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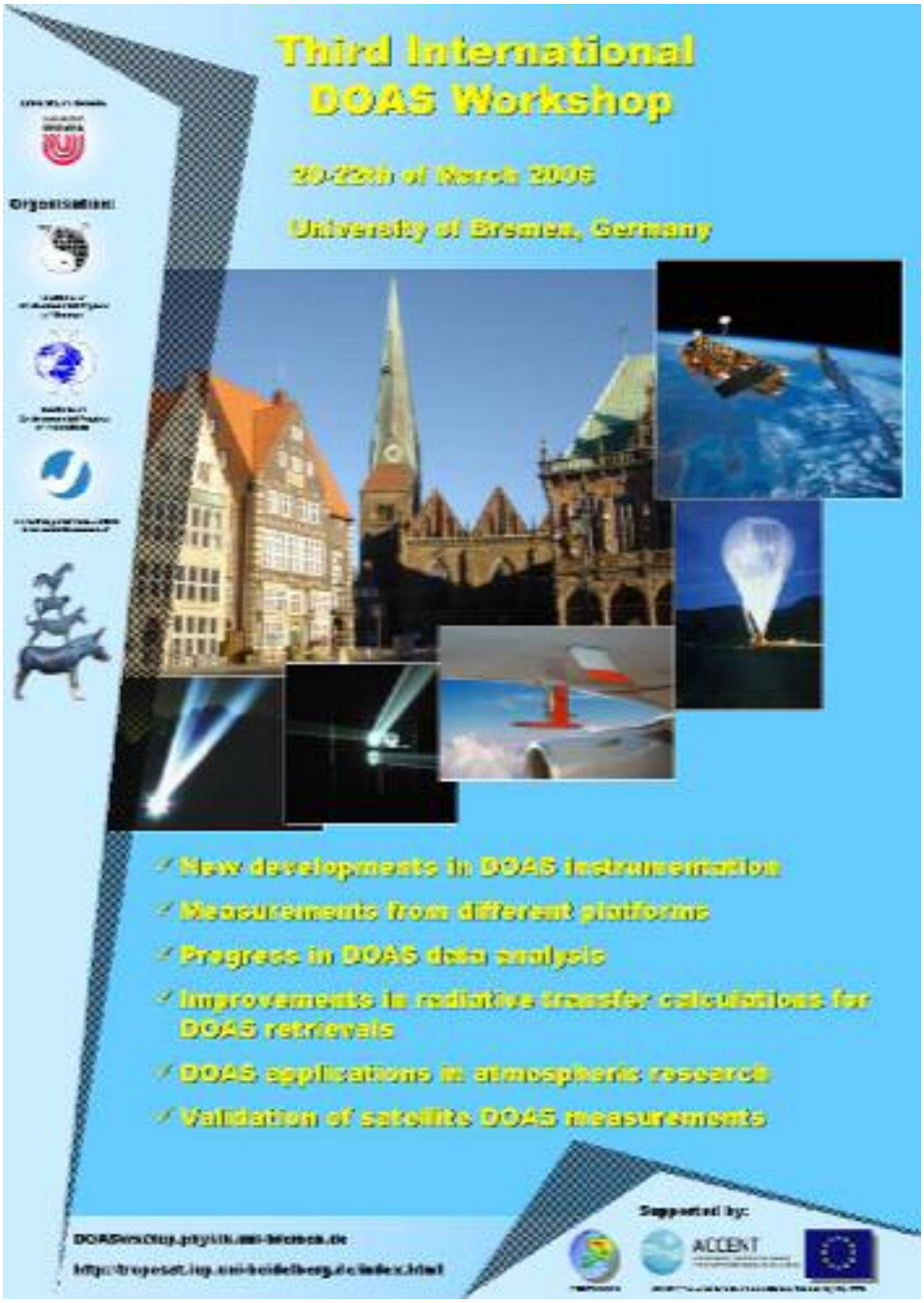
TROPOSAT-2

Report on the

Third International DOAS Workshop

Heidelberg, March 20-22, 2006

Thierry Marbach (IUP Heidelberg), Andreas Richter (IUP Bremen)



1. Overview of the third International DOAS Workshop

Like the previous two international DOAS workshops of 2001 and 2003, the third international DOAS workshop covered aspects of Differential Optical Absorption Spectroscopy related to all applications including spatially resolved DOAS-measurements. The Workshop has been hosted by the ACCENT/AT2 organization, which generously provided financial support for the meeting (see section 2). This funding also helped more students and overseas scientists to participate to the workshop through travel cost supports.

For this third meeting, one focus has been on instruments aboard satellite platforms (OMI, SCIAMACHY, GOME and GOME2 instruments). The meeting also encompassed the calibration and validation aspects of the satellite measurements showing results obtained from other platforms (ground based, aircraft and balloon borne instruments). Also included were instrumental developments and improvement of algorithms for the retrieval of tropospheric data (UV/vis, IR, Aerosol) as well as synergistic use of models and observations.

The third DOAS workshop was the best frequented so far. The 92 participants represented 18 countries (Belgium, Canada, El-Salvador, France, Germany, Italy, Japan, Mexico, New-Zealand, PR China, Russia, South Korea, Spain, Sweden, Switzerland, The Netherlands, UK, and USA). Theirs contributions were distributed over 50 talks and 31 posters. Several sessions have been established in order to fit to the AT2 and ACCENT policy (satellite presentations were present in all sessions, see section 3). The presentations gave a wide overview of the DOAS-technique and its applications. The first session was about new developments in DOAS instrumentation, showing active long-path DOAS with different light sources (LED, laser, white light sources), also new small instrumentation, tomographic applications and ground-based imaging DOAS. A second sessions focussed on DOAS measurements from different platforms: fixed (ground-based multi-axis DOAS, ground-based passive zenith-sky DOAS), portable, cars, ships, aircrafts, and balloons. The progress in DOAS data analysis and improvements in radiative transfer calculations for DOAS applications were discussed within in a third session including the presentation of the SAPHIR chamber experiments and radiative transfer modelling (scattering, Ring effect, polarisation) as well as IR applications. Other DOAS applications were covered in a fourth session (e.g. volcanic applications or pollution monitoring). The last outlook session was dedicated to integration with other instruments, validation and future satellite projects. This program construction permitted to have satellite DOAS and results from other platforms in each session and to foster comparison and interaction between the different kind of results, instead of having them in separated sessions. During the meeting, the satellite DOAS instruments and other platforms provided plenty of interesting results in the field of SCIAMACHY limb measurements (NO_2, BrO, OClO), SCIAMACHY occultation measurements (O_3, NO_3), GOME and SCIAMACHY nadir data products and interpretation (O_3, H_2O, SO_2, HCHO, Glyoxal), impact of clouds, validation, OMI results and validation. Some highlights are presented in section 4.

2. Budget Balance

Income (euros)		**Expenses (euros)**	
ACCENT/AT2 funding support	**15,000.00**	Travel support - 4 from within Germany or neighbouring European countries - 3 from distant European countries - 9 from outside Europe	**12,981.96**
Registrations fees (78 full participants, 50 euros fees)	**3,900.00**	100 Badges	**129.92**
		100 Wokshop CDs (including burning, label and covercard printing, slimcase, and shipping)	**631.16**
		Catering service	**1,633.58**
		Hiwi (student helper)	**519.20**
		Conference dinner	**2,366.03**
		Hand out files	**100.00**
		fixing material, water, juice etc.	**123.35**
Total	**18,900.00**		**18,485.20**

3. Programme of the Third International DOAS Workshop 2006

Oral Presentations

March 20

11:15 Registration opens

12:15 Lunch

13:45 Opening: Welcome and logistics

Session 1: New developments in DOAS instrumentation

14:00 O1-01 **Ulrich Platt** *Spatially Resolved DOAS Measurements of Trace Gases and Aerosol*

14:30 O1-02 **Denis Poehler** *Tomographic DOAS Measurements of 2D Trace Gas Distributions Above the City Centre of Heidelberg, Germany*

14:45 O1-03 **Roland Leigh** *Measurement of NO2 in Leicester by Concurrent Multi-Axis DOAS*

15:00 O1-04 **Chulkyo Lee** *MAX-DOAS Measurements of ClO, BrO, and SO2 in the Plume of Sakurajima Volcano in Japan during Spring 2004 and Fall 2005*

15:15 O1-05 **Christoph Kern** *Applicability of Light-Emitting Diodes as Light Sources for Active DOAS Measurements*

15:30 O1-06 **Michael Eisinger** *GOME-2 on METOP: Approaching Launch*

15:45 **Break**

16:15 O1-07 **Hitoshi Irie** *MAX-DOAS Measurements of Tropospheric NO2 in Japan*

16:30 O1-08 **Marco Bruns** *NO2 Profile Retrieval Using Airborne Multi Axis UV-Visible Skylight Absorption Measurements*

16:45 O1-09 **Johan deHaan** *OMI DOAS Retrieval Algorithms with Focus on O3, NO2, and the Influence of Clouds*

17:00 O1-10 **Sven Kühl** *SCIAMACHY Limb Measurements of NO2, BrO and OClO*

17:15 O1-11 **Jerome Meyer** *Occultation Measurements with SCIAMACHY: an Overview*

17:30 O1-12 **Ossama Ibrahim** *Auto-Max DOAS: A New Measurement Platform*

17:45 O1-13 **Erna Frins** *Tomographic MAX-DOAS Observations of Sun Illuminated Targets: A New Technique Providing Well Defined Absorption Paths in the Boundary Layer*

18:00 Wine and Posters

March 21

Session 2: Measurements from different platforms

9:00 O2-01 **Rod Jones** *Broad Band Cavity Ringdown Spectroscopy - an in Situ DOAS for Atmospheric Composition Measurements and Laboratory Spectroscopic Studies*

9:30 O2-02 **Nicole Bobrowski** *Measurements of Sulphur Dioxide and Halogen Oxides in Volcanic Plumes*

9:45 O2-03 **Clive Oppenheimer** *Colossal Sulphur and Bromine Degassing from Ambrym Volcano, Vanuatu*

10:00 O2-04 **Muhammad Fahim Khokhar** *7-year Temporal Trend of Anthropogenic SO2 Emissions over USA Identified from GOME Observations*

10:15 O2-05 **Lara Gunn** *Determining Tropospheric Composition from Satellite Measurements*

10:30 O2-06 **Mark Weber** *Retrieval Requirements for Homogenisation of Satellite Total Ozone Data from Multiple GOME Type Spectrometers*

10:45 **Break**

11:15 O2-07 **Michael Barkley** *Measuring Atmospheric CO2 from Space Using Full Spectral Initiation (FSI) WFM-DOAS*

11:30 O2-08 **Janis Pukite** *Limb Retrieval of Stratospheric Trace Gases from SCIAMACHY Using Monte Carlo Radiative Transfer Modeling*

11:45 O2-09 **Lena Kritten** *Balloon-Borne Stratospheric Time resolved Tracegas Profiles*

12:00 O2-10 **François Hendrick** *Seasonal Variation and Trends of Tropospheric and Stratospheric BrO Derived from Ground-based DOAS Observations at 60°N'*

12:15 Lunch & Posters

March 21

Session 3: Progress in DOAS data analysis and improvements in radiative transfer calculations for DOAS applications

14:00 O3-01 **Jens Bossmeyer** *Intercomparison Experiments at the Atmosphere Simulation Chamber Saphir*

14:30 O3-02 **Ralf Sussmann** *New Retrieval Approach to Tropospheric NO2 by Synergistic Inversion of Satellite Nadir DOAS Soundings and Ground-based FTIR Measurements*

14:45 O3-03 **Andy Langford** *Measurements of the Ring Effect in the Near-Ultraviolet*

15:00 O3-04 **Vitchko Tsanev** *Optimization of SO2 Retrieval in Volcanic Plumes*

15:15 O3-05 **Udo Friess** *Inverse Modelling of Multi-Axis DOAS Measurements: a New Technique to Derive Information on Atmospheric Aerosols*

15:30 O3-06 **Stefan Noel** *Water Vapour Retrieval from GOME and SCIAMACHY Nadir Data*

15:45 **Break**

16:15 O3-07 **Steffen Beirle** *DOAS Retrieval of Glyoxal from Space*

16:30 O3-08 **Michael Buchwitz** *SCIAMACHY Global Carbon Gas Measurements: Methane, Carbon Dioxide, and Carbon Monoxide*

16:45 O3-09 **Ping Wang** *Impact of the Effective Cloud Fraction Assumption on Tropospheric NO2 Retrieval from Space*

17:00 O3-10 **Robyn Schofield**
Retrieval of Liquid Water Path and Radius

17:15 O3-11 **Oleg Postylyakov** *Vector Spherical Radiative Transfer Model MCC++: Linearization with Respect to BRDF Surface Properties*

17:30 O3-12 **Alexei Rozanov** *Retrieval of BrO Vertical Distributions from SCIAMACHY Limb Measurements: Data Quality Assessment Algorithm Improvements*

17:45 O3-13 **Andreas Richter** *How can we improve tropospheric measurements from space?*

19:00 Conference Dinner at *Haus am Walde*

March 22

Session 4: Applications of DOAS measurements

9:00 O4-01 **Alfonso Saiz-Lopez** *DOAS Observations of Halogen Oxides in Coastal Antarctica*

9:30 O4-02 **Karin Kreher** *Long-term Zenith-sky and Multi-axis BrO Measurements during Antarctic Spring and Autumn: Bromine Explosion Events on Stratospheric Background Measurements*

9:45 O4-03 **Nicolas Theys** *Tropospheric and Stratospheric BrO Evaluations from Ground-Based Multi-Axis DOAS Measurements at Reunion Island*

10:00 O4-04 **Klaus Schäfer** *Determination of NO and NO2 Aircraft Emission Indices at Airports by Open-path DOAS*

10:15 O4-05 **Annemarie Fraser** *Intercomparison of Ground-Based Zenith-Sky DOAS Measurements of Ozone and NO2: Results From the SAOZ and UT-GBS Instruments*

10:30 O4-06 **Bo Galle** *NOVAC – Network for Observation of Volcanic and Atmospheric Change*

10:45 **Break**

11:15 O4-07 **Roberto Basaldud** *Remote Sensing of SO2 and NO2 Emissions from Industrial Sources in Mexico by Passive DOAS*

11:30 O4-08 **Pucai Wang** *Air Pollution Monitoring by Using DOAS Technique*

11:45 O4-09 **Thierry Marbach** *Isoprene and biomass burning emissions from satellite observations: Synergistic use of HCHO and NO2 trace gas measurements*

12:00 O4-10 **Folkard Wittrock** *The Retrieval of Oxygenated Volatile Organic Compounds by Remote Sensing Techniques*

12:15 Lunch & Posters

Session 5: Outlook: Integration with other measurements / validation / future satellite projects

14:00 O5-01 **John Burrows** *GEOTROPE*

14:30 O5-02 **Mark Kroon** *More than One Year of Data from the Ozone Monitoring Instrument – Validation Results*

14:45 O5-03 **Lok N. Lamsal** *Retrieval and Validation of WFDOAS Total Ozone from SCIAMACHY*

15:00 O5-04 **Marian Taslakov** *Space Resolved Open-Path Detection of Trace Gases by mid IR Quantum Cascade Laser*

Poster Presentations (Posters were displayed throughout the meeting)

Session 1: New developments in DOAS instrumentation

P1-01 **Halla et al.**	*Trace Gas Measurements Using MAX-DOAS in a Polluted Marine Environment*
P1-02 **Lee et al.**	*2-dimensional Mapping of Volcanic Halogen Species and Sulphur Dioxide with Imaging-DOAS*
P1-03 **Merten et al.**	*Improvement of the Detection Limit of Active-DOAS-Measurements by use of Fibre Light Source*
P1-04 **Pinardi et al.**	*Multi-Axis DOAS Measurements During Format and Dandelions Campaigns*
P1-05 **Schlosser et al.**	*HCHO Detection by High-Resolution Laser DOAS*

Session 2: Measurements from different platforms

P2-01 **Goutail et al.**	*Pollution Monitoring Above the City of Paris Using the SAOZ Spectrometer Measurements*
P2-02 **Korshunov et al.**	*Simple DOAS Instruments for Routine Environmental Measurements*
P2-03 **Olmos et al.**	*Ground-based Mini-DOAS Techniques for Volcanic Gas Surveillance*
P2-04 **Shavrina et al.**	*FTIR Ozone Observations in Kiev*
P2-05 **Wagner et al.**	*Global Trends of Cloud Cover Derived from GOME Satellite Observation from 1996-2003*

Session 3: Progress in DOAS data analysis and improvements in radiative transfer calculations for DOAS applications

P3-01 **Bossmeyer et al.**	*Evaluation of the Formaldehyde Absorption Cross Section*
P3-02 **Rodenas et al.**	*Correction for the Absorption Cross-Section of HCHO. Comparison Between Techniques*
P3-03 **Petritoli et al.**	*Tropospheric NO2 Column from SCIAMACHY in Northern Italy: Study on the Aerosol Contribution on the Retrieval*
P3-04 **Merten et al.**	*New Application Software for Differential Optical Absorption Spectroscopy (DOAS)*
P3-05 **Wilms-Grabe et al.**	*Comparison of GOME NO2 Products Retrieved by Different Scientific Groups*
P3-06 **Postylyakov et al.**	*Effect of Polarization on Accuracy of DOAS Weighting Function Calculations*
P3-07 **Grzegorski et al.**	*Cloud Retrieval Using Data From SCIAMACHY and GOME: The Heidelberg Iterative Cloud Retrieval Utilities (HICRU)*

Session 4: Applications of DOAS measurements

P4-01 **Curci et al.**	*cancelled*
P4-02 **De Smedt et al.**	*Improved Retrieval of Formaldehyde Columns from GOME and Comparison with 3D-CTM Calculations.*
P4-03 **Ladstätter-Weißenmayer et al.**	*A study of the Trace Gas Columns of O3, NO2 and HCHO over the Mediterranean Region in May 1999*
P4-04 **Dix et al.**	*DOAS Measurements on Board the CARIBIC Aircraft Project: New Results*
P4-05 **Frankenberg et al.**	*Satellite Chartography of Atmospheric Methane and Carbon Monoxide from SCIAMACHY Onboard ENVISAT*
P4-06 **Jung et al.**	*Application of Long-path Differential Optical Absorption Spectroscopy for 2D-Mapping of Trace Gas Mixing Ratio Near a Highway*

P4-07 **Kramer et al.**	*A comparison of CMAX-DOAS Measurements, in Situ Data, and Satellite Retrievals of NO2 in an Urban Environment.*
P4-08 **Rudamas et al.**	*Mini-DOAS Measurements of Gas Emissions from Power Plants in El Salvador*
P4-09 **Oetjen et al.**	*Comparison of Modelled and Measured Chlorine Dioxide Slant Columns for the Arctic Winter 2004/2005*
P4-10 **Kirk et al.**	*MAX-DOAS Measurements of BrO during the Antarctic Polarstern Cruise in September 2006*
P4-11**Oshchepkov et al.**	*Microphysics of polar stratospheric clouds from observations of the Improved Limb Atmospheric Spectrometer (ILAS)*
P4-12 **Bril et al.**	*Numerical assessments of retrieval algorithms for GOSAT SWIR FTS observation Data: aerosol and cirrus cloud correction*
P4-13 **Wolff et al.**	*A new light-weight balloon-borne optical sensor for the measurement of ozone and other stratospheric trace gases*

Session 5: Outlook: Integration with other measurements / validation / future satellite projects

P5-01 **Goutail et al.**	*Validation of Satellite Data on Total NO2: GOME, SCIAMACHY and OMI Nadir Viewing Instruments Compared to UV-Visible SAOZ Network*

4. Scientific outcomes - Workshop's highlights

4.1. Satellite DOAS – Limb and occultation measurements

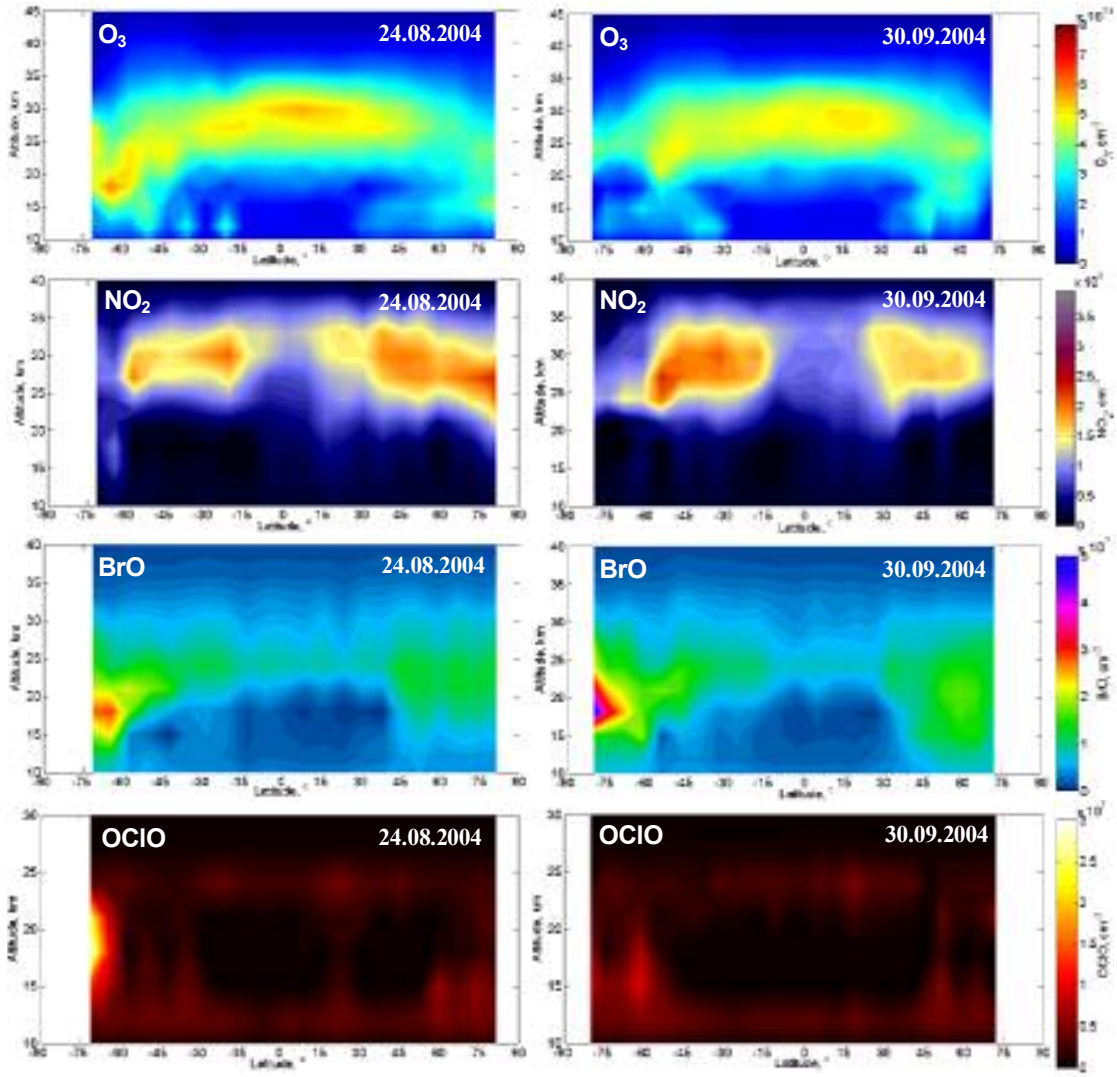
4.1.1. SCIAMACHY Limb measurements of NO_2, BrO and OClO

This presentation showed the progress in DOAS limb retrieval from the SCIAMACHY instruments. Profiles for O_3, NO_2, BrO, and OClO have been presented (Fig. 1) and the first validation looks good (Fig. 2).

Presented by:
Sven Kühl et al., Institute of Environmental Physics, University of Heidelberg, Germany

Abstract:
The Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY) measures scattered sun radiances also in limb viewing mode, which allows determining vertical profiles of atmospheric trace gases. First results on the retrieval of NO_2, BrO and OClO profiles from the SCIAMACHY Limb measurements are presented.
For the profile retrieval we use a two step approach: First, differential Slant Column Densities (dSCDs) of the respective absorber are determined in the UV/VIS spectral range by Differential Optical Absorption Spectroscopy (DOAS). Inversion of the retrieved SCDs (as function of tangent height) yields vertical profiles of the trace gas concentration (as function of altitude). For that purpose, we apply an optimal estimation method, utilizing box air mass factors calculated by the full spherical radiative transfer model TRACY as weighting functions.
The influence of several parameters on the quality of the profile retrieval, like the wavelength range chosen as fitting window, the trace gas reference spectra included in the DOAS fit or the choice of the Fraunhofer reference, is examined. In addition, the significance of the obtained dataset of concentration profiles of NO_2, BrO and OClO for studies on stratospheric chemistry is discussed and the agreement with other space borne measurements of stratospheric trace gas profiles (SMR on ODIN, MLS on AURA) is investigated in case studies.

Fig. 1: On the left side an example of the trace gas retrieval for NO_2, BrO and OClO for two orbits (on 24.08.2004 and 30.09.2004.)



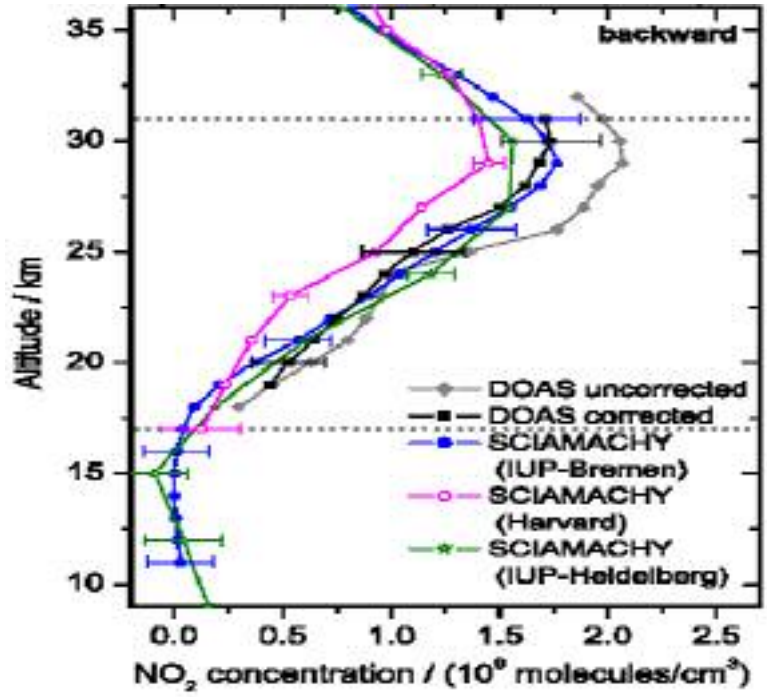


Fig. 2: NO_2 validations results

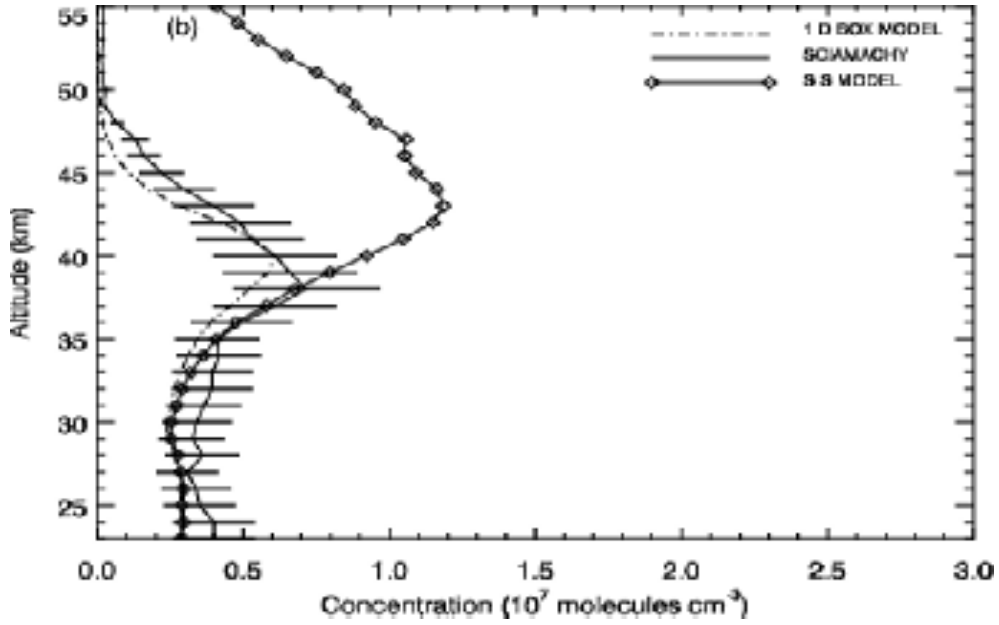
4.1.2. Occultation measurements with SCIMACHY: an overview

This presentation showed SCIAMACHY lunar occultation results in which NO_3 has been clearly identified. Also shown is the good agreement with the model profile (Fig 3).

Presented by:
Jerome Meyer et al., Institute of Environmental Physics, University of Bremen, Germany

Abstract:
Among limb and nadir measurements, SCIAMACHY is capable of performing solar and lunar occultation. In this measurement mode SCIAMACHY tracks the rising Sun or Moon directly through the atmosphere. Dividing atmospheric measurements by extraterrestrial references gives transmission spectra which are suitable for a DOAS-like retrieval approach.
Up to now, it was shown that vertical profiles of O_3 and NO_2 can be retrieved with good quality from both solar and lunar occultation measurements. Errors are in the order of 10% and 15%, respectively. Furthermore, nighttime chemistry of NO_3 was investigated with lunar occultation measurements over Antarctica. Comparative studies with photochemical models showed good agreement and confirmed the current understanding of nighttime NO_x chemistry to be reasonable.

Fig. 3:



Comparison of modelled and measured NO_3 profiles.

4.2. Satellite DOAS: GOME / SCIAMACHY nadir data products and interpretation

4.2.1. The retrieval of oxygenated volatile organic compounds by remote sensing techniques

This presentation showed clear glyoxal signal with high correlation with HCHO (Fig. 4). The glyoxal sources seem to be anthropogenic, biomass emissions, and fires. Some areas with enhanced values over water could be due to emission or transport.

Presented by:
Folkard Wittrock et al., Institute of Environmental Physics, University of Bremen, Germany

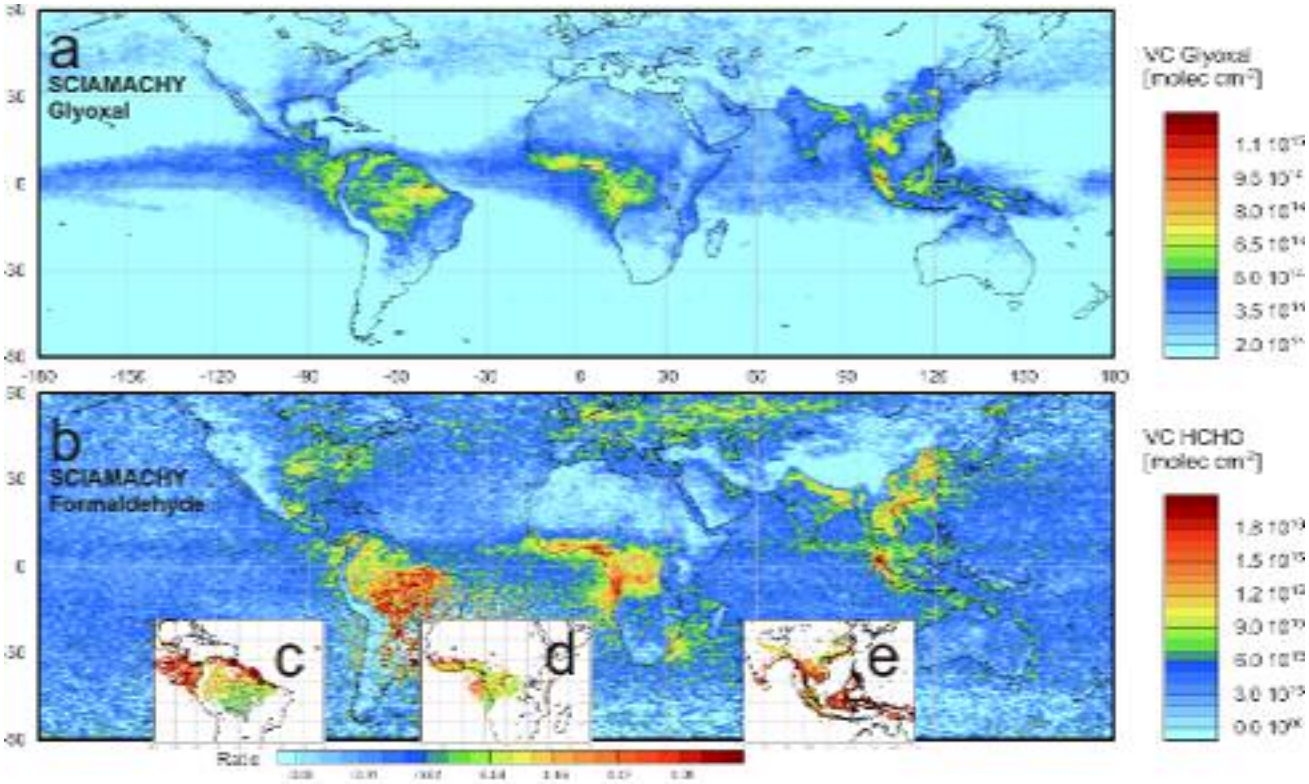


Fig. 4: Comparison of HCHO and Glyoxal results measured by SCIAMACHY.

Abstract:
This work describes global measurements of the trace gases formaldehyde and glyoxal derived from stray light spectra in the ultraviolet and visible wavelength region measured by the satellite instrument SCIAMACHY along with ground-based MAX-DOAS instruments. The analysis was carried out using the method of the Differential Optical Absorption Spectroscopy (DOAS). New algorithms to derive vertical columns of the satellite instruments are developed and described. For the ground-based geometry a way was found to derive profile information for the tropospheric absorbers.
A number of case studies illustrates the significance of biogenic emissions and of biomass burning for the global distribution of the oxygenated volatile organic compounds. A comparison with results from a global atmosphere model shows only a moderate agreement in many regions of the Earth. This reflects the limited state of knowledge at present about the very complex physical and chemical processes in the troposphere.

4.2.2. DOAS retrieval of Glyoxal from Space

This presentation showed very good correlation between Glyoxal and NO_2 for some sources what gives information on the emission type (Fig. 5)

Presented by:
Steffen Beirle et al., Institute of Environmental Physics, University of Heidelberg, Germany

Abstract:
Glyoxal is formed by the oxidation of several VOCs, and is therefore a good tracer for fast VOC chemistry.
Glyoxal has characteristic absorption bands in the blue spectral range, allowing remote sensing by DOAS. Ground based measurements of glyoxal have been successfully performed in Mexico City (Volkamer et al., 2005). From space, the detection of enhanced glyoxal column densities has been reported over Africa and Hong Kong (Kurosu, 2005).
Here we discuss the potential of the detection of glyoxal from the satellite instrument SCIAMACHY. Sensitivity studies on fit parameters, cloud influence and possible spectral interferences are perfomed, and resulting glyoxal column densities will be presented.

Reference

Kurosu, T., 2005,
http://www.cfa.harvard.edu/~tkurosu/SatelliteInstruments/OMI/SampleImages/Glyoxal/
Volkamer, R. et al., 2005, DOAS measurement of glyoxal as an indicator for fast VOC chemistry in urban air, GRL 32.

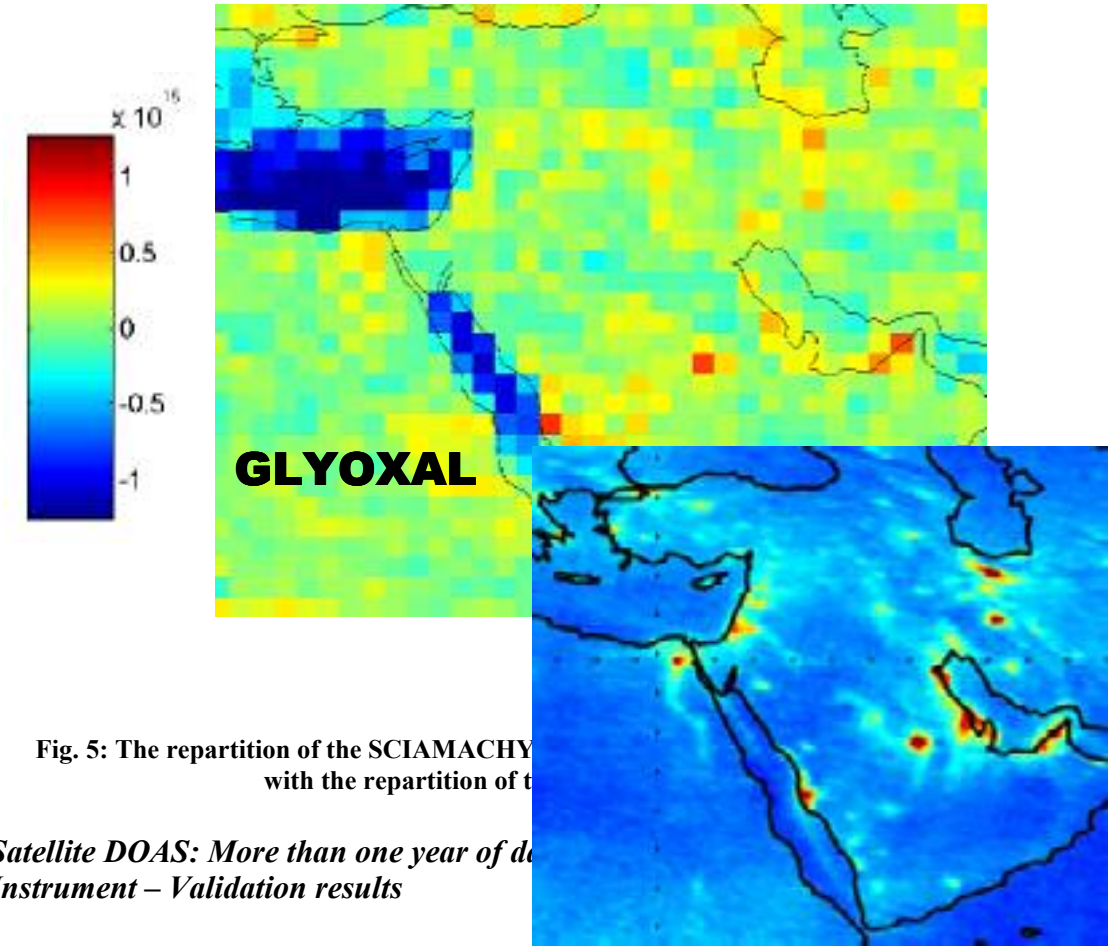


Fig. 5: The repartition of the SCIAMACHY
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4.3. Satellite DOAS: More than one year of d
Instrument – Validation results

This presentation showed very good OMI data products (Fig. 6). In addition the validation (Fig. 7) is promising and data release is approaching.

Presented by:
Mark Kroon et al., Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

Abstract:

The Ozone Monitoring Instrument (OMI) is one of four instruments on the NASA EOS-Aura satellite that was successfully launched on July 15th, 2004. OMI is a compact nadir viewing, wide swath, ultraviolet-visible (UV/Vis) imaging spectrometer that was contributed to the Aura mission by the Netherlands and Finland. Starting from September 26th of 2004, OMI is producing science data on a nominal basis.

In this contribution we present an overview of the validation results as achieved during the first year of OMI operation. Validation results comprise of OMI comparisons with ground based Brewer, Dobson, FTIR and SAOZ observations, the results of a series of NASA Aura Validation Experiment (AVE) campaigns, and results achieved within the framework of the OMI Announcement of Opportunity. Furthermore we will introduce and discuss the role of the Aura Validation Data Center (AVDC) and provide an update on current and planned validation activities.

Please visit http://www.knmi.nl/omi for more information on OMI.

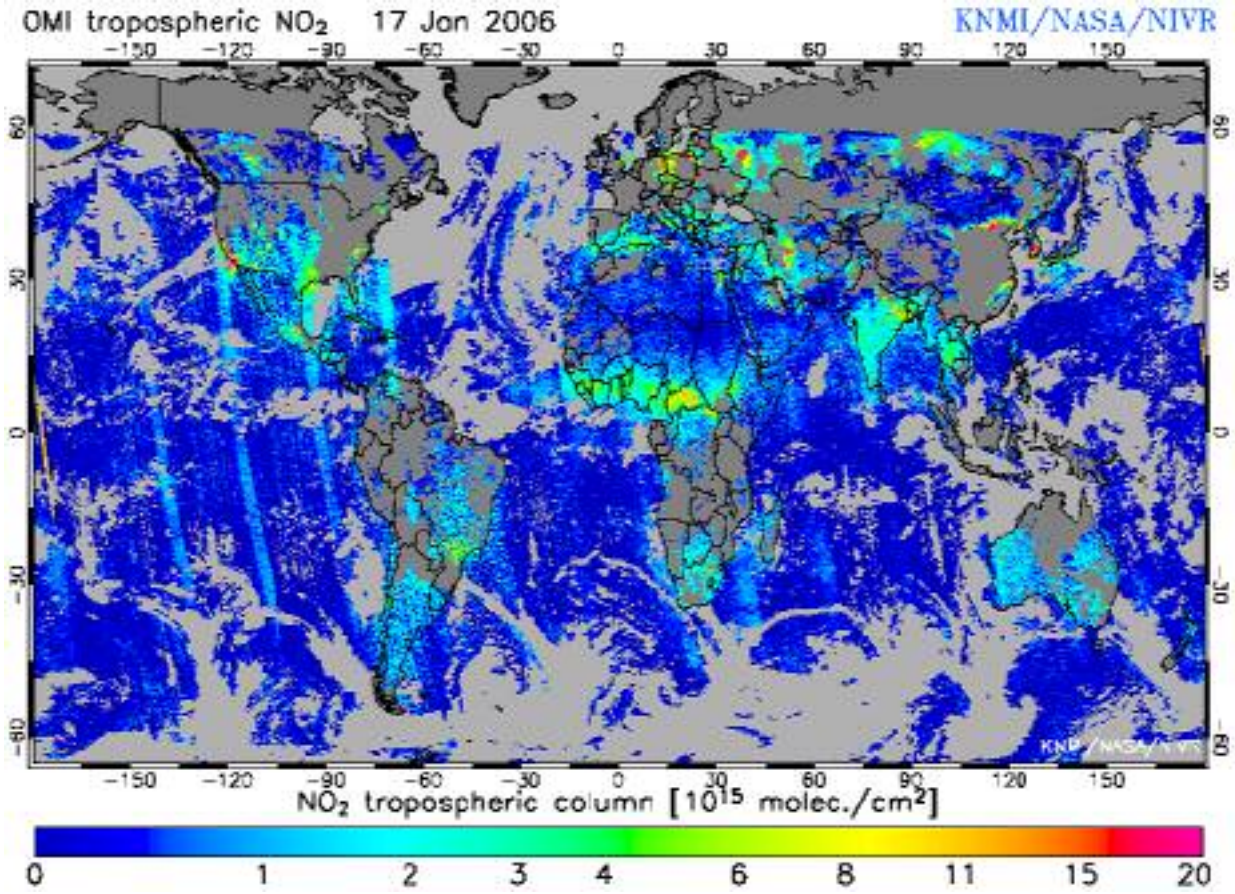

Fig. 6: Example of OMI tropospheric NO_2 column.

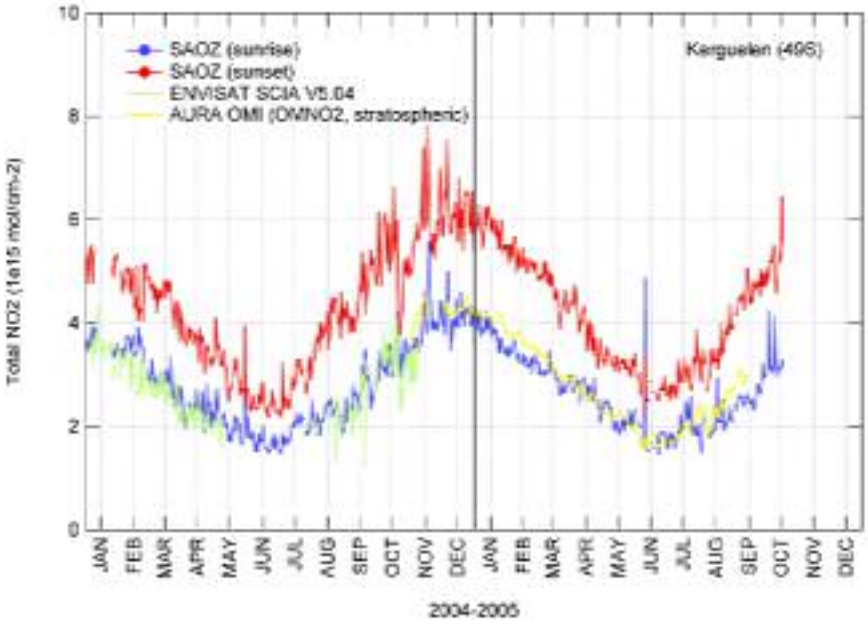

Fig. 7: OMI validation results

4.4. Satelitte DOAS: Measuring atmospheric CO_2 from space using full spectral initiation (FSI) wfm-doas

This presentation showed CO_2 from SCIAMACHY using FSI-WFM DOAS data analysis. The modelled and measured results in phase over desert, but out of phase over vegetation (Fig. 8).

Presented by:
Michael P Barkley et al., EOS, Space Research Centre, University of Leicester, UK

Abstract:
Satellite measurements of the atmospheric CO_2 concentration is a rapidly evolving area of scientific research which can help reduce the uncertainties in the global carbon cycle fluxes and provide insight into surface sources and sinks. One of the emerging CO_2 measurement techniques is a relatively new retrieval algorithm called *Weighting Function Modified Differential Optical Absorption Spectroscopy* (WFM-DOAS) developed by Buchwitz et al., (2000). This algorithm is designed to measure the total columns of CO_2 (and other greenhouse gases) through the application to spectral measurements in the near–infrared (NIR), made by the SCIAMACHY instrument on-board ENVISAT. The algorithm itself is based on fitting the logarithm of a model reference spectrum and its derivatives to the logarithm of the ratio of a measured nadir radiance and solar irradiance spectrum. A detailed error assessment of this technique has been conducted and it has been found necessary to include suitable *a priori* information within the retrieval in order to minimize the errors on the retrieved CO_2 columns. Hence, we introduce a new CO_2 retrieval algorithm called Full Spectral Initiation (FSI) WFM-DOAS which generates a reference spectrum for each individual SCIAMACHY observation using the known properties of the atmosphere and surface the time of the measurement. Initial retrievals over Siberia during 2003 show that the measured CO_2 columns are not biased from the input *a priori* data and that whilst the monthly averaged CO_2 distributions contain a high degree of variability, they also contain significant spatial features

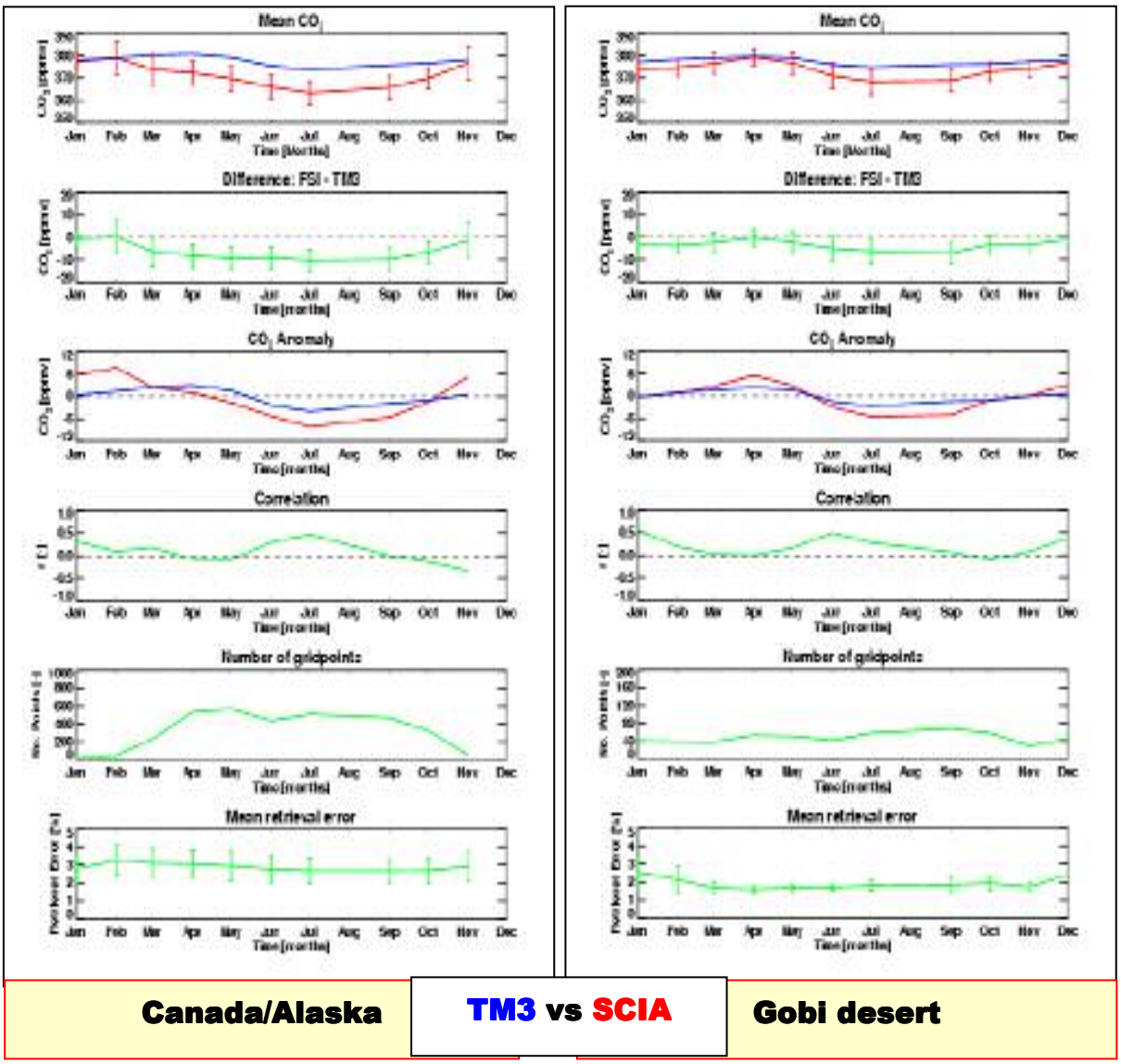

Fig. 8: Modelled and measured CO_2 results over desert and vegetation.

Reference

Buchwitz, M., Rozanov, V.V and Burrows J.P., 2000, A near infrared optimised DOAS method for the fast global retrieval of atmospheric CH_4, CO, CO_2, H_2O and N_2O total column amounts from SCIAMACHY / ENVISAT-1 nadir radiances, *J. Geophys. Res*. **105**, 15231-15246

4.5. Ground-based DOAS: DOAS observations of halogen oxides in coastal Antarctica

This presentation showed IO and BrO spring peak of about 20 pptv and a winter minimum (possible semi-annual trend). Also showed was a total removal of O_3 observed in September (Fig. 9). This high variability of O_3 in september, correlated with moderate halogen levels.

Presented by:
Alfonso Saiz-Lopez et al., School of Environmental Sciences, University of East Anglia, Norwich, UK

Abstract:
We report boundary layer DOAS measurements of the IO and BrO radicals at Halley Bay (75° S 25° W) in coastal Antarctica during the project CHABLIS (Chemistry of the Antarctic Boundary Layer and Interface with Snow). The year-round measurements were made using a long-path DOAS instrument, operating with an effective optical pathlength of 8 km and 4-5 m over the ice surface. The Halley Bay Station is located on the shelf ice in coastal Antarctica, at an approximate distance of 12 km from the ocean. The concentration profiles of the halogen oxides have a marked diurnal and seasonal variation. Modelling results on halogen sources and impact upon the Antarctic tropospheric chemistry will also be presented.

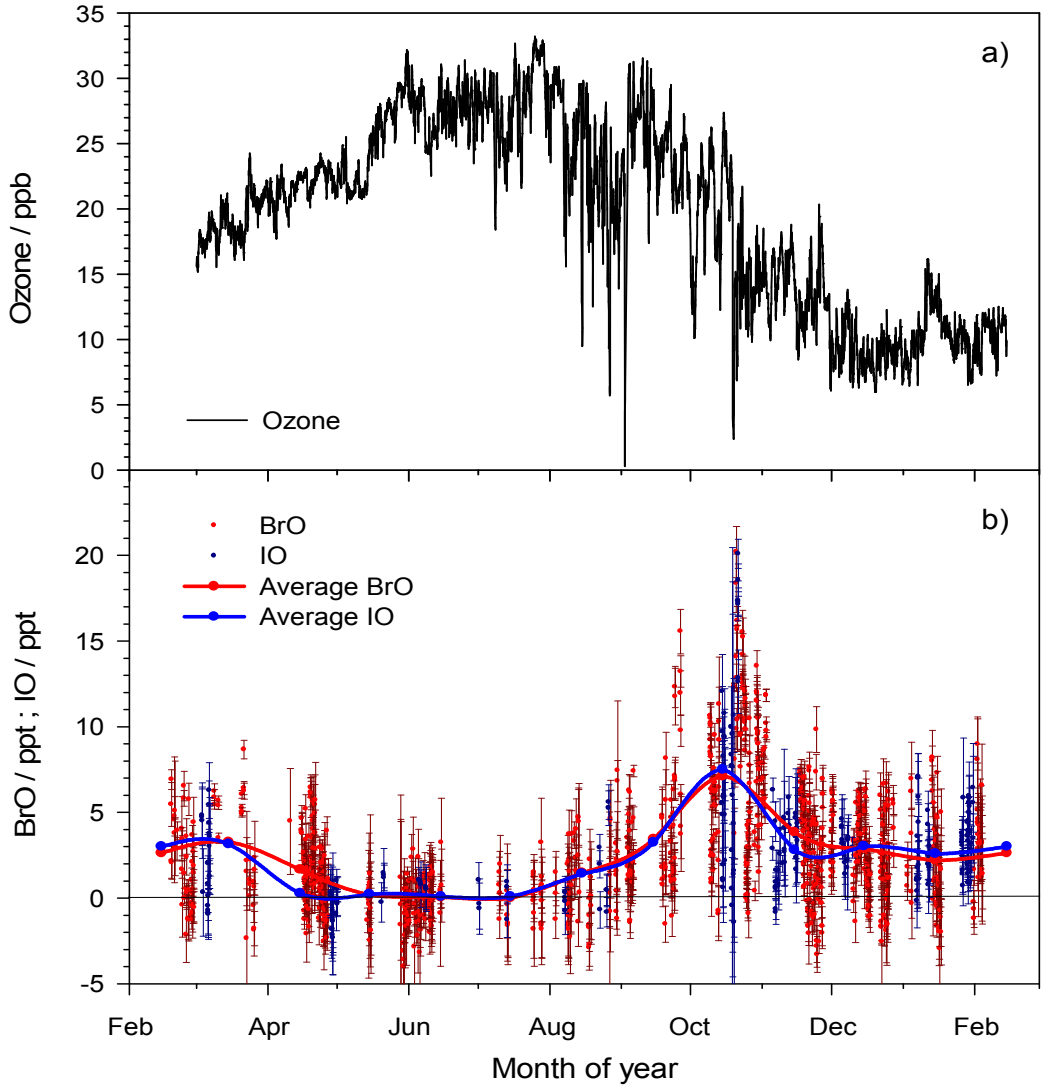

Fig. 9: IO and BrO results compared to O3 measurements

4.6. Ground-based DOAS: NOVAC – Network for Observation of volcanic and atmospheric change

This presentation showed the project of a "global" network of Mini-DOAS instruments for volcanic monitoring (Fig. 10). One of the outcome will be additional data for satellite validation.

Presented by:
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Abstract :
NOVAC is a recently started project, funded by European Union, with the aim to establish a global network of stations for the quantitative measurement of volcanic gas emissions. The network is based on a novel type of instrument, the Scanning Dual-beam mini-DOAS, developed within the EU-project DORSIVA. Primarily the instruments will be used to provide new parameters in the toolbox of the observatories for risk assessment, gas emission estimates and geophysical research on the local scale. In addition to this, data are exploited for other scientific purposes than local volcanic gas emissions, e.g. global estimates of volcanic gas emissions, large scale volcanic correlations, studies of climate change and studies of stratospheric ozone depletion. In particular large scale validation of satellite instruments for observing volcanic gas emissions will be possible for the first time, allowing to bring observation of volcanic gas emissions from space a significant step forward.
The Scanning Dual-beam Mini-DOAS instrument represents a major breakthrough in volcanic gas monitoring; it is capable of real-time automatic, unattended measurement of the total emission fluxes of SO_2 and BrO from a volcano with better then 5 minutes time resolution during daylight. The high time-resolution of the data enables correlations with other geophysical data, e.g. seismic data, thus significantly extending the information available for real-time risk assessment and research at the volcano. By comparing high time resolution gas emission data with emissions from neighbouring volcanoes on different geographical scales, or with other geophysical events (earthquakes, tidal waves) mechanisms of volcanic forcing may be revealed.
The consortium encompasses observatories of 15 volcanoes from five continents, including some of the most active and strongest degassing volcanoes in the world.

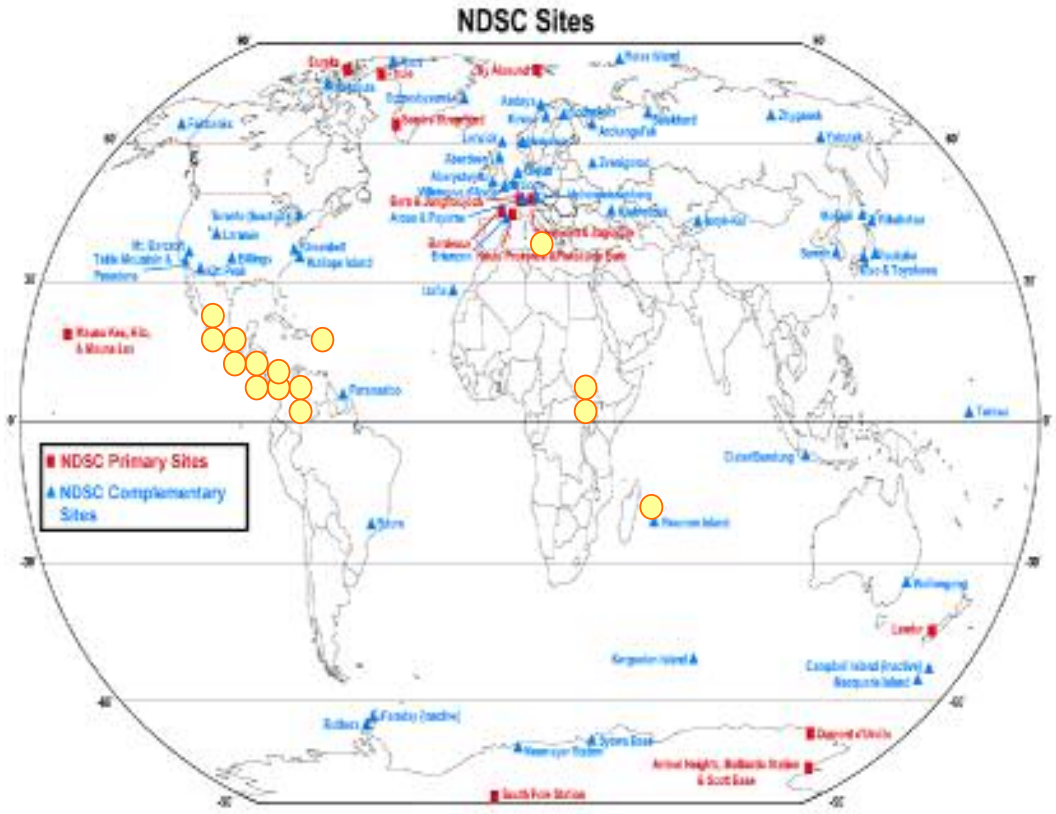

Fig. 10: Repartition of the Stations of the NOVAC network

5. Summary and outlook

The third international DOAS workshop was a great success (very good feed-backs) and provided people working with the same technique on different data to compare their results and to develop new ways to use, elaborate, and improve the various DOAS instruments and applications. The participants also benefited from the synergistic presentation of the different utilization of the DOAS technique (and other instruments) presented during the workshop. The main feeling that came out from the meeting is that the DOAS community is alive and kicking! Multi-axis applications are developing quickly. The main applications are monitoring of volcanic activity, pollution studies, and investigations of the halogen chemistry. For the satellites applications the limb retrievals are improving, IR products move ahead. The exploitation of long time series is just beginning and new products are possible (Glyoxal). Dense ground-based networks should help for validation. Much more exciting data will be available as OMI data will be released soon and GOME-2 launch is approaching (17th of July)

To support the scientific exchange induce by the workshop, a workshop CD was produced and sent to all participants. This CD contains all the oral presentations and most poster presentations as well as the book of abstracts and the list of participants (address, phone, email), intended for scientific communication and information exchange after the Workshop time.

The Chinese delegation through its speaker Dr. Pucai Wang volunteered to organize the fourth international DOA workshop in Beijing in 2008, another indication of the rapid internationalization of the field,

Acknowledgments

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