Geophysical Research Abstracts
Vol. 21, EGU2019-5505, 2019
EGU General Assembly 2019

Major population centres in Europe and Asia as sources for reactive nitrogen species: First results from the aircraft campaign EMeRGe in 2017 and 2018

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Major Population Centres (MPCs) are substantial sources of trace gases and particles. In this context nitrogen oxides are of special interest. On the local and regional scale nitrogen oxides impact directly and indirectly on human health. On all scales they impact on tropospheric chemistry contributing to the catalytic formation of ozone and the oxidizing capacity of air masses. They also control the lifetime of short-lived hydrocarbons and long-lived greenhouses gases like methane.
Within the EMeRGe (Effect of the Transport and Transformation of Pollutants on the Regional to Global scales) – project, measurements have been performed with the German research aircraft HALO (High Altitude and Long Range Research Aircraft) in the summer 2017 and spring 2018.
During the summer deployment phase in July 2017, the pollution plumes of European MPCs such as London, Rome, the Ruhr area and the Po valley were probed. During the spring deployment phase in March and April 2018 aircraft measurements have been conducted to study the emission plumes from Asian MPCs in China, Japan, Korea, the Philippines and Taiwan.
Here, the focus is laid on the measurement of nitric oxide (NO) and the sum of all reactive nitrogen species (NO_y). These observations are presented and discussed together with related and relevant trace gases as carbon monoxide, ozone and others. It was found that MPCs emissions substantially increase the burden of nitrogen oxides especially in the boundary layer. Total reactive nitrogen and carbon monoxide enhancements were highly correlated. While median nitrogen oxides concentration levels are comparable in both regions, significantly higher CO median values have been observed during EMeRGe-Asia. The ratio of these two trace gases is used to study the emission characteristics of source regions in Europe and Asia. Additionally, dispersion simulations and back-trajectory calculations are used to trace back the origin of the probed air masses and to evaluate the influence of the air mass age on the observed trace gas ratios.