10. Monitoring Ozone Depletion

Introduction

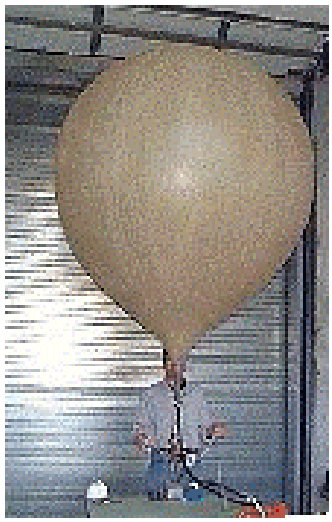
In 1974, after millions of tons of CFCs had been manufactured and sold, chemists F. Sherwood Rowland and Mario Molina of the University of California began to wonder where all these CFCs ended up. Rowland and Molina theorised that short waves of ultraviolet radiation from the Sun in the stratosphere would break up CFCs, and that the free chlorine atoms would then enter into a chain reaction, destroying ozone. Many people, however, remained unconvinced of the danger until the mid-1980s, when a severe annual depletion of ozone was first monitored by the British Antarctic Survey above Antarctica. The depletion above the South Pole was so severe that the British geophysicist, Joe Farman, who first measured it assumed his spectrophotometer must be broken and sent the device back to England to be repaired. Once the depletion was verified, it came to be known throughout the world through a series of NASA satellite photos as the Antarctic Ozone Hole.

Evidence for Stratospheric Ozone Depletion

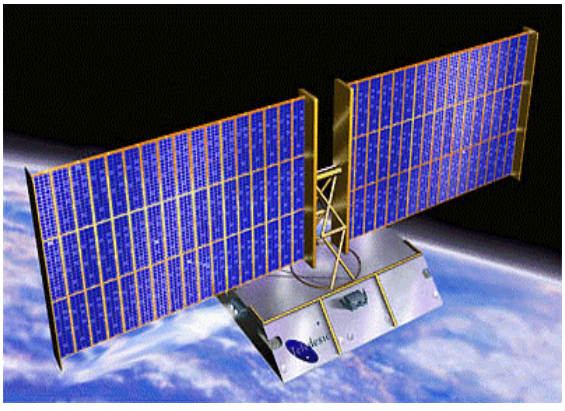
Laboratory studies, backed by satellite and ground-based measurements, show that chlorine reacts very rapidly with ozone. They also show that the chlorine oxide formed in that reaction undergoes further processes that regenerate the original chlorine, allowing the sequence to be repeated very many times (a "chain reaction"). Similar reactions also take place between bromine and ozone. Many other reactions are often also taking place simultaneously in the stratosphere, making the connections among the changes difficult to untangle. Nevertheless, whenever chlorine (or bromine) and ozone are found together in the stratosphere, the ozone-destroying reactions must be taking place. Observations of

the Antarctic ozone hole have given a convincing and unmistakable demonstration of these processes.

Monitoring of Ozone Depletion



There has been much monitoring of the condition of the ozone layer in the last decade since the Antarctic ozone hole was first discovered by the British Antarctic Survey. This has utilised satellites and other ground-based resources that are dedicated to observing the destruction of stratospheric ozone. The main satellite that monitors the ozone is the TOMS (Total Ozone Mapping Spectrometer) satellite. The TOMS satellite measures the ozone levels from the back-scattered sunlight in the ultraviolet (UV) range. Another satellite is NASA's UARS (Upper Atmosphere Research Satellite) which was launched in September 1991. This satellite is unique because it was configured to not only measure ozone levels, but also levels of ozone-depleting chemicals. GOME, launched in April 1995 on the ERS-2 satellite, marks the beginning of a long-term European ozone monitoring effort. Scientists expect to receive high quality data on the global distribution of ozone and several other climate-influencing trace gases in the Earth's atmosphere.



The German Neumayer Antarctic Research Station was completed in March of 1992, which is located on the Ekstsoem Ice Shelf. This ground-based station studies geographical, meteorological, and air chemistry conditions.

In 1987, Canada became the first country in the world to focus on the Arctic ozone layer, following the discovery of the ozone hole over the Antarctic. A cross-country network of monitoring stations has kept continuous watch on Canada's ozone layer for more than three decades. The existence of these early records, before any major human influence on the upper atmosphere, is vital to understanding the changes that have occurred in the ozone layer.

In the UK, stratospheric ozone levels are monitored every winter and spring at Cambourne, in Cornwall and Lerwick, in the Shetland Isles.