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Calculative Z-R-relation determination for snowfall-events by means of realistically modelled winterly precipitation particles

F. Teschl (1), W. L. Randeu (1,2) and M. Schönhuber (2)

(1) Institute of Broadband Communications, Graz University of Technology, Austria,
(2) Institute of Applied Systems Technology, Joanneum Research, Graz, Austria
(franz.teschl@tugraz.at / Fax: +43-316-463697 / Phone: +43-316-873-4446)

Radar measurements of precipitation critically depend on the relation between the radar reflectivity factor Z and the precipitation rate R. Hundreds of such relations exist for different regions and precipitation types. In the present study the Z-R-relations of several snowfall-events in the mountains of Styria (Austria) were determined calculatively by modelling a variety of precipitation particles and determining their radar cross sections at weather radar frequencies by means of the Finite Element Method. The particles' distribution was measured by the 2D-Video-Distrometer (2DVD), a ground based imaging precipitation gauge. The 2DVD provides time, size, shape and falling velocity information of every single precipitation particle that falls through its sensing area. The whole spectrum of recorded particles was discretised in six particle-dimension-classes with corresponding quantity. Characteristic particles of each class were realistically modelled in a CAD-tool and their radar cross sections were determined my means of the Finite Element Method. Together with the quantity information of each particle-class within a volume the reflectivity Z was determined. As an imaging distrometer provides only sparse information on the inner structure of frozen precipitation particles and, as a consequence, on the precipitation rate, computational algorithms and a heated tipping bucked raingauge were used to correct the precipitation rate provided by the 2DVD. For all snowfall-events the particles' distribution was steadily re-calculated after several minutes. Finally all corresponding Z-R-values within an precipitation event were approximated by an equation of the form $Z = a R^b$, finding strong distinctions between different types of frozen precipitation.