Geophysical Research Abstracts, Vol. 8, 06154, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06154

The effect of beam shielding on polarimetric rainfall estimates – Do phase-based quantitative precipitation estimates at C-band really increase the accuracy?

F. Friedrich (1), G. Germann (1), G. Galli (1), J. J. Gourley (2), P. Tabary (3) and J. Parent du Chatelet (3)

(1) MeteoSwiss, Locarno, Switzerland, (2) National Severe Storms Laboratory, Norman, OK, USA, (3) Meteo-France, DSO, Centre de Meteorologie Radar, Trappes, France

Ground clutter returns from mountains, buildings, trees, or power lines bias reflectivity measurements due to strong backscattering signal or shielding of the proceeding transmitted power. Polarimetric radars not only measure reflectivity from horizontally- and vertically-transmitted signals, but also the differences in phase shift referred to as differential phase shift (ϕ_{dp}). Several studies showed that in shielded areas differential phase measurements have advantages over power measurements for estimating rainfall because they are immune to beam shielding and unbiased by ground clutter cancellers.

The effect of beam shielding on rainfall estimates was investigated in this study using data measured by the C-band polarimetric Doppler radar at Trappes located about 30 km southwest Paris, France. Rainfall estimates within areas of strong beam shielding ($>$ 50 %) were compared to those derived within areas with low beam shielding ($<$ 10 %). Physically-based relationships were applied between rain amount and a) reflectivity at horizontal polarization (Z_h), b) Z_h and differential reflectivity (Z_{dr}), c) specific differential propagation phase (K_{dp}), and d) K_{dp} and Z_{dr}. The results of the different methods were compared to each other and to the rain rates derived from a dense network of rain gauges for convective and stratiform cases.

Range profiles of ϕ_{dp} show a very high spatial variation which is related to resonance effects and the influence of the backscattering differential phase. The latter biases rain rates at C-band due to Mie scattering effects when the effective diameters of raindrops exceed 3 mm. An accuracy in rain rate of about 10 mm h^{-1}requires an error in K_{dp} of less than 0.4° km^{-1}. In order to achieve this accuracy, ϕ_{dp} profiles need to be smoothed using filtering techniques before K_{dp} is estimated. Common techniques used to estimate K_{dp}, such as linear regression, have been shown to cause errors larger than the needed accuracy for rainrate estimation, which limits the applicability of K_{dp} at C-band.