Geophysical Research Abstracts
Vol. 16, EGU2014-9069, 2014
EGU General Assembly 2014

The microphysical information content of polarimetric radar measurements in the melting layer

Silke Troemel (1), Alexander V. Ryzhkov (2), Pengfei Zhang (2), and Clemens Simmer (3)

(1) Hans-Ertel-Centre for Weather Research, Atmospheric Dynamics and Predictability Branch, University Bonn, Bonn, Germany (silke.troemel@uni-bonn.de), (2) Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma, Norman, Oklahoma, and NOAA/OAR/National Severe Storms Laboratory, Norman, Oklahoma, (3) Meteorological Institute, University Bonn, Bonn, Germany

The practical utilization of the backscatter differential phase δ, measured by polarimetric weather radars, is not well explored yet. δ is defined as the difference between the phases of horizontally and vertically polarized components of the wave caused by backscattering from objects within the radar resolution volume. δ bears important information about the dominant size of raindrops and wet snowflakes in the melting layer. The backscatter differential phase, which is immune to attenuation, partial beam blockage, and radar miscalibration, would complement the information routinely available from reflectivity Z_H, differential reflectivity Z_{DR}, and cross-correlation coefficient ρ_{hv} which are traditionally used for characterizing microphysical properties of the melting layer.

Actual measurements of δ have been performed with a number of polarimetric WSR-88D radars operated at S band in US. Similar observations of δ were made in Germany using research X band radars in Bonn (BoXPol) and Jülich (JüXPol). Contrary to our expectations δgbservations at S band showed much higher magnitudes than the δ observations at X band. Maximal observed δ at X band is 8.5°, whereas maximal observed δ at S band is 40°. Model simulations which assume spheroidal shapes for melting snowflakes in the absence of aggregation within the melting layer yield much lower values of δ than observed, especially at S band. According to simulations of δ the simulated values of δ are relatively small and barely exceed 4° at X, C, and S bands. Indeed, the simulations assume that mixed-phase particles do not interact with each other and wet snowflakes do not aggregate. Taking aggregation into account in the model the magnitude of δ can be significantly higher. The huge observed δ magnitudes at S band ranging from 18 to 40°, however, are impressive and unexpected at first. Since all X band observations are from Germany and all S band observations taken into account are from the U.S., part of this effect may be attributed to the climate difference between the U.S. and Germany. Thus, dual frequency observations of δ in the same storm have been included to verify the unexpected high δ observations at larger wavelengths. Measurements from C band radars from the German Weather Service network show again δ of 30° and more, while the overlapping research X band radars provide δ values around 5°. Similar dual frequency observations will be performed with C band scanning ARM precipitation radars and WSR-88D S band radars.

Theoretical simulations using a two-layer T-matrix code are used to examine conditions which may favor more intense aggregation within the melting layer and explain the origin of observed pronounced signatures at S and C bands. To simulate these δ magnitudes the presence of very large water-coated snowflakes with diameters exceeding 1 cm has to be assumed.

The important information about microphysical properties, aggregation processes and growth of snowflakes within the melting layer in all polarimetric radar variables will be elaborated and presented.