

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



GPM from NOAA's Satellite and Information Services Perspective

3rd NOAA User Workshop on the
Global Precipitation Measurement (GPM) Mission: Proving Ground

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Global Precipitation Mission (GPM)

Objectives:

- Understand horizontal and vertical structure of rainfall, its macro- & micro-physical nature, & its associated latent heating
- Train & calibrate retrieval algorithms for constellation radiometers
- Provide sufficient global sampling to significantly reduce uncertainties in short-term rainfall accumulations
- Extend scientific and societal applications



Core Satellite

- TRMM-like spacecraft (NASA)
- H2-A rocket launch (NASDA)
- Non-sun-synchronous orbit
  ~ 65^0 inclination
  ~ 400km altitude
- Dual Frequency radar (NASDA)
  Ku-Ka Bands (13.6-35GHz)
  ~4km horizontal resolution
  ~250m vertical resolution
- Multifrequency radiometer (NASA)
  10.7, 19, 22, 37, 85, 150, 183 GHz, V & H

Constellation Satellites

- Pre-existing operational/experimental &dedicated satellites with PMW radiometers
- Revisit time
  3-hour global at ~90% of time
- Sun-synch & non-sun-synch orbits
  600-900 km altitudes

Precipitation Processing System

- Produces global precipitation products
- Products defined by GPM partners

Precipitation Validation Sites for Error Characterization

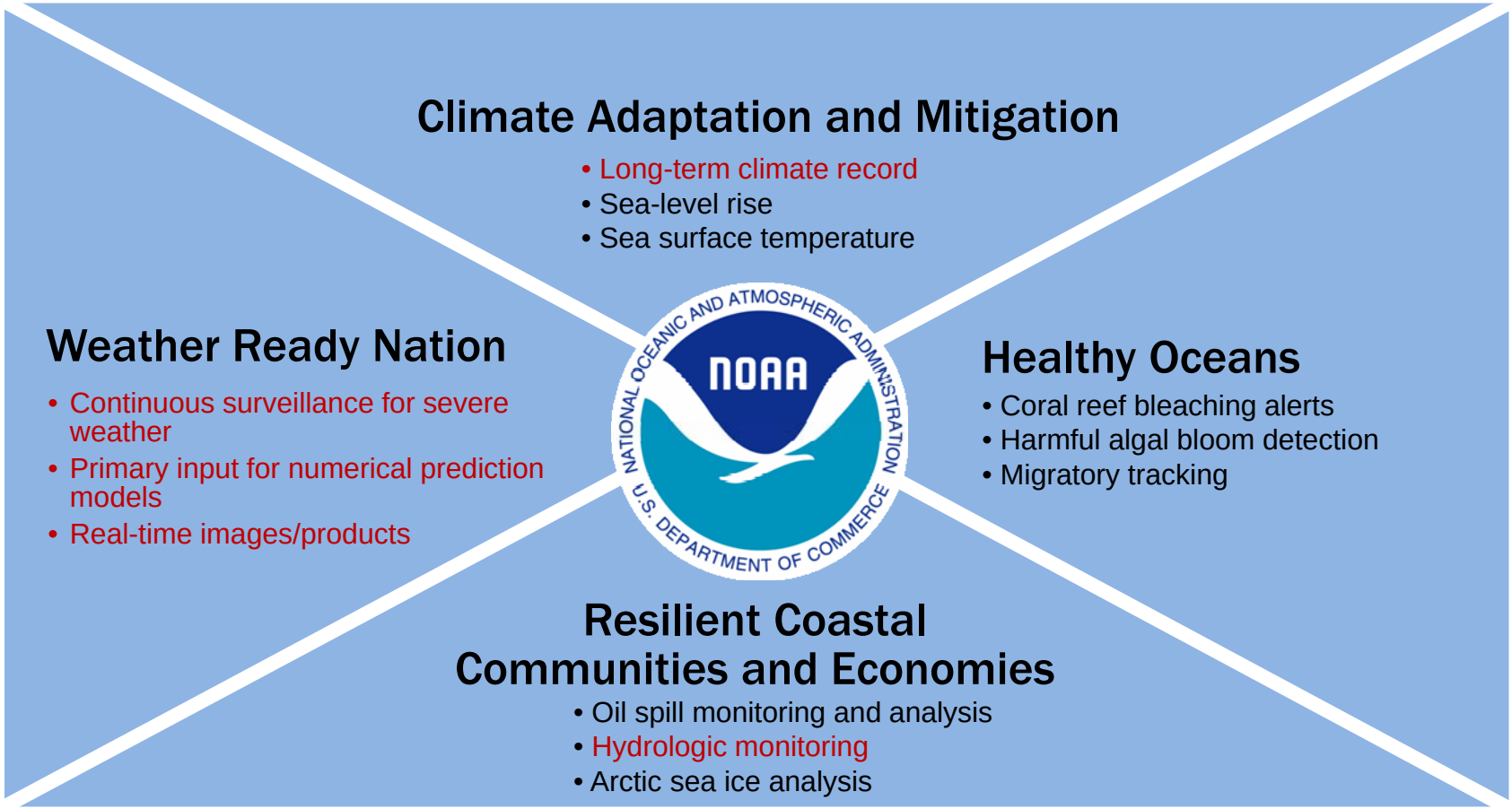
- Select/globally distributed ground validation “Supersites” (research quality radar, up looking radiometers-radar-profile system, rain gauge-disdrometer network, & T-q soundings)
- Dense & frequently reporting regional rain gauge networks

The GPM Innovation

- The NASA Global Precipitation Mission dramatically extends the precipitation monitoring techniques developed for the Tropical Rainfall TRMM.
- The innovation of TRMM was the nadir-looking precipitation radar-in-space, coupled with a broad swath microwave imager on the same platform.
- The innovation of GPM is the coupling of dual-frequency nadir-looking precipitation radars to a constellation of broad-swath microwave imagers on polar-orbiting satellites operated by both US and international partners.
- The GPM "core" satellite enables the common calibration for precipitation estimates from the entire constellation of microwave imagers aboard all satellites.
- **The Goal:** A multi-satellite constellation, operating as a coordinated whole, would provide precipitation rates and related products with near-global coverage every 3 hours or less, and a spatial resolution of 5 - 25 km!

NOAA's satellite mission aligns with NOAA and DOC strategic plans

NOAA satellite data products and services underpin and support the priorities and goals of the Administration, Department of Commerce, and NOAA.



Note: Red highlighted text depicts priorities addressed by GPM

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Continuity of Polar Satellite Microwave Precipitation Missions

Era	Mission	Sensor	Country	Timeframe
Heritage Missions	TRMM	TMI, PR	USA / Japan	1997-2014
	POES	AMSU-A, -B, MHS	USA (NOAA)	1999-2013
	EOS Aqua	AMSR-E, HSB	USA / Japan / Brazil	2002-2011, 2002-2003
	DMSP-16, -17, -18	SSMIS	USA	2003-2014
	MetOp-A	AMSU-A, MHS	EUMETSAT	2006-2013
	MetOp-B	AMSU-A, MHS	EUMETSAT	2012-2017
Continuity Missions	Megha-Tropiques	MADRAS/SAPHIR	India / France (CNES)	2011-2016
	S-NPP	ATMS	USA (NOAA)	2011-2016
	MetOp-C	AMSU-A, MHS	EUMETSAT	2017-2022
	GCOM-W1	AMSR2	Japan (JAXA)	2012-2017
	JPSS-1, -2	ATMS	USA (NOAA)	2017-2027
	GPM Core	GMI, DFPR	USA / Japan (JAXA)	2014-2019
	DMSP-19, -20	SSMIS	USA	2014-20122
Future Missions	GCOM-W2, -W3	AMSR2	Japan	2016-2024
	JPSS-3, -4	ATMS	USA (NOAA)	2024-2034
	WFS (was DWSS)	MIS	USA	2018-2026
	EPS SG	MI	EUMETSAT	2021-2031
	FY-3 C	MWIS / MWTH / MWRI	China (CMA)	2015-2020

NESDIS Investment Priorities

GPM directly fulfills several of NESDIS priorities

- Maintain continuity of satellite operations and the infrastructure to distribute environmental data that is necessary to monitor and observe the Earth's Environment
- Assess and execute opportunities to transfer appropriate research capabilities to NOAA operations
- Develop and implement product applications to support future satellite missions
- Continue to seize viable opportunities to partner with other agencies and foreign entities to leverage capabilities for reducing existing data gaps

NOAA Perspective and Opportunity

- Precipitation Constellation
  - GPM is more than just the core satellite (Feb 2014– GMI+DPR)
  - DMSP, POES/JPSS, MetOp, NPP, … and international missions, are all part of GPM
- Research to Operations and Continuity
  - Supports 2007 NRC recommendation for NOAA to "operationalize" GPM Precipitation Processing System
  - Supports 2010 National Space Policy to "Transition mature research and development Earth observation satellites to long-term operations"
    - MOU between NASA and NOAA going through legal review
    - L1RD and Concept of Operations documents being coordinated by NESDIS Offices with NOAA user community
- Leveraging
  - Builds on immensely successful demonstration and proven value of TRMM
  - Leverages huge joint NASA and JAXA investment (> $1B) in GPM Mission
  - Leverages multi-billion dollar satellite investments by U.S. and international partners
- GEOSS
  - Strong documented international interest and support for GPM and operational follow-on is a key piece of the space-based Global Observing System and Global Climate Observing System
  - GPM and follow-on mission recommended in WMO GOS 2025 Vision and CGMS baseline

NOAA Benefits, Applications, Advances

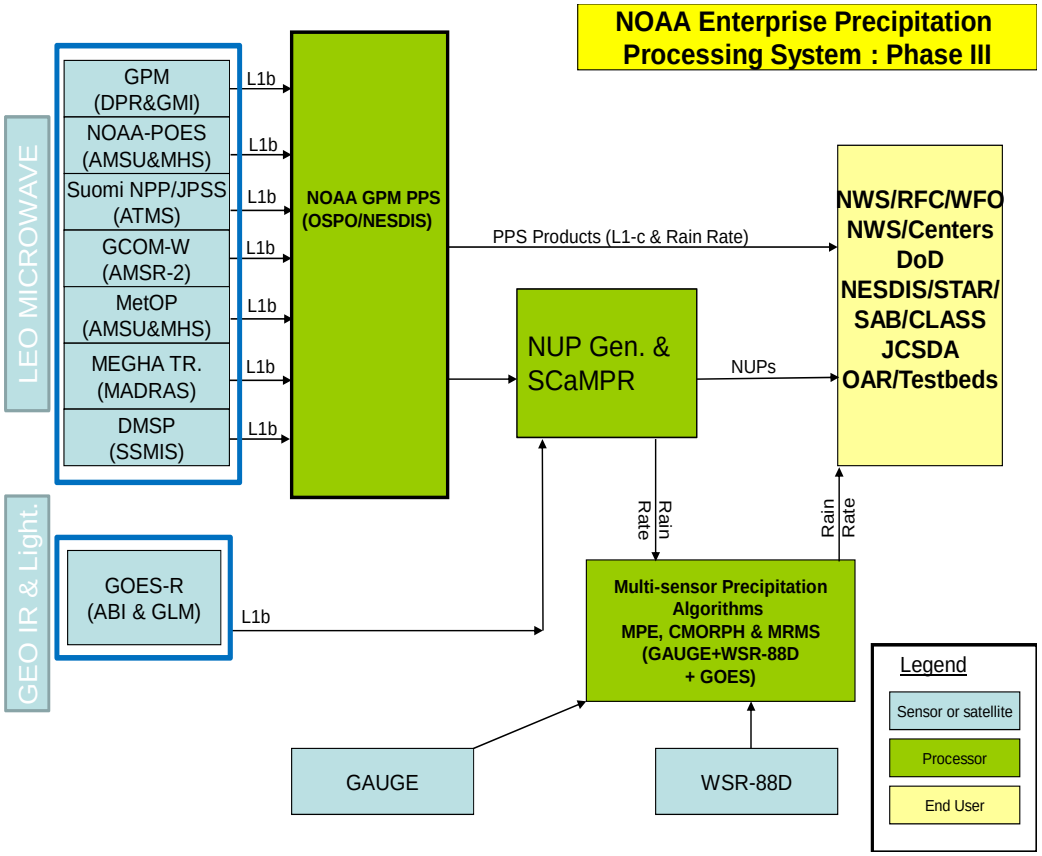
GPM will help to improve NOAA's ability to monitor & predict severe hydrological events (i.e., hurricanes, flash floods, drought, coastal evacuations, etc.)

- GPM Constellation could achieve 10-25 km resolution precipitation related observations globally, every 3hours
- GPM provides critical information for data assimilation and NWP

GPM will significantly advance regional & global climate monitoring assessments

- Precision radiometer will anchor calibration among satellites for climate-quality data records (CDR's)

GPM operational ground system will consolidate precipitation processing in NOAA there by achieving operational efficiency. This perfectly aligns with NOAA level enterprise consolidation of ground system operations.

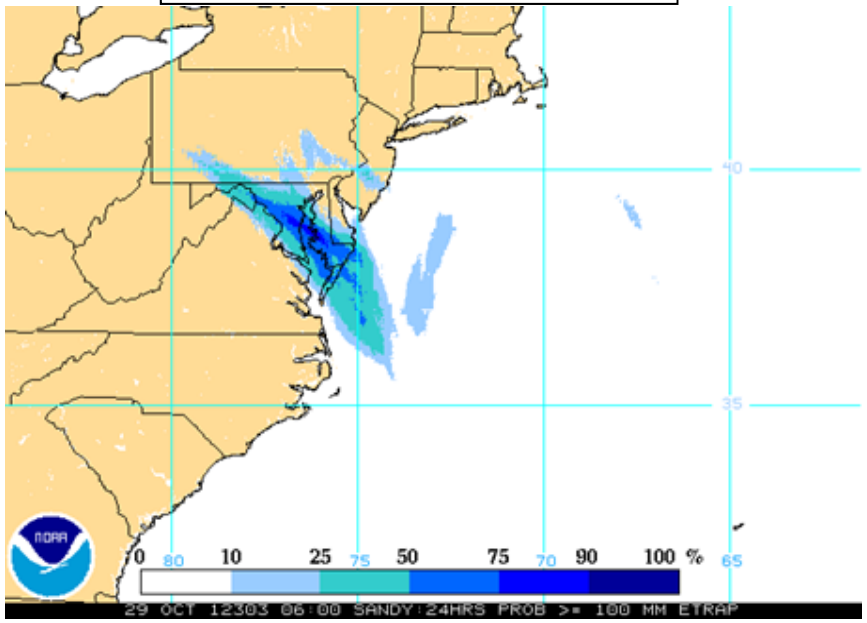


GPM Use at NOAA - eTRaP

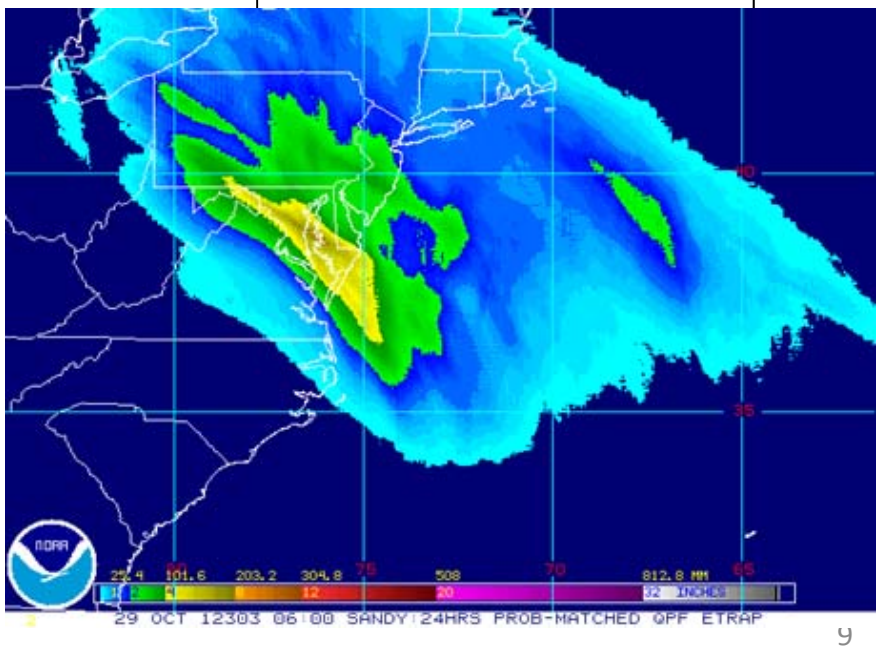
- Ensemble Tropical Rainfall Potential [eTRaP]uses all available passive MW rain estimates to generate rainfall potential and probabilities of exceeding thresholds.
- The more members used in ensemble, the more accurate the predictions
  - Presently, the number of available ensemble members is decreasing due to aging constellation. However, new recently launched sensors (i.e, ATMS, MADRAS, AMSR-2) will help to mitigate this concern.

Hurricane Sandy – Oct 29, 2012

Probability of Rain >4”



Total 24-hour Rainfall



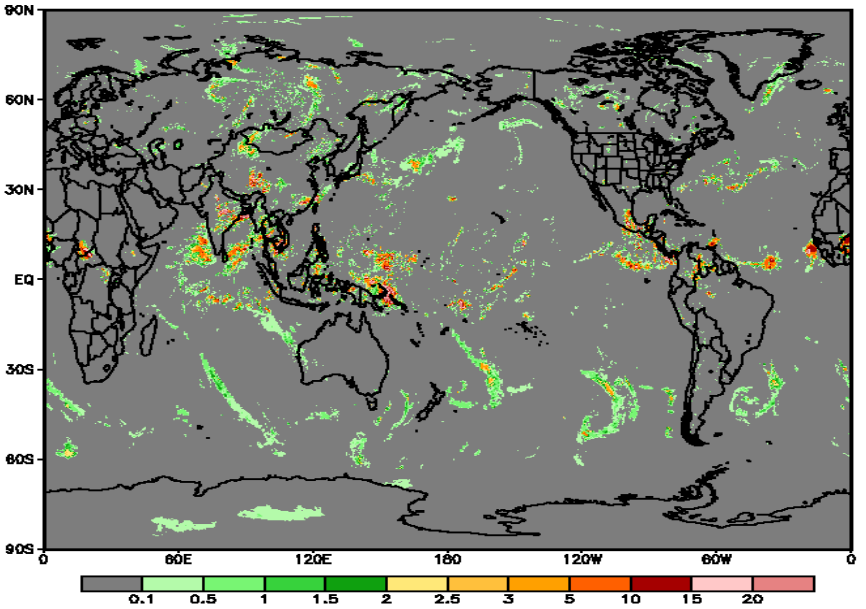
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Pole-to-Pole CMORPH and Integrated Regional Precipitation Analyses

P.Xie and R.Joyce

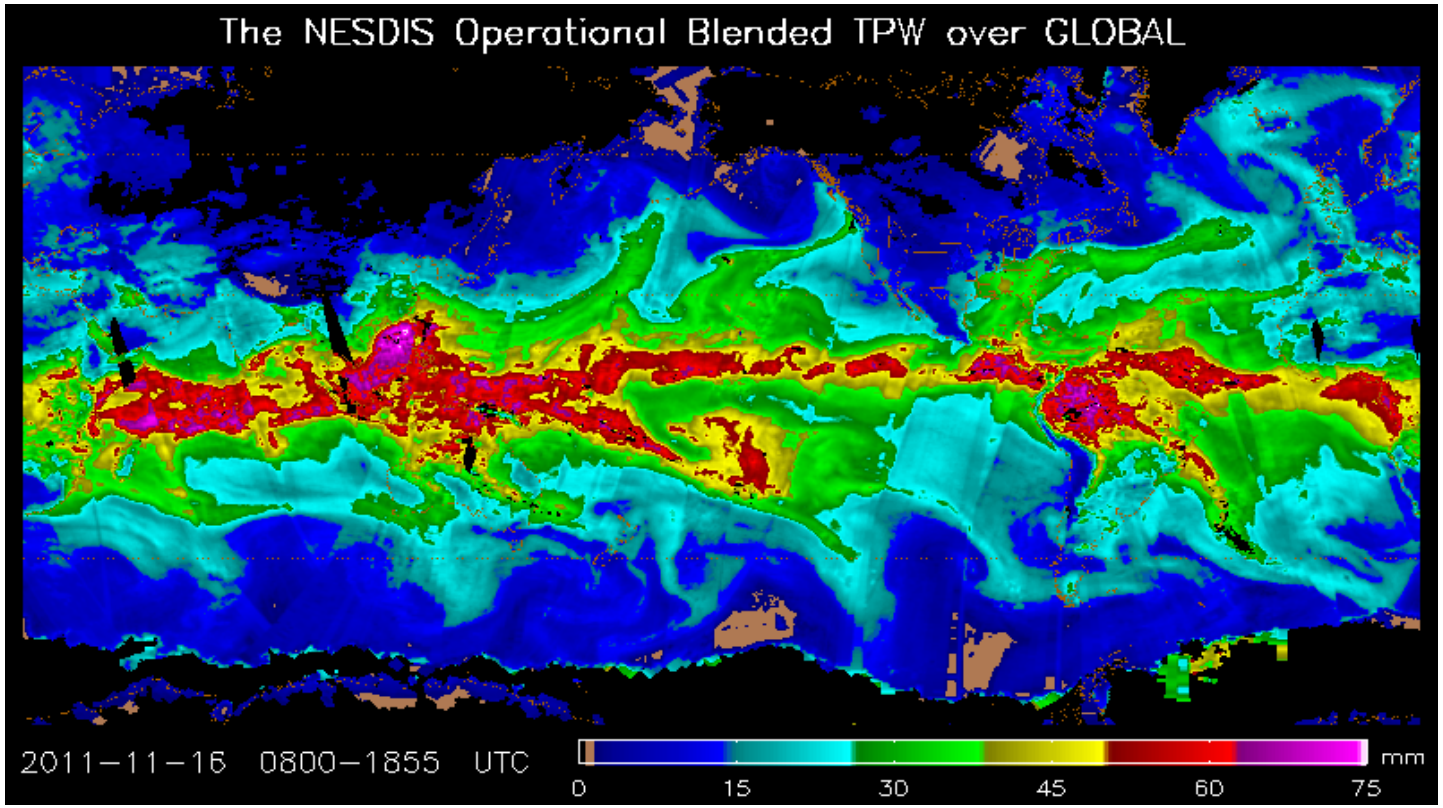
- **Pole-to-pole CMORPH**
  - *0.05°lat/lon over the globe in 30-min interval*
  - *Integration of PMW, GEO/LEO IR, and model info through Kalman filter*
  - *Framework designed, prototype under development*
- **Regional CMORPH**
  - *With R. Kuligowski*
  - *2km grid 15-min analysis over North America and nearby ocean*
  - *Including GOES-R hi-res IR*
  - *Products comprised of different latencies (15-min to 18 hours)*
- **Gauge-Radar-Satellite-Model merged analyses**
  - *With Y.Zhang and OHD*
  - *Hourly analysis over CONUS*
  - *OI technique*
  - *Prototype being tested*

Sample Pole-to-pole CMORPH For 10:00GMT, July 1, 2009



GPM Use at NOAA - TPW

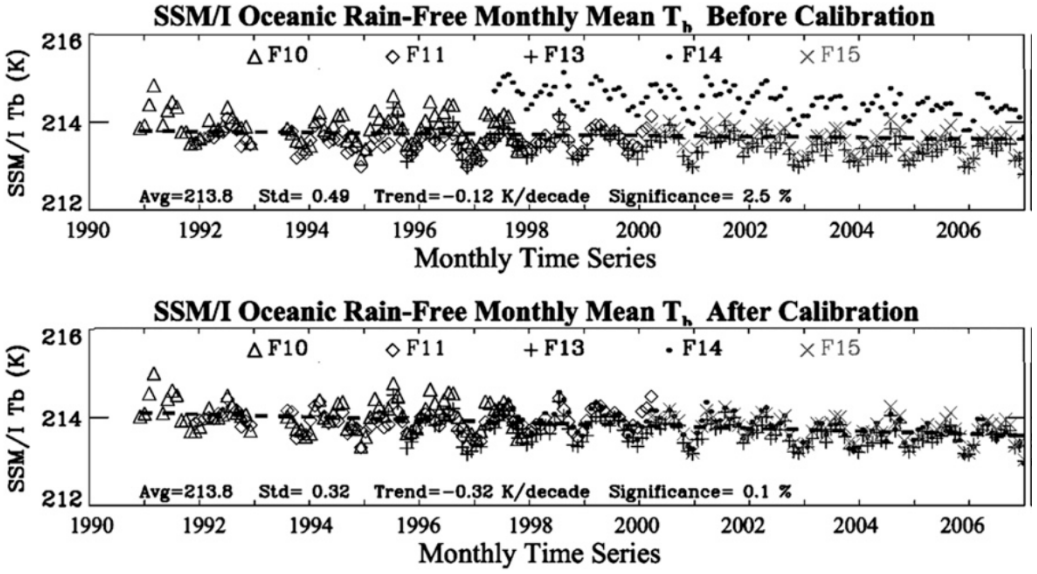
- GPM Constellation will be key contributors to this blended product
- Intercalibrated radiances should help minimize the discontinuities currently seen by merging in multiple data sources



GPM - Critical for Climate Data Records

- NOAA's Climate Data Record (CDR) program
  - 25 year intercalibrated MW imager time series from SSM/I
    - TRMM helped serve as a calibration standard
  - 12 year AMSU time series nearing completion
- GPM's Microwave Imager (GMI) critical calibration anchor to extend the MW CDR's
  - Close collaboration with NASA's MW calibration team and NOAA's GSICS group

From Yang et al., *JAMC*, 2011



Summary

- Mankind can live without many things, water is NOT one of them
  - Monitoring and forecasting changes in precipitation is critical
  - Critical not only to changes in severity but also availability
- GPM presents a great opportunity for the community
  - New opportunities for improving forecast of significant events
  - Increased operational efficiencies
  - Increased international and inter-agency cooperation
  - Advanced regional & global climate monitoring assessments
- Heritage systems are working well
- Continuity systems on-orbit or in the build cycle
- Budget difficulties around the globe present a challenge
  - Continue to be champions for the mission
  - Keep our eyes on our roles, success is the best key to continuity
- Have a great conference