

## *Global Precipitation Measurement*

### *System Requirements Review Level 1 Requirements*

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- *Flow from Science*
- *Allocation to Elements*
- *Driving Requirements*
- *Current Status*



## Earth Science Enterprise Science Questions

**Variability** - I-1 Global Precipitation  
**Response** - III-1 Clouds & Hydrology  
**Consequences** - IV-1 Local Weather  
**Prediction** - V-1 Weather Forecast  
                   V-2 Climate Variation  
                   V-3 Long Term Climate

Direct Contribution to Answering Science Questions

## GPM Science Objectives

- \* **Climate Observation** - to accurately measure global/regional variability of precipitation to improve global climate models.
- \* **Weather Prediction** - to improve the accuracy of global and regional weather prediction models through more accurate measurement of rain rates and latent heating.
- \* **Global Water Cycle** - to improve the understanding and predictability of floods and fresh water resources through more frequent and complete sampling of precipitation.

## GPM Science Drivers

- \* **Global Coverage** - instantaneous rain rate measurements sufficiently frequent to avoid diurnal aliasing, and with 10 km resolution.
- \* **Measure** 4-D structure of rainfall rates and drop size distribution.
- \* **Accuracy Threshold** - Bias error < 5%
- \* **Precision Threshold** - < 25%
- \* **Latency** - Deliver near-real-time and 3-hour products.

## NASA Program Constraints

- \* **Budget** -
- \* **Schedule** - IOC of primary S/C shall be 2007
- \* **Partnerships** - Utilize NASDA contributions and coordinate schedules
- \* **Lifetime** - 3 years required, 5 year goal
- \* **Reliability** - PRA required, flight systems single-fault tolerant
- \* **End-of-Life Reentry** - Meet NASA policy directive

## Level One Performance Requirements

Measurement (3.1.1)

Validation (3.1.2)

Science Products (3.1.3)



## Level 1 Performance Requirements

### Measurement (3.1.1)

- \* **Precipitation (3.1.1.1)**
- \* **Latent Heat (3.1.1.2)**
- \* **Drop Size Distribution (3.1.1.3)**

#### Spacecraft :

- \* Utilize multiple S/C to achieve geographic and temporal coverage
- \* S/C shall have 3 year design lifetime with a 5 year goal.
- \* Reliability *TBD*

#### Primary S/C (3.2.1.1.2) -

- \* Instrument Accommodation -  
Dual Frequency Radar  
Multi-channel Polarized Passive  
Microwave Radiometer Suite
- \* Launch Accommodation - NASDA H2-A
- \* Operating Orbit - 65° / 400 km

#### Constellation S/C (3.2.1.2.2) -

- \* Instrument Accommodation -  
Passive Microwave Radiometer
- \* Launch Accommodation - *TBD*
- \* Operating Orbit - Various

### Validation (3.1.2)

#### Space Validation & Calibration (3.1.2.1) :

- \* Use Primary S/C observations to generate a transfer standard to calibrate Constellation instruments.

#### Ground Validation & Calibration (3.1.2.2) :

- \* Provide independent measurements of precipitation reaching the surface.
- \* Maintain operation from two years prior to launch of the Primary S/C through three years after the launch of the Primary S/C.

#### A) Local Area SuperSite -

- \* 2 NASA-provided, remainder contributed

#### B) Regional Rain Gauge Network -

- \* 1 NASA-provided, remainder contributed

### Science Products (3.1.3)

#### Immediate (3.1.3.1) :

- \* Level 0 data and rain images
- \* Data Latency < 3hours
- \* Precision 25% -- 50%

#### 3-Hour Products (3.1.3.2) :

- \* Level 1&2 data and rain images
- \* Sampling period 3 -- 6 hours
- \* Precision 15% -- 40%

#### Monthly Climate Products (3.1.3.3) :

- \* Level 1,2&3 products
- \* Product resolution < 3 hours
- \* Estimate accuracy <5%

### Instruments (3.2) :

- \* Utilize multiple instruments to achieve scope of precipitation observations

#### Space Based (3.2.1) -

- \* Dual Frequency Precipitation Radar (Provided by NASDA)
- \* Multi-channel, Polarized, Conical Scan, Passive Microwave Radiometer

#### Ground Based (3.2.2) -

- \* Radar
- \* Rain Gauges
- \* Disdrometers
- \* *other instruments TBD*

#### Public Outreach Data Access (6) :

- \* Near-Real-Time data shall be made available through internet interfaces.
- \* Data latency shall be no more than 3 hours with a goal of less than 45 minutes.



- **Precipitation sampling**
  - Resolve diurnal cycle
  - Ingest multiple data streams from NASA and domestic and foreign partners
- **Drop size distribution measurement**
  - Fundamental feature of precipitation
  - Enabled by dual-frequency precipitation radar (DPR)
  - 5km horizontal and 500m vertical resolution
- **Error estimates**
  - Critical to users
  - Drives GV and algorithm efforts
- **NASA/NASDA partnership**
  - DPR
  - H2A-202 launch vehicle
- **Latency and Completeness**
  - 3 hours for 90% of data
  - 72 hours for 98% of data
- **Lifetime: 3 years with a goal of 5**
- **End-of-Life disposal**



- **Review Status:**

- Workshop with HQ in June 2001
- Initial Draft peer review by GSFC/ HQ Committee August 2001
- Major Revision accepted by Committee October 2001
- Current Revision reviewed informally in April 2002, few changes since October 2001
- HQ will baseline document after SRR
- Signoff by confirmation review

- **Requirement Status:**

- All 70 Requirements Allocated to GPM Elements or L2 requirements
- 6 TBD's Remain to be Filled
  - 3 Programmatic
  - 3 Technical

