

An Update on the NESDIS Hydrometeorological Products

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April 29, 2014

Outline

- **Overview of NESDIS Operational Capability**
- **Current and Upcoming New Capability**
 - **Enhancements**
 - **New Satellite and Product Capabilities**
 - **Enterprise Approach for Precipitation Products**

Operational Product Suites of Interest

MSPPS – Microwave Surface and Precipitation Products System

MiRS – Microwave Integration Retrieval System

GHE – Global HydroEstimator

bTPW – Blended Total Precipitable Water

bRR – Blended Rain Rate

eTRAP - Ensemble Tropical Rainfall Potential (eTRaP)

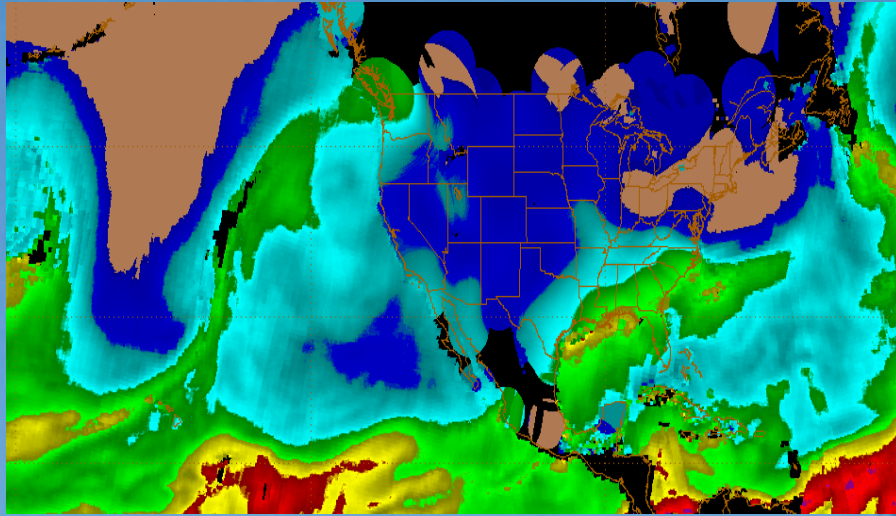
SMOPS – Soil Moisture Operational Products System

Algo	Products	Satellites/Sensors	Res	Type	Formats
MSPPS	Rainfall rate, Snowfall rate, TPW, CLW, Snow Cover, Sea Ice, etc	NOAA-18&NOAA-19&Metop-A & Metop-B / <i>AMSU-A&MHS</i>	16 km	Level-2, Level-3	HDF-EOS, McIDAS area, PNG
MiRS	Rainfall rate, TPW, CLW, Snow Cover, Sea Ice, etc	NOAA-18 & NOAA-19 & Metop-A & Metop-B / <i>AMSU-A&MHS</i> ; <i>DMSP F18/SSMIS</i>	45 km	Level-2, Level-3	HDF-EOS, netCDF4, McIDAS area, PNGs
GHE	Rainfall rate, multi-hours and multi-days rainfall total	GOES-E & GOES-W & MTSAT & Meteosat-7 & Meteosat-10 <i>IR Imager</i>	4km	Level-3	netCDF4, McIDAS area, GRIB1/GRIB2, GIFs
bTPW	Global Total Precipitable Water Map	NOAA-18, NOAA-19, Metop-A and Metop-B / <i>AMSU-A&MHS</i> , <i>GOES-W/-E</i> , <i>GPS-Met</i> , <i>DMSP F18/SSMIS</i>	16km	Level-4	HDF-EOS, McIDAS area, AWIPS, PNGs
bRR	Global Rainfall Rate Map	NOAA-18, NOAA-19, Metop-A and Metop-B / <i>AMSU-A&MHS</i> , <i>DMSP F18/SSMIS</i>	16km	Level-4	HDF-EOS, McIDAS area, AWIPS, PNGs
eTRAP	Prob-matched QPF, Probability	NOAA-18, NOAA-19, Metop-A and Metop-B / <i>AMSU-A&MHS</i> , <i>GOES-W/-E</i> , <i>DMSP F17, F18/SSMIS</i>	4km	Level-3	ASCII, McIDAS area, GIFs
SMOPS	Global Soil Moisture Map	Metop-A/ASCAT, Coriolis/Windsat, SMOS	0.25 degree	Level-4	netCDF4, GRIB2, GIFs

Enhancements - Blended TPW

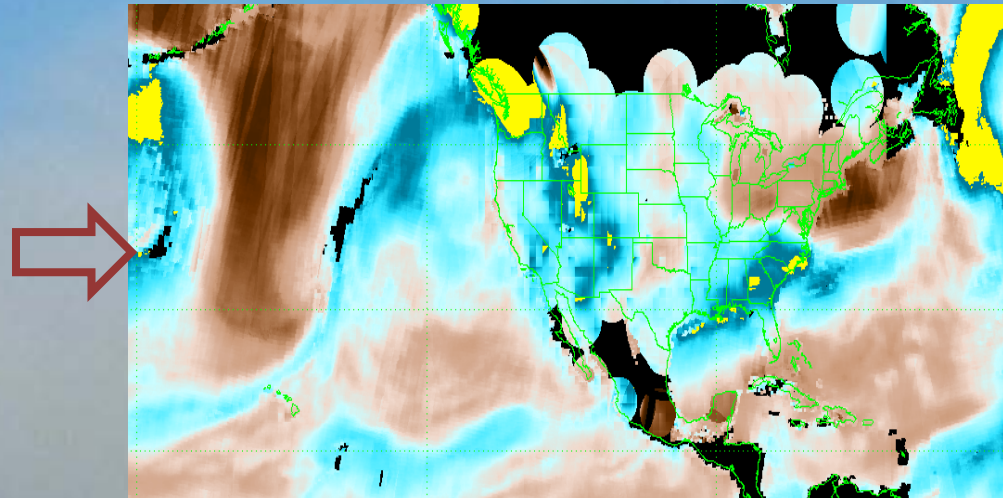
- **Unified global TPW map generated from multi-satellites and -algorithms**
 - **Operational:** since March 2009
 - **Satellites:** N15, N16, N17, N18, N19 and Metop-A/-B, GPS-Met, GOES-E&-W
 - **Ocean**
 - MSPPS TPW from NOAA-15, -16, -17, -18, -19 and Metop-A/-B
 - **Land**
 - GPS-Met over CONUS, Alaska and Hawaii – primary data source over CONUS
 - MIRS AMSU TPW from N18, N19 and Metop-A over CONUS when GPS is not available, and also over other Landmasks over global
 - GOES over CONUS, and part of east pacific ocean – used to fill the hole when no GPS and MIRS TPW are available
 - **Products:** *TPW, Percentage of Normal TPW; 16km*
 - **Formats:** HDF-EOS, McIDAS area and AWIPS
 - **Data Access:** DDS, ADDE and AWIPS
 - The imagery products are also available on the Internet through:
<http://www.ospo.noaa.gov/Products/bTPW/index.html>

Blended TPW

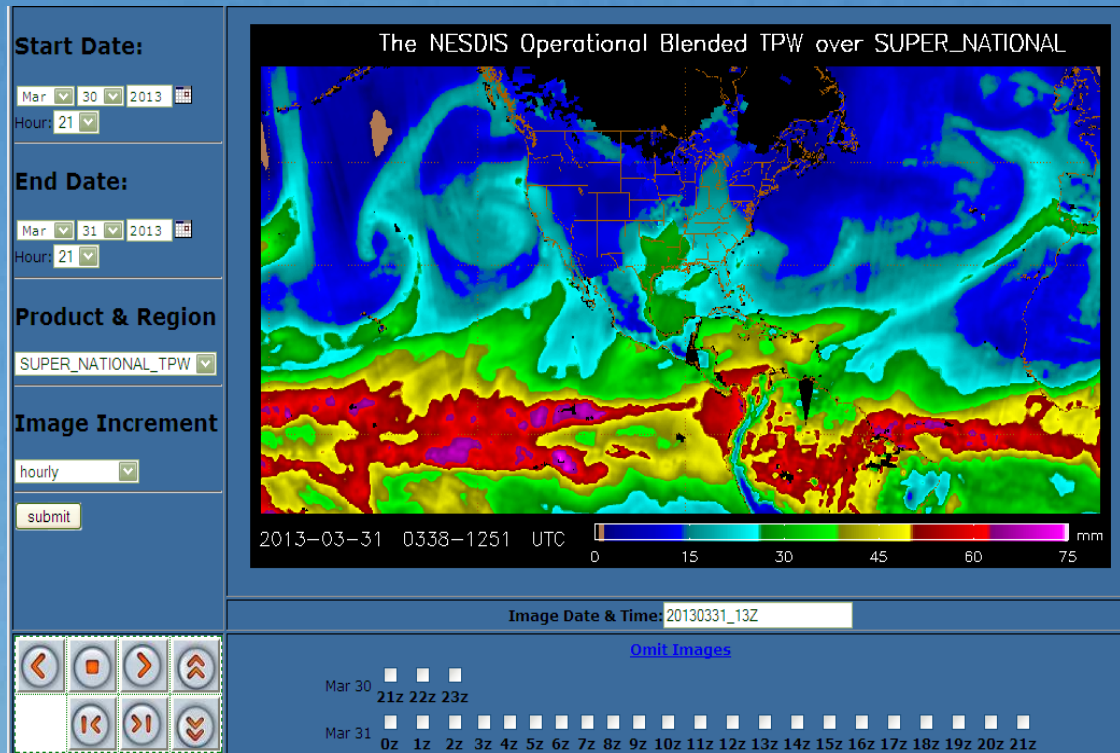


Blended TPW – Merges TPW from AMSU, SSMIS, GOES and GPS-Met into a unified resource to provide forecasters no-gap TPW coverage over globe and serves as a very helpful tool for forecasters to identify conditions that could result in heavy precipitation and subsequent flooding.

Percent of Normal TPW - Compares the blended TPW with the NVAP (NASA Water Vapor Project) weekly mean. It helps forecasters quickly see areas where active weather is occurring and assess the severity of the situation. For instance, the “Yellow” areas indicate TPW > 200% of the weekly mean, and are threat areas



Blended TPW – Animation Tool



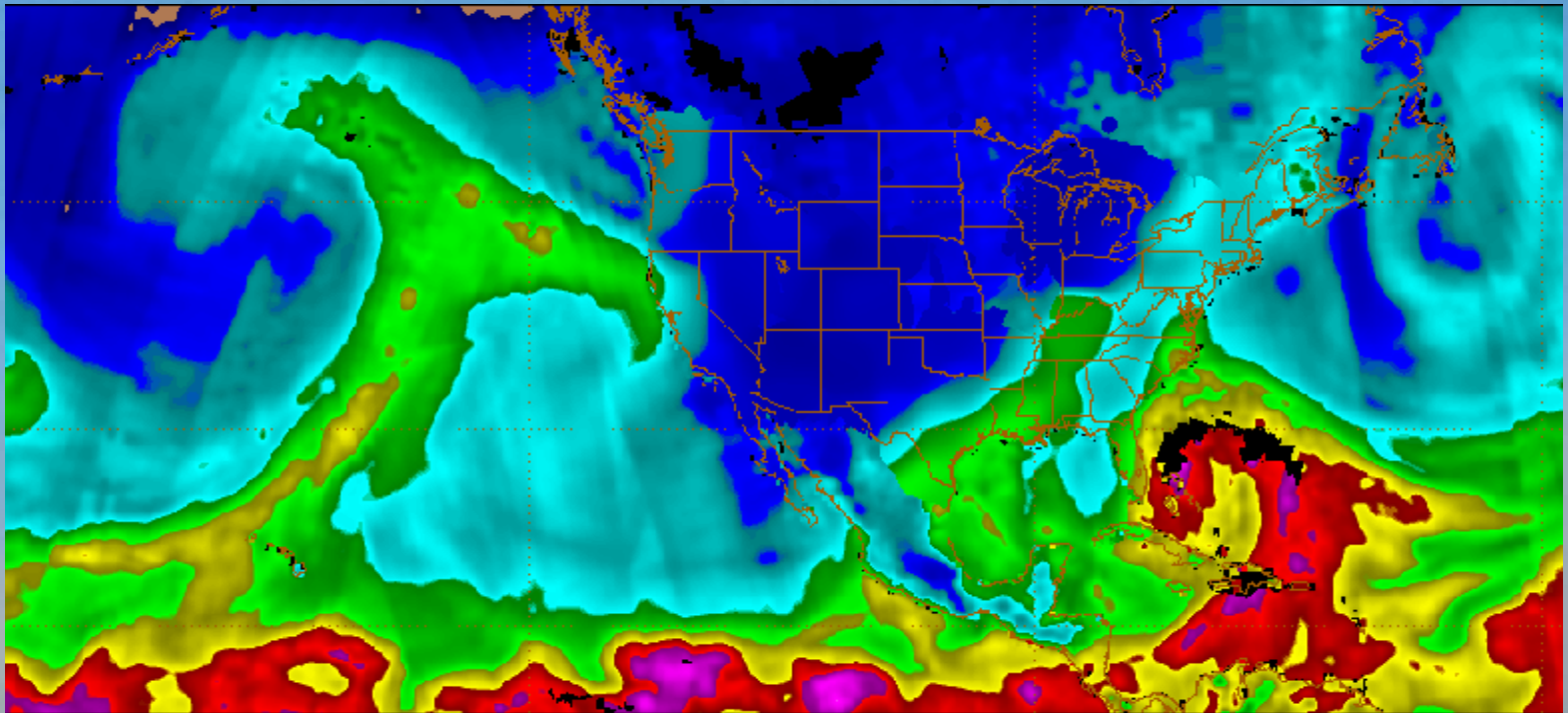
- **Products** – Blended TPW and Percentage of TPW Normal (PCT)
- **Refresh** – Hourly with the latest 12 hour data from multi-satellites/sensors
- **Map Projection** – Mercator
- **Coverage** – Global Ocean and Land excluding poles (71 N to 71 S)
- **Resolution** – 16 km at equator
- **Format:** HDF-EOS, McIDAS and AWIPS

- **Animation** – Near-real time loops of blended TPW and PCT available at: <http://www.ospo.noaa.gov/bTPW>
- **Regions** – 15 area of interest regions for zooming in details
- **Image Interval** – 1 hour, 3, 6, 12 and 24 hours
- **Historical Data** – up to three months

Enhancements - Blended TPW

– The Upcoming Updates

- To include high resolution MiRS products from Metop-B and S-NPP ATMS TPW: *May ~ Jun 2014*
- To include GCOM-W1 AMSR-2 TPW: *Aug 2014*
- CONUS products with higher temporal and spatial resolution - 8km, data latency less than 4 hours : *Nov 2014*
- To include M-T and GPM TPW: *Pending for FY15 PSDI funding*



Enhancements - Blended Rain Rate

– Unified global rainfall rate map generated from multi-satellites and -algorithms

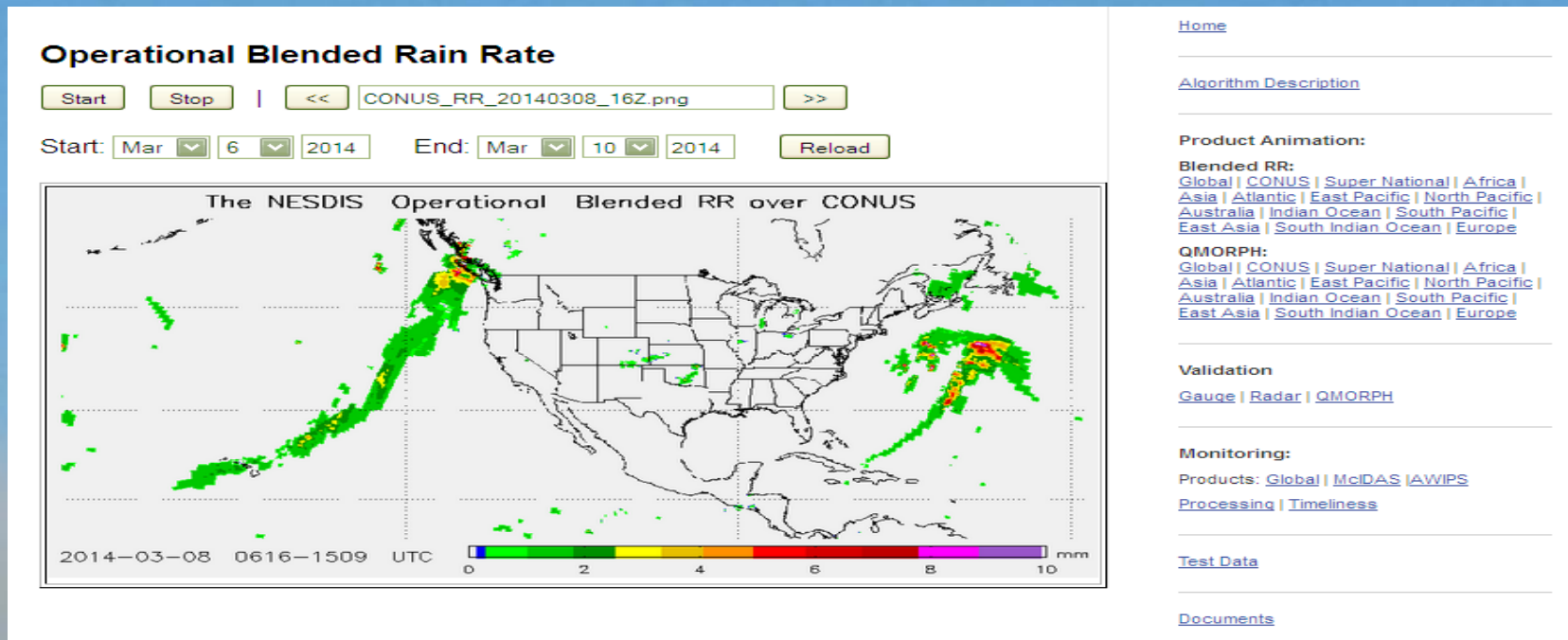
- **Operational:** since September 18, 2012
- **Satellites:**
 - MSPPS AMSU RR from N18, N19 and Metop-A/-B
 - FNMOC SSMIS RR from F17 and F18
- **Products:** *Rain Rate; 16km*
- **Formats:** HDF-EOS, McIDAS and AWIPS
- **Data Access:** DDS, ADDE and AWIPS
- The imagery products are also available on the Internet through:
<http://www.osdpd.noaa.gov/Products/atmosphere/brr>

Enhancements - Blended Rain Rate

– The Upcoming Updates

- To include MiRS high resolution MiRS products from NPP ATMS RR: *May ~ June 2014*
- To include GCOM-W1 AMSR-2 RR: *Aug 2014*
- To include MiRS AMSU RR from F18, F19 and Metop-A and SSMIS RR from F17, F18 when the high resolution products are available: *Oct 2014*
- To include M-T and GPM RR: *Pending for FY15 PSDI funding*

<http://www.osdpd.noaa.gov/Products/atmosphere/brr>



Enhancements - GHE

– Global rainfall map generated from multi-satellites

- **Operational: April 30, 2012**
- **Satellites:** GOES-E, GOES-W, MTSAT, Meteosat-7 & -9/-10
- **Products:** *Instantaneous rain rate, 1 hour, 3 hour, 6 hour, 24 hour and also multi-day rainfall accumulation; 4km*
- **Formats:** GRIB1, McIDAS area and netCDF4
- **Data Access:** DDS and McIDAS ADDE (satepsdist4)
- The imagery products are also available on the Internet through:
<http://www.ospo.noaa.gov/Products/atmosphere/ghe>

– The Upcoming Updates

- GRIB1 → GRIB2: pending for NWS AWIPS-II implementation
- Possible updates to include Himawari-8 (Pending for Funding)

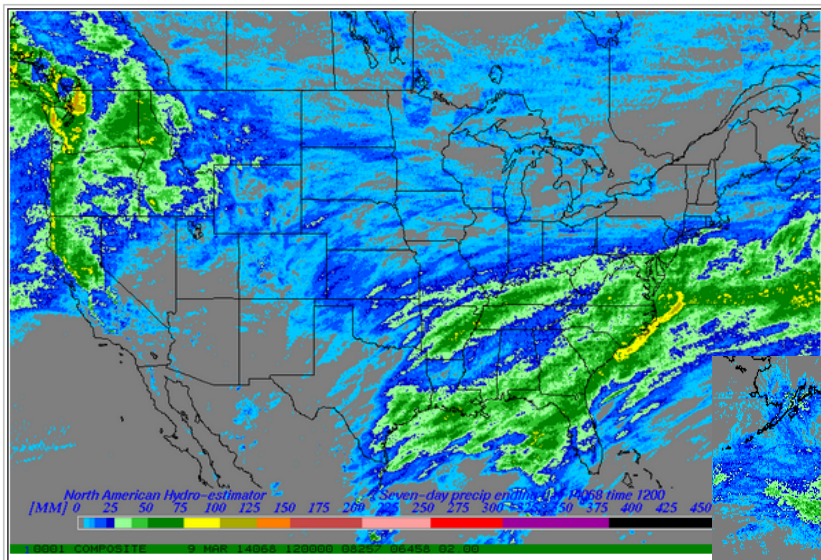
NESDIS Operational Global Hydro-Estimator Rainfall

Operational Hydro-Estimator Satellite Rainfall Estimates

7-Day Rainfall Totals

Start |

Start: End:



[GHE Home](#)

[Algorithm Description](#)

Global Product:

[Instantaneous](#)

[1-hour](#) | [3-hour](#) | [6-hour](#)

[1-day](#) | [2-day](#) | [3-day](#)

[4-day](#) | [5-day](#) | [6-day](#) | [7-day](#)

CONUS Product:

[Instantaneous](#)

[1-hour](#) | [3-hour](#) | [6-hour](#)

[1-day](#) | [2-day](#) | [3-day](#)

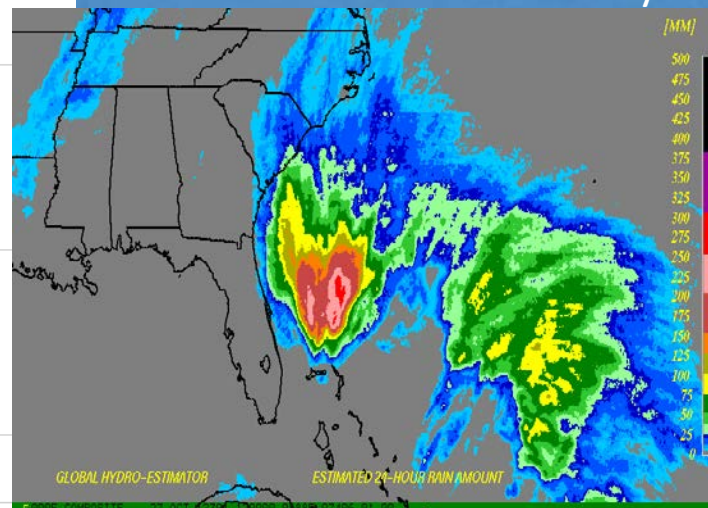
[4-day](#) | [5-day](#) | [6-day](#) | [7-day](#)

[Validation](#)

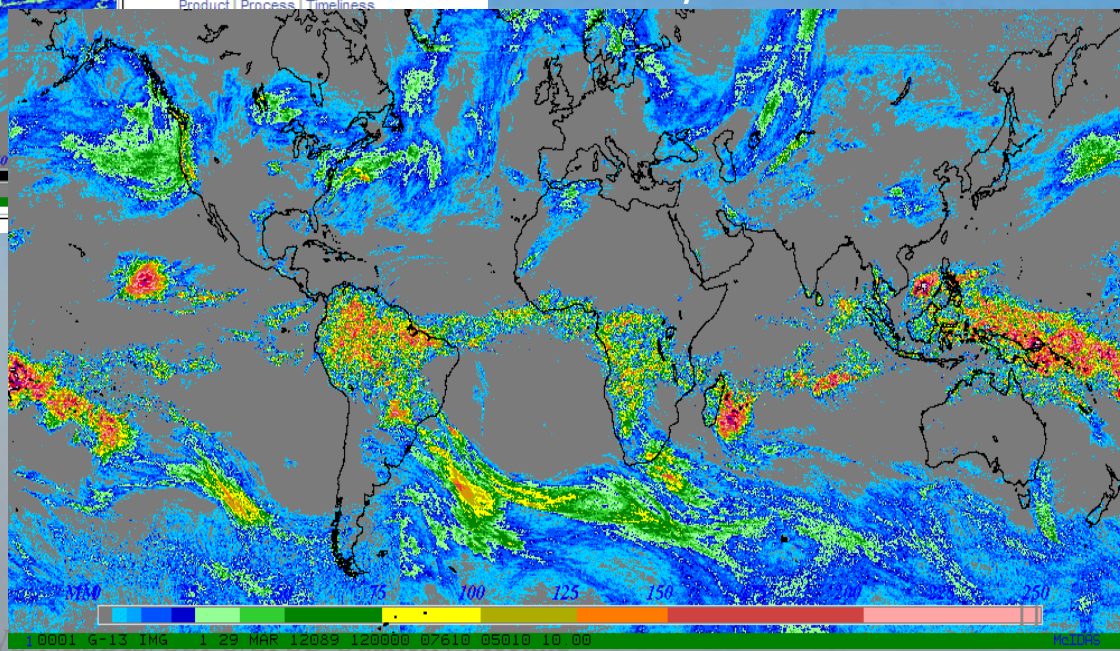
Monitoring:

[Product](#) | [Process](#) | [Timeliness](#)

24-hour Rainfall Total - Sandy



5-Day Rainfall Total



Enhancements - MiRS

– Operational: since Aug 2007

- **Satellites:** N18, N19 and Metop-A/-B, F18, S-NPP
- **Products:** T(z), q(z), RR, TPW, CLW, SnowC, SWE, SIce, IWP, SEM, LST, RWP; Orbital and Gridded; 45km; 0.25degree.
- **Formats:** HDF-EOS, netCDF4 and McIDAS
- **Data Access:** DDS and ADDE
- The imagery products are also available on the Internet through:
<http://www.ospo.noaa.gov/Products/atmosphere/mirs/index.html>

– Latest Updates:

- MiRS Metop-B products with high resolution: April 2013
- MiRS NPP products with high resolution: *Dec 2013*
- Termination of MiRS F16 products on Feb 24, 2014 due to sensor data quality issue

– The Upcoming Updates

- MiRS M-T TPW, RR/RR flag products: *Jun 2014*
- *MiRS high resolution products from F18, F19, Metop-A, F17 and F18: Aug 2014*
- *MiRS GPM/GMI TPW & RR: Feb 2016*

Examples of MiRS S-NPP Products

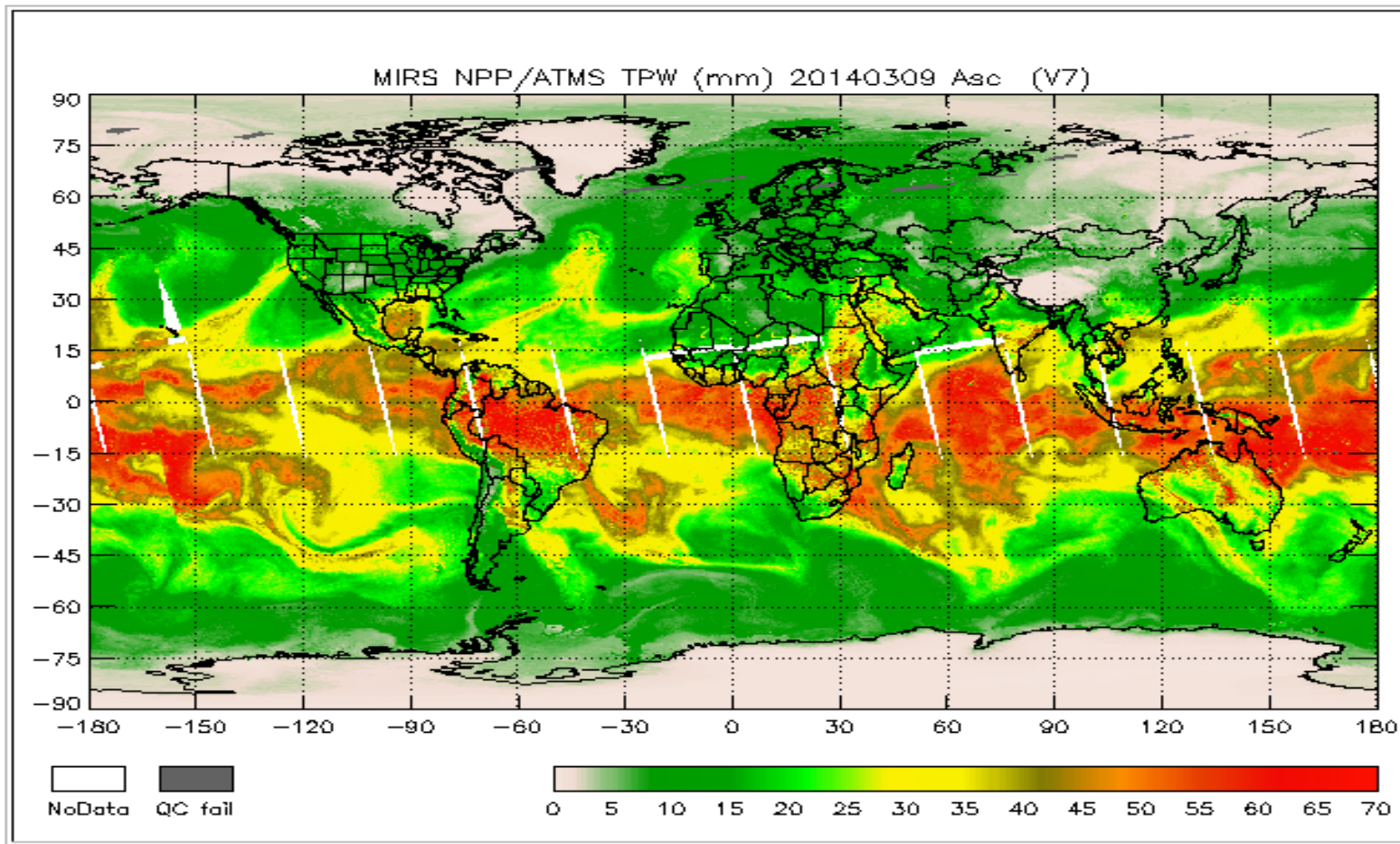
<http://www.ospo.noaa.gov/Products/atmosphere/mirs/>

4 Panels

Start Animation

Stop Animation

Satellite: Algorithm: Product:
Orbit: Area: Year: Month: day: Browse:



SMOPS

– Global soil moisture map generated from multi-satellites and/or -algorithms

- **Operational available since Sept 26, 2012**
- **Satellites:** Coriolis/Windsat, Metop-A/ASCAT, SMOS
- **Products:** *0.25x0.25 Degrees; 6 Hourly, Daily*
- **Formats:** GRIB2 and netCDF4
- **Data Access:** DDS
- The imagery products are also available on the Internet through:
<http://www.ospo.noaa.gov/Products/land/smops>

– The Upcoming Updates

- ASCAT soil moisture from Metop-B: *July 2014*
- NOAA NRT soil moisture from SMOS: *July 2014*
- AMSR-2 soil moisture from GCOM-W1: *Sep 2015*

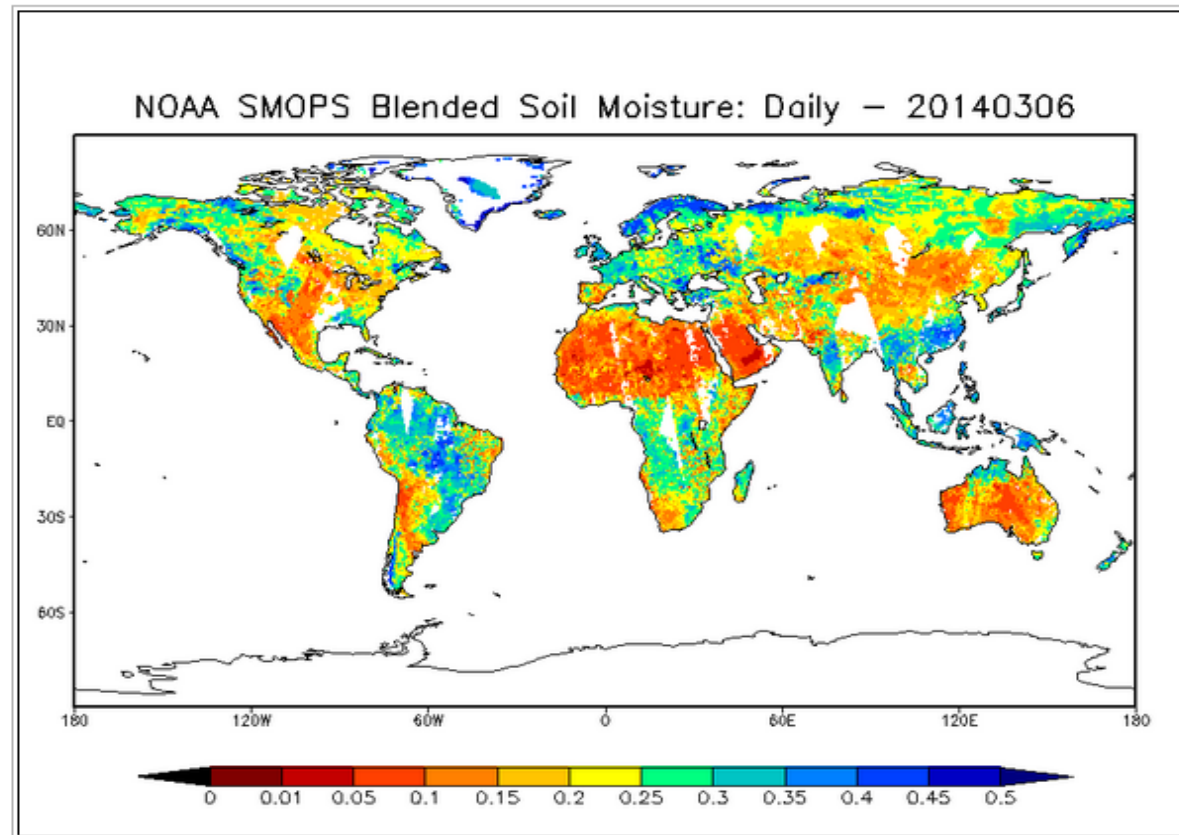
Examples of Soil Moisture Products

<http://www.ospo.noaa.gov/Products/land/smops/index.html>

Soil Moisture Products - Daily

Start | Stop | << NOAA_SMOPS_Blended_SoilMoisture >>

Start: Feb 25 2014 End: Mar 9 2014 Reload



[SMOPS Home](#)

[Algorithm Description](#)

Satellites/Sensors:

[ASCAT](#) | [SMOS](#) | [WindSat](#) | [AMSR2](#)
[AMSR-E](#)

Product Animation:

[Daily](#) | [6-hourly](#)

Validation:

[In Situ](#) | [Time Series](#)

Monitoring:

[Product](#) | [Time Series](#) |
[Processing](#) | [Timeliness](#)

[Test Data](#)

[Documents](#)

[IPT Members](#)

[Links](#)

Retirement - MSPPS

– Operational: since 1998

- **Satellites:** N15, N16, N17, N18, N19 and Metop-A/-B
- **Products:** RR, SFR, TPW, CLW, SnowC, SWE, Slce, IWP, SEM, LST; Orbital and Gridded; 16km; 45km; 0.25degree.
- **Formats:** HDF-EOS, BUFR and McIDAS
- **Data Access:** DDS and ADDE
- The imagery products are also available on the Internet through:
<http://www.ospo.noaa.gov/Products/atmosphere/mspps/index.html>

– The Upcoming Changes

- No MSPPS products from S-NPP and beyond
- Scheduled retirement when the MiRS high resolution and SFR products are available in late of 2014

New Product – MSPPS Snowfall Rate

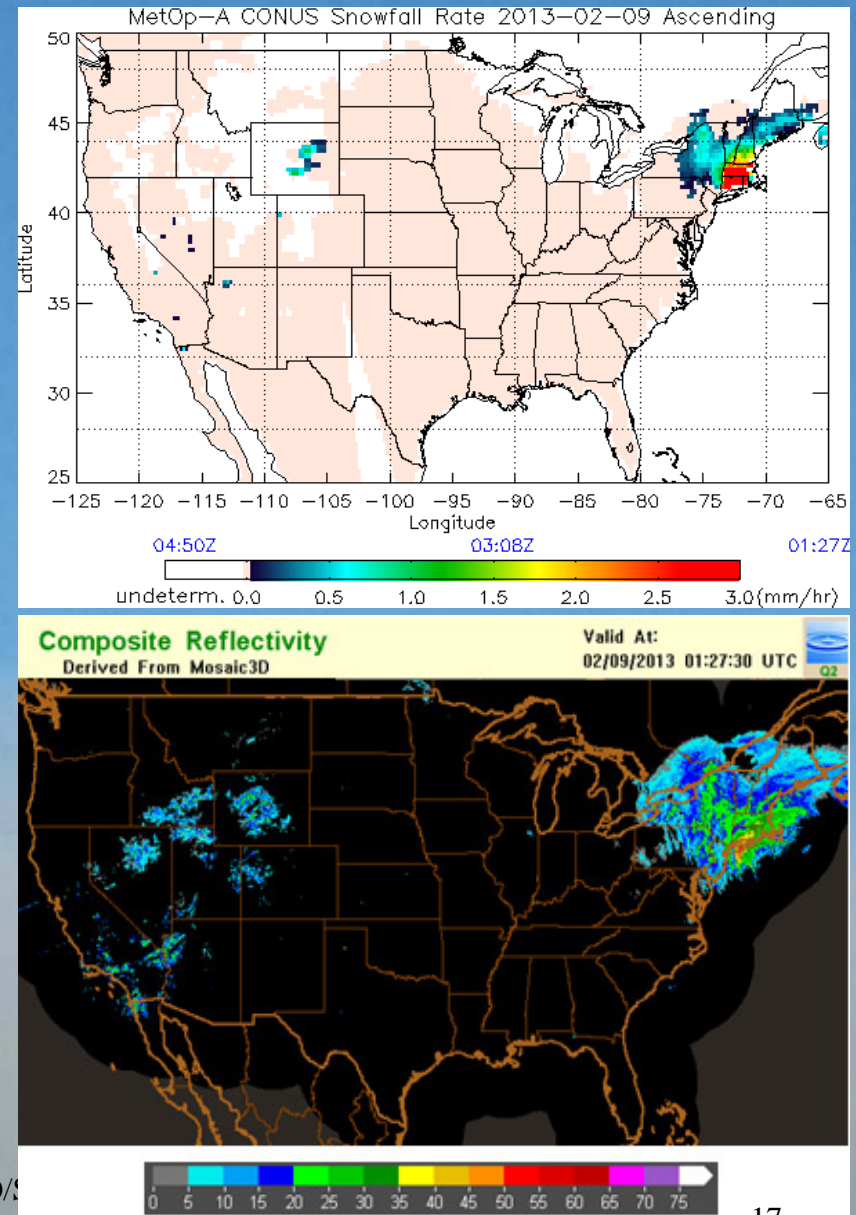
– Product Specifics

- Satellite retrieved water equivalent snowfall rate (SFR) over global land using measurements from passive microwave sensors, AMSU/MHS
- Resolution: 16 km x 16 km at nadir
- Maximum snowfall rate: 5 mm/hr
- AMSU/MHS SFR is operational at NESDIS with four satellites through MSPPS (N18, N19, MOA, MOB)
 - Up to 8 obs/day at a given location
- Validated against NMQ, StageIV, and gauge snowfall data

– Ongoing Activities

- NWS WFOs real-time evaluation
- Development of S-NPP ATMS SFR algorithm
- Transition AMSU SFR to MiRS

(Provided by H. Meng, NESDIS/STAR)



Upcoming New Satellite Capabilities

Satellites/Sensors	Algo	Products	Planned Schedule
S-NPP/ATMS; JPSS-1/ATMS	MiRS	Rainfall Rate, TPW, CLW, Snow Cover, Sea Ice, etc	Feb 2014; TBD
GCOM-W1/AMSR-2	GPDS/GPROF	Rainfall Rate, TPW, CLW, Snow Cover, Sea Ice, Soil Moisture, etc	June ~ July 2014; Sept 2015
Megha- Tropiques/SAPHIR	MiRS	Rainfall Rate, TPW, etc	June 2014
GPM/GMI	GPROF/MiRS	Rainfall Rate, TPW, etc.	Dec 2014; Feb 2016
GOES-R/ABI	SCaMPR	Probability of Rainfall, Rainfall Potential, QPE	Jan ~ Mar 2017

Upcoming New Products (< 6 months)

– GPDS (GCOM-W1 Processing and Distribution System)

- **Operational:** June ~ July 2014 Day-1; Sept 2015 Day-2
 - **Satellites/Sensors:** GCOM-W1/AMSR-2
 - **Products:** *BTs, TPW, CLW, RR, OSW, Snow, Sea Ice, Soil Moisture, etc.*
 - **Formats:** netCDF4 and McIDAS
 - **Data Access:** DDS and McIDAS ADDE (satepsdist4)
 - The imagery products will be available on the Internet through:
<http://www.ospo.noaa.gov/Products/atmosphere/gdps>

– MTRoPS (M-T Operational Products System)

- **Operational:** Jun 2014
 - **Satellites/Sensors:** Megha-Tropiques
 - **Products:** *BTs, TPW, RR*
 - **Formats:** netCDF4 and McIDAS
 - **Data Access:** DDS and McIDAS ADDE (satepsdist4)
 - The imagery products will be available on the Internet through:
<http://www.ospo.noaa.gov/Products/atmosphere/mtrops>

GPM Updates

- Satellite and Sensor Status
 - GPM Core – Launched successfully in Feb. 2014 (by JAXA)
 - Primary sensors
 - GMI (NASA) – 13 channel (10-183 GHz) conically scanning radiometer (successor to TRMM TMI)
 - Enhancement for cold season precipitation over land
 - DPR (JAXA) – Ka/Ku band radar (successor to TRMM PR)
 - Dual frequency helps improve vertical structure of precipitation
 - Dual frequency improves sensitivity to lighter precipitation
- NOAA Access to GPM Data
 - GMI turned on and spinning in science mode – 3/4/14 sensors
 - Test data sets made available to NOAA (example shown on backup slides)
 - NESDIS operation will pull the data from NASA to serve NOAA users before NOAA enterprise GPM precipitation product system is developed and transitioned into operation.

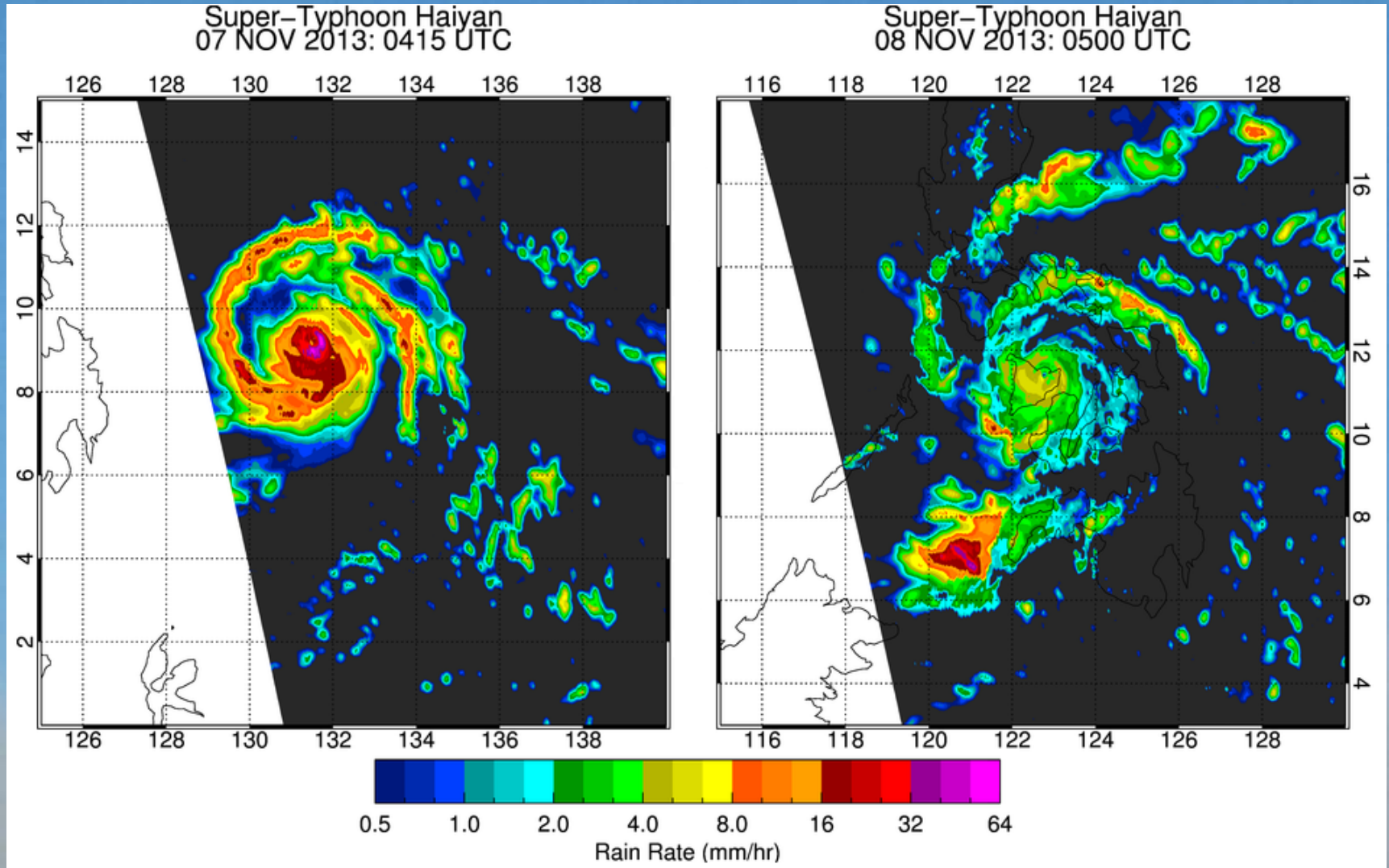
Looking Forward

- The GPM core and constellation satellites would provide precipitation and related products with near-global coverage every 3 hours or less
- NOAA is moving forward for an enterprise approach to utilize the GPM constellation resource and capability in supporting the need of NOAA operational precipitation mission
- Improved blended products through the inclusion of newer satellite capabilities, improved science, etc.

Thank You!

Backup Slides

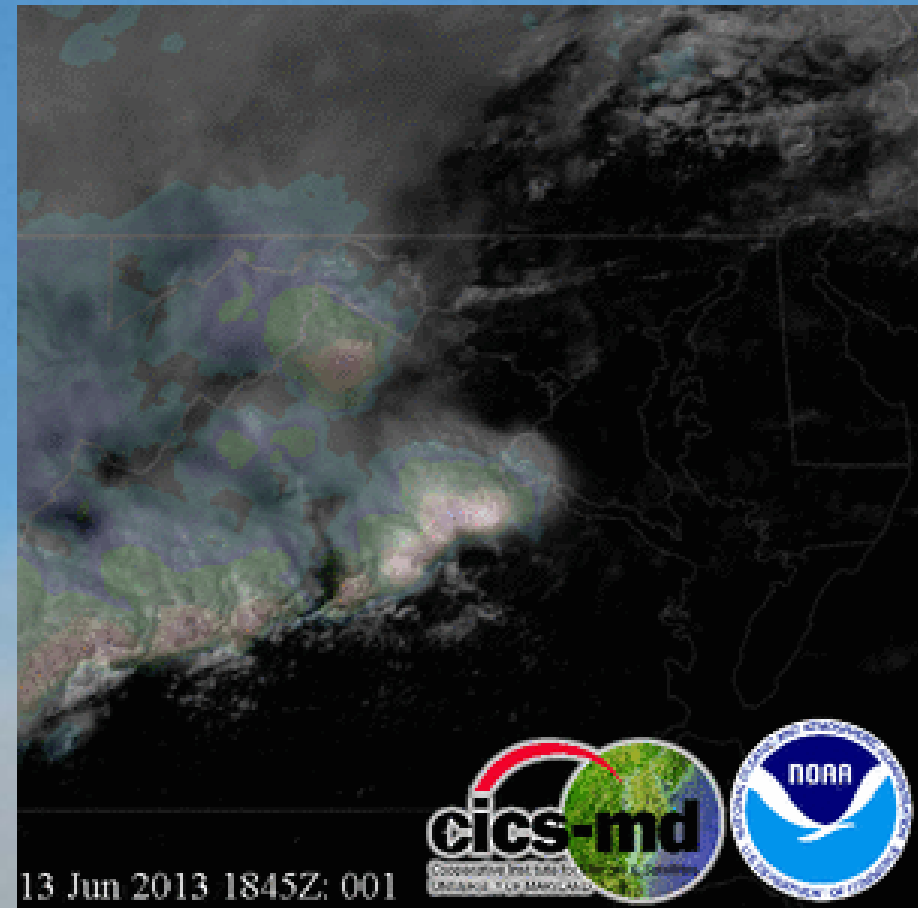
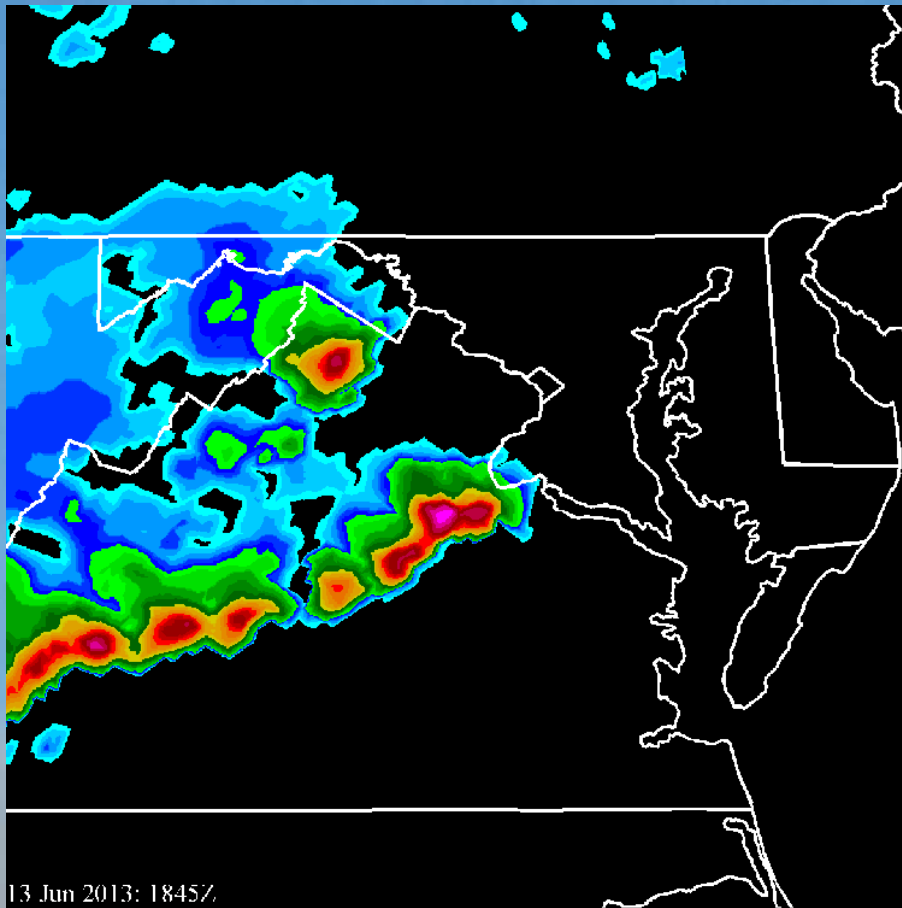
Super-Typhoon Haiyan – GCOM/AMSR-2



(Images provided by Patrick Meyers/CICS)

Tornado Outbreak – GCOM/AMSR-2

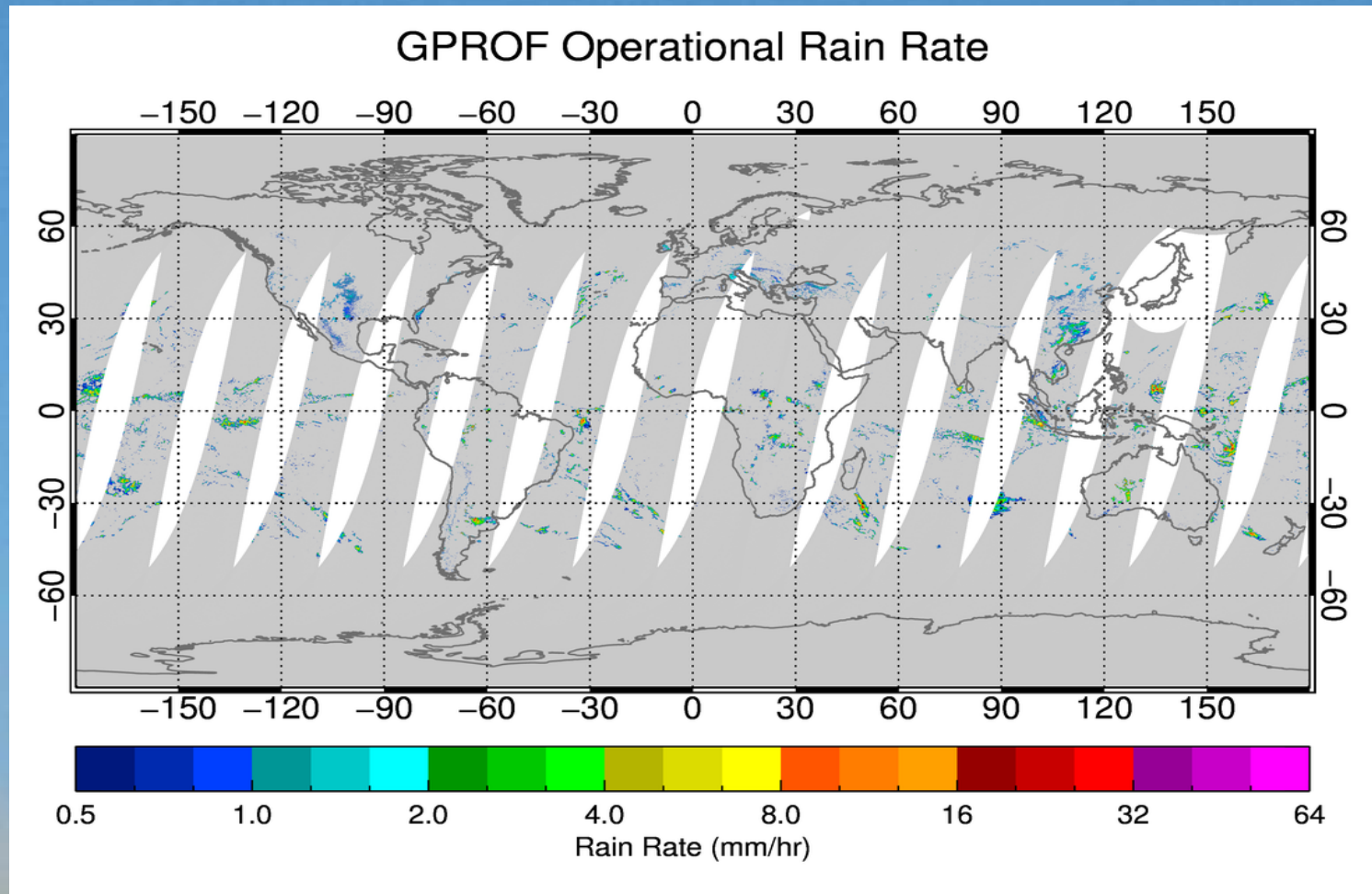
13 June 2013



(Images provided by Patrick Meyers/CICS)

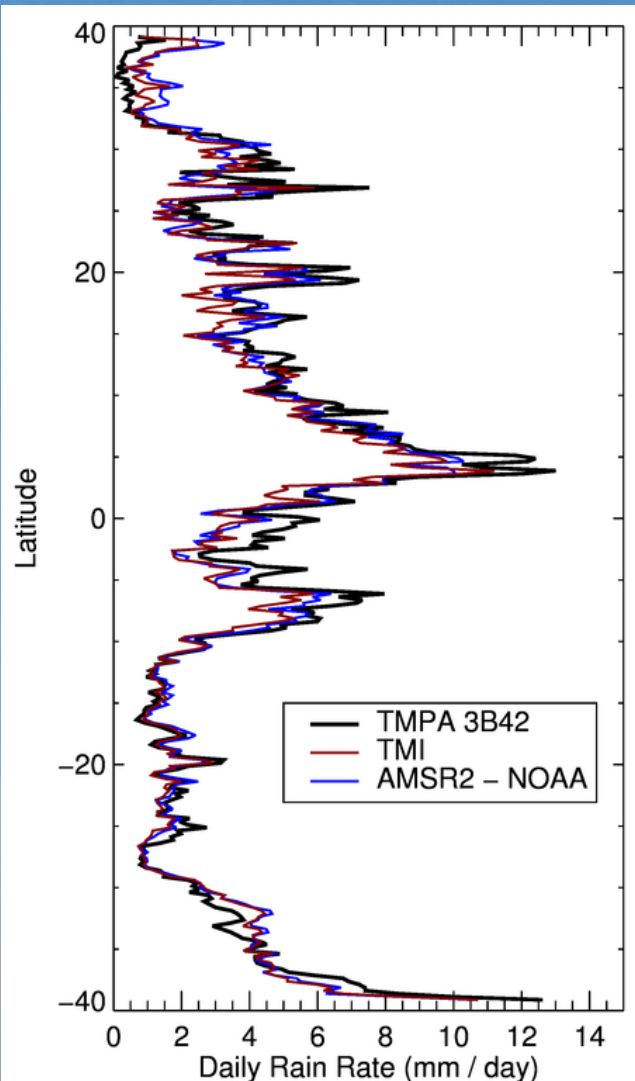
Daily Rain Rates – GCOM/AMSR-2

6 April 2014



(Images provided by Patrick Meyers/CICS)

AMSR-2 RR Validation with TRMM



- AMSR2 Level 2 swath retrievals
- 2A12: Level 2 TMI rain retrievals
- 3B42: Level 3 3-hr estimate from multiple satellites

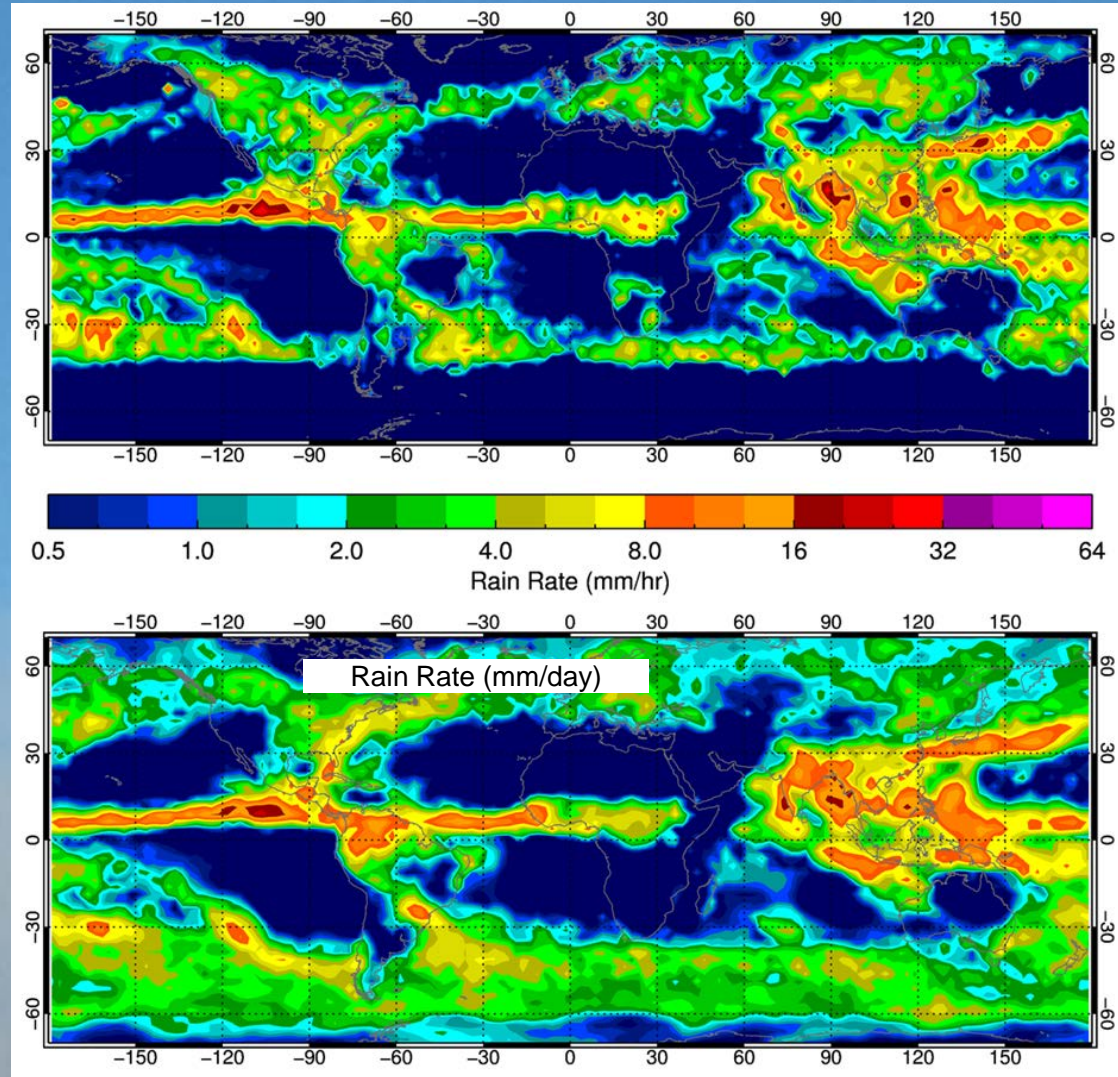
RMSD (mm/hr)	Land	Ocean	Overall
Requirements	5.0	2.0	–
TMI & TMPA	3.1	1.2	1.6
AMSR2 & TMI	3.6	1.2	1.8
AMSR2 & TMPA	3.1	1.4	1.9

(Images provided by Patrick Meyers/CICS)

Comparisons of AMSR-2 and GPCP

Monthly Precipitation
June 2013

AMSR2/GPROF



(Images provided by Patrick Meyers/CICS)

Megha-Tropiques Recent Results

(Rain - T. Islam, CIRA; TPW – I. Moradi, CICS)

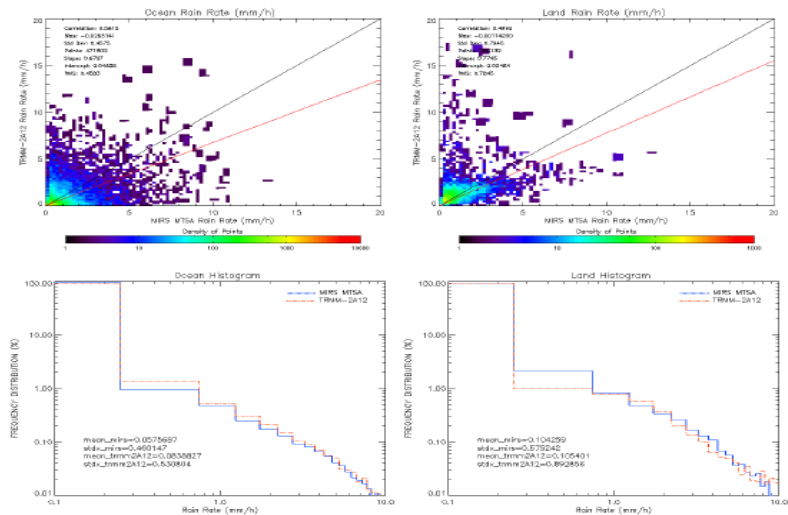
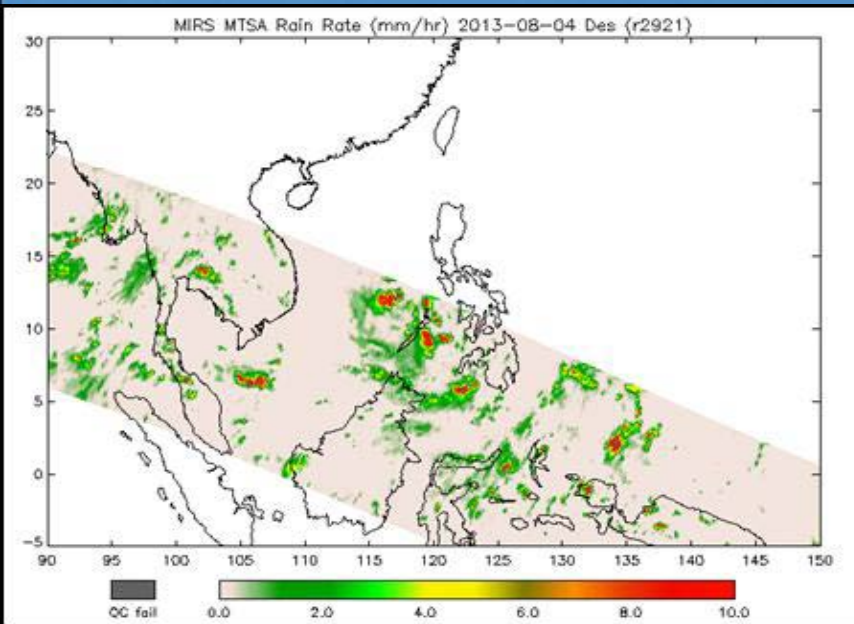
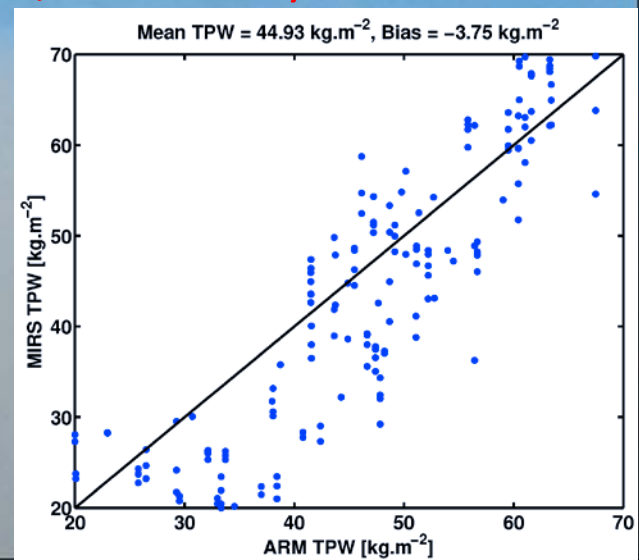
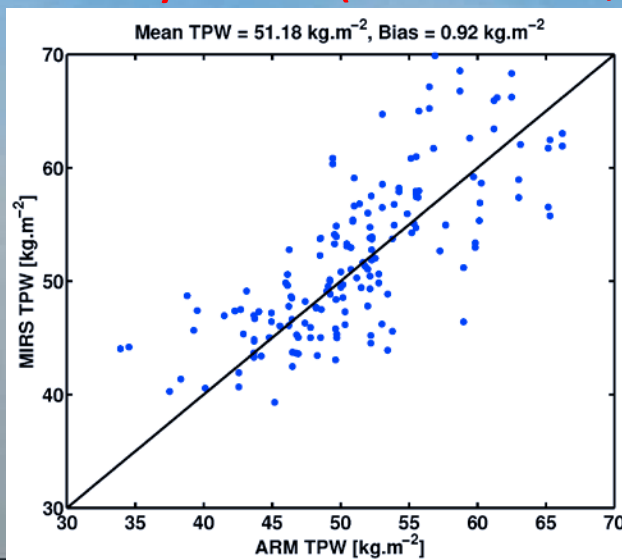
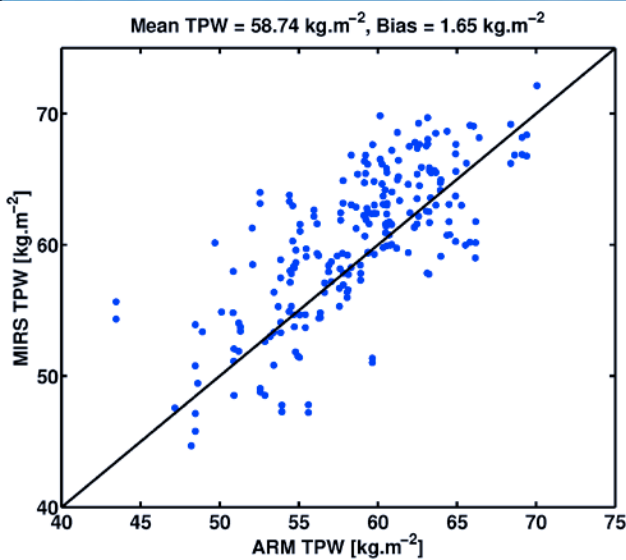


Figure 4: Independent assessment of MiRS SAPHIR rain rate retrieval against TRMM GPROF algorithm (March – August 2013 validation period).

MiRS SAPHIR only TPW (Ocean – L, C; Land – R)

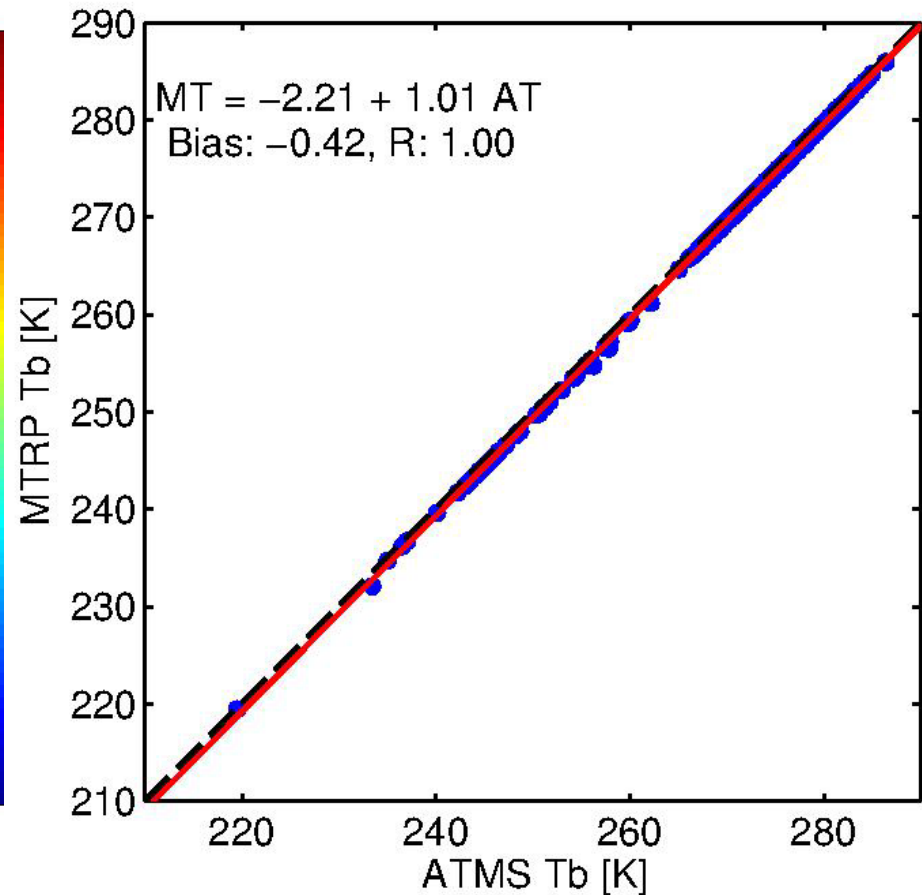
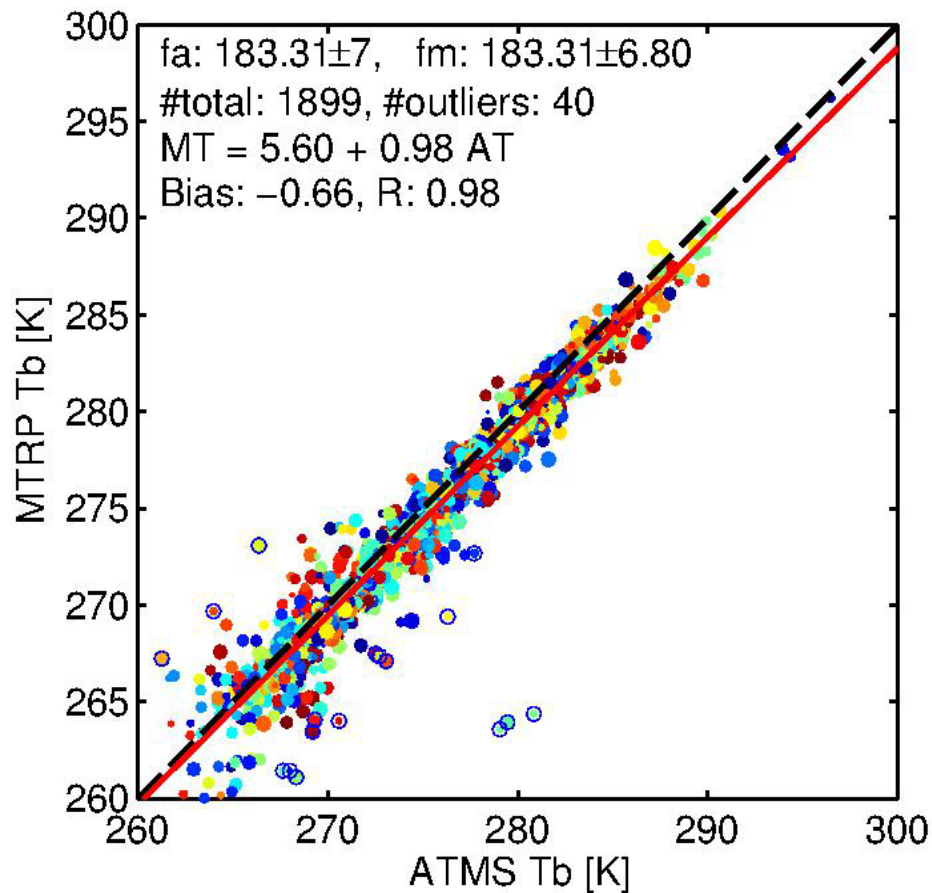


SAPHIR vs. ATMS

Observations

December 2012

Simulations

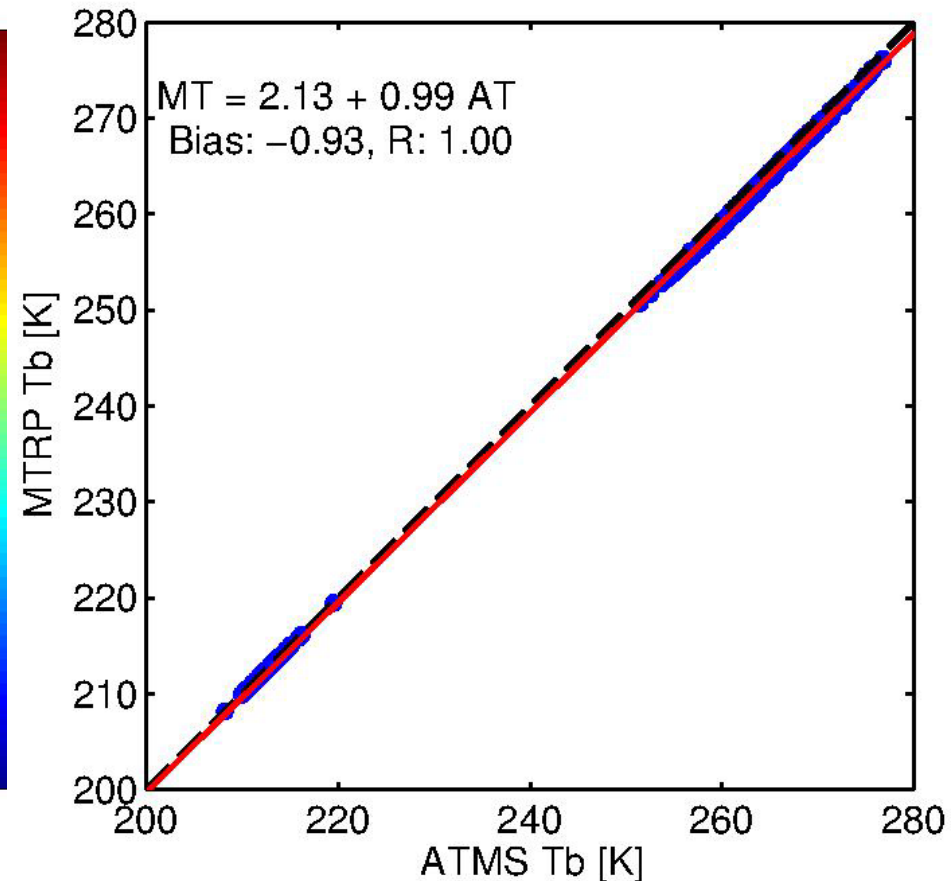
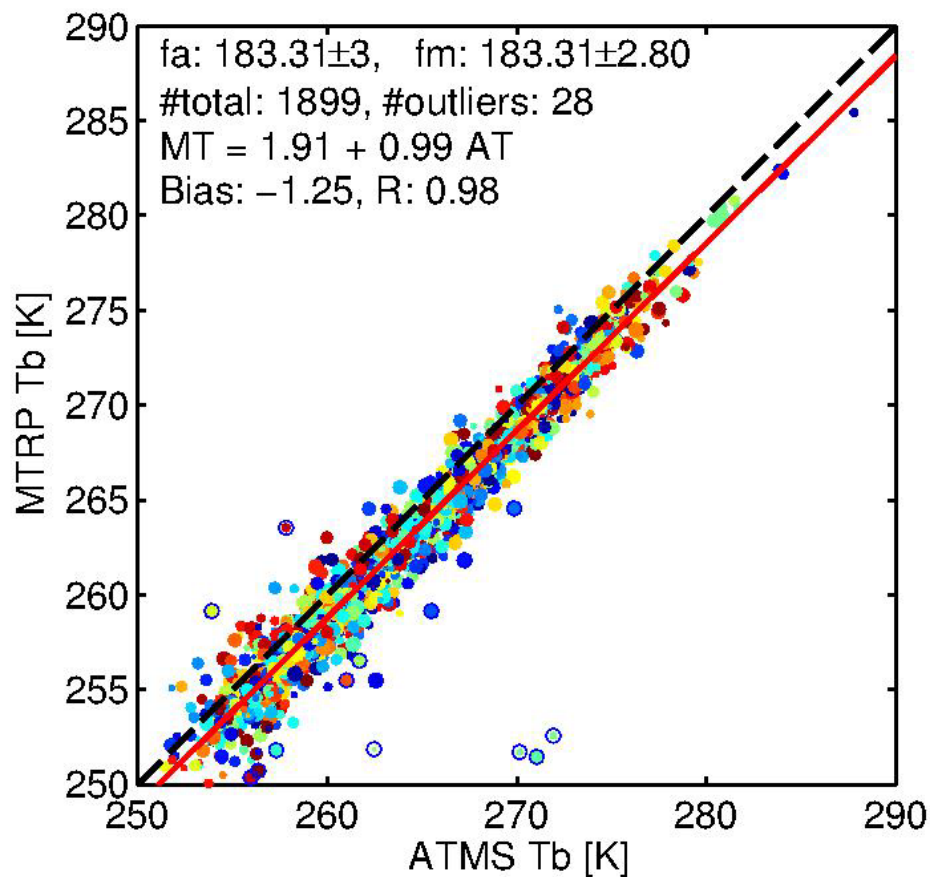


SAPHIR vs. ATMS

Observations

December 2012

Simulations



Summary

Freq ATMS	Freq SAPHIR	Bias (Obs)	Bias (Sim)	Obs-Sim
183±7.0	183±6.8	-0.66	-0.42	-0.24
183±4.5	183±4.2	-1.51	-0.91	-0.6
183±3.0	183±2.8	-1.25	-0.93	-0.32
183±1.0	183±1.1	0.52	0.90	-0.38

GPM (NASA/JAXA)

R.Ferraro, STAR/CoRP

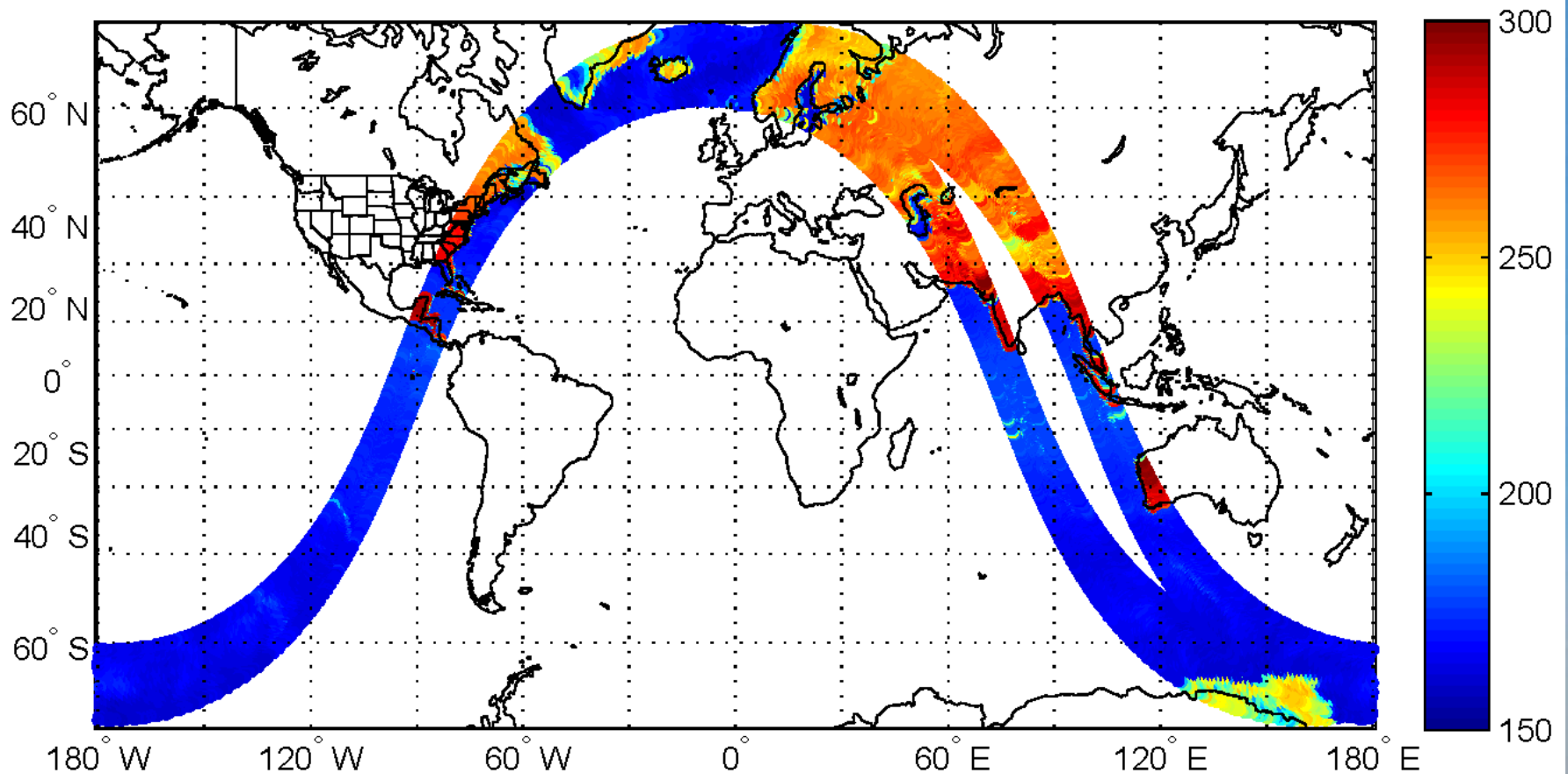
- Satellite and Sensor Status:
 - GPM Core – successful launch Feb. 27, 2014 (by JAXA)
 - 3/4/14 - GMI turned on and spinning in science mode
 - Test data sets received (next slide)
 - Primary sensors
 - GMI (NASA) – 13 channel (10-183 GHz) conically scanning radiometer (successor to TRMM TMI)
 - Enhancement for cold season precipitation over land
 - DPR (JAXA) – Ka/Ku band radar (successor to TRMM PR)
 - Dual frequency helps improve vertical structure of precipitation
 - Dual frequency improves sensitivity to lighter precipitation



More Mission Details at:
http://www.nasa.gov/mission_pages/GPM/main/

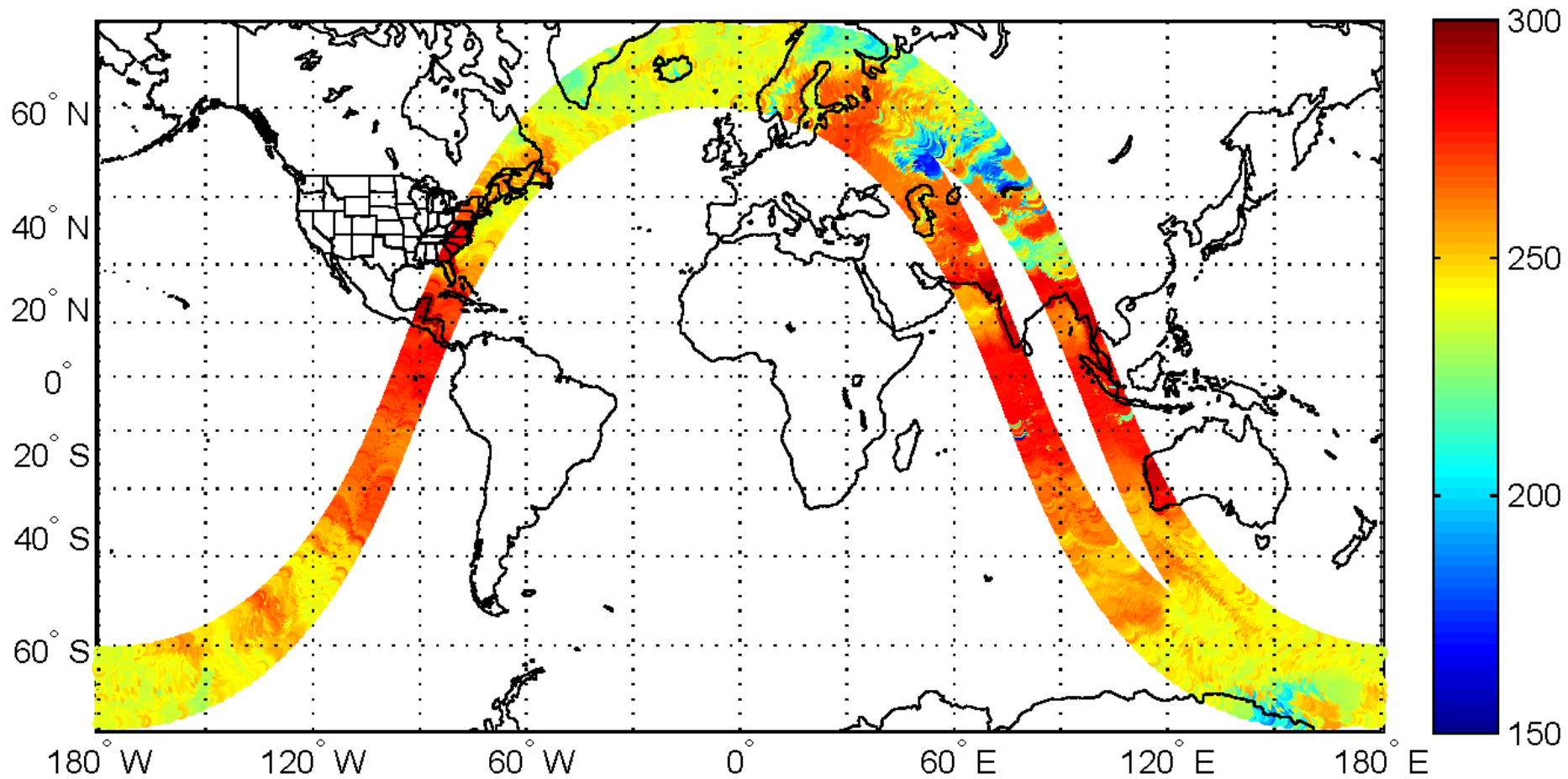
Early GMI orbits -3/21/14

10V



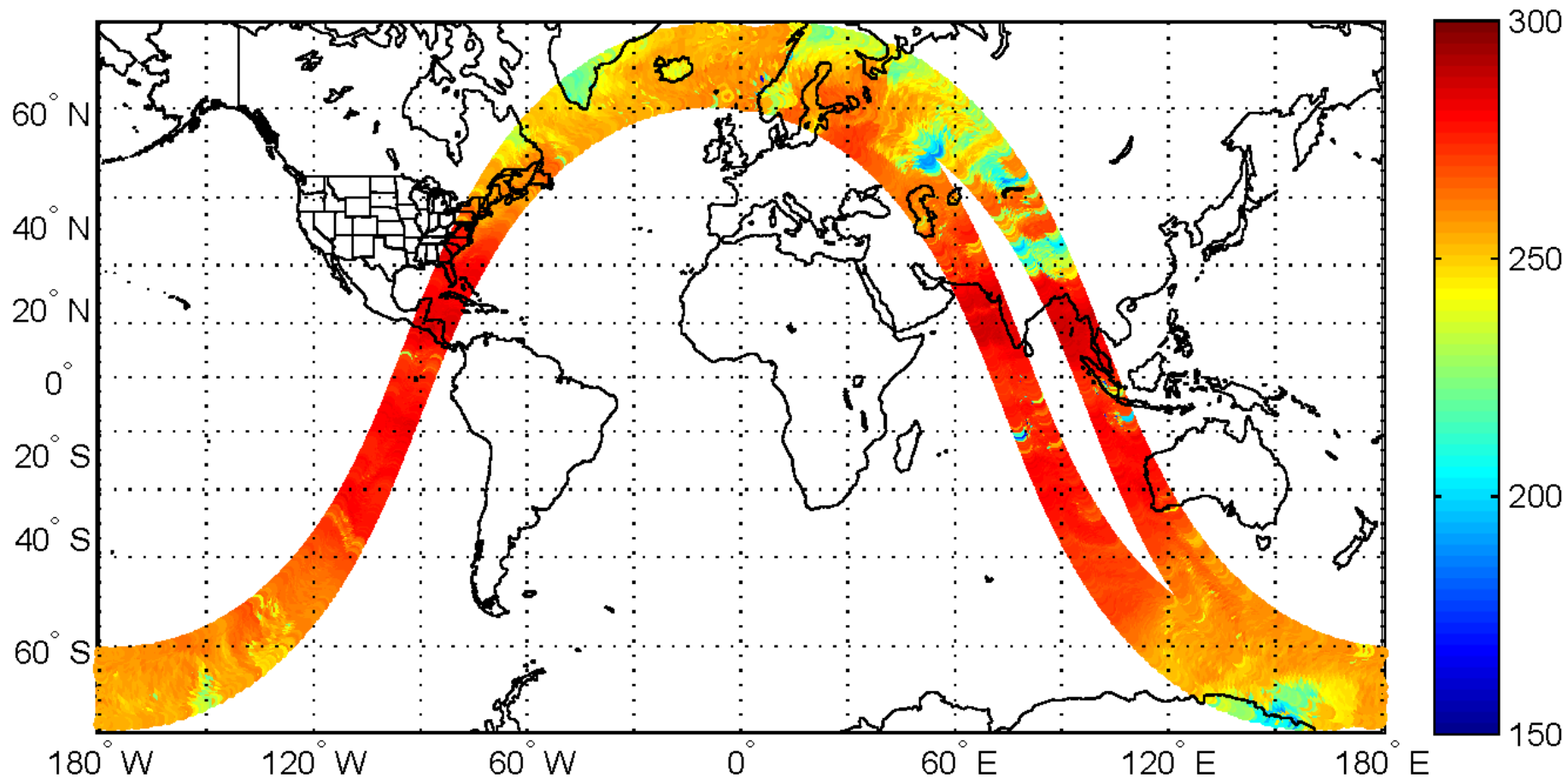
Early GMI orbits -3/21/14

85V



Early GMI orbits -3/21/14

166V



Data Access

- **Real-time data access to ESPC DDS through Data Access Request(DAR):**

<http://www.ospo.noaa.gov/Organization/About/access.html>

- **Historical data access through NOAA/CLASS/NCDC:**

<http://www.class.ngdc.noaa.gov/saa/products/welcome>

- **Imagery Products through Internet:**

MSPPS - <http://www.ospo.noaa.gov/Products/atmosphere/mspps>

MiRS - <http://www.ospo.noaa.gov/Products/atmosphere/mirs>

GHE - <http://www.ospo.noaa.gov/Products/atmosphere/ghe>

bRR - <http://www.ospo.noaa.gov/Products/atmosphere/brr>

bTPW - <http://www.ospo.noaa.gov/bTPW>

SMOPS - <http://www.ospo.noaa.gov/Products/land/smops>

- **Questions/Comments:** *Limin.Zhao@noaa.gov*