PMM Science Status

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NASA Goddard Space Flight Center

2013 PMM Science Team Meeting, March 18-21, Annapolis, MD

Welcome & Congratulations

To the 2013-2015 PMM Science Team

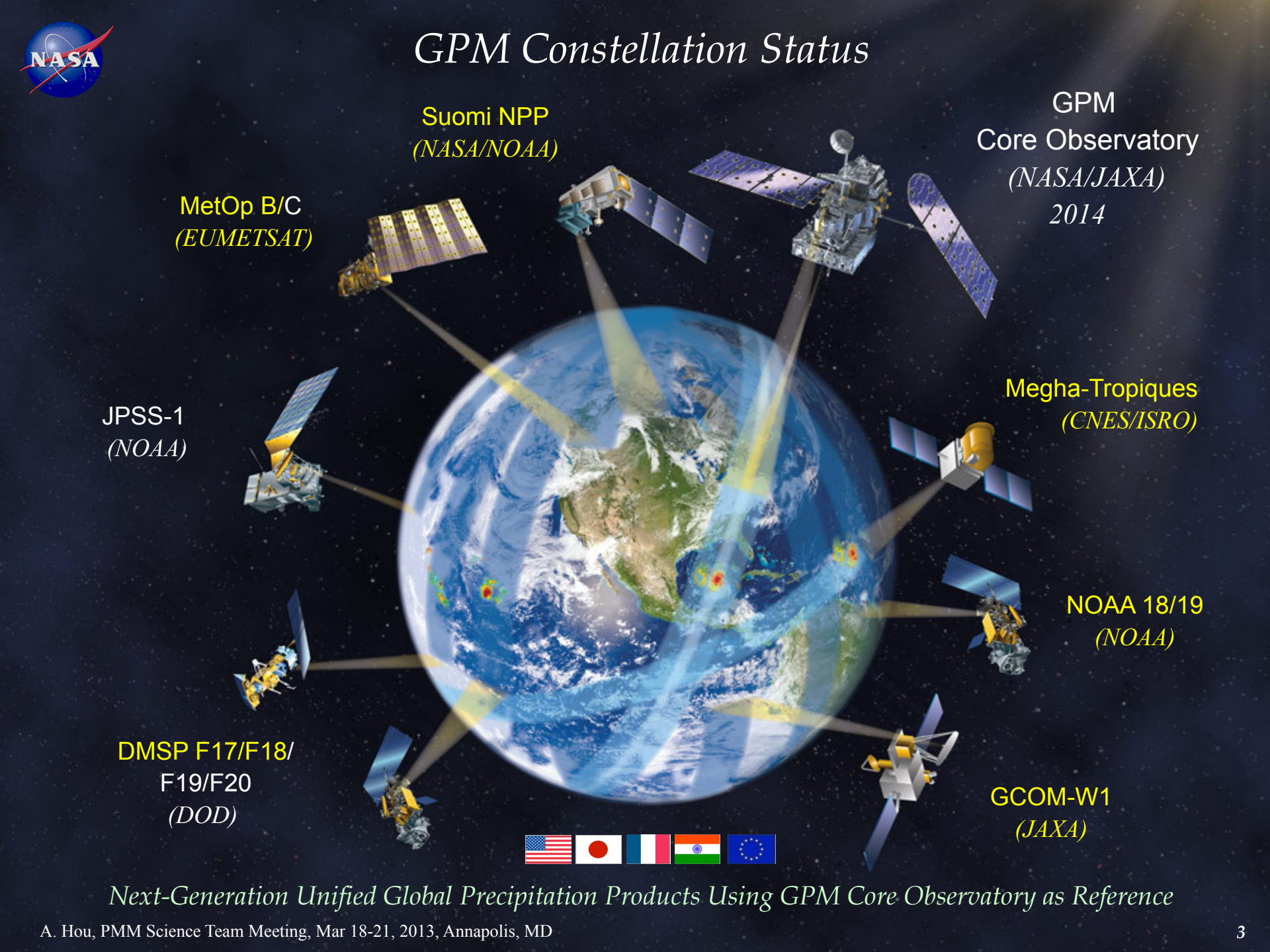
- New U.S. PI's:

  - Brian Colle (State University of New York, Stony Brook)
  - Yang Hong (University of Oklahoma, Norman)
  - Eugenia Kalnay (University of Maryland, College Park)
  - Clifford Mass (University of Washington)
  - Anita Rapp (Texas A&M University)
  - Carl Schreck (North Carolina State University)

- New international PI:

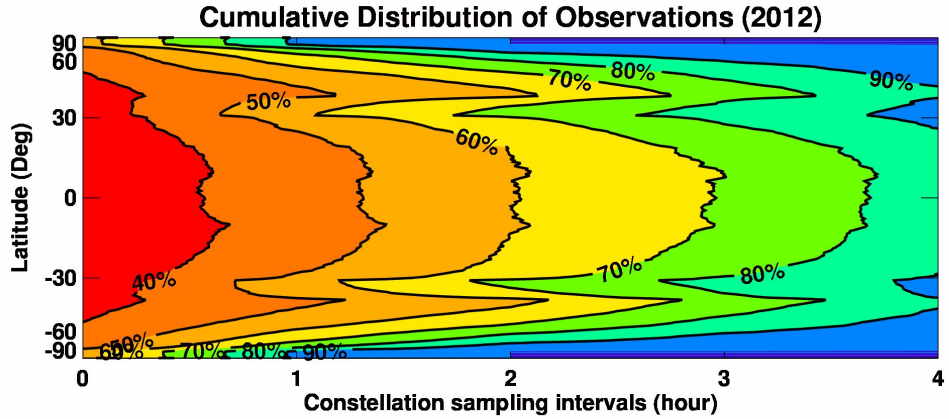
  - Alexis Berne (École Polytechnique Fédérale de Lausanne, Switzerland)

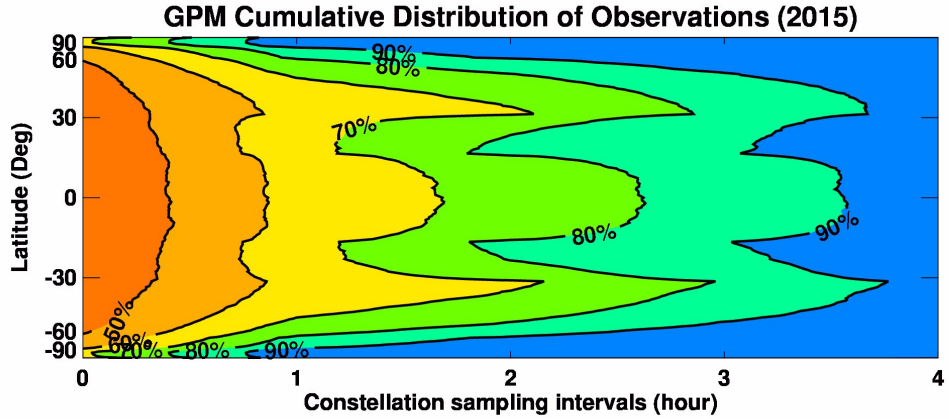
GPM Constellation Status

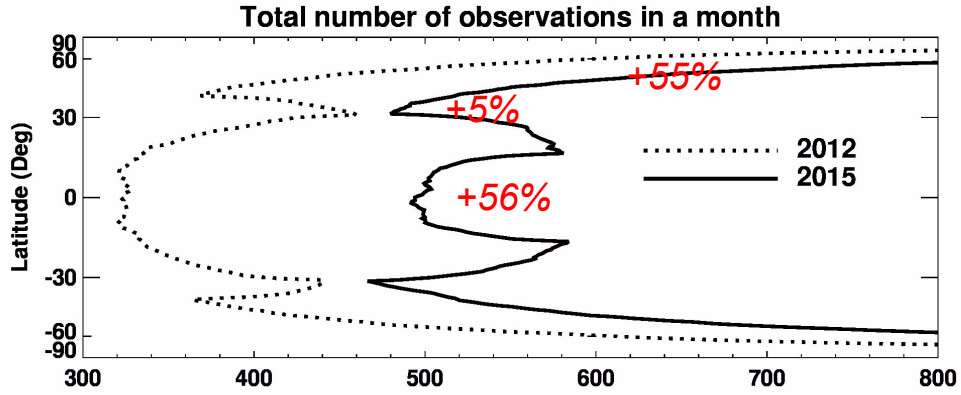


Next-Generation Unified Global Precipitation Products Using GPM Core Observatory as Reference

GPM Constellation Sampling Relative to Current Capability







Current (2012)

- Less than 50% of observations are less than 1 hr apart
- 70-80% are less than 3 hr apart

GPM (2015)

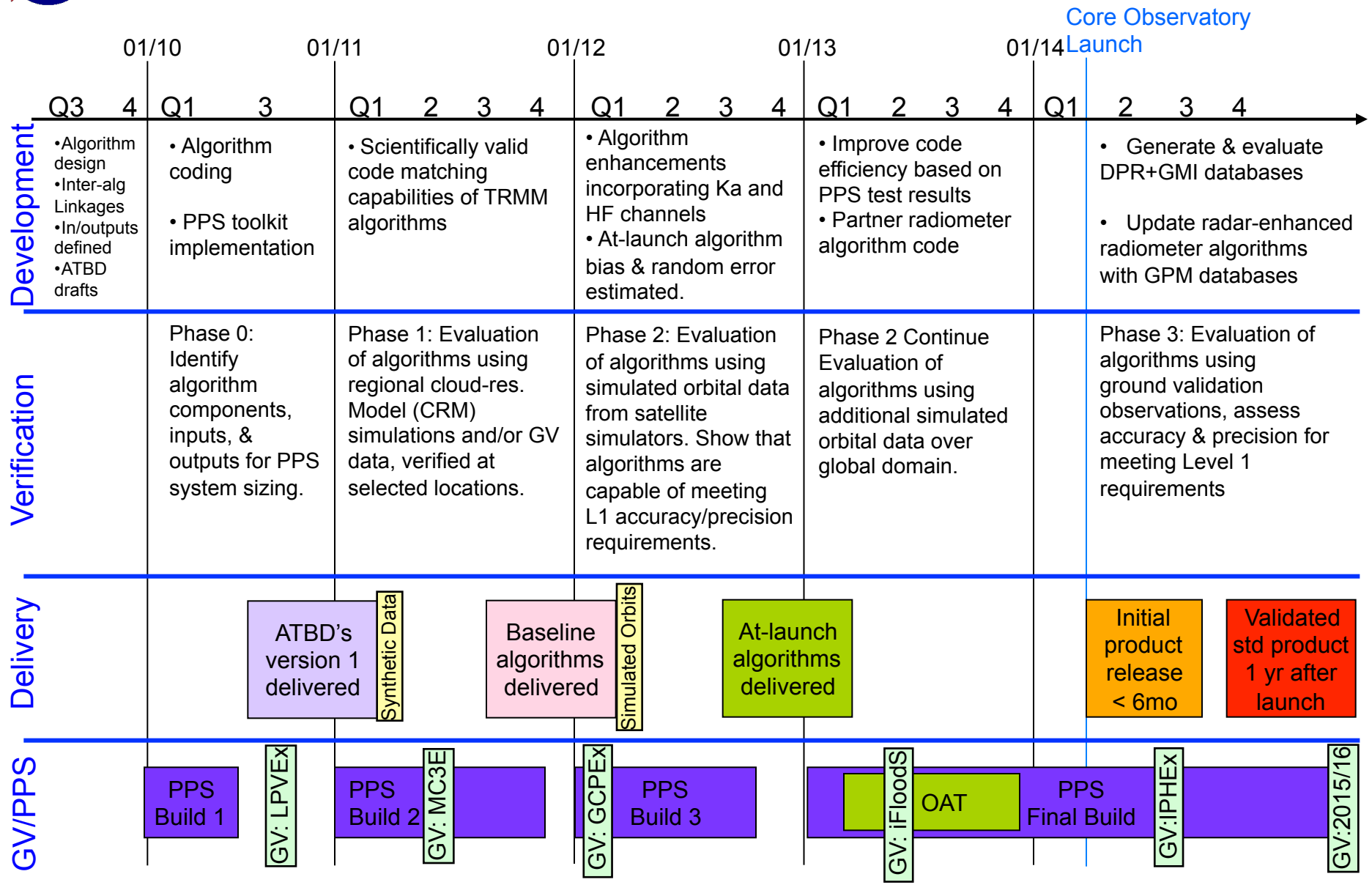
- More than 60% of observations less than 1 hr apart
- 80-90% are less than 3 hrs apart at all latitudes

- Greater number of observations relative to 2012

2012: TRMM, F16, F17, F18, NOAA-18, NOAA-19, MetOp-A

2015: GPM Core, F17, F18, F19, MT, GCOM-W1, NPP, NOAA-18, NOAA-19, MetOp-B

Integrated Schedule of PMM Science Development & Deliveries



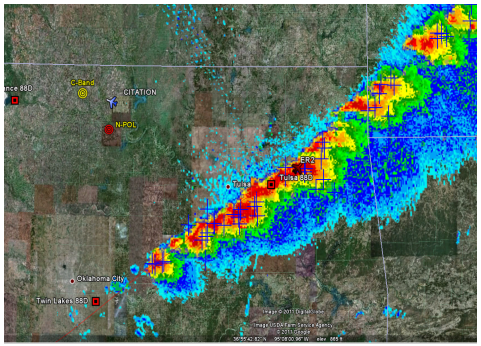
Progress in Ground Validation

- GV paradigm shifted from general physical process studies to focused science investigations guided by retrieval algorithm needs:
  - Traceability matrices linking GV measurements to algorithm parameters.
  - GV data beginning to contribute to algorithm development and testing.
- Moving beyond precipitation measurements to quantifying measurement uncertainties to better support modeling and merging algorithm development:
  - Error Characterization Demonstration Site at NASA Wallops Flight Facility.
  - Opportunities for additional sites.
- Community consensus on common measurement methodologies:
  - Shared software for comparing satellite and ground measurements.
  - Recommended calibration standards for post-launch validation sites. Radar scanning strategy under development.
- Growing international collaboration for evaluating and improving GPM algorithms and products worldwide:
  - 22 active PMM projects in 14 countries
  - International GV workshops hosted by GV partners (Next one in Rome, Nov. 2013).

Summary of GV Status

- Completed six successful campaigns for physical validation:
  - 2 major GPM field campaigns: MC3E (Apr-Jun 2011) & GCPEx (Jan-Feb 2012).
  - 2 leveraged partner campaigns: C3VP (Jan 2007) & LPVEx (Sep-Oct 2010).
  - Contributions to 2 partner efforts: Pre-CHUVA (Mar 2010) & HyMeX (Sep-Oct 2012).
  - ** Campaign data being used by algorithm developer and sat-simulator modelers.*
- Upcoming integrated hydrological validation campaigns:
  - Iowa Flood Studies (IFloodS): Apr-Jun 2013
  - Integrated Precipitation and Hydrology Experiment (IPHEX): May-Jun 2014
- Direct validation:
  - Established a Precipitation GV Research Facility at WFF, now fully operational.
  - Operational Validation Network (VN) providing ground radar and coincident satellite overpass data over CONUS. The VN software being used by international partners.
  - Automated NMQ rain rate data stream for L2/L3 product validation in testing phase.
  - ** NMQ database being used for radiometer algorithm development over land.*
- New international collaborations:
  - New agreement with Environment Canada to operate GV instruments at 3 Canadian WMO Solid Precipitation Inter-comparison Experiment (SPICE) sites.
  - New agreement with the Finnish Meteorological Institute to operate GV instruments at the Sodankyla Snowfall Observatory in northern Finland (~70N).
  - Implementation agreement with S. Korea on GV data exchange.
  - Pending collaboration with EUMETSAT H-SAF (H-SAF presentation Tue morning).

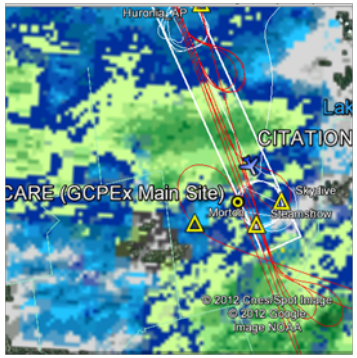
NASA-DOE MC3E (April 22 – June 6, 2011)


- 70 ER-2 and 45 Citation flight hours including 8 ER-2/Citation coordinated missions
- 3 ER-2 emissivity missions
- Citation microphysics and cloud missions
- Continuous sampling by 5-7 ground radars
- Launch of ~1200 radiosondes

NASA-EC GCPEx (January 17 – February 28, 2012)





- 80 ER-2, 40 Citation, 20 C580 flight hours with 3 triple aircraft missions
- 2 DC-8 emissivity missions
- Citation and C580 microphysics and cloud missions
- Continuous sampling by 4 ground radars (W, Ka/Ku, X, C-Band)
- 25 Events sampled

MC3E Algorithm-GV Traceability Matrix

Algorithm issues or assumptions	Applicable Measured and/or Diagnosed Parameters																
	Z	Z_{DFR}	R	PSD_{sfc}	PSD_{col}	PID	ρ_b	ρ_p	T	Q_v	Q_{soil}	CN CCN	TW_c	CW	IW	ε/σ_{sfc}	T_B
Path integrated attenuation approach(es)	◆	◆	◆	◆	◆	◆				◆			◆	◆		◆	
Hydrometeor Identification (3D)	◆	◆	◆	◆	◆	◆	◆		◆				◆	◆	◆		
Hydrometeor melting model	◆	◆			◆	◆	◆	◆	◆				◆		◆	◆	◆
Melting layer identification	◆	◆			◆	◆			◆						◆		
Convective/Stratiform partitioning	◆	◆	◆	◆	◆	◆											◆
Dual-Frequency rain rate retrieval	◆	◆	◆	◆	◆	◆										◆	
Near surface rain estimate/rain profile	◆	◆	◆	◆	◆	◆										◆	
Sub-pixel DSD and rain variability (correlation, errors, beam filling)	◆	◆	◆	◆	◆	◆											◆
DSD profile and "ε" adjustments	◆	◆	◆	◆	◆	◆											◆
Column/Land surface emission			◆						◆	◆	◆					◆	◆
Rain/no rain discrimination	◆	◆	◆	◆	◆	◆			◆	◆			◆	◆	◆	◆	◆
Ice particle vs. volume extinction	◆	◆			◆	◆	◆	◆	◆	◆					◆		◆
Cloud water profiles	◆	◆	◆						◆	◆		◆	◆	◆	◆		◆
Ice process, scattering, and rainfall	◆	◆	◆	◆	◆	◆	◆	◆					◆	◆	◆		◆
Regime controls on precipitation process	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆	◆	◆	◆	◆	◆
DSD Gamma-Triplet correlations	◆	◆	◆	◆	◆	◆							◆				
CRM/LSM Satellite Simulator Physics	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

MC3E GV measurements			Applicable Measured and/or Diagnosed Parameters																
	Instruments	Measurable	Z	Z_{DFR}	R	PSD_{sfc}	PSD_{col}	PID	ρ_b	ρ_p	T	Q_v	Q_{soil}	CN, CCN	TW_c	CW	IW	ε/σ_{sfc}	T_B
Ground Radar and Profiler	NPOL, DOE S/C/X Dual-Pol	Z, Vr, W, ZDR, Φ_{DP}, ρ_{hv}, LDR	☒		☒	☒	☒	☒											
	D3R Ka/Ku Dual-Pol	Z, Vr, DFR, W, ZDR, Φ_{DP}, ρ_{hv}, LDR	☒	☒	☒	☒	☒	☒											
	S/UHF Profiling	Z, Vr, W	☒		☒	☒	☒	☒											
	MRR K-band Profiling	Z, Vr, W	☒		☒	☒	☒	☒											
	Ka/W-band Radar	Spectra (Z, Vr)	☒		☒	☒										☒			☒
Ground Gauge and Radiometer	2DVD/Parsivel Array	DSD, shape, fall spd	☒		☒	☒		☒											
	Rain gauge array	Rain rate/accum			☒														
	Sounding Array	P, T, RH, wind									☒	☒							
	ADMIRARI Radiometer, MRR	T_B 19, 37 Z 24 GHz	☒		☒											☒			
	DOE/OK Surface Inst.	P,T,RH, soil moisture and aerosols			☒						☒	☒	☒	☒					
	AERI Radiometers	T/RH Profile									☒	☒							
	DOE Flux tower	Eddy fluxes (T,q,u)									☒	☒							
Aircraft	HIWRAP (Ka/Ku Radar)	Z, Vr, DFR, W, ZDR, Φ_{DP}, ρ_{hv}, LDR	☒	☒	☒		☒	☒										☒	
	CoSMIR (Radiometer)	T_B 37,89, 165.5,183 H/V															☒	☒	☒
	AMPR (Radiometer)	T_B 10,19,37,85 H/V															☒	☒	☒
	2D-C/CIP/2D-P, HVPS	Precip. Image	☒		☒		☒	☒	☒	☒					☒		☒		
	CDP	Cloud Water/Spectra														☒			
	Nevzorov	Total water							☒						☒	☒	☒		
	King Probe	Cloud water bulk														☒			
	Rosemount Icing Probe	Supercooled water														☒			
	CN/UHSAS	Aerosol spectra												☒					
	MAPIR Radiometer	T_B 1.4 GHz H/V									☒		☒						

Improving physical parameters in retrieval algorithms using campaign measurements

Campaign Data

+

Microphysics/EM Modelers (WGs!)

+

Algorithm Developers

=> *Algorithm Refinements*

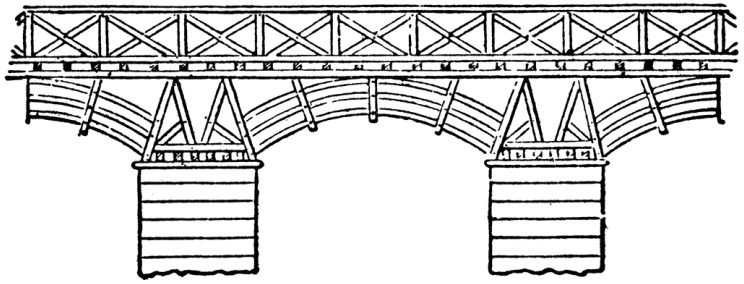
To 1st WG/team that improves algorithm performance using field campaign data

Special Recognition of Accomplishments Goes To:

The DSD Working Group and the Combined Algorithm Team

For progress in improving the Combined DPR+GMI Algorithm with better scattering tables and DSD covariance information derived from MC3E field campaign data

GV Data Algorithm



Algorithm Status

- GPM algorithm code delivery on schedule:
  - Baseline DPR, GMI, & Combined codes for L2 products delivered to PPS and MOS in Dec. 2011.
  - At-launch Sensor and iMERGE codes delivered in Nov.-Dec. 2012.
  - Additional code deliveries to PPS for End to End (ETE) Testing and Operational Acceptance Testing (OAT):
    - March 2013 – ETE#1 Incremental Code (GPM Core sensor algorithms)
    - September 2013 – ETE#3/OAT Incremental Code (final code)
- NASA-JAXA JPST algorithm reviews:
  - 3rd JPST algorithm panel review Friday morning, Mar. 22.
- Algorithm status reports (Wed afternoon):
  - Algorithm team meetings on Thursday, Mar 21.
- Radiometer intercalibration status update (Wed afternoon)

Education & Public Outreach Highlights

- Education:

  - Master Teachers Program to develop lesson plans for Middle School science classrooms focusing on GPM science themes.
  - Informal outdoor education by teachers in the Outdoor Environmental Education Program in Montgomery County.
  - Beta testing a new Student Ambassadors program for colleges students to develop materials, games, and hands-on activities to be used for workshops, conferences, and classroom visits.

- Outreach:

  - New GPM education website at http://pmm.nasa.gov/education
  - Social media: Twitter account @NASA_Rain and Facebook page @NASA.Rain
  - Contests: Completed 2 photo contests on "Extreme Weather" and "Let It Snow". "GPM Anime Character Challenge" contest underway for students (age 13+) and adults to develop anime character based on GPM science themes.
  - GPM Science On a Sphere (SOS) entitled "WATER FALLS" to be premiered in Oct. 2013.

Other Business

- GPM Science Implementation Plan available from URL:
  - https://webdrive.gsfc.nasa.gov/longauth/600/gail.s.jackson/uVPBBoC-launch
  - *Username:* SIPMarch2013, *Password:* SIPMarch2013
- Next X-cal WG meeting to be hosted by CNES/CNRS:
  - May 23-24, 2013, Toulouse, France.
- 6th International Workshop for GPM Ground Validation to be hosted by CNR/ISAC:
  - November 4-8, 2013, Rome, Italy.
- Science team newsletter: Contributions/feedback welcome