

## ***Global Precipitation Measurement (GPM) Program Overview***

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***System Definition Review***

***Greenbelt, MD***

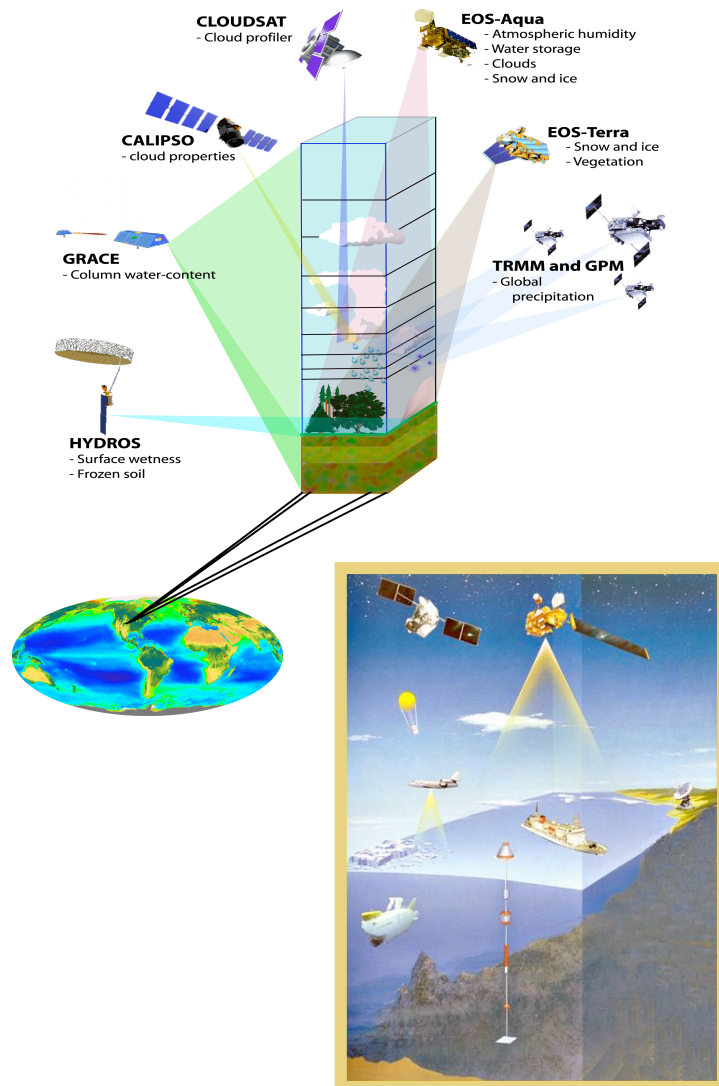
***December 6, 2005***



*Steven P. Neeck  
NASA Headquarters*



# GPM Global Water and Energy Cycle Observation Strategy



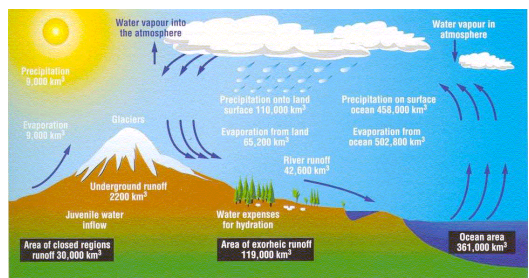
## GPM

- **Flagship mission for NASA's Global Water and Energy Cycle (GWEC) research and applications**
- **Important contribution to the U.S. Climate Change Science Program & the U.S. Weather Research Program**
- **Building on**
  - **the success of TRMM**
  - **NASA/JAXA capabilities in precipitation measurements from space**
  - **national and international partnerships in satellite constellation formation and ground validation**
- **Candidate component of the emerging Global Earth Observing System of Systems (GEOSS), an international effort to provide comprehensive, long-term, and coordinated observations of the Earth**



# GPM Importance to ESS Science Research Strategy

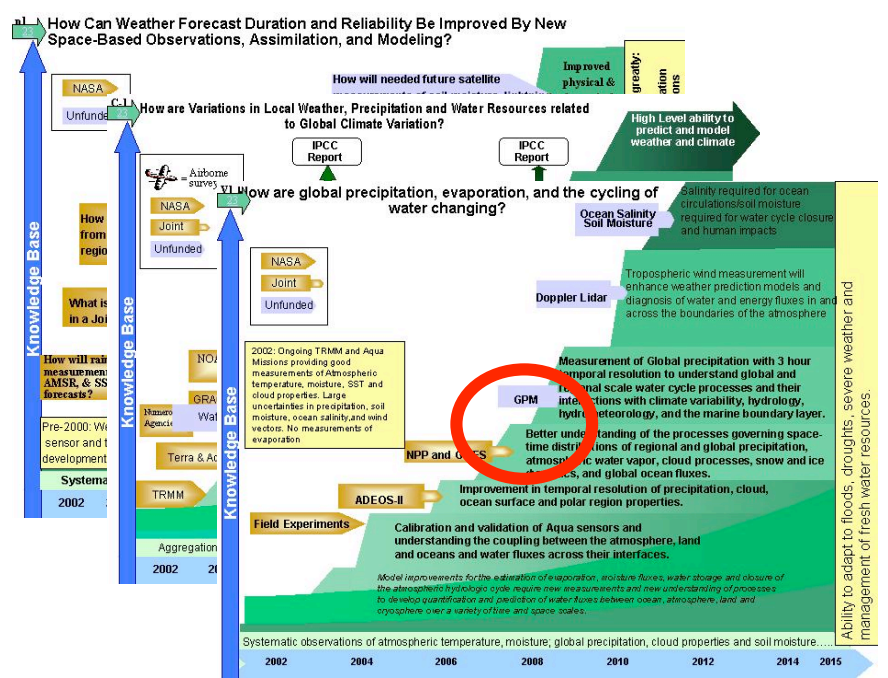
GLOBAL PRECIPITATION MEASUREMENT



- **Precipitation links moisture, clouds, latent heating and large-scale circulation – key to understanding the Earth’s climate and how it responds to perturbations**
- **GPM’s global atmospheric monitoring of water and energy is a key contributor to ESS Science Theme Roadmaps:**
  - Water & Energy Cycle
  - Weather
- **And is crucial to answering science questions:**
  - How are global precipitation, evaporation & the cycling of water changing?
  - How are variations in local weather, precipitation, and water resources related to global climate variation?
  - How can weather (forecast duration and reliability) be improved by new space-borne observations, data assimilation, and modelling?

## Science Questions from the Research Strategy

Variability	Forcing	Response	Consequence	Prediction
Precipitation, evaporation & cycling of water changing?	Atmospheric constituents & solar radiation on climate?	Clouds & surface hydrological processes on climate?	Weather variation related to climate variation?	Weather forecasting improvement?
Global ocean circulation varying?	Changes in land cover & land use?	Ecosystem responses & affects on global carbon cycle?	Consequences in land cover & land use?	Climate variations?
Global ecosystems changing?	Surface transformation?	Changes in global ocean circulation?	Coastal region change?	Trends in long-term climate?
Stratospheric ozone changing?		Stratospheric trace constituent responses?		Future atmospheric chemical impacts?
Ice cover mass changing?		Sea level affected by climate change?		Future concentrations of carbon dioxide and methane?
Motions of Earth & interior processes?		Pollution effects?		



GPM SDR, December 6, 2005

- **Advancing precipitation measurement capability from space:**
  - through combined use of active and wide-band passive remote-sensing techniques
- **Advancing understanding of global water/energy cycle variability and fresh water availability:**
  - through better measurement of the space-time variability of global precipitation
- **Improving weather forecasting skills:**
  - through more accurate and frequent measurement of instantaneous rain rates
- **Improving climate modeling & prediction capabilities:**
  - through better understanding of precipitation microphysics, surface water fluxes, soil moisture storage, and latent heating distribution in the atmosphere
- **Improving prediction capabilities for floods, droughts, fresh water resources, crop conditions, & other water-related applications**
  - through improved temporal sampling and high-resolution spatial coverage

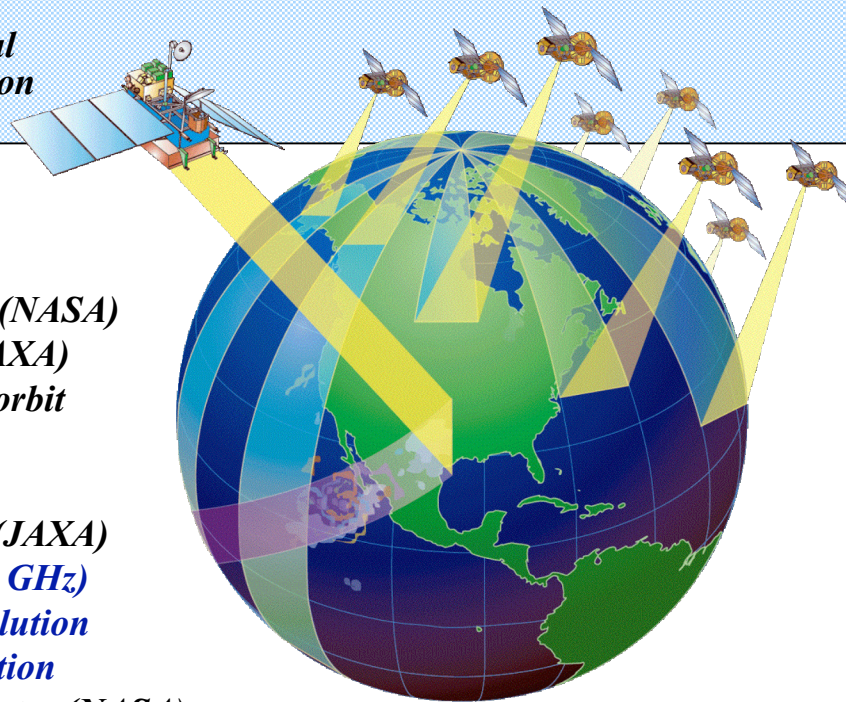
**A science mission with integrated applications**

**goals**



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

- Provide sufficient global sampling to significantly reduce uncertainties in short-term rainfall accumulations
- Extend scientific and societal applications



## Core Spacecraft

- TRMM-like spacecraft (NASA)
- H-IIA launch (TBC, JAXA)
- Non-sun-synchronous orbit
  - ~ 65° inclination
  - ~ 407 km altitude
- Dual frequency radar (JAXA)
  - Ku-Ka Bands (13.6-35 GHz)
  - ~ 4 km horizontal resolution
  - ~ 250 m vertical resolution
- Multifrequency radiometer (NASA)
  - 10.65, 18.7, 23.8, 36.5, 89.0, 166, 183.3 GHz

## Constellation Satellites

- Pre-existing operational-experimental & dedicated satellites with PMW radiometers
- Revisit time
  - 3-hour goal ~90% of time
- Sun-synch & non-sun-synch orbits
  - 600-900 km altitudes

## Precipitation Processing System

- Global precipitation products from input data provided by a consortium of cooperative international partners

## Ground Validation Sites

- Ground measurement & calibration
- Cooperative international partners



- **NASA is responsible for**
  - Key elements of the Core observatory (spacecraft, ground system, and the GMI instrument)
  - One constellation spacecraft and its ground system
  - Precipitation Processing System (PPS)
  - Ground validation sites
- **JAXA is responsible for**
  - The Ka-band Precipitation Radar (to fly on the Core spacecraft)
  - The Ku-band Precipitation Radar (to fly on the Core spacecraft)
  - The launch vehicle for the Core spacecraft (TBC)
  - Constellation spacecraft (GCOM-W AMSR/FO)
- **Other US agencies**
  - To contribute radiometer rainfall measurement data streams from existing and planned satellites (DMSP, NPOESS, etc.) for ingest by the PPS
  - To provide ground validation facilities, data processing/distribution, data archiving
- **Other international partners**
  - Invited to support GPM by providing spacecraft, instruments, rain gauge networks, ground validation facilities, etc.



- **GPM was the outgrowth of the highly successful TRMM launched on November 1997**
- **Easton Workshop – August 1998**
  - GPM (designated as EOS-9) was recommended as the principal systematic measurement of the Global Water and Energy Cycle Panel
  - GPM was strongly endorsed by Applications Panel
- **EOS-9 Post-2002 Mission Study – April 1999**
  - Planned as constellation at 70° inclination
  - NASA HQ recommended use of existing operational meteorological systems (e.g. DMSP-SSM/I and NPOESS - CMIS)
- **Advanced Study – October 2000 to November 2001**
  - GSFC designated lead
  - Coordination Group established with NASDA
- **Formulation – November 2001 to present**
  - GSFC designated to lead in July 2002 FAD
  - SRR and SCR held in 2002
  - Partnership discussions initiated/held with ISRO/CNES (2002), KARI (2003), ESA (2003), NSPO (2004), AEB (2005)



- **Technical**

- *Formulation Phase (Phase B) continues in FY2006*
- *GPM Microwave Imager (GMI) development proceeding.*
  - *Contract awarded to Ball Aerospace Technologies Corporation*
  - *High frequency capability (163 GHz and 183 GHz) approved*
  - *Delivery in 2009*
- *Joint industry and government implementation approach for Core Spacecraft*
  - *RFO for 7 month multi-vendor Avionics package study*
- *JAXA Dual-frequency Precipitation Radar development proceeding*
  - *KuPR engineering model in development*
  - *KaPR engineering model undergoing testing*

- **Budget**

- *NASA's FY2006 proposed budget funds GPM at \$24M in FY2006*
  - *Appropriations Bill signed by President November 22, 2005*

- **International Partnerships**

- *NASA-JAXA Formulation Phase Memorandum of Understanding (MOU) was signed and implemented in July 2005*
- *5<sup>th</sup> GPM International Planning Workshop held in November 2005*
- *1<sup>st</sup> NASA-AEB Bilateral Group Meeting held in December 2005*





- **Domestic Partnerships**

- *Discussions of NOAA participation continue in NASA-NOAA Global Precipitation Capability Working Group as part of the NASA-NOAA Joint Working Group on Research and Operations (R&O) framework*
- *GPM was discussed and supported by NOAA during the NAS Committee on the Future of Rainfall Measuring Missions meeting on October 17-18, 2005*
- *Department of Energy expressed interest in ARM Program contributions to GV*

- **Schedule**

- *Targeting 2010 LRD for Core Spacecraft and 2012 LRD for Constellation Spacecraft*

- **Upcoming Meetings**

- *Precipitation Measurement Missions (PMM) Science Team Meeting to be held December 12-15, 2005 @ Monterey, CA*
- *PPS Build 1 Review to be held February 21-22, 2006 @ GSFC*



- **Measurement Based Initiative**
- **“Facility” Provided for Including New Partners**
  - GPM to seek out partnership opportunities for data streams, data processing, and calibration & validation sites
  - Partnerships constructed to promote “global” interest in global precipitation measurement
- **Japan is a Critical Partner**
  - Assumes that the JAXA/NASA partnership will be successful
    - Includes radar, launch vehicle (TBC), and constellation satellite contributions by JAXA
- **Initial Capability - Circa 2010**
  - Core Spacecraft schedule synchronized with the JAXA development schedule
- **Category 1 project (High Priority) per NPR 7120.5C**
- **Class B payload (High Priority, Low Risk) per NPR 8705.4**
- **Mission Life - 3 years minimum with 5 year goal**
- **Technology - minimize new technology development in critical path**

- **Complete mission preliminary design – FY06**
  - *Satellites, instruments, and ground system*
- **Confirm Mission – FY07**
  - *Formal approval to implement*
- **Mature International Partnerships – FY06-07**
- **Mature Domestic Inter-Agency Partnerships – FY06-07**



- **Recommendation** – “The Committee recommends the Global Precipitation Measurement mission be launched without further delays.” (p. ES-3)
- **NASA Response** – “NASA agrees, and will work to fund the earliest practicable launch date in the FY07 budget request.”

\* Earth Science and Applications from Space: Urgent Needs and Opportunities to Serve the Nation, *The National Academies Press, 2005.*



Councils

- Leadership Council
- Science Management Council
- Program Management Council
- Operations Council

