

GROUND BASED FTIR, OZONESONDE AND LIDAR MEASUREMENTS FOR THE VALIDATION OF SCIAMACHY (AOID 331)

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ABSTRACT/RESUME

Ground based Fourier Transform Infrared (FTIR) measurements have been performed at the Arctic Station of Ny-Ålesund, at the mid latitude site Bremen, as well as on board the German research vessel 'Polarstern'. Additionally, aerosol and ozone lidar measurements were conducted and ozonesondes have been launched at Ny-Ålesund. Here, we give an overview of the data recorded so far, and show first comparisons of the data with Sciamachy products.

1 FTIR MEASUREMENTS

For the validation of the Sciamachy instrument, measurements with three FTIR spectrometers have been performed. These measurements provide high resolved absorption spectra of the atmosphere, using the sun or the moon as a light source. Generally, the total columns of more than 20 different trace gases can be retrieved from these data. Additionally, in case sufficiently high resolved spectra are recorded, height resolved information with a coarse resolution of 6-8 km can be obtained for a subset of these molecules.

1.1 Ny-Ålesund

In Ny-Ålesund (78.92 N, 11.93 E), FTIR measurements have been performed since 1992 [1], and in the same year the site was accepted as a primary station within the NDSC (Network for Detection of Stratospheric Change). The instrument used is a Bruker 120 HR spectrometer.

The last possible solar measurements for the year 2002 were performed on September 26, and on the same date the first lunar measurements could be recorded. Lunar measurements are only possible at about 6 days around full moon.

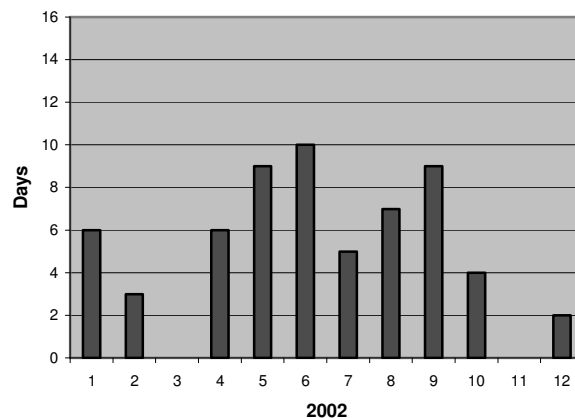


Fig. 1 Number of measuring days in the year 2002 at the Arctic site of Ny-Ålesund (until December 18, 2002).

Data obtained between June 10, 2002 and September 9, 2002 have been analyzed and submitted to the database. These include the total columns of CH₄, CO, CO₂, H₂O, HNO₃, N₂O, NO, NO₂, and O₃. Some of these data have also been used in the AO project 126 [2]. The retrieval of profiles from the present data is under work.

For the site of Ny-Ålesund, the only Sciamachy data provided by ESA and coincident with FTIR measurements so far are the total columns of O₃ and NO₂ for August 12, 2002. The ozone total columns determined from Sciamachy measurements (SCIA/V3.53) range between 190 DU and 211 DU, with an error of about 1%, while we retrieve total columns between 254 DU and 260 DU from FTIR measurements at the same date. As for NO₂, Sciamachy data range between 0.218 DU and 0.270 DU, while we determine values between 0.194 DU and 0.201 DU. Thus, with respect to the FTIR measurements, Sciamachy seems to underestimate total ozone, and overestimate total columns of NO₂. However, since we only have one day of correlative data, we cannot draw any conclusions from this.

1.2 Polarstern

A mobile FTIR spectrometer (Bruker 120m) mounted inside a container was used for measurements on board the German research vessel Polarstern between October 26, 2002 and November 22, 2002, during the Polarstern Expedition ANT-XX/1. During this time, weather conditions permitted high quality measurements on seven days, while on five additional days only lower resolution measurements could be performed. Measurements on other days were prevented by dense cloud fields. An overview of the positions and dates of these measurements is shown in Fig. 3 and Tab. 1. Currently, these data are analyzed. Currently, the FTIR instrument is still mounted on Polarstern, and FTIR measurements will be restarted on January 25, 2003, on Expedition ANT-XX/3 starting from Cape Town and reaching Bremerhaven on February 17, 2003. Further measurements are planned for the Expedition ANT-XXI/1 in October/November 2003, travelling from Bremerhaven to Punta Arenas.

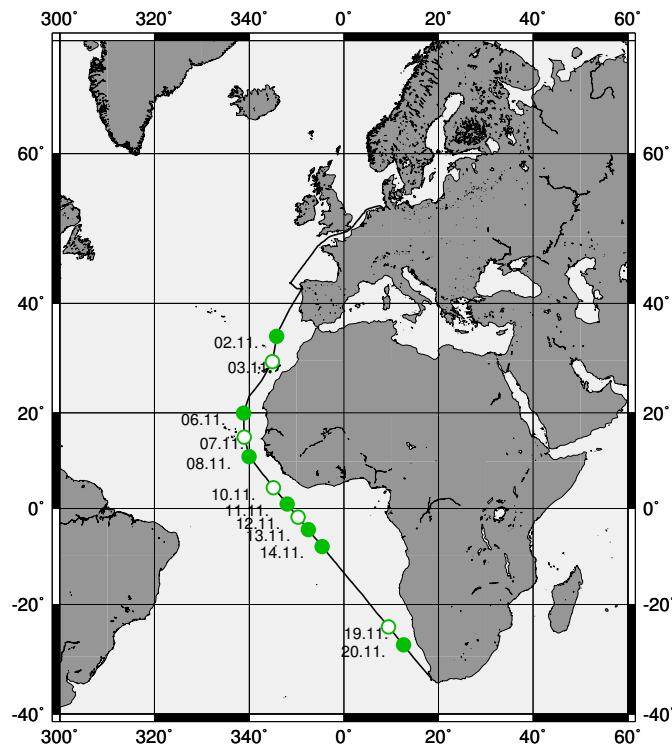


Fig. 2, Polarstern cruise between October 26 and November 22, 2002. The filled circles mark the positions of the vessel while data of good quality could be recorded, while the open circles mark those positions, where weather conditions only allowed the recording of lower quality data.

Tab. 1, Dates and approximate positions of Polarstern measurements.

| Date | Approx. Latitude | Approx. Longitude | Data |
|------------|------------------|-------------------|---------------------|
| 02.11.2002 | 35 N | 14 W | High resolution |
| 03.11.2002 | 30 N | 15 W | Low resolution |
| 06.11.2002 | 20 N | 21 W | High resolution |
| 07.11.2002 | 15 N | 21 W | Low resolution |
| 08.11.2002 | 11 N | 20 W | High resolution |
| 10.11.2002 | 5 N | 15 W | Low resolution |
| 11.11.2002 | 1 N | 12 W | High resolution |
| 12.11.2002 | 2 S | 10 W | Low resolution |
| 13.11.2002 | 4 S | 8 W | High resolution |
| 14.11.2002 | 8 S | 5 W | Low/High resolution |
| 19.11.2002 | 24 S | 9 O | Low resolution |
| 20.11.2002 | 28 S | 12 O | High resolution |

1.3 Bremen

The measuring site in Bremen is located at 53.107 N and 8.854 E. As in Ny-Ålesund, a Bruker 120 HR spectrometer is used. In Fig. 2 we show an overview of the data recorded in the last months. Data obtained between September 2, 2002, and October 10, 2002, have been analyzed and submitted to the database. These include the total columns of CH₄, CO, CO₂, H₂O, and O₃.

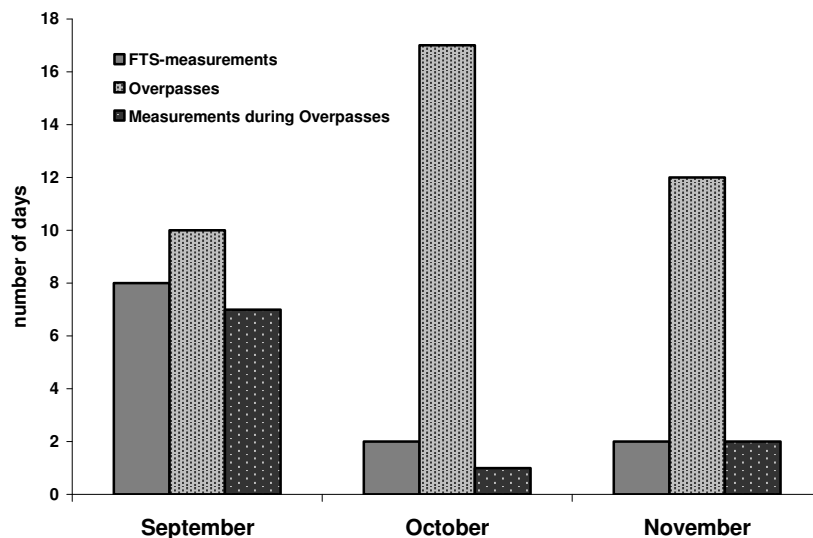


Fig. 3 Overview of the number of measurements that have been performed in Bremen since September 2002.

2 OZONE SOUNDINGS FROM NY-ÅLESUND

At the Arctic Site of Ny-Ålesund, ozonesondes are launched on a weekly basis, with additional sondes launched during campaigns. Between September 25 and November 17, 2002, the launch frequency was intensified for the validation of the SAGE III satellite, while since November 25, 2002, additional sondes are launched according to the Match campaign for the determination of stratospheric ozone loss. All these data are made available for the validation of Sciamachy, and data obtained on 43 days between July 6 and November 28, 2002, have been submitted to the database so far. Comparisons of ozonesondes profiles with Sciamachy profiles for Ny-Ålesund are shown in [3].

In Fig. 4, a comparison between the ozone total columns derived from ozonesondes and from Sciamachy (SCIA/V3.53) is shown. Those Sciamachy data were selected with a maximum distance between the centre of the ground pixel and the station of less than 200 km. However, one has to be aware that while ascending, the ozonesondes drift from the station (e.g. at 25 km altitude, the sondes have typically drifted horizontally between 30 km and 100 km). The total columns

from ozonesondes used in Fig. 4 are estimated by integrating the measured profiles and assuming a constant volume mixing ratio above the burst level of the sonde. This constant value is taken as an average of the last measured sonde data. This estimated part of the total column typically accounts for 20-30 DU. No total columns were calculated for those sondes with burst levels below 25 km altitude.

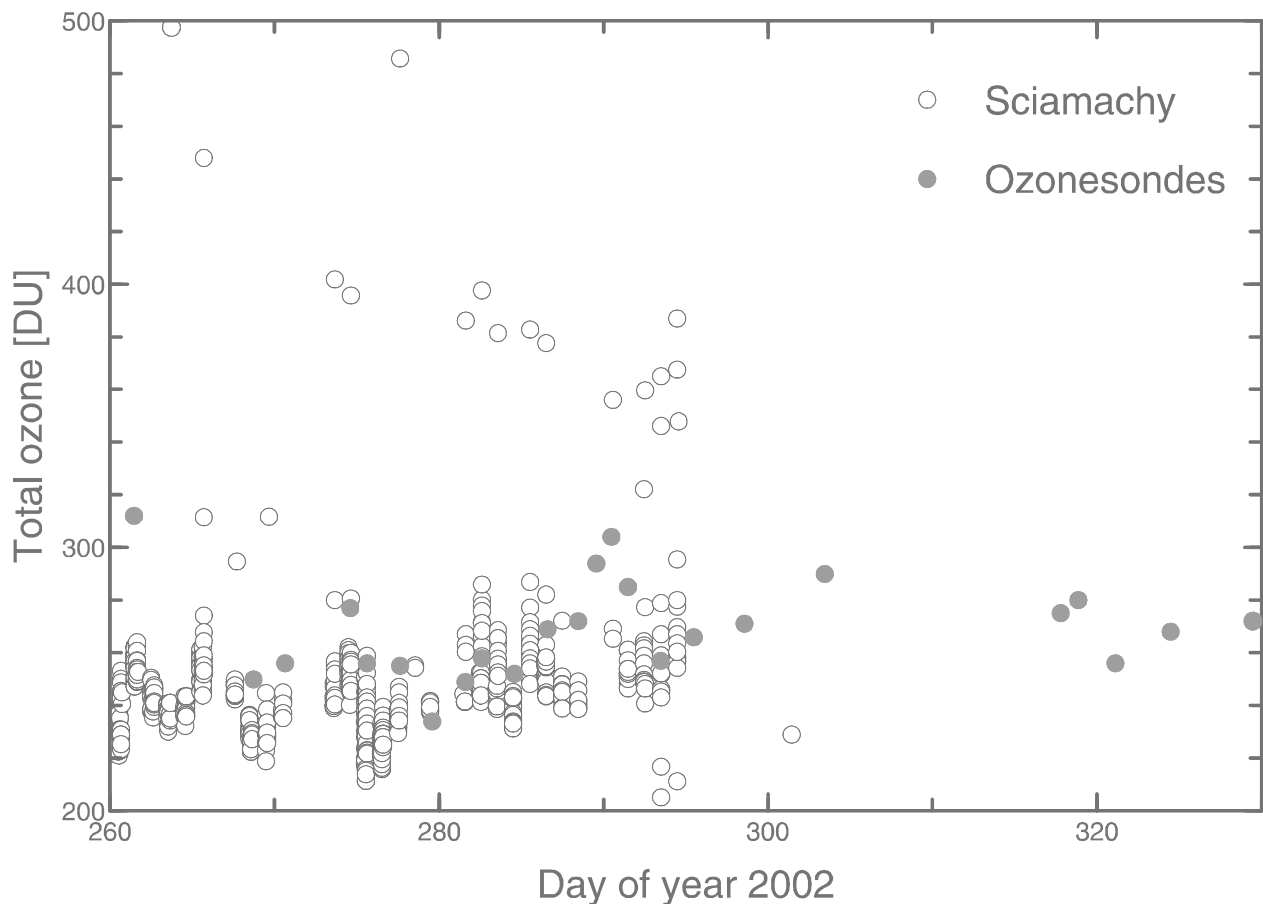


Fig. 4 Comparison of total ozone at the Arctic Site of Ny-Ålesund derived from ozonesondes with total ozone derived from Sciamachy data (SCIA/V3.53).

3 AEROSOL- AND OZONE LIDAR MEASUREMENTS FROM NY-ÅLESUND

The multi wavelength lidar system at Ny-Ålesund can simultaneously measure stratospheric aerosol and ozone profiles, as well as temperature profiles between the tropopause and up to 44 km altitude [3]. The instrument was successfully validated according to NDSC standards in 1998 [4]. In 2002, the measurement campaign began on 2nd October. Until the end of the year lidar observations were conducted on a total of 36 days. Fig. 5 shows a comparison of ozone lidar profiles from 16. October with the corresponding profile of an ozone sonde launched at the same site on the same day. The ozone lidar profiles show the altitude range covered, which varies from 9 – 34 km to 22 – 44 km depending on instrumental parameters (low altitude – high altitude mode). Aerosol lidar measurements showed a clean stratosphere until December, when strong signals of Polar Stratospheric Clouds (PSC) appeared and stayed above Spitsbergen until the end of the month. The temperature measurements during December showed the development of a stratospheric warming in the upper stratosphere, with temperatures up to more than 300 K at 45 km. However, the warming did not descend to the lower stratosphere, so that temperatures stayed cold enough for PSC formation.

Ozone lidar data is currently being processed for submission into the ENVISAT data bank. Due to a calibration

process which will be performed after the winter period, aerosol profiles will only be submitted in late March – early April 2003 for this winter.

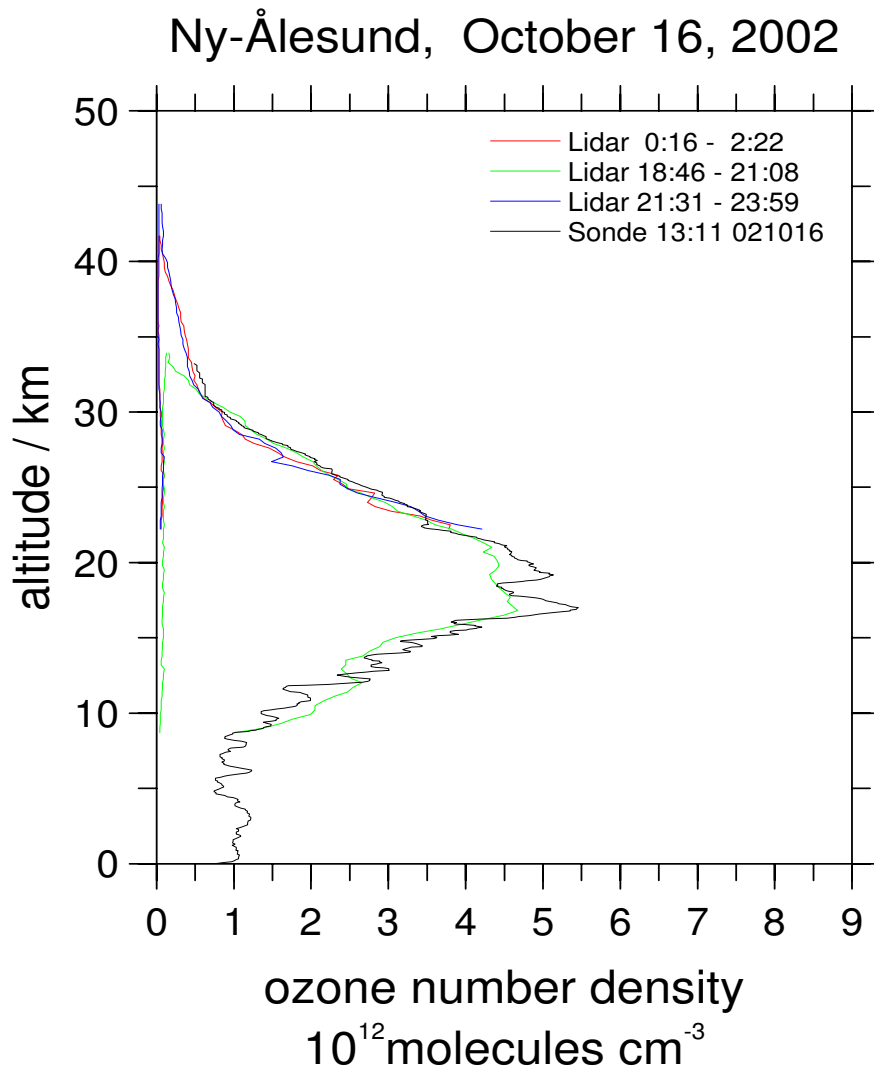


Fig. 5 Ozone concentration profiles versus altitude as measured on 16. Oct. 2002 at Ny-Ålesund, Spitsbergen. Lidar profiles are averaged according to the time indicated and have been obtained in low altitude mode (green line) and high altitude mode (blue and red line) respectively.

4 REFERENCES

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