

Better understanding of anthropogenic greenhouse gas emissions using aircraft-borne in-situ observations: Overview on first measurement results and future activities at DLR-IPA

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One of the main objectives of the “Paris Agreement” is to keep the global temperature rise this century well below 2°C above pre-industrial levels. This ambitious goal can only be achieved by a severe reduction of greenhouse gas emissions. The development of efficient mitigation strategies however requires detailed knowledge of current emission source strengths for the two main anthropogenic greenhouse gases, carbon dioxide (CO₂) and methane (CH₄). Usually, estimates of anthropogenic emissions are based on “bottom-up” calculations by using activity rates multiplied with specific emission factors, but it is well-known that these estimates inhibit large total uncertainties. Therefore, there is a strong need for an *independent* and *objective* verification of emissions from individual sources based on atmospheric observations, usually referred to as “top-down” approaches. While “top-down” studies based on satellite data provide information on global and regional scales, airborne in-situ measurements reveal more detailed insights into specific, individual sources on smaller, local scales. Thus, the airborne measurements allow the study of single emission sources with high spatial resolution and accuracy.

Here we present an overview on current activities at DLR-IPA to conduct and analyze airborne in-situ observations for a better understanding and quantification of emissions from two of the main anthropogenic sectors: *fossil fuel extraction* and *urban agglomerations*. We report on recent greenhouse gas measurements carried out onboard the German research aircraft HALO during the EMerGe (Effect of **M**egacities on the Transport and Transformation of Pollutants on the **R**egional to **G**lobal Scales) campaigns in Europe and Asia, as well as from observations made onboard the NASA-C130 aircraft during the recent ACT (**A**tmospheric **C**arbon and **T**ransport) - America deployments.

Finally, we will present future in-situ measurement activities using the two DLR aircraft Cessna Caravan and Falcon. Within the CoMet (**C**O₂ and **M**ethane) mission in Upper Silesia in June 2018, we aim to study methane emissions from one of the strongest European sources of coal extraction located in Upper Silesia in Poland. The in-situ measurements will be supported by airborne remote sensing and ground-based measurements. Furthermore, state-of-the-art modelling activities are planned to support the data analyses. Within the project Methane-To-Go, first airborne greenhouse gas measurements will be carried out in 2019 to study the Methane emissions from the Offshore Gas and Oil operations in the Persian/Arabian Gulf region, one of the hot spot regions worldwide of fossil fuel extraction.