Updates in the GPM combined algorithm

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Objectives

Investigate and mitigate existing deficiencies in the GPM combined algorithm.

- Negative biases in convective rain estimates due to severe attenuation and non-uniform beam filling.
- No precipitation estimates in the regions affected by ground clutter.
- No precipitation estimates when the radar signal is below the noise level.

Background

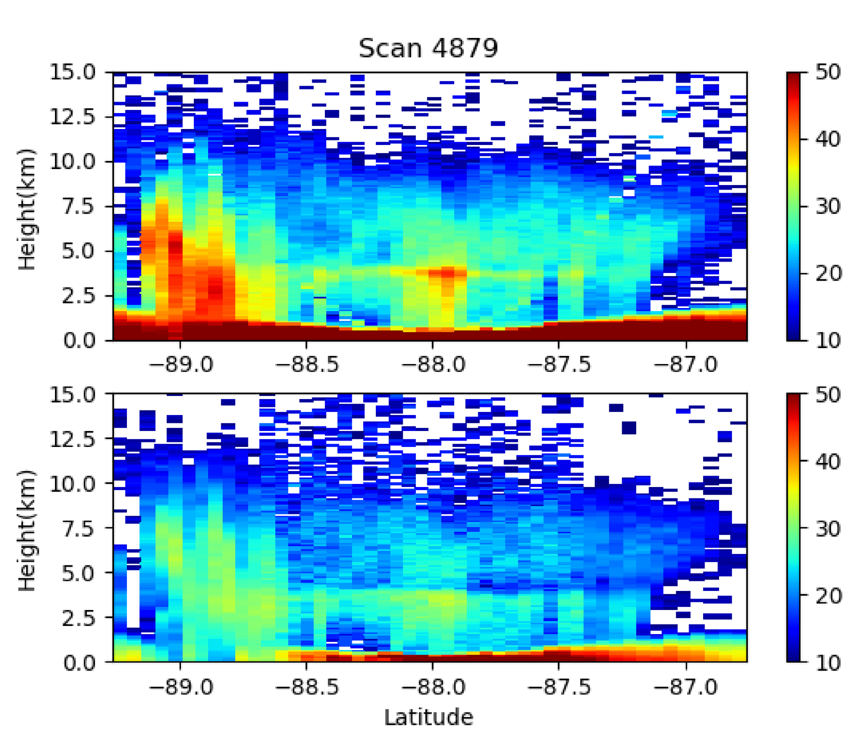

Figure 1:Across track reflectivity observations for orbit 24418

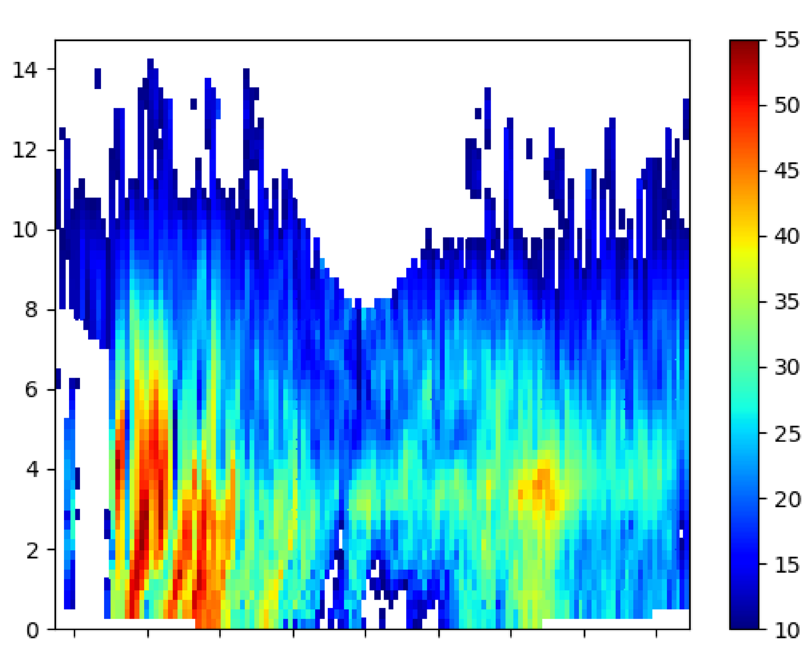

Figure 2:Corresponding NEXRAD observations

General Considerations

Dual frequency space-borne radar observations are difficult to unambiguously and unbiasedly interpret because

- Strong variability within the radar observing volumes may enhance near-surface reflectivity observations at Ku-band.
- Multiple scattering enhances the Ka-band observations.
- Non-uniform beam filling tend to reduce the Path Integrated Attenuation estimated from a Surface Reference Technique.

Physical and statistical models to mitigate these effects exist, but they need to be **calibrated**.

Methodology

- Use combined (and DPR) precipitation retrievals collocated with MRMS estimates.
- Analyze systematic and random differences.
- Derive and estimate methodology to the estimate dn as a function of the vertical reflectivity profile that enables unbiased surface precipitation estimates.
- **Derive down-scaling methodology that enables unbiased Ka-band reflectivity calculations.**

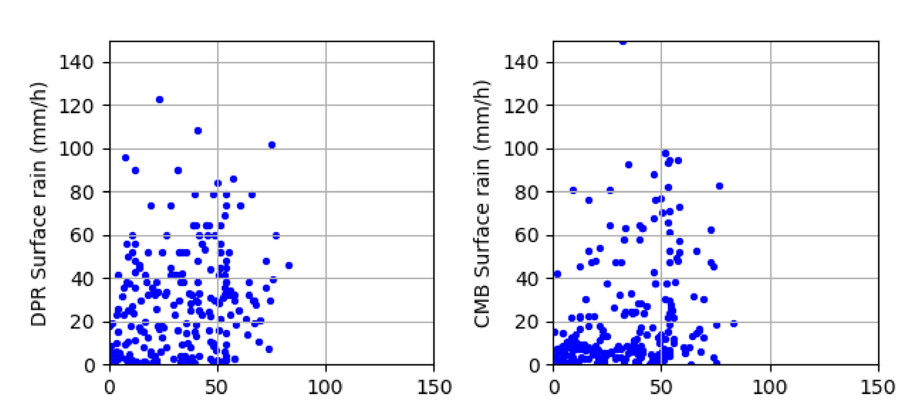

Figure 3:GPM surface rain estimates against MRMS.

As point comparisons are generally too noisy to facilitate effective adjustments, a methodology based on the clustering of the Ku-band reflectivity profiles was used.

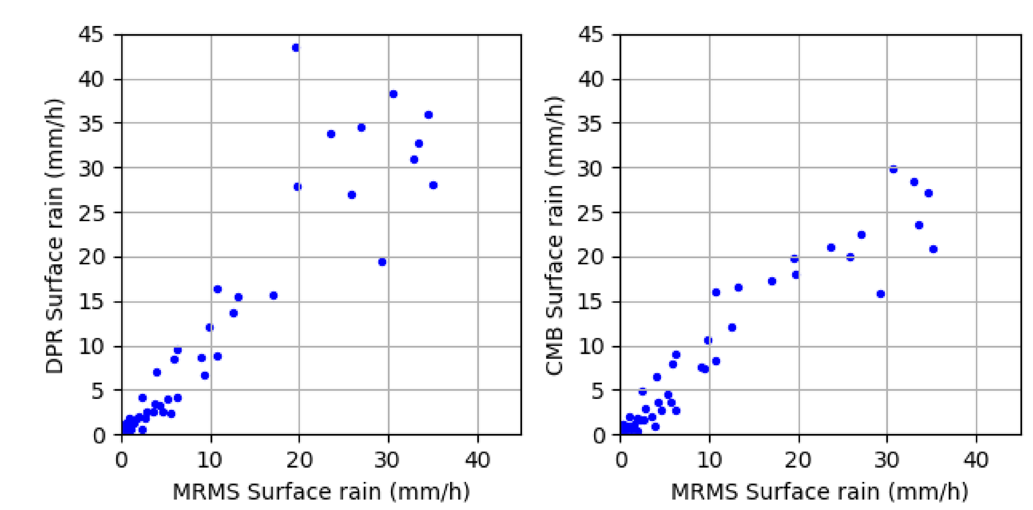

Figure 4:Class-averaged GPM surface rain estimates against MRMS.

Results

- Efficient k-means clustering methodology is used to partition the observed reflectivity classes into 50 classes
- An optimal dn is derived for each class and used in the estimation process.

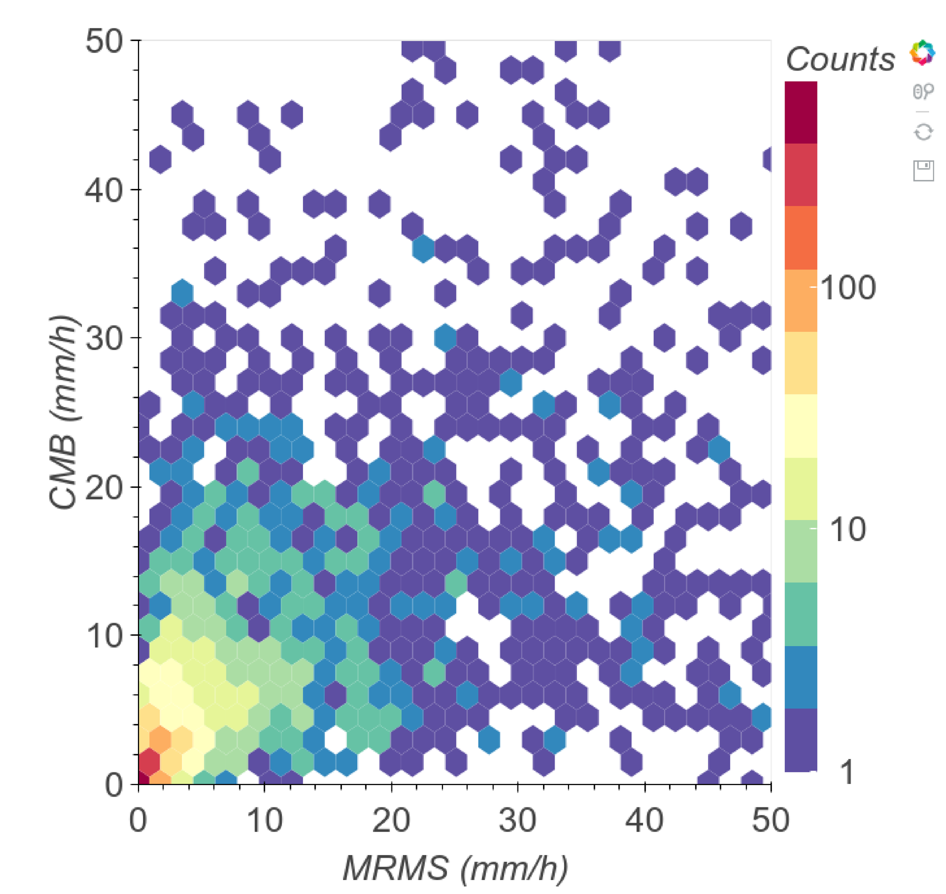

Figure 5:GPM surface rain estimates against MRMS.

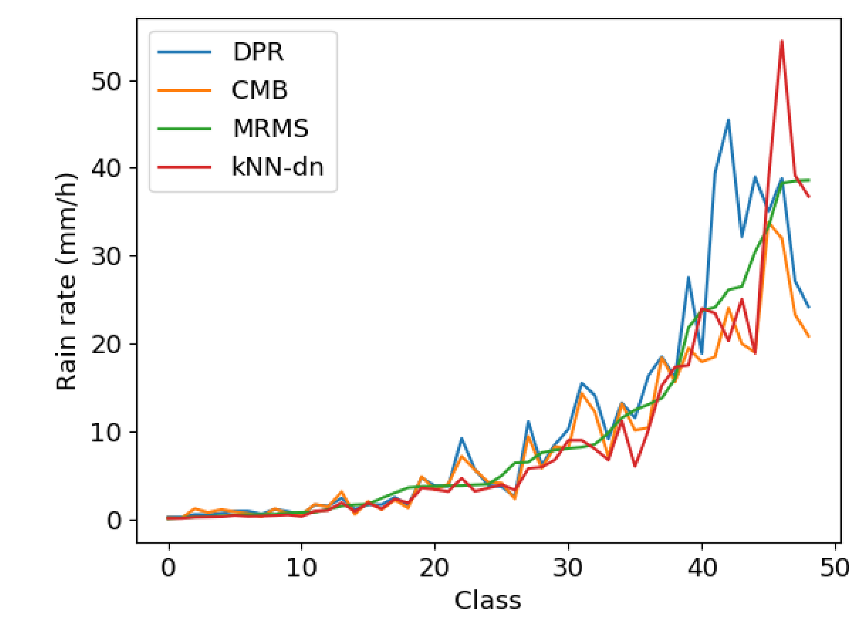

Figure 6:GPM and MRMS surface rain estimates as function of class.

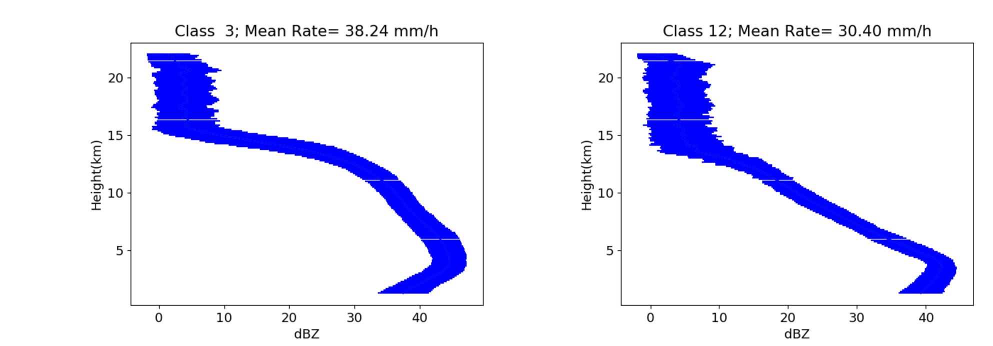

Figure 7:Examples of classes with large negative and positive.

Conclusions

- Clustering analysis useful in filtering out noise and revealing discrepancies between retrievals and MRMS.
- Correlation between CMB (DPR) and MRMS estimates is low at the instantaneous level, but increases significantly after clustering.
- Consistency between dual-frequency retrievals and MRMS can be used to optimize parameterizations required in the calculation of unbiased reflectivities at Ka-band.
- Information from the cluster analysis can readily be incorporated into the operational retrievals.

Acknowledgements

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