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Data Set Description:

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|---|---|
| PI: | Prof. Justus Notholt |
| Instrument: | Millimeter wave radiometer |
| Site(s): | Ny-Alesund |
| Measurement Quantities: | Ozone vmr |

Contact Information:


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Reference Articles:


**2013**

Influence of solar radiation on the diurnal and seasonal variability of $O_3$ and $H_2O$ in the stratosphere and lower mesosphere, based on continuous observations in the tropics and the high Arctic M. Palm; Golchert, S. H. W.; Sinnhuber, M.; Hochschild, G. & Notholt, J. in Lübken, F. J. (ed.) Climate and Weather of the Sun-Earth System (CAWSES) Springer, 2013, 125

**2010**

Integrated water vapor above Ny Ålesund, Spitsbergen: a multi-sensor intercomparison Palm, M.; Melsheimer, C.; Noël, S.; Heise, S.; Notholt, J.; Burrows, J. & Schrems, O. Atmos. Chem. Phys, 2010, 10, 1-12

The ground based MW radiometer OZORAM on Spitsbergen - description and validation of stratospheric and mesospheric O3-measurements M. Palm, C. G. Hoffmann, S. H. W. Golchert, and J. Notholt Atmos. Meas. Tech. Discuss., 3, 1933-1970, 2010

**1998**

Sinnhuber, Bjoern-Martin, J. Langer, U. Klein, U. Raffalski, K. F. Kuenzi and O. Schrems, Ground based millimeter-wave observations of Arctic ozone depletion during winter and spring 1996/97, Submitted to GRL Feb 1998

Raffalski, Uwe, U. Klein, B. Franke, J. Langer, B.-M. Sinnhuber, J. Trentmann, K. F. Kuenzi and O. Schrems, Ground based millimeter-wave observations of Arctic chlorine activation during winter and spring 1996/97, Submitted to GRL Feb 1998

**1997**

Franke, Bernd, U. Klein, J. Langer, U. Raffalski, B.-M. Sinnhuber, R. Tuckermann, F. Wittrock, K. F. Kuenzi, Simultaneous Ground-Based Measurements of ClO, OClO and BrO at the NDSC Station Ny-Alesund, Spitsbergen, Proceedings of the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Klein, Ulf, B. Franke, J. Langer, U. Raffalski, B.-M. Sinnhuber, K. F. Kuenzi, R. L. DeZafra, M. McDonald, V. Nagar, G. Hochschild, H. Berg, G. Kopp, R, Krupa, M. Kunz, H. Masuko, S. Ochiai, Chlorine Monoxide Radiometer Intercomparison in Ny-Alesund, 1997, Proceedings of the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Langer, Jens, B.-M. Sinnhuber, U. Klein, K. F. Kuenzi, On the Evolution of Arctic Lower Stratospheric Ozone in Spring 1997, Ground-Based Microwave Measurements at Ny-Alesund, Spitsbergen Proceedings of the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Raffalski, Uwe, B. Franke, U. Klein, J. Langer, B.-M. Sinnhuber, K. F. Kuenzi, Enhanced Chlorine Monoxide obove Spitsbergen in Spring 1997 measured by the Ground-Based mm-Wave Radiometer RAM, Proceedings of the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Sinnhuber, Bjoern-Martin, U. Klein, V. Eyring, J. Trentmann, R. Mueller, H. Bovensmann, J. P. Burrows, K. F. Kuenzi, Dynamically Controlled Photochemistry of Mid-Stratospheric Ozone, Proceedings of the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Sinnhuber, Bjoern-Martin, A High Resolution Picture of the Arctic Polar Vortex Evolution during the Winter 1996/97, Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

Tuckermann, Rudolf, U. Klein, K. F. Kuenzi, BRE-RAM: A Ground-based mm-Wave Ozone Radiometer at Bremen, Germany, Poster at the Fourth European Symposium on Ozone Research, Schliersee, Germany, September 1997

**1996**

Langer, Jens, U. Klein, K. F. Kuenzi, U. Raffalski, B.-M. Sinnhuber, A Versatile Millimeter Wave Radiometer for spectroscopic Measurements of Atmospheric Trace Gases, Proceedings of the XVIII Quadrennial Ozone Symposium, L'Aquila, Italy, September 1996

Raffalski, Uwe, J. Langer, B.-M. Sinnhuber, K. F. Kuenzi, Millimeter-Wave Measurements of Stratospheric Chlorine Monoxide Profiles in the Arctic Compared with Model Results, 21. General Assembly of the European Geophysical Society, Le Hague, May 1996

Raffalski, Uwe, U. Klein, K. F. Kuenzi, J. Langer, B.-M. Sinnhuber, Arctic Stratospheric Ozone and Chlorine Monoxide and Water Vapor at the NDSC-Station Ny-Alesund, Spitsbergen, 1994-1996, Proceedings of the XVIII Quadrennial Ozone Symposium, L'Aquila, Italy, September 1996

Sinnhuber, Bjoern-Martin, U. Klein, K. F. Kuenzi, J. Langer, U. Raffalski, On Short- and Long-term Variability of Arctic Stratospheric Ozone, Proceedings of the XVIII Quadrennial Ozone Symposium, L'Aquila, Italy, September 1996

**1995**

Schwaab, Gerhard W., U. Klein, K. F. Kuenzi, U. Raffalski, Millimeter-Wave Measurements at the Arctic NDSC-Station Ny-Alesund in the Winters of 1992/93 and 1993/94, Proc. of the International Geoscience and Remote Sensing Symposium, Pasadena, 1995

Schwaab, Gerhard W., U. Raffalski, B.-M. Sinnhuber, Millimeter-Wave Observations of Ozone and Chlorine Monoxide at Ny-Alesund, Spitsbergen, from 1993 to 1994, International Conference of Ozone in the Lower Stratosphere, Halkidiki, 1995

Sinnhuber, Bjoern-Martin, U. Raffalski, G. W. Schwaab, Ground-Based Millimeter Wave Measurements of Stratospheric Ozone and Chlorine Monoxide at the Arctic NDSC Station Ny-Alesund, Proc. of the International Geoscience and Remote Sensing Symposium, 2072-2074, Firenze, July 1995

Sinnhuber, Bjoern-Martin, K. F. Kuenzi, J. Langer, G. W. Schwaab, Ground Based Millimeter-Wave Monitoring of Ozone third European Symposium on Polar Stratospheric Ozone at Ny-Alesund, Spitsbergen, from 1993 to 1995, Research, Schliersee, September 1995

Raffalski, Uwe, B.-M. Sinnhuber, G. W. Schwaab, Millimeter-Wave Observations of Chlorine Monoxide at Ny-Alesund, Spitsbergen, in the Winters 1993/94 and 1994/95, Third European Symopsium on Polar Stratospheric Ozone Research, Schliersee, September 1995

**1994**

Klein, Ulf, G. W. Schwaab, K. F. Kuenzi, U. Raffalski, Measurements of Stratospheric Ozone and Chlorine Monoxide with a Ground-Based Microwave Receiver at Ny-Alesund, Spitsbergen, XIX. General Assembly of the European Geophysical Society, Grenoble 1994

**1993**

Klein, Ulf, K. F. Kuenzi, G. W. Schwaab, A broadband Microwave Receiver for Atmospheric Measurements: The Instrument and First Results, Eighteenth International Conference on Infrared and Millimetre Waves, Colchester, December 1993

Instrument Description:

The Radiometer for Atmospheric Measurements (RAM) is a ground-based microwave radiometer, which detects an emission line of ozone at 142.175 GHz. The RAM is a passive device. The signal of the atmosphere is passed through a quasi optical system, which focusses the beam and is frequency selective. The beam is mixed with a strong signal from a local oscillator to transform it to a lower frequency in order to amplify it (heterodyne principle). The intermediate frequency is 6.8 GHz to 8.5 GHz. The amplified spectrum is analyzed by an FFT spectrometer (Aquiris AC240) The spectrum is calibrated with the spectra of a hot and a cold calibration load, which emit black body radiation (total power method).

Algorithm Description:

The algorithm transforms the spectra into profiles of volume mixing ratio. There is a nearly linear relationship Ax=d between the spectrum d and the vmr x, so an inversion algorithm is used. Because the problem is ill-posed, a-priori-information is used to evaluate the profiles. The used algorithm is called Optimal Estimation. An a-priori covariance of 1 ppm is used for most heights.
In addition to the spectra temperature and pressure profiles from NCEP and ECMWF are needed to calculate the data. The result is height as the independent variable and vmr as the dependent variable. The resolution is about 10 km in a range from 12 to 55 km height.

Expected Precision/Accuracy:

The relative error in the vmr is less than 10% for heights above 18 km and less than 20% for lower heights (compared with ozone sondes).

Instrument history:

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| 20.11.94 | begin of continous measurements |
| 17.02.95 | polarizer added for suppression of unwelcome radiation |
| 03.11.95 | dichroatic plate added as a bandpass |
| 11.12.96 | bandwidth of the spectra doubled |
| 11.02.97 | elimination of a fabry-perot-effect that caused a baseline on the spectrum |
| 18.05.97-14.11.97 | AOS changed |
| 03.2003 | AOS replaced after major failure. |
| 08.2006 | AOS appended with an CTS to finely resolve the O3 line center. Measurement strategy refined to resolve mesospheric enhancement. |
| 10.2007 | AOS had a majhor failure. AOS and CTS replaced by an FFTS (AC240). |
| 2008 | Instrument upgraded and rebuild. |
| Since 2008 | Instrument running in the mesospheric mode. |
| 07.2019 | Lokal Oscillator failed. Due to the Corona pandemic replacement was not yet possible. |
| Update: | Lokal Oscillator failed. The measurement program was discontinued, the instrument will not return into operations. |