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# Press Release

## The International Ozone Commission, on the 37th anniversary of the Montreal Protocol, reports successes, developments, and future challenges in monitoring ozone layer recovery.

**September 16th is the International Day for the Preservation of the Ozone Layer**, celebrating the signing anniversary of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. The Montreal Protocol is the treaty, ratified by every country in the world, that controls the production and use of ozone depleting substances (ODSs) such as chlorofluorocarbons (CFCs) and their early replacements. As a result of the Protocol, ODSs are declining and the ozone layer, including the Antarctic ozone hole, is showing signs of recovery, ensuring continued protection of life on Earth from harmful solar ultraviolet radiation. Nevertheless, the future evolution of surface solar ultraviolet radiation has important uncertainties caused by the expected changes in our climate.

**The theme of the 2024 International Day for the Preservation of the Ozone Layer is "Montreal Protocol: Advancing Climate Action".** This theme acknowledges the Protocol's accomplishments beyond its central focus of putting the world on the road to repairing the ozone layer. Specifically, as ODSs are also potent greenhouse gases, their decline has also contributed to a reduction in the warming of the climate. It is estimated that the Protocol has postponed the expected date of an ice-free Arctic by up to 15 years. The 2016 Kigali Amendment to the Protocol, ratified by 80% of the original Protocol signatories, phases down production of the ozone-safe hydrofluorocarbons (HFCs) in light of their global warming potential, in favor of newer compounds that have a smaller climate footprint.

**Among the numerous and diverse studies on the ozone layer and the processes affecting it carried out over the past year, many have provided reassurances that the core factors affecting ozone layer stability are generally well understood and that ozone recovery is continuing in line with expectations.** The January 2022 eruption of the undersea Hunga volcano, which injected an unprecedented amount of water vapor into the stratosphere, has provided a unique opportunity to test our understanding of the processes affecting stratospheric ozone, as embodied in state-of-the-art atmospheric models. Although both the aerosol particles and water vapor from the eruption have temporarily changed stratospheric dynamics and chemistry, the observations have broadly been in line with expectations from models. The plume did not reach the southern polar regions early enough to impact the 2022 Antarctic ozone hole, where chlorine from ODSs rapidly destroy ozone every spring. In contrast, the 2023 Antarctic winter started with record levels of stratospheric water vapor at high southern latitudes, resulting in unprecedented early conversion of chlorine to ozone-destroying forms in May-June. However, the amount of chlorine converted was much smaller than is typically seen in August-September, when sunlight returns to polar latitudes and ozone destruction is strongest. Therefore, the excess water vapor from the Hunga eruption had little overall impact on the 2023 Antarctic ozone hole.

**Notwithstanding the accomplishments of the Montreal Protocol to date, other studies published over the last year have highlighted the need for further research into potential new threats to the ozone layer**. For instance, one study showed that recent measurements of the composition of stratospheric aerosols includes a notable concentration of aluminium and other elements, attributed to the increasing number of re-entering spacecraft breaking apart in the upper atmosphere. The study noted that the amount of metals deposited in the atmosphere by re-entering spacecraft is expected to approach that from meteors in future, given the rapidly increasing number of small-satellite launches planned in the coming years. This work highlights a need for clearer understanding of the potential of such metal-containing aerosols to affect ozone abundances.

**The 2024 Quadrennial Ozone Symposium (QOS)** was hosted by scientists from the United States of America and held in a hybrid in-person/remote format from July 15–19 in Boulder, Colorado. The participation of more than 220 scientists, 180 of whom attended in person, highlights the continued strong interest of the scientific community in research related to ozone in the stratosphere and troposphere, the processes driving changes in ozone abundances, and the impacts of those changes.

**A recurring topic in the Symposium was the anticipated cessation of spaceborne vertically resolved measurements of gases other than ozone that are needed to distinguish chemical and dynamical influences on ozone distribution.** Following the anticipated 2026 termination of NASA's Aura mission (launched in 2004) with its cornerstone Microwave Limb Sounder (MLS) instrument, and the eventual demise of the Canadian ACE-FTS instrument (launched in 2003), there will no longer be any stratospheric measurements of long-lived trace gases (which characterize changes in atmospheric circulation) or of many of the reactive gases that are involved in ozone chemistry. This will increase reliance on limited ground-based, airborne, and balloon-borne observations of these species, and raise the importance of continued funding for such measurements in an era of declining research budgets.

**The International Ozone Commission notes with concern an ongoing decline in both budgets for ozone-related research and the number of scientists engaged in such studies.** Despite the tremendous progress made in understanding the processes affecting atmospheric ozone over the last few decades, the atmosphere has not lost its ability to surprise. Continual vigilance, in the form of both sustained measurements and state-of-art models and laboratory studies, is essential for ensuring that stratospheric ozone continues to evolve as expected in response to the Montreal Protocol and changing climate.

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- IO3C: https://www.io3c.org
- United Nations Environment Program's Ozone Secretariat World Ozone Day 2024: https://ozone.unep.org/ozone-day/montreal-protocol-advancing-climate-action
- WMO Northern Hemisphere Ozone Mapping Center: http://lap.physics.auth.gr/ozonemaps
- World Ozone and Ultraviolet Data Center: http://www.woudc.org
- O3 Global: http://www.temis.nl/protocols/O3global.html
- Ozone Hole Watch: http://ozonewatch.gsfc.nasa.gov/
- World Meteorological Organization (WMO). Scientific Assessment of Ozone Depletion: 2022, GAW Report No. 278, 509 pp.; WMO: Geneva, 2022. https://ozone.unep.org/science/assessment/sap