



ML-CIRRUS - the HALO mission on mid latitude cirrus clouds

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Clouds are a major source of uncertainty in current climate predictions. In particular, the observation of cirrus cloud variability and the classification of cirrus cloud properties in distinct meteorological regimes are prone to substantial ambiguities.

Here we present results of the ML-CIRRUS mission with the German atmospheric science community high altitude long range aircraft HALO. The first in-situ cloud mission with the new research aircraft combined a state-of-the-art cloud instrumentation consisting of 9 wing station probes with a novel aerosol, trace gas and radiation instrumentation and a high spectral resolution LIDAR inside the cabin. Further, a newly designed counter flow virtual impactor system allowed for the detection of ice residuals. In addition, models were specifically developed to support flight planning by forecasts of the occurrence and properties of natural cirrus (CLAMS, ECMWF) and frontal cirrus (WCB-ETH), as well as of aircraft induced clouds (CoCiP).

In March and April 2014, the HALO research aircraft performed 16 flights (88 flight hours) in mid-latitude cirrus clouds and contrail cirrus at longitudes from 15 deg W to 15 deg E and latitudes from 36 to 58 deg N. Cirrus clouds with an ice water content $< 0.5 \text{ mg m}^{-3}$ were encountered up to 14 km altitude over a wide range of temperatures down to 204 K. More than 22 hours of in-situ observations in cirrus clouds plus remote sensing with the radiation instruments and the LIDAR onboard HALO allow to derive statistically significant data sets on microphysical and optical properties of mid latitude cirrus clouds. The clouds were observed in different meteorological regimes including jet stream cirrus, lee wave cirrus and convective clouds - with a strong focus on frontal cirrus. Besides natural cirrus, aircraft induced contrail cirrus were probed during 4 flights and an interesting contrail cirrus outbreak situation was encountered over the Atlantic.

Here we present an overview and first results of the ML-CIRRUS mission. Major progress in cloud research will be achieved by combining the analysis of cirrus clouds properties measured with in-situ and remote sensing instrumentation on aircraft with satellite retrievals of clouds and cloud modelling.