

DROP SHAPE STUDIES IN RAIN USING 2D VIDEO DISDROMETER AND POLARIMETRIC, DUAL-WAVELENGTH RADAR

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1. INTRODUCTION

Rain drop shapes play an important role in algorithm development for determining rainfall rates from polarimetric radar measurements [1]. It has been shown previously that the 2D video disdrometer (2DVD) [2] is capable of providing accurate information on drop shapes. An artificial rain experiment conducted under calm wind conditions [3, 4] yielded the mean drop shapes and the shape variations due to drop oscillations after a fall of 80 m. Later, the mean shapes as well as the axis ratio distributions were compared with wind-tunnel measurements and were shown to be in good agreement [5]. 2DVD measurements in natural rain have also been made, and very recently, one event study [6] in Alabama, USA, has indicated that drop shapes can at times vary somewhat from the aforementioned mean shapes. This was verified using polarimetric radar measurements at C-band made over the 2DVD site. In this paper, we present another event study from another location, namely, South-East Queensland near Brisbane, Australia, where a well calibrated 2DVD was recently installed at a location which not only has polarimetric radar coverage but also dual-wavelength radar observations at S and X bands.

2. 2DVD MEASUREMENTS

Since the installation of the 2DVD in November 2008, several events have been recorded, many of which has been analyzed to determine the drop shapes and the drop axis ratio distributions for various drop diameter intervals. The modes of the various axis ratio distributions are similar to those from the artificial rain experiment, but the skewness has been observed to be considerably higher, the distributions being skewed towards more spherical axis ratios for some events. Moreover, in the 1.6 – 1.8 mm range, there seems an unusually wide axis ratio distribution, possibly indicating oscillations due to the resonance with eddy-shedding frequency.

3. RADAR OBSERVATIONS

Most of the events recorded by the 2DVD were accompanied by the S-band (dual polarization) and X band radar observations, with precisely aligned and precisely matched radar-beams. One example was on 09 December 2008, a wide spread rain event with several convective cores, one of which passed over the 2DVD site between 01:40 – 02:20 UTC. The variation of the X-band specific attenuation (k_h) with the differential propagation phase (K_{dp}) at S-band was derived from the radar measurements. When compared with the corresponding calculations using the 2DVD derived drop size distributions and the drop shapes from [3], some differences are observed. These differences can be attributed to the significant positive skewness observed with the axis ratio distributions measured by the 2DVD for this event.

3. REFERENCES

[1] Bringi, V.N. and C. Chandrasekar, *Polarimetric Doppler Weather Radar*, Cambridge University Press, 2001.

[2] Schönhuber, M., G. Lammer, and W.L. Randeu, “The 2D Video Disdrometer”, Chapter 1 in *Precipitation: Advances in Measurement, Estimation and Prediction*. Michaelides S (Ed.). Springer, ISBN: 978-3-540-77654-3, 2008.

- [3] M. Thurai, and V. N. Bringi 2005, “Drop Axis Ratios from a 2D Video Disdrometer”, *J. Atmos. Oceanic Technol.*, vol. 22, pp. 966–978, 2005.
- [4] M. Thurai, G. J. Huang, V. N. Bringi, W. L. Randeu, and M. Schönhuber, “Drop Shapes, Model Comparisons, and Calculations of Polarimetric Radar Parameters in Rain”, *J. Atmos. Oceanic Technol.*, vol. 24, pp. 1019–1032, 2007.
- [5] M. Thurai, M. Szakáll, V. N. Bringi, K. V. Beard, S.K. Mitra, S. Borrmann, “Drop shapes and axis ratio distributions: comparison between 2-D video disdrometer and wind-tunnel measurements”, *J. Atmos. Oceanic Technol.* 2009 early online release, posted February 2009, DOI: 10.1175/2009JTECHA1244.1.
- [6] M. Thurai, V. N. Bringi, and W. A. Petersen, “Rain microstructure retrievals using 2-D video disdrometer and C-band polarimetric radar”, *Advances in Geosci.*, vol. 20, pp. 13-18, 2009.