

NOAA's Activities and Contributions to GPM

**Ralph Ferraro
NOAA/NESDIS
College Park, MD**

7-10 November 2011

2011 PMM Science Team Meeting – Denver, CO





Outline



- **Update on Satellite Programs**
 - **POES and ATMS**
 - **International Partners:**
 - METOP
 - GCOM/AMSR-2
 - M-T/CNES & ISRO
 - FY-3/China
 - **NASA**
 - MOU
 - Transition Planning
- **Science Activities**
 - **PMM Science Team**
 - **AMSU/MHS Snowfall Rates**
 - **GV Activities**
 - HMT
 - Q2 for TRMM product validation
 - Precipitation Cal/Val Center
 - **Satellite Calibration – GSICS, X-CAL, NOAA CDR program**
 - **GOES-R**
- **NOAA User Workshops on GPM**
- **Summary and Future**





Update on (NOAA) POES Satellites



- **NOAA/POES (AMSU-A/AMSU-B/MHS)**
 - **NOAA-16**
 - Operating in degraded mode for precipitation
 - **NOAA-18, NOAA-19 operating properly**
- **NPP**
 - **Successfully launched Oct 28, 2011**
- **Coordination with EUMETSAT (AMSU-A/MHS)**
 - **MetOp-A is operating properly**
 - **MetOp-B – April 2012 launch**
- **DMSP (SSMIS)**
 - **SSMIS F-16, F-17 and F-18 still operating...**
 - **F-19 launch ~ Jan 2014**
 - **F-20 launch TBD but no earlier than Oct 2014**





Joint Polar Satellite System (JPSS)

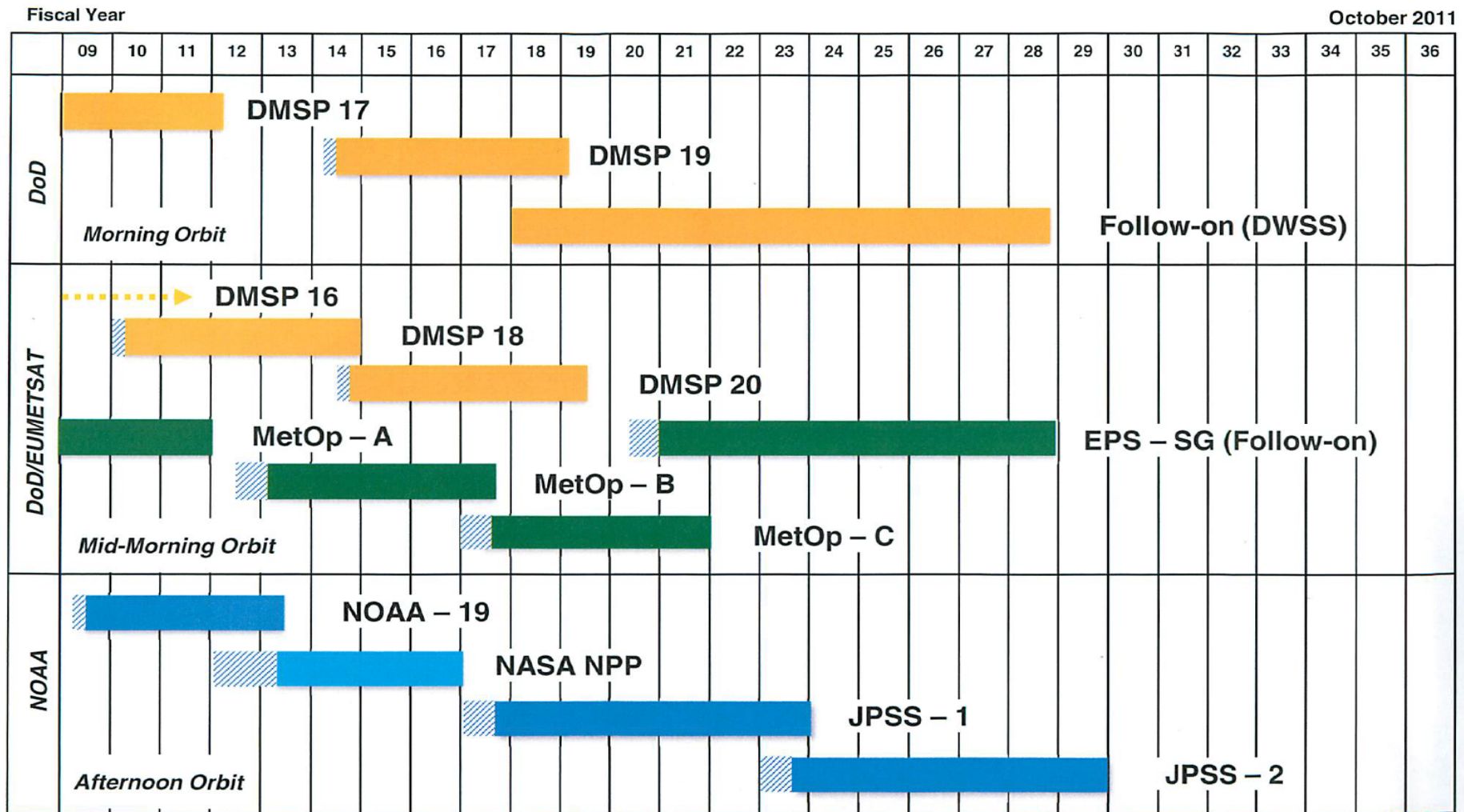
- NPP
 - October 28, 2011 launch
 - ATMS key payload for precipitation
 - ATMS turn on tomorrow!
 - Precipitation is not an official EDR for NPP
 - NDE will run MIRS for ATMS; includes rain rate
- JPSS (Joint Polar Satellite System)
 - JPSS-1 (~2016) and JPSS-2 (~2022)
 - Slipped due to budget pressures
 - ATMS key payload for precipitation
 - MIRS
- DWSS (Defense Weather Satellite System)
 - Last heard, it's being "reworked"
 - Bottom line...no definitive plans for SSMIS continuity
- NOAA partnership with JAXA on GCOM
 - AMSR-2 key payload for precipitation
 - NOAA EDR's being lead by NESDIS/STAR
 - GPROF will likely be run as the precipitation EDR

7-10 November 2011

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Continuity of NOAA's Polar (Primary) Operational Satellite Programs



Approved: Mary E. Hugg
 Assistant Administrator for
 Satellite and Information Services

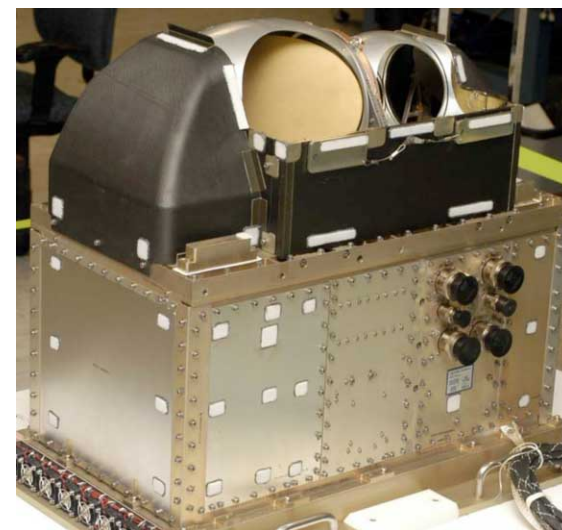
Signed on: 20 Oct 2011

 Satellite is operational beyond design life
  Post Launch Test
  Operational



Advanced Technology Microwave Sounder (ATMS)

Channel	Center Frequency (GHz)	Maximum Bandwidth (GHz)	Center Frequency Stability (MHz)	Temperature Sensitivity (K) NEAT	Channel	Center Frequency (GHz)	Maximum Bandwidth (GHz)	Center Frequency Stability (MHz)	Temperature Sensitivity (K) NEAT
1	23.8	0.27	<10	0.70	12	57.290344 ±0.3222 ±0.048	0.036	<1.2	1.20
2	31.4	0.18	<10	0.80	13	57.290344 ±0.3222 ±0.022	0.016	<1.6	1.50
3	50.3	0.18	<10	0.90	14	57.290344 ±0.3222 ±0.010	0.008	<0.5	2.40
4	51.76	0.40	<5	0.70	15	57.290344 ±0.3222 ±0.0045	0.003	<0.5	3.60
5	52.8	0.40	<5	0.70	16	88.2	2.0	<200	0.50
6	53.596 ±0.115	0.17	<5	0.70	17	165.5	3.0	<200	0.60
7	54.40	0.40	<5	0.70	18	183.31±7	2.0	<30	0.80
8	54.94	0.40	<10	0.70	19	183.31±4.5	2.0	<30	0.80
9	55.50	0.33	<10	0.70	20	183.31±3	1.0	<30	0.80
10	57.290344	0.33	<0.5	0.75	21	183.31±1.8	1.0	<30	0.80
11	57.290344 ±0.217	0.078	<0.5	1.20	22	183.31±1	0.5	<30	0.90



- Reduced size/power relative to predecessor AMSU
- Improved spatial coverage (no gaps between swaths)
- Nyquist spatial sampling of temperature bands: Improved information content relative to AMSU-A

- ATMS features important to precipitation algorithms:

- Five H₂O bands at 183 GHz
- 165 vs. 150 GHz (closer to GMI)
- Wider swath width
- Better sampling





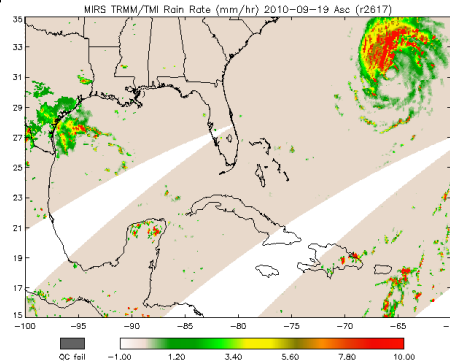
Partners/Status

- **International:**
 - **India/France - M-T**
 - NOAA effort to acquire data via NASA, reformat, generate in-house EDR's (MIRS), distribute across NOAA
 - **China - FY-3**
 - Emerging opportunities to acquire FY-3 data in n.r.t.
 - Already collaborating on Science
- **NASA**
 - **Formal MOU on GPM being worked in legal**
 - **R20 Transition Planning**
 - **PMM Team**



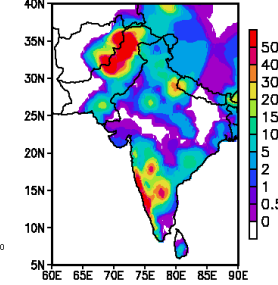


Participation on PMM Science Team

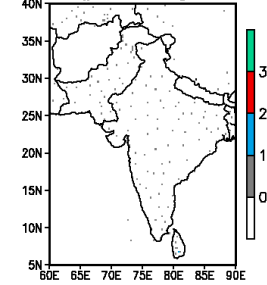


Daily Precip [mm/day] July 28 2010

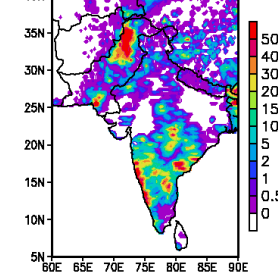
GAUGE



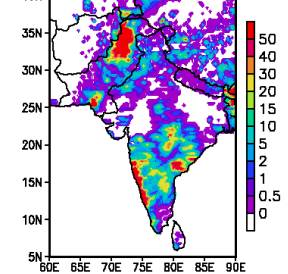
of Gauge



CMORPH_ORG



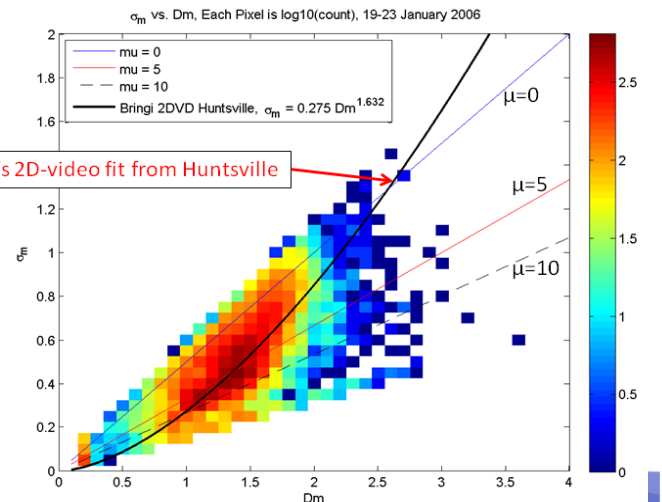
CMORPH_MERG



- Six NOAA PI's on NASA's PMM science team, jointly funded between NASA and NOAA (FY10-FY12)
- Full NOAA funding secured in FY11
- Shows expansion in interest in GPM a NOAA
 - Four funders within NESDIS
 - OSD, STAR, NCDC, and GOES-R
 - Two funders within OAR
 - USWRP and CPO

Williams' analysis of Profiler TWP-ICE data, 19-23 Jan 2006
The color bar refers to the log(freq of occurrence) plot below.

Solution finds best μ using log spectra. Then calculate σ_m .





Details on NOAA PI Lead Projects (1/2)



- **Boukabara (NESDIS/STAR) – “A Physical Rainfall Rate Algorithm for All Surfaces: Applicability to All Microwave Sensors Including TRMM & GPM”**
 - **Extend MiRS to GPM era sensors**
- **Ferraro (NESDIS/STAR) – “Land Surface Characterization for GPM-era Algorithms”**
 - **Develop and implement unified land characterization scheme for improved precipitation over land**
- **Groisman (NESDIS/NCDC) – “In Situ Precipitation Dataset in High Latitudes of the N.H. for calibration of GPM Mission Products”**
 - **Obtain unique ground observations of snowfall rates for validation of and merging with GPM-era satellite estimates**





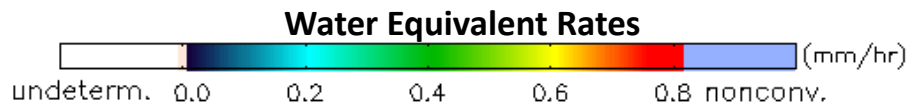
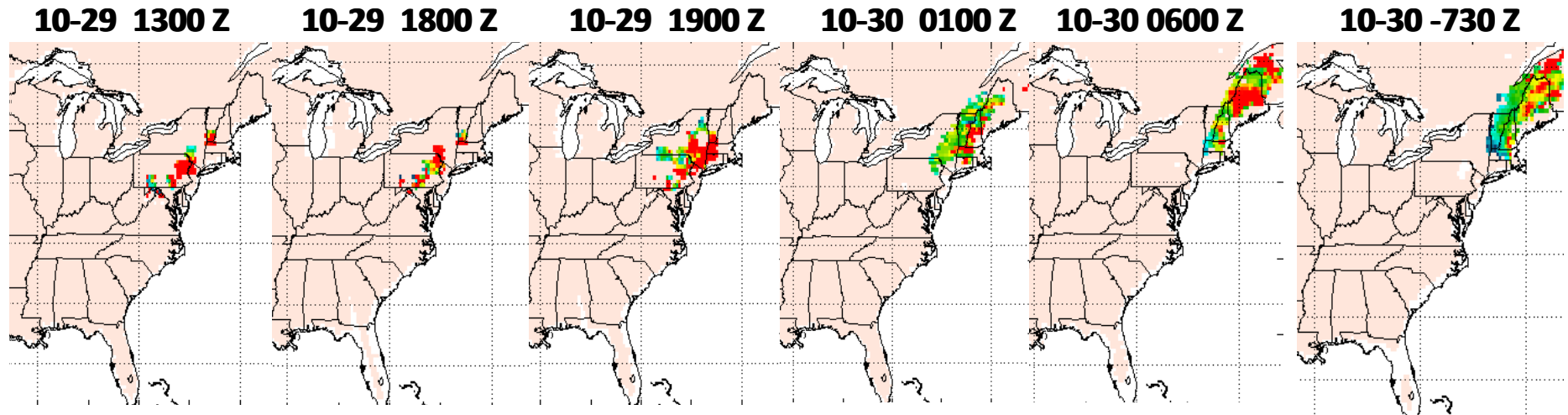
Details on NOAA PI Lead Projects (2/2)



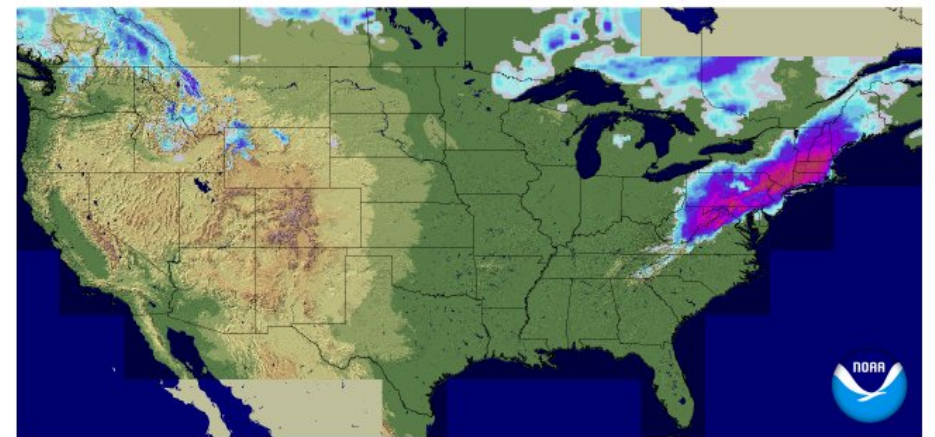
- **Weng (NESDIS/STAR) – “ Development of Microwave Emissivity Models for GPM Applications”**
 - **Extend ongoing emissivity model development to GPM-era sensors to improve cold season precipitation, in particular, high-frequency measurements**
- **Williams (OAR/ESRL) – “Temporal and Spatial Correlation of Drop Size Distribution Parameters to Improve Satellite-based Precipitation Products”**
 - **Utilize advanced radars to determine DSD which is critical to improve and validate physically based precipitation retrieval algorithm**
- **Xie (NWS/NCEP) – “Improvement of a Multi-Instrument, Multi-Satellite Algorithm for High-Resolution Pole-to-Pole Global Precipitation Analysis”**
 - **Improve CMOPRH global precipitation product to include regional gauges and new satellite sources and “converge” with TMPA and PERSIANN**



AMSU/MHS Snowfall Rates



Scaled Snow Precipitation
24-Hour Total Ending 2011-10-30 06



- AMSU/MHS Product running in experimental mode; hope to go operational in near future (issue on the operations side of the house...)
- Also working with SPoRT Center (perhaps get product to NWS users in advance)
- Focal point - Huan.Meng@noaa.gov

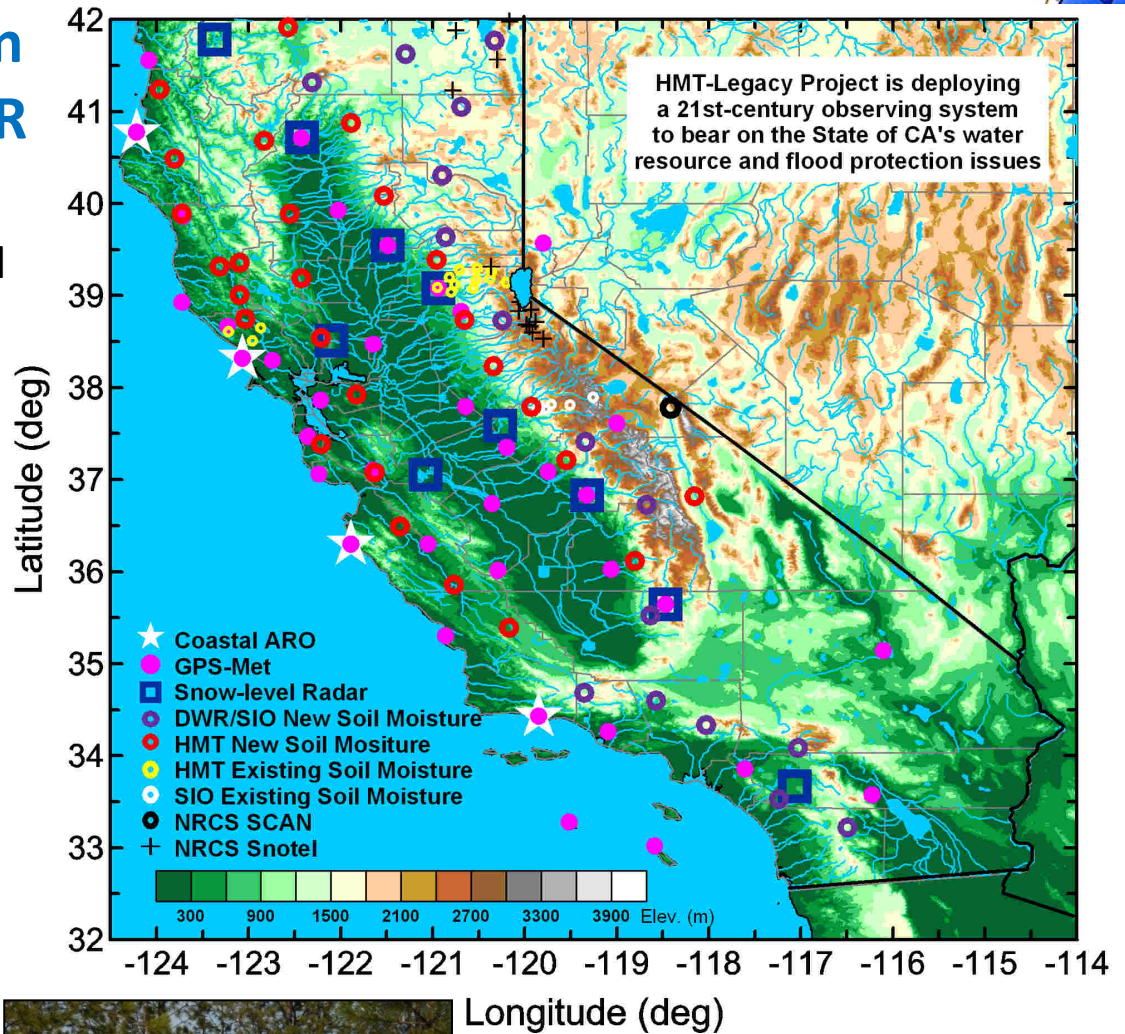




HMT-Legacy Project in CA funded by CA-DWR

- Permanent observing system being installed 2008-2013 could be used for satellite cal./val. activities
- 10 FMCW radar sites to measure the snow level
- 43 soil moisture monitoring sites, most including precipitation measurements
- 36 GPS-Met sites for integrated water vapor measurements
- Four coastal atmospheric river observatories

Slide courtesy of
A. White/R. Cifelli,
NOAA/ESRL



Slide courtesy of R. Cifelli/A. White; NOAA/ESRL

NOAA HMT-SE

- HMT-SE is a Pilot Project led by the Physical Sciences Division at ESRL with partners across NOAA, NASA, and the academic community
- Planned for May-September 2013 in western N.C.
- Primary focus is Quantitative Precipitation Estimation (QPE)
- Quantitative Precipitation Forecasting (QPF) and Hydrologic/Surface Process activities also planned, depending on funding
- HMT-SE will complement NASA GPM integrated hydrology ground validation campaign in same region



Slide courtesy of R. Cifelli/A. White; NOAA/ESRL

NOAA Deployment for HMT-SE

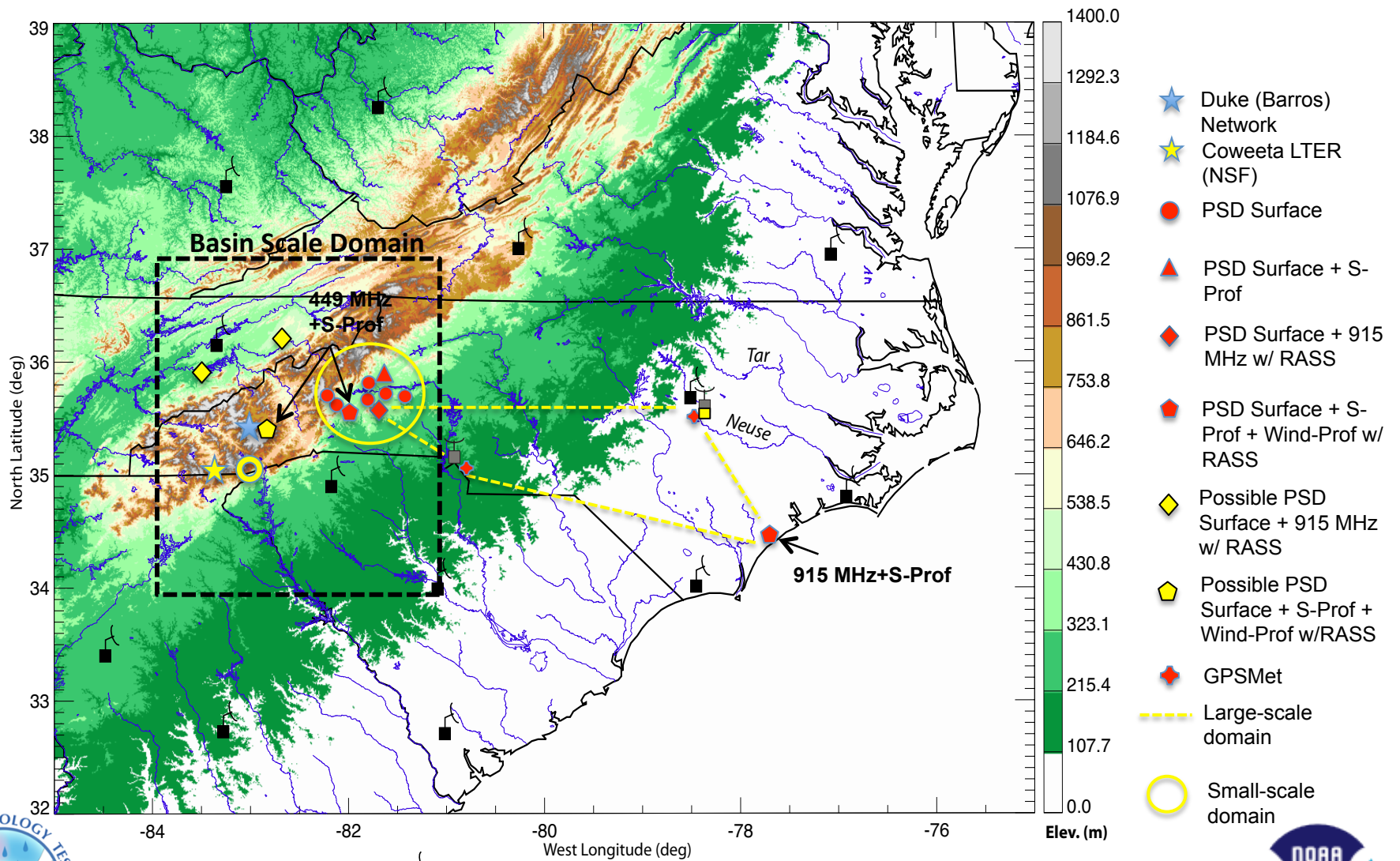
- 6 Profiling radar and surface meteorology sites
 - 449 and 915 MHz for wind profiling
 - S-band for vertical structure/DSD retrievals
 - Parsival disdrometer
 - rain gauge
 - Temp, RH, Td, Pres, wind
- 6 Stand-alone surface sites
 - May include surface moisture
 - Redundant rain gauges but probably no disdrometer
- 2 additional sites (Charlotte and Raleigh CAP profilers)
 - GPS for integrated water vapor



Slide courtesy of R. Cifelli/A. White; NOAA/ESRL

HMT-SE Regional Scale Map

May 1 – October 1, 2013



- ★ Duke (Barros) Network
- ★ Coweeta LTER (NSF)
- PSD Surface
- ▲ PSD Surface + S-Prof
- ◆ PSD Surface + 915 MHz w/ RASS
- ◆ PSD Surface + S-Prof + Wind-Prof w/ RASS
- ◆ Possible PSD Surface + 915 MHz w/ RASS
- ◆ Possible PSD Surface + S-Prof + Wind-Prof w/RASS
- ◆ GPSMet
- Large-scale domain
- Small-scale domain



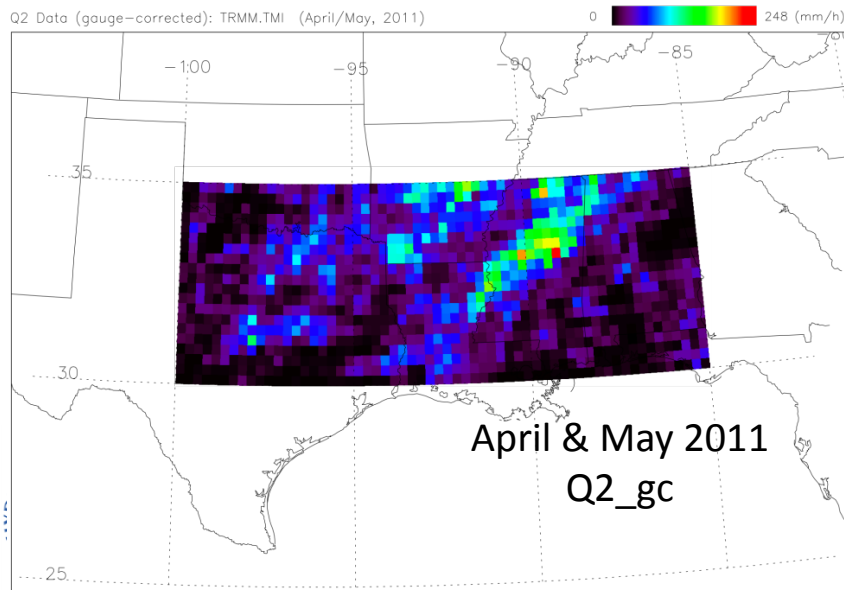
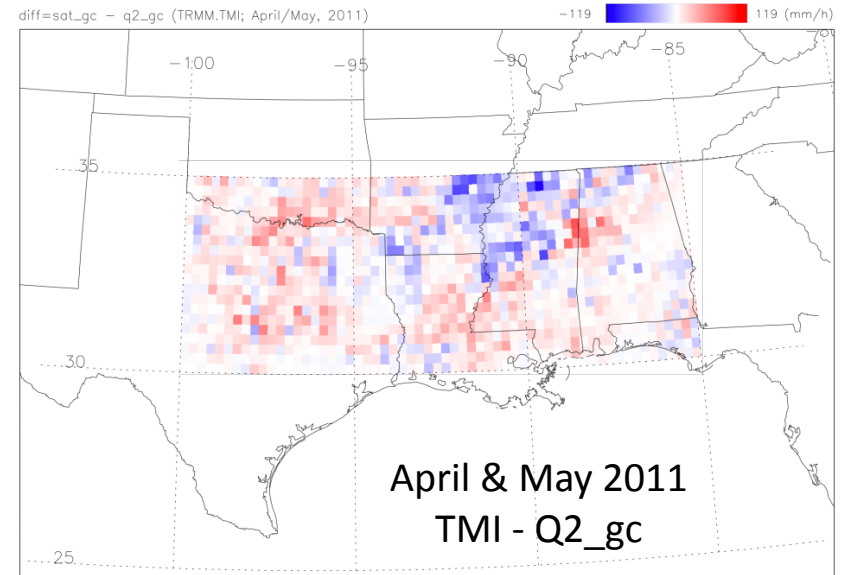
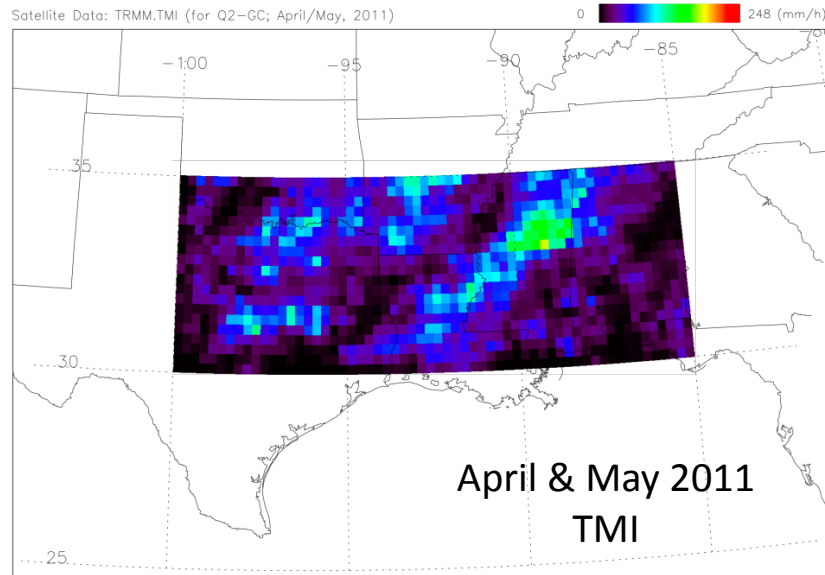
- NWS WSR-88D
- CAP Profiler (operational)

- Pisgah Astronomical Research Inst. (PARI) – Wind Profiler (915?)
- CAP Profiler (not operational)



Slide courtesy of Eyal Amitai, NASA & Chapman Univ.

Satellite-by-Satellite Comparisons



Sat/Q2 Area Average Rain Rate Ratio

Satellite	$\Sigma R_{SAT} / \Sigma R_{Q2}$		$\Sigma R_{SAT} / \Sigma R_{Q2_{gc}}$	
	April	May	April	May
All	1.11	1.08	1.26	1.22
METOP2A/MHS	1.46	1.29	1.69	1.43
NOAA19/MHS	1.29	1.08	1.54	1.23
NOAA18/MHS	1.22	1.23	1.35	1.37
TMI	0.90	0.97	1.02	1.12
AQUA/AMSRE	0.85	0.84	0.92	0.95
NOAA16/AMSUB	0.44	N/A	0.50	N/A

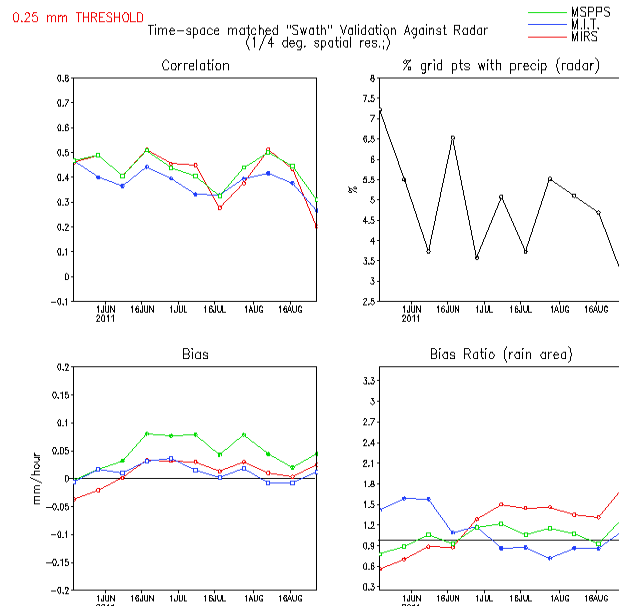
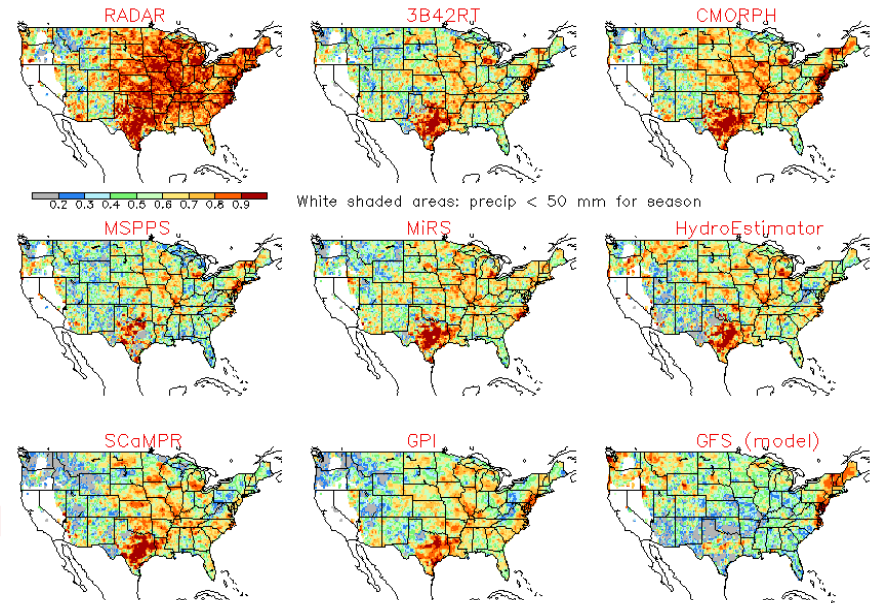


Precipitation Cal/Val Center

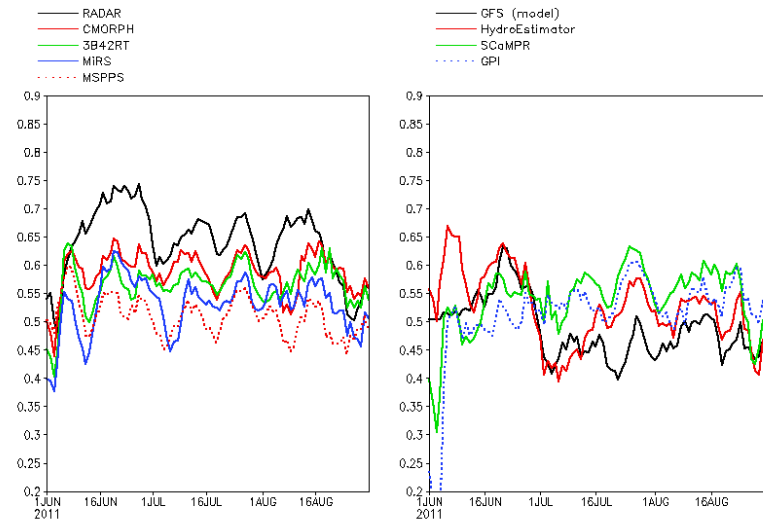


- **Funded by NESDIS/STAR Cal/Val Program**
 - Led by **J. Janowiak (D. Vila) @ CICS**
- **Supports NESDIS Precip. Oversight Panel**
 - **“One stop shopping” for satellite precipitation validation**
- **Builds off IPWG activities**
 - **Automated**
 - **Various time & space scales**
- **Data generation & results interpretation**
 - **Quarterly metrics provided for operational and experimental algorithms**

Temporal Correlation (JJA_2011)



Heidke Skill Score (Prc > 1 mm/day)
JJA_2011 (5 day running mean)



7-10 Nov

Meeting – D

L7



Satellite Calibration Activities



- NESDIS/STAR is coordinating agency for WMO GSICS
 - “Global Space-based Inter-Calibration System”
 - GSICS includes several international satellite agencies, including NASA, JAXA, EUMETSAT, KMA, CMA, ...
- NESDIS is working with NASA on X-Cal Working Group
 - SSM/I and SSMIS
 - AMSU/MHS
- Synergies with NOAA’s CDR Program
 - Funded efforts for SSM/I CDR, AMSU CDR
 - Joint March 2011 X-CAL/AMSU/SSMT2 meeting in College Park

GSICS
Global Space-based Inter-Calibration System
An international collaboration to examine and harmonize data from operational weather satellites to improve climate monitoring and weather forecasting

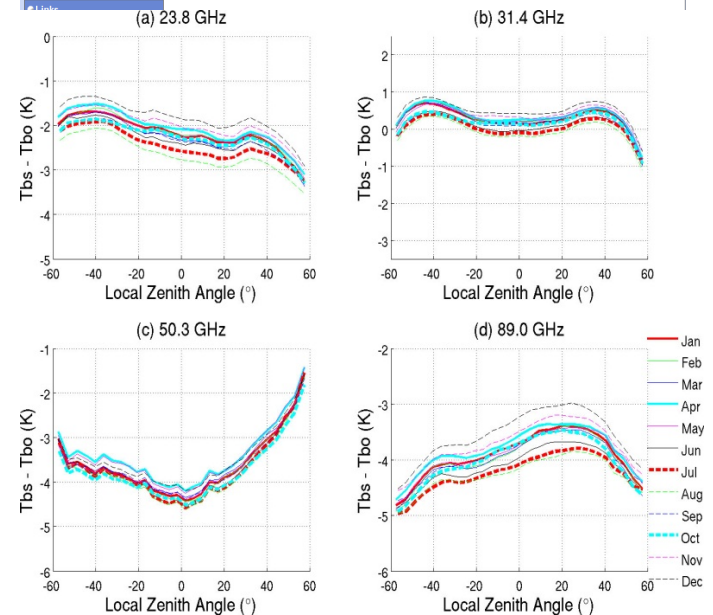
WMO • CMA • CNES
EUMETSAT • KMA • JMA
NOAA • NASA • NIST

GSICS Mission and Goals

Mission
Assure high-quality, inter-calibrated measurements from the international constellation of operational satellites to support the GEOS5 goal of increasing the accuracy and interoperability of environmental products and applications for societal benefit.

Goals
The primary goal of GSICS is to improve the use of space-based global observations for weather, climate and environmental applications through operational inter-calibration of the space component of the WMO World Weather Watch (WWW) Global Observing System (GOS) and Global Earth Observing System of Systems (GEOS). The basic GSICS strategies to achieve this goal are:

- To establish a GSICS Virtual Library to efficiently share information, software and data relevant to calibration;
- To build collaborations ensuring that each satellite instrument meets specifications by making pre-launch tests traceable to SI standards;
- To improve on-orbit calibration of satellite instrument observations by means of an integrated calval system, including instrument performance monitoring, inter-satellite/inter-sensor calibration, lunar and stellar calibration, vicarious calibration and validation with reference sites;
- To establish a distributed research component and a plan for research to operations transition;





NOAA's CDR Program



• Projects of interest to GPM:

- Kummerow – SSMI-SSMIS FCDR's
- Ferraro – AMSU FCDR/TCDR's
- Adler – GPCP V2 Transition to NCDC

• Upon completion

- “Transparency”
- Transition to NCDC for continuation
- PI's remain stewards of data sets for prolonged period

The screenshot shows the NOAA National Climatic Data Center website. The header includes the NOAA logo and the text "NOAA NATIONAL CLIMATIC DATA CENTER NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION". Navigation links include Home, Operational CDRs, Developmental CDRs, Opportunities, and Library. A search bar is labeled "SEARCH NCDC". The main heading is "CLIMATE DATA RECORD PROGRAM". Below this is a large image of a satellite in orbit over Earth. A sidebar on the left contains links for "Serving the Public", "Data", "Development Guidelines", and "Contact Us", along with a "News" section featuring "Successful launch of the NPP Satellite, October 28, 2011". The main content area has a "Welcome to NCDC's CDR Program" heading and text explaining the program's mission and history. A right sidebar features "Serving the Public" with images and labels for "Energy", "Water", "Disaster", and "Agriculture", each with a corresponding list of related programs and research projects.

Welcome to NCDC's CDR Program

NOAA's National Climatic Data Center (NCDC) recently initiated a satellite Climate Data Record (CDR) program to continuously provide objective climate information derived from weather satellite data that NOAA has collected for more than 30 years. These data comprise the longest record of global satellite mapping measurements in the world, and are complemented by data from other sources including NASA and Department of Defense satellites as well as foreign satellites.

The mission of NOAA's Climate Data Record Program is to develop and implement a robust, sustainable, and scientifically defensible approach to producing and preserving climate records from satellite data.

WHAT ARE CDRs?

The National Research Council (NRC) defines a CDR as a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change. ([National Research Council, 2004](#)).

For the first time, NOAA is applying modern data analysis methods, which have advanced significantly in the last decade, to these historical global satellite data. This process will unravel the underlying climate trend and variability information and return new economic and scientific value from the records. In parallel, NCDC will maintain and extend these Climate Data Records by applying the same methods to present-day and future satellite measurements.

WHY ARE CDRs IMPORTANT?

The results will provide trustworthy information on how, where and to what extent the land, oceans, atmosphere and ice sheets are changing. In turn, this information will be used by energy, water resources, agriculture, human health, national security, coastal community and other interest groups. Our CDR data will

Serving the Public

- Energy**
- Water**
- Disaster**
- Agriculture**

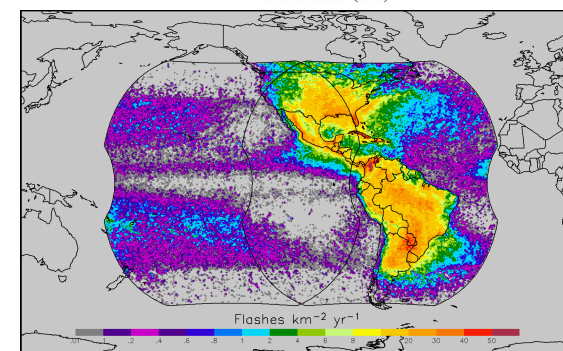
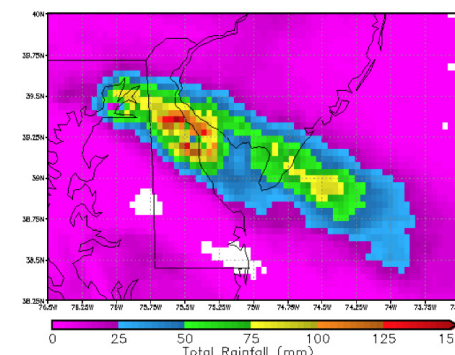
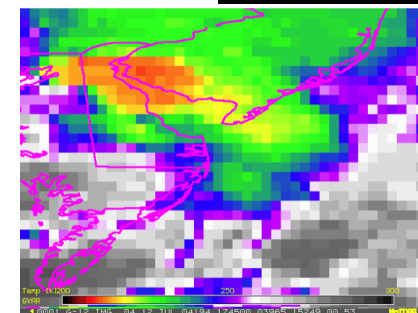
- [NOAA's Climate Portal](#)
- [United States Global Change Research Program](#)
- [Group on Earth Observations](#)





GOES-R and Synergy with GPM

- With launch in 2016, GOES-R will contain sensors that will be useful for rapid refresh precipitation estimation and storm monitoring
 - ABI (Advanced Baseline Imager)
 - GLM (Geostationary Lightning Mapper)
- Baseline rain products based off of SCaMPR technique
 - Uses MW rain rates as calibrator for ABI Channels
- GOES-R3 (Risk Reduction Program)
 - Use of GLM to improve passive MW convective-stratiform separation (N. Wang, PI)
 - Improve GPROF retrievals and in turn, SCaMPR
 - Use of GLM to improve ABI convective-stratiform separation (R. Adler, PI)
 - Improve SCaMPR technique (ABI)
- GOES-R contributions/interest in GPM GV
 - Ground lighting sensors in support of CHUVA





1st NOAA User Workshop on GPM



- NOAA held 1st GPM User Workshop in August 2010
 - Workshop report distributed March 17
- The main workshop recommendations are
 - Accelerate the use of GPM data at NOAA through the development of a NOAA GPM Proving Ground and use of existing test beds.
 - Enhance R&D, and encourage scientific and technological innovation to maximize use of GPM-era data at NOAA
 - Develop synergy with other existing and developing programs
 - Provide GPM-era data operationally at NOAA with minimal data latency and in a variety of formats
 - Develop a dedicated NOAA budget for GPM and for mission continuity
- Follow on workshop late 2011 – User focus Around these five recommendations





2nd NOAA User Workshop on GPM



- Nov. 29 – Dec. 1, 2011, College Park, MD
 - Intended audience – current and future users of satellite precipitation/water cycle products and radiances that rely on NOAA products
 - Nearly 50 registrants to date



2nd NOAA User Workshop on the Global Precipitation Measurement (GPM) Missions

November 29 - December 1, 2011

Earth System Science Interdisciplinary Center
University of Maryland Research Park (M-Square)
5825 University Research Court, College Park, MD



Online Registration for the Workshop now available. Sign up today!



Global Precipitation Measurement (GPM) Mission

November 29 - December 1, 2011



- [Draft Agenda](#), (PDF, 16 KB, **New: 10/28/2011**)
- [Final Circular](#), (PDF, 46 KB)
- [NASA Precipitation Measurement Missions website](#)
- [GPM Information for Travellers](#), (PDF, 40 KB)
- [2010 GPM Meeting Final Report](#), (PDF, 1.78 MB)

Overarching questions:

- How can NOAA prepare for and accelerate use for GPM data?
- How can NOAA enhance R&D and encourage scientific innovation via GPM-era data?
- How can NOAA develop synergy with other existing programs?
- How can GPM data be delivered to users in a timely manner and in the formats needed?
- How can NOAA integrate GPM-era data/products into “merged products and move toward a “One-NOAA” suite of water cycle products?

Expected outcome:

- Detailed set of actions, with focal points, that can be achieved over the next 3 years

Meeting Objectives

This three-day meeting, co-sponsored by NESDIS/STAR and NWS/OHD, will follow up on the highly successful first workshop in August 2010 and will focus on user applications of GPM-era data and products. The meeting will be organized around the five high level recommendations from the first workshop with anticipated outcomes for each topic as follows:

1. How can NOAA prepare for and accelerate the use of GPM data?

Expected outcome:

An action plan that utilizes existing and planned NOAA test beds and defines a NOAA GPM proving ground.

2. How can NOAA enhance its R&D and encourage scientific and technological innovation to maximize use of GPM-era data?

Expected outcome:

A prioritized list and action plan of envisioned R&D which will utilize GPM-era data

3. How can NOAA develop synergy with other existing and developing programs that are likely to have budgets over the next five years?

Expected outcomes:

Identify linkages to major NOAA programs related to hydrology and their associated observing systems and a set of specific actions to get them engaged with GPM. Preliminary draft plan for the proposed “One-NOAA-One Precipitation” project

4. What is the path forward to provide GPM-era data operationally at NOAA with minimal data latency and in the necessary format?

Expected outcome:

A clear definition of the full spectrum of user needs in terms of both the continuity of current data products and potential products from GPM-era sensors.

5. How can NOAA integrate GPM-era satellite data into “merged” products (e.g., Q2, CMORPH, etc.) and move toward a “One NOAA” suite of precipitation products?

Expected outcome:

An action plan describing how GPM data could be utilized for multi-sensor precipitation estimation and the anticipated benefit to current NOAA precipitation product(s)



Intended Participants:

Current and future users of satellite based precipitation and water cycle products and radiance data from government, private sector and academia.

For more information, contact the workshop organizers:

- Ralph Ferraro, NESDIS/STAR, Ralph.Ferraro@noaa.gov
- Rob Cfeil, OAR/ESRL, Rob.Cfeil@noaa.gov
- Chandra Kondragunta, NESDIS/OSD, Chandra.Kondragunta@noaa.gov
- Pingping Xie, NWS/CPC, Pingping.Xie@noaa.gov

If you are interested in attending, please contact Ralph Ferraro at Ralph.Ferraro@noaa.gov.





Summary and Future Plans



- **NOAA continues to be an active player in GPM and related activities**
 - **Lead role in JPSS science**
 - **Supporting it's PI's on the PMM science team**
 - **GV activities – HMT and GOES-R**
 - **Calibration - GSICS & X-CAL**
 - **CDR program – now supporting 3 projects related to water cycle sensors/CDR's**
 - **International partnerships**
 - **Advocacy – Upcoming 2nd NOAA User Workshop on GPM**
- **NOAA will continue to prepare for GPM**
 - **Budget and planning process**
 - **Competition is tough and money is tighter than ever**
 - **Working hard on innovative FY14 funding initiative**
 - **Looking for more NOAA partners for GPM data use and synergy**
 - **Educate and Inform (Some think no need for GPM...we will use TRMM!)**
 - **JCSDA**
 - **JPSS**
 - **Pursue recommendations from NOAA GPM User Workshops**

