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In situ CO_2 and tracer observations in the 2015/16 Arctic UTLS with the new HAGAR-V instrument on board the HALO research aircraft

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During the POLSTRACC/GW-LCYCLE/SALSA (PGS) campaign the German High Altitude and LOng range research aircraft (HALO) intensively probed the bottom of the polar vortex and the adjacent mid to high latitude upper troposphere / lower stratosphere (UTLS) throughout the entire winter/spring during the extraordinarily cold Arctic winter 2015/16. A total of 18 science flights were performed from Oberpfaffenhofen, Germany, and Kiruna, Sweden, during three phases, in December 2015, early January to early February 2016, and late February to mid March 2016.

During PGS, the University of Wuppertal deployed for the first time the High Altitude Gas Analyzer –V (HAGAR-V), a new 5-channel in-situ tracer instrument developed for HALO to study the chemical composition, dynamics, and transport in the UTLS. HAGAR-V combines i) a fast CO_2 measurement by NDIR analyzer (every 1-3 s), ii) a 2-channel GC/ECD-system measuring long-lived tracers (during PGS: CH_4, CFC-12, CFC-11 every 90s, SF_6 every 30 s) and iii) a 2-channel GC/MS system targeting short-lived tracers (NMHCs and chlorinated hydrocarbons) with local lifetimes at the midlatitude tropopause ranging from several days to just under a year. The University of Mainz deployed the well-established TRIHOP instrument employing the TDL absorption technique to measure N_2O, CH_4, and CO every 10 s.

We will give an overview of the new HAGAR-V instrument and present the measurements of CO_2 and long-lived tracers, with a focus on the temporal development of vertical distributions and tracer correlations throughout the winter. In particular, an observed change of the correlation of CO_2 with N_2O between January and late February/March is likely caused by isentropic mixing in the high-latitude UTLS. We will also compare the tracer distributions during PGS with those observed from the M55 Geophysica aircraft during previous Arctic campaigns.