

# **An Update on the NESDIS Operational Hydrometeorological Products**

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***March 12, 2014***

# Outlines

- **Overview of NESDIS Operational Capability**
- **Operational Hydrometeorological Products**
  - **Current Status**
  - **Planned Updates**
- **Upcoming and Future Capability**
  - **New Satellite and Product Capabilities**
  - **Enterprise Approach for Precipitation Products**

# Satellites for Hydrological Applications

- Satellites are particularly useful where ground measurements are:
  - Not taken or missing: Sparse rain gauges and data delivery failure (maybe caused by an extreme rainfall event)
  - Of questionable quality: Radar missing offshore rain; radar beam blockage in mountains
  - Not possible: Open ocean
- NESDIS provides operational satellite products of hydrological parameters from each individual satellite it operates
  - GOES – visible and IR based, rapid update
  - POES – passive MW, 5 satellites, 4~6 hour global coverage
- NOAA also utilizes satellite assets from other agencies like NASA, DoD, EUMETSAT, Japan/JAXA, etc

# NESDIS Operational Hydrometeorological Data and Products

Geostationary (Regional, rapid update)	Low Earth Orbiting (Global, 3-6 hourly)
Visible, IR and WV loops	Visible, IR and microwave imagery
Rain Rate	Rain and Snowfall Rate
Total Precipitable Water(TPW) (cloud free)	TPW (all weather; ocean only in some cases)
Snow and Ice Cover	Snow Cover/Water Equivalent/Sea Ice Concentration
	Soil Moisture
Blended Products	
Blended TPW (with LEO, GPS Met and GEO data)	
Blended Rain Rate (LEOs, GEOs)	
Ensemble Tropical Rainfall Potential (eTRaP)	
Snow and Ice Map (IMS)	
Global Soil Moisture Map (SMOPS)	

# Operational Products Suites of Interests

**MSPPS** – Microwave Surface and Precipitation Products System

**MiRS** – Microwave Integration Retrieval System

**GHE** – Global HydroEstimator

**bTPW** – Blended Total Precipitable Water

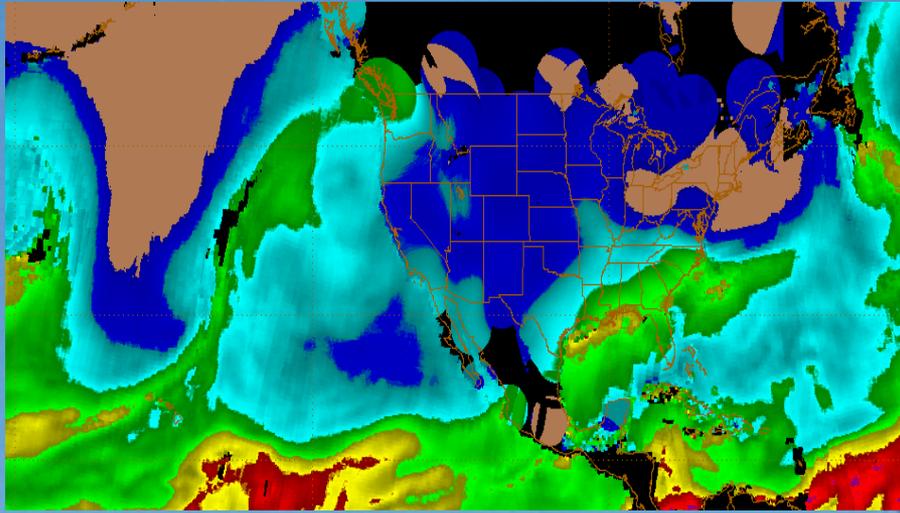
**bRR** – Blended Rain Rate

**eTRAP** - Ensemble Tropical Rainfall Potential (eTRaP)

**SMOPS** – Soil Moisture Operational Products System

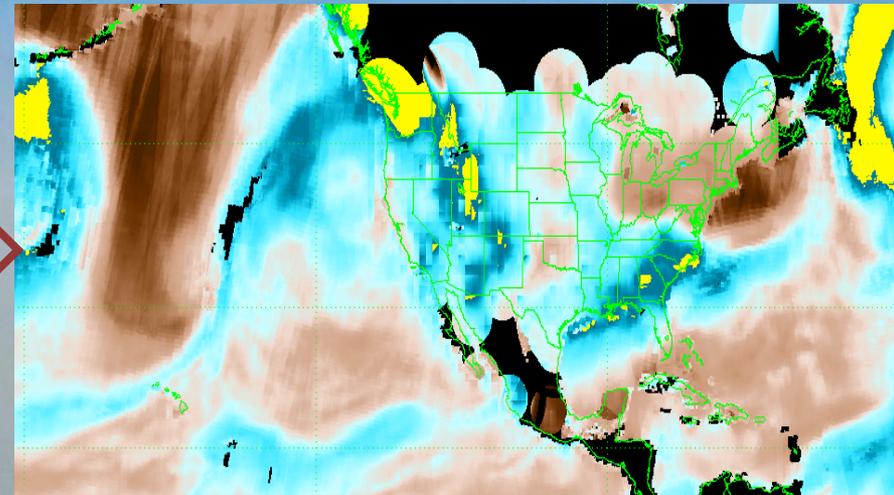
Algo	Products	Satellites/Sensors	Res	Type	Formats
<b>MSPPS</b>	Rainfall rate, Snowfall rate, TPW, CLW, etc	NOAA-18&NOAA-19&Metop-A & Metop-B <i>/AMSU-A&amp;MHS</i>	16 km	Level-2, Level-3	HDF-EOS, McIDAS area, PNG
<b>MiRS</b>	Rainfall rate, TPW, CLW, etc	NOAA-18 & NOAA-19 & Metop-A & Metop-B <i>/AMSU-A&amp;MHS;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

# 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

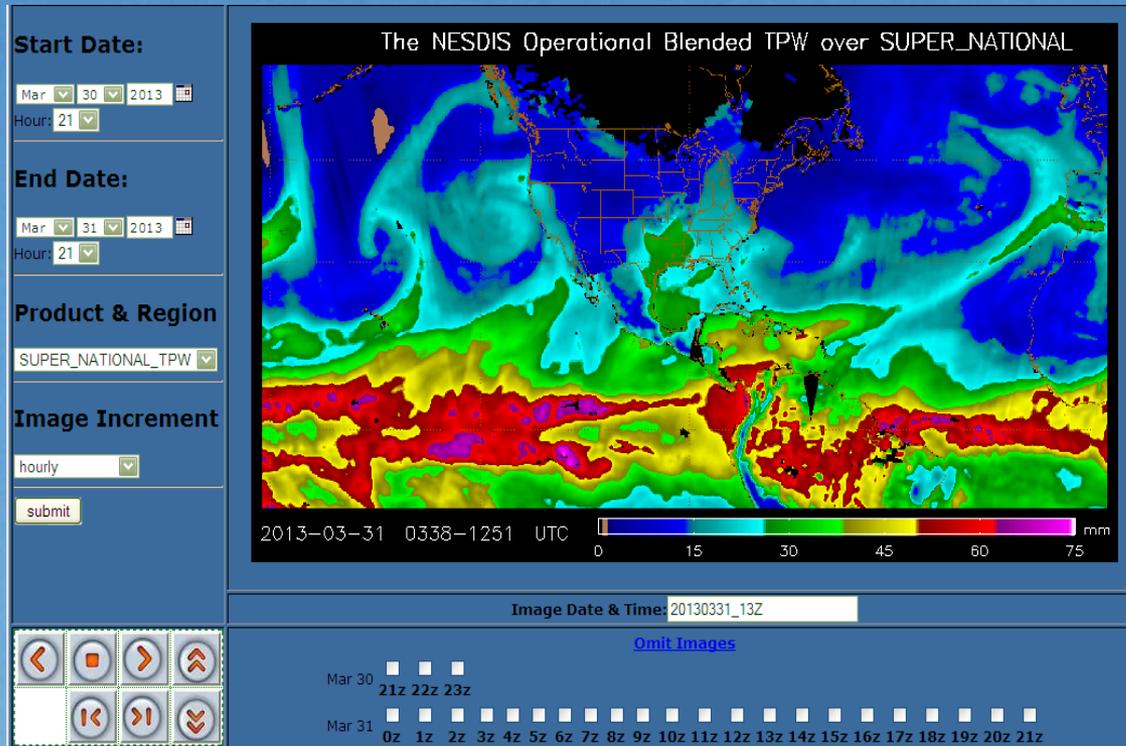


# Blended TPW

## – Current Status

- **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 – Animation Tool



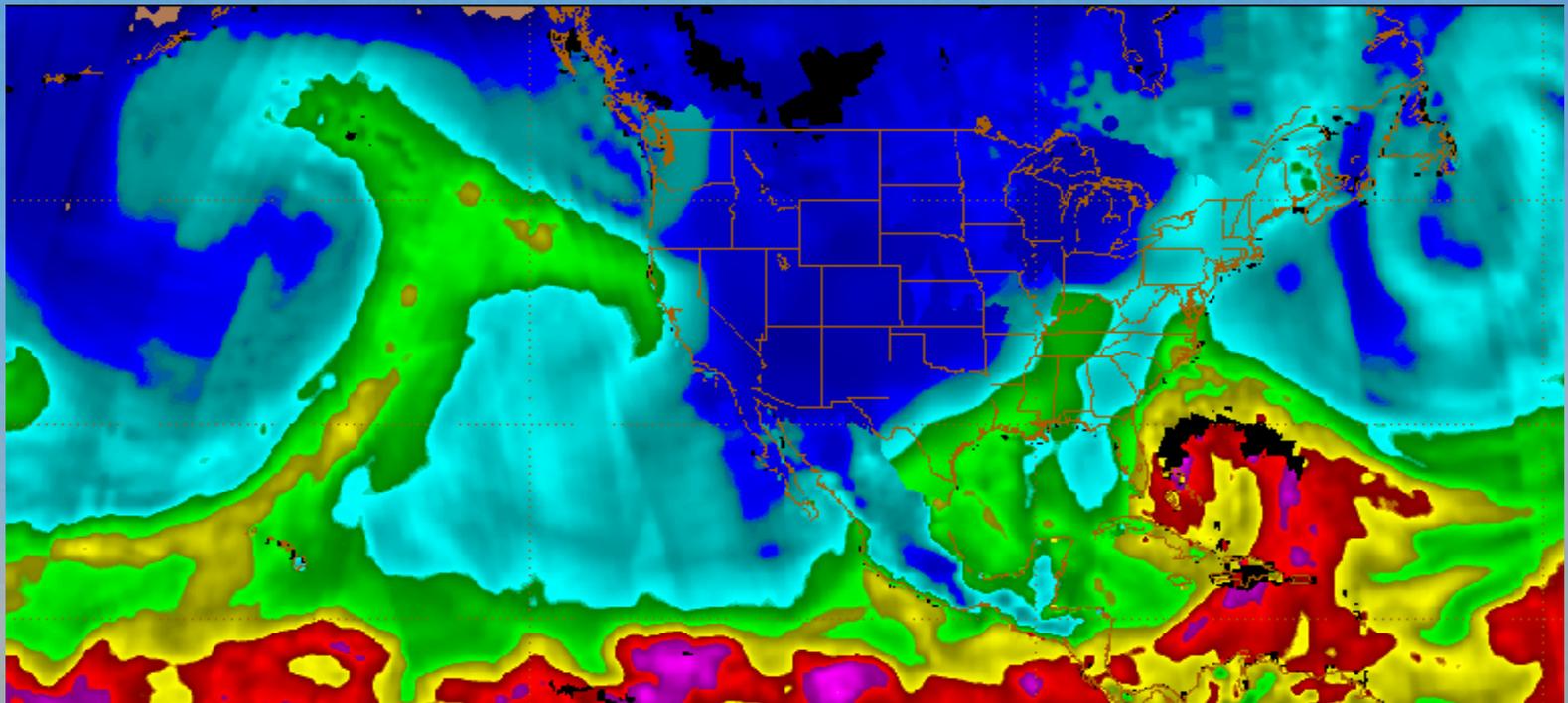
- **Products** – Blended TPW and Percentage of TPW Normal (PCT)
- **Refresh** – Hourly with the latest 12 hour data from multi-satellites/sensors
- **Map Projection** – Mercator
- **Coverage** – Global Ocean and Land excluding poles (71°N to 71°S )
- **Resolution** – 16 km at equator
- **Format:** HDF-EOS,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

# Blended TPW

## – The Upcoming Updates

- Update to include high resolution Metop-B TPW from MiRS: *Apr 2014*
- Update to include NPP ATMS TPW: *Apr 2014*
- Update 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*
- Update to include M-T TPW: *May 2015*



# 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>

## – The Upcoming Updates

- To include MiRS NPP ATMS RR: *May 2014*
- To include GCOM-W1 AMSR-2 RR: *Aug 2014*
- To include MiRS AMSU and SSMIS RR when the high resolution products are available: *Oct 2014*

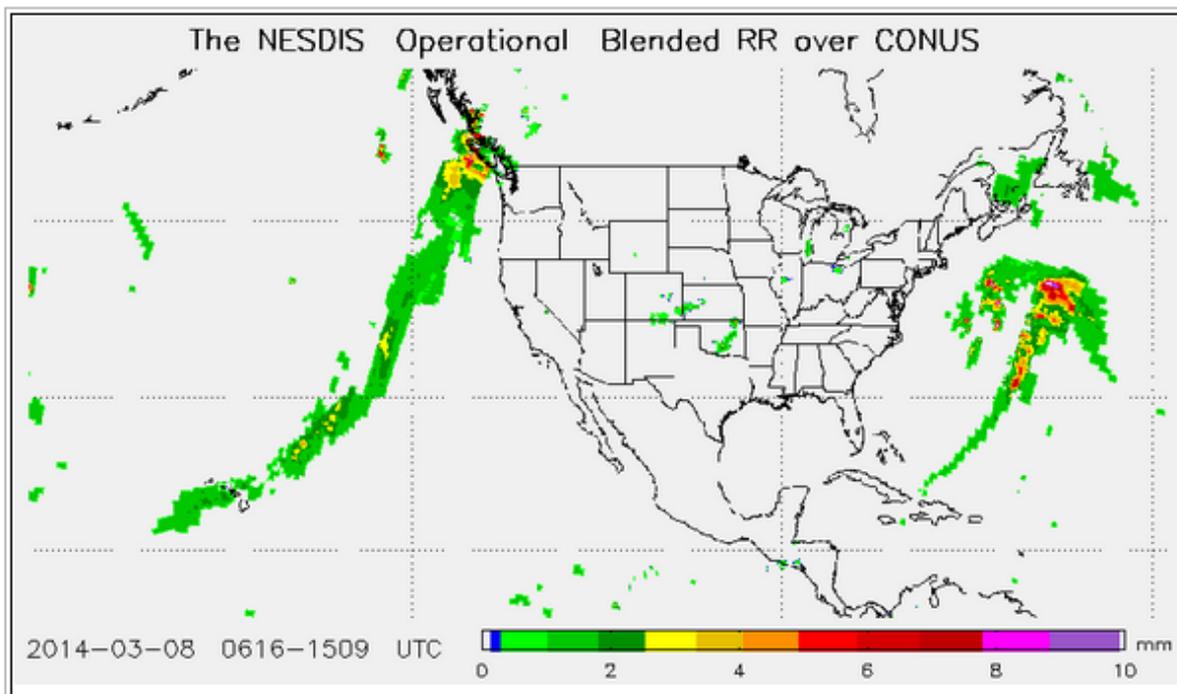
# Blended Rain Rate

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

## Operational Blended Rain Rate

Start Stop | << CONUS\_RR\_20140308\_16Z.png >>

Start: Mar 6 2014 End: Mar 10 2014 Reload



[Home](#)

[Algorithm Description](#)

**Product Animation:**

**Blended RR:**

[Global](#) | [CONUS](#) | [Super National](#) | [Africa](#) | [Asia](#) | [Atlantic](#) | [East Pacific](#) | [North Pacific](#) | [Australia](#) | [Indian Ocean](#) | [South Pacific](#) | [East Asia](#) | [South Indian Ocean](#) | [Europe](#)

**QMORPH:**

[Global](#) | [CONUS](#) | [Super National](#) | [Africa](#) | [Asia](#) | [Atlantic](#) | [East Pacific](#) | [North Pacific](#) | [Australia](#) | [Indian Ocean](#) | [South Pacific](#) | [East Asia](#) | [South Indian Ocean](#) | [Europe](#)

**Validation**

[Gauge](#) | [Radar](#) | [QMORPH](#)

**Monitoring:**

Products: [Global](#) | [McIDAS](#) | [AWIPS](#)

[Processing](#) | [Timeliness](#)

[Test Data](#)

[Documents](#)

# 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

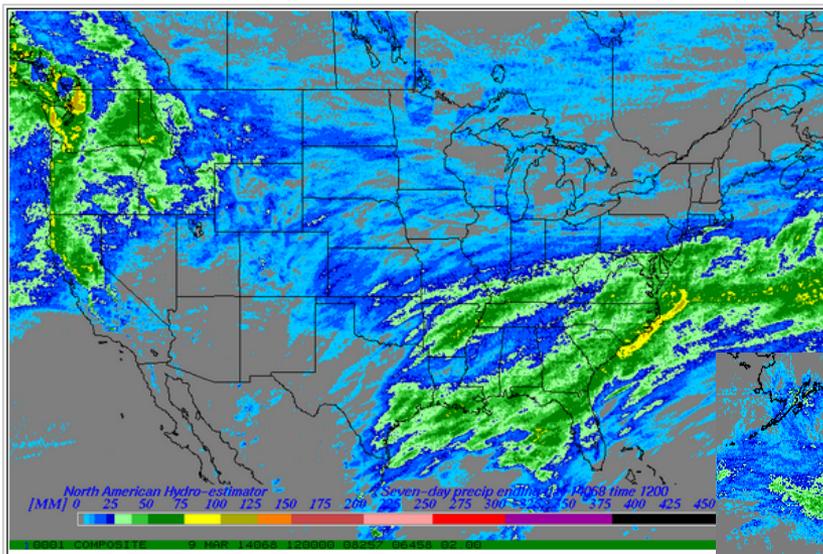
# NESDIS Operational Global Hydro-Estimator Rainfall

## Operational Hydro-Estimator Satellite Rainfall Estimates

### 7-Day Rainfall Totals

Start  |  NAMHE\_7DAY\_2014068\_1200.GIF

Start: Mar  2  2014 End: Mar  9  2014



[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](#)

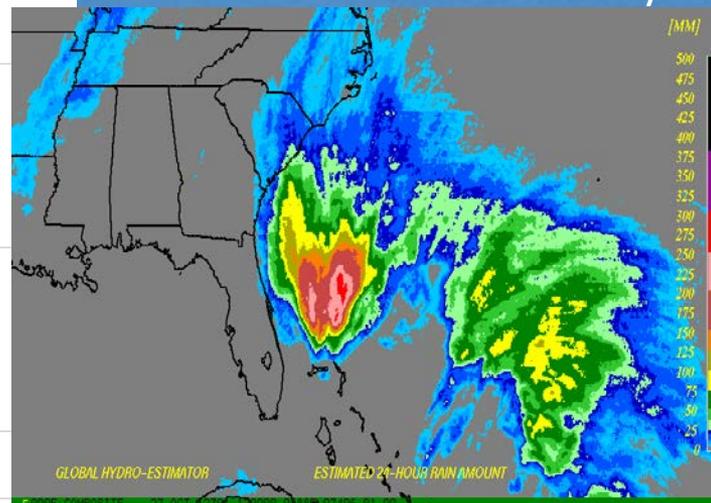
[4-day](#) | [5-day](#) | [6-day](#) | [7-day](#)

[Validation](#)

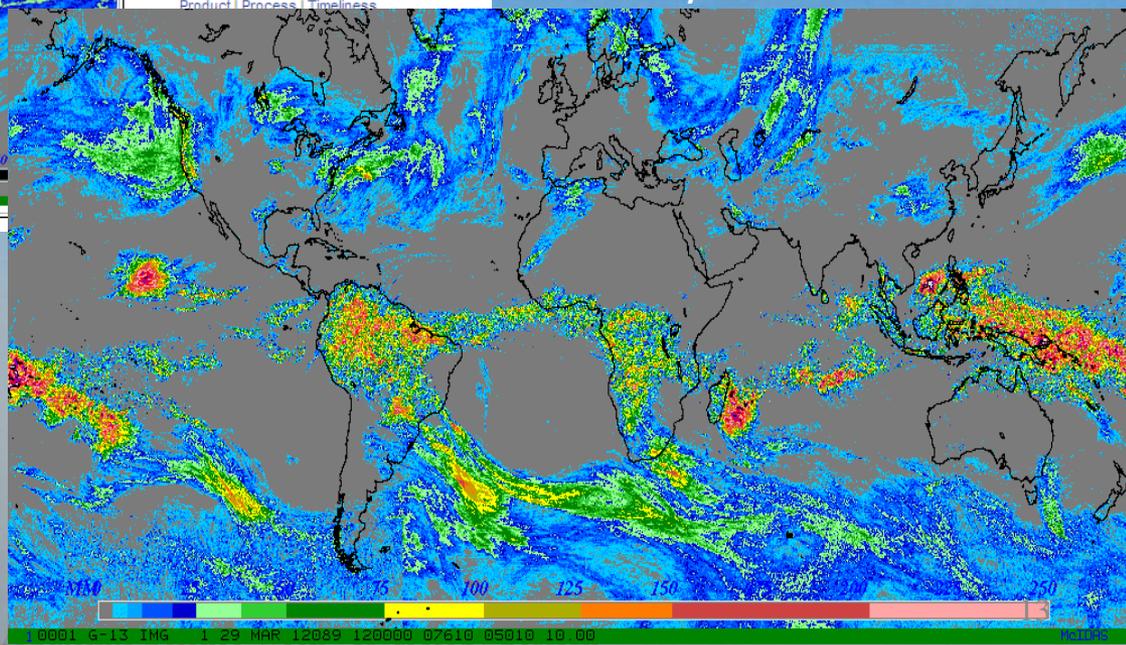
Monitoring:

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

## 24-hour Rainfall Total - Sandy



## 5-Day Rainfall Total



# 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: Aug 2014*

# Examples of MiRS S-NPP Products

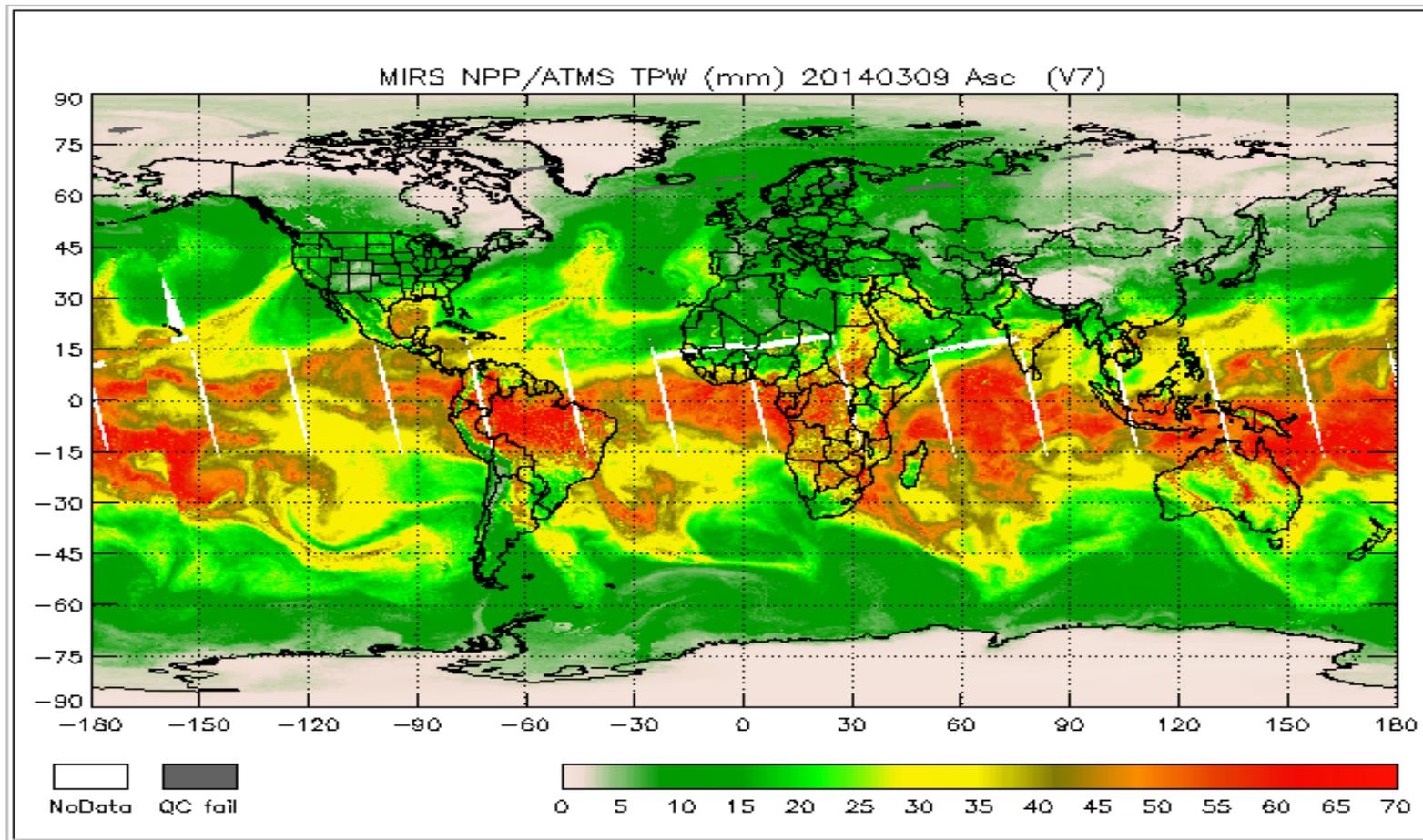
<http://www.ospo.noaa.gov/Products/atmosphere/mirs/>

4 Panels

Start Animation

Stop Animation

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



# MSPPS

## – Operational: since 1998

- **Satellites:** N15, N16, N17, N18, N19 and Metop-A/-B
- **Products:** RR, SFR, TPW, CLW, SnowC, SWE, SIce, 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

# MSPPS – Snowfall Rate

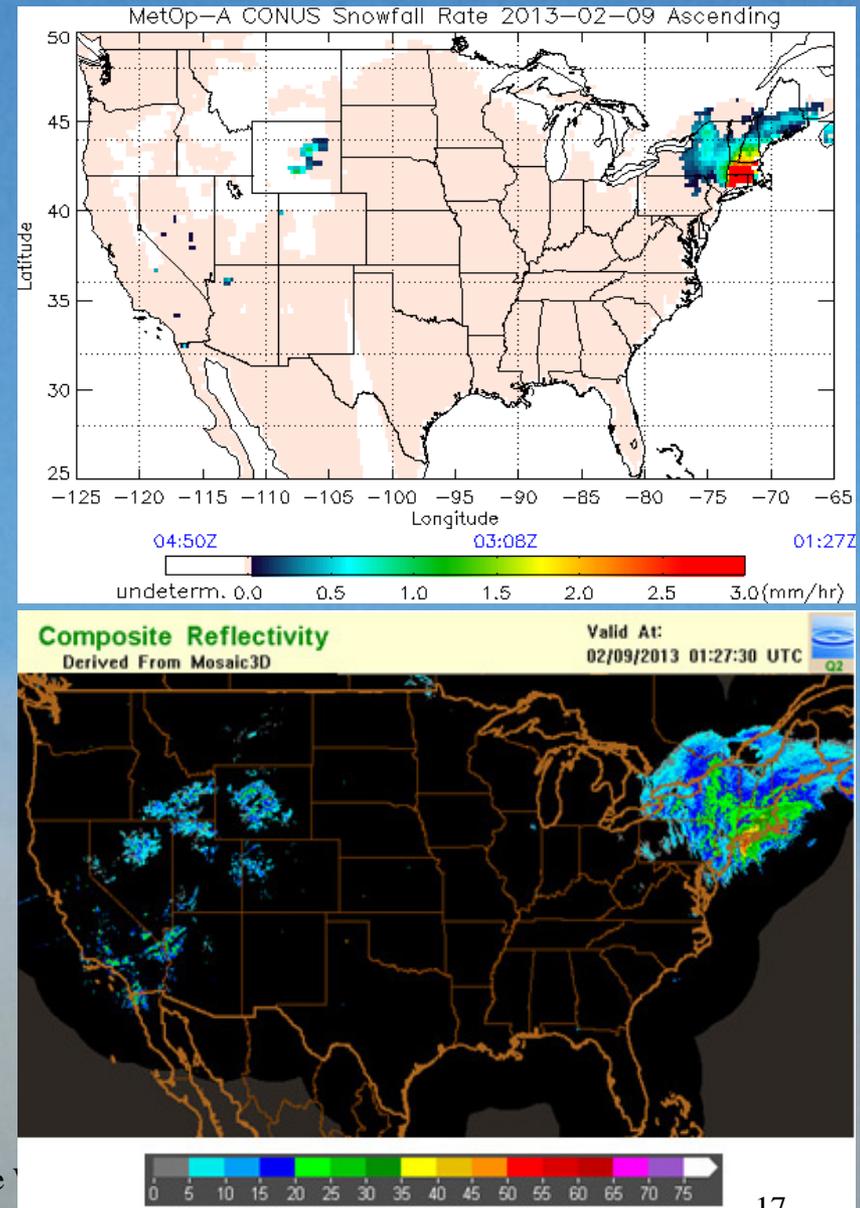
## – Product Specifics

- 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

*(Provided by H. Meng, NESDIS/STAR)*



# eTRAP

– Ensemble forecast of 6~24-hour rainfall potential for tropical systems based on extrapolation of satellite-derived rainfall rates along predicted storm track

- **Operational:** since 2009
- **Satellites:** Rainfall Rate from N18, N19 and Metop-A/-B, F16, F17, F18, GOES-W/GOES-E, MTSAT, Meteosat
- **Products:** Probability (PoP), Prob-Matched QPF (PMQPF)
- **Formats:** ASCII, McIDAS and gifs
- **Data Access:** DDS, McIDAS ADDE and FTP
- The imagery products are also available on the Internet through:  
<http://www.ssd.noaa.gov/PS/TROP/etrap.html>

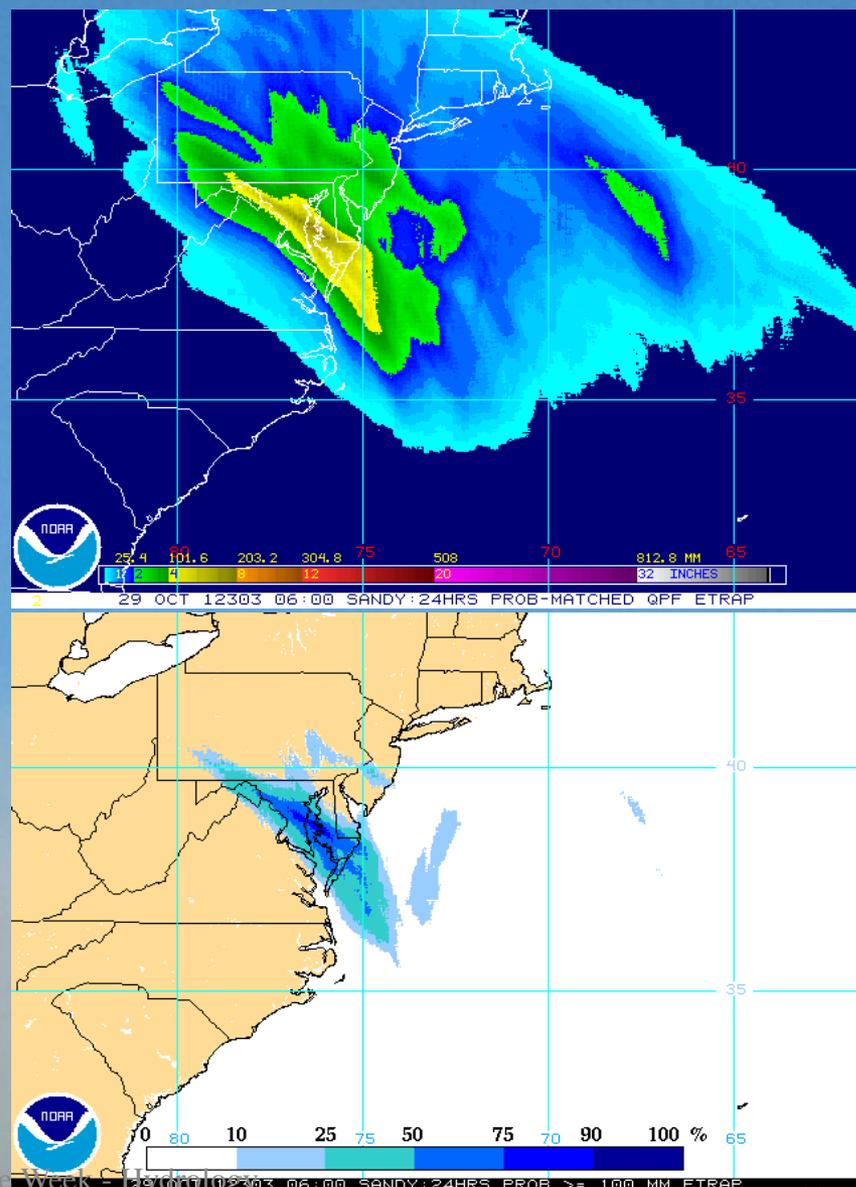
– **The Upcoming Changes**

- Add orographic, shear, storm rotation adjustments
- Add additional ensemble members from S-NPP ATMS

# eTRaP – Sandy – US Landfall

- 24-hr estimates ending 06 UTC 30 October 2011
- Multiple satellite estimates used for this ensemble prediction
  - POES NOAA-18 and NOAA-19 (AMSU)
  - Metop-A (AMSU)
  - TRMM (TMI)
  - DMSP-17 and DMSP-18 (SSMIS)
- Maximum 24-hr rainfall predicted approximately 8 inches in MD/DE
- Probability of 4 inch rain exceeds 50% over large region

*(Provided by S. Kussulson, NESDIS/OSPO)*



# 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:** 0.25x.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 2014*

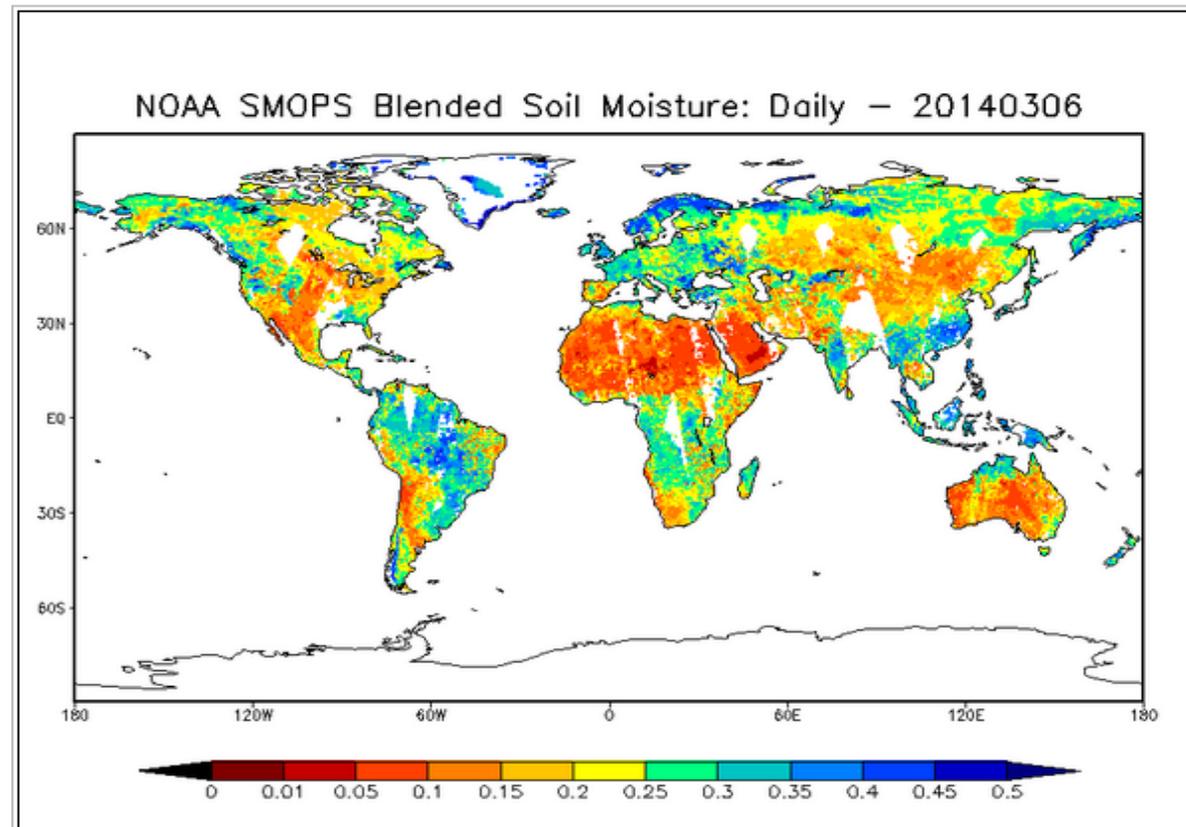
# Examples of Soil Moisture Products

<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](#)

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# 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	GPROF	Rainfall Rate, TPW, CLW, Snow Cover, Sea Ice, Soil Moisture, etc	May 2014; Sept 2015
Megha- Tropiques/SAPHIR	MiRS	Rainfall Rate, TPW, etc	June 2014
GOES-R/ABI	SCaMPR	Probability of Rainfall, Rainfall Potential, QPE	Jan ~ Mar 2017
GPM/GMI	GPROF/MiRS	Rainfall Rate, TPW, CLW, etc	Dec 2014

# GPM Updates

- Satellite and Sensor Status
  - GPM Core – Launched successfully 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 Data
  - 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

# 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>
  - eTRAP* - <http://www.ssd.noaa.gov/PS/TROP/etrap.html>
  - SMOPS* - <http://www.ospo.noaa.gov/Products/land/smops>
- **Questions/Comments:** *Limin.Zhao@noaa.gov*

# Upcoming New Products (< 6 months)

## – GPDS – GCOM-W Processing and Distribution System

- **Operational:** April~ May 2014 Day-1; Sept 2014 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>

## – MToPS (M-T Operational Products System)

- **Operational:** Jun 2014
  - **Satellites/Sensors:** Megha-Tropiques
  - **Products:** *BTs, TPW, RR, CLW, Ocean Wind Speed*
  - **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/mtops>