Ground-based FTIR measurements at Izaña Observatory on Tenerife in 1999

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Abstract
Since February 1999 atmospheric absorption spectra using the sun as the source of radiation have been recorded by a ground-based FTIR (Fourier Transform InfraRed) spectrometer (Bruker IFS 120 M). Besides zenith column amounts (ZCA) of trace gases like O3, H2O, HDO, N2O, CH4, HF, HCl, ClONO2, NO, NO2, and HNO3, profiles of gases with narrow absorption lines like O3, NO, HCl and HF can be retrieved. First results of profiles of O3 and HCl and of columns of O3, HCl and NO2 are shown. O3 profiles are compared with ozone sonde and Brewer data. Column amounts of NO2 are compared with DOAS (Differential Optical Absorption Spectroscopy) data.

1. Measurement Site
The FTIR spectrometer was installed at Izaña Observatory (IZO) in February 1999. IZO is operated by the Instituto Nacional de Meteorología (INM) of Spain. Izaña is situated at 28°18’N and 16°29’W on the island of Tenerife (Canary Islands, Spain). It is mostly above a subsidence temperature inversion layer (sea cloud) due to its location on the top of a mountain plateau (2360m a.s.l.). This provides excellent conditions for infrared measurements.

A Brewer MARK-III spectrophotometer [2], which is run by the INM and a DOAS spectrometer [3], which is operated by INTA are also installed at Izaña and are used to compare O3 and NO2 column amounts, respectively. The retrieved O3 profile is compared with ECC A-6 sondes [4], launched from Santa Cruz (35 km north-west of Izaña).

2. First Results and Comparison
The radiative transfer code KOPRA (Karlsruher Optimized Radiative-transfer Algorithm) [1] is used for spectra simulation. Profiles are obtained by the retrieval PROFFIT code using the Phillipps-Tikhonov approach. Input data for the evaluation are HITRAN 96 data, p-, T-profiles (sondes), climatological profiles of trace gases (initial profiles), zenith angle and instrumental parameters.

Fits of O3, HCl and NO2 are shown in Fig 1a-c. Residuals between measurement and simulation show no systematic deviations near the absorption lines.
Fig 1 a-c: Typical residuum between measured and simulated spectra of O$_3$, HCl and NO$_2$ in absolute radiances.

ECC O$_3$-sonde (28.4.99)

retrieved O$_3$ profile

VMR O$_3$ [ppm]

0 1 2 3 4

25.2.99

VMR HCl [ppb]

0 1 2 3 4

Height [km]

0 1 2 3

28.4.99

ECC O$_3$-sonde (28.4.99)

VMR O$_3$ [ppm]

0 1 2 3 4 5 6 7 8 9 10

[ppb]

VMR HCl [ppb]

0 1 2 3 4

Height [km]

0 1 2 3

ECC O$_3$-sonde (24.2.99)

retrieved HCl profile

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retrieved HCl profile

VMR O$_3$ [ppm]

0 1 2 3 4 5 6 7 8 9 10

[ppb]

VMR HCl [ppb]

0 1 2 3 4

Height [km]

0 1 2 3
Fig. 2 a, b: Retrieved O₃ profiles compared with sonde profiles. Plotted are also HCl profiles from the same day.

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<th>Date</th>
<th>O₃ [DU]</th>
<th>NO₂ [10¹⁵ molec/cm²]</th>
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<td>DOAS</td>
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<td>265.3 -5.2</td>
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</table>

Tab. 1: ZCA of O₃ and NO₂ compared with Brewer and DOAS data, respectively.

The retrieved O₃ and NO₂ columns agree well with Brewer and DOAS data, respectively (Tab. 1). The O₃ profiles show also good agreement with profiles of ozone sondes (Fig. 2). The height resolution of the FTIR profiles up to 30 km is approx. 8 km.

As for the column of O₃ an abrupt increase of the columns of HCl and HF has been observed at the end of April (HCl: 25.4. 2.28 10¹⁵ molec/cm²; 30.4. 3.21 10¹⁵ molec/cm²; HF: 25.4. 9.00 10¹⁴ molec/cm²; 30.4. 1.12 10¹⁵ molec/cm²). This is in good agreement with trajectory and potential vorticity maps, which indicates that tropical air masses were sampled at the end of April.

2. Outlook
The measurements will be performed within the NDSC (Network for Detection of Stratospheric Change) and aim to investigate seasonal cycles and to record long-term trends of stratospheric components in the subtropical region. A further automatization of the measurement and, in particular, of the data evaluation procedure will be done in order to provide near real time profiles for at least two days of observation per week. In addition to the retrieved profiles of O₃ and HCl, the retrieval of profiles of NO and HF is in preparation. Furthermore, column amounts of H₂O, HDO, N₂O, CH₄, HF, HCl, ClONO₂, NO, and HNO₃ will also be available. In order to discuss the results in more detail model calculations will be made.

References
