

File Revision Date:
September 9, 2025

Data Set Description:

PI: Justus Notholt
Responsible Scientist: Mathias Palm
Instrument: Bruker IFS 120-5 HR
Site(s): Ny-Ålesund, Spitsbergen (78.924 N, 11.939 E, 20 m a.s.l.)
Measurement Quantities: Solar and lunar (during polar night) observations of atmospheric trace gases.
Total columns of more than 20 trace gases, concentration profiles in up to 3-4 layers for a few trace gases on request.

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Reference Articles:

J. Notholt, R. Neuber, O. Schrems, T. v. Clarmann, Stratospheric trace gas concentrations in the Arctic polar night derived by FTIR-spectroscopy with the moon as IR light source, *Geophys. Res. Letters*, 20, 2059-2062, 1993.

J. Notholt, The moon as light source for FTIR measurements of stratospheric trace gases during the polar night: Application for HNO₃ in the Arctic *J. Geophys. Res.*, 99, 3607-3614, 1994.

J. Notholt, O. Schrems, Ground-based FTIR measurements of vertical column densities of several trace gases above Spitzbergen, *Geophys. Res. Letters*, 21, 1355-1358, 1994.

J. Notholt, T. v. Clarmann, G. P. Adrian, O. Schrems, Ground-based FTIR measurements of ClONO₂ column amounts in the Arctic, *Geophys. Res. Letters*, 21, 1359-1362, 1994.

J. Notholt, FTIR measurements of HF, N₂O, and CFCs during the Arctic polar night with the moon as light source, subsidence during winter 1992/93 *Geophys. Res. Letters*, 22, 2385-2388, 1994.

J. Notholt, P. von der Gathen, S. Peil, Heterogeneous conversion of HCl and ClONO₂ during the Arctic winter 1992/93 initiating the ozone depletion, *J. Geophys. Res.*, 100, 11269-11274, 1995.

J. Notholt, A. Meier, S. Peil, Total column densities of tropospheric and stratospheric trace gases in the undisturbed Arctic summer atmosphere, *J. Atm. Chem.*, 20, 311-332, 1995.

J. Notholt, O. Schrems, Ground-based FTIR spectroscopic absorption measurements of stratospheric trace gases with the sun and moon as light sources, *J. Mol. Structure*, 347, 407-416, 1995.

A. Meier, J. Notholt, Determination of the isotopic abundances of heavy O₃ as observed in arctic ground-based FTIR spectra, *Geophys. Res. Lett.*, 23, 511-554, 1996.

C. Paton Walsh, W. Bell, T. Gardiner, N. Swann, P. Woods, J. Notholt, H. Schütt, B. Galle, W. Arlander, J. Mellqvist, An uncertainty budget for ground-based Fourier transform infrared column measurements of HCl, HF, N₂O, and HNO₃ deduced from results of side-by-side instrument intercomparisons, *J. Geophys. Res.*, 102, 8867-8873, 1997.

J. Notholt, G. Toon, F. Stordal, S. Solberg, N. Schmidbauer, A. Meier, E. Becker, B. Sen Seasonal variations of Atmospheric trace gases in the high Arctic at 79°N *J. Geophys. Res.*, 102, 12855-12861, 1997.

J. Notholt, G. C. Toon, R. Lehmann, B. Sen, J.-F. Blavier Comparison of Arctic and Antarctic trace gas column abundances from ground-based FTIR spectrometry *J. Geophys. Res.*, 102, 12863-12869, 1997.

M. P. Chipperfield, M. Burton, W. Bell, C. P. Walsh, T. Blumenstock, M. T. Coffey, J. W. Hannigan, W. G. Mankin, B. Galle, E. Mahieu, R. Zander, J. Notholt, B. Sen, G. C. Toon, On the use of HF as a reference for stratospheric observations, *J. Geophys. Res.*, 102, 12901-12919, 1997.

M. Rex, N. R. Harris, P. von der Gathen, R. Lehmann, G. O. Braathen, E. Reimer, A. Beck, M. P. Chipperfield, R. Alfier, M. Allaart, F. O'Connor, H. Dier, V. Dorokhov, H. Fast, M. Gil, E. Kyrö, Z. Litynska, I. S. Mikkelsen, M. Molyneux, H. Nakane, J. Notholt, M. Rummukainen, P. Viatte, J. Wenger, Prolonged stratospheric ozone loss in the 1995/96 Arctic winter, *Nature*, 389, 835-838, 1997.

N. S. Pougatchev, N. B. Jones, B. J. Connor, C. P. Rinsland, E. Becker, M. T. Coffey, V. S. Connors, Ph. Demoulin, A. V. Dzhola, H. Fast, E. I. Grechko, J. W. Hannigan, M. Koike, Y. Kondo, E. Mahieu, W. G. Mankin, R. L. Mittermeier, J. Notholt, H. G. Reichle Jr., B. Sen, G. C. Toon, L. N. Yurganov, R. Zander, Y. Zhao, Carbon Monoxide Ground-based Infrared Solar Spectroscopic Measurements During 1994 MAPS Flights, *J. Geophys. Res.*, 103, 19317-19325, 1998.

G. C. Toon, F.-F. Blavier, B. Sen, R. J. Salawitch, G. B. Osterman, J. Notholt, M. Rex, G. T. McElroy, J. M. Russell III, Ground-based observations of Arctic Ozone loss during spring and summer 1997. *J. Geophys. Res.*, 104, 26497-26510, 1999.

E. Becker, J. Notholt, Intercomparison and validation of FTIR measurements with the sun, the moon and emission in the Arctic, *J. Quant. Spec. Rad. Transfer*, 65, 779-786, 2000.

Q. Li, D.J. Jacob, I. Bey, R. M. Yantosca, Y. Zhao, Y. Kondo, J. Notholt, Atmospheric Hydrogen Cyanide (HCN): Biomass burning source, ocean sink? *Geophys. Res. Letters*, 27, 357-360, 2000.

M. Rex, K. Dethloff, D. Handorf, A. Herber, R. Lehmann, R. Neuber, J. Notholt, A. Rinke, P. von der Gathen, A. Weisheimer, H. Gernandt, Arctic and Antarctic ozone layer observations: chemical and dynamical aspects of variability and long-term changes in the polar stratosphere, *Polar Research* 19(2), 193-204, 2000.

T. Albrecht, J. Notholt, R. Wolke, S. Solberg, C. Dye, H. Malberg, Variations of CH₂O and C₂H₂ determined from groundbased FTIR measurements and comparison with model results, *Adv. Space Res.*, 29, 1713-1718, 2002.

A. Herber, L.W. Thomason, H. Gernandt, U. Leiterer, D. Nagel, K-H. Schulz, J. Kaptur, T. Albrecht, J. Notholt, Continuous day and Night aerosol optical depth observations in the Arctic between 1991 and 1999, *J. Geophys. Res.*, 107, AAC 6, 1-14, 2002.

C.P. Rinsland, A. Goldman, E. Mahieu, R. Zander, J. Notholt, N.B. Jones, D.W.T. Griffith, T.M. Stephen, L.S. Chiou, Ground-based infrared spectroscopic measurements of carbonyl sulfide: Free tropospheric trends from a 24-year time series of solar absorption measurements, *J. Geophys. Res.*, 107, ACH 24, 1-9, 2002.

J. Mellqvist, B. Galle, T. Blumenstock, F. Hase, D. Yashov, J. Notholt, B. Sen, J.-F. Blavier, G.C. Toon, M.P. Chipperfield, Ground-based FTIR observations of chlorine activation and ozone depletion inside the Arctic vortex during the winter of 1999/2000, *J. Geophys. Res.*, 107, 10.1029/2001JD001080, 2002.

J. Notholt, R. Lehmann, The moon as light source for atmospheric trace gas observations: measurement technique and analysis method, *J. Quant. Spectros. & Rad. Trans.*, 76, 435-445, 2003.

J. Notholt, Z. Kuang, C.P. Rinsland, G.C. Toon, M. Rex, N. Jones, T. Albrecht, H. Deckelmann, J. Krieg, C. Weinzierl, H. Bingemer, R. Weller, O. Schrems, Enhanced upper tropical tropospheric COS: Impact on the stratospheric aerosol layer, *Science*, 300, 307-310, 2003.

Y.J. Orsolini, H. Eskes, G. Hansen, U.-P. Hoppe, A. Kylling, E. Kyrö, J. Notholt, R. Van der A, P. von der Gathen, Summertime low-ozone episodes at northern high latitudes, *Quarterly Journal of the Royal Meteorological Society*, 129, 3265-3276, 2003.

C.P. Rinsland, E. Mahieu, R. Zander, N.B. Jones, M.P. Chipperfield, A. Goldman, J. Anderson, J. M. Russell III, P. Demoulin, J. Notholt, G.C. Toon, J.-F. Blavier, B. Sen, R. Sussmann, S.W. Wood, A. Meier, D.W.T. Griffith, L.S. Chiou, F.J. Murcray, T.M. Stephen, F. Hase, S. Mikuteit, A. Schultz, T. Blumenstock Long-Term Trends of Inorganic Chlorine from Ground-Based Infrared Solar Spectra: Past Increases and Evidence for Stabilization *J. Geophys. Res.*, 108, D8, 4252, doi:10.1029/2002JD003001, 2003.

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

Instrument Description:

Commercial interferometer, IFS120 HR from Bruker GmbH, Karlsruhe Germany. Electronic upgraded.
max. possible optical path difference: 360 cm
total spectral region used: 300 nm to 15 μ m.
Internal parallel beam diameter: 6 cm
Active solar/lunar tracker to focus the sun light on the entrance aperture.
LN-cooled MCT-, InSb- and InGaAs detectors for the IR, Si- and GaP-diodes and photomultipliers for UV/Vis.
KBr-, CaF₂- and quartz-glass-beamsplitters.

Algorithm Description:

The retrieval of the column abundances is performed by the GFIT algorithm, which used temperature profiles from sondes launched daily in Ny-Aalesund, and an initial set of vmr profiles derived from MkIV balloon measurements (G. Toon, JPL), which were then stretched/compressed above 10 km altitude to account for day-to-day variations in the amount of subsidence.

The concentration profiles are derived using SFIT2/SFIT4, based on the optimal estimation method.

Due to the much lower temperature of the moon compared to the sun the lunar observations have to be corrected to account for the atmospheric self emission.

Expected Precision/Accuracy of Instrument:

The errors tabulated in the main part of the data file, determined from the quality of the spectral fits, represent the 1-sigma measurement precisions. These errors are appropriate for comparing columns measured on different days. For most gases, the main systematic errors arise from uncertainties in the assumed vmr profiles shapes, and from uncertainties in the spectroscopic parameters (of both the target gas and interfering gases).

Instrument History:

- Measurements started in March 1992.
- First lunar observations in December 1992.
- First FTUV/Vis observations in 1994.
- First emission observations in 1994.

- until 1995: Bruker IFS 120M (max. possible optical path difference: 257 cm)
- since then: Bruker 120 HR (max. possible optical path difference: 360 cm)

- 2012 update of 120 HR to new electronic
- 2015 automated measurements performed except the region 500-2100 cm⁻¹ where operator assistance is still necessary.

Measurements until 1994 were performed by placing the instrument inside a thermostated container in Ny-Aalesund, approx. 10 m above sea level. Since 1994 the instrument is mounted inside the dedicated NDSC-building 200 m apart from the container location, approx. 20 m above sea level.

Since 2003 accepted ACTRIS instrument (www.actris.eu)

L0/L1 Data

The L0/L1 data are stored permanently at
the IUP University of Bremen, Bremen, Germany
the BIRA Brussels, Belgium (partially)

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