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Examining the correlations between drop size distribution parameters using data from two side-by-side 2D-video disdrometers

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As part of a long-term observation campaign, 7500 pair samples of temporally matched 1 minute averaged drop size distribution (DSD) measurements have been recorded by two side-by-side (frequently calibrated) 2D-video disdrometers. The measurement campaign was conducted in Huntsville, Alabama, over a nine-month period, which includes a variety of rain types and regimes. These datasets have been used to examine the correlation between DSD parameters. One such correlation is the often quoted μ-Λ relationship estimated assuming gamma DSDs. If such a physical correlation does exist, then this would simplify DSD retrievals from radar measurements, both dual-polarized, ground based radars as well as dual-wavelength, spaceborne radars. However, it is still not clear to what extent the correlation is physical as opposed to being artificially introduced by the estimation procedure itself.

One way to address the above issue is to make use of the side-by-side disdrometer datasets. Two different types of estimation procedures were used, one being the truncated method of moments and the other using direct μ estimation from normalized and scaled DSD. The validity of the possible μ-Λ relationship is examined by (a) relating the estimated μ versus the estimated Λ from the same disdrometer datasets and (b) by 'cross-relating' the μ from one disdrometer with the corresponding Λ from the second disdrometer dataset. The latter process (i.e. cross-relating μ-Λ) would remove any artificially-introduced correlations.

The same process was repeated to examine the Dm versus σm (that is, the mass weighted mean diameter versus the standard deviation of the mass spectrum) correlations. The results show that the cross-related Dm versus σm gives variation somewhat similar to that using the single disdrometer dataset. The estimation procedure used for these two parameters do not have any assumptions regarding the shape of the DSD (i.e. no gamma DSD assumption).