

## ***Interactive comment on “Correction of raindrop size distributions measured by Parsivel disdrometers, using a two-dimensional-video-disdrometer as a reference” by T. H. Raupach and A. Berne***

### **Anonymous Referee #1**

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Title: Correction of raindrop size distributions measured by Parsivel disdrometers, using a two-dimensional video disdrometer as a reference Author: T. H. Raupach and A. Berne Journal: Atmos. Meas. Tech. (doi:10.5194/amtd-7-8521-2014) General Comments: This manuscript tries to correct the size and fall velocity measurement errors of Parsivel disdrometer using two-dimensional video disdrometer (2DVD) as a reference. The authors did detailed work. The second author and his former and current graduate students published numerous per-reviewed articles using Parsivel disdrometers. The research group at Environmental Remote Sensing Laboratory owns more than a dozen

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first generation of Parsivel manufactured by OTT and their motivation to correct the measurement errors are well understood. Indeed, the manuscript states that the authors plan to study the small-scale variability of raindrop size distribution using Parsivel disdrometers. As the authors listed the pertinent literature in the introduction, there are several studies where the comparative studies were done between Parsivel and 2DVD disdrometers. Among those, Thurai et al. 2011 and Tokay et al. 2013 showed that OTT Parsivel had shortcomings on both small and large drop sizes. The manufacturer confirmed the shortcomings of the OTT Parsivel and attributed to the inexpensive and inhomogeneous laser device. This is a hardware issue and this reviewer thinks that it can be corrected through software update. The authors used 2DVD as a reference. It is true that 2DVD is superior to the OTT Parsivel but it has its own shortcomings. The 2DVD underestimates the small drops less than 0.5 mm in diameter. The removal of secondary drops due to splashing and mismatching are one of the key issues of 2DVD data processing. The authors introduce a new velocity based threshold (equations 12 and 13), which retains most of the small drops that have been traditionally eliminated due to percent velocity criterion. The new velocity thresholds are subjective and do not screen the mismatched or secondary drops. Since 2DVD is used as a reference, this is an important aspect for this study. The authors used Gunn and Kinzer observations as a reference to correct OTT Parsivel fall velocities. This means that the raindrops are assumed to be falling in still air. If that is the case, it might be better to use Gunn and Kinzer observations in calculating size distribution and rain parameters. The second generation of OTT Parsivel (Parsivel2) corrected the overestimation of small drops but had a severe underestimation of midsize drops starting at 1.0 mm in diameter. The manufacturer admitted this matter and attributed to a software bug.

Perhaps the most important aspect of this study is the correction of the size distribution. It is done based on hourly observations. What is the minimum number of observations in an hour to be included to the  $P(i)$  ratio? Figure 7 shows the  $P(i)$  median for 8 different rain rate intervals. Given the fact that OTT Parsivel overestimates rain intensity, why the authors used Parsivel-derived rain rate? The 2DVD rain rate could be a better

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reference or we are missing a point. The authors showed that the correction has a better performance at small drop end but there are large deviations at larger sizes. The overestimation of midsize and large drops is one of the key problems of OTT Parsivel. The drops larger than 2.0 -2.5 mm are overestimated by OTT Parsivel. This problem was resolved in OTT Parsivel2. The probability distributions (Figure 11) showed that the corrected fourth and fifth moments did not have a good agreement with 2DVD. The agreement with a gauge did not show a clear improvement even though the authors think so. While this reviewer appreciates the effort on correcting OTT Parsivel, the findings did not convince that the corrected number concentrations provide more accurate size distribution. It is questionable that these corrections can be applied elsewhere. It should not be applied to OTT Parsivel2 since the firmware is different.

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