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Assessment of trend uncertainties for long-term limb profile and total ozone datasets

With the enactment of the Montreal Protocol in 1987 and its Amendments phasing out ozone-depleting substances (ODS), a gradual recovery of the ozone layer has been observed, particularly in the upper stratosphere. Apart from ODS, ozone is also significantly influenced by atmospheric dynamics and changes in greenhouse gases. For attribution of long-term ozone changes and variability and their uncertainties, multiple linear regression (MLR) is applied to merged satellite datasets that span a period of more than 40 years until and including the year 2024.

We assess ozone trends from four long-term ozone profile datasets (GOZCARDS, SAGE-CCI-OMPS, SAGE-SCIA-OMPS and SWOOSH) and six total ozone datasets (MSR2, GSG, GTO-ECV, SBUV NOAA, SBUV NASA and WOUDC) using the MLR with appropriate proxies accounting for dynamical variability and long-term changes in ozone. The combined assessment of total and stratospheric column trends allows us to asses the question if tropospheric ozone trend play a role in zonal mean trends of total ozone trends. In 2024 total ozone column amounts in the northern hemisphere were reaching levels, that were among the highest since 1960. The ability of the MLR to account for that year's extreme values is a good test for the appropriate choice of proxies in the regression.

Drifts between timeseries'from different datasets contribute to uncertainties in long-term trends. The spread of drifts are on the order of 0.75%/decade among the ozone profile datasets and about 0.5%/decade among the total ozone datasets before and after the middle 1990s, when stratospheric halogens from ODS reached the peak.

The merged ozone profile datasets were analysed using common ozone units (number density) and altitude (geometric altitude). Units conversion were applied to SWOOSH and GOZCARDS and it can add to trend uncertainties when the conversion is applied to monthly mean data (like in the merged datasets) rather than individual daily profiles. In most cases no additional uncertainties in the trends from the conversion was found but in few cases uncertainties of up to 1%/decade were found.

We present updated ozone trends until end of 2024 derived from both ozone profile and total ozone merged datasets and discuss contributions to trend uncertainties.

Topic

Atmospheric composition (Earth and planets), chemistry and transport

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