Geophysical Research Abstracts,
Vol. 11, EGU2009-13666, 2009
EGU General Assembly 2009
© Author(s) 2009

Probabilistic approach to constrained techniques for path attenuation compensation: A numerical study for C- and X-band radars

F.S. Marzano (1,2), M. Montopoli (2), and G. Ferrauto (2)
(1) DIE – CETEMPS, Sapienza University of Rome, Italy, (2) DIEI – CETEMPS, University of L'Aquila, Italy

It is well established that weather radar systems operating at frequencies approximately equal to 5 GHz or greater can suffer from rain attenuation. Rain rate estimates at these attenuated wavelengths can be accomplished through the Hitschfeld-Bordan (HB) algorithm (Hitschfeld and Bordan, 1954). It has been widely demonstrated that the forward implementation of the HB alghoritm can lead to unstable solutions when the path attenuation becomes large. The divergence associated with the HB method can be prevented by restricting its use for light rain rates. In case of moderate to high rain rates, the attenuation correction is typically based on constrained methods, such as the surface reference techniques (SRT), especially developed for single frequency, incoherent and non-polarimetric airborne weather radars (Iguchi and Meneghini, 1994). These methods uses the path integrated attenuation (PIA) as a constraint in a manner to find a stable solution through a backward implementation of the HB algorithm. PIA measurements are generally extracted from the echo that arise from reference surfaces, such as mountains (for ground-base radars) or the sea (for airborn radars). For polarimetric weather radars, PIA estimate is directly related to Φ_{DP}.

Different surface reference methods can be derived by adjusting different model parameters in such a way that the path integrated attenuation calculated from the measured Z_m profile equals the estimated PIA. Then, the α-adjustment or constant-adjustment methods can be constructed if the coefficient α in the $k-Z$ relationship k=αZ^{β} or the radar constant are adjusted, respectively. Effectiveness of the constrained methods strongly depends on the PIA estimate accuracy, especially when the path attenuation is weak. In order to avoid inaccuracies in the attenuation correction when rain is weak, a hybrid (HYB) of the SRT and the HB method can be used (Meneghini et al, 2000).

In this work, we focus on non-polarimetric, ground-based radar systems operating at C-band and X-band. Following a probabilistic approach, synthetic rain profiles are generated and comparisons among the constrained techniques for path attenuation compensation are performed. Quantification of the accuracy and robustness of the constrained methods is also carried out and the influence of uncertainties affecting the radar measurements, that is uncertainties in the radar calibration, DSD parametrization and PIA estimate, is investigated.