



April 13-14, 2010
SIT-25
Tokyo, Japan



Precipitation Constellation (PC)

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April 14, 2010

Progress Since SIT-24

- ✓ **Initiated study of the availability of conical scanning microwave imagers (MI)**
 - **For late-GPM Phase and the Post-GPM Phase**

- ✓ **Open source code made available for GPM prototype validation network data visualization/analysis**
 - **<http://opensource.gsfc.nasa.gov/projects/GPM/index.php>**

- ✓ **CNES/ISRO released joint Megha-Tropiques AO**

- ✓ **CNES/ISRO Megha-Tropiques/GPM cooperation**
 - **Preparing formal agreement**

- ✓ **EUMETSAT expressed interest in GPM cooperation**
 - **Will provide METOP MHS data**

- ✓ **INPE/CNES conducting joint GPM constellation satellite Phase 0 study**

- ✓ **Meetings/Workshops held**
 - **Precipitation Measuring Missions Science Team, October 26-29, 2009, Salt Lake City, UT, USA (NASA)**
 - **2nd Joint Precipitation Science Team Meeting, October 30, 2009, Salt Lake City, UT, USA (NASA, JAXA)**

Progress Since SIT-24 (cont.)

- **X-Calibration Working Group (WG) (in coordination with CGMS/GSICS)**
 - October 25, 2009, Salt Lake City, UT, USA
 - March 5-6, 2010, College Park, MD, USA
 - NASA, JAXA, CNES, ISRO, INPE, CONAE, NOAA, NRL, EUMETSAT, JMA, CMA, UKMET, Universities from the U.S. are participating
 - <http://www.gpm-x-cal.info/>

- ✓ **Meetings/Workshops in planning**
 - **3rd Joint Precipitation Science Team Meeting, April 19, 2010, Tokyo, Japan (NASA, JAXA)**
 - **JAXA Precipitation Measuring Missions Science Team Meeting, April 20-21, 2010, Tokyo, Japan, (JAXA)**
 - **4th GPM International Ground Validation Workshop, June 21-23, 2010, Helsinki, Finland (NASA, FMI, JAXA)**

- ✓ **CEOS Meetings/Workshops held**
 - **3rd Precipitation Constellation Workshop, October 29-30, 2009, Salt Lake City, UT, USA**
 - Finalized 2009-2010 plans
 - Discussed PC new directions
 - **23rd Plenary, November 3-5, 2009, Phuket, Thailand**
 - Provided PC status
 - **3rd CEOS-GEO Remapping Workshop, January 25-27, 2010, Arlington, VA, USA**
 - 4 new/extended PC CEOS proposed Actions submitted
 - 2 Category 1 and 2 Category 2 CEOS-GEO Actions assigned
 - **CEOS Climate Response to GCOS Workshop, January 27-18, 2010, Arlington, VA, USA**
 - Provided PC comments on GCOS IP-10
 - **WGCV-31, March 2-4, 2010, Potomac, MD**
 - Provided PC status and recommendations

Progress Since SIT-24 (cont.)

- ✓ Moving GPM from formulation to implementation phase at NASA and JAXA
 - ✓ GPM Ground System (NASA) SRR (2Q2009) COMPLETED
 - ✓ GPM GMI (NASA) CDR (2Q2009) COMPLETED
 - ✓ GPM DPR (JAXA) CDR (3Q2009) COMPLETED
 - ✓ GPM Ground System (NASA) PDR (4Q2009) COMPLETED
 - ✓ GPM Mission (NASA) KDP-C (4Q2009) COMPLETED
 - ✓ GPM Mission (NASA) CDR (4Q2009) COMPLETED

GPM officially confirmed and well into Phase C

Current/Future Challenges

- *Formalizing international agreements on GPM participation*
 - *Discussions within CEOS PC forums as appropriate*
 - *LIO partnership is new challenge*
- *Enhancing high-sensitivity light and solid precipitation measurement capability in polar latitudes*
 - *Discussions within CEOS PC forums as appropriate*
 - *Does ESA EE-8 represent an opportunity?*
- *Exploring opportunities to include additional space-based and ground assets from other nations to augment the next generation PC (e.g. the possible use of Russian or Chinese radiometers)*
 - *See Specific Agency Requests (SIT 22-7 and SIT 22-8 Actions)*
 - *PC recently made contact with Director of SRC PLANETA*
 - *CMA participating at working level in X-Calibration Working Group*
- *Continued support for open data sharing through CEOS and GEO*
 - *The PC supports the CEOS SIT in the development of a specific data sharing policy/philosophy not only for CEOS but also sanctioned by GEO.*
 - *NASA and JAXA working through the GPM Data Working Group (GDaWG) to promote to potential GPM participants the advantages of open data sharing for the next-generation PC.*



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Backup

Specific Agency Requests

- NRSCC/NSMC to identify PC POC and make available to the PC radiometer data from the recently launched FY-3 MWRI and MWHS imager and sounders
 - *Addressed in SIT 22-8 Action – No change in status*

- ROSHYDROMET to identify PC POC and make available to the PC radiometric data from the MTVZA sounder/imagers
 - *Addressed in SIT 22-7 Action – No change in status*

We continue to invite both organizations to PC-related meetings including The 3rd CEOS Precipitation Constellation Workshop (October 2009, Salt Lake City, Utah, USA) and the 8th GPM International Planning Workshop (June 2009, Paris, France)

CMA has been supporting the X-Cal Working Group at the working level

2010 Success Criteria

- From the *2009-2010 Precipitation Constellation Work Plan*:
 - Execute and complete the identified joint activities
 - Produce the identified deliverables from individual Precipitation Constellation members
- Joint Activities are in the following areas:
 - Mission Operation and Development - 13
 - Linkages to User Communities - 6
 - PC Framework - 7
 - Data exchange - 4
 - Cal/Val - 5
 - Algorithm and Products - 3
 - Meetings and Workshops - 1
- Individual Precipitation Constellation Deliverables fall under the following categories:
 - Hardware; Satellite, sensor, data-distribution systems - 10
 - Software; Algorithm development/improvement, data-processing, products - 11
 - Applications - 6
- Results will be reported in *2009-2010 Precipitation Constellation Accomplishments Report*

CEOS-GEO Actions

- ✓ **2009 CEOS-GEO Actions**
 - **Two designated CEOS-GEO Category-1 Actions COMPLETED**
 - AR-09-02a_20, AR-09-03d_9
 - **Two designated CEOS-GEO Category-2 Actions COMPLETED**
 - AR-09-02a_10, AR-09-02a_25
 - **One designated CEOS-GEO Category-2 Action DELETED (single CEOS Agency participation)**
 - AR-09-03d_8
 - **One designated CEOS-GEO Category-2 Action REMAPPED**
 - CL-06-01c_22

- ✓ **2010 CEOS-GEO Actions**
 - **Two NEW designated CEOS-GEO Category-1 Actions**
 - AR-09-02a_34, AR-09-03a_35
 - **Two NEW designated CEOS-GEO Category-2 Actions**
 - AR-09-02a_36, CL-09-02b_3

2010 Category 1 & 2 Actions

AR-09-02a_34 Continue progress in instrument and spacecraft manufacturing and testing for GPM implementation, advancing GPM science algorithms through ground validation experiments, and partnership building with space agencies to contribute additional microwave sensors and satellites to the GPM constellation.

AR-09-02a_35 Continue TRMM operations through 2010. Complete 13 years of TRMM 3-hr, multi-satellite standard products (TMPA, 3B42).

AR-09-02a_36 Conduct study of the availability of conical scanning microwave imagers (MI) in the late-GPM Phase and the Post-GPM Phase of the Precipitation Constellation.

CL-09-02b_3 Evaluate and implement improved TRMM algorithm

- Implement Version 7 of the TRMM standard algorithms
- Reprocessing and public release of the Version 7 standard products

Goals of the Precipitation Constellation

To establish an international framework to guide, facilitate, and coordinate the continued advancements of multi-satellite global precipitation missions

- 1) To provide a framework for implementation and monitoring of GEO task AR-06-10

Advocate and facilitate the timely implementation of the Global Precipitation Measurement (GPM) mission and encourage more nations to contribute to the GPM constellation

- 2) To sustain and enhance an accurate and timely global precipitation data record including a Fundamental Climate Data Record essential for understanding the integrated weather/climate/ecological system, managing freshwater resources, and monitoring and predicting high-impact natural hazard events.

This data record should be fit for the purpose specified by GCOS for the monitoring of Precipitation as an essential climate variable (ECV) (as defined in the recent GCOS document 'Systematic Observation Requirements for Satellite-based Products for Climate')

Implementation

- The implementation of CEOS PC is in four phases

year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
phase	study phase	GPM preparatory phase					GPM phase					post -GPM phase	
							<div style="border: 1px dashed black; padding: 10px; width: fit-content; margin: 0 auto;">GPM</div>						

Participation

- CEOS SIT Liaison:
 - USA - NOAA: Mary Kicza, Mary.Kicza@noaa.gov
- Study Lead Agencies:
 - Japan – JAXA: Riko Oki, oki.riko@jaxa.jp & USA – NASA: Steven Neeck, steven.neeck@nasa.gov
- Space Agency Participants:
 - France - CNES: Didier Renaut, didier.renaut@cnes.fr
 - India - ISRO: V. Hegde, vshegde@isro.gov.in
 - Brazil - INPE: Carlos Frederico Angelis, angelis@cptec.inpe.br
 - Europe - ESA: Einar-Arland Herland, einar-arland.herland@esa.int
 - China - CAST/NRSCC: contacted
 - Russia – ROSHYDROMET: contacted
 - USA - NOAA: Ralph Ferraro, ralph.r.ferraro@noaa.gov
 - USA - Naval Research Laboratory: Ian Adams, ian.adams@nrl.navy.mil
 - Europe - EUMETSAT: Johannes Schmetz, Johannes.Schmetz@eumetsat.int
 - Germany - DLR: Martin Hagen, martin.hagen@dlr.de
 - Canada - Canadian Space Agency: David Kendall, Dave.Kendall@space.gc.ca

Participation (cont.)

- User Community Representatives:
 - CGMS-IPWG: George Huffman, george.j.huffman@nasa.gov
 - GEWEX: Chris Kummerow, kummerow@atmos.colostate.edu
 - WCRP/IGWCO: Rick Lawford, lawford@umbc.edu
 - GCOS: Paul Mason, p.j.mason@reading.ac.uk
 - Peter Bauer, Peter.Bauer@ecmwf.int
 - Phil Arkin, parkin@essic.umd.edu

U.S. Study Team

- Steven Neeck/NASA HQ
- Ramesh Kakar/NASA HQ
- Arthur Hou/NASA GSFC
- Bob Adler/ UMBC
- Erich Stocker/NASA GSFC (SEO POC)
- Scott Braun/NASA GSFC (Visualization POC)
- Ralph Ferraro/NOAA
- Joe Turk/JPL
- Ian Adams/NRL
- Chris Kummerow/Colorado State University

Japan Study Team

- Riko Oki, JAXA
- Masahiro Kojima, JAXA
- Kinji Furukawa, JAXA (SEO POC)
- Keizo Nakagawa, JAXA
- Misako Kachi, JAXA (Visualization POC)
- Toshiaki Takeshima, JAXA
- Kengo Aizawa, JAXA
- Keiji Imaoka, JAXA
- Kazuo Umezawa, JAXA
- Kenji Nakamura, Nagoya University
- Toshio Iguchi, NICT
- Ken'ichi Okamoto, Osaka Prefecture University
- Toshio Koike, University of Tokyo
- Jun Matsumoto, Tokyo Metropolitan University
- Kazuhiko Fukami Public Works Research Institute
- Yoshiaki Takeuchi, Japan Meteorological Agency
- Yoshiyuki Chihara, Ministry of Education, Culture, Sports, Science and Technology

Action: AR-09-02a_20 Description

Status: **CLOSED**

Action: AR-09-02a_20

Category #: 1

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck

Due Date: 1/6/2009

Participating Organizations: NASA, JAXA, CNES, ISRO, INPE, ESA, CAST/NRSCC, NOAA, NRL, EUMETSAT, DLR, CSA, Universities from the U.S. and Asia (Korea)

Participating CEOS groups: PC, WGCV (invited)

Action Description

- Improved PC radiometer intercalibration through new methodologies developed by the Precipitation Measurement Missions (PMM) Science Team intercalibration working group in coordination with the CGMS/GSICS.
 - Implement improved correction algorithm developed in initial phase of the first intercalibration study (see DA-07-03_1) for TRMM Level 1B brightness temperature product (May 30, 2009)

Action: AR-09-02a_20 Status

- Precipitation Measurement Missions (PMM) Science Team intercalibration working group developed radiometer correction software based on sun angle information provided by the Precipitation Processing System (PPS) project. PPS has implemented this improved intercalibration technique as part of the TRMM Version 7 standard algorithms development.

Action: AR-09-03d_9 Description

Status: **CLOSED**

Action: AR-09-03d_9

Category #: 1

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck

Due Date: 2/1/2009

Participating Organizations: NASA

Participating CEOS groups: PC

Action Description

- Production of Merged TRMM Multi-satellite Precipitation Products.
- Make the Version 6 merged realtime algorithm the production version.

Action: AR-09-03d_9 Status

- Version 6 development and testing completed. Switch over to production version implemented and products available for users at <ftp://trmmopen.gsfc.nasa.gov/pub/merged>

Action: AR-09-02a_10 Description

Status: **CLOSED**

Action: AR-09-02a_10

Category #: 2

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 31/12/2009

Participating Organizations: NASA, JAXA

Participating CEOS groups: PC

Action Description

- Continued progress on moving the Global Precipitation Measurement (GPM) mission from formulation to implementation phase at NASA and JAXA.
- Major near-term milestones are:
 - GPM Core Spacecraft/Mission (NASA) PDR (4Q2008)
 - GPM GMI (NASA) CDR (2Q2009)
 - 8th GPM International Planning Workshop (NASA, JAXA, CNES) (2Q2009)
 - GPM DPR (JAXA) CDR (4Q2009)
 - GPM Mission (NASA) Confirmation (4Q2009)
 - GPM Mission (NASA) CDR (4Q2009)

Action: AR-09-02a_10 Status

- All major near-term milestones have been completed:
 - GPM Core Spacecraft/Mission (NASA) PDR
 - GPM GMI (NASA) CDR (2Q2009)
 - 8th GPM International Planning Workshop (NASA, JAXA, CNES) (2Q2009)
 - GPM DPR (JAXA) CDR (4Q2009)
 - GPM Mission (NASA) Confirmation (4Q2009)
 - GPM Mission (NASA) CDR (4Q2009)

Action: AR-09-02a_25 Description

Status: **CLOSED**

Action: AR-09-02a_25

Category #: 2

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 31/12/2009

Participating Organizations: NASA, JAXA

Participating CEOS groups: PC

Action Description

- Continue TRMM operations through 2009. Action is necessary to support GPM Preparatory Phase of PC.
- Complete of 12 years of TRMM 3-hr, multi-satellite standard products (TMPA, 3B42).

Action: AR-09-02a_25 Status

- TRMM flight operations and data processing fully funded through September 2009 (preliminarily through September 2011). Precipitation Radar operations restored following switch to redundant electronics. Spacecraft and instruments in good health with robust consumables. NASA Senior Review approved TRMM operations extension to 2010-2013. TRMM operations through 2009 completed. Completed 12 years of TRMM 3-hr, multi-satellite standard products (TMPA, 3B42).

Action: AR-09-02a_34 Description

Status: **OPEN**

Action: AR-09-02a_34

Category #: 1

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 31/12/2010

Participating Organizations: NASA, JAXA, NOAA, EUMETSAT, INPE, CNES, ISRO

Participating CEOS groups: PC

Action Description

- Continue progress in instrument and spacecraft manufacturing and testing for GPM implementation, advancing GPM science algorithms through ground validation experiments, and partnership building with space agencies to contribute additional microwave sensors and satellites to the GPM constellation. Action is necessary to realize GPM Phase of Precipitation Constellation.
- Major near-term milestones are:
 - Complete Pre-CHUVA Ground Validation experiment (NASA, INPE)(1Q2010)
 - Complete GMI-2 Delta-CDR (NASA)(2Q2010)
 - Complete Ground System CDR (NASA)(2Q2010)
 - Complete Core Spacecraft subsystem ETU testing and Manufacturing Readiness Reviews (NASA)(2Q2010)
 - Complete LPVEX Ground Validation experiment (NASA, FMI)(3Q2010)
 - Fabricate and test Core Spacecraft subsystems (NASA)(4Q2010)
 - Fabricate, integrate, and prepare GMI-1 for testing (NASA)(4Q2010)
 - Fabricate, integrate, and test KuPR and KaPR PFM's (JAXA)(4Q2010)
 - Develop and implement a NASA-CNES-ISRO agreement on Megha Tropiques-GPM cooperation (4Q2010)
 - Develop and implement a NASA-INPE agreement on GPM cooperation (4Q2010)

Action: AR-09-02a_34 Status

- Pre-CHUVA Ground Validation experiment (NASA, INPE) completed (April 2010).

Action: AR-09-02a_35 Description

Status: **OPEN**

Action: AR-09-02a_35

Category #: 1

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 31/12/2010

Participating Organizations: NASA, JAXA

Participating CEOS groups: PC

Action Description

- Continue TRMM operations through 2010. Action is necessary to support GPM Preparatory Phase of PC.
- Complete 13 years of TRMM 3-hr, multi-satellite standard products (TMPA, 3B42).

Action: AR-09-02a_35 Status

- TRMM flight operations and data processing fully funded through September 2011 (preliminarily through September 2013). Spacecraft and instruments in good health with robust consumables (April 2010).

Action: AR-09-02a_36 Description

Status: **OPEN**

Action: AR-09-02a_36

Category #: 2

Primary SBA Area: Transverse

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 31/12/2010

Participating Organizations: NASA, JAXA, NOAA, EUMETSAT

Participating CEOS groups: PC

Action Description

- Conduct study of the availability of conical scanning microwave imagers (MI) in the late-GPM Phase and the Post-GPM Phase of the Precipitation Constellation

Action: AR-09-02a_36 Status

- Draft outline of study plan, schedule, and proposed division of work prepared (April 2010).

Action: CL-09-02b_3 Description

Status: **OPEN**

Action: CL-09-02b_3

Category #: 2

Primary SBA Area: Climate

NASA Point of Contact: Steven Neeck, Riko Oki

Due Date: 1/4/2010

Participating Organizations: NASA, JAXA

Participating CEOS groups: PC

Action Description

- Evaluate and implement improved TRMM algorithm
 - Implement Version 7 of the TRMM standard algorithms (June 1, 2010)
 - Reprocessing and public release of the Version 7 standard products (July 1, 2010)

Action: CL-09-02b_3 Status

- Version 7 algorithm in development (January 2009). Rescheduled deliverable milestones to reflect delays in getting final algorithm from code developers. Using test code as workaround. Some impact from Precipitation Radar anomaly (October 2009). Completed multi-month run of Version 7 in test mode (December 2009). Began Version 7 Operational Acceptance Testing (January 2010). Operational Acceptance Testing continues. Team revised milestones to permit more thorough analysis of test data (April 2010).

PC Approach

- Develop a consistent framework to produce inter-calibrated precipitation sensor measurements and retrieval products
- Identify key points of agreement for space agency co-operation in order to meet the needs of both the data producer and user communities
- Results-focused, identifying what steps are necessary by space agencies (and other groups responsible for product generation, in-situ observations etc) to develop the constellation data sets and information services. CEOS PC should also encourage the development and evaluation of precipitation products produced from the constellation data. This should include inter-comparisons and validation against high quality ground data.
- Recognize the Constellation member's national plans for implementing their respective Earth observing programs (e.g. the U.S. Decadal Survey).
- Have strong collaboration with the CEOS Working Group on Calibration and Validation (WGCV) and the CEOS Working Group on Information Systems and Services (WGISS)

Progress Since 21st CEOS Plenary (cont.)

- ✓ **CEOS SIT-21**
 - Presented PC status, 2008 success criteria

- ✓ **2nd CEOS Precipitation Constellation Workshop, June 5-6, Tokyo, Japan (JAXA)**
 - Hosted by JAXA
 - 30 participants, including CEOS Agencies and user community representatives

- ✓ **Moving GPM from formulation to implementation phase at NASA and JAXA**
 - GPM DPR (JAXA) PDR (1Q2008) **COMPLETED**
 - GPM DPR (JAXA) Delta PDR (2Q2008) **COMPLETED**
 - GPM Mission (NASA) PDR (4Q2008)
 - GPM Mission (NASA) KDP-C (1Q2009)

- ✓ **Future plans finalized**
 - CEOS PC Implementation Plan
 - CEOS PC 2008 Work Plan

- ✓ **Meetings/Workshops held**
 - Regional Workshop on Tropical Cyclone Research, May 26-30, La Reunion (CNES, CNRS, Meteo-France, Eumetsat, WMO)
 - 2nd GPM Asia Workshop, June 2-4, Hamamatsu (JAXA, NASA)
 - Precipitation Measuring Missions Science Team, August 4-5, Fort Collins, CO, USA (NASA)