CS/07

AGGAC II

Advanced exploitation of Ground-based measurements for Atmospheric Chemistry and Climate applications

DURATION OF THE PROJECT
15/12/2010 – 14/12/2014

BUDGET
1.194.472 €

KEYWORDS
Ground-based remote sensing; atmospheric composition, climate change, spectrometry

CONTEXT

AGACC-II fits in the national and international efforts to monitor the variability and long-term evolution of the atmosphere, and to identify and understand the interaction between atmospheric changes and environmental changes. There is a particular focus on climate change. Better understanding of the impact of human activities on the atmosphere and climate is essential to decide new policies to protect our natural environment. AGACC-II also fits in our national obligations to report environmental parameters: results will be integrated in national and international assessments of the evolution of the ozone layer and of the climate, and they will support appropriate decision making.

PROJECT DESCRIPTION

Objectives

The general objective of AGACC-II is to improve different techniques of ground-based remote sensing of the terrestrial atmosphere. These techniques are: Brewer, MAXDOAS and Fourier transform infrared spectrometry (FTIR), and sunphotometry. We will also deploy an aerosol lidar instrument (ceilometer). The observations will take place at 3 operational sites: Ukkel, Jungfraujoch in the Swiss Alps, and Ile de La Réunion East of Madagascar in the Indian Ocean. We will start measuring at a fourth site namely at the University of Bujumbura in Burundi.

We can distinguish four, more specific, objectives:

(1) The derivation of new information on important atmospheric greenhouse gases, namely carbon dioxide, methane and nitrous oxide (CO_2, CH_4 and N_2O, resp.) and carbon tetrafluoride (CF_4) and carbon tetrachloride (CCl_4).

(2) The expansion and / or improvement of the series of atmospheric constituents that can be measured from the ground with FTIR spectrometry, such as methyl chloride (CH_3Cl), methanol (CH_3OH), ethylene (C_2H_4), acetone ($(CH_3)_2CO$) and PAN (peroxyacetyl nitrate, $C_2H_3NO_5$). At Jungfraujoch, we will also try to detect and quantify more substitutes for CFCs, such as HFC-134a (CH_2FCF_3). These are extremely important in the context of the Montreal and Kyoto Protocols.

(3) Increasing our expertise in the field of aerosol remote sensing, and determining the direct impact of these aerosols on the radiation balance. We will seek to determine additional optical parameters of the aerosols. An aerosol lidar instrument will provide information on the vertical distribution and measure the height of the boundary layer.

(4) The study of emissions over Africa. We will perform MAXDOAS measurements of aerosols and some ozone precursors such as glyoxal, formaldehyde and tropospheric nitrogen dioxide (NO_2) in Bujumbura. We will study the transport from Africa to the Indian Ocean.

Methodology

New or improved so-called “inversion strategies” will be designed to derive geophysical parameters from the spectral data of the different instruments. Thereby we will fully exploit the synergy between the different instruments. We will also conduct laboratory experiments to improve the quantitative spectroscopic parameters of some atmospheric gases. These parameters are essential in the development of inversion strategies.

Where possible, long time series (at Jungfraujoch since 1976!) will be analyzed with the new or optimized inversion strategies and spectroscopic data. Seasonal and annual variations of the various gases will be studied and these will be compared with model simulations and satellite data. Transport will be studied using FLEXPART simulations.

INTERACTION BETWEEN THE DIFFERENT PARTNERS

The four partner institutes will combine their complementary expertise and instrumentation. The KMI-IRM is responsible for the ceilometer and Brewer spectrometer. Together with the BIRA-IASB, it will use the sunphotometric data. The BIRA-IASB has expertise in MAXDOAS technology and in FTIR spectrometry in the near and mid-infrared at Ile de la Réunion. The ULg is an expert in FTIR observations in the mid-infrared at Jungfraujoch. The ULB will support the observations by delivering spectroscopic parameters based on laboratory measurements, for which it has an international reputation.

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EXPECTED OUTCOMES; LINK WITH INTERNATIONAL PROGRAMMES

The AGACC-II data will be very useful for the verification of global and regional chemistry climate models. The latter are used to understand atmospheric processes and biogeochemical cycles, and to predict the future state of the atmosphere and climate. In addition, laboratory and field data will be delivered to international databases such as HITRAN and GEISA on one hand and NDACC (Network for the Detection of Atmospheric Composition Change) and TCCON (Total Carbon Column Observing Network) on the other hand. The partners KMI-IRM, ULg and BIRA-IASB have been members of the NDACC network for a long time. Thanks to AGACC-II the BIRA-IASB also hopes to qualify as a member of the TCCON network.
Some results will be immediately attractive to policymakers: long-term trends of greenhouse gases, direct effect of aerosols on the radiation balance over Ukkel, organic chlorine and fluorine budgets, ... But in the longer term, all AGACC-II results are relevant for environmental policy, because atmospheric composition monitoring provides essential inputs to every environmental report for assisting policymakers.

PARTNERS

Activities

We have already indicated what role they play in the project. Here we look into the overall activities of the partners (and / or institutions) themselves, and why they are important for this project.

BIRA-IASB and KMI-IRM: Federal Scientific Institutions of the Space Pole

- The BIRA-IASB conducts research in space aeronomy, i.e. the chemistry and physics of the atmospheres of the Earth and other objects in the solar system. Related service delivery to the population and the government is also one of its tasks.
- The KMI-IRM delivers services to the population and the government in terms of hydro-meteorology, climatology, and geophysics. These services are supported by observations and scientific research.

The GIRPAS team of the University of Liège is doing atmospheric research since the seventies, from the ground, balloons and satellites. It is best known for his long time series of high-quality data from the observatory of Jungfraujoch.

The SCQP partner of the Université Libre de Bruxelles has an international reputation in high-resolution molecular laboratory spectroscopy. Its goal is to provide reference data to support research on planetary atmospheres.

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Follow-up Committee

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