



HAL
open science

Trends in polar ozone loss since 1989: Potential sign of recovery in Arctic ozone column

Andrea Pazmino, Florence Goutail, Sophie Godin-Beekmann, Alain Hauchecorne, M P Chipperfield, W Feng, Franck Lefèvre, M van Roozendaal, N Jepsen, T Svendby, et al.

► To cite this version:

Andrea Pazmino, Florence Goutail, Sophie Godin-Beekmann, Alain Hauchecorne, M P Chipperfield, et al.. Trends in polar ozone loss since 1989: Potential sign of recovery in Arctic ozone column. ACTRIS Science Conference 2024, May 2024, Rennes, France. insu-04624798

HAL Id: insu-04624798

<https://insu.hal.science/insu-04624798>

Submitted on 25 Jun 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Trends in polar ozone loss since 1989: Potential sign of recovery in Arctic ozone column

A. Pazmiño¹, F. Goutail¹, S. Godin-Beekmann¹, A. Hauchecorne¹, M. P. Chipperfield^{2,3}, W. Feng^{2,4}, F. Lefèvre¹, M. Van Roozendaal⁵, N. Jepsen⁶, T. Svendby⁷, R. Kivi⁸, K. Strong⁹ and K. A. Walker⁹

¹LATMOS/IPSL, UVSQ, Université Paris-Saclay, Sorbonne Université, CNRS, Guyancourt, France

²School of Earth and Environment, University of Leeds, Leeds, UK

³National Centre for Earth Observation, University of Leeds, Leeds, UK

⁴National Centre for Atmospheric Science, University of Leeds, Leeds, UK

⁵Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium

⁶National Center for Climate Research, Danish Meteorological Institute, Copenhagen, Denmark

⁷ATMOS, Norwegian Institute for Air Research, Kjeller, Norway

⁸Space and Earth Observation Centre, Finnish Meteorological Institute, Sodankylä, Finland

⁹Department of Physics, University of Toronto, Toronto, Canada

Keywords: trend, ozone loss, polar regions.

Presenting author email: andrea.pazmino@latmos.ipsl.fr

The first signs of healing of the ozone layer in the polar regions linked to the decrease of ODSs were detected in Antarctica by Yang *et al.* (2008), who showed a statistically significant levelling off of the decrease in total ozone during Spring, and by Solomon *et al.* (2016), who presented evidence of a statistically significant increase of total ozone during September in the middle of the depletion period. This increase was confirmed by later studies using measurements and model simulations. In contrast, in the Arctic, the large variability in meteorological conditions prevents detection of ozone recovery as shown by the recent trend study of Weber *et al.* (2021).

This presentation is based on the new results on ozone trends in polar regions (Pazmiño *et al.*, 2023) where ozone depletion during recent winters in both hemispheres was analysed.

Data and Methodology

In order to estimate annual ozone depletion in the polar regions, ground-based SAOZ ozone columns and ozone Multi-Sensor Reanalysis (MSR2) data reanalysis as well as simulations of ozone by the SLIMCAT chemical-transport model are used. In this work, another CTM model, REPROBUS, will be also used for analysis.

The ozone loss is obtained by applying the passive tracer method (Goutail *et al.*, 1999). The loss is computed at each polar station by subtracting the measured total ozone (SAOZ and MSR2 merged dataset) when the station is inside the polar vortex, from the corresponding passive ozone column simulated by SLIMCAT.

Three metrics are used in trend analyses that aim to assess the ozone recovery rate over both polar regions: (1) the maximum ozone loss at the end of the winter, (2) the onset day of ozone loss reaching a specific threshold, and (3) the ozone loss residuals computed from the differences between annual ozone loss and ozone loss values regressed with respect to sunlit volume

of polar stratospheric clouds (VPSC). A trend since 2000 is calculated for each metric.

Main results

In the Antarctic, the three metrics present significant trends for the period 2000–2021 confirming the recovery of ozone in that region. In the Arctic, the two first metrics do not present significant results while the third one provides a significant negative trend of the residual ozone loss at the 2σ level showing a potential quantitative detection of ozone recovery in the Arctic springtime lower stratosphere.

This work was supported by the Centre National de la Recherche Scientifique (CNRS/INSU), the Centre National de Recherche Spatiale (CNES), and the Institut Paul Emile Victor (IPEV).

Goutail, F., Pommereau, J. P., Phillips, C., Deniel, C., Sarkissian, A., Lefevre, F., Kyro, E., Rummukainen, M., Ericksen, P., Andersen, S. B., Kaastadt Hoiskar, B.-A., Braathen, G., Dorokhov, V., and Khatatov, V. U. (1999) *J. Atmos. Chem.*, 32, 1–34.

Pazmiño, A., Goutail, F., Godin-Beekmann, S., Hauchecorne, A., Pommereau, J.-P., Chipperfield, M. P., Feng, W., Lefèvre, F., Lecouffe, A., Van Roozendaal, M., Jepsen, N., Hansen, G., Kivi, R., Strong, K., and Walker, K. A. (2023) *Atmos. Chem. Phys.*, 23, 15655–15670.

Solomon, S., Ivy, D. J., Kinnison, D., Mills, M. J., Neely, R. R., and Schmidt, A. (2016) *Science*, 353, 269–274.

Weber, M., Arosio, C., Feng, W., Dhomse, S. S., Chipperfield, M. P., Meier, A., Burrows, J. P., Eichmann, K.-U., Richter, A., and Rozanov, A. (2021) *J. Geophys. Res. Atmos.*, 126, e2020JD034386.

Yang, E.-S., Cunnold, D. M., Newchurch, M. J., Salawitch, R. J., McCormick, M. P., Russell, J. M., Zawodny, J. M., and Oltmans, S. J. (2008) *J. Geophys. Res.*, 113, D20308y.