Current Status and Future Outlook for NOAA/NESDIS Operational Precipitation Products

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Outline

- Operational products
  - POES-based products
  - GOES-based products
  - Blended products
- Emerging products
- The Future – Challenges and Plans
  - New Algorithms and Approaches
  - Future "Enterprise" Product Systems at NOAA

Primary NESDIS Operational Products/Systems

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)

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 */AMSU-A&MHS*	16 km	Level-2, Level-3	HDF-EOS, McIDAS area, PNG
MiRS	Rainfall rate, Snowfall rate, TPW, CLW, Snow Cover, Sea Ice, etc	NOAA-18 & NOAA-19 & Metop-A & Metop-B */AMSU-A&MHS*; DMSP F17&F18/*SSMIS, NPP/ATMS, M-T/SAPHIR, GPM/GMI*	Varies (Lo and Hi Res)	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 *IR Imager*	4 km	Level-3	netCDF4, McIDAS area, GRIB1/GRIB2, GIFs
bTPW	Global Total Precipitable Water Map	NOAA-18, NOAA-19, Metop-A and Metop-B */AMSU-A&MHS, GOES-W/-E, GPS-Met, DMSP F17&F18/SSMIS, NPP/ATMS, GPM/GMI, GCOM AMSR-2*	16 km	Level-4	HDF-EOS, McIDAS area, AWIPS, PNGs
bRR	Global Rainfall Rate Map	NOAA-18, NOAA-19, Metop-A and Metop-B */AMSU-A&MHS, DMSP 17&F18/SSMIS, NPP/ATMS, GPM/GMI, GCOM-AMSR-2*	16 km	Level-4	HDF-EOS, McIDAS area, AWIPS, PNGs
eTRAP	Prob-matched QPF, Probability	NOAA-18, NOAA-19, Metop-A and Metop-B */AMSU-A&MHS, GOES-W/-E, DMSP F17, F18/SSMIS, NPP/ATMS, GPM/GMI, GCOM-AMSR-2*	4 km	Level-3	ASCII, McIDAS area, GIFs

Emerging New Capabilities

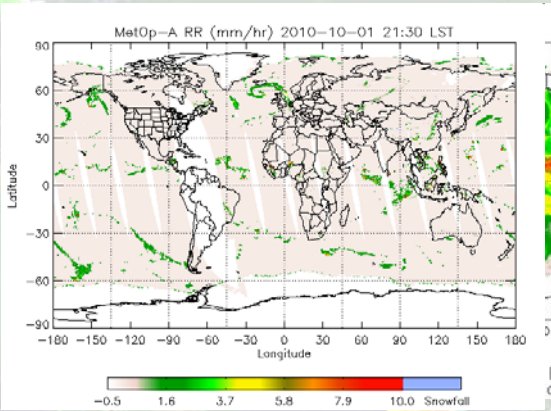
MiRS – Microwave Integration Retrieval System
GPROF – Goddard Profiling Algorithm
GPDS - GCOM-W Processing and Distribution System
SCaMPR - Self-Calibrating Multivariate Precipitation Retrieval

Satellites/ Sensors	Algorithm	Products	Planned Schedule
GCOM-W1/AMSR-2	GPDS/GPROF2010V2	Rainfall Rate, TPW, CLW, Snow Cover, Sea Ice, Soil Moisture, etc	Experimental now; operational by March 2015
M-T/SAPHIR	MiRS	Rainfall Rate, TPW	Operational by February 2015
GPM/GMI	GPROF/MiRS	Rainfall Rate, TPW, etc.	Experimental; operational Feb 2016
GOES-R/ABI (GLM)	SCaMPR	Probability of Rainfall, Rainfall Potential, QPE	Jan ~ Mar 2017

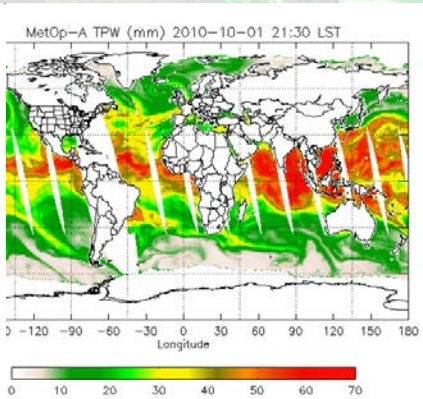
A few more details on POES Products

- MSPPS
  - Heritage AMSU algorithms
    - Snowfall rates over land
  - N18, N19, MOA, MOB
  - Other EDR's like TPW, CLW, etc.
  - Retirement in 2015
- MIRS
  - 1DVAR scheme
    - T, RH, hydrometeor profiles, TPW, CLW, emissivity, etc.
    - SFR merger (MSPPS retirement)
  - Portable to variety of sensors
  - N18, N19, MOA, MOB, S-NPP, M-T
- GPDS
  - GCOM AMSR-2
  - GPROF2010V2 for rain rates
    - Heritage NASA (Bayesian) approach
    - V2 uses climatological screens
  - Other EDR's like TPW, CLW, etc.

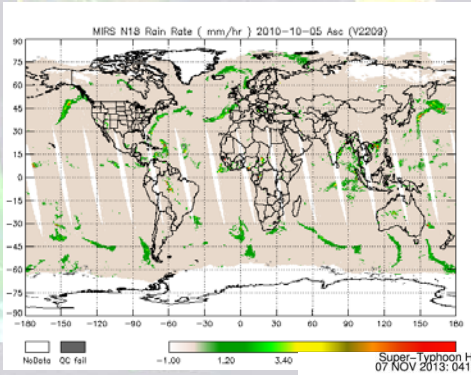
MSPPS Rain Rate



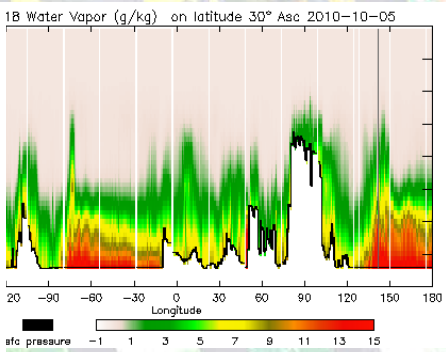
MSPPS TPW



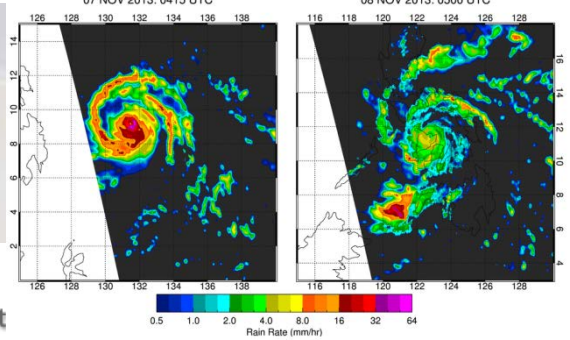
MIRS Rain Rate



MIRS WV Profiles



GCOM AMSR2 Rain Rates

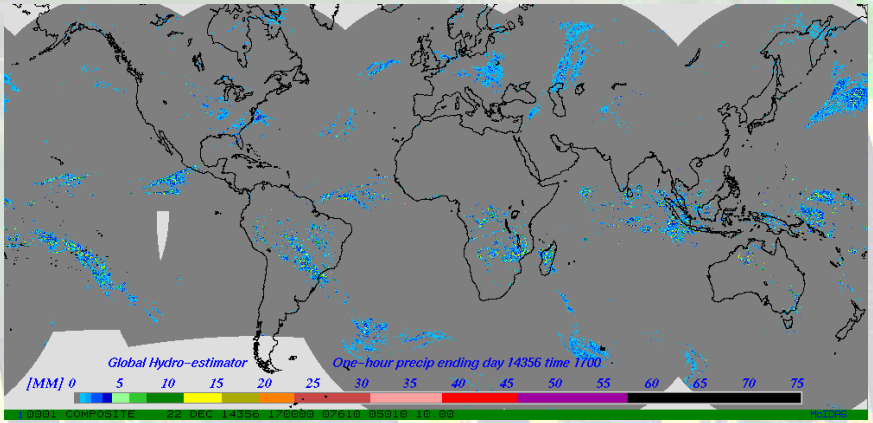


GOES Short-Term Rainfall Products

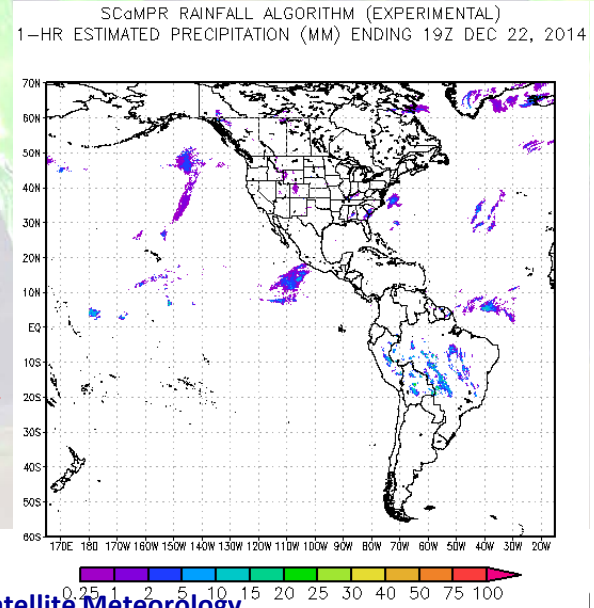
Courtesy of R. Kuligowski

- **Current:**
  - Hydro-Estimator
    - IR-only plus adjustments using NWP model data
    - Operational globally
  - Experimental SCaMPR
    - Multi-spectral IR calibrated against MW
    - Currently Western Hemisphere only
- **GOES-R (2016+) Era:**
  - Rainfall Rate
    - Modification of SCaMPR with additional spectral bands

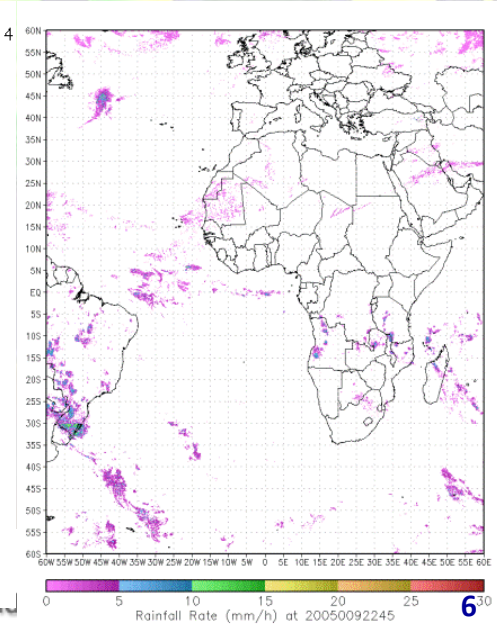
Hydro-Estimator



SCaMPR



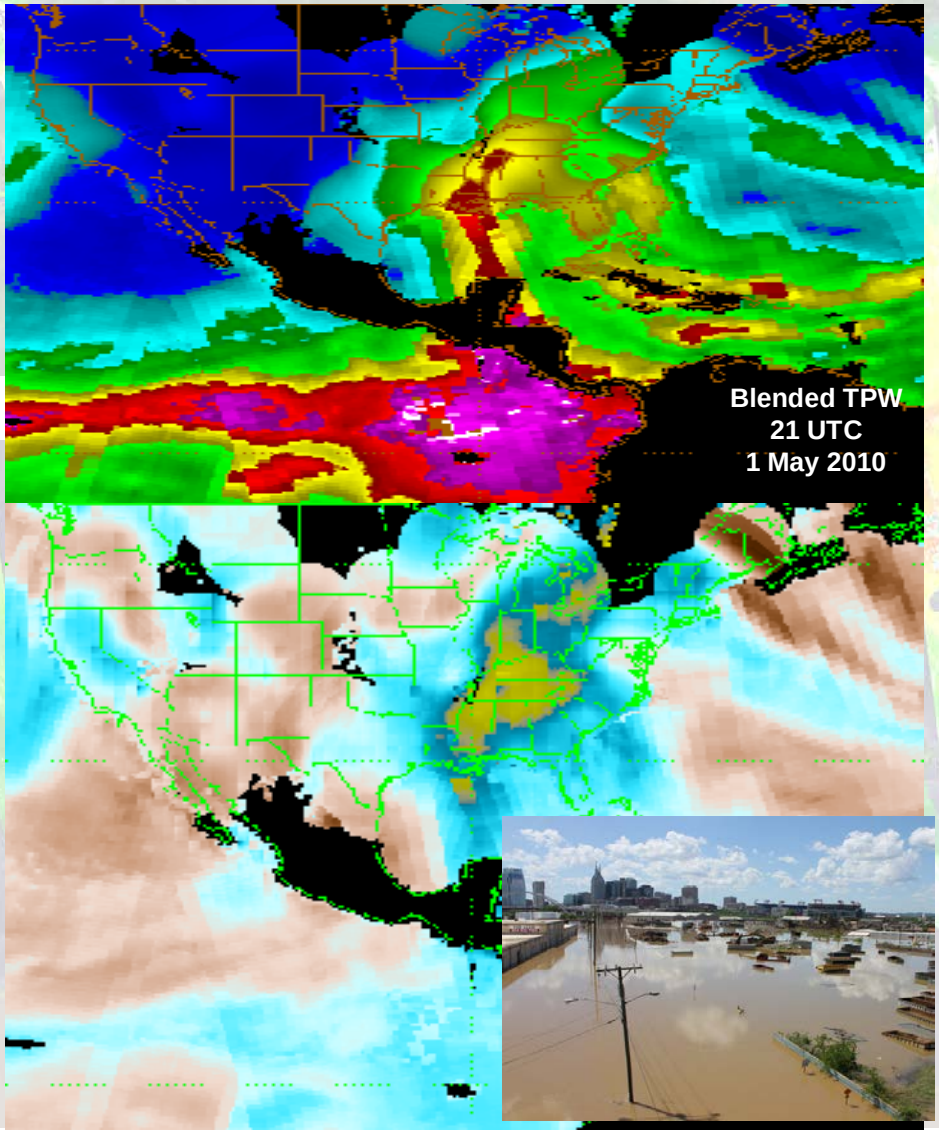
GOES-R Rainfall Rate



Blended TPW (bTPW) Product

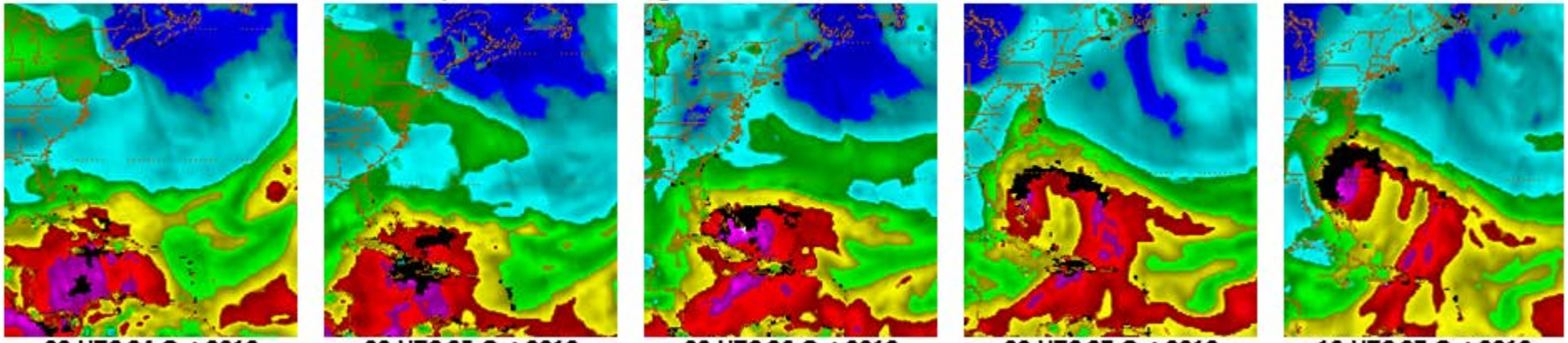
http://www.osdpd.noaa.gov/bTPW/index.html

- bTPW algorithm – Kidder and Jones, 2007
  - Histogram matching to common reference
- The bTPW product combines all available data sources into a "seamless" product for use by the NWS forecaster in AWIPS format
  - Ocean – Satellite MW
  - Land – Satellite MW and GOES Sounder; GPS Met
- Most flooding events can be linked to "atmospheric rivers" – high TPW that focus on a given location for extended period
  - Connection from (sub)tropics to mid and high latitudes
- Product is useful to weather forecasters
  - Timing & magnitude of moisture "surges" (NWP models might miss)
- Companion TPW Anomaly (from climatology) Product



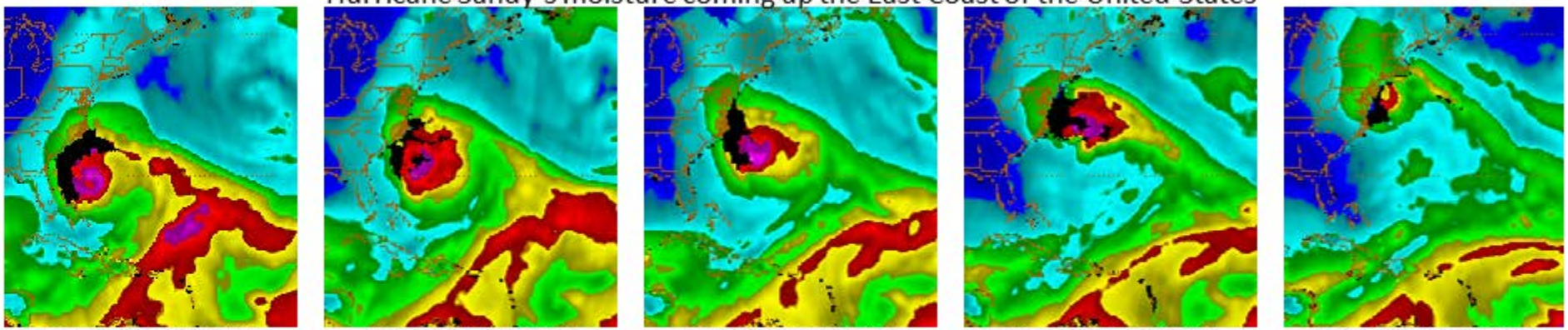
bTPW Sequence of Sandy

Sandy's moisture lifting north toward the Southeast United States

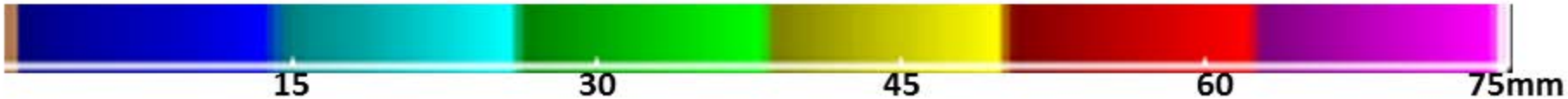


00 UTC 24 Oct 2012 | 00 UTC 25 Oct 2012 | 00 UTC 26 Oct 2012 | 00 UTC 27 Oct 2012 | 12 UTC 27 Oct 2012

Hurricane Sandy's moisture coming up the East Coast of the United States

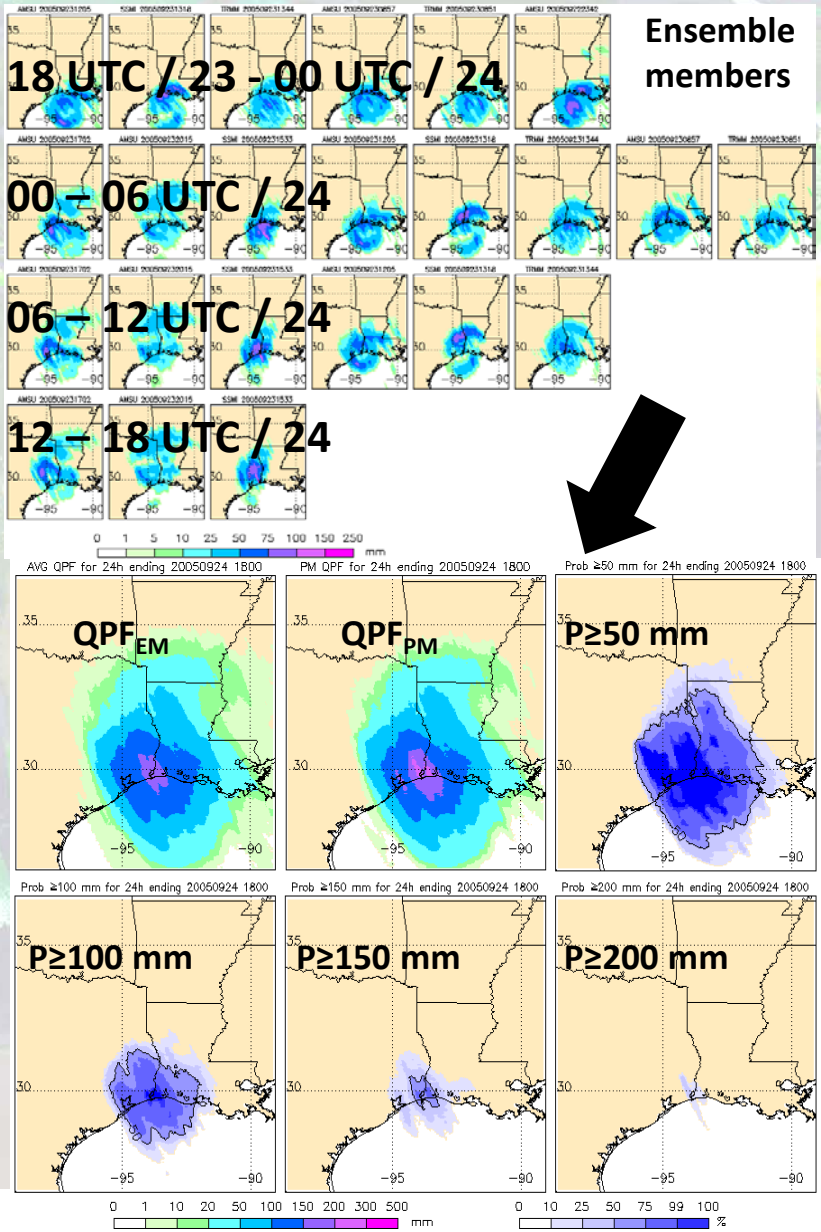


00 UTC 28 Oct 2012 | 12 UTC 28 Oct 2012 | 00 UTC 29 Oct 2012 | 12 UTC 29 Oct 2012 | 00 UTC 30 Oct 2012



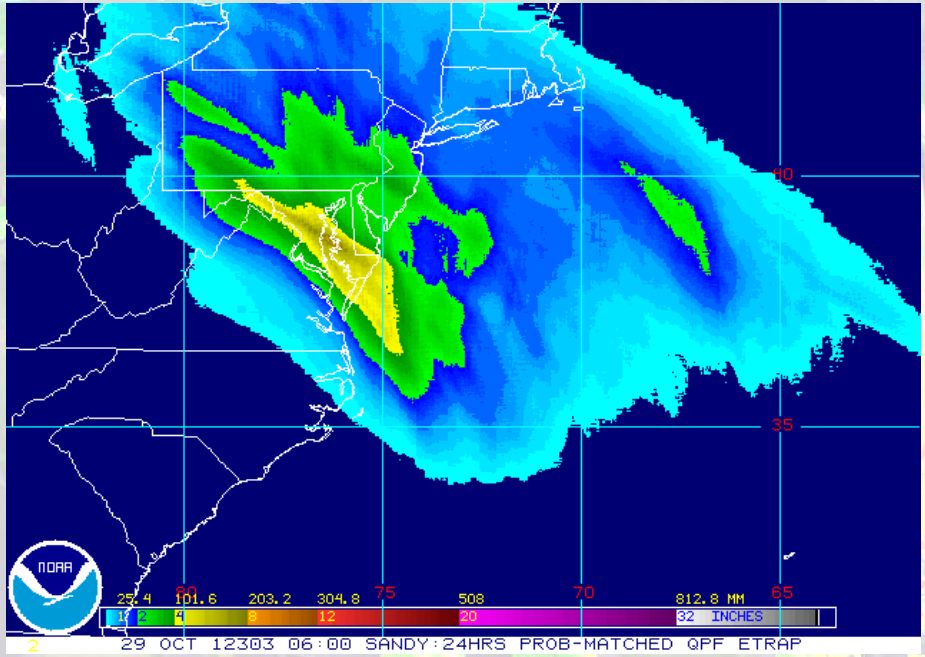
Ensemble Tropical Rainfall Potential (eTRaP)

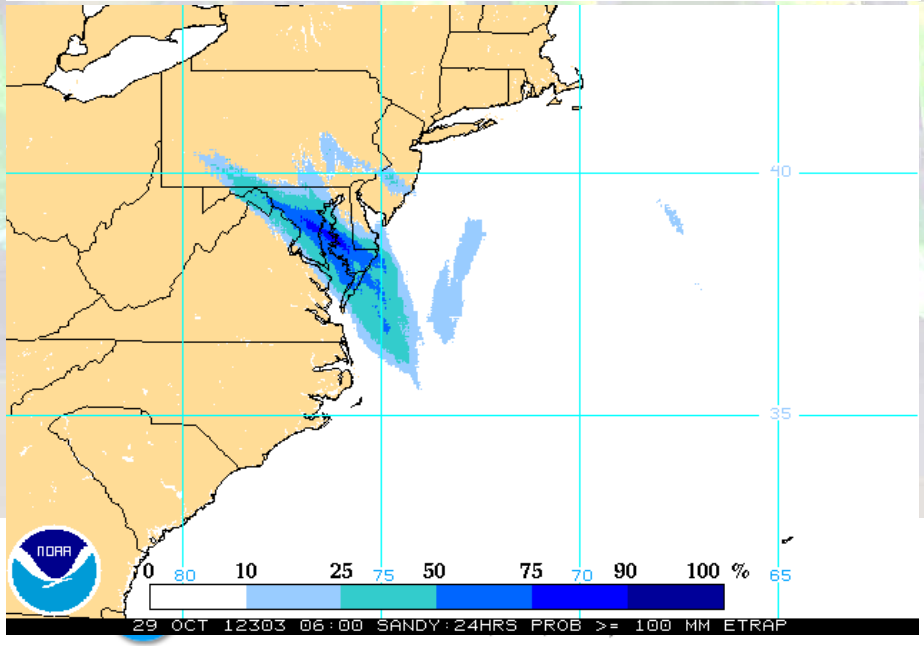
- Forecast of 24-hour rainfall potential for tropical systems about to make landfall.
- Based on extrapolation of microwave-derived rainfall rates along predicted storm track.
- Ensembles improve deterministic forecasts and provide uncertainty information
- Produced worldwide and available via the Internet:
  http://www.ssd.noaa.gov/PS/TROP/etrap.html



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

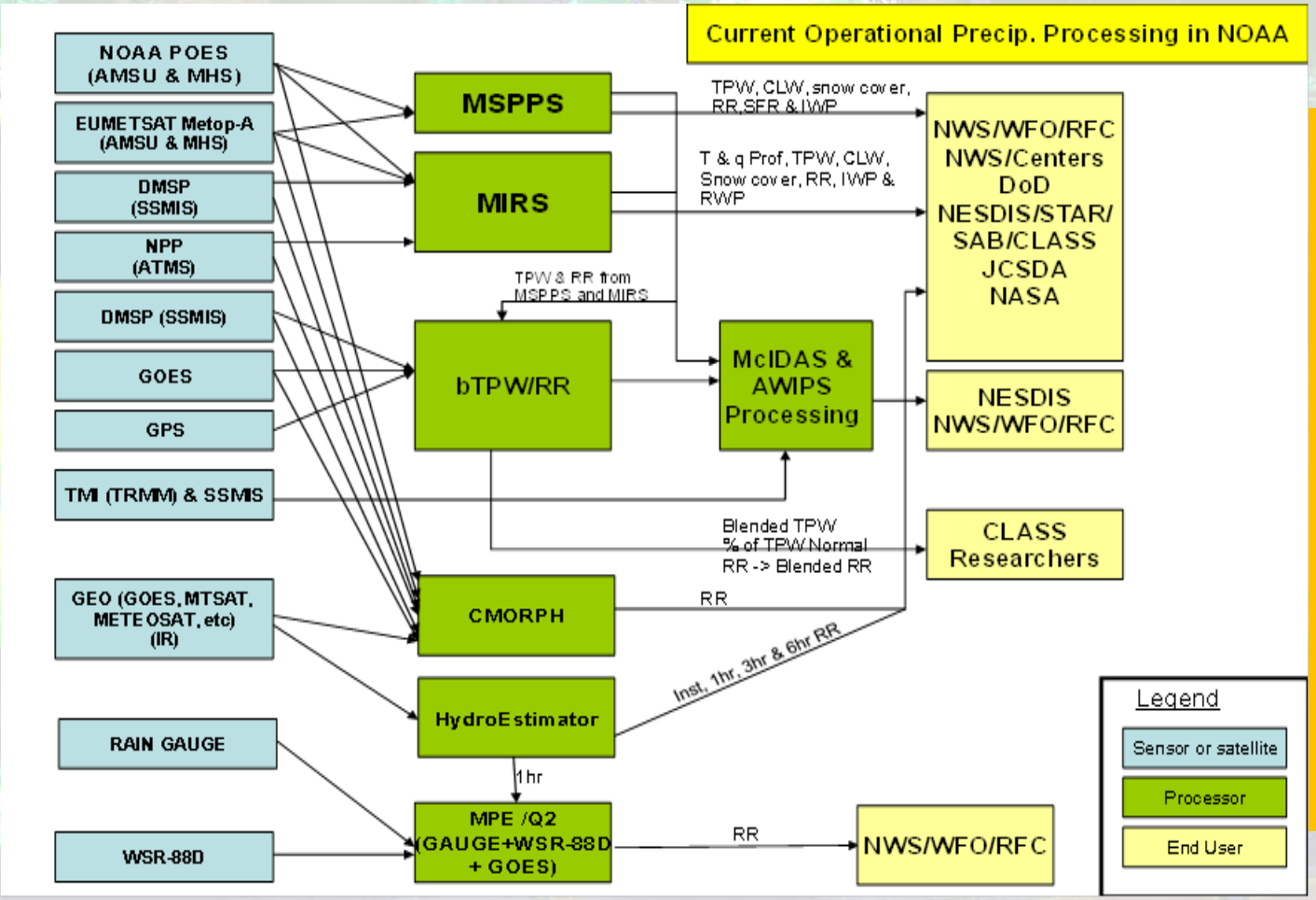




Looking to the Future…New Ideas & Challenges

- Too many satellites, product systems, algorithms…
  - But we need to satisfy a wide array of users
    - Temporal, spatial scales + LATENCY
- How do we get from today to "tomorrow"?
  - GOES-R, JPSS, non-NOAA satellites
  - Similarities but differences…
  - NESDIS restructuring
    - NESDIS Ground Enterprise Architecture System (GEARS)
- New opportunities
  - Delivering POES products faster
    - Direct Broadcast/OCONUS
  - New technologies
    - GLM and ABI on GOES-R; VIIRS and ATMS on JPSS
    - Role of GPM and other upcoming missions
  - Data fusion
    - Satellite and ground measurements

Current Status of NOAA Product Systems



Too many:

- Data streams
- Product systems (aka – Stove Pipes)
- Algorithms

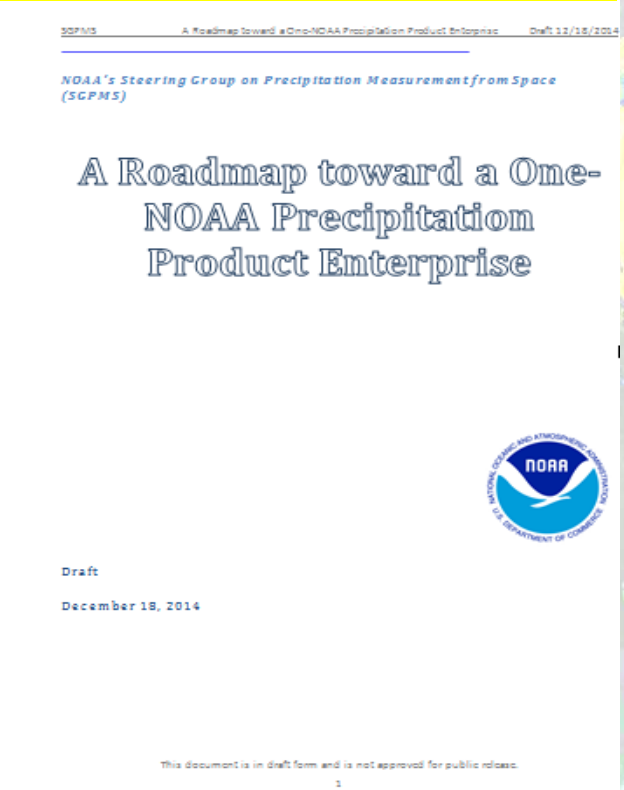
Lack commonality:

- Preprocessing
- Ancillary data

A solution lies ahead….

What we are trying to do…

Develop a roadmap across all of NOAA


SGPMS A Roadmap toward a One-NOAA Precipitation Product Enterprise Draft 12/18/2014

NOAA's Steering Group on Precipitation Measurement from Space (SGPMS)

A Roadmap toward a One-NOAA Precipitation Product Enterprise

Draft

December 18, 2014

This document is in draft form and is not approved for public release.

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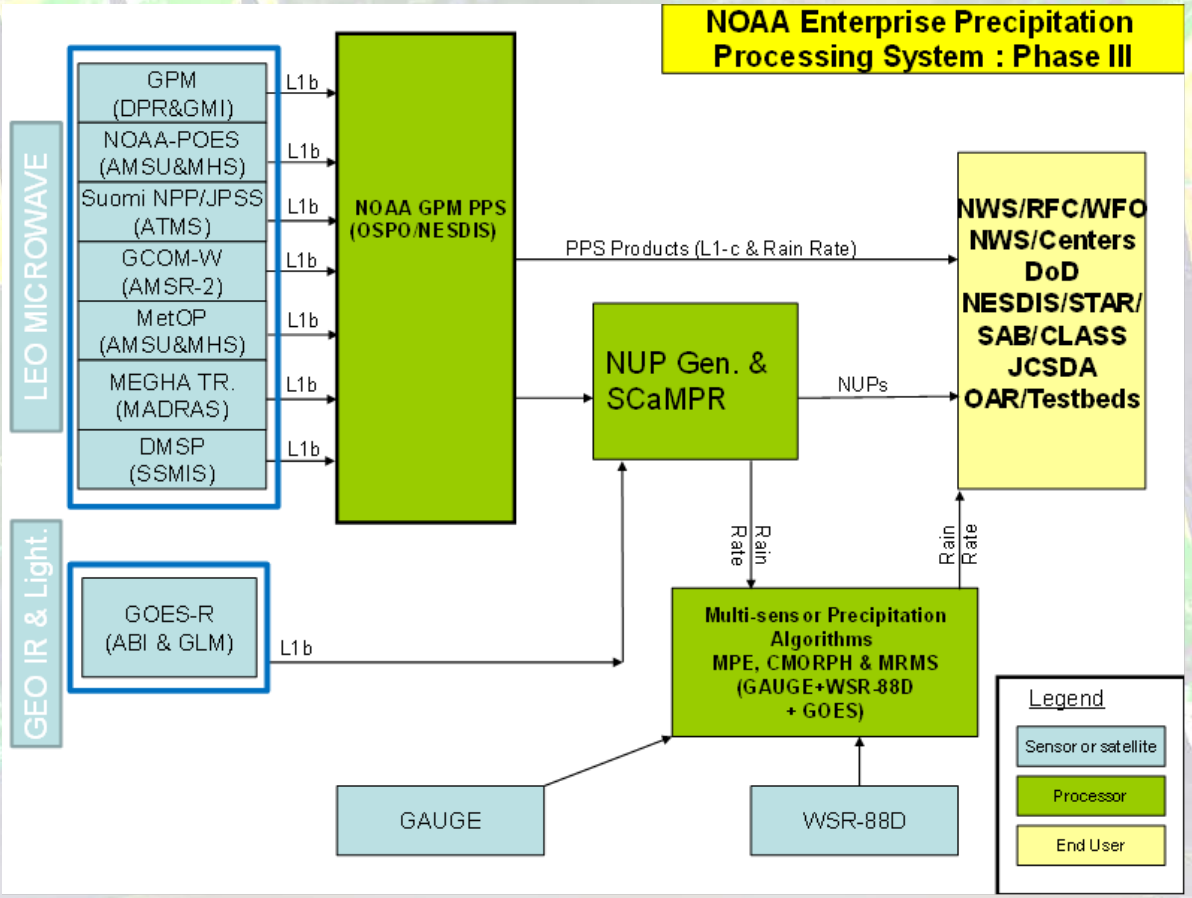
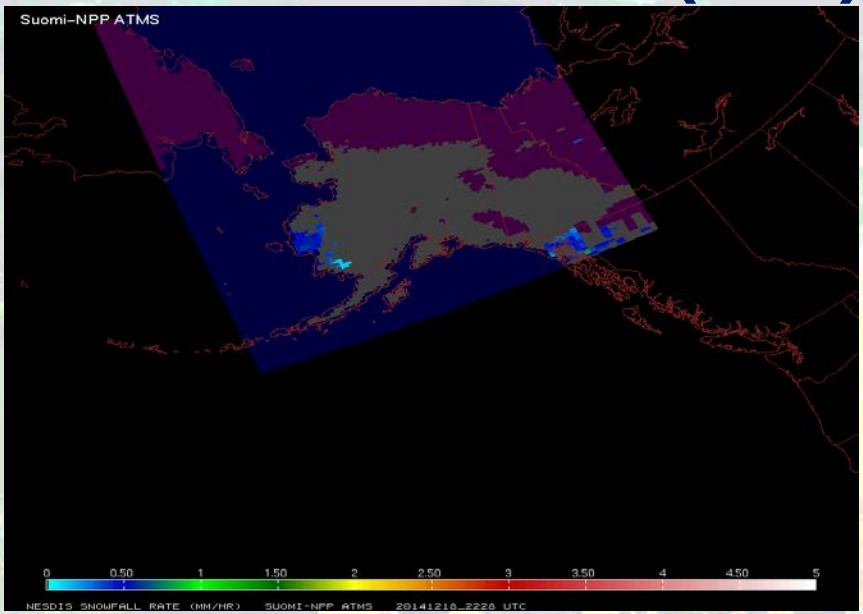
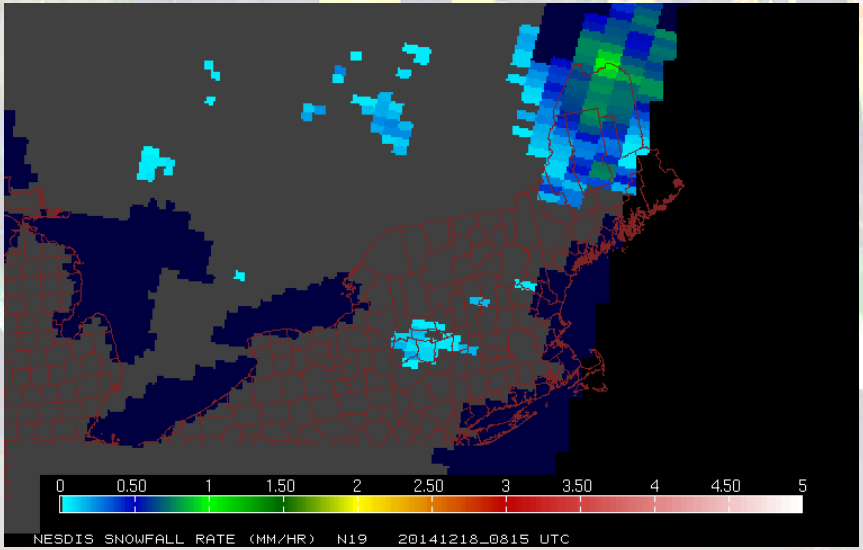
Utilize NASA's investment on GPM PPS to optimize satellite processing at NOAA and form the basis for a true integrated precipitation system at NOAA



Exploiting Direct Broadcast - MW Snowfall Rates (SFR)

- POES MW products can be limited in operational forecasting due to large data latency
  - Exploiting direct broadcast (DB) for use over CONUS can reduce latency to 30 minutes or less!
- The NESDIS SFR product has been gaining interest by NWSFO through recent use of DB
  - Obtaining DB L1 data through Univ. WI and Univ. AK
  - N-18, N-19, MOA, MOB, S-NPP
- SFR evaluations ongoing via NASA SPoRT and NWS
- Website: **http://cics.umd.edu/sfr/conus**



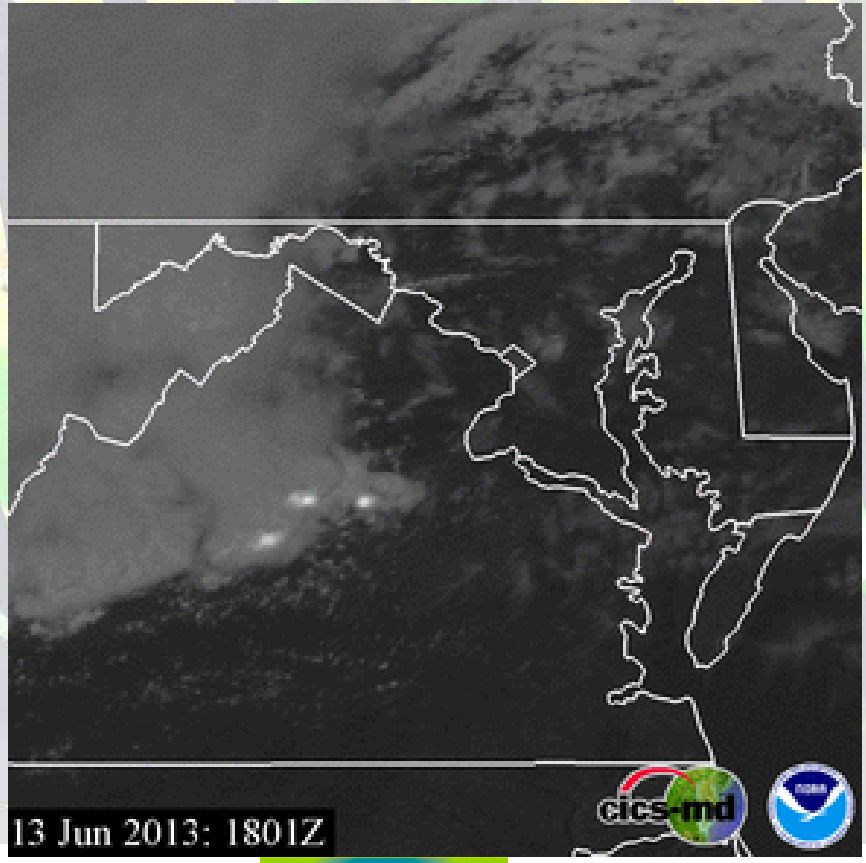


Courtesy of Patrick Meyers, CICS-MD

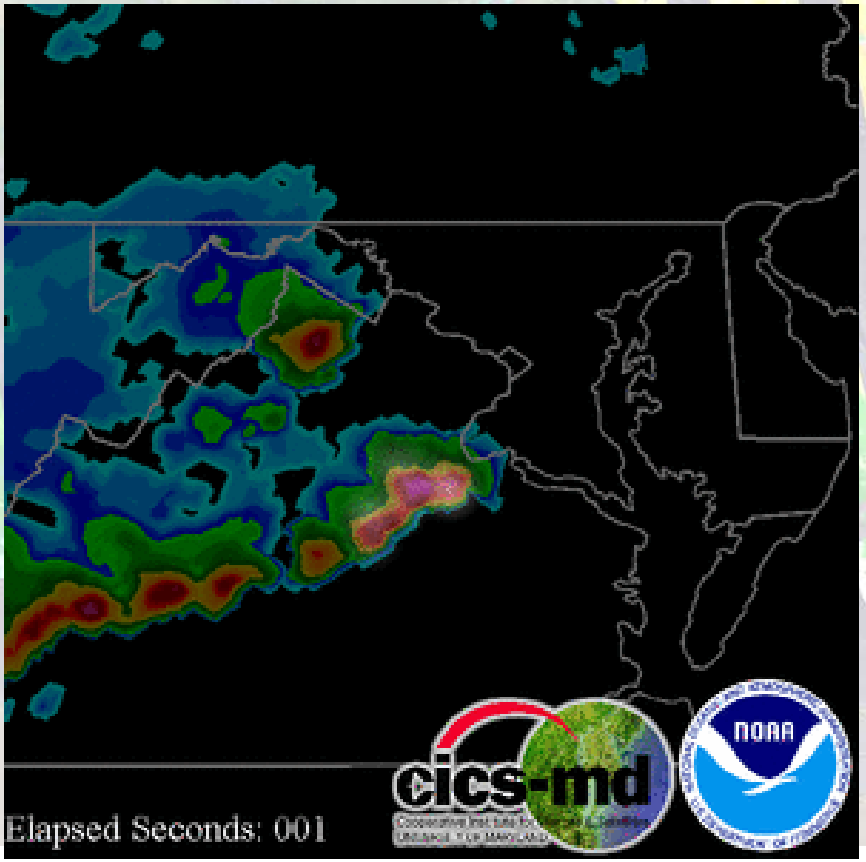
New Data Fusion Opportunities

Showing the potential synergy from GOES-R ABI & GLM, and GCOM AMSR2

Minute Lightning Density with 2 Long-track Tornados



Lightning Flashes Each Second Overlaid on AMSR2 Precipitation



Questions?