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Drop by drop scattering properties of a radar bin : a numerical experiment

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This paper presents the development and initial results of a numerical simulation of pseudo-radar observations computed as the sum of the electric field backscattered by each drop. Simulations are carried out for three successive radar bins with a gate length of 30 m and beam width of 1°.

The first step is the simulation of a 100 m x 100 m x 100 m volume with all its drops. The 3D raindrop generator relies on the findings on the rainfall field very small scales (mm to few tens of m) spatio-temporal structure, of the HYDROP experiment and a recent analysis of 2D video disdrometer data in a Multifractal framework. More precisely: (i) The Liquid Water Content (LWC) distribution is represented with the help a multiplicative cascade down to 0.5 m, below which it is considered as homogeneous. (ii) Within each 0.5 x 0.5 x 0.5 m3 patch, liquid water is distributed into drops according to a pre-defined Drop Size Distribution (DSD) and located randomly uniformly. (iii) Such configuration is compared with the one consisting of the same drops uniformly distributed over the 50 x 50 x 50 m3 volume.
Then the backscattered field by the drops located within a radar bin are computed as the sum a individual contribution. Antenna beam weighing is taken into account

Due to the fact that the radar wave length is much smaller than the “patches” size for rainfall, it appears that as theoretically expected we retrieved an exponential distribution for potential measure horizontal reflectivity. A much lower dispersion is noticed for differential reflectivity. We show that a simple ballistic assumption for drop velocities does not enable to reproduce radar observations, and turbulence must be taken into account. Finally the sensitivity of these outputs to the various model parameters is quantified.