OCTAVE

Oxygenated organic Compounds in the Tropical Atmosphere: variability and atmosphere-biosphere Exchanges

DURATION
15/01/2017 - 15/04/2021

BUDGET
632 378 €

PROJECT DESCRIPTION

Oxygenated Volatile Organic Compounds (OVOCs) have a significant impact on the atmospheric oxidative capacity and climate. Methanol, acetaldehyde and acetone are among the most abundant OVOCs, especially in the marine atmosphere. However, large discrepancies in OVOC budget estimates still exist, mostly due to incomplete representation of photochemical OVOC production, and uncertainties in terrestrial emissions and ocean/atmosphere exchanges of OVOCs and their precursors. The paucity of OVOC observations in tropical regions strongly contributes to those uncertainties. A better understanding of OVOC sources and sinks is required to quantify their impact on atmospheric oxidants, on the lifetime of methane and consequently on climate.

The OCTAVE project aims to provide an improved assessment of the budget and role of OVOCs in tropical regions, and especially over oceans, relying on an integrated approach combining in situ measurements, satellite retrievals and modelling. The specific objectives are:

- to generate a 2-year dataset of atmospheric measurements of OVOCs and related compounds by mass spectrometry (PTR-MS) and remote sensing infrared spectroscopy (FTIR) at the high-altitude site of Maïdo (2155 m a.s.l.) on Reunion Island, in the Indian Ocean
- to identify and quantify OVOC sources contributing to the measurements at Reunion Island, with the help of multivariate statistical analysis, back trajectory calculations and 3-dimensional modelling.
- to apply an innovative methodology to generate improved and better characterized global distributions of the column abundances of methanol and other VOCs using multi-annual remote sensing data from the IASI (Infrared Atmospheric Sounding Interferometer) sensor on the MetOp satellite.
- to perform an updated model evaluation of the budget of OVOCs, based on spaceborne data (for CH_3OH) and a wide collection of aircraft, ship-based and ground-based measurements, including those obtained at La Réunion. The resulting impact of OVOCs on the oxidizing capacity of the atmosphere will be determined.

Local measurements at the Maïdo observatory will be performed by BIRA-IASB with both PTR-MS and FTIR. PTR-MS will provide long-term high temporal resolution concentration measurements at ground level. Continuous FTIR measurements with a Bruker high-resolution spectrometer will provide total columns of many compounds, among which several OVOCs and related species (e.g. CH_3OH, CO, C_2H_2, HCOOH, HCHO). The time series of the target gases obtained with both techniques will allow determining their seasonal and diurnal cycle and day-to-day variability. The international partner of the project, CNRS/LACy at La Réunion, will contribute to the identification of (O)VOC sources and sinks at regional scale by using the FLEXPART Lagrangian model coupled with the ECMWF global forecasts at 15km resolution. A Bayesian inversion model will be applied on the in-situ (O)VOC concentration measurements to estimate the source and sink surface fluxes based on source-receptor relationships calculated by FLEXPART.

At ULB, the spatial distributions of several VOCs in the tropical region will be retrieved from the IASI sensor for a 10 year period (2008-2018) using an innovative methodology, relying on hyperspectral indices and neural networks. Altogether, this suite of observations from a single sounder will provide a rather unique view of the sources and transport patterns in the tropical regions, which will complete the local measurements made at La Reunion.

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The global CTM IMAGESv2 will be used at BIRA-IASB to assess the role and budget of methanol, acetone and acetaldehyde in tropical regions, using the spaceborne and ground-based observations obtained in the project. An inverse modelling framework based on IMAGES will be used to constrain OVOC sources and sinks based on IASI data, on in situ data at Reunion Island as well as on data obtained during previous measurement campaigns.

The expected outcome of the project will be a better understanding of atmosphere-biosphere exchanges and their variability, with a focus on the Tropics and especially on oceanic regions, important modulators of the climate change. The identification and quantification of (O)VOC sources and sinks is very important for understanding the evolution of the atmosphere as a whole, and for assessing the respective roles of natural emissions and human-induced changes on the Earth System. The better understanding of (O)VOC emissions and their impact on the oxidizing capacity of the atmosphere, or the possible identification of so far unknown processes should open new science directions, and enhance further collaborations. The broader implications could impact decision-making through the integration of the results in Earth System models and the study of their impacts.

View of the Maïdo Observatory at Reunion Island

CONTACT INFORMATION

Coordinator

Trissevgeni STAVRAKOU
Royal Belgian Institute for Space Aeronomy (BIRA-IASB)
Department Atmospheric Composition
trissevgeni.stavrakou@aeronomie.be

Partners

Pierre-François COHEUR
Université Libre de Bruxelles (ULB)
pfcoheur@ulb.ac.be

Jérôme BRIOUDE
LACy, CNRS and Université de La Réunion, Réunion, France
jerome.brioude@univ-reunion.fr

Project research scientists

Crist Amelynck, Maite Bauwens (BIRA-IASB), Lieven Clarisse, Cathy Clerbaux (ULB), Aurélie Colomb (CNRS-LAMP), Christian Hermans, Martine De Mazière, Jean-François Müller, Corinne Vigouroux, Niels Schoon (BIRA-IASB), Pierre Tulet (CNRS-LACy), Bert Verreyken (BIRA and CNRS-LACy)

LINKS

http://octave.aeronomie.be

Tropospheric Modelling group of BIRA-IASB
http://tropo.aeronomie.be/ and
http://emissions.aeronomie.be

Infrared observation group of BIRA-IASB
http://infrared.aeronomie.be/fr/index.php

Chimie Quantique et Photophysique Department of ULB
http://www.ulb.ac.be/cpm/index.html

The LACy Tropospheric team
http://lacy.univ-reunion.fr/equipe/troposphere

BELGIAN SCIENCE POLICY OFFICE
Louizalaan 231 Avenue Louise • B-1050 Brussels
Tel. +32 (0)2 238 34 11
http://www.belspo.be/brain-be/ • Email : BRAIN-be@belspo.be

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