2nd URSI AT-RASC, Gran Canaria, 28 May – 1 June 2018

Comaparison of disdrometer performance during GPM-GV IFloodS field campaign

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Nowadays, disdrometers of different type (i.e. optical, impact, video, laser and Doppler) are widely used worldwide to estimate rain drop size distribution (DSD) and rainfall rate. In the last few years they become more reliable, easy to operate with regular maintenance, and economically affordable, however disdrometers are still considered as a research tool and national weather services around the world do not use them as operational ground-based instrumentation. As a consequence disdrometer data are generally available through targeted field campaign or are managed by research Institutes or Universities. In the first case, a number of disdrometers, most of the time of different type and co-located, are dislocated in a specific area for the entire duration of the field campaign, generally few months, while in the second case it is possible to have a longer time series of disdrometer data (few years) although most of the time measurements from only one disdrometer are available.

In this study the rich dataset from Iowa Flooding Studies (IFloodS) field campaign has been used to compare the measurements of different types of co-located disdrometers and to shed some light on the performance of these devices in the estimation of rainfall and DSD parameters.

IFloodS disdrometer dataset includes data from three different sites where a Micro rain Radar (MRR), a two-dimensional video disdrometer (2DVD), and an Autonomous OTT Parsivel2 Unit (APU) have been co-located. 2DVD and APU are ground based disdrometer with a different measuring principle and a nominal measuring area of 54 cm2 and 100 cm2 respectively. MRR is a Doppler disdrometer that provides DSD measurements along the vertical. In this study, for comparison purpose, we consider only the MRR measurements at the first reliable bin closest to the ground (namely in this case the bin at 105 m AGL). IFloodS was two-month long, took place in eastern Iowa (US) and, more importantly, the rain was abundant ranging from light to heavy rain.

First a post-processing of the disdrometer data has been performed in order to filter out the possible presence of spurious drops and to maximize the accuracy of disdrometer dataset in all the different rain regimes. Then, the performance of 2DVD, APU and MRR in determining reflectivity factor (Z), rainfall rate (R), mean mass-weighted raindrop diameter (D_{mass}), and normalized intercept parameter (N_w) has been evaluated.

Results shown that measurements at ground from the three different devices are in good agreement. In particular, the bias for Z is almost always less or around 1 dB for all the three Sites, the only exception is for Site 2, where a consistent underestimation of MRR is obtained. The latter can be due mainly to instrumental issues. The agreement in terms of rain rate gives a percent bias that ranges between -8.3% and 17.3% for the comparison of 2DVD and APU data and is a bit higher when MRR is compared with 2DVD (-32.5%, 35.9%, -6.5% for Site1, Site 2 and Site 3, respectively). The agreement in terms of DSD parameters (both D_{mass} and N_w) is very good, in particular for D_{mass} (bias around 0.2 m), while the MRR seems to detect a higher number of drops (in particular for the small size drops, namely with diameter less than 1 mm) with respect to 2DVD and APU. The latter can be due to the different size of the measuring area.