Q13: How large is the depletion of the global ozone layer?

The ozone layer has been depleted gradually since 1980 and now is about an average of 3% lower over the globe. The depletion, which exceeds the natural variations of the ozone layer, is very small near the equator and increases with latitude toward the poles. The large average depletion in polar regions is primarily a result of the late winter/spring ozone destruction that occurs there annually.

Stratospheric ozone has decreased over the globe since the 1980s. The depletion, which in the period 1997-2001 averaged about 3% (see ***Figure Q13-1***), is larger than natural variations in ozone. The observations shown in ***Figure Q13-1*** have been smoothed to remove regular ozone changes that are due to seasonal and solar effects (see *Q14*). The increase in reactive halogen gases in the stratosphere is considered to be the primary cause of the average depletion. The lowest ozone values in recent years occurred following the 1991 eruption of Mt. Pinatubo, which increased the number of sulfur-containing particles in the stratosphere. The particles remain in the stratosphere for several years, increasing the effectiveness of reactive halogen gases in destroying ozone (see *Q14*).

Observed ozone depletion varies significantly with latitude on the globe (see ***Figure Q13-1***). The largest losses occur at the highest southern latitudes as a result of the severe ozone loss over Antarctica each winter/spring period. The next largest losses are observed in the Northern Hemisphere, caused in part by winter/spring losses over the Arctic. Air depleted in ozone over both polar regions spreads away from the poles during and after each winter/spring period. Ozone depletion also occurs directly at latitudes between the equator and polar regions, but is smaller because of smaller amounts of reactive halogen gases present there.

Tropical regions. There has been little or no depletion of total ozone in the tropics (between about 20° latitude north and south of the equator in ***Figure Q13-1***). In this region of the lower stratosphere, air has only recently (less than 18 months) been transported from the lower atmosphere. As a result, the conversion of halogen source gases to reactive halogen gases is very small. Because of the low abundance of reactive gases, total ozone depletion in this region is also very small. In contrast, stratospheric air in polar regions has been in the stratosphere for an average of 4 to 7 years, and the abundance of reactive halogen gases is much larger.

Seasonal changes. The magnitude of global ozone depletion also depends on season of the year. In the period pre-1980 to 1997-2001, average total ozone decreased by about 3% in northern middle latitudes (35°N-60°N) and about 6% at southern middle latitudes (35°S-60°S). The seasonality of these changes is different in the two hemispheres. In the Northern Hemisphere, larger decreases are observed in winter/spring (4%) than in summer/autumn (2%). In the Southern Hemisphere, the decreases are about the same (6%) during all seasons.

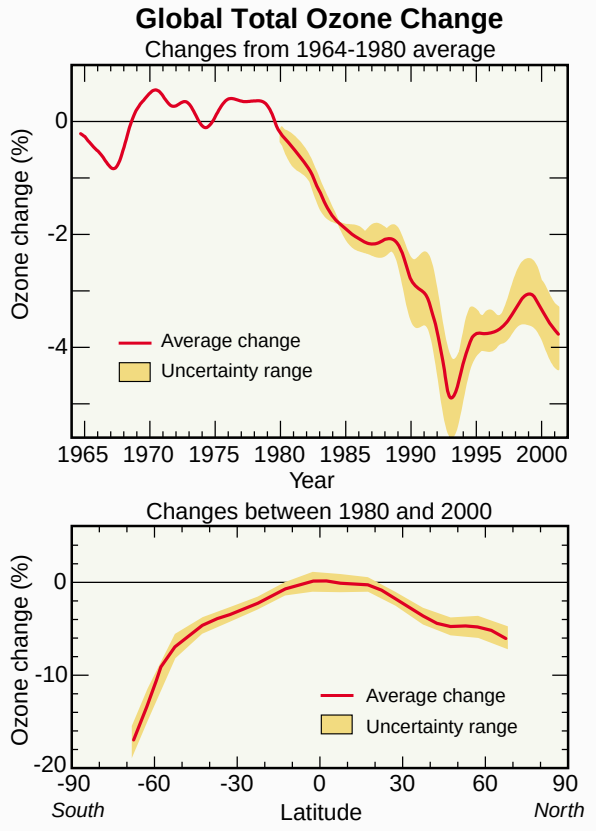

Figure Q13-1. Global total ozone changes. Global total ozone values decreased by an average of a few percent in the last two decades, as measured by satellite instruments. In the top panel, global ozone changes are compared with average global ozone found in the period of 1964 to 1980. Between 1980 and 2000, the largest decreases occurred following the volcanic eruption of Mt. Pinatubo in 1991. In the 1997 to 2001 period global ozone was reduced by about 3% from the 1964-1980 average. In the bottom panel, ozone changes between 1980 and 2000 are compared for different latitudes. The largest decreases have occurred at the highest latitudes in both hemispheres because of the large winter/spring depletion in polar regions. The losses in the Southern Hemisphere are greater than those in the Northern Hemisphere because of the greater losses that occur each year in the Antarctic stratosphere. Long-term changes in the tropics are much smaller because reactive halogen gases are not abundant in the tropical lower stratosphere.