The Antarctic Ozone Hole

Richard Stolarski
NASA Goddard Space Flight Center

The issue of stratospheric ozone depletion first arose in the early 1970s. In 1974 Molina and Rowland put forward the theory that chlorofluorocarbons (CFCs) would accumulate in the atmosphere, be transported to the stratosphere, and lead to ozone destruction. Enough evidence was gathered indicating the basic correctness of this theory that international negotiations were begun on the Montreal Protocol to limit ozone-depleting substances. In 1985 the entire field received a shock when the data from the British Antarctic Survey station at Halley Bay, Antarctica were published by Farman et al. showing a 40% decrease in the October amount of ozone over the station since the late 1970s. This was quickly confirmed by the ozone data from NASA's Total Ozone Mapping Spectrometer (TOMS) instrument on the Nimbus 7 satellite and shown to be a continent-wide phenomenon. Several theories were put forward, but aircraft data produced the so-called "smoking gun" evidence that the reason for the Antarctic hole was the accumulation of chlorine containing compounds that could efficiently destroy ozone in the special meteorological conditions of the cold, isolated Antarctic vortex. Since that time, the phenomenon of the Antarctic ozone hole has become better understood through a combination of continued measurement of the ozone by a series of successor instruments to the TOMS and through intensive measurements of the chemicals involved in the destruction of ozone by instruments on the Upper Atmosphere Research Satellite (UARS) and the Aura satellite. I will focus on how we can use the data from Aura and other satellites to map out the seasonal evolution of the ozone hole by measuring the three-dimensional distributions of ozone, chlorine compounds, and nitrogen compounds. We have come a long way from the first attempts to gain data that could be used to differentiate among competing theories for the development of the Antarctic ozone hole.