Effect of cloud microphysics on particle growth under mixed phase conditions

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Mixed phase clouds contain both ice particles and super-cooled cloud water droplets in the same volume of air. Currently, one of the main challenges is to observe and understand how ice particles grow by interacting with liquid water within the mixed-phase clouds. In the mid latitudes this process is one of the most efficient processes for precipitation formation. It is particularly important to understand under which conditions growth processes are most efficient within such clouds. The observation of microphysical cloud properties from the ground is one possible approach to study the liquid-ice interaction that play a role on the ice crystal growth processes.

The study presented here is based on a ground-based multi-sensor technique. Dataset of this study was taken during the ACCEPT campaign (Analysis of the Composition of mixed-phase Clouds with Extended Polarization Techniques) at Cabauw The Netherlands, autumn 2014. Measurements with the Transportable Atmospheric RAdar (TARA), S-band precipitation radar profiler, from the Delft Technical University, and Ka-band cloud radar systems were performed in cooperation with the Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany. All the radar systems had full Doppler capabilities. In addition , TARA and one of the Ka-band radar systems had full polarimetric capabilities as well, in order to get information of the ice phase within mixed-phase cloud systems. Lidar, microwave radiometer and radiosonde measurements were combined to describe the liquid phase within such clouds. So a whole characterisation of microphysical processes within mixed-phase cloud systems could be done.

This study shows how such a combination of instruments is used to:
- Detect the liquid layer within the ice clouds
- Describe the microphysical conditions for ice particle growth within mixed phase clouds based on cloud hydrometeor shape, size, number concentration obtained from measurements

The project aims to observe, understand and quantify the influence of super-cooled liquid layer on ice crystals growth processes under ambient conditions. In this work, a first analysis of the dataset is presented. Several case studies of changes of the cloud microphysical properties in relation to the presence of liquid water are shown.