Comparison of TRMM PR Retrievals to DSD Data in Southeast Texas

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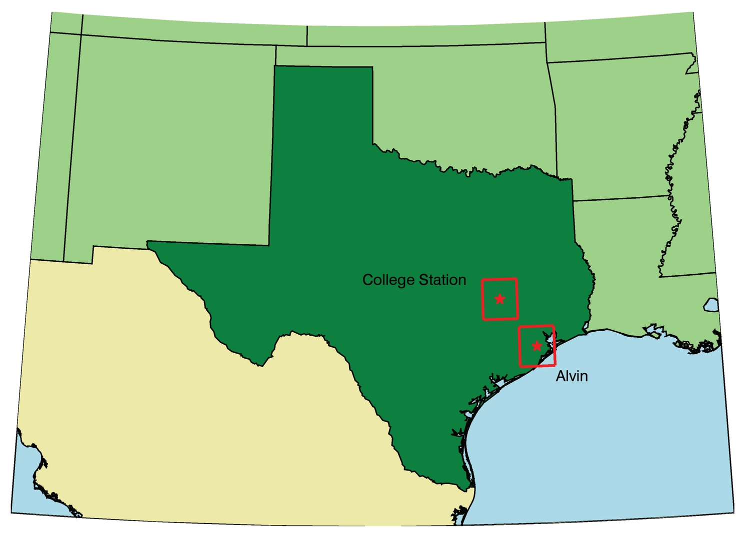
Introduction

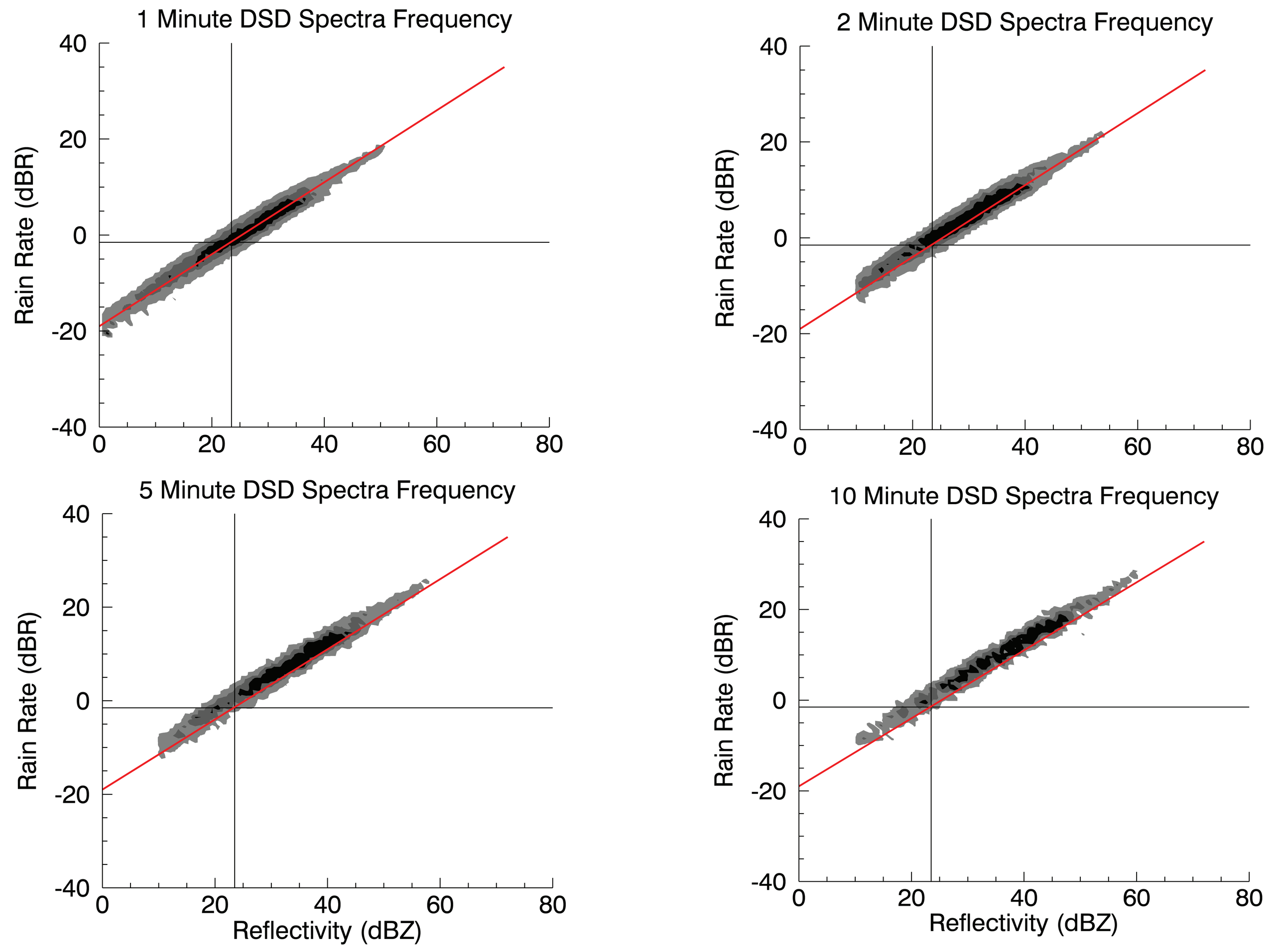
Changes to the TRMM Precipitation Radar (PR) 2A25 algorithm between V6 and V7 have impacted rain rate retrievals across the tropics, esp. at higher reflectivities. This poster compares 2A25 retrievals to surface-based disdrometer observations to assess the role (and accuracy) of drop-size distribution (DSD) assumptions in the changes.

DSD for 420 rain events were measured using a Joss-Waldvogel disdrometer over a 9-year period (2004-2013) in southeast Texas. Rain events were identified in the DSD data based on criteria from Steiner and Smith (2000). 628 TRMM over-flights captured data in a 1°x1° domain over each instrument site within +/- 3 hours of the event stop/start times.

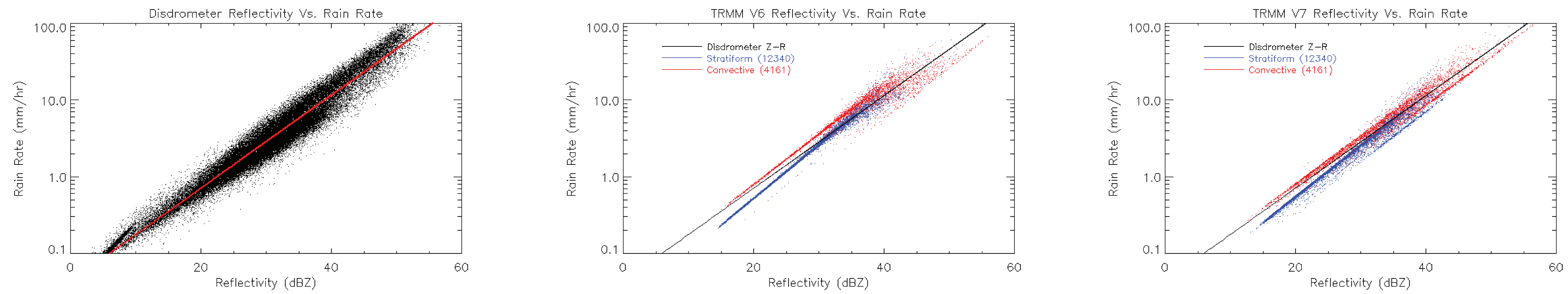


Data and Methods

Reflectivity (Z) and rain rate (R) values were calculated for the 1-, 2-, 5-, and 10-min DSD spectra. Higher averaging times lead to higher R values for the same Z and may be warranted because of the PR's relatively large footprint of 5 km, but we use 1-min averages to be consistent with convention. Coefficients for a power law of the form Z = a*Rb were then calculated using a linear least-squares fit in logarithmic space in order to obtain a regional climatological Z-R relation $Z=177.3R^{1.66}$. To decrease the error of the DSD-derived rainfall parameters Z and R, only parameters calculated from DSD samples consisting 100 drops or more were used to find the Z-R relation.

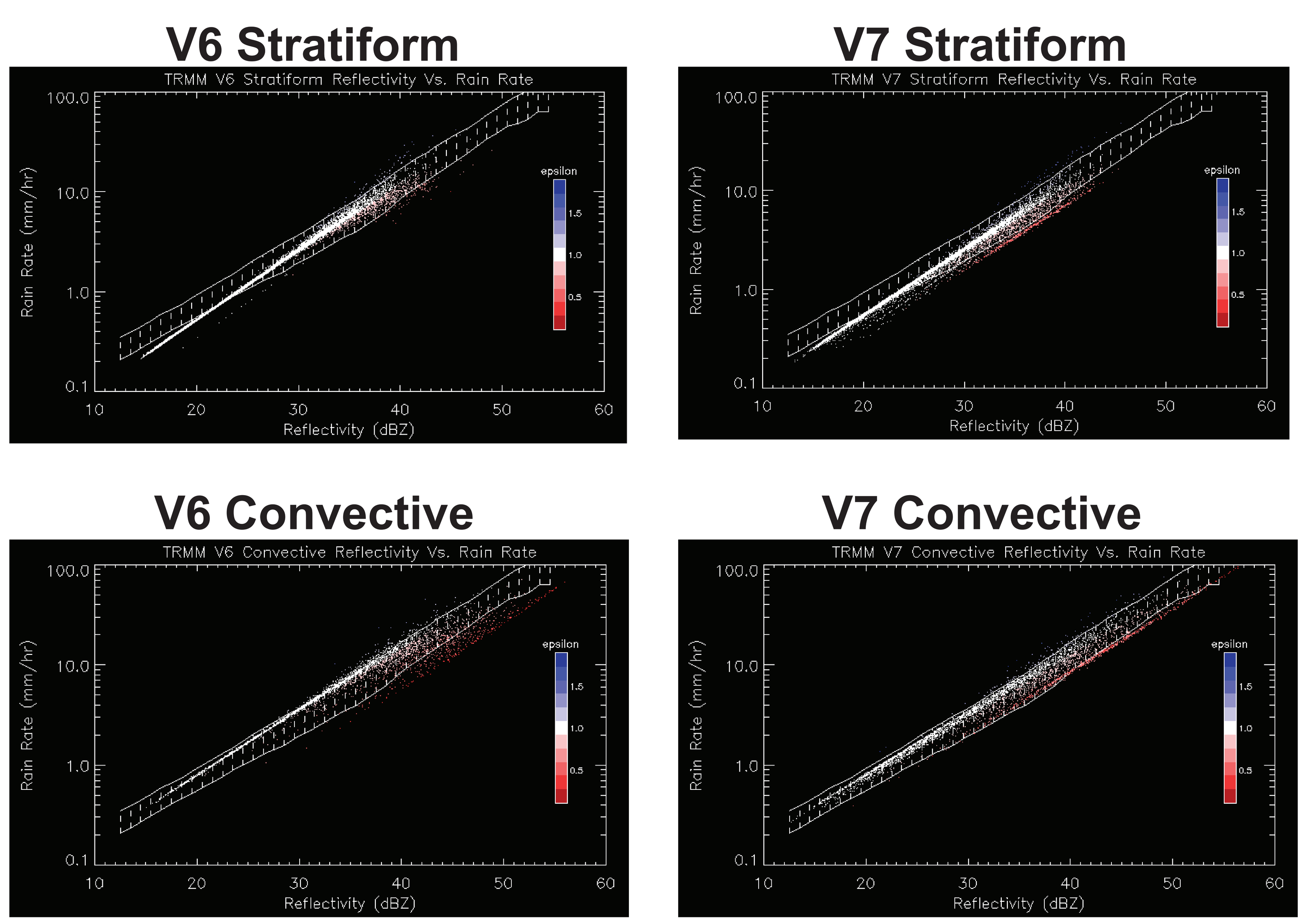


Reflectivity and Rain Rate Comparisons



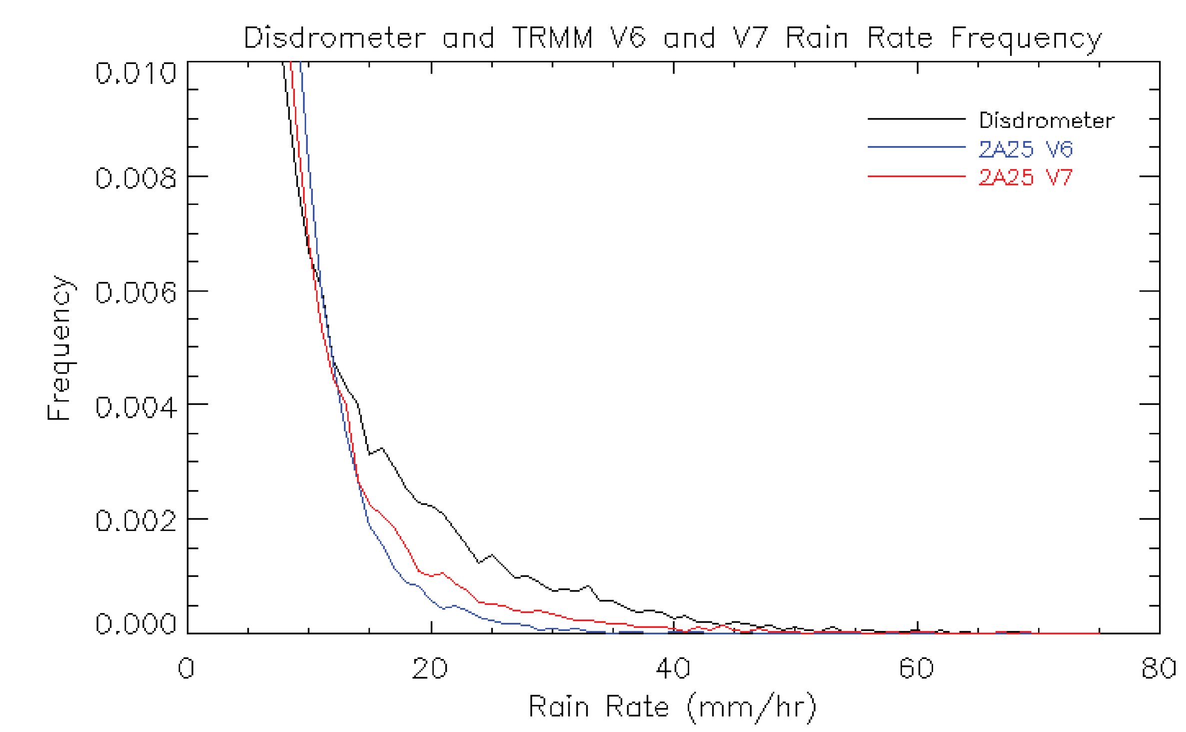
- Low reflectivity (< 30 dBZ): V7 rain rates are less constrained compared to V6 with more stratiform points farther away from the climatological Z-R curve
- Moderate reflectivity (30-40 dBZ): V6 stratiform rain rates are closer to the climatological Z-R curve, V7 stratiform rates meet a hard stop
- High reflectivity (> 40 dBZ and generally convective): V6 rain rates have a larger spread whereas V7 rain rates more closely follow the climatological Z-R curve but with a hard stop
- The slope of V7 convective and stratiform data appears to better follow the climatological Z-R curve

TRMM Z-R Data with Epsilon



- The k-Ze relation adjustment factor, epsilon, can be adjusted from a nominal value of 1.0 and corresponds to DSD model adjustments where a decrease (increase) in epsilon indicates an increase in the number of large (small) drops
- White lines indicate area of 1 standard deviation of disdrometer-derived rain rates
- (Top) More extreme adjustments to V7 stratiform epsilon values at Z >= 30 dBZ results in lower rain rates that fall outside and below the spread of disdrometer rain rates
- (Bottom) Adjustments to V7 epsilon values at Z >= 30 dBZ results in higher convective rain rate values that better converge on the disdrometer spread as compared to V6

Rain Rate Frequency



- TRMM rain rate frequency distributions are shifted toward low rates with V7 improving on V6 compared to ground data, but still missing rates higher than 10 mm/hr
- Results agree with a recent study by Kirstetter et al. (2013)

Future Work

Future work will further explore the role of epsilon in the adjustment of the 2A25 stratiform and convective DSD models and possible links to low convective rain rates seen especially over land areas such as West Africa and South America. A type-by-type comparison utilizing 2A23 rain type data for PR retrievals with extreme values of epsilon may also reveal differences from PR retrievals with values of epilson closer to 1.0.

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