



# Comparison of Disdrometer and Rain Gauge Measurements during pre-CHUVA\*



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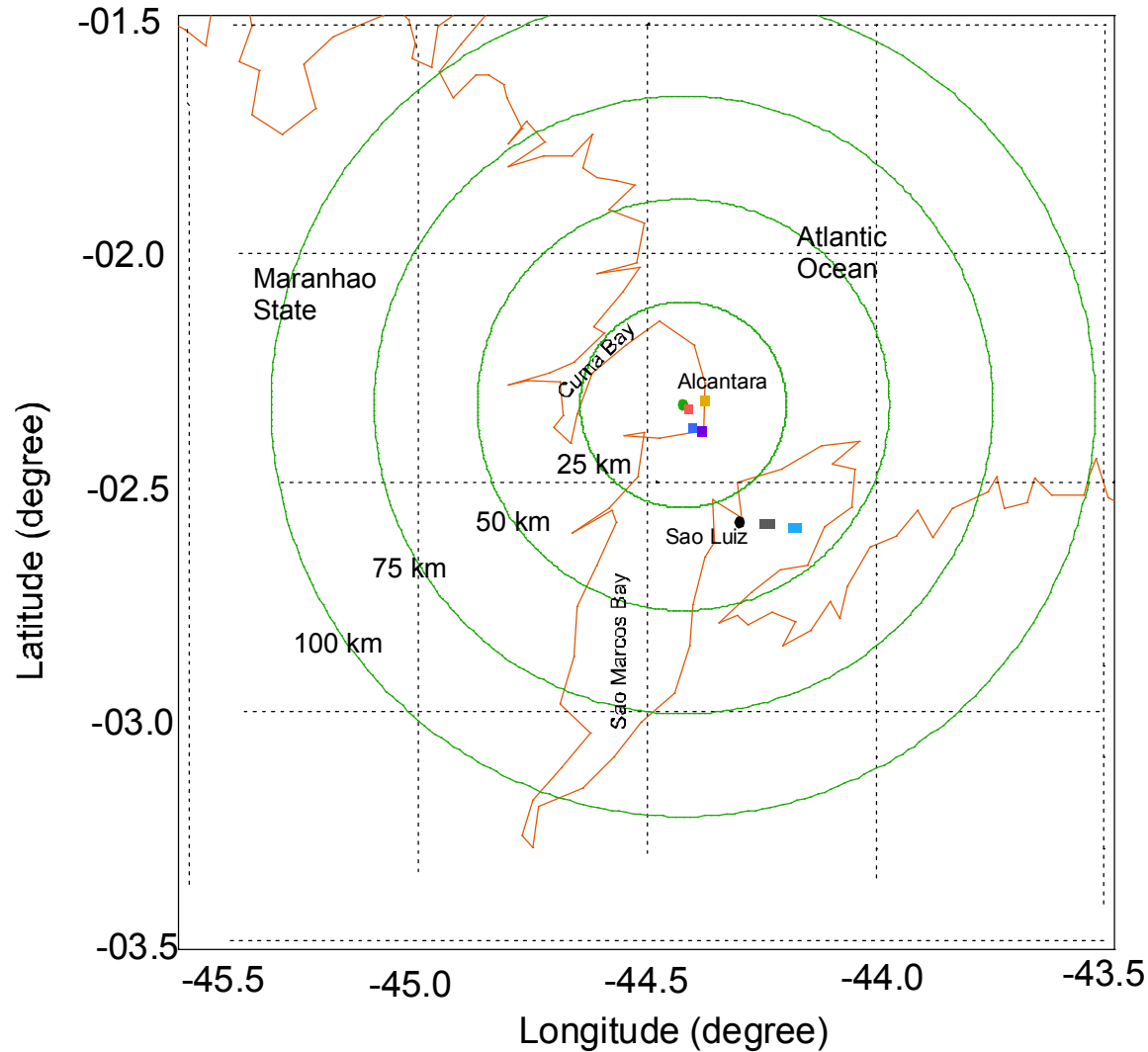
<sup>5</sup>Science Systems Applications Inc.

<sup>6</sup>NASA Marshall Space Flight Center

\*Cloud processes of the main precipitation systems in Brazil: A contribution to cloud resolving modeling and to the global precipitation measurement

Field Campaign period: March 1-26, 2010

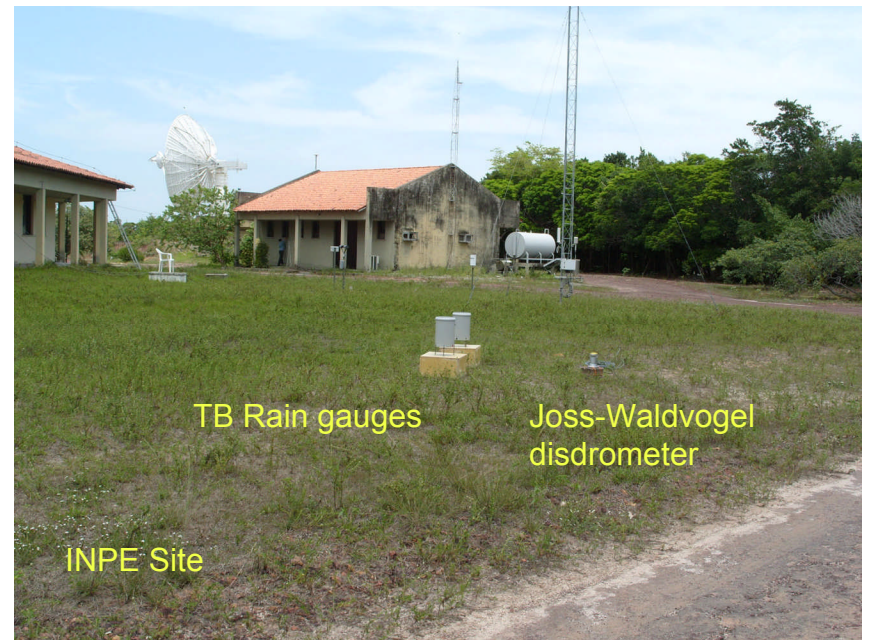
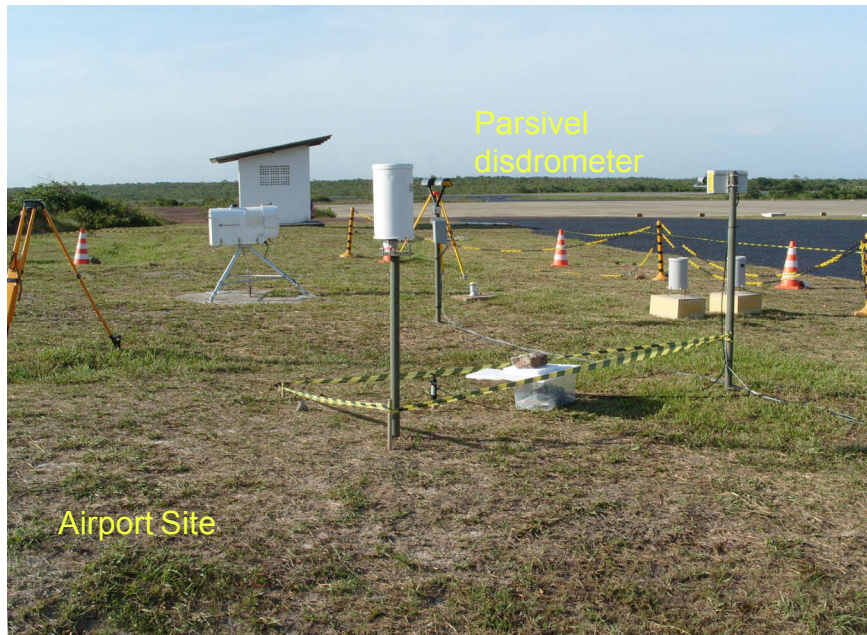
# Pre-CHUVA Data Acquisition Network



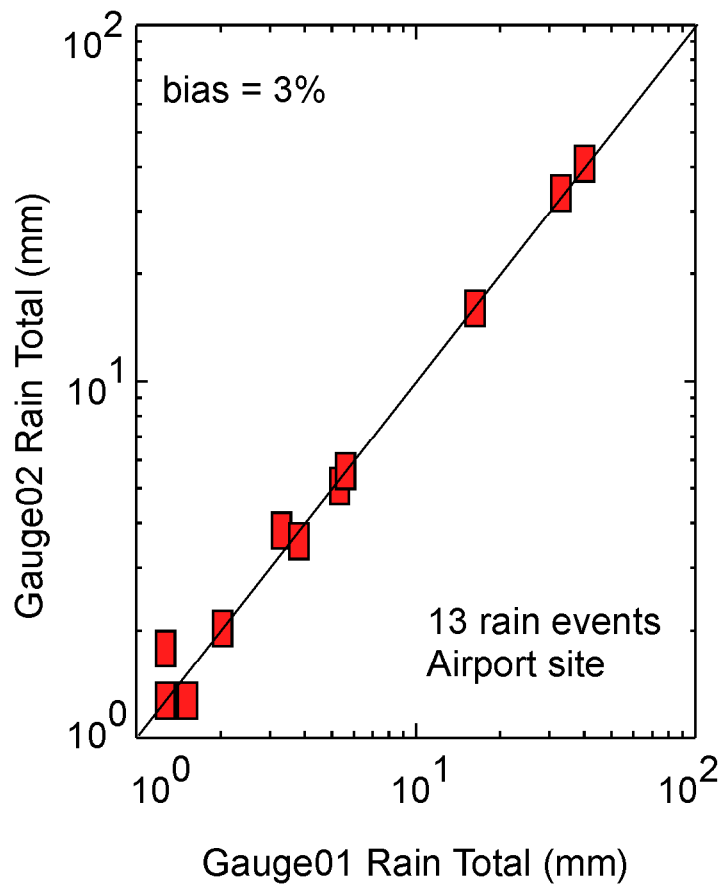
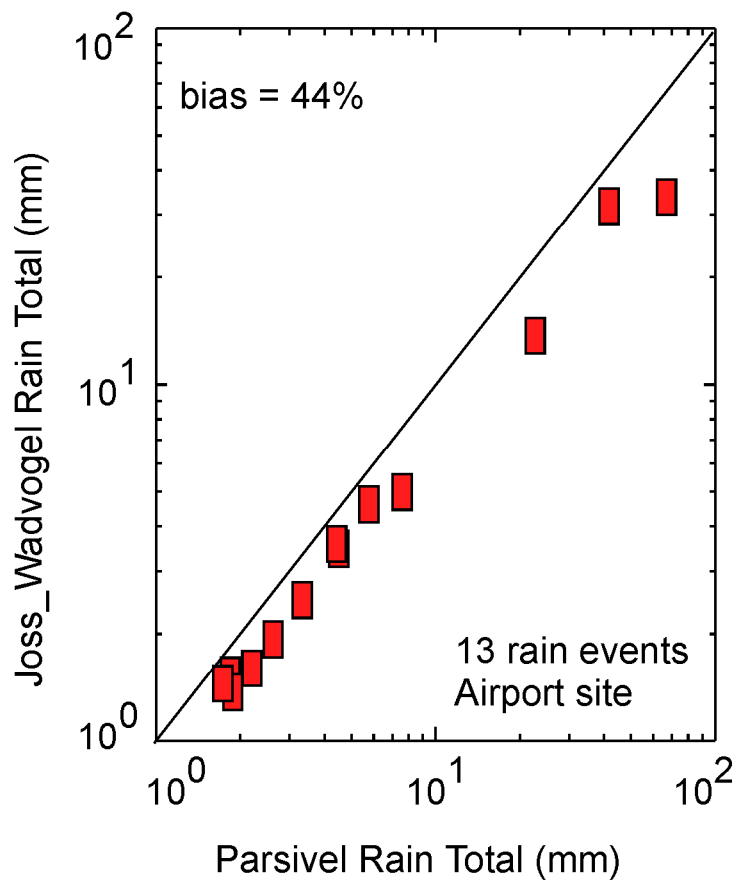
- X-band polarimetric radar
- Disdrometer&Gauge site (INPE)
- Disdrometer&Gauge site (Airport)
- Admirari
- Anemometer tower
- Sao Luiz International Airport
- University of Maranhao

- $\Delta$  (radar-airport) = 5.8 km
- $\Delta$  (radar-INPE) = 2.0 km
- $\Delta$  (radar-Admirari) = 7.7 km
- $\Delta$  (airport-INPE) = 4.3 km
- $\Delta$  (airport-Admirari) = 2.4 km
- $\Delta$  (INPE-Admirari) = 5.9 km

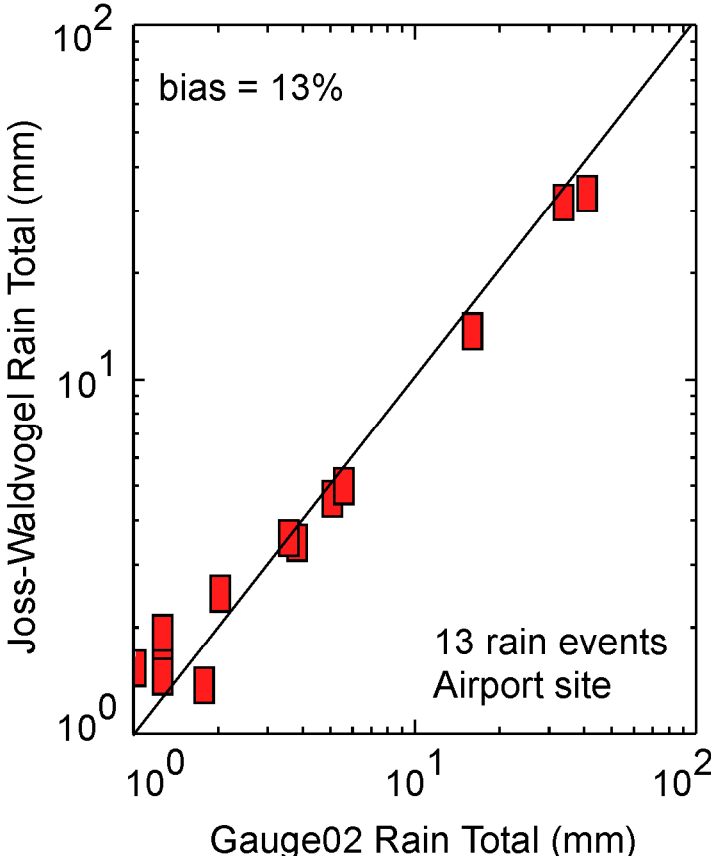
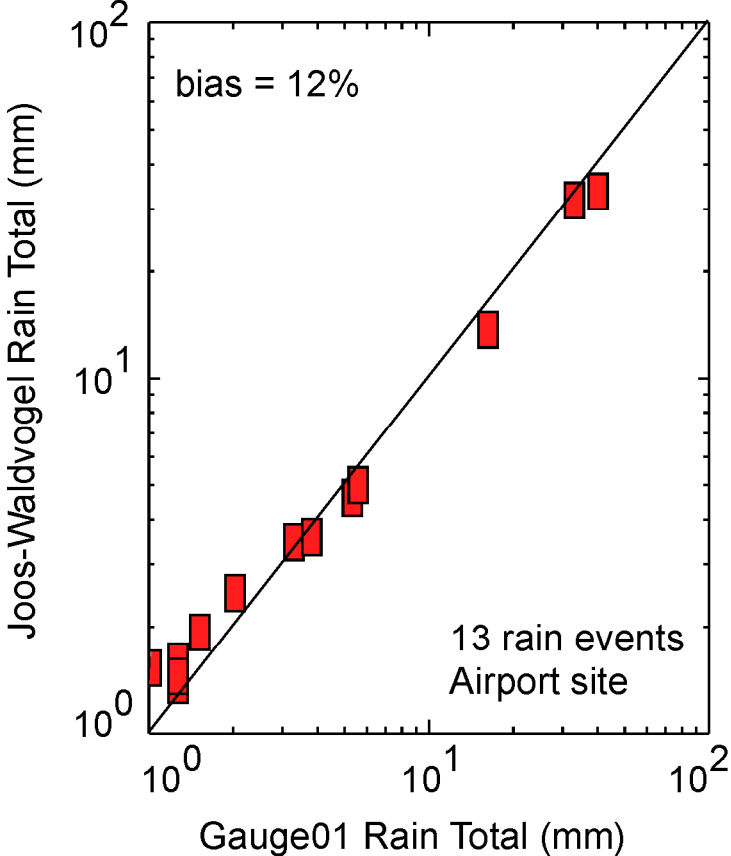
# pre-CHUVA Disdrometer & Rain Gauge Sites



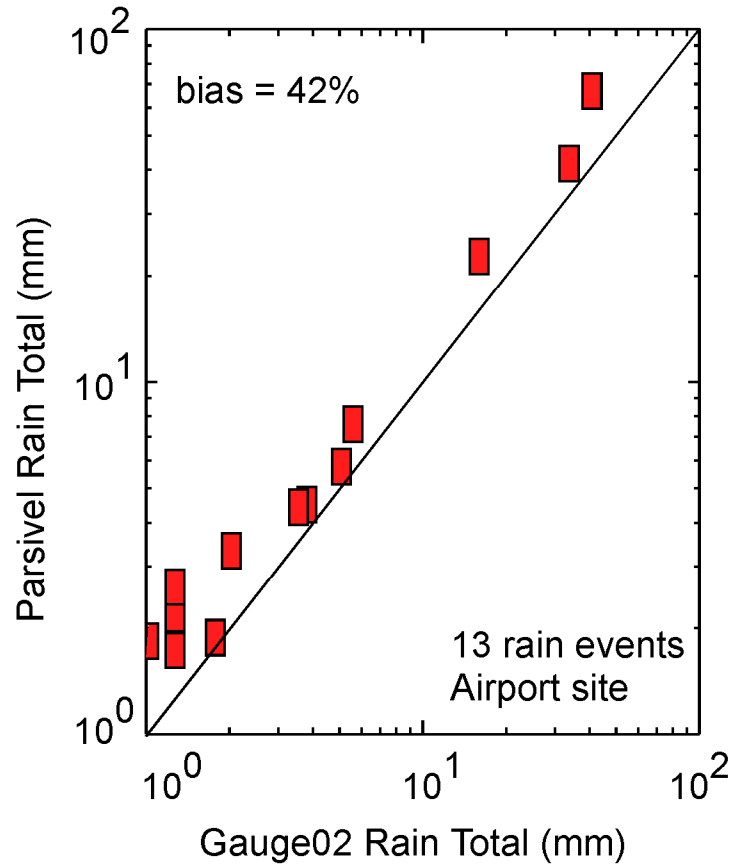
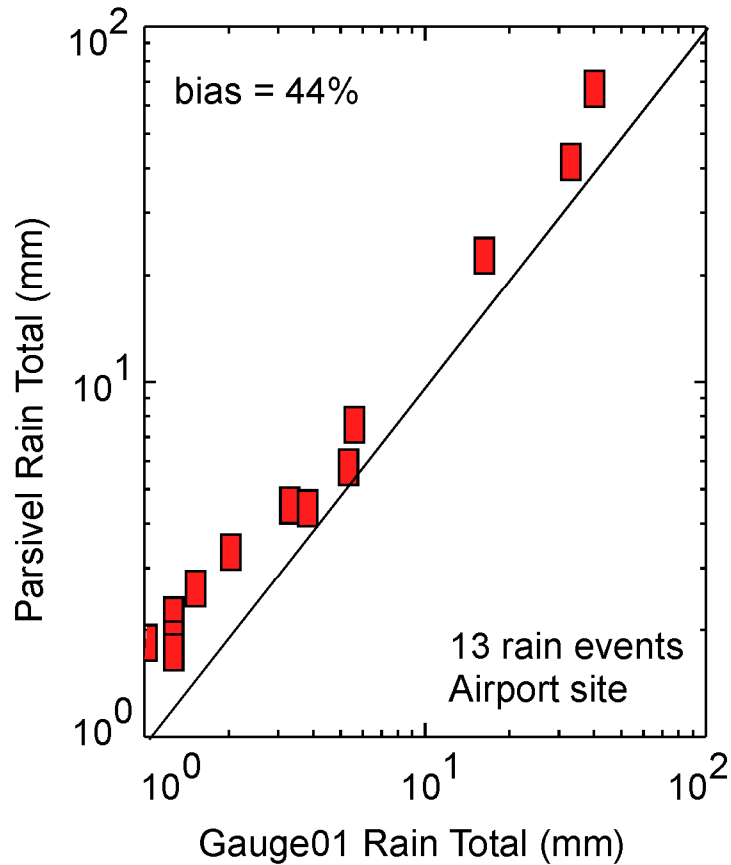
# Comparison of Rain Accumulation



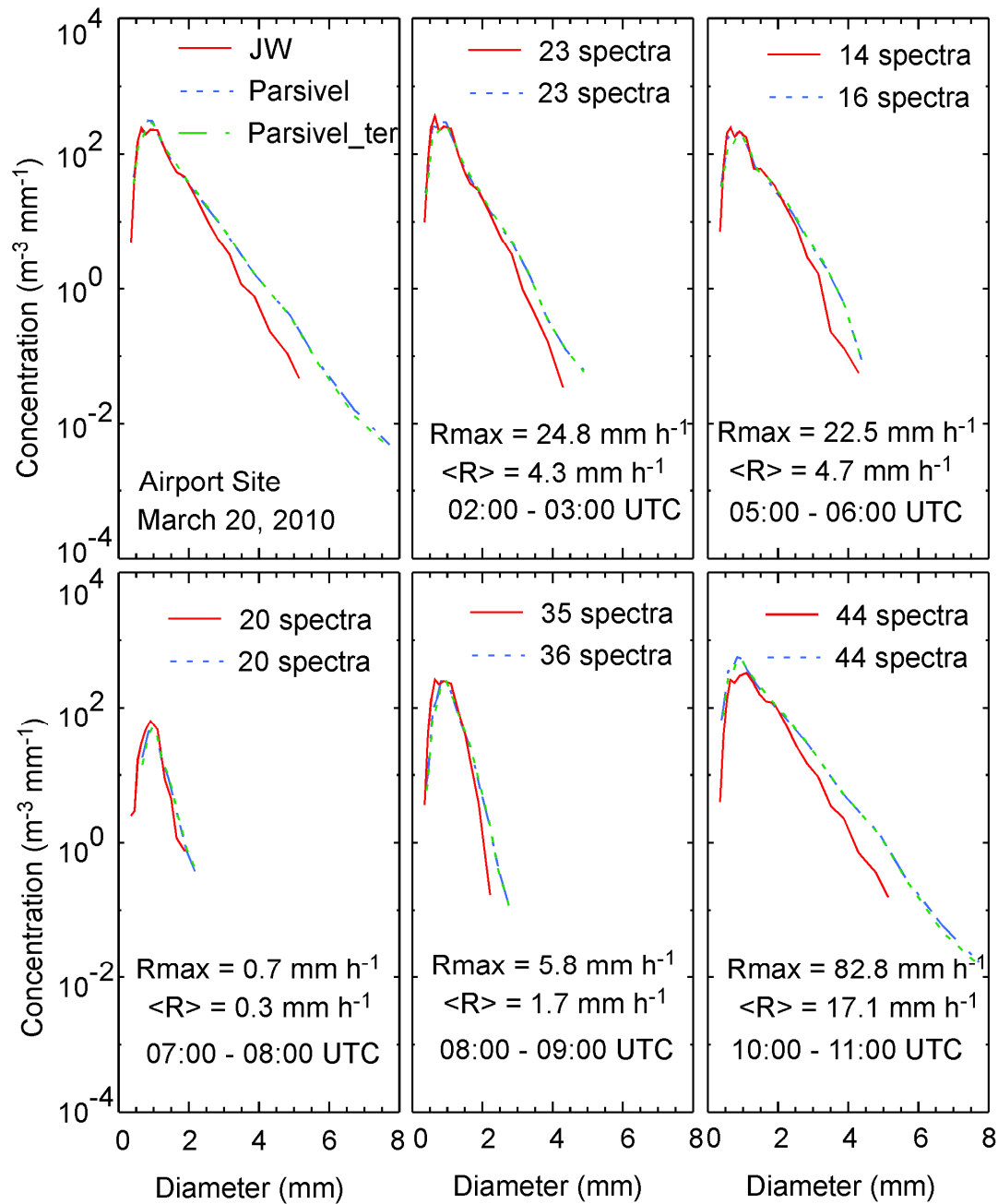
# Comparison of Rain Accumulation



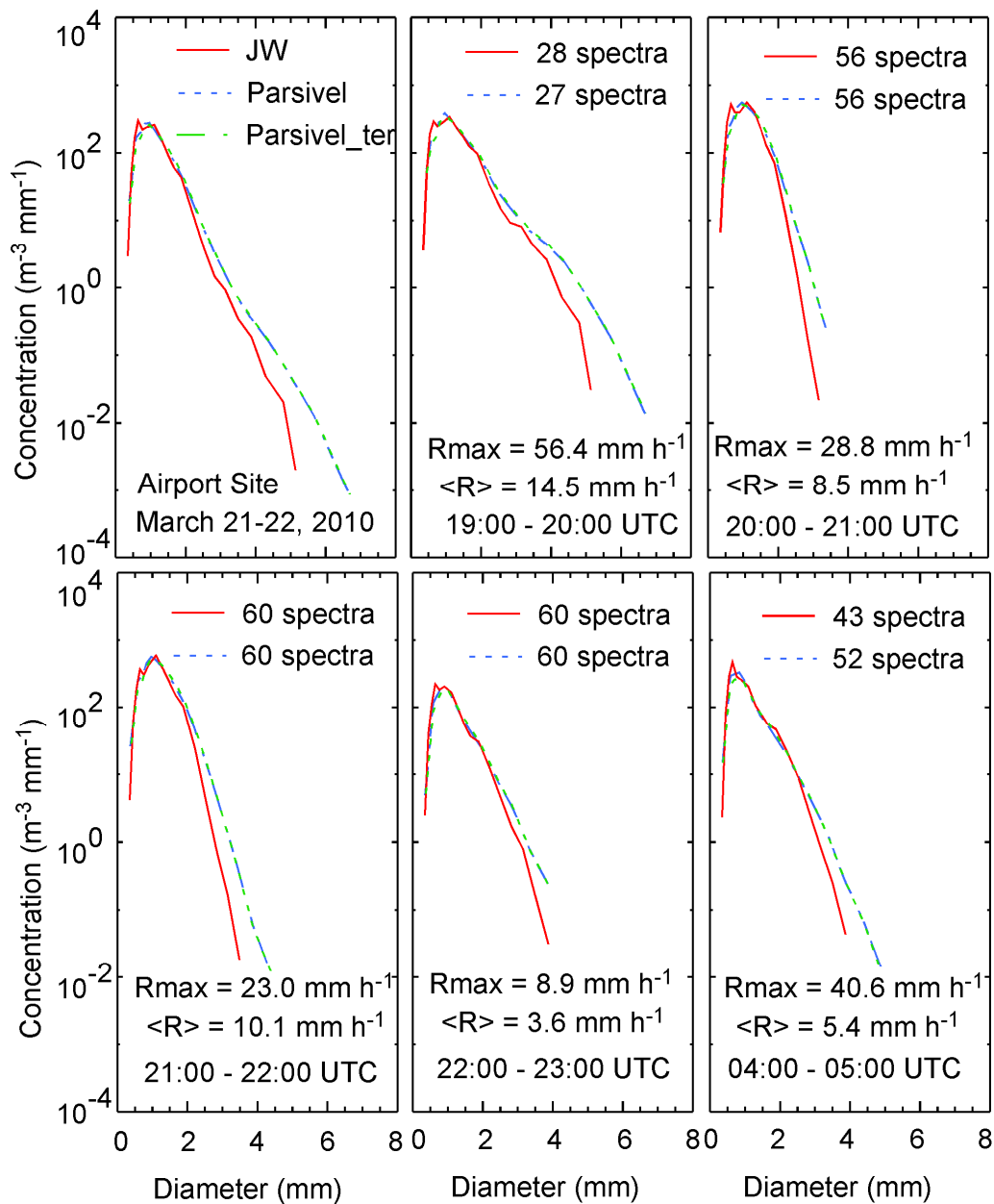
# Comparison of Rain Accumulation



# Comparison of Raindrop Size Distribution (event)

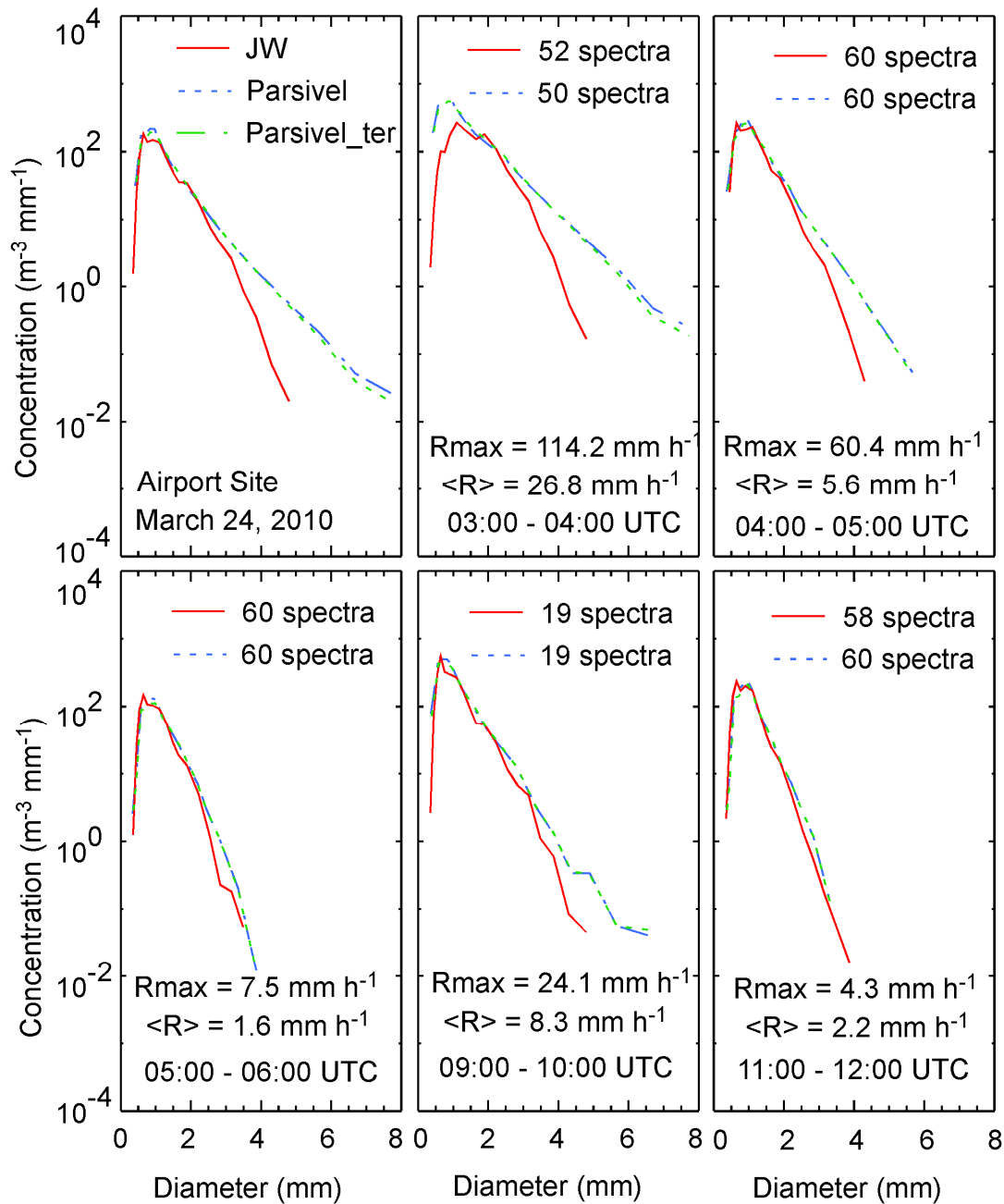


# Comparison of Raindrop Size Distribution (event)

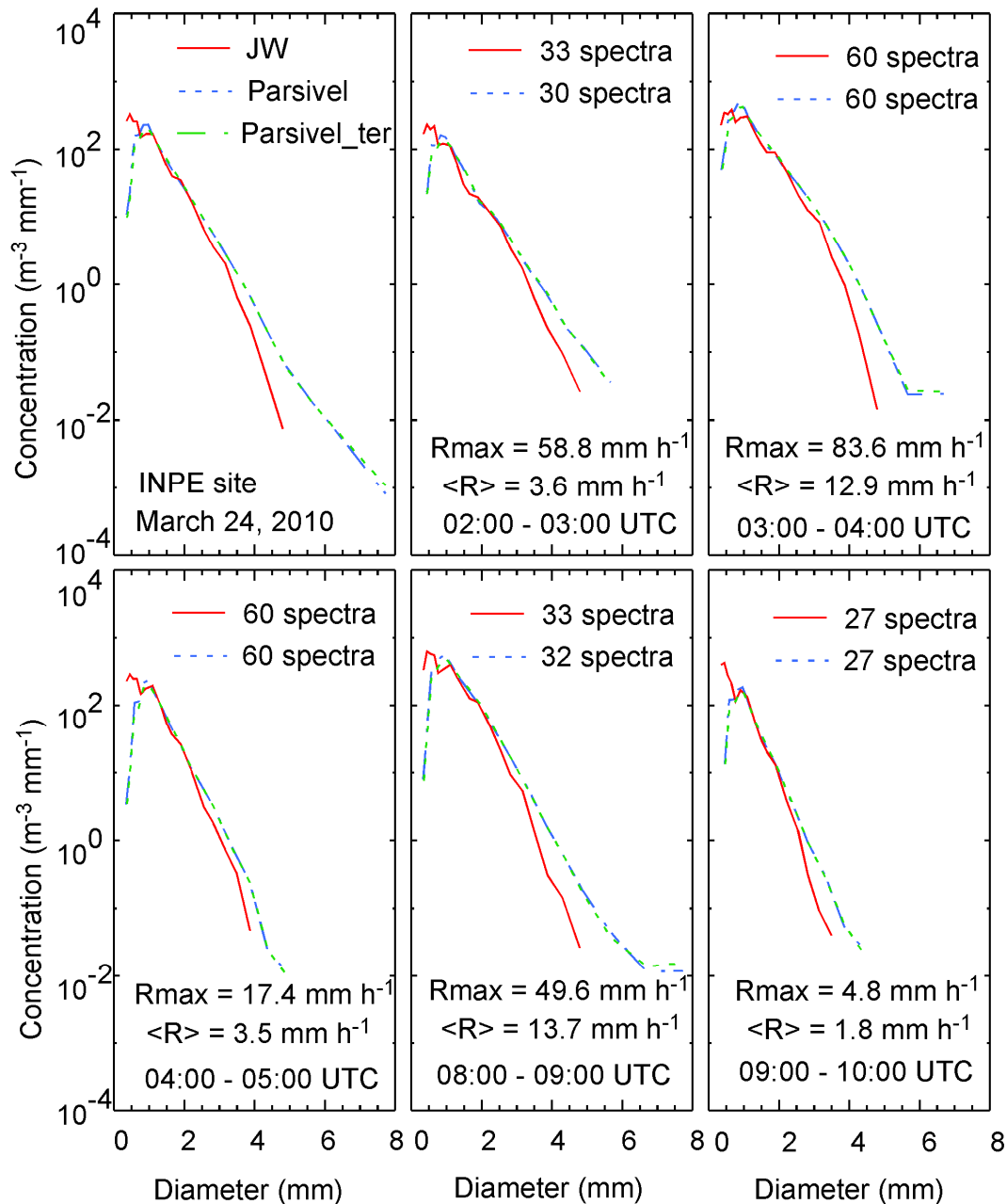




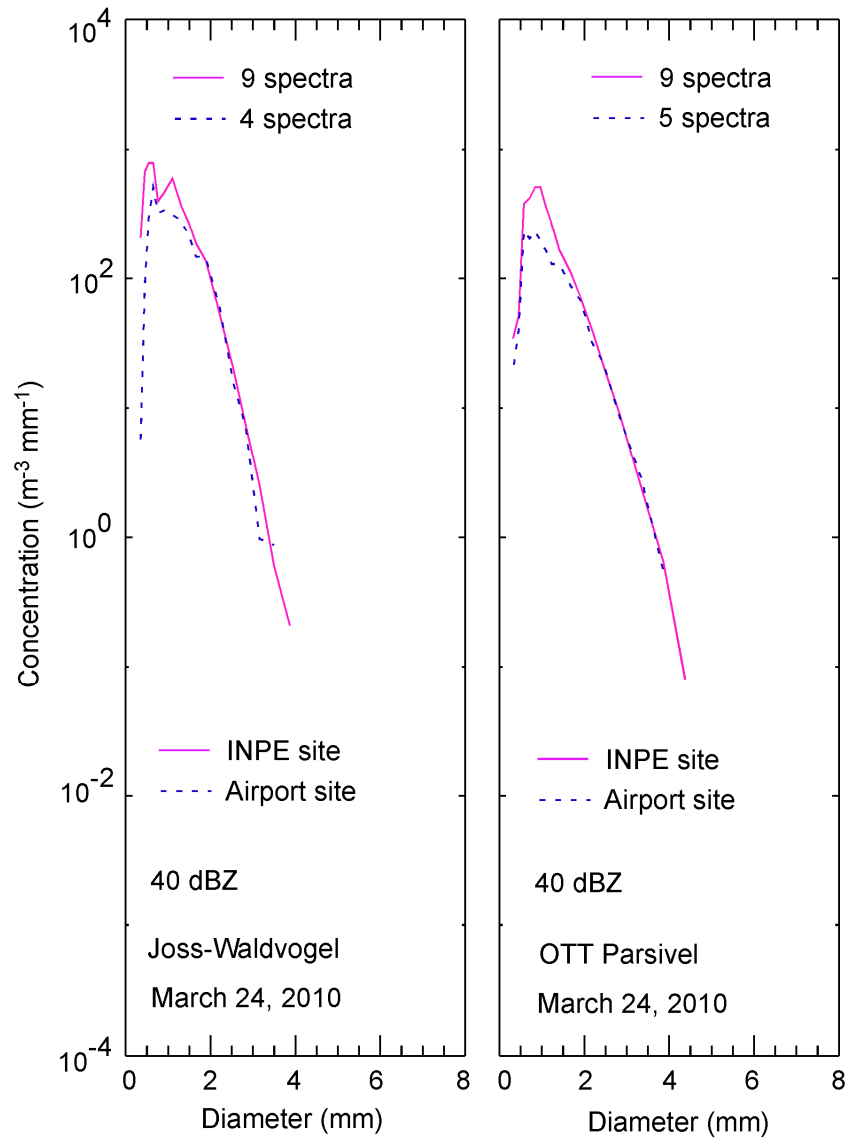
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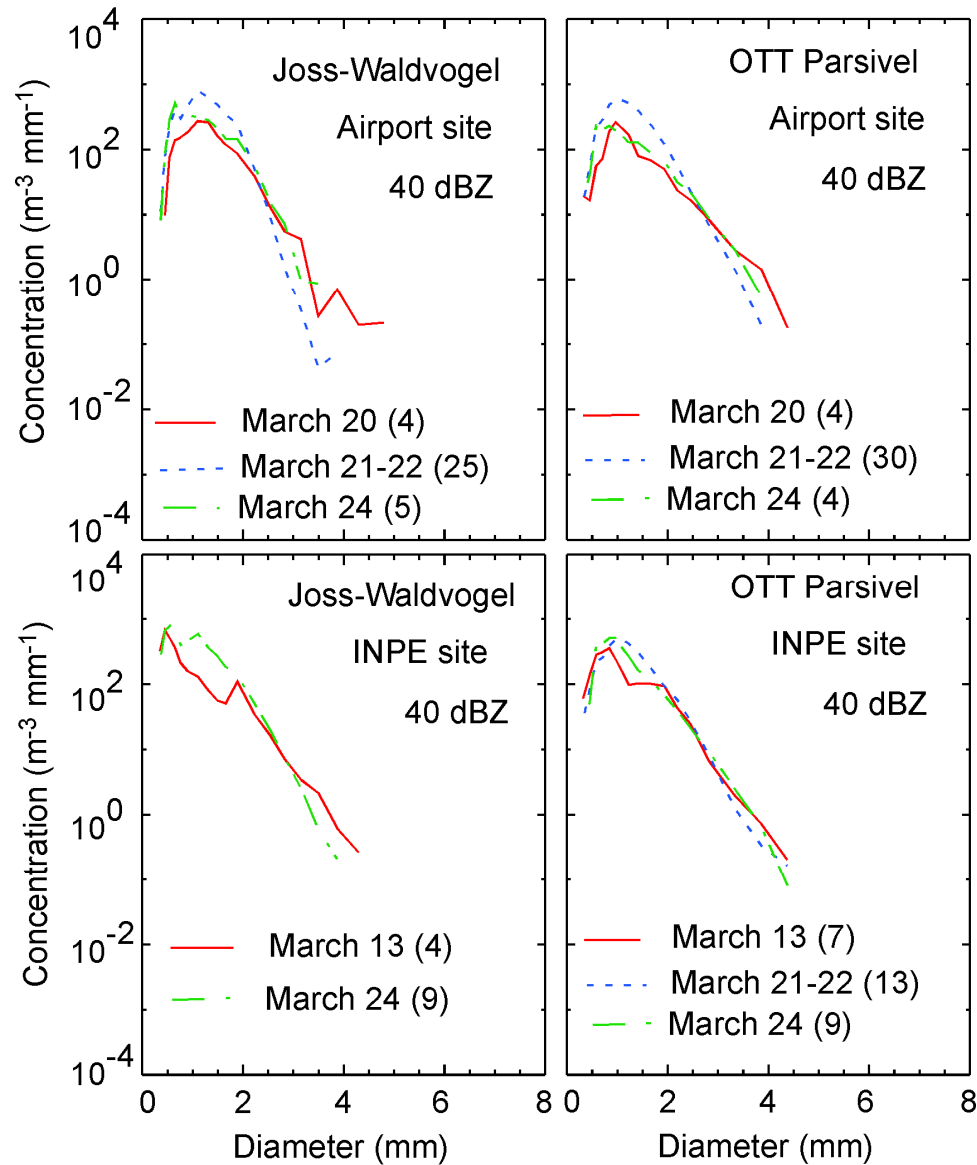
# Comparison of Raindrop Size Distribution (event)



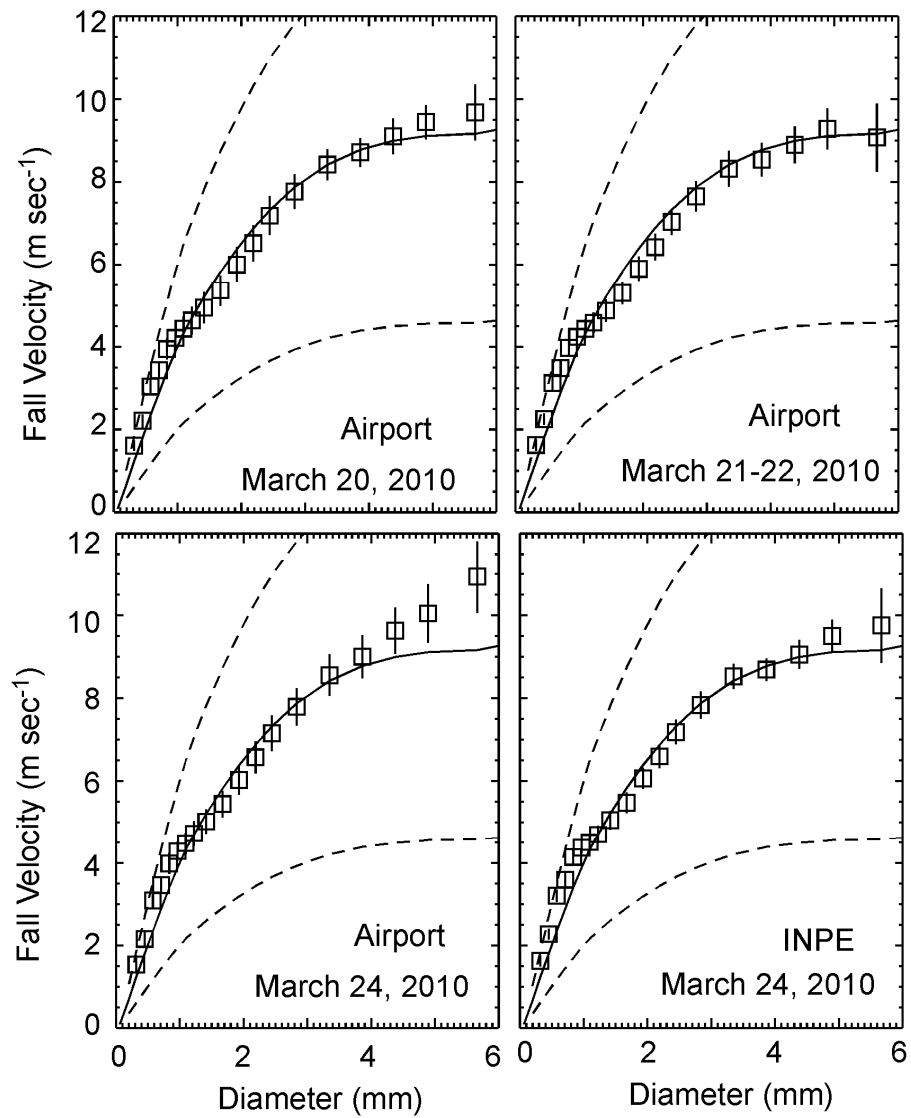
# Comparison of Raindrop Size Distribution (instrument)



# Comparison of Raindrop Size Distribution (microphysics)



# OTT Parsivel Fall Velocity Measurements



## Parameterization of Raindrop Size Distribution

$$N(D) = N_T^* f(m) \left( \frac{D}{D_{\text{mass}}} \right)^m \exp \left[ - (4 + m) \frac{D}{D_{\text{mass}}} \right]$$

where

$$f(m) = \frac{(4 + m)^{m+1}}{\Gamma(m + 1)} \quad N_T^* = \frac{N_T}{D_{\text{mass}}}$$

$$N(D) = N_w g(m) \left( \frac{D}{D_{\text{mass}}} \right)^m \exp \left[ - (4 + m) \frac{D}{D_{\text{mass}}} \right]$$

where

$$g(m) = \frac{6(4 + m)^{4+m}}{256\Gamma(m + 4)} \quad N_w = \frac{256W}{\pi\rho_w D_{\text{mass}}^4}$$

# Comparison of Raindrop Size Distribution Parameters

Gamma model parameters	03/20/10	03/21-22/10	03/24/10	03/24/10
Normalized intercept ( $N_T^*$ )	113	155	77	134
Normalized intercept ( $N_w$ )	1486	2825	1090	1495
Mean mass Diameter ( $D_{mass}$ )	2.03	1.64	2.01	1.87
Shape parameter (m)	2.4, 1.7	4.2, 2.8	2.7, 2.8	1.8, 2.1

Gamma model parameters	03/20/10	03/21-22/10	03/24/10	03/24/10
Normalized intercept ( $N_T^*$ )	106	135	68	82
Normalized intercept ( $N_w$ )	989	2151	447	1109
Mean mass Diameter ( $D_{mass}$ )	2.45	1.83	2.85	2.44
Shape parameter (m)	1.2, 0.4	3.3, 1.6	0.6, -0.6	2.5, 1.9

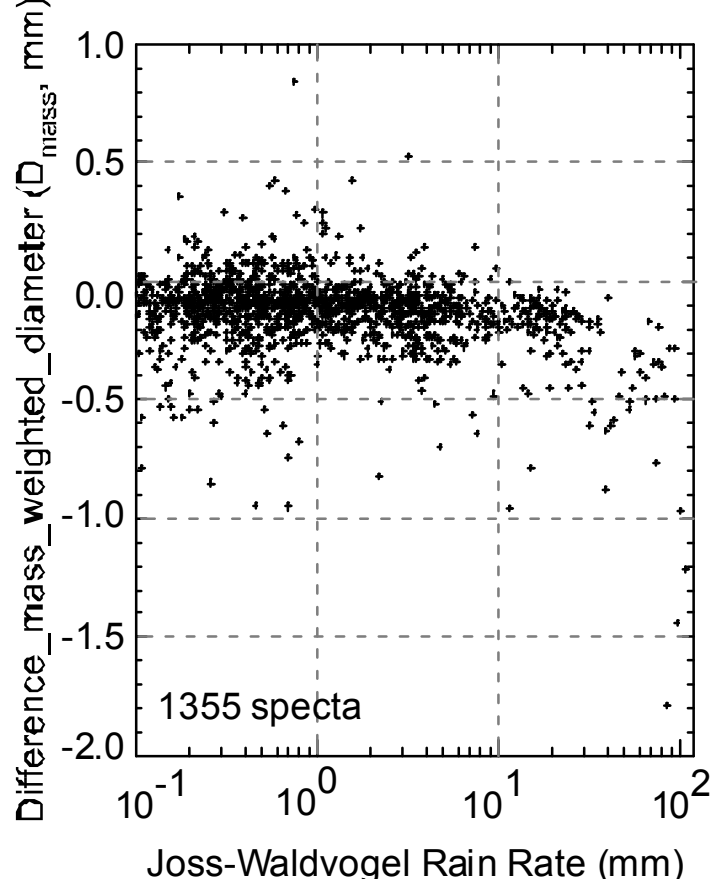
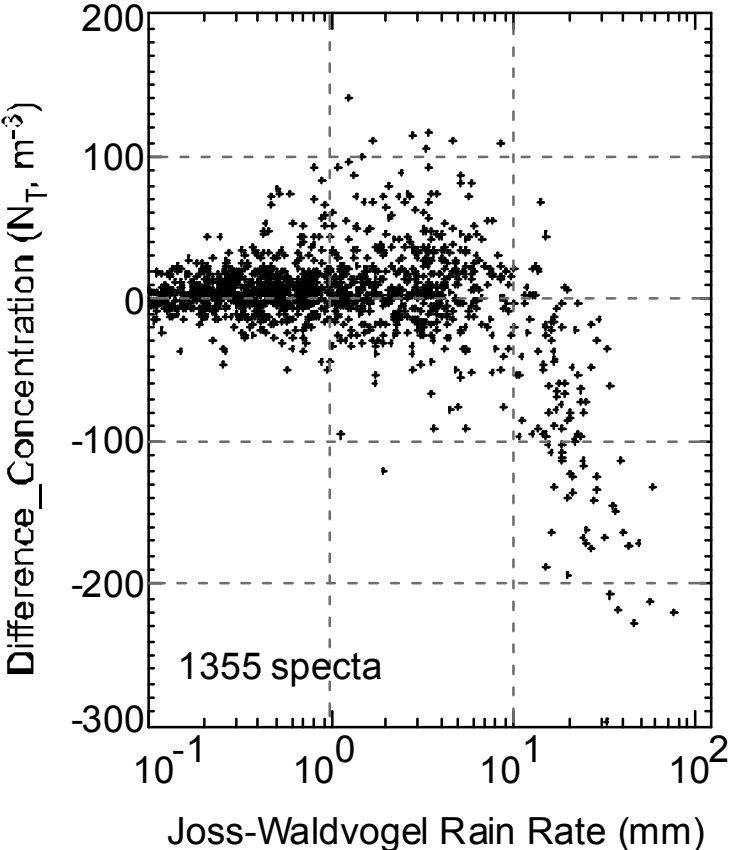
## Comparison of Integral Rain Parameters

Integral rain parameters	03/20/10	03/21-22/10	03/24/10	03/24/10
Concentration ( $N_T$ )	231	255	155	250
Liquid Water Content (W)	0.314	0.253	0.219	0.225
Rain Rate (RR)	7.0	5.0	4.9	4.8
Reflectivity (Z)	39	35	37	36

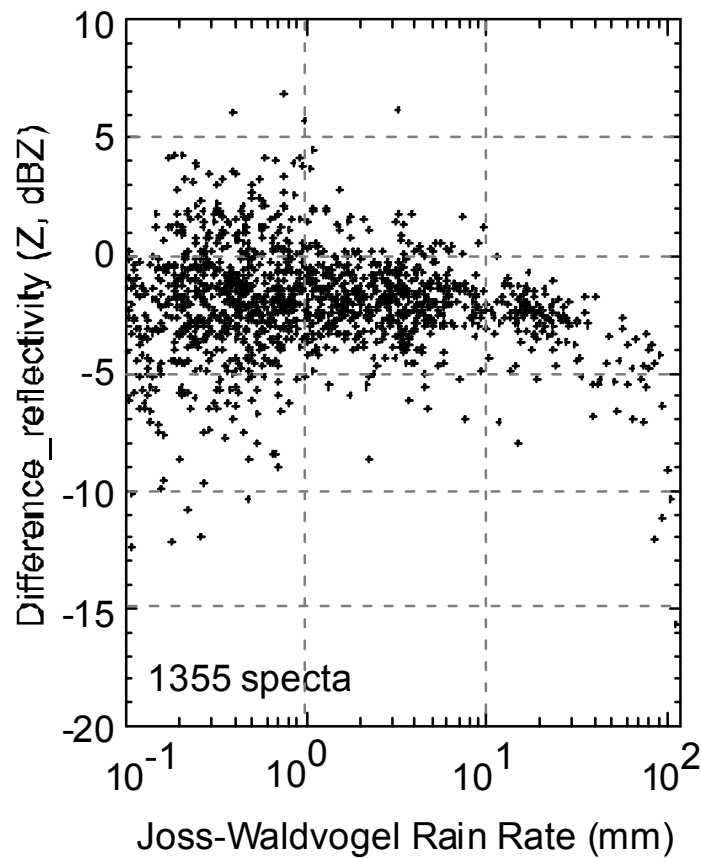
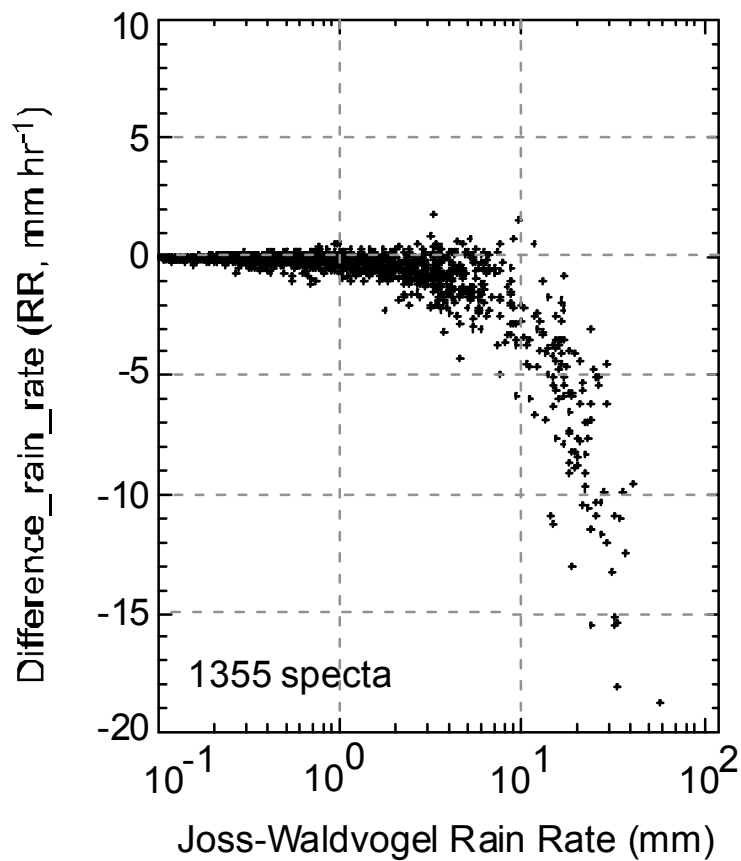
Integral rain parameters	03/20/10	03/21-22/10	03/24/10	03/24/10
Concentration ( $N_T$ )	262	248	196	201
Liquid Water Content (W)	0.438	0.300	0.366	0.483
Rain Rate (RR)	10.6	6.3	9.3	11.9
Reflectivity (Z)	43	37	45	43



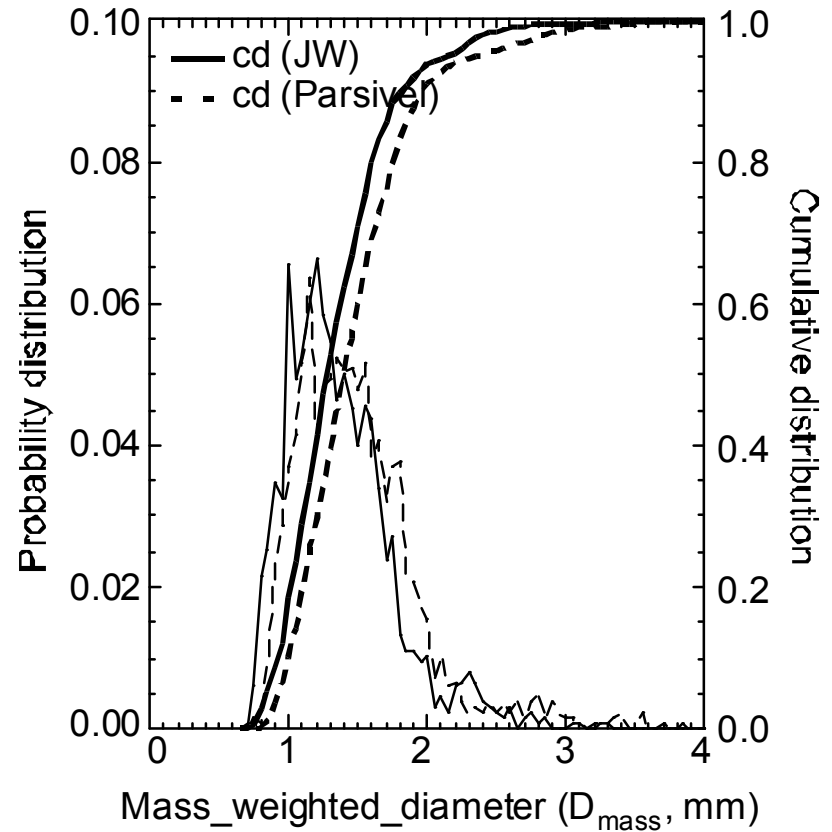
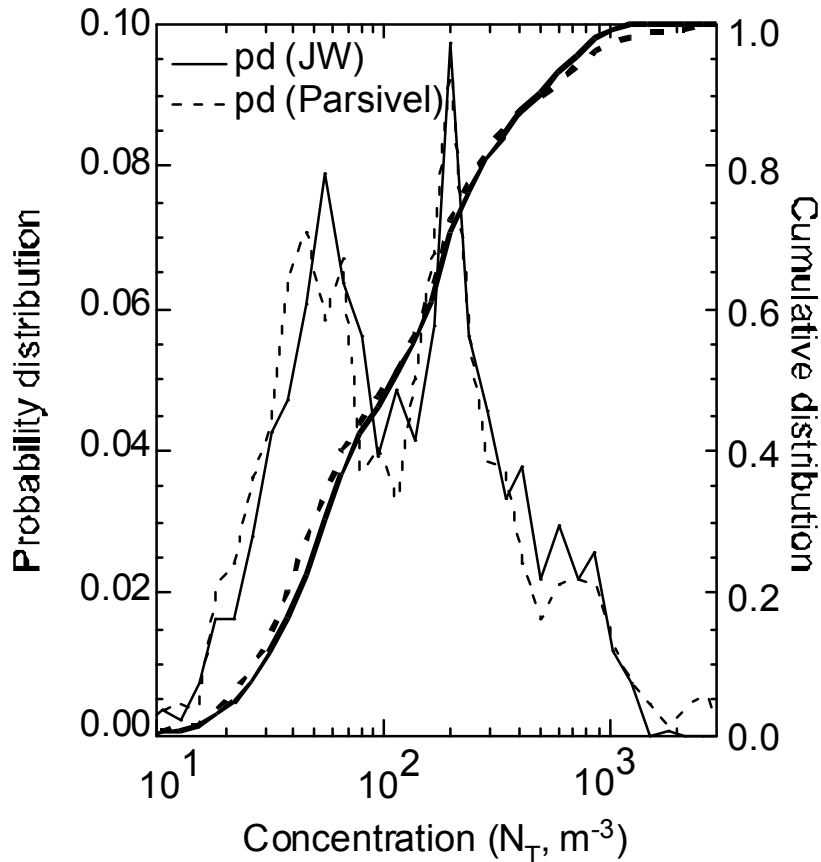
# Comparison of Raindrop Size Distribution Parameters



## Comparison of Integral Rain Parameters



# Probability and Cumulative Distributions of Raindrop Size Distribution Parameters



# Probability and Cumulative Distributions of Integral Rain Parameters

