

Interactive comment on “Binning effects on in-situ raindrop size distribution measurements” by R. Checa-Garcia et al.

Anonymous Referee #2

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General comments:

In the presented manuscript, the authors investigate the effect of binning on integral rainfall parameters and estimators of the DSD for different types of disdrometers. To address this issue, the authors used simulated Gamma drop size distributions as well as 2DVD measurements collected during a 2-month campaign. Globally, the paper is well organized and clearly shows that a significant amount of work has been done. The addressed topic is of scientific interest and the authors show that measurement uncertainties/errors are prevailing to direct binning effects. Unfortunately, the comprehension of the manuscript is by far not so easy due to numerous unclear sentences (see specific and technical comments below) and missing information (time resolution considered, notations used, references). This is definitely not helping the reader

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to understand the paper. To my opinion, this manuscript is missing some explanations of the scientific assumptions behind this approach. For instance, disdrometers are considered to sample correctly all the drops that fall in their respective sampling area, which is unfortunately not true in more realistic conditions.

Specific comments:

- p.2341, Introduction, l.2-3: This formulation is confusing. "rain rate" is an integral parameter of the DSD, not rainfall. Please distinguish between "rainfall" (natural phenomenon) and "rain rate/intensity" which is a physical parameter human use to characterise rainfall. This confusing formulation appears all along the manuscript (text, figures, legends). See specific comments hereafter.

- p.2341, Introduction, l.25-28: At least two other scientific contributions should be mentioned concerning the representativeness of disdrometer measurements: Tapiador et al, 2010: "An experiment to measure the spatial variability of rain drop size distribution using sixteen laser disdrometers" Jaffrain and Berne, 2012b: "Quantification of the Small-Scale Spatial Structure of the Raindrop Size Distribution from a Network of Disdrometers"

- p.2342, Introduction, l.1-3: There is various different studies that have addressed the Z-R law representativity issue. Once again, you should acknowledge at least some of the existing works (Campos and Zawadzki, 2000; Uijlenhoet, 2001; Steiner and Smith, 2004; Chapon et al, 2008; Jaffrain and Berne, 2012a; ...).

- p.2342-2343, Introduction: the authors should add one or two sentences referring to existing works on measurement uncertainties and sampling errors (e.g., Gage et al, 2004; Tokay et al, 2005; Krajewski et al., 2006; Sieck et al, 2007; Jaffrain and Berne, 2011).

- p.2345, Section 2.1, Eq (1): Please explain the notations used in your equation. For example, explain "D" and "f(D)". This comment is valid for other equations, Tables and

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Figures in this paper.

- p.2347, Section 2.1.2, l.10-11: How these min and max diameter of 0.7 mm and 4.3 mm respectively have been chosen ? Please add a few words on this choice.
- p.2352, Section 2.3.2, l.10: Be careful with the notation you are using. I guess "D0" refer to $D_i=0$. Usually, in DSD studies, D0 is the notation used for the "median-volume diameter". This can be confusing as a first reading.
- p.2356, Section 3.1: As mentioned by the authors, the 2DVD measures three properties of raindrops: drop size, vertical velocity and 2D-shape of the drops. Just for clarification for people who do not really know 2DVD instrument, this is not providing an information on the general shape (3D) of the drop. It rather provide the shape of the particle as seen by each of the two orthogonal cameras.
- Section 3.2: The collection of drops detected by different instruments is estimated as a function of each instrument's sampling area. I know that it is difficult to distinguish between binning effects and measurements issues, but did the authors take into account drops partially detected by the instruments ? This appears for drops falling at the edge of the instrument's measuring area and this is usually partially filtered by the disdrometers. According to my reading, I guess the authors have considered that the instruments can measure 100% of the drops that are in the measuring area of the different disdrometers. This assumption, which is not representative of more realistic conditions, should at least be mentioned.
- p.2357, Section 3.3: "mass-weighted diameter" appears at l.6 and "Dmass" notation at l.16, but you do not link both. When first mentioning the mass-weighted diameter, please introduce its notation.
- p.2357, Section 3.3, l.24-25: Here "D" notation is used to denote Disdrometer. Please choose an other notation as it it really confusing with the previous uses of "D" as drop diameter.

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- In Section 3, no information is provided on the temporal resolution considered in this work. This appears (1min) only at the very end, in the legend of some Figures. This can have significant influences on the observed results. The authors should present this.
- p.2359, Section 4, l.8-9: "... using experimental designs like Tokay et al. (2005)". I suggest "... using a collocated instruments approach.". This is related to the comment in order to add in the introduction some references on measurements issues.
- p.2370, Table 4: "Accumulated rainfall (Racc) is measured... and maximum rainfall (Rmax) ...". Please clarify the notation you are using in the legend.
- p.2377, Fig.7: The second column is not showing "rainfall" but "rain rate" or "rain intensity". Moreover, the notation "Z" (Dmass) appears for the third (fourth) column but this is not explain in the legend nor in the manuscript. Please correct these issues.
- Fig.8 and 9.: Once again a notation issue (Nt, R, Z). Moreover, for this two Figures, "D" stands for Disdrometer and not drop diameter.

Technical comments:

The quality of the manuscript should be improved in order to ease understanding. It suffers from various non clear sentences that should be reformulated.

- p.2342, l.3: "rain rate (Z-R) relations"
- p.2342, l.8-11: "While there have been ... comparative studies" This sentence is not clear. Please reformulate.
- p.2343, l.22: "It is possible because of the smaller ..."
- p.2348, l.5-7: "The freedom in the choice ... subset in each case)". This sentence is not clear. Please reformulate.
- p.2351, l.13: "..., considering also the relevance of an uncertainty on the shape ..."

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- p.2351, l.19-22: "There is the possibility ... , similar to real case". This long and complicated sentence is not clear. Please reformulate.
- p.2355, l.23-24: "are explained" appears twice in this sentence.
- p.2356, l.10-11: "... more than 50% from from Gunzer...", "from" appears twice.
- p.2357, l.14-15: "In the case of the Thies, larger sampling ...". I guess a comma is missing.
- p.2358, l.5: "However Fig.8 also ...". Remove "the" before Fig.8.
- p.2358, l.7: "Fig.9 supports...". Remove "the" before Fig.9.
- p.2358, l.10-11: "...these effects should be considered as an asymptotic statistical property". I guess "as" was missing in this sentence.
- p.2359, l.3: "... maximum verosimilitude". This is not mentioned in the manuscript, so why using this denomination in the conclusion. The reader has no clue on what you are referring to.

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