

GLOBAL COOLING:

Science and Myth

by Jason M. Vogel and Brian Lazar



Worried about climate change? Have no fear, the planet is getting colder at least according to some. This is more than speculation by skeptics: According to the World Meteorological Organization, global average temperature spiked in 1998 and has been in a cooling trend since then. Sure, 2008 was the 10th-warmest year on record since 1850, but if climate change is really happening, then shouldn't 2008 have been warmer than 1998? After all, greenhouse gas concentrations in 2008 were at an all time high. If you work in the fields of climate or weather, chances are you have heard this argument before.

Global cooling has received a lot of attention recently, in the press as well as in scientific and political circles. While thousands of scientists diligently study climate change, a backlash has developed that attempts to contradict the consensus of organizations

such as the Intergovernmental Panel on Climate Change (IPCC), the National Academy of Sciences, the American Geophysical Union, and the American Meteorological Society. This backlash does not simply contend that these scientific organizations and the thousands of scientists that populate them are wrong, but that they actually have everything backwards. These skeptics say that we are not in a period of warming global temperatures, but, in fact, face an imminent period of global cooling—one that may already have begun.

The idea of global warming burned itself into the American consciousness in 1988. NASA scientist James Hansen's testimony to Congress that year may have been the tipping point, but the American public and the American press had already been softened up considerably by the ozone hole in the ozone. The discovery of the ozone hole in 1985 by the British Antarctic Survey and the sudden realization that humankind could radically alter the planet's atmosphere changed the way that humans thought about the environment forever. If millions

of people using aerosol spray cans could create a hole in the earth's protective ozone layer and expose all of humanity to increased cancer risks, then surely all of the pollution pumped out of smokestacks and tailpipes could pose global environmental problems as well. By 1990, however, the public and press frenzy that accompanied Hansen's testimony was widely viewed as overblown. Congress decided to pump new money into climate research, and scientists have been investigating the potential problem ever since, with the vast majority of scientists asserting, with ever greater confidence, that mankind is warming the planet through deforestation and our emissions of greenhouse gases from cars, smokestacks, and landfills.

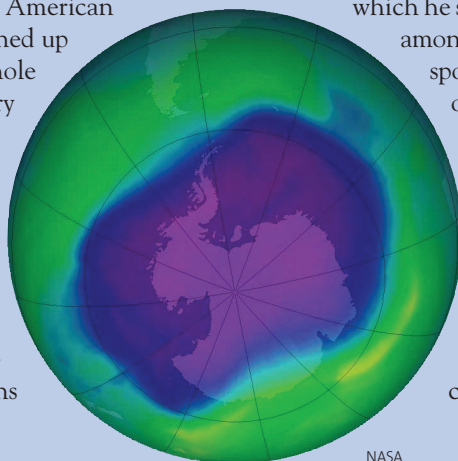
Concurrently, a small but committed cadre of scientists, politicians, pundits, and interest groups has been levying attacks at the scientific consensus. These scientists, led by S. Fred Singer, professor emeritus of environmental

“These examples merely scratch the surface of climate change skepticism”

science the University of Virginia, held their own International Conference on Climate Change in 2008 and twice in 2009, leading to the formation of the Nongovernmental International Panel on Climate Change (NIPCC), which released the 2008 report *Nature, Not Human Activity, Rules the Climate*. In his preface to the report, Singer states: “On the most important issue, the IPCC's claim that [temperature increases are very likely due to anthropogenic greenhouse gas concentrations], NIPCC reaches the opposite conclusion—namely, that natural causes are very likely to be the dominant cause.”

The 2009 *Old Farmer's Almanac* contains an article by climate change skeptic Joseph D'Aleo titled “Is Global Warming on the Wane?” in which he states: “We at the Almanac are

among those who believe that sunspot cycles and their effects on oceans correlate with climate changes. Studying these and other factors suggests that a cold, not warm, climate may be in our future.” That same year, *Washington Post* opinion columnist George F. Will wrote a February 15, 2009, editorial on climate change that concluded, “Real



NASA

Image of largest Antarctic ozone hole every recorded (September 2006).

GLOBAL COOLING: CONCEPTUAL HISTORY AND SCIENTIFIC CONTEXT

Global cooling refers to a decrease in the average surface temperature of the Earth on the order of decades or longer. Global cooling and the descent into a new ice age is highly likely on the scale of hundreds to thousands of years due to natural cycles, such as the intensity of solar radiation and small changes in the Earth's orbit around the sun. Shorter term cooling can also be caused by volcanic eruptions, regular climate fluctuations such as El Niño, and air pollution. Between the 1940s and 1960s the surface temperature of the Earth cooled slightly, setting off a wave of speculation that the Earth was cooling and perhaps even headed for a new ice age. The cooling during this period is most often attributed to air pollution from industrial activity and the large-scale burning of forests. Environmental legislation in the late 1960s and early 1970s greatly reduced this air pollution. In the 1960s and 1970s scientists intensively studied the cooling effects of air pollution on climate because of concern about fallout from nuclear bombs, the formation of contrails from air traffic, urban smog, and government plans to build a fleet of supersonic transport airplanes.

Global warming refers to an increase in the average surface temperature of the Earth on the order of decades or longer. Numerous scientific assessments have concluded that global warming is already happening due to greenhouse gases, such as carbon dioxide, produced by industrial activity and changes in land use. The scientists who studied cooling in the 1960s and 1970s were well aware of the warming effect of increasing carbon dioxide concentrations. It was not until 1978, however, that scientists concluded that greenhouse gas warming would outweigh air-pollution-induced cooling. Scientists posit hypotheses, empirically test those hypotheses, and reject, revise, or accept those hypotheses as empirical evidence dictates. In the late 1970s, scientists came to understand that greenhouse gas warming would outweigh air pollution cooling, because of multiple independent lines of inquiry that all led toward the same conclusion.

Three common global cooling arguments made by global warming skeptics are presented below with a response:

Arguments

1. **Global warming is just the current fad in a journalistic seesaw between global warming and global cooling.**

2. **There is no agreement within the scientific community on global warming or its human causes; consequently the entire global warming debate is based on speculation, not evidence.**

3. **Any rise in temperature is entirely due to variations in solar radiation, such as sunspot cycles, or natural climate variability. These trends also indicate imminent global cooling.**

Responses

News coverage can sometimes be biased or sensational. While journalists have covered both global warming and global cooling, the highest quality journalistic coverage never took advocacy positions and simply stated the facts of observed weather or contemporary scientific thought. Most journalists took great care in their statements about global cooling in the 1970s to indicate that they were covering an uncertain topic on which scientists disagreed.

Many respected scientific bodies agree that human activities are altering the atmosphere and warming the Earth, including: the Intergovernmental Panel on Climate Change, the National Academy of Sciences, the American Meteorological Society, the American Geophysical Union, the American Association for the Advancement of Science, and many others. Furthermore, researchers have studied scientific agreement on global warming by reviewing scientific publications and by surveying earth scientists. Both studies concluded that the vast majority of scientists agree that the surface temperature of the Earth has risen and human activity is a significant contributing factor.

While solar variability does affect climate, the bulk of the temperature changes observed in the 20th century are explained by greenhouse gases, volcanic eruptions, and aerosols – with a small contribution from solar variability. There is no reason to expect the physics and chemistry that have driven the climate system during the 20th century to suddenly change.

calamities [the economy] take our minds off hypothetical ones. Besides, according to the U.N. World Meteorological Organization, there has been no recorded global warming for more than a decade, or one-third of the span since the global cooling scare.” These examples merely scratch the surface of climate change skepticism. Other prominent examples include Senator James Inhofe’s minority Web page for the Senate Committee on Environment and Public Works and Michael Crichton’s 2004 best-selling novel *State of Fear*.

What Is Global Cooling?

The term global cooling has been used to refer to discrete cooling trends in global average temperature that may last on the order of decades, and also to a scientific theory positing the earth’s descent into the next ice age. Because of this variation in usage, the specific meaning of global cooling has to be evaluated on a case-by-case basis.

Between the 1940s and the 1970s, global average temperatures cooled, constituting a period of

global cooling and sparking concerns in the 1970s among some scientists, members of the press, and decision-makers that the earth could be headed into a new ice age. Many of these early climate researchers were geologists who had spent their careers puzzling over the mysteries of ice ages: Why did they happen, what triggered them, and how long did they last?

While some people jumped to the conclusion that the earth was headed into another ice age, most were extremely careful to nuance their claims and observations, acknowledging that climate is hard to understand and predict. The theory of global cooling received brief prominence in the early 1970s due to media reports, two record cold winters, consequent political attention, and observed cooling over the previous few decades. Most scientists, however, rejected the idea that global cooling would continue and perhaps lead to another ice age in the immediate future, as scientific understanding of atmospheric chemistry and physics improved and because temperatures started warming as many scientists had projected.

The difference between global cooling and greenhouse gas warming can be thought of in many ways, each containing important insights into the climate system. Global cooling and the descent into a new ice age are highly likely on the scale of hundreds to thousands of years. Climate warming due to human activities is highly likely in the immediate future—indeed numerous scientific assessments have concluded that it is already happening. Global cooling, as popularly discussed, is largely the result of natural cycles, such as the intensity of solar radiation and decadal climate oscillations. Climate warming, as popularly discussed, is largely the result of the accumulation of greenhouse gases in the atmosphere due to human industrial activity and land use. Most importantly, the causes behind global cooling and climate warming are not mutually exclusive.

Natural Cycles and Climate

An ice age is a period of time when ice sheets cover part of the earth's land surface. We currently live in an ice age as indicated by the large masses of ice on Greenland and Antarctica. Within an ice age, there are glacial (i.e., cold) periods when land and sea ice cover increases, and interglacial (i.e., warm) periods when land and sea ice cover decreases. As colloquially used, an "ice age" often refers to the "glacial" period within an ice age of decreased atmospheric and oceanic temperatures. Glacial periods operate on 40,000- and 100,000-year cycles, and interglacial periods last tens of thousands of years. The earth is currently in an interglacial period, and the previous glacial maximum occurred more than 11,000 years ago.

A number of forces affect the onset of glacial and interglacial periods, including minor changes to the earth's orbit around the sun and the tilt of the earth's axis (together known as Milankovitch cycles), changes in sunspot activity, the atmospheric composition of greenhouse gases, the reflectivity of the earth's surface, large meteor

impacts, volcanic eruptions, and other factors. Each of these natural forces changes the amount of incident solar radiation that is absorbed by the earth's atmosphere and oceans.

Scientists believe that these changes in incident solar radiation, and the associated feedback mechanisms, are the main drivers of glaciation. Conventional scientific wisdom holds that interglacial periods, such as the period in which we now live, last around 12,000 years, which would mean that we are nearing the end of the present interglacial period and may return to a glacial period of cooler, dryer climate, advancing continental ice sheets, and increased sea ice extent in the coming centuries, although this conventional wisdom has been challenged.

Furthermore, natural climate oscillations can also cause periods of cooler or warmer temperatures on shorter time scales. While poorly understood, these climate oscillations have warm and cool phases that cause significant changes in sea surface temperatures, air temperatures, wind strength, precipitation, and other climate variables. Some of these oscillations occur on intradecadal timescales, such as the El Niño Southern Oscillation, which recurs every two to seven years, while others have inter-decadal timescales, such as the Pacific Decadal Oscillation and the North Atlantic Oscillation, which occur every 20 or 30 years.

Any of these natural phenomena, or their interactions, can lead to global cooling.

Climate change skeptics consistently claim that the 1970s was a period of general scientific consensus that the world was cooling. These claims of scientific consensus on global cooling come from people as varied as U.S. Senator James Inhofe, best-selling author Michael Crichton, and climatologist Pat Michaels. However, a recent survey by Peterson et al. of the scientific literature of the time indicates that no such consensus existed. This study surveyed scientific articles on global cooling and global warming between 1965 and

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1979, identifying only seven articles supporting the theory of global cooling compared to 44 articles supporting global warming. Furthermore, the cooling articles garnered a proportionate number of journal citations. In other words, the evidence indicates that no scientific consensus on cooling existed during this time; global cooling simply received prominent media attention.

Global Cooling Enters the Global Warming Debate

Many people have used the scientific theories and media reports of global cooling from the 1970s as an argument against the current scientific consensus on global warming. Furthermore, because global average temperature spiked in 1998, global cooling arguments are being made anew about the decade 1998-2008. Most global cooling arguments present the complex process of scientific discovery as a swing from advocating global cooling to advocating global warming, typically due to ignorance or self-interest. But scientists posit hypotheses, empirically test those

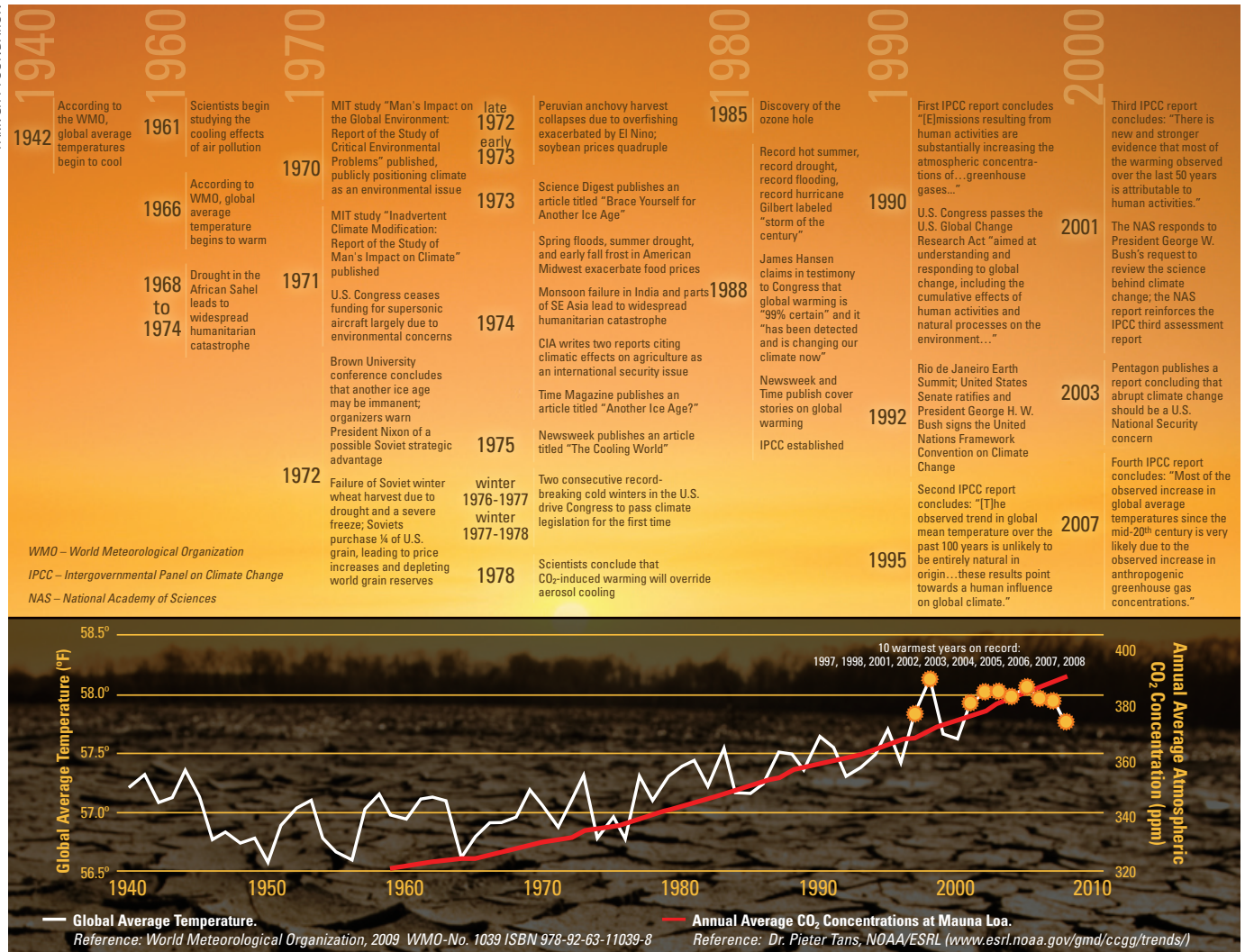
hypotheses, and reject, revise, or accept those hypotheses as empirical evidence dictates. Three common global cooling arguments made by climate change skeptics are presented below along with a response.

Argument 1: The Media Seesaw

Global warming is just the current fad in a journalistic seesaw between global warming and global cooling.

Journalists have covered both global warming and global cooling, but the highest quality journalistic coverage never took advocacy positions and simply stated the facts of observed weather and/or current scientific thought. Many of the articles cited by climate change skeptics as advocating one position or another were actually quite careful in their statements to indicate that they were covering an uncertain topic on which scientists disagreed.

Ultimately, however, conflating news coverage—especially the headlines attached to sto-



ries—with the evolving scientific understanding of climate misses the point entirely. Even if news coverage is biased or sensational, that does not mean that scientists are biased or sensational. For an accurate understanding of the state of climate science, one needs to look beyond the news media at the science itself.

Argument 2: Scientific Disagreement

There is no agreement within the scientific community on global warming or its human causes; consequently the entire climate change debate is based on speculation, not evidence.

In fact, many respected scientific bodies have said just the opposite—that human activities are altering the atmosphere, and this is leading to warming temperatures. These scientific bodies include the IPCC (2007a), the National Academy of Sciences, the American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science, along with many other national and international scientific bodies.

One researcher analyzed 928 abstracts from peer-reviewed scientific publications between 1993 and 2003 with the keywords “global climate change.” Of the 928 articles analyzed, 75 percent explicitly or implicitly accepted global warming, 25 percent dealt with methods or paleoclimate (e.g., studies of the last ice age), and none of the papers disagreed that global warming is occurring. This demonstrates the strong, evidence-based scientific consensus that climate change is real.

Another pair of researchers tackled the question of scientific consensus using a different method. These researchers surveyed 3,146 earth scientists, including some with “well-documented dissenting opinions on global warming theory.” According to the results of this survey, 90 percent of respondents believed that temperatures had risen, and some 82 percent believed human activity was a significant contributing factor. These researchers concluded, “It seems that the debate on the authenticity of global warming and the role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes.”

Finally, it is worth emphasizing that the scientific consensus on global warming is based on thousands of rigorous, evidence-based, peer-reviewed studies over several decades. As evidence has accumulated through scientific study that human activities are affecting the climate, the IPCC has increased its reported confidence in its conclusions.

Argument 3: Warming Is Due to Nature

Any rise in temperature is entirely due to variations in solar output or natural climate variability such as the North Atlantic Oscillation. These trends also indicate imminent global cooling.

While solar variability does affect climate, greenhouse gases, volcanic eruptions, and aerosols explain the bulk of 20th century observed temperature changes—with a small contribution from solar variability. There is no reason to expect the physics and chemistry that have driven the climate system during the 20th century to suddenly and inexplicably change.

However, natural climate cooling and human-induced climate warming are not mutually exclusive. Solar output has a substantial effect on climate, as do planetary climate oscillations such as the El Niño Southern Oscillation and the North Atlantic Oscillation. These natural cycles add layers of complexity to the climate effects of greenhouse gases. Climate change can mean less cooling during periods of decreased solar output or during a cool phase of the North Atlantic Oscillation. Alternatively, climate change can mean greater warming during periods of increased solar output or during a warm phase of the North Atlantic Oscillation.

Natural climate variability has a major effect on current climate and may even cause the climate to cool while greenhouse gas concentrations continue to increase. However, observed cooling or an unusually cold winter does not mean that greenhouse gas warming poses no threat. The essential point here is that drawing simple conclusions from a system as complex as the climate is difficult. Any statement about climate change entrains significant uncertainty, and such uncertainty needs to be communicated effectively for scientists, decision-makers, and the public to make informed judgments about the relative confidence we have in projections of future climate. While a broad base of evidence indicates that the globe has warmed over the last several decades and a broad scientific consensus indicates a high likelihood of future warming, significant uncertainty accompanies projections of the magnitude of future climate change, which involves complex phenomena that prevent precise forecasting.



Glacier Perito Moreno National Park in Argentina, Patagonia.

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A Call to Action

The story of global cooling provides insight into the world of scientific research on a high-profile topic of global importance. While pundits, advocates, and the media often present a dichotomy between either global cooling on the one hand or global warming on the other, the physical reality is much more complex. Nevertheless, climate change skeptics continue to point to the 1970s global cooling theory, the spike of global average temperature in 1998, and even to individual cold weather events, as alleged proof that climate change is a hoax. The main claims of climate change skeptics regarding global cooling, however, are irrelevant, oversimplified, or patently false.

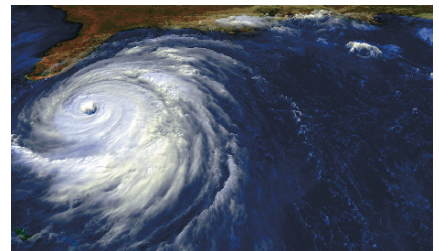
The concept of global climate change is riddled with complications and uncertainties—each of which merit continued scientific debate. Nevertheless, the impacts of a changing climate are real and have significant effects on people, their property, and their environment. These range from severe drought to heat waves to melting permafrost. A Florida family who loses their house because of skyrocketing insurance rates, Alaskan villagers who must abandon their com-

munity as it erodes into the sea, and wetland species that lose their habitat to rising sea levels will find little comfort in an abstract debate about global cooling. There are many generations to come that are very likely to experience greater climate impacts than our predecessors or we have experienced. The time has come to stop jockeying for political points, to recognize the reality faced by many citizens, and to tackle the difficult task of protecting people, their property, and their environment from adverse climate impacts.

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