

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. M. Van Roozendael: project leader UV-Vis

Dr. Martine De Mazière: project leader FTIR

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Project description:

UV-Vis (main results, significance of results, progress in 2012)

The long-term monitoring of ozone and nitrogen dioxide stratospheric columns initiated in 1990 as part of the BIRA-IASB contribution to the Network for the Detection of Atmospheric Composition Change (NDACC) has been continued in 2012 using the SAOZ instrument. Quality checked data have been regularly submitted to the NDACC data base hosted at NOAA. In addition to the SAOZ stratospheric monitoring, BIRA-IASB has been operating a new MAXDOAS instrument since June 2010. This instrument provides complementary measurements of total contents and tropospheric vertical distributions of a number of trace gases, incl. NO₂, O₃, H₂CO, BrO, H₂O and aerosols. The data analysis is currently ongoing as part of the BIRA-IASB contribution to the EU FP7 NORS (Demonstration Network Of ground-based Remote Sensing Observations in support of the GMES Atmospheric Service) project as well as within the EU FP7 ACTRIS project. In these projects, the primary focus is on tropospheric NO₂ retrieval and their link to in-situ measurements performed by EMPA at the Jungfraujoch station. A second important objective of the NORS project is to set up an operational processing chain for near-real-time delivery of key data sets in support of the GMES Atmospheric Service, currently developed within the EU FP7 MACC-2 project.

Another ongoing activity as part of the national project AGACC-II concerns the study of the possible synergistic use of MAXDOAS and FTIR measurements for formaldehyde (H₂CO) measurements at the Jungfraujoch. In this context, an intercomparison exercise of H₂CO slant columns measurements has been conducted by BIRA using MAX-DOAS data from the international CINDI (Cabouw Intercomparison of Nitrogen Dioxide measuring Instruments) campaign that took place in Cabouw, The Netherlands, in June-July 2009. Nine atmospheric research groups simultaneously operating MAX-DOAS instruments of various designs were involved in this exercise. This study has led to a major consolidation of the H₂CO DOAS analysis methodology (Pinardi et al., 2012) which now forms the basis for more challenging measurements at the high altitude Jungfraujoch station. Preliminary comparisons with FTIR measurements have been conducted highlighting the need to better investigate the impact of the large difference in the height-dependent sensitivity of both techniques.

FTIR solar absorption spectrometry (main results, significance of results, progress in 2012)

BIRA-IASB collaborates with the University of Liège (ULg) for the exploitation of the Fourier transform infrared measurements at the Jungfraujoch and it coordinates a number of national (Belgian) and European projects in which the Jungfraujoch measurements play an important role.

We are working on a more advanced analysis of the O₃ trends (total column trends and partial column trends in 4 atmospheric layers based on FTIR data) for the period 1995-2012. In addition to a statistical analysis of the trends with the bootstrap resampling method, we are now also investigating a regression analysis, highlighting the various processes that impact the observed O₃ variability and trends. Also non-European stations are included in the study.

The study is part of the SI²N initiative¹ and will be published in a special issue dedicated to SI²N. The Jungfraujoch data represent the northern mid-latitude situation in this study.

The work on the coordinated validation of the IASI FORLI CO and HNO₃ data, using NDACC FTIR data, has been published in 2012 for CO (Kerzenmacher et al., 2012) and will be published in 2013 for HNO₃.

BIRA-IASB is partner in the EU FP7 ACTRIS Research Infrastructure project. It is responsible for investigating how VOC remote sensing measurements can be linked to in-situ measurements. To this end, it uses the FTIR data at the Jungfraujoch, for CO and C₂H₆. Preliminary results have been reported but the study is still ongoing.

The Jungfraujoch is one of the 4 demonstration stations in the EU FP7 project NORS that is coordinated by BIRA-IASB and started in November 2011 (<http://nors.aeronomie.be>). Concerning the FTIR measurements, we will work on CO, CH₄, NO₂ and H₂CO. The objective is to make a more rapid data analysis and submission to the NDACC database, for use in the validation of the GMES Atmospheric Service products. Research will be undertaken as to common retrieval strategies for NO₂ and H₂CO, and regarding a better characterisation of the FTIR data products (error budgets, representativeness...).

Key words:

Atmospheric composition, long-term monitoring, optical remote sensing, vertical inversion methods, satellite and model validation

Internet data bases:

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- The data are archived in the NDACC database (<http://www.ndacc.org/>), 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>).
 - A revised HDF GEOMS format for UV-Vis DOAS data products has been implemented at the NDACC data base, as a contribution to the NORS project
 - The GEOMS HDF format for FTIR vertical profile data has been implemented at the NDACC database.
 - In the frame of NORS, the data submission will be done in the GEOMS HDF format to the NDACC database, within 1 month after data acquisition.

Collaborating partners/networks:

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- Collaborations with University of Liège and NDACC partners
 - Collaboration with European FTIR and UV-Vis teams and modelling teams in the frame of the EU project NORS;
 - Collaboration with M. Chipperfield of Univ. Leeds.
 - Both the UV-Vis and FTIR observations contribute to the international Network for the Detection of Atmospheric Composition Changes (NDACC).
 - Collaboration with B. Buchmann, D. Brunner, S. Henne, S. Reimann and M. Steinbacher of EMPA (NORS and ACTRIS projects)
 - Collaboration with F. Goutail and A. Pazmino of LATMOS, France (SAOZ)
 - Collaboration with the GOME, ENVISAT, OMI, ACE and MetOp GOME-2 and IASI satellite communities.
 - Collaboration with Université Libre de Bruxelles for IASI FORLI data validation.

¹ SPARC/IO₃C/IGACO-O3/NDACC Activity on Past changes in the Vertical Distribution of Ozone

Scientific publications and public outreach 2012:

Refereed journal articles and their internet access

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<http://infrared.aeronomie.be/>
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