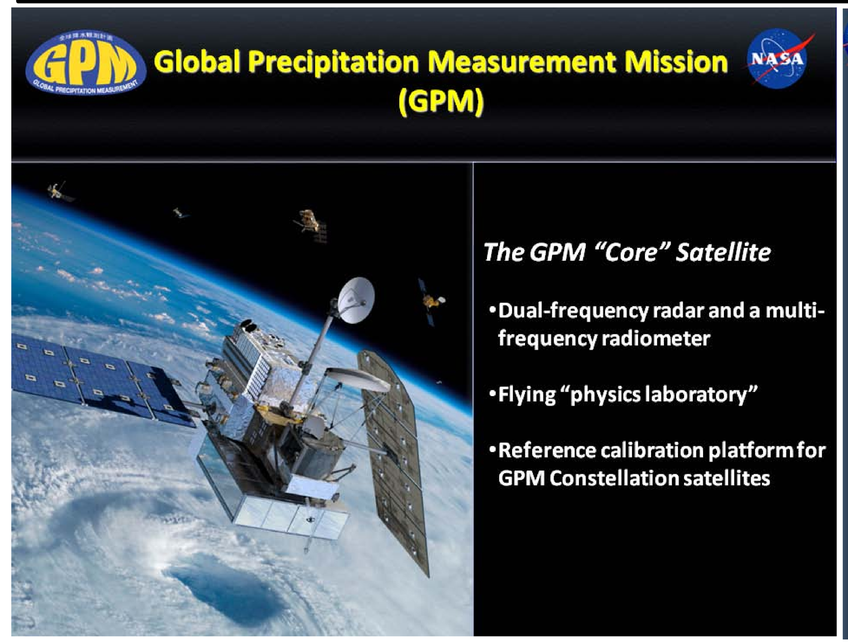
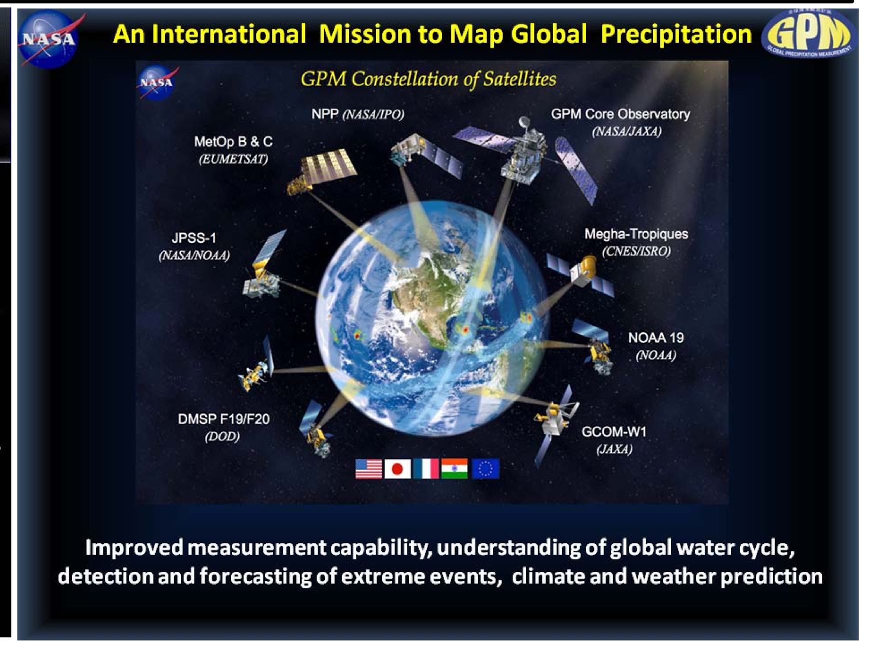
179 Radar Deployments and Field Sampling for GPM Ground Validation Field Campaigns

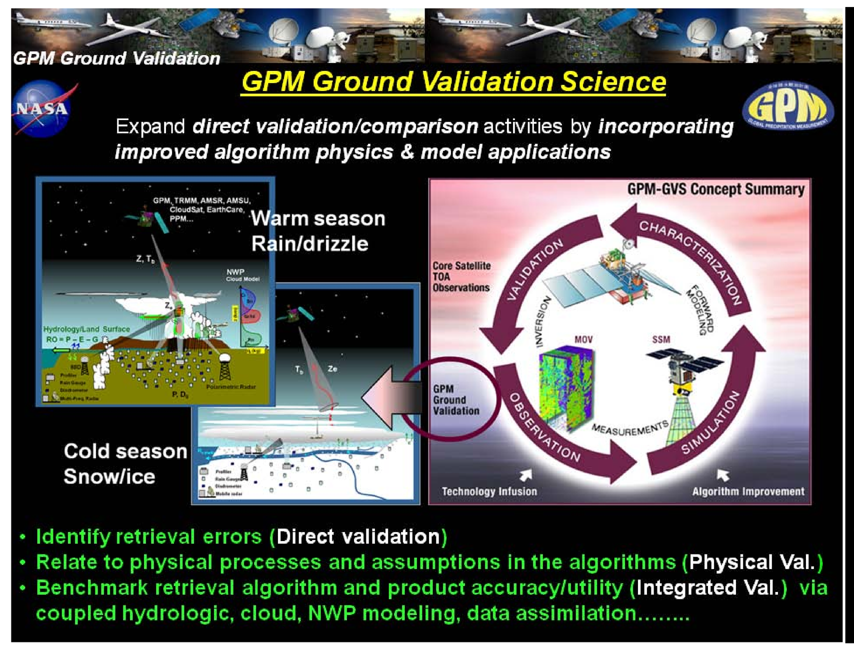
W. A. Petersen[1], V.N. Bringi[2], V. Chandrasekar[2], S. A. Rutledge[3], D. B. Wolff[1], A. Tokay[4], L. D. Carey[5], M. Thurai[2]

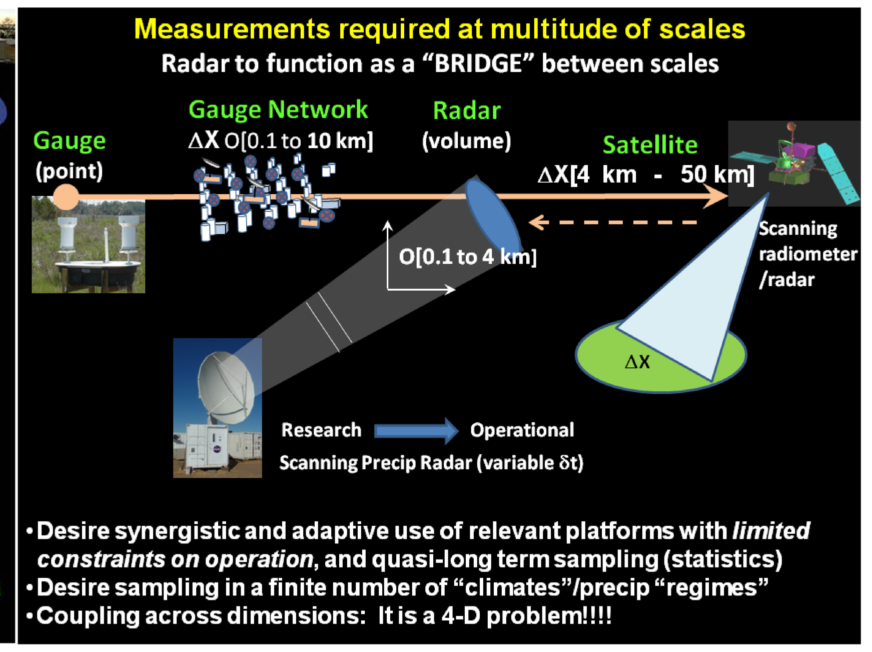
[1]NASA GSFC/Wallops Flight Facility, Wallops Island, VA, 23337; [2]Dept. Elec. Engr./[3]Atmos. Sci. Colorado State University, Fort Collins, CO, [4]NASA GSFC/UMBC Greenbelt, MD; [5]Dept. Atmos.Sci., University Alabama-Huntsville, Huntsville , AL

1. The Global Precipitation Measurement (GPM) Mission: A fundamental role/need for radars and supporting precipitation measurements









- **Radars: Fundamental to GPM algorithm validation for characterizing column precipitation profiles and variability (e.g., DSD, water contents, type), mapping rainfall, and discerning precipitation process physics**
- **Numerous rich datasets have been collected during current and ongoing GPM GV field efforts**

2. Top down: Multi-Parameter Radar, Radiometers and Reference Networks

Airborne

View from the top- Satellite "simulators"

- CoSMIR, AMPR Radiometers
- HIWRAP, APR-2, Ka-Ku Radars

Column microphysics

- Cloud Microphysics Suite (e.g., 2D-C/P/S, CIP,CPI,CDP, HVPS-3, Nevzorov, King)

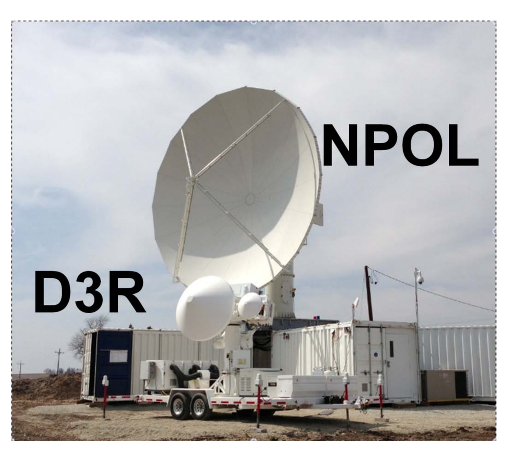
Ground: Dual-pol/Dual-Freq. Radar

Column precipitation microphysics, rates, DSD

•Scanning: W, Ka, Ku, X, C, S

•E.g., NPOL, D3R, King City, X/C-SAPR

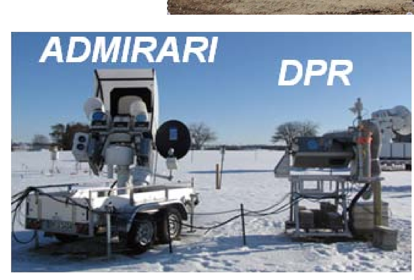
•Profiling: W, K, X-band, S/UHF



Radiometer (ADMIRARI/DPR)

Column TB, Water Path

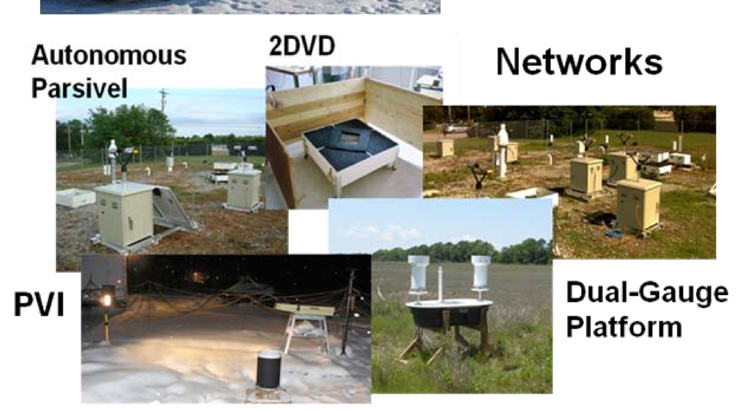
•ADMIRARI (10-37 GHz), DPR (89-150GHz)



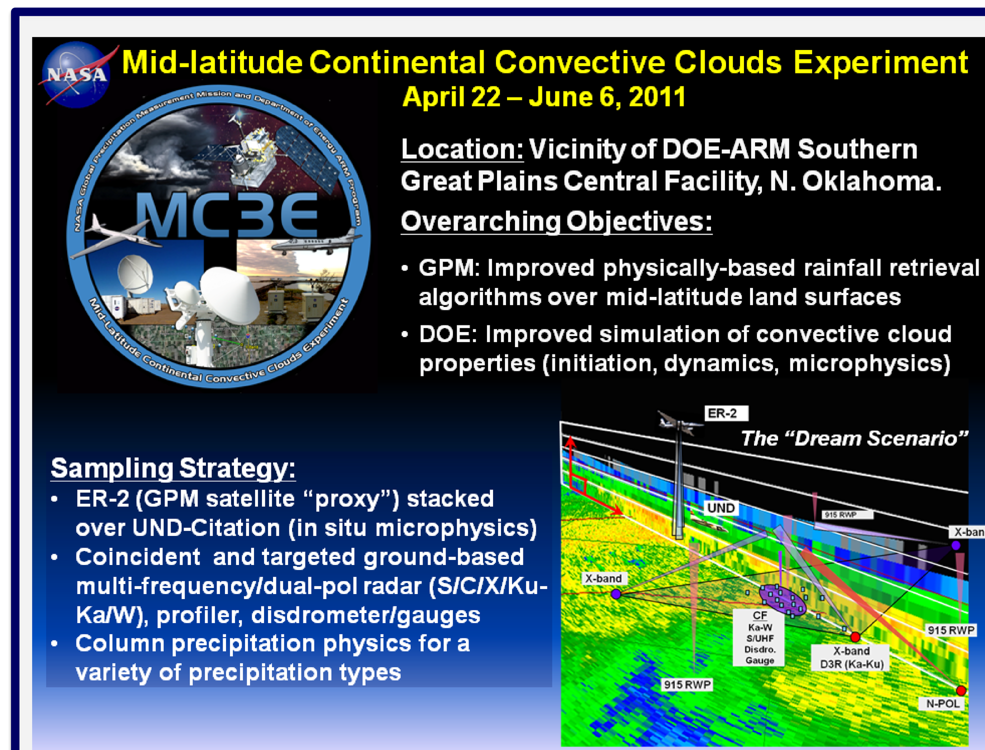
Precipitation Rates / DSD

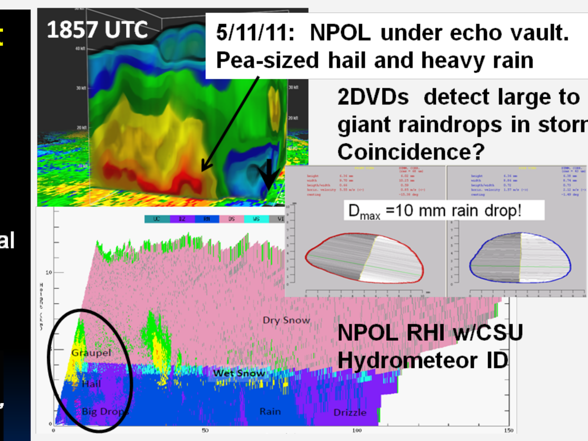
Connect/Reference column to surface

- Disdrometers (2DVD,Parsivel, JW))
- Dual-gauge platform dense networks
- All weather hot-plates
- OTT Pluvio^2 weighing gauges
- Precipitation Video Imager



3. Select GV Field Efforts, Observations, and Results: MC3E and IFlooDS

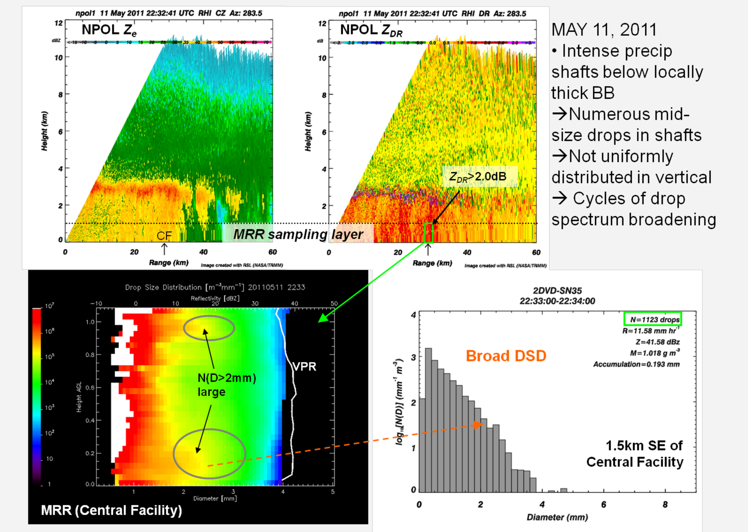




May 11, 2011 Rain variability

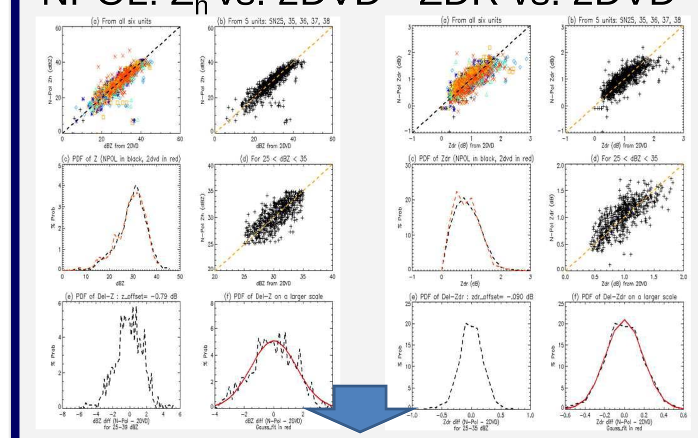
Large drop "tail" in mixed convective-stratiform DSD

Also observed in robust stratiform



Mid-large drop-size "patches" in MRR at low levels and in 2DVD.

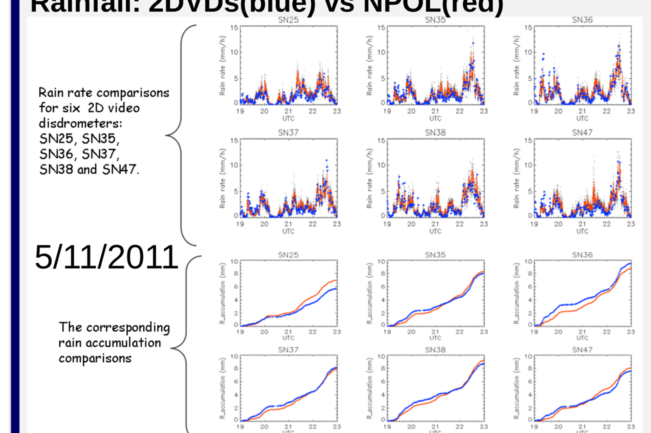
NPOL: Z_h vs. 2DVD   ZDR vs. 2DVD



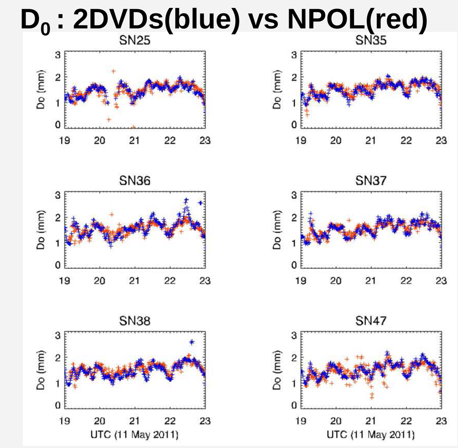
NPOL Z, ZDR data calibration verified with 2DVD network DSD Data

***Critical to ongoing rain,DSD variability studies** (cf. Bringi et al. paper[s]this conf.)*

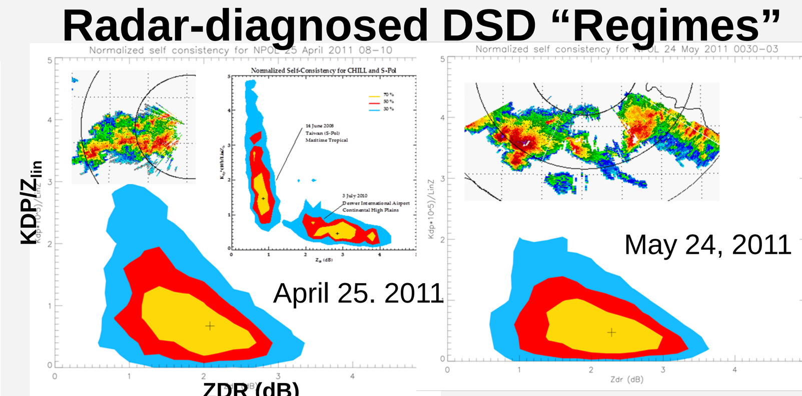
Rainfall: 2DVDs(blue) vs NPOL(red)



D_0 : 2DVDs(blue) vs NPOL(red)



Radar-diagnosed DSD "Regimes"

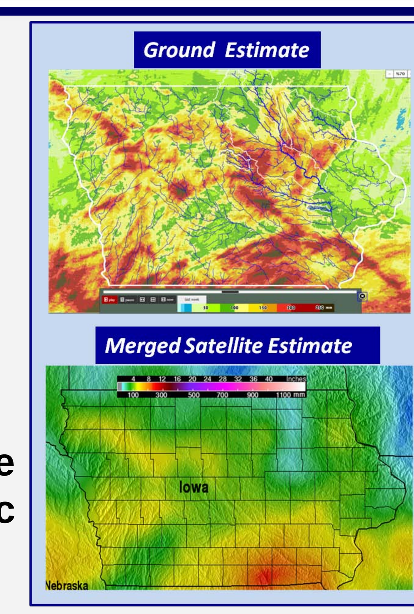


Ice and coalescence DSD process   Ice dominated DSD process

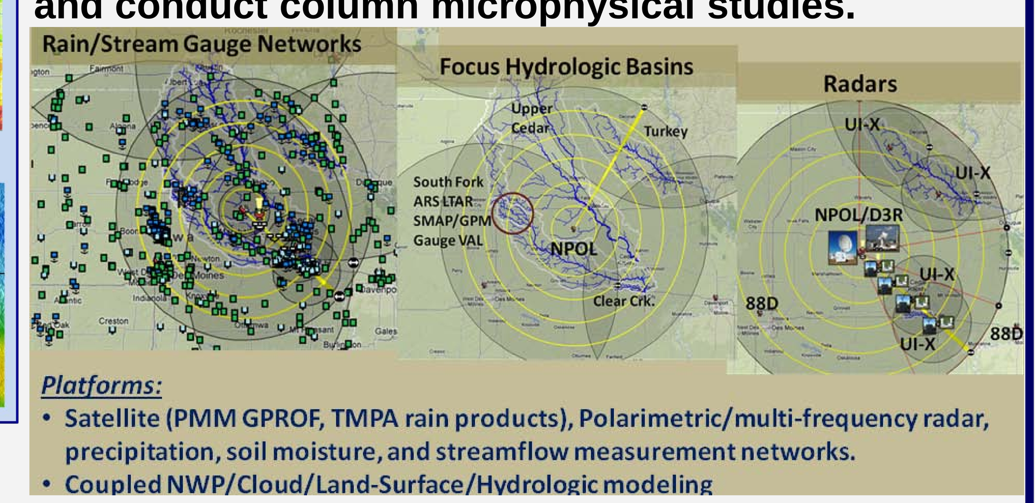
May–June 2013, Iowa

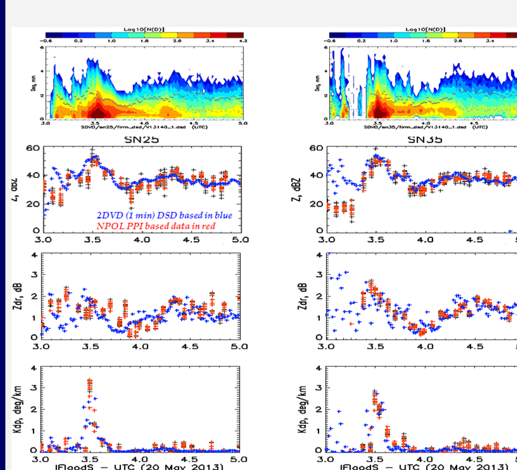
•Assess sources of uncertainty in satellite estimates of rainfall

•Assess / improve satellite data use(s) for hydrologic prediction



NPOL, D3R and U. Iowa XPOL radars operated under multi-satellite coverage and over reference gauge/disdrometer arrays to optimize rain mapping and conduct column microphysical studies.



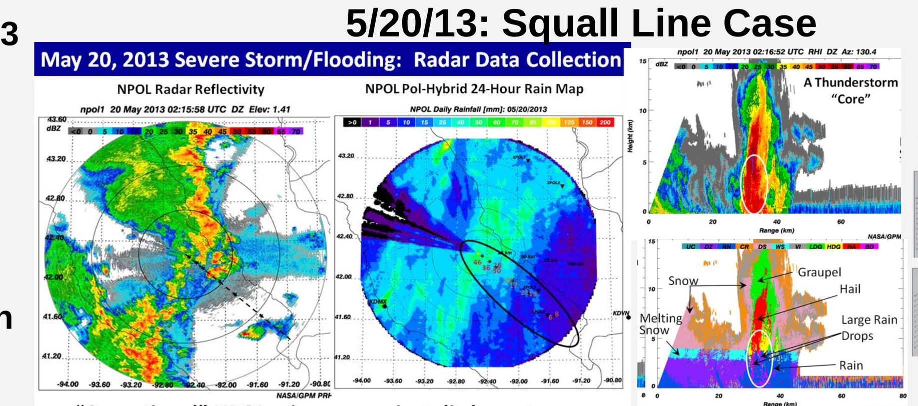


NPOL Calibration Comparison with 2DVD-ray 5/20/2013

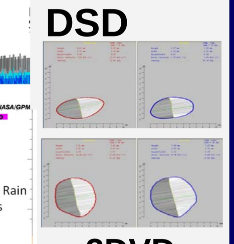
Within ~0.5 dB of KDP/ZDR/Z_h

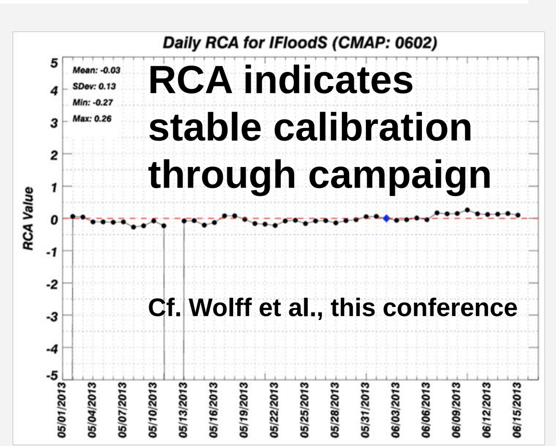
Adjust for bias, monitor with Relative Calibration Adjustment (RCA)

5/20/13: Squall Line Case



Ice-phase impacts DSD



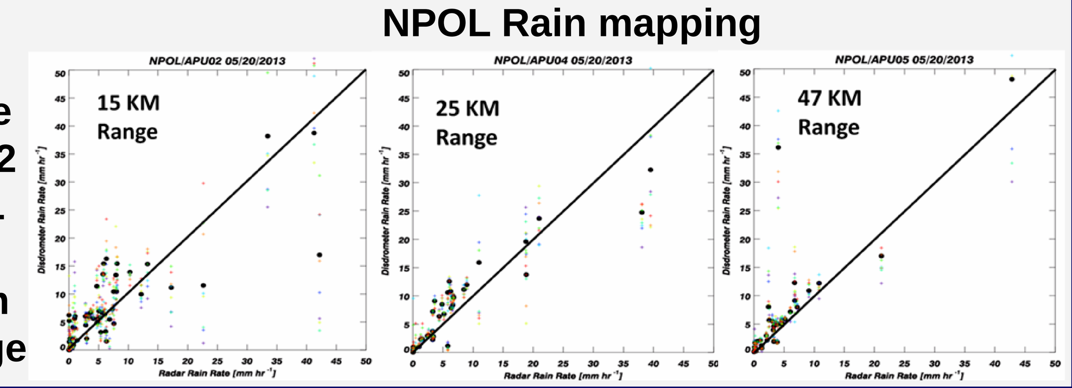


RCA indicates stable calibration through campaign

Cf. Wolff et al., this conference

NPOL Rain mapping

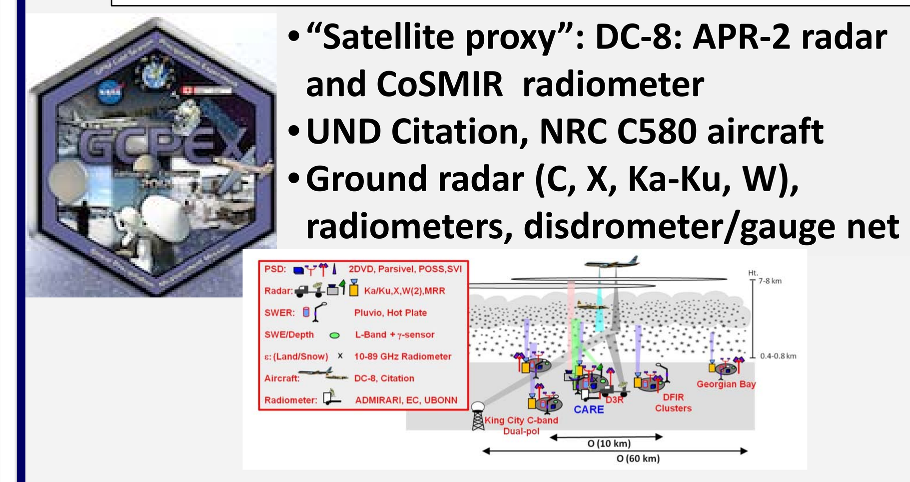
***1-minute* Rain Rate Parsivel-2 vs. NPOL Hybrid algorithm with range**

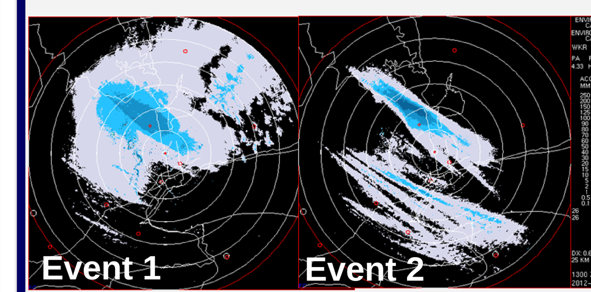


4. Select GV Field Efforts, Observations, and Results: GCPEX and NASA Wallops

GCPEX: GPM Cold Season Precipitation Experiment (Jan-Feb. 2012)

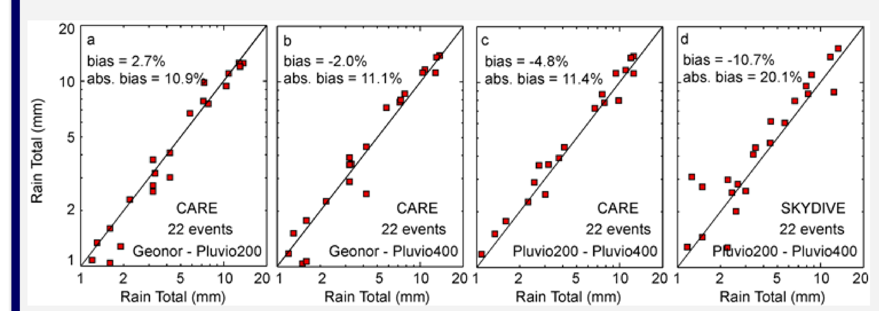
- "Satellite proxy": DC-8: APR-2 radar and CoSMIR radiometer
- UND Citation, NRC C580 aircraft
- Ground radar (C, X, Ka-Ku, W), radiometers, disdrometer/gauge net





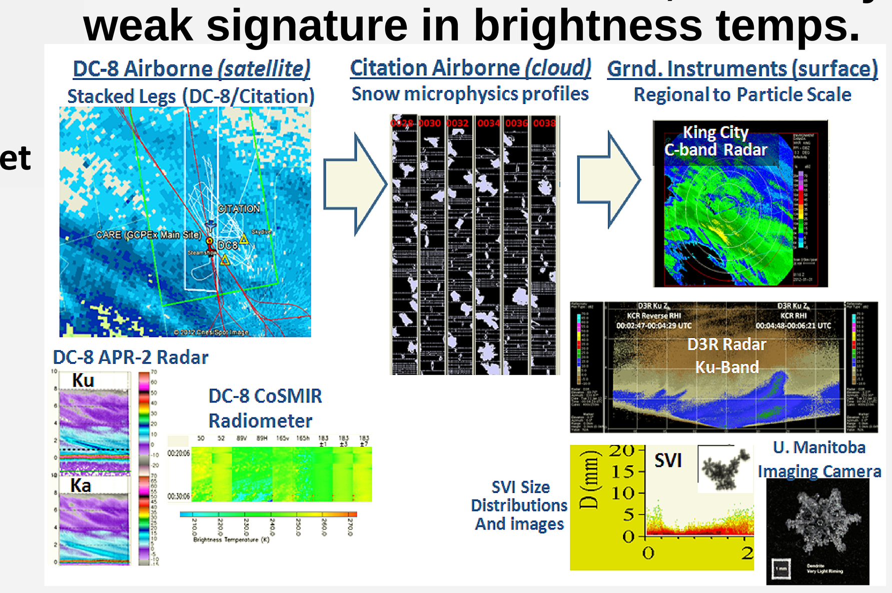
Station	Rnge/Az.	Pixels	Pluvio
	34 / 331	7x7	
		mm	mm
CARE	Event 1	1.1	0.8
	Event 2	1.0	1.1
Morten	36 / 311		
	Event 1	0.6	0.2
	Event 2	0.3	0.3
Steamshow	27 / 334		
	Event 1	1.0	0.3
	Event 2	0.7	0.7
Skydive	31 / 350		
	Event 1	1.1	1.1
	Event 2	1.2	1.7
Huronia	86 / 341		
	Event 1	0.4	0.8
	Event 2	0.0	0.9

King City radar SWE map computed from 2DVD Z-S: $355.88{*}S^{1.78}$ (courtesy, G. Huang, D. Hudak); Compare to Pluvio 200/400-reference on right.

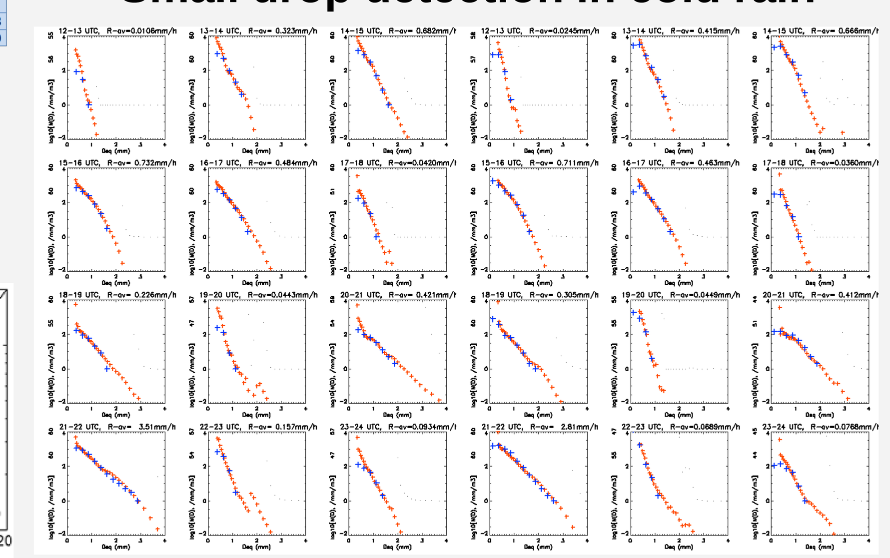


Verified consistency of reference SWE (Pluvio$_2$ 200 vs. 400)

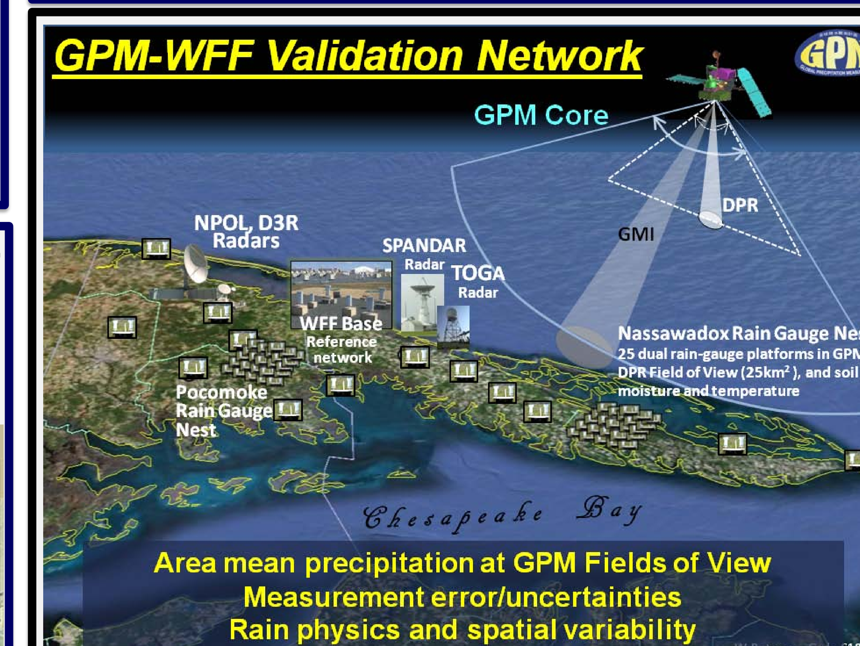
01/31/2012: Moderate snow; relatively weak signature in brightness temps.

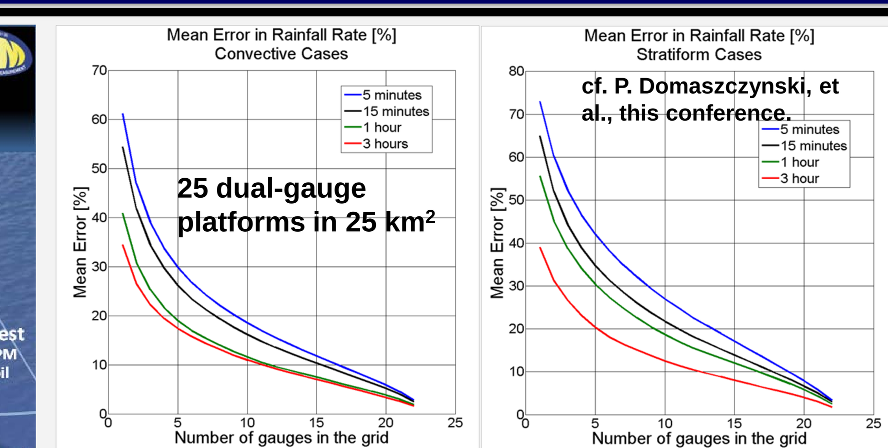


Small drop detection in cold rain



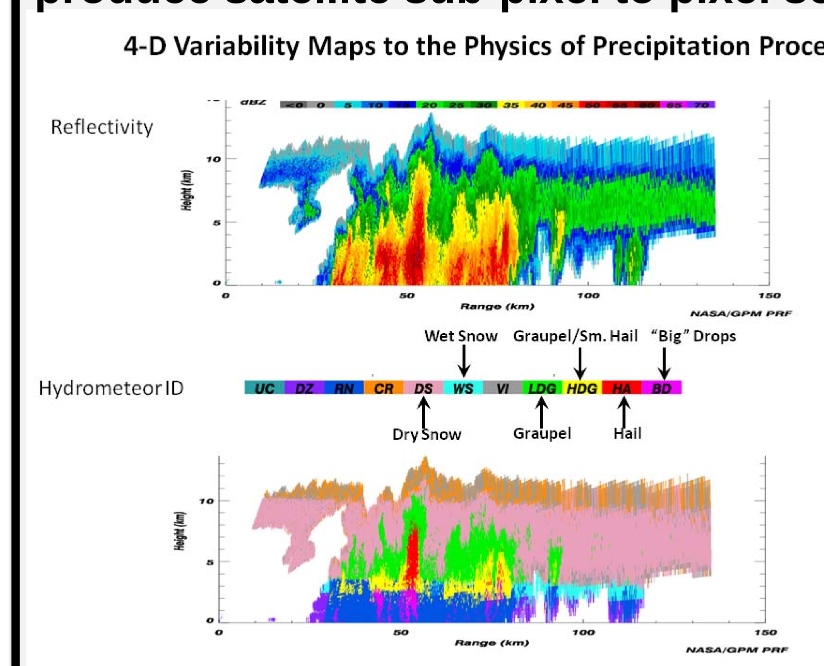
1/17/2012: POSS (red) vs. 2DVD (blue) DSD. 2DVD Small-drop counts increase using single camera methods.

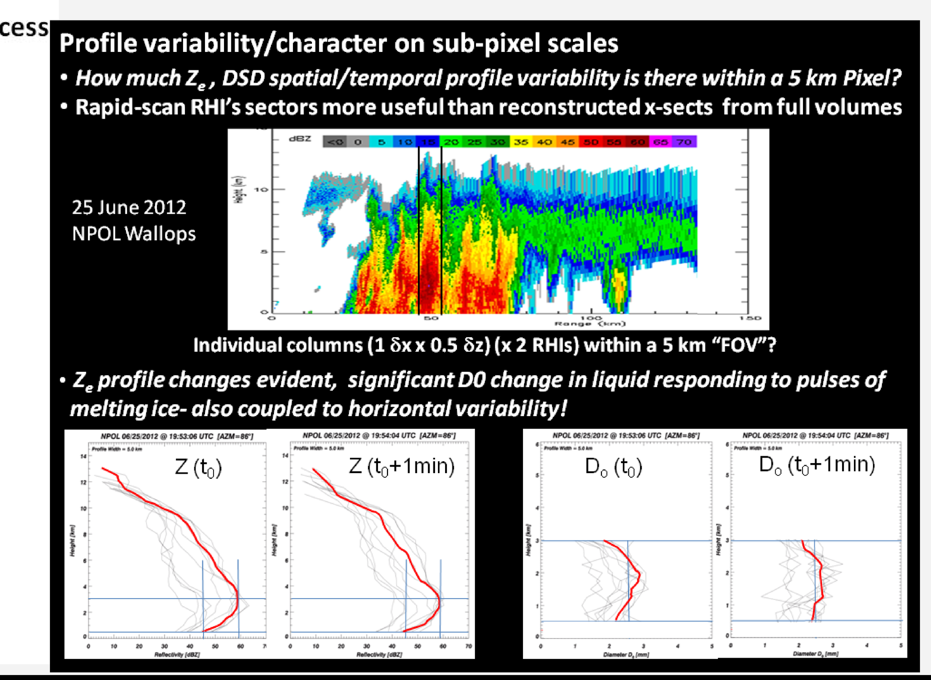




How many gauges to get a "representative" area mean rainfall over satellite fields of view (e.g., 5 - 25 km)

How do vertical profile variability and microphysical process couple to produce satellite sub-pixel to pixel scale spatial variability in rain properties?





***Summary:* GPM has collected myriad high quality multi-parameter radar, gauge, and disdrometer field datasets to support pre-launch GPM physical validation efforts. Collection and analysis efforts will continue into post-launch era.**

Acknowledgements: We acknowledge Dr.'s D. Hudak, G. Huang, P. Domaszczynski, and Mr. P. Gatlin, for their contributions to this poster. We acknowledge the GPM/PMM Program (especially Dr.'s R. Kakar, A. Hou, and M. Schwaller) for funding support.