Retrieval of Ice Microphysics using Simultaneous Measurements at C- and Ka-Band

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The synergy of radars using different wavelength provides additional information on the physics of clouds and precipitation. While C-band weather radar are not sensitive enough to detect small ice and water particles, almost no attenuation is observed for weak or medium precipitation. Radar backscatter is mainly in the Rayleigh regime. On the other hand, Ka-band cloud radars are sensitive to detect small ice and water particles. However, attenuation limits the ability to perform detailed measurements in rain. For particles larger than about 1 mm Mie scatter resonances have to be considered. Dual-wavelength reflectivity ratio will be dominated by these effects.
Synchronous RHI scans are performed with DLR's dual-polarization C-band radar POLDIRAD and a Mira-35 Ka-band cloud radar operated at the University of Munich. The two radars are separated by a distance of about 23 km and have an overlapping measurement range of about 35 km. Both reflectivity measurements agree quite well in the reflectivity range between -10 and 10 dBz. For lower reflectivity values the measurements with the C-band radar are limited to short ranges. At reflectivity values above 15 dBz attenaution effects are visible. Interestingly in ice clouds the overlapping region of both radar observations is quite large and the C-band radar has a high detection efficiency in ice clouds. This gives evidence of the presence of larger ice particles were the backscatter is sufficient high enough due to the D^6 dependence.
The high sensitivty to ice particles in the combination of both wavelenghts allows for the investigation of the initiation of precipitation through the ice phase - the cold rain process. The dual-wavelength measurements provide an enhanced hydrometeor classification and allow for the retrieval of ice microphysics parameters like median volume diameter, effective radius, and ice water content. Other processes which are observable are drizzle formation, cloud glaciation, distinction between depositional growth of small ice particles, and onset of quicker ice particle growth into precipitation sized particles by aggregation and initiation of first preciptation at surface.

Keywords: weather radar, cloud radar, dual-wavelength measurements, ice microphysics, precpitation initiation