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Rain microstructure retrievals using 2-D video disdrometer and C-band polarimetric radar

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Abstract. Measurements using the 2-D video disdrometer (2DVD) taken during a heavy rainfall event in Huntsville, Alabama, are analysed. The 2DVD images were processed to derive the rain microstructure parameters for each individual drop, which in turn were used as input to the T-matrix method to compute the forward and back scatter amplitudes of each drop at C-band. The polarimetric radar variables were then calculated from the individual drop contribution over a finite time period, e.g., 1 min. The calculated co-polar reflectivity, differential reflectivity, specific differential propagation phase and the co-polar correlation coefficient were compared with measurements from a C-band polarimetric radar located 15 km away. An attenuation-correction method based on the specific differential propagation phase was applied to the co-polar and differential reflectivity data from the C-band radar, after ensuring accurate radar calibration. Time series comparisons of the parameters derived from the 2DVD and C-band radar data show very good agreement for all four quantities, the agreement being sometimes better than the computations using the 1-min drop size distribution and bulk assumptions on rain microstructure (such as mean shapes and model-based assumptions for drop orientation). The agreement is particularly improved in the case of co-polar correlation coefficient since this parameter is very sensitive to variation of shapes as well as orientation angles. The calculations mark the first attempt at utilizing experimentally derived "drop- by-drop" rain microstructure information to compute the radar polarimetric parameters and to demonstrate the value of utilizing the 2-D video disdrometer for studying rain microstructure under various precipitation conditions. Histograms of drop orientation angles as well as the most probable drop shapes and the corresponding variations were also derived and compared with prior results from the 80 m fall "artificial rain" experiment.

Full Article in PDF (PDF, 907 KB)

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