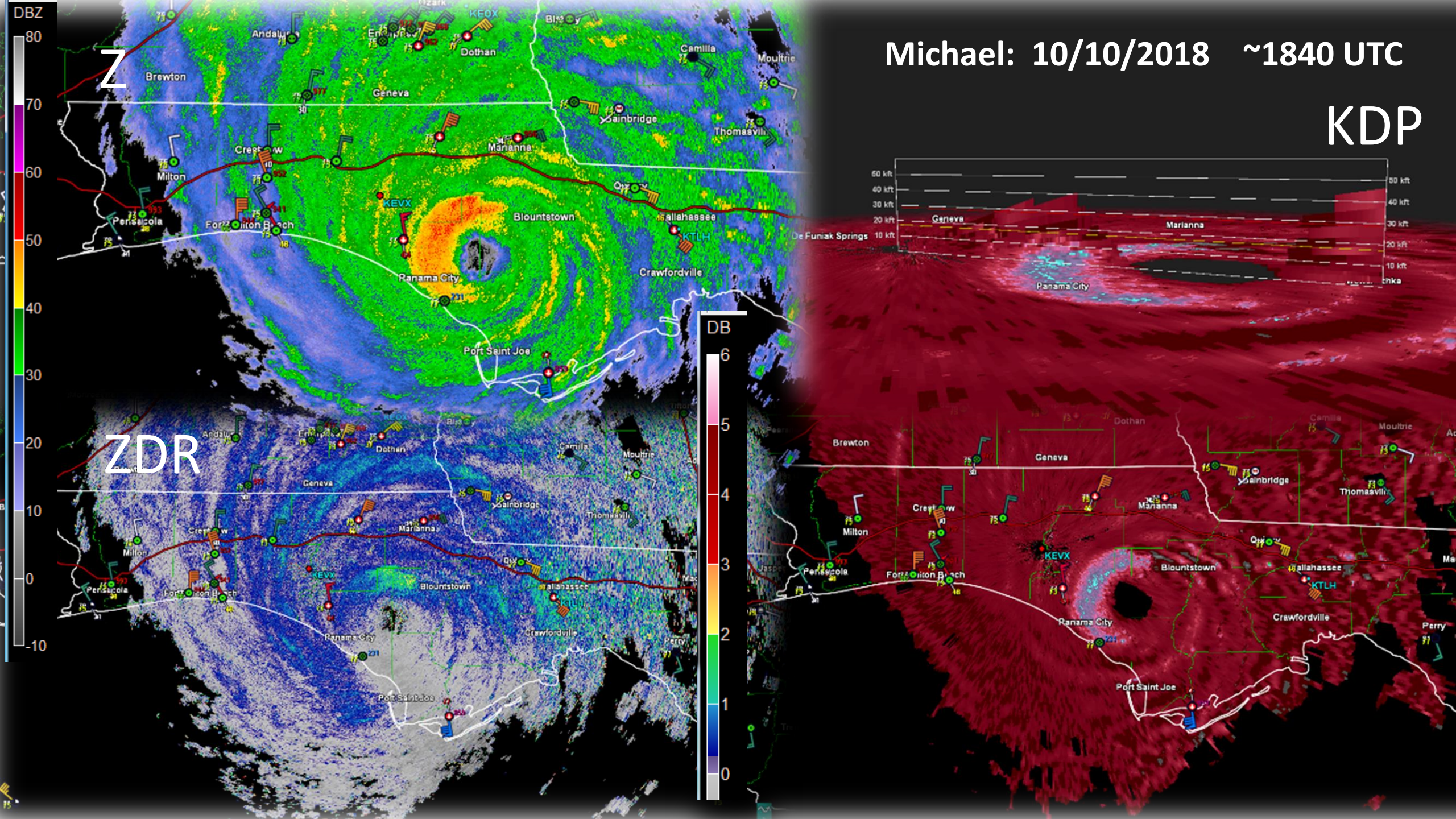
GPM GV: Activities Across the Swath

Walt Petersen, Earth Science Branch, ST-11, NASA-MSFC

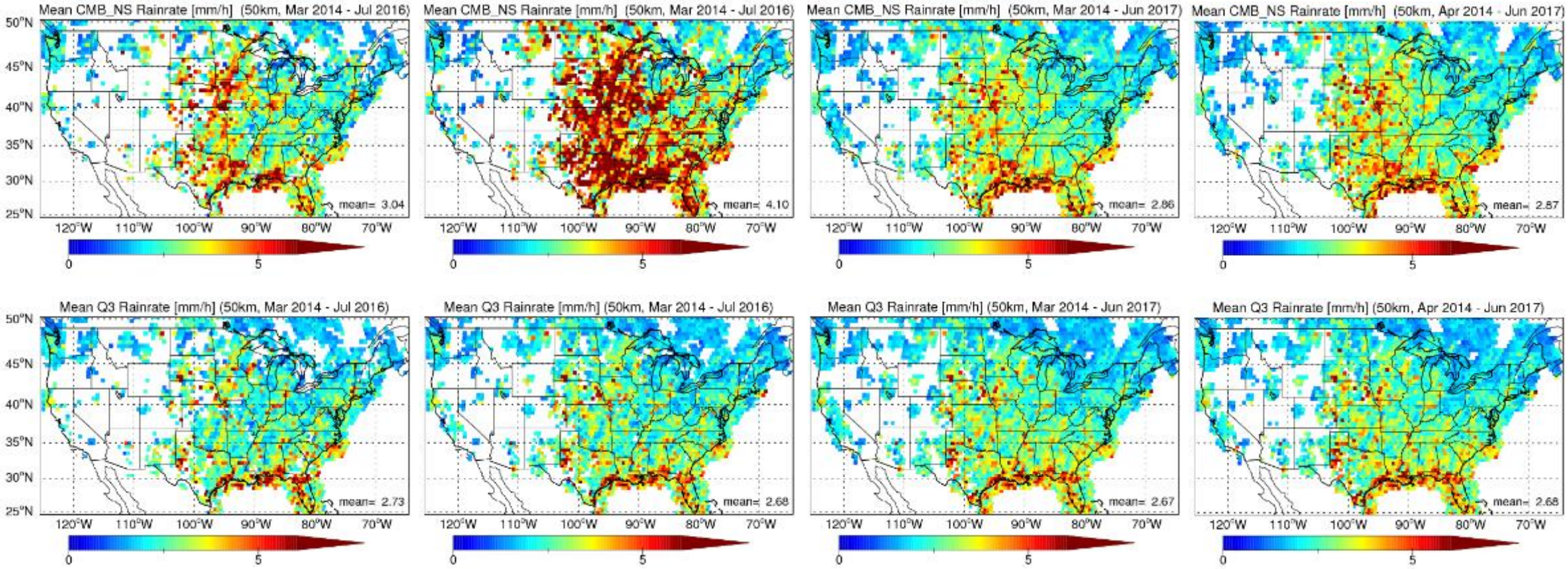
- Version 6
- NASA GV IMERG Validation efforts
- Snow
- New Datasets


Michael: 10/10/2018 ~1840 UTC
Z
DBZ
80
70
60
50
40
30
20
10
0
-10
ZDR
DB
6
5
4
3
2
1
0
KDP
Brewton
Geneva
Dothan
Camilla
Moultrie
Bainbridge
Thomasville
Marianna
Milton
Pensacola
Crestview
Blountstown
Tallahassee
KTLH
KEVX
Panama City
Crawfordville
Port Saint Joe
Perry
De Funiak Springs
60 kft
40 kft
30 kft
20 kft
10 kft

Radar Algorithms: Looks at V6. Big Changes occurred in V3-V5…V6 generally looks similar to V5

E.g., Ku + GMI

Launch V3 | V4 | V5 | 2018 ITE607 (V6)

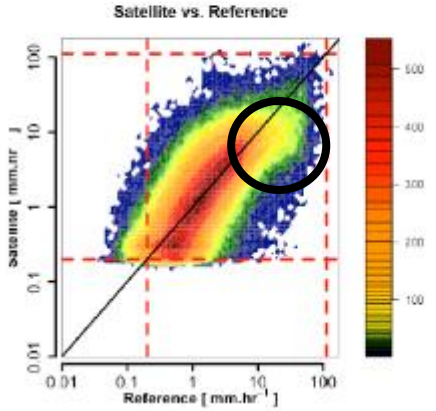


(relative to MRMS for 0.2 mm/hr lower limit on liquid only rates; RQI > 0.9)

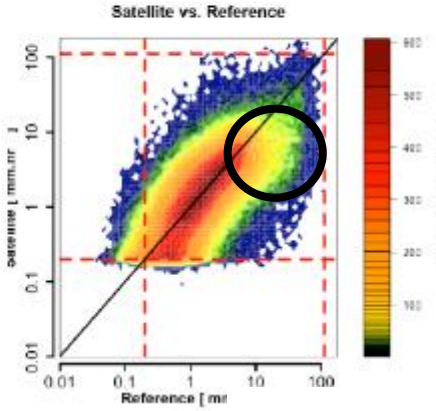
Version Evolution by Rain Types: 2AKu

All Rain

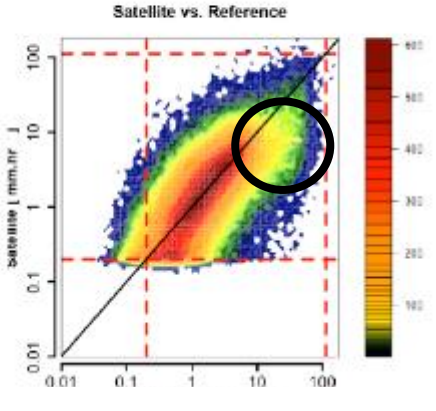
KU V04



KU V05

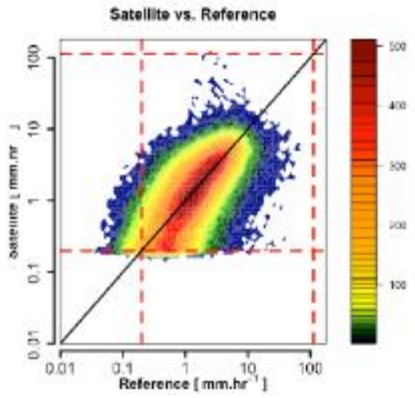


KU ITE601

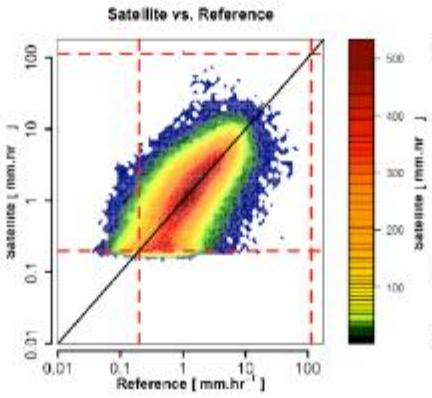


Stratiform

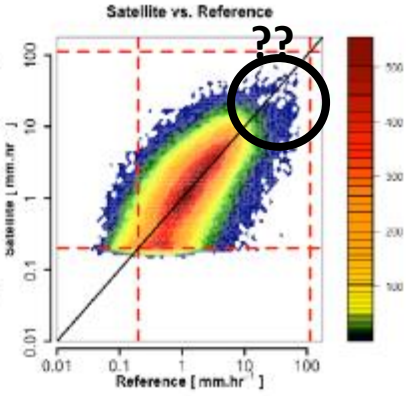
KU V04



KU V05

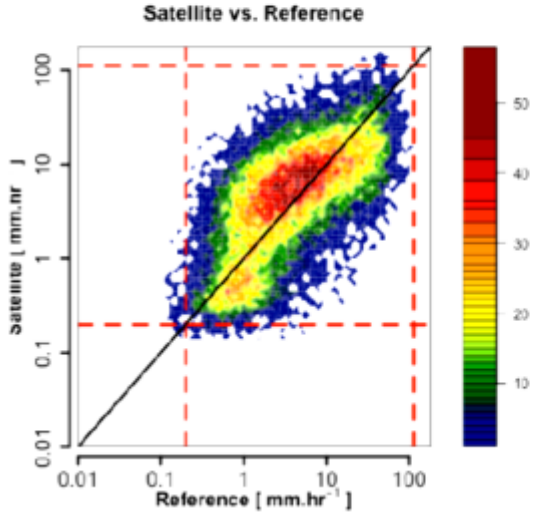


KU ITE601

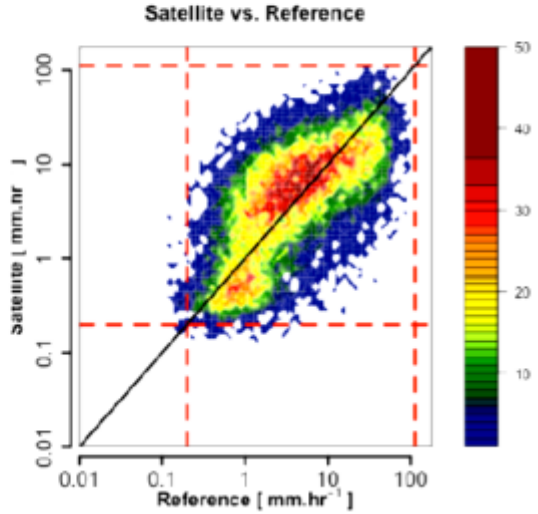


Convective

CMB-MS/NS V05A



CMB-MS/NS ITE607

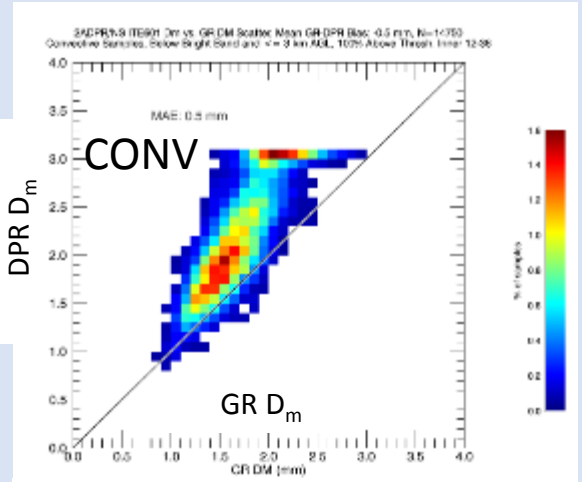


Are we arriving at consistent answers for physics? Version 6 (5) Modes of DSD- D_m vs. GV

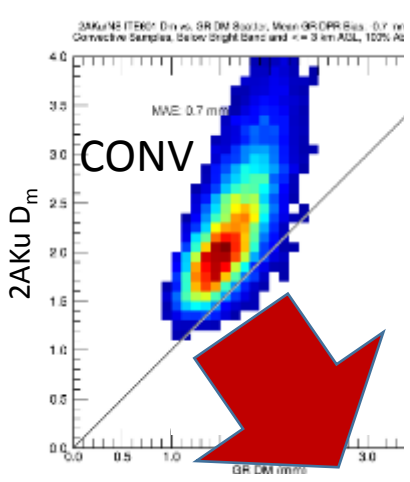
Function of Algorithm Type (DFR, si … tation Type (C/S)

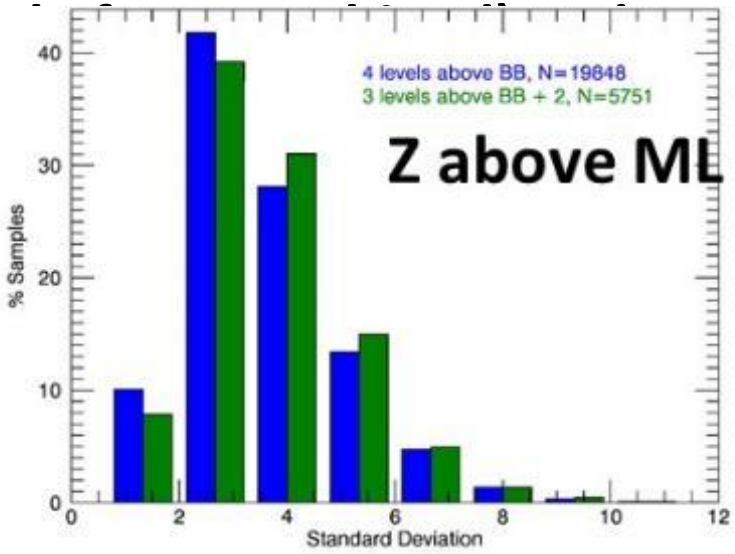
DPR/KuPR … ined

DPR Ku+Ka

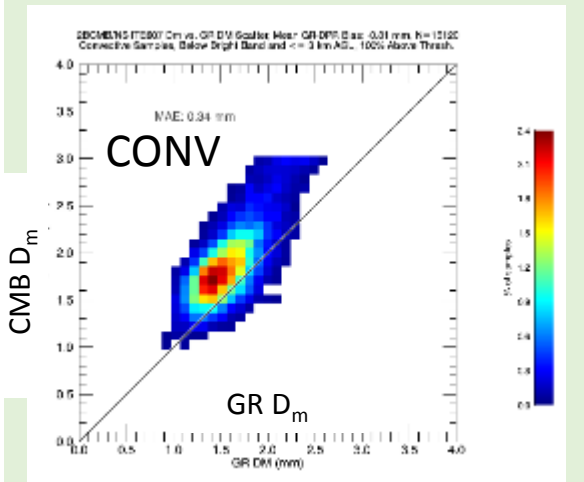


2AKu

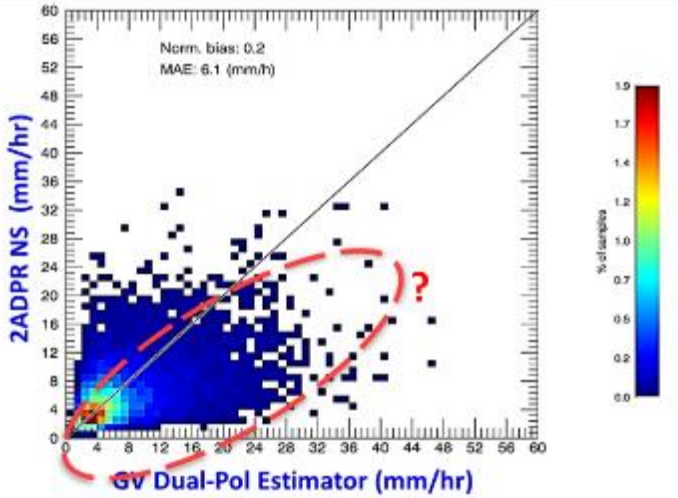




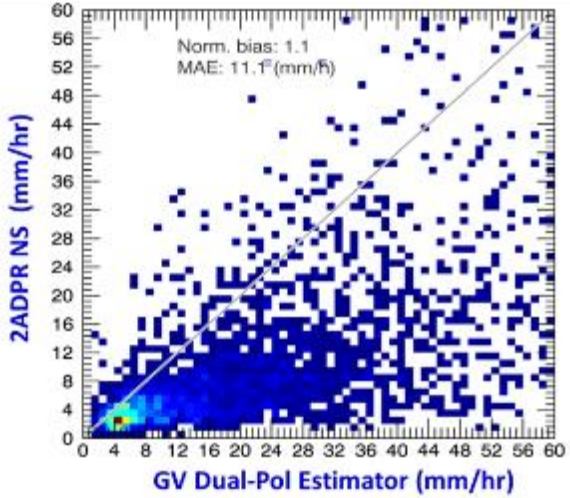
Ku + GMI



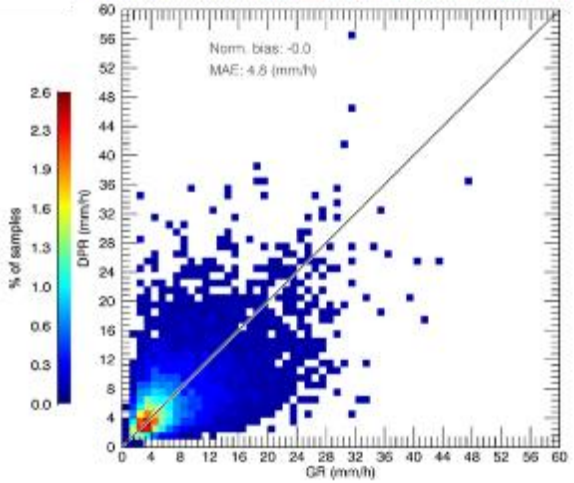
2AKu

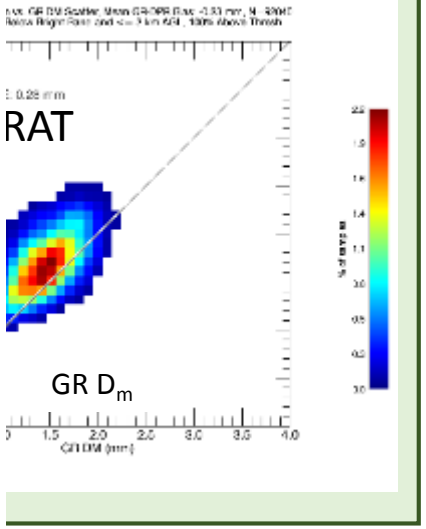


2AKu vs. GV RR (D_m > 2.5 mm)



2AKu vs. GV RR (D_m > 2.5 mm REMOVED)

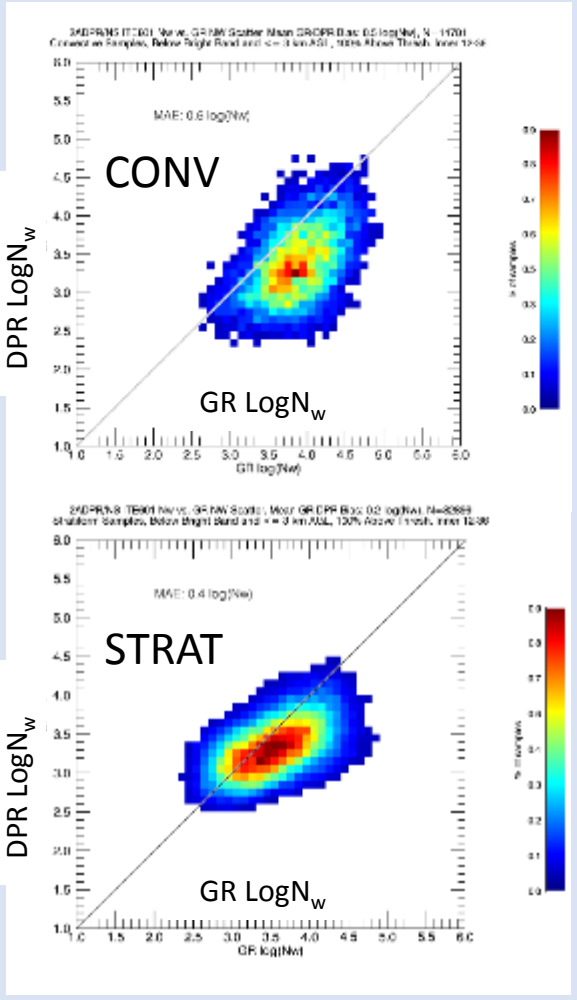




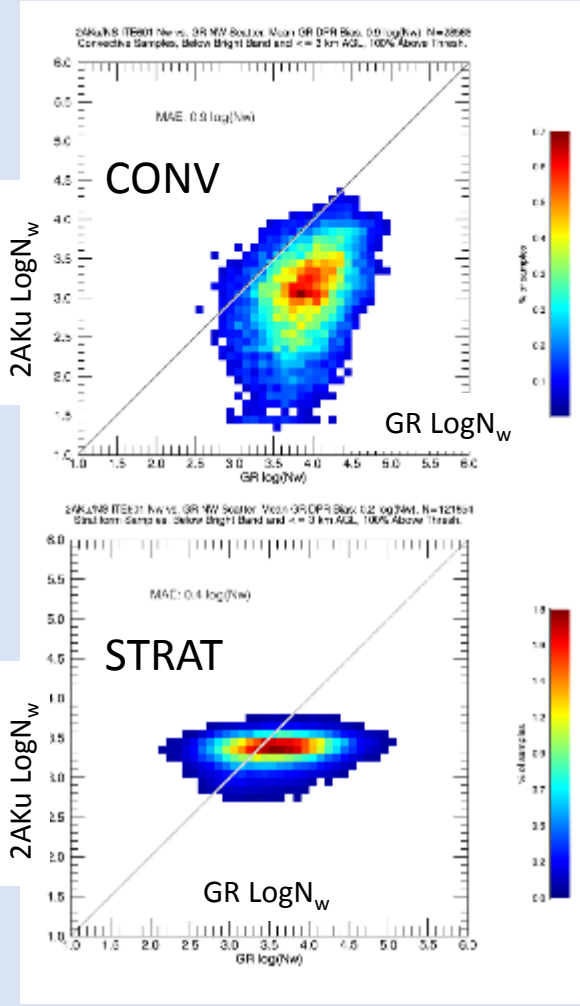
Right Answers for Right Reasons? Version 6 (5) Modes of DSD- N_W vs. GV Function of Algorithm Type (DFR, single freq, combined) and Precipitation Type (C/S)

DPR/KuPR

DPR Ku+Ka

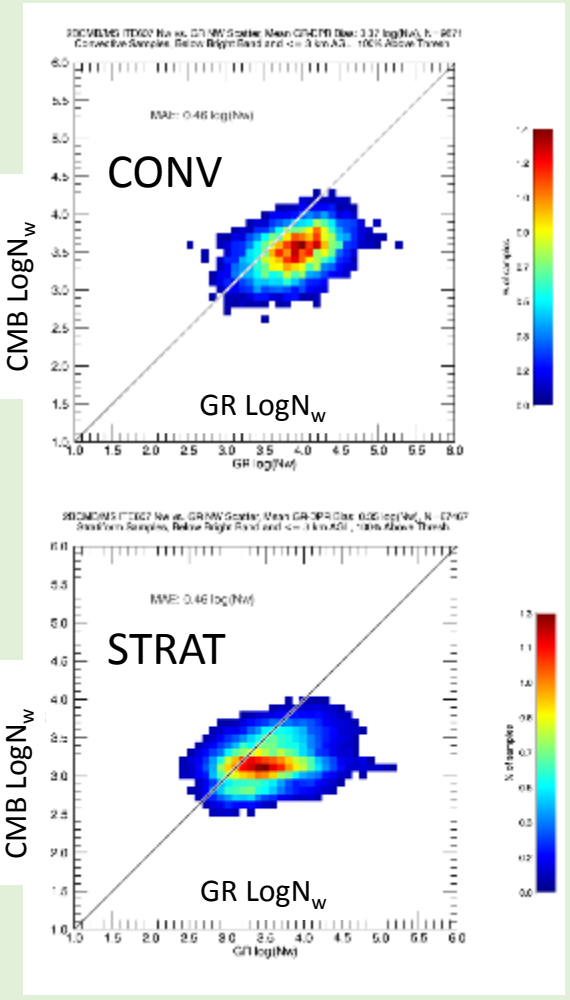


2AKu

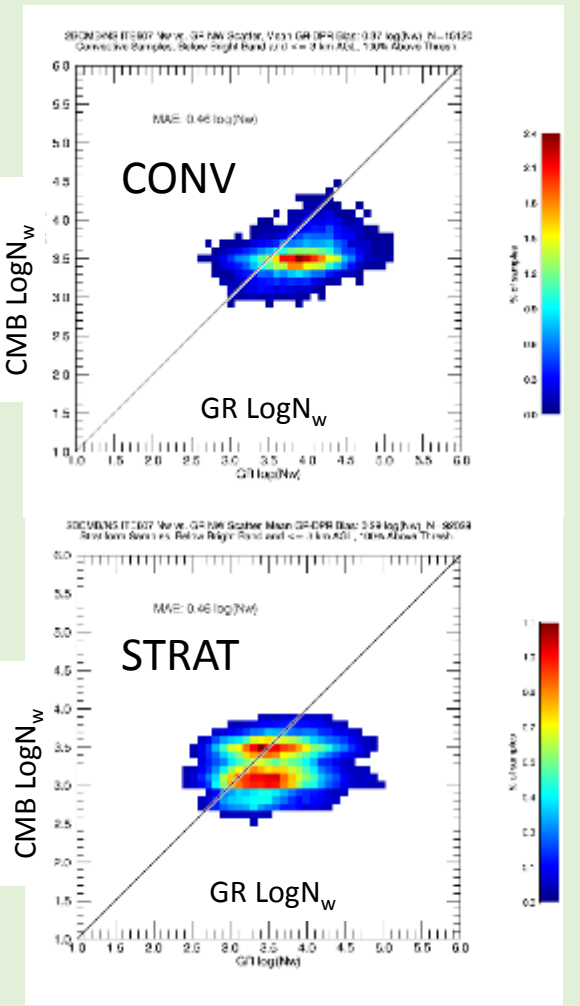


Combined

Ku+Ka+GMI



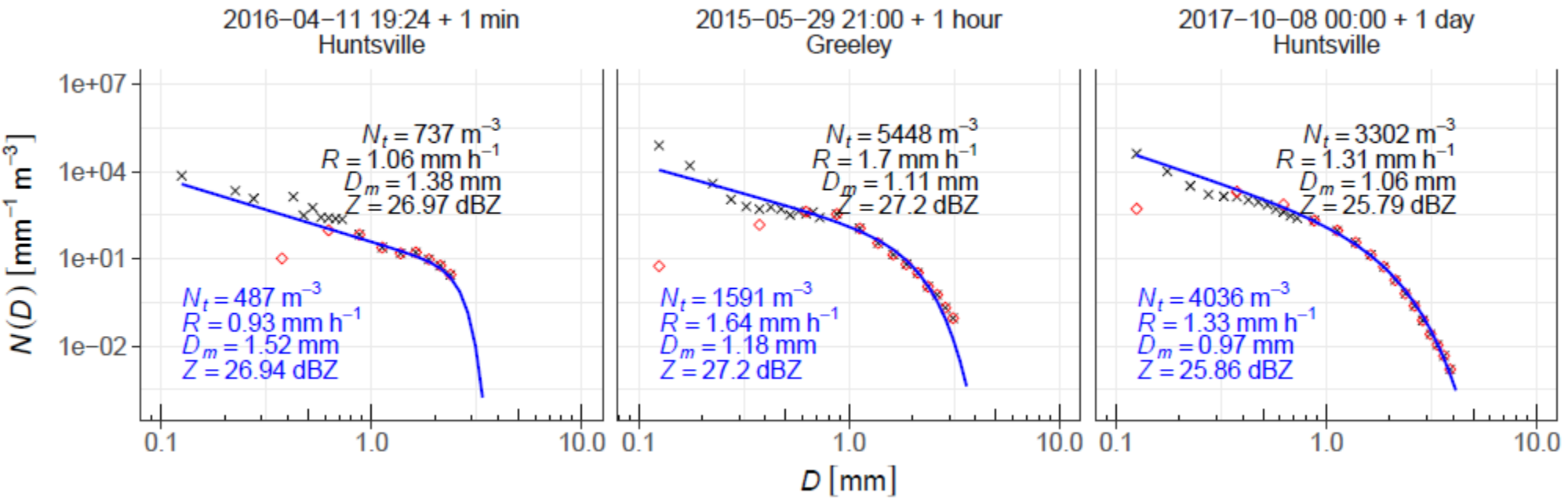
Ku + GMI



Improving Light Rain Retrievals on thes Small drop End?

Advertisement for Berne/Thurai Talk Thursday 11:30

DSD measurements can be truncated on large (> ~5 mm) or small (< ~0.4-0.5 mm) ends of the size spectrum depending on the instrument used. Creates a biased view functional form of the DSD.



Complete DSD: MPS+2DVD

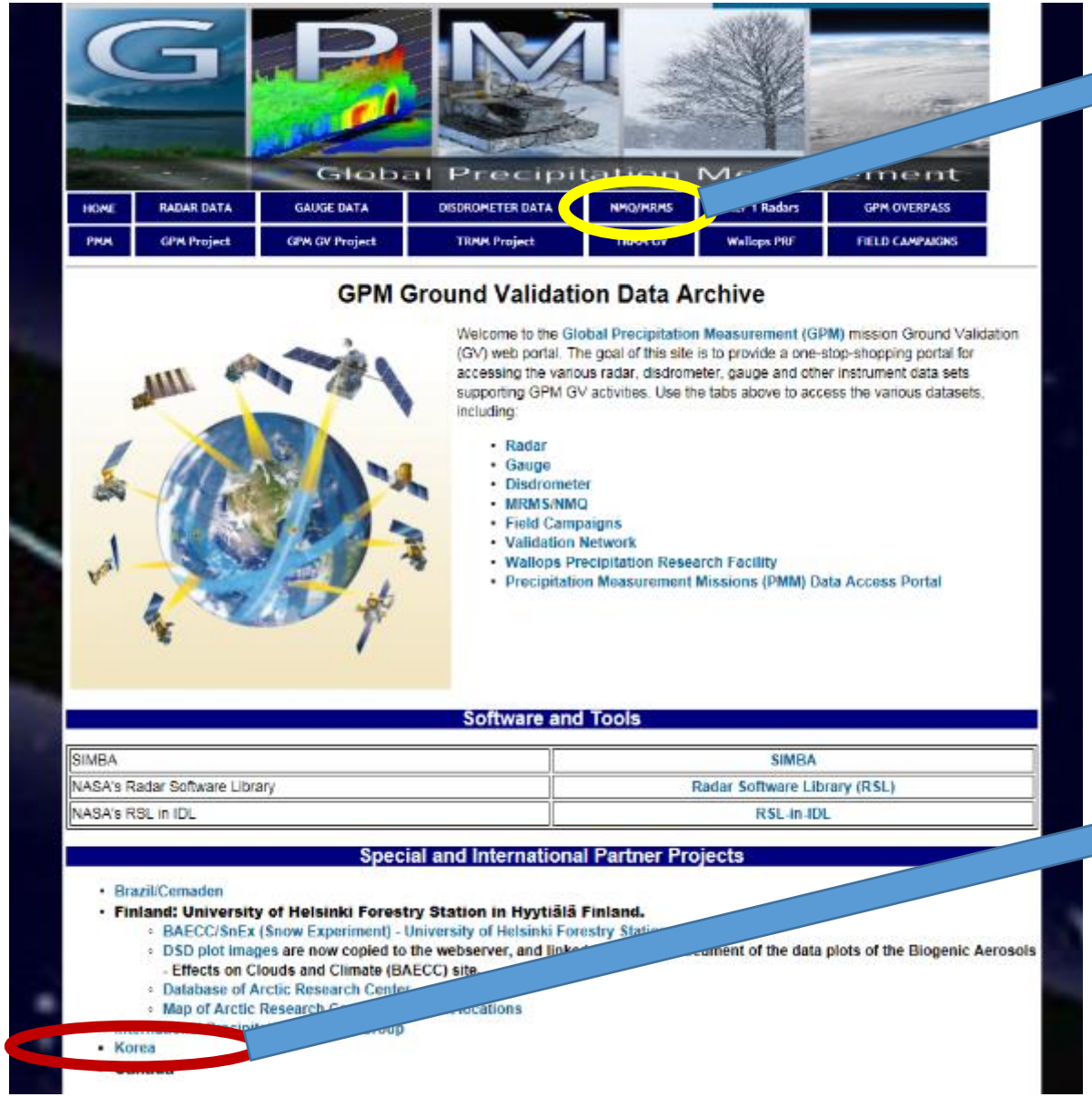
DSD type
× Complete
◇ Incomplete

Cf. A. Berne, M. Thurai et al. talk

Is there a way/how might the double moment normalization/generalized gamma approach be applied for improved light rain retrieval?

IMERG Continental to Regional Scale Validation

https://gpm-gv.gsfc.nasa.gov/

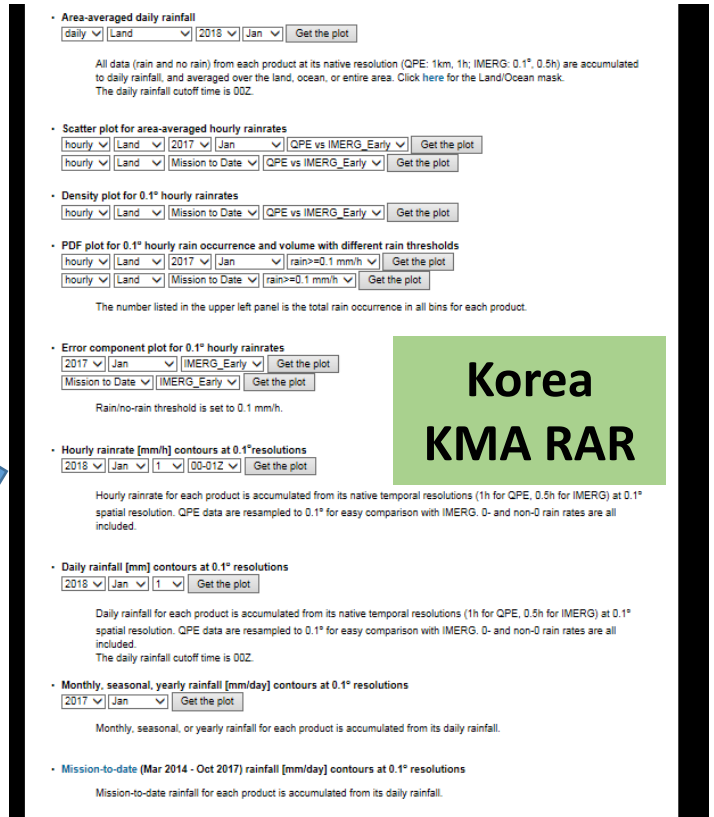


Level-3 hourly (or half-hourly) gauge-adjusted/filtered NMQ rainrates at 0.01° resolution are used in this study to compare with gauge measurements over various areas (Nassawadox, VA; Pocomoke, MD; South Fork Basin, IA), as well as TMPA 3B42 and IMERG over the CONUS.

Level-2 NMQ instantaneous rainrates are used to compare with 2AGPROF, 2ADPR, 2BCMGMI, 2AKU, as well as MHS (Microwave Humidity Sounder flown on the NOAA and METOPS satellites) over the CONUS.

- Comparisons with near-realtime IMERG (Late and Early Runs) over the CONUS
- Comparisons with 3B42 & final-run IMERG over the CONUS
- Comparisons with GMI over the CONUS
- Comparisons with MHS from NOAA18, NOAA19, METOPA and METOPB over the CONU
- Comparisons with GMI, DPR, CMB and KU over the CONUS (footprint-matched)
- Comparisons with gauges over Nassawadox, VA and Pocomoke, MD
- Comparisons with gauges over Pocomoke, MD
- Comparisons with gauges over South Fork Basin, IA
- Comparisons with gauges from HalfDeg Gauge Network over Delmarva Peninsula near MD-VA boundary

CONUS MRMS



Korea KMA RAR

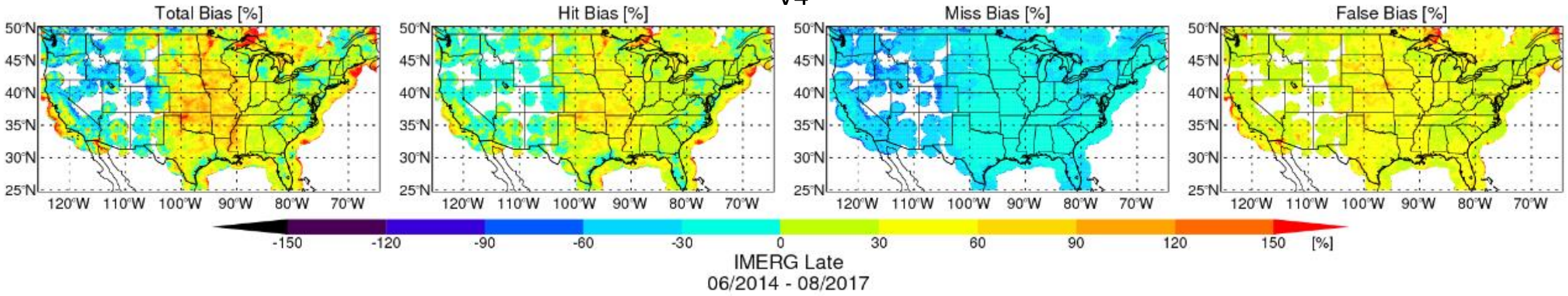
Rain maps (30 minute, hourly, daily, monthly, annual, seasonal...mission to date)

PDFs, scatter, scatter density, time series....

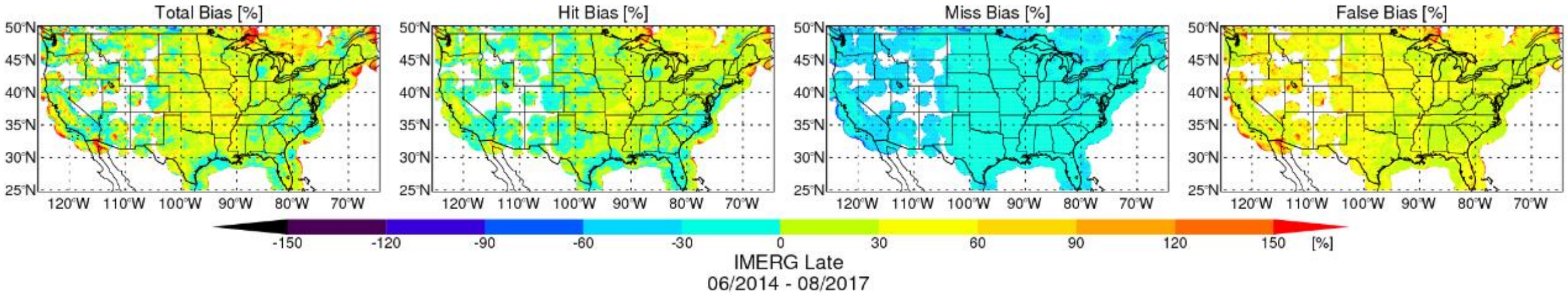
3B42 and IMERG.....

Continental Bias Error Assessments: CONUS GV-MRMS
IMERG-Late 0.1º 30 minute

V4



V5



Clear improvements over C. U.S. (likely in response to GPROF improvement in V5)

False alarms and "Hit" bias have larger net contribution to Total Bias- both can be tied to sensors and algorithms.

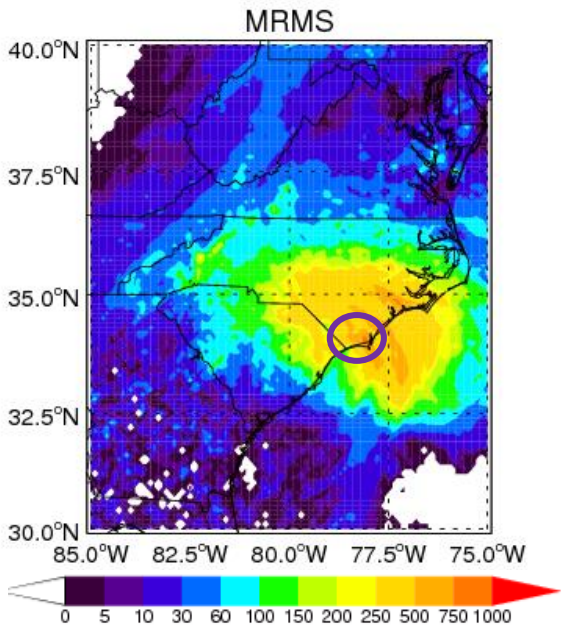
MRMS and IMERG 7-Day Rain Accumulations: Hurricane Florence 10-16 September 2018

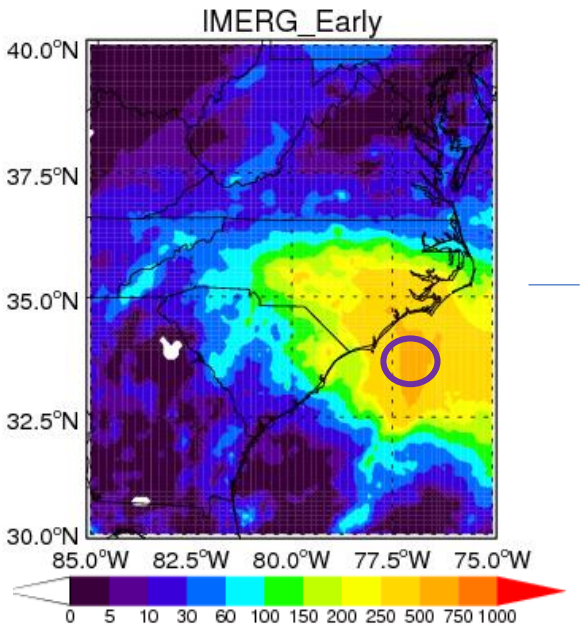
Max Rain Accumulations:
MRMS: 890 mı
IMERG_E: 744 mı
IMERG_L: 862 mı

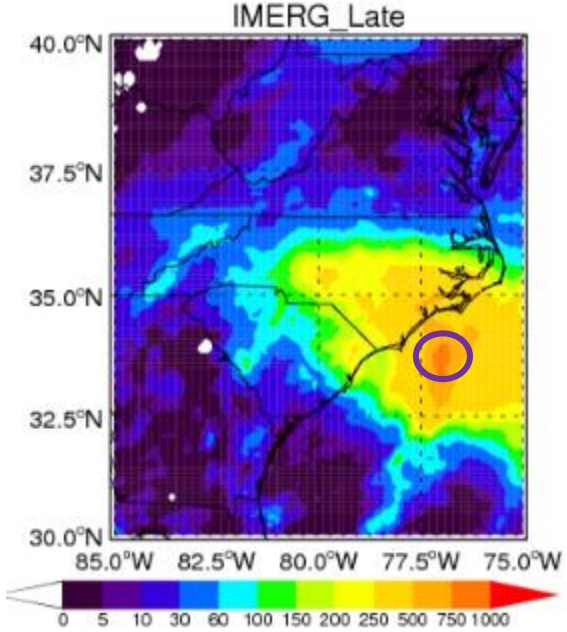
Gauge maximums of order 30-36 inches (762-914 mm)

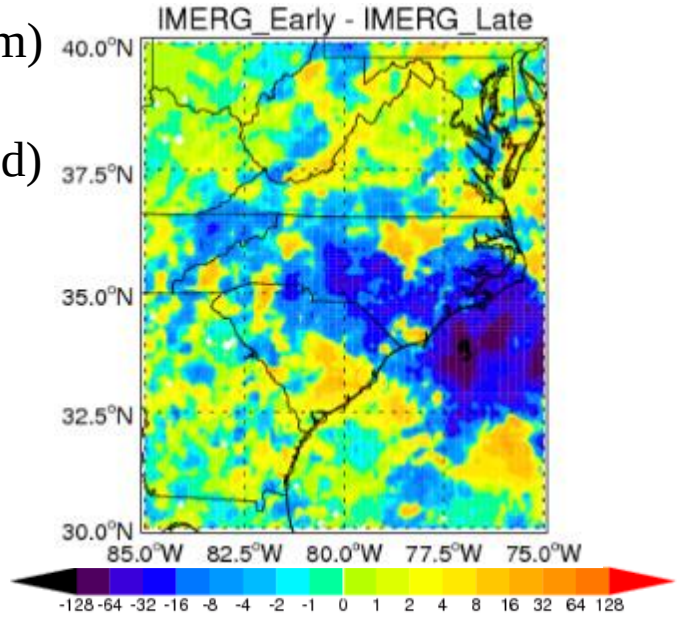
Correlations (Accumulated)

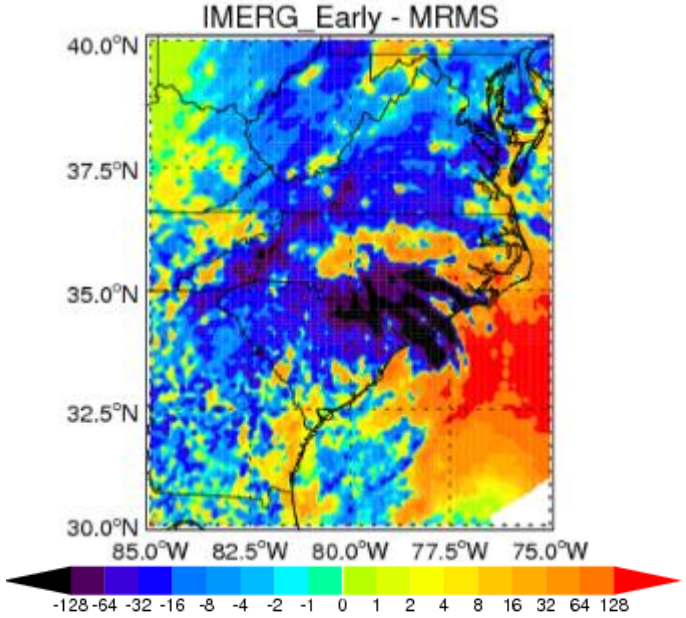
IMERG-E: 0.84
IMERG-L: 0.83

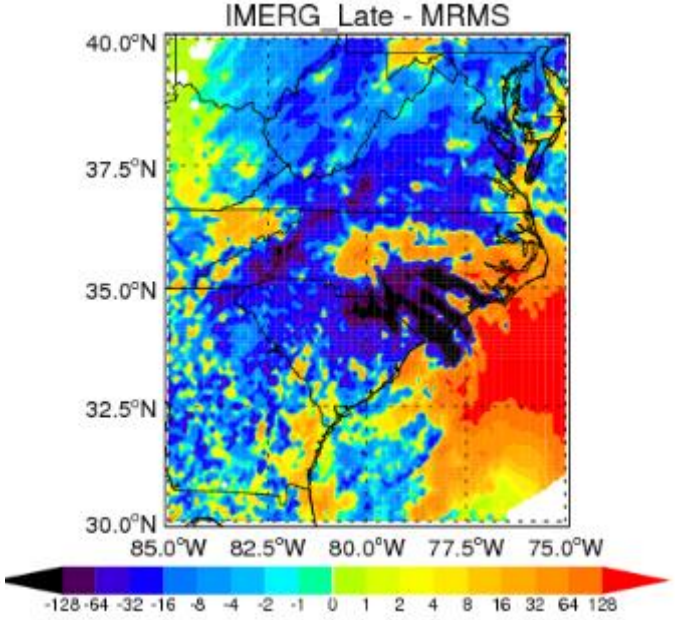






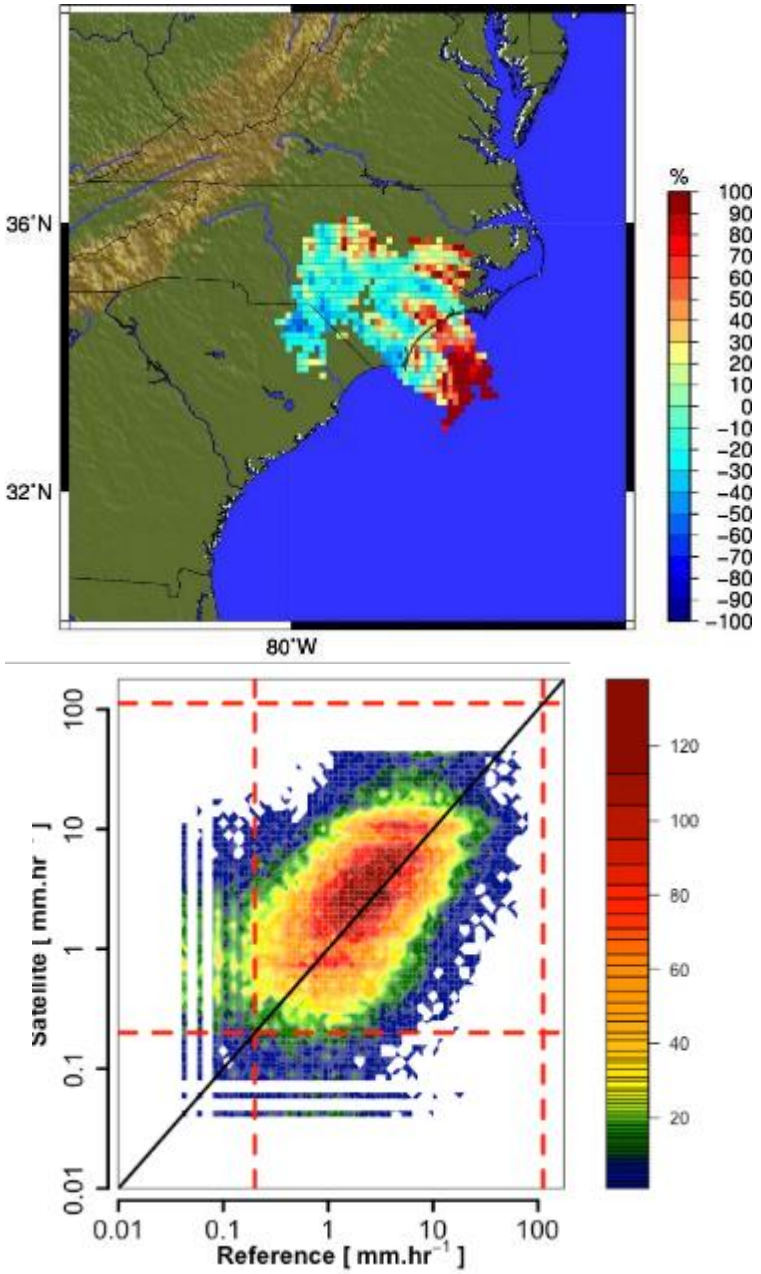




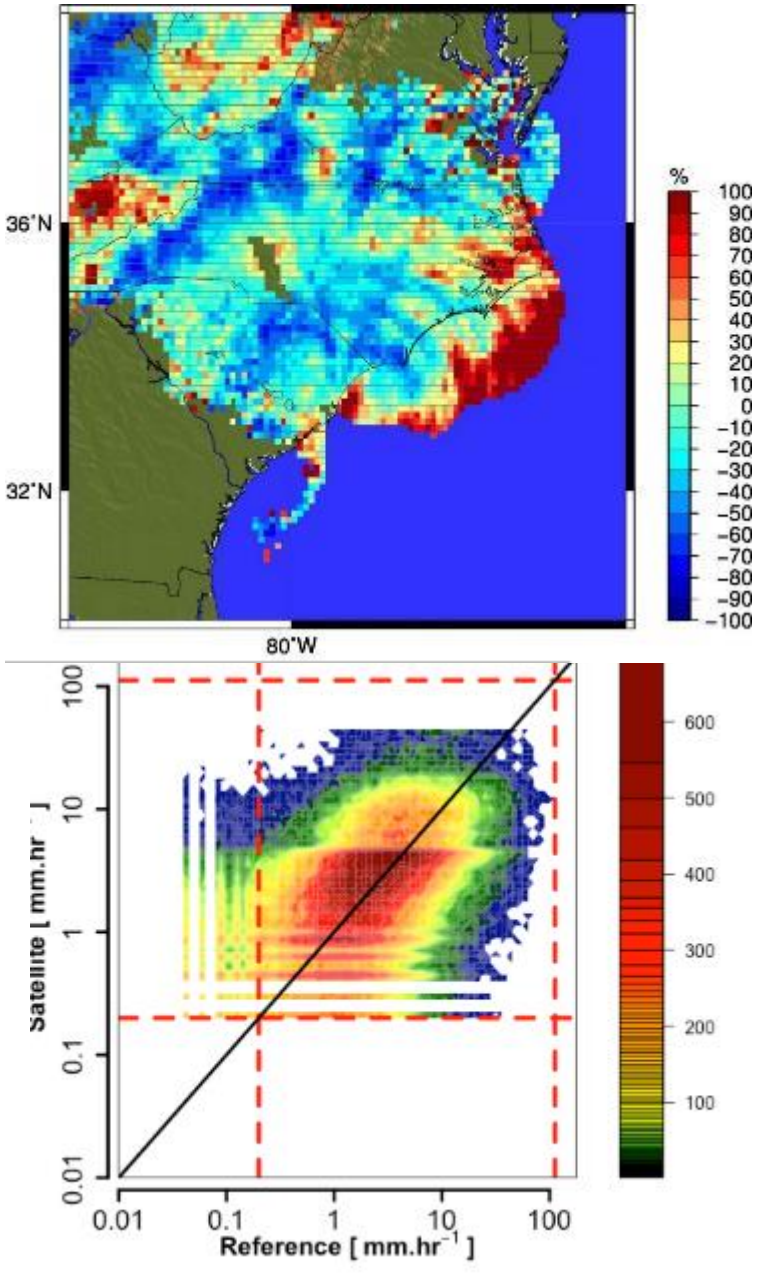


Relative Bias Components for Florence

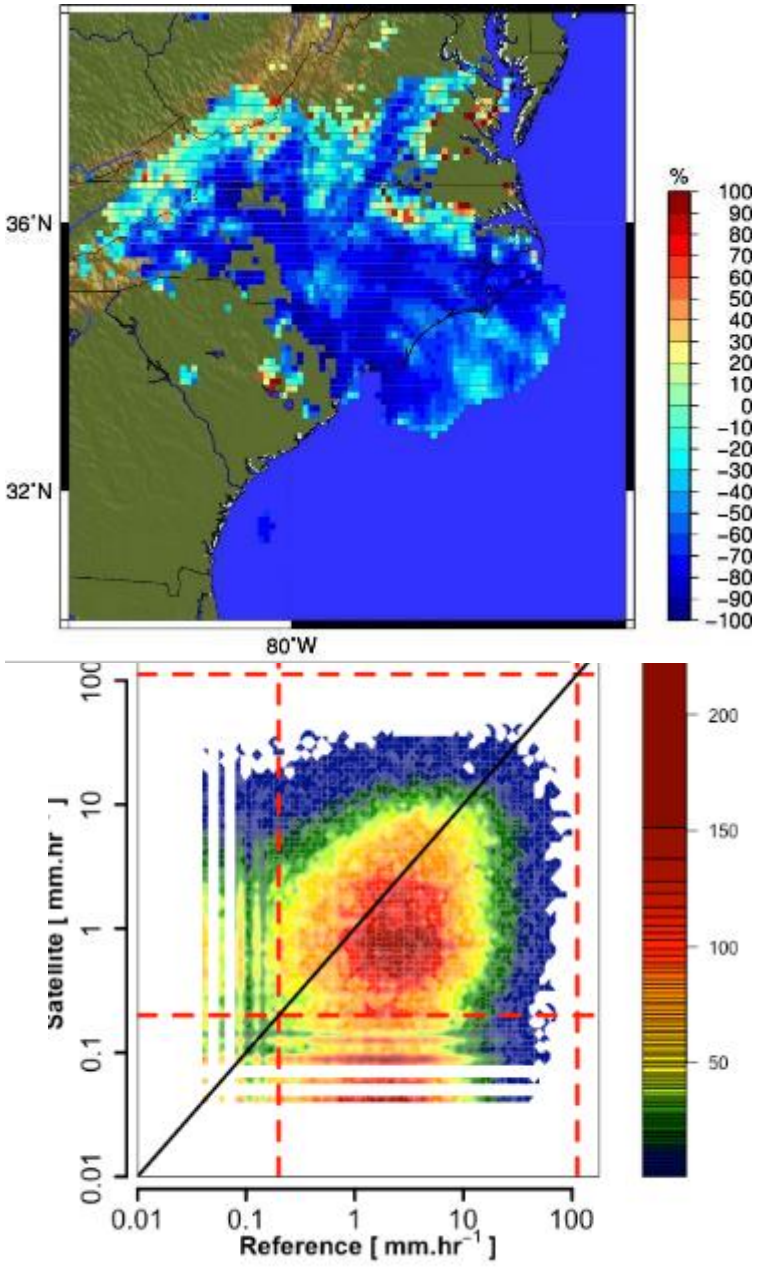
HQ (Microwave)



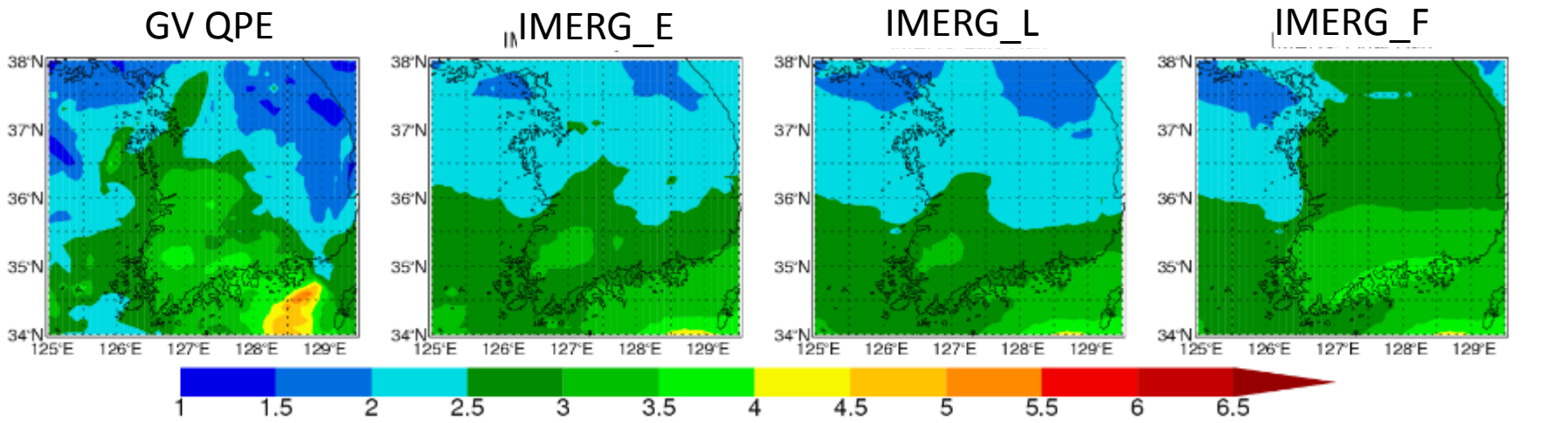
PrecipCal

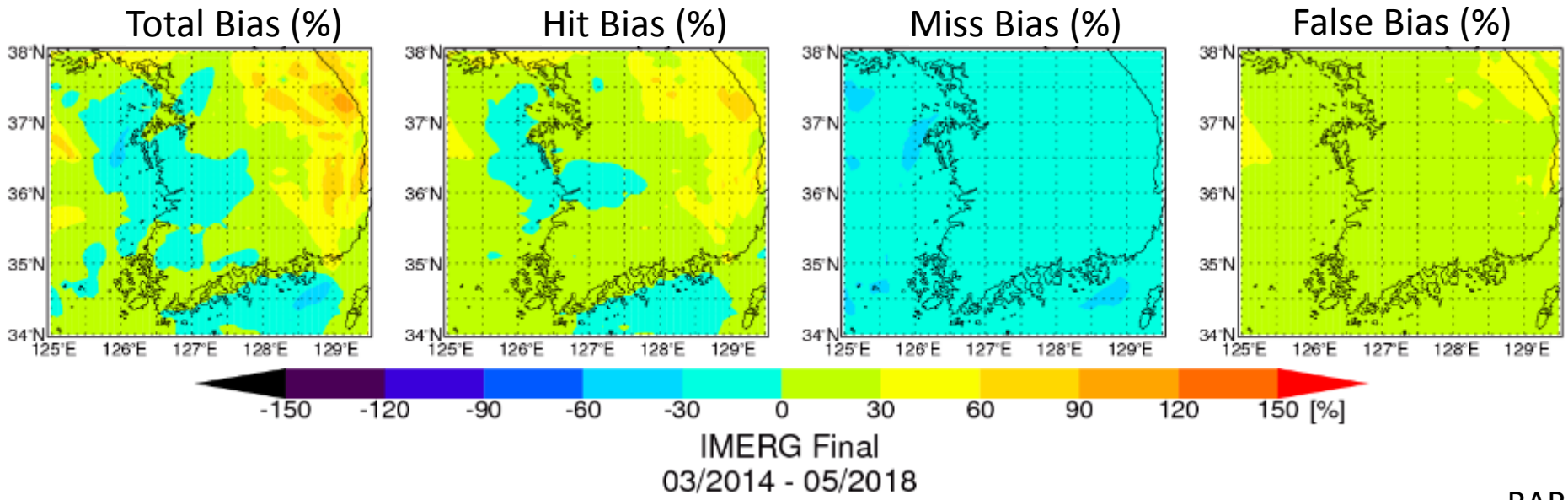


IR



Multi-Year IMERG Validation Over Korea Using KMA RAR: Error Components





Hit bias dominates total bias error with some contribution by false alarms

IMERG F (with GC correction) actual makes things a little worse…….

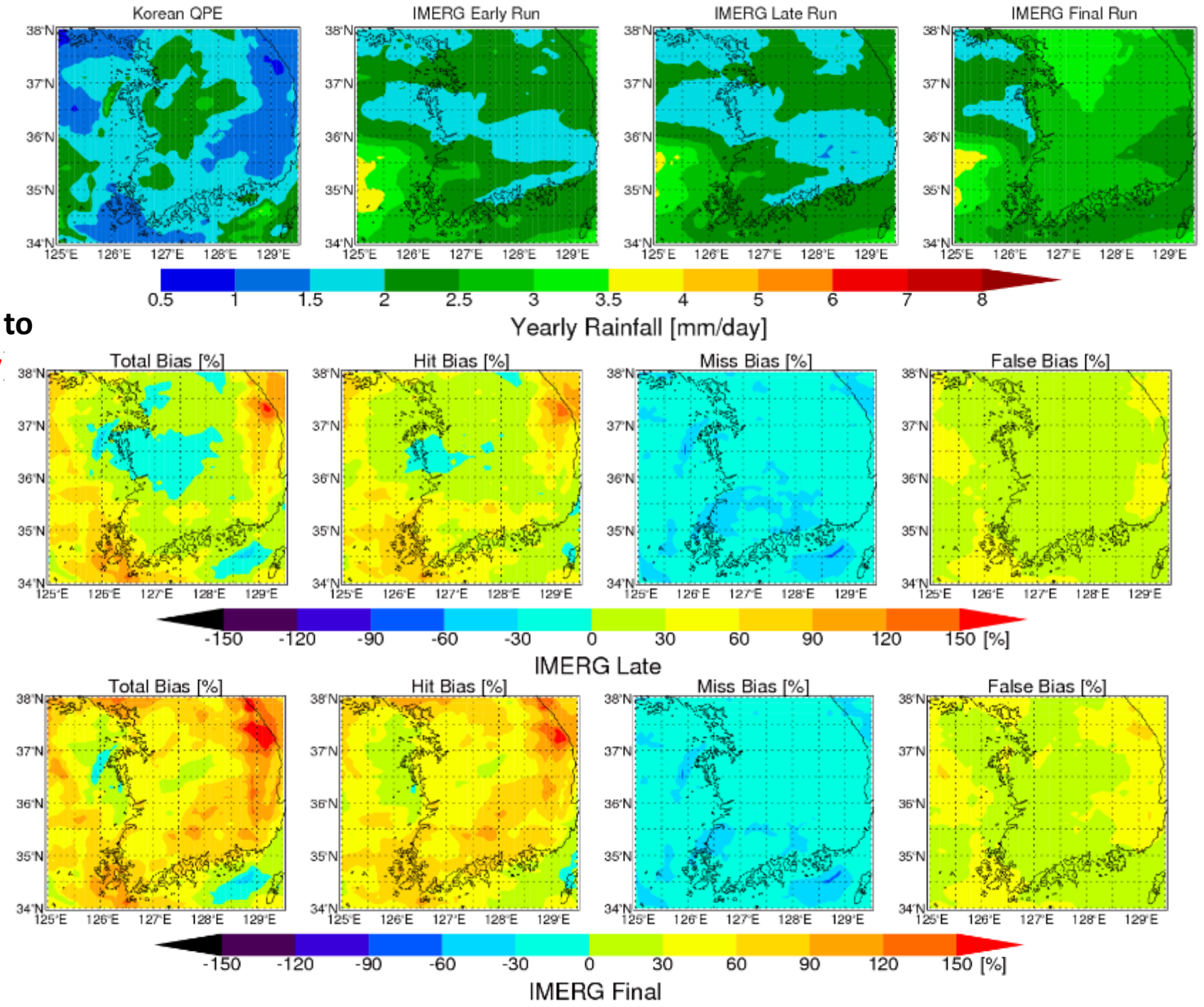
RAR Data kindly provided by Dr. G. Ryu, International PMM Science Team member

Strange Behavior 2017

2017 makes a significant contribution to the multi-year statistics (not sure why

Final makes things worse.

Big contributor is *HIT* bias



Diurnal Cycle Behavior of IMERG

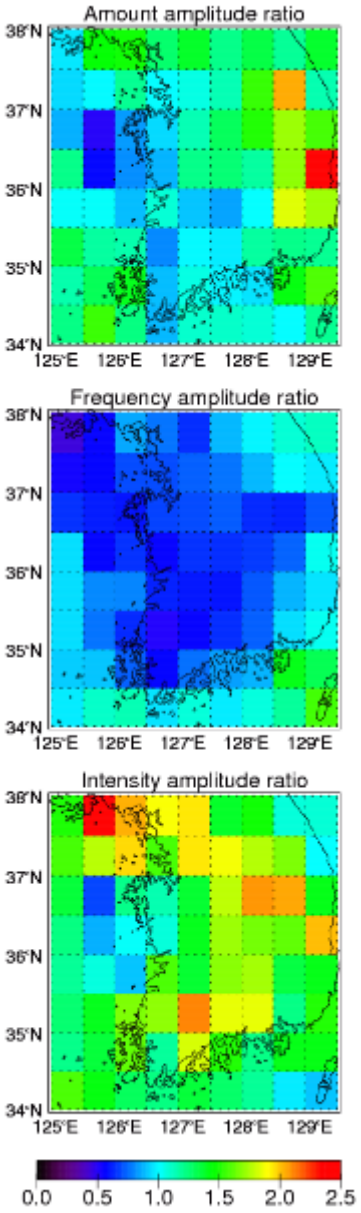
Diurnal Amplitude Ratio (IMERG/RAR)

IMERG/RAR(GV)

Amounts

Frequency

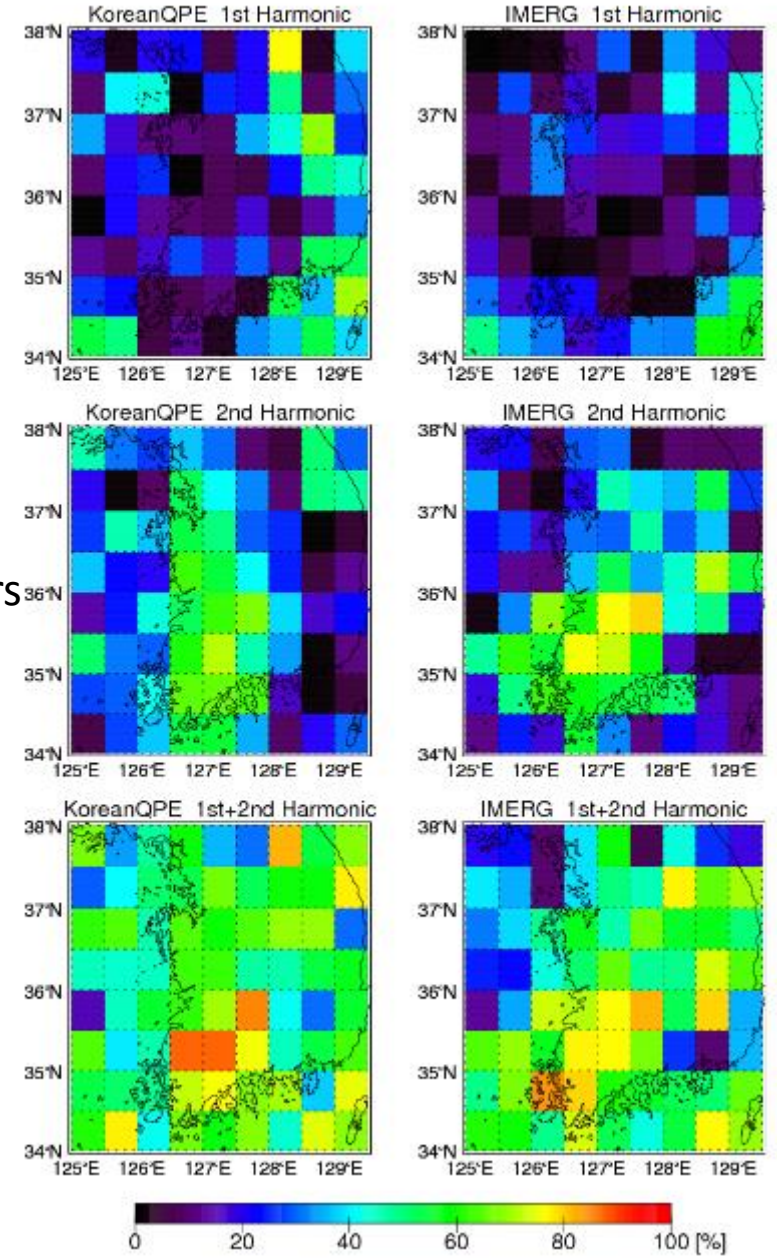
Intensity



% of Variance in S1 and S2

RAR

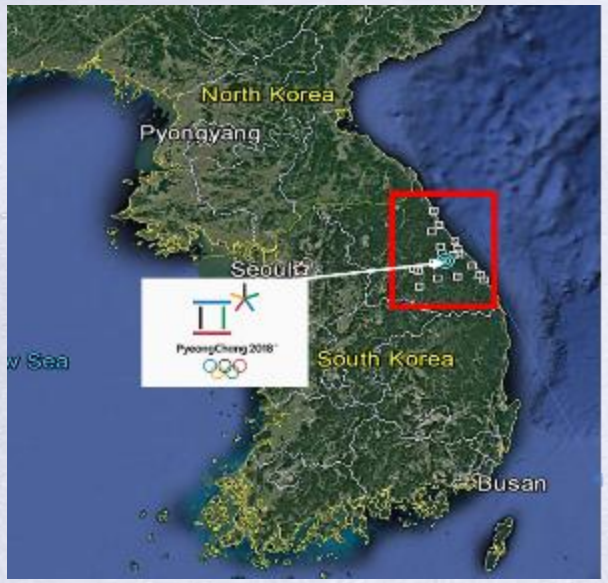
IMERG



Pattern may contribute to the bias and hence provide information on key regime/precip type contributors

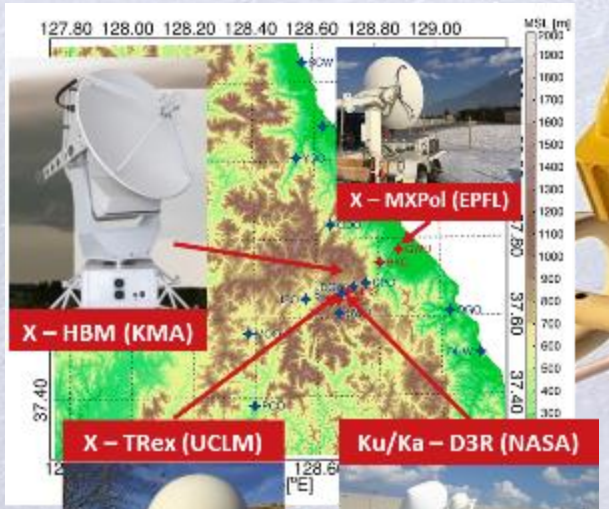
Work to be done.

ICE-POP 2018: Prediction *and* Observations for Mountain Snow



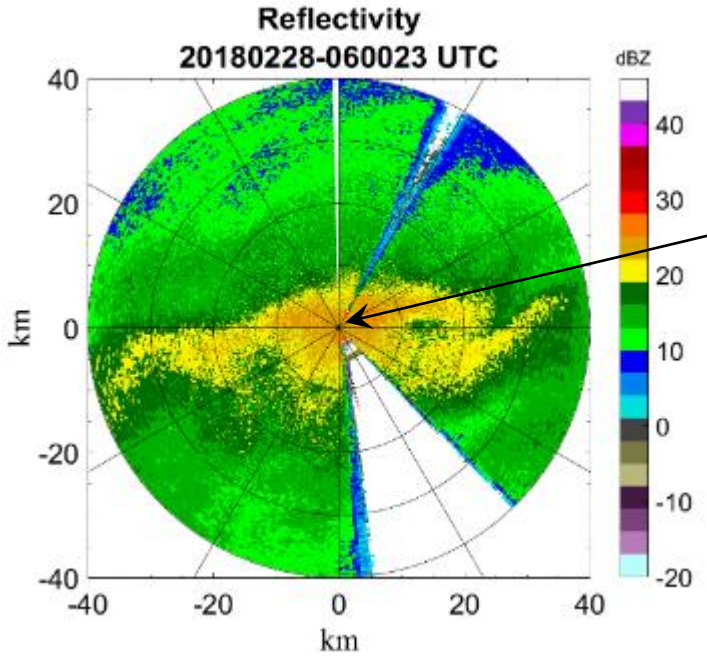
IOP: 2/18-4/18

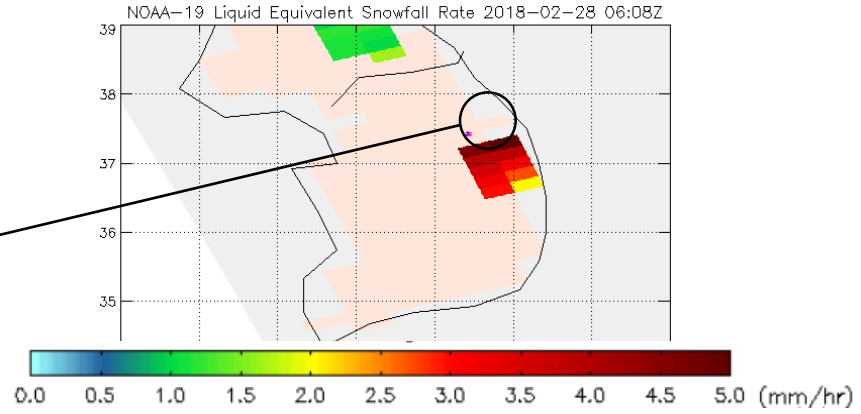
- **Good test of models and observations!**
  - **Numerous observational data types/sets moving from coast to the mountains. (rain, mix, snow)- nice D3R, PIP and disdrometer datasets! Data in QC/review.**
  - **Relatively small, but manageable number of cases- light to heavy snow.**
  - **Numerous *good* GPM overpasses- no DPR overpasses during precip.**
  - **Complex physics observed.**
  - **How consistent will satellites, ground observations and models be for QPE?**



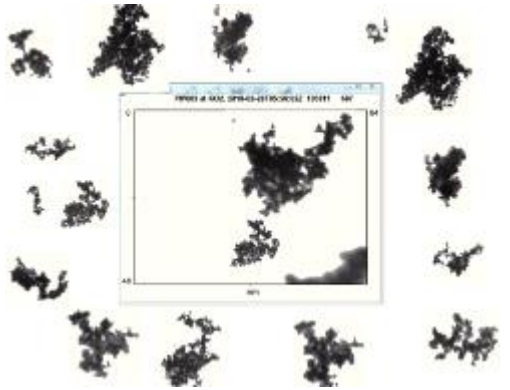
Acknowledgement: We are grateful to the KMA and WMO for making ICE-POP 2018 possible during the Olympic and Paralympic Winter Games PyeongChang2018

Physics: 28 Feb. 2018 Example (55 mm liquid; 45-60 cm snow depth



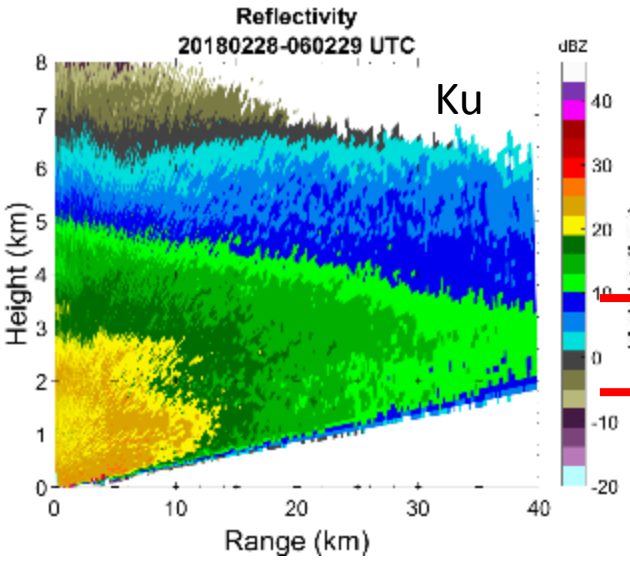


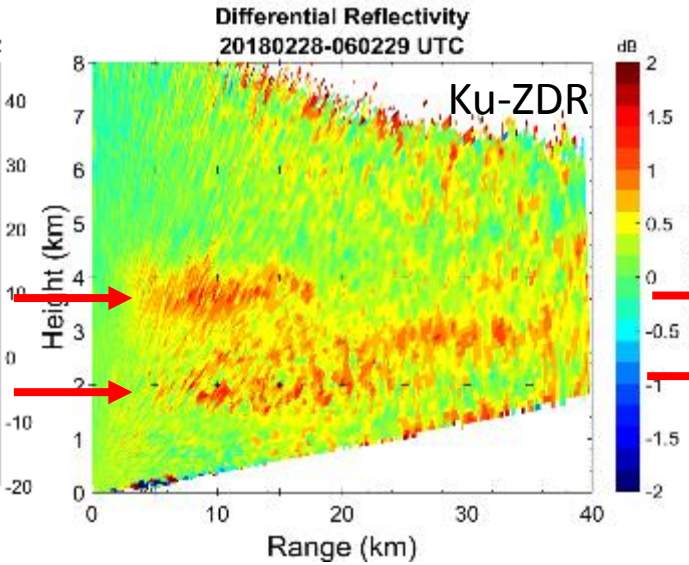
NESDIS SFR Algorithm (MHS; NOAA 19)
Snowfall rates consistent with KMA radar and PIP (4-6 mm/hr)- but south. (GFS- issue!)

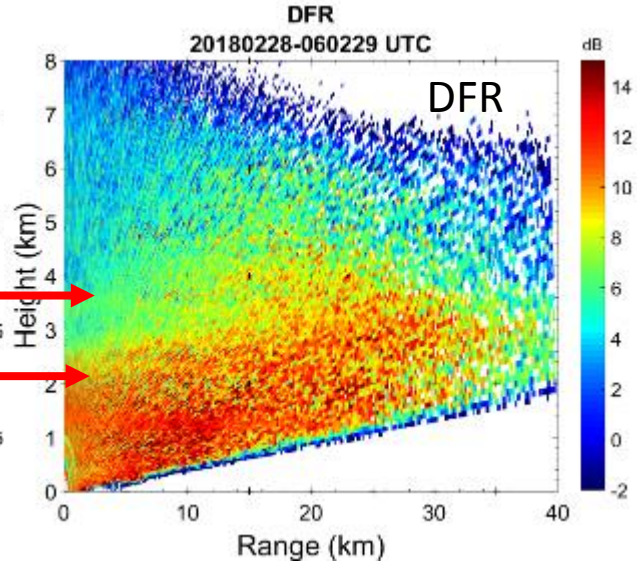


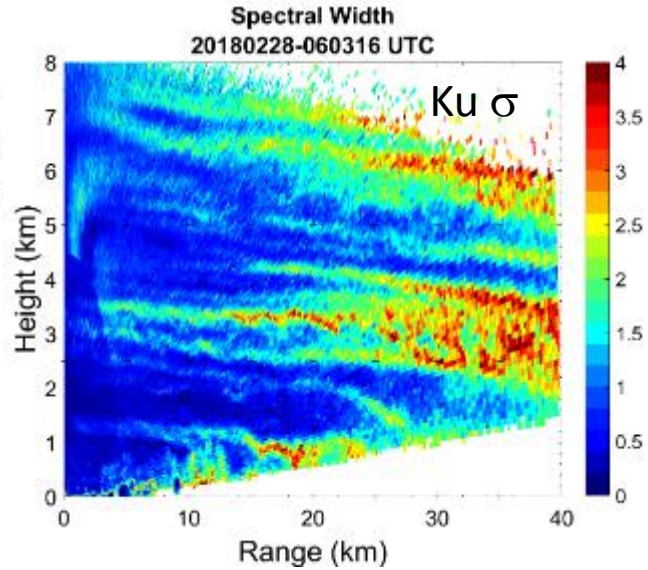
PIP 0556 UTC: Large Aggregates (largest ~2.5 mm)

D3R: Complex, turbulence-enhanced heavy snow event 2/28/18







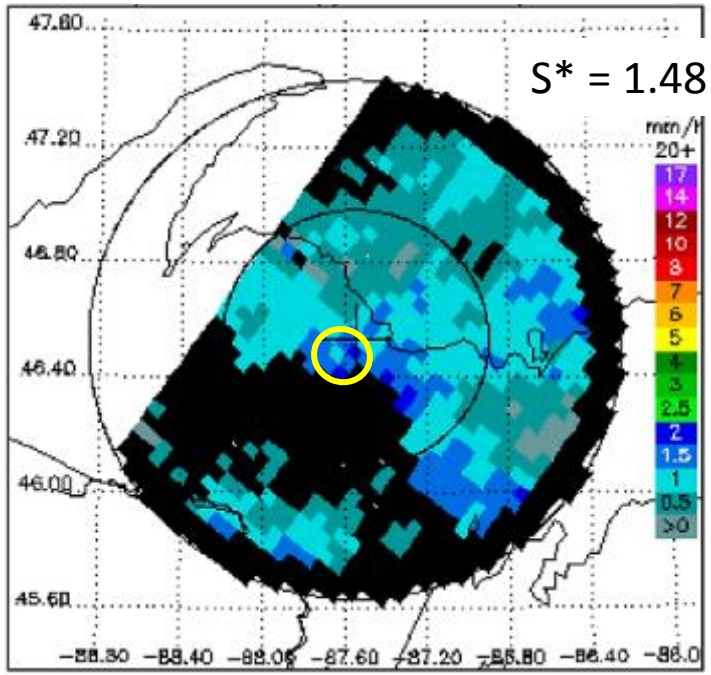


Expanding snow products……

Implementing Dual-Pol and PQPE SWER in VN Products
Testing against GPM GV - NWS Marquette Pluvio Gauge Network

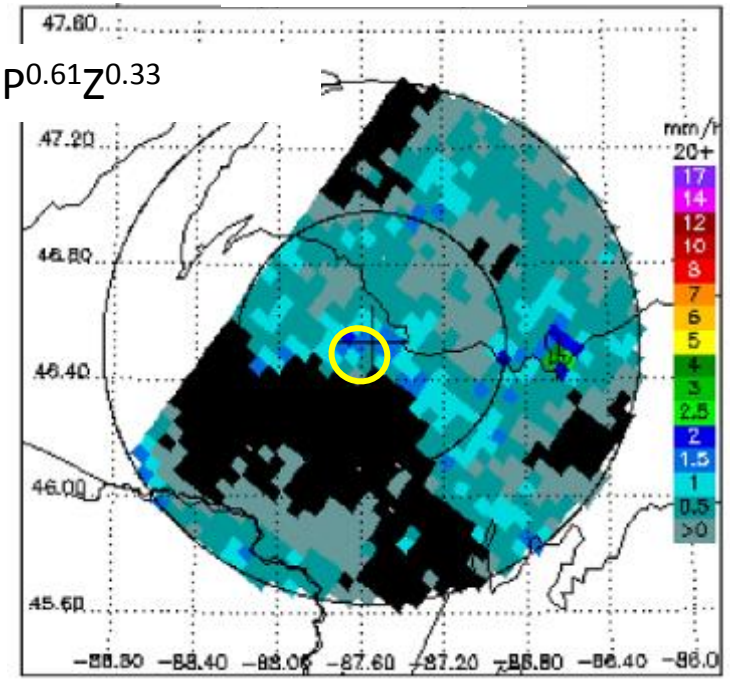
Example Case: April 15, 2018

KMQT SWE Dual-Pol



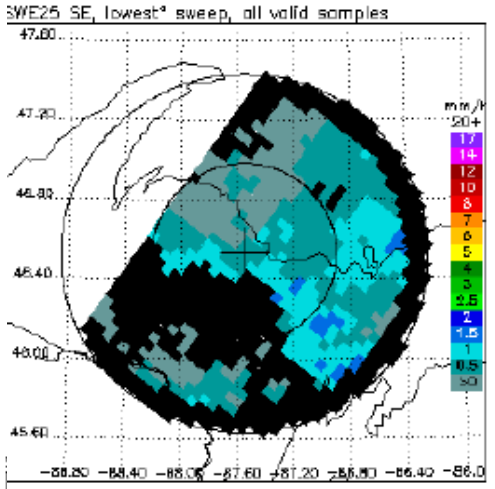
$S^* = 1.48 KDP^{0.61} Z^{0.33}$

DPR NS SWE



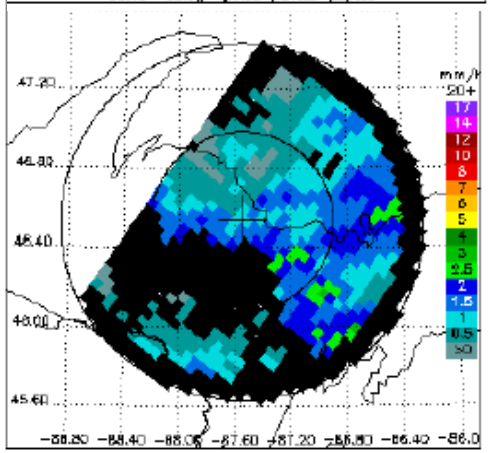
PQPE25 SWE

$Z=255\ S^{2.42}$



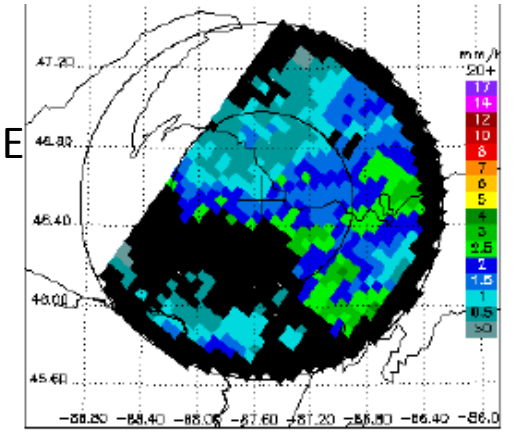
PQPE50 SWE

$Z = 59.5\ S^{2.57}$



PQPE75 SWE

$Z=33.3\ S^{2.58}$



Mean MQT Pluvio 400 Network 11(21) minute mean SWER):

Mean: 2.4 (2.4) mm/hr

Max: 3.2 (3.3) mm/hr

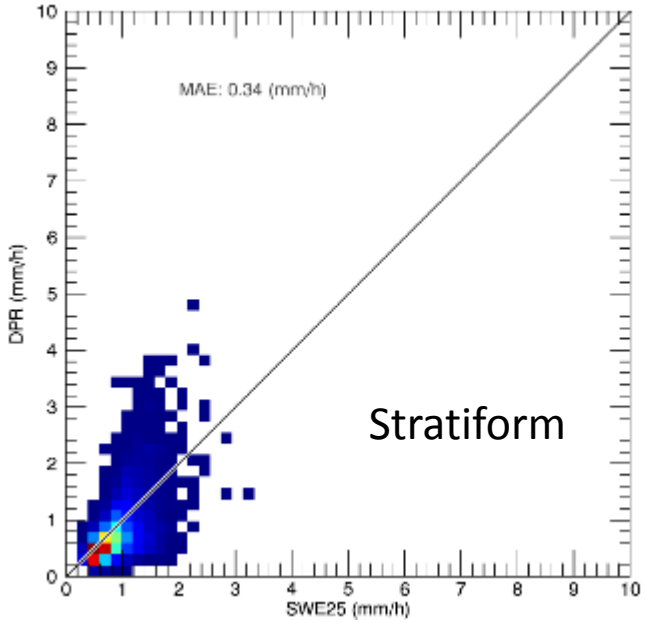
Min: 1.4 (1.4) mm/hr

Relative to Pluvio Network, DPR NS perhaps a little low;
Dual-pol, PQPE 50 and 75 are closer

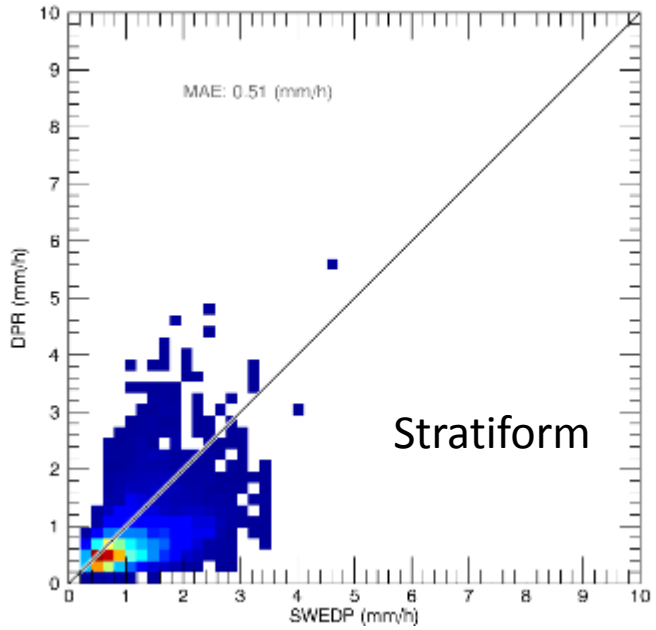
*Bukovčić and Rhyzhkov (2018)

VN Preliminary Results for DPR MS 2017/18. PQPE 25th%, DP Closest Match

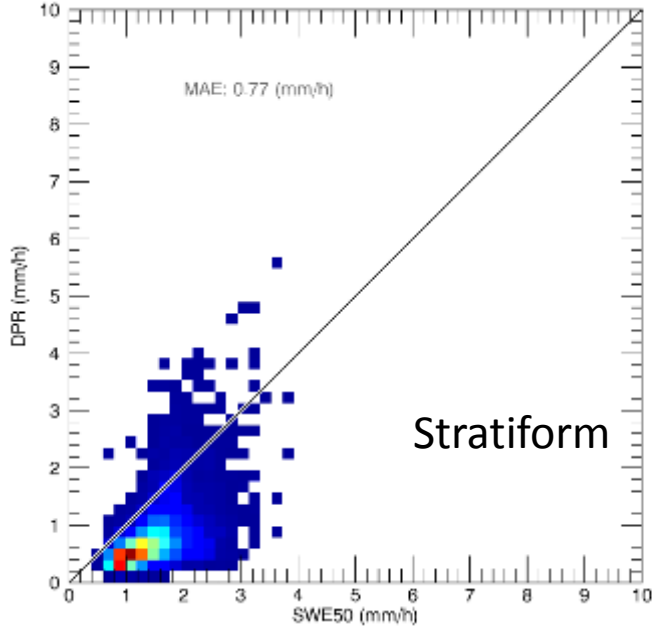
PQPE (25th %) SWE Rate

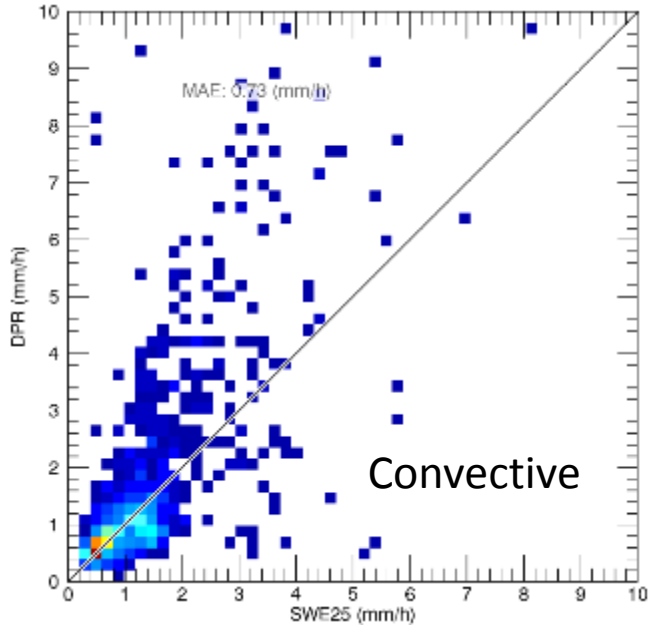


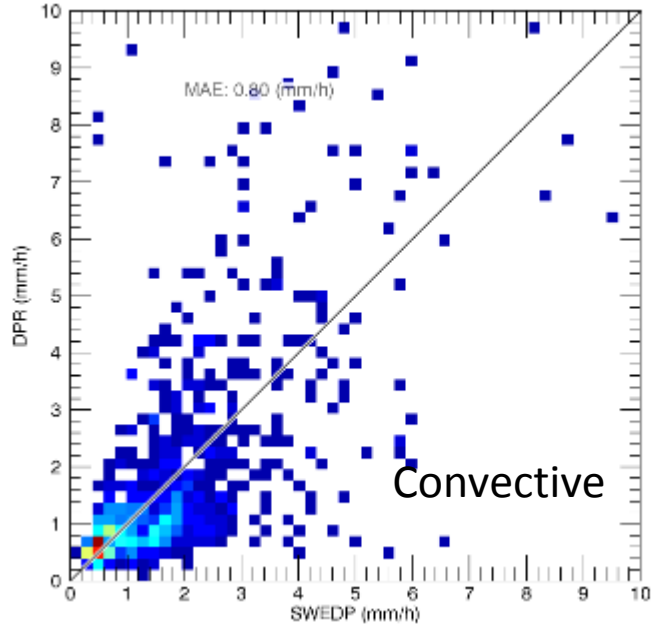
Dual-Pol (KDP,Z)* SWE Rate

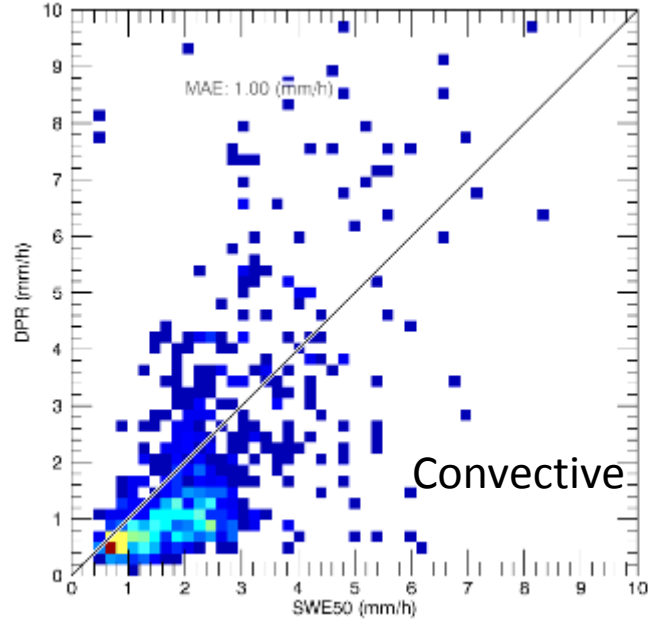


PQPE (50th %) SWE Rate





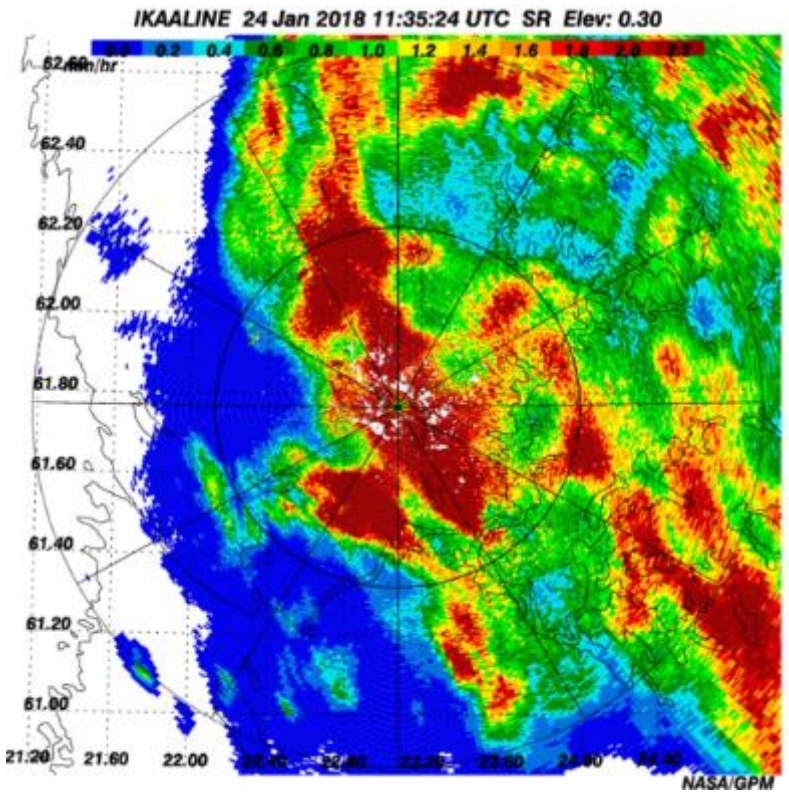




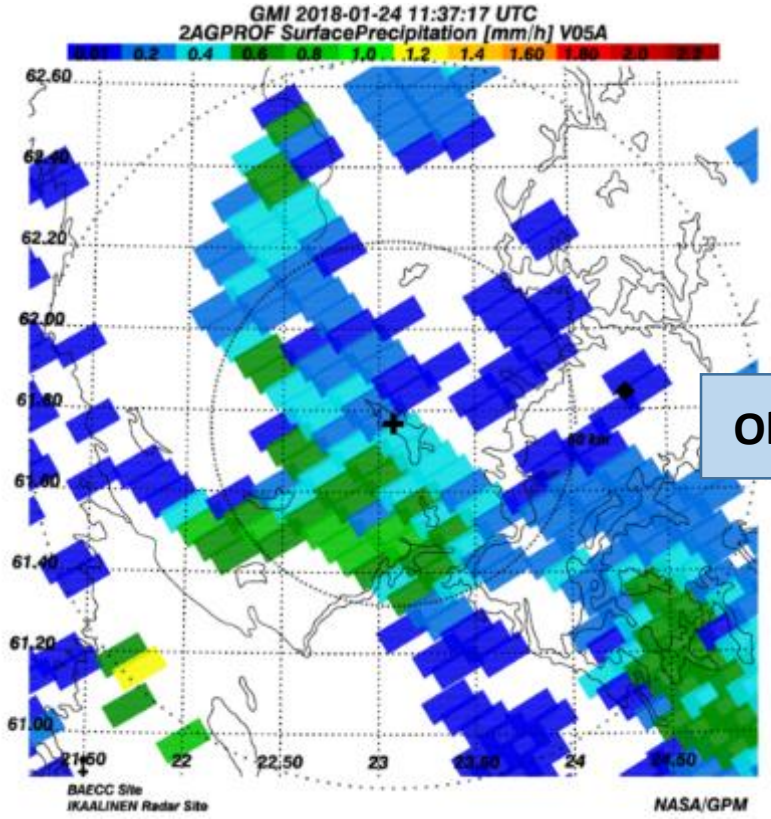
NASA GV, Finland (Moisseev, von Lerber), and ECCC (Hudak, Rodriguez) Collaboration on "tuned" SWE-Rate Maps

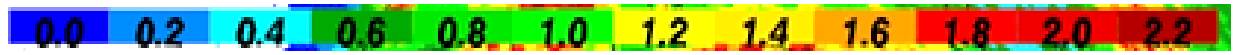
Finland 2016/2017, 2017/18 Case Analyses Underway and ECCC Cases at CARE Site for 2014 onward

IKA Radar Snowfall Rate



GMI GPROF Snowfall Rate

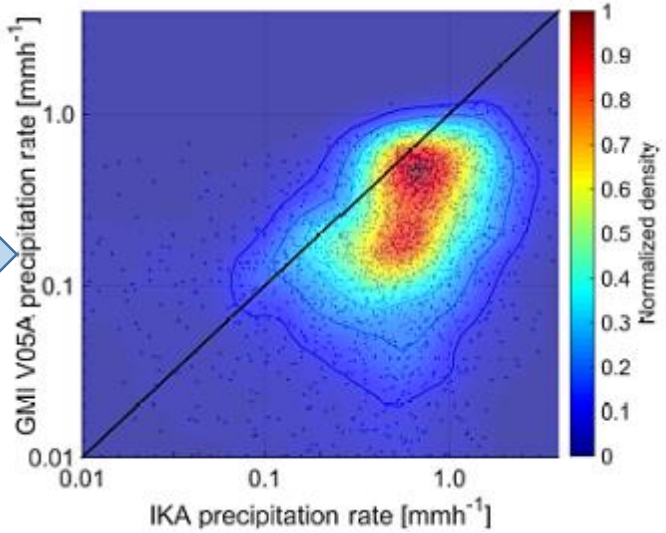




mm hr^{-1}

Objective

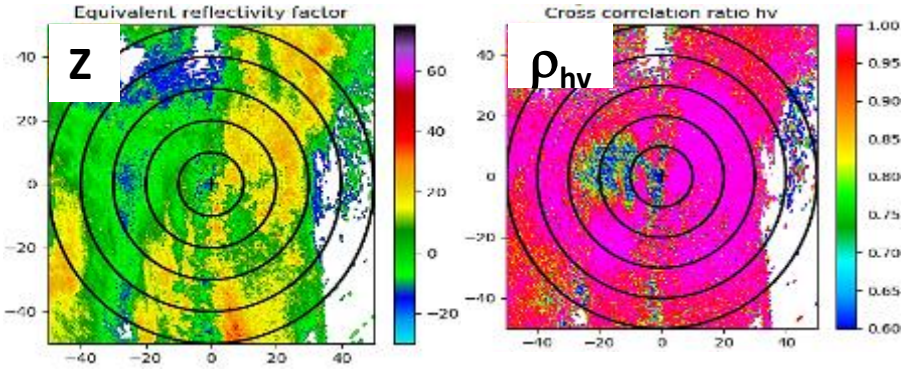
*GMI V5



Ikaalinen (IKA Radar) 1/24/2018; Numerous cases from 2016/17, 17/18 with multiple overpasses will be add to existing 2014-2016 gridded dataset*

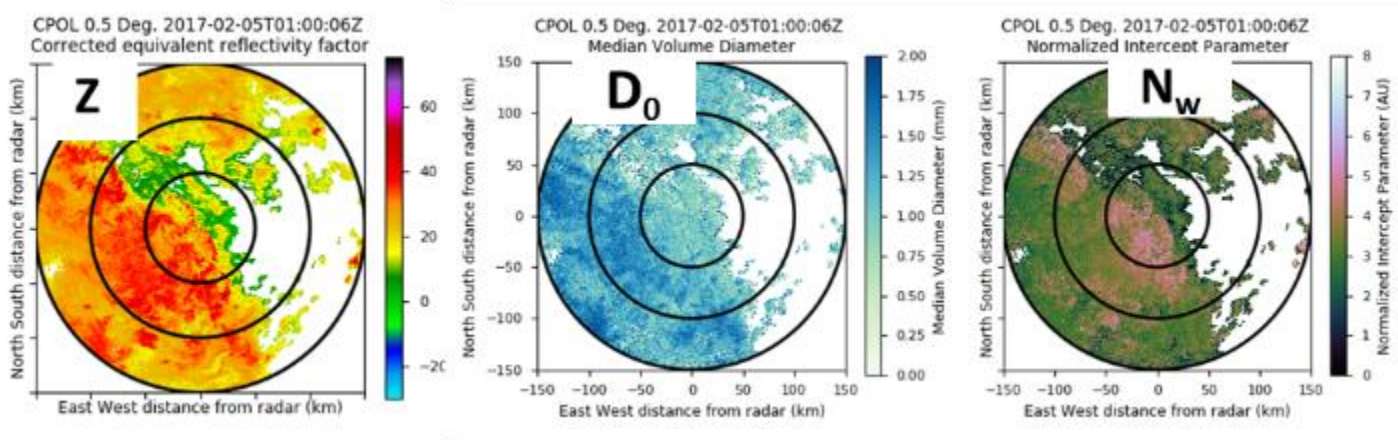
(*used to help verify improvements associated with change in algorithm for snow-covered surfaces in GPROF V5)

New Datasets in 2018



- **Netherlands dual-pol C-band** (VN radar; rain rates, DSD etc.)
  - Den Helder and Herwijgnen radars
  - Creating C-band HID, DSD, rain rate files- ingest to VN
  - Broader PMM collaboration (H. Leijnse- KNMI, R. Uilenhoet- U. Wagningen)

- **Darwin CPOL** 4-years of *reprocessed* data (working with Monash U., Australian BOM (collected data), and DOE ANL)
  - 19-yrs, C-Band dual-polarimetric, 10-min. cycle, volume scan, RHI and vertically pointing data.
  - Calibrated, attenuation-corrected moments hybrid rain rates, HID, DSD (D_0, N_w)
  - Radar files + two grids (1 km, 70km; 2 km, 150 km)
- Collaborators: S. Collis, ANL, V. Louf, A. Protat BOM



- **Meteo France La Reunion Island** (Dominque Faure, Olivier Bousquet; with help from P. Kirstetter)
  - S-band dual-pol radar data (VN network) and gridded rain rates (still working formats for pol data)
  - 2DVD DSDs (processed and ready)
- **IFloodS Rain Reference** (Contact- W. Krajewski, U. Iowa): Gridded radar/gauge rain composites (5) hourly, 500m - 4 km [Seo et al. 2018, accepted] Also on GHRC DAAC
- **ARS, NOAA; Walnut Gulch, AZ:**- Additional monsoon season of 2DVD DSDs, profiles and rain rates (e.g., Tan et al., 2018).

SUMMARY

- V6 DPR/CMB similar performance to V5 for DPR/Combined products……..
- But….Moving forward from V6; V7- need more parameter-controlled algorithm validation- e.g., aspects of DSD parms examined with PIA and markers for NUBF/MS in convection, over orography, etc.- traced to impacts (rain rate); get the right answer for right reason.
- Expanding focus placed on IMERG product validation and trace back (location/dataset, event types- e.g., extreme events, estimator driven)
- Complete extended/new VN (dual-pol, PQPE) and case-based approaches to snow GV datasets for enhancing/building products. Expanded development of field and partner contributions (ICE-POP, Marquette network, Finland, ECCC etc.)
- Regimes: New large radar datasets from Netherlands, Maritime Continent, La Reunion coming on line.

***Acknowledgements*: D. Wolff, P. Kirstetter, J. Wang, D. Marks, A. Tokay, L. P. Addario, T. Berendes, J. Case, and the GV Team.**