

# Improved parameterizations in the GPM combined algorithm

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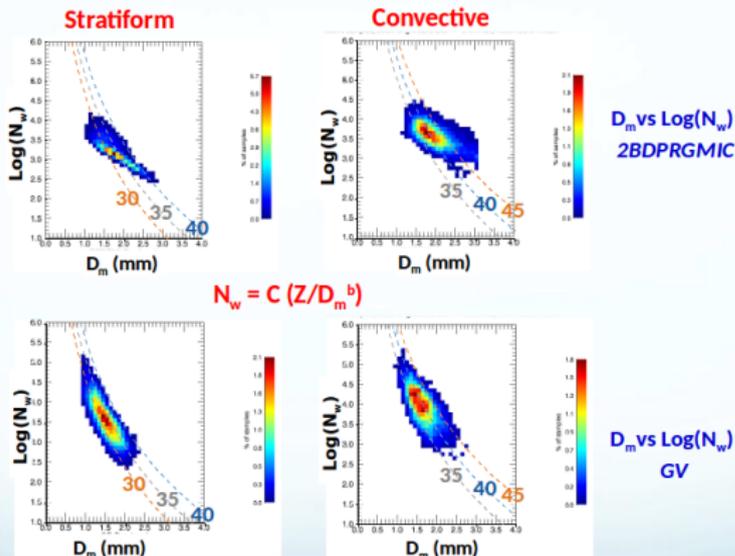
# Brief history parameterizations in the combined algorithm

	Parameterizations	Impact
V2	No (NUBF & Multiple Scattering)	Terrible performance
V3	NUBF	Not too good, not too bad performance
V4	NUBF & Multiple Scattering	Significant overestimation over land
V5	2.5-D NUBF & Multiple Scattering	Questionable $N_w$ distributions

# Evidence from Walt Petersen and the GV team



**Combined Algorithm:** MS Swath with GV (DSD, Rain, Z...)

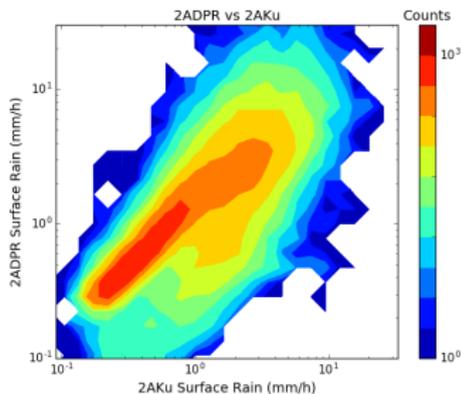


$N_w$  vs.  $D_m$  trend in combined algorithm different from GV (and DPR) for approximately the same precipitation (and Z) sample.....

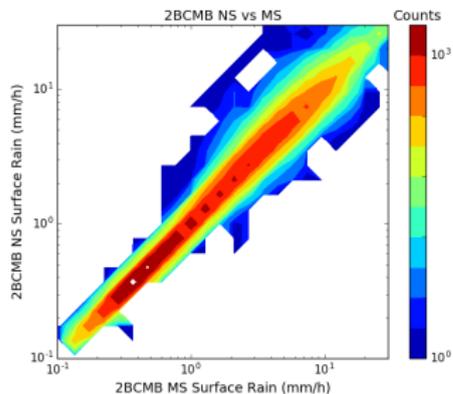


# Dual vs Single Frequency Surface Rain Estimates

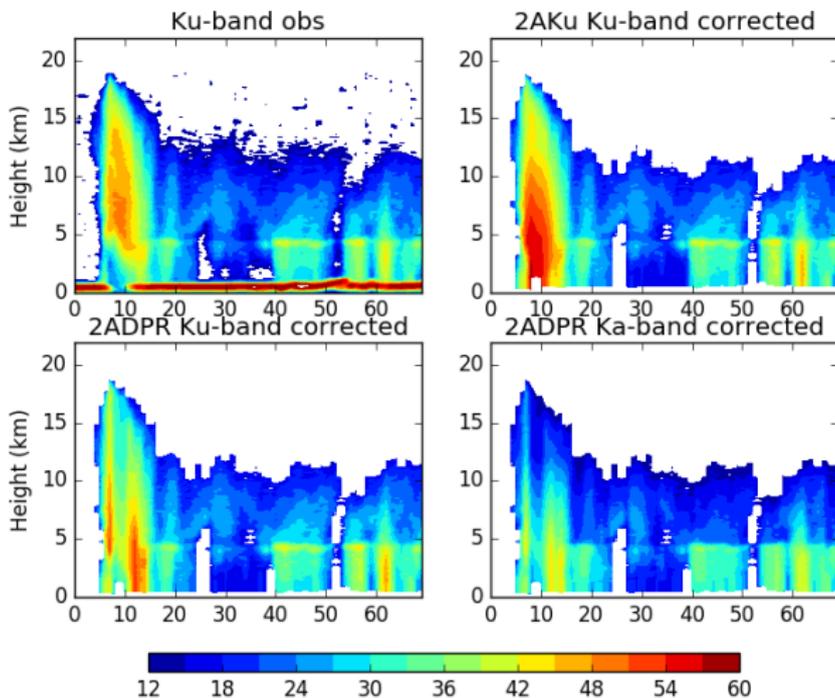
## DPR Algorithm



## Combined Algorithm

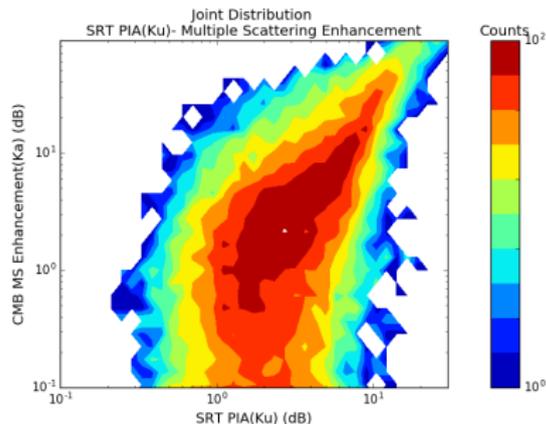


# Is more aggressive optimization better?



# Multiple Scattering at Ka-band vs PIA

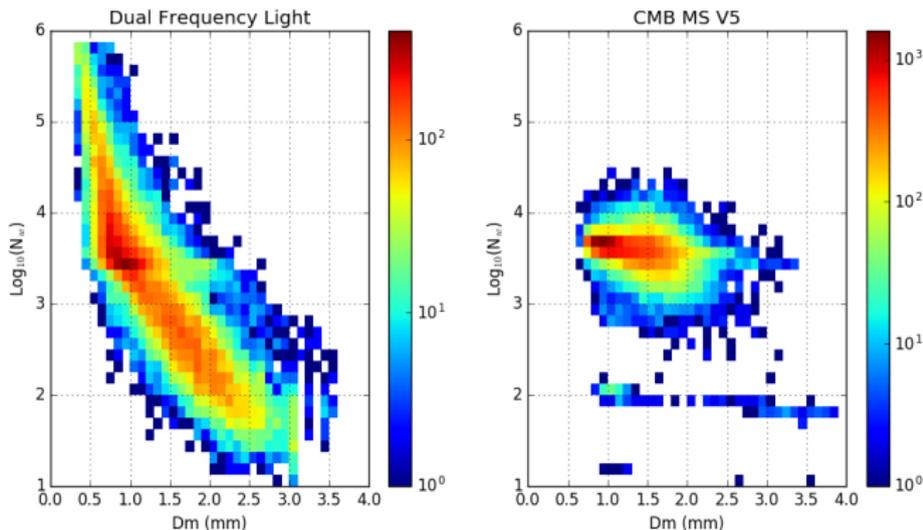
- Multiple scattering is highly correlated with SRT PIA
- When SRT PIA is large (reliabFlag==1), single frequency estimates are likely to be more reliable than dual frequency estimates



# Investigation Methodology

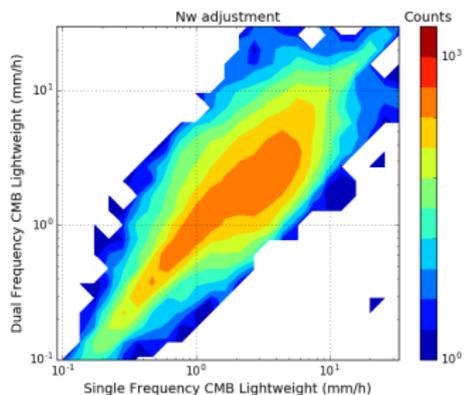
- Use a simplified retrieval framework based on the basic components of the combined algorithm
- Assume  $N_w$  vertically constant below the freezing level
- Derive dual-frequency retrievals using the Gauss-Newton approach
- Analyze  $N_w$ - $D_m$  behavior and dual vs single frequency retrievals
- Investigate methodologies to transfer  $N_w$ - $D_m$  information from dual-frequency to single frequency retrievals (e.g. ML & and weak constraints)

# $N_w$ - $D_m$ behavior – Dual Frequency Simplified Retrievals

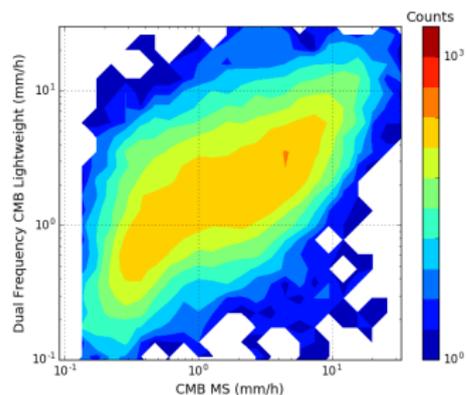


# Dual vs Single Frequency Surface Rain Estimates – Simplified Retrievals –

DF-Simplified vs SF-Simplified

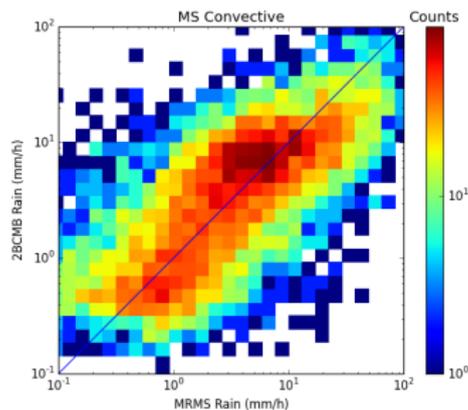
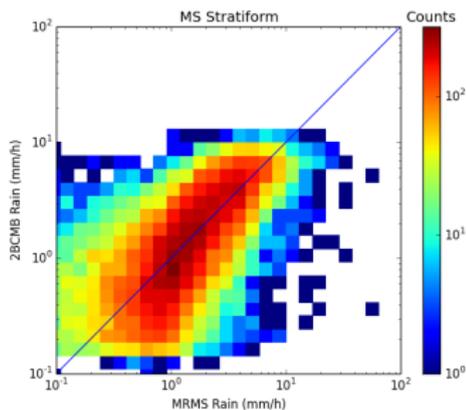


DF-Simplified vs V5 CMB MS



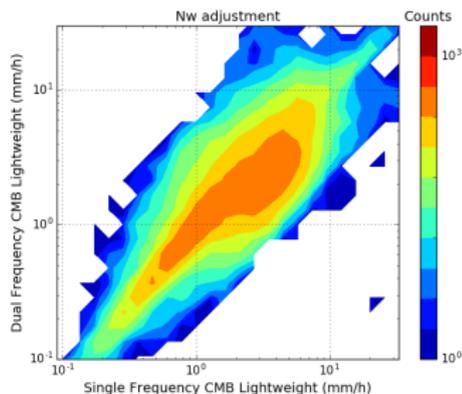
# Comparisons of CMB ITE104 with MRMS

## MS retrievals

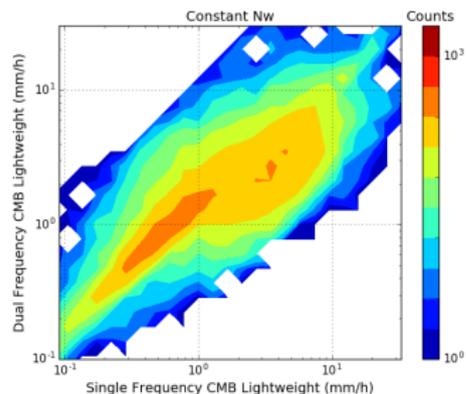


# Dual vs Single Frequency Surface Rain Estimates – Simplified Retrievals –

DF-Simplified vs SF-Simplified  
ML &  $N_w$  adjustment

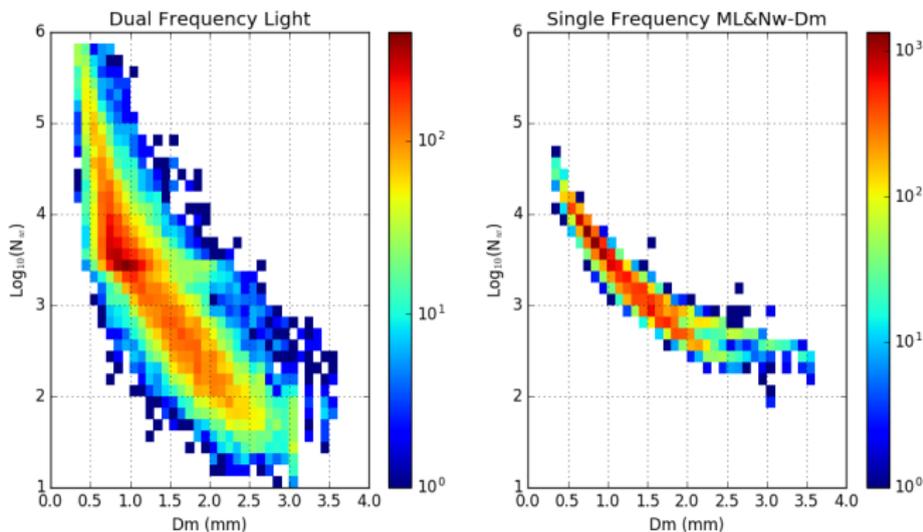


DF-Simplified vs CMB MS  
no  $N_w$  adjustment



# $N_w$ - $D_m$ behavior – Dual Frequency Simplified Retrievals

## Variable $N_w$ and constant $N_w$



# Conclusions

- Tighter fits of dual frequency data appear to improve the estimates of low to moderate intensity convective rain
- The methods and findings of this study can be extended to stratiform precipitation and can be readily incorporated into the combined algorithm
- Additional investigations are required to determine when tighter fits become detrimental
- Future work needs to be more specific and incorporate knowledge emerging from the work of other PMM investigators:
  - Information on the ice phase from triple frequency observations from OLYMPEX/RADEX and IPHEX (PI: G. Heymsfield)
  - Reconcile GPM CMB composites of Extratropical Cyclones (ETCs) with composites from other estimates (PI: C. Naud)