Global Precipitation Measurement (GPM) Program Overview

System Definition Review
Greenbelt, MD
December 6, 2005

Steven P. Neeck
NASA Headquarters
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
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 and 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?

Importance to ESS Science Research Strategy
GPM Science Objectives

- **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*
**GPM Reference Concept**

**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

**Ground Validation Sites**
- Ground measurement & calibration
- Cooperative international partners

**Precipitation Processing System**
- Global precipitation products from input data provided by a consortium of cooperative international partners

**GPM**

GPM SDR, December 6, 2005
Proposed Partner Responsibilities

• **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
• **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
  – 5th GPM International Planning Workshop held in November 2005
  – 1st 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
Mission Constraints

• **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**
  • **End of Life** - NPD 8710.3 and NSS 1740.14 compliant
Near-Term Goals

- **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.”

Science Mission Directorate – NASA HQ

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

Associate Administrator (AA)
- M. Cleave

Deputy AA
- C. Hartman

Deputy AA
- M. Luther

Mission Support
- NASA Management Offices
- Administrative Processes

Mission
- Earth-Sun System
- Solar System
- Universe

Mission Enabling
- Business Management
- NASA Centers
- Mission & Systems Management

NASA Centers
- JPL
- GSFC
- ARC
Earth-Sun System Division – NASA HQ

Earth-Sun System
Director: Richard Fisher (Act.)
Deputy: Charles Gay (Act.)

Research Sciences
Director: Jack Kaye
Deputies: Lucia Tsaoussi & Bill Wagner

Applied Sciences
Director: Ron Birk
Deputy: Martin Frederick

Flight Programs
Director: Ted Hammer (Act.)
Deputy: Steve Neeck (Act.)