

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

Brice Barret, Thierry Coosemans, Caroline Fayt, François Hendrick, Christian Hermans, François Humbled, Jean-Christopher Lambert, Vincent Soebijanta: team scientists

Pierre Gérard, José Granville: team support engineers

Project description:

UV-Vis

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, the SAOZ NO₂ and O₃ column data have been submitted to the ENVISAT Cal/Val data base and used for the geophysical validation of key components of the satellite measurement system for atmospheric composition, namely, NO₂ and O₃ column data from ERS-2 GOME and ENVISAT SCIAMACHY within the ESA/PRODEX CINAMON project (AOID158, coordinated by BIRA-IASB), and integrated NO₂ profile data from UARS HALOE, ERBS SAGE-II and SPOT-4 POAM-III within a research project funded by the Federal Office for Scientific Policy. SAOZ data have also been intensively used in the development of an advanced retrieval algorithm for GOME ozone columns based on direct line fitting of GOME ultraviolet spectra, within the ESA GODFIT project. Besides this, an algorithm for the vertical profile inversion of stratospheric NO₂ has been designed as part of the EU project QUILT (<http://nadir.nilu.no/quilt>). This algorithm has been validated using various datasets (e.g., Harestua ground-based UV-Vis data in comparison with MIPAS satellite data) and will be applied to the Jungfraujoch data series.

FTIR solar absorption spectrometry

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). Since 2001, BIRA-IASB is focusing on the development and characterisation of vertical inversion techniques. After a complete characterisation of the vertical profiles of ozone retrieved from the FTIR spectra, a similar procedure has been applied to FTIR measurements of CO. The retrieved vertical profiles and total columns have been compared with in-situ surface measurements of CO done by EMPA and with observations of CO from the satellite instrument MOPITT onboard Terra. Overall the agreements are very good, taking into account the limits of each measurement technique. The results prove the sensitivity of the FTIR measurements

of CO from the lower stratosphere down to the surface. This shows that the FTIR spectrometry has a unique capability to derive tropospheric abundances for a number of species for which hardly any other experimental data exist at present.

In 2003 the EC project UFTIR (<http://www.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 additional species (N₂O, CH₄, C₂H₆, HCFC-22), re-analysing the existing time series, and comparing them with model results.

In 2003, 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>). More valuable results are expected in 2004, when we will get reprocessed ENVISAT data from ESA.

Key words

Ozone, NO₂, CO, 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>).

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
- Initiation of collaborations with A. Prévot (PSI), S. Reimann (EMPA) and I. Balin (EPFL).
- Collaboration with the GOME and ENVISAT satellite communities

Scientific publications and public outreach 2003:

Refereed journal articles

B. Barret, M. De Mazière and E. Mahieu, Ground-based FTIR measurements of CO from the Jungfraujoch: characterisation and comparison with in-situ surface and MOPITT data, *ACP*, 3, 2217-2223, 2003.

Newman, P.A., N. R. P. Harris, A. Adriani, G. Amanatidis, J. Anderson, G. Braathen, W. Brune, K. Carslaw, M. Craig, P. DeCola, M. Guirlet, S. Hipskind, M. Kurylo, H. Küllmann, N. Larsen, G. Mégie, J.-P. Pommereau, L. Poole, M. Schoeberl, F. Stroh, B. Toon, C. Trepte, and M. Van Roozendael, An overview of the SOLVE-THESEO 2000 campaign, *J. Geophys. Res.*, 107, doi:10.1029/2001JD001303, 2002.

Book sections

M. De Mazière, and B. Barret, Retrieval of tropospheric information from ground-based FTIR observations, supported by synergistic exploitation of various ground-based and space-borne measurement techniques and data, in P. Borrell, P.M. Borrell,

J.P. Burrows and U. Platt, *Sounding the troposphere from space: a new era for atmospheric chemistry (TROPOSAT: EUROTRAC-2 Subproject Final Report)*, Springer, 315-326, 2003.

Van Roozendael, M., C. Fayt, C. Hermans, and J.-C. Lambert, Retrieval of tropospheric BrO and NO₂ from UV-visible Observations, in P. Borrell, P.M. Borrell, J.P. Burrows and U. Platt, *Sounding the troposphere from space: a new era for atmospheric chemistry (TROPOSAT: EUROTRAC-2 Subproject Final Report)*, Springer, 67-71, 2003.

Valks, P.J.M., A.J.M. Piters, J.-C. Lambert, C. Zehner, and H. Kelder, A Fast Delivery System for the retrieval of near-real time ozone columns from GOME data, *International Journal of Remote Sensing*, Vol. 24, pp. 423-436, 2003.

Conference papers

M. De Mazière, B. Barret, T. Coosemans, F. Hendrick, J.C. Lambert, V. Soebijanta, M. Van Roozendael, Validation of MIPAS operational level 2 products using ground-based network data, oral presentation at ASSFTS11, October 8-10, 2003, Bad Wildbad, Germany.

De Mazière, M., T. Coosemans, B. Barret, T. Blumenstock, P. Demoulin, H. Fast, D. Griffith, N. Jones, E. Mahieu, J. Mellqvist, R. Mittermeier, J. Notholt, C. Rinsland, A. Schulz, D. Smale, A. Strandberg, R. Sussmann, S. Wood, and M. Buchwitz, Validation of ENVISAT-1 level-2 products related to lower atmosphere O₃ and NO_y chemistry by an FTIR quasi-global network, in Proc. First ENVISAT Validation Workshop, ESA/ESRIN, Italy, 9-13 Dec. 2002, ESA SP-531, 2003.

Lambert, J.-C., J. Granville, M. Allaart, T. Blumenstock, T. Coosemans, M. De Mazière, U. Friess, M. Gil, F. Goutail, D. V. Ionov, I. Kostadinov, E. Kyrö, A. Petritoli, A. Piters, A. Richter, H. K. Roscoe, H. Schets, J. D. Shanklin, V. T. Soebijanta, T. Suortti, M. Van Roozendael, C. Varotsos, and T. Wagner, Ground-based comparisons of early SCIAMACHY O₃ and NO₂ columns, in Proc. ENVISAT Validation Workshop, Frascati, 9-13 Dec. 2002, ESA SP-531, 2003

Lambert, J.-C., V. Soebijanta, Y. Orsolini, S. B. Andersen, A. Bui Van, J. P. Burrows, Y. Calisesi, C. Cambridge, H. Claude, M.-R. De Backer-Barilly, J. de La Noë, M. De Mazière, V. Dorokhov, A. Fahre Vik, S. Godin-Beekmann, F. Goutail, G. H. Hansen, G. Hochschild, B. A. Høiskar, P. V. Johnston, N. Kämpfer, K. Kreher, E. Kyrö, J. Leveau, J. Mäder, G. Milinevski, J-P. Pommereau, P. Quinn, U. Raffalski, A. Richter, H. K. Roscoe, J. D. Shanklin, J. Staehelin, K. Stebel, R. Stubi, T. Suortti, K. K. Tørnkqvist, M. Van Roozendael, G. Vaughan, and Folkart Wittrock, Coordinated Ground-based Validation of ENVISAT Atmospheric Chemistry with NDSC Network Data: Commissioning phase Report, in Proc. First ENVISAT Validation Workshop, ESA/ESRIN, Italy, 9-13 Dec. 2002, ESA SP-531, 2003.

Note: the ESA SP-531 papers can be consulted at

http://envisat.esa.int/pub/ESA_DOC/envisat_val_1202/proceedings

Thesis

B. Barret, Inversion et caractérisation de profils de constituants atmosphériques à partir de mesures FTIR sol, Thèse soutenue à l'Université Libre de Bruxelles, le 19 septembre 2003 (Promoteur: P.C. Simon, Co-promoteur: M. De Mazière) - grade obtenu: Docteur en Sciences.

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