A 3D + time stochastic simulator of raindrop size distributions

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The first 3D + time stochastic simulator of raindrop size distributions at the meso-gamma scale with realistic spatial and temporal correlation structures (including in the vertical dimension up to the melting layer) is presented. It is based on a non-stationary representation of rainfall fields in which both the average drop size and drop concentrations depend on the distance/time to the nearest dry region/period. The residual space-time correlation structure of the DSD parameters is modeled using a non-separable space-time variogram specifically developed for temporally advected random fields. Spatial and temporal variations are linked through a time regularization parameter, an average horizontal advection and an average fall speed along the vertical axis. A simple and intuitive procedure for parameterizing the simulator using radar and disdrometer data is presented. The authors show some examples of simulated DSD fields and discuss possible applications of their simulator. This includes issues related to attenuation correction and the merging of polarimetric measurements from a network of X-band radars. The authors also examine more theoretical issues like the link between space-time variability of rainfall fields and DSD variables.