# More Hot Air

*Weighing probability against risk in global warming*

By Rick Wehr

Readers of *The Bulletin* may be wondering what to believe about global warming after reading last issue's Forum by Bhuwan Prasad (Heated Debate, Jan. 13). If there is a heated debate about global warming, it is only because it is often buoyed up by too much hot air.

To bring this issue back down to earth, let us present the story of Working Group I of the United Nations Intergovernmental Panel on Climate Change. WGI is an international team of 637 scientists who specialize in the study of Earth's climate and who have been examining all the available peer-reviewed scientific literature relevant to the issue of global climate change. In 2001 these experts came to the conclusion, at the end of a 944-page document entitled Climate Change 2001: The Scientific Basis, that, "In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."

Now skepticism is a crucial part of science and elitism does not serve science well. But it is nonetheless striking how much media attention is given to people, both scientists and non-scientists, who have little expertise in the study of Earth's climate and who have reviewed little of the available literature when they attempt to argue in some small number of pages that anthropogenic, or manmade, greenhouse gas emissions are not a likely cause of global warming.

In this single page, it is no more possible for us to argue comprehensively that humans are probably causing global warming than it was for Prasad to argue the opposite. However, it is important to address two central fallacies in the common argument that anthropogenic greenhouse gas emissions are not a likely cause of global warming and, therefore, that we should not reduce those emissions.

The first fallacy is the claim that greenhouse gas emissions are not a likely cause of global warming. This claim is based on misinformation and a flawed interpretation of the physical principles involved.

First of all, we should distinguish the greenhouse effect from global warming. If Earth had no atmosphere, the global mean surface temperature of the planet would be -18 degrees Celsius. Fortunately for us, the atmosphere traps some infrared radiation that would otherwise escape to space and so the global mean surface temperature of the actual Earth is around 15 degrees. This phenomenon is called the greenhouse effect and occurs naturally. Note that, despite comments in the Forum article, the greenhouse effect has nothing to do with the heat content of water vapour or carbon dioxide.

Global warming is a related but distinct term that refers to an increase in the global mean surface temperature. In theory, global warming could be caused by several factors including, for example, an increase in the greenhouse effect or a decrease in (reflective) surface ice cover. In the real atmosphere, these factors are continuously engaged in a complicated set of interactions that include both positive and negative feedbacks and nonlinear behaviour. Accordingly, one cannot intuitively predict how the Earth-atmosphere-ocean system will respond to any given change. Statements like "Manmade sources account for only 0.2 per cent of greenhouse gases" say nothing about the possible effect of manmade sources since a small change in one factor may trigger a large change in another. It is necessary to conduct a careful mathematical analysis to obtain any predictive power, particularly when a change of a few degrees in temperature is potentially catastrophic.


MIKE CONSTABLE

It is true that temperature changes on such a scale have occurred over Earth's history due to natural factors and Prasad is right in pointing out that Earth may be warming or cooling depending on the time scale considered. However, he is incorrect when he states that the temperature is decreasing when viewed from the 16th century or when viewed over the last 18 years. In fact, figures in Climate Change 2001: The Scientific Basis clearly show that the temperature was slowly decreasing from the year 1000 until about 1900, but then began a sharp climb. The temperature levelled off between 1940 and 1975 and then resumed its sharp climb, which has continued until the present day (i.e., during the last 18 years). The temperature today is higher than it has been at any time in the last 1,000 years.

Prasad is also right that carbon dioxide levels are only one of many factors affecting global climate and that is one reason why comparisons with more distant periods such as the late Ordovician (about 440 million years ago) are problematic. However, long-term factors like continental drift, glaciation and variations in the solar input, which may cloud comparisons with the Ordovician, have not changed significantly over the last 50 years. The issue is whether the observed increase in temperature during this recent period is the beginning of a trend that we are inducing. And the bottom line is that, accounting for all known factors, WGI was still able to conclude that the measured increase in anthropogenic greenhouse gas levels successfully explains the measured increase in temperature and is the only known factor that does.

Let us now turn our attention to the second fallacy, the reasoning that we should not reduce emissions unless they are a likely cause of global warming.

This fallacy ignores the fact that decisions are not based on probability alone, but on risk, which includes both probability and consequence. The probability of an event might be small but if the consequences of that event are large, it might present a high risk that we should avoid. For example, the consequences of crashing a car are more serious than those of being late for our supervisor's dinner party. Therefore, we drive carefully to the party, increasing the probability of the low consequence event to avoid the high consequence one.

In the case of global warming, the potential consequences of reducing our emissions are insignificant next to the potential consequences of not reducing them. If we reduce our emissions and find that we were wrong about global warming, we will have lost at most a few per cent of our expected GDP and gained in innovation and sustainable living. If we do not reduce our emissions but find that we were right about global warming, then we will have brought upon ourselves the widespread loss of human lives, the relocation of millions more and untold ecological damage. Thus only a slight chance that we are causing global warming is necessary to compel us to change our behaviour.

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Imagine that you are skiing and you think you see a cliff ahead. Do you continue at your current speed until you are sure that there is a cliff or do you slow down until you are sure that there is not?

If we may be allowed to play off Prasad's final thought, we are led to conclude that global warming is a significant risk and that the role of the different elements in the complex climate system must first be understood in greater depth before any further emission into that system is permitted.

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