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High Altitude and Long-range Aircraft (HALO) measurements of carbon monoxide and methane to characterize dynamical transport processes in the tropical upper troposphere

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The dynamics and transport processes in the upper troposphere are of great importance for the global long-term distribution of greenhouse gases and pollution tracers, and hence for the anthropogenic impact on the Earth climate. Especially in the tropics, large amounts of carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are produced by e.g. biomass burning, anthropogenic and agricultural activities. These tracers are vertically transported by deep convective cells in the InterTropical Convergence Zone (ITCZ) into the Tropical Tropopause Layer (TTL). Long-range transport processes distribute the tracers globally, which have lifetimes of up to years and decades. It is crucial to understand the details of the transport processes and how the tracers are distributed throughout the upper troposphere and the lower stratosphere (UTLS).

During several aircraft campaigns (CAFE Brazil 2022/2023, SouthTrac 2019, CAFE Africa 2018, OMO 2015, ESMVal 2012) CO, CH_4 and N_2O have been measured nearly globally and especially in the tropics with quantum cascade laser absorption spectrometers deployed on the High Altitude and Long-range Aircraft (HALO). Combining these measurements, we can present a good overview of the large-scale distribution of the tracers in particular in the tropical troposphere up to altitudes of approx. 14 km.

The in-situ aircraft measurements will be used to study interhemispheric transport processes and regional trace gas budgets at the base of the TTL. Therefore, they will be further combined and investigated with modelling data and back trajectories.