File Revision Date:

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Data Set Description:

PI:	Tove M. Svendby SAOZ UV-Visible Spectrometer
Site(s):	Ny-Ålesund 78.9 N, 11.9 E
Measurement Quantities:	O3, NO2

Contact Information:

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Reference Articles:

Pommereau, J.P. and F. Goutail, O3 and NO2 Ground-Based Measurements by Visible Spectrometry during Arctic Winter and Spring 1988, Geophys. Res. Lett., 891, 1988.

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Goutail, F., J.-P. Pommereau, F. Lefèvre, M. Van Roozendael, S.B. Andersen, B.-A. Kåstad Høiskar, V. Dorokhov, E. Kyro, M.P. Chipperfield, and W. Feng; Early unusual ozone loss during the Arctic winter 2002/2003 compared to other winters, Atmos. Chem. Phys., 5, 665-677, 2005.

Instrument Description:

The SAOZ is made of a commercial Jobin-Yvon CP200 flat field spectrometer equipped with a holographic grating and a Hamamatsu diode array uncooled detector, with an entrance slit allowing an average resolution of the order of 1 nm in the range 300-600 nm. There are two versions of the instrument: one is using a 200 gr/mm grating associated to a 512-diode array detector and a 25-micron entrance slit and the other is using a 360 gr/mm grating associated to a 1024 diode array detector and a 50 micron entrance slit allowing a better oversampling (2 instead of 1). The spectrometer is placed in a dust-and-water proof container on the top of which a quartz window is mounted in order to look at the zenith sky with a total field of view of 10°. The instrument is driven by a PC, which records and analyses the spectra in real time. Measurements are performed from sunrise to sunset until a Solar Zenith Angle (SZA) of 94°. The exposure time is adjusted automatically in order to optimize the signal and the spectra are co-added in memory. The dark current is measured each time the duration of exposure changes and subtracted. Averages of ozone and NO2 morning and evening vertical columns measured between 86° and 91° SZA are calculated and reported to the NDSC. Columns transmitted to NDSC data bank are reprocessed data, only possible after original spectra are received at the laboratory from the remote stations.

Algorithm Description:

The spectral analysis is described below. Retrieval code: SAM5.9.0 from CNRS, France. After a precise wavelength alignment with the use of the Fraunhofer solar absorption lines, actual spectra are divided by a reference spectrum recorded at high sun on a clear and unpolluted day. Monotonic large trends are then removed by subtracting the same spectrum smoothed at a broad bandpass (40 nm) resulting in an atmospheric differential spectrum, into which narrow features corresponding to absorption by ozone, nitrogen dioxide, O4 (oxygen dimer), water vapour and OClO, are remaining. Slant columns are then calculated by least squares fitting between the signal and the differential cross sections of each absorber in an iterative process in which the contributions of the various species are calculated and removed sequentially. Ozone is measured in the Chappuis visible bands (450-570 nm) where the cross sections are independent of the temperature; nitrogen dioxide in 412-490 nm range; O4 in two bands (465-484 nm and 556-584 nm); and H2O in one band (440-600 nm).

Expected Precision/Accuracy of Instrument:

Converting slant columns relative to a given reference spectrum into vertical columns requires the knowledge of the optical path of the light scattered at zenith, that is the Air Mass Factor (AMF) and the residual amount of constituent still present in the reference spectrum. The AMF is calculated by modelling the radiative transfer of the sunlight into the atmosphere. In the visible at 500 nm, the average atmospheric scattering layer at 90? SZA is located around 10-12 km, that is below the ozone and nitrogen dioxide peak concentration and above tropospheric clouds. We use 'standard' SAOZ AMF for NO2 and seasonal AMF calculated using ozone profiles from Ny-Ålesund for O3. At 90° SZA they are 17.34, 17.04, 16.69, 16.37, 16.49, 16.82 (Feb-Apr, Aug-Oct) for ozone and 17.77 for NO2, respectively. The residual amount of constituent present in the reference spectrum is determined by a Bouguer-Langley plot (slant column versus AMF) extrapolated to zero air mass. The precision of the total column measurements at twilight (86-91° SZA) is 2 Dobson Unit for ozone and 1.5 1014 mol/cm2 for NO2. The accuracy, including uncertainties of cross-sections and their temperature dependencies and that of Air Mass Factors (vertical profiles of the constituent, stratospheric temperature seasonal changes and photochemical changes for NO2) is: ± 10% for ozone and +25, -45% for NO2 at the polar circle in winter, where the column is the smallest.

Instrument History:

starting date:	1990/09/06/
spectrometer:	Jobin Yvon CP200, grating: 200 gr/mm, 300-600nm, FWMH: 1nm
detector:	PCD, 512 pixel

entrance slit:	25 microns
instrument n°:	8
starting date:	1997/04/03/
spectrometer:	Jobin Yvon CP200, grating: 360 gr/mm, 300-600nm, FWMH: 1nm
detector:	NMOS, 1024 pixel
entrance slit:	50 microns

March 22, 2005:	SAOZ instrument failure
August 2005:	Electronic box upgraded
August 2006:	SAOZ start
October 2017:	all data since 2000 re-analyzed
July 2022:	O3, NO2 residuals updated, all data since March 2014 re-analyze