



An ICOS laser spectrometer for regular in-situ measurements of CH₄ and CO₂ aboard the CARIBIC passenger aircraft

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The flying laboratory CARIBIC (Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrument Container) has now successfully been running for more than 10 years and has already delivered a vast and valuable variety of data concerning atmospheric gases and aerosol particles. Passenger aircrafts operate at an altitude of 8-12 km and thus in the upper troposphere and lowermost stratosphere (UT/LMS), which is a dynamically, chemically, and radiatively extremely complex and not well understood region of the atmosphere. The monthly operation of CARIBIC *inter alia* enables to study seasonal and interannual variations of the measured gases and particles and results in a unique dataset for the validation of satellite observations and model results.

The CARIBIC measurement container is currently undergoing a period of reconstruction with the integration of both improved and new instruments. Here we present a new instrument for simultaneous in-situ measurements of methane (CH₄) and carbon dioxide (CO₂). Of these important greenhouse gases, CH₄ has - until now - only been measured by laboratory analysis of 14 gas samples collected during each flight. However, our newly developed instrument - which is based on off-axis integrated cavity output spectroscopy (OA-ICOS) - provides a very high temporal (≥ 1 s) and spatial (≥ 250 m) resolution. The OA-ICOS technique allows for high sensitivity due to its long effective absorption path length, and its optical and mechanical integrity. It is thus a highly suitable tool for measurements under harsh aircraft conditions.

The instrument setup as well as the laboratory characterization with respect to precision and accuracy will be described. Based on the first actual flight data, an outlook will be given as to the contribution of our measurements to the current state of research.