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A Lidar's view on cirrus optical properties during ML-CIRRUS – characterizations in clear and aerosol loaded air masses

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Cirrus clouds play an important role in Earth's radiation budget, and their inadequate representation in global circulation models still leads to high uncertainties in climate prediction. This can only be overcome by gaining more knowledge on cirrus, their formation, microphysics and the influences of the meteorological situation and aerosols. One direct anthropogenic impact on cirrus stems from increasing air traffic. It is known that aviation emissions alter the chemical balance and aerosol composition of upper tropospheric air masses. Beyond the direct creation of contrails, these emissions also have the potential to alter cloud properties of cirrus occurring in affected regions. Another aerosol type that affects the mid-latitudes regularly is Saharan Dust. Although such effects could possibly influence cirrus clouds in large areas, only few observational studies are available to investigate these aspects and their influence on cirrus optical properties.

The ML-CIRRUS campaign 2014 was specifically designed to characterize cirrus in the mid-latitudes and to investigate the influence of aviation and aerosols. Therefore multiple flights with the research aircraft HALO were performed in high air traffic regions, Saharan dust loaded situations, and in unperturbed air masses. We study cirrus clouds found in these conditions by analyzing active remote sensing data from the high spectral resolution and differential absorption lidar WALES mounted aboard HALO. It is capable to provide key optical properties such as backscatter ratio and depolarization ratio, but also the atmospheric water vapor concentration and thus relative humidity. By combining our measurements with trajectory analysis, also information on the origin of the clouds is accessible.

We present our measurements of cirrus clouds in the mid-latitudes and analyze their properties in the context of different aerosol loaded air masses, meteorological situations, and air traffic frequency. Most prominent, we find strong differences in the measured cirrus particle depolarization ratio from case to case, with mode distances in the order of 10 percent points.