GPM from NOAA's Satellite and Information Services Perspective

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

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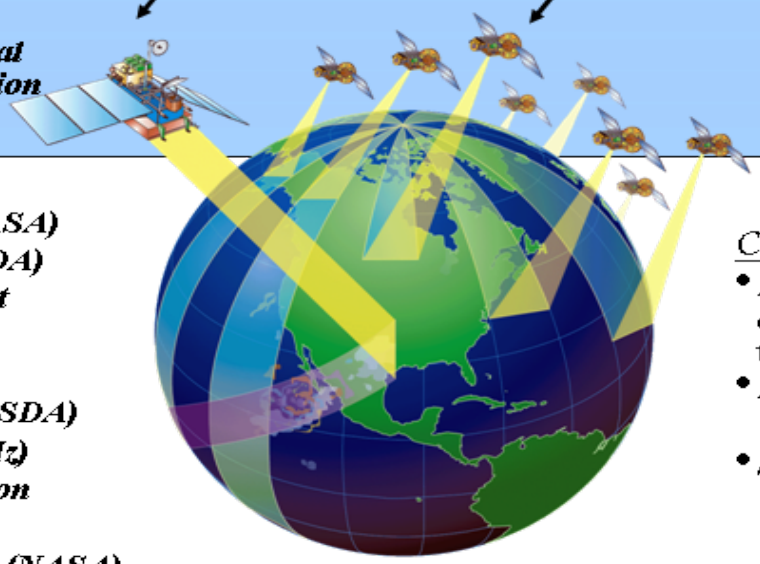
Global Precipitation Mission (GPM)

OBJECTIVES

- *Understand horizontal & vertical structure of rainfall, its macro- & micro-physical nature, & its associated latent heating*
- *Train & calibrate retrieval algorithms for constellation radiometers*

OBJECTIVES

- *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° inclination*
  - *~400 km altitude*
- *Dual frequency radar (NASDA)*
  - *Ku-Ka Bands (13.6-35 GHz)*
  - *~ 4 km horizontal resolution*
  - *~250 m 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 goal 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 radiometer-radar-profiler system, raingauge-disdrometer network, & T-q soundings)*
- *Dense & frequently reporting regional rain gauge networks*

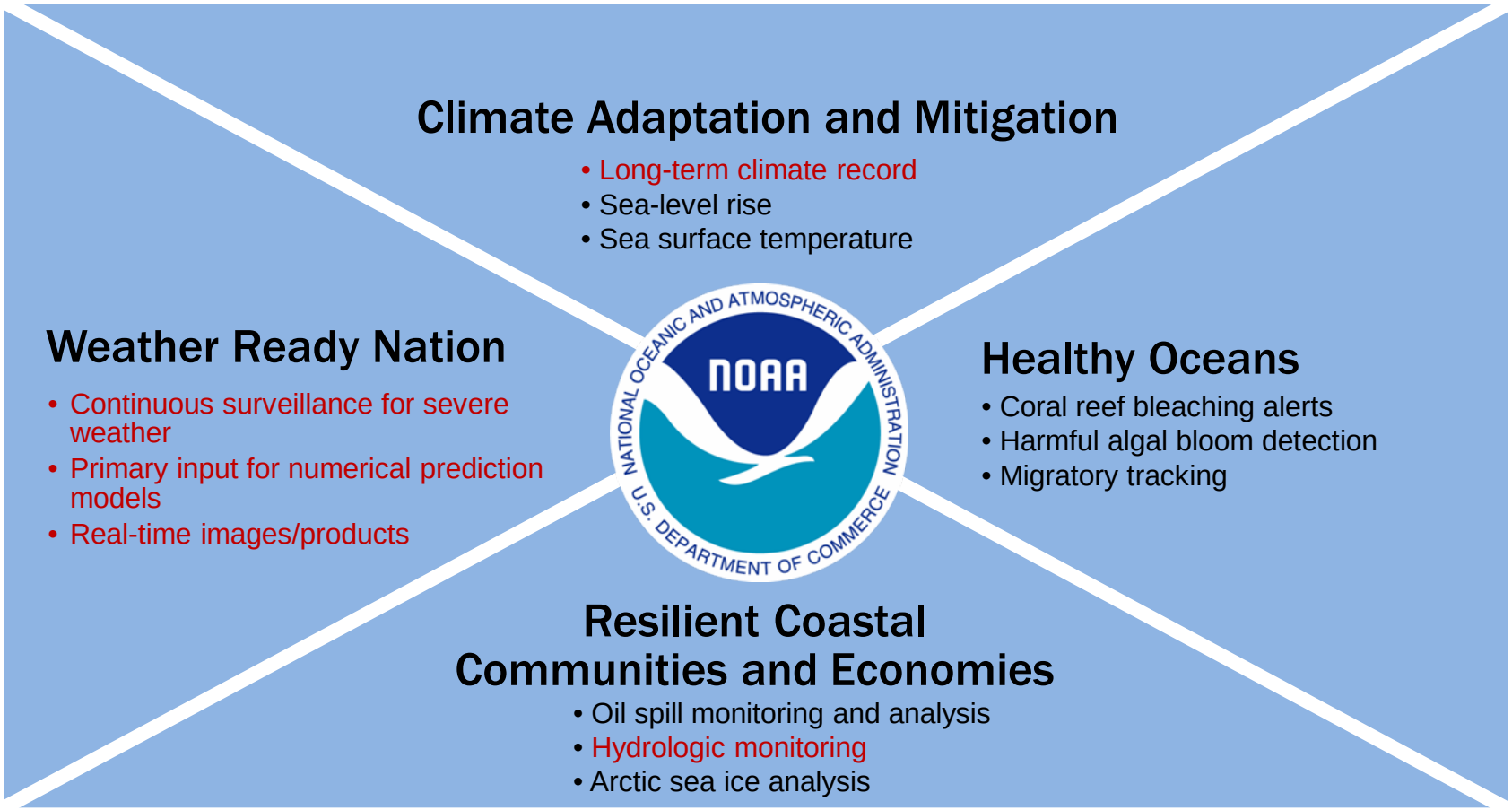
Slide courtesy of NASA

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 six 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

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Continuity of Polar Satellite Microwave Precipitation Missions

Era	Mission	Sensor	Country	Timeframe
Heritage Missions	TRMM	TMI, PR	USA / Japan	1997-2012
	POES	AMSU-A, -B, MHS	USA (NOAA)	1999-2012
	EOS Aqua	AMSR-E, HSB	USA / Japan / Brazil	2002-2011, 2002-2003
	DMSP-16, -17, -18	SSMIS	USA	2003-2014
	MetOp-A	AMSU-A, -B, MHS	EUMETSAT	2006-2012
Continuity Missions	Megha-Tropiques	MADRAS	India / France (CNES)	2011-2016
	NPP	ATMS	USA (NOAA)	2011-2016
	MetOp-B, C	AMSU-A, -B, MHS	EUMETSAT	2012-2022
	GCOM-W1	AMSR2	Japan (JAXA)	2012-2017
	GPM Core	GMI, DFPR	USA / Japan (JAXA)	2014-2019
	DMSP-19, -20	SSMIS	USA	2014-2019
Future Missions	GCOM-W2, -W3	AMSR2	Japan	2016-2024
	JPSS	ATMS	USA (NOAA)	2017-2034
	DWSS	MIS	USA	2018-2026
	Post - MetOp	MI	EUMETSAT	2021-2031
	FY-3 Series	MWIS / MWTH / MWRI	China (CMA)	2008-2023

NESDIS Investment Priorities

GPM directly fulfills four out of five NESDIS FY 2014 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

Maintain continuity of current satellite acquisition programs

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
    - Draft Transition Plan 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

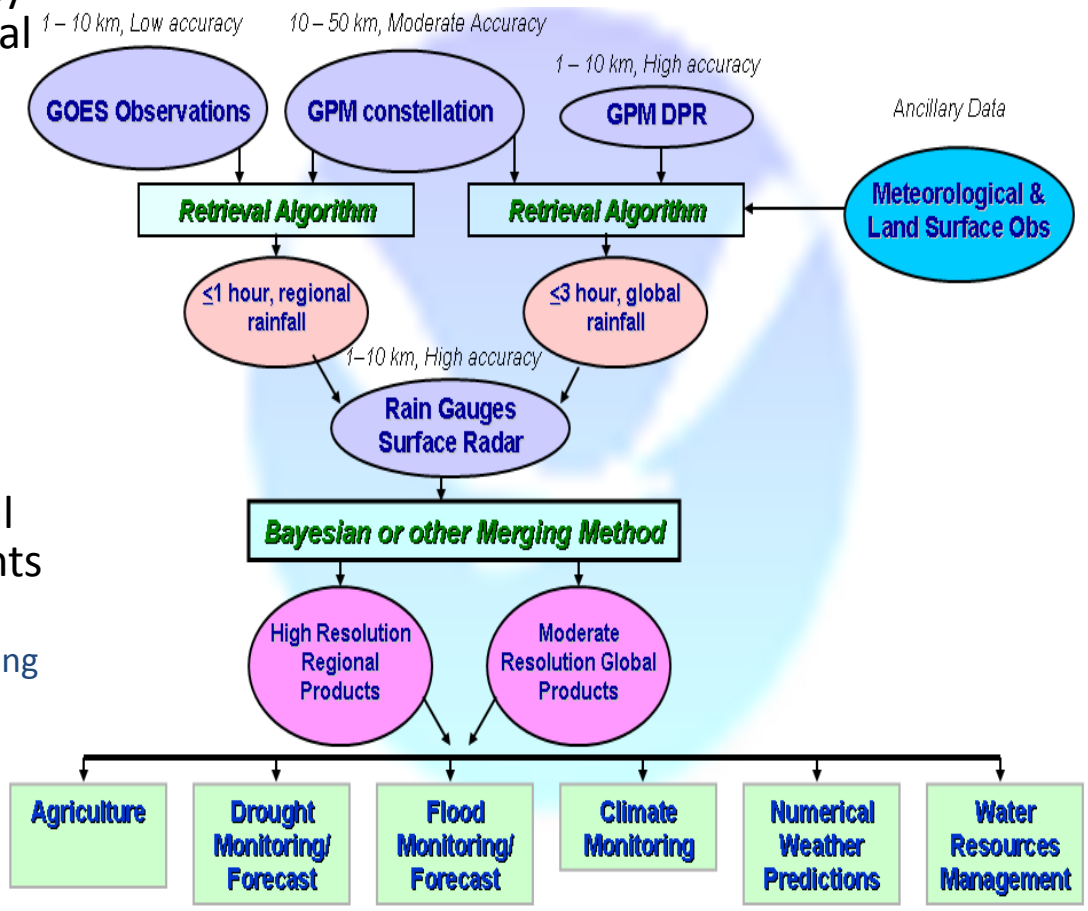
GPM will help to improve NOAA's ability to monitor & predict severe hydrological events (i.e., hurricanes, flash floods, drought, coastal evacuations, etc.)

- 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)

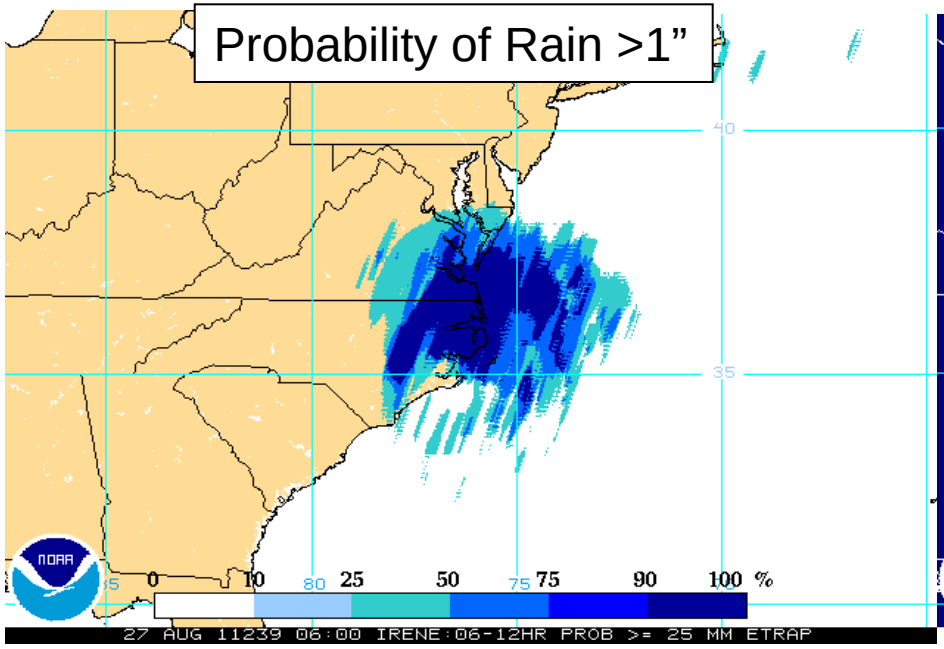
GPM operational ground system will advance development of optimally integrated satellite and in situ precipitation products (rain gauges and surface radar)

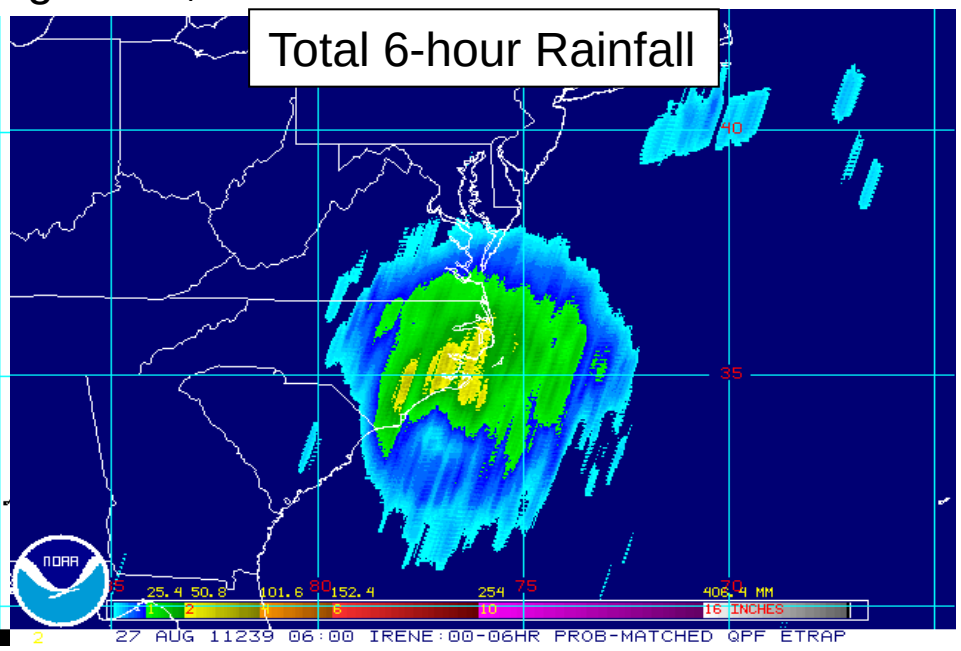


GPM Use at NOAA - eTRaP

- 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 umber of available ensemble members is decreasing due to aging constellation. However, new recently launched sensors (i.e, ATMS, MADRAS) will help to mitigate this concern.

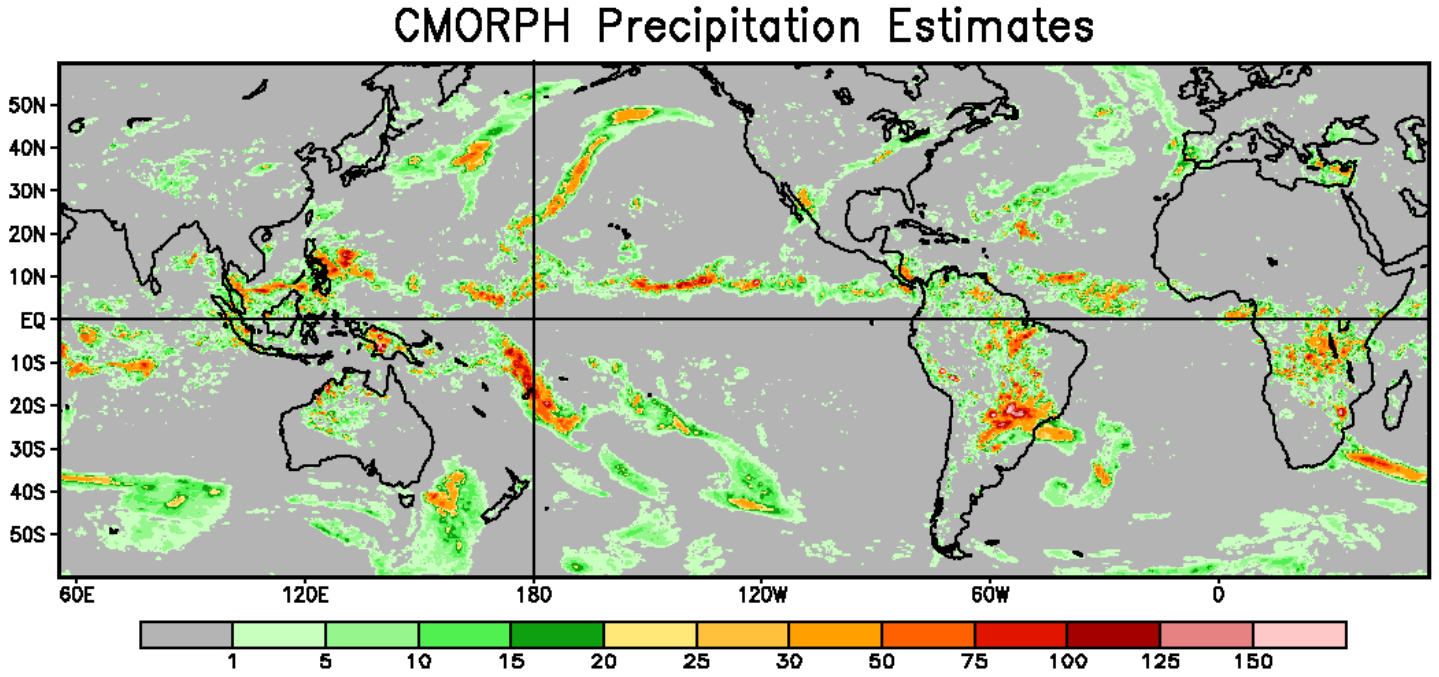
Hurricane Irene – August 27, 2011





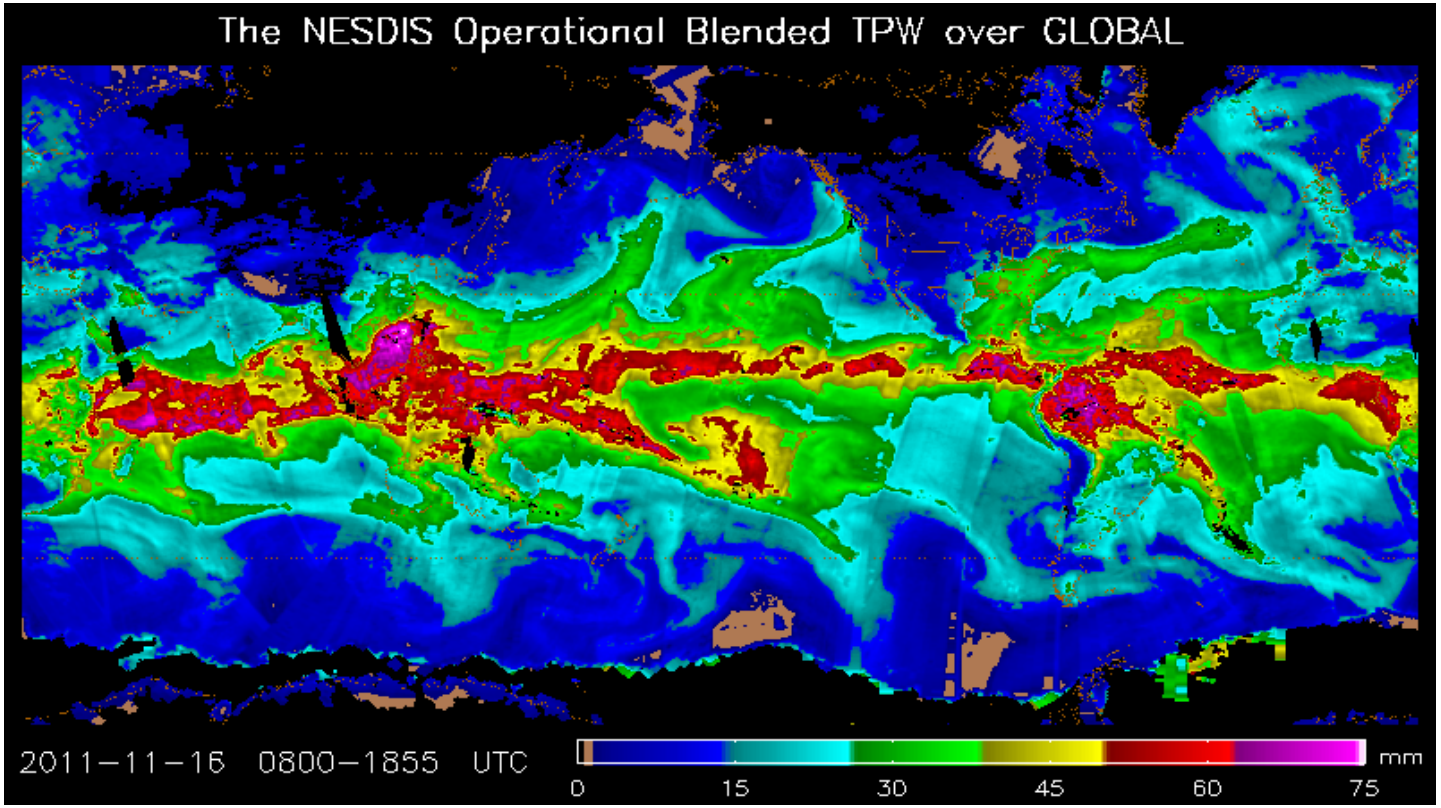
GPM Use at NOAA - CMORPH

- NCEP's Climate Prediction Center generates a blended satellite, 3-hourly global precipitation product [CMORPH = CPC MORPHing Technique]
- Product is based on all available MW data, combined with a global IR cloud product
- GPM-era data are critical to sustain and enhance this product and expand to higher latitudes



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



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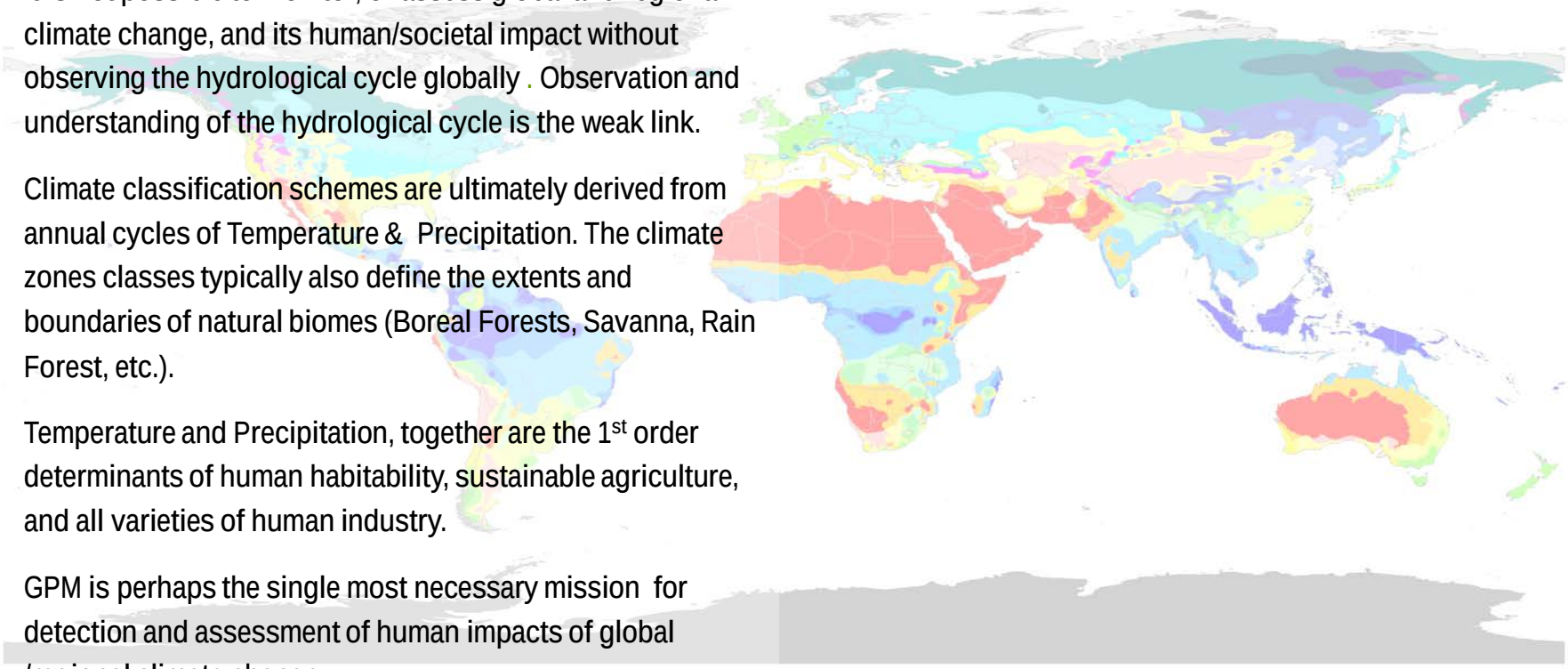
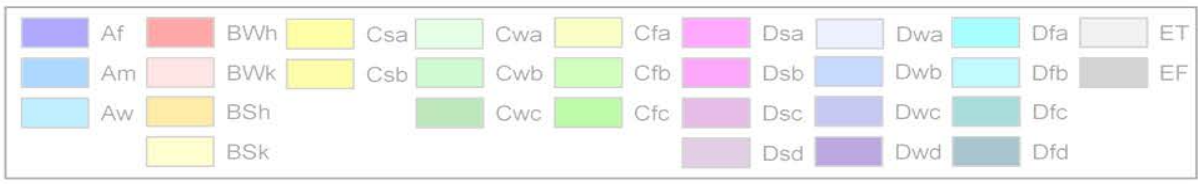
GPM - The Essential Climate View

World map of Köppen-Geiger climate classification

- It is not possible to monitor, or assess global and regional climate change, and its human/societal impact without observing the hydrological cycle globally . Observation and understanding of the hydrological cycle is the weak link.
- Climate classification schemes are ultimately derived from annual cycles of Temperature & Precipitation. The climate zones classes typically also define the extents and boundaries of natural biomes (Boreal Forests, Savanna, Rain Forest, etc.).
- Temperature and Precipitation, together are the 1st order determinants of human habitability, sustainable agriculture, and all varieties of human industry.
- GPM is perhaps the single most necessary mission for detection and assessment of human impacts of global /regional climate change





DATA SOURCE : GHCN v2.0 station data Temperature (N = 4,844) and Precipitation (N = 12,396)

PERIOD OF RECORD : All available

MIN LENGTH : ≥30 for each month

RESOLUTION : 0.1 degree lat/long

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Budget Challenges