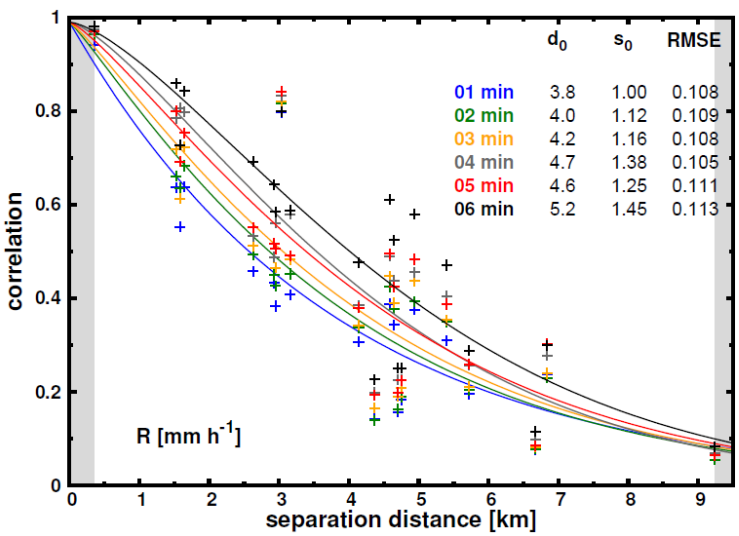
Spatial Variability of Rainfall and Raindrop Size Distribution Parameters Observed by 2-D Video Disdrometer and Rain Gauges during MC3E

Jan-Bernd Schröer[1], Ali Tokay[2],
Clemens Simmer[1] and Walter A. Petersen[3]

[1] Meteorological Institute of the University of Bonn, Germany
[2] JCET-UMBC NASA Goddard Space Flight Center
[3] NASA-GSFC Wallops Flight Facility

Stretched Exponential Function

$$r(d) = r_0 \exp\left[-\left(\frac{d}{d_0}\right)^{s_0}\right]$$



r = correlation coefficient

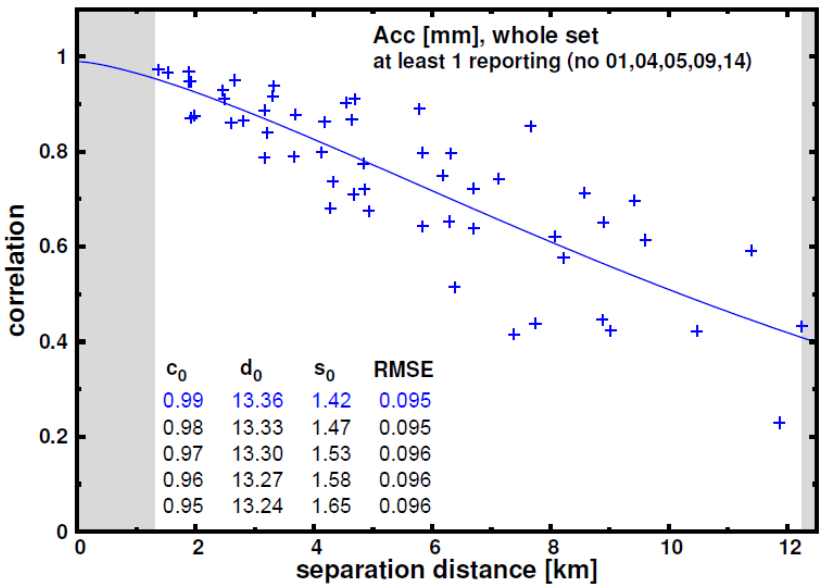
r_0=nugget parameter (correlation between collocated instruments)

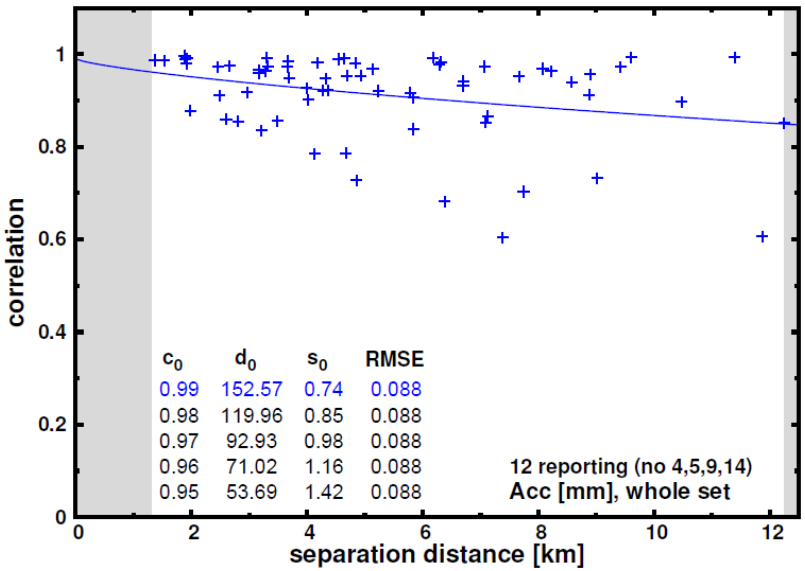
d =separation distance

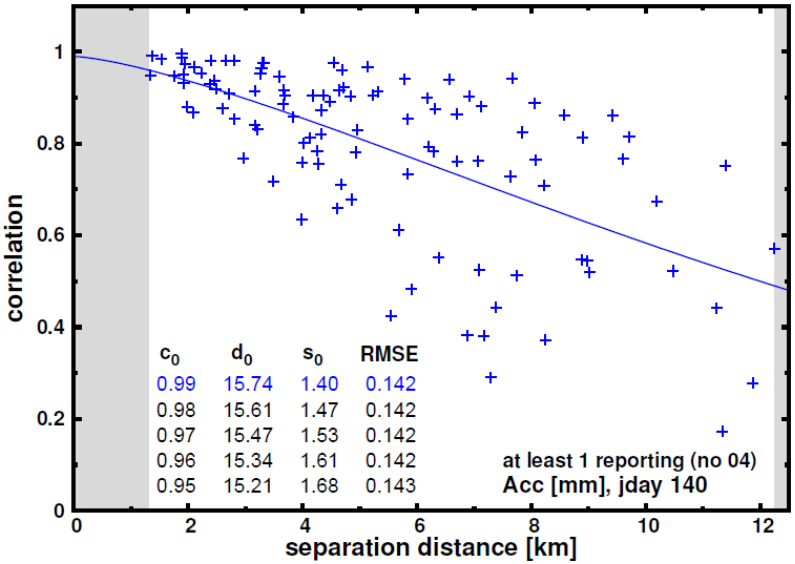
d_0=decorrelation distance

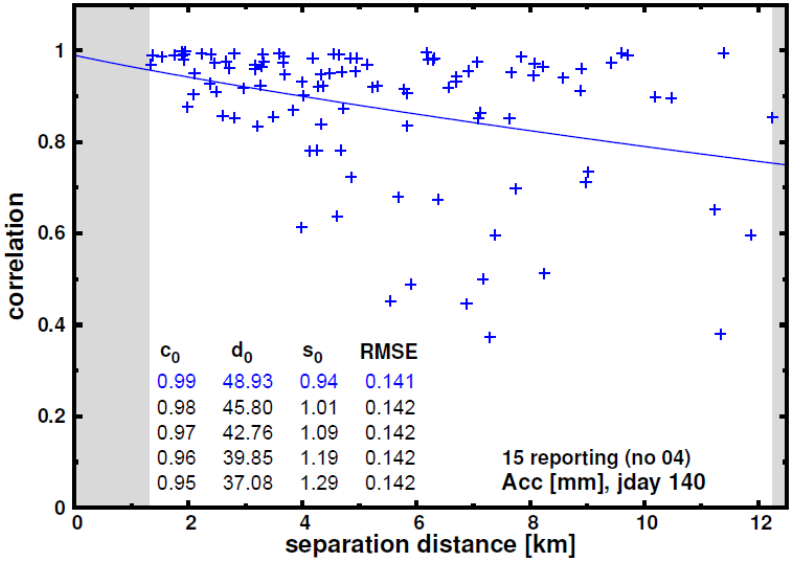
s_0 =shape parameter

Spatial Variability of Rainfall – Rain Gauges

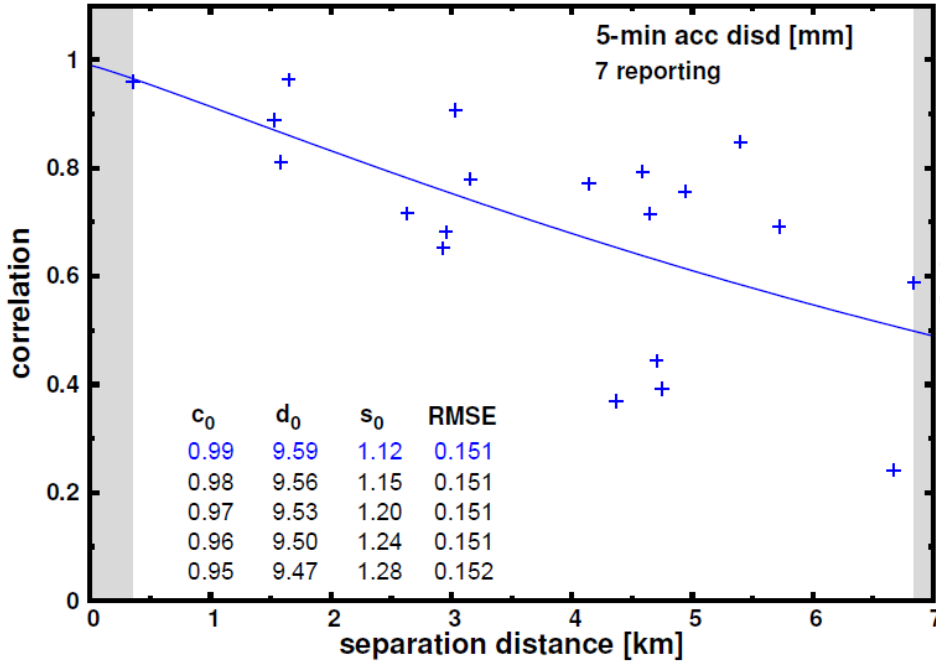


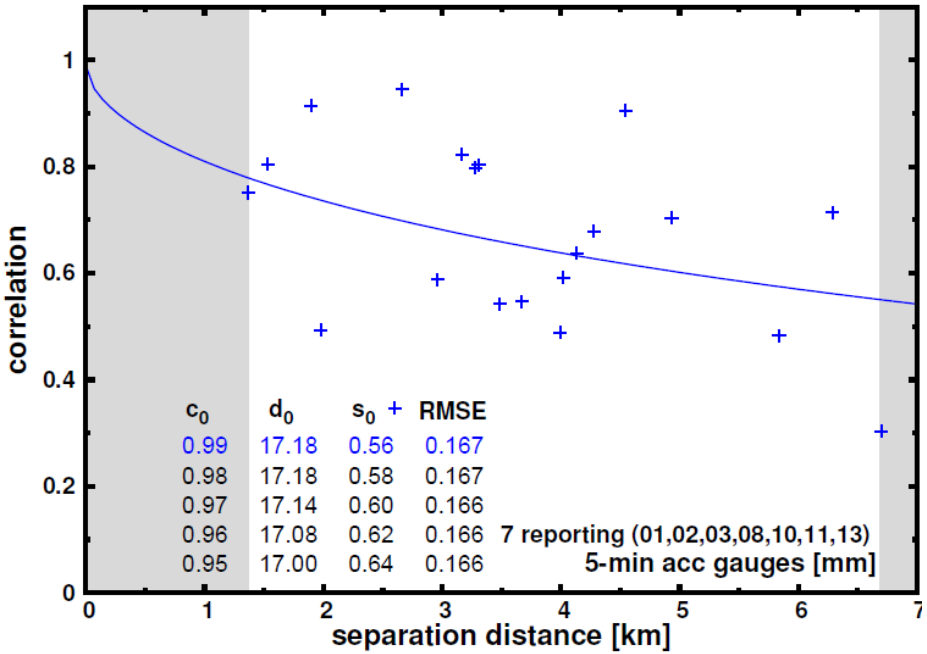






Spatial Variability of Rainfall
– 2-D Video Disdrometer and Rain Gauges





Normalized Raindrop Size Distribution

$$N(D) = N_T^* f(\mu_1) \left(\frac{D}{D_m}\right)^{\mu_1} e^{-(4+\mu_1)\frac{D}{D_m}}$$

$$N(D) = N_W g(\mu_2) \left(\frac{D}{D_m}\right)^{\mu_2} e^{-(4+\mu_2)\frac{D}{D_m}}$$

$$f(\mu_1) = \frac{(4+\mu_1)^{\mu_1+1}}{\Gamma(\mu_1+1)} \qquad N_T^* = \frac{N_T}{D_m}$$

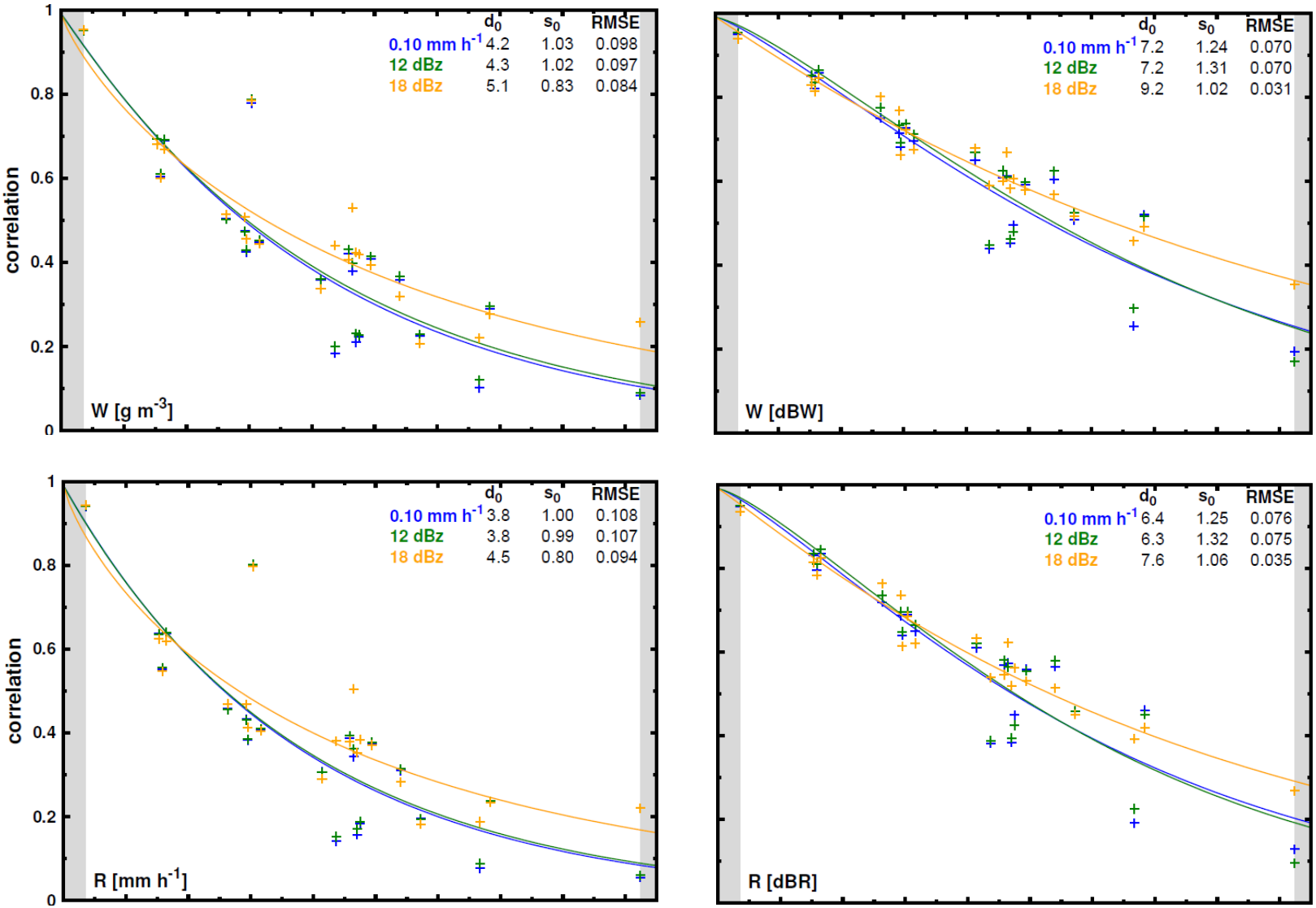
$$g(\mu_2) = \frac{6(4+\mu_2)^{\mu_2+4}}{\Gamma(\mu_2+4)} \qquad N_W = \frac{256W}{\pi \rho_w D_m^4}$$

D: drop diameter
μ : shape parameter
D_{mass} :mean mass diameter
W : liquid water content

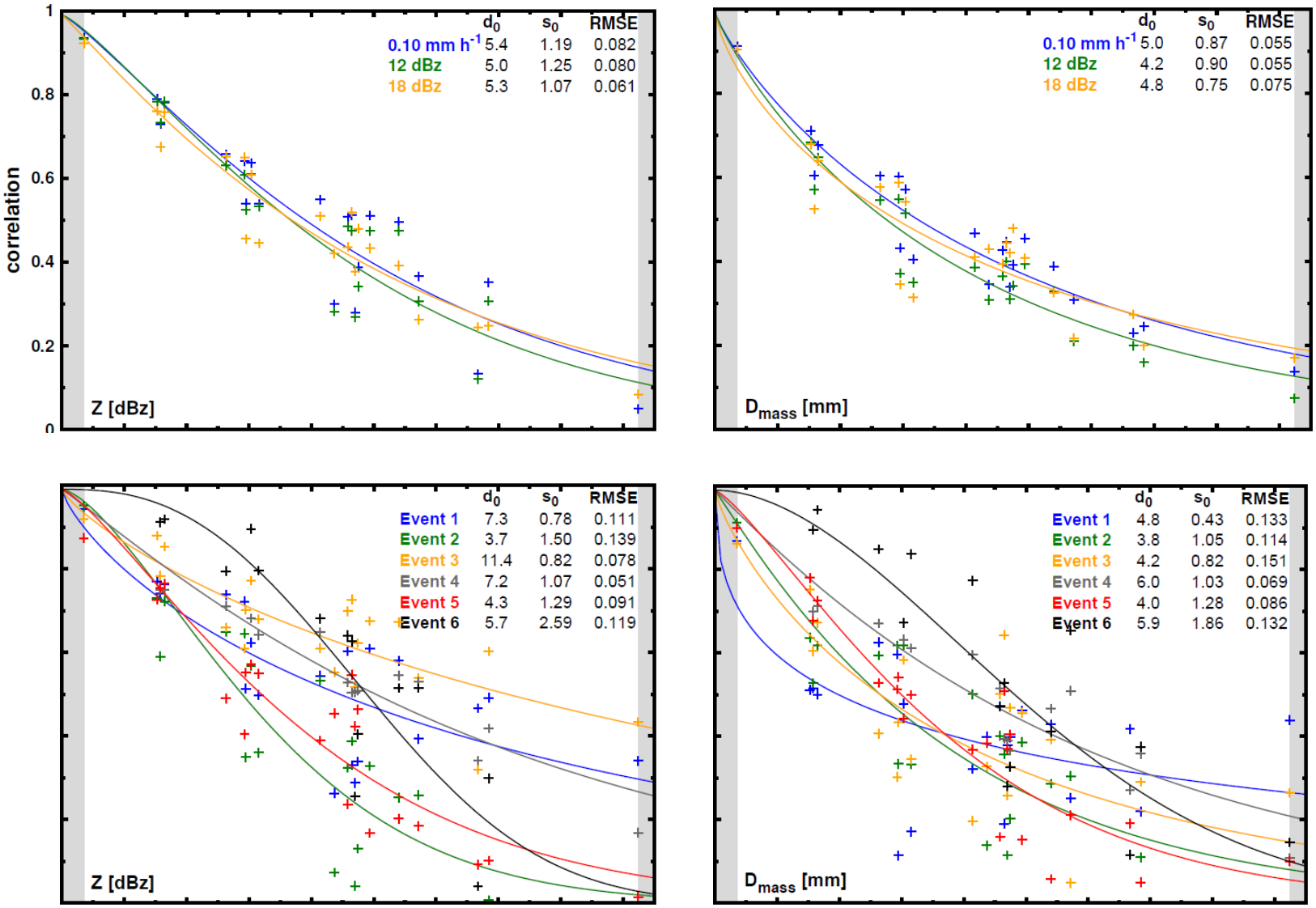
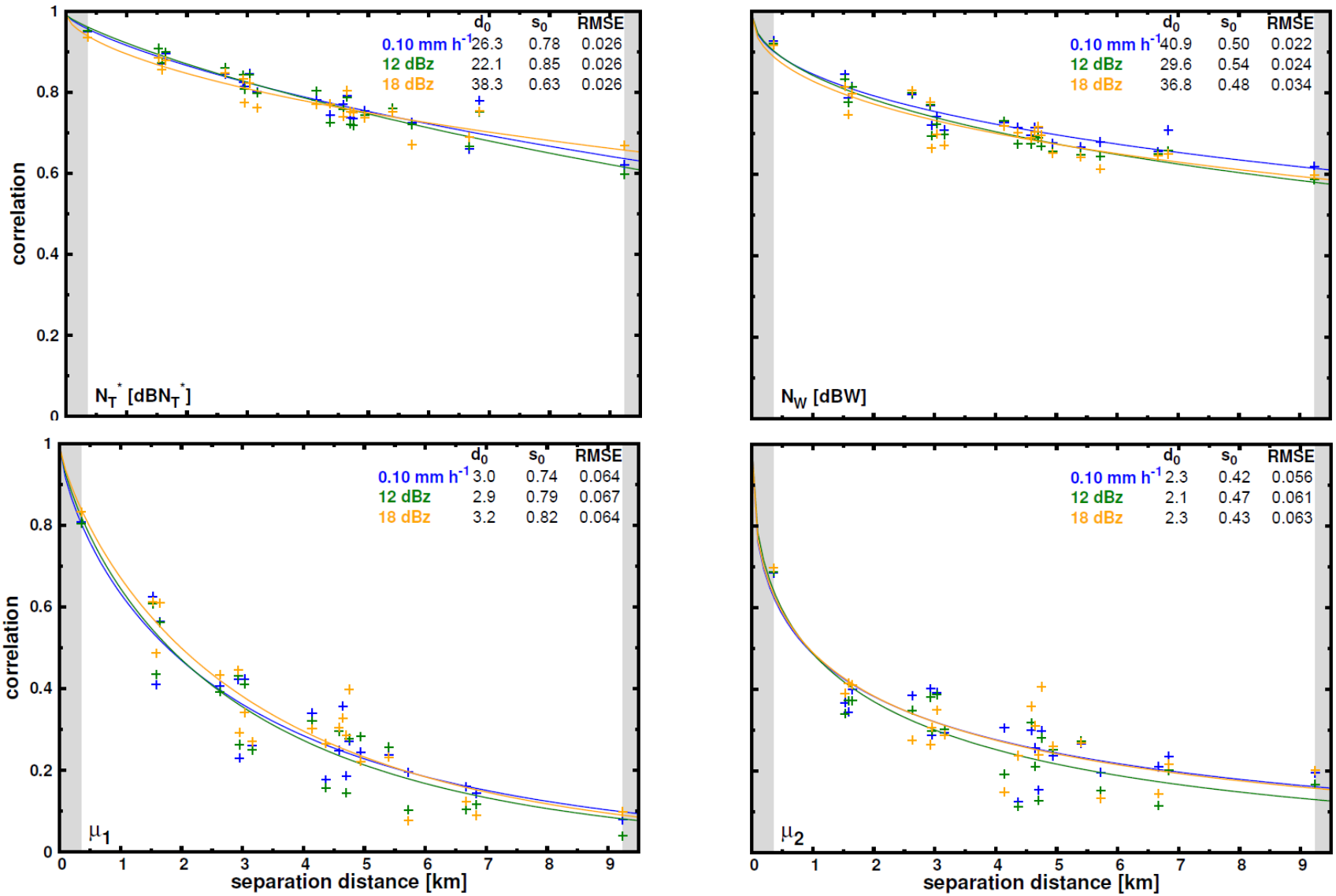
N_T^* : normalized intercept parameter wrt the total concentration

N_W : normalized intercept parameter wrt the liquid water content

Spatial Variability of Liquid Water Content (W) and Rain Rate (R) – 2-D Video Disdrometer



Spatial Variability of Reflectivity (R) and Mean Mass Diameter (D_{mass}) – 2-D Video Disdrometer



Spatial Variability of Normalized Intercept (N_T^* , N_W) and Shape Parameters (μ_1, μ_2) – 2-D Video Disdrometer