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Precipitation classification at mid-latitudes in terms of drop size distribution parameters

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The problem of the estimation of precipitation dimensional parameters is reaching renewed interest in the last years for two main reasons: from one side, new instruments have been proposed (based on a wide variety of physical principles) for more accurate measurements; on the other side, more complete information on the precipitation characteristics (than the simple instantaneous rainrate) are needed for the radar calibration or satellite sensors interpretation. In particular, the drop size distribution (DSD) becomes an important parameter for active and passive rainfall sensors, especially when the detailed knowledge of the physics of the precipitation is involved in the retrieval process. The discrimination between convective or stratiform precipitation (C/S) is of great relevance; however, in mid-latitude regions, these studies are insufficient while in the last few years the attention was mainly focused on tropical oceanic case studies. The present work focuses on the understanding of the drop size characteristics of the precipitation and suggests an operational application in radar calibration. Experimental sites in southern and northern Italy were established. They were equipped with a Joss-Waldvogel disdrometer (JW), an X-band pluvio-disdrometer (Pludix) and a tipping-bucket rain-gauge, all with sampling time lower than one minute. The JW is an impact disdrometer. Pludix, on the other side, is a low-power X-band, CW, radar detecting the electromagnetic radiation backscattered by falling hydrometeors. The drops fall speed derived from the Doppler spectrum is converted in drop size. The two disdrometers provided during the different experimental campaigns in the target areas covering all the Italian territory, a wide and unique dataset of DSD for various rainfall events. Disdrometric data, a classification of the precipitation (into C and S) and a microphysical characterization of the rain episodes are so available. The main results were: agreement with past studies at these latitudes; insignificant differences between

the different stations in Italy both in the DSD and rainfall integral parameters; the classical tropical C/S discrimination algorithms fail at these latitudes. A new C/S discrimination technique was implemented using the exponential and gamma DSD fitting the observed distribution; the C and S precipitation has shown different microphysical characteristics in terms of different values of DSD and rainfall integral parameters observed at the ground. It is important to point out that in the C episodes it is more difficult to fit in an analytical DSD model the real distribution because of the presence of an high number of degrees of freedom to correctly describe the phenomena (e.g. the drop break-up). An application of the disdrometers in the area covered by multiparametric radar for calibration purposes is suggested, while conversely radar data might systematically help in C/S discrimination.