Dual-polarization based QPE in presence of hail contamination

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Hail contamination of radar observations is a serious factor affecting the quality of radar-based quantitative precipitation estimations (QPE). Dual-polarization radar measurements are sensitive to the shape of the hydrometeors. For example co-polar differential phase observations (this method makes use of the phase component of the complex received signal for the same transmitted waveform as Zdr) are not affected by spherical hydrometeors, such as most hail particles. In this study, the applicability of differential phase (PhiDP) measurements for estimating rainfall intensity in presence of hail contamination will be studied. In the case of phase measurement, the speed of propagation is also affected by the asymmetry of the larger drops. Because of the longer dimension of the horizontal axis of drops, the medium is effectively denser for horizontal than for vertical polarization so that the speed of light is reduced for horizontal polarization. This causes the horizontal wavelength to be slightly compressed (more phase cycles per unit distance) in comparison with the vertical wavelength which leads to a phase difference between horizontal and vertical. The phase difference $\Phi H - \Phi V$ is called PhiDP and this is measured in units of degrees.

 The study will be based on six years of Helsinki Testbed observations (2005-2010). The Helsinki Testbed was established in 2005 jointly by the Finnish Meteorological Institute and Vaisala. As a part of the Testbed instrumental setup more than 60 Vaisala WXT 510 weather transmitters were installed in the Helsinki Metropolitan area. The weather transmitters are capable of precipitation intensity measurements, as well as of discrimination between rain and hail. Since the establishment of the Testbed, the transmitters have reported more than 100 hail hits. This is a unique dataset since it is not only providing records of hail occurrences, but also provides exact location and times of those events.