

Research signals major milestone in cutting harmful gases that deplete ozone and worsen global warming

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Image shows the high-altitude Integrated Carbon Observation System (ICOS) Jungfrau station in Switzerland, which was used to make measurements in this research. Credit: Jungfrau.ch

A new study has revealed significant progress in the drive to reduce levels in the atmosphere of chemicals that destroy Earth's ozone layer,

confirming the success of historic regulations limiting their production.

The findings, led by the University of Bristol and published in *Nature Climate Change*, show for the first time a notable decline in the atmospheric levels of potent ozone-depleting substances (ODS), called hydrochlorofluorocarbons (HCFCs). These HCFCs are also harmful greenhouse gases, so a reduction should also lessen [global warming](#).

The Montreal Protocol was agreed to internationally in 1987 to introduce controls on the production and usage of ODS, which were once widely used in the manufacture of hundreds of products, including refrigerators, aerosol sprays, foams and packaging.

HCFCs were developed as replacements for chlorofluorocarbons (CFCs). While production of CFCs has been banned globally since 2010, HCFC production and usage is still being phased out.

Lead author Dr. Luke Western, Marie Curie Research Fellow at the University's School of Chemistry, said, "The results are very encouraging. They underscore the great importance of establishing and sticking to international protocols. Without the Montreal Protocol, this success would not have been possible, so it's a resounding endorsement of multilateral commitments to combat stratospheric ozone depletion, with additional benefits in tackling human-induced climate change."

The international study shows the total amount of ozone depleting chlorine contained in all HCFCs peaked in 2021. Because these compounds are also potent greenhouse gases, their contribution to climate change also peaked in that year. This maximum occurred five years before the most recent predictions. Although the drop between 2021 and 2023 was less than 1%, it still shows HCFC emissions are heading in the right direction.

Dr. Western said, "Their production is currently being phased out globally, with a completion date slated for 2040. In turn, these HCFCs are being replaced by non-ozone depleting hydrofluorocarbons (HFCs) and other compounds. By enforcing strict controls and promoting the adoption of ozone-friendly alternatives, the protocol has successfully curbed the release and levels of HCFCs into the atmosphere."

The results rely on high-precision measurements at globally distributed atmospheric observatories, using data from the Advanced Global Atmospheric Gases Experiment (AGAGE) and the National Atmospheric and Oceanic Administration (NOAA).

"We use highly sensitive measurement techniques and thorough protocols to ensure the reliability of these observations," said co-author Dr. Martin Vollmer, an [atmospheric scientist](#) at the Swiss Federal Laboratories for Materials Science and Technology (EMPA).

Co-author Dr. Isaac Vimont, a research scientist at the NOAA in the United States, added, "This study highlights the critical need to be vigilant and proactive in our [environmental monitoring](#), ensuring other controlled ozone depleting and greenhouse gases follow a similar trend which will help to protect the planet for future generations."

More information: Luke M. Western et al, A decrease in radiative forcing and equivalent effective chlorine from hydrochlorofluorocarbons, *Nature Climate Change* (2024). DOI: 10.1038/s41558-024-02038-7 , www.nature.com/articles/s41558-024-02038-7

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