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Geostatistical Simulation of 2D Fields of Raindrop Size Distributions at the Meso-γ Scale

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The large variability of the rain drop size distribution (DSD) in space and time must be taken into account to improve remote sensing of precipitation. The ability to simulate a large number of 2D fields of DSDs sharing the same statistical properties provides a very useful simulation framework that nicely complements experimental approaches based on DSD ground measurements. These simulations can be used to investigate radar beam propagation through rain and to evaluate different radar retrieval techniques.

The proposed approach uses geostatistical methods to provide structural analysis and stochastic simulation of DSD fields. First, the DSD is assumed to follow a Gamma distribution with three parameters. Therefore, 2D fields of DSDs can be described as a three-component multivariate random function. Such 2D fields are normalized using a Gaussian anamorphosis and simulated by taking advantage of fast multivariate Gaussian simulation algorithms. Variograms and cross-variograms are used to generate fields with identical spatial structure that are consistent with the observations.

To assess the proposed approach, the method is applied to data collected during intense Mediterranean rainfall. Taylor's hypothesis is invoked to convert time series into 1D range profiles. The anisotropy of the DSD fields is derived from radar reflectivity measurements. A large number of DSD fields are generated and the corresponding reflectivity fields are derived. Simulated and measured reflectivity fields are in good agreement with respect to the mean, the standard deviation and the spatial structure, demonstrating the promising potential of the proposed stochastic model of DSD fields.