CHLOROFLUOROCARBONS
a threat to the ozone layer by Tom Clarkson

In New Zealand we face many threats to our environment. Nevertheless, with most of these we can approach the future with some optimism because the decisions on remedies or controls can be made entirely within New Zealand. With the right public perceptions and the appropriate political will, people, industries or the government can exert positive management over our environment at risk. However, the two greatest environmental hazards faced by New Zealand through the next few decades are almost independent of any decisions made in New Zealand. When an issue is a global one, New Zealand, with less than a thousandth of the world population, has a very small voice.*

The two great hazards are the greenhouse effect, warming our atmosphere and oceans, and the depletion of the ozone layer, changing our solar radiation climate. Both these effects are caused by the unregulated release of trace gases into the atmosphere. The greenhouse effect arises largely from carbon dioxide from fossil fuel burning, and the ozone depletion from the release of an entirely synthetic group of chemicals, the chlorofluorocarbons (CFCs). In this article I will discuss only the ozone depletion problem, bearing in mind that the greenhouse effect is closely related.

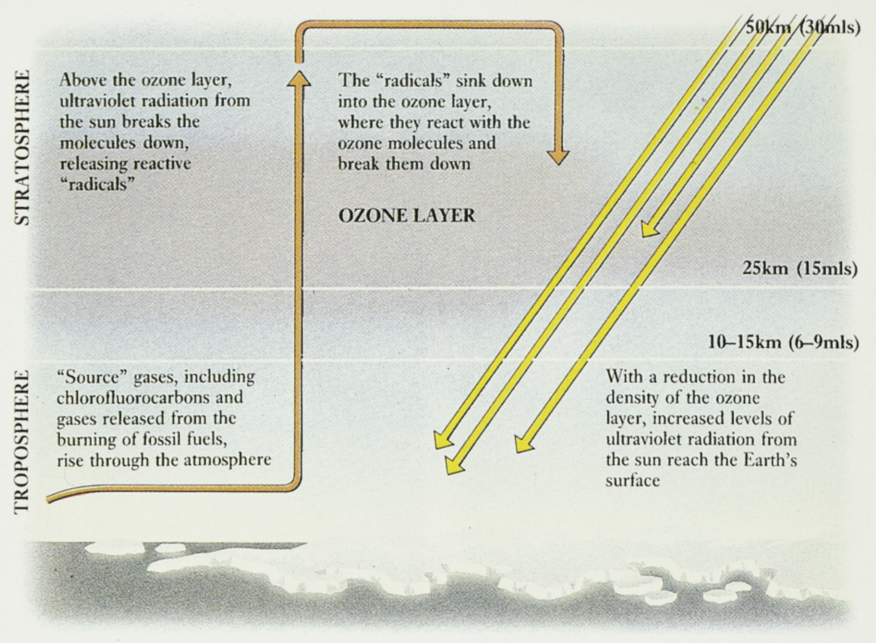

Figure 4: Free chlorine atoms, or radicals, sink down into the ozone layer and attack the ozone (0_3) to form chlorine monoxide (C10 and 0_2). The C10 then combines with a free oxygen atom to form 0_2 and a chlorine atom. This catalytic reaction repeats itself, so that for every chlorine atom released, an estimated 100,000 molecules of ozone are removed from the atmosphere. Courtesy of Greenpeace

Earth's radiation shield

The ozone layer is the earth's radiation shield. The minute traces of this gas, between 75 and 50 kms up in the stratosphere, absorb solar ultraviolet radiation and so protect all life below from harmful effects.

A decrease in ozone concentration and a consequent increase in uv radiation leads to increased incidence of some forms of skin cancer and eye cataracts. Other parts of the biosphere are also very vulnerable to changes in their uv climate. For example, micro-organisms in the surface layers of the sea can be seriously affected, and their niche at the bottom of the food-chain and the wide variety of juvenile species involved, means that the marine eco-system is likely to change. The ozone layer, in absorbing solar energy, also leads to the existence of the deep stable stratosphere, where vertical winds are restricted, and which is an effective cap on the weather systems below. Changes in ozone will lead to changes in weather patterns.

The ozone layer is fragile. If it were all brought down to ground level the layer would only be 3mm thick. Thus it is with alarm we note that since about 1970, between 1.7 and 3 percent of stratospheric ozone has vanished from the temperate regions of the globe. This is after allowances have been made for natural variations due to the sunspot cycle, major volcanic eruptions, atmospheric circulation effects such as El Niño, all of which influence ozone. A 1 percent depletion of ozone is estimated to lead to a 5 percent increase in skin cancer incidence. It is also very alarming that during the 1980s, ozone over the Antarctic has been vanishing for about two months each spring. This is the "ozone hole", where in October 1987 only about half the normal amount of ozone was present south of the Antarctic Circle.

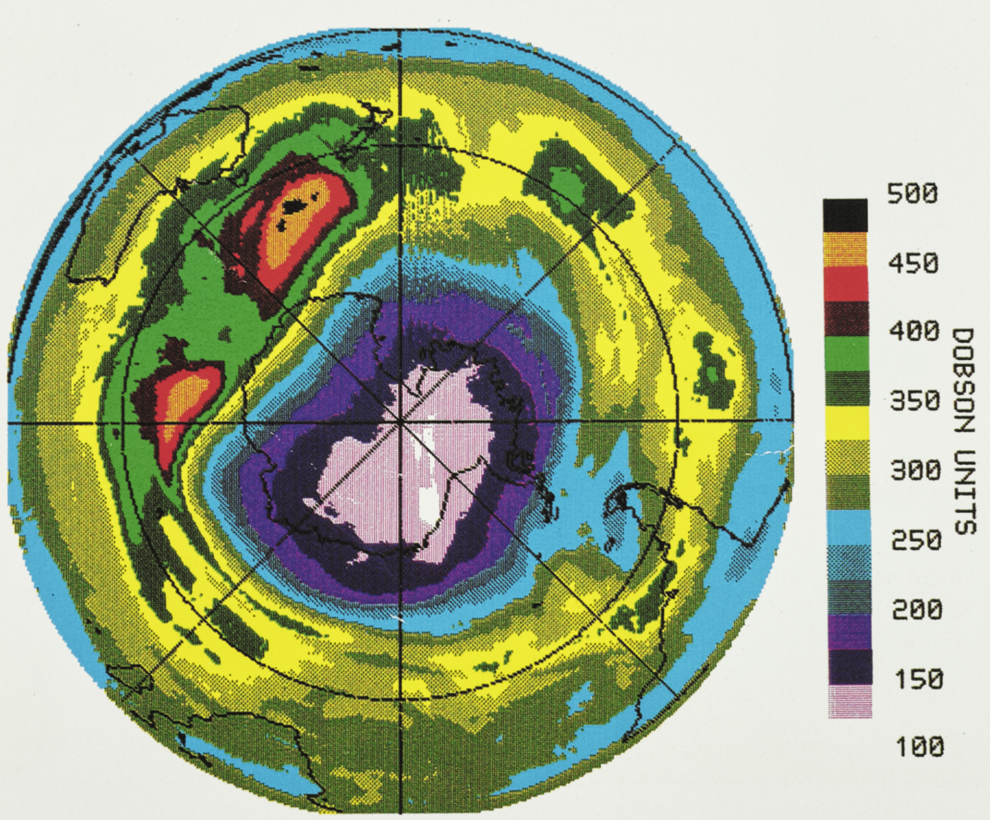

Figure 3: This picture of the ozone over the Southern Hemisphere was based on readings from Nimbus 7 on 7 October 1987. In a 'normal' spring, ozone over Antarctica could be expected to remain thicker than 250 Dobson units (i.e. a 2.5mm layer at atmospheric pressure).

Top suspect

Chlorine has now become firmly established as the top suspect for causing the ozone hole, largely as the result of intense experimental programmes conducted by US agencies during the past two spring seasons. The chlorine is from the now ubiquitous CFC gases, which together with the