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Quantification of the radar subgrid variability of the raindrop size distribution from a network of disdrometers

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The subgrid variability of the raindrop size distribution (DSD) is a crucial information for reliable quantitative estimation of rainfall using remote sensing techniques. To investigate this question, a network of 16 optical disdrometers has been deployed over a typical weather radar pixel (about 1×1 km2) in Lausanne, Switzerland. A set of 36 rainfall events have been classified according to three types: convective, transitional and frontal. In a first step, the spatial structure of the DSD is quantified using spatial correlation for comparison with the literature, showing a good agreement with previous studies. The spatial structure of important quantities related to the DSD, namely the total concentration of drops Nt, the mass-weighted diameter Dm and the rain rate R, is quantified using variograms. Results clearly highlight that DSD fields are organized and not randomly distributed even at a scale below 1 km. Moreover, convective type rainfall exhibits larger variability of the DSD than transitional and frontal ones. The temporal resolution is shown to have an influence on the results as increasing time steps tends to decrease the subgrid variability. Finally, this study presents a possible application of such information by quantifying the error associated with the use of point measurements as areal estimates at larger scales. Analyses have been conducted for different sizes of domain ranging from 100×100 m2 to 1000×1000 m2 . As expected, this error is increasing with the size of the domain. For instance, for a domain of about 1000×1000 m2, the error associated with rain rate estimates is in the order of 25% for all types of rain.