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Synergy between micro rain radar and disdrometer to improve raindrop size distribution vertical profiles

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An experimental setup composed of one 2D video disdrometer (2DVD) and a K-band vertically pointing micro rain radar (MRR) has been adopted in different climate regions of the globe in order to better characterize the rain drop size distribution (DSD) at ground and its vertical variability in the column of air above the instrument. The raindrop size distributions collected by 2D video disdrometer are considered to be fairly accurate within the typical sizes of drops. MRR is an affordable continuous wave frequency-modulated radar (CWFM) typically used at vertical incidence, that allows to estimate DSD vertical profiles from Doppler spectra determined by drops falling at different velocities and at different heights. However, the MRR standard processing assumption of absence of vertical wind, along with some characteristics of the implementation of the CWFM scheme, limit the usefulness of this instrument during heavy precipitations or in convection, when influence of air motion on DSD retrieval is not negligible. In this conditions, some issues such as Doppler spectra aliasing and range-Doppler ambiguity limit need to be taken into account. In this study, we show a reprocessing methodology of MRR Doppler spectra to reduce the uncertainty on MRR profiles estimates and to increase the trustworthiness of MRR data during convections. To achieve this goal we exploited the synergy of MRR and coincident 2DVD measurements collected in Rome (Italy) from September to November 2012 during the first Special Observation Period of the Hydrological Cycle in the Mediterranean Experiment. In the configuration used MRR provides DSD profiles almost from the ground level to 1000 meters with a height resolution of 35 meters and time resolution of 10 seconds. Results show that the reprocessing procedure leads to a better agreement between the reflectivity of the reprocessed MRR spectra at the lowest MRR bin and that obtained from the 2DVD data. Furthermore, vertical profiles of MRR-estimated DSDs and their relevant moments (namely median volume diameter and reflectivity) are presented for some relevant rain events.