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New ozone-depleting chemicals found in the atmosphere

Four ozone-depleting gases, previously undetected in the atmosphere, have been found by new research. The work suggests that more than 74 000 tonnes of these human-made substances have been released since 1978, and that two are continuing to accumulate in the atmosphere. However, it is not yet known where they come from.

The discovery of the hole in the ozone layer in 1985 led to a 130-nation agreement, the Montreal Protocol of 1987. This agreed to the phasing out and banning of chlorofluorocarbons (CFCs), the main cause of ozone depletion. These had been used as coolants for refrigeration or as dry cleaning solvents, among other uses.

The first stage of phasing out CFCs relied on their replacement with hydrochlorofluorocarbons (HCFCs), which break down faster than CFCs, causing less damage to the ozone layer. Some uses of CFCs were exempt from this ban, for example, for specific industrial purposes or as intermediate products in the production of other substances. Both CFCs and HCFCs are also greenhouse gases, with much stronger climate effects than CO_2.

However, this new research has identified four ozone depleting substances (ODSs) not previously detected. The gases were identified in samples of air collected in Tasmania between 1978 and 2012, and extracted from pockets of air trapped in 'firn' snow in Greenland in 2008. This type of snow provides a 'natural archive' of the atmosphere going back around a century.

Three of the ODSs were CFCs, labelled CFC-112, CFC-112a, and CFC-113a. The fourth was a new HCFC, called HCFC-133a. By analysing the firn samples, the researchers could see that there were insignificant amounts of these ODSs in the air before the 1960s. This suggests they have a human origin. They estimate that more than 74 000 tonnes of these four ODSs have been released in to the atmosphere since that time.

Levels of two of these gases appear to have increased between the 1960s and the 1990s, before slowly decreasing. This pattern is similar to other CFCs controlled under the Montreal Protocol. However, the remaining two ODSs have both been increasing over time. Levels of HCFC-133a appear to have increased by as much as 45% during the two and a half years prior to 2012.

Although levels of these emissions are relatively small compared to pre-Montreal Protocol CFC levels, some are long-lived. The fact that two of them are still increasing is a problem for both the ozone layer and climate change.

The authors highlight that it is important, but very difficult, to determine the origin of these previously undetected ODSs, though there are a number of possible sources. For example, CFC-113a is exempt from the Montreal Protocol as a substance ('feedstock') used in the production of some pesticides. There were also periods of growth and decline in atmospheric levels of HCFC-133a, which the authors suggest could be traced to industrial emitters changing production procedures or product ranges.

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