TRMM PR DSD Retrievals Over Southeast Texas

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Introduction

Drop-size distributions (DSD) for 161 rain events were measured using a Joss-Waldvogel disdrometer over a 4-year period (2004-2008) outside of College Station, Texas. 76 of these events coincided with TRMM over-flights within +/- 8 hours of the event stop/start time, respectively. The TRMM 2A25 algorithm adjusts an initial Z-R relation based on the reflectivity profile for each pixel. This study compares the DSD data to TRMM Precipitation Radar (PR) data versions 6 and 7 in order to highlight final Z-R values after these adjustments have been made.

Data and Methods

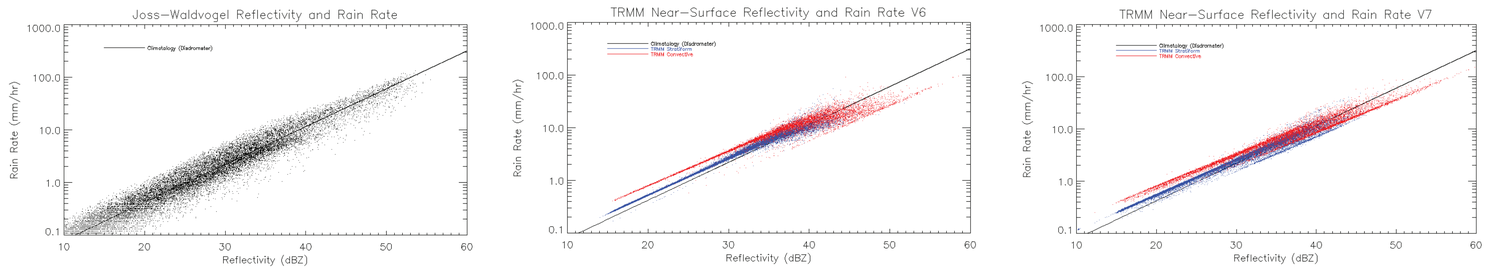
161 rain events were identified in the DSD data by using the following criteria, modified from Steiner and Smith (2000):

- A period with rain rates greater than 0.1 mm h^{-1} constituted a rain event
- Rain events must have at least 2.5 mm of total rainfall accumulation
- Rain events separated by at least 4 hours are considered separate events
- 1-min raindrop spectra needed at least 100 drops

Reflectivity and rain rate values were calculated and compiled for each rain event from the 1-min DSD spectra. Calculations were also made for averaging periods of 2, 5, and 10 min. Coefficients for a power law of the form $Z = a*R^b$ were then calculated using a linear least-squares fit in logarithmic space. This method was applied to each storm as well as to all DSD spectra in order to obtain a climatological Z-R relation.

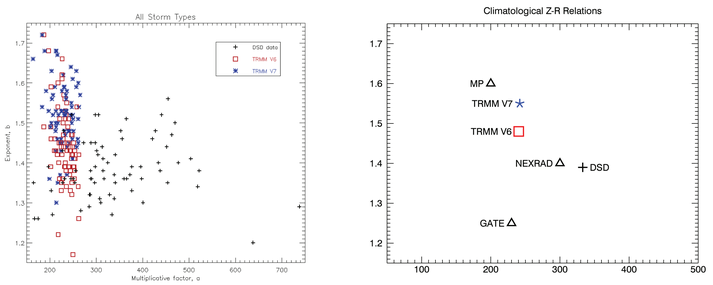
For comparison, TRMM 2A25 near-surface reflectivity and rain rate data were sampled over a 3° x 3° domain centered over College Station for 76 of the 161 rain events. 2A23 data was used to identify stratiform and convective pixels when necessary. The same curve fitting methods described above were used to obtain Z-R relations for each TRMM overpass coinciding with a rain event.

Reflectivity and Rain Rate Comparisons



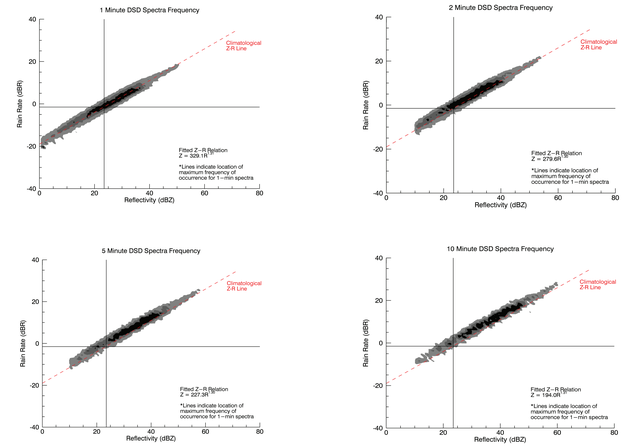
- At low reflectivity values (< 30 dBZ), V6 and V7 rain rates are almost always higher than the climatological Z-R, but are still within the disdrometer spread
- At high reflectivity values (> 40 dBZ and generally convective), V6 rain rates appear to fall well below the climatological Z-R curve and outside of the disdrometer spread with some improvement seen in V7
- At moderate reflectivity values (30-40 dBZ), V6 stratiform points converge on the climatological Z-R line and convective points are above the line, whereas V7 convective and stratiform points overlap near the line (although some V7 stratiform rain rates show a low bias)

Rain Event Comparisons



- (Left) Power law relationships for each of the rain events shows a bias in TRMM 2A25 data toward lower values of the multiplicative factor, a, as compared to Z-R relations derived from the disdrometer data
- (Right) Comparing Z-R relationships calculated for all 76 TRMM rain events, it is seen that TRMM is close to the stratiform-like Marshall-Palmer (MP) relationship with V7 appearing closer. The disdrometer-derived climatological Z-R relationship appears close to that used for NEXRAD

DSD Spectra Time Sensitivity



- As the temporal averaging of DSD spectra from disdrometer data is increased, the distribution of occurrence of derived rain parameters shifts toward higher values
- This sensitivity is consequential when comparing point data to radar rain parameters which are collected from relatively large volumes. Which temporal size is correct?

Future Work

Future work will examine additional ground-based radar data such as NEXRAD and ADRAD observations for comparison with TRMM PR reflectivity and rain rate distributions. The sensitivity of disdrometer-derived rain parameters to the rain spectra's temporal length (1-min, 2-min, etc.) also needs to be considered when comparing with TRMM data. Further study of the differences found when the data is classified and divided into different synoptic regimes based on wide-scale forcing (warm front, cold front, etc.) will also be completed.

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