Interactive comment on “Evaluation of radar multiple scattering effects in Cloudsat configuration” by A. Battaglia et al.

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High $LDR$ values can certainly be due to non-spherical particles. However (see discussion and reference Wolde-Vali at page 12) the frequency of occurrence of $LDR > -10 \, dB$ is very rare, especially at nadir view. On the other hand we predict such large values of $LDR$ as soon as $MS$ is relevant (and in particular increasing more and more going deep within the medium). In this sense we believe this as a peculiar feature of $MS$. Note that the introduction of non-spherical particle scattering properties is not believed to change this $LDR$ signature in a significative way just because this strong depolarization comes from the contribution of higher than 1 order of scattering. A paper including profiles with non-spherical particles is now under preparation.

Reply to minor points:
1. Obviously the longer time is taken into account. Practically the MonteCarlo code solves the time-dependent radiative transfer equation.

2. In the GCE-CRM six hydrometeors are considered including uniform size cloud droplets (radius $10\mu m$) and ice crystals (radius $10\mu m$), raindrops, graupel (density $0.4 g/cm^3$) and snow (density $0.1 g/cm^3$) with the latter three hydrometeor classes having exponential size distribution with a fixed intercept parameter $N_0$. While for rain this intercept is always equal to $1.6 \times 10^4 m^{-3}mm^{-1}$, for graupel and snow this parameter is equal to $1.6 \times 10^4$ and $3.2 \times 10^4 m^{-3}mm^{-1}$ respectively. Mixed-phase hydrometeors are not included.

3. The surface is always considered as a black surface. However this is not relevant because only ranges shorter than the surface-range itself are considered in the paper. A consistent surface model is necessary only when the return from ranges longer than the surface-range are seeked. Do not be scared by a reflectivity enhancement by 70-80 dB. It may also be infinite, e.g. in the case when there is a finite cloud and the $MS$ produces a signal for ranges longer than the bottom of the layer (from where one would expect no signal at all). The key thing is that the signal we see from a certain range may actually be produced completely in an upper level. Therefore the signal from a certain range can be totally decoupled by what is actually present at that range.

4. Yes it is certainly true that high $LDR$ are found in correspondence of low signal (because of strong attenuation). According to a suggestion from the people who performed the Wakasa Bay experiment we used a cut off at -40 dBZ for the cross polar reflectivities. We also are concerned with the interpretation of these measurements where not thought to investigate $MS$ effects (so there was not particular care in the $LDR$ product). Our message here is that even in airborne configuration $MS$ should be detectable, but it requires high quality measurements since it manifest itself in region of high attenuation (thus where signal
is very low). Cloudsat is not equipped with $LDR$ capabilities but we recommend future airborne campaigns to perform ad hoc studies on this topic.

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