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Global warming: predictions versus reality

Jury still out on global warming

Chris de Freitas, an associate professor of geography and environmental science at the University of Auckland and winner of the 2001 New Zealand Science Communicator Award, examines 10 commonly held misconceptions about global warming.

THERE IS PROBABLY no environmental issue that is as misunderstood as global warming. The commonly held view is that carbon dioxide is a pollutant that is dramatically warming the Earth's climate, causing rising sea levels and triggering severe weather changes. Supposedly, evidence of global warming is all around, in the form of cold spells, heat waves, floods, droughts and storms. Global warming has become the universal scapegoat for climate variability and the basis for prophesies of future catastrophe.

Why does this view prevail? At least part of the answer is the disproportionate influence of the summary reports published every six years or so by the United Nations Intergovernmental Panel on Climate Change (IPCC). The 900-page IPCC Scientific Assessment Reports on which the summaries are based are generally good compilations of climate science. But only experts read them. The IPCC's voice to policymakers and the public is through summaries, in particular the brief, politically approved Summaries for Policymakers (SPMs). Unfortunately, these distillations are biased, tend to overstate problems and display a penchant for simplifying and dramatising scientific speculation.

Consider just one example. The 2001 SPM states: "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." But the main scientific report contradicts this interpretation: “The fact that the global mean temperature has increased since the late 19th Century and that other trends have been observed does not necessarily mean that an anthropogenic [human-induced] effect on the climate system has been identified. Climate has always varied on all time-scales, so the observed change may be natural.”

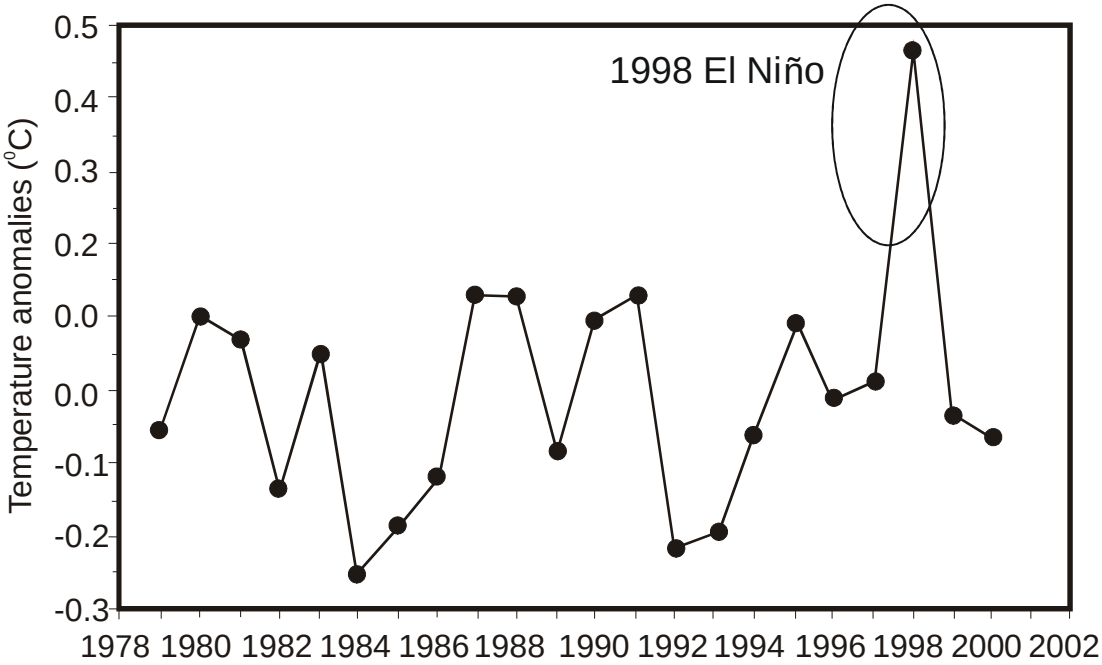
The scientific debate surrounding global warming hinges on certain key questions. What role do humans play in the global carbon cycle? Is the global climate warming? If it is, what part of that warming is due to human activities? How good is the evidence? What are the likely outcomes? The task of finding answers to these questions is hindered by widespread confusion regarding key facets of global-warming science. The confusion has given rise to several fallacies, which I examine below.

Fallacy One: Carbon dioxide in the atmosphere is increasing at an alarming rate.

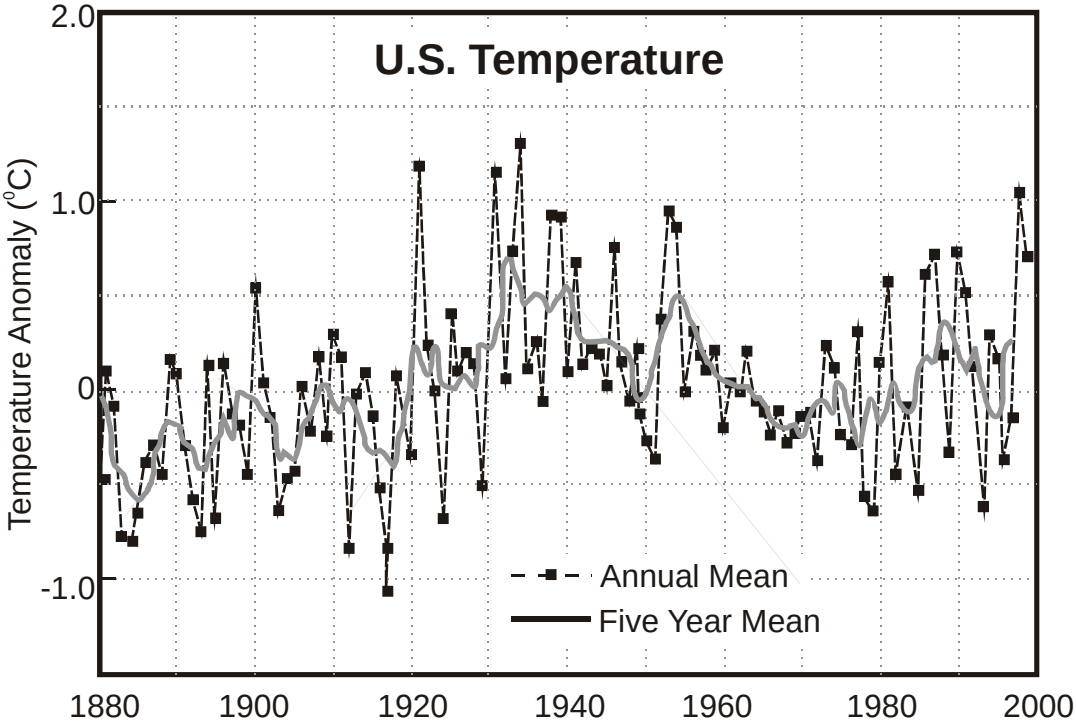
Each year, human activity—primarily the burning of coal, oil and natural gas and the production of cement—emits about 6.5 gigatons of carbon into the atmosphere. Despite this sizeable output, the annual rate of increase of carbon dioxide (CO_2) in the atmosphere is highly variable, falling close to zero in some years (such as 1992) and declining in others (such as 1997 and 1998). Despite increased emissions, CO_2 levels are stabilising as a result of natural feedback systems. Carbon dioxide is food for plants. The more there is, the more they use. Research has shown that CO_2 absorption by terrestrial plants could reach 10 gigatons of carbon a year—over three times the current net annual increase in atmospheric CO_2 from global fossil-fuel combustion. There is every indication that the predicted high CO_2 concentrations of the future will not eventuate.

Fallacy Two: There is a close relationship between changes in atmospheric carbon dioxide and global temperature.

Recent trends in global air temperature do not correspond closely with changes in CO_2 concentration in the atmosphere. According to the IPCC, air-temperature measurements taken at the surface of the Earth show that the average global temperature has increased by about 0.6º C over the past century. Most of this rise occurred before 1940, but over 80 per cent of the CO_2 entered the



Mean annual temperatures of the Earth as recorded by satellite (above) show the conspicuous effect of short-term anomalies such as the 1998 El Niño but little or no long-term no warming trend. Temperature records from* ground *weather stations in the United States (below) also show little warming.



atmosphere after 1940. In fact, from the late 1930s to the late 1970s the Earth's atmosphere cooled, despite increasing levels of CO_2.

A close association between paleo-temperatures and past CO_2 concentrations has long been used to support predictions of global warming. But recent research has challenged this interpretation, showing that atmospheric CO_2 concentration follows the temperature (both up and down)—and not vice versa. The results of these and other studies do not support the notion that CO_2 is the all-important driver of climate change.

Fallacy Three: Global temperature has increased over the past two decades.

The IPCC relies on air temperatures measured at the Earth's surface to reconstruct variations in the Earth's annual mean temperature over the past century. The data come from weather stations, most of them on land close to towns and cities. These data show warming in the range 0.3–0.6º C over the past century.

Modification of the land by human activity can have a significant effect on climate near the ground. The best-documented example is the "urban heat island" effect, in which warming due to asphalt and concrete can make an urban area as much as 12º C warmer than its rural surroundings. The IPCC claims that it uses a "de-urbanised" record, but several researchers have demonstrated that only very small changes in population are enough to induce a statistically significant local warming. Where warming occurs, it results from a rise in the minimum temperature, rather than the maximum, and in cold climates, in winter, and at night—which is what one would expect from so-called "urbanisation" effects.

Many temperature measurements are of questionable value because they are made by weather stations located at airports which originally were in rural areas but have now been swallowed by cities. The problem of acquiring representative data has been made worse by the fact that two-thirds of the weather stations operating in 1975 have been closed down.

Newer methods for measuring atmospheric temperatures have been largely ignored by the IPCC. Since 1979, temperature measurements of the lower atmosphere have been made by satellites using microwave radiometry. The satellite data, which have been independently validated by balloon radiosonde measurements, have an accuracy of 0.1º C, which is considerably better than the accuracy of thermometer measurements made on the surface of the Earth.

The satellites measure the part of the lower atmosphere—the portion which, according to the climate models, should be experiencing the greatest warming due to an enhanced greenhouse effect. But the data show no significant warming trend.

Fallacy Four: Global climate models provide reliable forecasts of future climate.

Global climate models are computer simulations of global climate. The scientists who construct these models accept that they do not adequately handle key aspects of the climate system, such as the role of clouds and aspects of heat transfer in ocean circulation. Water vapour dominates the greenhouse effect, and global-warming predictions are based heavily on how water vapour is likely to respond to increased CO_2. But climate science is not yet capable of predicting this response.

From their inception, global climate models have predicted spuriously high global temperatures. As the models have improved over the past decade, the IPCC's best estimates of global warming by the year 2100 have become progressively smaller: 3.3º C in 1990, 2.8º C in 1992 and 2º C in 1996. IPCC 2001 breaks the tradition of giving a best estimate; instead, it introduced the concept of "storylines" to speculate about warming as high as 5.8º C in 2100. Storylines depict future states, and replace the "scenarios" used in the 1996 report, which in turn replaced "predictions" and "projections" used even earlier.

The predictions from global climate models are of little value until they are more consistent and reliable. A climate model is just a hypothesis until there is empirical evidence that proves it is correct. In a good deal of the literature on global warming the research content is based solely on model results that are treated as real data, but are, in fact, far removed from reality.

Fallacy Five: Global climate trends during the past century are very unlike those of the past.

The most recent IPCC Summary for Policymakers (2001) gives prominence to one of many reconstructions of global temperature change over the past 1000 years which have been made using proxy climate data. The IPCC uses the reconstruction to support the view that global warming over the past 50 years has been unusual in the context of the past millennium and likely to have been due to an increase in atmospheric concentrations of anthropogenic greenhouse gases.

According to the vast weight

of scientific evidence, this is untrue. The 20th century was neither the warmest century nor the century with the most extreme weather of the past 1000 years. The Medieval Warm Period of 800 to 1300 A.D. saw temperatures as high in many parts of the world as were seen in the 20th century.

Fallacy Six: Humans are responsible for global warming.
Climate is naturally variable and always changing. Climate is always either warming or cooling. The notion of constant climate is incorrect. All observed changes in climate over the past 100 years have been well within the range of natural climatic variation.

Recent research suggests that climate change may be related to variability in the sun's energy output. Although the work is in its early stages, the results show some correlation with observed global temperature trends.

Fallacy Seven: Global warming will produce a rise in sea level.
Over the short term, climate warming could cause sea level to rise, mainly by the thermal expansion of the oceans. (Melting of polar ice caps is not involved, as this is a long-term response.) Even so, records show no acceleration in sea level rise in the 20th century. Seas have been rising since the end of the last ice age, long before industrialisation began.

It is worth noting that warming induced by greenhouse gas emissions could actually lower sea level. Modest warming of the Earth would increase evaporation from the oceans, leading to increased deposition of snow on the polar ice caps, principally in the Antarctic. This process would involve the transfer of large amounts of water from the oceans to the ice sheets. The reasoning is that even if the Antarctic air warms, it would still be below freezing, but its water-holding capacity would increase. With more moisture in the atmosphere over the Antarctic, snowfall would increase and ice sheets would grow, locking up water that would otherwise be in the sea.

There is a difference between scientific findings and scientists' speculations. Often the public is not told which it is being fed.

During the strong warming episode of 1920-40, sea-level rise did not accelerate but actually stopped. According to US researcher Fred Singer, of the Science & Environmental Policy Project: "All these findings point to the conclusion that future warming will slow down rather than accelerate the ongoing rise in sea levels."

Fallacy Eight: Global warming will result in more extreme weather events.
The media tell us that floods, droughts and increased frequency of hurricanes are proof of global warming. Yet the 1996 IPCC report states, "Overall, there is no evidence that extreme weather events, or climate variability, has increased, in a global sense, through the 20th century," and the 2001 report adds, "no systematic changes in the frequency of tornadoes, thunder days, or hail are evident."

In the Atlantic region, the number of intense hurricanes declined during the 1970s and 1980s, and the period 1991-1994 experienced the smallest number of hurricanes of any four years over the past half century.

More warmth may, in fact, mean a more stable climate. Some researchers predict that an increase in CO_2 will decrease temperature variability.

Fallacy Nine: The IPCC's predictions are reasonable.
The IPCC's treatment of emission scenarios has been criticised as merely the personal opinions of their creators, who do not seem especially interested in checking whether any of the scenarios agree with past or present trends. In particular, recent unwelcome changes in the levels of greenhouse-gas emissions—such as the fact that CO_2 emissions from the combustion of fossil fuels have fallen for the years 1997 and 1998—are ignored. Over half the models listed in the 2001 IPCC report assume that CO_2 in the atmosphere is increasing at a rate of about 1 per cent a year, when the measured rate of increase for the past 33 years has been half this.

It is also noteworthy that the rate of increase in emissions of the only other important greenhouse trace gas, atmospheric methane, has fallen steadily for the past 17 years, and, since 1998, there has been a fall in the concentration of atmospheric methane. Unlike CO_2, methane in the atmosphere decomposes relatively rapidly—within about 10 years—so its atmospheric concentration depends on a constant supply. Methane's importance as a greenhouse gas seems to be decreasing, despite the emphasis placed on it by the IPCC.

Fallacy Ten: The threat of human-caused climate change justifies taking the action proposed in the Kyoto Protocol. The climate science community is unanimous on the view that the Kyoto Protocol would be ineffective in reducing the predicted global temperature increase. The required emission cuts would, according to the climate models, reduce warming by as little as 0.06° C by 2100. Reductions of this size would be lost in the "noise" of natural climate variability.

THE CONTROVERSY surrounding global warming comes as much from attempts by ideologues and special-interest groups to promote their own agendas as it does from scientific uncertainty. A scientist, like anyone, can be biased, politically motivated or ideologically driven. There is a difference between scientific findings and scientists' speculations. Often the public is not told which is which.

Global warming involves a scientifically feasible mechanism that links climate change to the concentration of greenhouse gases in the atmosphere. It is important to appreciate that there is scientific debate rather than consensus on the subject. A balanced summary of the field would include the following statement. *Although the future state of global climate is uncertain, there is no reason to believe that catastrophic change is underway. The Earth's surface has warmed slightly, but floods, droughts, hurricanes and tornadoes have not changed for the worse. The atmosphere may warm because of human activity, but if it does, the expected change is unlikely to be much more than 1º C, and probably less, in the next 100 years.*

Even the climate models promoted by the IPCC do not suggest that catastrophic change is under way. They suggest that increases in greenhouse gases are likely to give rise to a warmer and wetter climate in most places, and, in particular, warmer nights and warmer winters. Generally, higher latitudes would warm more than lower (equatorial) latitudes. This would mean milder winters in those regions, and, coupled with increased atmospheric CO_2, more robust ecosystems with more vegetation—hardly a major threat. For many countries, the negative economic impact of Kyoto-like policies would be far greater than any change caused by global warming.

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