

ANTARCTIC OZONE: NEW INSIGHTS FROM THE INTERNATIONAL POLAR YEAR

Australia is participating in an International Polar Year (IPY) project that will help improve future predictions of atmospheric ozone.

The ORACLE-03 project brings together an extensive array of measurement and modelling approaches to shed new light on fundamental aspects of ozone loss and related processes in the polar regions.

There is considerable interest in Antarctic polar ozone owing to anticipation of the first significant signs of recovery in the ozone hole phenomenon. Since the 1980s, dramatic episodes of ozone destruction have occurred in the Antarctic stratosphere each spring, particularly between 12 km and 25 km above the Earth's surface. This phenomenon is directly related to the release, since the mid 1900s, of certain man-made ozone-depleting gases. There have also been smaller and less regular depletions over the Arctic in spring, as well as a general decline in ozone levels outside the tropics.

Ozone plays two important roles in the environment. Firstly, although ozone is only a very small part of the atmosphere, it acts as an efficient natural sunscreen, absorbing most of the ultraviolet sunlight that is harmful to life. Secondly, ozone influences the vertical structure of the atmosphere through heating and cooling processes. Thus, changing the natural level of ozone may directly influence ecosystems and climate.

In September 1987 the Montreal Protocol was signed to limit the production and release of ozone depleting substances. By the mid-1990s, levels of some harmful, man-made gases started to decline at the Earth's surface. However, because of their relatively long atmospheric lifetimes, levels of these gases likely peaked in the stratosphere only recently. Currently, the severity of spring ozone loss over Antarctica is dictated more by



Bureau of Meteorology observer Annette Schlub launches an ozonesonde balloon at Davis.

Stratospheric clouds, seen here illuminated by the sun during twilight, only occur at high polar latitudes in winter, at temperatures less than -80°C , and promote chemical changes in the atmosphere that destroy ozone.

stratospheric temperatures during winter (with cold winters causing greater ozone loss) than by changes in the levels of the harmful gases. Our best assessment is that stratospheric levels of ozone depleting substances should now be declining, and the first signs of ozone recovery will appear around 2018. The return of Antarctic ozone levels to pre-1980 conditions will occur between 2060 and 2075.

Our appreciation of the importance of ozone is relatively recent. Identified as a naturally occurring atmospheric gas in the mid 1800s, it wasn't until the 1880s that the filtering affects of ozone on ultraviolet light was realised. By the 1920s the importance of ozone on climate was becoming apparent. Around this time, the first accurate methods were developed to measure the amount of ozone in the atmospheric column.

Ozone research accelerated during the International Geophysical Year (IGY) of 1957-58. Pioneering work identified the world-wide distribution of ozone and its seasonal behaviour, established modern ozone measurement protocols, and developed new analysis techniques. Australia played a leading role in the measurement programme, operating instruments at Macquarie Island, Aspendale (near Melbourne) and Brisbane. The only two Antarctic measurement sites were at Halley Bay and Argentine Island, both operated by the United Kingdom¹. The measurements at Halley Bay provided crucial baseline information on spring ozone that enabled scientists to recognise the first signs of the Antarctic ozone hole

Fifty years on, we are investigating ozone-related processes that were completely unexpected during the IGY. As with many areas of IGY endeavour, the measurements made during that time have been invaluable in raising our awareness and understanding of environmental issues.

International ozone research during the IPY emphasises improving our understanding of ozone loss processes, so that predictions of future trends can be made with greater certainty. A key contribution of the ORACLE-03 project to this effort will be the accurate measurement of atmospheric parameters, particularly over the poles where ozone is most sensitive to change. Part of this work will involve the release of balloon-borne sensors or 'ozonesondes' from more than 40 Antarctic and Arctic sites, to accurately measure the vertical profile of ozone and other meteorological parameters, to altitudes in excess of 30 km.

Scientists at Australia's Davis station will participate in efforts to track and make multiple in-situ measurements of ozone inside air streams

moving around Antarctica. The work, coordinated by the Alfred Wegener Institute in Germany, will involve careful coordination of ozonesonde releases, and the collection of measurements by satellite and ground-based instruments. Researchers will also take advantage of the long-term ozone measurement programme currently operating on Macquarie Island.

Thanks to the networks of measurements sites, international data centres and space-based environmental monitoring systems inspired by the IGY, we are well positioned to attempt a more complete understanding of our natural environment, and leave a lasting legacy of precise measurements for the benefit of future scientists. Ozone research associated with the IPY will provide greater certainty about future climate, and confirmation that international cooperation in controlling the release of ozone depleting substances is improving the health of the atmosphere.

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Further information

ORACLE-03 Project

www.awi-potsdam.de/www-pot/atmo/ORACLE-03

Scientists find Antarctic ozone hole to recover later than expected

earthobservatory.nasa.gov/Newsroom/NasaNews/2006/2006062922540.html

Australian Bureau of Meteorology

www.bom.gov.au/inside/oeb/atmoswatch/aboutozone.shtml

¹ The Argentine Island station is now called Vernadsky, and is operated by the Ukraine. The Halley Bay site is near the location of the current Halley station. Ozone measurements at both of these stations continue today.