# 1.098 Greenhouse Gas Emissions from Major Population Centers in Europe and Asia: Aircraft-borne CH4 in-situ observations during the EMeRGe field missions.

Early Career Scientist

Presenting Author:
**Theresa Klausner**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany, theresa.klausner@dlr.de

Co-Authors:
**Anke Roiger**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Hans Schlager**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Heidi Huntrieser**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Helmut Ziereis**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Robert Baumann**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Mariano Mertens**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Lisa Eirenschmalz**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Paul Stock**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Michael Lichtenstern**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Greta Stratmann**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Alina Fiehn**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Patrick Jöckel**, German Aerospace Center (DLR), Institute of Atmospheric Physics, Oberpfaffenhofen, Germany
**Rebecca Fisher**, Royal Holloway University of London, Egham, United Kingdom
**Maria Dolores Andrés Hernández**, University of Bremen, Institute of Environmental Physics and Remote Sensing, Bremen, Germany
**John P. Burrows**, University of Bremen, Institute of Environmental Physics and Remote Sensing, Bremen, Germany

Abstract:

Major Population Centers (MPCs) accommodate more than half of the world population but cover only 2% of the terrestrial Earth's surface. Thus industry, energy usage, air pollution, and enhanced greenhouse gas emissions agglomerate in narrow areas. About one third of global anthropogenic methane ($CH_4$) originates from urban agglomerations, i.e. from pipeline leaks, landfills, and sewage treatment plants. Emission inventories significantly underestimate these emissions by 7-15%. However, a more accurate quantification is needed to develop efficient mitigation strategies for reducing $CH_4$.
We report on aircraft-borne $CH_4$ in-situ measurements during EMeRGe, investigating the *Effect of Megacities on the Transport and Transformation of Pollutants on the Regional to Global Scales*. Mission flights were carried out with the German research aircraft HALO over Europe (July 2017 from Germany) and Asia (March-April 2018 from Taiwan) probing pollution plumes of various MPCs mainly at altitudes below 3 km.
Individual $CH_4$ footprints are identified and the increase in $CH_4$ mixing ratio is quantified by using in-situ measurements downwind of selected urban hotspots to better understand the regional impact of urban $CH_4$ emissions. In addition to $CH_4$ further trace gases (e.g. $CO_2$, NOx, CO, $O_3$) are analyzed to identify different potential anthropogenic and natural emission sources. The probed air masses are traced back to their possible emission source area using numerical models.
In-situ observations during EMeRGe-Europe show that $CH_4$ enhancements are most distinctive in the boundary layer, with highest mixing ratios encountered in the Po Valley, London and BeNeLux (up to 2.4 ppm). First analysis indicates that a clear apportionment to individual $CH_4$ sources is hampered by the agglomeration of heavy industry and small cities surrounding MPCs. Sampled emissions from Asian MPCs show similar maximum $CH_4$ concentrations (e.g. Tainan, Manila, Yangtze Delta; up to 2.1 ppm) but in general higher background values at low altitudes compared to Europe.