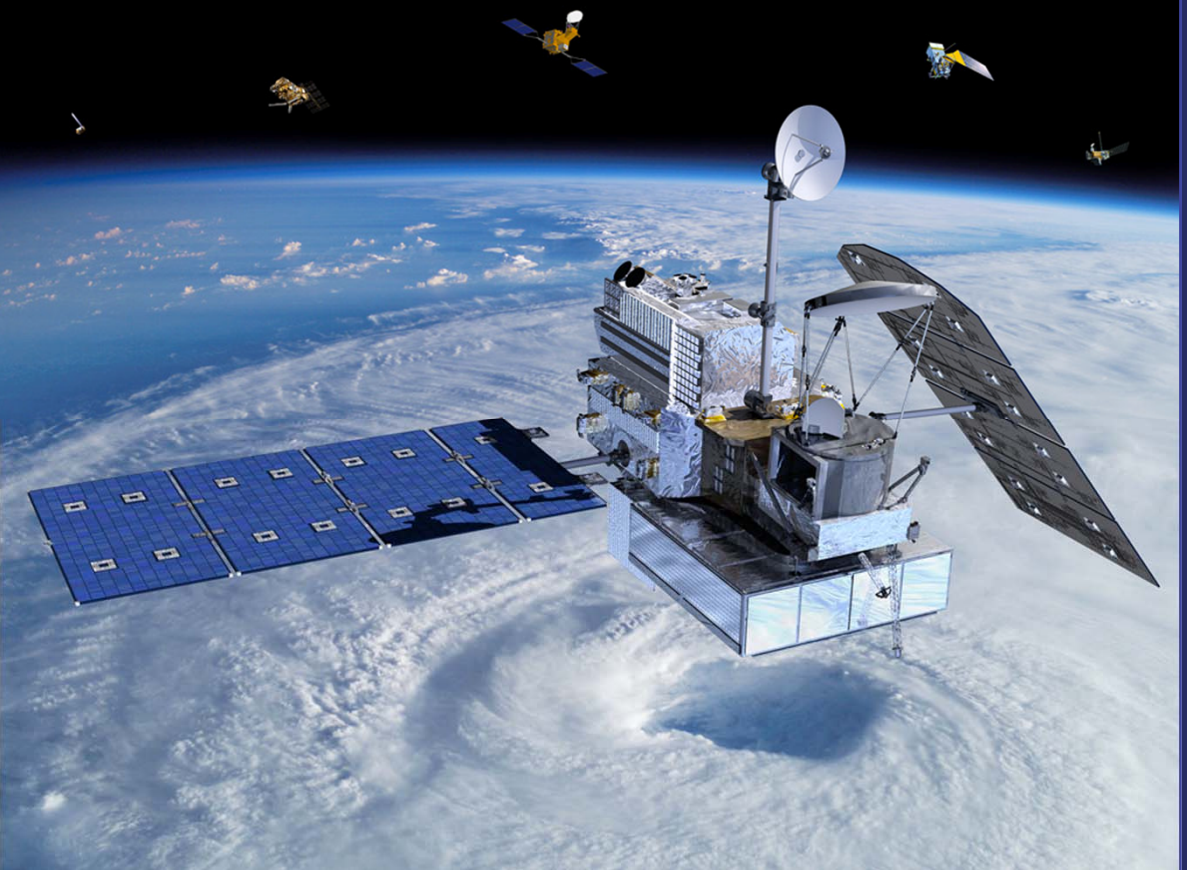
Next-Generation Global Precipitation Measurements for Science & Applications

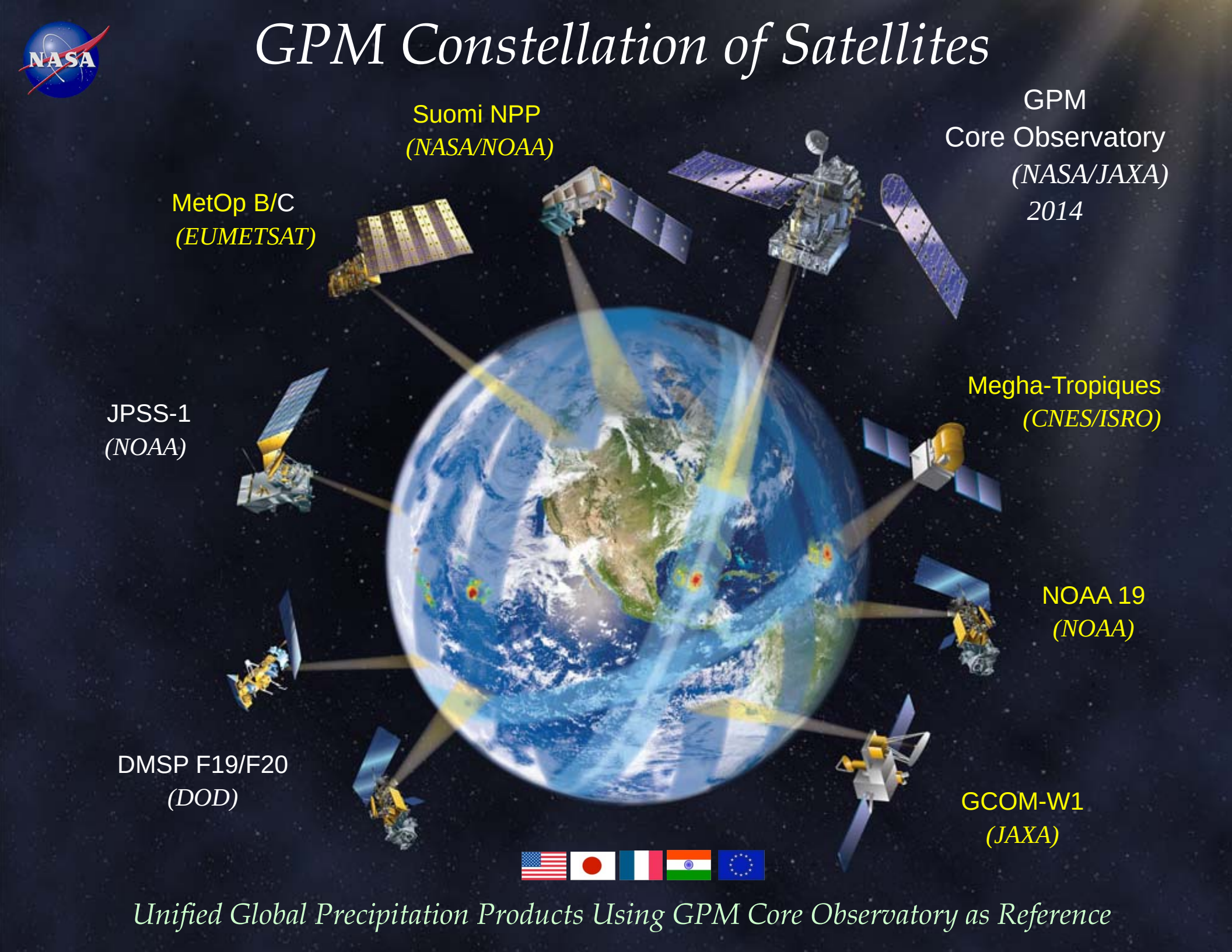


Arthur Y. Hou

NASA Goddard Space Flight Center

The 15th Anniversary of the Tropical Rainfall Measuring Mission (TRMM)
November 12, 2012, Tokyo, Japan

GPM Constellation of Satellites



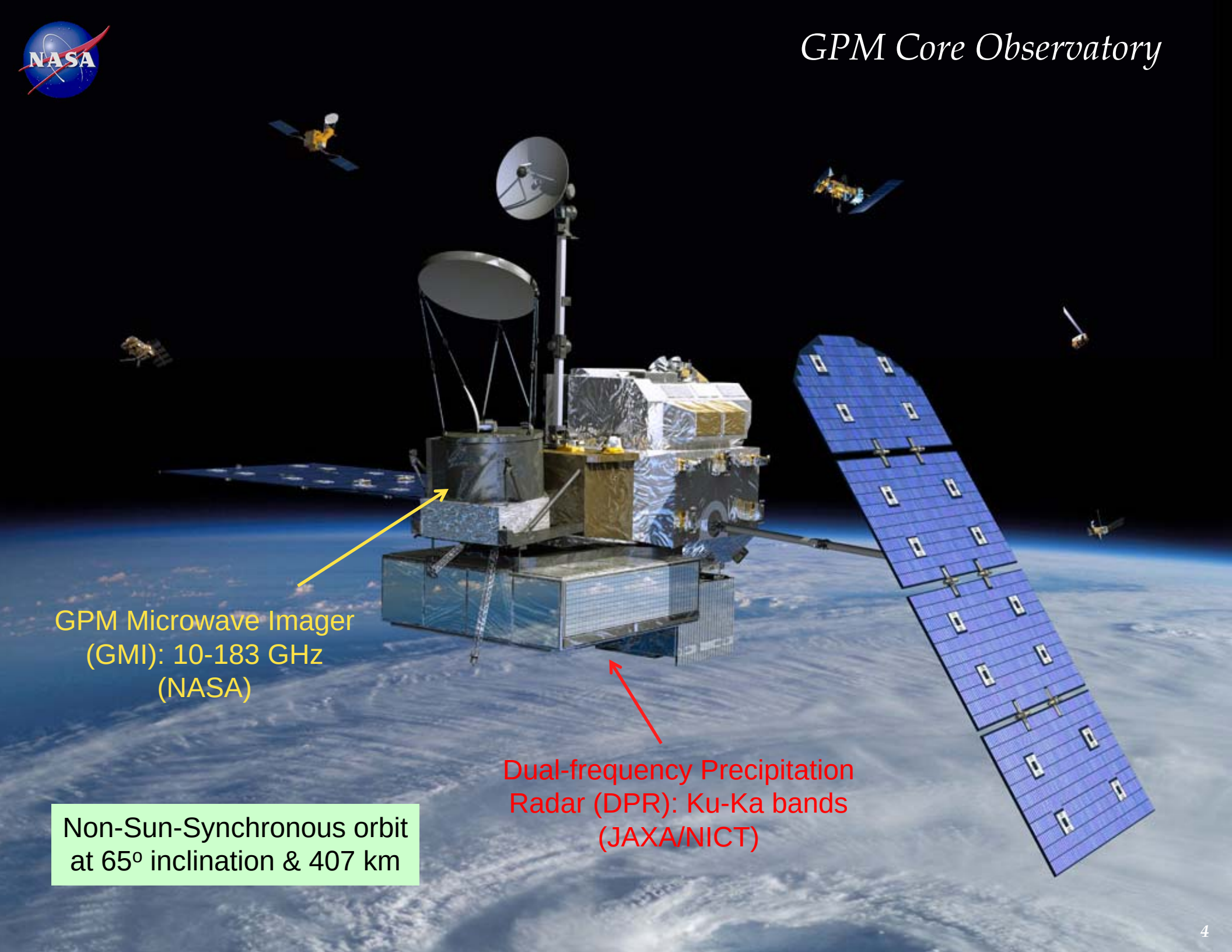
Unified Global Precipitation Products Using GPM Core Observatory as Reference

GPM Mission Concept

- Use coordinated precipitation measurements by a constellation of microwave radiometers to obtain global coverage and high sampling rate through international partnerships.

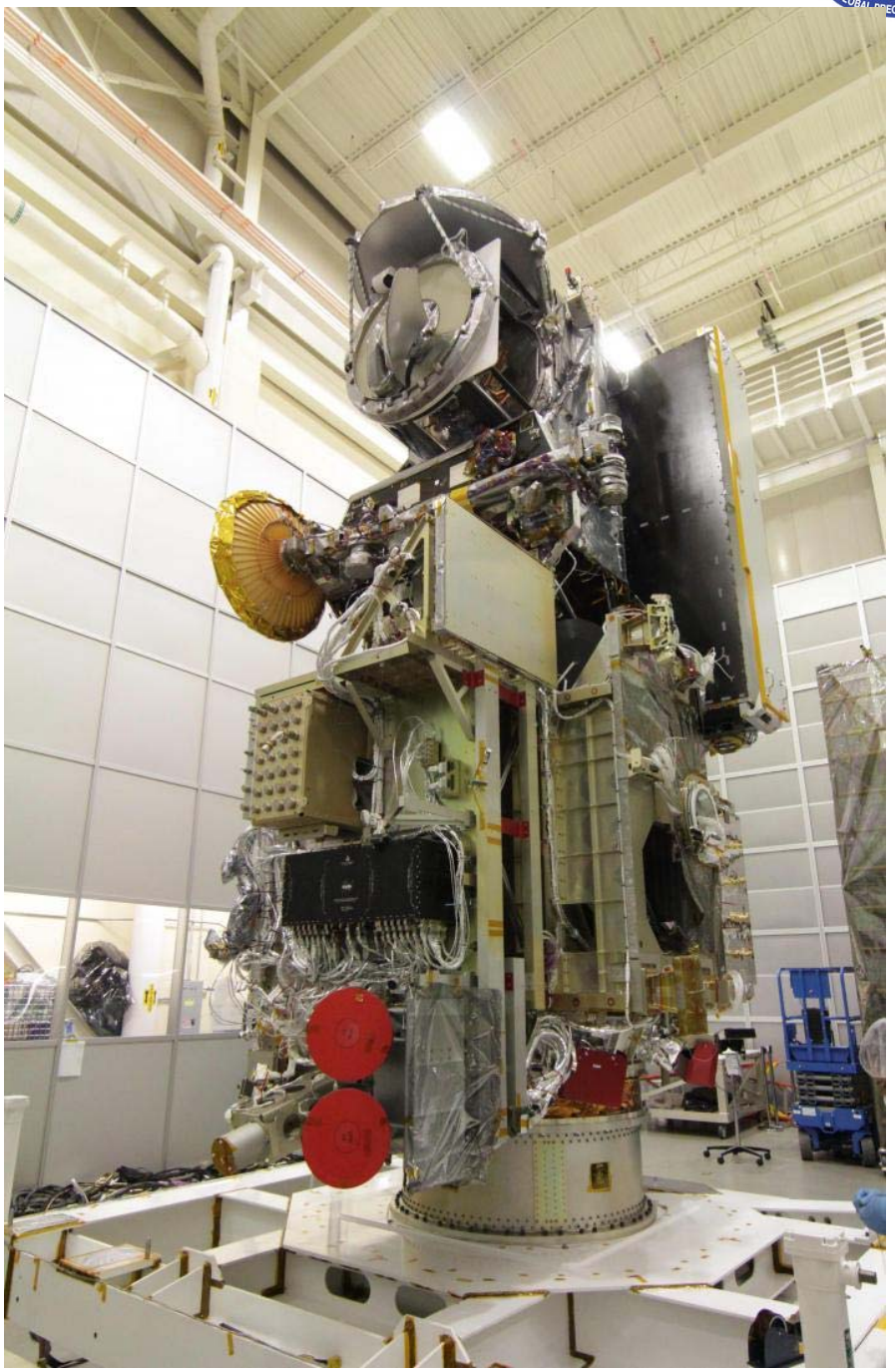
- Use combined observations from *active and passive* sensors on the GPM Core satellite to improve the accuracy and consistency of precipitation estimates from all constellation satellites.

GPM Core Observatory



Non-Sun-Synchronous orbit at 65^{o} inclination & 407 km

Core Observatory Integration & Testing at NASA/GSFC



Launch from Tanegashima Island, Japan in 2014

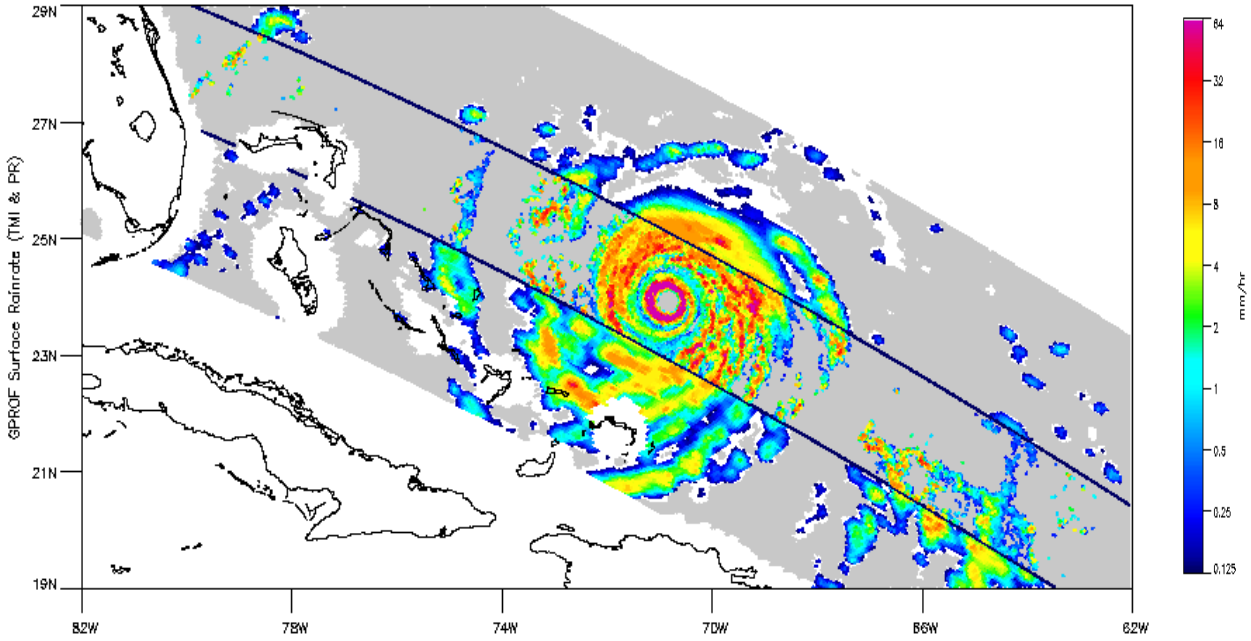
Role of the GPM Core Observatory

- Set a new standard for precipitation measurements from space:
  - Using combined measurements from an advanced radar/radiometer system specifically designed for this purpose.
  - Better remote-sensing accuracy and higher sensitivity to light rain and snowfall relative to NASA/JAXA Tropical Rainfall Measuring Mission (TRMM).
- Unify and improve precipitation data products from all constellation radiometers:
  - By using a common observational database consistent with DPR and GMI measurements.
- Improve sampling capability of the GPM constellation to characterize the diurnal variation of precipitation and to provide more accurate estimates of rain accumulation.
  - By filling the temporal gaps between observations at fixed local times by GPM constellation satellites flying in polar orbits.

Advanced Precipitation Measurements From Space

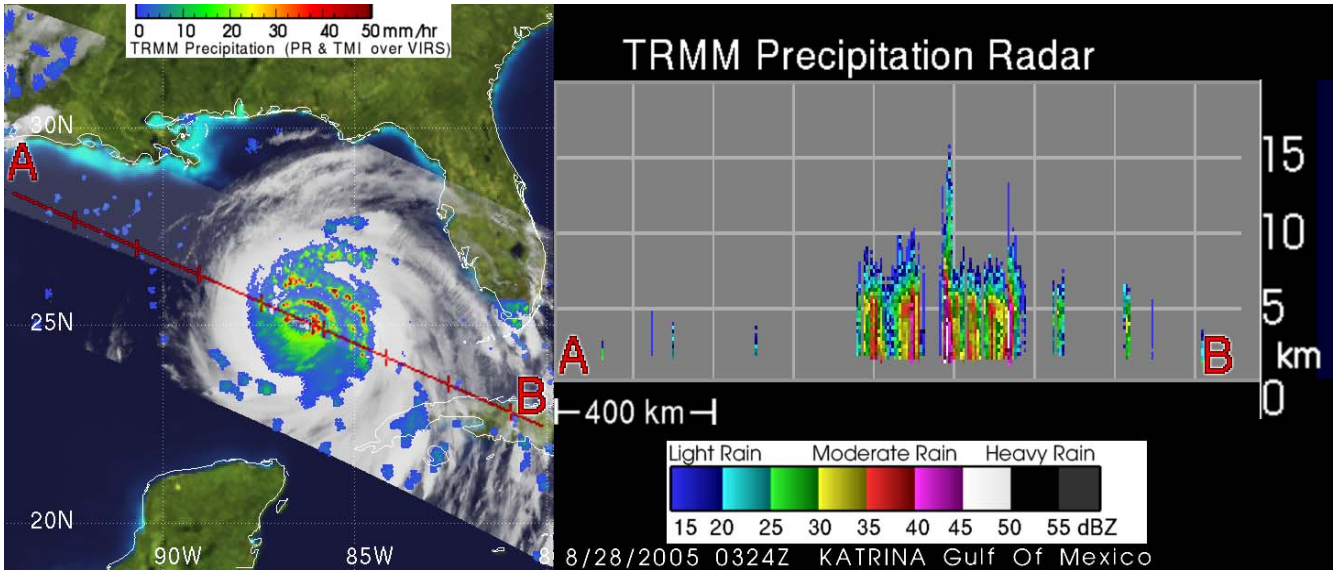
- GPM will set a new benchmark in precipitation retrieval accuracy in areas where DPR and GMI measurements overlap.
- GPM will provide more accurate and consistent precipitation retrievals from all constellation radiometers using a DPR/GMI-derived database instead of the model-simulated database used in the TRMM era.
- Proof-of-Concept demonstration using TRMM PR and TMI:

Excellent match between "radiometer" rain retrieval (outer swath) using a PR/TMI-derived database and PR rain retrieval at a higher spatial resolution (inner swath)

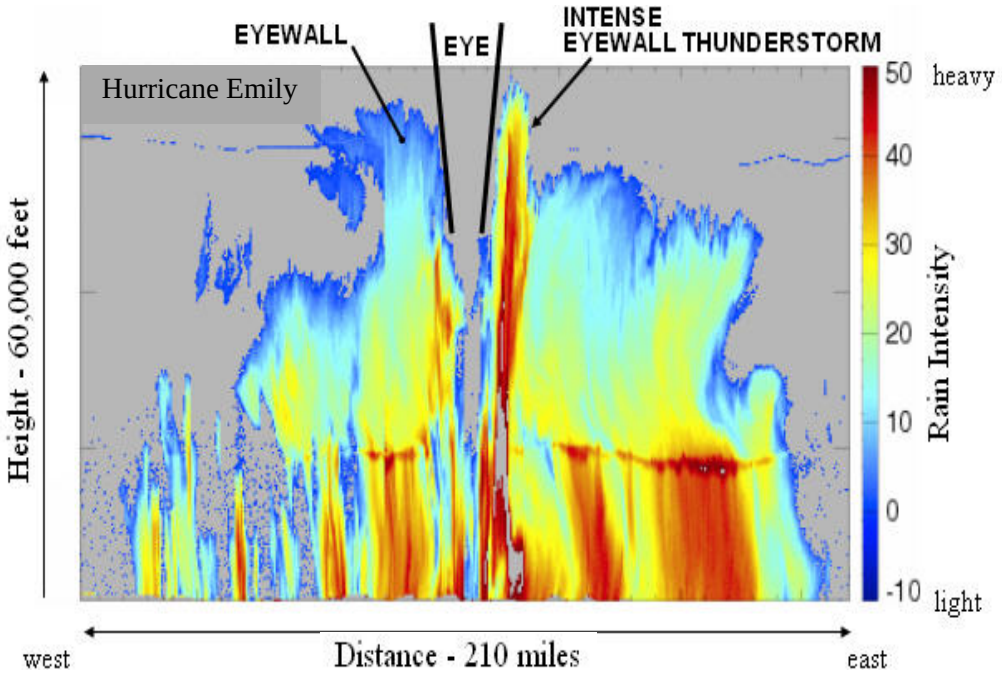


New Insights Into 3-Dimensional Storm Structure

3D TRMM radar view of Hurricane Katrina (8/28/2005)



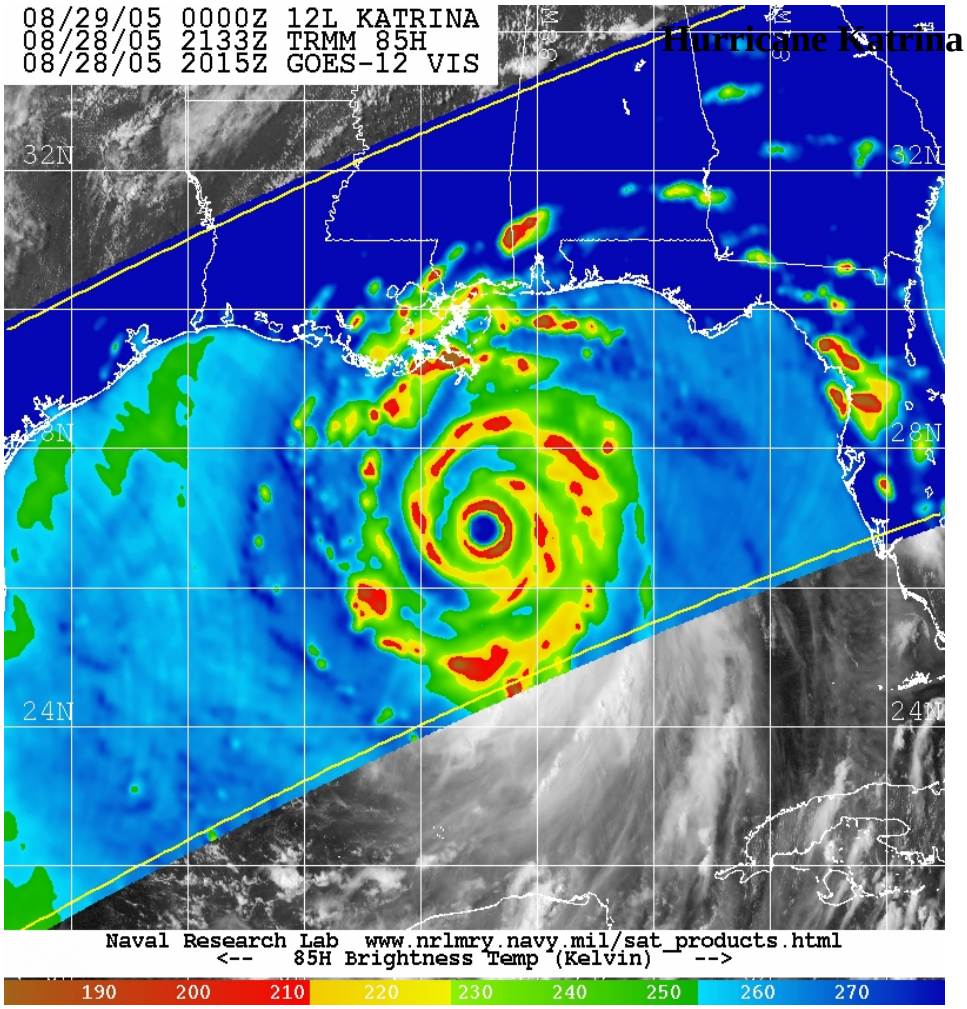
Deep convective tower in the eyewall of Katrina seen by TRMM PR as the storm intensified to Category 5



ER-2 Doppler Radar (Courtesy G. Heymsfield)

- DPR will have higher sensitivity to detect light rain structures and provide detailed information on microphysical properties of precipitation systems.
- GPM will provide observations of 3D precipitation structure to better understand the transition of tropical storms into midlatitude frontal systems.

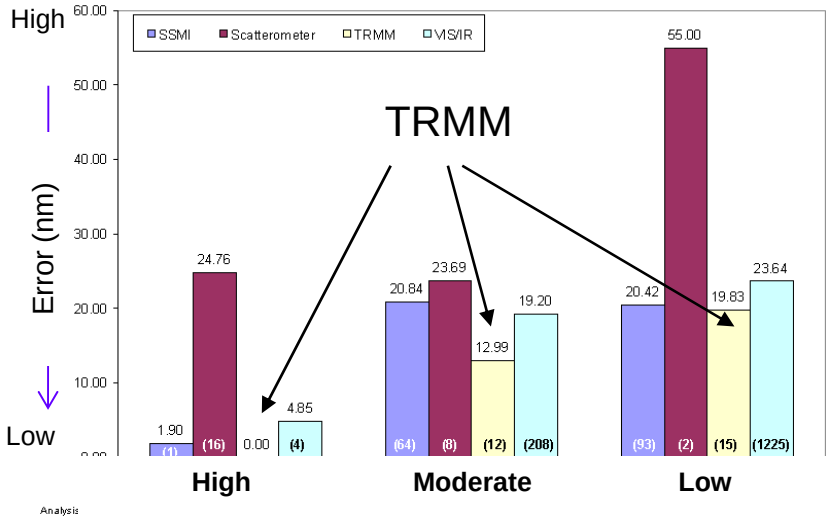
High-Resolution Radiometric Data for Storm Tracking and Position Fix



High-resolution microwave radiometer data can provide accurate position fix and track monitoring of typhoons, hurricanes, and midlatitude storms.

GMI on the Core Observatory offers high-resolution imaging data within 20 minutes of data collection.

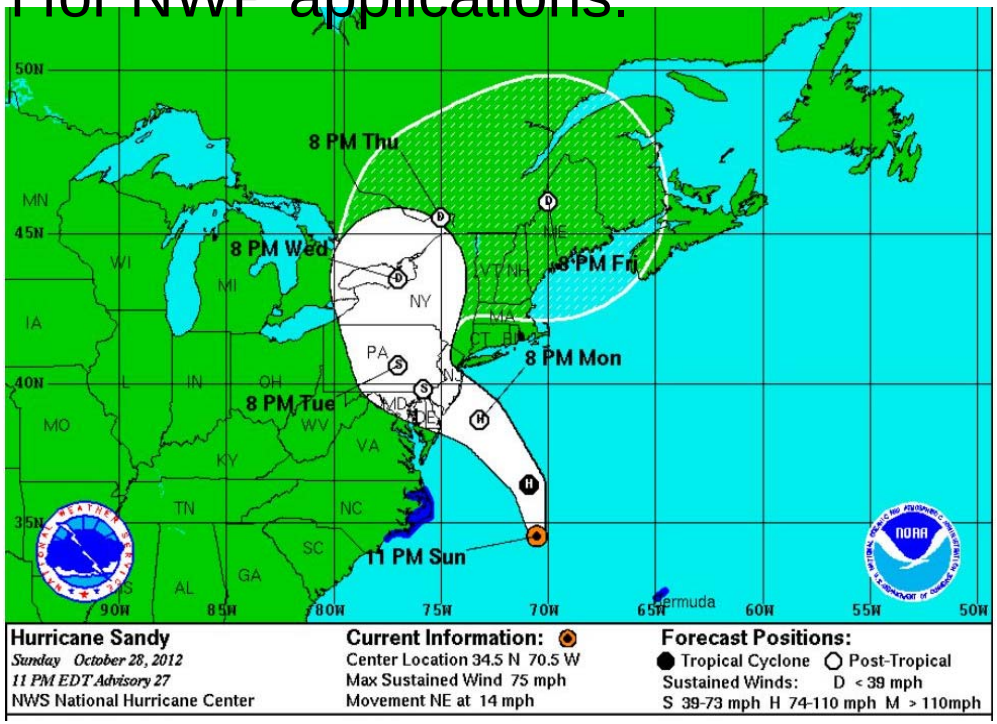
Position Error in Nautical Miles



Position Confidence Accuracy in Hurricane Track

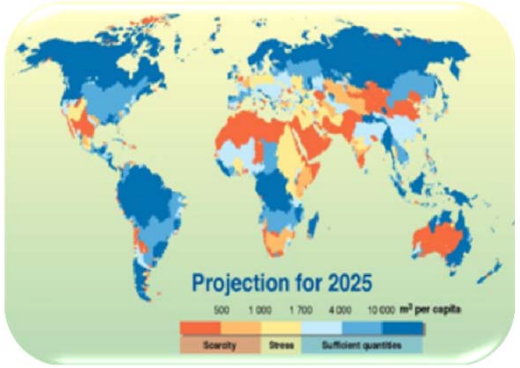
Numerical Weather Prediction (NWP)

- Assimilation of precipitation information into global and regional forecast systems has been shown to improve atmospheric analyses and short-range forecasts in a variety of situations.
- Precipitation observations are currently used operationally at numerical weather forecast centers in Europe, Japan, and the United States.
- GPM will provide GMI and DPR precipitation data within 180 minutes of data collection for NWP applications.



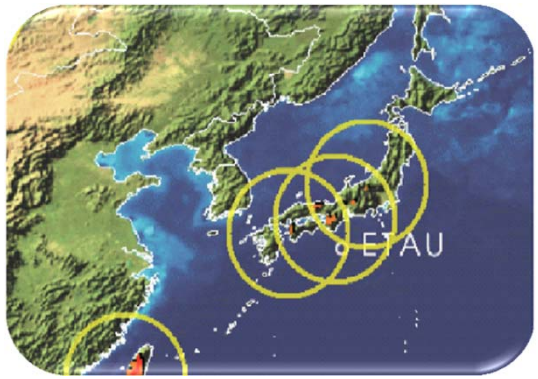
High-Resolution Unified Global Precipitation Data Products for Societal Applications

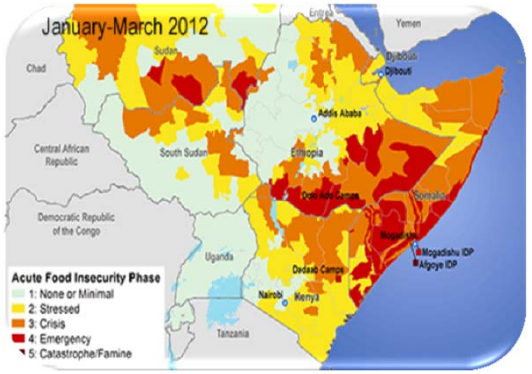
Global Flood Monitoring



Freshwater Management

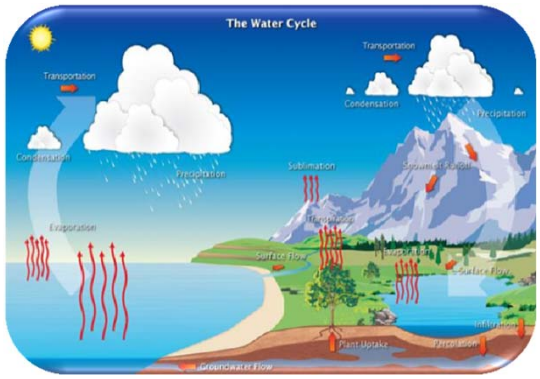
Landslide Hazard Forecasts

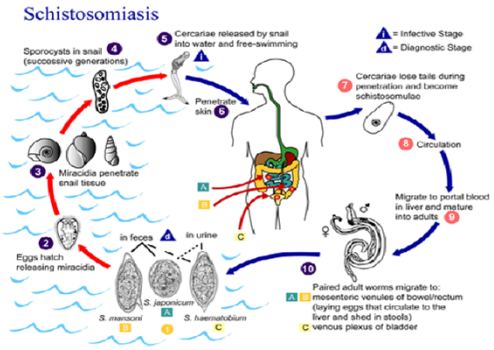




Crop Forecastin g

Land Surface Modeling





Tracking of Water-borne Diseases

Summary

GPM is an international satellite mission to unify and advance precipitation measurements from a constellation of microwave sensors for research and applications

- Advanced active/passive sensor capabilities
  - *Higher sensitivity to light rain and solid precipitation than TRMM instruments*
  - *Insights into microphysical properties of precipitation*
- Next-generation unified global precipitation data products
  - *Consistent radiometric data from a constellation of microwave sensors*
  - *Unified precipitation retrieval using a common hydrometeor database consistent with combined DPR/GMI measurements*
- Near real-time data for operational use and societal applications
- GPM is the first implementation of the CEOS Precipitation Constellation for meeting GEOSS objectives and the societal needs identified by the GEO.

CEOS: Coordination Group on Meteorological Satellites
GEOSS: Global Earth Observation System of Systems
GEO: Group on Earth Observations