Atmospheric Measurement Techniques Discussions

Interactive comment on "Effect of sampling variation on error of rainfall variables measured by optical disdrometer" *by* X. C. Liu et al.

Anonymous Referee #3

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1 Summary

This manuscript presents a simulation study of the sampling effects on various quantities related to rainfall measured by optical disdrometers. The arrival of raindrops is supposed to be a Poisson process, and its parameter is related to climatological/characteristic DSD measured for different types of rain events in China. The sampling effect due to the size of the sample, the size of the sampling area and the rain rate are then investigated for different moments/descriptors of the DSD and for different optical disdrometers, as well as the sampling uncertainty in fall speed estimates. These errors appear to be limited for the considered quantities.

2 Recommendation

The idea motivating this study is interesting and relevant as the DSD is more and more commonly measured and used, in particular for radar rain rate estimation. However, the approach employed and the results presented in this manuscript are not well explained/introduced. So the reader is a bit confused on what exactly is investigated and how. In addition, there are major issues in my opinion (e.g., reflectivity values in the order of 100 dBZ) which question the validity/reliability of the results and conclusions. Given the large amount of work required to address these issues and to reshape the manuscript, I recommend to reject this manuscript. In order to help the authors improving their manuscript, I provide below a list of comments/suggestions about issues to be addressed.

3 General comments

1. The English is not good enough for publication in an international journal like AMT. Although I am not a native speaker, I found many strange or misleading sentences in the text that must be corrected. For example, the use of the terms "number", "concentration", "size" and "denstity" throughout the text is confusing/misleading. Just in the abstract, what exactly is "water concentration" on l.9, "number density" on l.11, "margin probability" on l.12, "sampling size" on l.14? I am aware that this is not easy for non-native speakers, but this must be done.

2. Section 2 is not clear, and the approach to simulate raindrops arrival time and DSDs should be better explained (and the required assumptions and associated limitations should be mentioned). This is a key issue as all the results and conclusions depend on the quality of the simulated DSDs.

3. Related to the previous item, the fact that the authors provide radar reflectivity

values in the order of 100 dBZ is a big concern. First such values are not realistic (reflectivity in rain is around 60 dBZ max, maybe a bit more in exceptional cases, but I have never seen measured values around 100 dBZ). Second, this raises the question of the maximum (equivolumetric) raindrop diameter simulated, about which I could not find any info in the text. So I am wondering if the authors have rigorously check their simulations...

4. The goal is to quantify the sampling effect in DSD measurements from optical disdrometers. The DSDs are however simulated from Gamma DSD fitted to measured DSDs. The quality of the fit of the Gamma DSD model on the measured DSD spectra should be discussed or at least mentioned.

4 Specific comments

1. P.8896, l.26: a better reference than *Battaglia et al.* (2010) presenting the Parsivel is *Löffler-Mang and Joss* (2000).

2. P.8897, l.8-9: this radar is known as MRR. The POSS could also be mentioned (*Sheppard*, 1990).

3. P.8898, l.9-11: The sampling uncertainty associated with Parsivel has been experimentally investigated and quantified *Jaffrain and Berne* (2011). This reference should be in this manuscript.

4. P.8899, Eq.1 and l.2-3: $N(D)$ given in Eq.1 is not the concentration of drops per unit volume, $N(D)dD$ is (the number of drops with diameter between D and $D + dD$ per unit volume). In addition, N_0 in Eq.1 is not the total concentration number (its units depend on μ). Moreover, the units should be provided for quantities/variables used in all the equations throughout the paper.

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5. P.8899, l.23-24: there are also studies in the literature that do not support the Poisson model for raindrops (see the work by Jameson and co-authors for example).

6. P.8900, Eq.4: λ here is confusing with λ in Eq.1. It should be changed.

7. P.8900, Eq.7: a reference should be given for this model, as it does not seem to be commonly used (maybe I am wrong...).

8. P.8901-8902, Eq.11-14: over what range of diameter are these sums computed?

9. P.8903, l.2: if ti is true, a reference showing that Parsivel is the "the most widely used instrument" should be given.

10. P.8903, l.5: I think that this sampling area of 180×27 mm^2 corresponds to the PMTech instrument, and I think it is 180×30 mm^2 for the OTT Parsivel.

11. P.8903, l.19: why 10 runs and not 5 or 100?

12. P.8903, l.20: what is the definition of this relative error?

13. P.8904, Section 3.2: what is the sample size (in number of drops) or duration considered in this analysis?

14. P.8906, l.26-27: as the drops partially crossing the beam are better detected (and removed) by Parsivel thanks to the 2 photodiodes, I am surprised that the error is positive in N_d in Table 6 (+0.14%), indicating an overestimation of the total number of drops. I would expect an underestimation if the "margin fallers" are removed...

15. P.8906, Section 3.4: it would be very interesting to investigate the probability to have multiple drops at the same time as a function of the sampling area. This is the main reason to keep it relatively small (except for the 2DVD for which the 2 perpendicular cameras help solving this issue).

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16. References: the article by *Battaglia et al.* (2010) was published in 2010 not in 2009.

17. Table 1: the parameter μ of the Gamma DSD model should be given as well. In addition, the units are erroneous for N_0.

18. Tables 2-3-4: the values of reflectivity reported in these tables are way too large.

19. Figure 1: the notation $R_{...}$ in the legend of the figure is confusing as R is supposed to be constant (as indicated in the caption). Maybe the term "DSD" should be used?

20. Figure 2: I am surprised that the higher order moments of the DSD (like Z) are less sensitive to the sample size. A few big drops less (or more) due to sampling effects have a larger influence on the higher order moment values. The authors should comment on this.

References

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 8895, 2012.