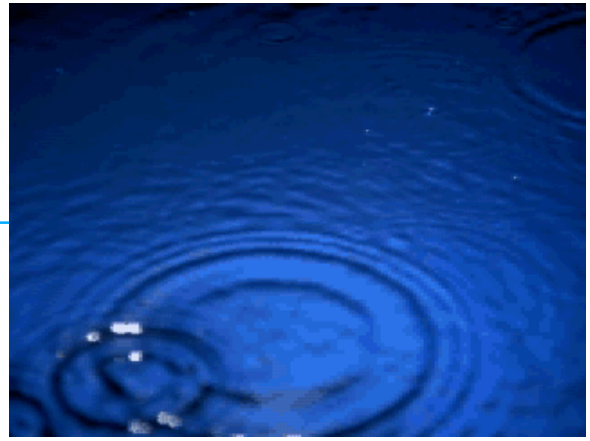
GPM

GLOBAL PRECIPITATION MEASUREMENT

GPM
Global Precipitation Measurement



GPM-SMAP Synergy

Christa D. Peters-Lidard, NASA/GSFC, GPM Hydrology Applications Lead
Arthur Y. Hou, NASA/GSFC, GPM Project Scientist
Gail Skofronick-Jackson, NASA/GSFC, GPM Deputy Project Scientist
Christian D. Kummerow, CSU, GPM GV Panel CoChair, PMM Team Member

July 9, 2007

GPM: A Constellation Satellite Mission

Designed to unify and advance global precipitation measurements through

- *advanced microwave sensors & algorithms (DPR & GMI)*
- *a consistent framework for inter-satellite calibration*
- *international science collaboration in algorithm development, ground validation, and improved use of precipitation data in research & applications*

NASA constellation at ~40° inclination

- *Improved near-real time hurricane monitoring and prediction*

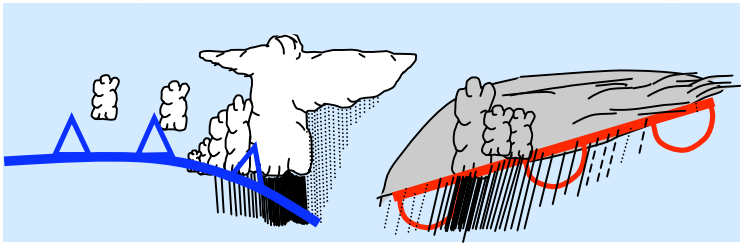
GPM Core
NASA-40°
GCOM-W
F18, F19
Megha-Tropiques
NOAA-N′
NPP
MetOp-B
NPOESS-C1

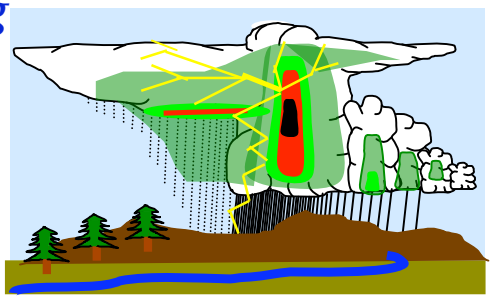
NASA-JAXA GPM Core Spacecraft at 65° inclination (serving as a precipitation physics observatory and calibration reference)

- *Increased sensitivity for light rain and snow detection*
- *Better overall measurement accuracy*
- *Uniform calibration of brightness temperatures of Constellation sensors*
- *Detailed microphysical information and a common cloud database for rain & snow retrievals from Core & Constellation sensors*

GPM Science Objectives

- *Precipitation measurement technology:* ***advancing precipitation measurement capability from space***
  - *through combined use of active and wide-band passive remote-sensing techniques to calibrate dedicated & operational PMW sensors to achieve global coverage*
- *Water/energy cycle variability:* ***advancing understanding of global water/energy cycle and fresh water availability***
  - *through better measurement of the space-time variability of global precipitation*
- *Weather prediction:* ***improving NWP skills***
  - *through more accurate and frequent measurement of instantaneous rain rates*
- *Hydrometeorological prediction:* ***advancing flood-hazard and fresh-water-resource prediction capabilities***
  - *through improved temporal sampling and spatial coverage*
- *Climate prediction:* ***improving climate prediction capability***
  - *through better understanding of precipitation microphysics, surface water fluxes, soil moisture storage, and latent heating*





GPM Applications & Validation

- *Applications - Making GPM data products and resources accessible to users and stakeholders beyond the traditional precipitation science community - by establishing broader and more effective use of space-based precipitation data products in decision-support of a wide variety of societal applications*
  - *Freshwater Utilization and Resource Management*
  - *Natural Hazard Monitoring/Prediction (Flood Warnings, Hurricane and Cyclone Observation, Winter Weather Events)*
  - *Operational Weather Forecasting*
  - *Climate Change Assessment*
  - *Agriculture*
  - *Transportation*
  - *Policy and Planning*

- *Validation - Ground Measurement Advisory Panel recommends:*
  - *Surface precipitation statistical validation sites for direct assessment of GPM satellite data products*
  - *Precipitation process sites for improving understanding of precipitation physics, modeling, and satellite retrieval algorithms*
  - *Integrated hydrological sites for improving hydrological applications*

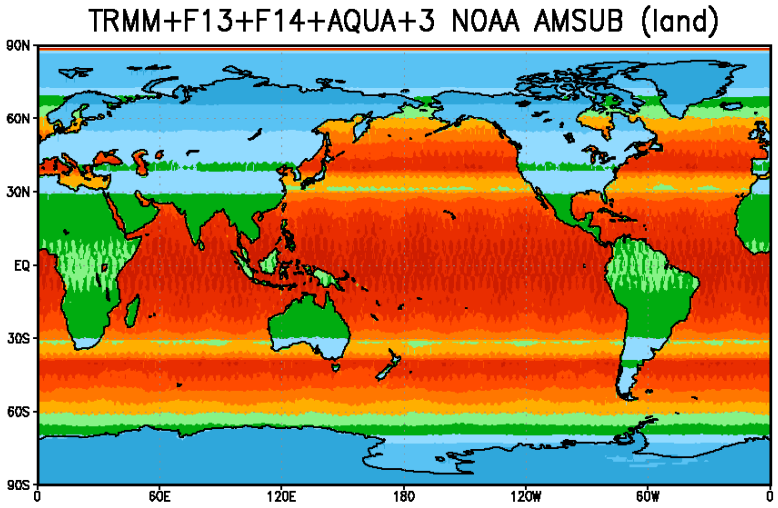
Constellation Revisit Time: GPM in 2014 vs. Current Capability

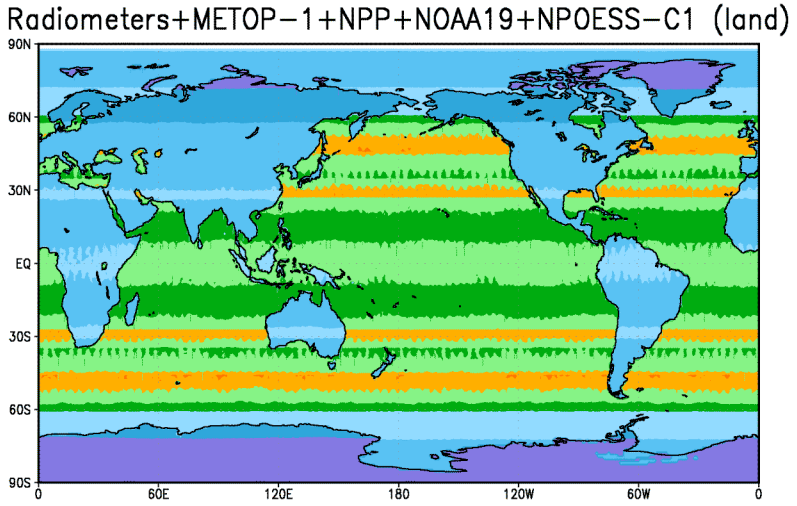
4 Conical-Scanning Imagers plus 3 Cross-track Sounders Over Land

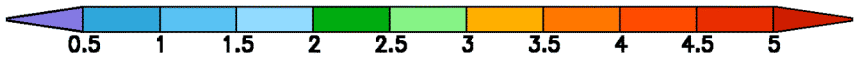
(≤ 3h over 45% of globe)

6 Conical-Scanning Imagers Plus 4 Cross-track Sounders Over Land

(≤ 3h over 92% of globe)







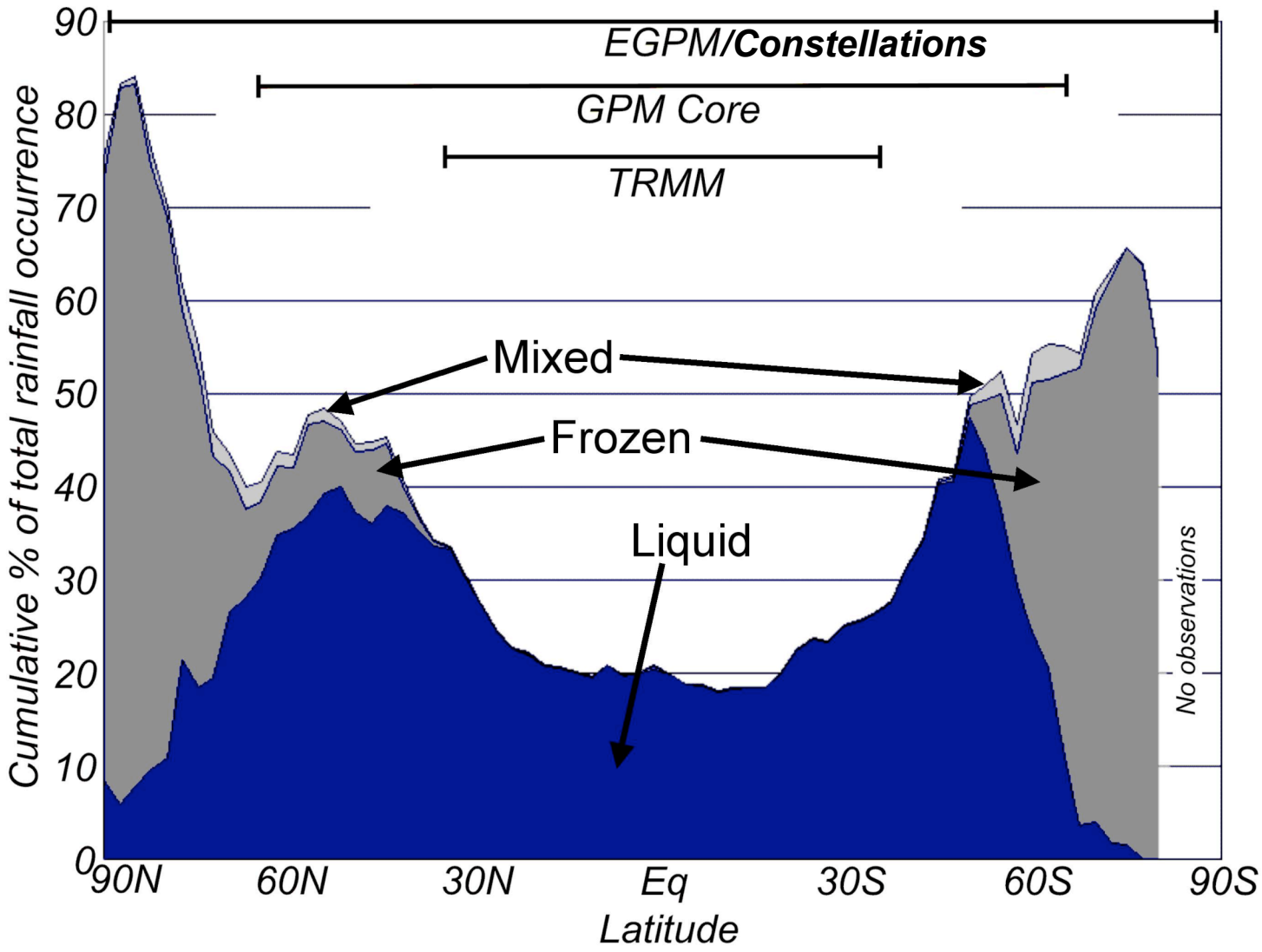
Hour

Lin & Hou (2006)

TMI, F13, F14, Aqua + 3 NOAA AMSU-B's over land

GPM Core, NASA-1(40º), F18, F19, GCOM-W, Megha-Tropiques + (MetOp-B, NPP, NOAA-N', & NPOESS-C1) over land

Precipitation regimes

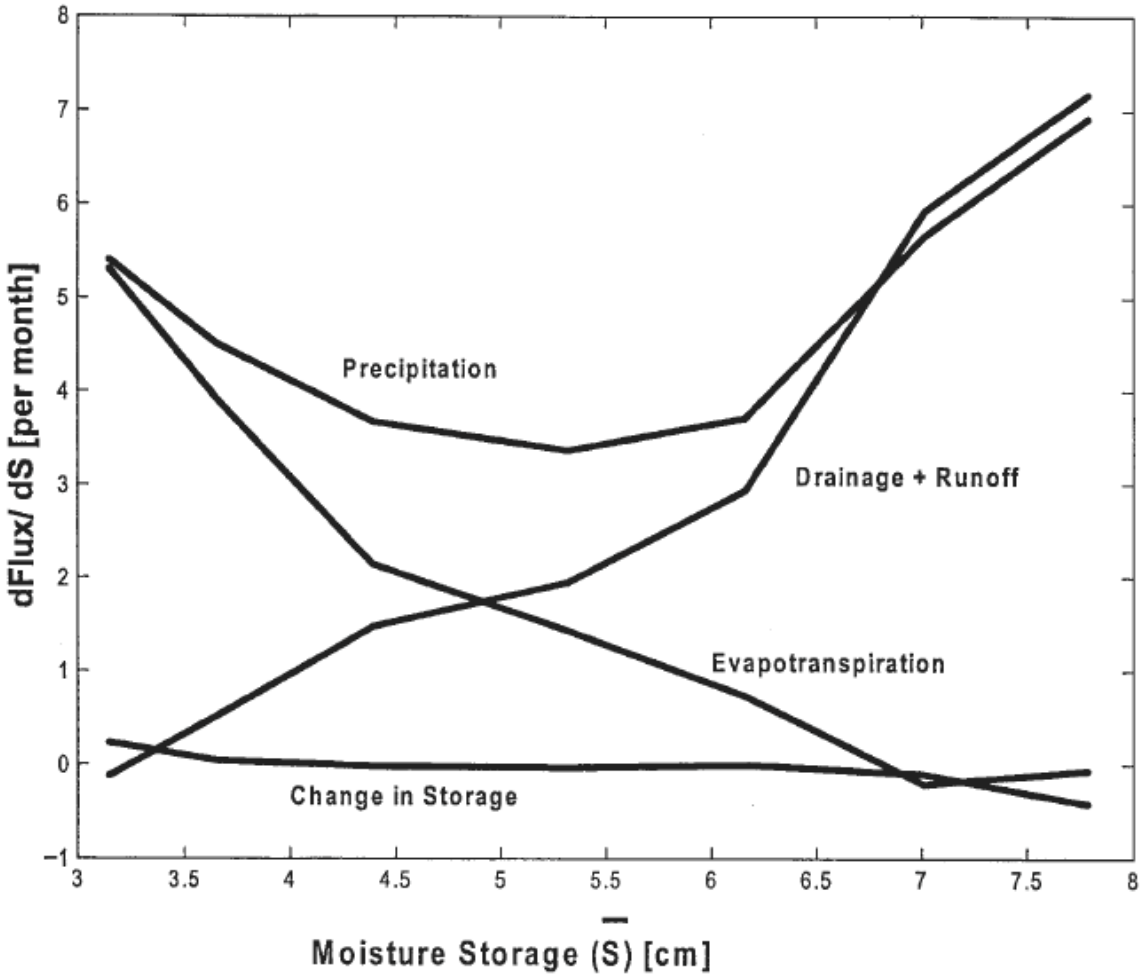


GPM-SMAP Synergy

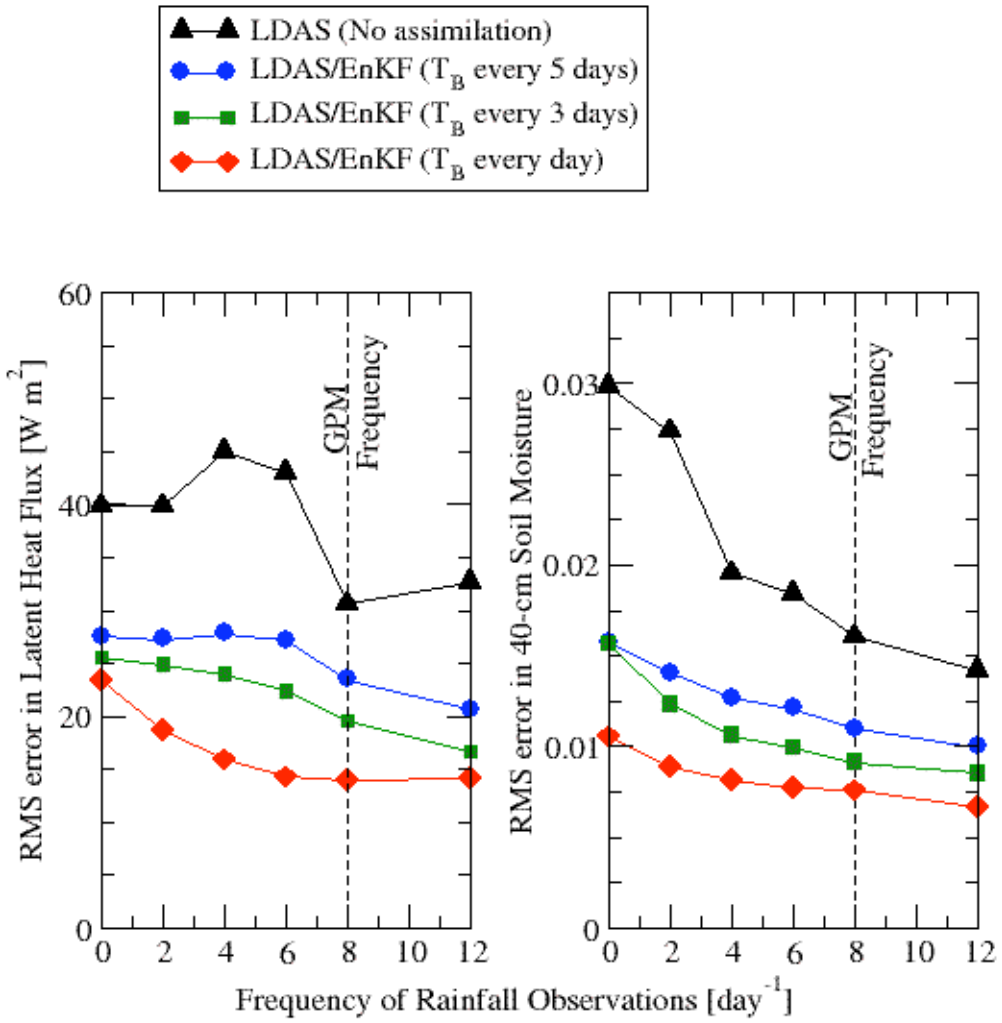
- *Understanding water and energy cycle linkages:*
  - *Non-parameterized estimation of closure function as in Salvucci, WRR, 2001*
- *Enhanced Land Surface Flux/State Forecasting:*
  - *SMAP Tb combined with GPM P should reduce flux/state errors as in Crow et al., EOS, 2006*
- *Enhanced Flood Forecasting:*
  - *SMAP Soil Moisture combined with GPM P should reduce flood forecasting errors as in Crow et al., 2005; Bindlish et al., 2007*
- *Independent Validation for GPM:*
  - *SMAP Soil Moisture assimilated into a simple model could provide an independent estimate of GPM errors in data-poor regions as in Crow and Bolten, 2007*
- *Improved surface emissivity characterization:*
  - *SMAP soil moisture, temperature and freeze/thaw products can improve representation of surface emissivities to help improve GPM PM retrievals. -*
- *GPM as a SMAP Input Source:*
  - *E.g., GMI 36.5GHz soil temperature and DPR Precipitation*

Understanding water and energy cycle linkages

Non-parameterized estimation of closure function as in Salvucci. WRR. 2001

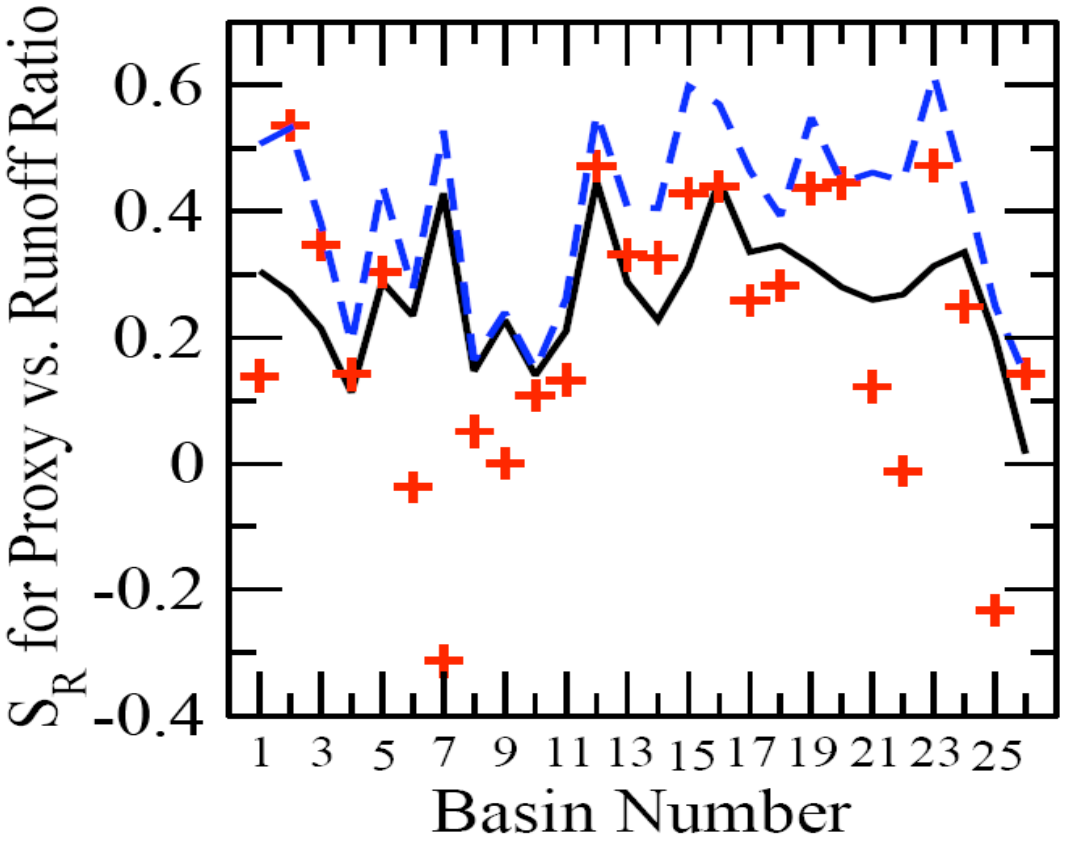


SMAP Tb combined with GPM P should reduce flux/state errors as in Crow et al., EOS, 2006



SMAP Soil Moisture combined with GPM P should reduce flood forecasting errors as in Crow et al., 2005; Bindlish et al., 2007

Red+=TMI only
Black=model only
Blue= assimilating TMI input model



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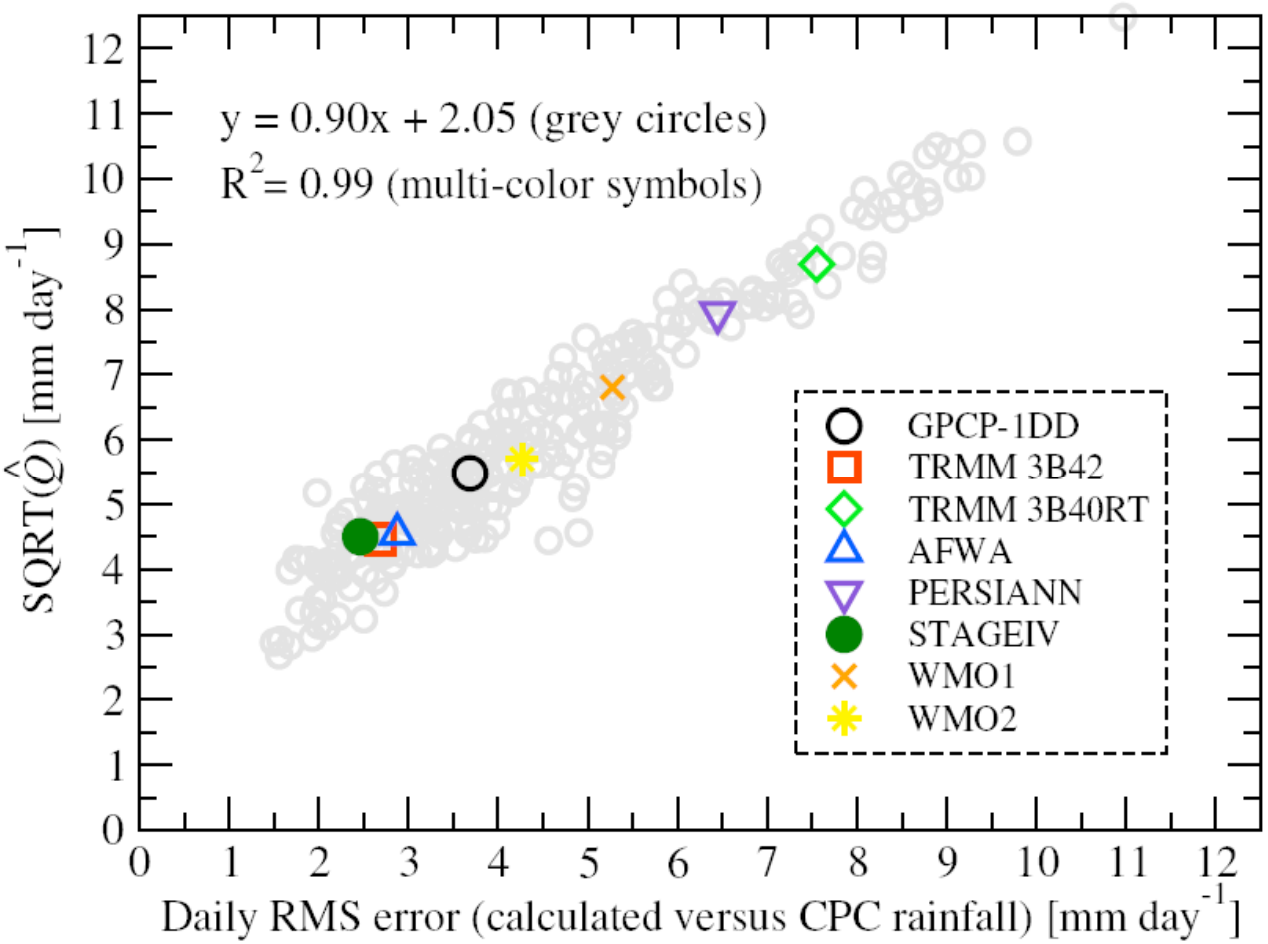
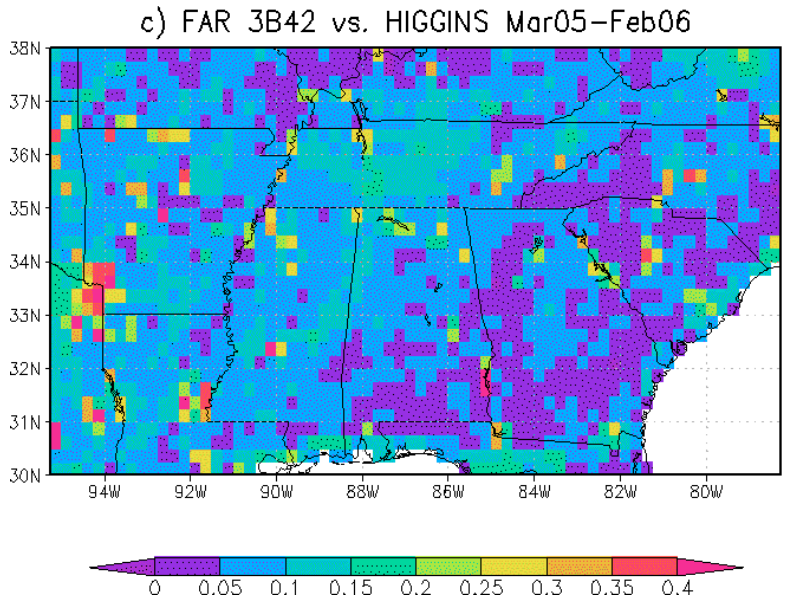
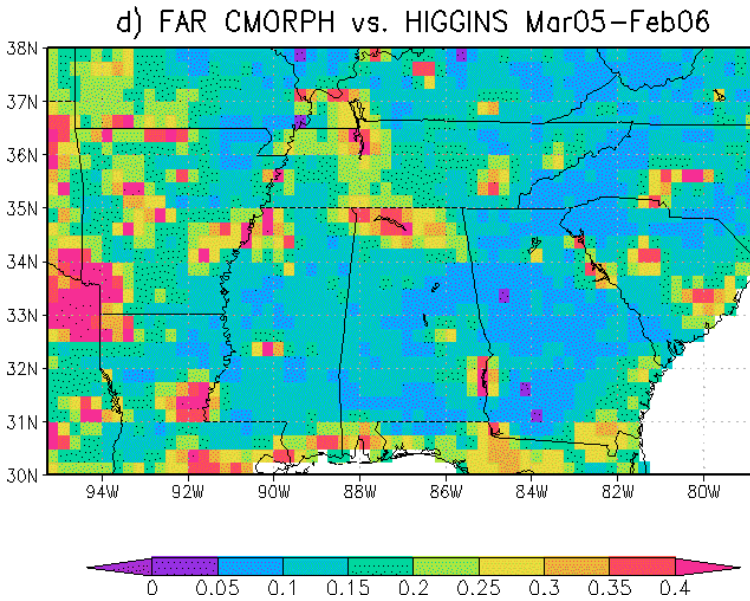
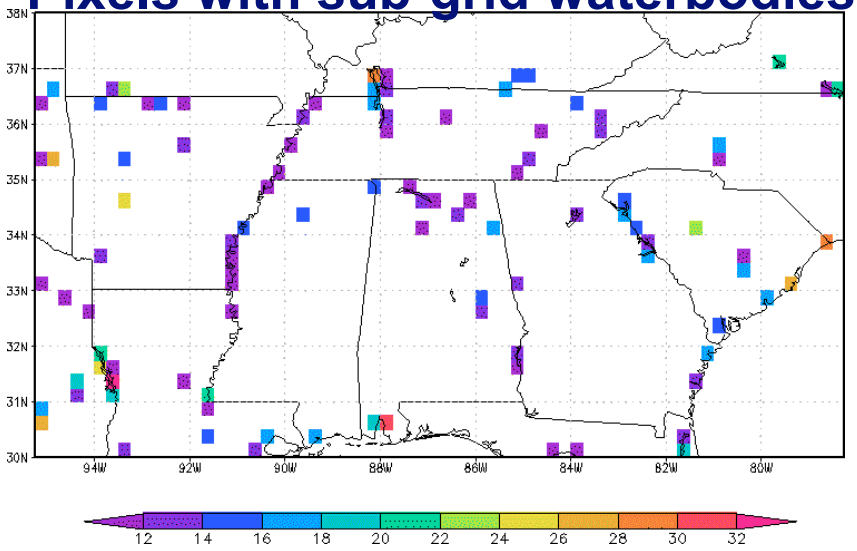


Sensitivity of Rainfall Retrievals to Surface Emissivity



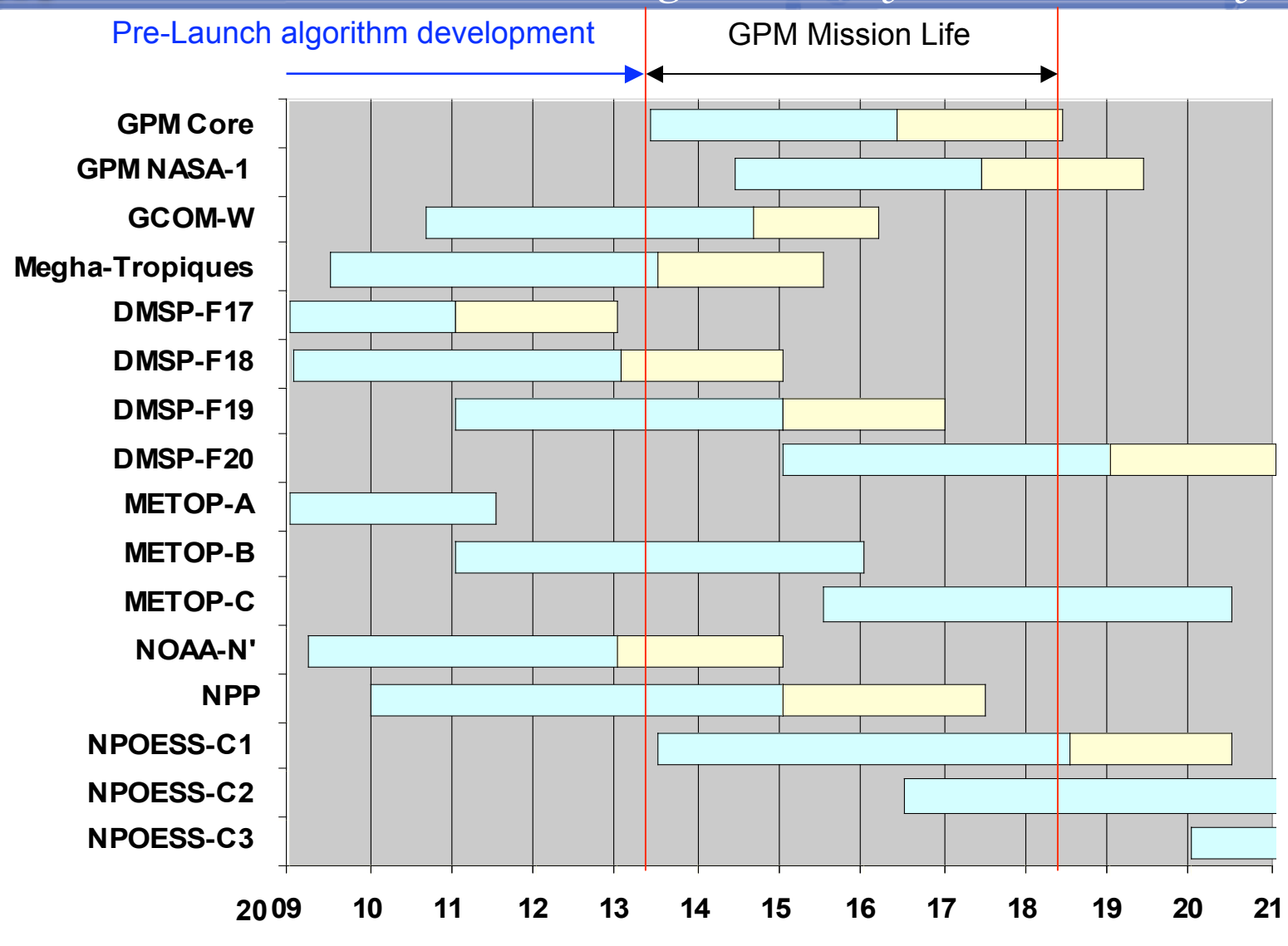


Pixels with sub-grid waterbodies



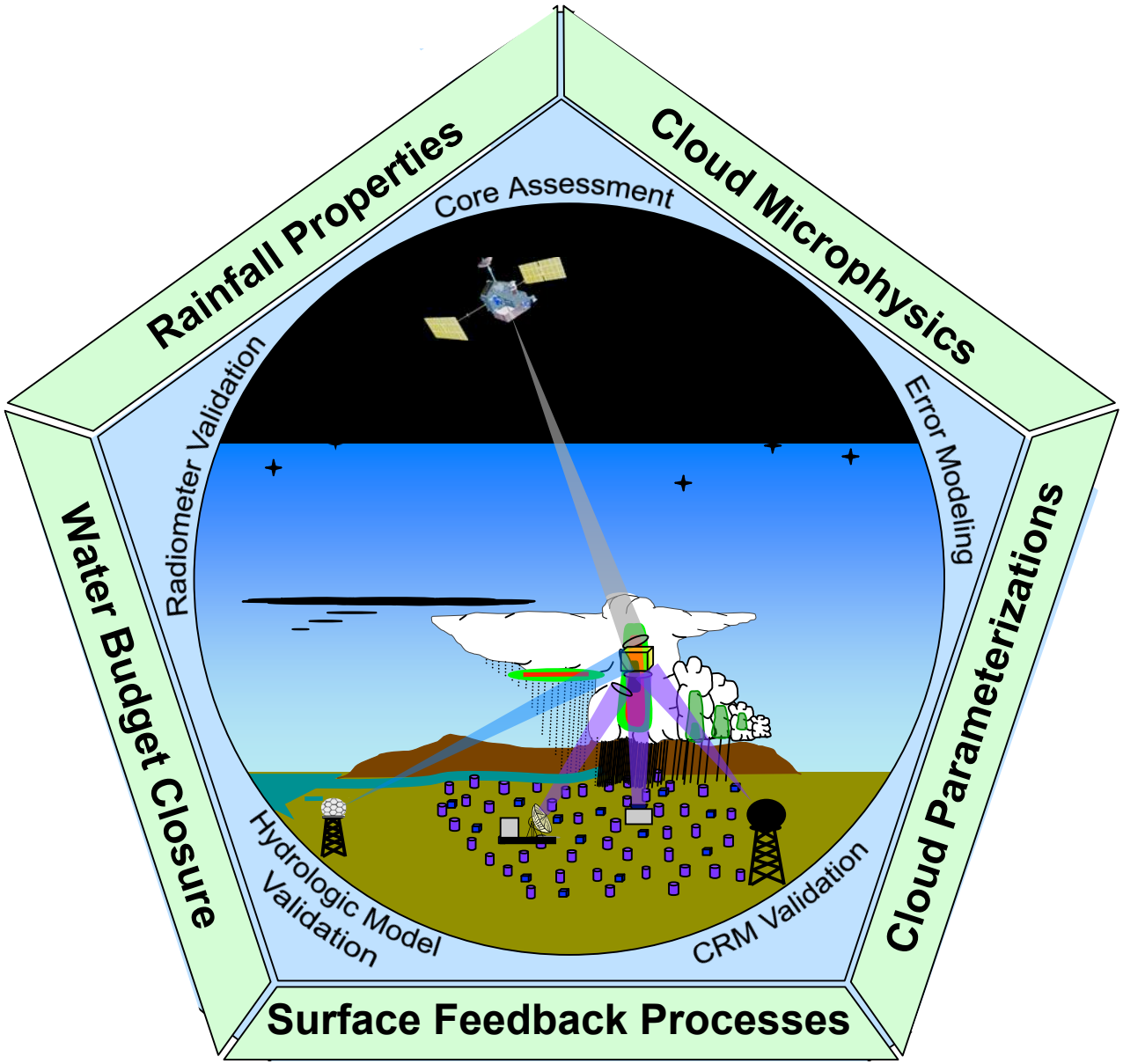
Tian and Peters-Lidard, GRL, 2007

Timing is the Key to Maximize Synergy



(based on currently available estimates)

GPM GV Goals Overlap Significantly with SMAP Goals



- *Backup slides*

Expected GPM Constellation Performance

	Average Revisit Time (hr)					Coverage of Revisit Times ≤ 3 hr (%)				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
	Land					Land				
Tropics	1.6	1.5	1.8	2.0	2.7	100	100	100	100	100
Extratropics	1.1	1.0	1.0	1.2	1.6	100	100	100	100	100
Globe	1.4	1.2	1.4	1.5	2.1	100	100	100	100	100
	Ocean					Ocean				
Tropics	3.1	2.5	3.9	4.9	6.6	54.2	93.4	0	0	0
Extratropics	3.2	2.6	2.6	3.3	4.8	37.0	78.0	78.0	30.1	0
Globe	3.1	2.5	3.3	4.1	5.8	46.5	86.9	37.4	14.4	0
	Land and Ocean					Land and Ocean				
Tropics	2.6	2.2	3.2	3.9	5.2	70.3	95.7	35.1	35.1	35.1
Extratropics	2.3	1.9	1.9	2.4	3.5	63.5	87.3	87.3	59.5	42.0
Globe	2.4	2.0	2.5	3.1	4.3	67.2	91.9	61.6	47.6	38.7

Constellation performance may be further enhanced with the additional partners (e.g. Brazil, China)

GMI Instantaneous Field-of-Views