

Disdrometer Rain Drop Statistics for Darwin and the Southern Great Plains Site

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The ARM Program purchased two impact disdrometers late in 2005 to provide surface measurements of rain drop size distribution. The first was deployed at the Tropical Western Pacific Darwin site where data collection began February 3rd of 2006. The second was deployed at the Southern Great Plains (SGP) Central Facility; data collection started April 10th of 2006. Rain from a number of convective and stratiform events has been observed and the drop size spectra have been analyzed to determine the range in mean drop diameter as well as its median and mode. N_0 and Λ , parameters from a Marshall-Palmer fit to the number density spectra, were tracked as well. A comparison was made between the pre- and post- dead time corrected values for mean drop diameter, N_0 and Λ . The correction is often made to remove a large drop bias due to hysteresis in the movement of the disdrometer sensor plunger. The rain drop spectra can be used to calculate radar reflectivity and mean Doppler velocity. The Darwin results have been compared to the observed MMCR (35GHz) reflectivities, while in the SGP case the calculated reflectivities were compared to both WACR (95GHz) and MMCR data.

STM update-No SGP data will be discussed. The instrument has been sent to Distromet for repair and calibration.

Background

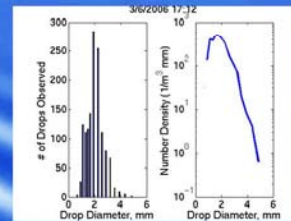
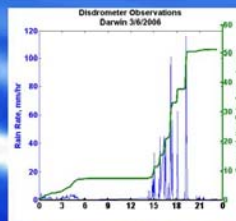
Top Left- disdrometer at Darwin

Top Right- disdrometer close up, height 17 cm

The main purpose of the disdrometer is to measure drop size distribution, which it does over 20 size classes from 0.3mm to 5.4mm. The disdrometer transforms the vertical plunger motion from raindrop impact into electrical impulses whose strength is proportional to drop diameter. The disdrometer results can be used to infer rain rate, rain amount and several other properties including drop number density, radar reflectivity, liquid water content, and energy flux. Two coefficients, N_0 and Λ , from an exponential fit between drop diameter and drop number density, are routinely included in the data stream.

Bottom Left, Stormy Day

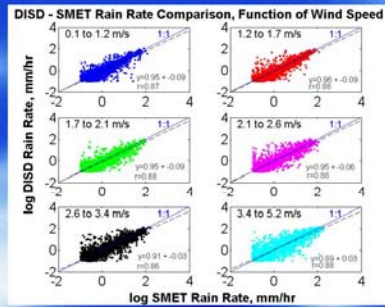
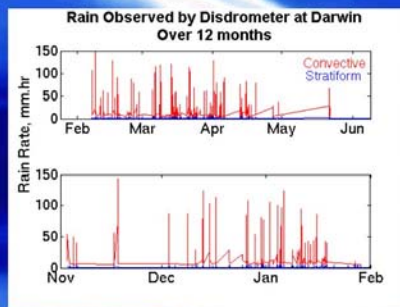
Bottom Right, Example Drop Spectra



New Observations

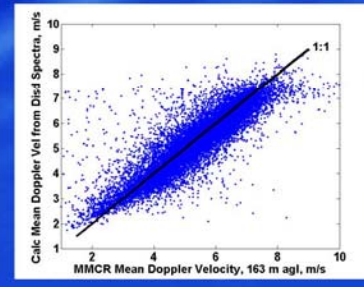
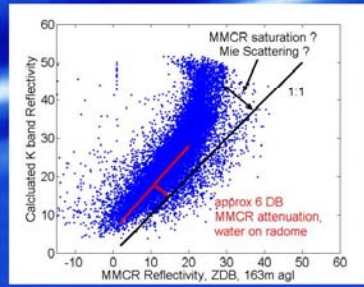
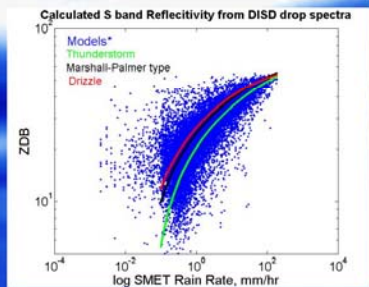
Raindrop Characteristics		
	Stratiform	Convective*
Mean	0.83mm	1.21mm
Median	0.77	1.12
Mode	0.56	1.12

*Convective = rain rate > 5mm/hr



Disdrometer – SMET Comparison
 The disdrometer rain rate measurements show good agreement with those determined by the SMET system (correlation coefficient, $r_s = 0.88$). The disdrometer values, however, tend to be biased low and this bias increases with higher wind speeds.

Right - Example of potential use of disdrometer data for Z-R relationship studies.
 Middle Right - Comparison of calculated reflectivity from disdrometer drop spectra compared with low level MMCR returns. Remember that the MMCR is not a "rain radar". It is a cloud radar.
 Far Right - Comparison of Mean Doppler Velocity calculated from disdrometer drop spectra with low level MMCR values.



*Jan, J., Thomas, J.C., and Waldvogel, A., 1968. The variation of raindrop size distributions at Laramie, Wyo., U.S. Conf. on Cloud Physics, Amer. Meteor. Soc., Boston, Mass., 269, 272.



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