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Evaluation of radar multiple scattering effects in Cloudsat configuration

A. Battaglia[1], M. O. Ajewole[2], and C. Simmer[3]
[1]Meteorological Institute, University of Bonn, Bonn, Germany
[2]Department of Physics, Federal University of Technology, Akure, Nigeria
[3]Meteorological Institute, University of Bonn, Bonn, Germany

Abstract. MonteCarlo simulations have been performed to evaluate the importance of multiple scattering effects in co- and cross-polar radar returns for 94 GHz radars in Cloudsat and airborne configurations. Thousands of vertically structured profiles derived from some different cloud resolving models are used as a test-bed. Mie theory is used to derive the single scattering properties of the atmospheric hydrometeors. Multiple scattering effects in the co-polar channel (reflectivity enhancement) are particularly elusive, especially in airborne configuration. They can be quite consistent in satellite configurations, like CloudSat, especially in regions of high attenuation and in the presence of highly forward scattering layers associated with snow and graupel particles. When the cross polar returns are analysed [but note that CloudSat does not measure any linear depolarization ratio (*LDR* hereafter)], high *LDR* values appear both in space and in airborne configurations. The *LDR* signatures are footprints of multiple scattering effects; although depolarization values as high as −5 dB can be generated including non-spherical particles in single scattering modelling, multiple scattering computations can produce values close to complete depolarization (i.e. *LDR*=0 dB). Our simulated *LDR* profiles from an air-borne platform well reproduce, in a simple frame, some experimental observations collected during the Wakasa Bay experiment. Since *LDR* instrumental uncertainties were not positively accounted for during that experiment, more focused campaigns with air-borne polarimetric radar are recommended. Multiple scattering effects can be important for CloudSat applications like rainfall and snowfall retrievals since single scattering based algorithms will be otherwise burdened by positive biases.

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