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Energy and Climate

Whenever the weather in a region departs from norms for a few weeks or more, anxious queries arise. Is the world's climate changing? When leading meteorologists are questioned they usually equivocate. At one time considerable optimism was voiced that new insights would be gained soon from modeling calculations. In the past decade much time on some of the most powerful computers has been devoted to such calculations. But success has been elusive. The best performance on weather seems to be in short-range prediction—that is, the next day or two. Even then surprises occur. In predicting weather, meteorologists can take as a point of departure current conditions, but in attempting to estimate climatic change there is little guidance. Some cyclical patterns related to the 11-year sunspot activity have been noted, and a 2- to 3-year cycle also seems to persist.

Meteorologists still hold out global modeling as the best hope for achieving climate prediction. However, optimism has been replaced by a sober realization that the problem is enormously complex. In a recent report* Verner E. Suomi listed 27 variables that must be monitored to obtain data needed for studies of climate dynamics. These include total solar flux, cloudiness, surface albedo, sea and surface temperature, thickness of polar ice sheets, water vapor, CO_2, and tropospheric aerosols. Human activity has been changing at least three of the variables—albedo, aerosols, and CO_2. The report emphasizes potential effects of increasing and long-term use of fossil fuels.

One fact about CO_2 that is known with certainty is that the concentration in the atmosphere is increasing. Charles Keeling has been conducting precise measurements of atmospheric CO_2 since 1957. In two decades the concentration at the south pole has increased from 314 to 331 parts per million. It is estimated that since the beginning of the industrial revolution the change has been about 13 percent. Roger Revelle has analyzed cogent factors. Part of the increase is due to deforestation. About half of the CO_2 that has been produced remains in the atmosphere, and the rest has been absorbed in the ocean or removed by increased photosynthesis.

What are the likely future trends? For the remainder of this century the clearing of land will continue and the use of fossil fuel will increase. As a result, by the year 2000 the CO_2 concentration will exceed preindustrial levels by about 25 percent. Ultimately, other forms of energy such as solar may come to play a more substantial role. However, humanity's appetite for energy use seems insatiable.

What will be the climatic consequences of increased CO_2? S. Manabe and R. T. Wetherald have calculated that a doubling of CO_2 would lead to an average global increase in temperature of 2.5°C. Their model was necessarily oversimplified, but it seems plausible on the basis of a greenhouse effect. However, a few scientists can be found who privately suggest that because of complex feedback phenomena the net effect of increased CO_2 might be global cooling.

The most likely trend appears to be warming, with effects considerably greater in the polar regions than at mid-latitudes. In the polar regions CO_2 can have a relatively large greenhouse effect. Changes in global circulation would also contribute to the increase.

Humanity is in the process of conducting a great global experiment. If unpleasant effects are encountered they cannot be quickly reversed. Although a comprehensive understanding of what is going on may be difficult to attain, prudence requires at least a determined and sustained effort.

Congress is considering bills aimed at improving climate monitoring, augmenting climate research, improving services related to the climate, and identifying the domestic and international impacts of changes in the climate. Such legislation should be enacted.—PHILIP H. ABELSON

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