Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-466-AC3, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Automated precipitation monitoring with the Thies disdrometer: Biases and ways for improvement" *by* Michael Fehlmann et al.

Michael Fehlmann et al.

michael.fehlmann@unige.ch

Received and published: 17 June 2020

Specific comments

3.1 I find that your introduction might benefit from adding further explanations, in particular when it comes to the use of laser disdrometers outside of precipitation amounts measurements; e.g. gathering of DSD for parameterisation of models and retrievals. Typically line 20, you mention the "verification of dual-pol radars" but it is not reduced to this, and you could possibly mention all the different usage of the DSD (not only for the Thies) but for disdrometers in general.

Response: You are right. We amended further usages.

Changes in the manuscript (section 1): Beside the calibration and verification of rain-

Printer-friendly version

Discussion paper

fall estimation by radar and satellite, disdrometers are also used for a proper understanding of hydrometeorological regimes and soil erosion, pollution wash off in urban environments or interactions of rainfall with crop and forest canopies (Angulo-Martinez, 2018; Frasson and Krajewski, 2011; Nanko et al., 2004; Nanko et al., 2013).

3.2 Lines 21 and 22: “not many studies have assessed uncertainties of disdrometers” – this is not really correct, and quite perilous to state this without including a succinct literature review. There are plenty of studies assessing uncertainties of disdrometers (usually by comparing disdrometers of different make-up / manufacturers / principles, or/and co-located instruments), but they often investigate the OTT Parsivels (both versions) and 2DVD in their majority. For the Thies in particular, you could mention here Angulo-Martinez et al. (2018) and Guyot et al. (2019), both published in the companion EGU-journal HESS.

Angulo-Martínez, M., Beguería, S., Latorre, B., & Fernández-Raga, M.: Comparison of precipitation measurements by OTT Parsivel 2 and Thies LPM optical disdrometers. Hydrology and Earth System Sciences, 22(5), 2811, https://doi.org/10.5194/hess-22-2811-2018, 2018.

Guyot, A., Pudashine, J., Protat, A., Uijlenhoet, R., Pauwels, V. R. N., Seed, A., and Walker, J. P.: Effect of disdrometer type on rain drop size distribution characterisation: a new dataset for south-eastern Australia, Hydrol. Earth Syst. Sci., 23, 4737–4761, https://doi.org/10.5194/hess-23-4737-2019, 2019.

In these two studies, measurements of rainfall are evaluated using respectively OTT Parsivel1 and 2 and Thies LPM. This could serve as well for your discussion, in particular when it comes to the uncertainties and systematic under-estimation of rainfall by Thies instruments. We find in Guyot et al. (2019) that Thies underestimated liquid precipitation when compared to the OTT Parsivels (1 and 2).

Response: Thank you, you are right. We changed the sentence mentioning that there are only few studies mentioning the uncertainties of the Thies distrometer, including

also literature suggested by reviewer #1 (please see corresponding comment). Also, we included a sentence in the discussion mentioning Guyot et al. (2019).

Changes in the manuscript (sections 1 and 4): We changed the sentence in the introduction: However, there are only few studies which assess the uncertainties of the Thies disdrometer, mostly comparing the instrument to OTT Parsivel disdrometers (e.g., Adirosi et al., 2018; Angulo-Martínez et al., 2018; Guyot et al., 2019; Upton and Brawn, 2008) and in a few cases to rain gauges (e.g., Lanza and Vuerich, 2012; Lanzinger et al., 2006). In the discussion we added: Finally, when compared the OTT Parsivels, Guyot et al. (2019) found that the Thies disdrometer [. . .] underestimates liquid precipitation compared to both Parsivel1 and Parsivel2.

3.3 Line 28 to 30. I believe these findings have been revisited in Thurai et al. (2016) and later Thurai and Bringi (2018), Raupach et al. (2019)? The 2DVD seems to underestimate droplets in the lower range of diameters (< 0.5 mm), meaning that their use as reference can be questionable in some circumstances in particular over that range. Overall, it would be great to mention that there is no perfect reference that one can use, and each instrument will be affected by uncertainties. For the 2DVD, it would be great to mention that the literature is evolving and previous findings might not hold anymore or only partially.

Thurai, M. and Bringi, V. N.: Application of the generalized gamma model to represent the full rain drop size distribution spectra, J. Appl. Meteorol. Clim., 57, 1197–1210, https://doi.org/10.1175/jamc-d-17-0235.1, 2018.

Thurai, M., Gatlin, P., Bringi, V. N., Petersen, W., Kennedy, P., Notaroš, B., & Carey, L. (2017). Toward completing the raindrop size spectrum: Case studies involving 2Dvideo disdrometer, droplet spectrometer, and polarimetric radar measurements. Journal of Applied Meteorology and Climatology, 56(4), 877-896.

Raupach, T. H., Thurai, M., Bringi, V. N., & Berne, A. (2019). Reconstructing the drizzle mode of the raindrop size distribution using double-moment normalization. Journal of

Applied Meteorology and Climatology, 58(1), 145-164.

Response: We think at the end we have to have some reference, but we added that the 2DVD seems to underestimate small particles

Changes in the manuscript (section 1): We added the following to the introduction: ". . .,even if the 2DVD seems to underestimate droplets in the lower range of diameters, i.e. below 0.5 mm (Raupach et al., 2019; Thurai et al., 2017; Thurai and Bringi , 2018).

3.4 In your manuscript, it would be great to differentiate the two types of Parsivel (1 and 2) using a superscript, as in the second version; the manufacturer has corrected some issues in particular in the lower range of diameters.

Response: Thank you for this comment, we have tried to better make this distinction when referring explicitly to one of these instruments

Changes in the manuscript (section 4): In addition to other comments added during this revision, this was changed in the following sentence of the manuscript: "For example, the OTT Parsivel1 disdrometer only underestimates drops with sizes ranging between 0.8 and 1.6 mm and only during periods of higher rainfall intensity."

3.5 In terms of rainfall, we have found in Guyot et al. (2019) that the Thies starts to underestimate the number of droplets from 0.75 mm onwards towards larger diameters (instead of 0.5 mm as mentioned in your paper) when compared to Parsivel1. Since we do not use the same reference (in your case 2DVD), this might explain the difference but again here I think it is good to keep in mind that 2DVD is not an absolute reference and has been questioned for his accuracy in the recent literature.

Response: Thank you for this hint, as you are mentioning we are using the 2dvd as a reference. As Raupach and Berne (2015) are writing: If a better reference becomes available, exactly the same approach could be applied to correct the Parsivel (or indeed any other disdrometer) and to improve the agreement with the reference.

Changes in the manuscript (section 4): Guyot et al. (2019) found that the Thies dis-

drometer starts to underestimate the number of droplets from 0.75 mm onwards towards larger diameters when compared to Parsivel1...

3.6 Data availability: It adds a great value to the work to make the data accessible openly on a repository (and possibly the code as well, mentioning libraries having been used if any to give credits to the authors). One of the strengths of open-access articles is also to promote that accessibility of data and code so that work can be re-produced, and data shared easily.

Response: Thank you for this comment. We now published the following data on Zenodo (doi: 10.5281/zenodo.3895297): - Thies disdrometer measurement outputs: daily .csv files. - OTT pluviometer measurement outputs: daily .csv files. - 2DVD measurement outputs: daily .sno files (containing the information of successfully matched hydrometeors) provided in ASCII format. - Metadata, i.e. user manuals and specifications for these 3 measurement instruments.

We have only used standard libraries (in the R software environment) for the processing of the data. Regarding the classification algorithm applied to 2DVD measurements, we were in close exchange with Joanneum Research and partly used empirical relationships derived by them, which we mention in the methodology section (2.2) as well as in the acknowledgements.

Changes in the manuscript (data availability section): The data used in this study, i.e. measurement outputs of the Thies disdrometer, the OTT pluviometer as well as the two-dimensional video disdrometer (2017-07-01–2019-06-30), can be found in Fehlmann et al. (2020).

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-466, 2020.