An Update on NOAA Operational Precipitation Products and NOAA's Contributions to the PMM Science Team

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[1]NOAA/NESDIS/STAR; [2]NOAA/NWS/NCEP/CPC

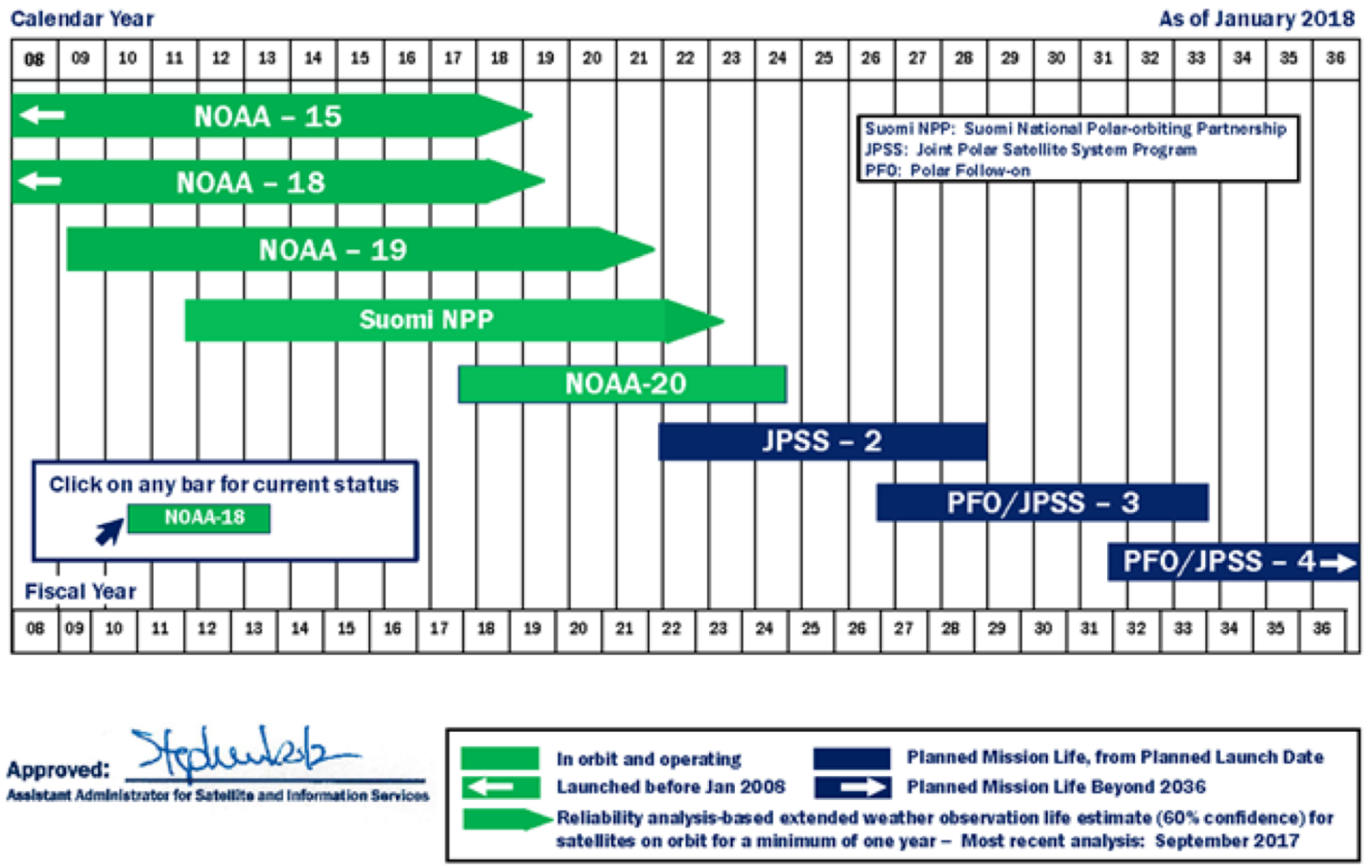
College Park, MD

Includes contributions by other PI's and affiliates on the NOAA PMM Science Team

Outline

- Status of NOAA Satellites
- Status of NESDIS Operational Products/use of GPM
- Example uses & validation – Florence Focus
- NOAA contributions to PMM Science Team
  - Joint accomplishments during the past year
  - Plans for upcoming 3-years
- GOES Lightning Mapper and synergies with MW

LEO Satellites

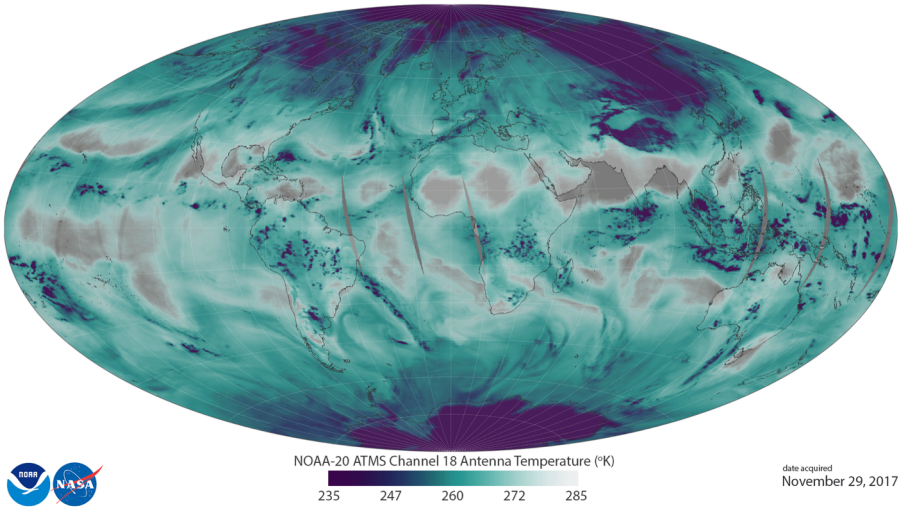


We also exploit MetOp; DMSP; GPM; GCOM-W1; M-T

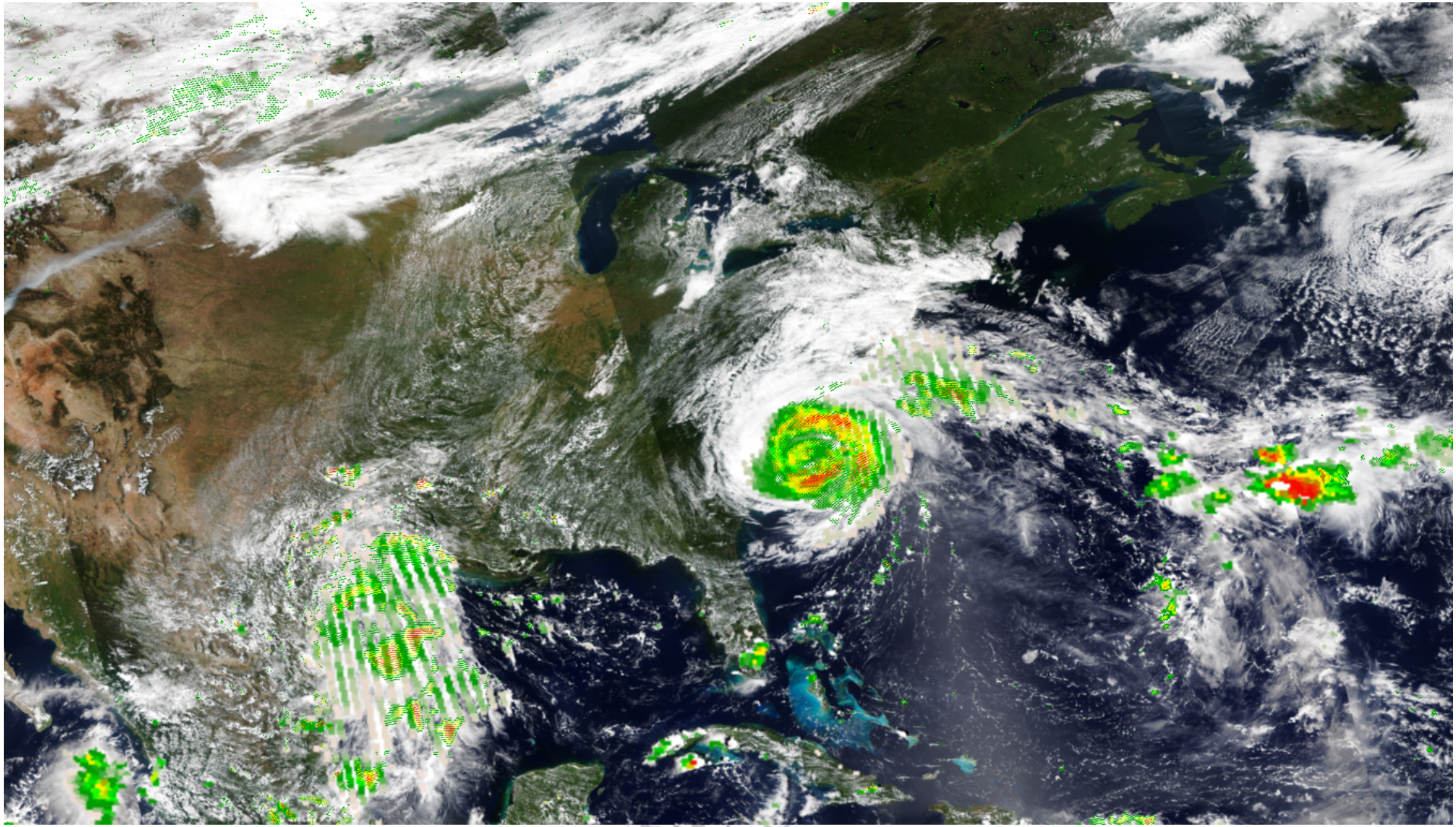
Update on Satellites - JPSS

- S-NPP
  - Still in pretty good shape, a few anomalies but these are being dealt with and no real major impact to operations

- JPSS-1 launched on 11/18/17
  - Officially called NOAA-20
  - Orbit ~30 min after S-NPP
    - Opportunities for synergies
  - Most SDR's and EDR's reached provisional maturity in Jan-Feb 2018, now moving forward towards full maturity



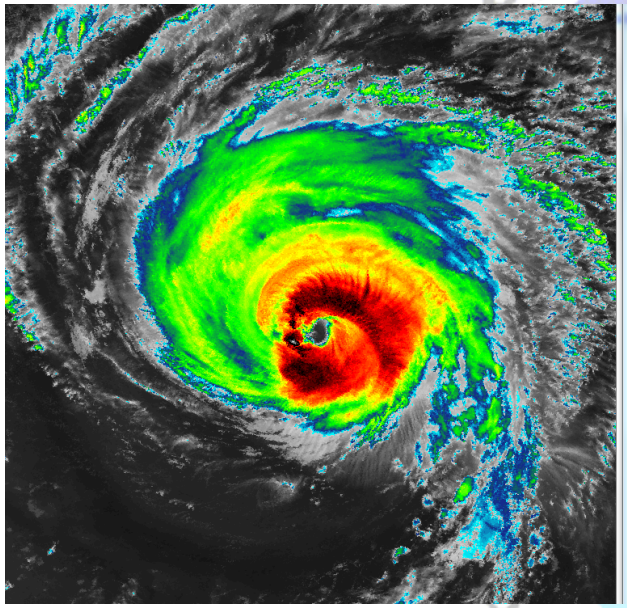
N-20 VIIRS and ATMS/MiRS Rain Rates



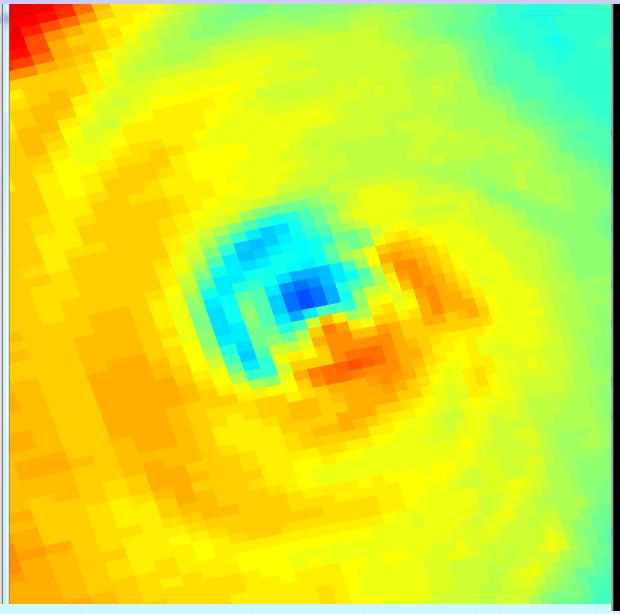
N-20 VIIRS, ATMS, MiRS

P. Meyers – CICS-M

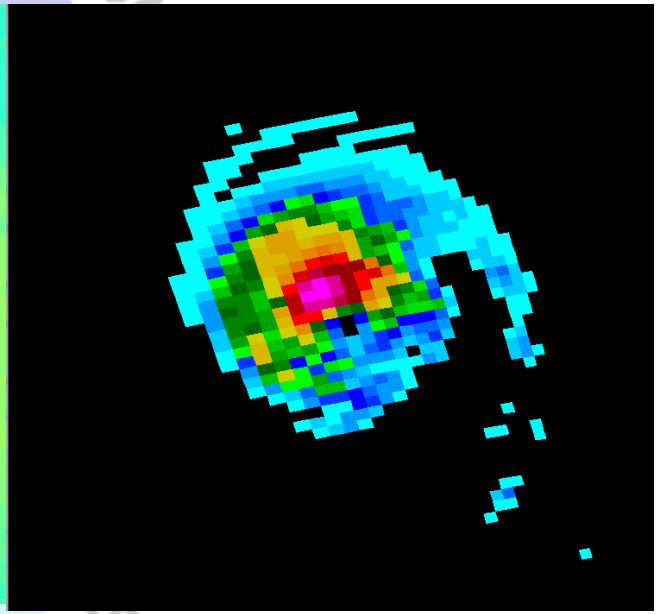
Color enhanced IR



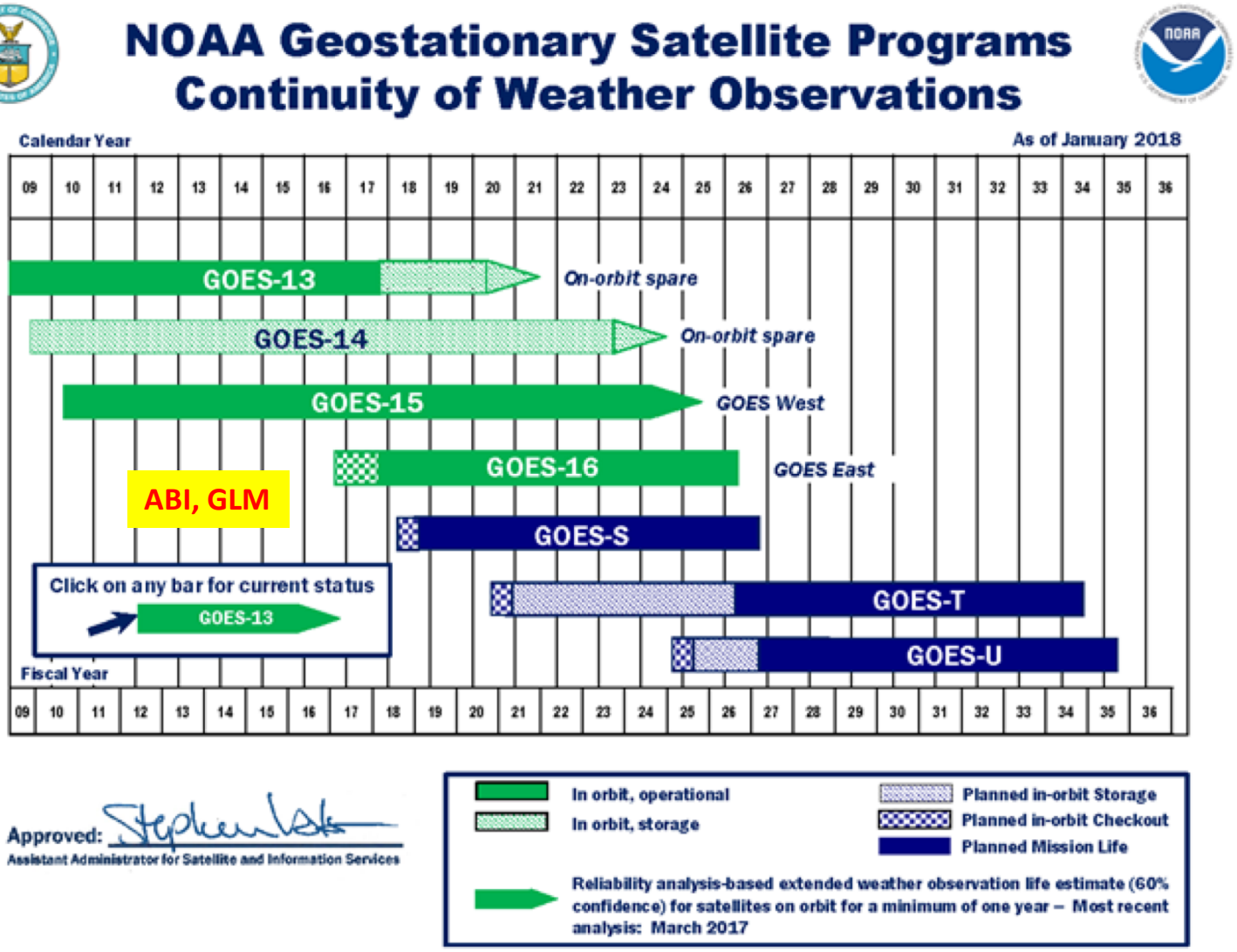
ATMS 183±1



Rain Rates



GEO Satellites

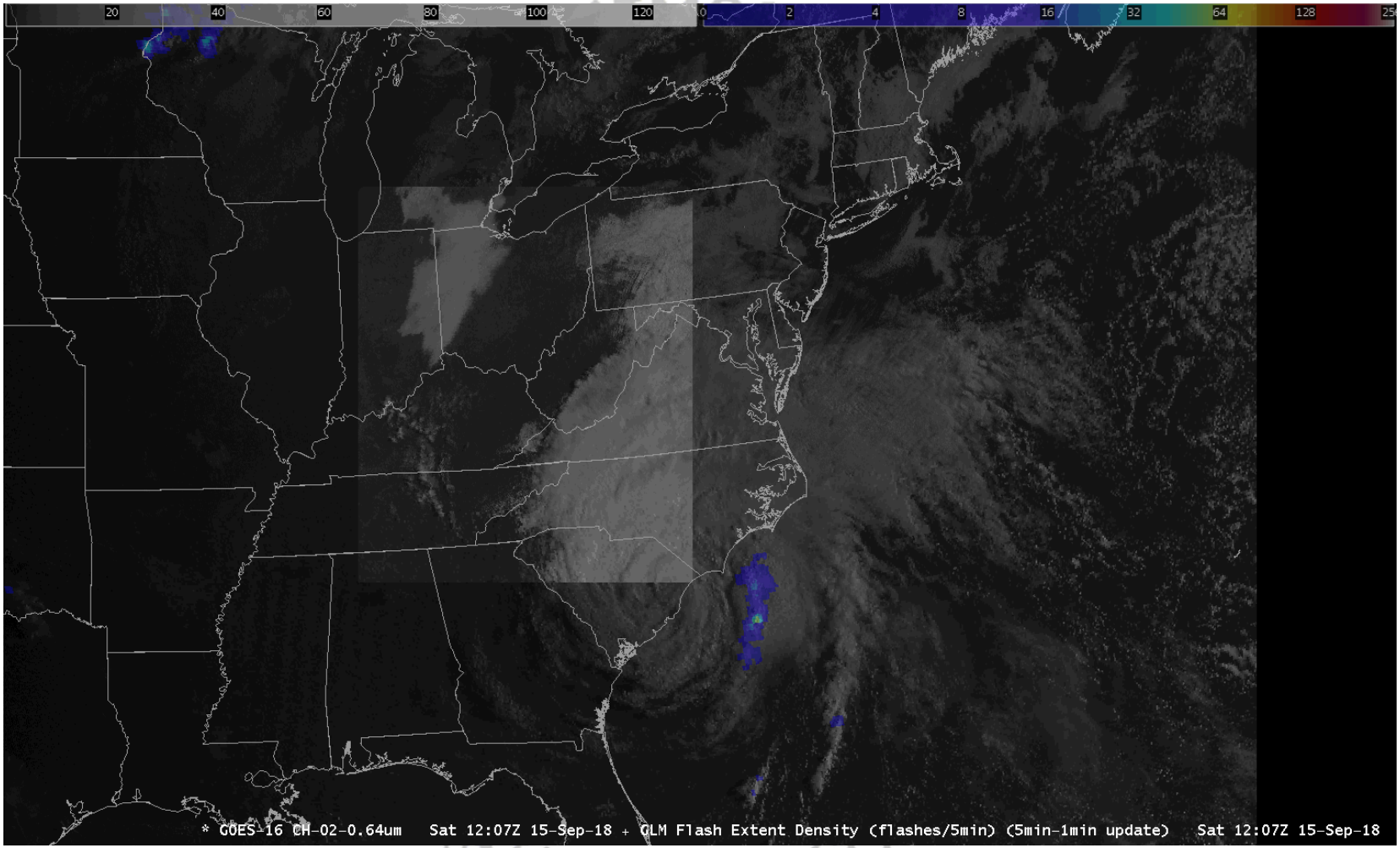


Update on Satellites - GOES

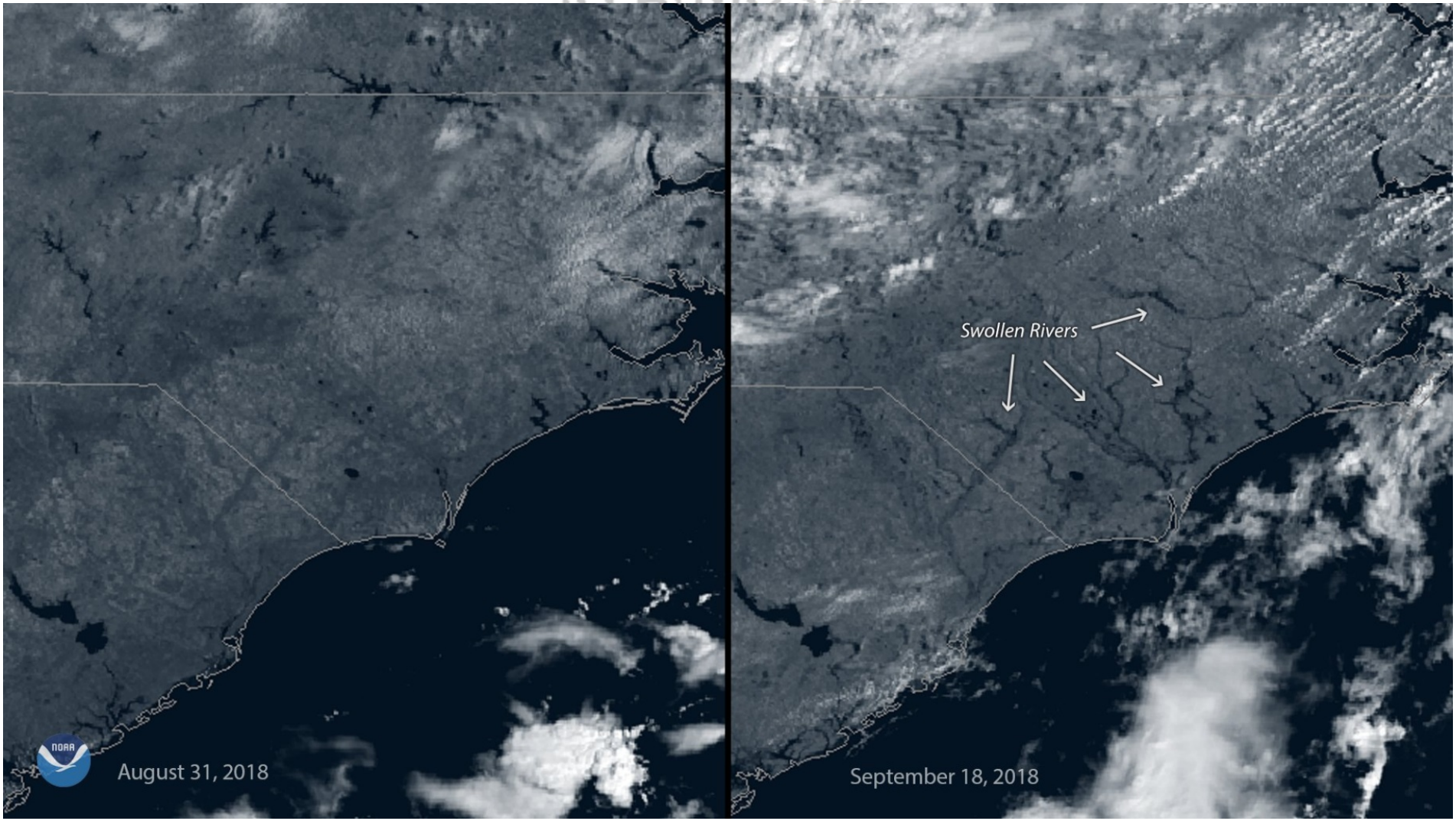
- GOES-16
  - Most products are now operational
  - GLM has reached operational status
  - Moved to GOES-East position (75.2 W) on Dec. 11, 2017; operational on Dec. 18

- GOES-17
  - Launched 3/1/18
  - Moving to GOES-West position (137 W) by late October
  - Will operate in tandem with GOES-15 for ~ 6 months
  - ABI sensor having radiator issues
    - Mainly impacts near-IR channels and when out of sun
    - Mitigation plans are being developed, including use of Himawari to support NOAA operations

GOES-16 ABI and GLM

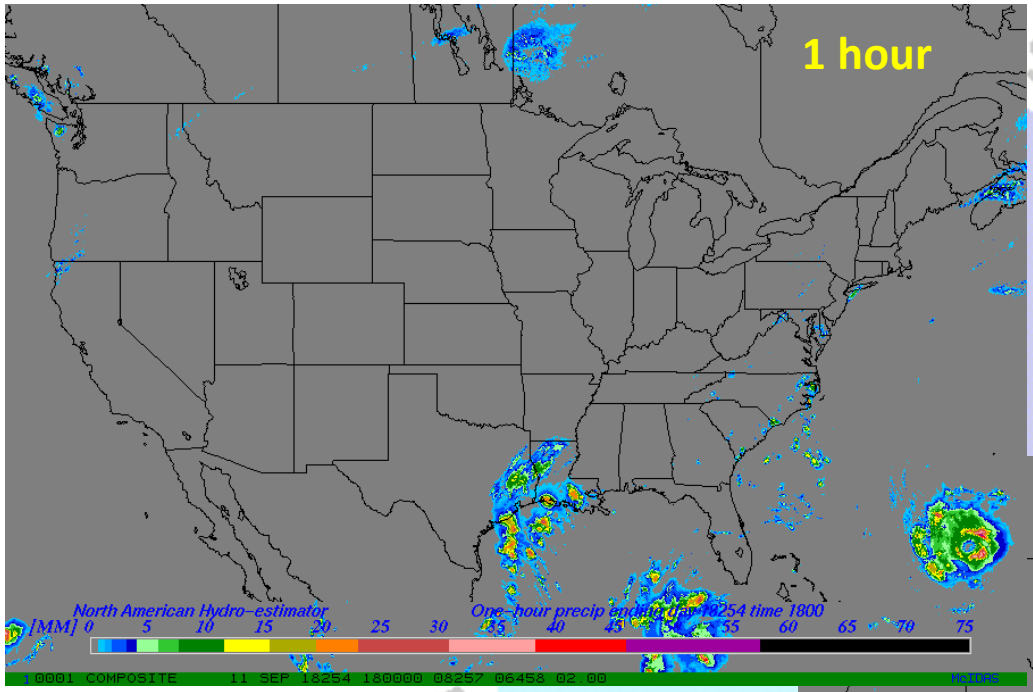


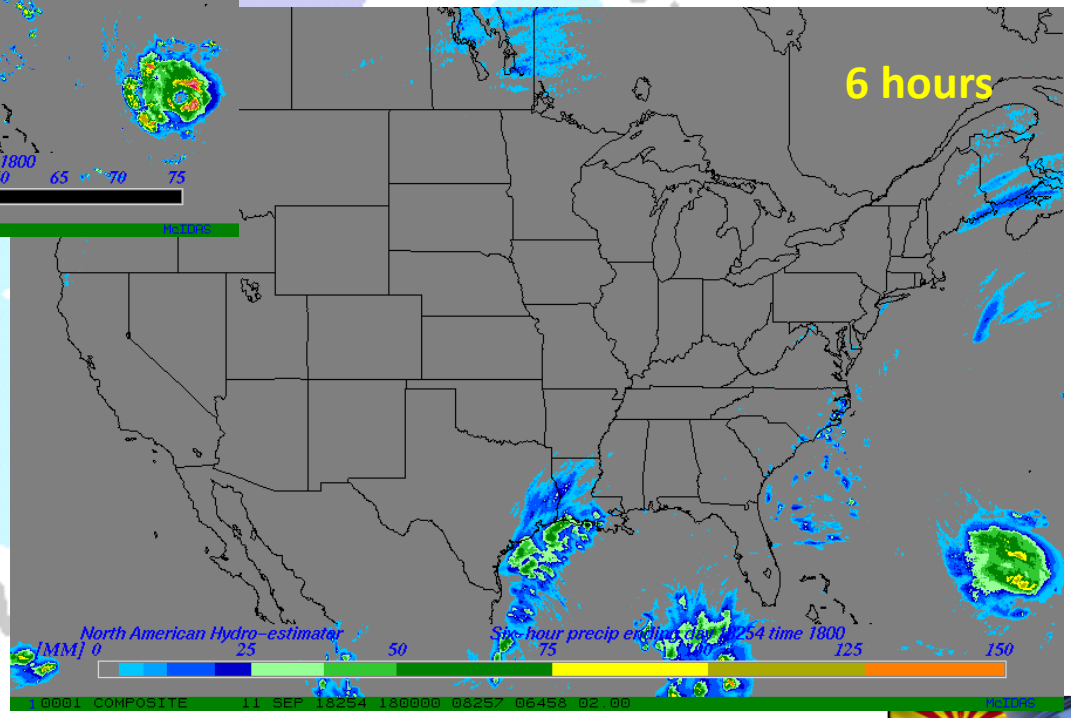
GOES-16 ABI



GOES-16 Rain Rates

Limin Zhao, NESDIS/OSPO





Primary Operational Product Systems

(Support S-NPP, NOAA-20, GPM, GCOM, POES, DMSP, MetOp, M-T)

- **Microwave Integrated Retrieval System (MiRS)**
  - http://www.ospo.noaa.gov/Products/atmosphere/mirs/index.html
- **Microwave Snowfall Rate (SFR)** ★
  - http://www.ospo.noaa.gov/Products/atmosphere/mirs/index.html
- **NOAA Operational GCOM-W1 AMSR2 Products System (NOGAPS)** ★
  - http://www.ospo.noaa.gov/Products/atmosphere/gpds/
- **NESDIS Operational Soil Moisture Products (SMOPS)**
  - http://www.ospo.noaa.gov/Products/land/smops/index.html
- **Blended TPW/RR (bTPW/bRR)** ★
  - http://www.ospo.noaa.gov/Products/atmosphere/brr/
- **Ensemble Tropical Rainfall Predcition (eTRaP)**
  - http://www.ssd.noaa.gov/PS/TROP/etrap.html

NESDIS Operational Snowfall Rates (SFR)

SNOWFALL RATES FROM SATELLITE DATA HELP WEATHER FORECASTERS

By Ralph Ferraro, Huan Meng, Brad Zavodsky, Sheldon Kusselson, Deirdre Kann, Brian Guyer, Aaron Jacobs, Sarah Perfater, Michael Folmer, Jun Dong, Cezar Kongoli, Banghua Yan, Nai-Yu Wang, and Limin Zhao

In the early morning hours of 28 January 2014, satellite data showed snow accumulating in the clouds over Birmingham, Ala., but weather forecasters predicted only a light dusting of snow for the day ahead. Over the course of the next several hours, snow began to fall—and kept on falling. Although the area got only a couple of inches of snow, it was enough to bring this southern city to a standstill. Commuters abandoned their cars on freeways and spent the night in office buildings and shopping centers. Children slept in classrooms and day care centers because their parents could not come to bring them home.

Rainfall rates derived from satellite data have a long legacy in operational weather forecasting because their information complements ground observations such as weather

A new data product calculates snowfall rates from weather data beamed directly from several satellites, helping meteorologists provide fast, accurate weather reports and forecasts.

AP Photo/Butch Dill

August 2018 Earth & Space Science News Eos.org // 19

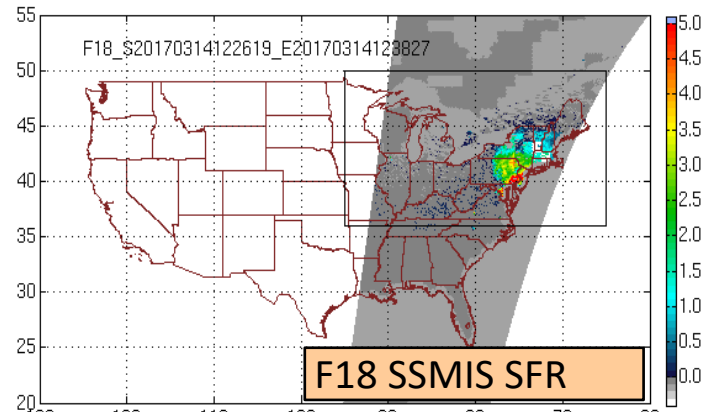
Ferraro, R., Meng, H., et al. (2018), Snowfall rates from satellite data help weather forecasters, Eos, 99, https://doi.org/10.1029/2018EO096715 . Published on 23 April 2018.

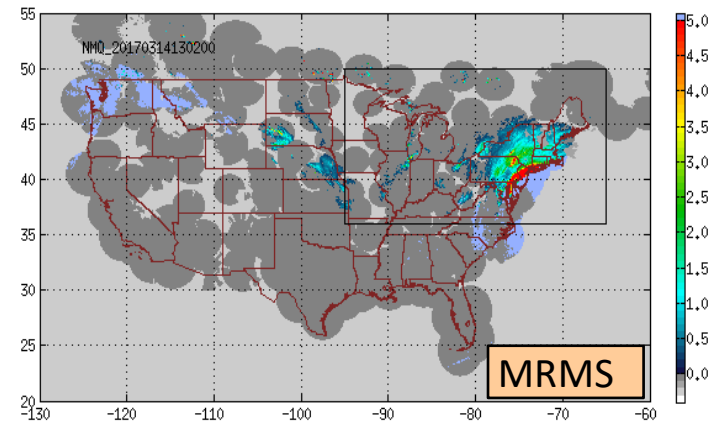
Enhancement of NOAA Operational Snowfall Rate (SFR) Product for GPM Constellation Satellites

Huan Meng, NESDIS/STAR

- **SSMIS Land SFR**
  - ✓ F16, F17, and F18; three satellites to improve SFR temporal resolution
  - ✓ Logistic regression snowfall detection (SD) model; under further development
  - ✓ 1DVAR-based snowfall rate algorithm
  - ✓ Separate algorithm for each satellite due to failed channels and different sensor characteristics
  - ✓ ATMS and MHS SFR outperform SSMIS SFR

	Corr Coeff	Bias (mm/hr)	RMS (mm/hr)
F16	0.44	0.01	0.94
F17	0.56	-0.11	0.88
F18	0.42	-0.06	0.91



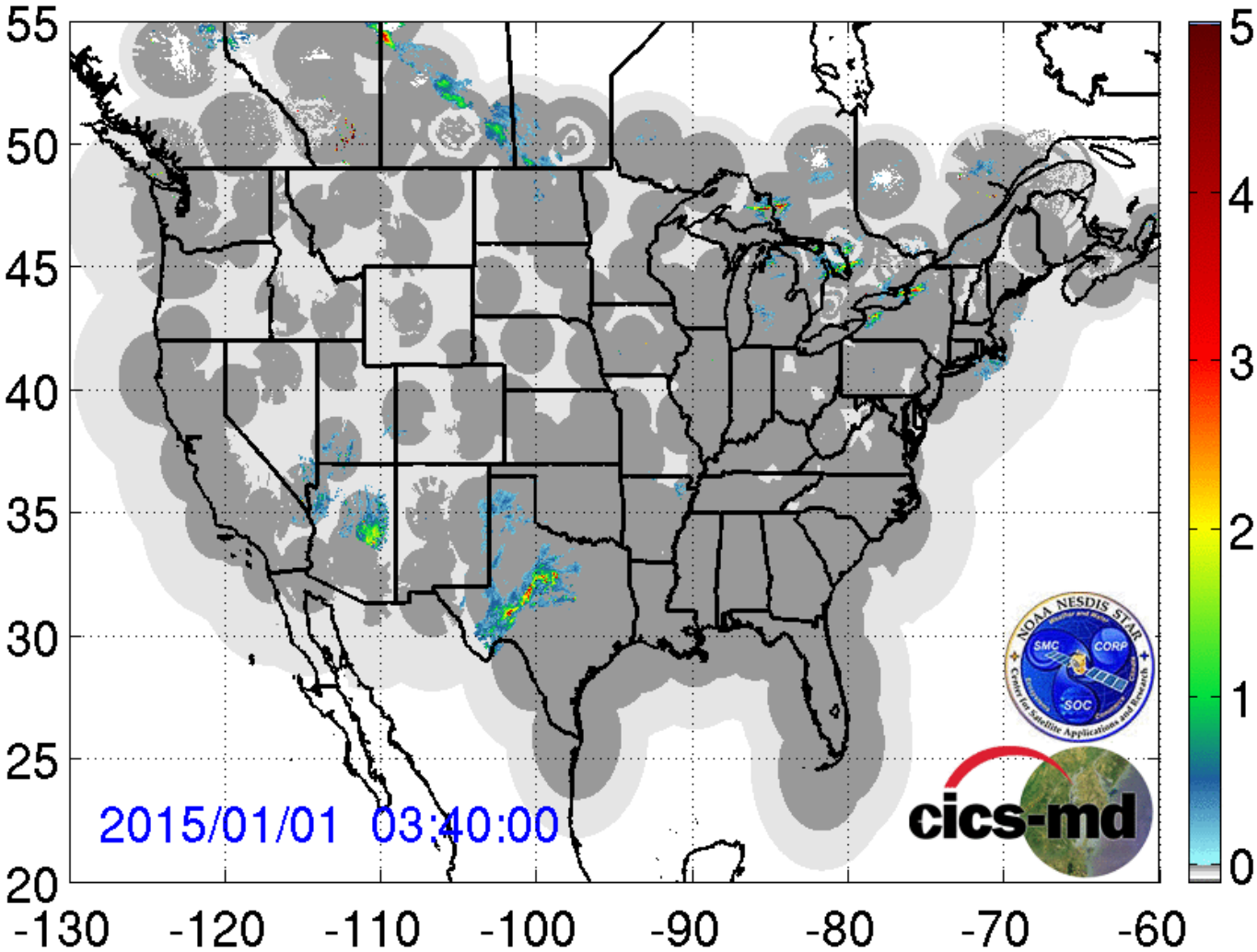


- **GMI Land SFR**
  - ✓ Same SD and SFR algorithm frameworks as SSMIS
  - ✓ SD statistics indicate very good performance against ground observations; comparable to ATMS
  - ✓ Algorithm completion by end of 2017

	POD (%)	FAR (%)	HSS
Warm Regime	67.1	15.3	0.49
Cold Regime	52.9	14.5	0.39

Use of SFR to fill in radar gaps

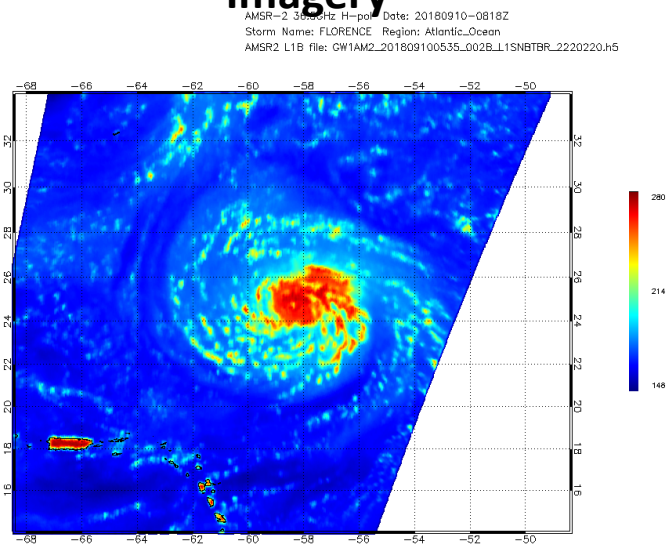
Huan Meng, NESDIS/STAR



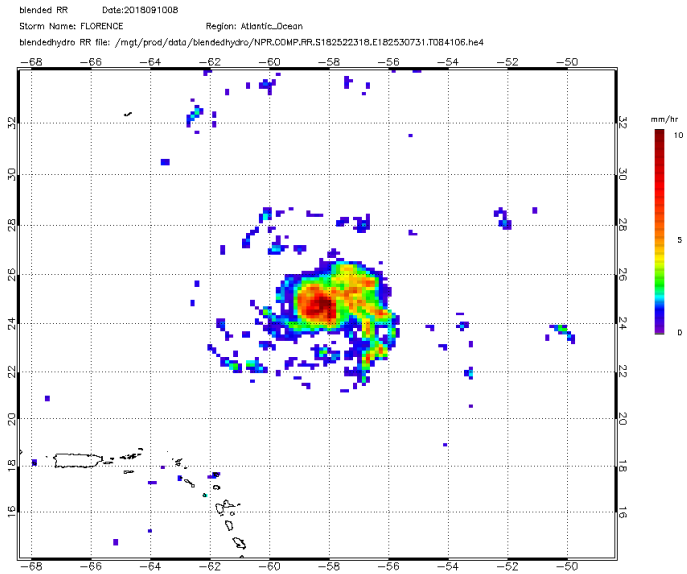
NOAA GCOM Products

Limin Zhao, NESDIS/OSPO

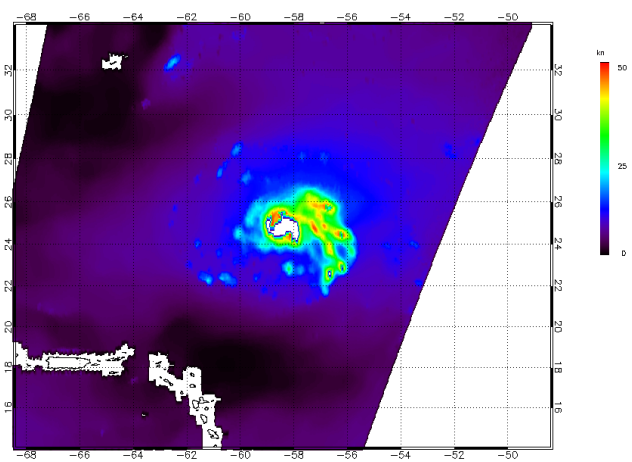
Imagery



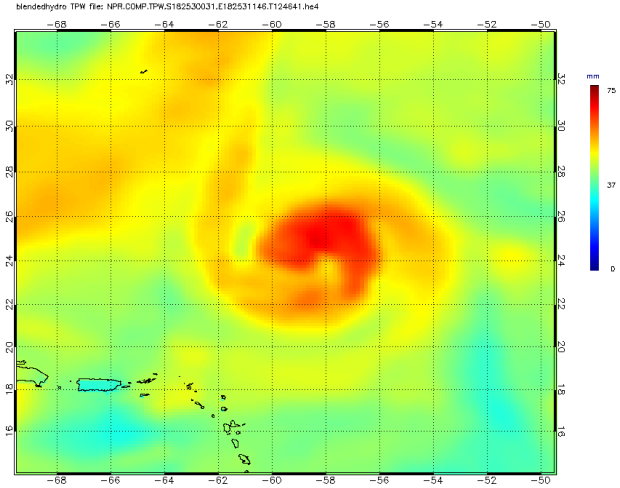
Rain Rates



Ocean Surface Wind Speed



TPW



NOAA GCOM Precipitation Update - Screening Comparison

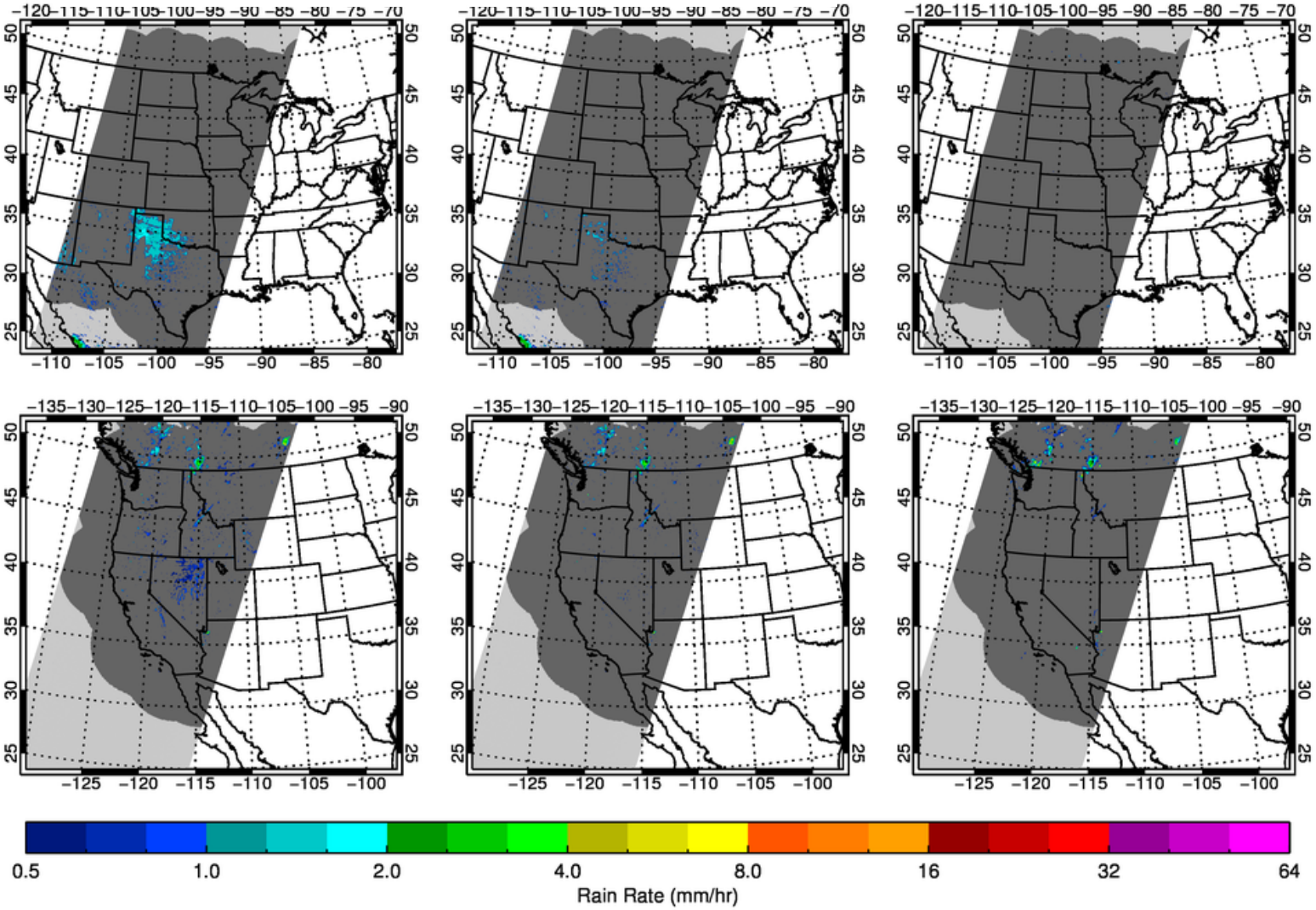
P. Meyers – CICS-M

GPROF2010 Version 2 Version 3 Ground Radar

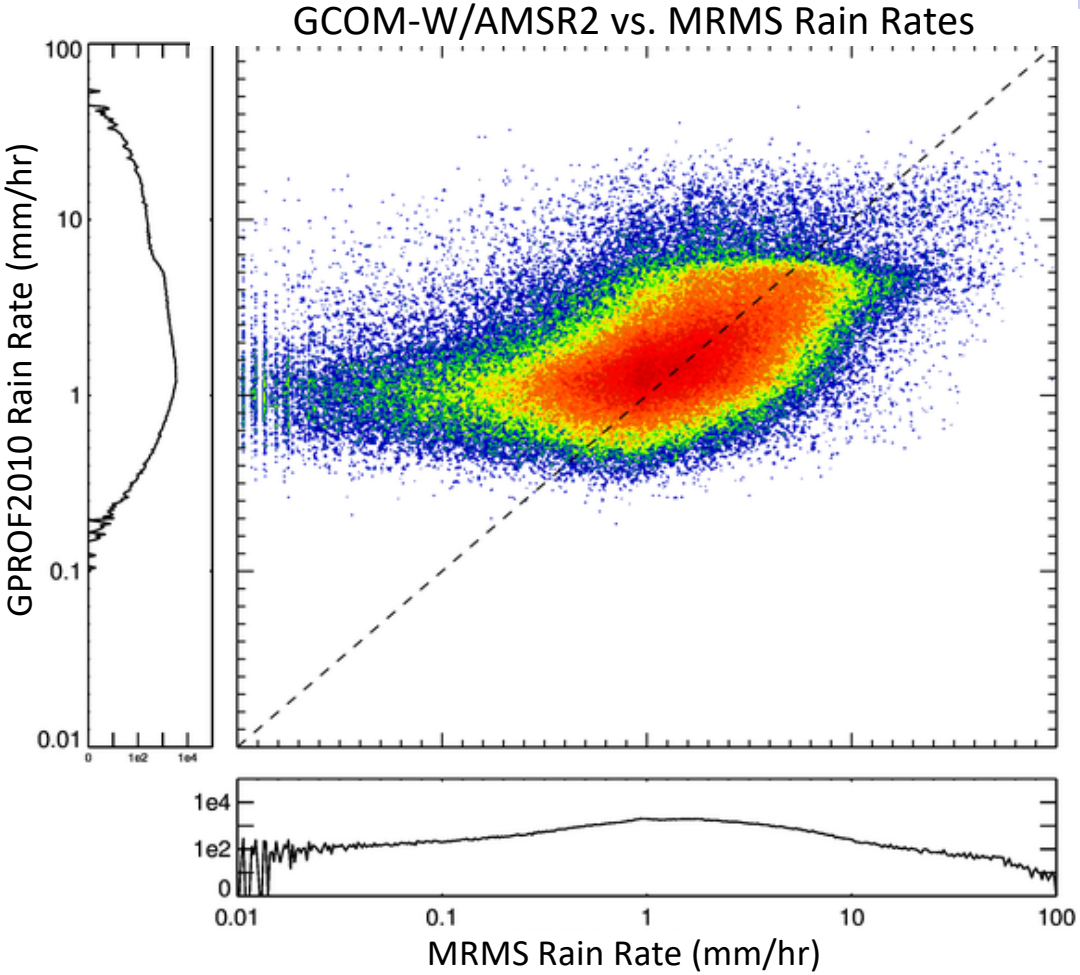
False alarms - cold, arid *Reduction in false alarms*

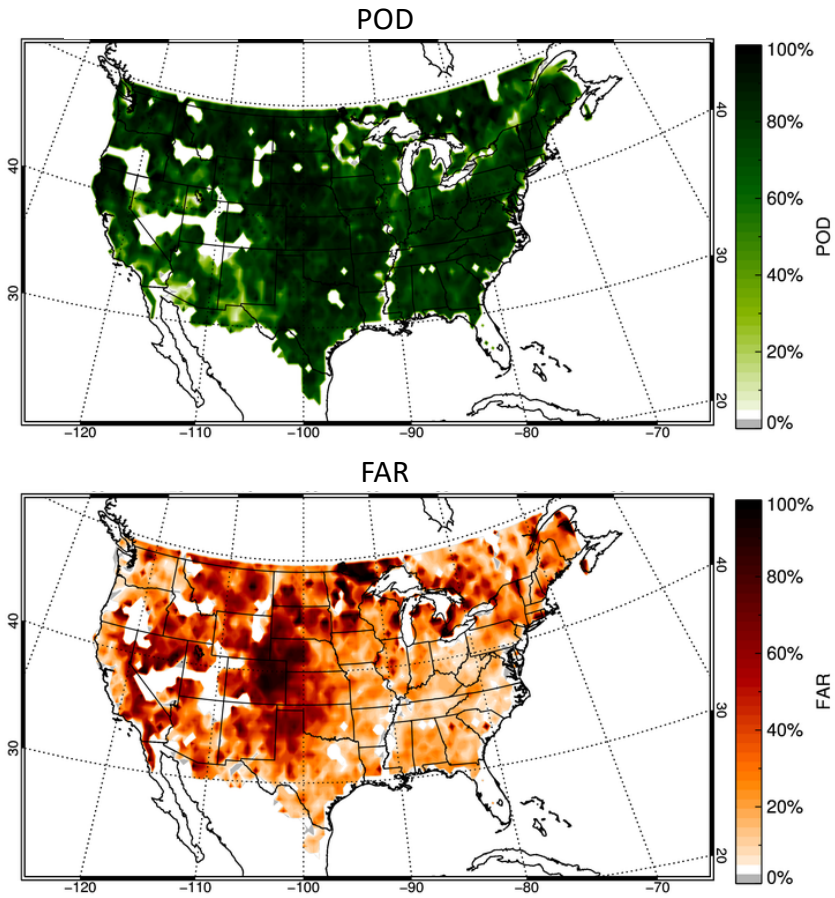
2 FEB 2018

2 JUL 2018



GPROF2010V3

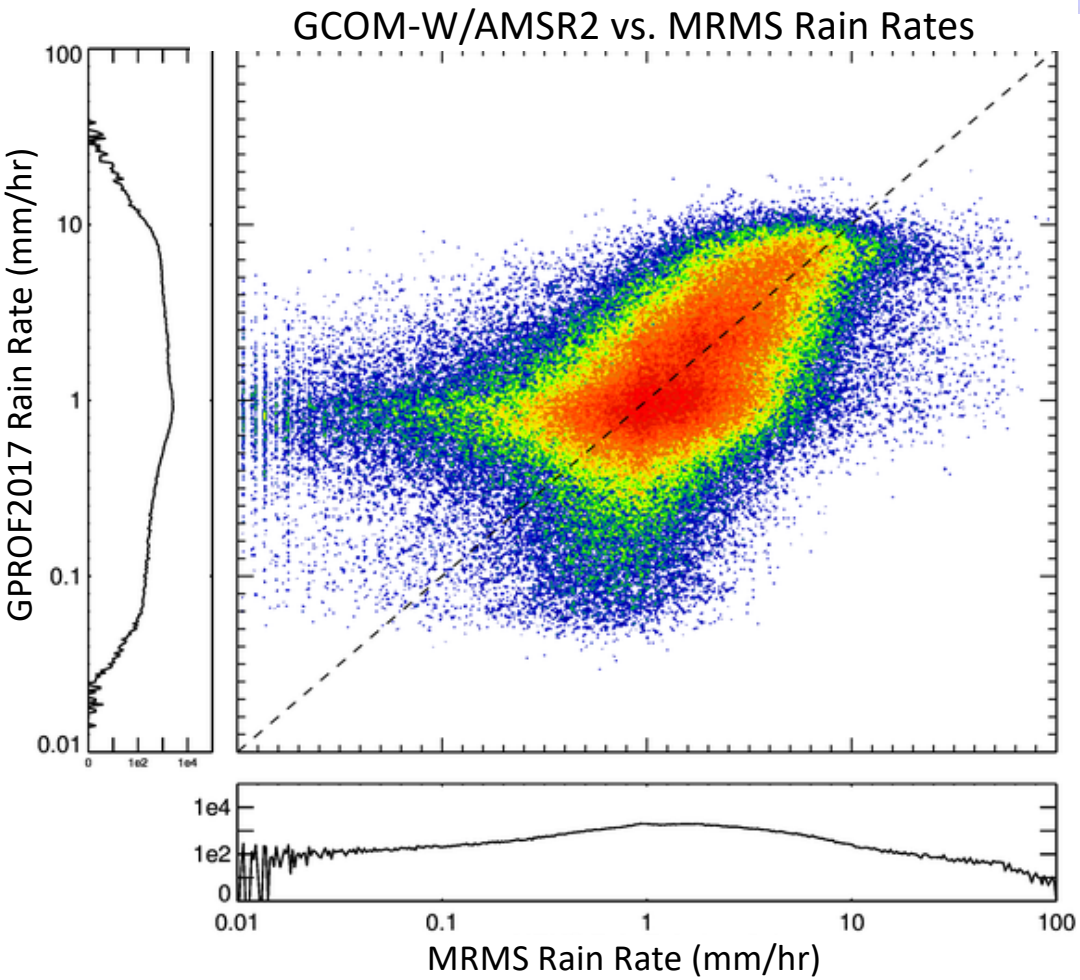


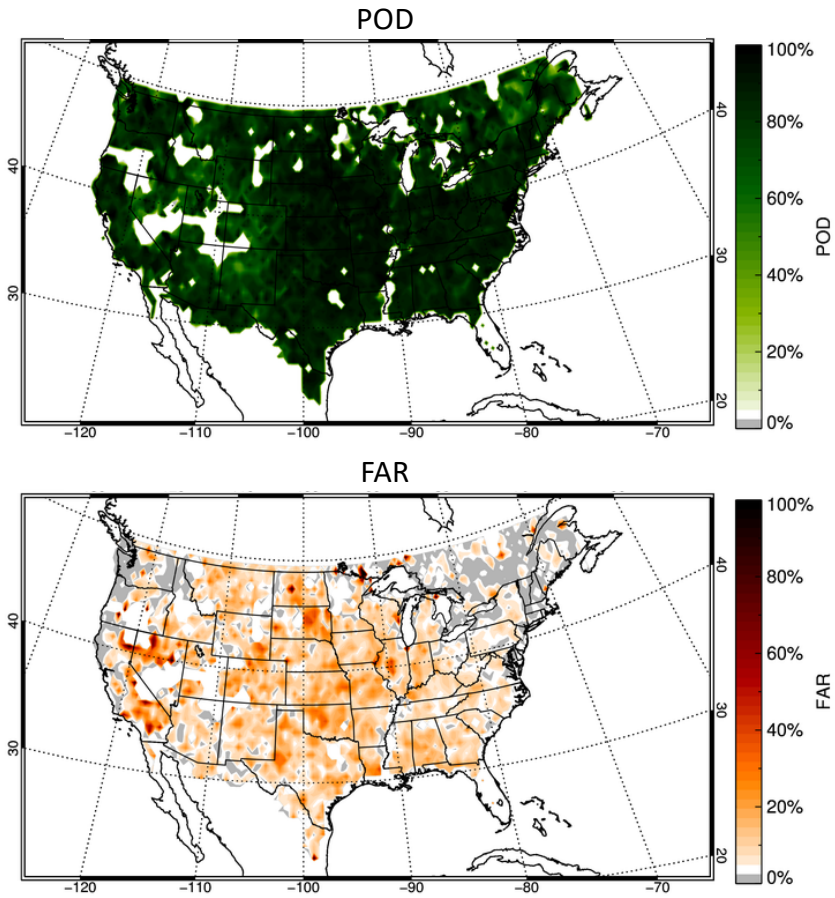


GPROF2017

P. Meyers – CICS-M
V. Petkovic - CIRA

NOAA plans to implement GPROF2017 in 2019

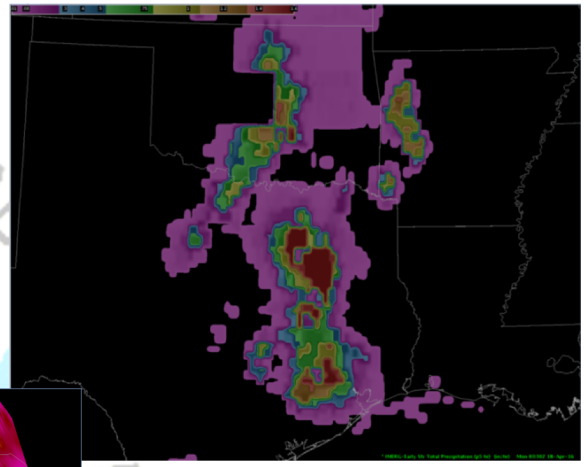


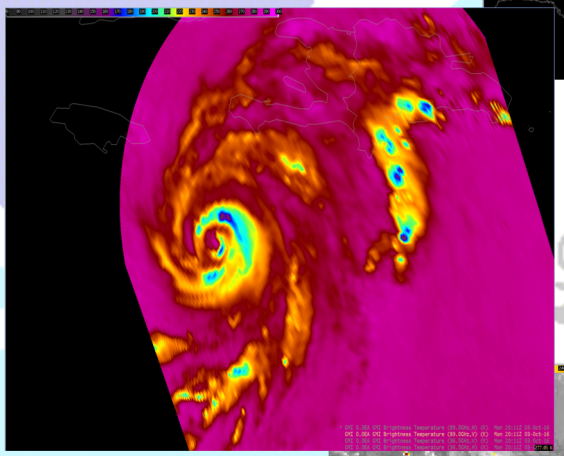


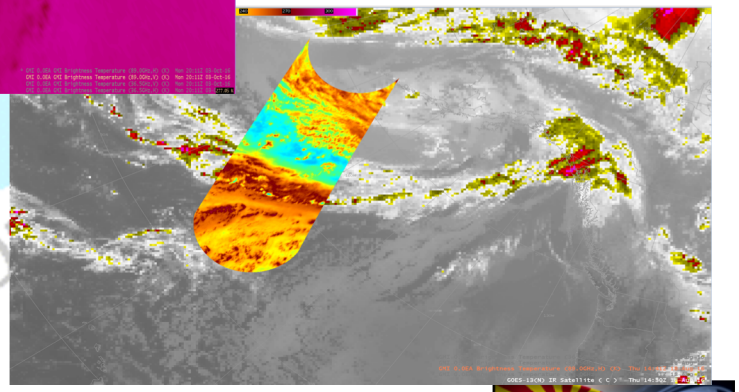
NWS use of GPM on AWIPS

J. Harris – NOAA/NWS

- GPM GMI Imagery and IMERG rescheduled for fielding in late CY18
  - GPM GMI Imagery Channels 6-9 (36 and 89GHz, V&H polarizations)
  - GPM IMERG-Early Precip & Precip Error @ 30 min intervals
  - GPM IMERG-Late Precip & Precip Error @ 30 min intervals
- NASA SPoRT serving GPM products via their own network
  - OCONUS region
- NASA SPoRT developing GPM training modules and guides







Example – Training Module

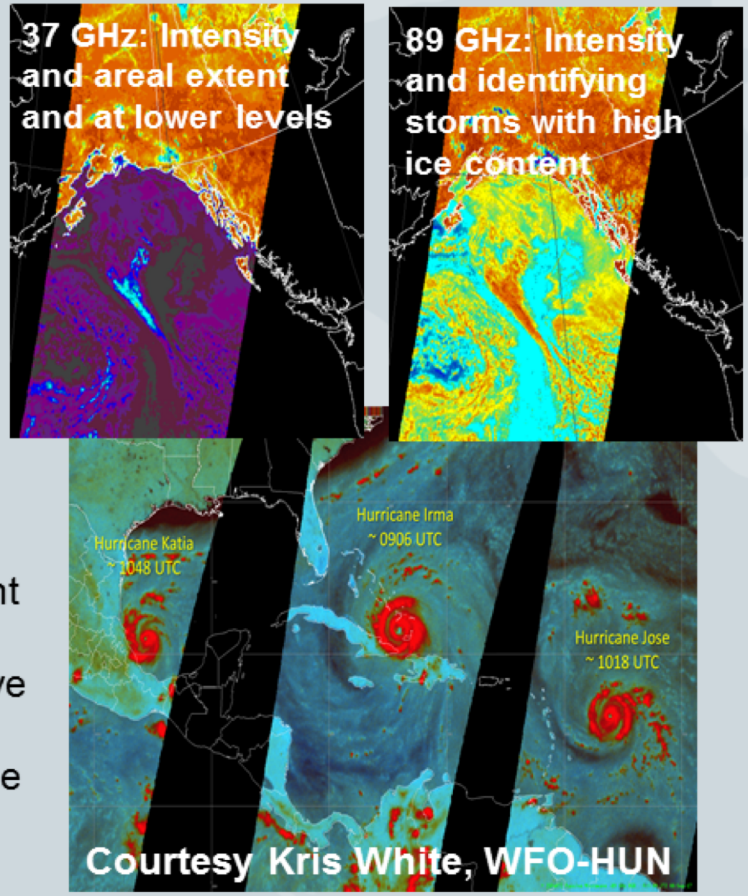
G. Stano/NASA-MSFC

Operational Uses: Spectral Bands

MICROWAVE
CONSTELLATION
APPLICATIONS
INITIATIVES

- Traditionally used for
  - Proxy for rain rate at surface (e.g., 37 GHz)
  - Proxy for convective activity (e.g., 89 GHz)
- Channels can be combined in RGBs or used to estimate rain rate

"Enhanced BD-curve [an enhancement technique for estimating intensity] infrared imagery and a GPM microwave composite image indicate improved banding over the western portion of the circulation and the earlier ragged eye presentation has become much more distinct." –NHC Forecast Discussion



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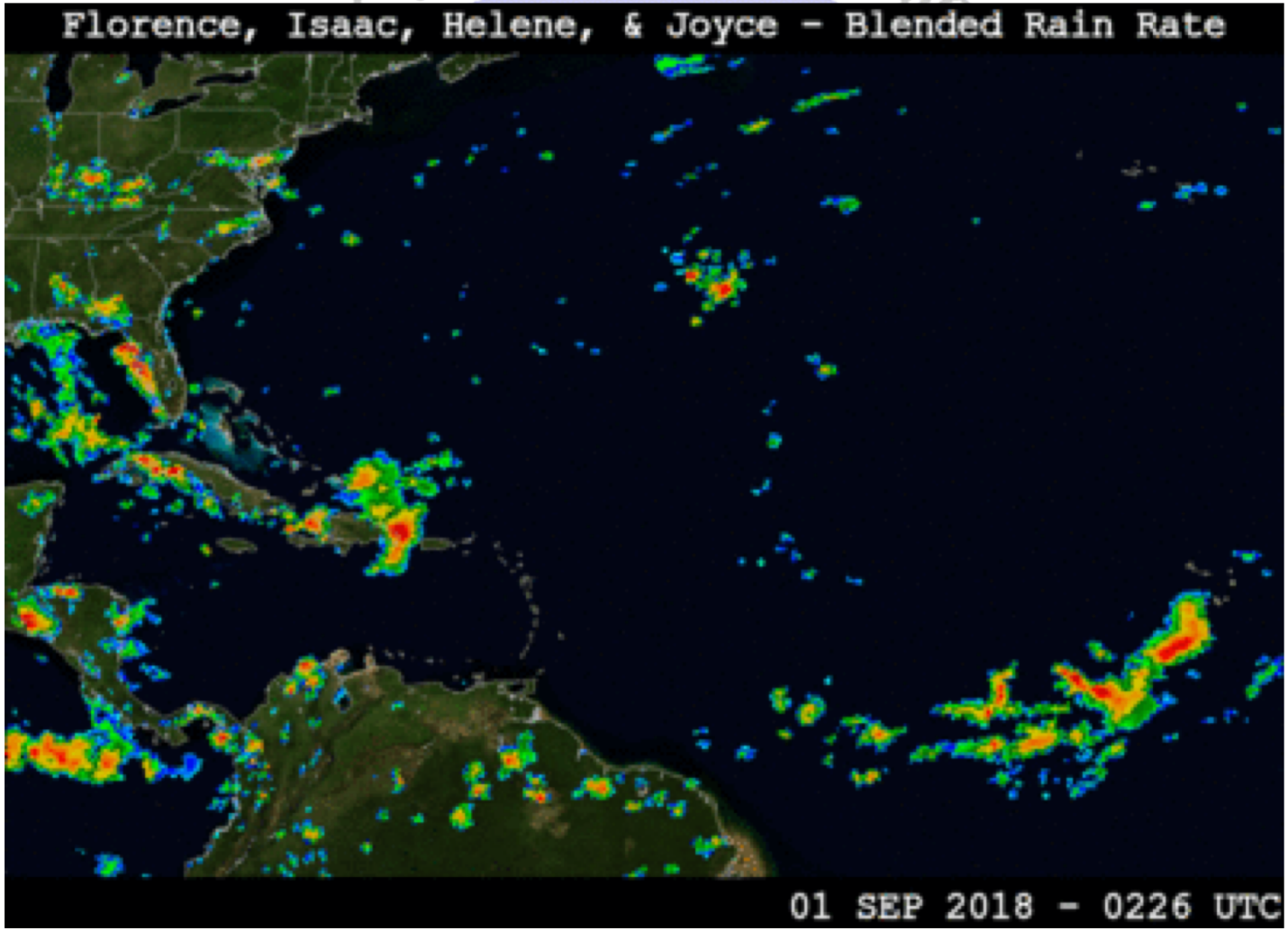
NOAA/NESDIS Blended Rain Rate (bRR)

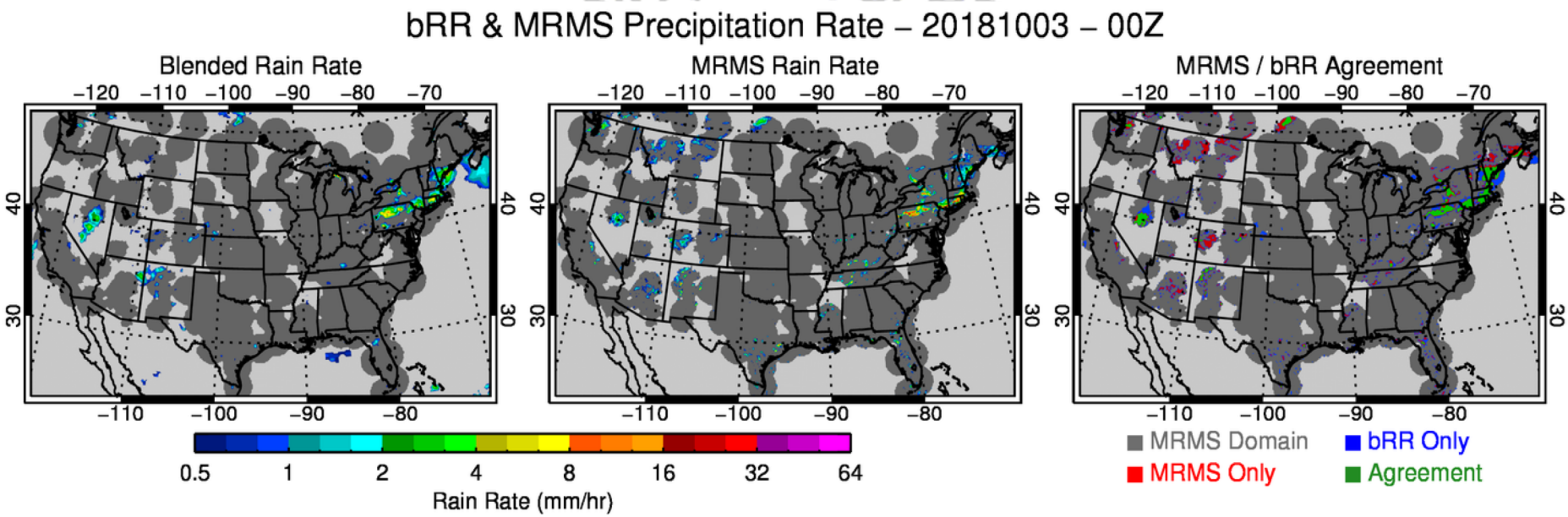
P. Meyers – CICS-M

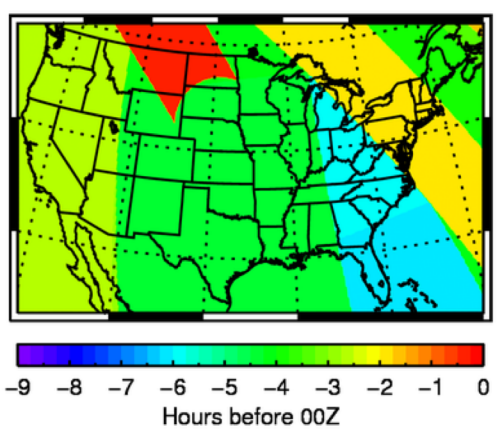
Composite, MiRS rain rates for last 12 hours – low latency product for AWIPS use

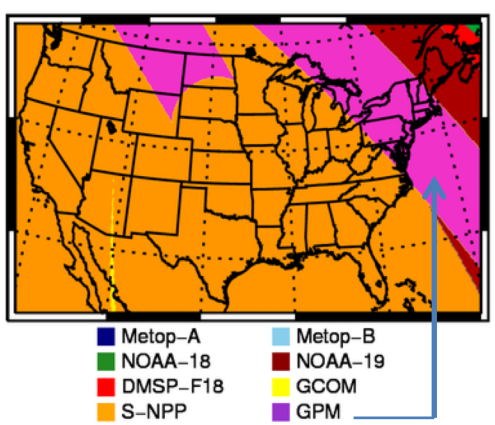


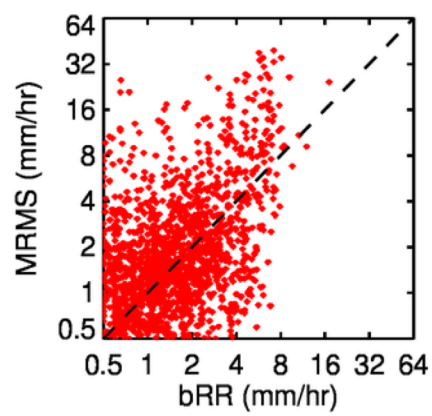
Example: Routine Monitoring bRR vs MRMS

http://cics.umd.edu/pmeyers/brr









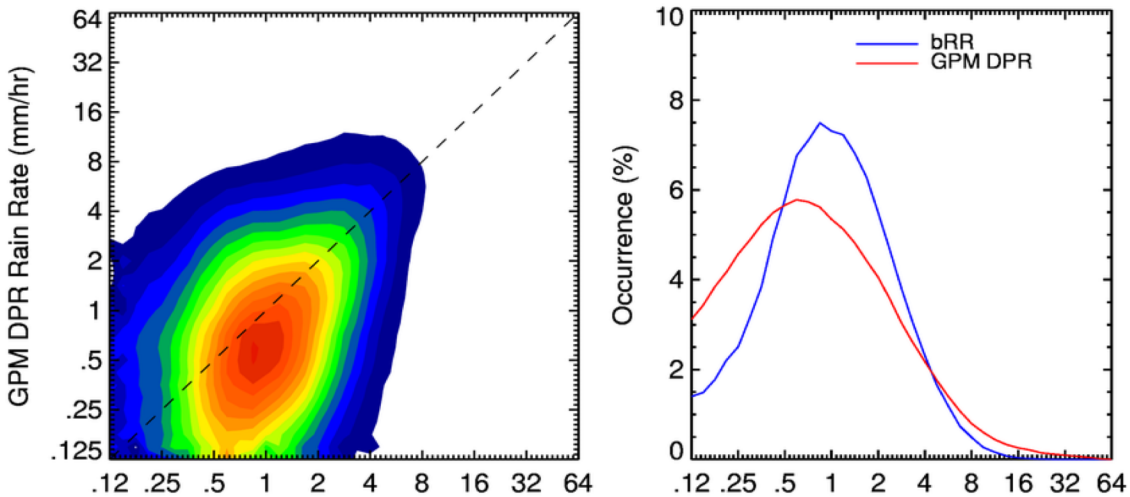
Reference Statistics

RMSD	:	3.48 mm/hr
r	:	0.47
POD	:	38.4%
FAR	:	43.1%

Using DPR to validate bRR components (note these are histogram adjusted L2)

- Collocated L2 GPM Dual Precipitation Radar (DPR) with bRR
- One month – July 2018 – over full domain
- < ±5 minute overpass window
- Arithmetic mean of DPR pixels in bRR grid box
- Only cases with ≥4 DPR pixels (arbitrary) to smooth the radar field
- *Also similar matchups with MRMS as a third data source*

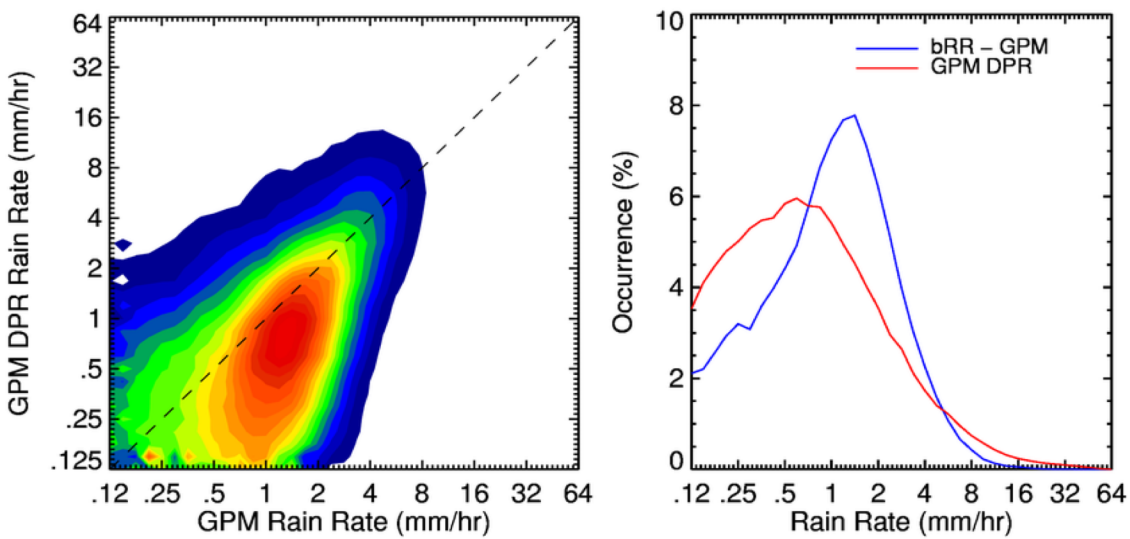
bRR – DPR Evaluation: Non–GPM



Non-GPM Satellites

n Obs	:	19314
RMSD	:	3.07 mm/hr
Bias	:	-3.4%
r	:	0.39
POD	:	57.7%
FAR	:	49.5%

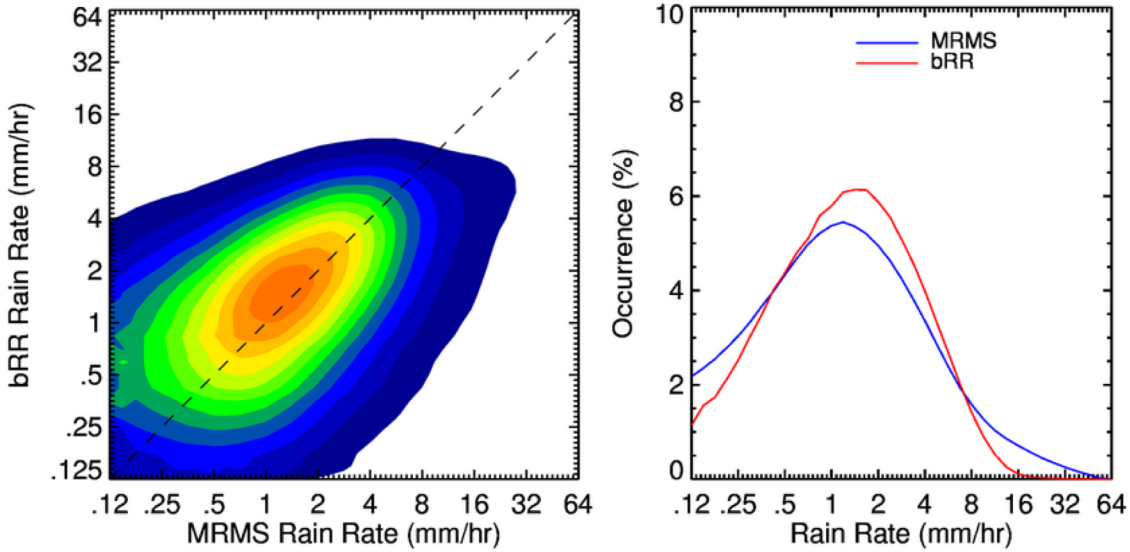
bRR – DPR Evaluation: GPM



GPM Stats

n Obs	:	8661
RMSD	:	2.97 mm/hr
Bias	:	3.1%
r	:	0.53
POD	:	79.1%
FAR	:	37.2%

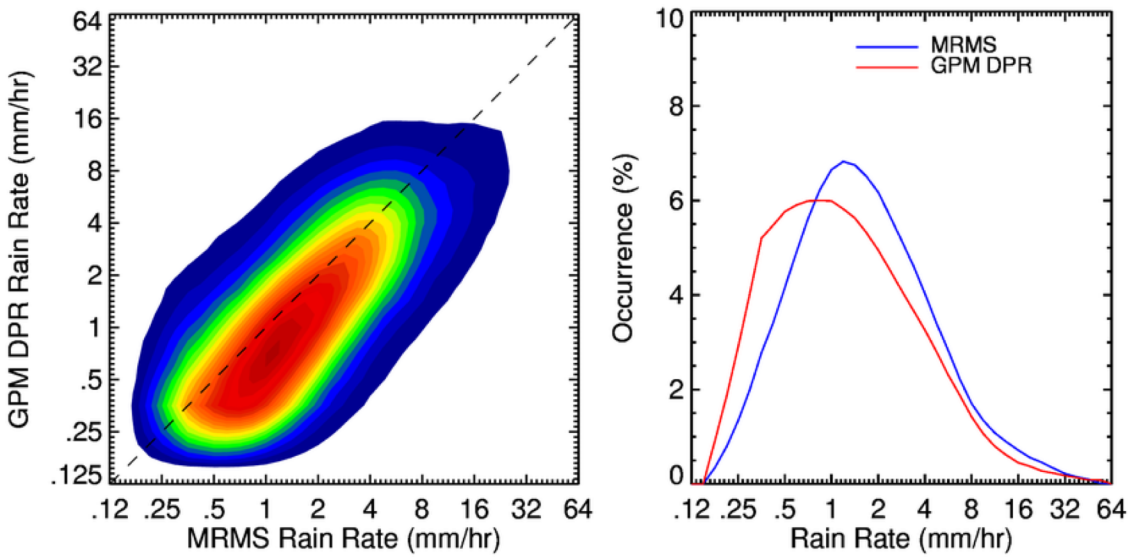
MRMS – BRR Evaluation



bRR vs MRMS

RMSD	:	4.56 mm/hr
Bias	:	27.5%
r	:	0.39
POD	:	66.4%
FAR	:	42.2%

MRMS – DPR Evaluation

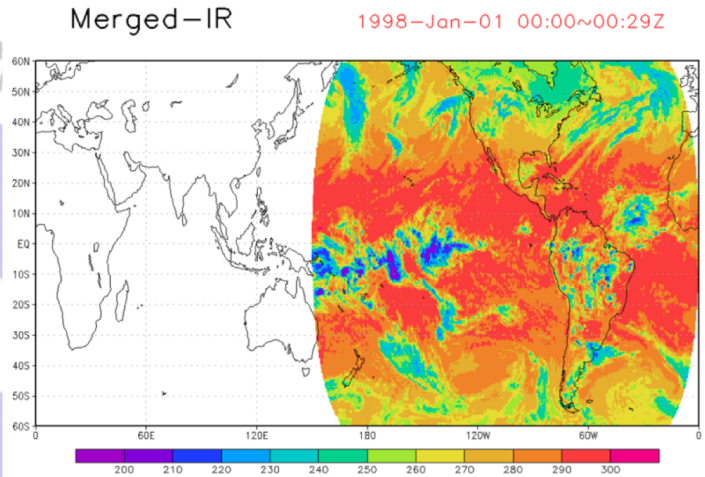


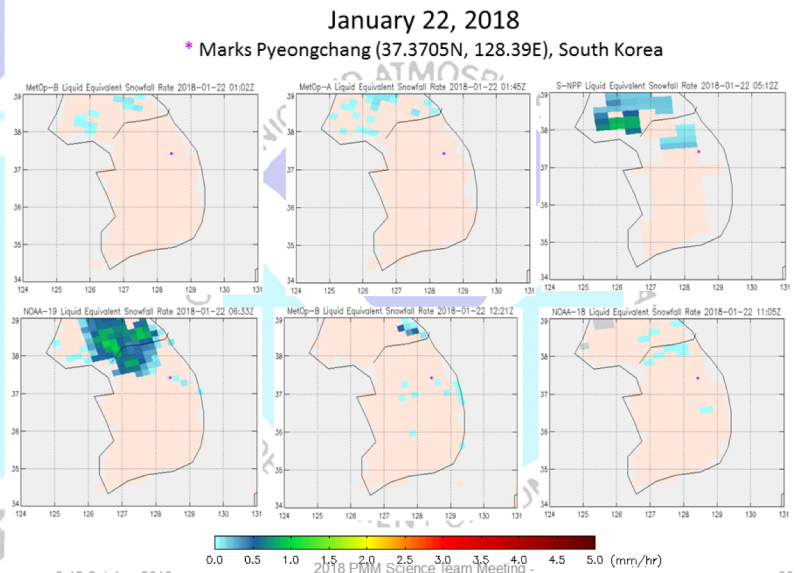
OPS: MRMS

RMSD	:	4.49 mm/hr
Bias	:	20.0%
r	:	0.56
POD	:	96.5%
FAR	:	9.5%

Other Relevant Activities

- MOU renewed another 5 years!
- MRMS/GPM GV
- TRMM and GPM reprocessing
  - Autosnow
  - 4 km GEO IR
- SFR for Korean Winter experiment





"NOAA PMM Omnibus" Project – Primary Efforts

1. **GPROF usage by NOAA to support operational GCOM AMSR-2 products** (JPSS supported)
   - Transition GPROF2017 into NESDIS operations
   - Customize if needed
   - Assess performance

2. **Operational NOAA snowfall rates, including GPM** (JPSS supported)
   - Continued comparison between NESDIS SFR and GPM GPROF SFR
   - NWS assessments
   - Use of SFR in NCEP/WPC Winter Weather Experiment (w/Mike Bodner, 2018-19)

3. **Comparisons of GPM observations with GOES-16/17 ABI and GLM** (GOES-R and NESDIS STAR supported)
   - Exploiting AWIPS system, examine co-incident observations of GMI, ABI and GLM
   - Is there any advantage to using GLM to help constrain GPROF databases?

4. **Improvement to CMORPH – Pole to Pole Precipitation CMORPH2** (JPSS and CPO supported)

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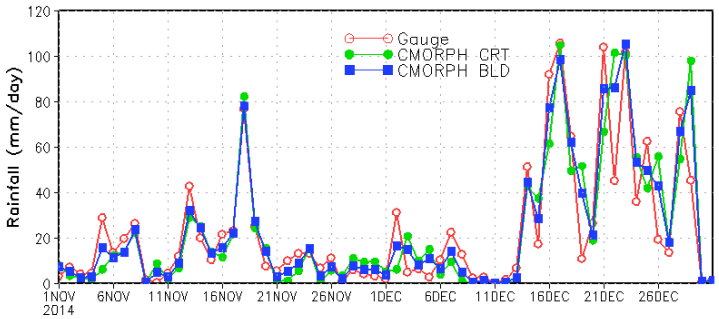
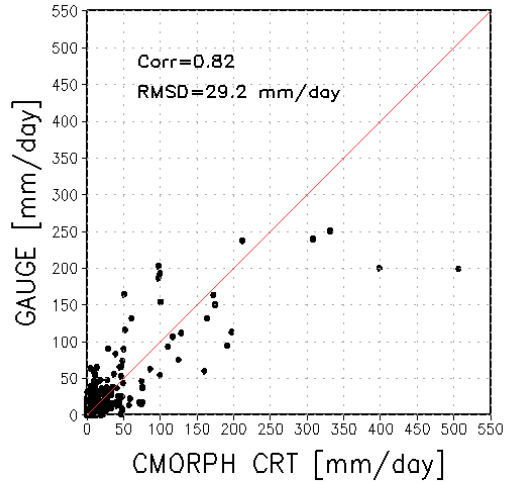
   - Establishing a sub-system as a part of the CMORPH2 to perform evaluation of L2 retrievals for all PMW sensors generated by NASA/GPM and NESDIS/STAR on a real-time basis;
   - Exploring optimal strategy to quantify precipitation of solid and mixed phases with L2 inputs from various sources
   - Optimize real-time production schedule

Operational CMORPH

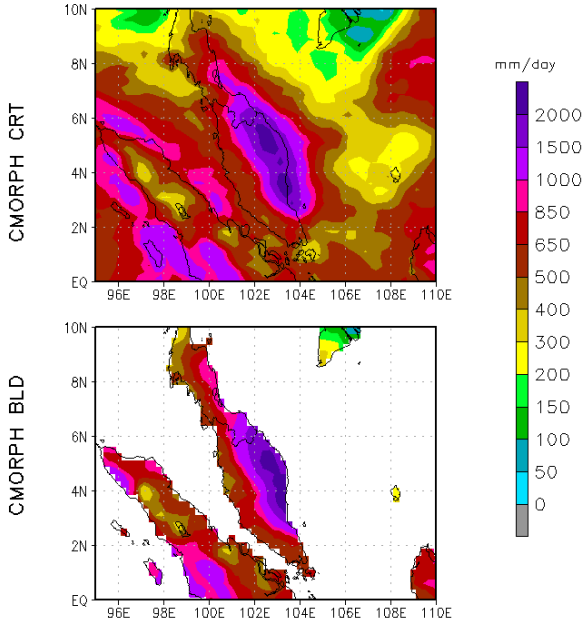
P. Xie, R. Joyce, S. Wu, and L. Ren NOAA/NWS/CPC

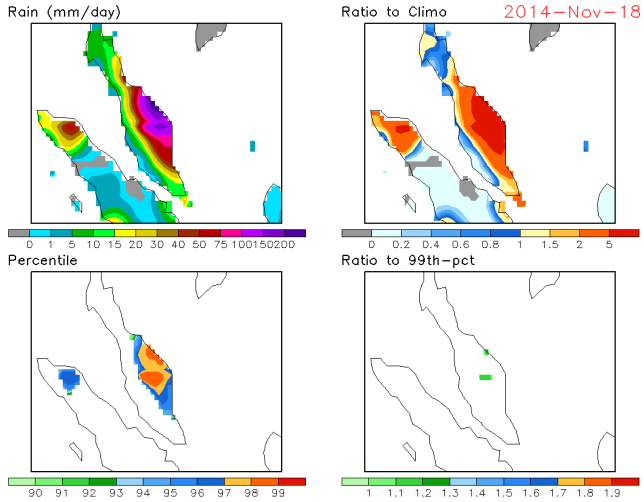
- CMORPH provided to WMO Spaced Based Weather and Climate Extreme Monitoring Project for case studies of heavy rainfall and drought events over SE Asia





Daily precipitation from the bias corrected CMORPH shows very good agreement with the CPC gauge analysis over the target domain in Malaysia.





Daily precipitation for 18 Nov., 2018 from CMORPH_CRT

(top-left)

Total precipitation (mm)

(top-right)

Ratio to the 20-year mean

(bottom-left)

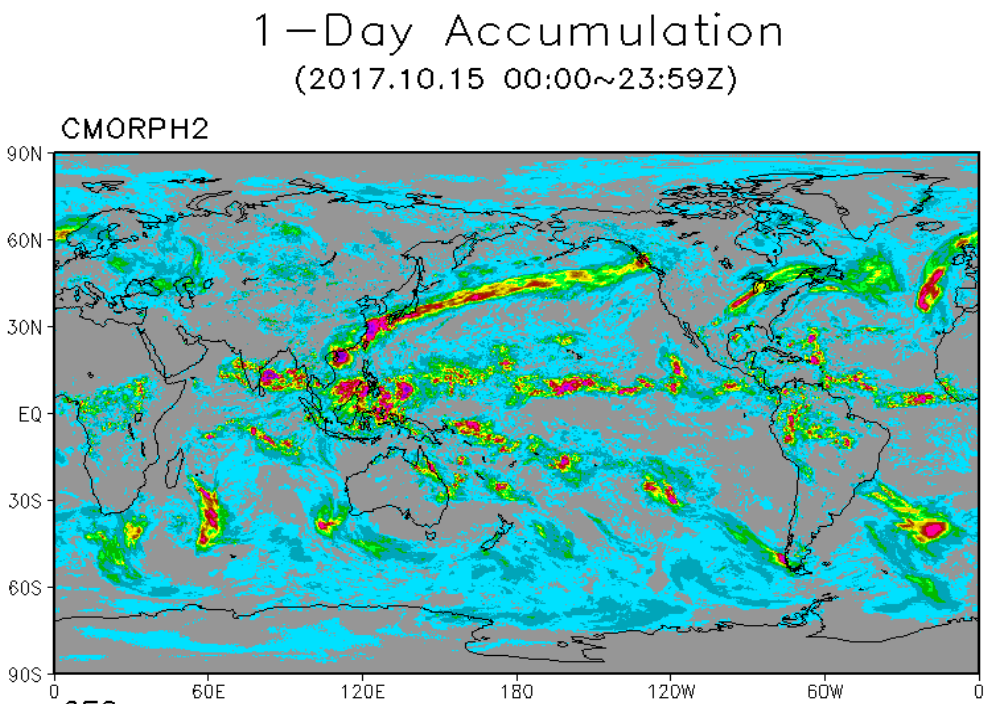
Daily precipitation percentiles

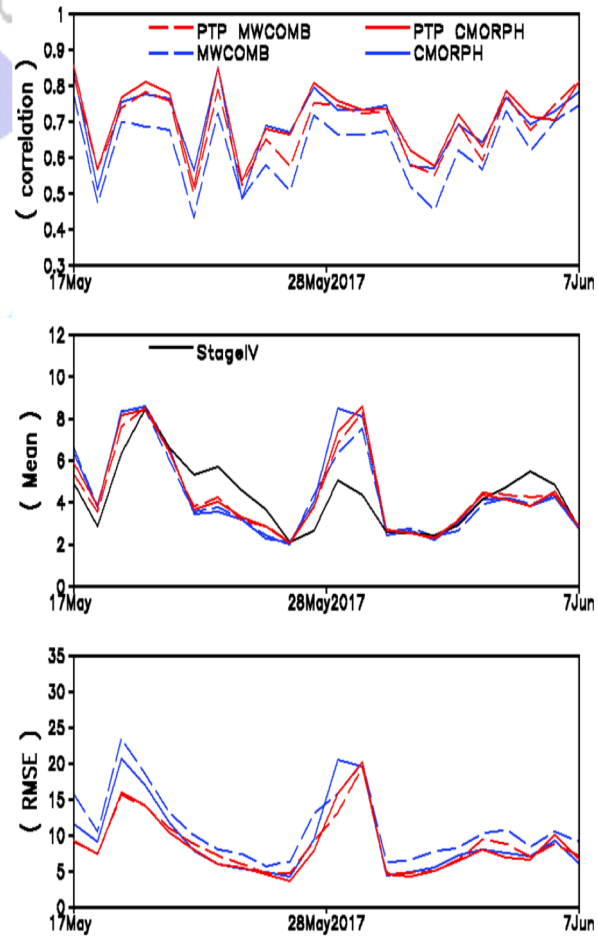
(bottom-right)

Ratio to 99th percentile

2nd Generation CMORPH

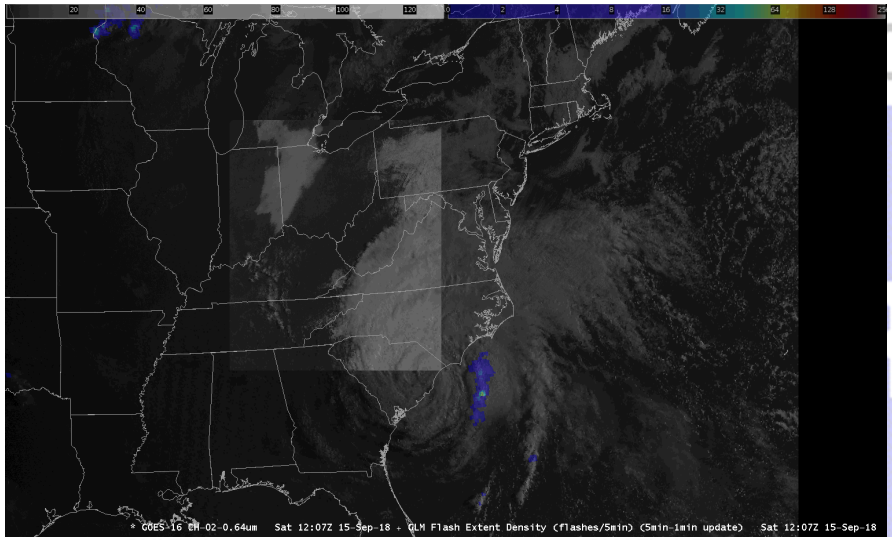
- Pole-to-Pole Complete Global Coverage
- Explicit snowfall representation
- Started real-time test production while fine-tuning algorithm piece by piece
- Focused on AVHRR IR precip estimates and preliminary examinations

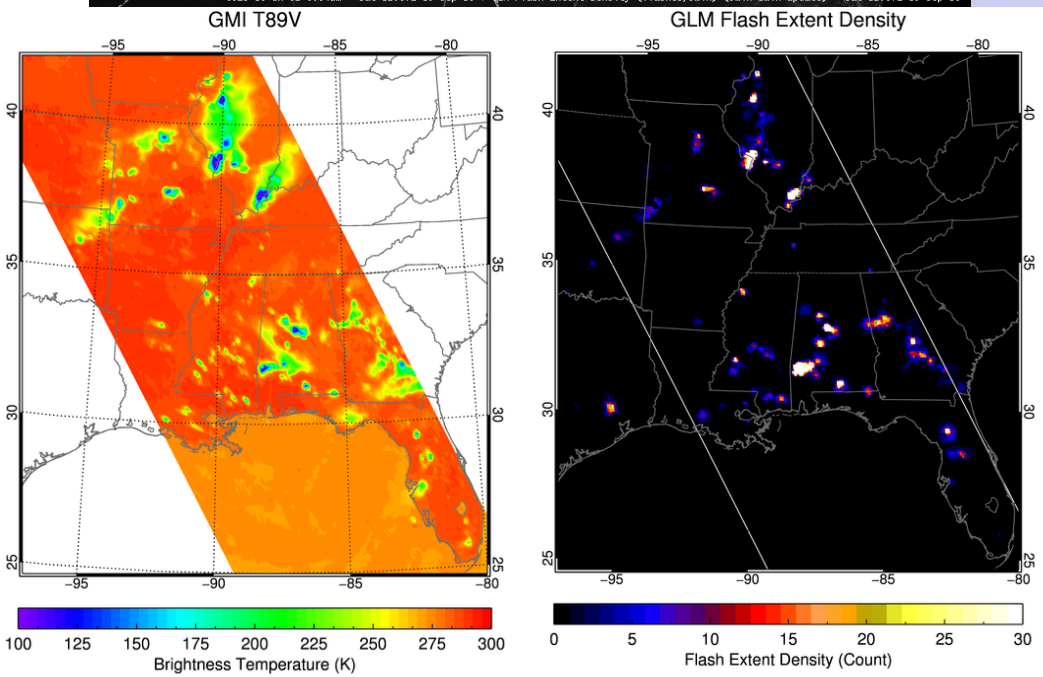


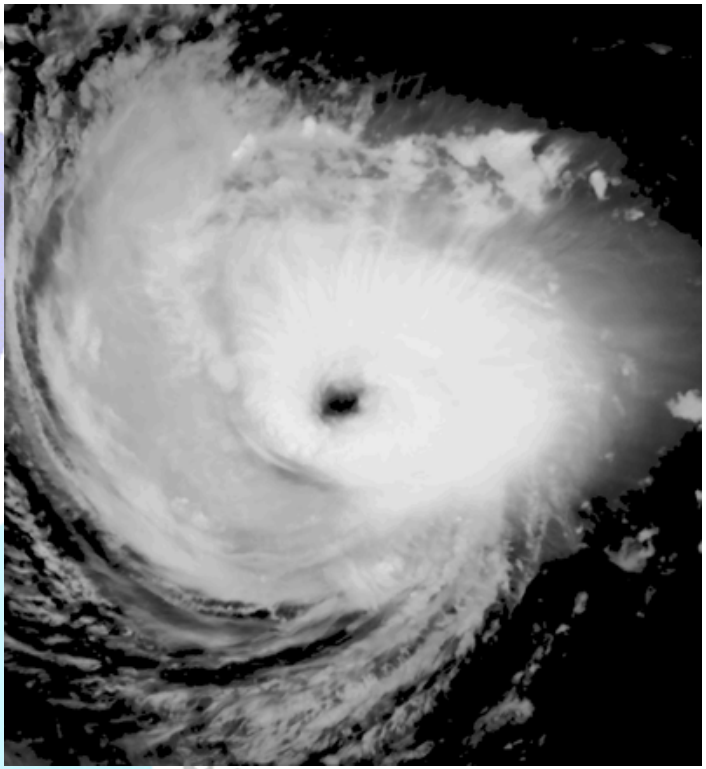


GOES-R era - Relationship between Lightning and MW Scattering?

P. Meyers – CICS-M







How can we exploit space based lightning observations to improve precipitation retrievals?

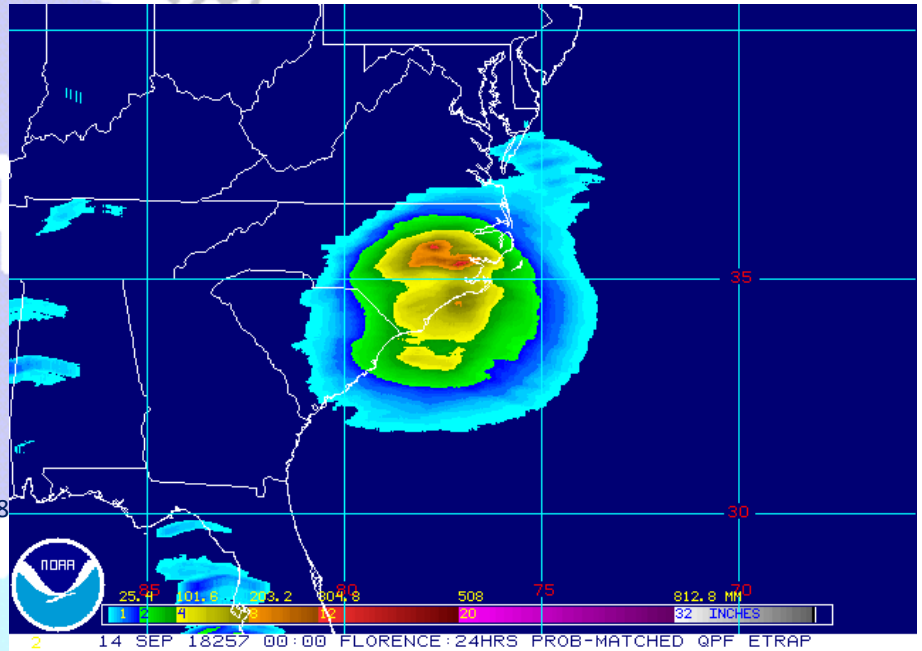
Extra Stuff….

Ensemble TRaP (eTRaP) - Florence

14 individual estimates went into this forecast:

- RCLIPER (climatology)
- NOAA-18 and NOAA-19 MiRS rain rates
- MetOp-A and MetOp-B MiRS rain rates
- DMSP F-17 and F-18 MiRS rain rates
- GMI MiRS rain rates

24-hr rainfall potential



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/data/Petrap/2018/FLORENCE/2018FLORENCE.WTNT21.KNHC.131438.AMSUM2.09131429
/data/Petrap/2018/FLORENCE/2018FLORENCE.WTNT21.KNHC.131438.AMSUNN.09131304
/data/Petrap/2018/FLORENCE/2018FLORENCE.WTNT21.KNHC.131438.SSMISB.09131215
/data/Petrap/2018/FLORENCE/2018FLORENCE.WTNT21.KNHC.132000.RCLIPER.09132000
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Grid information: nc,nr,clat,clon: 800 800 34.00 77.50
Total independent TRaPs used: 14
Ensemble members before cull to 200 : 5 x 8 x 12 x 14 = 6720
Total Ensemble TRaP members: 200