

The Polar Stratosphere in a Changing Climate (POLSTRACC): First results from the extraordinary Arctic winter 2015/16

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The aircraft campaign POLSTRACC studied the bottom of the polar vortex and the high-latitude upper troposphere / lower stratosphere (UTLS) along with their impact on lower latitudes throughout the entire winter/spring cycle during the extraordinarily cold Arctic winter 2015/16. The overarching mission goal has been to provide new scientific knowledge on the Arctic lowermost stratosphere and upper troposphere under the present load of halogens and state of climate variables several years after the last intensive Arctic campaigns.

POLSTRACC employed the German High Altitude and Long range research aircraft (HALO) offering a payload capacity of more than 3t, a range of almost 10.000 km and a maximum altitude of about 15 km. The payload comprised an innovative combination of remote sensing techniques providing 2- and partly 3-D distributions of Cirrus, polar stratospheric clouds (PSCs), temperature, and a large number of substances above and underneath the flight level and precise in-situ instruments measuring T, O₃, H₂O, tracers of different lifetimes and chemically active species at the aircraft level with high temporal resolution. Drop sondes added information about the vertical structure of the troposphere and tropopause region. The POLSTRACC consortium includes national (KIT, Forschungszentrum Jülich, DLR, PTB and the Universities of Frankfurt, Heidelberg, Mainz and Wuppertal) and international partners (e.g. NASA).

The field campaign was divided into three phases for addressing (i) the early polar winter vortex and its wide-scale surroundings in December 2015, (ii) the evolution of the mid-winter polar vortex from January to early March 2016, and (iii) the late winter dissipating vortex and its impact on the lower latitude UTLS in March 2016. The airborne field observations were complemented by ground-based activities (e.g. lidars, radars and radio soundings) and satellite observations (e.g. CALIPSO, MLS and ACE-FTS). Mission and flight planning was supported by a variety of model tools.

First results for the winter 2015/16 from the POLSTRACC observations show extended polar stratospheric clouds reaching sometimes even down to HALO flight levels at 13-14 km during almost all HALO sorties in January and February. Particulate NO_y and redistribution of gas-phase NO_y was observed down to HALO flight levels. Significant chlorine activation in the lowermost stratosphere was deduced from observations of HCl and ClONO₂, along with halogen source gas observations which indicated the presence of high levels of inorganic chlorine of more than 1 ppb in the lowermost stratosphere. Aged vortex air masses characterized by high amounts of inorganic chlorine and indications of ozone loss down to potential temperature levels of 380-400K were probed before the major warming started around mid-March.

The presentation is intended to give a brief overview of the mission along with first results.