

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 Roozendael: project leader UV-Vis

B. Dils, Caroline Fayt, François Hendrick, Christian Hermans, Karen Janssens, Jean-Christopher Lambert, Gaia Pinardi, Corinne Vigouroux,: team scientists

Pierre Gérard, José Granville, T. Jacobs: team support engineers

Project description:

UV-Vis (main results, significance of results, progress in 2004)

BIRA-IASB operates a zenith-sky looking UV-visible spectrometer installed on the Sphinx platform since June 1990. Of the French CNRS SAOZ (Système d'Analyse par Observations Zénithales) design, this instrument has been qualified for operation within the international NDSC (Network for the Detection of Stratospheric Change). Twice daily at twilight, it provides measurements of the ozone and nitrogen dioxide total columns suitable for long-term climatological studies and for satellite validation. In 2003-2004, the SAOZ NO₂ and O₃ column data have been submitted to the NDSC and ENVISAT Cal/Val databases and used for the geophysical validation of NO₂ and O₃ column data from ERS-2 GOME and ENVISAT SCIAMACHY within the ESA/PRODEX CINAMON project (AOID158, coordinated by BIRA-IASB). SAOZ data have also been used in the context of the implementation of a new operational algorithm for the GOME instrument as part of the ESA UPAS/GDOAS GDP4.0 project. The stratospheric NO₂ vertical profile inversion algorithm, developed in 2003 as part of the EU project QUILT (<http://nadir.nilu.no/quilt>), has been applied to selected data sets from the Jungfraujoch. Its usefulness for the validation of NO₂ profile measurements from space has been demonstrated in the framework of the ENVISAT validation. Instrumental developments have also taken place during 2004, with the preparation of a new multi-axis DOAS spectrometer, which will be installed in the course of 2005 to complement SAOZ observations. In comparison to SAOZ, the new DOAS instrument has improved performances for NO₂ detection, and enhanced capabilities to derive vertical profile information in both the troposphere and the stratosphere. It also enables the detection of additional trace gases (HCHO, BrO, SO₂) relevant to the monitoring of air quality.

FTIR solar absorption spectrometry (main results, significance of results, progress in 2004)

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

In 2003, comparisons have been performed between in-situ, ground-based remote sensing and MOPITT satellite observations of CO at the Jungfraujoch (Barret, B. et al., 2003). They showed an overall good agreement, but some discrepancies in summer months between the in-situ and the remote-sensing observations. Therefore, in 2004, we have investigated the origin of CO measured at the Jungfraujoch. In

particular, we studied (1) whether the discrepancies can be explained by specific transport phenomena, like vertical uplifting, and (2), whether one can observe a diurnal variation in the remote-sensing data that is comparable to the one observed in the in-situ measurements. To this end, transport models have been studied, and comparisons between CO observations and Geos-Chem model results at the Jungfraujoch have been performed. Up to now, the results have not been conclusive. It appears difficult to have a sufficiently good representation of the mountainous region of the Jungfraujoch in global trajectory and chemistry transport models to address the issue. Part of this work was done in collaboration with PSI (Dr. A. Prévot) and EPFL (Dr. I. Bey) – we hope to continue it.

In 2003 the EC project UFTIR (<http://ww.nilu.no/uftir>), coordinated by BIRA-IASB, has started. The Jungfraujoch as well as all other European NDSC stations equipped with FTIR instruments are included in the project. The project aims at optimising the vertical inversion of 6 species, that are O₃, CO, N₂O, CH₄, C₂H₆, and HCFC-22, re-analysing the existing time series, and comparing them with model results. Good progress has been made in 2004: a common retrieval strategy has been established and the partners have started to do the re-analysis of the timeseries, including trend determination. The Jungfraujoch data are being revised accordingly, in a combined effort between the University of Liège (ULg) and BIRA-IASB. Revised data delivery is planned for the first half of 2005.

In 2004, the validation of ENVISAT SCIAMACHY and MIPAS data using Jungfraujoch and other ground-based NDSC FTIR data has continued in the frame of the ESA/PRODEX project FTIRval (AOID126, coordinated by BIRA-IASB) and in the frame of the EC project Evergreen (<http://www.knmi.nl/evergreen>). It has been demonstrated that the vertical profile information retrieved from the FTIR data can be exploited for the validation of MIPAS profiles, in particular for HNO₃ and N₂O profiles. It has also been verified 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.

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 will be submitted to NADIR/NILU in a dedicated database for 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).
- Collaboration with B. Buchmann, 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 2004:

Refereed journal articles

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Goutail, F., J.-P. Pommereau, F. Lefèvre, M. Van Roozendael, S. B. Andersen, B.-A. Kåstad Høiskar, V. Dorokhov, E. Kyro, M. P. Chipperfield and W. Feng, Early unusual ozone loss during the Arctic winter 2002/03 compared to other winters, submitted to *Atmos. Chem. Phys.* (2004).

Conference papers

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M. De Mazière, B. Barret, T. Blumenstock, M. Buchwitz, R. De Beek, P. Demoulin, H. Fast, A. Gloudemans, A. Griesfeller, D. Griffith, D. Ionov, K. Janssens, N. Jones, E. Mahieu, J. Mellqvist, R. L. Mittermeier, J. Notholt, C. Rinsland, H. Schrijver, A. Schultz, D. Smale, A. Strandberg, K. Strong, R. Sussmann, T. Warneke, S. Wood, comparisons between sciamachy scientific products and groundbased FTIR data for total columns of CO, CH₄ and N₂O, Proceedings of the Second Workshop on the

Atmospheric Chemistry Validation of ENVISAT (ACVE-2) (Esrin, Italy, May 3-7, 2004), SP-562 (ESA), 97-104, 2004.

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Data books and reports

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N. Harris and M. De Mazière, The Montreal Protocol: Stratospheric Ozone Depletion

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