Stratospheric Ozone
The hole in the ozone layer

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This fact sheet is one of a series, developed from material presented in Victoria's first comprehensive State of the Environment Report. The Report is a major undertaking of the Commissioner for Environmental Sustainability and covers a broad range of environmental issues affecting the State. Its purpose is to improve community understanding of Victoria's environment, and through the use of recommendations, to ensure its protection for present and future generations. The report was released in December 2008 and is available at www.ces.vic.gov.au

Key findings

- Emission of chlorofluorocarbons (CFCs) and other chemicals leads to depletion of stratospheric ozone, exposing both marine and terrestrial life to harmful amounts of ultraviolet radiation.
- The Antarctic ozone hole reached its largest about the year 2000, resulting in up to 130% more ultraviolet-B radiation reaching the Earth's surface. From 2000 the size of the hole has remained stable, or may be in slow decline.
- Ozone depletion halted in the late 1990s leaving ozone levels over Melbourne relatively stable, but at a level at least 10% lower than the late 1950s.
- Significant ozone recovery is expected over the next five years and full recovery is possible with global adherence to international agreements.
- Expected future atmospheric concentrations of nitrous oxide and methane may reverse anticipated ozone recovery.

Bombarded from outer space

Ozone is an important part of the atmosphere which absorbs harmful ultraviolet radiation, preventing it from reaching the Earth's surface. Ozone is naturally and continuously produced and destroyed in the stratosphere. In the mid-1970s it was found that chlorofluorocarbons (CFCs), the chemicals used in spray-cans, refrigerants, foam-blowing agents and solvents, could deplete the ozone layer. Depletion of the ozone layer is now accepted as an international concern such that emission of ozone depleting substances is limited by agreement under the Montréal Protocol.

Excess ultraviolet radiation at the Earth's surface can reduce plant growth, damage human health by impacting on the immune system, eyes and skin, interfere with growth and reproduction of marine organisms, and degrade synthetic plastics and surface coatings, as well as bio-polymers such as wood, paper, wool and cotton.

Consequences of reduced levels of stratospheric ozone over Antarctica could exacerbate certain climate change factors and lead to changes in the East Australian (ocean) Current.

The hole in the ozone layer

An ozone hole is defined as a region poleward of 60° where total ozone levels are less than 220 Dobson Units (DU). Under normal conditions, the average concentration in the ozone layer is around 300 DU.

A progressive loss of ozone was observed at mid- and polar latitudes with a rapid reduction in ozone over Antarctica occurring from the mid-1970s to the mid-1990s, leading to a regional loss of about 60%. In addition to global ozone depletion, a hole in the ozone layer, a pronounced thinning of it's lower portion, was discovered over Antarctica in the 1980s (see Figure 1).

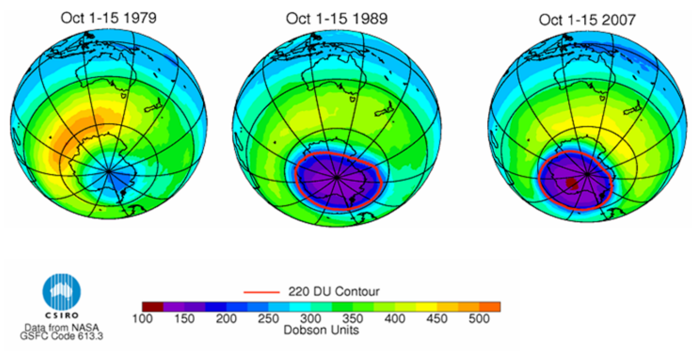

Figure 1. The changing size of the hole (shown as the red line) in the ozone layer

The area of the Antarctic ozone hole grew rapidly at about 2 million km^2 per year during the 1980s and about 0.5 million km^2 per year during the 1990s. The ozone hole became larger than the Antarctic continent by 1985 and larger than the southern polar zone by 1992. At its maximum, about the year 2000, the hole was approximately 30 million km^2 – almost four times the size of Australia. The area of the Antarctic ozone hole is currently at a maximum and may be in slow decline.

Mid-latitude ozone concentrations

Ozone levels over southern Australasia reached a minimum in 1998 (see Figure 2). Mean summertime ozone levels were 275 DU in 1998/1999, increasing in 2002/2003 before declining again to 276 DU in 2006/2007. The major cause of this reduced concentration is the break-up of the ozone hole and spreading of ozone-depleted polar air into the ozone-richer air at mid-latitudes.

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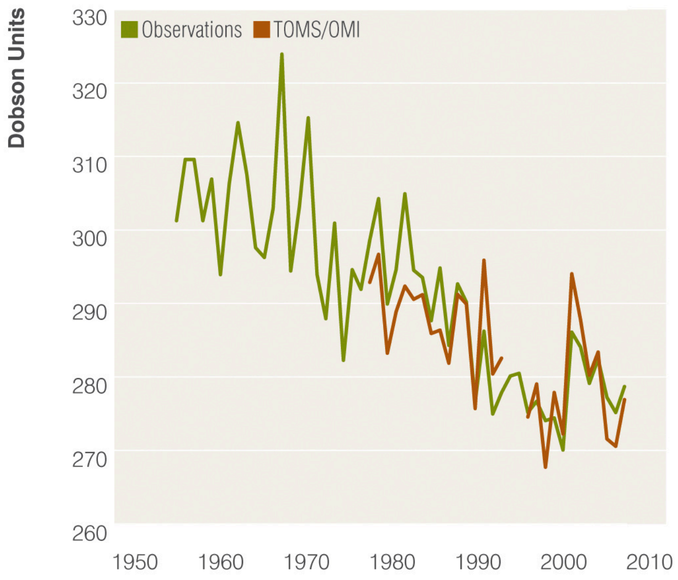

Figure 2. Summer total ozone concentration recorded in Australia and New Zealand

Significant ozone depletion has been evident over Melbourne for some time. Up to the late to 1970s ozone losses were 3.1% per decade accelerating to 7.5% per decade up to 1992. The period to 2006 was stable with the exception of the summer of 2006/2007, when the lowest summertime ozone levels for Melbourne since 1956 were recorded.

Unintended consequences of modern life

Global emissions of ozone-depleting substances, including CFCs, peaked around 1990 at 2.1 million tonnes per year, and by 2005 had declined by 70% to 0.5 million tonnes. CFCs were formerly used widely in industry as refrigerants, propellants, and cleaning solvents until their use was prohibited by the Montréal Protocol, because of effects on the ozone layer.

CFC emissions continue from old refrigeration and air conditioning equipment that is still in use, or buried in landfills with CFC-emitting foams and aerosol cans. 60% of future ozone depletion will be caused by CFCs yet to be released from stocks largely in the developed world. In addition to CFCs, there are other substances used in fire suppression, quarantine and industry that deplete stratospheric ozone.

Emissions of ozone-depleting substances from the Melbourne and Port Phillip region have declined at a rate of 3.9% per year from 700 tonnes in 1995 to 300 tonnes in 2007. Most of the decline in emissions occurred in the mid-to-late 1990s, when phase outs were completed.

CFCs have in part been replaced by hydrofluorocarbons (HCFCs) which have no known effect on the ozone layer. Most HCFC emissions are from operational refrigeration and air conditioning equipment. However, these substances are known greenhouse gases and in terms of climate change, are much more potent than carbon dioxide.

The global response

The Montréal Protocol on Substances that Deplete the Ozone Layer came into effect in 1989 with the agreement of 55 nations. Strengthened several times since then, the Protocol represents successful worldwide action to control and limit the use of ozone-depleting substances.

Australia has put the Montréal Protocol into practice through the *Ozone Protection and Synthetic Gas Management Act 1989*, which has enabled it to meet or exceed all of its international obligations.

Australia will effectively phase out consumption of HCFCs by 2018, thereby consuming some 63% less HCFC in the period to 2020 than permitted under the Protocol.

What the Commissioner says

"*The strategies and policies put in place to minimise the use of ozone depleting substances have had a good degree of success, and provide a good example of the power of international cooperation for environmental benefit.*

"However, there remain a limited number of permissible uses for ozone depleting substances in Victoria, and these should be reduced, wherever possible.

"In addition, it is important that CSIRO and others continue to monitor ozone depleting substances, particularly any atmospheric changes that may occur with climate change."

What you can do

- Check with your local council to ensure that your old fridge or air-conditioner is disposed of responsibly. Refrigerant Reclamation Australia operates a product stewardship scheme to recover and reclaim refrigerant in domestic and industrial appliances.
- Protect yourself. Victoria is particularly vulnerable to low stratospheric ozone levels and high ultraviolet radiation, so "Slip on a shirt, slop on sunscreen and slap on a hat".

For more information

See the State of Environment Report Victoria 2008, Part 4.1 Atmosphere, A2 Stratospheric Ozone Depletion.

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