AMAXDOAS measurements from DLR Falcon Part1: north route

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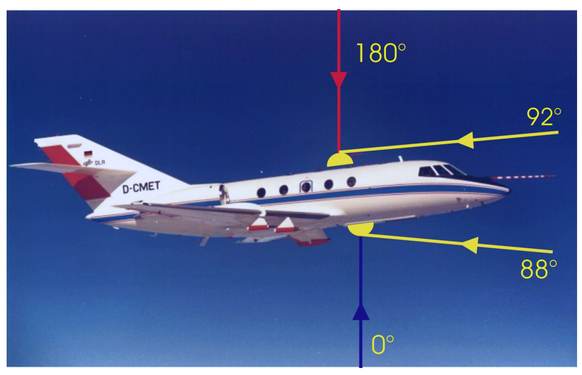
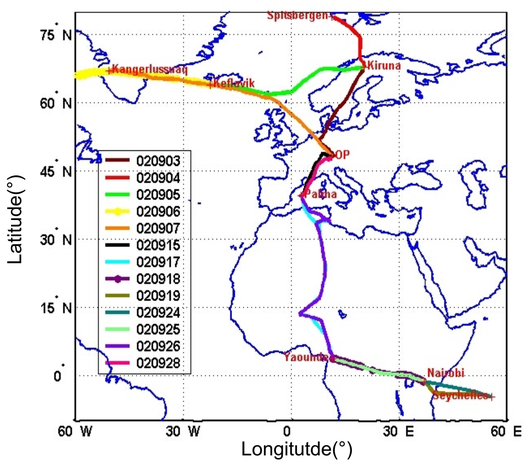
Introduction

The AMAXDOAS instrument is a new Multi Axis Airborne DOAS system which was flown on the DLR Falcon in September 2002 as part of the SCIAMACHY validation campaign. The campaign consisted of two flight routes, one to the north from Munich to Kangerlussuaq (Greenland), the second to the south, from Munich to the Seychelles. The AMAXDOAS instrument measures tropospheric and stratospheric columns of O3, NO2, and other trace species absorbing in the UV/visible wavelength range. In this presentation, the instrument and the data analysis are described and first results from the flights are presented and compared to satellite measurements from GOME and SCIAMACHY.

AMAXDOAS Measurement

- AMAXDOAS measures the scattered sunlight in four directions simultaneously, the viewing angles being 0°, 88°, 92° and 180°, (Figure left).
- Spectrometer wavelength ranges are 330-440nm (UV spectrometer) and 440-570nm (visible spectrometer).
- Spectra are recorded every 10 seconds (UV) and 20 seconds (Visible).
- The measurements cover a large distance: 60°W-60°E, 10°S-80°N (Figure right).
- AMAXDOAS measures at about 10km height.

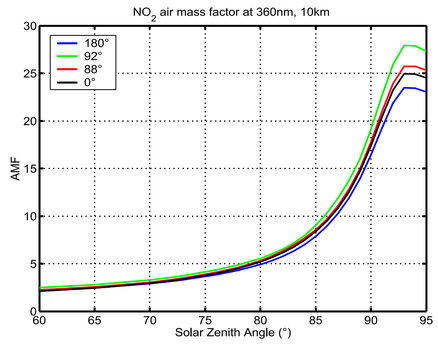




Data Analysis

DOAS Fit
The DOAS method is used for data analysis. The fit wavelength ranges for O3 and BrO is 345-359nm, for NO2 it is 345-380nm. The O3, NO2, BrO, O4 and Ring reference spectra are included in the fit. The background spectrum is a spectrum measured at high sun at about 10km height during the same flight.

Air Mass Factors
The slant columns are converted to vertical columns by air mass factors which are calculated with the radiative transfer model SCIATRAN. AMF are calculated at 10km, four viewing directions and several wavelengths. The atmospheric profile is a US 1976 standard profile. No clouds effects are considered up to now.



NO2 AMF at 360nm. The AMFs increase with solar zenith angle, no big difference for the four directions. The zenith view direction have smaller AMFs.

Selected References

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Platt, U., Differential optical absorption spectroscopy (DOAS), in Air Monitoring by Spectroscopic Techniques, M. W. Sigrist (Ed.), Chemical Analysis Series Vol. 127, John Wiley, New York, 1994.
Bruns, M., J. P. Burrows1, K.-P. Heue, U. Platt, A. Richter, A. Rozanov, T. Wagner, P. Wang, Retrieval of Profile Information from Airborne Multi Axis UV/visible Skylight Absorption Measurements, paper in preparation.

see also: Www.doas-bremen.de

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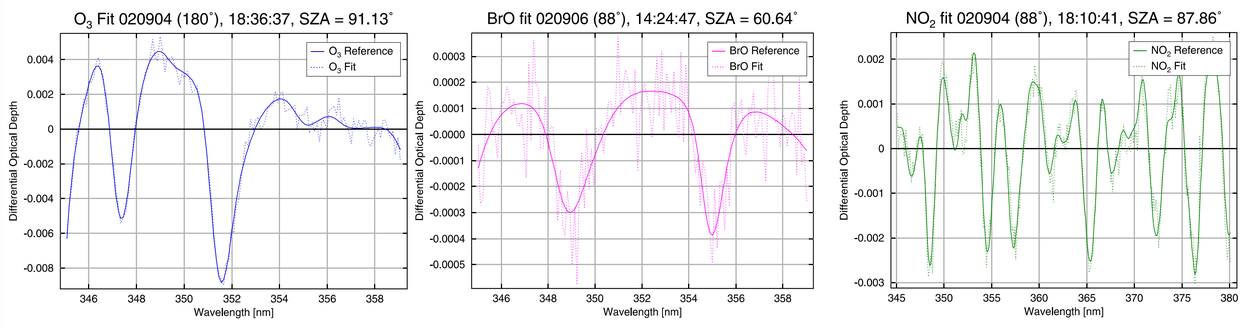
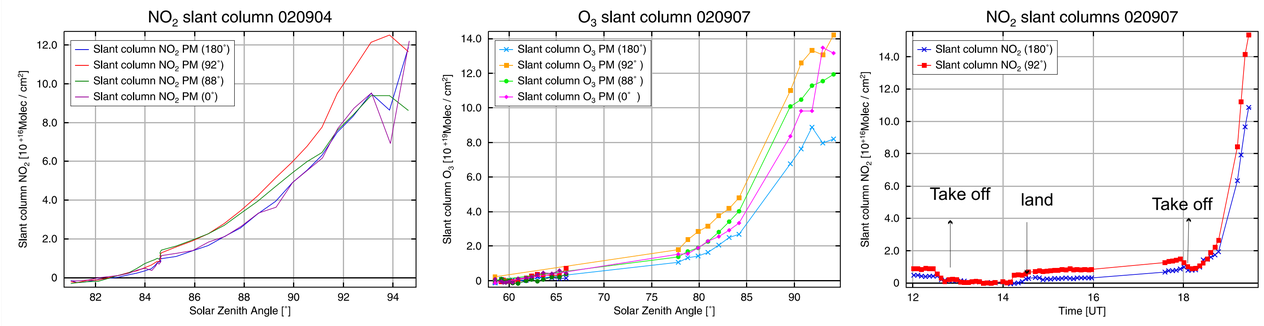
Results

The O3, NO2 and BrO structures are clearly identified from AMAXDOAS measurements. The fits are excellent!



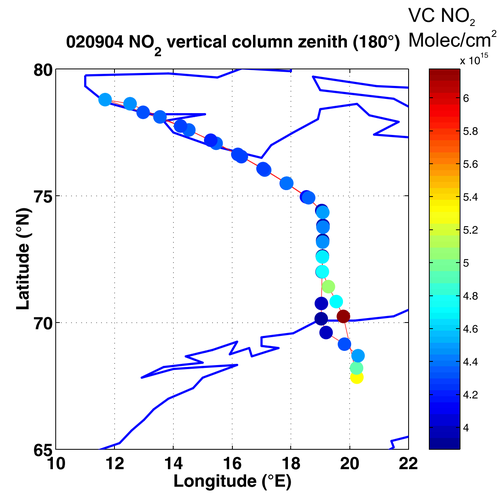
NO2 (020904) and O3(020907) slant columns at four viewing directions are plotted with solar zenith angle. The slant columns increase smoothly with solar zenith angle as predicted by the AMFs. The zenith direction(180°) has the smallest slant columns. The difference in the four directions are larger than expected, which might be caused by cloud influences.

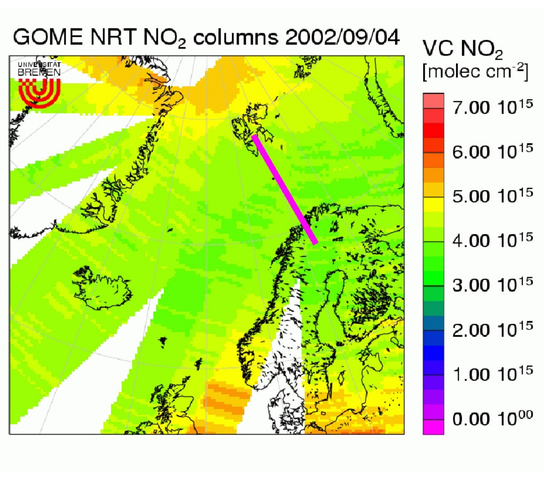


The left figure is the NO2 time series on Sep. 7th. We can see the height character of AMAXDOAS measurement. When the Falcon is on the ground, the NO2 slant columns are larger than in the air. During take off and landing the NO2 slant columns are also changing with height. Are there some profile information?

Comparison with Satellite

AMAXDOAS NO2 and O3 slant columns at zenith direction(180°) are converted to vertical columns and compared with GOME satellite Nadir NO2 and O3 vertical columns. These two figures are GOME NO2 20020904 and AMAXDOAS NO2 20020904.





Summary and Conclusions

AMAXDOAS on board Falcon successfully measured the O3, NO2 and BrO et al trace gases during the Sciaval campaign in September 2002 and accumulated lots of data for SCIAMACHY validation.
This presentation shows first results of the AMAXDOAS sciaval campaign. The NO2 vertical column on Sep. 4th is comparable with GOME data. The average NO2 vertical column is about $4.4*10^{15}$molec/cm^2.
As there were always clouds during flight, we have to calculate more accurate AMFs to get the slant columns from all directions.
The absorption is lower at 10km compared to ground based measurement, which is more difficult for the weak absorbers. But it is also an advantage to separate stratosphere and troposphere absorptions.

Acknowledgements

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