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The Science and Politics of Global Warming

The efforts of policymakers to chart a responsible course between development and environmental protection are challenged by the uncertainties of data about human impacts on the earth's climate.

Michael H. Glantz

In reassessing the social currents of the past few decades, one could effectively argue that people around the world have entered an age of environmental enlightenment. Indeed, it is somewhat brash to make such a statement, for certainly no one, centuries ago, proclaimed "we are now entering the Renaissance" or the age of exploration. People did what they felt compelled to do and, later,historians annointed those periods with descriptive labels.

Nevertheless, concern about the state of local, national, and global environments has become widespread: People, from the very young to the elderly, are becoming sensitized to environmental issues. Government leaders, too, are taking environmental issues more seriously, as evidenced by the largest environmental convention ever, at what the Brazilians call ECO '92, the Earth Summit.

Popular attention has focused primarily on three key environmental issues of global concern; global warming of the atmosphere, depletion of the stratospheric ozone layer, and tropical deforestation. These issues are connected to each other. Deforestation and fire have been integrally linked to increases in atmospheric carbon dioxide. The chemicals that deplete stratospheric ozone, called chloroflurocarbons or CFCs, are also efficient greenhouse gases.

People have become interested in the global warming issue because of its potential impacts on ecosystems and economies.

For most of the 1980s the possible consequences of global warming that were reported in the media could be classified as worst–case possibilities. In the late 1980s, however, there was a backlash against the speculation that global warming was occurring and human activity was to blame in that warming. Now the global warming issue is plagued by scientific controversy.

Each month there is a growing number of suggestions, often called scenarios, of how agricultural production, sea level, water resources, and human activities might be affected by global warming. How valid are these suggestions? How seriously should they be taken by decisionmakers?

Global warming: what is the problem?

There has been a great deal of discussion in the past few years about the possible consequences of a warming of the earth's lower atmosphere. This expected warming (a human–induced enhancement of the naturally occurring greenhouse effect) has primarily been blamed on activities such as the burning of fossil fuels, the emission of man–made chemicals such as CFCs, certain kinds of agriculture such as the growing of white rice and the use of certain fertilizers, and tropical deforestation. Such activities result in an increase in trace gases in the atmosphere that trap outgoing longwave radiation, thereby heating up the lower atmosphere, contributing to the greenhouse effect. The main greenhouse gases of concern are CO_2, CFCs, methane, and nitrous oxide.

The greenhouse effect was first articulated in the 1820s by French scientist Jean–Baptiste Fourier. By the turn of the nineteenth century, Swedish chemist Svante Arrhenius referred to the anthropogenic enhancement of the greenhouse effect. He noted that coal burning would add carbon dioxide to the atmosphere, which would, in turn, lead to a warming of the global atmosphere. Arrhenius viewed global warming as beneficial, because it would counter the expected inevitable return of an ice age.

In the early 1970s, scientists identified several signs suggesting that the earth might be entering into the early stages of an ice age. Several government reports, scientific articles, and books were published about the possible impact sof a global cooling. These used such provocative titles as *Weather Conspiracy,* "When the Sahel Freezes Over," *The Cooling*, and *Fire and Ice*. A U.S. congressional committee was convened to discuss global cooling. Ironically, the same committee, a decade later, was discussing global warming.

By the late 1970s, a natural global cooling was no longer a scientific (and eventually political) concern. From the mid–1970s, some scientists were becoming more concerned about the possibility of an anthropogenically induced global warming. Since then, there has been mounting concern (but no unanimity) that the earth's atmosphere may be warming because of a human–enhanced greenhouse effect. The earth's atmosphere has warmed by 0.5 to 0.7°C in this century. However, the question remains whether the warming is natural or is the result of human activity.

In the late 1970s and the 1980s scientist used atmospheric general circulation models to generate hypotheses about the impacts on temperature and precipitation of a projected doubling (by the middle of the next century) of pre–Industrial Revolution levels of certain greenhouse gases (especially carbon dioxide) in the atmosphere. These hypotheses have raised concern about the implications for ecology, economy, and the policy of a possible global warming.

Although the basic theory behind the greenhouse effect is on solid ground, it is not known how a global atmospheric warming might affect other natural processes. For example, an increase in evaporation and cloud cover could either reinforce or counter some of the proposed worst–case scenarios of a human–induce global warming at the regional and local levels.

Thus far, much of the anthropogenically produced greenhouse gases (GHGs) have come from industrial activity in the developed countries; the United States alone contributes about a fourth of the annual atmospheric CO_2 content; Western European countries collectively contribute about one–eighth. Brazil, China, and India are considered (by some) to be the major Third World GHG contributors.

It has however, been suggested that in future decades, the developing countries will contribute the build of greenhouse gases as they destroy their tropical rainforests and industrialize their economies. Additional pressures from Third World countries will likely result from rapid increases in their population.

Who says there's a problem?

People who have formed views on the global warming issue can, according to their perceptions of the greenhouse problem, be divided into three categories: hawks, doves, and owls. ➤

Hawks believe that human–induced global warming is real, is under way, and that it may already be too late to stave off some of its early effects. They suggest that policies must be enacted now to slow down the rate of greenhouse gas emissions. They argue that the atmosphere is already committed to some warming in future decades as a result of anthropogenic greenhouse gas emissions to date and their delayed impacts on climate. Many of the dire (often worst–case) scenarios about the consequences of global warming come from the hawks.

Doves, on the other extreme, believe that the naturally occurring greenhouse effect is not being intensified by human activities, or if it is, that the consequences of such activities will not overwhelm natural processes on which societies have become dependent. Some doves even believe that the more CO_2 the better as it enhances plant growth; deserts would green and food production would increase severalfold.

Owls occupy the middle ground. They view the increase in the atmospheric content of GHGs as a serious potential problem. They are not yet certain, however, of the short – or long–term implications of global warming for specific societies and ecosystems because the computer models on which such projections are based have many deficiencies.

One major limitation is that assumptions made in converting real–world processes into mathematical expressions for developing computer models introduce additional scientific uncertainties, and therefore model outputs can also be questioned. Aside from the difficulties associated with properly understanding, and then representing, the feedback mechanisms in these general circulation models, problems also exist with respect to model resolution. In these models, several thousand grid points encase the globe, with each grid point representing a large, often hertogeneous land surface for which only an average condition can be represented. These deficiencies make the use of models in policy processes troublesome.

Owls, nevertheless, do believe that an environmental problem may be in the offing but feel that there is time to act cautiously. They believe that actions (such as improving energy efficiency and afforestation) could be taken now that would be beneficial, regardless of whether the climate in future decades does change. I believe that most scientist and a large portion of the general public are owls.

While it is possible to excuse past actions that produces excessive amounts of greenhouse gases on grounds of ignorance, future actions that do so are inexcusable. They can no longer be viewed as inadvertent.

Is anyone responsible?

Industrialized countries sharply increased their contribution of atmospheric GHGs since the mid–1700s. Their output of CO_2, the GHG of major concern, has been recognized as being a direct result of "industrial metabolism." Deforestation and related processes account for an estimated 20 per cent of the anthropogenic enhancement of atmospheric CO_2.

Most developing countries hold the attitude that since they did not cause the global warming problem they should not have to sacrifice in order to resolve it. They argue that people in industrialized countries consume considerably more energy that do those in the developing world. Third World scientists also suggest that industrialized countries' calculations of GHG emissions are biased. And these biases can be detrimental because the GHG calculations are likely to be used in international negotiations to determine allowable national (and per capita) contributions of CO_2 emissions. Developing country leaders also assert that it is unfair, for example, to equate the CO_2 produced due to the manufacture or use of "nonessential" items in a developed country with the methane produced while growing life–sustaining wet rise in developing countries. For the former it is an economic issue: for the latter it is a matter of life or death.

Global warming would affect everyone – directly or indirectly, either favorably or adversely. Most observers suggest that developing countries would be more vulnerable to climate change than the developed ones. They also contend that the poor within a society would be more adversely affected than those who are financially better off. This issue requires deeper consideration. One could easily argue that in the industrialised societies the tolerance level for discomfort, let alone major change, is much lower than in developing countries.

Environmental decisions made today will surely affect the environments of future generations. Discussions of our environmental legacy for future generations immediately raise issues of intergenerational equity, obligation, and responsibility. These discussions are, in turn, explicitly linked to intragenerational equity, underscoring a moral obligation to improve the quality of life of those alive today, even if the global climate were not to change.

When are these changes supposed to occur?

Some of the hawks suggest that we will begin to feel the consequences of a human–induced global warming in the early decades of the next century. Others, more ardent, contend that we are already feeling the impacts of human–induced global warming through an increase in the intensity, duration, and frequency of droughts around the globe. Doves and owls point to the many scientific uncertainties that permeate the global warming issue, arguing that actions taken today in response to global warming would be premature. Nevertheless, policy actions can be taken today even in the absence of full knowledge of the consequences of global warming for ecology and economy. Such actions are usually referred to as a "no regrets" strategy, resulting in "win/win" situations. They include, but are not limited to, the following: the development, transfer, and use of new energy technologies and improved energy efficiency; improved land management (stop the loss of biodiversity; afforestation) and food production practices; a reassessment of population policy (population numbers by themselves are not necessarily the problem – is is their combination with available resources that is more critical); improved understanding of the interaction of climate and human activities. These are proactive responses that can yield benefits to society. In addition, they can reduce GHG emissions and could slow down the expected rate of global warming, pushing its proposed worst aspects decades further into the future.

Current speculation suggest that the rate of global warming would be on the order of 0.3°C. per decade in the next century under a "business as usual" scenario. Steps could be taken to reduce this rate from 03 to 0.2 or 0.1°C. Slowing down the rate of warming would buy more time for researchers to better understand the processes involved and to develop environment–friendly human activities and energy resources. It would also provide more time for ecosystems to adapt to changing environmental conditions. And policymakers would have more time to identify policy options for responding to a potential global warming and its consequences. Often the rates of environmental change are as important to decisionmakers as the processes of change.

Where are changes supposed to occur?

There are several days to generate ➳

scenarios about the spatial distribution of the possible regional impacts of global warming. These include: historical observations of recent climate fluctuations on a time scale of decades; computer modeling of the implications of increased greenhouse assess; reconsructions of global climate and biogeography thousands of years ago; and forecasting how societies might respond to climate changes in the future by assessing how they have responded to extreme meteorological events in the recent past (e.g. called forecasting by analogy).

Each of these approaches to scenario development provides highly speculative glimpses of the future. To date, no one has successfully identified a method to forecast future states of the atmosphere. It would, therefore, be misleading to rely on any one of the scenario sources as a basis for making specific policy recommendations in a specified region or locale. The scenarios should not be taken as predictions or forecasts. They can, however, be used to create awareness among policymakers often need to assess the regional consequences of potential climate change.

Winners and losers. At present, there are no reliable clues as to who the region–specific winners or losers might be in the realization of a worst–case global warming scenario. No objective measures have been developed to identify what one means by a win or a loss. A little more rain in a given region might not be beneficial, unless it falls at the right time in the agricultural production cycle, when it is needed (by a specific crop) or where it could be used. Conversely, a little less precipitation in a given region might not necessarily be a loss. The value of rainfall timing and amounts will depend on ecological and human needs in specific locations at specific times. However, some people believe that steps can more easily be taken and international conventions more easily agreed to, if all are led to believe that they will lose in a changing global climate.

Surprises. Many regional and local phenomena occur on a spatial scale that is too small to be incorporated into the computer models, which have grid sizes on the order of hundreds of miles on each side. Recall that an unusually high number of Florida freezes and their impacts on citrus production occurred in the 1980s, the hottest decade on record; policymakers, therefore, should expect local and regional counter–intuitive surprises resulting from climate change.

What's a policymaker to do?

The possible responses depend heavily on the kind of future one would like to create. With respect to the GHGs, especially CO_2, just about everyone is a producer, from the peasant in the tropical rain forest who burns underbrush in order to plant subsistence crops, to the nomads gathering firewood to cook their evening meals, to giant industrial complexes that rely on fossil fuels.

The responses to anthropogenic increases in greenhouse gas emissions fall into three possible categories: prevention, adaptation, and mitigation.

Prevention. Not only must new increases in GHGs be balanced out by their reductions elsewhere, but, if the contemporary global climate regime is to be maintained, net reductions in GHG emissions must also be considered. This is especially true for GHGs with long residence times in the atmosphere, such as CFCs, whose atmospheric residence time is estimated at 60 to 200 years. (CO_2's atmospheric residence time is on the order of decades). Undertaking preventive measures is the most difficult political course to follow. This course demands significant sacrifices mainly from industrialized countries, whose economies and life–styles are grounded in the continued, if not expanded, use of fossil fuels and in other GHG–generating activities.

Adaptation. Faced with other more immediate and more pressing political and economic problems, many societies tend to let policy considerations of the proposed human–induced global warming problem slide. The implications of dramatic climate change in the middle of the next century do not generate the same urgency that immediate food shortages, military conflicts, desertification, or economic development needs do. Many believe that adaptation would be the most favored option of today's decisionmakers. Adaptation policies enable them to let the problem continue unaddressed until there is more scientific evidence to reliably prove or disprove that global warming is real and dangerous, or until the global warming effects are perceived to be more immediate.

Mitigation. Mitigative responses to climate change would require advance response to anticipated impacts. Here history can be quite instructive. Reevaluating the effectiveness of responses to recent environmental stresses could provide insights into how best to prepare for an uncertain climate change some decades in the future. Solutions will have to be regionally and locally based because there are no universally accepted views on when, where, or how global warming might manifest itself at the regional level.

In conclusion

The global warming issue has generated considerable debate about the role of science in the policy–making process. Chronic problems as to how decisionmakers should deal with uncertainties that pervade science are likely to continue well into the future. There is no "silver bullet" solution to the global warming issue, barring some unforeseen scientific breakthrough in the near future. In the meantime, policymakers need to make decisions and, uncertainties notwithstanding, decisions do get made.

The debates on global warming – its causes, effects, and possible remedies – have also become politicized. And once politicized, it seems the scientific information itself becomes of less importance than how it is used to advantage. A current example of this situation can be taken from the deliberations of the Intergovernmental Negotiating Committee (INC) for a Framework Convention on Climate Change.

Some years ago, the Intergovernmental Panel on Climate Change (IPCC) produced a state–of–the–art report on climate change, its impacts and its policy implications. Since then, the INC had begun to negotiate an international framework convention to be signed at the Earth Summit in Rio de Janeiro. INC negotiators have excluded the IPCC scientists from their deliberations. This strongly implies that the science has become irrelevant to the policy debates. As one INC negotiator commented, "negotiators to the framework climate convention are more afraid of a bad climate convention than they are of a bad climate change." Barring a major scientific breakthrough on the global warming issue, uncertainties will remain and political maneuverings will be the order of the day.

Michael H. Glantz is a program director of the Environmental and Societal Impacts Group at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.

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