

Precipitation Constellation (PC)

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WGCV-36

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Background: The CEOS Precipitation Constellation was established in 2007 with the participation of seven CEOS members as one of the four prototype CEOS Constellations.

Purpose: Its primary role is to establish an international framework to guide, facilitate, and coordinate the continued advancement of multi-satellite global precipitation missions.

1. To provide a framework for implementation and monitoring of GEO task AR-06-10 (subsequently merged into DA-07-03, AR-09-02, IN-01-C2).

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)



CEOS PC is unique in having:

1. An existing constellation of precipitation sensors using TRMM as a reference for providing multiple merged multi-satellite global precipitation products for research and applications,
2. An international constellation satellite mission in implementation, the Global Precipitation Measurement (GPM) mission envisioned to be a realization of the CEOS PC to be launched in early 2014, which includes other existing and planned missions capable of observing precipitation like the recently launched S-NPP, Megha-Tropiques, GCOM-W1, and MetOp-B satellites.



- The implementation of CEOS PC is in four phases

year	2007	2008	2009	2010	2011	2012-2013	2014	2015	2016	2017	2018	2019	2020
phase	study phase	GPM preparatory phase					GPM phase					post -GPM phase	
							<div style="border: 1px dashed black; padding: 10px; text-align: center;"> GPM </div>						

PC Phase Descriptions

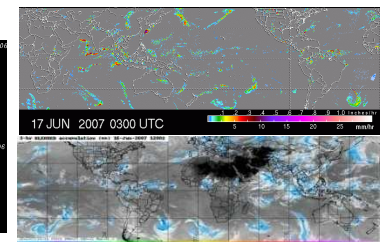
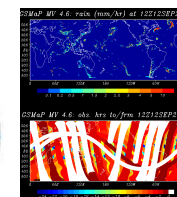
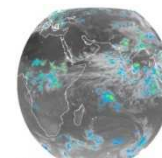
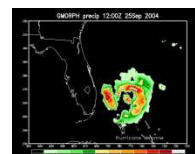
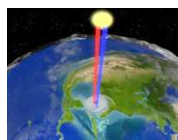


- **Study Phase (2007)**
 - Startup activities and survey existing PC member multi-satellite products: NASA TRMM 3B42, JAXA GSMaP, NOAA CMORPH/QMORPH, NRL-Blend SRE, EUMETSAT MPE

- **GPM preparatory phase (2008-2013)**
 - Comparison of different methods of inter-calibration for generating uniform precipitation estimates from diverse types of precipitation sensors
 - Evaluation of different multi-sensor precipitation products
 - The prototyping of uses of merged data products from multiple sensors as well as evaluation of tools to support such use

- **GPM phase (2014-2018)**
 - Launch and operation of GPM, the first constellation-focused mission that will improve precipitation estimates through extensive intercalibration and the use of a reference standard

- **Post-GPM phase (after 2018)**
 - Beyond timeframe of GEOSS 10-Year Implementation Plan
 - Lessons learned from GPM and other PC activities will serve to guide the planning and further evolution of CEOS PC





- **PC Data Portal with links to CEOS Water Portal**
 - Completion of First Phase “link only” interface – March 2013
 - Planning/study for and implementation of Second Phase “query/results/order based” interface – May 2013 to December 2014

- **Precipitation ECV support – Response to GCOS Action A-8 - *Ensure continuity of satellite precipitation products***
 - Deliverables #1, #2, #3, #4, #5 (see next page for details)

- **Deployment of GPM phase constellation satellites and maintaining continuity with TRMM**



○ Deliverables

1. Sustainment and enhancement of constellation of satellites carrying microwave radiometers (both imagers and sounders) and moderate inclination satellite carrying microwave imager and precipitation radar.
2. Well characterized and stable Level 1B calibrated, geolocated brightness temperature (T_b) products from each PC radiometer.
3. Inter-calibrated brightness temperature (T_c) products by applying the GPM core observatory reference standard.
4. Precipitation retrievals using physically based a-priori database constructed from combined radiometer/radar measurement.
5. Global monthly PDF of precipitation intensity based on the above.



○ Advocacy of post-GPM phase PC

- Potential Microwave Imager (MI) shortfall in post-GPM era
 - ❖ Initiate GCOM-W2 development with objective to provide AMSR2 measurement continuity with GCOM-W1 (JAXA)
 - ❖ Initiate development of Microwave Imager (MWI) for METOP SG (EUMETSAT)
 - ❖ Develop and implement approach to obtain FY-3 MWRI data on a routine and timely basis (EUMETSAT, NOAA, NASA)
 - ❖ Develop and implement approach to obtain Meteor M N2 MTZVA data on a routine and timely basis (EUMETSAT, NOAA, NASA)
 - ❖ Develop a timeline for development and deployment of the geostationary PATH radiometer (NASA)
- Light and solid precipitation measurements at high latitudes
 - ❖ Conduct concept study of light/solid precipitation measurement capability in the ACE Cloud Profiling Radar (NASA)
- GPM FO
 - ❖ Conduct concept study of FO to GPM (JAXA, NASA)



○ Current status

- 2011-2013 Work Plan approved at 4th PC WS
- PC response to GCOS IP Action A8 submitted
- M-T, Suomi NPP, GCOM-W1, and MetOp-B recent additions to space segment
- CEOS-GEO Actions WA-01-C1_3, WA-01-C1_4
- X-Calibration Working Group (WG) (in coordination with CGMS/GSICS)
- Updating December 2011 Study of Conical scanning microwave imagers (MI) in the late GPM Phase/Post-GPM Phase of the Precipitation Constellation

○ Schedules

- 2011-2013 Work Plan
- 2013 PC Data Portal schedule per WA-01-C1_3, WA-01-C1_4

○ Key players, programs

- NASA ESD Flight & Research Programs (PMM Science Team)
- JAXA GPM/DPR & GCOM-W1 Projects & PMM Science Team
- NOAA NESDIS
- CNES/ISRO M-T Projects & Joint Science Team
- INPE GPM-Br
- EUMETSAT Ops & LEO Programmes
- NRL Ocean & Atmospheric Science Directorate



- **X-Cal Working Group Meeting (hosted by CNES/CNRS), May 23-24, 2013, Toulouse, France**
- **6th GPM Ground Validation Workshop (hosted by CNR), November 4-8, 2013, Rome, Italy**
- **5th Precipitation Constellation Workshop, deferred to 2013-2014, location TBD**



- **Advancement of Cal/Val is essential to meeting the goals of the CEOS PC and realizing the multi-satellite precipitation measuring systems of the future**
- **Passive microwave radiometer calibration (e.g. GMI, TMI, AMSR-2, etc.)**
- **Passive microwave radiometer inter-satellite calibration (X-Cal WG)**
- **Space based precipitation radar calibration (e.g. GPM DPR)**
- **Ground Validation System (GVS) critical component of GPM system**
 - **Pre-launch retrieval algorithm development**
 - **Post-launch product validation**
 - **Major functions/development items: validation network (national, international), field campaigns (DOE, NOAA, international partners), Ku/Ka band Dual-frequency, Dual-polarized, Doppler Radar (D3R)**
 - **<http://pmm.nasa.gov/science/ground-validation>**



○ X-Calibration Working Group (X-Cal WG)

- International working group (in coordination with WMO CGMS/GSICS) to develop a consensus reference standard for cross-calibration of microwave radiometers to produce uniform global precipitation products within a consistent framework.
- Twelve WG meetings held since 2007
- 13th WG meeting, May 23-24, 2013, Toulouse, France
- NASA, JAXA, CNES, ISRO, INPE, CONAE, NOAA, NRL, EUMETSAT, JMA, UKMET, Universities from the U.S. and Asia participate (WGCV/MSSG invited since January 2008)
- Discovered/Fixed Problem in TMI (*ca.* 2K p-p), implemented fix in V7 algorithm
- Implementation of L1C intercalibration processing (conical imagers and sounders) including calibration constants for pre-launch PPS
- Instrument liaisons for 9 contemporary passive microwave instruments
- <http://www.gpm-x-cal.info/>



- **Invitation for WGCV/MSSG to participate in X-Cal WG reiterated**
 - **Consider the 6th GPM Ground Validation Workshop (hosted by CNR), November 4-8, 2013, Rome, Italy**
 - **We also welcome dialog with the PC on other aspects of our activities and potential WGCV/MSSG interests/support**



Committee on Earth Observation Satellites

WGCV-36
Shanghai, China
May 15, 2013

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- **Gail Jackson/NASA GSFC**
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- **Yoshiaki Takeuchi, Japan Meteorological Agency**
- **Yoshiyuki Chihara, Ministry of Education, Culture, Sports, Science and Technology**



- **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)**