Validated Maturity Science Review For GCOM-W1/AMSR2 Day-1 Products

Presented by STAR GCOM-W1/AMSR2 Project

Date: 2016/10/19

Outline

- Algorithm Cal/Val Team Members
- Product Requirements
- Evaluation of algorithm performance to specification requirements
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error Budget
- Identification of Processing Environment
- Users & User Feedback
- Documentations (Science Maturity Check List)
- Conclusion
- Path Forward

GCOM-W AMSR2 Cal/Val Team

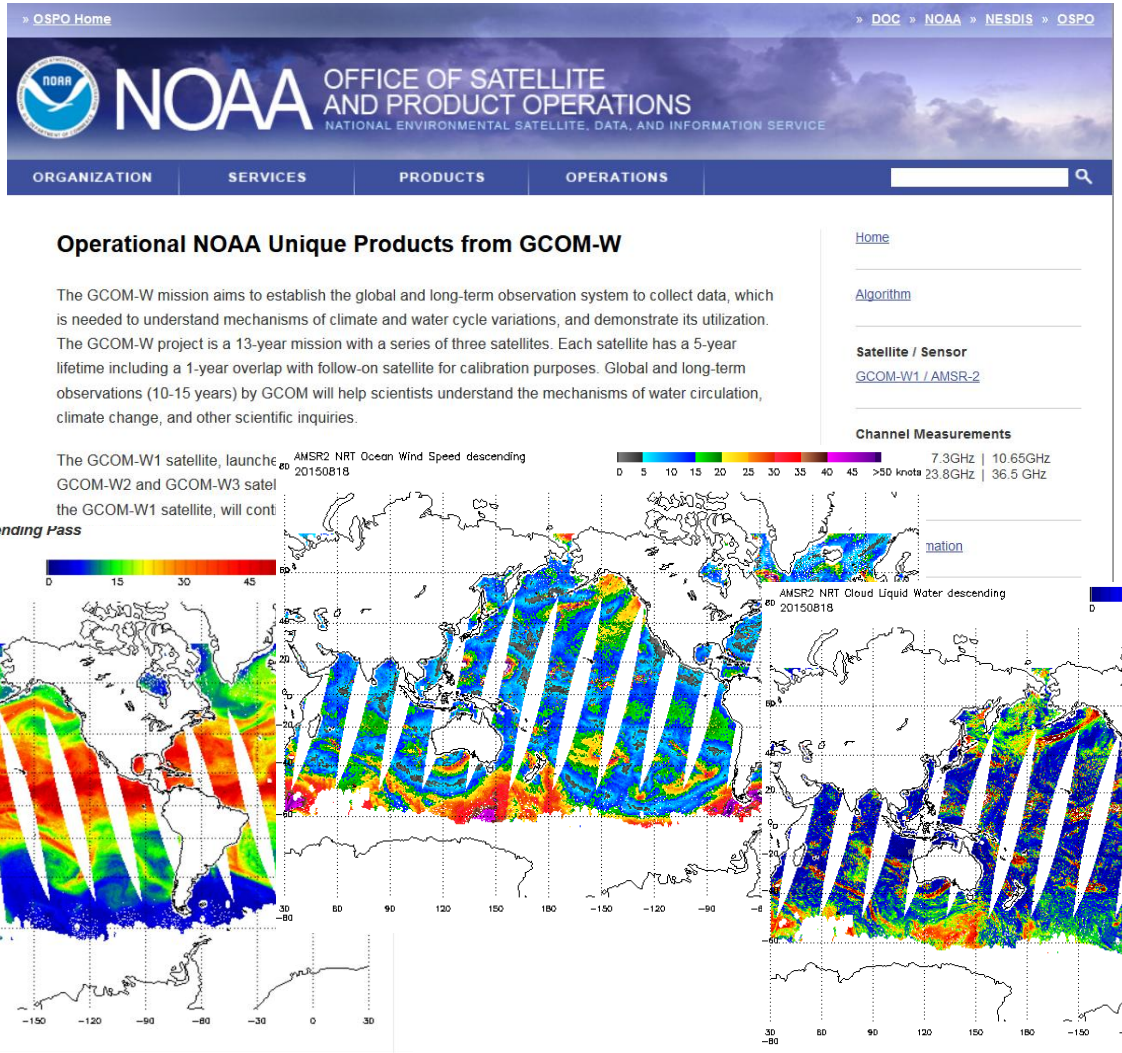
Day-1 Algorithm Cal/Val Team Members

Name	Organization	Major Task
Paul Chang	NOAA/STAR	NOAA/STAR project lead,
Ralph Ferraro	NOAA/STAR	NOAA/STAR project deputy, precipitation focal point
Zorana Jelenak	UCAR	Ocean scene product algorithm development, validation, testing and monitoring, TB cal/val
Suleiman Alsweiss*/Joe Sapp	GST	Ocean scene product algorithm development, validation, testing and monitoring, TB cal/val
Patrick Meyers	CICS-MD	Precipitation algorithm development, validation, testing and monitoring
Eileen Maturi	NOAA/STAR	NOAA/STAR Blended SST focal point
Andy Harris	CICS-MD	SST validation
Walter Wolf	NOAA/STAR	Systems integration and algorithm transition focal point
Tom King & Tish Soulliard	IMSG	Systems integration and algorithm transition

Examples of Products

http://www.ospo.noaa.gov/Products/atmosphere/gpds/

And at http://manati.star.nesdis.noaa.gov/gcom/



Quality of the Product

- The GCOM-W1 GAASP Day-1 products have been validated against the JPSS L1RD supplements, and the results were presented at ARR.
  - CLW and TPW are validated with GDAS, TMI, NOAA-19
  - SST is validated with Reynolds, TMI and Buoys
  - SSW is validated with GDAS, TMI and Buoys
  - Precipitation is validated with TMI, TMPA, and GPCP
- Presented here is a summary of validation results allocated to JPSS L1RD Supplement (2.7), which show that all AMSR-2 Day-1 products meet the requirements.

JPSS L1RD Supplement Table 6.1.1 - Imagery (AMSR-2)

Attribute	Requirement	Observed
Imagery Applicable Conditions: 1. Delivered under "all weather“ conditions 2. Each channel shall be provided at its highest native resolution. 3. All channels shall be Vertically and Horizontally polarized. 4. All channels sampled at 10 km except 89 GHz, which is at 5 km.		
a. Horizontal Sampling Interval (1)	10 km except 89 GHz which is at 5 km (2)	As required
b. Mapping Uncertainty, 3 Sigma	5 km	As required
c. Refresh	At least 90% coverage of the globe about every 20 hours (monthly average) (3)	As required

Notes:
1. "Horizontal Sampling Interval" better reflects the way the data is to be taken rather than specifying "Horizontal Spatial Resolution“ which is used for other EDRs. The Sampling Interval does not necessarily equal the HSR.
2. All channels are sampled at 10 km except 89 GHz, which is at 5 km. All channels V & H polarization. The native resolutions for each channel are as follows:
6.925 GHz - 35 x 62 km
7.3 GHz - 35 x 62 km
10.65 GHz - 24 x 42 km
18.7 GHz - 14 x 22 km
23.8 GHz - 15 x 26 km
36.5 GHz - 7 x 12 km
89.0 GHz - 3 x 5 km
3. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

JPSS L1RD Supplement Table 6.1.2 - Cloud Liquid Water (AMSR-2)

Attribute	Requirement	Observed
CLW Applicable Conditions: 1. Delivered under "all weather“ conditions		
a. Horizontal Cell Size	10 km (37 GHz FOV size); 10 km sampling (1)	As required
b. Vertical Reporting Interval	Total Column	As required
c. Mapping Uncertainty, 3 Sigma	5 km	As required
d. Measurement Uncertainty (1 kg/m^2 = 1 mm)	0.05 mm over ocean; Best efforts over land	0.03 ~ 0.09 mm over ocean, not available over land
e. Measurement Accuracy	0.01 mm	0.01mm
f. Coverage	Global Ice-free Oceans	As required
g. Refresh	At least 90% coverage of the globe about every 20 hours (monthly average) (2)	As required
h. Range (1 kg/m^2 = 1 mm)	0.005 - 1 mm	0 ~ 1 mm
Notes: 1. HCS is consistent with 36 GHz SDR product HCS. 2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.		

JPSS L1RD Supplement Table 6.1.3 - Total Precipitable Water (AMSR-2)

Attribute	Requirement	Observed
a. Horizontal Cell Size	10 km (21 GHz FOV sampling) (1)	As required
b. Mapping Uncertainty, 3 Sigma	5 km	As required
c. Measurement Range	1 - 75 mm	0 ~ 75 mm
d. Measurement Uncertainty	2 mm or 10%, whichever is greater	1.1 ~ 1.8 mm
e. Measurement Accuracy	1 mm	0.1 ~ 0.7 mm
f. Refresh	At least 90% coverage of the globe every 20 hours (monthly average).	As required
g. Coverage	Ice-free global ocean	As required

Notes:
1. This HCS consistent with the 23 GHz SDR product HCS.
2. This refresh requirement is consistent with the AMSR-2 cross-track swath width design of 1450 km for a single orbit plane.
3. The spatial distribution of the assessment data is global, encompassing the natural variability of the different geophysical conditions.
4. Refresh, coverage and horizontal size are all dependent on the refresh, coverage and horizontal size of the brightness temperatures
measurements. The MiRS algorithm outputs characteristics will reproduce the TB characteristics of these factors.

JPSS L1RD Supplement Table 6.1.4 - Sea Surface Winds - Speed (AMSR-2)

Attribute	Requirement	Observed
SSW Applicable Conditions: 1. Delivered under "all weather“ conditions		
a. Horizontal Cell Size (Wind speed)	33 km (10.7 GHz FOV size) (3); 10 km sampling	As required
b. Mapping Uncertainty, 3 Sigma	TBS-11	As required
c. Measurement Range (Speed)	2 – 30 m/sec	0 ~ 30 m/sec
d. Measurement Uncertainty (Speed)	Greater of 2.0 m/sec or 10%	0.9 ~ 1.5 m/sec
e. Measurement Accuracy	0.5 m/sec (4)	0.1 ~ 0.3 m/sec
f. Refresh	At least 90% coverage of the globe about every 20 hours (monthly average) (5)	As required
g. Geographic Coverage	Global Ice-free Oceans	As required

Notes:
1. There is no SSW capability on JPSS.
2. There is no SSW - Direction capability on GCOM (AMSR-2).
3. This HCS is consistent with the 10 GHz SDR product HCS.
4. Accuracy requirements apply for Cloud Liquid Water up to 2mm.
5. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.

JPSS L1RD Supplement Table 6.1.5 - Sea Surface Temperature (AMSR-2)

Attribute	Requirement	Observed
SST Applicable Conditions: 1. Delivered under "all weather"		
a. Horizontal Cell Size	40 km (1)	As required
b. Mapping Uncertainty, 3 Sigma	5 km	As required
c. Measurement Range	271 K to 313 K (2)	
d. Measurement Accuracy, Skin & Bulk	0.5 K	0.1 K
e. Measurement Uncertainty	1.0 K	0.8 ~ 0.9 K
f. Refresh	At least 90% coverage of the globe about every 20 hours (monthly average) (3)	As required
g. Geographic Coverage	Global Oceans (4)	As required

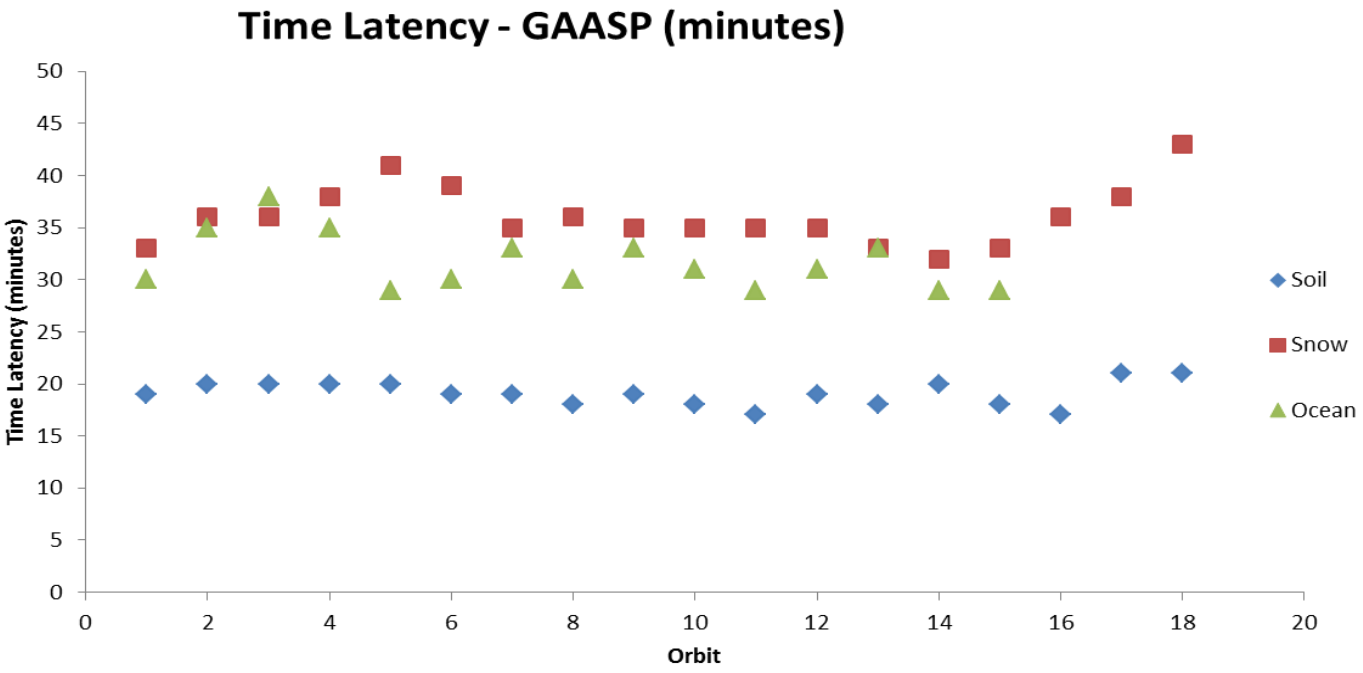
Notes:
1. This HCS requirement is consistent with the 6 GHz SDR product HCS.
2. For all weather, 301 K is the AMSR-E limit. 307 K is the realistic upper limit (Objective) per the MOAT.
3. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.
4. Note that MW instruments cannot retrieve within ~50-100 km of land due to contamination of the side-lobe, so coastal waters are problematic.
5. The characterization of errors for each retrieval is a MW SST user community requirement ((e.g.) GHRSST L2P format). Although not defined in this document, such error characteristic will be defined for the AMSR-2 SST product as an objective requirement

JPSS L1RD Supplement Table 6.1.6 - Precipitation Type/Rate (AMSR-2)

Attribute	Requirement	Observed
PT/R Applicable Conditions: 1. Delivered under "all weather“ conditions		
a. Horizontal Cell Size	5 km land (89 GHz FOV) (1); 5 km ocean (37 GHz FOV size); 5 - 10 km sampling	As required
b. Mapping Uncertainty, 3 Sigma	< 5 km	As required
c. Measurement Range	0 - 50 mm/hr	0 ~ 75 mm/hr
d. Measurement Precision	0.05 mm/hr	0.01 mm/hr
e. Measurement Uncertainty	2 mm/hr ocean; 5 mm/hr over land	1.2 ~ 1.4 mm/hr over ocean; 3.1 ~ 3.6 mm/hr over land
f. Refresh	At least 90% coverage of the globe about every 20 hours (monthly average) (2)	As required
g. Precipitation Type	Stratiform or Convective	Convective rain available
Notes: 1. The HCS is consistent with the 89 GHz SDR product HCS. 2. This Refresh requirement is consistent with the AMSR-2 Cross-track Swath Width design of 1450 km for a single orbit plane.		

Product Time Latency

- The GAASP products are generated whenever a AMSR-2 L1B orbital data is available
- The product time latency here counts the time from the last observation received to the product generated, including data transfer time from JAXA -> NASA -> DDS -> NDE, but not the delay in the product distribution.
- The time latency requirement is currently TBD in JPSS L1RD for orbital processing



AMSR2 On-Orbit Calibration

- AMSR2 observed brightness temperatures (Tbs) will be used to infer several geophysical parameters over land and ocean
- Calibrated AMSR2 Tbs significantly improve performance and accuracy of geophysical retrieval algorithms
  - Identifying and correcting residual calibration biases in AMSR2 Tbs reduce retrievals errors

Calibration Strategy

- The double difference (DD) approach was used to inter-calibrate AMSR2 Tbs
  - Two instruments are needed (A & B) with one being the reference sensor

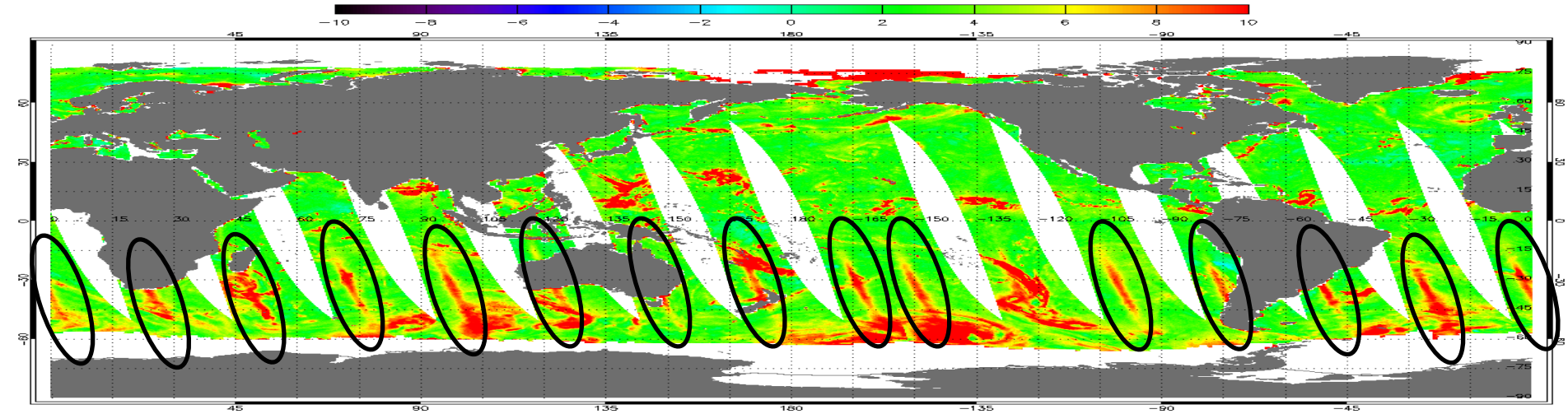
$$DD_{AB} = SD_A - SD_B$$

$$SD = Tb\_obs. - Tb\_sim.$$

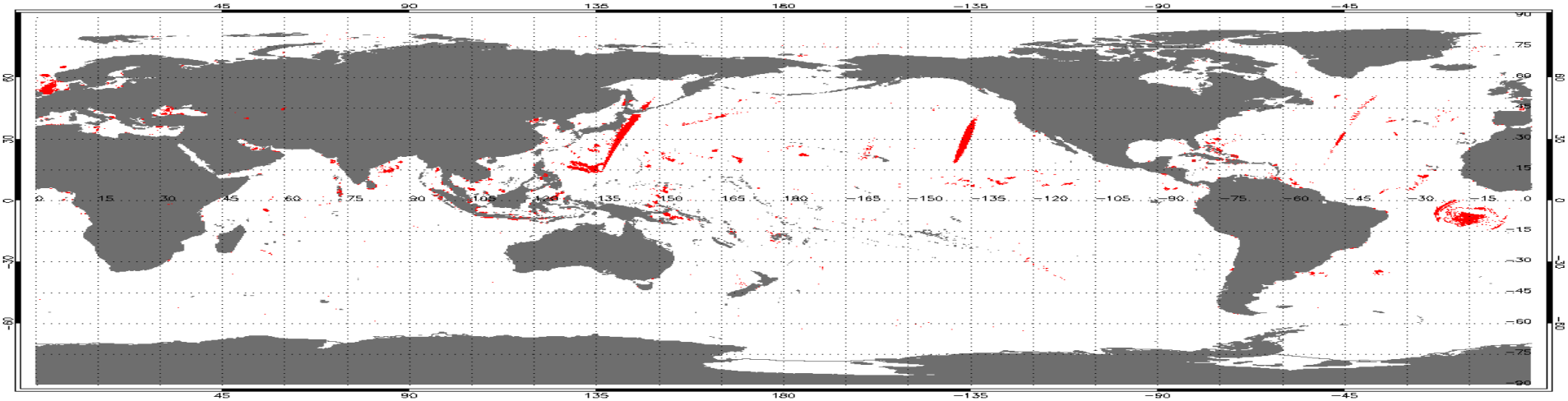
- TRMM microwave imager (TMI) was chosen as reference radiometer

Quality Control of Tb's (Sun Glint & RFI)

Sun Glint: [Tbh6_L1B – Tbh6_sim.], 08/02/2012

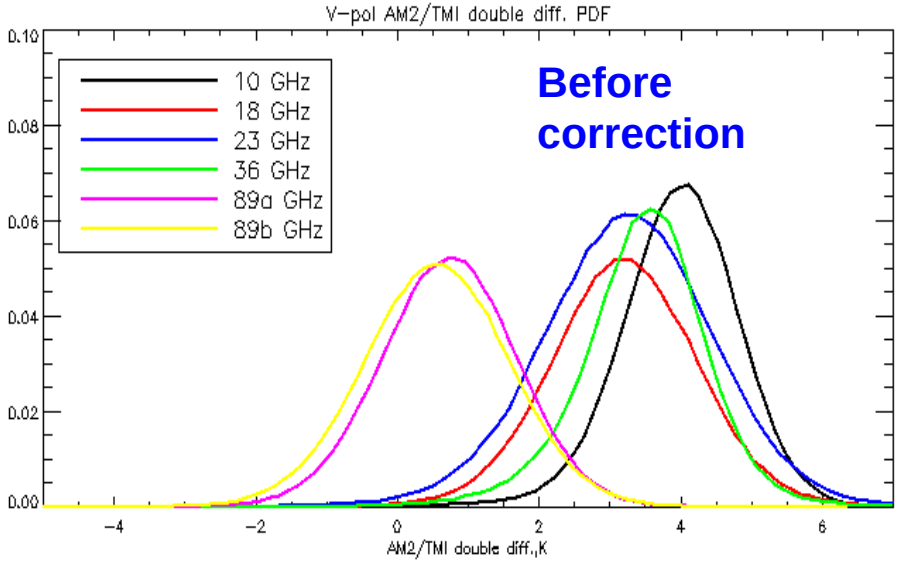


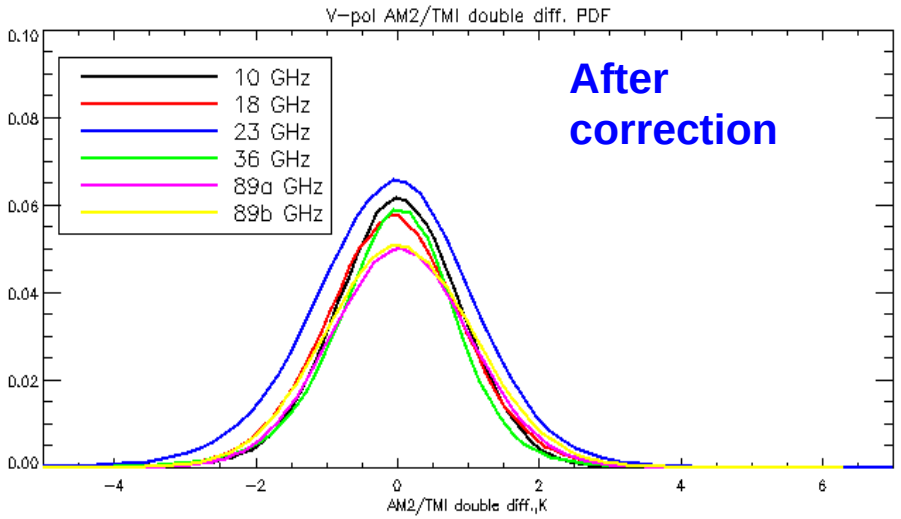
C-band RFI: Abs(Tbv6_L1B – Tbv7_L1B.) > 3, 08/02/2012



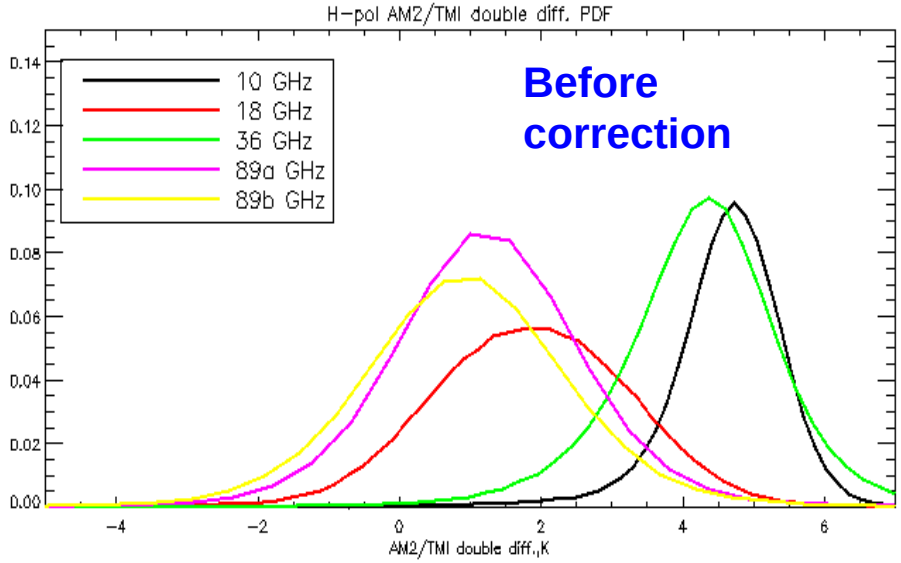
Double Difference PDFs of Brightness Temperatures

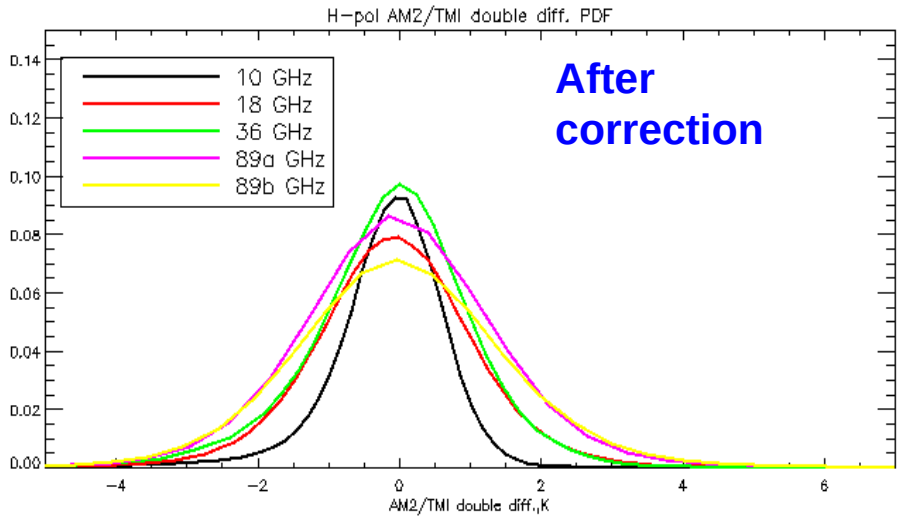
V-Pol



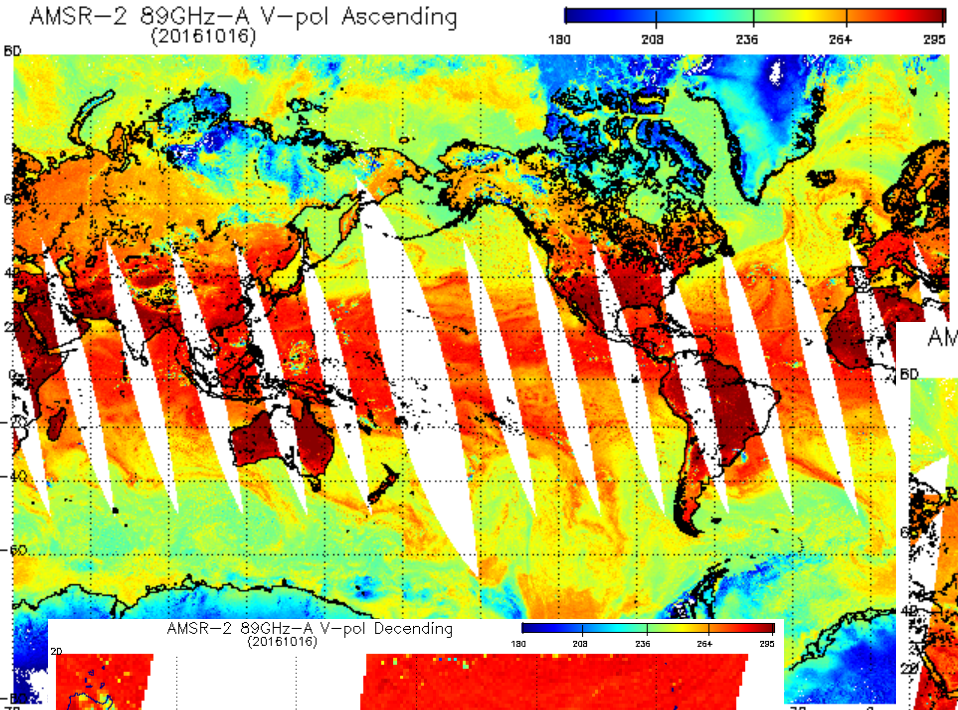


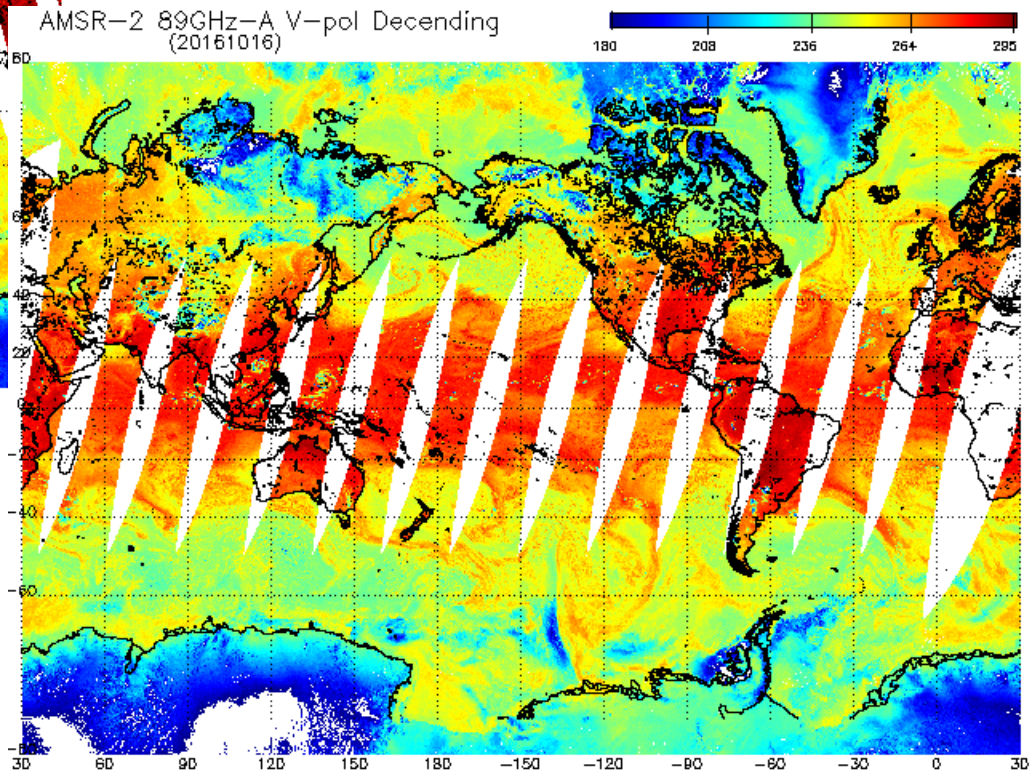
H-Pol

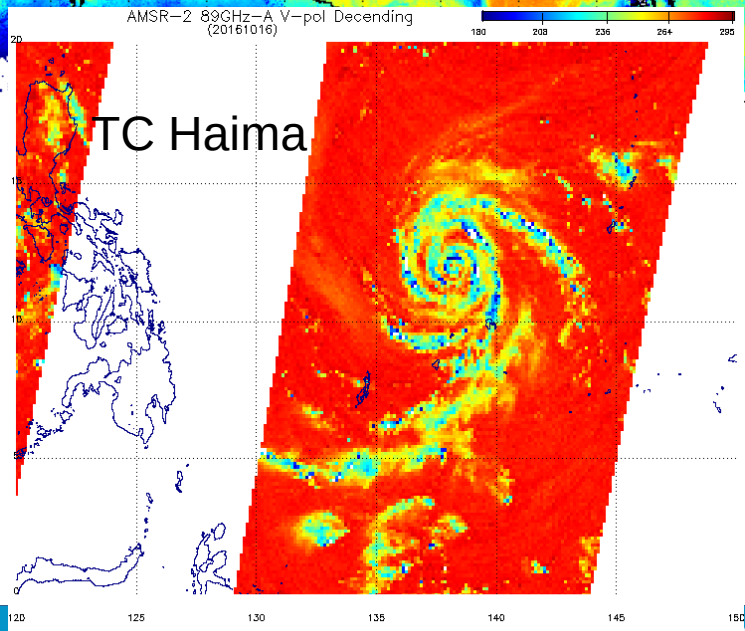




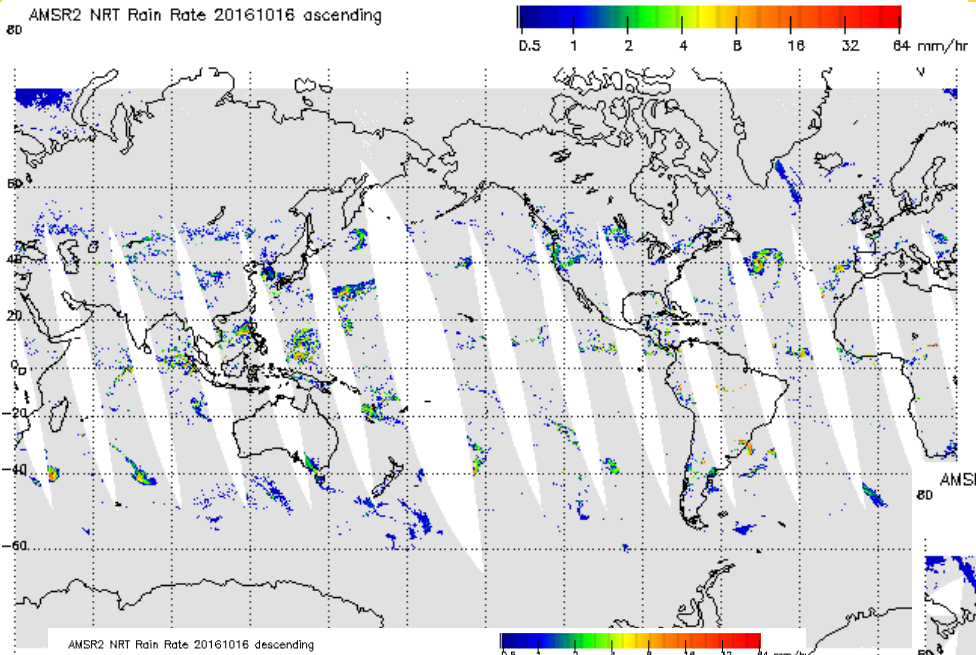
NOAA 85 GHz V-pol Tb Example (10/16/2016)

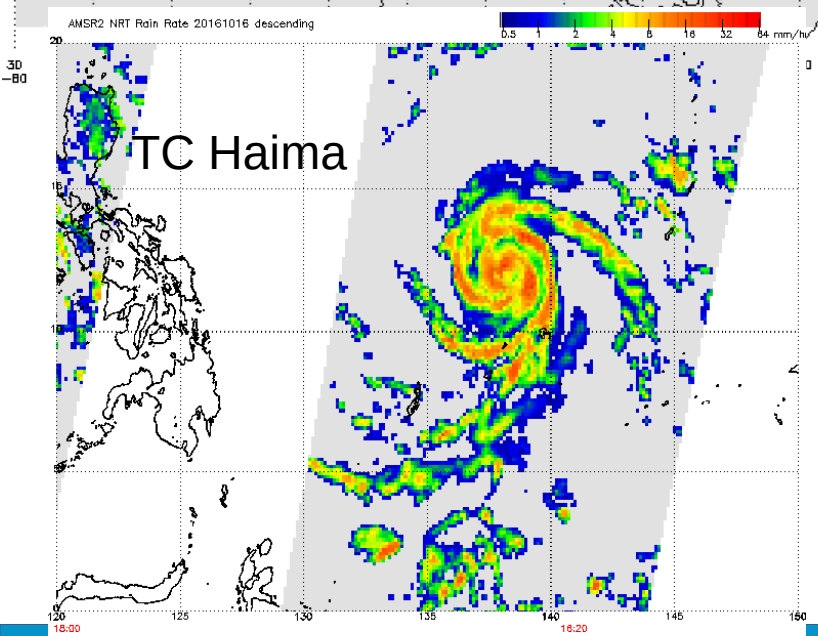


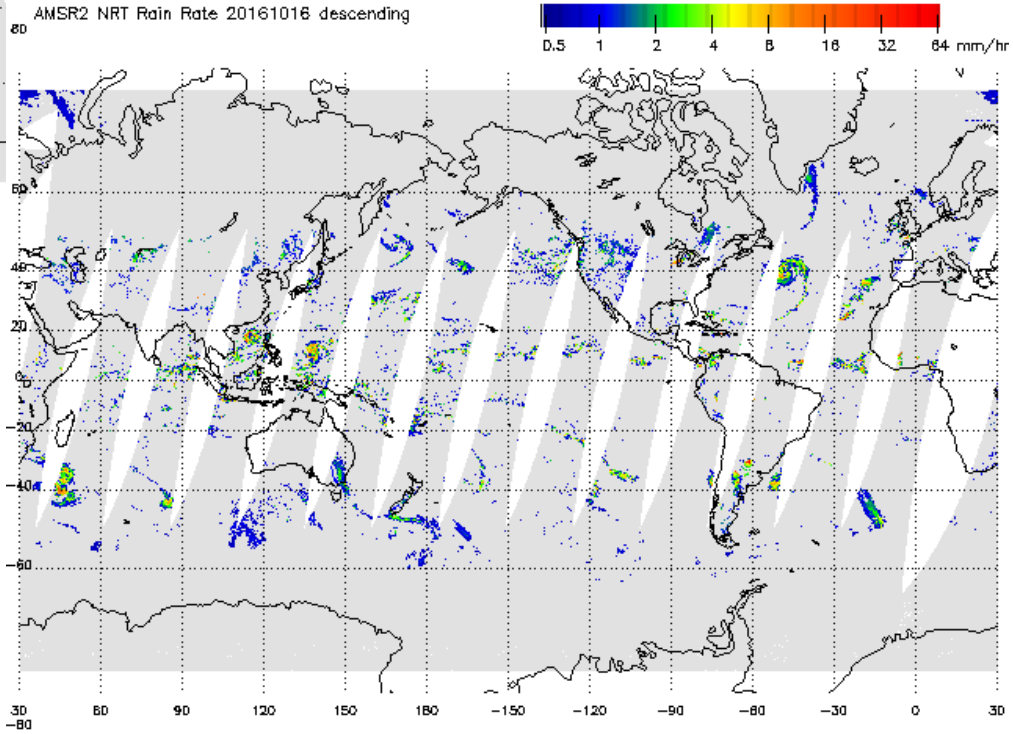




NOAA Precipitation Example (10/16/2016)



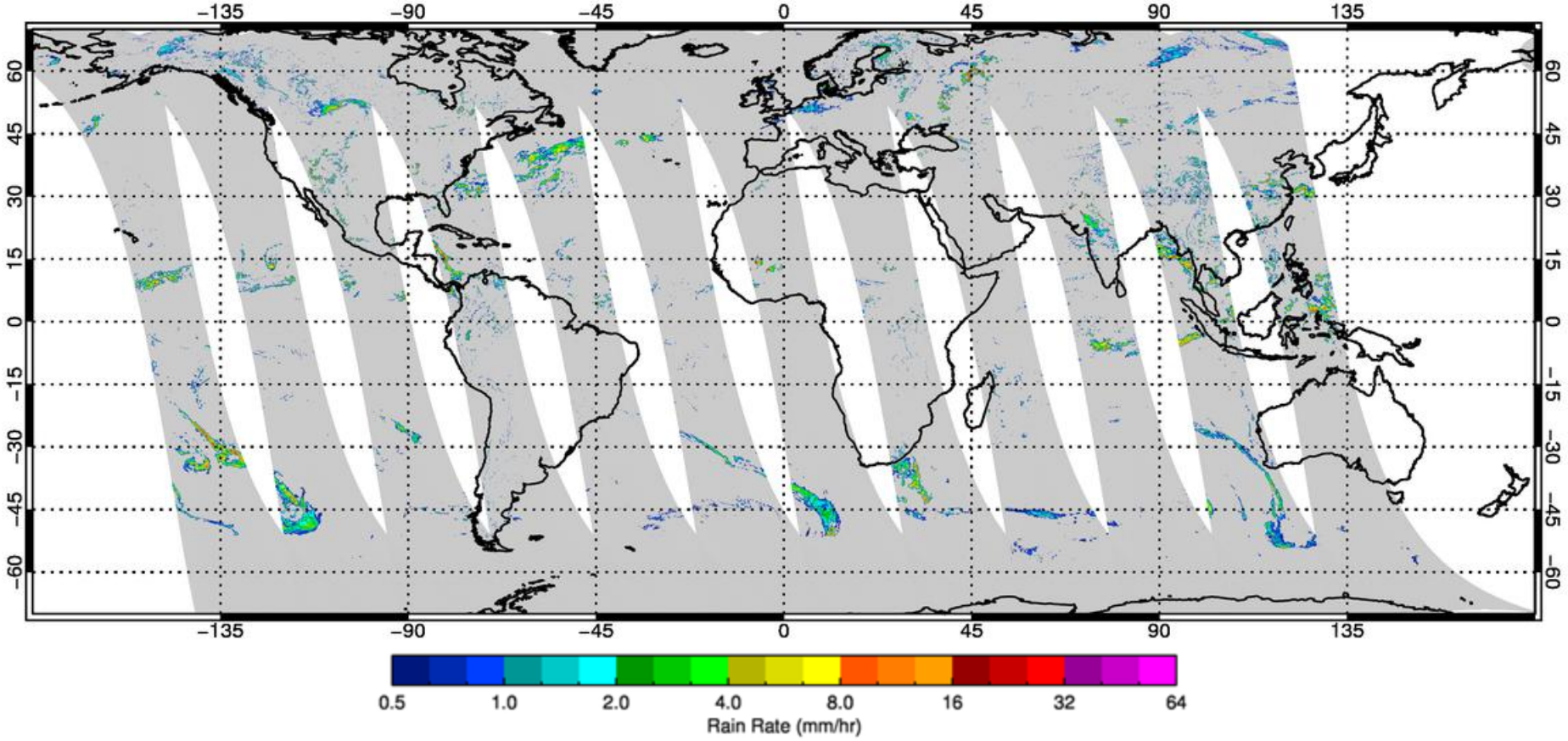




AMSR2 Precipitation Output

GPROF2010 Rain Rates for GCOM/AMSR2

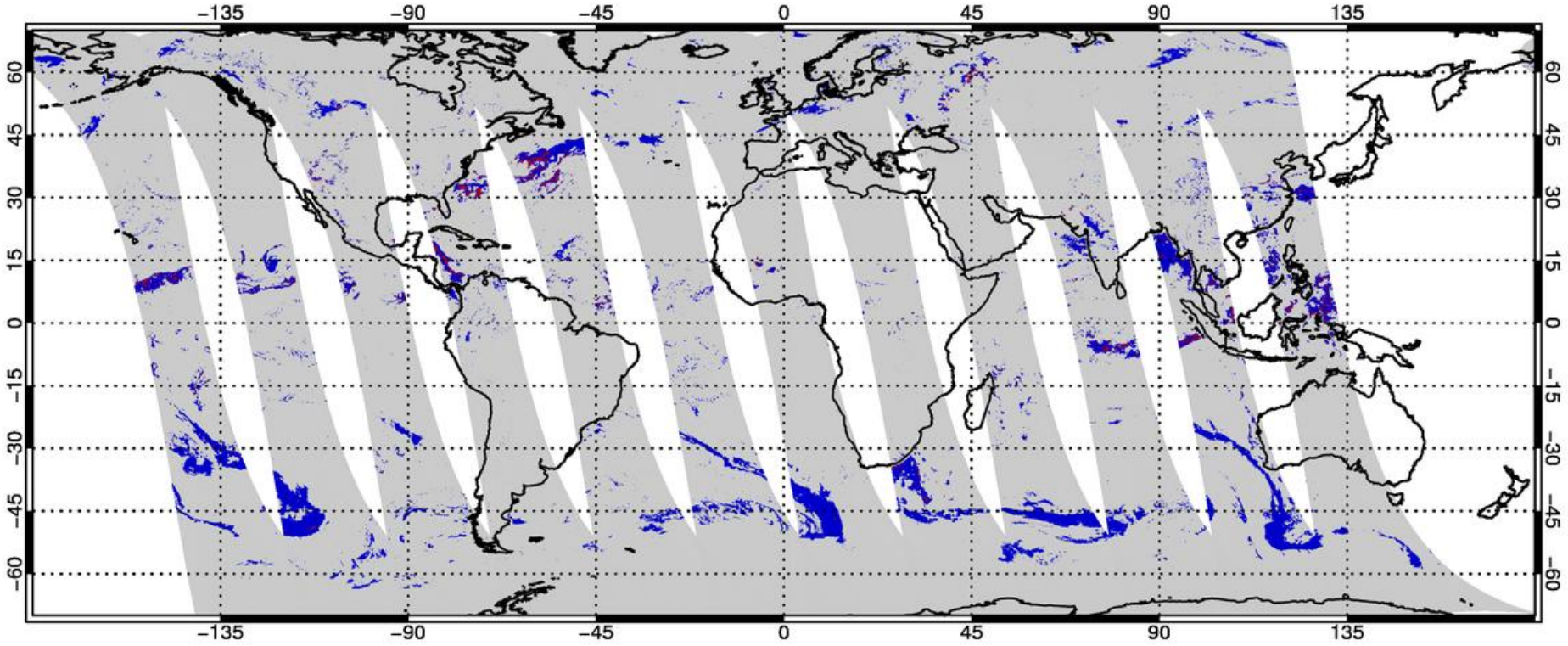
August 3rd, 2016



AMSR2 Precipitation Output

Convective/Stratiform Precipitation Separation

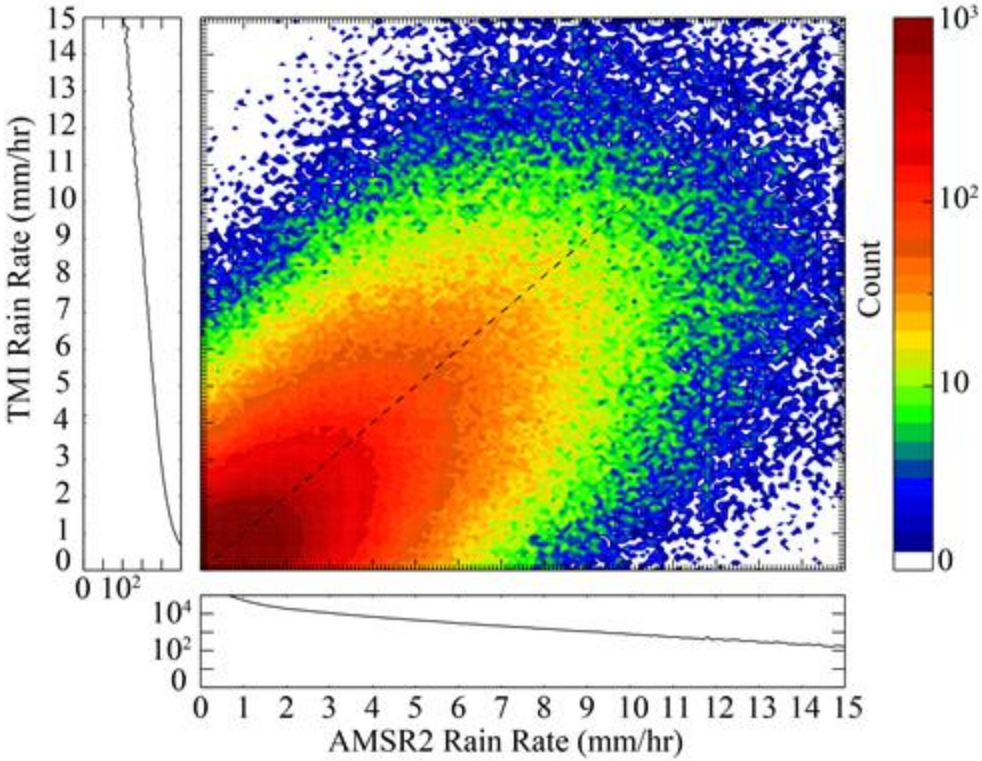
August 3rd, 2016



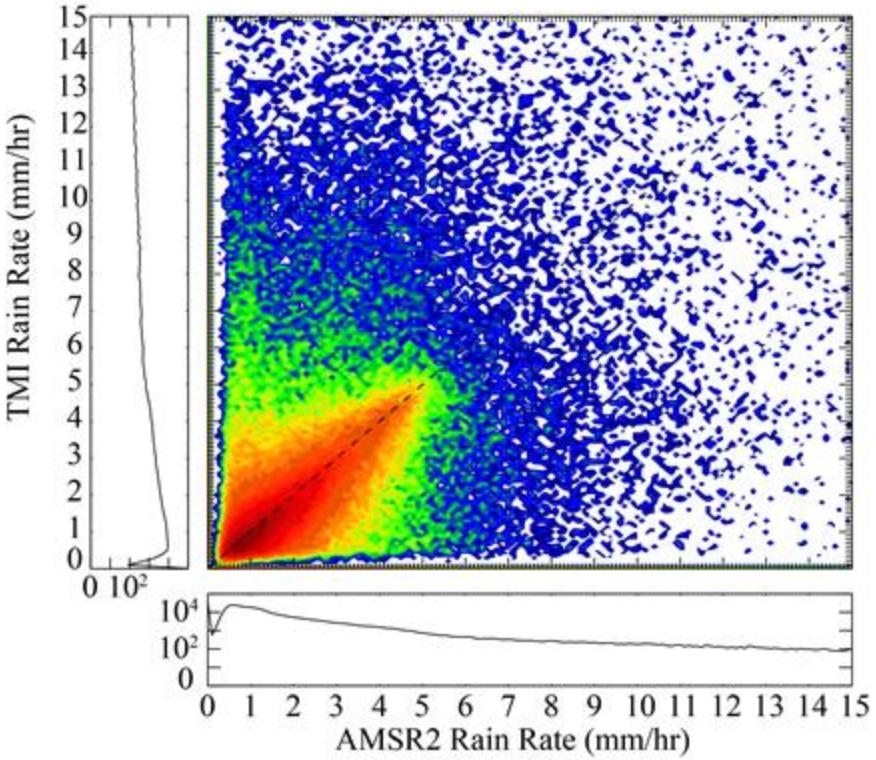
Validation - Instantaneous

GCOM-W vs. TMI Collocated Observations

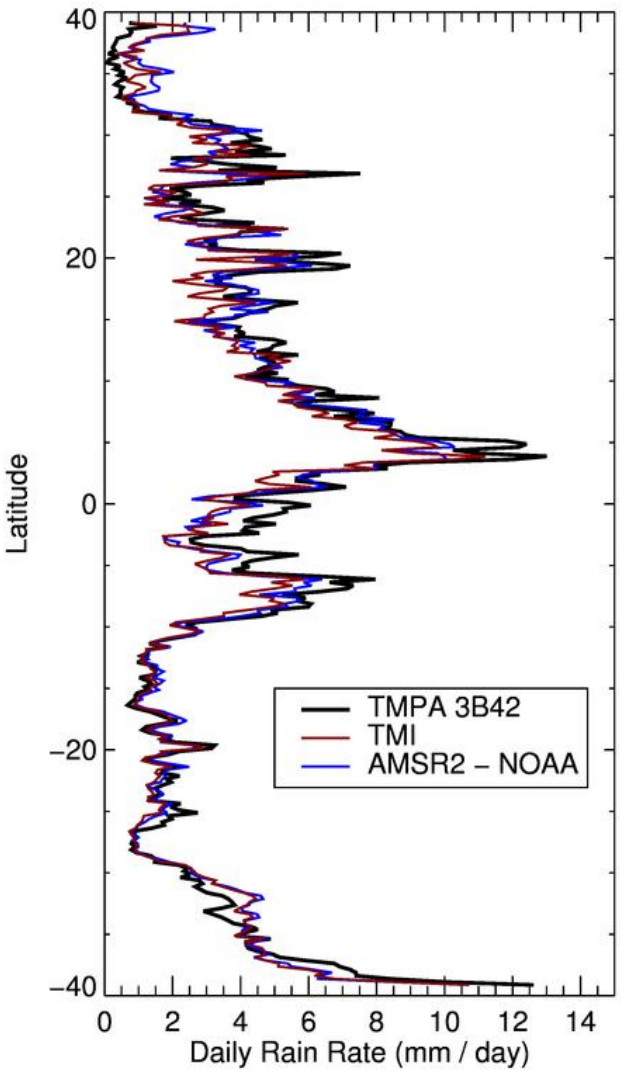
Ocean



Land



Validation - Instantaneous

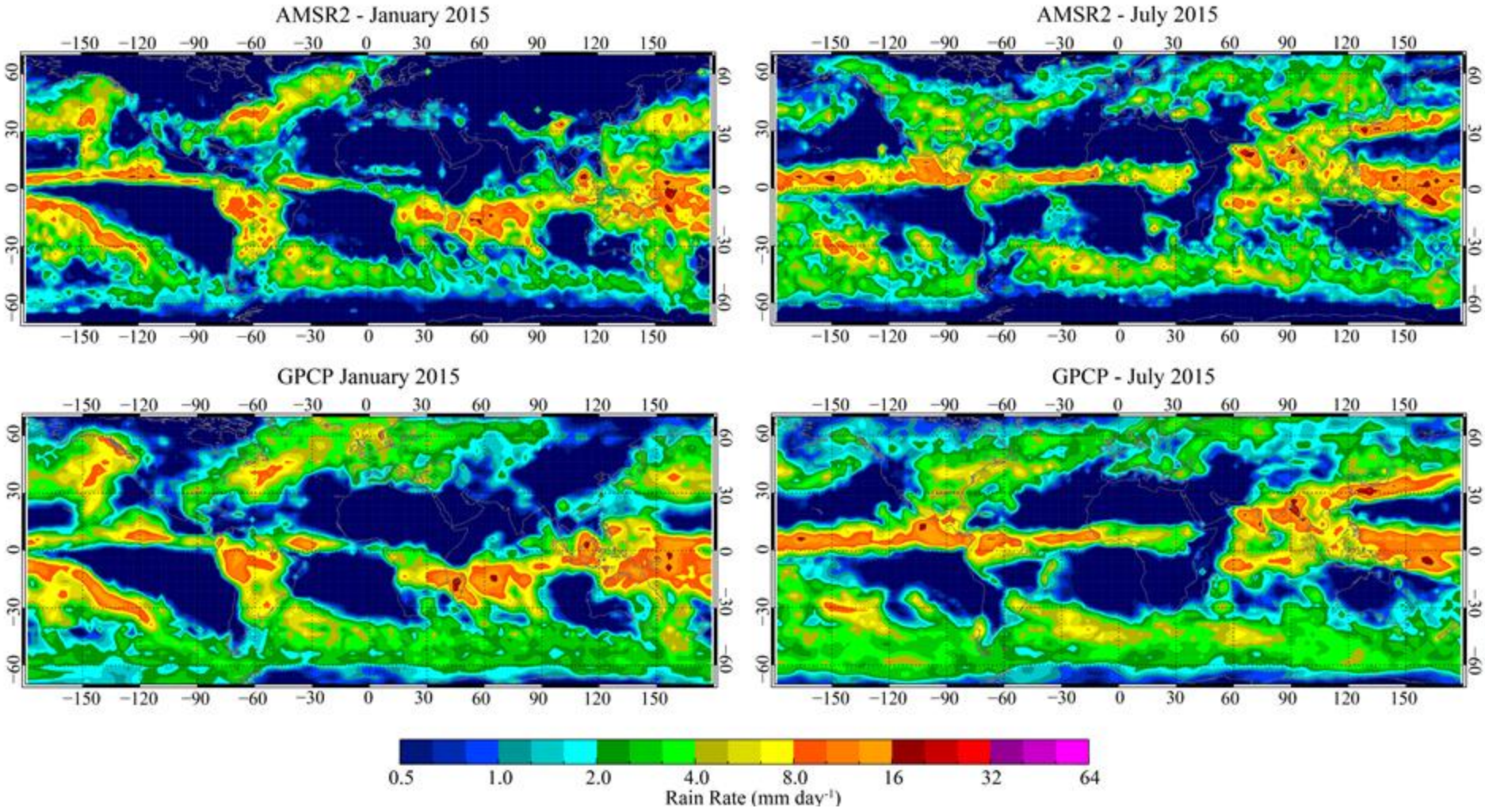


Instantaneous Rain Rate RMSD relative to TRMM Products

RMSD (mm/hr)	Land	Ocean	Overall
Requirements	5.0	2.0	–
TMI & TMPA	3.1	1.2	1.6
AMSR2 & TMI	3.6	1.2	1.8
AMSR2 &TMPA	3.1	1.4	1.9

Validation - Seasonal

GCOM-W vs. GPCP Monthly Precipitation

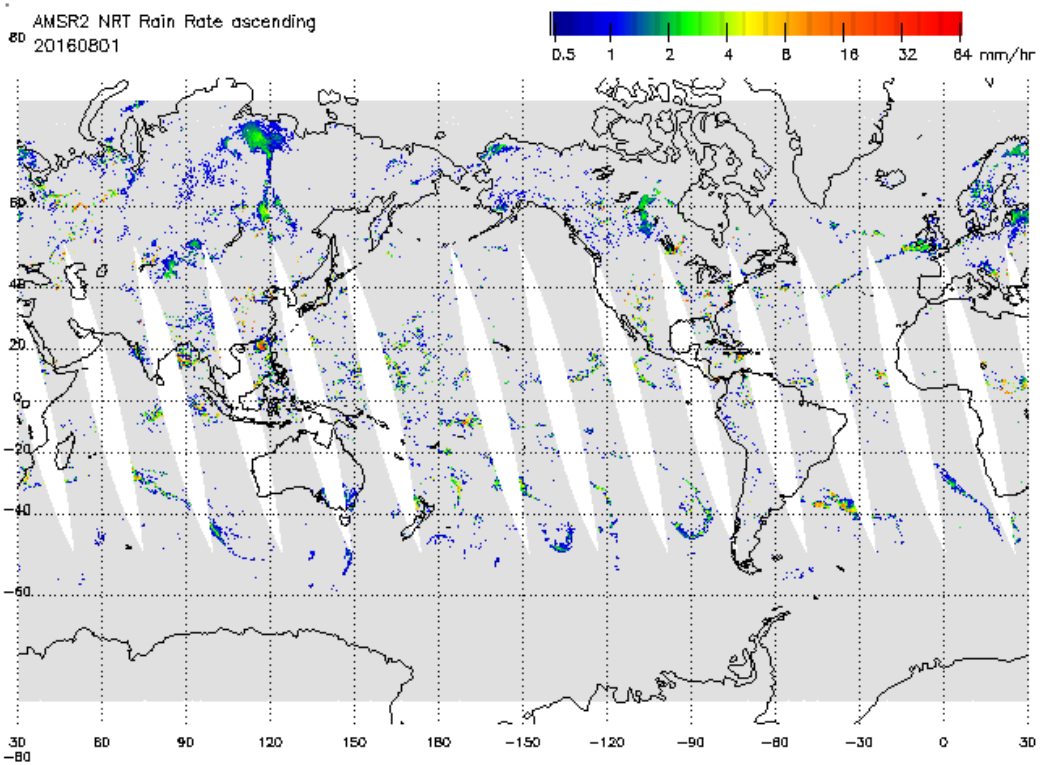


OSPO Product Monitoring

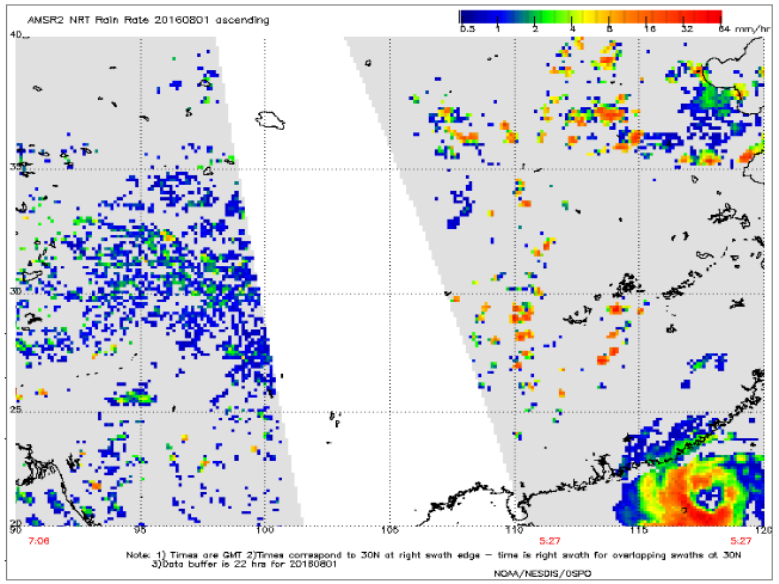
NOAA Operational GCOM-W1 AMSR-2 Products Maps

Map Types	Products	Available Dates
Daily	BTs GPs	2016-08-03
Realtime	CLW SSW RR SST TPW	2016-08-02
Storms		2016-08-01
		2016-07-31
		2016-07-30
		2016-07-29
		2016-07-28

Ascending Pass



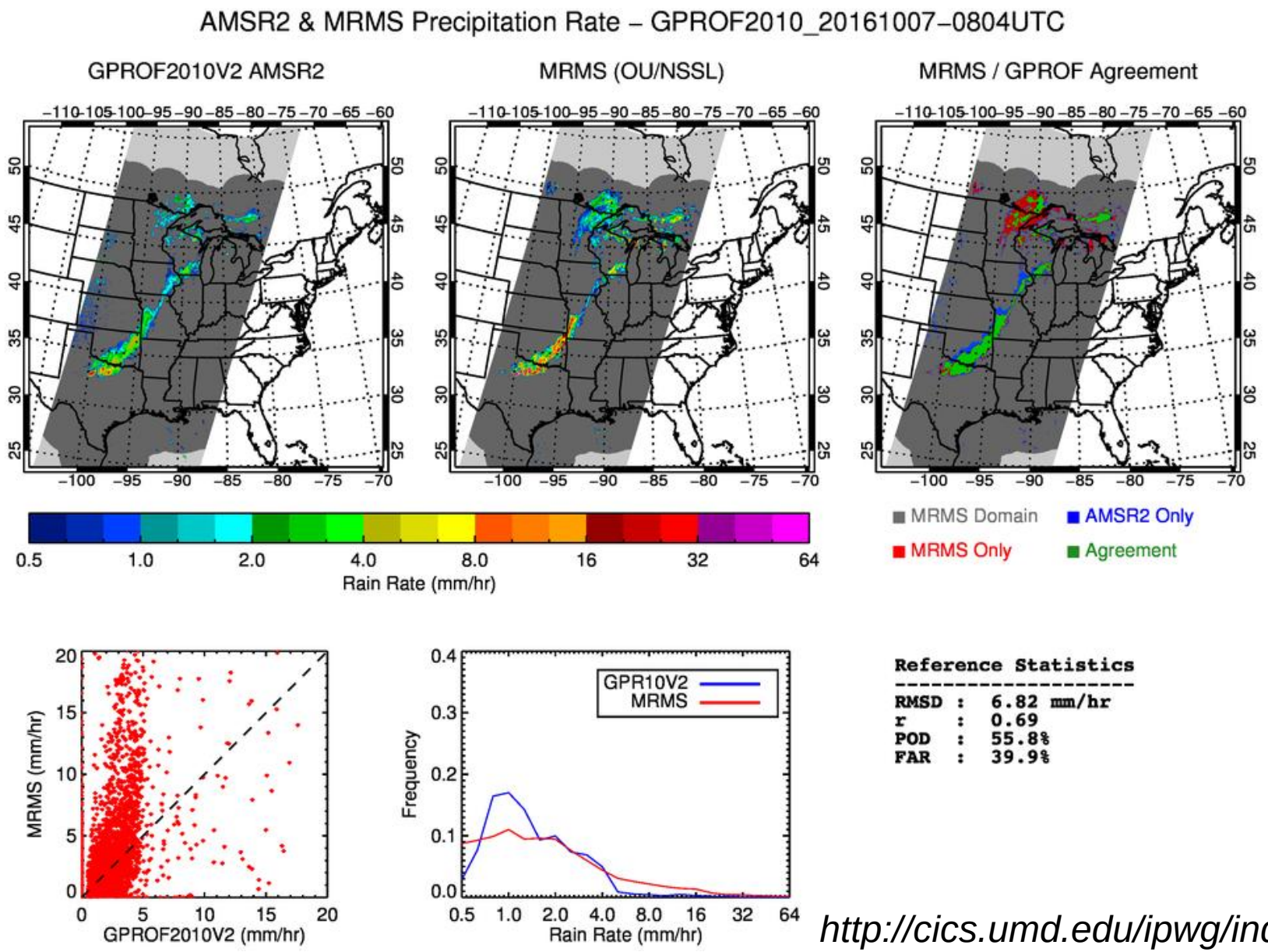
Zoomable Sectors



Typhoon Nida (Aug 1st 2016)

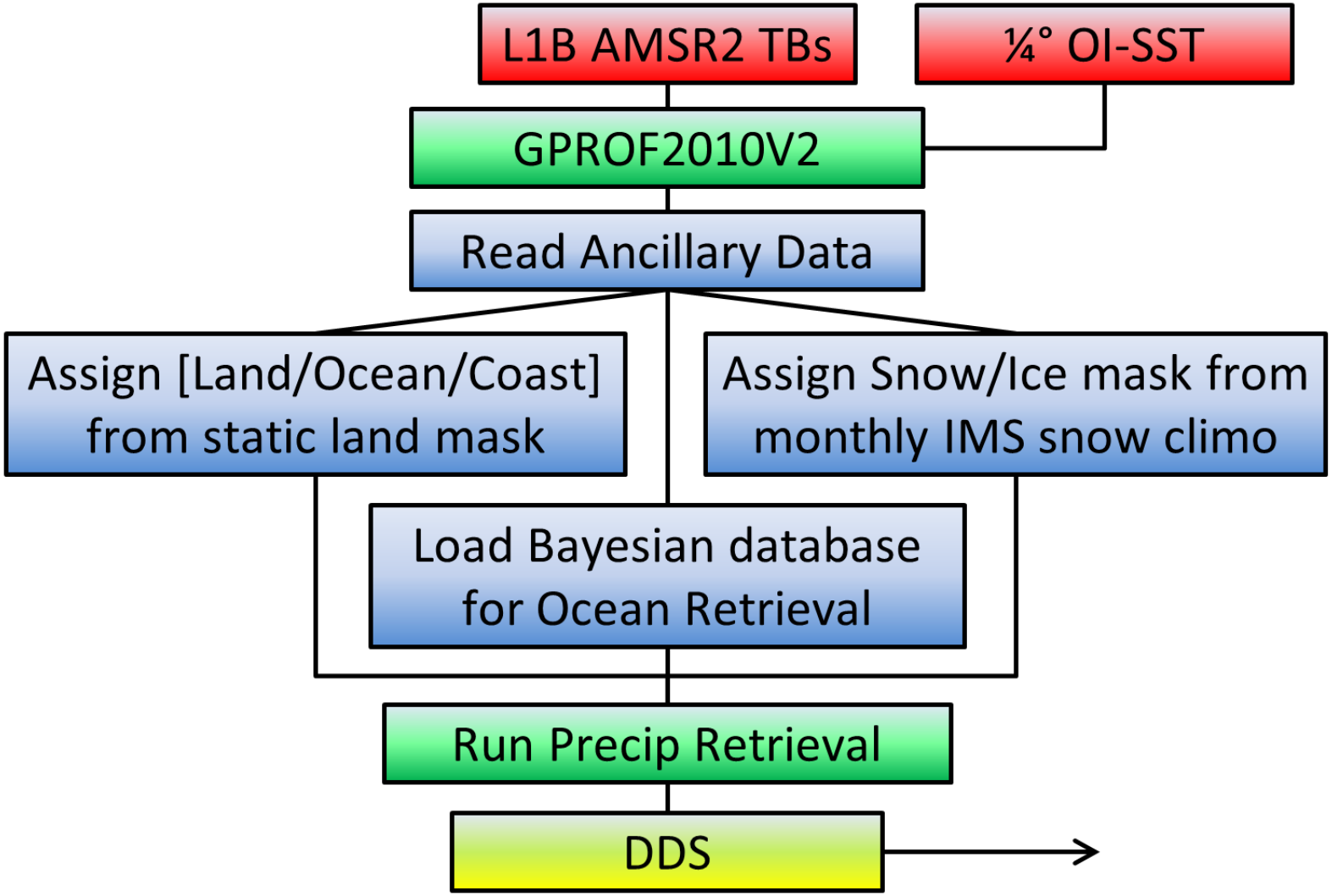
http://www.ospo.noaa.gov/Products/atmosphere/gpds/

Routine Swath Validation



http://cics.umd.edu/ipwg/index.html

Algorithm Inputs

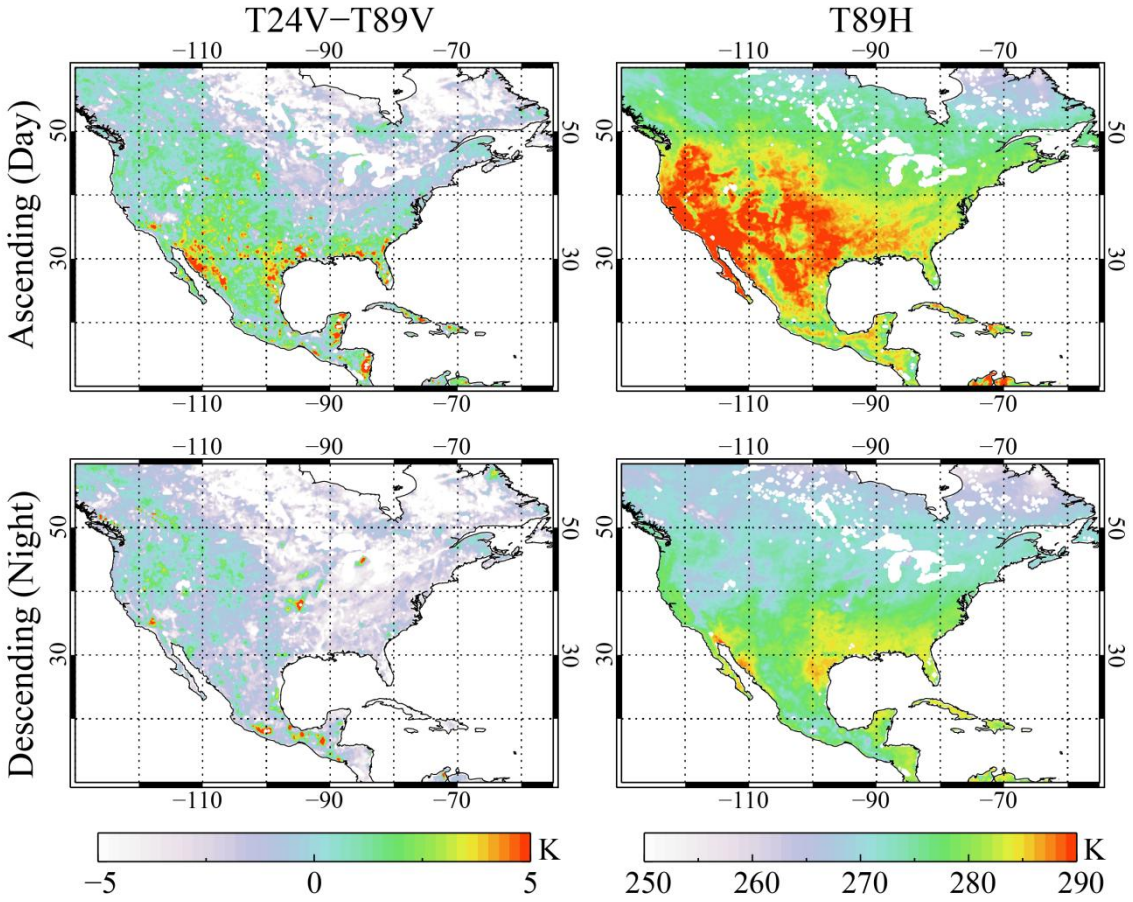


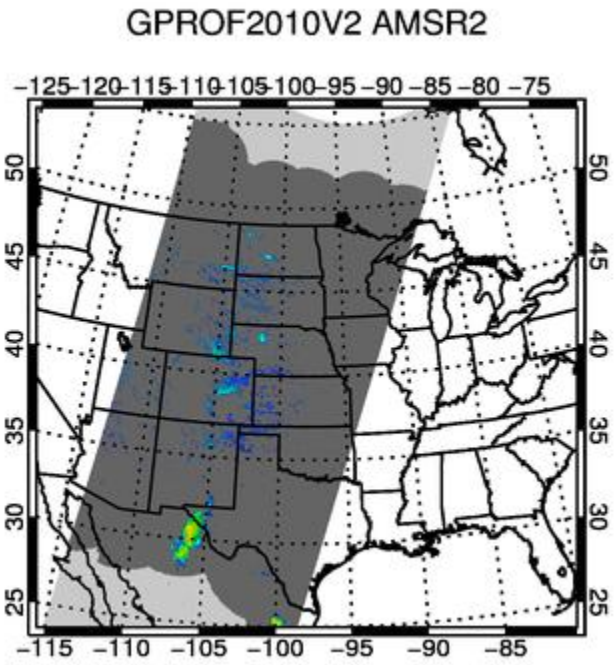
Quality Flag Analysis – Land

- 0
  - No quality issues
- 1
  - Ambiguous cold Tbs; may be precip or cold surface
- 2
  - Climatological snow/ice/desert
  - Screening for cold surface, arid land, or snow

Quality Flag Issues – Land

- Cold surface screening for descending node often fails, and low scattering index (T24 - T89) falsely identifies precip





Quality flag analysis - Ocean

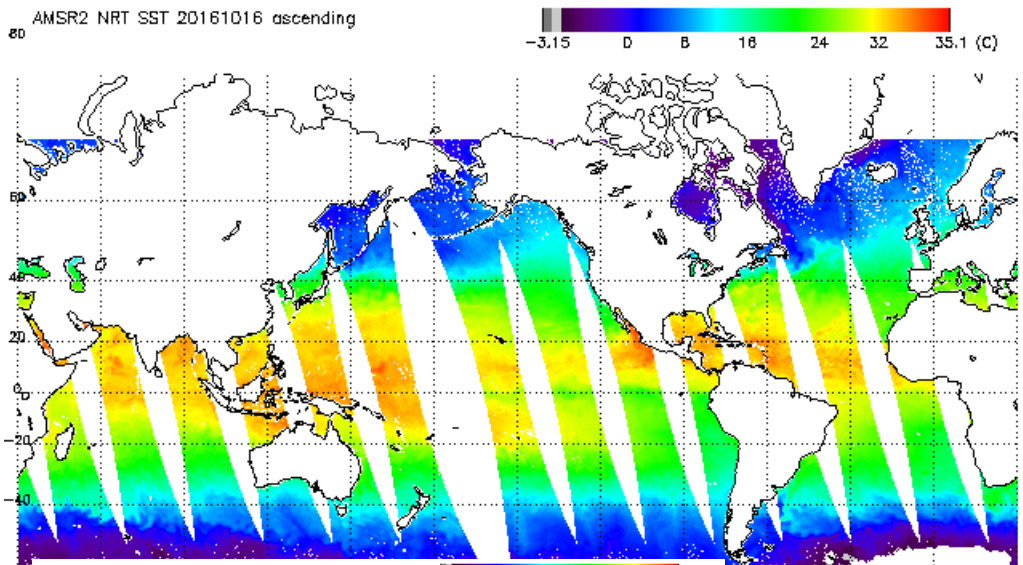
- 0
  - No quality issues
- 1
  - Extended bin search during Bayesian inversion
    - Typically at higher latitudes
- 2
  - Sea ice likely
- Potential improvement: Using GPM-derived database will improve the representation within the database at higher latitudes.

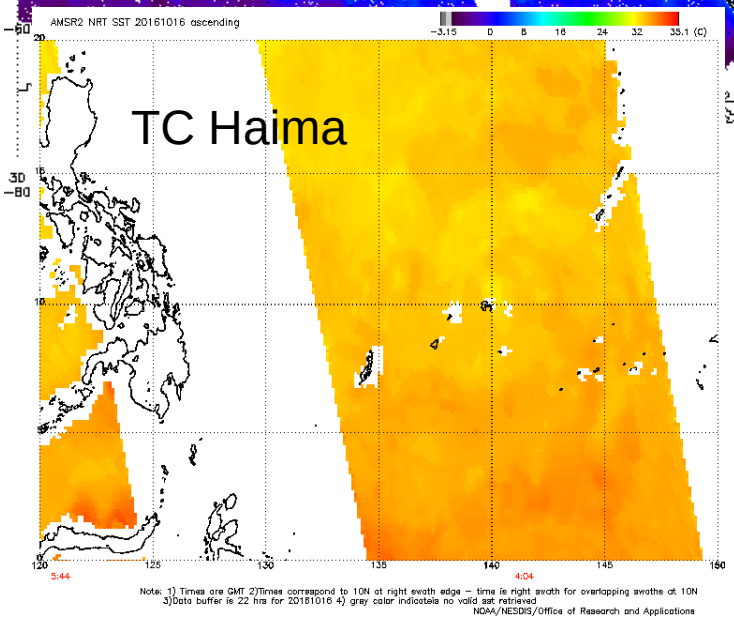
Error Budget

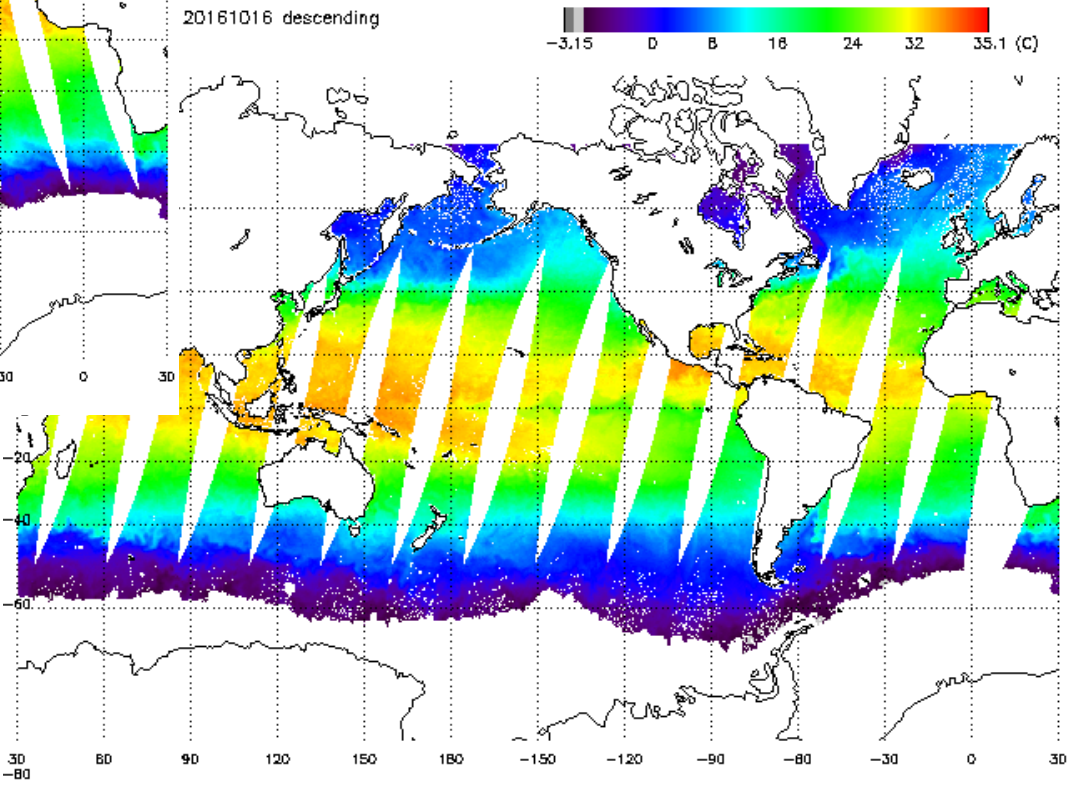
Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
Rain Rate	5.0 mm/hr (Land) 2.0 mm/hr (Ocean)	3.6 mm/hr 1.2 mm/hr	Sensor calibration RT Model Random Error	Relative to TMI [See Slide 6]
Measurement Range	0-50 mm/hr	0-75 mm/hr		L2 EDR
Measurement Precision	0.01 mm/hr	<0.01 mm/hr		L2 EDR
Rain Type	Convective/ Stratiform	Convective Rain Rate	Convective: 40% Stratiform: 95%	Accuracy relative to MRMS precip type

NOAA SST Example (10/16/2016)

% of flagged points (NOAA): ~ 27%







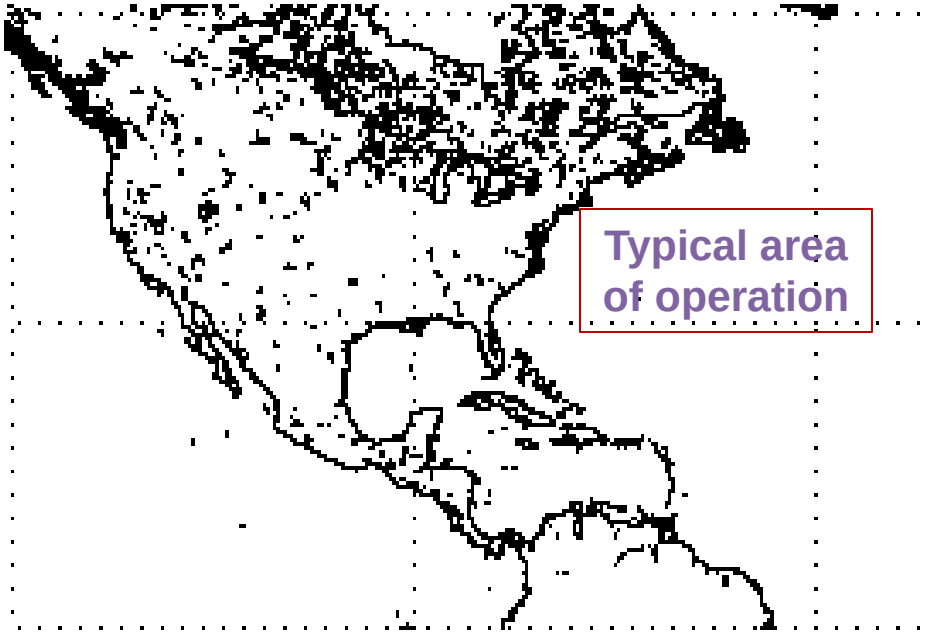
Validation - SST

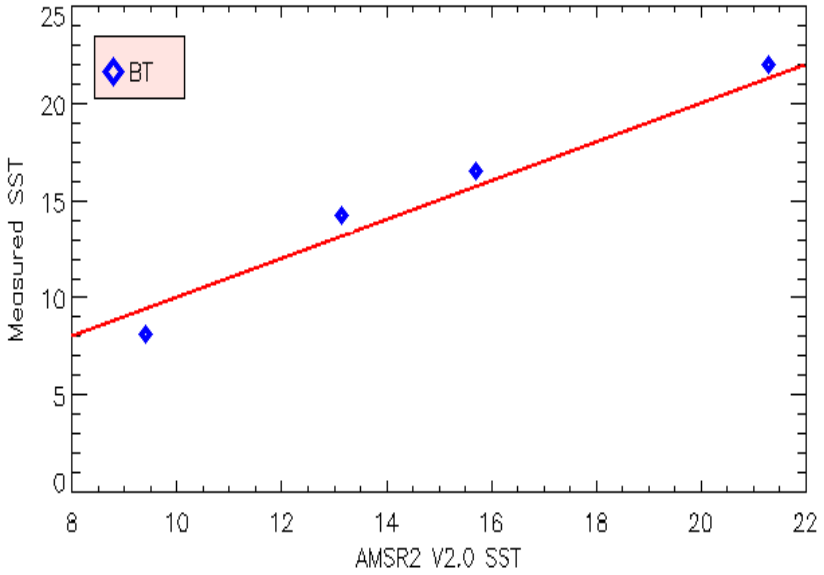
- Ancillary data for AMSR2 SST validation
  - Models : Reynolds
  - Measurements : TMI, Buoys

GCOM Sea Surface Temperature Requirements				
EDR Attribute	**Requirement**	**Status**		
		Reynolds	**TMI**	**Buoys**
Measurement range	**271 – 313 k**			
Measurement uncertainty	**1.0 k**	**0.5**	**0.6**	**0.7**
Measurement accuracy	**0.5 k**	**0.0**	**-0.2**	**0.2**

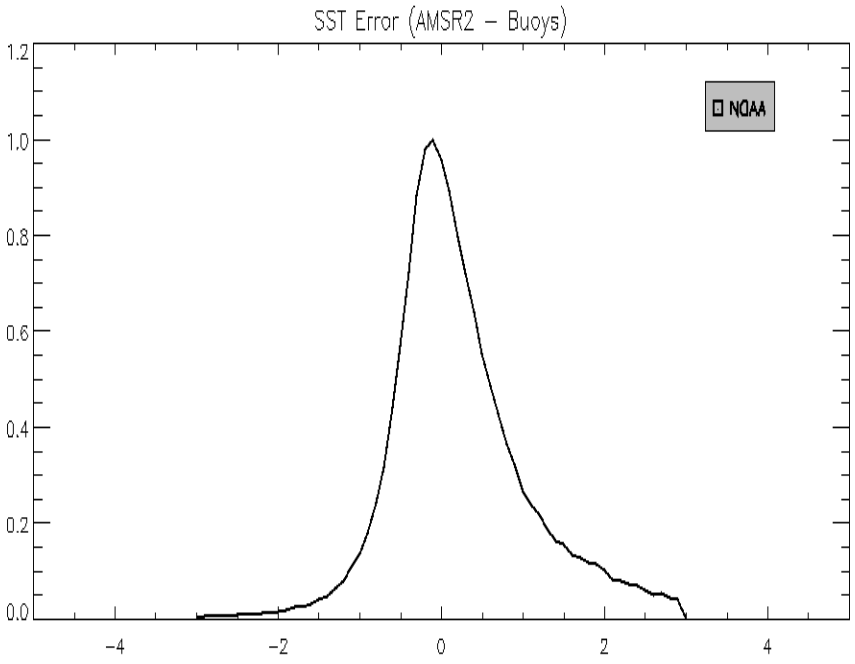
SST Validation/Field Experiments

- During 2016 winter season field experiments we dropped several Airborne expendable Bathy Thermograph (AXBT) to measure SST
  - Collocated with AMSR2 overpass

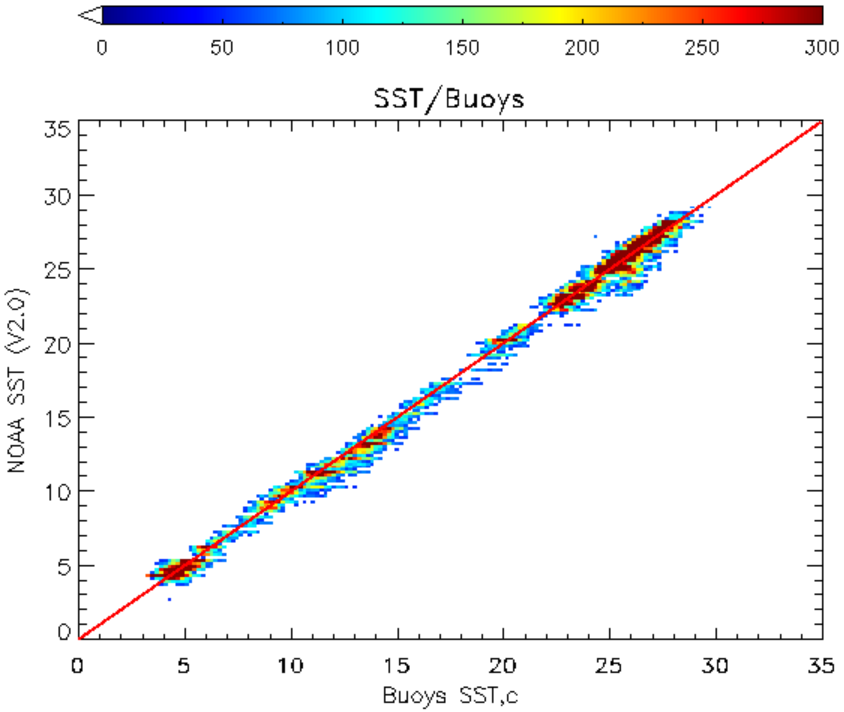




SST Validation / Buoys



SST Error, °c



Sea Surface Temperature Speed Error Budget

Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
SST	1.0K	0.5-0.7K	Sensor calibration Measurement variability Random Error	Relative to Reynolds, TMI, and Buoys
Measurement Range	271-313 K	271-313K		L2 EDR
Measurement Precision	0.5K	0.2K		L2 EDR

TPW Validation

- Ancillary data for AMSR2 TPW validation
  - TMI & AMSR2 EDRs from RSS
  - NOAA-19 EDRs from NOAA's Microwave Integrated Retrieval System (MIRS)

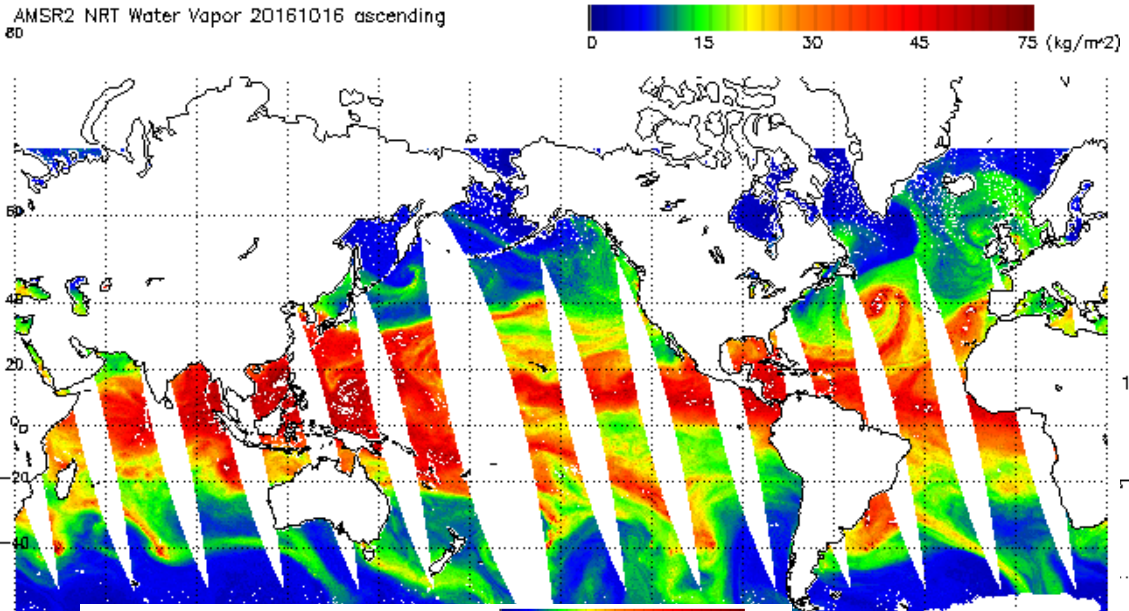
GCOM Total Precipitable Water Requirements				
EDR Attribute	**Requirement**	**Status**		
		TMI	**GDAS**	**NOAA19**
Measurement range	**1 – 75 mm**			
Measurement uncertainty	**2mm or 10% whichever is greater**	**1.1**	**1.8**	**1.4**
Measurement accuracy	**1 mm**	**0.0**	**0.1**	**0.7**

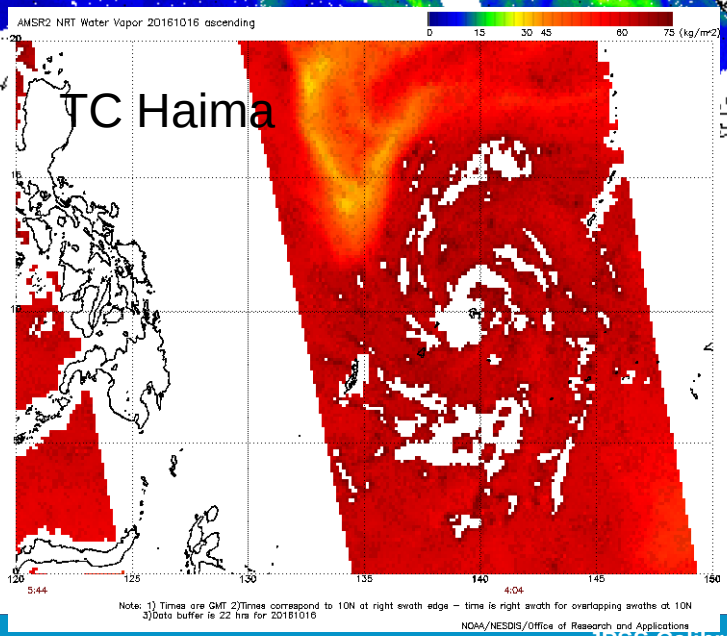
*** TPW & CLW changes are fastest of all other parameters. Interpolated 6H models are not expected to agree well with instantaneous measurements from AMSR2**

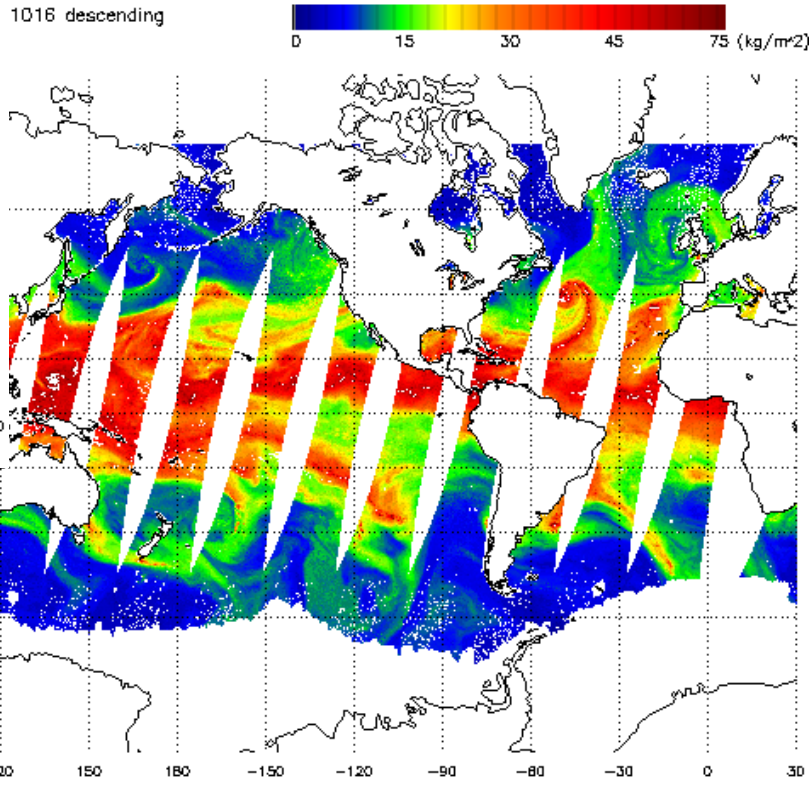
Ocean Surface Wind Speed Error Budget

Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
Wind Speed	2 m/sec or 10%	0.9-1.5 m/s	Sensor calibration Measurement variability Random Error	Relative to GDAS, TMI, and Buoys
Measurement Range	2-30 m/sec	0-30 m/sec		L2 EDR
Measurement Precision	0.5 m/sec	0.1-0.3 m/sec		L2 EDR

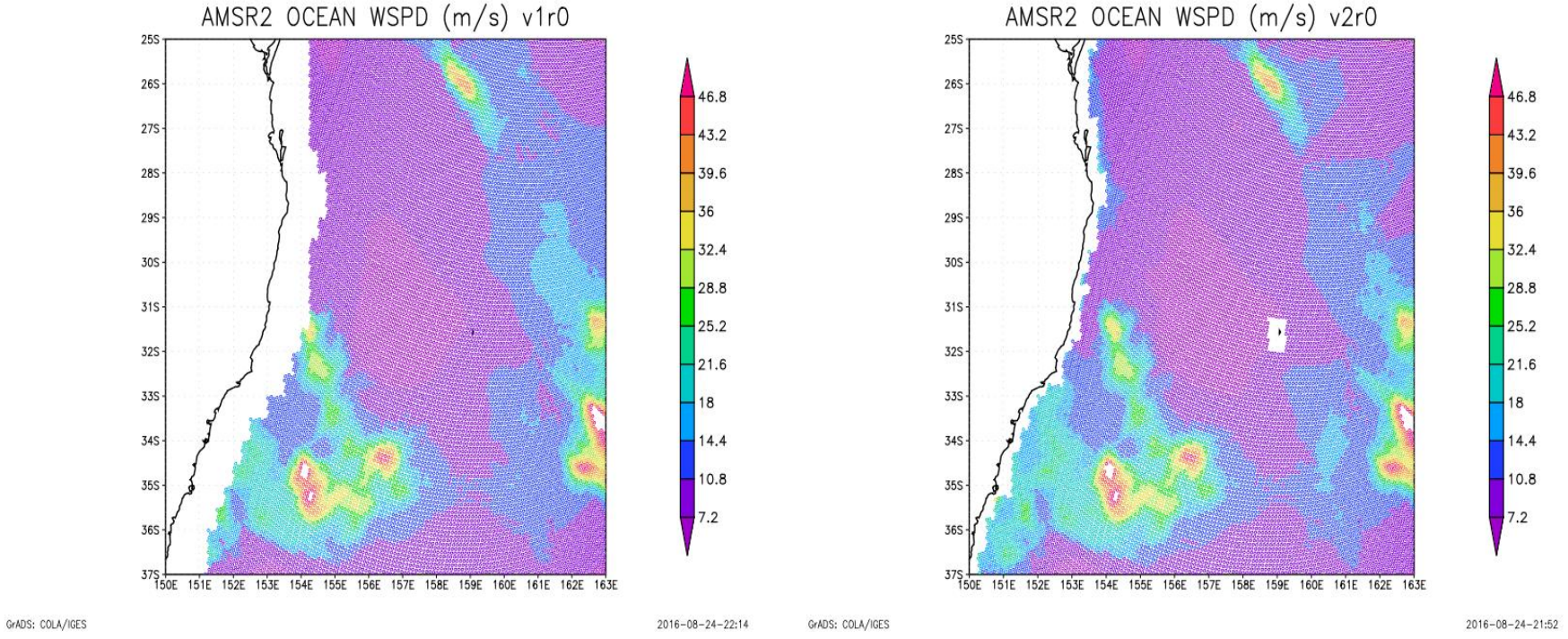
NOAA TPW Example (10/16/2016)







Improved TPW near Coast Line

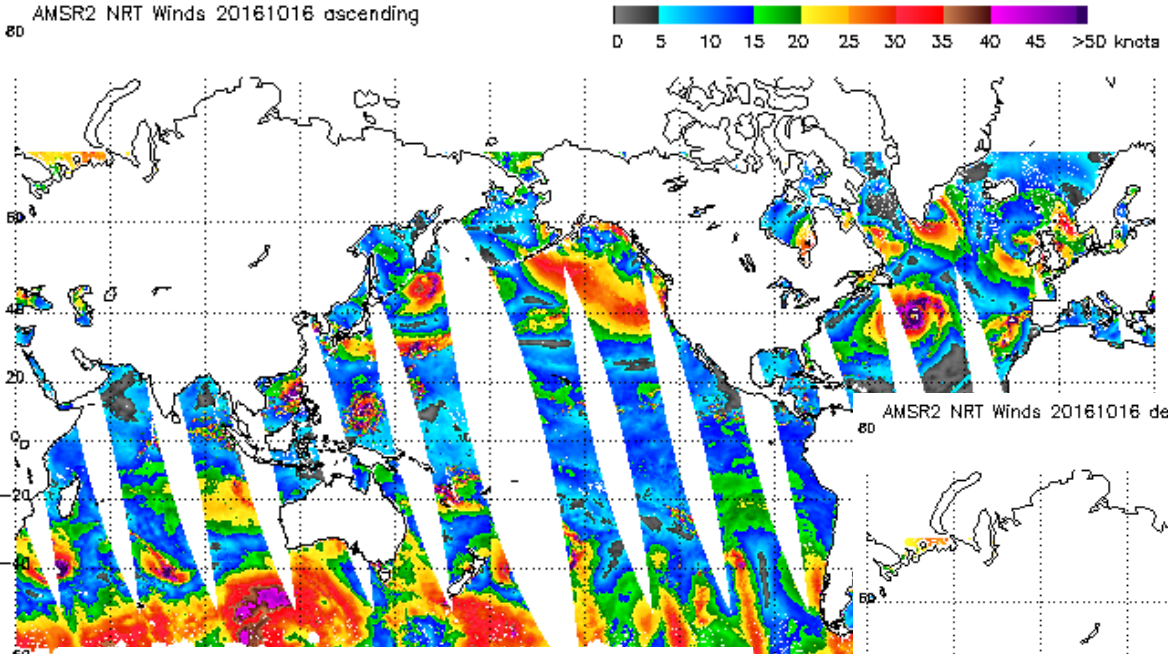


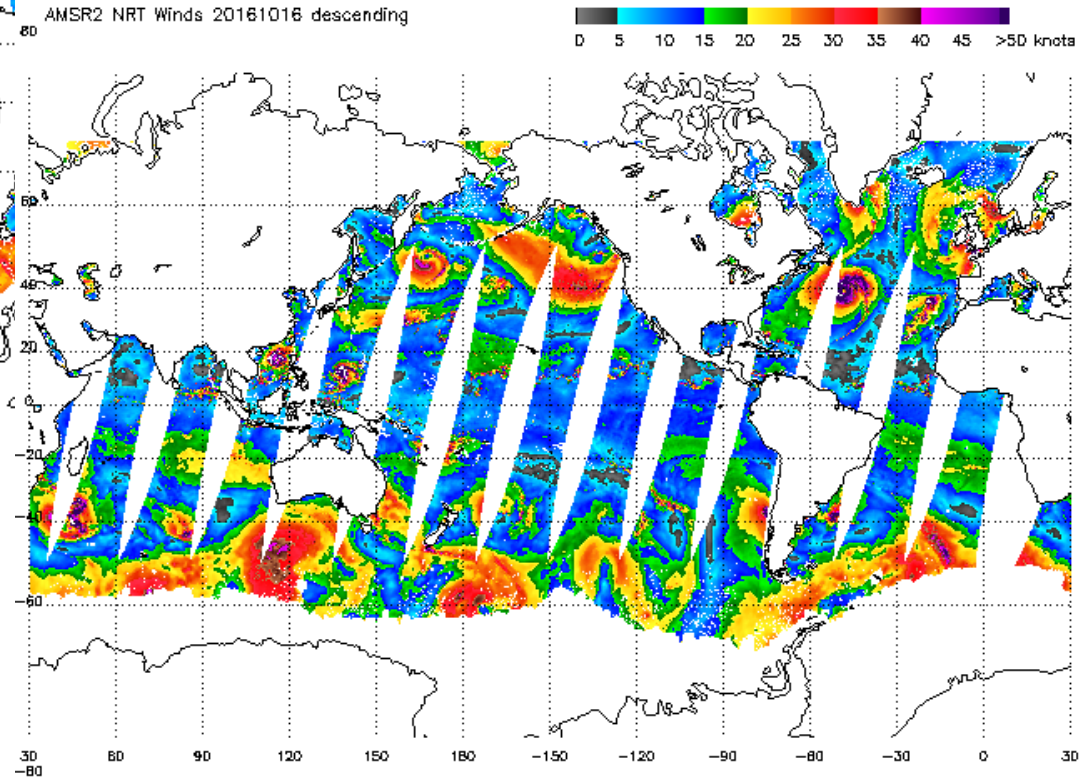
Significant improvement in the coverage along the coastlines (images credited to NWS/AWIPS, Lee Byerle and Mike Johnson)

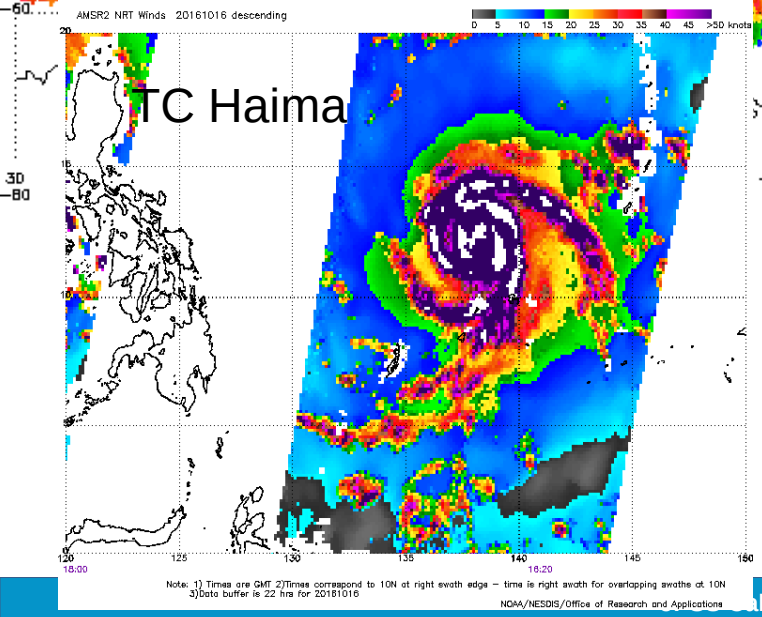
Total Precipitable Water Error Budget

Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
TPW	2 mm or 10%	1.1-1.8 mm	Sensor calibration Measurement variability Random Error	Relative to GDAS, TMI, and NOAA19
Measurement Range	1-75 mm	0.75 mm		L2 EDR
Measurement Precision	1 mm	0.1 -0.7 mm		L2 EDR

NOAA Wind Speed Example (10/16/2016)







SSW Validation

- Ancillary data for AMSR2 SSW validation
  - Models : GDAS
  - Measurements : TMI, Buoys

GCOM Sea Surface Wind Speed Requirements				
EDR Attribute	**Requirement**	**Status**		
		GDAS	**TMI**	**Buoys**
Measurement range	**2 – 30 m/s**			
Measurement uncertainty	**2 m/s or 10 % whichever is greater**	**1.3**	**0.9**	**1.5**
Measurement accuracy	**0.5 m/s**	**0.1**	**0.3**	**0.2**

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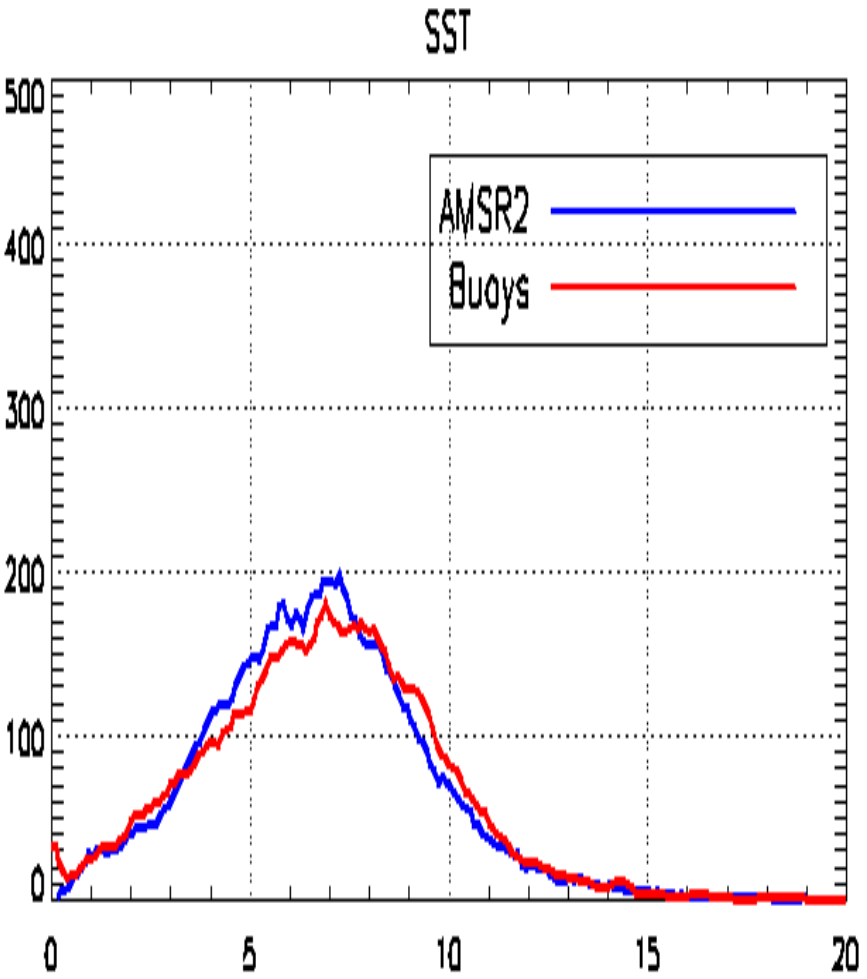
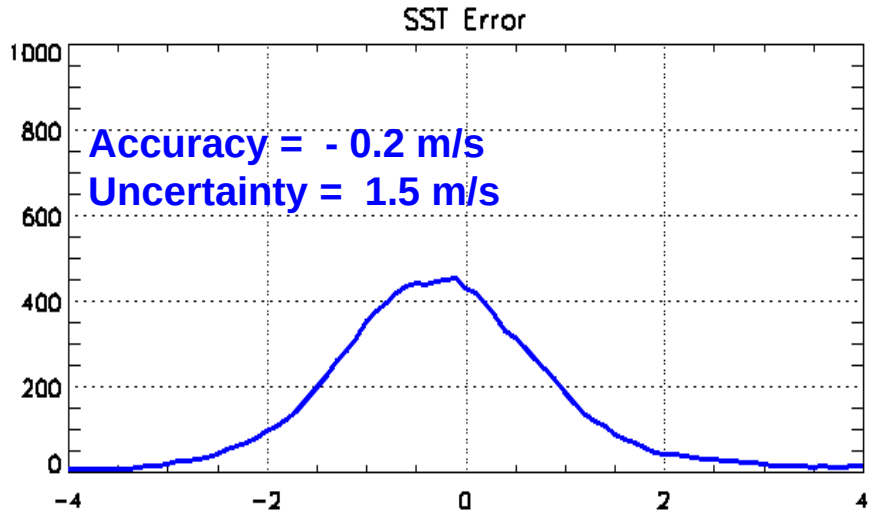
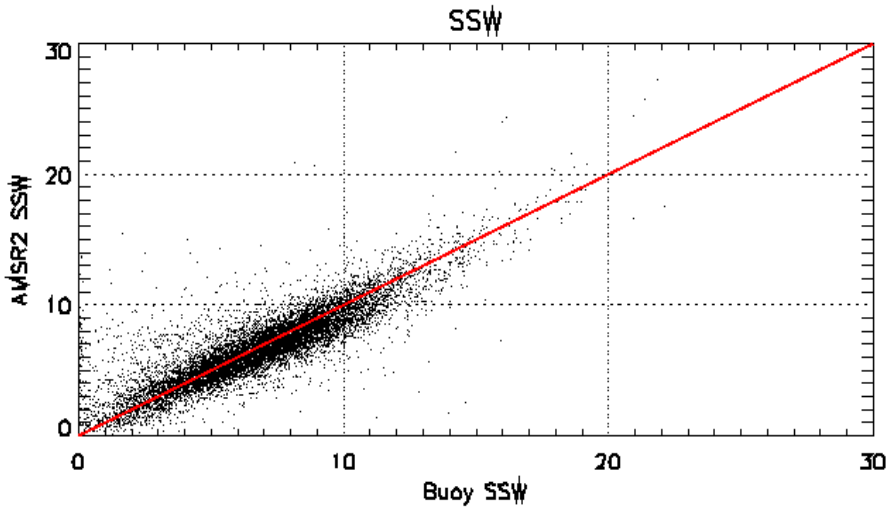
SSW Validation / Buoys



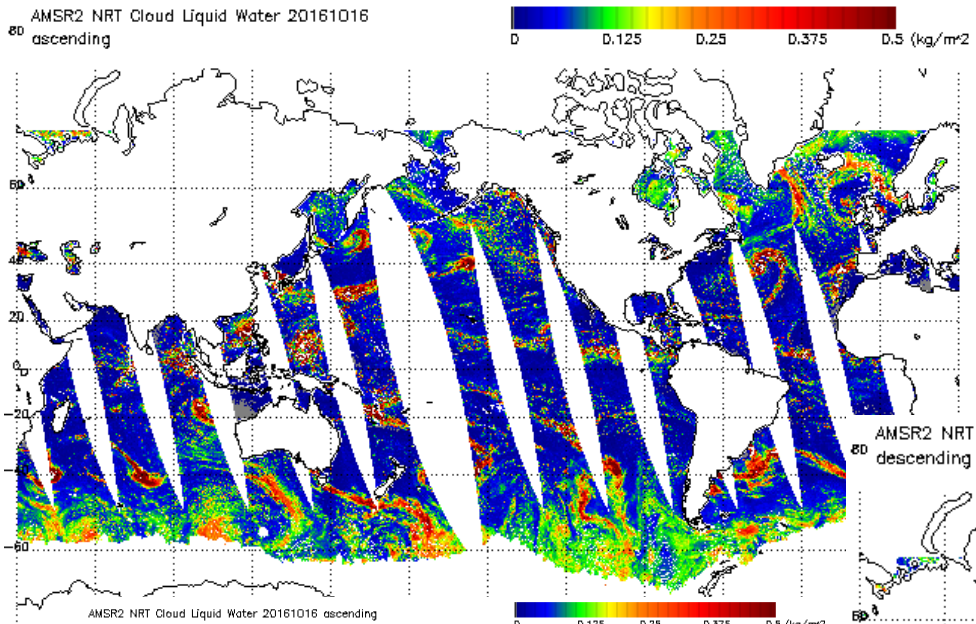


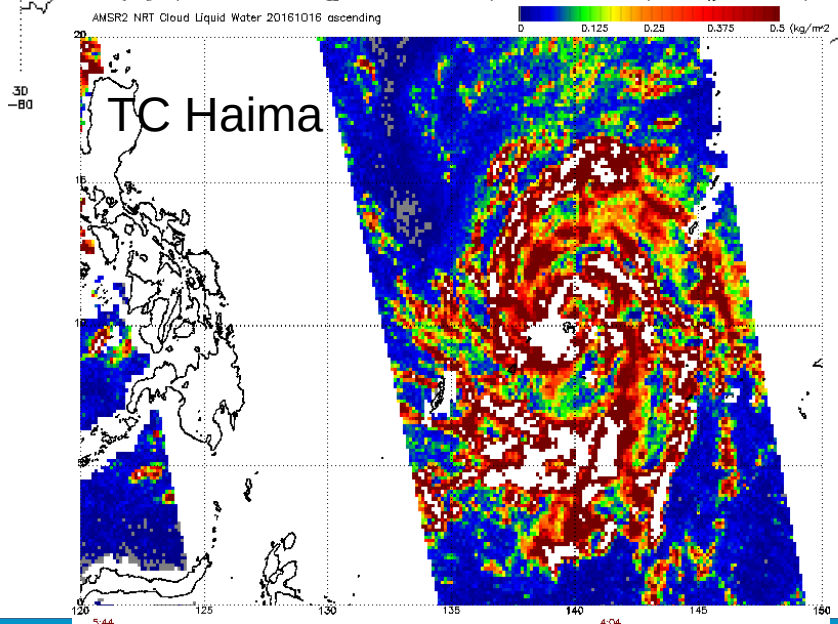


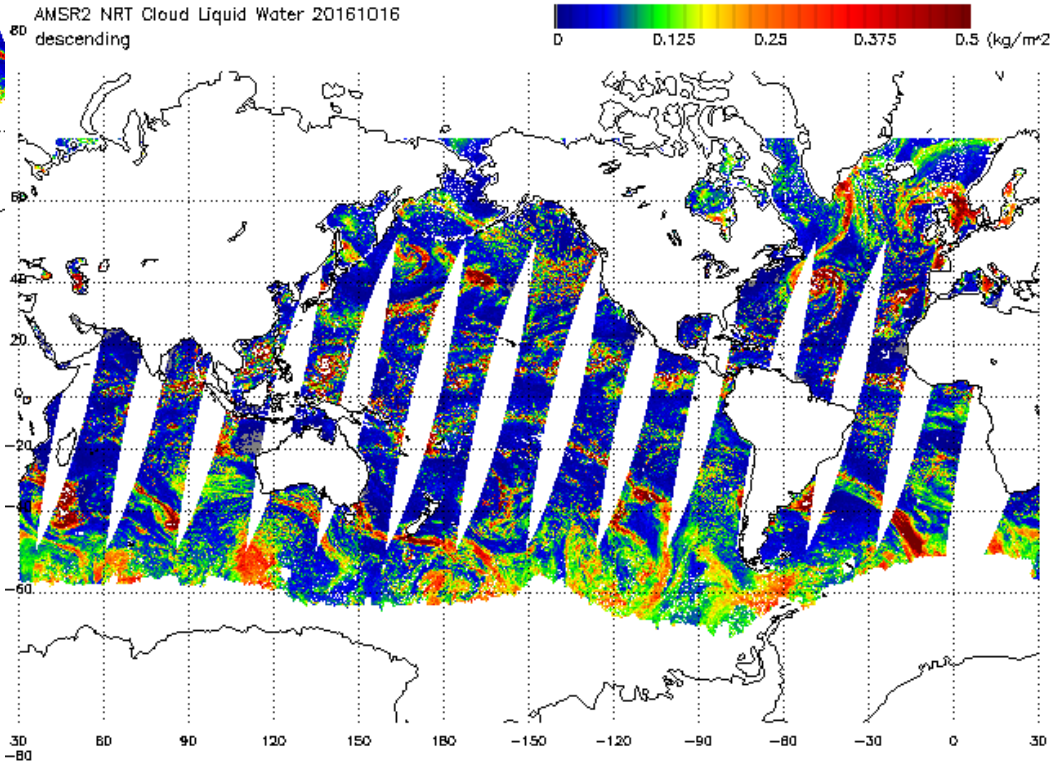
Ocean Surface Wind Speed Error Budget

Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
Wind Speed	2 m/sec or 10%	0.9-1.5 m/s	Sensor calibration Measurement variability Random Error	Relative to GDAS, TMI, and Buoys
Measurement Range	2-30 m/sec	0-30 m/sec		L2 EDR
Measurement Precision	0.5 m/sec	0.1-0.3 m/sec		L2 EDR

NOAA CLW Speed Example (10/16/2016)







CLW Validation

- Ancillary data for AMSR2 CLW validation
  - Models : GDAS
  - Measurements : TMI, NOAA-19

GCOM Cloud Liquid Water Requirements				
EDR Attribute	**Requirement**	**Status**		
		GDAS	**TMI**	**NOAA-19**
Measurement range	**0.005 – 1 mm**			
Measurement uncertainty	**0.05 mm over ocean**	**0.09***	**0.04**	**0.03**
Measurement accuracy	**0.01 mm**	**0.01**	**0.01**	**0.01**

***** CLW changes fastest of all other parameters. Interpolated 6H models are not expected to agree well with instantaneous measurements from AMSR2

Cloud Liquid Water Error Budget

Attribute Analyzed	L1RD Threshold	Validation Result	Error Summary	Support Artifacts
CLW	0.05 mm	0.03 – 0.09 mm	Sensor calibration Measurement variability Random Error	Relative to GDAS, TMI, and NOAA19
Measurement Range	0.005 – 1.0mm	0 – 1 mm		L2 EDR
Measurement Precision	0.01 mm	0.01 mm		L2 EDR

EDR Quality Control

- 16-bit QC flag included in AMSR2 EDR files
  - Bit0: RFI
  - Bit1: 0 < SSW < 30
  - Bit2:-2.5 < SST < 35
  - Bit3:0 < CLW < 1
  - Bit4:0 < TPW < 75
  - Bit5:0 < RR < 70
  - Bit6:SSW > 20
  - Bit7:CLW > 0.18
  - Bit8:TPW > 60
  - Bit9: RR > 1
  - Bit10: SSW quality
  - Bit11: SST quality
  - Bit12: CLW quality
  - Bit13: TPW quality
  - Bit14: RR quality
  - Bit15: Spare

Check if value within boundaries

Check if value in upper range

Cross check parameters (e.g. if SSW > 17 and CLW > 0.3 then Bit11 will be set)

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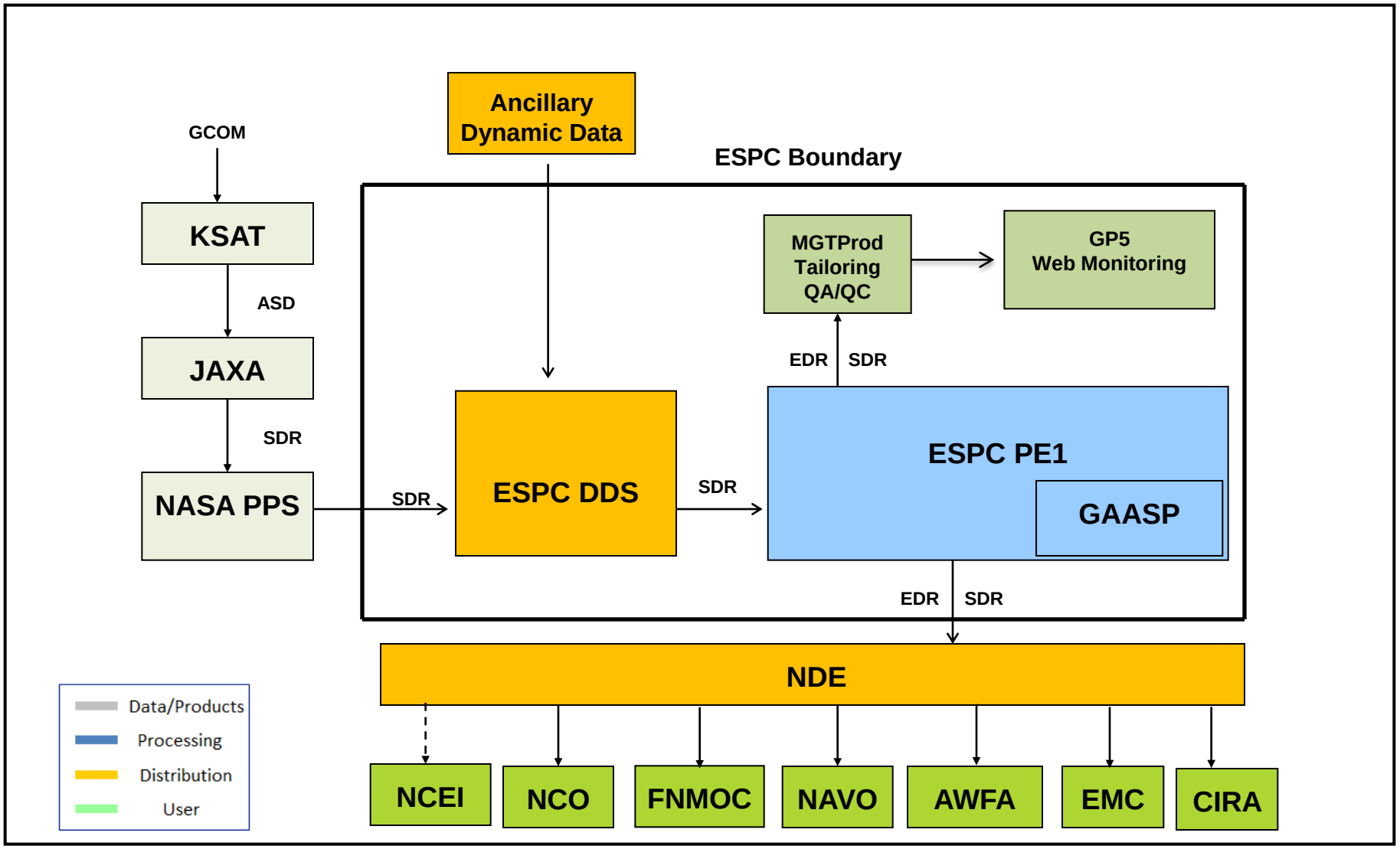
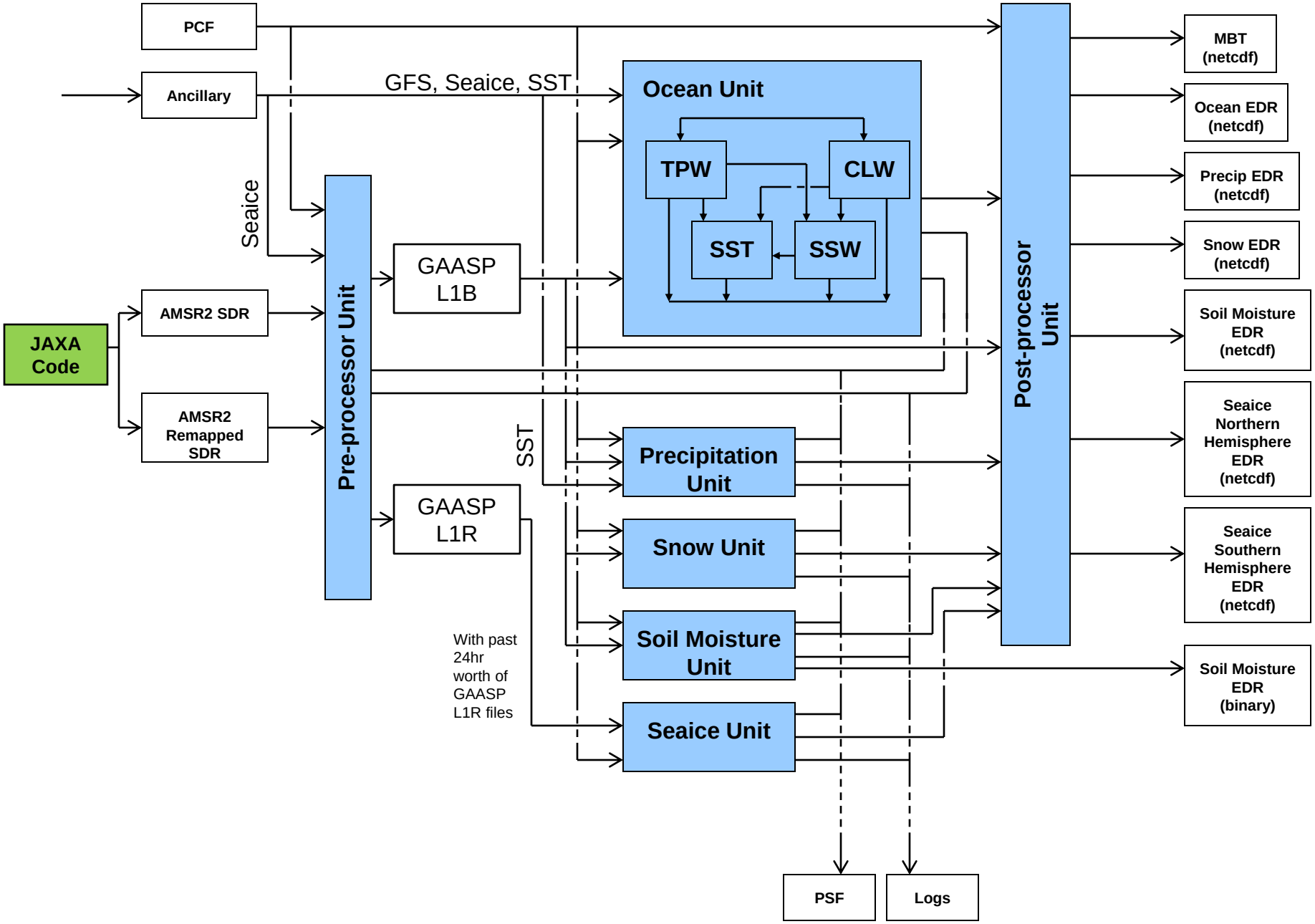
IT System Architecture and Data Flow *(NDE 1.0 version)*



GAASP Software Unit Data Flow: Day 2



GAASP External Dynamic Input Data

External Dynamic Input Data								
Input File	**Name Pattern**	**Source**	**Update Frequency**	**When**	**EDR**	**Type**	**Format**	**Size**
AMSR2 SDR Native Res	GW1AM2_????????????_????_L1SGBTBR_1110110.h5	IDPS via NDE	~100 minutes	Day 1	MBT, SST, SSW, TPW, CLW, PR, SM, ST, SC, SD, SWE	Input	HDF5	9.2 MB
AMSR2 SDR Remapped	GW1AM2_????????????_????_L1SGRTBR_1110110.h5	IDPS via NDE	~100 minutes	Day 1	SST, SSW, TPW, CLW, SIC	Input	HDF5	12.7 MB
GFS Forecast (0.5 degree)	gfs.t??z.pgrb2f??.????????	DDS	6 hours	Day 1	SST, SSW, TPW, CLW	Ancillary	GRIB2	18.5 MB
Daily OI SST	avhrr-only-v2.????????_preliminary	DDS	Daily	Day 1	PR, SST, SSW, TPW, CLW	Ancillary	Binary	1.8 MB
Sea Ice	seaice.t00z.5min.grb.grib2.????????	DDS	Daily	Day 1	RFI	Ancillary	GRIB2	0.5 MB

GAASP External Output Data

External Output Data (Day1)

Output File	Name Pattern	Update Frequency	When	Format	Size
AMSR2 SDR Native Res	AMSR2-MBT_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 1	netCDF4	244 MB
Ocean (CLW, TPW, SST, SSW)	AMSR2-OCEAN_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 1	netCDF4	160 MB
Precip (PT/R)	AMSR2-PRECIP_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 1	netCDF4	60 MB
SST	AMSR2-GHRSST_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 1	netCDF4	TBD MB
Land (SM & ST)	AMSR2-SOIL_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 2	netCDF4	31 MB
Land (SM & ST)	AMSR2-SOIL_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.bin	~100 minutes	Day 2	Binary	4.9 MB
Snow (SC/D & SWE)	AMSR2-SNOW_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 2	netCDF4	37 MB
Sea Ice (SIC) – Northern Hemisphere	AMSR2-SEAICE-NH_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 2	netCDF4	64 MB
Sea Ice (SIC) – Southern Hemisphere	AMSR2-SEAICE-SH_v2r0_GW1_sYYYYMMDDhhmmsss_eYYYYMMDDhhmmsss_cYYYYMMDDhhmmsss.nc	~100 minutes	Day 2	netCDF4	24 MB

Task and Schedules

- Tasks:
  - Defined in JPSS Technical Task Agreement (TTA) - "GCOM-W1 Implementation"
- Key Milestones:
  - Project Milestones
    - Preliminary Design Review – Nov 8, 2012
    - Critical Design Review – May 1, 2013
    - Software Code Review – Sept 18, 2013
    - Day-1 Algorithm Readiness Review for Day-1 – Dec 19, 2014
    - Day-1 Operational Readiness Review for Day-1– Aug 21, 2015
    - Day-1 SPSRB Decision Briefing for Day-1 – Sept 23, 2015
    - Day-1 Operations Commence for Day-1 – Nov 4, 2015
    - Day-2 Algorithm Readiness Review for Day-2 – May 9, 2016
    - Day-2 Software Code Review – Jun 20, 2016
    - Day-2 Operational Readiness Review for Day-2– Aug 26, 2016
    - Day-2 SPSRB Decision Briefing for Day-2 – Sept 21, 2016
    - Day-2 Operations Commence for Day-2 – Sept 30, 2016
  - NWS User Milestones
    - May 9: Test data available
    - Sept 30: Operational data available

Users

- NWS
  - AWIPS, NAWIPS, web pages
- DoD
- R&D community
- Others

- Downstream product list
  - Blended SST
  - Blended Rainrate
  - Blended TPW

User Examples

NHC Hurricane Matthew Discussion

Hurricane MATTHEW

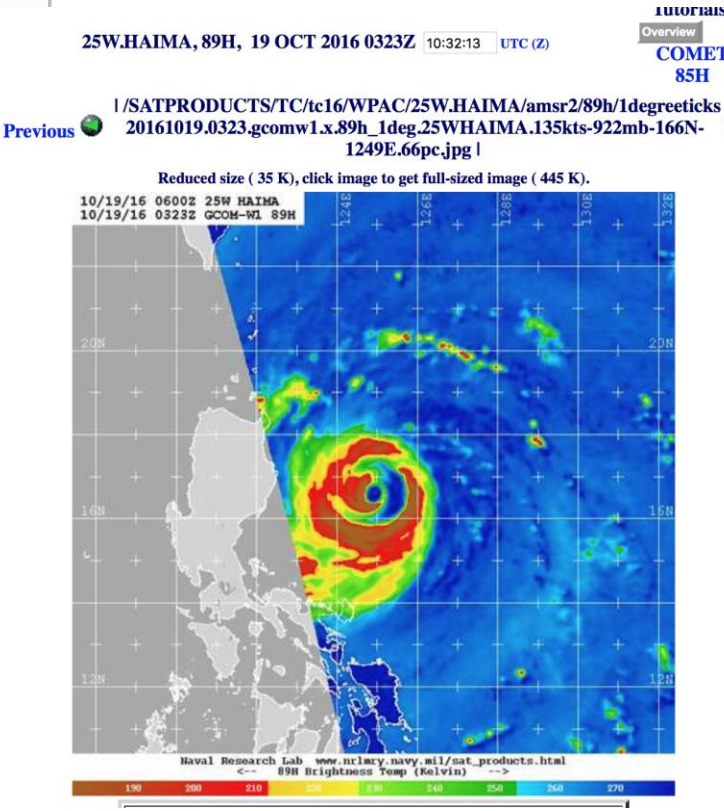
```
ZCZC MIATCDAT4 ALL
TTAA00 KNHC DDHHMM

HURRICANE MATTHEW DISCUSSION NUMBER  17
NWS NATIONAL HURRICANE CENTER MIAMI FL       AL142016
500 AM EDT SUN OCT 02 2016

The overall organization of the hurricane has changed little
overnight, with the small eye remaining distinct in infrared
satellite pictures.  A very recent AMSR2 microwave overpass showed
no indication of an eyewall replacement, but there was a notable dr
slot between the inner core and the outer bands over the southern
portion of the circulation.  Although Dvorak data T-numbers
decreased slightly at 0600 UTC, the objective and subjective CI
numbers are about the same as before, so the initial intensity will
remain 130 kt for this advisory.  Another Air Force Reserve
Hurricane Hunter aircraft is scheduled to investigate Matthew this
morning, which should provide a better assessment of the hurricane'
current strength and structure. Although some weakening is predicte
during the next couple of days, Matthew is expected to remain a
powerful hurricane when it approaches the islands of the Greater
Antilles in a couple of days. The upper-level wind environment is
expected to remain favorable over the Bahamas, and warm waters in
that area should allow Matthew to maintain much of its intensity
while it moves over that area later in the forecast period.

Matthew has been moving slowly west-northwestward during the past
few hours, but the longer-term motion estimate is northwest or 320
degrees at 4 kt.  The forecast track reasoning remains unchanged
from before.  Matthew should move slowly northwestward today,
and then turn northward tonight as a mid- to upper-level trough
develops over the eastern Gulf of Mexico.  This motion will take
Matthew towards Jamaica, western Haiti, and eastern Cuba over the
next couple of days.  After that time, the global models bend
```

AMSR-2 pass over Typhoon Haima (Navy/NRL Tropical Cyclone Page)

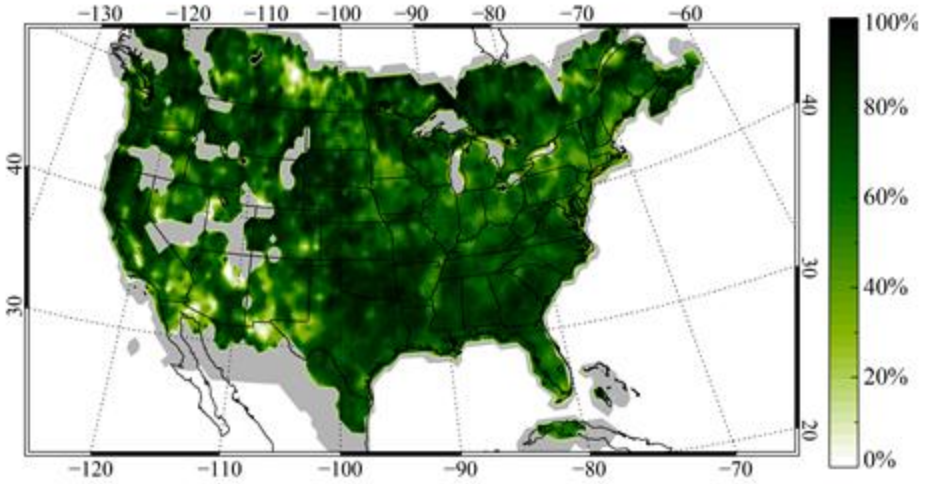


Documentations Check-List

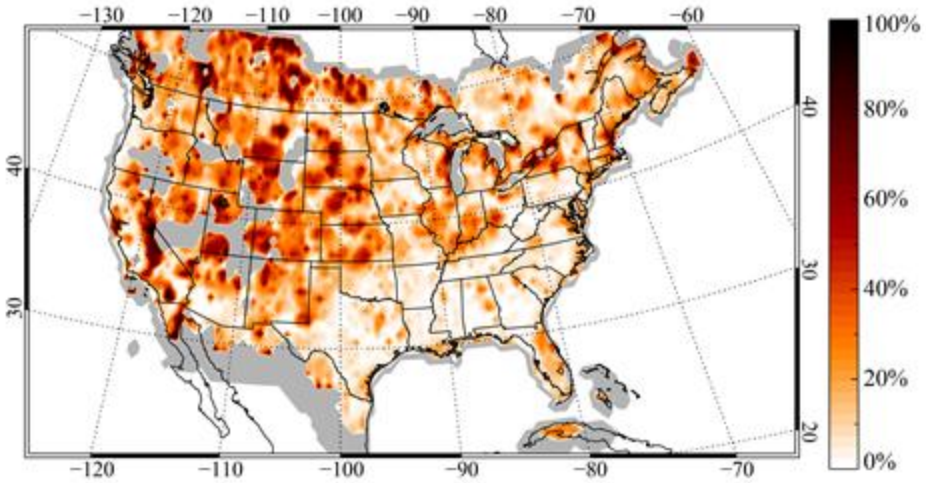
Science Maturity Check List	Yes ?
ReadMe for Data Product Users	✓*
Algorithm Theoretical Basis Document (ATBD)	✓
Algorithm Calibration/Validation Plan	✓*
(External/Internal) Users Manual	✓
System Maintenance Manual (for ESPC products)	✓
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	✓
Regular Validation Reports (at least. annually) (Demonstrates long-term performance of the algorithm)	✓

Issues to Address / Future Improvements

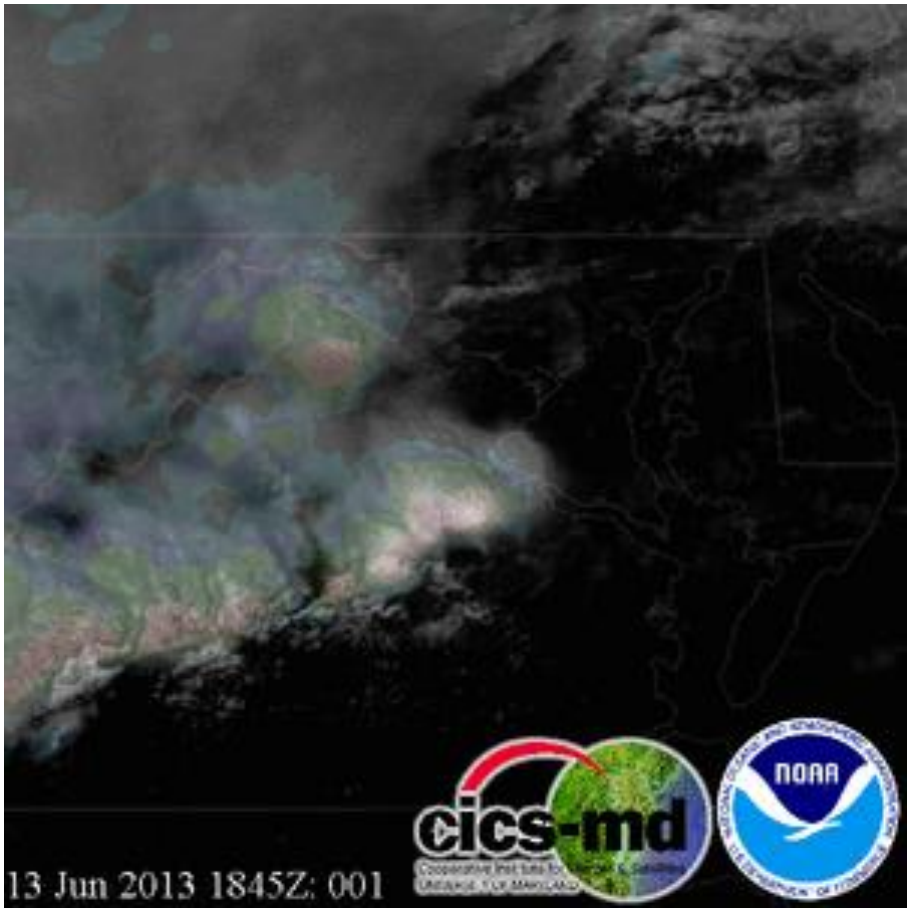
Probability of Detection



False Alarm Ratio

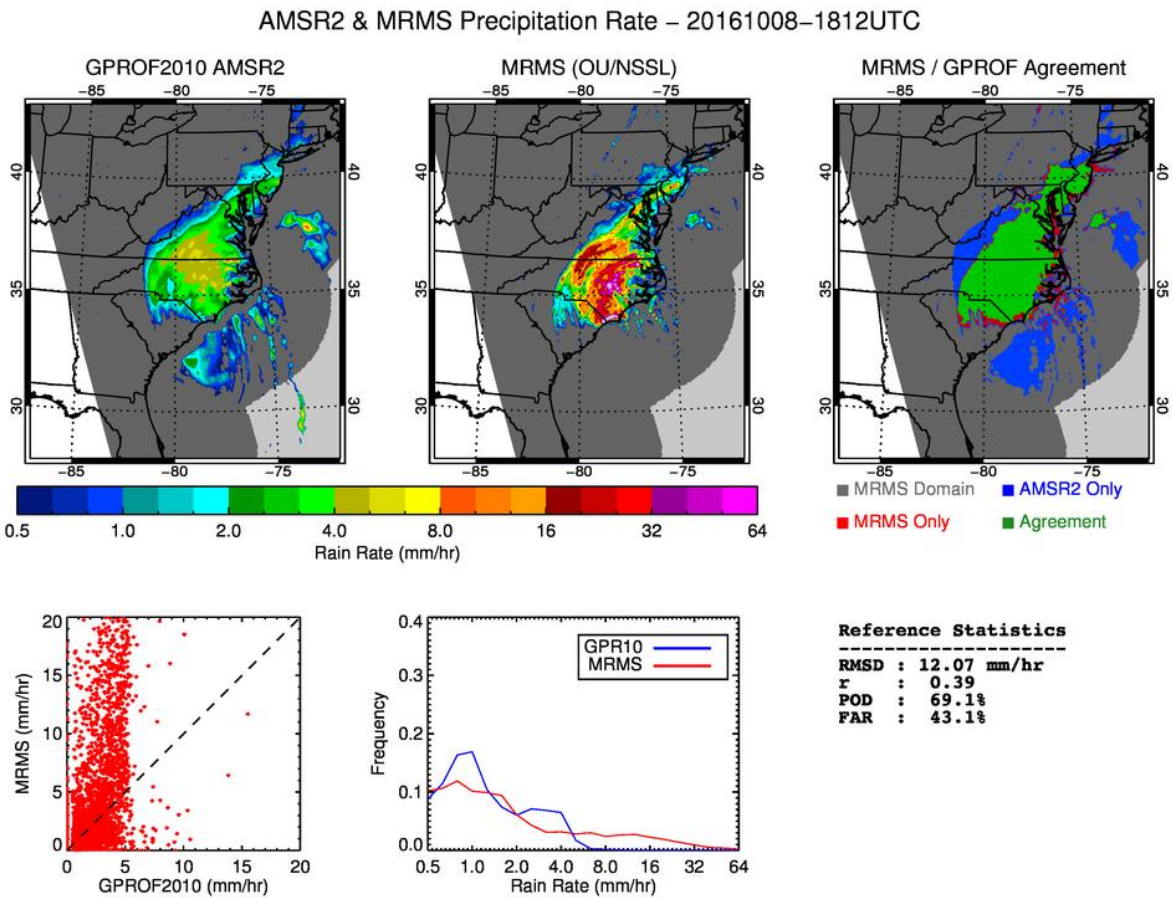


Incorporate Multi-Sensor Inputs

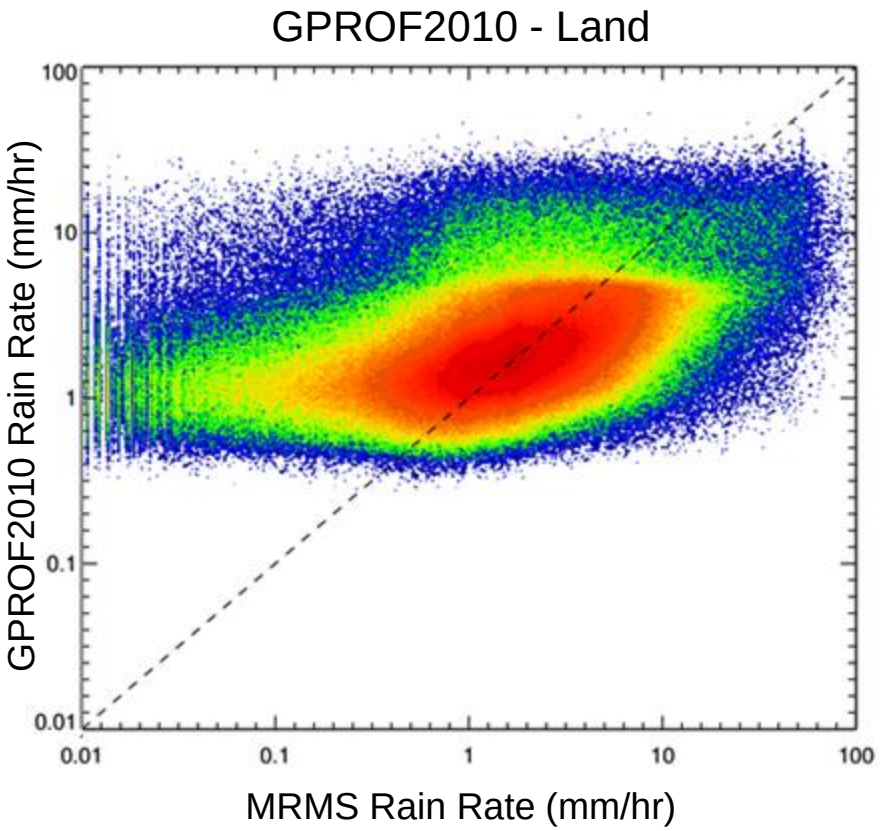


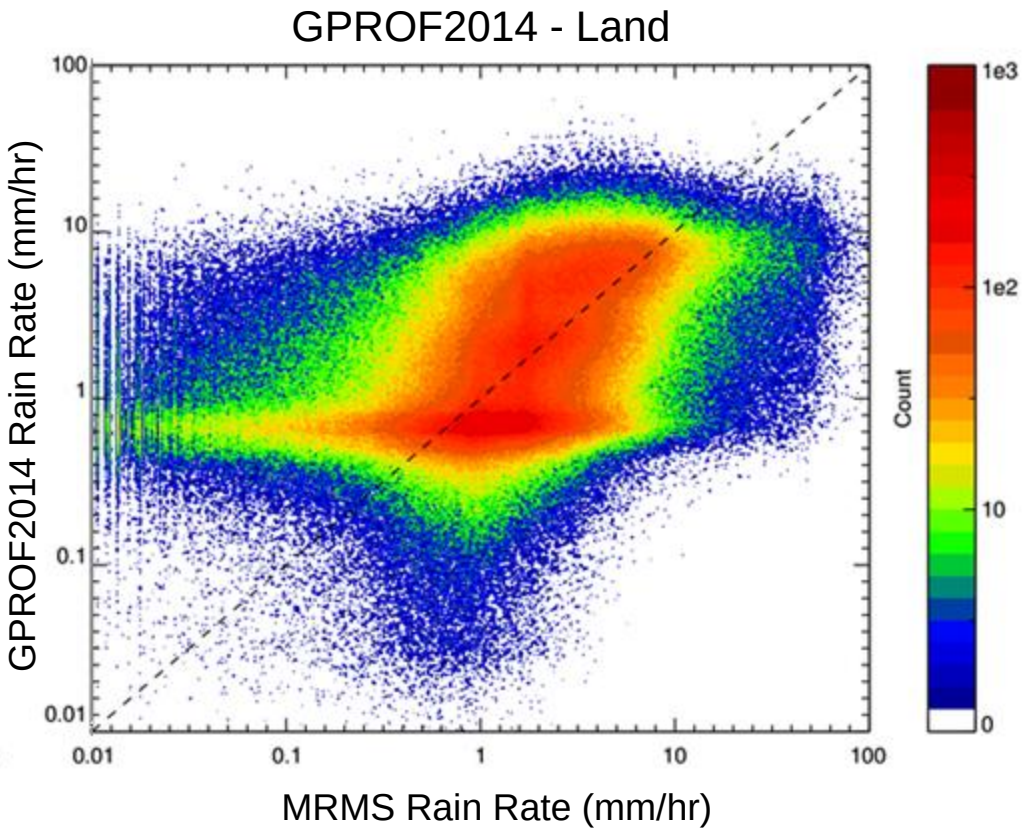
Issues to Address / Future Improvements

- Global algorithm updates, (i.e., diurnal sensitivity, geographic biases, JAXA L1 processing updates etc.)
- Region/Regime-specific algorithm (i.e. OCONUS / Tropical Cyclones / Coastal)
- Rain rate relationships are not always valid for special cases



Path Forward – Evaluating GPROF2014





- Empirical Retrieval
- Continuation from AMSR-E algorithm

- Fully Bayesian Scheme
- Collaboration with NASA/GPM
- Still under development/testing

Conclusion

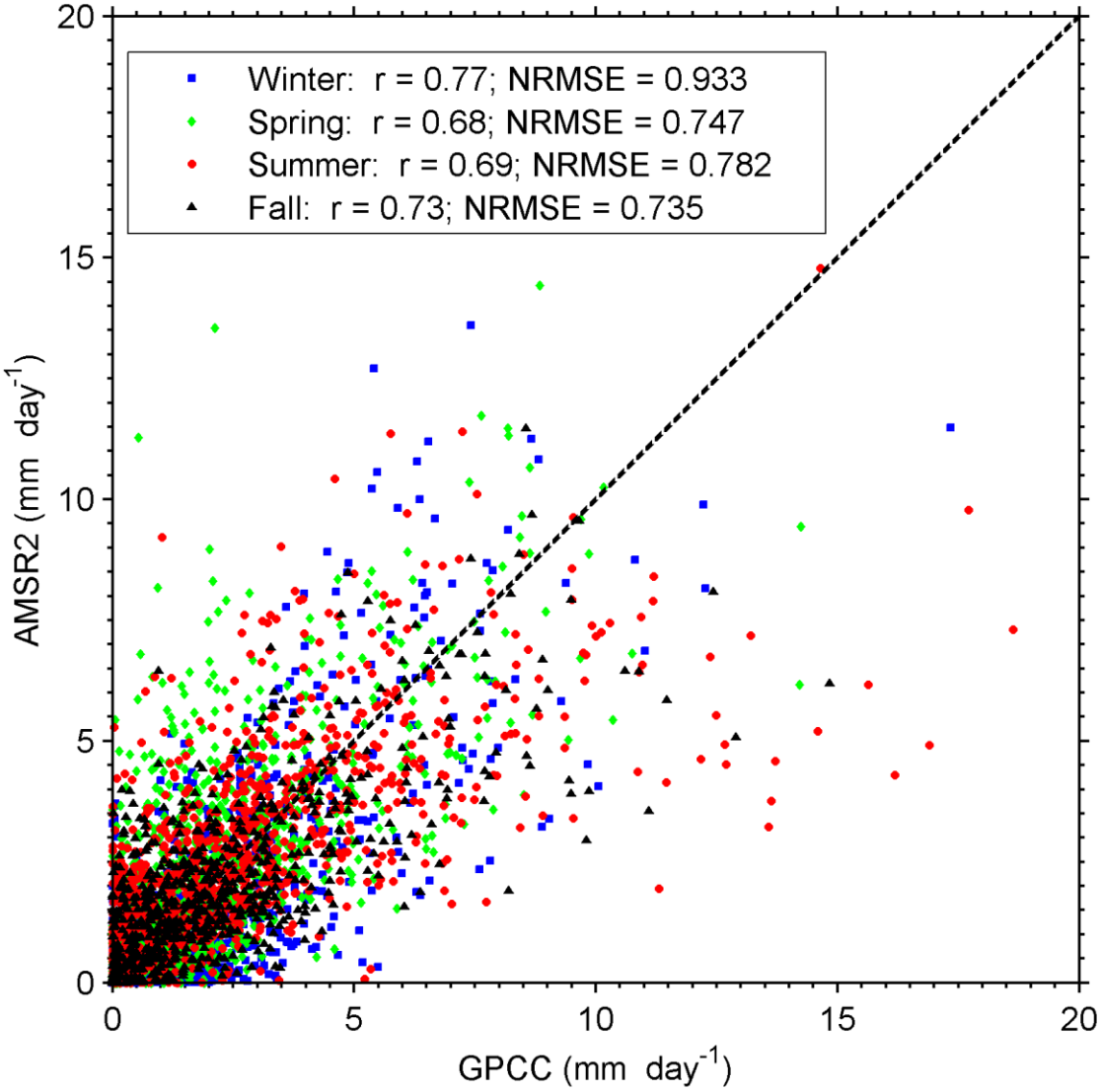
- GCOM-W/AMSR2 Project Team recommends algorithm validated maturity
  - Meet all JPSS L1RD requirements
  - Updated documentation needed
  - Routine monitoring by OSPO and STAR

Meyers, P. C. and R. R. Ferraro: Precipitation from the Advanced Microwave Scanning Radiometer 2. *J. of Sel. Top. Earth Obs. Remote Sens.*, **9**, 2611-2618, doi: 10.1109/JSTARS.2015.2513666.

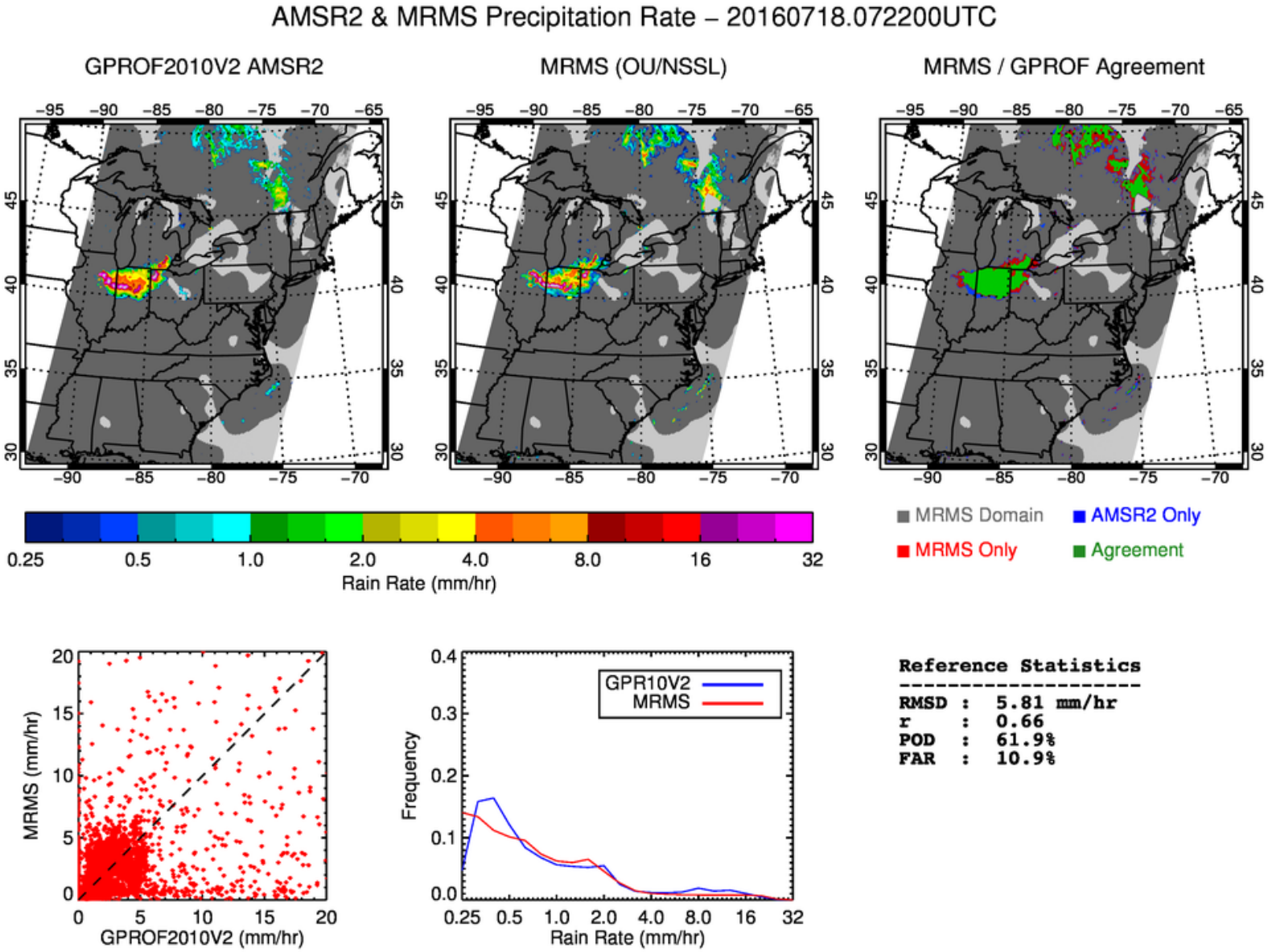
Suleiman, S. O., Z. Jelenak, P. S. Chang, J. D. Park, and P. Meyers: Inter- Calibration Results of the Advanced Microwave Scanning Radiometer – 2 Over Ocean. IEEE J of Sel. *Top. Earth Obs. Remote Sens.*, 9, 4230-4238, doi:10.1109/JSTARS.2014.2330980

BACKUP MATERIAL

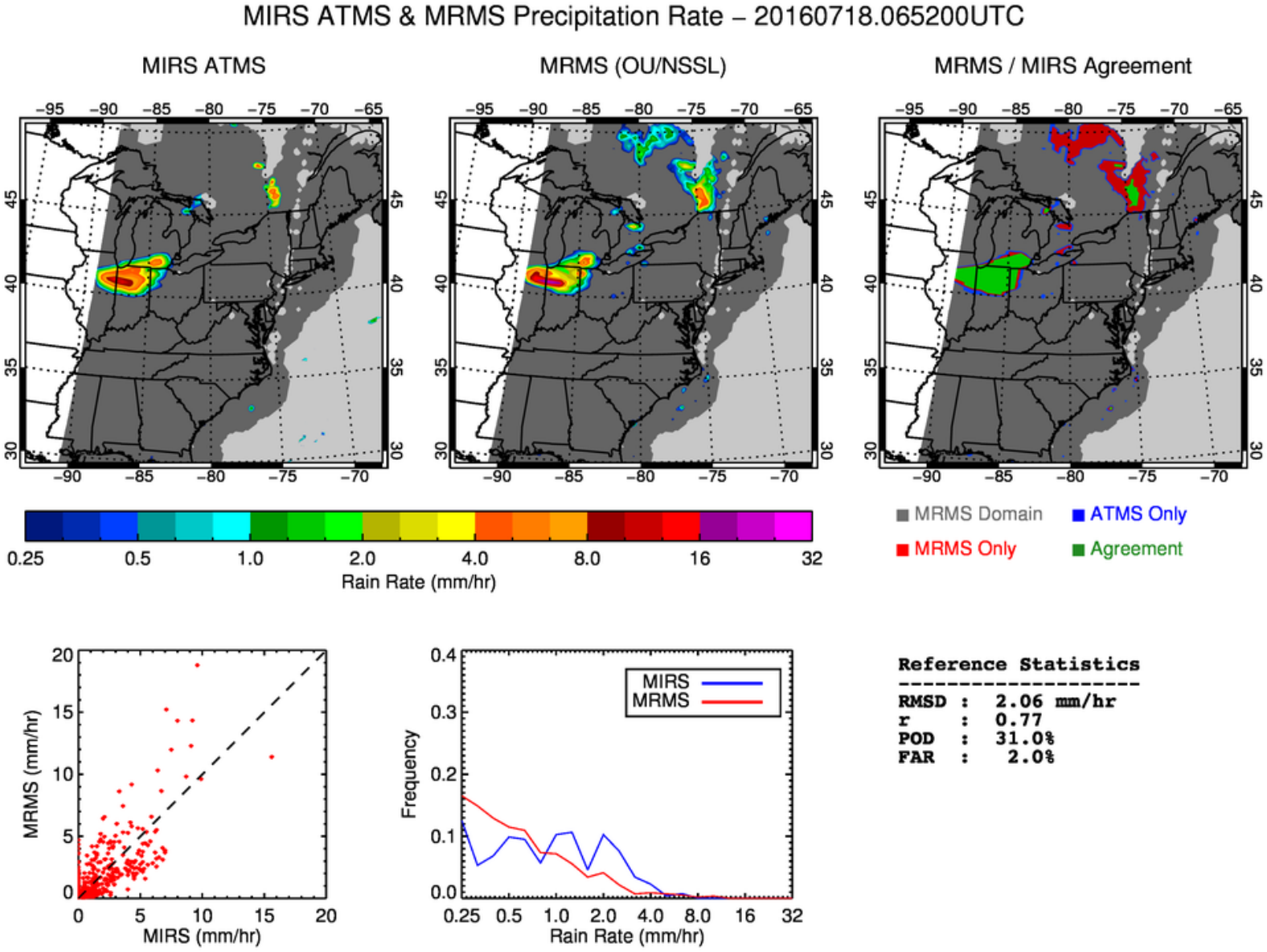
AMSR2 vs GPCC Gauge Analysis



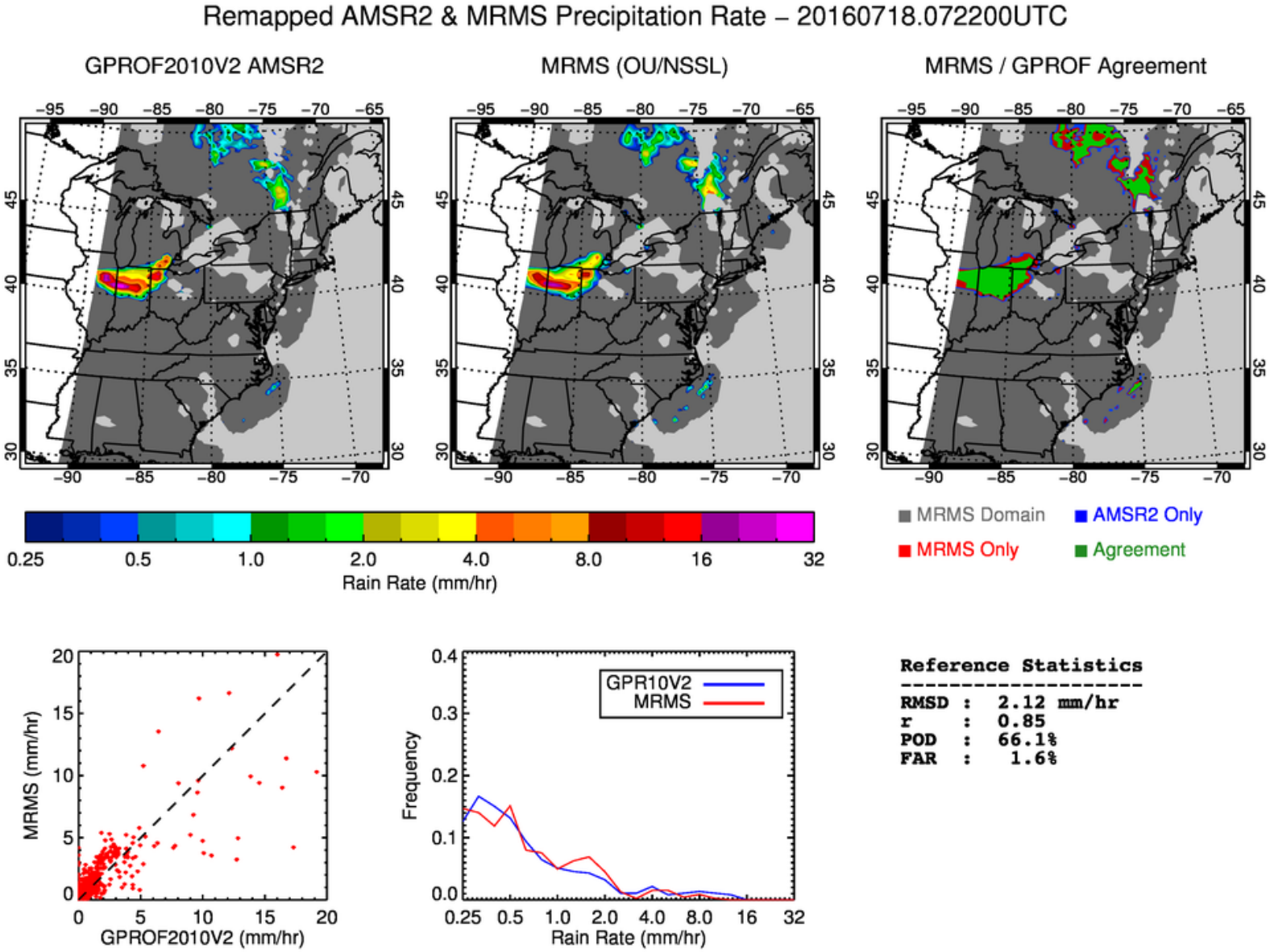
AMSR2 – Native Resolution



ATMS (MIRS) – Native Resolution



AMSR2 @ ATMS Resolution



ATMS @ AMSR2 Resolution