Investigation of Arctic mixed-phase clouds during ACLOUD with the novel active and passive microwave package MiRAC

Mario Mech[1], Susanne Crewell[1], Leif-Leonard Kliesch[1], Andreas Anhäuser[1], Andre Ehrlich[2], Manfred Wendisch[2], Stephan Mertes[3], Andreas Macke[3], Roland Neuber[4], and the ACLOUD team

[1]Universität zu Köln, Cologne, Germany
[2]Universität Leipzig, Leipzip, Germany
[3]Leibniz Institute for Tropospheric Research, Leipzig, Germany
[4]Alfred-Wegener-Institute for Marine and Polar Research, Potsdam, Germany

The contribution of Arctic mixed-phase clouds to the Arctic Amplification is still not clear as there are major deficits in their representation in regional and climate models. The Transregional Collaborative Research Center (TR 172) "Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms (AC)³" tries to increase the understanding of these clouds. Within the framework of (AC)³, a major contribution to the aims will be made by the field campaign "Arctic Cloud Observations Using airborne measurements during polar Day" (ACLOUD) conducted in May/June 2017. Two identical but complimentary equipped research aircraft, Polar 5 & 6 by the Alfred Wegener Institute for Polar and Marine Research, Germany, were operated from Longyearbyen at Spitzbergen to investigate Arctic boundary layer mixed-phase clouds by in situ and remote sensing measurements. Flight pattern were coordinated with satellite overpasses and ground-based measurements at the research station in Ny-Ålesund and the research vessel Polarstern which performed comprehensive measurements on board and with an ice floe camp at 80° deg north.

Within this presentation we will introduce the ACLOUD campaign, the instrumentation employed on the aircraft, data collected, and a first analyses of the measurements taken during the flights by the instrumentation on both aircraft. Special focus will be put on the remote sensing instrumentation and its measurements on Polar 5 with the key component the Microwave Radar/radiometer for Arctic Clouds (MiRAC). MiRAC consists of a 94 GHz frequency modulated continuous wave (FMCW) radar and passive radiometer with frequencies in the millimeter/sub-millimeter range at 89 and between 183 and 340 GHz similar to future satellites. The brightness temperatures of the passive components of MiRAC can be used to retrieve the cloud liquid water path, humidity profiles, and cloud ice properties. After correction for aircraft motion and orientation, the radar observations of MiRAC can be used to provide information on the vertical structure of clouds, as well as higher moments of the Doppler spectrum. By the combination MiRAC observation with the lidar, the visuell and infrared measurements and the dropsondes onboard Polar 5, a complete picture of the vertical structure of the clouds over sea ice and open ocean in various arctic summer conditions can be constructed.