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Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #1

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General comments:

Simulated Gamma drop size distributions are used to investigate the effect of binning on the estimation of DSD parameters (and associated moments) for different types of disdrometers and estimation methods. The topic is of interest but the results are not very conclusive. For example, it is unclear what role the binning effect really plays in practical applications compared to other and more important problems like sampling uncertainties and measurement errors. As pointed out by the authors, the major source of error/bias does not appear to come from the binning itself but from a truncation of the size distribution at the lower/upper end of the distribution (depending on the disdrometer). This is a well-known problem that can be partially accounted for in practice through the use of better and more robust estimators for mu, lambda and Nt. In gen-

eral, the paper is well structured and sufficiently clear. It suffers, however, from a poor usage of the English language. There are many vague and unclear sentences, typos and repetitions (see below for a short list of them).

Specific comments:

Introduction, p.2341, ll.2-3: Actually, the rain rate (or rainfall intensity) is an integral quantity of the drop size distribution, not the "rainfall". In addition, I do not understand why rainfall is an "element of energy". Please be more specific.

Introduction, p.2341: It may be worth mentioning how the diameter of raindrops (which are not necessarily spherical) is defined.

Introduction, p.2342: Jaffrain and Berne 2011 ("Experimental quantification of the sampling uncertainty associated with measurements from Parsivel disdrometers") performed a very detailed and rigorous evaluation of the sampling uncertainty of OTT Parsivel disdrometer. Their work should be mentioned and acknowledged.

In section 4, the authors claim that binning effects (for larger drop diameters) lead to an overestimation of approx. 5% of the reflectivity and that this effect is additive with respect to other sources of uncertainty. I do not fully agree with this statement. It assumes that disdrometers classify the drops into their respective diameter classes with 100% accuracy. In practical applications, drop sizes are never classified 100% correctly. This might actually be even more important than binning itself.

The authors should state more clearly the limits of their study. Most of the conclusions heavily rely on the assumption that drop sizes have a Gamma distribution. This is a good and widely used model but unfortunately only an approximation.

An important finding of this study is that (depending on the disdrometer), different ways of estimating the DSD parameters might be necessary (instead of the traditional method of moments and max.likelihood). These new estimation methods include additional knowledge about the drop diameter discretization and the lower/upper drop size

limits of the instrument.

In section 3, p.2358, the authors mention that binning effects should be viewed as asymptotical statistical properties over long time series. In practice, however, binning effects are likely to be completely masked by sampling uncertainties and measurement errors. Again, I think the major problem here is the assumption that disdrometers measure the drop size with 100% accuracy. This is not a very realistic assumption.

The authors should specify more clearly at which temporal resolution they work. The only information I could find was in Figures 7-9 (1 min). This is important because DSD parameters are known to be scale dependent. An alternative would be to work on normalized DSD parameters (e.g., single or double moment normalization).

Typos:

There are numerous typos and unclear sentences in the paper. The following list is (by far) not exhaustive. Some editing by a native English speaker would help.

- Abstract, l.9: "according to each instrument"

- Abstract, l.12: "which allowed us to estimate"

- Abstract, l.13: "from the available dataset"

- Abstract, l.18: "Regarding the DSD parameters"

- Abstract, ll.20-21: "Noticeable differences between instruments for all estimation methods are reported"

- Abstract, ll.21-23: "The measurements of 2DVD allow ... areas than 2DVD". This sentence does not make any sense.

- Introduction, p.2341, l.7: "the concentration of drops per unit volume of air for a given diameter interval"

- Introduction, p.2342, ll.1-3: "These factors are also ... derived from disdrometer

measurements". This sentence is not very clear. Please reformulate.

- Introduction, p.2343, ll.22-23: "This is possible because of the smaller cross sectional sampling area of JWD, Parsivel and Thies."

- Section 2, p.2345, l.1: "Assessing binning effects using simulated DSDs"

- Section 2, p.2345, l.14: "per unit volume"

- Section 2, p.2345, ll.21-22: "The sampling process ... average number of drops". This sentence does not make any sense.

- Section 2, p.2345, ll.22-24 "This figure is derived ... is obtained". Another unclear sentence. Please reformulate.

- Section 2, p.2351, l.9: "requires maximizing the function ML"

- Section 2, p.2355, l23: "In the following sections, the properties of the dataset and the methods used in this analysis are explained."

- Section 3, p.2356, ll.10-11: there's two consecutive "from" before "Gunzer and Kinzer".

- Section 3, p.2358, ll. 4-5: "However, Fig. 8 also shows"

- Section 3, p.2358, ll.7-8: "Fig. 9 supports the idea"

- Section 4, p.2359, l.3: what's a method of verosimilitude? This does not sound like English.

- Appendix A, p.2360, l.21: "the possibility of moderate variations for mu".

- Appendix A, p.2360, l.28: "Regarding the proposed values of sigma ..."

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 2339, 2014.