Multi-axis DOAS observations of atmospheric trace gases at the Greenland ice cap

T. Medeke, S. Fietkau, A. Ladstätter-Weißenmayer, H. Oetjen, A. Richter, F. Wittrock and J. P. Burrows
Institute of Environmental Physics, University of Bremen, P. O. Box 330440, D-28334 Bremen, Germany
medeke@iup.physik.uni-bremen.de

Introduction

In July 2003 a new MAX-DOAS [1] instrument has been installed at Summit (Greenland see figure 1). MAX-DOAS is based on the well-known UV/VIS instruments, which use the sunlight scattered in the zenith sky as the light source and the method of Differential Optical Absorption Spectroscopy (DOAS) to derive column amounts of absorbers like ozone and nitrogen dioxide. Substantial enhancements have been applied to this standard setup to use different line of sights near to the horizon as additional light sources (MAX - multi axis).

In addition, this measurement technique can be used for both ground based observations (e.g. Network for Detection of Stratospheric Change - NDSC) and validation of satellite instruments (e.g. Global Ozone Monitoring Experiment - GOME, Scanning Imaging Absorption Spectrometer for Atmospheric Chartography - SCIAMACHY) which allows to combine highly time and spatial resolved data of selected locations with data of global coverage.

First results from measurements at the Summit part of the BREDOM (Bremen DOAS Network for Atmospheric Measurements) are presented and interpreted with the full-spherical radiation transport model SCIATRAN [2].

Measurement Site

The Summit camp sponsored by the National Science Foundation (NSF) is a scientific research station located at the peak of the Greenland ice cap at 3200 m altitude. This high altitude Arctic site is characterized by:

- low temperatures,
- very low water vapour column and
- a clean troposphere.

In figure 3 the temperature stabilized measurement container of the Bremen RAMAS group (Radiometer for Atmospheric Measurements At Summit) is shown where the DOAS instrument is installed.

First Results

In this section first preliminary results of the Summit DOAS instrument are presented. Figure 5 shows the comparison of the ozone measurements with TOMS. There is a good agreement of the TOMS data with the Summit measurements, the absolute values as well as the variation with time. For the ground based measurements morning and afternoon results of the first measurement of O₃, NO and BrO are presented.

Conclusions

At end of July 2003 the Summit DOAS station started its measurements. Preliminary results of the first measurement of O₃, NO, and BrO are presented. The O₃ vertical columns of TOMS and DOAS are in good agreement. A decreasing of NO related to the increasing darkness and the low amount of tropospheric NO can be seen in figure 6 and 7. For BrO a ten day time series is shown where the slant columns are very similar which indicates nearly constant atmospheric conditions.

Acknowledgements

Parts of this project (50EE0005) have been funded by:
- the German Federal Ministry of Education and Research (BMBF)
- the German Aerospace Agency (DLR)
- the German Research Council (DFG) and
- the University of Bremen.

We would like to thank the National Science Foundation (NSF) and the Bremen RAMAS team for their assistance and support to establish the Summit DOAS station.

References