British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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The Ozone Hole

It's over 30 years since the discovery of the Ozone Hole drew world attention to the impact of human activity on the global environment.

Why is the ozone layer important?

The ozone layer is the Earth's natural sunscreen that protects humans, plants and animals by filtering out harmful UV-B radiation. In the 1970s concern about the effect of man-made chemicals, especially chlorofluorocarbons (CFCs), on the ozone layer were raised by Paul Crutzen, Mario Molina and Sherwood Rowland. Their pioneering work was recognised in 1995 by the award of the Nobel Prize in Chemistry.

How was the Ozone Hole discovered?

Scientists from British Antarctic Survey (BAS) began monitoring ozone during the International Geophysical Year of 1957-58. In 1985, scientists discovered that since the mid-1970s ozone values over Halley and Faraday Research Stations had been steadily dropping when the Sun reappeared each spring. Something in the stratosphere (about 20km above Earth) was destroying ozone.

So what was wrong with the ozone layer?

We now know that during the polar winter, clouds form in the Antarctic ozone layer and chemical reactions on the clouds activate ozone destroying substances. When sunlight returns in the spring, these substances (mostly chlorine and bromine from compounds such as CFCs and halons) take part in efficient catalytic reactions that destroy ozone at around 1% per day. This discovery changed the world.

What happened after the hole was discovered?

NASA scientists used their satellite data to confirm that not only was the hole over British research stations but it covered the entire Antarctic continent. International efforts by scientists and politicians then led to steps to control the production and use of CFCs and other ozone-depleting chemicals. The resulting Montreal Protocol (1987) and its subsequent amendments is a successful example of leadership by all the world's governments in tackling a global environmental issue.

How successful is the Montreal Protocol?

The Protocol is having a clear effect and the amount of ozone-destroying substances in the atmosphere is going down. We are now seeing a slow recovery of the ozone layer over Antarctica. Nevertheless, the original compounds are so stable and long-lived that an ozone hole will exist each Antarctic spring for at least another 50 years.

Is there a hole over the Arctic?

Unlike Antarctica, which is a continent surrounded by oceans, the Arctic is an ocean surrounded by mountainous continents. This means that the stratospheric circulation is much more irregular. Because the Arctic ozone layer is not normally as cold as that of the Antarctic, stratospheric clouds are less common. So although a deep ozone hole over the North Pole is unlikely, ozone depletion can occur above the Arctic. When it does occur it usually lasts for a short period of time, however significant ozone depletion did occur in February 2016.

And what about elsewhere?

In 2016 stratospheric clouds were seen widely over the UK and a small, short-lived ozone hole passed over the country. Elsewhere in the Northern Hemisphere, stratospheric ozone depletion reached 10-15% in the 1990s, but is slowly recovering. Depletion is generally even greater in the Southern Hemisphere as a direct consequence of the deep Antarctic Ozone Hole. There has been little ozone depletion over the tropics and globally the depletion now averages out at about 3%.

Is the Ozone Hole linked to global warming?

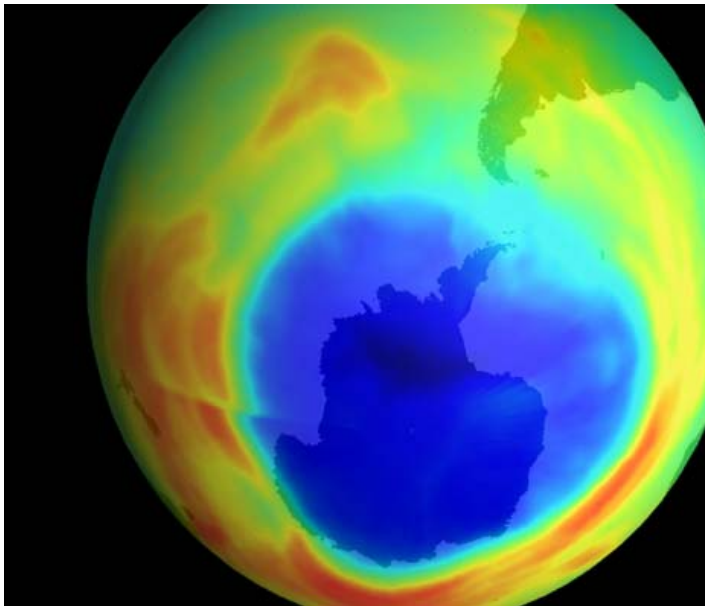
A side effect of global warming is that the temperature of the ozone layer is falling slightly. This means that more of the stratispheric clouds can form over Antarctica, and hence delay the recovery of the Ozone Hole. Elsewhere however the same cooling is likely to slightly thicken the ozone layer. The Ozone Hole can also help change the surface climate by changing where solar energy is absorbed in the atmosphere. Another link is that the ozone-depleting chemicals are greenhouse gasses, so reducing their amount has significantly helped in combating climate change.

What can we learn from the Ozone Hole discovery?

The ozone hole formed in less than a decade, and shows us just how sensitive our planet is to human activities. Other signals of the planet's health, which today are just beginning to be detected, may develop equally rapidly. The long series of careful measurements obtained by the British Antarctic Survey show how important it is to have a good baseline from which to measure changes.

FACTFILE

- The discovery of the Ozone Hole was first announced in a paper by British Antarctic Survey's Joe Farman, Brian Gardiner and Jonathan Shanklin, which appeared in the journal *Nature* in May 1985.
- Ozone in the atmosphere is measured using the Dobson Spectrophotometer – equipment designed in the 1920s, but still the world standard. Ozone is measured in Dobson Units, DU and a typical measurement is about 300 DU.
- An ozone hole is defined as an area of the atmosphere having ozone values less than 220 DU.
- If you took all the ozone in a vertical column above the instrument and brought it down to sea level it would form a layer just three millimetres thick.
- Major volcanic eruptions, such as the 1991 eruption of Mount Pinatubo in the Philippines may put material which enhances ozone depletion into the stratosphere.
- Scientists working in Antarctica wear high-factor sunscreen to avoid sunburn when working outside, especially as sunlight is also reflected from the snow surface. You can get burnt in as little as five minutes without it!



The Ozone Hole was discovered by British Antarctic Survey scientists (Image: NASA)