Comparison of measured and radar-equivalent gamma DSDs to investigate the effect of gamma raindrop size distribution assumption on the rain rates

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To date, the three-parameter gamma distribution is widely accepted and used by radar meteorologists and atmospheric physicists to model the natural drop size distribution (DSD). The goal of this study is to evaluate the error, in terms of rain rate, due to this assumption. First a methodology is set up to compare the rain rates of a disdrometer-measured DSD and a simulated gamma DSD equivalent in terms of radar measurements (reflectivity factor, differential reflectivity, and specific differential phase shift). The differences, in terms of normalized standard error (NSE) and normalized bias (NB), between the two rain rates will provide information about the influence of the gamma assumption on the computation of the rain rate. Furthermore the effects of radar frequency, drop shape-size relation, and disdrometer integration time were investigated. The study is performed using four datasets of DSDs collected by two-dimensional video disdrometers deployed in Huntsville (Alabama), in three different pre-launch campaigns of the NASA/JAXA GPM ground validation programme including the HyMeX SOP 1 field campaign in Rome. The resulting values of NSE and NB show that differences in rain rates exist and exceed those related to the methodology itself and disdrometer error sampling, supporting the finding that there is an error associated to gamma DSD assumption.