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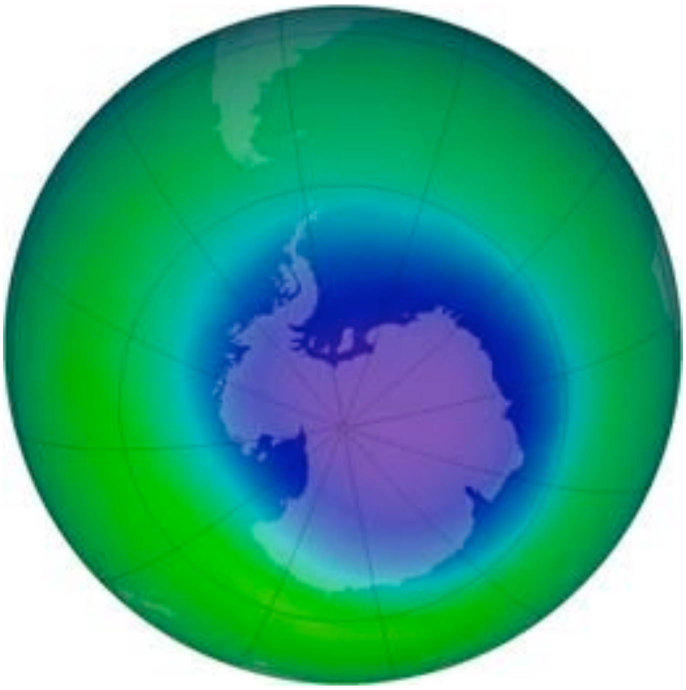
News



# First signs of ozone-hole recovery spotted

Antarctic ozone layer bouncing back after the phase-out of chlorofluorocarbons.

James Mitchell Crow

The average size of the Antarctic ozone hole in October 2010. Its recovery has so far been masked by annual fluctuations.NASA

The hole in the ozone layer over Antarctica is starting to heal, say researchers in Australia. The team is the first to detect a recovery in baseline average springtime ozone levels in the region, 22 years after the Montreal Protocol to ban chlorofluorocarbons (CFCs) and related ozone-destroying chemicals came into force.

Each spring, those chlorine- and bromine-releasing chemicals eat a hole in the ozone layer above the Antarctic. Thanks to the Montreal agreement, levels of anthropogenic ozone depleters detected in the region's stratosphere have been falling since around the turn of the millennium. However, detecting any corresponding ozone recovery has been difficult.

That difficulty is down to significant natural variations in average Antarctic stratospheric springtime ozone levels from year to year, which mean that the hole can be small one year and large the next. Scientists did not expect to be able to detect the gradual recovery of ozone for decades, masked as it is by these dramatic swings.

However, Murry Salby, an environmental scientist at Macquarie University in Sydney, Australia, and his colleagues have now shown how this annual fluctuation can be accounted for — and so removed from the data. They are left with the underlying systematic change in Antarctic ozone levels. Salby's calculations reveal that the levels are now rising; the findings are published in Geophysical Research Letters[1].

# Ice in the air

The team's breakthrough was in showing that annual swings in average springtime ozone levels are linked to changes in a particular pattern of stratospheric weather known as dynamical forcing. In years in which this phenomenon is strong during the winter, more cold air is trapped above the pole. As a result, there are more ice crystals in the atmosphere. These crystals form the surface on which chlorine destroys ozone, catalysed by sunlight returning to the Antarctic during the spring.

"I think this is the first convincing observationally-derived evidence of the ozone rebound," says Adrian McDonald, an atmospheric scientist at the University of Canterbury in Christchurch, New Zealand. "It's the first where the statistical significance is high enough, and you can see the pattern well enough, that you feel comfortable in believing it."

Salby's results reveal a fast decline in ozone levels until the late 1990s, then a slow rebound that closely matches what theoretical calculations had predicted, says David Karoly, a climate scientist at the University of Melbourne, Australia. "It is the sort of result that was expected, but is the first to provide detection of an increase in Antarctic ozone levels," he says.

Adding weight to Salby's argument, the increase in ozone levels revealed by the calculations closely mirror the decrease in the levels of anthropogenic chlorine in the region. "For now, they agree pretty well," says Salby. "My feeling is that as time goes on we will start to see other influences on the systematic evolution of ozone level beside chlorine." One such influence is likely to be the increasing concentration of carbon dioxide in the atmosphere.

# Slow change

Salby's data reveal that average springtime Antarctic ozone levels have already recovered by 15% since the late 1990s. However, projecting forward, natural weather-related fluctuations mean that even as late as 2085, ozone will still drop below 1980 levels for at least one year in every ten.

A complicating factor in that prediction is the influence of climate change, says Karoly. "Even when CFCs are removed, ozone levels will be different in the future than they were in the 1960s, because of changes in temperature in the stratosphere."

It's a relationship that goes both ways, however. "In the past four or five years it has become very clear that the ozone hole seems to have held back climate change over Antarctica," says McDonald. Ozone absorbs sunlight, so less ozone means the stratosphere heats up less. This has caused a change in circulation patterns around the Antarctic, which has trapped more cold air over the pole. As the ozone hole recovers, its future impact on Antarctic climate, and so on melting ice caps and global sea-level rise, is under debate.

"Some people are saying that, once the ozone hole totally recovers, because it has so far had a braking effect, maybe when that brake gets taken off then we'll have rapid change over the Antarctic. But there are many complexities in the system, and so other people are saying that it might not have very much effect. That is definitely work to be done by the climate-science community."

In the more immediate term, the strong correlation between winter weather patterns and springtime ozone levels means that the intensity of the ozone hole can now be forecast, says Salby. That is important because, at the end of each spring, the ozone-depleted air is released across the mid-latitudes of the southern hemisphere, affecting major population centres during the summer months by allowing increased levels of ultraviolet light to reach Earth's surface.

"If you know what the stratospheric forcing is during the winter, you can predict rather accurately the ozone level for the following spring," says Salby.

- ## References

1. Salby, M., Titova, E. & Deschamps, L. Geophys. Res. Lett. 38, L09702 (2011). | Article |