Ozone Layer Essay Test

The 2002 Antarctic Ozone Hole

The 2002 Antarctic ozone hole showed features that looked surprising at the time (see **Figure Q10-4**). That year exhibited much less ozone depletion as measured by the area of the ozone hole or minimum total ozone amounts in comparison with ozone holes in 2001 and 2003. The 2002 values now stand out clearly in the year-to-year changes in these quantities displayed in Figure Q10-2. There were no forecasts of an ozone hole with unusual features in 2002 because the meteorological and chemical conditions required to deplete ozone, namely low temperatures and available reactive halogen gases, were present that year and did not differ substantially from those in previous years. The ozone hole initially formed as expected in August and early September 2002. Later, during the last week of September, a rare meteorological event occurred that dramatically reshaped the ozone hole into two separate depleted regions (see Figure Q10-4). As a result of this disturbance, the combined area of these two regions in late September and early October was significantly less than that observed for the previous or subsequent ozone holes.

The unexpected meteorological influence in 2002 resulted from specific atmospheric air motions that sometimes occur in polar regions. Meteorological analyses of the Antarctic stratosphere show that it was warmed by very strong, large-scale weather systems that originated in the lower atmosphere (troposphere) at midlatitudes in late September. At that time, Antarctic temperatures are generally very low (see Q9) and ozone destruction rates are near their peak values. The influence of these tropospheric systems extended poleward and upward into the stratosphere, disturbing the normal circumpolar wind (polar vortex) and warming the lower stratosphere where ozone depletion was ongoing. Higher temperatures in late September reduced the rate of ozone depletion and led to the higher minimum value for total ozone shown in Figure Q10-2. The greater-than-normal impact of these weather disturbances during late winter/early spring when ozone loss processes are normally most effective resulted in less Antarctic ozone depletion in 2002.

The 2002 stratospheric warming event is the strongest in the many decades of Antarctic meteorological observations. Another warming event in 1988 caused somewhat smaller changes in the ozone hole features than in 2002. Large warming events are difficult to predict because of the complex conditions leading to their formation.

The size and maximum ozone depletion (depth) of the ozone hole from 2003 through 2017 returned to values similar to those observed from the mid-1990s to 2001 (see Figure Q10-2). The high ozone depletion found since the mid-1990s, with the exception of 2002, is expected to be typical of coming years. A significant, sustained reduction of Antarctic ozone depletion, leading to full recovery of total ozone, requires comparable, sustained reductions of ozone-depleting substances in the stratosphere. Even with the halogen source gas reductions already underway (see Q15), the return of Antarctic total ozone to 1980 values is not expected to occur until around 2060 (see Q20).

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What is the ozone hole? What is the connection between ozone depletion and climate change? How do we know that natural sources are not .... Ozone depletion consists of two related events observed since the late 1970s: a steady ... the lowest quarter of vitamin D (