trials in the U.S. between 1680 and 1730⁴²⁷ – one of the chilliest periods of that epoch. It was widely believed during the late Middle Ages that witches were capable of controlling the weather with their magic powers and, therefore, causing storms that could destroy harvests and cripple food production.

Things are not so different now. The same superstitions that caused medieval populations to fear and hunt witches can explain the phenomenon of cognitive dissonance among climate change alarmists who find it necessary to manipulate or deny the evidence against the theory of man-made global warming. The irony is that while climate change skeptics might be regarded as modern-day witches because they believe that global warming comes from natural forces, especially the sun, it's superstitious alarmists who are really the witches.

Climate change alarmism is often likened to religion, which is based on faith. However, while belief in anthropogenic global warming theory certainly has a strong element of faith, the excessive fear of impending disaster is more akin to superstition or witchcraft. But let's not burn the witches!

Witches or not, climate change alarmists go to great lengths to marginalize skeptics, in order to prop up the baseless assertion that global warming comes predominantly from human CO₂ emissions. Nonetheless, it's not the first time in the history of science that the mainstream view of the day has been badly mistaken.

The most famous example is Galileo Galilei, the distinguished Renaissance scientist who made important contributions to modern physics, but was tried by the Inquisition and confined to house arrest for the final years of his life – simply for promoting Copernicus' theory that the sun and not the Earth is the center of our solar system, contrary to church doctrine of the time. Had he not been so eminent, Galileo would probably have been burned at the stake.

Another example, which presents a striking parallel to current global warming hysteria and attempts by the climate "thought police" to suppress contrary opinions, is the persecution of 20th century Soviet Union geneticists by Stalin's

agricultural director, Trofim Lysenko. Lysenko's fictitious theory that crop yields could be increased by cold treating grain seeds not only led to devastating famines, but also to the banishment to labor camps of scientists who opposed his ideas, and even their execution.

Although we're a little more enlightened today, climate change skeptics often find they need to keep quiet about their views, especially in a professional setting, as I mentioned at the beginning of the book. There has been more than one recent instance of university academic staff being let go because of their skeptical stance on global warming.⁴²⁸

In March 2012, a group of 50 former NASA employees wrote an open letter to the space agency complaining about the "unbridled advocacy by NASA and GISS" of CO₂ being the major cause of climate change, and pointing out that this position was completely at odds with NASA's history of objectively evaluating its scientific data prior to making decisions or public statements.⁴²⁹ It's clear that the letter's authors, who included seven former astronauts, only felt safe enough to voice their concerns after retiring from NASA.

As we've seen, what the IPCC and climate change alarmists fall back on above all else, to reinforce the dubious claim that man-made CO₂ causes global warming, are computer climate models.

It's a sign of the times, and of today's embrace of junk science, that the projections of these computer models are rarely questioned, even though the models are full of unfounded assumptions. One of the biggest assumptions in most models is that the sensitivity of the climate to CO₂ is just the same now as it was during the ice ages, even though the climate was very different back then.

And there's all the difference in the world between a computer model used to design, say, an airplane and a computer climate simulation. Most of us have few qualms about traveling through the skies in a pressurized tube that sprouts wings, because we know somewhere – at least at the back of our minds, if we're not engineers or scientists – that our flying machine obeys the well-known laws of aerodynamics. So much so that we're completely comfortable when the pilot switches over to autopilot and the plane basically flies itself.

But the Earth's climate system is a far cry from a jet plane. I don't think it's too much of a stretch to say that our understanding of climate is still in its infancy. Barely 40 years have passed since a superstitious world came to believe en masse

that the next ice age was imminent, less than a decade before attention switched to global warming.

It's very presumptuous for us to think we're anywhere near unraveling the many mysteries of climatology, especially the role played by greenhouse gases. We know something about the sun and the atmosphere, about oceans and wind, but there's a whole lot we don't know about clouds, water vapor, atmospheric wind patterns, ocean heat and salinity, and cosmic rays – not to mention a host of other climatic variables and influences. All of these are incorporated in computer climate models as adjustable parameters, generally numbering in the hundreds.

Scientists in other fields sometimes agonize over the precise value of just a single adjustable parameter, often to a high degree of accuracy. Why should we pay any attention to the results of computer models containing multiple parameters, when most of the parameters can't be specified very accurately at all? No wonder so many climate predictions made by the IPCC's models have turned out to be wrong.

Even the most fundamental predictions about temperature made by the IPCC are incorrect. All its models project ever increasing global warming, from the year 2000 through the end of the century. Yet temperatures have been falling since 2001.

I'm not saying the mercury can't start going up again, but most IPCC computer models never even hinted that it might go down. And it's not just surface temperatures that have decreased: the ocean depths have stopped warming as well. Also faulty in climate models are the temperature trends at the North and South Poles, where the warming rate should be highest but is essentially the same as elsewhere on the planet, and forecasts of stronger hurricanes and the disappearance of the Arctic ice cap that haven't been borne out.

Could the models be any worse?

In essence, IPCC computer climate models are preprogrammed to deliver the result that a minuscule amount of CO₂ in the atmosphere is the dominant source of global warming.

Everything that conflicts with this result is either left out of the simulations altogether, or minimized – by deceit if necessary. This highly selective and scientifically dishonest approach is behind the IPCC claim that its computer models can only reproduce the 20th-century temperature record if they omit all sources

of natural variability except the sun, which the models barely account for in any case.

Never mind that there is abundant evidence that the sun's role in global warming has been grossly underestimated in climate models, nor that the models ignore indirect warming from solar blocking of cosmic rays and UV absorption in the ozone layer, nor that most models omit interconnections between the sun and the oceans. And never mind natural climate cycles such as the PDO that the IPCC can't even model adequately, let alone consider as possible alternatives to CO₂ as the source of global warming.

Yet the IPCC insists that it can say with 90% confidence that human activities since 1750 are the source of global warming, and that it is 90% sure of even higher temperatures in this century if we continue to emit CO₂ and other greenhouse gases. It's these high IPCC confidence levels, totally unjustified by the evidence, that have led to the false and scientifically untenable belief that a consensus exists on human-induced global warming.

Human nature being what it is, not all skeptics are paragons of scientific virtue either. I've come across Internet blogs in which authors bend the truth in defense of the skeptical cause, though such distortion is completely unnecessary even from a political viewpoint, with ample evidence to support the case against CO₂ as we've seen.

Were that the end of the story, there wouldn't be too much cause for concern. Science has undergone comparable attacks in the past – from the Inquisition and Lysenko, for example – and has survived, with corruption and suppression of the truth eventually yielding to renewed belief in the merits of the scientific process.

But the IPCC has spun its web of deceit so far and wide that many world leaders have latched on to the IPCC view that CO₂ emissions must be drastically curbed for the good of the planet, and the sooner the better. The problem with this erroneous alarmist message is that action on CO₂ is going to create a financial debacle and stunt economic growth, to fix something that doesn't need to be fixed in the first place. It will cost trillions of dollars to put a price on carbon worldwide, money that could be better spent dealing with the effects of global warming, if it resumes.

The real tragedy is not that we're doing nothing about global warming, but that most of the financial burden of this completely misguided global effort to control

CO₂ emissions will fall on the poor. The cost of carbon caps or a carbon tax will be especially devastating for developing countries, already struggling to catch up to their industrial neighbors.

The alarmist response to such social concerns is that carbon pricing is needed to prod energy companies into developing alternative, CO₂-free sources of energy, such as nuclear power and renewables. But to think that renewable sources can provide more than a fraction of our future energy needs, or that turning to renewables is going to cut CO₂ emissions very much, if at all – or is going to create jobs – is an illusion.

A prevalent belief among environmentalists is that wind turbines and solar cells can meet the bulk of the world's electricity demand. But as Earth-friendly as this belief may be, the reality is that neither the wind nor the sun can deliver energy on a constant basis, nor can the energy be readily stored. So steadier, backup sources are required, and that means continuing to rely on fossil fuels such as coal and natural gas, as recent Danish experience has shown.

But all this is a massive exercise in futility anyway, because CO₂ has little to do with global warming. If we could turn our attention away from CO₂ to one of humanity's real troubles, future generations are much more likely to thank us than if we squander our resources on an imaginary problem.

And, just like a roller coaster ride or a stock price trend, the warming of the 20th century eventually came to an end. Currently, the planet is in a cooling mode that began around 2001, just as it was twice before during the period since 1850. Yet the CO₂ level has been going up relentlessly during all this time, regardless of whether the thermometer was rising or falling.

The real test will come around 2016, a few years from now.

Even the most ardent climate change alarmists concede that a flat or cooling trend that lasts more than 15 years is incompatible with the predictions of computer climate models, which link global warming to rising CO₂. The models commonly predict temperature trends that are very slow and even negative over intervals up to a decade, say the modelers, but any standstill or decline for longer than 15 years would be the kiss of death⁴³⁰ – for both the models and the CO₂ global warming hypothesis.

With some alarmists already talking about renewed warming in 2013-2014, only time will tell.

Appendix: Climate Feedbacks and Sensitivity

Climate sensitivity can be expressed either as the temperature change caused by a doubling of the atmospheric CO₂ level, usually from its preindustrial level in 1850, or as a measure of the climate feedbacks that contribute to that sensitivity.

It is common to define a climate feedback parameter (measured in units of W/m² per °C), which is the inverse of the climate sensitivity parameter (measured in units of °C per W/m²).⁴³¹ The IPCC has created some confusion over the use of these terms by employing the same symbol λ for both of them at different times: its 2007 Fourth Assessment Report refers to λ as the climate feedback parameter,⁴³² while the 2001 Third Assessment Report defined λ as the climate sensitivity parameter.⁴³³ But the switch in terminology does bring the IPCC in line with current usage by most climatologists.

The climate feedback and sensitivity parameters are defined by:

$$\text{Feedback parameter } \lambda = \Delta F / \Delta T, \quad (\text{A1})$$

$$\text{Sensitivity parameter} = 1 / \lambda = \Delta T / \Delta F, \quad (\text{A2})$$

where ΔF (in units of W/m²) is the external radiative forcing and ΔT (in °C) is the change in global surface temperature due to that forcing. From Equation (A1) or (A2), the climate sensitivity ΔT is then:

$$\text{Sensitivity } \Delta T = \Delta F / \lambda, \quad (\text{A3})$$

where λ is the feedback parameter.

For greenhouse gases such as CO₂, well mixed into the atmosphere, a good approximation to the radiative forcing is:

$$\Delta F = 5.35 \ln(C/C_0),^{434} \quad (\text{A4})$$

in which C_0 and C are the concentrations of CO_2 , before and after the forcing ΔF takes effect, respectively. C_0 and C are usually measured in units of parts per million by volume (ppmv).

The value of ΔT corresponding to doubled CO_2 ($C = 2C_0$) is the most commonly used measure of climate sensitivity, sometimes known as the equilibrium climate sensitivity, but the sensitivity can be calculated for any change in CO_2 concentration.

While the climate sensitivity should in principle include other greenhouse gases such as methane, it turns out that the forcing from CO_2 alone is almost the same as the net forcing from all human sources included in IPCC climate models – which embrace both positive forcings such as greenhouse gases and negative forcings such as aerosols.⁴³⁵ Therefore, the sensitivity for CO_2 is a good measure of the overall climate sensitivity.

Values of the feedback parameter and the climate sensitivity, either taken from the technical literature or determined from the equations above, are shown in Table A.1 for a number of different climate models (IPCC and Hansen), and for calculations based on satellite observations (Lindzen and Spencer). The climate sensitivity numbers were presented previously in Table 4.2.

Table A.1: Calculated CO_2 Climate Sensitivity

Model or calculation	Feedback parameter ^a	Predicted temperature change	
		Today	At doubled CO_2
IPCC (2001)	0.9-2.1 ⁴³⁶		3.5°C ⁴³⁷
IPCC (2007)	0.7-2.0 ⁴³⁸	0.76°C ⁴³⁹	3.3°C ⁴⁴⁰
Hansen ⁴⁴¹	1.4	0.6°C	2.7°C
Lindzen ⁴⁴²	5.1	0.36°C ^b	0.73°C ^c
Spencer ⁴⁴³	up to 8.3	0.22°C ^b	0.45°C ^c
Zero CO_2 feedback	3.3 ⁴⁴⁴	0.55°C ^b	1.1°C ^c
Positive CO_2 feedback	< 3.3	> 0.55°C	> 1.1°C
Negative CO_2 feedback	> 3.3	< 0.55°C	< 1.1°C

^a Measured in units of W/m^2 per °C

^b Calculated from Equations (A3) and (A4), with $C = 393$ ppm (its 2012 level), and $C_0 = 280$ ppm (the preindustrial level, according to the IPCC⁴⁴⁵)

^c Calculated from Equations (A3) and (A4), with $C = 2C_0$

The IPCC models, which are mostly so-called Atmosphere-Ocean General Circulation Models (AOGCMs), are based on computer simulations of the Earth's climate, the climate sensitivity often being determined by matching the model output to paleoclimatic conditions. James Hansen's model, which is one of the current IPCC models and was developed at GISS, is listed separately.

Richard Lindzen's calculation (with Yong-Sang Choi), showing negative CO₂ feedback, is based on satellite observations of sea surface temperatures in the tropics and of outgoing longwave (infrared) radiation at the top of the atmosphere.⁴⁴² The authors conclude from their analysis that climate sensitivity is exaggerated by computer climate models, as seen by comparing the predictions from models in Table A.1 with those from experimental observations.

An earlier study by Lindzen and Choi had been strongly criticized for its computation of climate sensitivity and other shortcomings.⁴⁴⁶ Nevertheless, the later study, which took the criticisms into account, came to essentially the same conclusions as before – including overall negative feedback, and a climate sensitivity well below what computer models predict.

Roy Spencer's calculation of climate sensitivity is founded on satellite observations of both reflected shortwave (solar ultraviolet) and outgoing longwave (infrared) radiation over the global ocean.⁴⁴³ Like Lindzen and Choi's observational study, Spencer's analysis also finds that net CO₂ feedback is negative.

The range of feedback parameters shown for the IPCC models in Table A.1 reflects the variation between the different models. The climate sensitivities for doubled CO₂, however, are means over a large number of the models; the feedback parameters that correspond to the calculated sensitivities of 3.5°C (2001) and 3.3°C (2007) are both close to 1.1 W/m² per °C. Expressed in terms of the climate sensitivity parameter, which relates the temperature change to its associated forcing, this is a sensitivity of 0.9°C per W/m².

The climate sensitivities from IPCC models that have been matched to ice-age climate data range from 2.3°C to 3.7°C,⁴⁴⁷ corresponding to feedback parameters ranging from 1.6 to 1.0 W/m² per °C, respectively. Higher feedback parameters signify lower climate sensitivity, as can be seen from Equation (A3).

In Tables A.1 and 4.2, the 2007 IPCC value of the sensitivity for the present climate is 0.76°C, exactly the same as the IPCC's stated temperature increase since 1850,⁴⁴⁸ because the computer simulation results are fitted to this increase.

The present-day climate sensitivity of 0.6°C from the Hansen model is lower because it (as well as the value for doubled CO₂) is calculated relative to 1880, rather than 1850 when global temperatures were slightly lower (see Figure 1.1).

With the exception of the 2007 IPCC number, the present-day climate sensitivities in the two tables depend on the preindustrial baseline level C_0 that is assumed for the atmospheric CO₂ concentration. However, from Equations (A3) and (A4), the sensitivities for doubled CO₂ ($C = 2C_0$) are the same regardless of the baseline level, the only change for a higher baseline being a higher final CO₂ level.

Although Tables A.1 and 4.2 don't indicate any errors in the estimates of feedback parameter or climate sensitivity, which is for simplicity of presentation, all the numbers shown are subject to uncertainty. For example, the IPCC's 2007 estimate of 3.3°C for the mean climate sensitivity is actually $3.26 \pm 0.69^\circ\text{C}$, where the error is given as ± 1 standard deviation.⁴⁴⁰

Feedback and Amplification

As described in Chapter 4, positive feedbacks amplify the Earth's natural greenhouse effect for CO₂, while negative feedbacks diminish the effect.

Without any feedback at all, the climate sensitivity for doubled CO₂ is 1.1°C, corresponding to a feedback parameter of 3.3 W/m² per °C (Table A.1). This value of the feedback parameter, sometimes called the Planck feedback parameter, represents the infrared energy (3.3 W/m²) that the Earth would radiate away in response to a sudden warming of 1°C, as calculated by computer climate models.⁴⁴⁴

The calculation is based on the Stefan-Boltzmann law of blackbody emission, which governs the temperature dependence of emitted longwave (infrared) radiation. In the absence of other climate feedbacks, radiative temperature damping by the Earth is a strongly negative natural feedback.

Sensitivities above 1.1°C, which correspond to feedback parameters less than 3.3 W/m² per °C, are associated with net positive CO₂ feedback; sensitivities below 1.1°C, corresponding to feedback parameters greater than 3.3 W/m² per °C, imply that the net CO₂ feedback is negative.

Amplification factors for both types of feedback are shown in Table A.2. The amplification (or gain, in electronic terminology) is defined as:

$$\text{Amplification} = \Delta T / \Delta T_0, \quad (\text{A5})$$

APPENDIX

where ΔT is the climate sensitivity with feedback and ΔT_0 is the sensitivity without feedback.

Table A.2: CO₂ Amplification Factors

Type of feedback	Model or calculation	Feedback parameter ^a	Amplification ^b
Positive	IPCC (2007)	2.2 ^c	3.0 (200%)
Positive	Hansen	1.9	2.4 (140%)
Zero	None	0.0	1.0 (0%)
Negative	Lindzen	- 1.8	0.65 (-35%)
Negative	Spencer	down to - 5.0	0.4 (-60%)

^a Measured in W/m² per °C, relative to $\lambda_0 = 3.3$ W/m² per °C

^b At doubled CO₂

^c Corresponding to a value of 1.1 W/m² per °C for the IPCC (2007) feedback parameter in Table A.1

The amplification can be calculated directly from the climate sensitivity numbers in Table A.1, using Equation (A5), or from the feedback numbers in Table A.1, using the equation:

$$\text{Amplification} = \frac{1}{1 - \lambda/\lambda_0},^{449} \quad (\text{A6})$$

in which λ is the feedback parameter measured relative to the zero feedback value of $\lambda_0 = 3.3$ W/m² per °C, and $\lambda = \lambda_1 + \lambda_2 + \dots + \lambda_n$, where n is the number of independent feedbacks. Under the sign convention for Equation (A6), positive or negative feedback parameters have a positive or negative sign, respectively, and λ_0 is taken to be positive.

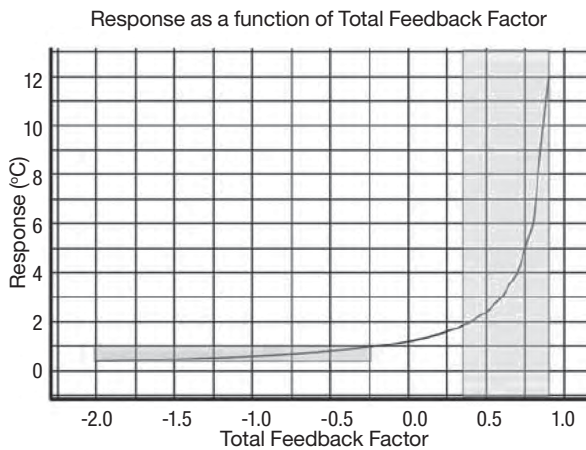
The amplification expressed as a percentage is also positive or negative for positive or negative feedback, respectively. Positive feedback or amplification results in magnification of the climate system's temperature response to CO₂ without feedback, while negative feedback or amplification results in diminution of the response.

When the feedback parameter in Table A.1 approaches zero, which means the relative feedback parameter in Table A.2 approaches λ_0 , the climate sensitivity and the amplification become infinite (Equations (A3) and (A6)). This corresponds to so much positive feedback that a runaway greenhouse effect occurs,

which could lead to a hothouse climate on Earth. Yet even the IPCC does not suggest that's likely.

The response of the climate system to small changes in feedback is illustrated in Figure A.1. For positive feedback, relatively small variations in feedback cause considerably larger changes in response – which is why the climate sensitivity in computer models covers such a large range. For negative feedback, large variations in feedback cause little change in response.

Figure A.1: CO₂ Climate Sensitivity and Feedback



Source: Lindzen and Choi.⁴⁴² The horizontal scale shows the feedback factor λ/λ_0 in Equation (A6), while the response indicated on the vertical scale is the climate sensitivity defined in Equation (A3).

Finally, we should note that everything on climate feedbacks and sensitivity summarized here is based on the assumption that the feedbacks are linear – that is, CO₂ and other feedbacks are linearly dependent on the temperature response. But the Earth's climate system is highly *nonlinear* in many ways, and can even be considered chaotic (showing apparently random behavior) in a mathematical sense. So any calculations of feedback and climate sensitivity should in principle be founded on nonlinear feedback theory.

Inclusion of nonlinear quadratic terms in the analysis of feedbacks from IPCC climate models appears to show significant nonlinearities, especially in the feedbacks from high clouds and temperature/altitude (lapse rate).⁴⁵⁰ This underlines how little is really understood about climate feedbacks.

Glossary

- AMO the Atlantic Multidecadal Oscillation, a natural climate cycle in the Atlantic Ocean
- aerosol a suspension of tiny particles in the atmosphere, often resulting from the burning of fossil fuels
- BEST Berkeley Earth Surface Temperature study
- cap-and-trade..... a market trading scheme that limits emissions of a toxic pollutant, or of a greenhouse gas such as CO₂, into the atmosphere
- carbon cap..... the limit imposed on annual CO₂ emissions in a cap-and-trade scheme
- CBO U.S. Congressional Budget Office
- Celsius the metric temperature scale
- Climategate..... the leaking of thousands of CRU emails and documents onto the Internet in 2009 and 2011; the emails were between top climate scientists over the period from 1996 to 2009
- climate sensitivity the response of the Earth's climate system to a forcing such as solar radiation or added CO₂ in the atmosphere; the sensitivity to CO₂ is often measured as the temperature increase caused by a doubling of the CO₂ level
- CO₂..... carbon dioxide
- CRU Climatic Research Unit at the University of East Anglia, UK

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- DOE..... U.S. Department of Energy
- EIA..... U.S. DOE Energy Information Administration
- El Niño..... a natural climate cycle that causes temperature fluctuations and other climatic effects in tropical regions of the eastern Pacific Ocean; El Niño is the warm phase of the El Niño – Southern Oscillation (ENSO)
- ENSO..... see El Niño
- EPA..... U.S. Environmental Protection Agency
- ETS..... emissions trading scheme; the same as cap-and-trade
- Fahrenheit..... the U.S. temperature scale
- feedback..... a response to a disturbance (forcing) that feeds back to modify the disturbance itself, either magnifying or diminishing it (positive or negative feedback, respectively); “zero” feedback in climatology corresponds to no change in the heat energy normally radiated away by the Earth – a situation that electronics engineers would describe as negative feedback, since heat is still being lost
- FOIA..... U.S. Freedom of Information Act, which gives citizens the right to access federal information, including information about federally funded research programs
- forcing..... radiative forcing, which is a disturbance that alters the climate system and that usually gives rise to feedback processes; related to climate sensitivity
- fossil fuel..... a fuel such as coal, oil or natural gas that is produced over millions of years by the decomposition of buried fossils, and that gives off CO₂ when burned
- GHCN..... the Global Historical Climatology Network
- GISS..... NASA Goddard Institute for Space Science
- greenhouse gas..... a gas in the atmosphere such as water vapor, CO₂, methane or nitrous oxide, all of which can trap heat radiated into space by the Earth; the main greenhouse gas is water vapor

GLOSSARY

HadCRU	the collaboration between the CRU at the University of East Anglia, UK and the UK Met Office's Hadley Centre
hockey stick	the name given to the erroneous IPCC graph published in 2001, showing reconstructed temperatures for the past 1,000 years and resembling a hockey stick on its side
ice age.	an extended period of severe global cooling in the past, lasting for tens or hundreds of thousands of years, when much of the Earth (especially the Northern Hemisphere) was covered by vast ice sheets and glaciers
ice core.	a cylindrical core of ice extracted from an ice sheet by hollow drilling; air bubbles trapped in the ice provide a historical proxy record of past temperatures and CO ₂ levels
IPCC	the UN's Intergovernmental Panel on Climate Change
Kyoto Protocol	a UN protocol to limit emissions of CO ₂ and other greenhouse gases, through a cap-and-trade system that mandates carbon caps for industrialized countries; the protocol, which has not been ratified by the U.S., took effect in 2005
La Niña	the cool phase of the El Niño – Southern Oscillation (ENSO), often following the El Niño warm phase
Little Ice Age.	an unusually cool period, but not as cold as the glacial ice ages in the Earth's distant past, that lasted from about 1500 to the beginning of modern global warming around 1850
Maunder Minimum . . .	the period from 1645 to 1715, when the sun's activity was low and the annual number of sunspots was close to zero
Medieval Warm Period . .	the previous period of global warming, lasting from approximately 800 to 1300
NAM	U.S. National Association of Manufacturers
NASA.	U.S. National Aeronautics and Space Administration

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- NCDC U.S. National Climatic Data Center, which is part of NOAA
- NOAA U.S. National Oceanic and Atmospheric Administration
- paleoclimatology the study of past climates, including past climate change
- PDO the Pacific Decadal Oscillation, a natural climate cycle in the Pacific Ocean of much longer duration than El Niño and La Niña
- RSS Remote Sensing Systems, which analyzes NOAA satellite data to compile the RSS temperature dataset
- temperature anomaly... the deviation of a particular temperature measurement from the average temperature over a period of time
- TSI total solar irradiance, a measure of the sun's brightness or activity
- UAH..... the University of Alabama in Huntsville, which analyzes NOAA satellite data to compile the UAH temperature dataset
- urban heat island..... a term referring to the warmth generated by urban surroundings, such as buildings and concrete, that biases measured temperatures upward
- USHCN the U.S. Historical Climatology Network
- UV ultraviolet, one of three main types of radiation emitted by the sun (ultraviolet, visible and infrared); UV and visible radiation are shortwave, while infrared is long-wave
- WMO..... the World Meteorological Organization

Notes and References

Chapter 1: Climate Change Delusions

- 1 The assumed connection is known as anthropogenic [human-caused] global warming (AGW) in climate science.
- 2 Steven Goddard, “Quick Flood Facts”, Real Science blog, October 18, 2011, found at <http://www.real-science.com/quick-flood-facts>.
- 3 Judith Curry, “Weather weirding: back to the 1950s”, Climate Etc. blog, September 5, 2011, found at <http://judithcurry.com/2011/09/05/weather-weirding-back-to-the-1950s/>.
- 4 Steven Goddard, “New GISS Data Set Heating Up The Arctic”, Real Science blog, January 15, 2012, found at <http://www.real-science.com/new-giss-data-set-heating-arctic>.
- 5 A recent book that profiles prominent global warming skeptics is titled *The Deniers*, in order to emphasize alarmists’ derogatory use of the term – Lawrence Solomon, *The Deniers: The World Renowned Scientists Who Stood Up Against Global Warming Hysteria, Political Persecution, and Fraud* (Richard Vigilante Books, 2008).
- 6 Ray Evans, “The Kyoto Protocol’s Statistical Fallacies”, *Quadrant*, May 2003; summarized by HighBeam Research at <http://www.highbeam.com/doc/1G1-102024975.html>.
- 7 “The Gore Campaign”, 60 Minutes interview by Lesley Stahl, CBS News, March 30, 2008, found at <http://www.cbsnews.com/video/watch/?id=3980795n&tag=contentBody;storyMediaBox>.
- 8 Pew Research Center found that only 38% of Americans surveyed in November 2011 say global warming is occurring mostly because of human activity, such as the burning of fossil fuels; reported at http://www.people-press.org/2011/12/01/modest-rise-in-number-saying-there-is-solid-evidence-of-global-warming/?src=rss_main. The other 62% are presumed to be skeptics.

- 9 Rasmussen Reports found that only 40% of likely U.S. voters surveyed in January 2012 think that global warming is primarily caused by human activity; reported at http://www.rasmussenreports.com/public_content/politics/current_events/environment_energy/energy_update. The other 60% are presumed to be skeptics.
- 10 Hans von Storch and Dennis Bray, “CliSci2008: A Survey of the Perspectives of Climate Scientists Concerning Climate Science and Climate Change”, GKSS report 2010/9, found at http://coast.gkss.de/staff/storch/pdf/GKSS_2010_9.CLISCI.pdf. The sum of responses 1, 2, 3 and ½ of 4 (out of 7 possible responses) to question 21, “How convinced are you that most of recent or near future climate change is, or will be, a result of anthropogenic causes?”, is 13.8%.
- 11 Peter T. Doran and Maggie Kendall Zimmerman, “Examining the scientific consensus on climate change”, *Eos Transactions AGU* 90, pp. 22-23 (2009), available at http://tigger.uic.edu/~pdoran/012009_Doran_final.pdf.
- 12 Ibid.
- 13 Stephen J. Farnsworth and S. Robert Lichter, “Structure of Scientific Opinion on Climate Change”, *International Journal of Public Opinion Research*, October 27, 2011; summarized by John Wihbey, Journalist’s Resource at <http://journalistsresource.org/studies/environment/climate-change/structure-scientific-opinion-climate-change/>.
- 14 William R. L. Anderegg, James W. Prall, Jacob Harold and Stephen H. Schneider, “Expert credibility in climate change”, *Proceedings of the National Academy of Sciences* 107, pp. 12107-12109 (2010), found at <http://www.pnas.org/content/107/27/12107.full.pdf+html>.
- 15 Eli Kintisch, “Scientists ‘Convinced’ of Climate Consensus More Prominent Than Opponents, Says Paper”, AAAS ScienceInsider, June 21, 2010, found at <http://news.sciencemag.org/scienceinsider/2010/06/scientists-convinced-of-climate.html>.
- 16 U.S. Senate Environment and Public Works Committee (Minority) Report, December 20, 2007, found at <http://epw.senate.gov/public/index.cfm?FuseAction=Minority.SenateReport>.
- 17 “More Than 1000 International Scientists Dissent Over Man-Made Global Warming Claims: Scientists Continue to Debunk Fading ‘Consensus’ in 2008 & 2009 & 2010”, Climate Depot report, December 8, 2010, found at <http://www.climatedepot.com/a/9035/SPECIAL-REPORT-More-Than-1000-International-Scientists-Dissent-Over-ManMade-Global-Warming-Claims--Challenge-UN-IPCC--Gore>.
- 18 Global Warming Petition Project, Oregon Institute of Science and Medicine, described at <http://www.petitionproject.org/>.

NOTES AND REFERENCES

- 19 Richard S. Lindzen, "Climate of Fear", *The Wall Street Journal*, Opinion Journal, April 12, 2006.
- 20 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 1: Historical Overview of Climate Change Science, Section 1.6.
- 21 Ibid.
- 22 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers.
- 23 For an explanation of greenhouse gases, see the next section "The CO₂ Global Warming Hypothesis" in this chapter.
- 24 IPCC, 2007, at <http://www.ipcc.ch/pdf/press-ar4/ipcc-flyer-low.pdf>.
- 25 John McLean, "The IPCC can't count its 'expert scientists': Author and reviewer numbers are wrong", January 18, 2009, found at http://mclean.ch/climate/docs/IPCC_numbers.pdf.
- 26 According to John McLean (in Reference 25 above), the IPCC's total of 3,750 authors and reviewers falls to 2,890 when duplicate names are removed. Multiplying the estimated 2,000 climate scientists by the ratio (2,890/3,750) gives an estimate of 1,541 climate scientists.
- 27 HadCRUT3 global combined land and sea surface temperature record, from <http://www.cru.uea.ac.uk/cru/info/warming/>. The Climatic Research Unit (CRU) is part of the University of East Anglia in the UK, and compiles the temperature record jointly with the UK Met Office Hadley Centre, the collaboration being known as HadCRU.
- 28 Slide 5 at http://climateprediction.net/schools/docs/correlation_causation.ppt#257,5, Data for last 150 years.
- 29 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 5. Although there is general agreement that warming has occurred, the exact amount of the temperature increase has been disputed, as discussed in Chapter 2: Science Gone Wrong of this book. As well as the temperature increase itself, the rate of temperature increase since 1980 is in dispute. If the increase is smaller than 0.8° Celsius (1.4° Fahrenheit), the CO₂ hypothesis is less likely to be valid. But in any case, the hypothesis is invalidated by the three red flags for CO₂ that are listed in the lower part of Table 1.2.
- 30 Today's (2012) CO₂ level in the atmosphere is 393 parts per million. This is 40% higher than its assumed preindustrial level in the 1700s, which was 280 parts per million according to the IPCC (in Reference 29 above, p. 2), or about 37% higher than in 1850. CO₂ data is always taken from locations well away from forests and other vegetation,

which temporarily generate CO₂ from overnight respiration, and far from any industrial activity.

- 31 See Chapter 4: CO₂ Sense and Sensitivity.
- 32 Solar radiation is absorbed and radiated by the Earth and its atmosphere in two different wavelength regions: absorption takes place at short (ultraviolet and visible) wavelengths, while heat is radiated away at long (infrared) wavelengths. Greenhouse gases in the atmosphere allow most of the incoming shortwave radiation to pass through, but absorb a substantial portion of the outgoing longwave radiation.
- 33 Svante Arrhenius, “Die vermutliche ursache der klimaschwankungen”, *Meddelanden från K. Vetenskapsakademiens Nobelinstitut* 1, pp. 1–10 (1906).
- 34 The atmosphere on Venus, which is very dense, consists of 97% CO₂. This near immersion of the planet in CO₂ contributes to the high and inhospitable surface temperature there of around 470° Celsius (880° Fahrenheit), though some of the greenhouse warming on Venus comes from thick banks of sulfuric acid clouds sitting above the CO₂.
- 35 Responses to questions 11c and 11d in Reference 10 above.
- 36 Sunspots are small dark spots on the sun’s surface which come from magnetic storms, and which can be seen through a filter on a telescope.
- 37 Cosmic rays are highly energetic charged particles, most of which originate in the shock waves of supernova explosions that occur far away in our galaxy.
- 38 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 1: Historical Overview of Climate Change Science, Section 1.4.3.

Chapter 2: Science Gone Wrong

- 39 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 1: Historical Overview of Climate Change, Section 1.2.
- 40 The scientific method consists of six basic steps: (1) Observation or data gathering; (2) Formulation of a hypothesis, which is an educated guess, to explain the observations; (3) Initial testing of the hypothesis by experiment; (4) Further, independent testing if the hypothesis is verified by the initial tests; (5) Elevation of the hypothesis, or several hypotheses, to a theory (based on a limited number of observations) or a law (based on many observations); (6) Modification or rejection of any hypothesis or theory if contrary observations are made at any stage. In formulating hypotheses, two of the standard reasoning processes used are induction and deduction. Induction reasons from a particular case to a general conclusion, while deduction reasons from general

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evidence to a particular conclusion – the CO₂ hypothesis is an example of deduction. An important element of the scientific method is the falsifiability criterion, which says that a single contrary observation can invalidate a whole theory or law (though not generally a hypothesis).

- 41 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 1: Historical Overview of Climate Change Science, Section 1.3.3.
- 42 Bias, a statistician's term, is known as systematic error in scientific parlance.
- 43 For examples in the U.S., see S. A. Changnon, "A rare long record of deep soil temperatures defines temporal temperature changes and an urban heat island", *Climatic Change* 38, pp. 113-128 (1999); and Jim Goodridge, slide 10 in "Impact of Climate Variation on Flood Control Planning in California", presentation at California Weather Symposium, Sierra College, Rocklin, CA, June 26, 1999, found at <http://cepsym.info/Sympro1999/goodridge.pdf>.
- 44 Anthony Watts, "Is the U.S. Surface Temperature Record Reliable?", Chicago, IL: The Heartland Institute, 2009. This is part of ongoing work in the Surface Stations Project; the project is cataloged at <http://www.surfacestations.org/>, and the 2009 report is available at Watts Up With That blog, http://wattsupwiththat.files.wordpress.com/2009/05/surfacestationsreport_spring09.pdf.
- 45 Ibid.
- 46 Souleymane Fall, Anthony Watts, John Nielsen-Gammon, Evan Jones, Dev Niyogi, John R. Christy and Roger A. Pielke Sr., "Analysis of the impacts of station exposure on the U.S. Historical Climatology Network temperatures and temperature trends", *Journal of Geophysical Research* 116, p. D14120 (2011), found at <http://pielkeclimatesci.files.wordpress.com/2011/07/r-367.pdf>.
- 47 The upward bias in U.S. Historical Climatology Network (USHCN) temperatures is estimated by Fall et al (in Reference 46 above) as 0.3° Celsius (0.5° Fahrenheit), at the poorest station sites compared to the best sites. The poorest and best sites from the Surface Stations Project that were chosen for the analysis number 61 and 80 stations, respectively. Multiplying the estimated bias for the poorest sites of 0.3° Celsius (0.5° Fahrenheit) by the fraction of poor sites (61/141) yields an overall bias of 0.13° Celsius (0.23° Fahrenheit).
- 48 Matthew J. Menne, Claude N. Williams Jr. and Michael A. Palecki, "On the reliability of the U.S. surface temperature record", *Journal of Geophysical Research* 115, p. D11108 (2010), found at <http://www1.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/menne-et-al2010.pdf>. The routine adjustments to USHCN raw data, which are known as homogenization,

- supposedly correct temperatures for changes introduced by the switch in the 1980s from older liquid-in-glass thermometers to newer electronic sensors, and for station siting changes.
- 49 Ross R. McKittrick and Patrick J. Michaels, “A test of corrections for extraneous signals in gridded surface temperature data”, *Climate Research* 26, pp. 159–173 (2004) and Erratum, *Climate Research* 27, pp. 265– 268 (2004), both available at <http://www.uoguelph.ca/~rmckitri/research/gdptemp.html>; and “Quantifying the influence of anthropogenic surface processes and inhomogeneities on gridded global climate data”, *Journal of Geophysical Research* 112, p. D24S09 (2007), found at <http://www.uoguelph.ca/~rmckitri/research/jgr07/M&M.JGRDec07.pdf>.
- 50 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Section 3.2.2.2.
- 51 The IPCC (in Reference 50 above, Executive Summary) claims that the global warming rate from urban heat islands is only 0.006° Celsius (0.01° Fahrenheit) per decade, compared with the overall land surface warming rate since 1980 of 0.27° Celsius (0.49° Fahrenheit) per decade – or a negligible 2.2%. This contrasts with the estimate made by McKittrick and Michaels (in Reference 49 above) that the urban heat island effect contributes 0.14° Celsius (0.25° Fahrenheit) of the 0.27° Celsius (0.49° Fahrenheit) per decade warming rate – more than 50% of the measured global warming rate on land.
- 52 McKittrick and Michaels (in Reference 49 above) estimate that the land surface warming rate since 1980 falls from the IPCC’s value of 0.27° Celsius (0.49° Fahrenheit) per decade to 0.13° Celsius (0.23° Fahrenheit) per decade, when urban heat islands are taken into account. This land warming rate can be combined with the IPCC ocean warming rate of 0.13° Celsius (0.23° Fahrenheit) per decade, which is the same value, to give a corrected post-1980 global warming rate also equal to 0.13° Celsius (0.23° Fahrenheit) per decade. This is 24% lower than the IPCC global warming rate of 0.17° Celsius (0.31° Fahrenheit) per decade. The IPCC warming rates (from Reference 50 above, Executive Summary) are weighted averages over the Northern and Southern Hemispheres.
- 53 The BEST study maintains that the global urban heating rate over the period 1950-2010 was $-0.19 \pm 0.19^\circ$ Celsius ($-0.34 \pm 0.34^\circ$ Fahrenheit) per century, a result that is consistent with either zero or a small negative effect. See “Influence of Urban Heating on the Global Temperature Land Average Using Rural Sites Identified from MODIS Classifications”, and also “Earth Atmospheric Land Surface Temperature and Station Quality in the United States”, at <http://berkeleyearth.org/available-resources/>.

NOTES AND REFERENCES

- 54 Roger Pielke Sr., “Erroneous Information in the Report ‘Procedural Review of EPA’s Greenhouse Gases Endangerment Finding Data Quality Processes’”, *Climate Science: Roger Pielke Sr. blog*, October 5, 2011, found at <http://pielkeclimatesci.wordpress.com/2011/10/05/erroneous-information-in-the-report-procedural-review-of-epas-greenhouse-gases-endangerment-finding-data-quality-processes/>.
- 55 “Do Judith Curry and Richard Muller disagree?”, reported by Watts Up With That blog, November 13, 2011, at <http://wattsupwiththat.com/2011/11/13/the-waxman-markey-circus-is-coming-to-town-dr-richard-muller-to-showcase-best-under-the-bigtop/>.
- 56 “Decadal Variations in the Global Atmospheric Land Temperatures”, Berkeley Earth Surface Temperature study, found at <http://berkeleyearth.org/available-resources/>.
- 57 Roy W. Spencer, “Latest Global Temps”, updated monthly at <http://www.drroyspencer.com/latest-global-temperatures/>. The graph shows the NOAA global satellite temperature record for the lower troposphere, which is the layer of the atmosphere closest to the Earth’s surface, compiled at the University of Alabama in Huntsville (UAH); another compilation of the same record is produced by Remote Sensing Systems (RSS).
- 58 UAH global land and sea surface satellite temperature record up to July 2012, reported at <http://vortex.nsstc.uah.edu/data/msu/t2lt/uahncdc.lt>. For the RSS dataset, found at http://www.ssmi.com/msu/msu_data_description.html#msu_amsu_time_series, the reported global warming rate to July 2012 was 0.13° Celsius (0.23° Fahrenheit) per decade.
- 59 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Executive Summary.
- 60 A. Sánchez-Lugo, J. J. Kennedy and P. Berrisford: [Global Climate] Temperatures in “State of the Climate in 2010”, *Bulletin of the American Meteorological Society* 92, p. S36 (2011), found at <http://www.ncdc.noaa.gov/bams-state-of-the-climate/2010.php>.
- 61 “The world is hotter than ever – NOAA”, ICECAP NOTE: UAH RELEASE, International Climate and Environmental Change Assessment Project (ICECAP) blog, July 16, 2010, found at http://icecap.us/index.php/go/joes-blog/the_world_is_hotter_than_ever_noaa2/.
- 62 NOAA National Climatic Data Center (NCDC), “Global Surface Temperature Anomalies”, found at <http://www.ncdc.noaa.gov/cmb-faq/anomalies.php>. The NCDC temperature record is part of the Global Historical Climatology Network (GHCN) database.
- 63 Anthony Watts, “New study shows half of the global warming in the USA is artificial”, Watts Up With That blog, July 29, 2012, found at <http://wattsupwiththat.com/2012/07/29/press-release-2/>. The new methodology was pioneered by Michel Leroy of METEOFrance,

- and utilizes the surface area – rather than just the distance – of heat sinks and sources near temperature sensors, in order to gauge their impact on temperature measurements. See also “An area and distance weighted analysis of the impacts of station exposure on the U.S. Historical Climatology Network temperatures and temperature trends’, a paper submitted for publication, at http://wattsupwiththat.files.wordpress.com/2012/07/watts-et-al_2012_discussion_paper_webrelease.pdf.
- 64 Ibid.
- 65 Craig Loehle and J. Huston McCulloch, “Correction to: A 2000-year global temperature reconstruction based on non-tree ring proxies”, *Energy & Environment* 19, pp. 93-100 (2008), found at <http://www.ncasi.org/publications/Detail.aspx?id=3025>. The proxies used in this reconstruction included ocean sediments, boreholes, pollen, and cave stalagmites.
- 66 IPCC, *Climate Change 2007: The Physical Science Basis*, Figure 6.4 and FAQ 2.1, Figure 1.
- 67 Michael E. Mann, Raymond S. Bradley and Malcolm K. Hughes, “Global-scale temperature patterns and climate forcing over the past six centuries”, *Nature* 392, pp. 779-787 (1998), found at <http://www.geo.umass.edu/faculty/bradley/mann1998.pdf>; and “Northern Hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations”, *Geophysical Research Letters* 26, pp. 759-762 (1999), found at <http://www.ncdc.noaa.gov/paleo/pubs/millennium-camera.pdf>.
- 68 IPCC, *Climate Change 2001: The Scientific Basis*, Figure 2.20.
- 69 IPCC, *Climate Change 1990: Scientific Assessment of Climate Change*, Figure 7.1(c).
- 70 As well as tree ring sensitivity to factors such as moisture and CO₂, this is partly because of divergence – a mathematical term that refers to trees showing a positive growth response to warming in a past calibration period, but a lesser or even negative response in recent times. For a discussion, see Craig Loehle, “A mathematical analysis of the divergence problem in dendroclimatology”, *Climatic Change* 94, pp. 233–245 (2009), available at http://icecap.us/images/uploads/Loehle_Divergence_CC.pdf.
- 71 Mann et al (in Reference 67 above) ignored tree-ring data from 1980 onwards, while other studies excluded it after about 1960.
- 72 Stephen McIntyre and Ross McKittrick, “Corrections to the Mann et. al. (1998) proxy data base and Northern Hemispheric average temperature series”, *Energy & Environment* 14, pp. 751-771 (2003), found at <http://www.uoguelph.ca/~rmckitri/research/MM03.pdf>; and “Hockey Sticks, Principal Components and Spurious Significance”, *Geophysical*

NOTES AND REFERENCES

- Research Letters* 32, p. L03710 (2005), found at <http://climateaudit.files.wordpress.com/2009/12/mcintyre-grl-2005.pdf>. Both papers are discussed further at <http://www.uoguelph.ca/~rmckitri/research/MM-W05-background.pdf>.
- 73 Ibid; principal components is a statistical term.
- 74 Edward J. Wegman, David W. Scott and Yasmin H. Said, U.S. House Committee on Energy and Commerce Ad Hoc Committee Report on the ‘Hockey Stick’ Global Climate Reconstruction, July 19, 2006, found at <http://www.uoguelph.ca/~rmckitri/research/WegmanReport.pdf>.
- 75 *Surface Temperature Reconstructions for the Last 2,000 Years* (National Academies Press, 2006), Executive Summary, found at <http://www.nap.edu/catalog/11676.html>.
- 76 See, for example, S. Fred Singer and Dennis T. Avery, *Unstoppable Global Warming: Every 1,500 Years* (Rowman & Littlefield, 2nd edition, 2008), pp. 46-92.
- 77 Michael E. Mann, Zhihua Zhang, Malcolm K. Hughes, Raymond S. Bradley, Sonya K. Miller, Scott Rutherford and Fenbiao Ni, “Proxy-based reconstructions of hemispheric and global surface temperature variations over the past two millennia”, *Proceedings of the National Academy of Sciences* 105, pp. 13252–13257 (2008), found at <http://www.pnas.org/content/early/2008/09/02/0805721105.full.pdf+html>. The proxies used in the new reconstruction included ice cores, lake sediments, corals, and cave stalagmites.
- 78 Richard Black, “Climate ‘hockey stick’ is revived”, found at <http://news.bbc.co.uk/2/hi/science/nature/7592575.stm>.
- 79 Stephen McIntyre and Ross R. McKittrick, “Proxy inconsistency and other problems in millennial paleoclimate reconstructions”, *Proceedings of the National Academy of Sciences* 106, p. E10 (2009), found at <http://www.pnas.org/content/106/6/E10.full>.
- 80 Keith R. Briffa, Vladimir V. Shishov, Thomas M. Melvin, Eugene A. Vaganov, Håken Grudd, Rashit M. Hantemirov, Matti Eronen and Muktar M. Naurzbaev, “Trends in recent temperature and radial tree growth spanning 2000 years across northwest Eurasia”, *Philosophical Transactions of the Royal Society B* 363, pp. 2269-2282 (2008), found at <http://rstb.royalsocietypublishing.org/content/363/1501/2269.full>.
- 81 Stephen McIntyre, “YAD06 – the Most Influential Tree in the World”, Watts Up With That blog, October 1, 2009, found at <http://wattsupwiththat.com/2009/10/01/mirror-posting-yad06-the-most-influential-tree-in-the-world/>.
- 82 Liu Yu, Cai QiuFang, Song HuiMing, An ZhiSheng and Hans W. Linderholm, “Amplitudes, rates, periodicities and causes of temperature variations in the past 2485 years and future trends over the central-eastern Tibetan Plateau”, *Chinese Science Bulletin* 56, pp. 2986-

- 2994 (2011), found at http://csb.scichina.com:8080/kxtbe/EN/volumn/volumn_6268.shtml#.
- 83 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 6: Palaeoclimate, Box 6.4 and Section 6.6.1.1.
- 84 David Deming, “Global warming, the politicization of science, and Michael Crichton’s *State of Fear*”, *Journal of Scientific Exploration* 19, no. 4 (2005), found at <http://www.mitosyfraudes.org/Polit/Deming.html>.
- 85 Ibid.
- 86 James Hansen, Reto Ruedy, Jay Glascoe and Makiko Sato, “Whither U.S. Climate?”, NASA GISS Science Briefs, August 1999, found at http://www.giss.nasa.gov/research/briefs/hansen_07/.
- 87 NASA GISS Surface Temperature Analysis, “Annual Mean Temperature Change in the United States”, found at http://data.giss.nasa.gov/gistemp/graphs_v3/.
- 88 An animated version of Figure 2.6, showing the switch in hottest year from 1934 to 1998, can be viewed at <http://wattsupwiththat.files.wordpress.com/2012/03/1998changesannotated1.gif>.
- 89 Glenn Elert, “Hottest Temperature on Earth”, The Physics Factbook, at <http://hypertextbook.com/facts/2000/MichaelLevin.shtml>.
- 90 “Climate of the Philippines”, at http://en.wikipedia.org/wiki/Climate_of_the_Philippines.
- 91 Matthew J. Menne, Claude N. Williams Jr. and Russell S. Vose, “The U.S. Historical Climatology Network Monthly Temperature Data, Version 2”, *Bulletin of the American Meteorological Society* 90, pp. 993-1107 (2009), available at <ftp://ftp.ncdc.noaa.gov/pub/data/ushcn/v2/monthly/menne-etal2009.pdf>. See also Reference 48 above.
- 92 Louise Gray, “Met Office: World warmed even more in last ten years than previously thought when Arctic data added”, *The Telegraph*, March 19, 2012, found at <http://www.telegraph.co.uk/earth/earthnews/9153473/Met-Office-World-warmed-even-more-in-last-ten-years-than-previously-thought-when-Arctic-data-added.html>.
- 93 Climategate email 0938018124.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=0938018124.txt>.
- 94 Climategate email 3451.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=3451.txt>.
- 95 Climategate email 1054736277.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1054736277.txt>.

NOTES AND REFERENCES

- 96 Climategate email 1076359809.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1076359809.txt>.
- 97 Climategate email 1107454306.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1107454306.txt>.
- 98 Climategate email 1109021312.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1109021312.txt>.
- 99 Climategate email 1147435800.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1147435800.txt>.
- 100 Douglas J. Keenan, “The fraud allegation against some climatic research of Wei-Chyung Wang”, *Energy & Environment* 18 , pp. 985-995 (2007), summarized and updated at <http://www.informath.org/apprise/a5620.htm>.
- 101 Wei-Chyung Wang, Zhaomei Zeng and Thomas R. Karl, “Urban heat islands in China”, *Geophysical Research Letters* 17, pp. 2377–2380 (1990), found at <http://www.informath.org/apprise/a5620/b23.pdf>.
- 102 P. D. Jones, P. Y. Groisman, M. Coughlan, N. Plummer, W.-C. Wang and T. R. Karl, “Assessment of urbanization effects in time series of surface air temperature over land”, *Nature* 347, pp. 169–172 (1990), found at <http://www.informath.org/apprise/a5620/b90.pdf>.
- 103 Douglas J. Keenan (February 2010), at <http://www.informath.org/apprise/a5620/b17.htm>.
- 104 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Section 3.2.2.2. Phil Jones, lead author of Reference 102 above, was also one of the two lead authors of this IPCC report chapter.
- 105 Fred Pearce, “Strange case of moving weather posts and a scientist under siege”, *The Guardian*, February 1, 2010, found at <http://www.guardian.co.uk/environment/2010/feb/01/dispute-weather-fraud>.
- 106 Climategate email 2655.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=2655.txt>.
- 107 Climategate email 1177163150.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1177163150.txt>.
- 108 P. D. Jones, D. H. Lister and Q. Li, “Urbanization effects in large-scale temperature records, with an emphasis on China”, *Journal of Geophysical Research* 113, p. D16122 (2008). The study concludes that urban-related warming in China during the period 1951–2004 was about 0.1° Celsius (0.2° Fahrenheit) per decade, which is 17 times larger than the IPCC’s estimated warming rate from urban heat islands (in Reference 104 above, Executive

- Summary). Over 5.4 decades, this amounts to a contribution from urbanization of 0.54° Celsius (0.97° Fahrenheit). The contribution is two thirds of the true climatic warming in China of 0.81° Celsius (1.5° Fahrenheit) over the same period.
- 109 Judith Curry, “On the credibility of climate research”, November 22, 2009, found at <http://camirror.wordpress.com/2009/11/22/curry-on-the-credibility-of-climate-research/>.
- 110 Clive Cook, “Climategate and the Big Green Lie”, *The Atlantic*, July 14, 2010, found at <http://www.theatlantic.com/politics/archive/2010/07/climategate-and-the-big-green-lie/59709/>.
- 111 Report of The Independent Climate Change E-mails Review, July 2010, found at <http://www.cce-review.org/>.
- 112 McKittrick and Michaels (in Reference 49 above) estimated a global warming rate on land of 0.14° Celsius (0.25° Fahrenheit) per decade from urban heat islands alone. The IPCC (in Reference 50 above) also dismisses another study that estimated the contribution of urbanization and other changes in land use at 0.09° Celsius (0.16° Fahrenheit) per decade in the U.S. [Eugenia Kalnay & Ming Cai, “Impact of urbanization and land-use change on climate”, *Nature* 423, pp. 528-531 (2003), found at <http://www.warwickhughes.com/climate/kalnay.pdf>].
- 113 Ross R. McKittrick and Patrick J. Michaels, Background Discussion on “Quantifying the influence of anthropogenic surface processes and inhomogeneities on gridded global climate data”, found at <http://www.uoguelph.ca/~rmckitri/research/jgr07/M&M.JGR07-background.pdf>.
- 114 Ibid.
- 115 IPCC, *Climate Change 2007: The Physical Science Basis*, Expert and Government Review Comments on the Second-Order Draft, Chapter 3, No. 3-285, found at <http://pds.lib.harvard.edu/pds/view/7786376?n=38&imagesize=1200&jp2Res=.25>.
- 116 Ross R. McKittrick, “Atmospheric oscillations do not explain the temperature-industrialization correlation”, Social Science Research Network, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1166424.
- 117 Climategate email 1089318616.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1089318616.txt>.
- 118 Climategate email 2469.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=2469.txt>.
- 119 Climategate email 3052.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=3052.txt>.

NOTES AND REFERENCES

- 120 “Concerned Scientists Reply on Global Warming”, *The Wall Street Journal*, February 21, 2012, found at <http://online.wsj.com/article/SB10001424052970203646004577213244084429540.html>.
- 121 See, for example, “Soon and Baliunas controversy”, at http://en.wikipedia.org/wiki/Soon_and_Baliunas_controversy.
- 122 Climategate email 1106322460.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1106322460.txt>.
- 123 Roy W. Spencer and William D. Braswell, “On the Misdiagnosis of Surface Temperature Feedbacks from Variations in Earth’s Radiant Energy Balance”, *Remote Sensing* 3, pp. 1603-1613 (2011), found at <http://www.mdpi.com/2072-4292/3/8/1603/pdf>.
- 124 Richard Monastersky, “Cool climate paper sinks journal editor”, Nature News blog, September 2, 2011, found at http://blogs.nature.com/news/2011/09/cool_climate_paper_sinks_journ.html.
- 125 Wolfgang Wagner, Editorial, “Taking Responsibility on Publishing the Controversial Paper ‘On the Misdiagnosis of Surface Temperature Feedbacks from Variations in Earth’s Radiant Energy Balance’ by Spencer and Braswell”, *Remote Sensing* 3, pp. 2002-2004 (2011), found at <http://www.mdpi.com/2072-4292/3/9/2002/pdf>.
- 126 IPCC, *Appendix A to the Principles Governing IPCC Work* (amended November 2003), Section 4.2, found at <http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a.pdf>.
- 127 “The exact changes to 1995 IPCC report: the crucial chapter 8 for the ‘Summary for Policymakers’ ”, found at <http://www.greenworldtrust.org.uk/Science/Social/IPCC-95-Ch8.htm>.
- 128 Frederick Seitz, “A Major Deception on Global Warming”, *The Wall Street Journal*, June 12, 1996.
- 129 Editorial, “Climate debate must not overheat”, *Nature* 381, p. 539 (1996), available at http://www.albany.edu/~scifraud/data/sci_fraud_3779.html.
- 130 Paul N. Edwards and Stephen H. Schneider, “The 1995 IPCC Report: Broad Consensus or ‘Scientific Cleansing?’”, *Ecofable/Ecoscience* 1, pp. 3-9 (1997), found at <http://pne.people.si.umich.edu/PDF/ecofables.pdf>.
- 131 InterAcademy Council, “Climate change assessments: Review of the processes and procedures of the IPCC”, Report by the Committee to Review the IPCC, October 2010, found at <http://reviewipcc.interacademycouncil.net/report.html>.

- 132 Donna Laframboise, “UN’s Climate Bible Gets 21 ‘F’s on Report Card”, NOconsensus.org blog, April 14, 2010, found at <http://www.noconsensus.org/ipcc-audit/findings-main-page.php>.

Chapter 3: Computer Snake Oil?

- 133 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 1: Historical Overview of Climate Change, Section 1.2.
- 134 CCSP, “Climate Models: An Assessment of Strengths and Limitations”, Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Department of Energy (DOE), Office of Biological and Environmental Research, 2008, Section 1.2, found at <http://www.climate-science.gov/Library/sap/sap3-1/final-report/sap3-1-final-all.pdf>.
- 135 Examples of processes or quantities represented by adjustable parameters in climate models include flows of the atmosphere and oceans; atmospheric turbulence near the earth’s surface (in the so-called boundary layer); the relative humidity threshold for cloud formation (separate sets of parameters for low-level and high-level clouds); the efficiency of precipitation evaporation; aerosol microphysics; ocean salinity; sea-ice dynamics; and many more.
- 136 Quoted by Freeman Dyson in “A meeting with Enrico Fermi”, *Nature* 427, p. 297 (2004); see http://www.cds.caltech.edu/~murray/books/AM08/pdf/am08-modeling_19Jul11.pdf.
- 137 James M. Murphy, David M. H. Sexton, David N. Barnett, Gareth S. Jones, Mark J. Webb, Matthew Collins and David A. Stainforth, “Quantification of modelling uncertainties in a large ensemble of climate change simulations”, *Nature* 430, pp. 768-772 (2004), found at http://climateprediction.net/science/pubs/nature_murphy_02771.pdf.
- 138 IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 8: Model Evaluation, Table 8.1.
- 139 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Table 8.1.
- 140 Global energy balance refers to the balance between the amount of absorbed sunlight at the top of the atmosphere and the amount of energy that the Earth radiates away to space, both of which are estimated to be 235-240 W/m² (watts per square meter) when averaged over a year. It is this balance that is believed to keep our planet at a constant average temperature over the short term. Computer climate models are tuned by adjusting parameters, typically for clouds, to maintain this energy balance. However, because

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- 235-240 W/m^2 is only an inexact theoretical calculation, the tuning procedure is also subject to uncertainty. This uncertainty can affect the model's ability to predict climate sensitivity, as discussed by F. A.-M. Bender [F. A.-M. Bender, "A note on the effect of GCM tuning on climate sensitivity", *Environmental Research Letters* 3, pp. 1-6 (2008), found at http://www.iop.org/EJ/article/1748-9326/3/1/014001/erl8_1_014001.html].
- 141 Section 2.5.2 in Reference 134 above, discussing the Community Climate System Model – one of the major classes of climate model used by IPCC modelers.
- 142 As described in IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation.
- 143 Kesten C. Green and J. Scott Armstrong, "Global warming: Forecasts by scientists versus scientific forecasts", *Energy & Environment* 18, pp. 997-1021 (2007), found at <http://www.forecastingprinciples.com/files/WarmAudit31.pdf>.
- 144 Ibid.
- 145 The main uses of adjustable cloud parameters are to approximate cloud formation and dissipation for cirrus (high-level) and stratus clouds; cumulus (low-level) cloud convection, in both fair weather and thunderstorms; turbulence; and conversions between cloud water, rainwater, ice crystals, and snow.
- 146 "Cloud-resolving models", which have grid boxes less than a few kilometers square, are already available, but take too long to run even on supercomputers today. These models can simulate features such as deep updrafts and downdrafts, cirrus anvil clouds, and aerosol-cloud interactions better than present-day climate models, though still require parameterization of many subgrid-scale processes.
- 147 J. Hansen et al, "Climate simulations for 1880–2003 with GISS model E", *Climate Dynamics* 29, pp. 661–696 (2007), found at http://pubs.giss.nasa.gov/docs/2007/2007_Hansen_etal_3.pdf. W/m^2 (watts per square meter) is a unit of radiative energy; hPa (hectopascals) is a unit of atmospheric pressure identical to mb (millibars), standard atmospheric pressure at sea level being 1013 hPa or 1013 mb.
- 148 United Nations Framework Convention on Climate Change (UNFCCC), Convention Text (1992), Article 2, found at <http://unfccc.int/resource/docs/convkp/conveng.pdf>.
- 149 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, FAQ 8.1.
- 150 Ibid, Section 8.6.3.2.
- 151 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 10: Global Climate Projections, Section 10.2.1.3 and Figure 10.11(a).

- 152 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Table 9.4.
- 153 Claire L. Parkinson, *Coming Climate Crisis? Consider the Past, Beware the Big Fix* (Rowman & Littlefield, reprinted 2012), Chapter 10.
- 154 Specifically, the troposphere – the lowest layer of the atmosphere.
- 155 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Section 9.2.2.1. Figure 9.1 (c) for well-mixed greenhouse gases, principally CO₂, shows a model warming rate of approximately 1.1° Celsius (2.0° Fahrenheit) per century from 1890 to 1999 at an altitude of 10 kilometers (6 miles), and a rate of approximately 0.5° Celsius (0.9° Fahrenheit) per century at ground level. The interval from 1890 to 1999 includes several global warming and cooling periods.
- 156 B.D.Santer, J.E.Penner and P.W.Thorne, “How well can the observed vertical temperature changes be reconciled with our understanding of the causes of these changes?”, in CCSP, “Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences”, Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, 2006, found at <http://www.climate-science.gov/Library/sap/sap1-1/finalreport/sap1-1-final-chap5.pdf>. The observed temperature change pattern in Figure 5.7, panel E shows the absence of any hot spot at an altitude of 10 kilometers (6 miles), during the global warming period from 1979 to 1999.
- 157 Weather balloon data such as atmospheric temperature and pressure, which indicates altitude, is transmitted back to a ground station by radiosonde as the balloon ascends through the atmosphere.
- 158 David H. Douglass, John R. Christy, Benjamin D. Pearson and S. Fred Singer, “A comparison of tropical temperature trends with model predictions”, *International Journal of Climatology* 28, pp. 1693–1701 (2008), found at <http://www.pas.rochester.edu/~douglass/papers/Published%20JOC1651.pdf>.
- 159 Ibid. Table III gives the model warming rate for the mid-troposphere (T_2) as 0.23° Celsius (0.41° Fahrenheit) per decade, based on simulations by 22 “Climate of the 20th Century” computer models.
- 160 B. D. Santer et al, “Consistency of modelled and observed temperature trends in the tropical troposphere”, *International Journal of Climatology* 28, pp. 1703-1722 (2008), found at https://publicaffairs.llnl.gov/news/news_releases/2008/NR-08-10-05-article.pdf. Table I gives the model warming rate for the mid-troposphere (T_2) as 0.20° Celsius

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- (0.36° Fahrenheit) per decade, based on simulations by 19 “Climate of the 20th Century” computer models.
- 161 Computer models do not reproduce tropical climate variability. In particular, the models are unable to predict the timing (except for the El Niño warm phase) and climatic effects of either the El Niño-Southern Oscillation (ENSO), which is an ocean-atmosphere cycle occurring at irregular intervals of 2-8 years, or the Pacific Decadal Oscillation (PDO), or the intraseasonal Madden-Julian Oscillation.
- 162 David Evans, “The Missing Hotspot”, found at <http://sciencespeak.com/MissingSignature.pdf>.
- 163 This is one of several positive feedback mechanisms that could enhance global warming in polar regions, if the CO₂ hypothesis were valid. The feedback mechanism involves warmth from CO₂ melting snow and ice to expose darker surfaces with lower reflectivity (albedo). The less reflective surfaces absorb more solar heat, enhancing the warming from CO₂ alone.
- 164 Igor V. Polyakov, Roman V. Bekryaev, Genrikh V. Alekseev, Uma S. Bhatt, Roger L. Colony, Mark A. Johnson, Alexander P. Maskhtas and David Walsh, “Variability and Trends of Air Temperature and Pressure in the Maritime Arctic, 1875-2000”, *Journal of Climate* 16, pp. 2067-2077 (2003), found at <http://journals.ametsoc.org/doi/pdf/10.1175/1520-0442%282003%29016%3C2067%3AVATOAT%3E2.0.CO%3B2>.
- 165 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, FAQ 8.1.
- 166 “Northern Sea Route”, Athropolis Facts: Cold, Icy and Arctic, found at <http://www.athropolis.com/arctic-facts/fact-nepass.htm>. The Northern Sea Route, a shipping lane that hugs the coast of Russia, was established by the former Soviet Union during the Arctic warm spell in the 1930s. But even today, a fleet of icebreakers is required to keep the lane open year-round.
- 167 Paul Homewood, “GHCN Temperature Adjustments Affect 40% Of The Arctic”, Not a Lot of People Know That blog, March 11, 2012, found at <http://notalotofpeopleknowthat.wordpress.com/2012/03/11/ghcn-temperature-adjustments-affect-40-of-the-arctic/>.
- 168 Peter T. Doran et al, “Antarctic climate cooling and terrestrial ecosystem response”, *Nature* 415, pp. 517-520 (2002), found at <http://www.montana.edu/lkbonney/DOCS/Publications/DoranEtAl2002ClimteCooling.pdf>.
- 169 Eric J. Steig, David P. Schneider, Scott D. Rutherford, Michael E. Mann, Josefino C. Comiso and Drew T. Shindell, “Warming of the Antarctic ice-sheet surface since the

- 1957 International Geophysical Year”, *Nature* 457, pp. 459-462 (2009), found at <http://www.meteo.psu.edu/~mann/shared/articles/SteigetelNature09.pdf>, and Corrigendum, *Nature* 460, p. 766 (2009), found at <http://www.nature.com/nature/journal/v460/n7256/full/nature08286.html>.
- 170 Hu McCulloch, “Steig 2009’s Non-Correction for Serial Correlation”, February 26, 2009, found at <http://climateaudit.org/2009/02/26/steig-2009s-non-correction-for-serial-correlation/>. The issue is what statisticians call serial correlation. Because of the limited number of Antarctic weather stations supplying actual temperature data, the much larger number of reconstructed temperatures across the continent are correlated. This correlation increases the statistical errors beyond those reported by Steig et al in their original paper (Reference 169 above). When the correlation is taken into account, as was done in the Corrigendum, the statistical errors for East Antarctica and the continent as a whole become so large that the temperature change over the past 50 years could be as small as zero.
- 171 Ryan O’Donnell, Nicholas Lewis, Steve McIntyre and Jeff Condon, “Improved Methods for PCA-Based Reconstructions: Case Study Using the Steig et al. (2009) Antarctic Temperature Reconstruction”, *Journal of Climate* 24, pp. 2099-2115 (2011).
- 172 Ibid, Supporting Information, found at <http://www.climateaudit.info/data/odonnell/4%2020101208%20SI%20Revised.pdf>.
- 173 Tore Hattermann, Ole Anders Nøst, Jonathan M. Lilly and Lars H. Smedsrud, “Two years of oceanic observations below the Fimbul Ice Shelf, Antarctica”, *Geophysical Research Letters* 39, p. L12605 (2012); summarized by Lewis Page, “Antarctic ice shelves not melting at all, new field data show”, *The Register, Science*, June 25, 2012, found at http://www.theregister.co.uk/2012/06/25/antarctic_ice_not_melting/.
- 174 Sea ice around Antarctica includes both ice shelves, which are thick slabs of glacial ice anchored to the coast, and floating pack ice.
- 175 NASA Earth Observatory Features, “Antarctic Sea Ice”, found at http://earthobservatory.nasa.gov/Features/WorldOfChange/sea_ice_south.php; and John Turner et al, “Non-annular atmospheric circulation change induced by stratospheric ozone depletion and its role in the recent increase of Antarctic sea ice extent”, *Geophysical Research Letters* 36, p. L08502 (2009), found at <http://ruby.fgcu.edu/courses/twimberley/EnviroPhilo/Turner.pdf>.
- 176 An animated display of Antarctic sea ice from 1991 to 2012 can be viewed at <http://www.youtube.com/watch?v=txpHVm-9rTg>.

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- 177 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 7: Couplings Between Changes in the Climate System and Biogeochemistry, Section 7.5.2.4. Aerosol particles in the atmosphere tend to remain in the Northern Hemisphere where they are produced, unlike greenhouse gases such as CO₂, which quickly become mixed between the two hemispheres.
- 178 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Table 3.3. From 1979 to 2005, the IPCC's observed warming rate was 0.24° Celsius (0.43° Fahrenheit) per decade in the Northern Hemisphere, and 0.09° Celsius (0.16° Fahrenheit) per decade in the Southern Hemisphere.
- 179 See the plotted graph for the "HADSST2 global sea surface temperature anomaly" data source, WoodForTrees.org blog, at <http://woodfortrees.org/plot/hadsst2gl/from:2000>. For a summary of ocean heat content analyses from 2003, see Robert S. Knox and David H. Douglass, "Recent Energy Balance of Earth", *International Journal of Geosciences* 1, pp. 99-101 (2010), found at <http://www.scirp.org/journal/PaperDownload.aspx?paperID=3446&returnUrl=http%3a%2f%>.
- 180 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Section 8.3.2.

Chapter 4: CO₂ Sense and Sensitivity

- 181 Typically, between barometric pressure and wind speed – with lower pressure increasing wind flow, which drops the pressure more and causes even higher winds, and so on.
- 182 For water vapor, which is the dominant greenhouse gas in the atmosphere, the idea is that a small increase in atmospheric CO₂ warms the Earth slightly via the greenhouse effect. This warming produces more water vapor by evaporation from oceans and lakes, and the extra water vapor then amplifies the warming even more. For clouds, the initial CO₂ warming produces more high-level clouds that cause further warming (as opposed to low-level clouds that cause cooling). Melting of terrestrial snow and sea ice by CO₂ warming exposes darker surfaces such as soil, rock and seawater, which have lower albedo. The less reflective surfaces absorb more of the sun's radiation and thus push temperatures higher. In all three cases, the tiny effect from CO₂ acting alone is magnified, according to climate modelers and the IPCC.
- 183 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Section 8.6.2.3. The combined water vapor-lapse rate feedback in IPCC atmosphere-ocean climate models is estimated to be 0.96 W/m² per °C, compared to the

- cloud feedback of 0.69 W/m^2 per $^{\circ}\text{C}$, and the snow and ice feedback of 0.26 W/m^2 per $^{\circ}\text{C}$. All these are positive feedbacks, though the lapse-rate feedback on its own is usually negative (see Reference 188 below).
- 184 The water vapor feedback, which depends on CO_2 through the greenhouse effect, is the strongest feedback in IPCC climate models. However, its strength depends on the assumption that global warming does not change the relative humidity in the lower atmosphere (troposphere), an assumption originally made in a 1979 study known as the Charney Report [“Carbon Dioxide and Climate: A Scientific Assessment”, National Academy of Sciences Report, 1979, found at http://www.atmos.ucla.edu/~brianpm/download/charney_report.pdf]. Warming theoretically increases the water vapor concentration (specific humidity) in the atmosphere, but also increases the saturation level for water vapor, which defines relative humidity. If the relative humidity distribution in the troposphere does not remain constant as warming occurs, the water vapor feedback may be weaker than estimated.
- 185 A detailed explanation is given in Reference 162 in Chapter 3: Computer Snake Oil?
- 186 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 7: Couplings Between Changes in the Climate System and Biogeochemistry, Section 7.3.5.
- 187 Ibid, Section 7.6.
- 188 Panel on Climate Change Feedbacks, National Research Council, *Understanding Climate Change Feedbacks* (National Academies Press, 2003), p. 24, found at http://www.nap.edu/openbook.php?record_id=10850&page=24. The technical term for the rate of decrease of temperature with altitude in the troposphere is the lapse rate. The greenhouse effect for CO_2 is enhanced or diminished by a higher or lower lapse rate, respectively, since water vapor in the colder, upper troposphere radiates less heat away from the Earth than water vapor closer to the warmer surface. In the tropics, where temperatures in the troposphere vary most strongly with altitude, the observed lapse rate is close to the moist adiabatic lapse rate and has been found to decrease with increasing surface temperature – so that the lapse rate feedback is negative, at least in the tropics. In most IPCC climate models, the lapse rate feedback is also negative, although it is positive in some models. Because temperature and water vapor changes are so tightly coupled, the positive water vapor feedback is generally combined with the lapse rate feedback.
- 189 Primarily from NASA’s Terra and Tropical Rainfall Measuring Mission (TRMM) satellites.

NOTES AND REFERENCES

- 190 Roy W. Spencer, William D. Braswell, John R. Christy and Justin Hnilo, "Cloud and radiation budget changes associated with tropical intraseasonal oscillations", *Geophysical Research Letters* 34, p. L15707 (2007), found at http://www.drroyspencer.com/Spencer_07GRL.pdf. The short-term, intraseasonal climate cycle studied was the Madden-Julian Oscillation. The increase in atmospheric temperature from the cool to the warm phase of this oscillation is, over a few weeks, about as large as the average global warming observed since 1850.
- 191 University of Alabama in Huntsville, "Cirrus Disappearance: Warming Might Thin Heat-Trapping Clouds", *ScienceDaily*, November 2, 2007, found at <http://www.sciencedaily.com/releases/2007/11/071102152636.htm>. The heat-trapping ability of high-altitude ice clouds exceeds their solar shading effect, which is the dominant feature of low-altitude clouds.
- 192 Richard S. Lindzen, Ming-Dah Chou and Arthur Y. Hou, "Does the Earth have an adaptive infrared iris?", *Bulletin of the American Meteorological Society* 82, pp. 417-432 (2001), found at <http://journals.ametsoc.org/doi/pdf/10.1175/1520-0477%282001%29082%3C0417%3ADTEHAA%3E2.3.CO%3B2>.
- 193 NASA's Aqua satellite.
- 194 Roy W. Spencer, "Satellite and climate model evidence against substantial manmade climate change", available at <http://www.drroyspencer.com/satellite-and-climate-model-evidence/>.
- 195 Roy W. Spencer, private communication (2009). The negative feedback in this second study was not observed in outgoing longwave (infrared) radiation from the Earth, as it was in the first study, but rather in reflected shortwave (ultraviolet) solar radiation. Spencer says that the satellite observations showed an excellent match with the IPCC climate models in the longwave region, suggesting that the total longwave feedback – which consists of the water vapor, lapse rate and high cloud feedbacks – is weakly positive. But this weak positive feedback is dominated by the strong negative feedback from low clouds in the shortwave region. The possibility of zero or even negative longwave feedback, also based on satellite observations, had been suggested earlier by Piers Forster and Jonathan Gregory [Piers M. de F. Forster and Jonathan M. Gregory, "The climate sensitivity and its components diagnosed from Earth radiation budget data", *Journal of Climate* 19, pp. 39-52 (2006), found at <http://journals.ametsoc.org/doi/pdf/10.1175/JCLI3611.1>].
- 196 Roger Davies and Matthew Molloy, "Global cloud height fluctuations measured by MISR on Terra from 2000 to 2010", *Geophysical Research Letters* 39, p. L03701 (2012);

- summarized in “NASA Satellite Finds Earth’s Clouds are Getting Lower”, NASA Jet Propulsion Laboratory News & Features, February 21, 2012, at <http://www.jpl.nasa.gov/news/news.cfm?release=2012-046>.
- 197 See, for example, Reference 123 in Chapter 2: Science Gone Wrong; and A. E. Dessler, “Cloud variations and the Earth’s energy budget”, *Geophysical Research Letters* 38, p. L19701 (2011), found at <http://geotest.tamu.edu/userfiles/216/Dessler2011.pdf>. According to Spencer and Braswell, cloud feedbacks cannot be easily disentangled from forcings because of the different time dependence with temperature of feedbacks, and of forcings such as increased CO₂ levels or changes in cloud cover. Feedback occurs almost simultaneously with the temperature change, but the temperature response to forcing lags behind due to the heat capacity of the oceans. But according to Dessler, cloud feedbacks can be separated from forcings because the forcing from clouds accounts for only a few percent of observed surface temperature changes, at least in his calculations.
- 198 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Section 8.6.3.2.2. In roughly half of the current IPCC climate models, the feedback from low-level tropical clouds in response to global warming is negative, which is the same as found from satellite data in the second University of Alabama study (see Reference 194 above). But the other half of the IPCC models predict positive feedback from low-level clouds, and all models predict net positive feedback from low-level and high-level clouds combined.
- 199 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Sections 9.2 and 9.6.1.
- 200 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 12.
- 201 Ibid.
- 202 Details of these climate sensitivity calculations, and references, are supplied in the Appendix: Climate Feedbacks and Sensitivity.
- 203 Nicholas Lewis, “The IPCC’s alteration of Forster & Gregory’s model-independent climate sensitivity results”, Climate Etc. blog, July 5, 2011, found at <http://judithcurry.com/2011/07/05/the-ipccs-alteration-of-forster-gregorys-model-independent-climate-sensitivity-results/>. For a less technical discussion, see Matt Ridley, “Scientific Heresy”, at http://wattsupwiththat.files.wordpress.com/2011/11/ridley_rsa_millar_speech_scientific_heresy.pdf.

NOTES AND REFERENCES

- 204 The increase in global surface temperatures since 1850 is 0.6° Celsius (1.1° Fahrenheit) when the urban heat island effect is taken into account, as discussed in Chapter 2: Science Gone Wrong. According to the IPCC (in Reference 200 above, p. 5), the increase since 1850 is 0.8° Celsius (1.4° Fahrenheit).
- 205 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Section 9.6.4.
- 206 Dan Pangburn, “Historical Data On Global Warming provided by U.S. Government Agencies”, March 15, 2008, found at <http://www.middlebury.net/op-ed/pangburn.html>.
- 207 Specifically, ice cores from the Russian Vostok station in East Antarctica. Past atmospheric CO₂ levels and surface temperatures are determined from ice cores by measuring the air composition and the oxygen ¹⁸O to ¹⁶O isotopic ratio, respectively, in air bubbles trapped by the ice. However, the measured levels may not be accurate. Because the air isn’t captured until enough snow has accumulated to pack the subsurface snow into ice, the age of the trapped air is less than the age of the surrounding ice, but by an amount that varies with local conditions. This introduces uncertainty into the timescale. And ice-core CO₂ levels may be inaccurate due to changes in the composition of the original air caused by complex physical and chemical processes that occur in the packed ice. Even if that is not the case, the CO₂ level in Antarctica and Greenland, from where most ice cores are extracted, is somewhat lower than the global average owing to absorption of CO₂ by the colder oceans in those regions.
- 208 Hubertus Fischer, Martin Wahlen, Jesse Smith, Derek Mastroianni and Bruce Deck, “Ice core records of atmospheric CO₂ around the last three glacial terminations”, *Science* 283, pp. 1712-1714 (1999), found at <http://epic.awi.de/825/1/Fis1999a.pdf>.
- 209 Nicolas Caillon, Jeffrey P. Severinghaus, Jean Jouzel, Jean-Marc Barnola, Jiancheng Kang and Volodya Y. Lipenkov, “Timing of atmospheric CO₂ and Antarctic temperature changes across termination III”, *Science* 299, pp. 1728-1731 (2003), found at <http://icebubbles.ucsd.edu/Publications/CaillonTermIII.pdf>.
- 210 Lowell Stott, Axel Timmermann and Robert Thunell, “Southern Hemisphere and deep-sea warming led deglacial atmospheric CO₂ rise and tropical warming”, *Science* 318, pp. 435-438 (2007). The amount of CO₂ released from or absorbed by the oceans as the temperature rises or falls, respectively, is thought to depend on temperature-induced changes both in CO₂ solubility and in ocean mixing processes for CO₂.
- 211 Jeremy D. Shakun et al, “Global warming preceded by increasing carbon dioxide concentrations during the last deglaciation”, *Nature* 484, pp. 49-55 (2012), found at <http://>

- sciences.blogs.liberation.fr/files/shakun-et-al.pdf. The proxies used in the temperature reconstruction included ocean and lake sediments, as well as ice cores.
- 212 See, for example, J. R. Toggweiler and David W. Lea, “Temperature differences between the hemispheres and ice age climate variability”, *Paleoceanography* 25, p. PA2212 (2010), found at http://www.gfdl.noaa.gov/bibliography/related_files/jrt1001.pdf.
- 213 Willis Eschenbach, “Shakun Redux: *Master tricksed us! I told you he was tricky!*”, Watts Up With That blog, April 7, 2012, found at <http://wattsupwiththat.com/2012/04/07/shakun-redux-master-tricksed-us-i-told-you-he-was-tricksy/>.
- 214 The orbital changes, which are caused by the gravitational tug of the massive planet Jupiter and by tidal forces exerted by the sun and moon, are known as Milankovitch cycles. See, for example, “Milankovitch cycles” at http://en.wikipedia.org/wiki/Milankovitch_cycles.
- 215 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 6: Palaeoclimate, Box 6.2 and Section 6.4.1.2.
- 216 The CO₂ feedback mechanisms that amplify cooling are the opposite of those that magnify warming (described in Reference 182 above). The idea is that a small decrease in atmospheric CO₂, caused by the temperature drop at the onset of an ice age, sets off further cooling through a reverse greenhouse effect. Another major, but slower feedback is thought to have come from growth of ice sheets, which are more reflective and absorb less sunlight than the water that froze to produce them. The lower absorption enhances the cooling and causes even more ice to form. At the end of an ice age, the ice sheet feedback enhances warming as the ice melts.
- 217 The continued rise of the CO₂ level beyond the end of the most recent ice age, and the CO₂ time lag, are barely visible in Figure 4.1 because of the compressed timescale. But they can be clearly seen at the termination of the previous ice age, on the right of the graph.
- 218 The same problem arises at the beginning of an ice age. Orbital changes can explain the initial temperature dip before atmospheric CO₂ took a downward turn 600-800 years later, as it was sucked into the oceans. But the CO₂ hypothesis has no explanation for what stopped the temperature from continuing to tumble at the end of its decline, while CO₂ kept falling for another 600-800 years.
- 219 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 6: Palaeoclimate, Sections 6.4.1.1 and 6.4.1.2.
- 220 Barbara Stenni, Valerie Masson-Delmotte, Sigfus Johnsen, Jean Jouzel, Antonio Longinelli, Eric Monnin, Regine Röthlisberger and Enrico Selmo, “An oceanic cold reversal during the last deglaciation”, *Science* 293, pp. 2074-2077 (2001), found at <http://www.ugcs.caltech>.

edu/~mel/ge148a/cold_reversal.pdf; see Fig. 3A. The transition from the last ice age to the present interglacial period took 6,000 to 7,000 years, during which the increase in average global temperature, which is approximately half the change measured at the poles, was about 4° Celsius (7° Fahrenheit). This was six to eight times slower than recent global warming, the actual ratio depending on the exact magnitude of the temperature increase since 1850 (see Reference 204 above). However, it is well known that post ice-age warming was interrupted by an event called the Younger Dryas that resulted in temporary cooling. The warming both before and after the Dryas event was faster, the warming following the event being only two to three times slower than modern global warming.

Chapter 5: Doing What Comes Naturally

- 221 Habibullo I. Abdussamatov, “Bicentennial Decrease of the Total Solar Irradiance Leads to Unbalanced Thermal Budget of the Earth and the Little Ice Age”, *Applied Physics Research* 4, pp. 178-184 (2012), available at <http://ccsenet.org/journal/index.php/apr/article/download/14754/10140>.
- 222 The solar system center of mass.
- 223 Known technically as the total solar irradiance (TSI), which is measured as the total energy from the sun that is incident on the top of the Earth’s atmosphere. TSI variations are too small to have been detectable before the first satellite observations of the sun were made in 1978.
- 224 S. Fred Singer and Dennis T. Avery, *Unstoppable Global Warming: Every 1,500 Years* (Rowman & Littlefield, 2nd edition, 2008).
- 225 Shahinaz M. Yousef, “The solar Wolf-Gleissberg cycle and its influence on the Earth”, International Conference For Environmental Hazards Mitigation (ICEHM2000), Cairo University, Egypt, September 2000, found at http://virtualacademia.com/pdf/cli267_293.pdf.
- 226 Theodor Landscheidt, “New Little Ice Age Instead of Global Warming?”, *Energy & Environment* 14, pp. 327-350 (2003), available at <http://bourabai.narod.ru/landscheidt/new-e.htm>.
- 227 Nicola Scafetta, “Testing an astronomically based decadal-scale empirical harmonic climate model versus the IPCC (2007) general circulation climate models”, *Journal of Atmospheric and Solar-Terrestrial Physics* 80, pp. 124-137 (2012), available at http://scienceandpublicpolicy.org/images/stories/papers/reprint/astronomical_harmonics.

- pdf, and Corrigendum, *Journal of Atmospheric and Solar-Terrestrial Physics* 80, p. 347 (2012).
- 228 Ibid.
- 229 Larry Bell, “Global Warming? No, Natural, Predictable Climate Change”, *Forbes*, January 10, 2012, found at <http://www.forbes.com/sites/larrybell/2012/01/10/global-warming-no-natural-predictable-climate-change/>.
- 230 Nicola Scafetta and Bruce J. West, “Phenomenological reconstructions of the solar signature in the Northern Hemisphere surface temperature records since 1600”, *Journal of Geophysical Research* 112, p. D24S03 (2007), found at <http://www.duke.edu/~ns2002/pdf/2007JD008437.pdf>. Scafetta and West’s paper is based on a phenomenological thermodynamic model, in which short-term variations in the sun’s activity over the 11-year solar cycle induce similar fluctuations in the Earth’s average temperature – fluctuations that are normally regarded as noise and averaged out in computer climate models.
- 231 Nicola Scafetta, “Empirical analysis of the solar contribution to global mean air surface temperature change”, *Journal of Atmospheric and Solar-Terrestrial Physics* 71, pp. 1916–1923 (2009), found at http://www.fel.duke.edu/~scafetta/pdf/Scafetta-JASP_1_2009.pdf. Scafetta’s paper utilizes a simple empirical model characterized by both fast (0.4 year) and slow (8-12 year) time responses to solar forcing, in contrast to the phenomenological model of solar activity employed by Scafetta and West in Reference 230 above. The empirical model shows that up to 65% of global warming since 1950 may have been induced by the sun.
- 232 Ibid, Fig.3.
- 233 Richard C. Willson, “Total Solar Irradiance (TSI) Monitoring and Requirements for Sustaining the TSI Database”, Active Cavity Radiometer Irradiance Monitor (ACRIM), at <http://acrim.com/TSI%20Monitoring.htm>.
- 234 Claus Fröhlich, “Solar constant: Construction of a Composite Total Solar Irradiance (TSI) Time Series from 1978 to present”, Physikalisch-Meteorologisches Observatorium Davos/World Radiation Center (PMOD/WRC), at <http://www.pmodwrc.ch/pmod.php?topic=tsi/composite/SolarConstant>.
- 235 Nicola Scafetta and Richard C. Willson, “ACRIM-gap and TSI trend issue resolved using a surface magnetic flux TSI proxy model”, *Geophysical Research Letters* 36, p. L05701 (2009); summarized by Richard C. Willson at <http://www.acrim.com/Presentations/AGU%20Presentations/2008/Poster%20GC23A-0734.pdf>. The difference between the

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ACRIM satellite data set (in Reference 233 above) and the PMOD data set (in Reference 234 above) arises from different procedures used to bridge a two-year gap in ACRIM data around 1990. The gap in data gathering occurred after the launch of a new ACRIM satellite was delayed by the Challenger disaster. As a result of the disparate gap-bridging procedures, the ACRIM composite data set shows the TSI increasing during solar cycles 21-23, while the PMOD composite shows no significant trend over the same period. ACRIM principal investigator Richard Willson says on the ACRIM website that the PMOD composite is designed to make the TSI data conform with predictions of a solar proxy model, developed by the PMOD team, at the peak of solar cycle 21, and that the ACRIM composite is superior. And Willson's ACRIM co-investigator Nicola Scafetta claims that only the ACRIM composite, and not the PMOD composite, is compatible with the 60-year cycle predicted by his astronomical climate model (in Reference 227 above).

- 236 Mike Lockwood, "Solar change and climate: an update in the light of the current exceptional solar minimum", *Proceedings of the Royal Society A*466, pp. 303-329 (2010), found at <http://rspa.royalsocietypublishing.org/content/466/2114/303.full.pdf+html>.
- 237 The solar wind is a stream of charged particles, mostly electrons and hydrogen nuclei, that are emitted by the sun and escape its gravity.
- 238 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Figure 9.4. According to Lockwood (in Reference 236 above), the current TSI peak-to-peak amplitude is 1.37 W/m^2 , corresponding to a change in solar radiative forcing of 0.24 W/m^2 in the absence of any amplification mechanism. For an amplification factor of 3 associated with positive feedback, as discussed in the section Amplification Mechanisms: Ozone of this chapter, the solar radiative forcing would then be 0.72 W/m^2 . The IPCC's 2007 estimate of CO_2 radiative forcing was 1.66 W/m^2 [IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 4], which would fall to 0.83 W/m^2 for an amplification factor of 0.5 associated with negative CO_2 feedback (see Appendix: Climate Feedbacks and Sensitivity). This is not too different from the hypothetical solar forcing but, as Lockwood points out, requires positive feedback for solar forcing, yet negative feedback for CO_2 forcing.
- 239 For a discussion of feedback, see Chapter 4: CO_2 Sense and Sensitivity. In general, the feedbacks that magnify or diminish the warming effect of CO_2 are different from those that magnify or diminish solar heating effects.

- 240 It's actually a lot more complicated than this. Some of the incoming energy from the sun is reflected without being absorbed at all, and much of the absorbed energy is later radiated away – some of it being reabsorbed in the atmosphere, and the rest released into space. Furthermore, most of the absorbed incoming solar radiation is shortwave (ultraviolet and visible), whereas outgoing radiation from the Earth is mostly longwave (infrared).
- 241 Henrik Svensmark, “Cosmoclimatology: A new theory emerges”, *Astronomy & Geophysics* 48, pp. 1.18-1.24 (2007), found at http://www.space.dtu.dk/upload/institutter/space/forskning/05_afdelinger/sun-climate/full_text_publications/svensmark_2007cosmoclimatology.pdf; Henrik Svensmark, Torsten Bondo and Jacob Svensmark, “Cosmic ray decreases affect atmospheric aerosols and clouds”, *Geophysical Research Letters* 36, p. L15101 (2009), available at <http://wattsupwiththat.files.wordpress.com/2009/08/svensmark-forebush.pdf>.
- 242 Ibid.
- 243 Ibid.
- 244 Nir J. Shaviv and Ján Veizer, “Celestial driver of Phanerozoic climate?”, *Geological Society of America Today* 13, pp. 4-10 (2003), available at http://cfa.atmos.washington.edu/2003Q4/211/articles_optional/CelestialDriver.pdf.
- 245 See Figures 2 and 3 in Reference 241 above (first reference) and Figure 2 in Reference 265 below.
- 246 At sea level, the cosmic ray flux is mostly muons. Muons are secondary cosmic rays formed by the interaction of primary cosmic ray particles, such as protons and helium nuclei, with air molecules higher in the atmosphere.
- 247 Jasper Kirkby et al, “Role of sulphuric acid, ammonia and galactic cosmic rays in atmospheric aerosol nucleation”, *Nature* 476, pp. 429–433 (2011); summarized by Geoff Brumfiel, “Cloud formation may be linked to cosmic rays”, *Nature News*, August 24, 2011, found at <http://www.nature.com/news/2011/110824/full/news.2011.504.html>. The larger cloud chamber makes it possible to produce actual cloud condensation nuclei, rather than just their building blocks as seen in the small-scale chamber used in the Copenhagen experiments.
- 248 This mechanism was first suggested by Robert Dickinson in 1975 [Robert E. Dickinson, “Solar Variability and the Lower Atmosphere”, *Bulletin of the American Meteorological Society* 56, pp. 1240–1248 (1975), found at <http://journals.ametsoc.org/doi/pdf/10.1175/1520-0477%281975%29056%3C1240%3ASVATLA%3E2.0.CO%3B2>]. A connection between cosmic rays and cloud formation was first put forward by Edward

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- Ney [Edward P. Ney, “Cosmic Radiation and the Weather”, *Nature* 183, pp. 451-452 (1959)].
- 249 “CERN’s CLOUD experiment provides unprecedented insight into cloud formation”, CERN Press Release, August 25, 2011, found at <http://press.web.cern.ch/press/pressreleases/releases2011/PR15.11E.html>.
- 250 Ibid. The additional vapors are thought to be organic compounds, probably produced by ternary nitrogen-containing molecules such as ammonia, dimethylamine, ethylamine and urea.
- 251 The International Satellite Cloud Climatology Project (ISCCP) defines low, middle and high clouds as those with cloud *top* pressures of >680 mb (millibars), 440-680 mb and <440 mb, respectively [NASA ISCCP Cloud Data & Products, “ISCCP D2 Selected Variable Descriptions: Cloud Types”, found at <http://isccp.giss.nasa.gov/products/variables.html>]. According to the Plymouth State Meteorology Program, low, middle and high clouds have *base* heights of <7,000 feet (2 kilometers), 7,000-18,000 feet (2-5 kilometers) and >18,000 feet (5 kilometers), respectively [Plymouth State University Meteorology Program Cloud Boutique, found at <http://vortex.plymouth.edu/cloud.html/>].
- 252 Mirela Voiculescu, Ilya G. Usoskin and Kalevi Mursula, “Different response of clouds to solar input”, *Geophysical Research Letters* 33, p. L21802 (2006), available at <http://ruby.fgcu.edu/Courses/Twimberley/EnviroPhilo/Mirela.pdf>.
- 253 T. Sloan and A. W. Wolfendale, “Testing the proposed causal link between cosmic rays and cloud cover”, *Environmental Research Letters* 3, p. 024001 (2008), found at http://iopscience.iop.org/1748-9326/3/2/024001/pdf/1748-9326_3_2_024001.pdf.
- 254 A. D. Erlykin, T. Sloan and A. W. Wolfendale, “The search for cosmic ray effects on clouds”, *Journal of Atmospheric and Solar-Terrestrial Physics* 71, pp. 955–958 (2009); and “Correlations of clouds, cosmic rays and solar irradiation over the Earth”, *Journal of Atmospheric and Solar-Terrestrial Physics* 72, pp. 151–156 (2010).
- 255 NASA Science News, “Cosmic Rays Hit Space Age High”, September 29, 2009, found at http://science.nasa.gov/science-news/science-at-nasa/2009/29sep_cosmicrays/.
- 256 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 2: Changes in Atmospheric Constituents and in Radiative Forcing, Section 2.7.1.3.
- 257 Ibid.
- 258 The stratosphere – the second lowest layer of the atmosphere, just above the troposphere.

- 259 The UV peak-to-peak amplitude is approximately 3.5-7% of the UV irradiance, depending on the wavelength, compared with a peak-to-peak variation of about 0.1% in the TSI (reference 265 below).
- 260 Ultraviolet (UV) radiation from the sun breaks up oxygen (O₂) molecules in the stratosphere into individual atoms of oxygen, which then combine with unsplit O₂ to form ozone (O₃), adding to the ozone layer. The ozone layer absorbs almost all the sun's UVB radiation, which causes sunburn and, at high doses, skin cancer. In addition to absorbing UV from the sun, ozone is a greenhouse gas like CO₂, although its concentration in the atmosphere is much lower.
- 261 The upper atmosphere (stratosphere) heats first, through absorption of solar UV by the ozone layer. The warmer stratosphere then radiates heat at infrared wavelengths to the lower atmosphere (troposphere). However, some of the ozone in the stratosphere also finds its way into the troposphere, depleting the ozone layer and cooling the stratosphere.
- 262 For a review, see L. J. Gray et al, "Solar influences on climate", *Reviews of Geophysics* 48, p. RG4001 (2010), Section 4.2.2, found at http://pubs.giss.nasa.gov/docs/2010/2010_Gray_et_al.pdf. It is thought that stratospheric wind shifts caused by changes in solar UV irradiance induce what are called planetary or Rossby waves in the stratosphere and troposphere – huge planet-encircling undulations that heat polar air.
- 263 M. Lockwood, R. G. Harrison, T. Woollings and S. K. Solanki, "Are cold winters in Europe associated with low solar activity?", *Environmental Research Letters* 5, p. 024001 (2010), found at http://iopscience.iop.org/1748-9326/5/2/024001/pdf/1748-9326_5_2_024001.pdf. In blocking events, the jet stream is locked in place by Rossby waves (see Reference 262 above).
- 264 Niall Firth, " 'Blocked' jetstream to blame for freak weather in Russia and Pakistan, say scientists", *Daily Mail*, August 12, 2010, found at <http://www.dailymail.co.uk/sciencetech/article-1302225/Blocked-jetstream-blame-freak-weather-Russia-Pakistan.html>.
- 265 Joanna D. Haigh, "The effects of solar variability on the Earth's climate", *Philosophical Transactions of the Royal Society of London* A361, pp. 95-111 (2003), found at <http://www.see.ed.ac.uk/~shs/Climate%20change/Climate%20model%20results/Haigh%20solar%20variation.pdf>.
- 266 Joanna D. Haigh, Ann R. Winning, Ralf Toumi and Jerald W. Harder, "An influence of solar spectral variations on radiative forcing of climate", *Nature* 467, pp. 696-699 (2010), summarized in *ScienceDaily*, October 6, 2010, found at <http://www.sciencedaily.com/releases/2010/10/101006141558.htm>.

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- 267 Lori K. Fenton, Paul E. Geissler and Robert M. Haberle, “Global warming and climate forcing by recent albedo changes on Mars”, *Nature* 446, pp. 646-649 (2007), found at <http://humbabe.arc.nasa.gov/~fenton/pdf/fenton/nature05718.pdf>. The warming was predicted by a computer climate model for Mars, in which the darker (lower albedo) surface absorbed more sunlight than the lighter, dusty surface 22 years earlier. The ice caps on Mars are solid CO₂, not water ice as on the Earth.
- 268 Mark A. Szwast, Mark I. Richardson and Ashwin R. Vasavada, “Surface dust redistribution on Mars as observed by the Mars Global Surveyor and Viking orbiters”, *Journal of Geophysical Research* 111, p. E11008 (2006).
- 269 L. A. Sromovsky, P. M. Fry, S. S. Limaye and K. H. Baines, “The nature of Neptune’s increasing brightness: Evidence for a seasonal response”, *Icarus* 163, pp. 256–261 (2003), found at <http://hubblesite.org/pubinfo/pdf/2003/17/paper.pdf>.
- 270 H. B. Hammel and G. W. Lockwood, “Suggestive correlations between the brightness of Neptune, solar variability, and Earth’s temperature”, *Geophysical Research Letters* 34, p. L08203 (2007); summarized in “Neptune News”, World Climate Report blog, May 8, 2007, found at <http://www.worldclimatereport.com/index.php/2007/05/08/neptune-news/>.
- 271 “MIT researcher finds evidence of global warming on Neptune’s largest moon”, News Office, Massachusetts Institute of Technology, June 24, 1998, found at <http://web.mit.edu/newsoffice/1998/triton.html>.
- 272 “Pluto is undergoing global warming, researchers find”, News Office, Massachusetts Institute of Technology, October 9, 2002, found at <http://web.mit.edu/newsoffice/2002/pluto.html>.
- 273 The two principal cosmogenic isotopes are the beryllium isotope ¹⁰Be, found in ice cores, and the carbon isotope ¹⁴C, generally measured in tree rings. Because greater solar activity reduces the number of cosmic rays available for atmospheric production of cosmogenic isotopes, which are then transported to the Earth’s surface, there is an inverse relation between the sun’s output and terrestrial isotope levels. Higher solar activity results in lower isotope levels, and vice versa.
- 274 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 2: Changes in Atmospheric Constituents and in Radiative Forcing, Section 2.7.1.2.1.
- 275 Y.-M. Wang, J. L. Lean and N. R. Sheeley, Jr., “Modeling the sun’s magnetic field and irradiance since 1713”, *The Astrophysical Journal* 625, pp. 522–538 (2005), found at http://iopscience.iop.org/0004-637X/625/1/522/pdf/0004-637X_625_1_522.pdf.

- 276 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 6: Palaeoclimate, Section 6.6.3.4. The IPCC's estimates of the increase in TSI since the time of the Maunder Minimum are: its selected low estimate of 0.08%, based on sunspot data and a computer model of the sun (see Reference 275 above); and a high estimate of 0.25%, derived from a ¹⁰Be ice-core record (see Reference 277 below). The 0.08% gain based on sunspot numbers consists of 0.04% from an increase in the average irradiance, plus half the current sunspot cycle amplitude estimated at 0.08% of the irradiance. The sunspot cycle amplitude during the Maunder Minimum was close to zero.
- 277 Edouard Bard, Grant Raisbeck, Françoise Yiou and Jean Jouzel, "Solar irradiance during the last 1200 years based on cosmogenic nuclides", *Tellus* 52B, pp. 985-992 (2000), found at <http://tellusb.net/index.php/tellusb/article/download/17080/19062>; Edouard Bard and Martin Frank, "Climate change and solar variability: What's new under the sun?", *Earth and Planetary Science Letters* 248, pp. 1-14 (2006), found at <http://geosci.uchicago.edu/~rtp1/BardPapers/Bard06EPSL.pdf>.
- 278 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Figure 9.4.
- 279 IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 6: Radiative Forcing of Climate Change, Section 6.11.1.2.
- 280 The closest the 2007 IPCC report (in Reference 278 above, Figure 9.5b) comes to calculating the solar contribution is by graphing the temperature predicted by its climate models over the period from 1900 to the present, with natural forcings alone. The only natural forcings considered are volcanic and solar, but volcanic forcing (which is negative, due to the aerosols released) is currently negligible since there has not been an explosive volcanic eruption since Mt. Pinatubo in 1991. Therefore, the IPCC's predicted temperature increase from natural forcings can be assumed to come just from the sun.
- 281 There are also significant El Niño and La Niña effects in the Indian Ocean and, to a lesser extent, in the Atlantic and Southern Oceans.
- 282 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Section 3.6.2.1.
- 283 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Section 8.4. See Reference 161 in Chapter 3: Computer Snake Oil?
- 284 Gerard Bond et al, "Persistent solar influence on North Atlantic climate during the Holocene", *Science* 294, pp. 2130-2136 (2001), found at <http://academic.evergreen.edu/z/zita/articles/solar/SolarForcingHolocene01Bond.pdf>. The research team used drift ice

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- measured in deep-sea sediment cores as an indicator of climate change, together with the cosmogenic isotopes ^{10}Be in Greenland ice cores and ^{14}C in tree rings as proxy indicators of solar activity. The deep-sea sediment cores contain glacial debris rafted into the oceans by icebergs, and then dropped onto the sea floor as the icebergs melted. The volume of glacial debris is largest, and it is carried farthest out to sea, when temperatures are lowest.
- 285 Ibid. The reduction in overturning (and possibly shutdown of the ocean conveyor altogether) at the end of the last ice age followed a massive influx of fresh water into the North Atlantic Ocean that drastically reduced surface salinity. Bond's team suggests that at strong solar minima, North Atlantic water may be similarly freshened by melting drift ice in the Arctic-Nordic Seas, blown there by solar-induced winds.
- 286 Gerald A. Meehl, Julie M. Arblaster, Katja Matthes, Fabrizio Sassi and Harry van Loon, "Amplifying the Pacific Climate System Response to a Small 11-Year Solar Cycle Forcing", *Science* 325, pp. 1114-1118 (2009), summarized in a slide presentation at http://www.agci.org/DB/PPTs/10S1_0613_JMeehl.pdf.
- 287 Ibid.
- 288 Jan-Erik Solheim, Kjell Stordahl and Ole Humlum, "The long sunspot cycle 23 predicts a significant temperature decrease in cycle 24", *Journal of Atmospheric and Solar-Terrestrial Physics* 80, pp. 267-284 (2012), found at http://pdn.sciencedirect.com/science?_ob=MiamiImageURL&_cid=271871&_user=10&_pii=S1364682612000417&_check=y&_origin=search&_zone=rslt_list_item&_coverDate=2012-05-31&wchp=dGLbVlk-zSkWb&md5=9e98bc0cca565a1b1dce6469ae9007e6&pid=1-s2.0-S1364682612000417-main.pdf&sqtrkid=0.5741416848978587.
- 289 Ibid.
- 290 Nir J. Shaviv, "Using the Oceans as a Calorimeter to Quantify the Solar Radiative Forcing", *Journal of Geophysical Research* 113, p. A11101 (2008), found at <http://www.sciencebits.com/files/articles/CalorimeterFinal.pdf>.
- 291 Joseph D'Aleo, "Reanalysis of the Climate Factors with USHCN Version 2", International Climate and Environmental Change Assessment Project (ICECAP) blog, January 25, 2008, found at http://icecap.us/index.php/go/joes-blog/reanalysis_of_the_climate_factors_with_ushcn_version_2/. Using data from the USHCN, D'Aleo noted a strong correlation ($R^2 = 0.85$) between the USHCN temperature record from 1900 to 2007 and the combined indices for the PDO and the AMO. The PDO and AMO indices are based on sea surface temperatures.

- 292 Roy W. Spencer, “Global warming as a natural response to cloud changes associated with the Pacific Decadal Oscillation (PDO)”, available at <http://www.drroyspencer.com/research-articles/global-warming-as-a-natural-response/>.
- 293 Joseph D’Aleo, “Reliving the 1950s (and 1890s): the 60 year cycle”, International Climate and Environmental Change Assessment Project (ICECAP) blog, July 8, 2012, found at http://icecap.us/index.php/go/joes-blog/reliving_the_1950s_and_1890s_the_60_year_cycle/.
- 294 This was also demonstrated over 30 years ago, adds Spencer, by Klaus Hasselmann [Claude Frankignoul and Klaus Hasselmann, “Stochastic climate models. Part II: Application to sea-surface temperature anomalies and thermocline variability”, *Tellus* 29, pp. 289-305 (1977), found at <http://onlinelibrary.wiley.com/doi/10.1111/j.2153-3490.1977.tb00740.x/pdf>]. It comes about because of the large heat capacity of the oceans, which results in a time lag between radiative heat input and corresponding changes in surface temperature, as discussed in the previous section of this chapter.
- 295 In this simple energy balance model, the two principal assumptions are the slab ocean depth, through which heat is mixed on multidecadal to centennial time scales, and cloud cover variations directly proportional to the observed PDO index values. A typical ocean mixing depth in the simulations was 800 meters (0.5 miles).
- 296 See Chapter 4: CO₂ Sense and Sensitivity.
- 297 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 2: Changes in Atmospheric Constituents and in Radiative Forcing, Section 2.7.
- 298 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Section 9.4.1.2.
- 299 Ibid, Section 9.4.1.4.
- 300 Foresight Institute, “Some Historical Perspective”, found at <http://www.foresight.org/nanodot/?p=3553>. The temperatures shown were obtained from an analysis of central Greenland ice cores, carried out by R. B. Alley and reported by NOAA [NOAA National Climatic Data Center, “NOAA Paleoclimatology”, GISP2 - Temperature Reconstruction and Accumulation Data, found at <http://www.ncdc.noaa.gov/paleo/metadata/noaa-icecore-2475.html>].

Chapter 6: Global Cooling

- 301 If the temperature slide is measured instead from 1998, as some skeptics like to do, the drop is even larger and the hiatus even longer. But this is only because global temperatures

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- spiked that year, due to the unusually strong El Niño of 1997-1998. When you measure a decline from an abnormally high starting point, you get an artificially big drop. That's data manipulation, of the kind that the alarmist IPCC often indulges in. However, the temperature decrease here can legitimately be measured from late 2001, when the mercury was steadier.
- 302 Kyle L. Swanson and Anastasios A. Tsonis, "Has the climate recently shifted?", *Geophysical Research Letters* 36, p. L06711 (2009), found at http://www.uwm.edu/~kswanson/publications/2008GL037022_all.pdf.
- 303 Ibid. Swanson and Tsonis postulate that global climate undergoes a major shift whenever four specific natural climate cycles resonate in phase, mutually reinforcing one another, at the same time as the coupling between the four cycles increases. The four cycles are ENSO, the PDO, the North Atlantic Oscillation and the North Pacific Index. However, the precise cause of this internal reorganization of the climate system is unknown.
- 304 According to HadCRU, the global temperature anomaly fell from 0.41° Celsius (0.74° Fahrenheit) in 2001 to 0.34° Celsius (0.61° Fahrenheit) in 2011 [HadCRUT3 "Global Temperature Record", found at <http://www.cru.uea.ac.uk/cru/data/temperature/hadcrut3gl.txt>]; according to NOAA, the decrease was smaller, from 0.54° Celsius (0.97° Fahrenheit) in 2001 to 0.51° Celsius (0.92° Fahrenheit) in 2011 [NOAA National Climatic Data Center, "State of the Climate Global Analysis", found at <http://www.ncdc.noaa.gov/sotc/global/2011/13>]. From these two estimates, the average decrease in the global temperature anomaly from 2001 to 2011 was 0.05° Celsius (0.09° Fahrenheit). For land temperatures only (excluding sea measurements), both HadCRU and NOAA maintain that the temperature anomaly increased slightly between 2001 and 2011.
- 305 Climategate email 1255352257.txt, found at ClimateGate FOIA Grepper, <http://www.ecowho.com/foia.php?file=1255352257.txt>.
- 306 Plotted graph for the "RSS MSU lower troposphere global mean" data source, WoodForTrees.org blog, at <http://woodfortrees.org/plot/rss/from:2001/to:2012/plot/rss/from:2001/to:2012/trend>.
- 307 In a later defense of his statement in the Climategate email (Reference 305 above), Kevin Trenberth claimed that he had only been lamenting the inadequacy of current measurement technology ["Check With Climate Scientists for Views on Climate", *The Wall Street Journal*, February 1, 2012, found at <http://online.wsj.com/article/SB10001424052970204740904577193270727472662.html>].

- 308 For a recent research paper supporting this notion, see Judah L. Cohen, Jason C. Furtado, Mathew A. Barlow, Vladimir A. Alexeev and Jessica E. Cherry, "Arctic warming, increasing snow cover and widespread boreal winter cooling", *Environmental Research Letters* 7, p. 014007 (2012), found at http://iopscience.iop.org/1748-9326/7/1/014007/pdf/1748-9326_7_1_014007.pdf. The authors argue that increases in high-latitude moisture and in Eurasian snow cover induce large-scale winter cooling in the Northern Hemisphere, especially in the eastern U.S. and northern Eurasia, in contrast to the predictions of computer climate models. Unfortunately, this hypothesis did not hold up during the Northern Hemisphere winter of 2011-2012, when the eastern U.S. experienced unusually mild weather.
- 309 HadCRUT3 global combined land and sea surface temperature record, from <http://www.cru.uea.ac.uk/cru/info/warming/>.
- 310 David Herring, "Earth's Temperature Tracker: From a Dimmer Past to a Brighter Future?", NASA Earth Observatory Features, November 5, 2007, found at http://earthobservatory.nasa.gov/Features/GISSTemperature/giss_temperature.php. The article discusses GISS chief James Hansen's ideas about aerosol cooling.
- 311 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 2: Changes in Atmospheric Constituents and in Radiative Forcing, Executive Summary.
- 312 Don J. Easterbrook, "Global Cooling is Here: Evidence for Predicting Global Cooling for the Next Three Decades", Global Research blog, November 2, 2008, found at <http://www.globalresearch.ca/index.php?context=va&aid=10783>. The observation of a 27-year cycle in global temperature is based on measurements of the oxygen ^{18}O to ^{16}O ratio in Greenland ice cores.
- 313 M. J. Owens, M. Lockwood, L. Barnard and C. J. Davis, "Solar cycle 24: Implications for energetic particles and long-term space climate change", *Geophysical Research Letters* 38, p. L19106 (2011), found at <http://www.agu.org/pubs/current/si/links/2011GL049328.pdf>. The recent grand solar maximum, which was the longest maximum on record, ended during the last solar minimum; the transition to the next grand solar minimum is expected to be rapid.
- 314 I. G. Usoskin, S. K. Solanki and G. A. Kovaltsov, "Grand minima and maxima of solar activity: new observational constraints", *Astronomy & Astrophysics* 471, pp. 301-309 (2007), found at <http://cc.oulu.fi/~usoskin/personal/aa7704-07.pdf>. Using the cosmogenic isotope ^{14}C in tree rings as a proxy for solar activity, the authors reconstructed grand solar

NOTES AND REFERENCES

- minima and maxima for the past 11,500 years; the minima and maxima have occurred at irregular intervals ranging from 100 to over 1,000 years.
- 315 Gordon J. Fulks, private communication (2012). The Minoan Warming, 1st and 2nd Roman Warmings, and the Medieval Warm Period depicted in Figure 5.3 all have approximately the same 200-year full width at half maximum.
- 316 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 10: Global Climate Projections, Executive Summary.
- 317 IPCC, *Special Report: Emissions Scenarios* (2000).
- 318 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 10: Global Climate Projections, Section 10.3.1. Over the period from 2000 to 2020, the average predicted temperature increase for three representative scenarios (Figure 10.5) is approximately 0.44° Celsius (0.79° Fahrenheit); this is equivalent to an increase of 0.22° Celsius (0.40° Fahrenheit) for the 10 years from the end of 2001 to the end of 2011.
- 319 The IPCC's prediction of a 0.22° Celsius (0.40° Fahrenheit) gain for the period from 2001 to 2011, added to the actual drop of 0.05° Celsius (0.09° Fahrenheit), gives an overestimate of 0.27° Celsius (0.49° Fahrenheit).
- 320 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Table 3.3. From 1979 to 2005, the IPCC's observed global warming rate was 0.17° Celsius (0.31° Fahrenheit) per decade. Using the same warming rate for the 3.1 decades from 1970 to 2001 gives a temperature increase over this period of 0.53° Celsius (1.0° Fahrenheit).
- 321 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, pp. 13-15.
- 322 Ibid.
- 323 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 3: Observations: Surface and Atmospheric Climate Change, Executive Summary and FAQ 3.3.
- 324 Ibid, Table 3.8.
- 325 Ryan N. Maue, "Global Tropical Cyclone Activity Update, Historical Tropical Cyclone Activity Graphics", found at <http://policlimate.com/tropical/index.html>. The Accumulated Cyclone Energy (ACE) index is a metric for the collective intensity and duration of tropical cyclones in any particular season. The ACE index measures the sum of the squares of the maximum sustained surface wind speed, at six hourly intervals, for every tropical storm. As seen in Figure 6.3, Maue's analysis shows a recent dramatic drop

- in the 24-month running sum of both the global and the Northern Hemisphere ACE indexes.
- 326 NOAA National Climatic Data Center, “U.S. Tornado Climatology”, found at <http://www.ncdc.noaa.gov/oa/climate/severeweather/tornadoes.html>.
- 327 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 4: Observations: Changes in Snow, Ice and Frozen Ground, Section 4.4.2.2.
- 328 Mark Serreze, National Snow and Ice Data Center, reported by *National Geographic News*, September 17, 2008, at <http://news.nationalgeographic.com/news/2008/09/080917-sea-ice.html>.
- 329 Some of the sun’s incoming radiation is reflected back into space by ice cover, especially near the poles. But once the ice melts, the darker surfaces with lower albedo exposed underneath absorb more solar radiation and contribute to global warming.
- 330 NOAA Arctic theme page, “Previous Arctic Report Cards”, found at http://www.arctic.noaa.gov/reportcard_previous.html. Summer Arctic ice, which shrinks to its minimum annual extent in September, reached its lowest point in 2007; winter ice, which covers its maximum area in March, was at its lowest level in 2006.
- 331 D. Perovich, W. Meier, J. Maslanik and J. Richter-Menge, NOAA, “Arctic Report Card: Update for 2011”, found at http://www.arctic.noaa.gov/reportcard/sea_ice.html.
- 332 The Cryosphere Today, “Northern Hemisphere Sea Ice Area”, found at <http://arctic.atmos.uiuc.edu/cryosphere/arctic.sea.ice.interactive.html>. An animated display of Arctic sea ice from 1978 to 2006 can be viewed at <http://arctic.atmos.uiuc.edu/cryosphere/all.final.1978-2006.mov>.
- 333 Ibid, “Global Sea Ice Area”, found at <http://arctic.atmos.uiuc.edu/cryosphere/IMAGES/global.daily.ice.area.withtrend.jpg>.
- 334 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 5: Observations: Oceanic Climate Change and Sea Level, Section 5.2.2.3.
- 335 Robert S. Knox and David H. Douglass, “Recent Energy Balance of Earth”, *International Journal of Geosciences* 1, pp. 99-101 (2010), found at <http://www.scirp.org/journal/PaperDownload.aspx?paperID=3446&returnUrl=http%3a%2f%2f>. In their paper, Knox and Douglass summarize the results of several ocean heat content analyses based on Argo float data: by Craig Loehle, Roger A. Pielke Sr., K. von Schuckmann et al, and themselves. In all analyses except the von Schuckmann et al study (see Reference 344 below), ocean heat content was measured from the surface to a depth of 700 meters (2,300 feet). Older data on ocean heat content before the Argo system was deployed in the early

NOTES AND REFERENCES

- 2000s comes primarily from expendable and mechanical bathythermograph (XBT and MBT, respectively) probes. However, there are various biases and systematic errors in XBT and MBT data.
- 336 NASA Earth Observatory, “Argo Robotic Instrument Network Now Covers Most of the Globe”, December 1, 2004, found at <http://earthobservatory.nasa.gov/Newsroom/view.php?id=25723>.
- 337 The exact amount of any global energy imbalance is disputed, as discussed in Reference 335 above. The imbalance cannot be measured accurately because it’s so small: estimates of its magnitude vary from close to zero to about 0.9 W/m^2 , compared with the total global energy balance of $235\text{-}240 \text{ W/m}^2$ (Reference 140 in Chapter 3: Computer Snake Oil?), both averaged over a year.
- 338 Kevin E. Trenberth and John T. Fasullo, “Tracking Earth’s Energy”, *Science* 328, pp. 316-317 (2010), found at <http://www.deas.harvard.edu/climate/seminars/pdfs/Perspectives.pdf>; and “Tracking Earth’s Energy: From El Niño to Global Warming”, *Surveys in Geophysics*, Online First, October 14, 2011, found at <http://www.springerlink.com/content/bquj732425827t15/fulltext.pdf>.
- 339 NOAA National Oceanographic Data Center, “Global Ocean Heat and Salt Content”, found at http://www.nodc.noaa.gov/OC5/3M_HEAT_CONTENT/.
- 340 S. Levitus, J. I. Antonov, T. P. Boyer, R. A. Locarnini, H. E. Garcia and A. V. Mishonov, “Global ocean heat content 1955–2008 in light of recently revealed instrumentation problems”, *Geophysical Research Letters* 36, p. L07608 (2009), found at <ftp://ftp.nodc.noaa.gov/pub/data.nodc/woa/PUBLICATIONS/grlheat08.pdf>. The analyses of ocean heat content in this paper were based mainly on older measurements using XBT and MBT probes, hydrographic bottles, and Conductivity-Temperature-Depth (CTD) instruments. All this data is less reliable than Argo float data (see Reference 335 above).
- 341 Gerald A. Meehl, Julie M. Arblaster, John T. Fasullo, Aixue Hu and Kevin E. Trenberth, “Model-based evidence of deep-ocean heat uptake during surface-temperature hiatus periods”, *Nature Climate Change* 1, pp. 360-364 (2011), summarized in NCAR/UCAR AtmosNews, “Deep oceans can mask global warming for decade-long periods”, September 16, 2011, found at <https://www2.ucar.edu/atmosnews/news/5364/deep-oceans-can-mask-global-warming-decade-long-periods>.
- 342 Ibid.
- 343 Roger Pielke Sr., “Torpedoing of the Use of the Global Average Surface Temperature Trend as the Diagnostic for Global Warming”, Climate Science: Roger Pielke Sr. blog, September

- 20, 2011, found at <http://pielkeclimatesci.wordpress.com/2011/09/20/torpedoing-of-the-use-of-the-global-average-surface-temperature-trend-as-the-diagnostic-for-global-warming/>.
- 344 K. von Schuckmann and P.-Y. Le Traon, “How well can we derive Global Ocean Indicators from Argo data?”, *Ocean Science* 7, pp. 783–791 (2011), found at <http://www.ocean-sci.net/7/783/2011/os-7-783-2011.pdf>.
- 345 Willis Eschenbach, “Argo Notes the Third”, Watts Up With That blog, February 29, 2012, found at <http://wattsupwiththat.com/2012/02/29/argo-notes-the-third/>.
- 346 Craig Loehle, “Cooling of the global ocean since 2003”, *Energy & Environment* 20, pp. 99-102 (2009), found at <http://www.ncasi.org/publications/Detail.aspx?id=3152>. Loehle calculates that the loss of heat from the upper 900 meters (3,000 feet) of the oceans between 2003 and 2008 was 0.35×10^{22} Joules per year, compared with an average gain in ocean heat to a depth of 700 meters (2,300 feet) between 1955 and 2003 of 0.23×10^{22} Joules per year, as estimated by Sydney Levitus et al [S. Levitus, J. Antonov and T. Boyer, “Warming of the world ocean, 1955–2003”, *Geophysical Research Letters* 32, p. L02604 (2005), found at <ftp://ftp.nodc.noaa.gov/pub/data.nodc/woa/PUBLICATIONS/grlheat05.pdf>].
- 347 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 5: Observations: Oceanic Climate Change and Sea Level, Executive Summary.
- 348 Ibid, Section 5.5.6. According to the IPCC, thermal expansion of the oceans contributed 60% of the total observed sea level rise between 1993 and 2003.
- 349 Ibid, Figure 5.13.
- 350 Ibid, Section 5.5.2.1.
- 351 Ibid, Section 5.5.2.2.
- 352 CU Sea Level Research Group, “2012_re12 Global Mean Sea Level Time Series (seasonal signals removed)”, found at <http://sealevel.colorado.edu/content/2012rel2-global-mean-sea-level-time-series-seasonal-signals-removed>.
- 353 J. R. Houston and R. G. Dean, “Sea-level acceleration based on U.S. tide gauges and extension of previous global-gauge analyses”, *Journal of Coastal Research* 27, pp. 409-417 (2011), found at http://www.abc.net.au/mediawatch/transcripts/1125_journal2.pdf; and “Reply to: Rahmstorf, S. and Vermeer, M., 2011, Discussion of: Houston, J. R. and Dean, R. G., 2011, ‘Sea-level acceleration based on U.S. tide gauges and extensions of previous global-gauge analyses’”, *Journal of Coastal Research* 27, pp. 788-790 (2011), found at <http://www.bioone.org/doi/pdf/10.2112/JCOASTRES-D-11A-00008.1>.

Chapter 7: Why It Matters

- 354 Tom LoBianco, “Obama climate plan could cost \$2 trillion”, *The Washington Times*, March 18, 2009, found at <http://www.washingtontimes.com/news/2009/mar/18/obama-climate-plan-could-cost-2-trillion/>. This estimated cost of a proposed U.S. cap-and-trade system for limiting CO₂ emissions came from congressional staff briefed by the White House.
- 355 The inflation-adjusted cost of World War II to the U.S. has been estimated at \$4-5 trillion. See, for example, <http://historical.whatitcosts.com/facts-world-war-II-pg2.htm>.
- 356 Nevertheless, the U.S. Environmental Protection Agency (EPA) issued an Endangerment Finding in 2009, stating that greenhouse gases such as CO₂ in the atmosphere are pollutants that contribute to global warming and threaten the public health. On this basis, the agency plans to issue rules to regulate greenhouse gas emissions from fossil fuel-fired power plants and from refineries. Legal challenges to both the Endangerment Finding and the intended rules were rejected by a U.S. federal appeals court in June 2012.
- 357 One tonne or metric ton is 1,000 kilograms – about 10% larger than a U.S. or short ton.
- 358 United Nations Framework Convention on Climate Change (UNFCCC), “Kyoto Protocol (1997)”, found at http://unfccc.int/kyoto_protocol/items/2830.php. The targeted greenhouse gases are CO₂, methane (CH₄), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), hydrofluorocarbons and perfluorocarbons.
- 359 China overtook the U.S. in annual CO₂ emissions in 2008, and is now the world’s largest CO₂ emitter. India is in third place globally.
- 360 Jenny Sumner, Lori Bird and Hillary Smith, “Carbon Taxes: A Review of Experience and Policy Design Considerations”, National Renewable Energy Laboratory Technical Report NREL/TP-6A2-47312, December 2009, found at <http://www.nrel.gov/docs/fy10/sti/47312.pdf>.
- 361 U.S. Energy Information Administration (EIA), Independent Statistics and Analysis, “Total Carbon Dioxide Emissions from the Consumption of Energy”, found at <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=90&pid=44&aid=8&cid=regions&syid=1992&eyid=2007&unit=MMTCD>.
- 362 Ibid. Emissions in all countries dropped by 2009, but only because the Great Recession slashed industrial demand, temporarily lowering CO₂ output.
- 363 European Commission Climate Action, “Emissions Trading System (EU ETS)”, found at http://ec.europa.eu/clima/policies/ets/index_en.htm.

- 364 U.S. Congressional Budget Office (CBO), “Who Gains and Who Pays Under Carbon Allowance Trading? The Distributional Effects of Alternative Policy Designs”, June 2000, reported in “Containing the Cost of a Cap-and-Trade Program for Carbon Dioxide Emissions”, May 20, 2008, available at <http://www.cbo.gov/publication/41699>.
- 365 Ibid.
- 366 U.S. EPA, “Analysis of the Lieberman-Warner Climate Security Act of 2008”, March 14, 2008, found at http://www.epa.gov/climatechange/Downloads/EPAactivities/s2191_EPA_Analysis.pdf.
- 367 “NAM and ACCF Unveil New Study Highlighting the National and 50-State Economic Impacts of the Lieberman-Warner Climate Change Bill”, *PR Newswire*, March 13, 2008, found at <http://www.prnewswire.com/news-releases/nam-and-accf-unveil-new-study-highlighting-the-national-and-50-state-economic-impacts-of-the-lieberman-warner-climate-change-bill-56911162.html>.
- 368 United Nations Framework Convention on Climate Change (UNFCCC, 1992), Article 2, found at <http://unfccc.int/resource/docs/convkp/conveng.pdf>.
- 369 At prevailing exchange rates in early 2012, a price of €30 per metric ton was equivalent to around \$36 per U.S. ton.
- 370 “European Union Emission Trading Scheme”, at http://en.wikipedia.org/wiki/European_Union_Emission_Trading_Scheme#cite_note-22.
- 371 Ibid.
- 372 Europa, “Emissions trading: Commission decides on first set of national allocation plans for the 2008-2012 trading period”, found at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1650&format=HTML&aged=0&language=EN&guiLanguage=en>.
- 373 Analysis of the EU CO₂ Market, found at <http://www.co2prices.eu/>.
- 374 Sonja van Renssen, “The fate of the EU carbon market hangs in the balance”, *European Energy Review*, April 12, 2012, found at http://www.europeanenergyreview.eu/site/pagina.php?id_mailing=272&toegang=7a614fd06c325499f1680b9896beedeb&id=3642.
- 375 Ibid.
- 376 “Set-aside could send EU CO₂ to 20 eur/t – Point Carbon”, *Reuters*, March 27, 2012, found at <http://www.reuters.com/article/2012/03/27/carbon-point-carbon-idUSL6E8ER4O320120327>.
- 377 European Commission Climate Action, “Emissions Trading System: Auctioning”, found at http://ec.europa.eu/clima/policies/ets/auctioning/index_en.htm.

NOTES AND REFERENCES

- 378 “American Clean Energy and Security Act of 2009”, at <http://www.gpo.gov/fdsys/pkg/BILLS-111hr2454pcs/pdf/BILLS-111hr2454pcs.pdf>.
- 379 U.S. EPA, “Acid Rain and Related Programs: 2007 Progress Report”, found at <http://www.epa.gov/airmarkt/progress/docs/2007ARPreport.pdf>.
- 380 An EPA analysis (see Reference 366 above) forecast that, if the legislation were enacted, the subsequently higher cost of living would chop between \$1 trillion and \$3 trillion annually off the national economy by the year 2050, which corresponds to a reduction of 2.3% to 6.9% in U.S. output. For comparison, the U.S. and European economies shrank by around 4% during the Great Recession.
- 381 See “Climate Change Accountability Act (Bill C-224)”, at [http://en.wikipedia.org/wiki/Climate_Change_Accountability_Act_\(Bill_C-224\)](http://en.wikipedia.org/wiki/Climate_Change_Accountability_Act_(Bill_C-224)).
- 382 “Canada to pull out of Kyoto protocol”, *Reuters*, December 12, 2011, found at <http://www.reuters.com/article/2011/12/12/us-kyoto-withdrawal-idUSTRE7BB1X420111212>.
- 383 California Environmental Protection Agency Air Resources Board (ARB), “California Air Resources Board adopts key element of state climate plan”, found at <http://www.arb.ca.gov/newsrel/newsrelease.php?id=245>.
- 384 Regional Greenhouse Gas Initiative, “Welcome”, found at <http://www.rggi.org/>. The nine states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.
- 385 California Environmental Protection Agency Air Resources Board (ARB), “Air Resources Board Announces Release of Draft Regulations for Cap-and-Trade Linkage with Québec”, found at <http://www.arb.ca.gov/newsrel/newsrelease.php?id=300>.
- 386 Government of Alberta Environment and Sustainable Resource Development, “Greenhouse Gas Reduction Program”, found at <http://environment.alberta.ca/01838.html>.
- 387 Ibid, “Regulating Greenhouse Gas Emissions”, at <http://environment.alberta.ca/0915.html>.
- 388 British Columbia Ministry of Environment, “British Columbia Greenhouse Gas Inventory Report”, found at http://www.env.gov.bc.ca/cas/mitigation/ghg_inventory/index.html.
- 389 “British Columbia Rethinks Its Pioneering Carbon Tax”, *National Geographic Daily News*, May 3, 2012, found at <http://news.nationalgeographic.com/news/energy/2012/05/120503-british-columbia-reviews-carbon-tax/>.
- 390 See, for example, CRA International, Inc., “Economic Analysis of the Lieberman-Warner Climate Security Act of 2007 Using CRA’s MRN-NEEM Model”, at <http://www>.

- crai.com/uploadedFiles/RELATING_MATERIALS/Publications/BC/Energy_and_Environment/files/CRA_NMA_S2191_April08_2008.pdf. CRA International is an independent business consulting firm.
- 391 Ministry of the Environment, Japan, “Japan’s Voluntary Emissions Trading Scheme (JVETS)”, March 19, 2009, found at <http://www.env.go.jp/en/earth/ets/jvets090319.pdf>.
- 392 Erik Vance, “Mexico passes climate-change law”, *Nature News*, April 23, 2012, found at <http://www.nature.com/news/mexico-passes-climate-change-law-1.10496>.
- 393 “Australia passes landmark carbon price laws”, *Reuters*, November 8, 2011, found at <http://www.reuters.com/article/2011/11/08/us-australia-carbon-idUSTRE7A60PO20111108>.
- 394 Ibid.
- 395 Climate change information New Zealand, “The New Zealand Emissions Trading Scheme”, found at <http://www.climatechange.govt.nz/emissions-trading-scheme/>.
- 396 Report on The New Zealand Emissions Trading Scheme, June 30, 2011, found at <http://www.climatechange.govt.nz/emissions-trading-scheme/building/reports/ets-report/ets-report-final.pdf>.
- 397 Dennis Shanahan, “NZ to ease back on emissions trading scheme”, *The Australian*, June 21, 2011, found at <http://www.theaustralian.com.au/national-affairs/nz-to-ease-back-on-carbon-plans/story-fn59niix-1226078803018>.
- 398 According to the U.S. EIA (in Reference 361 above), the worldwide increase in CO₂ emissions from the consumption of energy between 1997 and 2009 was 31%. The International Energy Agency (IEA), which compiles slightly different numbers, reported that CO₂ emissions in 2011 were the highest ever [IEA, “Global carbon-dioxide emissions increase by 1.0 Gt in 2011 to record high”, May 24, 2012, found at <http://www.iea.org/newsroomandevents/news/2012/may/name,27216,en.html>].
- 399 Fracking involves pumping millions of gallons of a sand, water and chemical slurry into a shale formation, first vertically and then horizontally, creating cracks that release natural gas from underground rocks. Groundwater contamination and spills from the process can be avoided by proper sealing of fracking wells as they pass through aquifers.
- 400 “IEA lauds unconventional gas reserves”, *UPI*, January 19, 2011, found at http://www.upi.com/Business_News/Energy-Resources/2011/01/19/IEA-lauds-unconventional-gas-reserves/UPI-83531295444312/.
- 401 Richard Martin, “America’s energy job machine is heating up”, *Fortune*, April 12, 2012, found at <http://tech.fortune.cnn.com/2012/04/12/energy-jobs-boom/>.

NOTES AND REFERENCES

- 402 U.S. EIA, “Annual Energy Outlook 2012”, June 2012, p. 3, found at [http://www.eia.gov/forecasts/aeo/pdf/0383\(2012\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf).
- 403 David Fridley, “Nine Challenges of Alternative Energy”, Post Carbon Institute Report, August 10, 2010, available at <http://www.postcarbon.org/Reader/PCReader-Fridley-Alternatives.pdf>.
- 404 David Rotman, “Can Energy Startups Be Saved?”, *Technology Review*, May/June 2012, found at http://www.technologyreview.com/printer_friendly_article.aspx?id=40234.
- 405 See Reference 120 in Chapter 2: Science Gone Wrong.
- 406 U.S. DOE, “20% Wind Energy by 2030: Increasing Wind Energy’s Contribution to U.S. Electricity Supply”, July 2008, found at <http://www.eere.energy.gov/wind/pdfs/41869.pdf>.
- 407 Ibid.
- 408 According to the DOE study (in Reference 406 above), generating 20% of U.S. electricity from wind by 2030 could avoid approximately 825 million metric tons (750 million U.S. tons) of CO₂ emissions from the electric sector, out of a projected 7,900 million metric tons (7,200 million U.S. tons) in total U.S. CO₂ emissions. The EIA (in Reference 402 above) estimates total CO₂ emissions in 2030 to be 5,800 million metric tons (5,300 million U.S. tons).
- 409 See Reference 402 above, p. 4.
- 410 U.S. EIA, Independent Statistics and Analysis, Monthly Energy Review, July 2012, Table 12.6, found at <http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf>. The EIA’s data shows that in the first quarter of 2012, U.S. CO₂ emissions from the electric sector fell 12% compared to the first quarter of 2011, suggesting that total CO₂ emissions for 2012 could fall back to 1990 levels. The drop reflects the increased use of natural gas for electricity generation, as well as a warm U.S. winter in 2011-2012.
- 411 Center for Politiske Studier, “Wind Energy – The Case of Denmark”, September 2009, p. 2, found at <http://www.ens.dk/en-US/supply/Renewable-energy/WindPower/Documents/Vindturbines%20in%20DK%20eng.pdf>.
- 412 Michael J. Trebilcock, “Speaking Truth to ‘Wind’ Power”, Citizens Against Lake Erie Wind Turbines blog, September 17, 2009, found at <http://lakeeriewindturbines.com/speaking-truth-to-%E2%80%9Cwind%E2%80%9D-power/>.
- 413 Andrew Gilligan, “An ill wind blows for Denmark’s green energy revolution”, *The Telegraph*, September 12, 2010, found at <http://www.telegraph.co.uk/news/worldnews/europe/denmark/7996606/An-ill-wind-blows-for-Denmarks-green-energy-revolution.html>.

- 414 See Reference 402 above, p. 148 and p. 163.
- 415 Ibid, p. 87. Coal is expected to contribute 38% of U.S. electricity demand in 2035, and natural gas 28%.
- 416 Aaron Glantz, “Number of Green Jobs Fails to Live Up to Promises”, *The New York Times*, August 18, 2011, found at <http://www.nytimes.com/2011/08/19/us/19bcgreen.html?pagewanted=all>.
- 417 The Brookings Institution, “Sizing the Clean Economy”, 2011, found at http://www.brookings.edu/~media/Series/resources/0713_clean_economy.pdf.
- 418 Gabriel Calzada Álvarez, Raquel Merino Jara and Juan Ramón Rallo Julián, “Study of the effects on employment of public aid to renewable energy sources”, King Juan Carlos University Report, March 2009, available at <http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf>.
- 419 Eric Lantz and Suzanne Tegen, “NREL Response to the Report *Study of the effects on employment of public aid to renewable energy sources* from King Juan Carlos University (Spain)”, National Renewable Energy Laboratory White Paper NREL/TP-6A2-46261, August 2009, found at <http://www.nrel.gov/docs/fy09/sti/46261.pdf>.
- 420 U.S. EIA, “Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010”, July 2011, Tables ES4 and ES5, found at <http://docs.wind-watch.org/US-subsidy-2010.pdf>. The 2010 electricity production subsidies and support for wind, coal and nuclear energy were \$4,986 million, \$1,189 million and \$2,499 million, for generation of 95, 1,851 and 807 million megawatt hours of electricity, respectively. Support includes tax credits and research & development costs.
- 421 Gwyn Morgan, “The sorry lessons of green-power subsidies”, *The Globe and Mail*, April 30, 2012, found at <http://www.theglobeandmail.com/report-on-business/rob-commentary/the-sorry-lessons-of-green-power-subsidies/article4103467/>.

Chapter 8: Reflections

- 422 See “Cognitive dissonance”, at http://en.wikipedia.org/wiki/Cognitive_dissonance. A related concept is confirmation bias, which refers to the tendency to selectively seek evidence confirming one’s beliefs. Cognitive dissonance is a slightly broader term that can include confirmation bias.
- 423 Will Dunham, “Feeling blue? Not like a Maya sacrificial victim”, *Reuters*, February 27, 2008, found at <http://www.reuters.com/article/2008/02/27/us-maya-blue-idUSN2742908120080227>.

NOTES AND REFERENCES

- 424 See, for example, Michael Winkelman, “Aztec Human Sacrifice: Cross-Cultural Assessments of the Ecological Hypothesis”, *Ethnology* 37, pp. 285-298 (1998), available at <http://www.jstor.org/stable/3774017>.
- 425 Warren Meyer, “Why Blowing Up Kids Seemed Like a Good Idea”, *Forbes*, October 7, 2010, found at <http://www.forbes.com/sites/warrenmeyer/2010/10/07/why-blowing-up-kids-seemed-like-a-good-idea/>. In his article, Meyer refers to several public calls for climate change skeptics to be punished – by jail, execution or, in the case of a tasteless video [which can be viewed at <http://www.youtube.com/watch?v=zR73mcZW7B4>] made by the alarmist 10:10 organization, blowing up child skeptics and other disbelievers in the theory of anthropogenic global warming.
- 426 Emily Oster, “Witchcraft, Weather and Economic Growth in Renaissance Europe”, *Journal of Economic Perspectives* 18, pp. 215–228 (2004), found at <http://home.uchicago.edu/eoster/withec.pdf>.
- 427 Natalie Wolchover, “Salem Witch Trials Followed Cold Weather, New Research Finds”, *The Huffington Post*, Science, April 21, 2012, found at http://www.huffingtonpost.com/2012/04/20/salem-witch-trials-weather-climate_n_1442110.html.
- 428 Anthony Watts, “Fired OSU instructor challenges job loss”, Watts Up With That blog, July 4, 2012, found at <http://wattsupwiththat.com/2012/07/04/fired-osu-instructor-challenges-job-loss/>.
- 429 P. Gosselin, “50 Top Astronauts, Scientists, Engineers Sign Letter Claiming Extremist GISS Is Turning NASA Into A Laughing Stock!”, NoTricksZone blog, April 10, 2012, found at <http://notrickszone.com/2012/04/10/50-top-astronauts-scientists-engineers-sign-letter-claiming-giss-is-turning-nasa-into-a-laughing-stock/>.
- 430 J. Knight, J. J. Kennedy, C. Folland, G. Harris, G. S. Jones, M. Palmer, D. Parker, A. Scaife, and P. Stott, “Do global temperature trends over the last decade falsify climate predictions?”, [Global Climate] Temperatures in “State of the Climate in 2008”, *Bulletin of the American Meteorological Society* 90, p. S21 (2009), found at http://www.metoffice.gov.uk/media/pdf/j/j/global_temperatures_09.pdf.

Appendix: Climate Feedbacks and Sensitivity

- 431 IPCC, *Climate Change 2007: The Physical Science Basis*, Annex I (Glossary).
- 432 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 8: Climate Models and Their Evaluation, Section 8.6.2.3.

- 433 IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 6: Radiative Forcing of Climate Change, Equation (6.1).
- 434 Ibid, Table 6.2.
- 435 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 4.
- 436 IPCC, *Climate Change 2001: The Scientific Basis*, Chapter 9: Projections of Future Climate Change, Table 9.A1.
- 437 IPCC, Ibid, Executive Summary.
- 438 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Section 9.6.2.1.
- 439 Ibid, Section 9.4.1.2.
- 440 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 10: Global Climate Projections, Box 10.2.
- 441 James Hansen et al, "Earth's energy imbalance: confirmation and implications", *Science* 308, pp. 1431-1435 (2005), found at http://pubs.giss.nasa.gov/docs/2005/2005_Hansen_et_al_1.pdf; and "Climate simulations for 1880–2003 with GISS model E", *Climate Dynamics* 29, pp. 661–696 (2007), found at http://pubs.giss.nasa.gov/docs/2007/2007_Hansen_et_al_3.pdf.
- 442 Richard S. Lindzen and Yong-Sang Choi, "On the Observational Determination of Climate Sensitivity and Its Implications", *Asia-Pacific Journal of Atmospheric Sciences* 47, pp. 377-390 (2011), found at <http://www-eaps.mit.edu/faculty/lindzen/236-Lindzen-Choi-2011.pdf>.
- 443 Roy W. Spencer, "Global warming as a natural response to cloud changes associated with the Pacific Decadal Oscillation (PDO)", found at <http://www.drroyspencer.com/research-articles/global-warming-as-a-natural-response/>. The calculated climate sensitivities of 0.22°C for today and 0.45°C for doubled CO₂ correspond to the maximum feedback parameter of 8.3 W/m² per °C.
- 444 Most climatologists take the zero feedback (Planck) feedback parameter to be 3.3 W/m² per °C, which is the mean value calculated by R. Colman from seven IPCC climate models [R. Colman, "A comparison of climate feedbacks in general circulation models", *Climate Dynamics* 20, pp. 865–873 (2003), found at ftp://eos.atmos.washington.edu/pub/breth/CPT/colman_climdyn03.pdf]. A slightly different value of 3.2 W/m² per °C was estimated from 14 climate models by Brian Soden and Isaac Held [Brian J. Soden and Isaac M. Held, "An assessment of climate feedbacks in coupled ocean–atmosphere

NOTES AND REFERENCES

- models”, *Journal of Climate* 19, pp. 3354-3360 (2006), found at http://www.gfdl.noaa.gov/bibliography/related_files/bjs0601.pdf].
- 445 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 2.
- 446 See, for example, Kevin E. Trenberth, John T. Fasullo, Chris O’Dell and Takmeng Wong, “Relationships between tropical sea surface temperature and top-of-atmosphere radiation”, *Geophysical Research Letters* 37, p. L03702 (2010), found at <http://www.cgd.ucar.edu/cas/Staff/Fasullo/refs/Trenberth2010etalGRL.pdf>.
- 447 IPCC, *Climate Change 2007: The Physical Science Basis*, Chapter 9: Understanding and Attributing Climate Change, Section 9.6.3.2.
- 448 IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, p. 5.
- 449 Sandrine Bony et al, “How well do we understand and evaluate climate change feedback processes?”, *Journal of Climate* 19, pp. 3445-3482 (2006), found at http://www.atmos.ucla.edu/csrl/publications/Hall/Bony_et_al_2006.pdf.
- 450 R. A. Colman, S. B. Power and B. J. McAvaney, “Non-linear climate feedback analysis in an atmospheric general circulation model”, *Climate Dynamics* 13, pp. 717-731 (1997).

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