

Name of research institute or organization:

Belgian Institute for Space Aeronomy (BIRA-IASB)

Title of project:

Atmospheric physics and chemistry

Project leader and team:

Dr. Martine De Mazière: project leader FTIR

Dr. M. Van Roozendaal: project leader UV-Vis

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Project description:

UV-Vis (main results, significance of results, progress in 2006)

BIRA-IASB operates a SAOZ (Système d'Analyse par Observations Zénithales) UV-visible spectrometer installed on the Sphinx platform since June 1990. Measurements of the ozone and nitrogen dioxide total columns are performed twice a day at twilight and used for long-term climatological studies as well as for satellite validation as part of the Network for the Detection of Atmospheric Composition Change (NDACC, former NDSC). SAOZ total ozone and NO₂ data are regularly submitted to the NDACC and ENVISAT Cal/Val databases and used for the geophysical validation of relevant satellite instruments. During 2006, the long-term validation of ERS-2 GOME and ENVISAT SCIAMACHY has been pursued within the ESA/PRODEX CINAMON project (AOID158, coordinated by BIRA-IASB). SAOZ data have also been used for the validation of OMI measurements as part of the ESA AO2931. Although it could not be installed in the course of 2006 as initially planned, the new multi-axis DOAS spectrometer has been assembled and tested in Brussels as well as during an intercomparison campaign in Cabauw, The Netherlands during September 2006. This new multi-axis DOAS spectrometer has improved performances for NO₂ detection, and enhanced capabilities to derive vertical profile information in both the troposphere and the stratosphere. Additionally it allows the monitoring of other important atmospheric species like HCHO, BrO and possibly SO₂ and aerosols.

FTIR solar absorption spectrometry (main results, significance of results, progress in 2006)

BIRA-IASB participates in the measurement of the atmospheric composition by Fourier transform infrared spectrometry coordinated by the University of Liege (see report by ULg).

The EC project UFTIR (<http://ww.nilu.no/uftir>; coordinated by BIRA-IASB), that included the Jungfraujoch observatory as well as all other European NDSC stations equipped with FTIR instruments, came to an end in the beginning of 2006. During the project, the vertical inversion strategies for 6 species, that are O₃, CO, N₂O, CH₄, C₂H₆, and HCFC-22, have been optimised. The spectral time series existing at each station have been re-analysed for deriving – in an optimised way – the time series of total columns or – when feasible – of vertical profiles of the target species. Publications for each of the target species are under preparation; BIRA-IASB is responsible for the publication concerning the FTIR ozone data and trends over Europe.

In 2006, the validation of ENVISAT SCIAMACHY and MIPAS data using Jungfraujoch and other ground-based NDSC FTIR data has continued in the frame of ESA/PRODEX project CINAMON (AOID126, coordinated by BIRA-IASB) and in the frame of the EC project Evergreen (<http://www.knmi.nl/evergreen>). The latter project ended early 2006. It has been demonstrated that the vertical profile information retrieved from the FTIR data can be very well exploited for the validation of MIPAS profiles, in particular for O₃, HNO₃ and N₂O profiles. Comparisons have also been performed between the FTIR data and 4D Var data assimilation analyses from the BIRA-IASB BASCOE system. They have highlighted the benefits and limitations of the present assimilation system (Vigouroux et al., 2007). It has also been shown that the FTIR total column data of CO, CH₄, N₂O and CO₂ represent a very valid contribution to the validation of the SCIAMACHY near-infrared products, and of comparable model data from TM4 and TM5. The validation efforts have contributed to the development of improved data retrieval algorithms.

Ground-based FTIR data from the Jungfraujoch have been submitted for the validation of vertical profile data from the ACE/Scisat solar occultation experiment. BIRA-IASB is focusing on the coordinated validation of CH₄, using various independent correlative data, including the NDACC FTIR data. A publication is planned in the first half of 2007.

The concentration of CO at Jungfraujoch is measured on a continuous basis at the surface by in-situ observations, with a non-dispersive infrared detection method. It is also observed regularly by FTIR remote-sensing methods in the boundary layer. In 2006, we have initiated comparisons between both data sets, and their interpretation using trajectory modelling, in collaboration with colleagues from the University of Liège and EMPA in Switzerland. A publication is planned early 2007.

Key words

atmospheric composition, long-term monitoring, optical remote sensing, vertical inversion methods, satellite validation

Internet databases

- The data are archived in the NDSC database (<http://www.ncep.noaa.gov/>), in the NADIR/NILU database (<http://www.nilu.no/projects/nadir>).
- Data processed for ENVISAT validation purposes are also submitted to the ENVISAT CAL/VAL database (<http://nadir.nilu.no/calval>).
- Revised FTIR timeseries in the frame of UFTIR have been submitted to NADIR/NILU in a dedicated database for UFTIR (see <http://www.nilu.no/uftir>). They will be copied to the NDSC database as soon as this one is upgraded to accept FTIR profile data.

Collaborating partners/networks:

- Collaborations with University of Liège, NDSC partners and partners of the EC projects QUILT, UFTIR, Evergreen.
- Collaboration with modellers, in particular M. Chipperfield of Univ. Leeds.
- Both the UV-Vis and FTIR observations contribute to the international Network for the Detection of Stratospheric Change (NDSC), now re-baptized NDACC, Network for the Detection of Atmospheric Composition Changes.
- Collaboration with S. Reimann, B. Buchmann, and D. Folini of EMPA
- Collaborations with A. Prévot (PSI) and I. Bey (EPFL)

- Collaboration with the GOME, ENVISAT, ACE and MetOp satellite communities.

Scientific publications and public outreach 2006:

Refereed journal articles

B. Dils, M. De Mazière, T. Blumenstock, M. Buchwitz, R. de Beek, P. Demoulin, P. Duchatelet, H. Fast, C. Frankenberg, A. Gloudemans, D. Griffith, N. Jones, T. Kerzenmacher, E. Mahieu, J. Mellqvist, S. Mikuteit, R. L. Mittermeier, J. Notholt, H. Schrijver, D. Smale, A. Strandberg, W. Stremme, K. Strong, R. Sussmann, J. Taylor, M. van den Broek, T. Wagner, T. Warneke, A. Wiacek, S. Wood, Comparisons between SCIAMACHY scientific products and ground-based FTIR data for total columns of CO, CH₄, CO₂ and N₂O, ACP, 6, 1953-1976, 2006.

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Vaughan, G., P. T. Quinn, A. C. Green, J. Bean, H. K. Roscoe, M. Van Roozendaal and F. Goutail, SAOZ measurements of stratospheric NO₂ at Aberystwyth, 1991-2004, *J. Environ. Monit.* 8, 353 - 361, 2006.

G. Wetzel, A. Bracher, B. Funke, F. Goutail, F. Hendrick, J.-C. Lambert, S. Mikuteit, C. Piccolo, M. Pirre, A. Bazureau, C. Belotti, T. Blumenstock, M. De Mazière, H. Fischer, N. Huret, D. Ionov, M. López-Puertas, G. Maucher, H. Oelhaf, J.-P. Pommereau, R. Ruhnke, M. Sinnhuber, G. Stiller, M. Van Roozendaal and G. Zhang, Validation of MIPAS-ENVISAT NO₂ operational data, submitted to ACPD, Dec. 2006.

Ugo Cortesi, et al., Geophysical validation of MIPAS-ENVISAT ozone data from the co-ordinated analysis of ESA level-2 operational products, to be submitted to ACP, 2007.

Conference papers

M. De Mazière, M. Kruglanski, B. Dils, C. Vigouroux, A.-C. Vandaele, T. Blumenstock, P. Demoulin, E. Mahieu, J. Notholt, S. Wood, N. Jones, Validation of IASI Atmospheric Chemistry Products for CO, O₃, HNO₃, N₂O and CH₄ with FTIR Ground-based network data, poster presentation; Proceedings of the 1st EPS/MetOp RAO Workshop, (May 2006, ESRIN), ESA Publications SP-618, 2006.

B. Dils, M. De Mazière, J. F. Müller, M. Buchwitz, R. de Beek, C. Frankenberg, A. Gloudemans, H. Schrijver, M. Van den Broek and contributing NDSC FTIR teams,

The evaluation of SCIAMACHY CO and CH₄ scientific data products, using ground-based FTIR measurements, Proceedings of the ESA Atmospheric Science Conference, (ESRIN, July 2006), ESA Publications SP-628, 2006.

M. Buchwitz, R. de Beek, J. P. Burrows, H. Bovensmann, B. Dils, and M. De Mazière, Carbon monoxide, methane and carbon dioxide retrieved from SCIAMACHY near-infrared nadir observations using WFM-DOAS, Proceedings of the ESA Atmospheric Science Conference, (ESRIN, July 2006), ESA Publications SP-628, 2006.

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