

Many claims are made about the scientific understanding of climate that are not backed up by the core literature that dominates the field. But as most people read only summary versions of the scientific literature, they're easily led astray by alarmist groups that exaggerate the concerns, while waving away the uncertainties that pervade climate science. Let's consider some key questions about climate change.

**Is the Atmosphere Warming Abnormally?**

Assuming that we can trust the temperature data that we have available to us, the answer seems to be "yes, in some places, in recent years, the average temperature of the Earth's atmosphere seems to be increasing slightly." But the question of whether it's getting hotter is meaningless without a discussion of historical perspective and relevant measuring period. Climate has fluctuated, often wildly,

falling, or staying the same simply by changing the start and end points of the period being examined.

**How Certain is our Understanding of the Role of Humanity in Causing Climate Change?**

Between our incomplete understanding of the climate system, and the difficulty of "scaling up" what we do know to the level of global climate effects, including effects on oceans, ecosystems, mountains, rivers, groundwater, solar variation, greenhouse gas emissions, clouds, aerosols, water vapor, and historical variation, then trying to scale the impacts back down to the local and regional level, we are left with a view best characterized as "through a glass, darkly."

One need not look beyond the landmark reports of the United Nations Intergovernmental Panel on Climate Change (IPCC) for

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# QUESTIONS PEOPLE ASK ABOUT CLIMATE CHANGE

*by Kenneth Green*

for more than four billion years. Given that we have so little hard data about past climate conditions, the most intellectually honest answer to this question is "maybe" and even that answer is meaningless without some kind of qualifying time frame, and standard of comparison.

Recently, we seem to be seeing a minor warming in the Earth's average temperature, as best as we can measure it (which isn't very well). That's because our hard temperature data spans only about 150 years. In fact, temperature records are spotty before about 40 years ago and only cover a tiny portion of the globe, mostly over land. In addition to that 150-year conventional surface temperature record, temperature readings taken from weather balloons cover the last 30 years, and satellite temperature readings cover the last 18 years. Given that fluctuating and spotty temperature record, one can create the impression that the temperature is rising,

expressions of that uncertainty. Of the twelve suspected "forcings" that are considered capable of changing the climate (either warming or cooling), the latest report ranks scientific understanding of only one type of forcing (from greenhouse gases) as "high." Fully 2/3 of the potential climate forcings, are ranked as "Very Low" in scientific understanding. Within those poorly understood forcings lies a climate cooling potential that could cancel out the theoreticized warming potential of the greenhouse gases altogether.

**Given What We Know, What's Our Best Course?**

For any risk we face, there are many available risk-reduction actions available to us that let us move toward decreased environmental risk for ourselves and our children. But does the actual evidence tell us what to do? No. But it does suggest what we can do with any probability of success.

At the most generic level our options range from the resilient to the anticipatory—from doing more research (and holding our greater resources back for a later time when we know more about the problem)—to picking specific climate interventions now, in the face of uncertainty.

But how do we decide whether an anticipatory approach is more likely to work? A framework developed by risk-policy authority Aaron Wildavsky helps us answer that question. Wildavsky observed that the limiting factor in determining whether or not a potential anticipatory risk-reduction action is likely to be more beneficial than a resilient one depends not on what we know, but on what we don't know. Think about the knowledge you need to "head a risk off at the pass," compared to "waiting to see the whites of its eyes." You need to know which pass the risk is coming from, its magnitude, its timing, what you'd need to head it off, what was happening at all the other passes that pose risks, and you'd have to know that while you were out there heading off speculated risks at the pass, the business isn't getting done that will feed you, and support you through well known risks like poor nutrition, lower quality housing, lower quality education, etc. If you have little knowledge about any of those variables, you're likely to waste your resources trying to head off an uncertain risk, leaving you more vulnerable to other risks.

For climate policy, prevailing uncertainties clearly suggest that a policy of research and observation is best at this time, because: 1) the conditions needed to assure a reasonable chance of success for anticipatory actions are quite stringent; 2) there are more ways to get things wrong than to get them right; and 3) mistakes leave us less well prepared to deal with other current or future problems.

**Will the Kyoto Protocol Fix the Problem?**

The belief that the Kyoto protocol by itself is unlikely to provide meaningful risk reduction benefits is widespread among those people cited as experts by proponents of the protocol at the 1997 Kyoto conference on climate change.

Jerry Mahlman, Director of the Geophysical Fluid Dynamics Laboratory at Princeton University, told the *Washington Post* that "The best Kyoto can do is to produce a small

decrease in the rate of increase" In a post-Kyoto Science news brief, Mahlman says that "it might take another 30 Kyotos over the next century" to cut global warming down to size.

Bert Bolin, the outgoing chairman of the United Nations Intergovernmental Panel on Climate Change, assessed the impact of Kyoto as a 0.4 percent reduction in greenhouse gas emissions compared to a no-protocol alternative, and concluded: "The Kyoto conference did not achieve much with regard to limiting the buildup of greenhouse gases in the atmosphere."

**Where do We Need More Research?**

While recent studies of climate have contributed a great deal to our understanding of climate dynamics, there is still much to learn. Many areas of uncertainty remain. Current climate change models have acknowledged weaknesses in their handling of changes in the sun's output, volcanic aerosols, oceanic processes, and land processes which can influence climate change.

**The Natural Variability of Climate**

Despite the extensive discussion of climate modeling and knowledge of past climate cycles, only the last 1000 years of climate variation are included in the two state-of-the-art climate models referred to by the IPCC. As discussed earlier, however, the time framework in which we view climate variability makes a significant difference in the conclusions we draw. Until we know which perspective is more reflective of Earth's climate as a whole—the last 10,000 years, or a longer period of time—it will be difficult to put recent warming trends in perspective, or to relate those trends to potential impacts on the climate, and on the Earth's flora and fauna.

**The Role of Solar Activity**

At the front end of the climate cycle is the single largest source of energy that is put into the system, namely, the sun. And while great attention has been paid to most other aspects of climate, little attention has been paid to the sun's role in the heating or cooling of the Earth. Several recent studies have highlighted this uncertainty, showing that solar variability may play a far larger role in the Earth's climate than it was previously given credit for

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by the IPCC. If the sun has been heating up in recent times, researchers observe, the increased solar radiation could be responsible for up to half of the observed climate warming of the past century. Astrophysicist Sallie L. Baliunas attributes up to 71 percent of the observed climate warming of the past century to increased solar irradiance.

**The Role of Clouds and Water Vapor**

Between the emission of greenhouse gases and change in the climate are a range of climate and biological cycles (“feedbacks”) that can influence the end result.

One such feedback is the influence of clouds, and water vapor. As the IPCC acknowledges: “the single largest uncertainty in determining the climate sensitivity to either natural or anthropogenic [or ‘manmade’] changes are clouds and their effects on radiation and their role in the hydrological cycle....At the present time, weaknesses in the parameterization of cloud formation and dissipation are probably the main impediment to improvements in the simulation of cloud effects on climate.”

**Conclusion**

Supporters of the Kyoto protocol wish to portray the scientific understanding of climate change as high, the uncertainties as low, and the need to reduce greenhouse gases as urgent. But a review of the science suggests that uncertainty is so high as to raise a good prospect that mandatory greenhouse gas reductions will produce little or no environmental benefit. Meanwhile, a review of the economic literature suggests that greenhouse gas mandates hold the potential for inflicting massive economic harm, while it is economic productivity that lets us afford to protect our environment and health in the first place.

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