# 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 $O_3$, $H_2O$, HDO, $N_2O$, $CH_4$, HF, HCl, $ClONO_2$, NO, $NO_2$, and $HNO_3$, profiles of gases with narrow absorption lines like $O_3$, NO, HCl and HF can be retrieved. First results of profiles of $O_3$ and HCl and of columns of $O_3$, HCl and $NO_2$ are shown. $O_3$ profiles are compared with ozone sonde and Brewer data. Column amounts of $NO_2$ are compared with DOAS (Differential Optical Absorption Spectroscopy) data.

## 1. Measurement Site

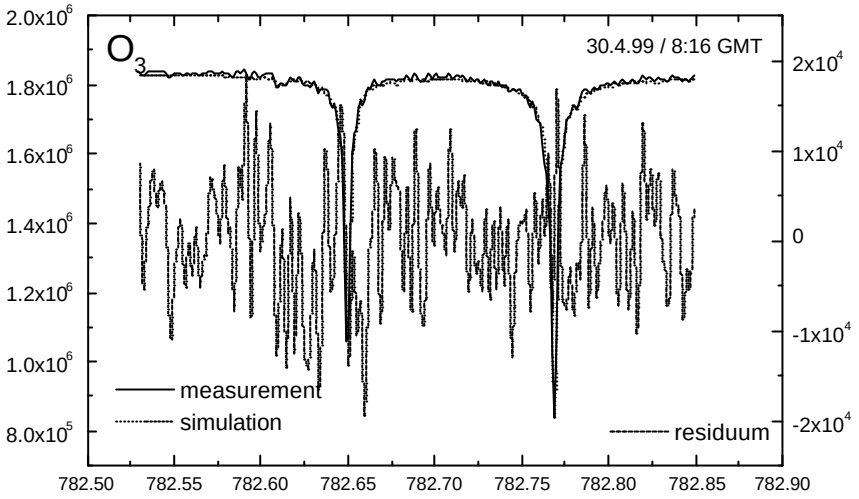
The FTIR spectrometer was installed at Izaña Observatory (IZO) in February 1999. IZO is operated by the Instituto Nacional de Meteorología (INM) of Spain. Izaña is situated at 28°18‘N and 16°29‘W on the island of Tenerife (Canary Islands, Spain). It is mostly above a subsidence temperature inversion 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 $O_3$ and $NO_2$ column amounts, respectively. The retrieved $O_3$ 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 $O_3$, HCl and $NO_2$ are shown in Fig 1a-c. Residua between measurement and simulation show no systematic deviations near the absorption lines.


O3
30.4.99 / 8:16 GMT
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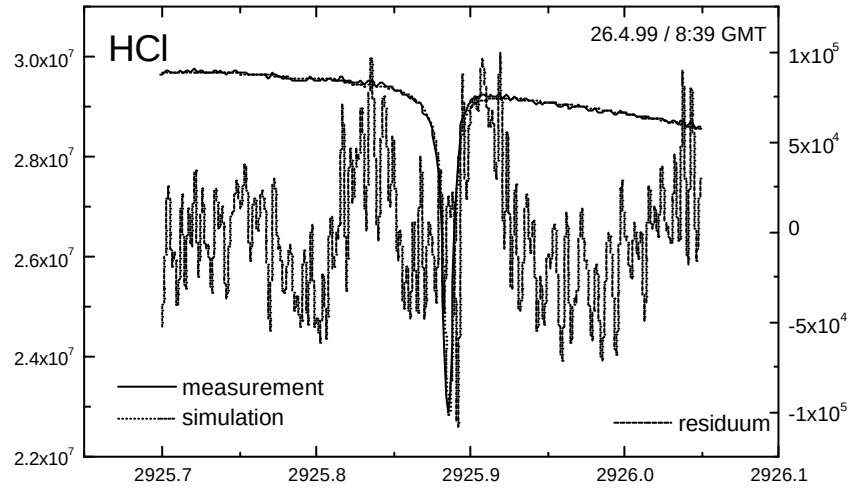
1.8x10^6
1.6x10^6
1.4x10^6
1.2x10^6
1.0x10^6
8.0x10^5
2x10^4
1x10^4
0
-1x10^4
-2x10^4
measurement
simulation
residuum
782.50
782.55
782.60
782.65
782.70
782.75
782.80
782.85
782.90


HCl
26.4.99 / 8:39 GMT
3.0x10^7
2.8x10^7
2.6x10^7
2.4x10^7
2.2x10^7
1x10^5
5x10^4
0
-5x10^4
-1x10^5
measurement
simulation
residuum
2925.7
2925.8
2925.9
2926.0
2926.1

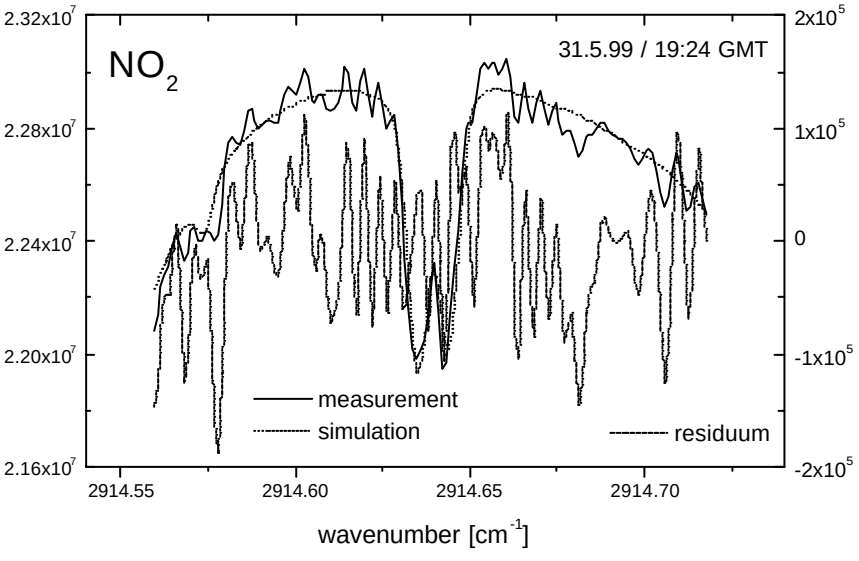
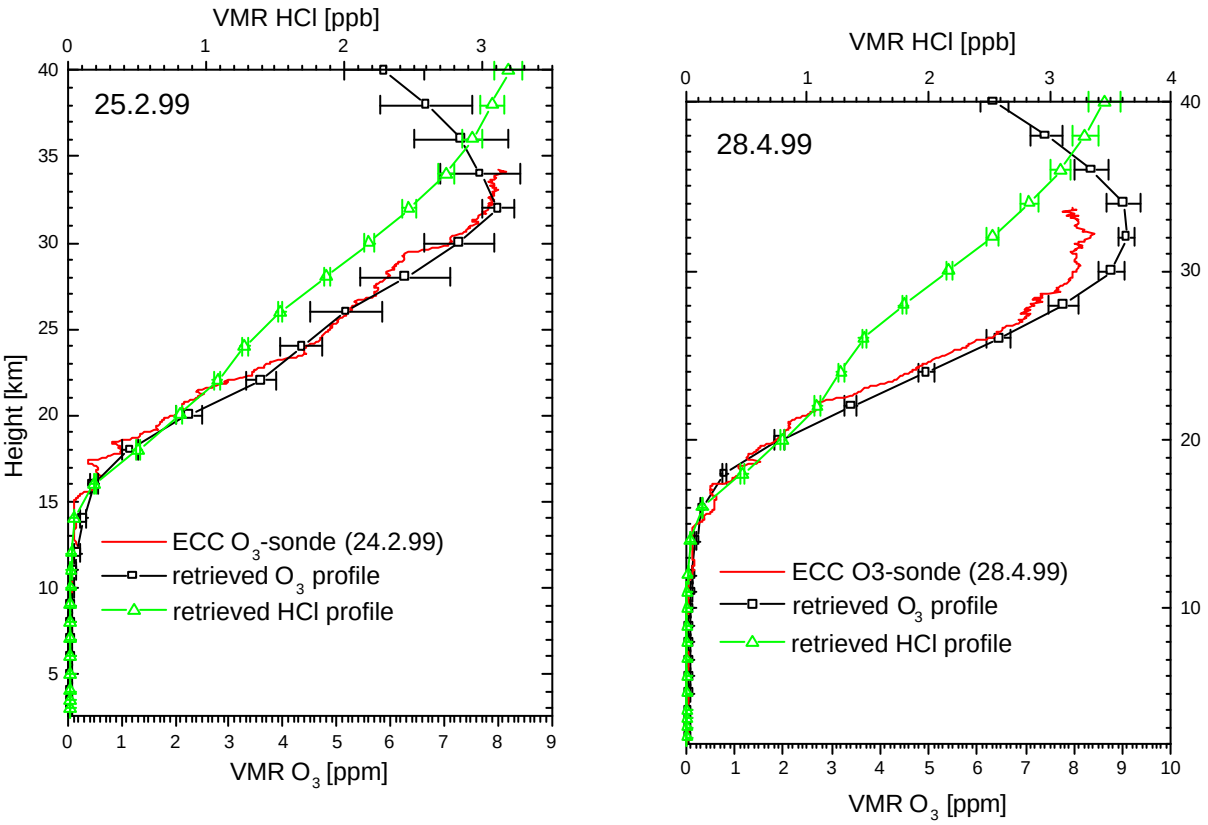

NO2
31.5.99 / 19:24 GMT
2.32x10^7
2.28x10^7
2.24x10^7
2.20x10^7
2.16x10^7
2x10^5
1x10^5
0
-1x10^5
-2x10^5
measurement
simulation
residuum
2914.55
2914.60
2914.65
2914.70
wavenumber [cm^-1]

Fig 1 a-c: Typical residuum between measured and simulated spectra of $O_3$, HCl and $NO_2$ in absolute radiances




[nW/cm² sterad $cm^{-1}$].

Fig. 2 a, b: Retrieved $O_3$ profiles compared with sonde profiles. Plotted are also HCl profiles from the same day.

| Date | $O_3$ [DU] | $O_3$ [DU] | $O_3$ | $NO_2$ [$10^{15}$ molec./cm$^2$] | $NO_2$ [$10^{15}$ molec./cm$^2$] | $NO_2$ |
|---|---|---|---|---|---|---|
| | FTIR | Brewer | Diff. [%] | FTIR | DOAS | Elev. angle [°] |
| 23.2. | 304.9 | 292.0 | -4.4 | | | |
| 25.2. | 313.7 | 296.0 | -6.0 | 2.91 | | 28.0 |
| 26.2. | 305.9 | 283.5 | -7.9 | 3.01 | 3.28 | 8.7 |
| 25.4. | 279.8 | 279.6 | +1.0 | 3.25 | 3.64 | 20.7 |
| 26.4. | 295.1 | 284.4 | -3.8 | | | |
| 28.4. | 325.2 | 304.9 | -6.7 | | | |
| 30.4. | 355.2 | 343.0 | -3.6 | | | |
| 19.5. | 285.7 | 288.8 | +1.1 | | | |
| 31.5. | 313.7 | 316.2 | +0.8 | 3.76 | 3.70 | 12.1 |
| 31.5. | | | | 3.71 | 3.67 | 7.1 |
| 31.5. | | | | 3.54 | 3.70 | 5.9 |
| 22.9. | 279.2 | 265.3 | -5.2 | | | |

Tab. 1: ZCA of $O_3$ and $NO_2$ compared with Brewer and DOAS data, respectively.

The retrieved $O_3$ and $NO_2$ columns agree well with Brewer and DOAS data, respectively (Tab. 1). The $O_3$ 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 $O_3$ an abrupt increase of the columns of HCl and HF has been observed at the end of April (HCl: 25.4. 2.28 $10^{15}$ molec./cm$^2$; 30.4. 3.21 $10^{15}$ molec./cm$^2$; HF: 25.4. 9.00 $10^{14}$ molec./cm$^2$; 30.4. 1.12 $10^{15}$ molec./cm$^2$). 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 $O_3$ and HCl, the retrieval of profiles of NO and HF is in preparation. Furthermore, column amounts of $H_2O$, HDO, $N_2O$, $CH_4$, HF, HCl, $ClONO_2$, NO, and $HNO_3$ will also be available. In order to discuss the results in more detail model calculations will be made.

## References

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