CLIMATE CHANGE IN AUSTRALIA TO THE YEAR 2030 AD

A summary of the scenario presented at CSIRO's "*Greenhouse 87: Planning for Climate Change*" conference organized by the CSIRO Division of Atmospheric Research*.

Atmospheric scientists predict significant global climate changes as a result of increasing levels of greenhouse gases in the atmosphere. The consequences of such changes in the energy budget of the atmosphere on regionally-specific climate changes is difficult to predict.

The scenario presented is a plausible future climate for the Australian region, made solely for the purpose of examining the type and magnitude of likely impacts of such changes. While the predicted changes in the gross features of global climate are regarded as highly probable, the regional changes suggested in this scenario are most speculative. The scenario deals only with the primary factors of climate such as temperature, rainfall, etc. No attempt is made to predict regional changes in secondary climate factors such as evaporation, soil moisture, etc., where the interaction of two or more primary factors is involved.

Predicting sea level rises is equally difficult. It is assumed that future rises will be in proportion to temperature changes with the proportionality based on previously observed changes. These rises are thought to be due to thermal expansion of sea water and possibly also to partial melting of mountain glaciers and the fringes of the high-latitude ice caps.

PREDICTED CHANGES

Temperature

A rise of 2 to 4°C in the annual mean temperature is predicted. Greatest warming would be in the south and in winter, and least warming in the north. Regional variations in this general picture might be expected due to changes in cloudiness, air-sea temperature differences, etc. Oceanic temperatures tend to lag behind atmospheric temperatures by about 10-20 years.

Rainfall

Higher spring, summer and autumn rainfall by up to 50% in those regions deriving such rain from the southward penetration of tropical/subtropical air during the Australian Monsoon season. This change would be a maximum at the southern limits of the summer rainfall regime. Winters will be generally 20% or more drier in areas deriving such rain from the eastward passage of midlatitude high and low pressure systems and associated frontal storms with the possible exception of Tasmania and southern Victoria. Daily maximum rainfall will increase some 20-30% with changes in the frequency distribution of the rainfall.

Sea level

A general rise of 0.2-1.4 m in sea level is expected but any local tendency due to subsidence, etc. must also be considered.

Tropical cyclones

The southern limit of tropical cyclones is expected to shift some 200-400 km further south and the maximum intensity may increase by 30-60%. The frequency of occurrence of tropical cyclones may change.

Snow line

The snow line would on average rise by about 100 m per 1°C warming, but local variations related to changes in storm frequency may be just as significant.

Wind speed

Wind speeds could decrease by 20% north of 36°S, but should increase south of 36°S due to changing north-south temperature gradients.

Evapotranspiration

Evapotranspiration from plants could decrease due to greater stomatal resistance at higher ambient CO_2 concentrations but generally greater leaf area may partially compensate.

* This abstract has been prepared by R. J. King and is drawn from the fuller account, including relevant literature, given as an appendix in Pearman, G. I. (ed.) (1988) *Greenhouse: Planning for Climate Change*. CSIRO, Melbourne, 752 pp.

A GUIDE TO THE GREENHOUSE EFFECT

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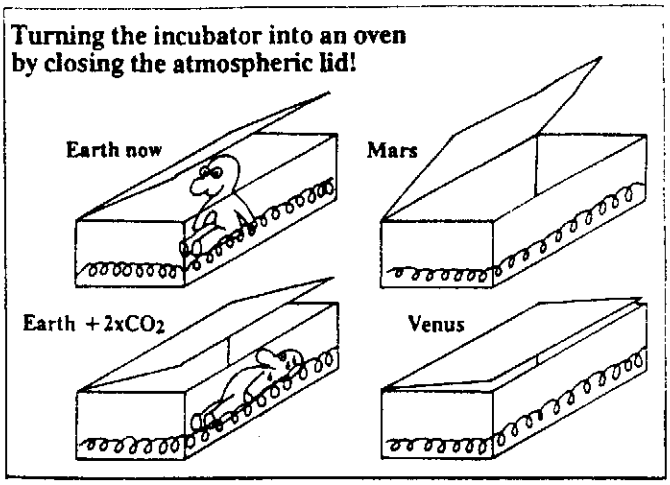
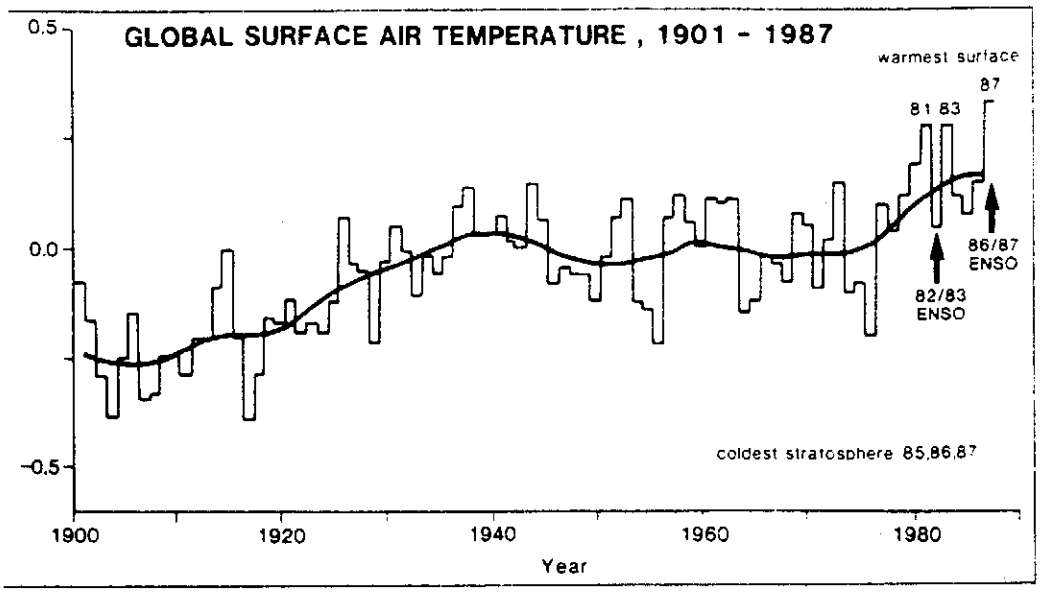
The 'greenhouse effect' is the best, most fully established theory in atmospheric science. It is this well-understood, greenhouse effect that keeps the Venus surface hot enough to bake potatoes out in the open while the lack of all but a very thin greenhouse makes the Martian surface resemble a very effective commercial deep freeze! Scientists predicted these temperatures with models before spacecraft measured them. The same models predict a warming for the Earth of between 3 and 4 degrees C by 2030.





We understand radiative transfer very well. The theory is based on sound physics and as far as we know there is no antidote within the natural Earth system — except of course to remove the gases from the atmosphere again. This is a very costly process; such a costly antidote to warming is not, in my opinion, something which we are likely to see.

There is considerable confusion and debate about temperature trends which have been measured for most of this century. Figure 1 shows the temperature increases this century. These temperature increases are derived from very many measurements of temperatures with thermometers which, whilst they might not have been absolutely accurate, agree and are generally mutually consistent. The general sense is of global surface temperatures (both land and ocean temperatures) increasing in an admittedly, somewhat oscillatory mode. The **important** point to make here is that these increases in temperature have absolutely nothing to do with the **predictions** of the greenhouse effect. They seem to be circumstantial evidence supporting the predictions and, indeed, they may well be the first hints of the greenhouse effect occurring on Earth; but they are not in themselves the basis of any of the greenhouse predictions.

The greenhouse is a very poor analogy for the effect which is called the greenhouse effect. In fact, greenhouses, those that are not heated by stoves, stay warm because they shelter the plants. It is a poor name for another, much more important reason: it sounds benign. By contrast, nuclear winter does not sound nice, the ozone hole is obviously a bad thing. The greenhouse analogy is not only a scientific misnomer, it is also an inadequate label because it does not emphasise how much our social and economic systems, and particularly our agricultural and water gathering activities, are going to be affected by the gradual warming and rainfall changes.

A better analogy might be 'turning the incubator of the planet Earth into an oven by closing the atmospheric lid' (Figure 2). The Earth is an efficient incubator. Life, since it first originated at least three and a half billion years ago, within a billion years of the planet being formed, has diversified and spread over all of the planet. At the moment, then, the incubator in which we live has its lid somewhat ajar; some energy from the surface is emitted back to space. The incubator heater can be thought of as the

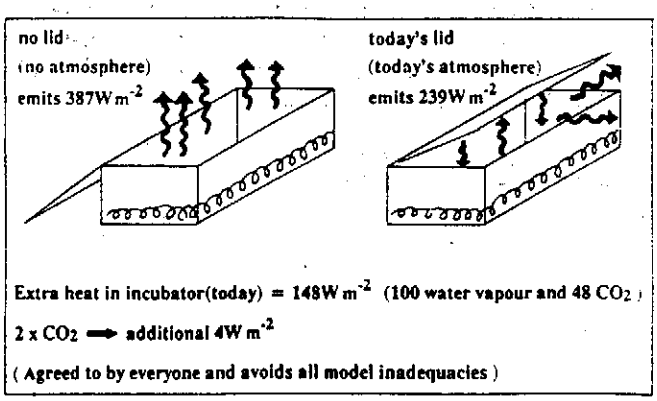


Figure 3: radiation emissions associated with closing incubator lid