Jumping the greenhouse gun

People who should know better have begun to talk as if they know the greenhouse effect has begun to work its way through the climatic system. That is premature.

ARE the effects of the expected greenhouse effect already with us? The view that they are has recently been given more attention than it should have been in evidence to the US Congress, and by Dr Kenneth Hare, the chairman of the climate planning board of Canada. Simple members of the US Congress, mindful as always of their constituents' interests and conscious of the severe drought that has brought many farming operations to a halt during this growing season, have been looking for a simple answer with which to respond to a common plight. What the Congress, and the rest of us, must understand is that it will never be possible to answer affirmatively the question "Is this the year the greenhouse effect began to bite?" The best that can be hoped for is that it will be possible retrospectively to note that this or that climatic effect is probably a consequence of this or that driving force.

This state of affairs is unavoidable, but not unprecedented. Indeed, this is precisely the kind of trouble people repeatedly encounter in, for example, trying to decide whether the decline of some species is a consequence of loss of habitat or of a more direct insult, such as a change in the pattern of pesticide use. Even recognizing that the greenhouse effect has arrived is bound to be among the more difficult exercises in relating effects to causes because there are so many conflicting influences and because of the complexity of the observational situation.

That is why it is worth remarking that, even in the past few decades, the history of the greenhouse problem is far from simple. One of the earliest systematic attempts to guess at the consequences of accumulating atmospheric carbon dioxide was the massive study carried out at the Massachusetts Institute of Technology in 1960, which predicted warming of the average surface temperature of the Earth by about 1° C by the time that carbon dioxide had doubled from its supposedly pre-industrial condition. That study, unfortunately, coincided with a period during which climatologists, concerned at the cooling trend beginning in about 1940, were more concerned to utter warnings of the difficulties that would be occasioned by the return of a general glaciation.

In reality, of course, there is no inconsistency between that alarm and Hare's assertion that global temperatures have been increasing for the past century, and have by now increased by a total of 0·4° C. It is entirely possible that a downward fluctuation may be accommodated within a generally rising statistical time series. Indeed, there is no reason why the cooling trend from 1940 for a quarter of a century may not have been consistent with increased retention near the surface of the Earth of energy inputs from the Sun; the accumulation of excess thermal energy may have been more than compensated for by its transfer to the heat reservoir of the global oceans. All that is easily understood, but suggests that there will be no sure way of telling that carbon dioxide has begun to do its expected work on periods of time shorter than those on which contrary effects have been recognized.

The problem, of course, is the familiar one of signal and noise. The larger the signal relative to the noise, the more easily it will be recognized. The greenhouse signal, however serious its long-term consequences, is in the short run relatively small. The interannual variations of average surface temperature at one particular spot on the surface of the Earth are comparable with the changes expected from a further doubling of carbon dioxide, so that the owner of a single thermometer, however sensitive, cannot hope to tell which way the trend is pointing. But it is also well known that attempts to calculate changes of average global temperature from regional measurements of temperature are complicated by the disparity of the quality of observations from one region to another on the surface of the Earth.

The best hope is that Earth satellites, by concentrating attention on the parameters that really matter (in this case, the balance between the inward flux of solar energy and the outward flux of infrared energy), will be able to provide a much less noisy background against which to look for a signal. Increasing temperature may be the parameter to fear, but it is not the one efficiently to watch. Hopes that it may be possible to find climatic characteristics, the frequency or strength of prevailing winds for example, that will be at once more sensitive and more reliable indicators of climatic change, seem similarly doomed to failure. Other things being equal, one would expect a parameter sensitive to change to be one subject to unusually great fluctuation. And while it may be possible to glean something worthwhile from, say, the retreat of glaciers and ice-caps where they persist, the inertia of these effects is inevitably so great that awaiting a clear signal from the noise is certain to mean waiting until it is too late.

The exercise might be a little simpler if there were not such good reason to believe that the link between carbon dioxide (and the other greenhouse gases) and climatic change is shot through with uncertainty. Although it has been known for nearly three decades that the quantity of carbon dioxide lodging in the atmosphere is only half of that discharged into it, whether the missing half finishes up in the biosphere or in the oceans is unknown — but is critical for the long-term prognosis. The link between an accumulation of excess heat and the surface temperature is similarly, but seriously, complicated by uncertainty about the role of the oceans as heat reservoirs.

These, unfortunately, are only some of the uncertainties. The well-known weakness of the climatic models, in this connection, is that real clouds (as distinct from average cloudiness) are on the face of it a source of negative feedback that may substantially moderate the expected size of the increase in temperature of the surface of the Earth. The variability of solar output is another spanner more recently thrown in the works. Is it a secular change, random or linked with the solar cycle? The disconcerting recognition that chlorofluorohydrocarbons, the chief candidates of ozone destruction, are likely to be more efficient moderators of solar energy is, however, unequivocal bad news.

What in the circumstances should people do? Sell farmland in the Middle West, putting the money into Canada instead? Move away from coastal cities against the threatened increase of the height of sea-level? At this stage, that would be precipitate. One year's drought does not make a greenhouse. For the time being, there are only two sensible courses of action that might be taken. First, urge that public funds be put into the direct measurement of the energy balance of the Earth; as things are, there is a danger that researchers and their sponsors will give themselves too great a sense of comfort by spending time and effort on work not directly related to what needs finding out. Second, urge that governments should prepare themselves for deciding what to do when (not if) the greenhouse effect becomes palpable. The increase of surface temperature might be reversed by not burning fossil fuels but not the melting of the ice.

John Maddox