Sensitivity analysis of polarimetric attenuation correction algorithms

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Polarimetry improves radar rainfall estimation. It allows a better separation of meteorological and non-meteorological echoes, a better identification of the type of hydrometeors, and an improved correction of the attenuation due to rain affecting the signal of weather radars working at C- and X-band. The attenuation correction is based on the near-linearity between the specific attenuation at horizontal(vertical) polarization and the specific differential phase shift (on propagation) Kdp. The coefficients of this relationship as well as those of the power law assumed between the specific attenuation and the radar reflectivity depend on the DSD and the dominant microphysical processes. Because raindrop size distribution (DSD) measurements are not available everywhere and all the time, it is difficult to accurately estimate these coefficients. In addition, phase measurements are noisy and can be affected by significant uncertainties, as well as Kdp. Finally, the radar calibration is also important in the process of attenuation correction. In order to investigate and quantify the sensitivity of the classical attenuation correction algorithms to the different parameters involved, a simulation experiment has been conducted. It is based on realistic simulated DSD fields from which all the necessary variables can be derived. The most commonly used algorithms for attenuation correction (namely ZPhi and the self-consistent -SC- version of it) are applied and the obtained corrected reflectivities are compared to the true ones. Uncertainty is added to the main parameters/variables and the respective sensitivities can be quantified. It is shown that ZPhi performs better than SC as long as the parameters are within 30% of their true values. Such accuracy is not easily achievable for all parameters and SC should be preferred if large uncertainties are expected.