



## **Introduction**

The layer of gases around the earth is called the atmosphere and it is essential to life on earth. It supplies oxygen to breathe and protection from harmful radiation from the sun and from small rocks flying through space. Its movements cause the changing weather, which happens in the lower part of the atmosphere as the sun heats the earth. The air circulates because the equator is warmer than the poles so hot air rises near the equator letting cold air rush in from the poles. This is complicated by the spin of the earth and the position and height of the land and sea below the moving air. It is very difficult to forecast the weather even with modern computers but it is even more difficult to predict the climate, which is the pattern of weather averaged over a long time.

Like the weather, the climate of the earth is always changing naturally. Over long periods of time, the way the earth circles the sun or the tilt of its spin axis changes. In the past, the earth has been both hotter and colder than now. In the last ice age 2000 years ago, the average temperatures were about 7°C lower than today and the ice covered most of Canada, Scandinavia and Russia. We are now in a warmer period between ice ages but even in this period there have been variations in climate. In Europe the 12<sup>th</sup> and 13<sup>th</sup> centuries were warmer, with vineyards flourishing in Britain and Belgium while in the 17<sup>th</sup> century it was colder and the River Thames regularly froze in winter. Then, the average world temperature was less than 1°C lower than now. We do not really know what causes these climate variations but even tiny temperature changes can affect the way we live.

## **What is the Greenhouse Effect?**

The Greenhouse Effect is a warming near the earth's surface that results from the earth's atmosphere trapping the sun's heat. Without this effect, the average surface temperature of the earth would be about 59°F (15°C) lower than it is.

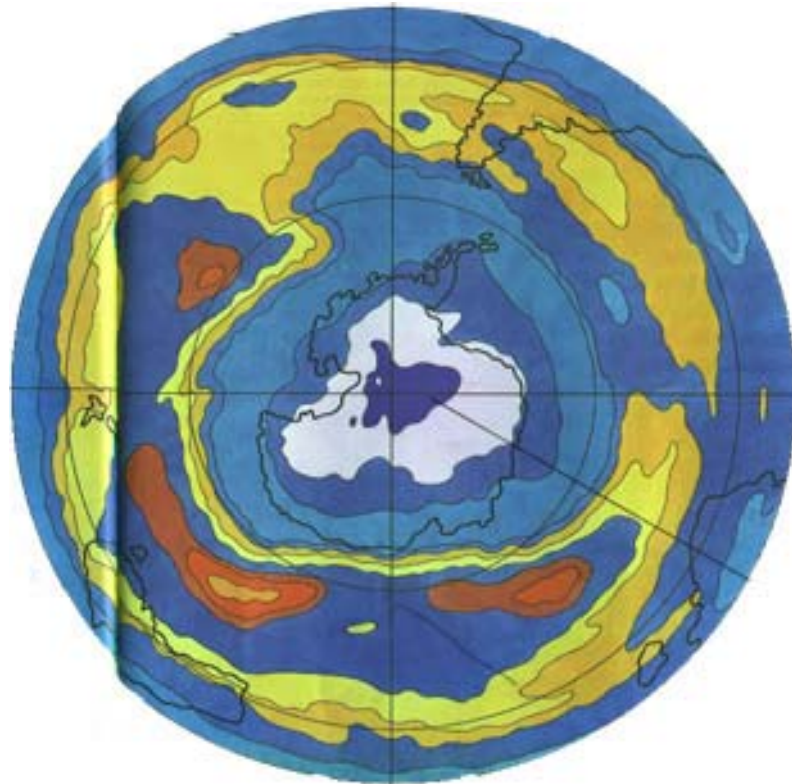
The greenhouse effect received its name because the earth's atmosphere acts much like the glass or plastic roof and walls of a greenhouse. Sunlight enters a greenhouse through the glass or plastic but the roof and walls slow the escape of heat and so heats the interior.

Similarly the earth's atmosphere allows most of the sunlight that reaches it to pass through and heat the earth's surface. The earth sends the heat energy back into the atmosphere as infrared radiation. Much of this infrared radiation does not pass freely into space, because certain gases in the atmosphere absorb it. These gases include carbon dioxide, ozone and water vapour. They grow warm and send infrared radiation back towards the earth adding to the warming at the surface.

Most of these bad effects are the results of man's activities. We have even produced man-made gases to run refrigerators and operate spray cans. These gases (CFS) are better at absorbing heat than the atmospheric gases and are also building up in the atmosphere. The amount of carbon dioxide in the atmosphere is increasing, chiefly because of the burning of coal, oil and natural gas. The destruction of forests, which absorb the gas, is also increasing the carbon dioxide level. Some scientists believe that from the mid 1900's to the late 2000's, the amount of carbon dioxide in the atmosphere will double. It is estimated that this doubling will intensify the greenhouse effect and increase the earth's average temperature by between 2.7°F to 10°F. Other gases being released into the atmosphere in growing amounts include CFCs, methane and nitrous oxide. These gases could double the climate-changing effect of the carbon dioxide.

The result of all this is that the earth is gradually getting hotter. Nobody knows what the consequences will be but they will probably be lead to drastic changes in the climate with more frequent drought in some places of the world and wetter weather in other places.

## The Ozone Layer



The Ozone layer high up in the atmosphere also influences conditions on earth. It is not a solid layer, just a region where molecules of the gas ozone are constantly being formed then broken down naturally by sunlight. This process absorbs dangerous ultraviolet radiation from the sun and warms the atmosphere. Ozone is made all over the world during the hours of daylight and is carried from place to place by the air currents. The height and thickness of the ozone layer vary in different places and with the time and seasons. The ozone layer is very fragile and we are now discovering how easy it is for pollutants to gobble up the ozone, leaving us without protection from ultraviolet radiation.

Scientists had measured the amounts of ozone layer for many years fearing it might be damaged by man-made air pollution. Then suddenly, in 1985, British scientists announced that they had discovered a thirty per cent decrease in the amount of ozone over Halley Bay in the Antarctic. At first they could not believe their measurements - they had expected damage to occur slowly. Also satellite scientists had told their computers to regard any very low readings as errors and therefore

missed the hole. The damage was so dramatic that scientists were extremely concerned.

### **Is The Hole Dangerous?**

As ultraviolet radiation from the sun is harmful to most life on earth, we need protection from it. Ultraviolet is the part of sunlight that causes a suntan and sunburn. It also can cause skin cancer and eye cataracts. These are the problems that will increase if the ozone layer is damaged.

Animals will have similar problems and plants will probably not grow so well, so crops will yield less food for animals and humans to eat. These effects will become gradually more severe if the ozone layer gets thinner, but if there was a catastrophic destruction of the ozone layer, life as we know it could cease to exist on earth altogether. The only living things could be down in the ocean where the ultraviolet radiation could not reach.

Consequently, the discovery of a hole in the ozone layer over the Antarctic frightened scientists and politicians. Records now show that the hole has appeared every Spring since the late 1970s. In 1987, ozone levels dropped by over fifty per cent over the entire Antarctic continent. Happily, the effect only appears for a short time in Spring then disappears for the rest of the year.

One of the biggest worries was when the hole had appeared so suddenly. Luckily it seems to happen because of the extreme conditions over the South Pole that do not occur anywhere else in the atmosphere. However, the concentration of ozone has also decreased by a few per cent over populated areas of the Northern Hemisphere.

## ECO thoughts

1. The climate system includes and is influenced by complex interactions between the atmosphere, ocean, land, ice and biosphere (the region where plants and animals live).
2. The most important greenhouse gases are carbon dioxide, methane, nitrous oxide and CFCs. There is nearly a third more carbon dioxide in the atmosphere today than there was 200 years ago.
3. Methane is a greenhouse gas made up of carbon and hydrogen gas. A single cow expels 500 liters of methane every day.
4. The greenhouse effect is very important. Without the greenhouse effect the Earth would not be warm enough for humans to live on. But if it becomes stronger then it could make the earth warmer than usual. Even a little extra warming may cause problems for humans, plants and animals.
5. Melting of the ice caps means that sea levels could rise by over one meter by the year 2030 making 15 million people homeless in Bangladesh.

## **OZONE Eaters**

The gases used in refrigerators are chemicals called CFCs. They are safe at ground level, but are dangerous to the atmosphere. Once CFCs are in the stratosphere (the area above the atmosphere), they can last for a 100 years or more before they are destroyed. Here they are broken down into chemicals by ultraviolet light from the sun. One of these chemicals is chlorine, which destroys the ozone layer.

### ***CFC sources***

CFCs are found in fridges, freezers and air conditioners and in some aerosol spray and fire extinguishers. Plastic foams used for packaging and furniture can be made with CFCs. In electronics factories, CFCs are used to clean the circuit boards that go into televisions and computers. The CFCs then gradually drift up into the atmosphere

## **The Green Issues**

Governments around the world became so concerned about the threat of CFCs to the ozone layer that they signed an agreement in 1987 called the Montreal Protocol. The countries that signed the agreement promised to stop using the worst CFCs by the end of the century. But all the gases which could destroy the ozone layer should be banned, not just the worst ones.