IKARE

Improving Knowledge of the Amazon Rainforest Emissions

DURATION	BUDGET
15/12/2015 – 15/03/2018	**149 940 €**

PROJECT DESCRIPTION

1) <u>Context / objectives / methodology</u>

The Amazonian rainforest has a significant impact on air quality via the emission of biogenic volatile organic compounds (VOC) which are responsible for the photochemical production of ozone and other atmospheric oxidants. The deforestation has exacerbated the fire occurrences in this region, which impacts climate change via the release of carbon (CO_2, CH_4, CO, VOC, …) in the atmosphere. Despite the impact of the Amazon region on climate change and human health, ground-based measurements over the region are very sparse. There is a crucial need, in particular for model and satellite validation, of such ground-based data in Amazonia.

This led us to perform the measurements of such key atmospheric species at Porto Velho (8.8°S, 63.9°W), Brazil, at the edge of the Amazon forest (Fig. 1). We rely on the strong expertise in remote sensing Fourier Transform InfraRed (FTIR) solar absorption measurements and data analysis that we acquired at Reunion Island. At this latter location, we are operating FTIR instruments in the frame of the NDACC (Network for the Detection of Atmospheric Composition Change) since 2002. The measurements are automated and remotely controlled at BIRA-IASB thanks to the implementation of BARCOS (Bruker Automation and Remote Control System). We also rely on the preparatory work that was carried out in the project BAAF (Cooperation agreement BL/35/FWI09). Through this project, the collaboration with the local Brazilian partner (IFRO) has been initiated, and our FTIR Bruker 125M spectrometer has been installed and put into operation in Porto Velho in June 2016.

In the IKARE project, we focus on the analysis of six species, to improve our knowledge of the Amazon rainforest emissions: formaldehyde (HCHO), methanol (CH_3OH), formic acid (HCOOH), carbon monoxide (CO), ethane (C_2H_6) and hydrogen cyanide (HCN).

We have five main objectives:

- **to optimize the spectra measurements for the cloudy conditions at Porto Velho.** This will be done by adapting the BARCOS system.

- **to provide optimized retrieval strategies for the six species under very humid conditions.** The retrieval software is SFIT4. Spectral micro-windows, a priori information of the target vertical profiles, choice of the regularization matrix in the inversion process, spectroscopic database, are the main parameters to be optimized in order to obtain the best possible data.

- **to provide the species time-series and associated variability at Porto Velho and archive the data for future validation purposes.** The time-series include the total columns and the low vertical resolution profiles which will be provided with their associated averaging kernels and uncertainty budgets. We will then study the amounts, seasonal cycles and day-to-day variability of the species. For formaldehyde, which has a short lifetime of 2-3 hours, we will be able to provide the diurnal cycle.

- **to compare with model data and evaluate the model input parameters.** For the available species (all the target gases, except HCN), we will compare with the model IMAGES, which is developed at BIRA-IASB and we will evaluate the model input parameters (emission databases EDGAR, GFED, emission ratios,…) by performing sensitivity studies. For HCN, the comparisons will be made with the GEOS-Chem model.

- **to explore the impact of different vegetation sources on the atmospheric composition at Porto Velho and derive emission ratios.** Particular features in the data will be explored using air mass trajectories from model FLEXPART and other data (e. g. MODIS Fire data) to detect where the source area is located and if a source can be assigned (e.g. biomass burning events). When peaks can be related to biomass burning events, we can derive the emission ratios as a function of the burned vegetation type.

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2) Impact of the project for the scientific community and the society

- A longer-term objective of the project is to **start long-term monitoring at Porto Velho and to certify this site as a new NDACC station**. This will increase the significance of the network by adding an instrument in a region of the world where ground-based observations are very sparse. This will increase the role of BIRA-IASB at the international level.

- Providing ground-based data in this region is of **great interest for the satellite community** which is lacking data for validation of their products in this part of the world (e.g. our HCHO data will be used in the TROVA project for the TROPOMI validation).

- Information on the species' concentrations, their diurnal and seasonal cycles and on emission ratios is strongly **needed by the modelling community** for verification of the model inputs and processes.

- The project is of great interest for the **local scientists**: they are associated to the instrumental operation of a new observatory and to the scientific studies that will be made with the data. This project will contribute to the education in the field of atmospheric research at the local university IFRO.

- **All the target gases of the project have an impact on air quality, so on human health.**

3) Outreach

The short-term outreach is the presentation of our results in conferences. Our first time-series of HCHO (4 months of data; Fig. 2) has been already shown in an oral presentation at the ACVE conference (18-20th October 2016). On the long-term, publication(s) in peer-reviewed scientific journals are planned.

CONTACT INFORMATION

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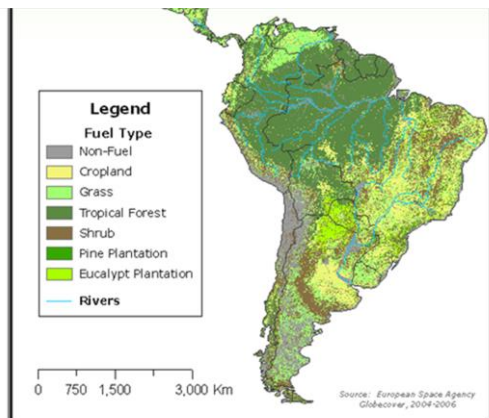Ciência eTecnologia de Rondônia (IFRO)
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Fig. 1: Vegetation type in South America and Porto Velho location.
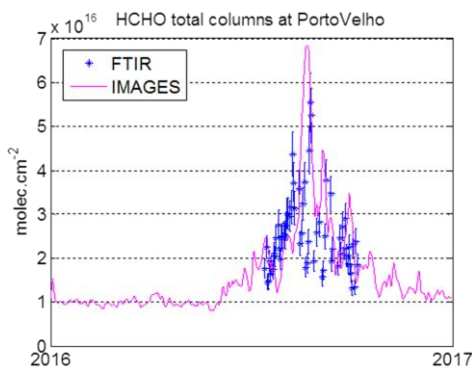

Fig. 2: Formaldehyde total columns at Porto Velho from FTIR measurements (in blue) and from the model IMAGES (in magenta: the model simulations have been performed for the year 2014).