



Characterizing vertical distributions of greenhouse gases from combined ground-based and airborne measurements to validate space missions: the MAGIC initiative

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Carbon dioxide (CO_2) and methane (CH_4) are the two main greenhouse gases (GHG) emitted by human activities. To better understand their concentration and vertical distribution in several key regions and to prepare future space missions dedicated to GHG, the MAGIC initiative has been put in place. MAGIC stands for: Monitoring of Atmospheric composition and Greenhouse gases through multi-Instruments Campaigns. Gathering about 40 scientists all together, the campaigns have two main goals: (i) to better understand the vertical exchange of GHG along the atmospheric column, in connection with atmospheric transport, sources and sinks of the gases at the surface and in the atmosphere; (ii) to contribute to the preparation and validation of space missions dedicated to the monitoring of greenhouse gases.

To address these objectives, various instruments are deployed on various platforms: aircraft, balloons, ground. They perform simultaneous observations of GHG concentration: direct in-situ observations at the surface or along the vertical, total and partial weighted columns. The MAGIC campaigns rely on SAFIRE Falcon20 measurements of gas concentrations, temperature/humidity/wind/particles and GHG ($CO_2/CH_4/CO/H_2O$) between 0 and 11 km altitude. The Falcon20 allows flying under any satellite tracks and making 0-11 km profiles at specific locations, such as ICOS/TCCON sites. They are complemented by balloon-borne instruments making 0-30 km profiles with AirCore atmospheric samplers and Amulse light laser-diode spectrometers launched at Aire-sur-l'Adour and Trainou, as well as by measurements of total columns with portable Fourier Transform Spectrometers from the ground (EM27sun and CHRIS).

The 2 first MAGIC campaigns have been organized in January and May 2018, the latter in the framework of the CoMet (Carbon dioxide and Methane) campaign lead by DLR. In particular, on May 24th, a coordinated flight between SAFIRE/Falcon20 and DLR/HALO has been performed to compare the column of CH_4 measured by the lidar CHARM-F on board HALO to the column computed from simultaneous Falcon20 and AirCore profiles. Altogether, 2 research aircrafts, 23 launches of meteorological balloons, four ICOS instrumented sites and a dozen instruments for measuring the concentration of gases have been deployed for the 2018 campaign.

This talk will present the results obtained during the MAGIC2018 campaign and highlight the strong benefit of having simultaneous measurements by aircraft, balloons and ground-based FTS to validate space missions. Plans for next MAGIC campaigns that will be organized in July 2019 in France and in summer 2020 tentatively in Sweden will be given.