First Results from SCIAMACHY UV/vis Nadir Measurements

UP 3.2

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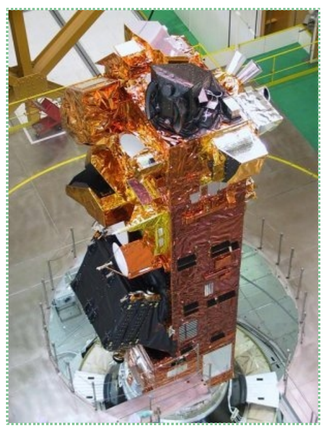
Introduction

In the last years, more and more measurements of atmospheric species from space have become available. One of the arguably most successful instruments for atmospheric chemistry research from space is the Global Ozone Monitoring Experiment (GOME) launched on ERS-2 in April 1995 and still providing data today. Although primarily designed to deliver total ozone columns, measurements from the GOME instrument have been used to determine columns of NO2, BrO, OClO, SO2, HCHO, H2O and also vertical profiles of O3.

In March 2002, the SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY (SCIAMACHY) was launched on board of ENVISAT. This instrument is in many respects an extended version of GOME, providing better spatial resolution, a wavelength range that extends into the NIR and most importantly the ability to measure alternatingly vertical profiles and nadir columns.

In this poster, first results from trace gas retrievals on SCIAMACHY UV/vis nadir measurements are presented and compared to collocated GOME measurements to provide a first validation

SCIAMACHY Instrument

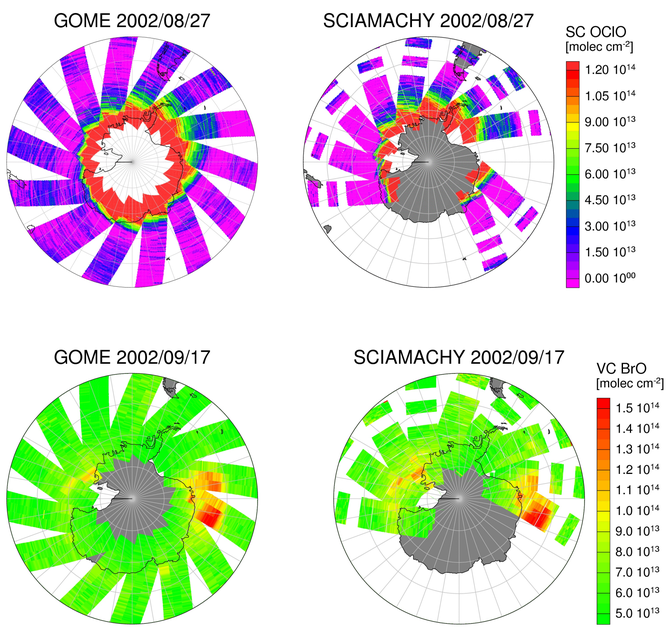


The SCIAMACHY instrument is a 8 channel grating spectrometer measuring in nadir, limb, and occultation (both solar and lunar) geometries. SCIAMACHY covers the spectral region from 220 to 2400 nm with a spectral resolution of 0.25 nm in the UV, 0.4 nm in the visible and less in the NIR. The size of the nadir ground-pixels depends on wavelength range and solar elevation and can be as small as 60 x 30 km2. The instrument was launched on ENVISAT in a sun-synchronuous orbit on March 1st, 2002 and is in nominal operation since August 2002.

Using the *Differential Optical Absorption Spectroscopy* (DOAS) technique, a number of atmospheric trace gases can be retrieved from the spectra, including O_3, NO_2, BrO, OClO, SO_2, HCHO, and H_2O. In the absence of clouds, a large part of the photons observed by SCIAMACHY in the nadir have penetrated down to the troposphere, and global maps of tropospheric concentration fields can be derived from the measurements.

Compared to GOME, the SCIAMACHY instrument has several advantages for nadir measurements, in particular the better spatial resolution and the ability to provide a nearly collocated stratospheric profile for each nadir measurement, which in principle will enable accurate tropospheric columns to be derived without external information.

Comparison GOME / SCIAMACHY

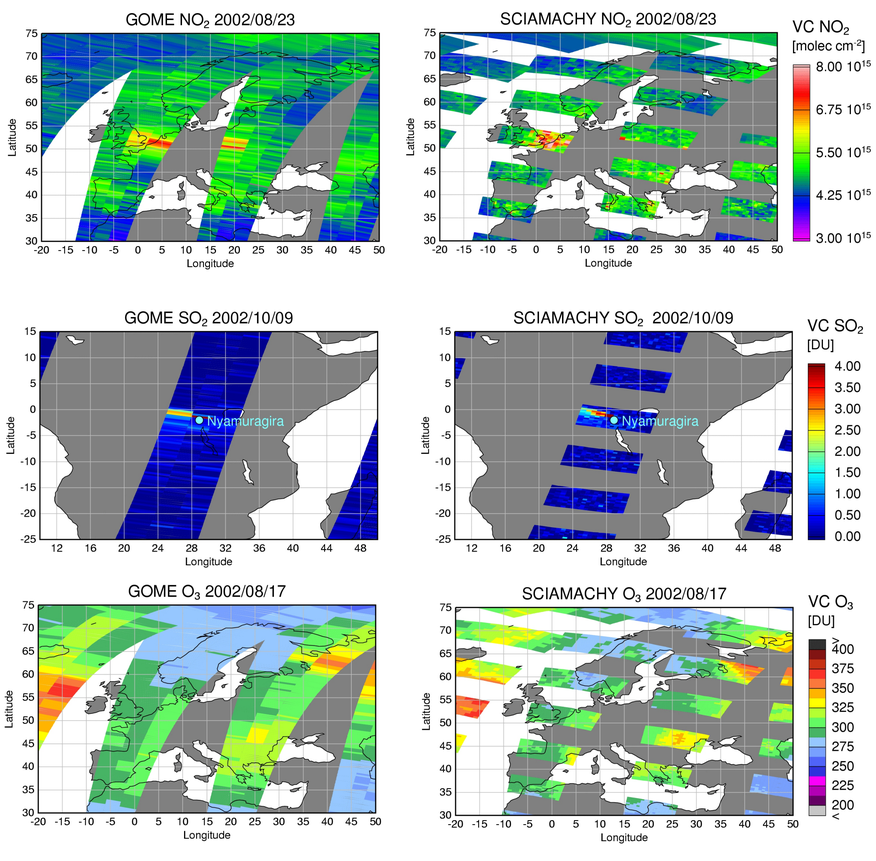


Currently, only a very limited number of operational products are available for SCIAMACHY. However, from the uncalibrated radiances, columns for O3, NO2, OClO, BrO, and SO2 can be retrieved using the DOAS algorithm developed at the IUP Bremen for the GOME data retrieval.

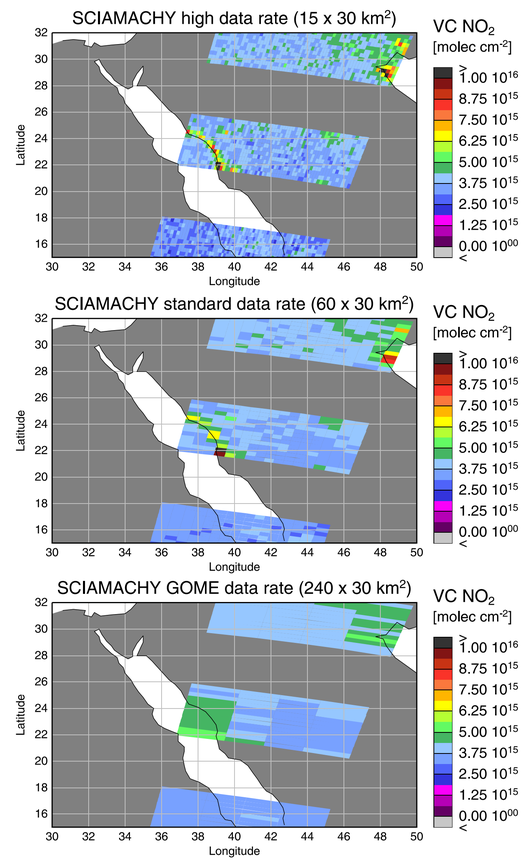
As data calibration still is an issue, all results have to be considered as preliminary. In the figures, selected results are shown for all trace gases comparing co-located GOME and SCIAMACHY measurements.

The main findings are

- "proof of concept" for many target species
- good overall agreement between GOME and SCIAMACHY
- better spatial resolution of SCIAMACHY
- improved detection of tropospheric plumes
- reduced coverage of SCIAMACHY as a result of alternating limb and nadir measurements
- some noise and polarization related problems in the BrO retrieval (see talk UP 5.4 of O. Afe on Friday, 12:15)



Resolution Effects



In the figures to the left, SCIAMACHY measurements from September 24th are shown at different spatial resolution: High data rate (rarely available), standard data rate and approximately GOME data rate, demonstrating the large variability in NO2.

For tropospheric measurements, the improved spatial resolution of SCIAMACHY has important consequences:

- the probability for cloud free pixels increases significantly, improving the sensitivity towards tropospheric absorbers
- local sources and concentration gradients can be resolved much better
- validation with independent measurements (that are mostly probing much smaller air volumes) is simplified.

This is important not only for the interpretation of SCIAMACHY measurements, but also for the existing GOME data set. In addition, for non-linear systems such as the ozone - NOx interaction, sub-pixel information is an important prerequisite for accurate modelling in the rather coarse atmospheric models which are available today.

Conclusions

UV/vis nadir measurements of the SCIAMACHY instrument on board of ENVISAT have been analysed for O3, NO2, OClO, BrO, and SO2 columns using the IUP Bremen DOAS algorithm. The results have been compared to co-located GOME measurements and good agreement was found.

The main advantage of SCIAMACHY for tropospheric measurements is the better spatial resolution, in particular for O3, NO2, and SO2 which allows much better identification and localisation of sources and plumes. In addition, the unique limb/nadir matching feature of SCIAMACHY will enable much more accurate tropospheric products to be generated (see poster UP 1.14 by B. Sierk et al.).

The main disadvantage of SCIAMACHY measurements is the reduced coverage as a result of the alternating limb, nadir, and occultation measurements.

With improvements in the calibration and data dissemination of the SCIAMACHY radiances expected for the next months, accurate tropospheric columns from SCIAMACHY should become available soon.

Acknowledgements

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Selected References

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see also: www.iup.physik.uni-bremen.de