Combining multiple scanning cloud radars and microwave radiometers for capturing 3-D structure of clouds

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Clouds play a key role in the hydrological cycle and radiative transfer. However, they occur on a smaller scale than the typical Global Circulation Models (GCMs) grid-box size, thus parametrizations are needed to describe their macrophyisical properties. This leads to uncertainties in cloud representation in GCMs, which should reduced by improving observational techniques and subsequently cloud parametrizations.
In April and May 2013 the High Definition of Clouds and Precipitation for advancing Climate Prediction ($HD(CP)^2$) Observational Prototype Experiment has taken place in Jülich, Germany. The international field campaign provides an intensive observational coverage of clouds and precipitation using different active and passive ground-based remote sensors. The mobile supersites from the Institute for Tropospheric Research of Leipzig (LACROS) and from Karlsruhe Institute of Technology (KIT) were deployed within a radius of four kilometres from the Jülich ObservatorY for Cloud Evolution (JOYCE).
Each of these supersites was equipped with a 35.5 GHz Doppler cloud radar with scanning capabilities, a scanning microwave radiometer and further remote sensing and in-situ sensonrs.
The following strategy for combined elevation scans was implemented: KIT radar performed continuously Range Height Indicator (RHI) scans from 45° to -45° elevation angles. The azimuth angle was adjusted every hour using wind Lidar data, in order to scan along the cross-wind direction. This provided a pencil beam Eulerian view of clouds passing over the area, as well as information on the horizontal inhomogeneity of microphysical processes occurring above. JOYCE radar was run continuously in the so-called “Domus” mode, consisting of six RHI scans from 10° to -10° elevation along six different equidistant azimuth directions. Whenever possible, LACROS radar was run in the Domus mode, using azimuth angles lying exactly in between JOYCE scanning directions to improve azimuth resolution (15 degrees). Furthermore, the scanning microwave radiometer of JOYCE was synchronized with JOYCE radar to perform Domus scans during cloudy days, giving additional information on the liquid water path of observed clouds.
Combining the observations collected at the three supersites, reconstruction of 3-D structures of clouds with high spatial resolution will be obtained and used to investigate cloud sub-grid variability. The results can also represent a test bed for future long-term observations using scanning cloud radars and microwave radiometers.