Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division

FACTS ABOUT THE OZONE ‘HOLE’

What is the ozone hole?

Since the late 1970s the level of ozone (O_3) over Antarctica has decreased significantly each spring, creating the phenomenon commonly referred to as the Antarctic ozone ‘hole’. Rather than a hole, it is actually a region of exceptionally depleted ozone (currently up to 60% loss) in the lower stratosphere (15–30 km altitude), which lasts for 3–4 months between September and December. A similar, though less severe depletion of ozone, has also occurred in the Arctic since the 1990s.

What causes ozone depletion?

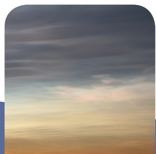
Ozone depletion is caused by chlorofluorocarbons (CFCs), methyl bromide, halons and related gases that have been released into the atmosphere by human activity (from such things as solvents, refrigerators, fire extinguishers and air conditioners). In the stratosphere, these molecules are broken down into simpler forms by ultraviolet light from the sun. These simpler forms are further altered to create reactive compounds involving chlorine and bromine, by chemical processes that occur on the surfaces of tiny suspended particles, known as stratospheric aerosols. The amount of these aerosols, and consequently the amount of chemical processing, is enhanced in the polar atmosphere during winter because of the presence of polar stratospheric clouds (PSCs).

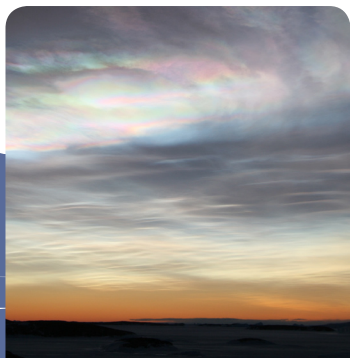
How do polar stratospheric clouds enhance ozone depletion?

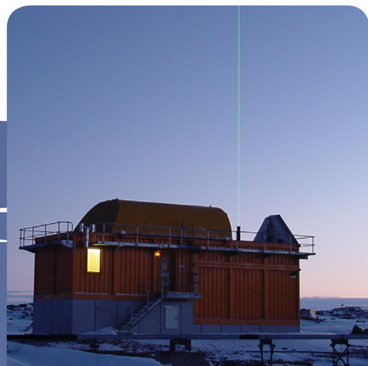
The formation of PSCs is related to the presence of a ‘polar vortex’ in the stratospheric circulation pattern of the southern hemisphere in winter. The polar vortex is a region where air undergoes little mixing with the rest of the atmosphere, allowing temperatures to drop as low as -85ºC and stay low during the polar night. The low temperatures allow water and other chemicals to condense, producing clouds of PSC aerosols between heights of 12 and 26 km.

When sunlight returns to the polar stratosphere in spring, the reactive compounds released by the PSCs are quickly broken down by ultraviolet light. This process creates free chlorine and bromine atoms that directly destroy ozone. The reactions occur in cycles that destroy many ozone molecules for each released chlorine and bromine atom. Ozone destruction peaks in early spring, and then declines as the atmosphere warms – the warming evaporates the PSCs and breaks down the vortex, resulting in the mixing of air between the polar region and lower latitudes.

The potential for ozone destruction each spring is related to the amount of PSC formation during the preceding winter, and the size and stability of the polar vortex.







Since the early 1990s the size of the Antarctic ozone hole has been controlled primarily by the size and strength of the polar vortex rather than the amount of ozone-depleting substances in the atmosphere. A record ozone hole, approximately 29 million square kilometers in size (more than twice the area of Antarctica) occurred on 24 September 2006, due to the polar vortex being unusually large, stable and cold.

What are we doing to stop ozone depletion?

On 16 September 1987 an international treaty – the Montreal Protocol – was created to protect the ozone layer, by phasing out the production of CFCs and other ozone-damaging gases. The total combined abundance of ozone-depleting compounds in the lower atmosphere peaked in about 1994 and is now slowly declining. Because of the long times required for CFCs to be removed from the stratosphere, a decrease in the size of the Antarctic ozone hole is not expected to be noticeable until 2015–2020, with recovery to pre-ozone hole levels between 2050 and 2070.

What is the effect of ozone depletion?

Stratospheric ozone losses have caused a cooling of the lower stratosphere particularly in the polar regions, resulting in changes to atmospheric circulation. Ozone loss also allows more ultraviolet (UV) light to reach ground-level, causing damage to living things. In humans, this damage includes sunburn, skin cancer and eye damage.

Does ozone depletion occur in the northern hemisphere?

The Arctic stratospheric air is generally warmer than in the Antarctic, and fewer PSCs form there. Therefore, ozone depletion in the Arctic is much less than in the Antarctic.

How do scientists at the Australian Antarctic Division measure ozone?

Scientists use a range of instruments to measure ozone concentrations, including balloons, satellites, and ground-based spectrometers and gas samplers. Work at the Australian Antarctic Division is aimed at helping to assess trends in temperatures and ozone concentrations in the stratosphere, as well as understanding the chemical processes related to polar stratospheric clouds.