GPM

Global Precipitation Measurement

8th NASA Supply Chain Quality Assurance Conference

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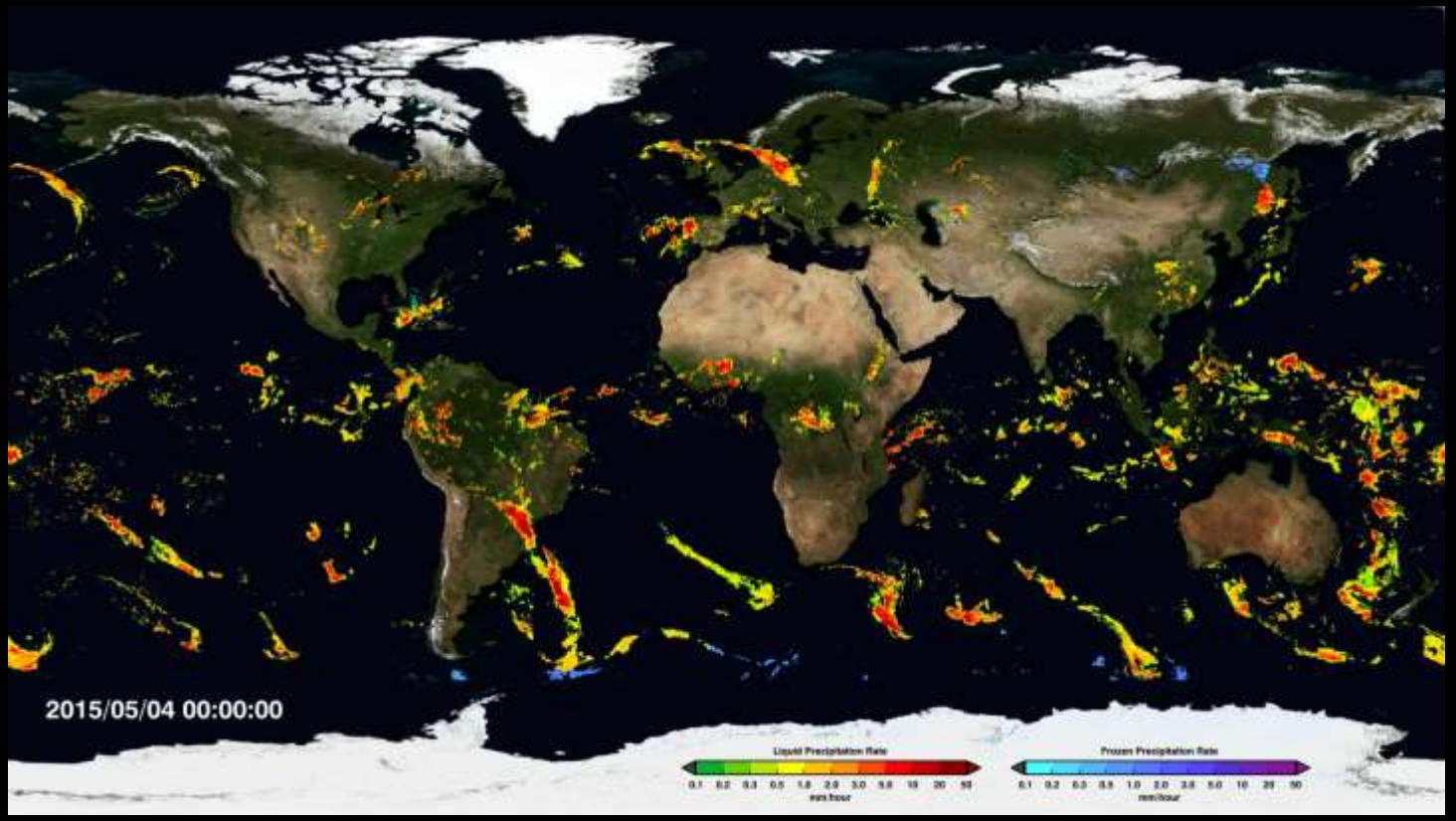


Measuring Global Precipitation from Space updated within 3 hours

GPM Measures precipitation around the globe

GLOBAL PRECIPITATION MEASUREMENT

- An International Partnership Mission with JAXA (Japan Aerospace and Exploration Agency) as NASA's main partner
- Category 1 – Class B
- Budget: $1B (excluding launch services and two radar instruments provided by JAXA)
- 3-Year mission life with 5-Year fuel plan including re-entry fuel

Mission Objective:

- Advancing precipitation measurement capability from space
- Improving knowledge of precipitation systems, water cycle variability, and fresh water availability
- Improving climate modeling and prediction
- Improving weather predication and 4-D climate reanalysis
- Improving hydrometeorological modeling and prediction

- **GPM Core Observatory (satellite) and 8 other satellites make up the GPM Constellation**

http://pmm.nasa.gov/GPM/science-objectives

Assembled in GPM Cleanroom building 29

- *300 - 400 made up the GPM Team; including private industry partners supporting Goddard*
- *Propulsion Subsystem integration was complex since it included front and back thrusters*
- **Instruments delivered and integrated in early 2012**

GPM is the largest satellite built at Goddard

- Launched into orbit on February 2014 from Tanegashima Japan
- Orbit is 407 Km with 65 degree inclination; (same altitude as Space Station)
- Latest calculations predicts enough fuel to last in orbit until 2035 and after that spacecraft will be commanded to enter earth's atmosphere
- Total weight 3850 kg
- Total power 2000 W

GLOBAL PRECIPITATION MEASUREMENT

GPM has three instruments

- Dual Precipitation Radars provided by JAXA
  - Ku Radar 13.6 GHz
    - Dimension (meter) ;2.5 x 2.4 x 0.6 m, Mass; 472 Kg, Power; 446W
  - Ka Radar 35.5 GHz
    - Dimension (meter); 1.2 x1.4 x 0.7 m, Mass; 336 Kg, Power; 344W

- GPM Microwave Imager (GMI) – Contracted to Ball Aerospace; Cost Plus Award Fee
  - Ball had many subcontractors

ITT Engineered for life

AASC Applied Aerospace Structures Corp.

ATK ATK SPACE SYSTEMS

MOOG

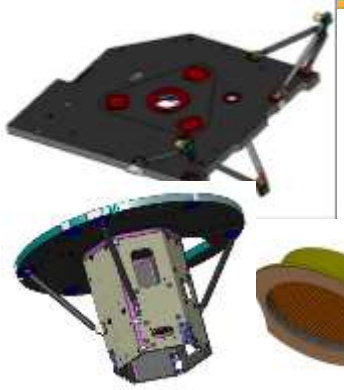
CMI custom microwave inc.

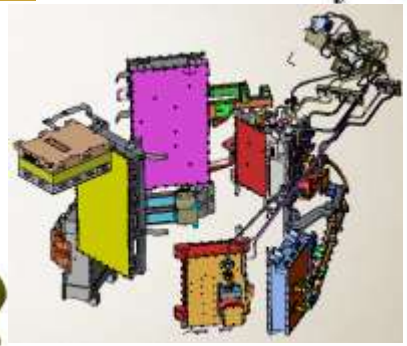
millitech

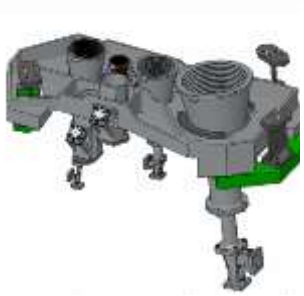
Remote Sensing Systems www.remss.com

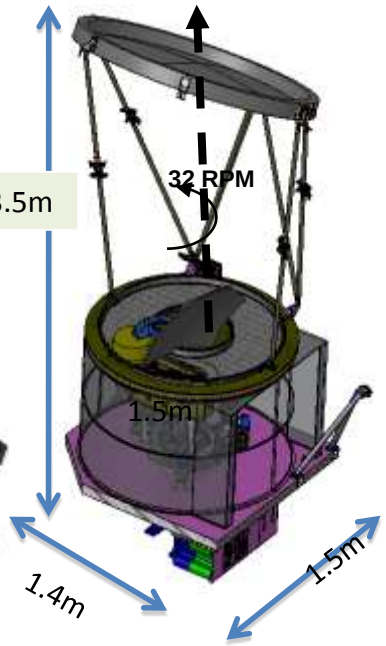
AXSYS TECHNOLOGIES

ZAX Millimeter Wave Corporation



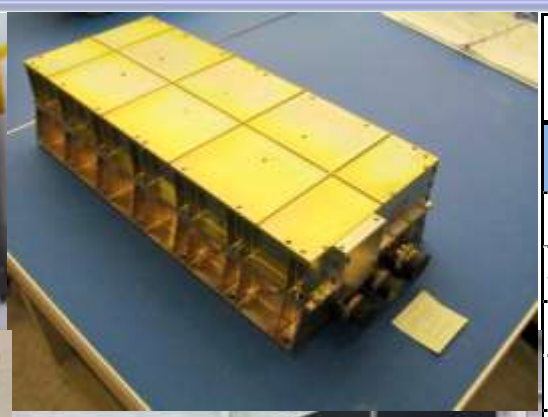






GPM spacecraft an in-house design with many subs

Subsystem/Item
GNC
Coarse Sun Sensors (CSS)
Medium Sun Sensors (MSS)
Mag. Torquer Bar (MTB)
3 Axis Magnetometers (TAM)
Star Trackers
Gyro/IRU
GPS Front End Electronics (LNA)
C&DH (CCC)
BAE Rad-750 Single Brd Comp (SBC)
Power
Battery
RF Comm
Transponder / Band Reject Filter / Diplexer
Power Dividers (Directional Couplers)
Hybrids
RF Switch
RF Coax Cable
HGAS
HGAS Gimbal Actuators
HGAS LRM Actuator Assys
HGAS Hinge Dampers



Subsystem/Item
Propulsion
Prop Tank
Thrusters
ISO Valves (Latch Valves)
Press Transducers
Fill & Drain
Filters
Solar Array
Solar Array Drive Assy
Solar Array Substrates
Solar Array Panel
Solar Array LRM Actuators
Solar Array Hinge Dampers
Thermal Control HW
Heat Pipes CCHP, PSE, MACE,C&DH
Heat Pipes CCHP, RWA, ST/IRU
Heat Pipes VCHP, Battery

Supply Chain Challenges for GPM

- **Procurement cycle began in 2009 with last deliveries (Flight Batteries) in early 2013**

- **Many subcontractors and many different processes**
  - How do we perform audits efficiently and take advantage of early Supply Chain audits?
  - Do we flow down NASA MAR or accept their processes?
  - How do we establish quality assurance equivalency?

- **When to audit spacecraft subcontractors and with what priorities?**
  - Coordinated closely with Mike and his team ahead of procurement cycle to audit potential vendors
  - Frequent audits at larger subs closely coordinated with Supply Chain Team
  - Mike and his team focused very closely not to duplicate audits
- **When and how do we audit Ball and its subcontracts and with what priorities?**
  - Ball audits most challenging in order to avoid disruption during manufacturing phase; dates closely coordinated Supply Chain Team
  - How do we handle very small subs with minor developments?

Goddard
SPACE FLIGHT CENTER