Keeping an eye on the Blue Marble: How NASA studies Earth's weather, climate and hydrology from space

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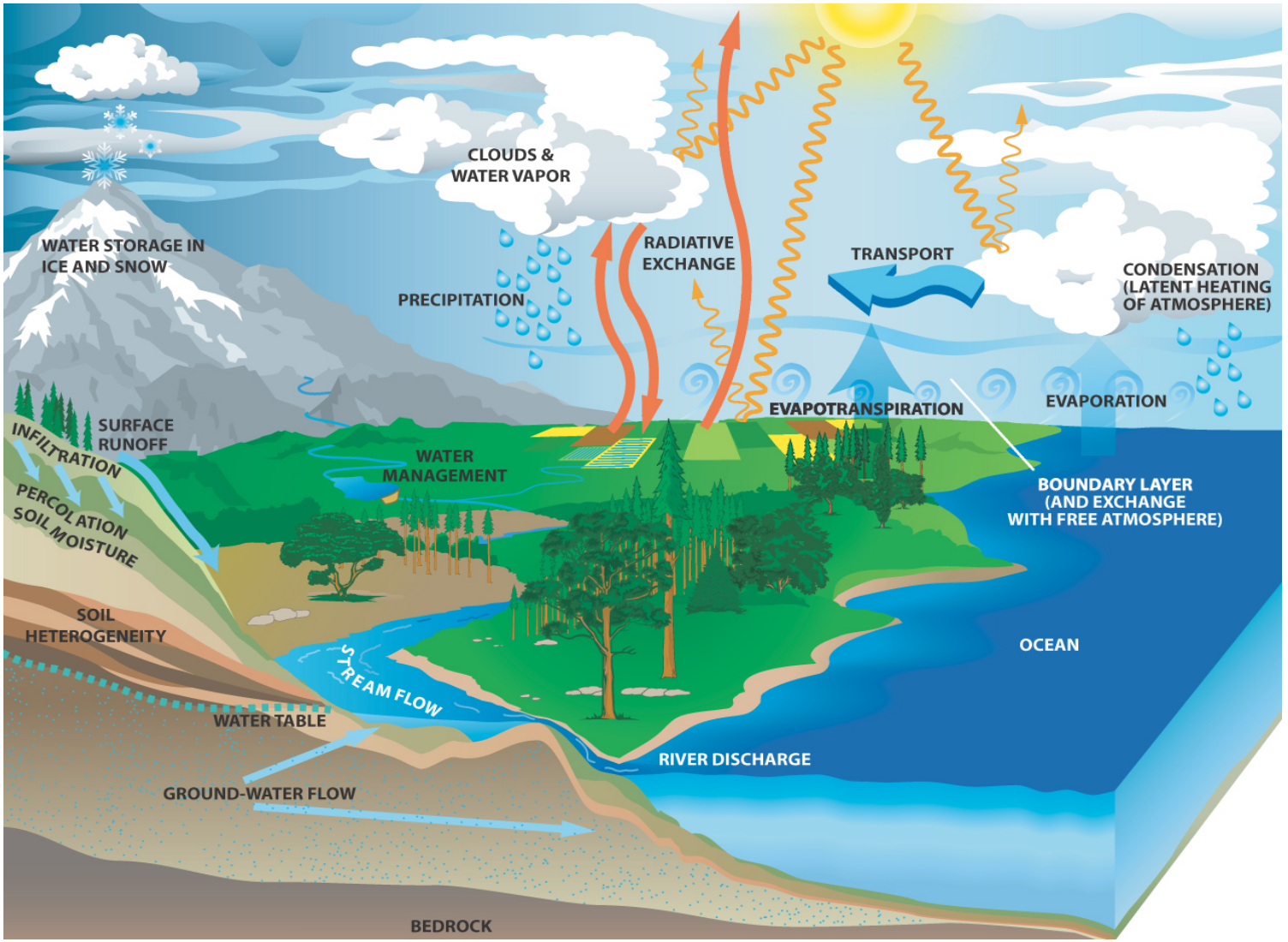
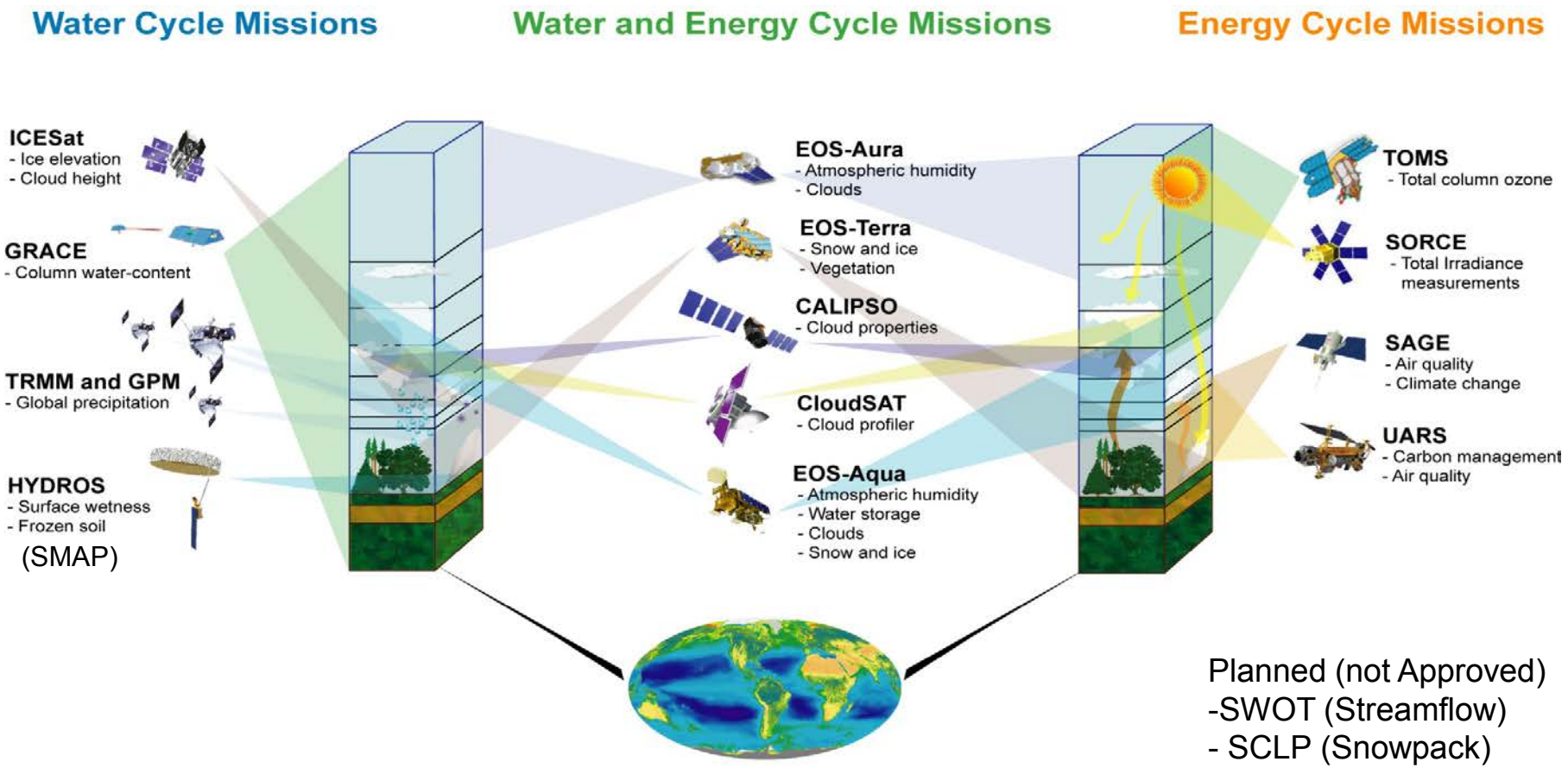
3-27-2014

http://pmm.nasa.gov

What are we really studying?



NASA's Water and Energy Satellites



Planned (not Approved)
-SWOT (Streamflow)
- SCLP (Snowpack)

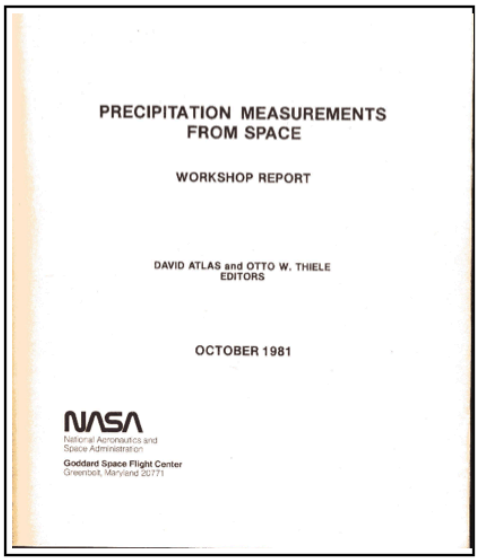
Complementary Water and Energy Cycle Missions

GLOBAL PRECIPITATION MEASUREMENT

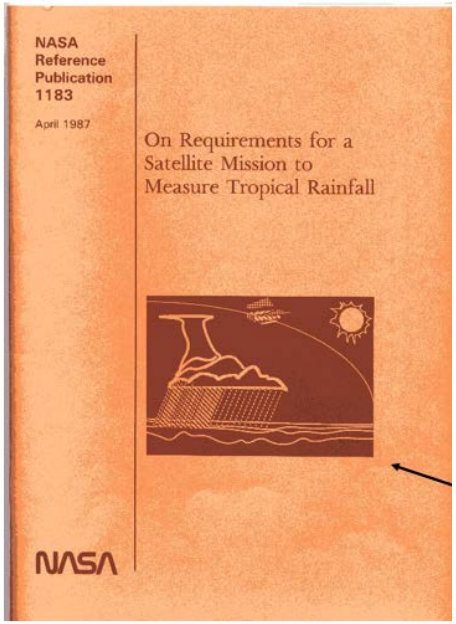
NASA Operating Missions

TRMM Launched November 27th, 1997

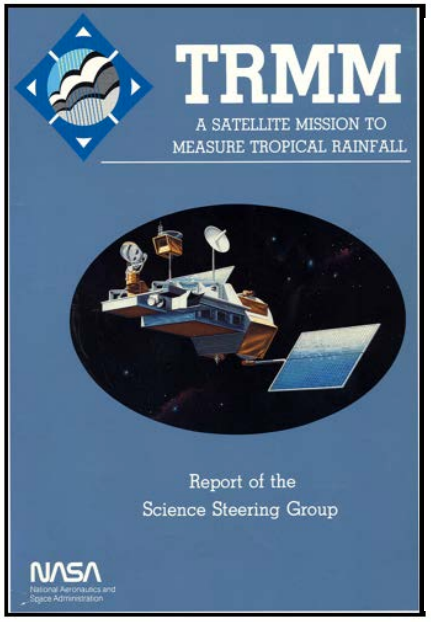
1981



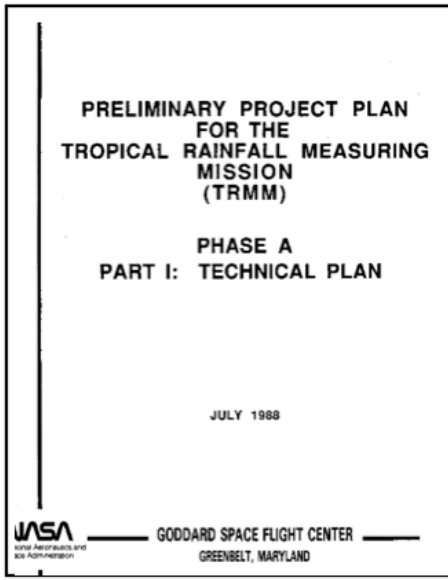
1987- TRMM concept proposed



1988- TRMM Steering Group



1988- Phase A plan for TRMM



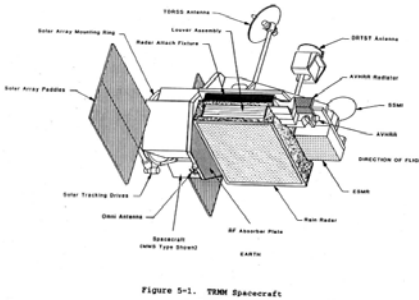
Instrument Payload:

TRMM Microwave Imager (TMI)
10, 19, 37, 86 GHz, conical scanning

Precipitation Radar (PR) [Japan]
14 GHz, cross-track scanning

Lightning Imaging Sensor (LIS) [MSFC]
Staring optical array

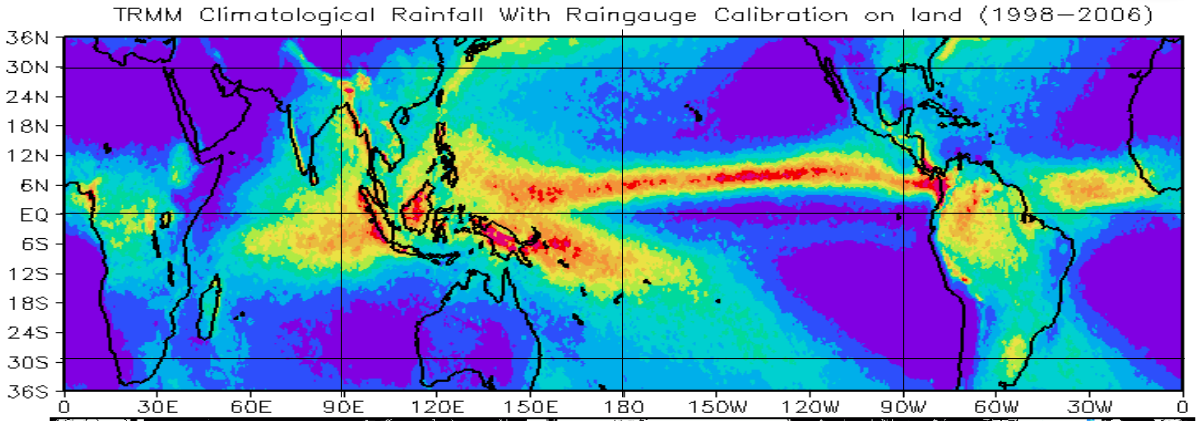
Visible IR Scanner (VIRS)
5-channel, cross-track scanning



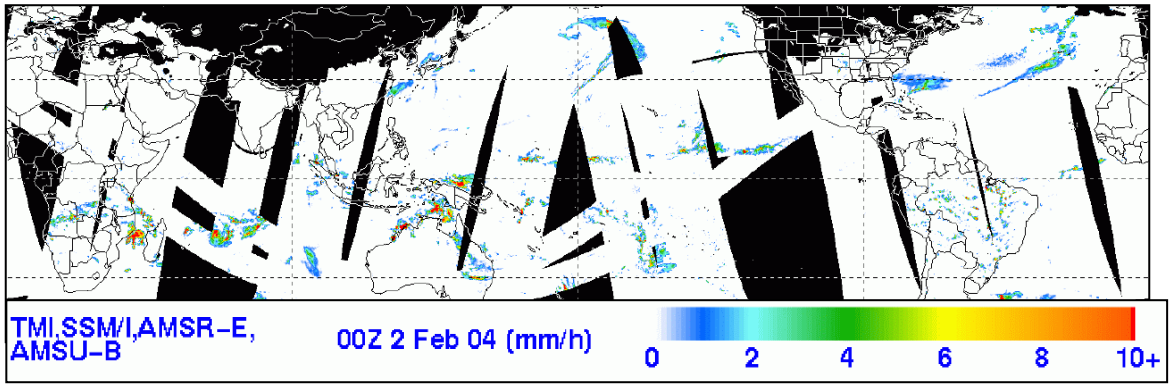
TRMM's legacy

GLOBAL PRECIPITATION MEASUREMENT

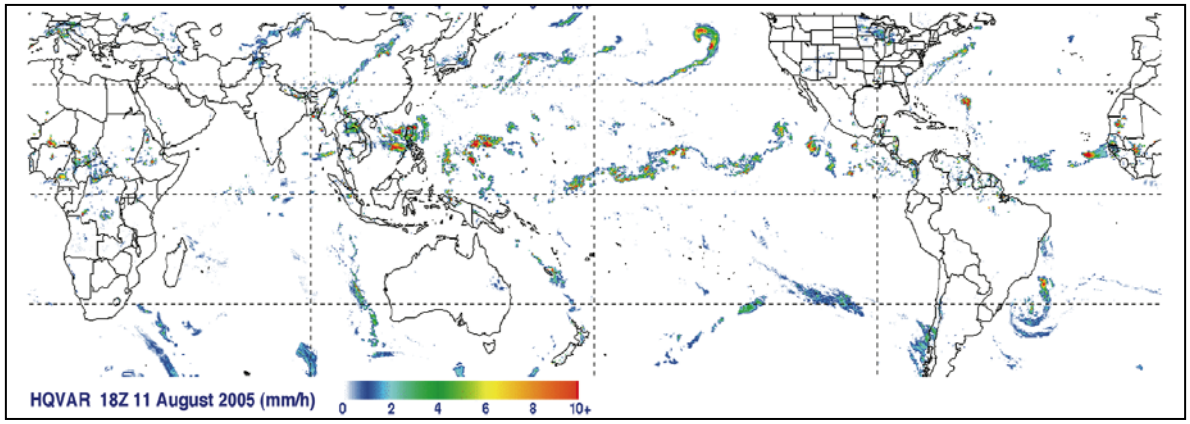
TRMM Climatology in the tropics and subtropics. Now has 16+ years of data to evaluate daily to interannual cycles



3-hour window with passive microwave information (gap filled with Geo-IR)
Calibrated by TRMM

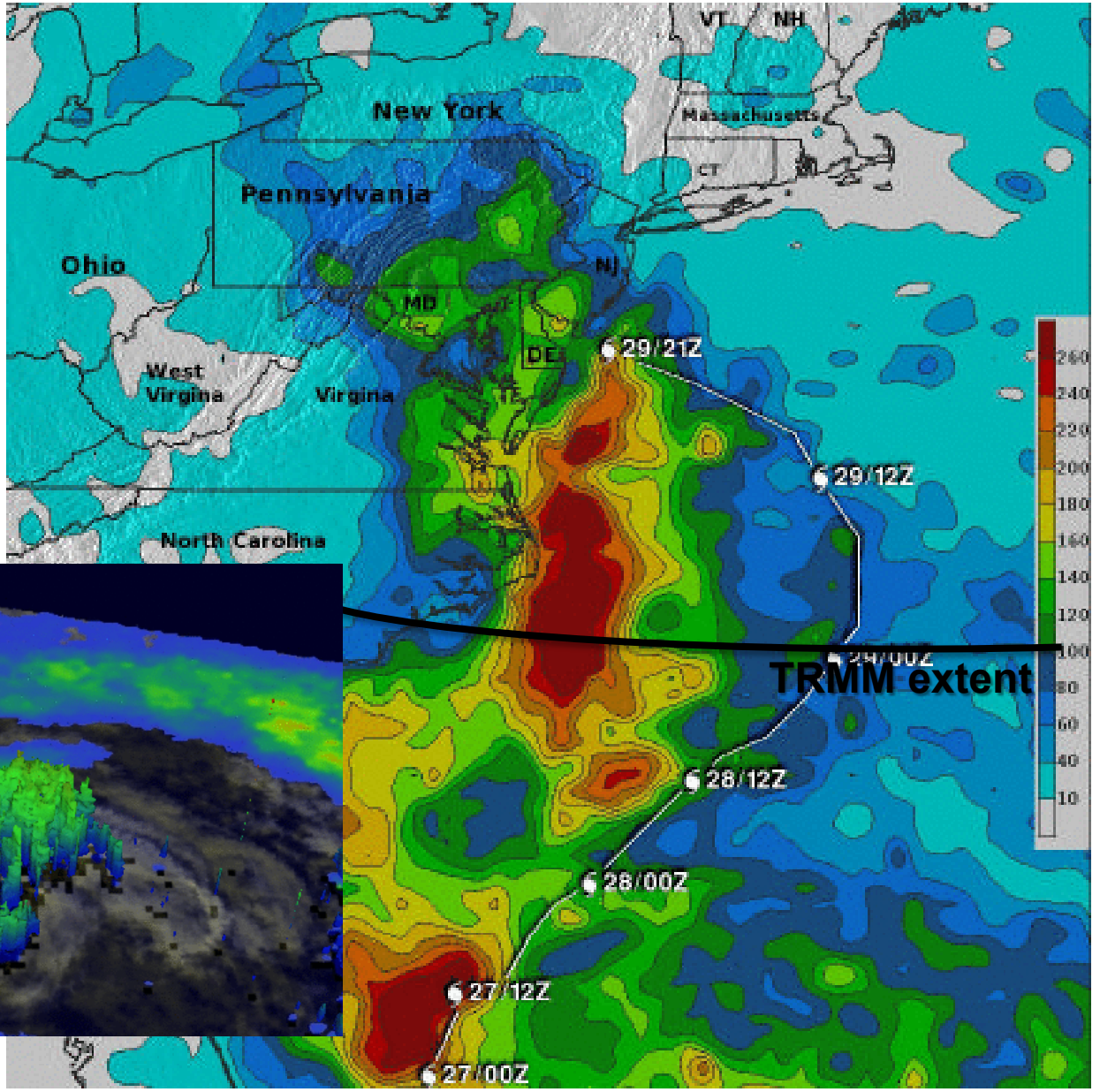


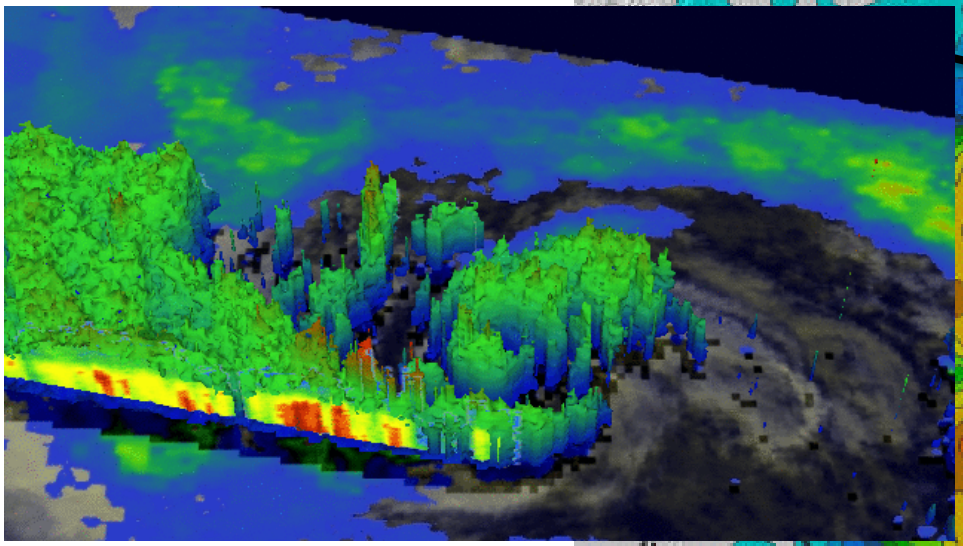
Near real-time product available ~6-12 hours after observation time



Hurricane Sandy (Oct. 22-31st, 2012)

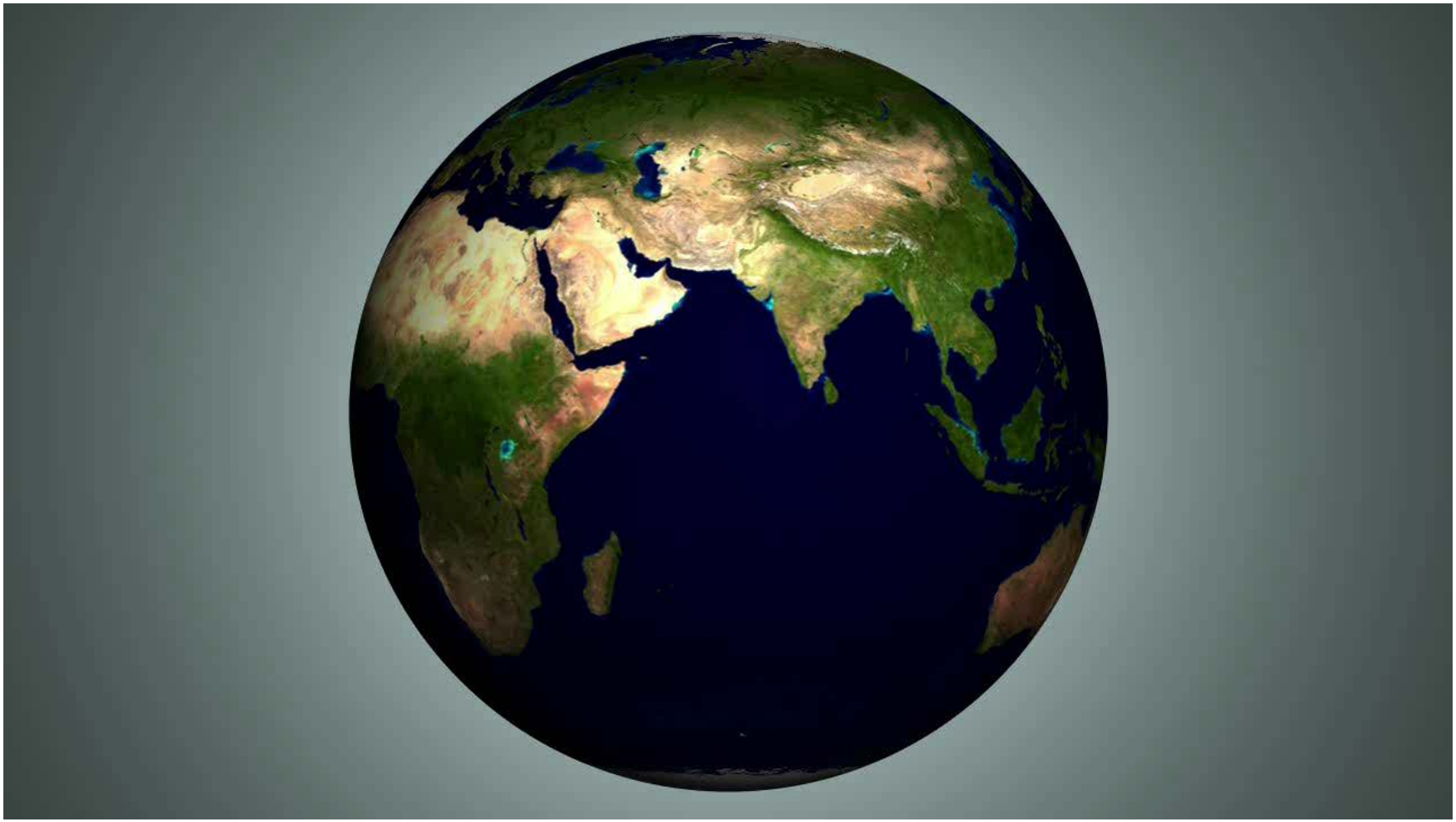
TRMM image on Oct. 28th





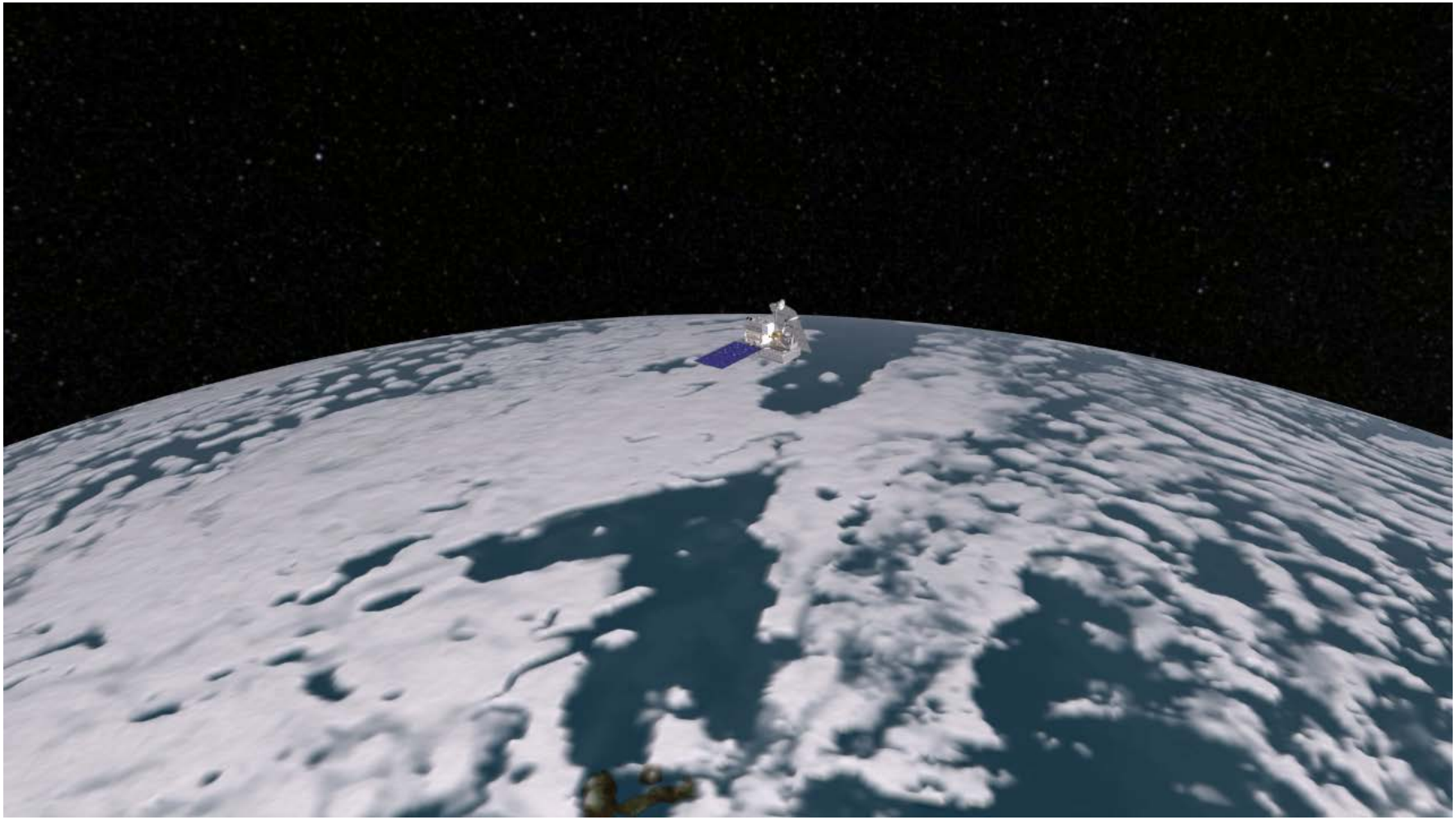
http://youtu.be/0_2pcVIJvBM

Introducing Global Precipitation Measurement (GPM)



TRMM versus GPM coverage animation: http://svs.gsfc.nasa.gov/goto?11165
GPM constellation animation:
http://gpm.nasa.gov/education/videos/global-precipitation-measurement-constellation

The GPM Core Observatory

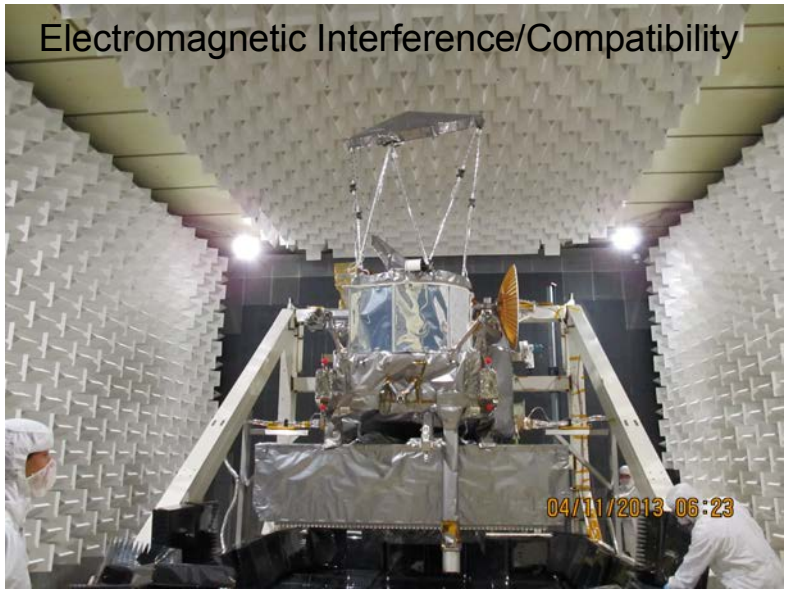


GPM instrument animation: http://svs.gsfc.nasa.gov/goto?4016

Satellite Integration and Testing

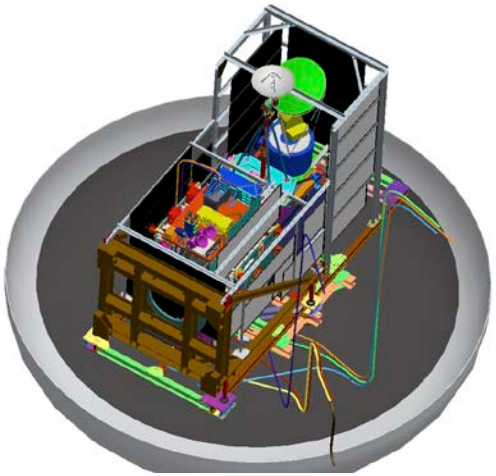
GLOBAL PRECIPITATION MEASUREMENT

Electromagnetic Interference/Compatibility



Vibration and Acoustic Testing

GPM Core Observatory in the Space Environmental Simulator at Goddard Space Flight Center



Mission Operations Control

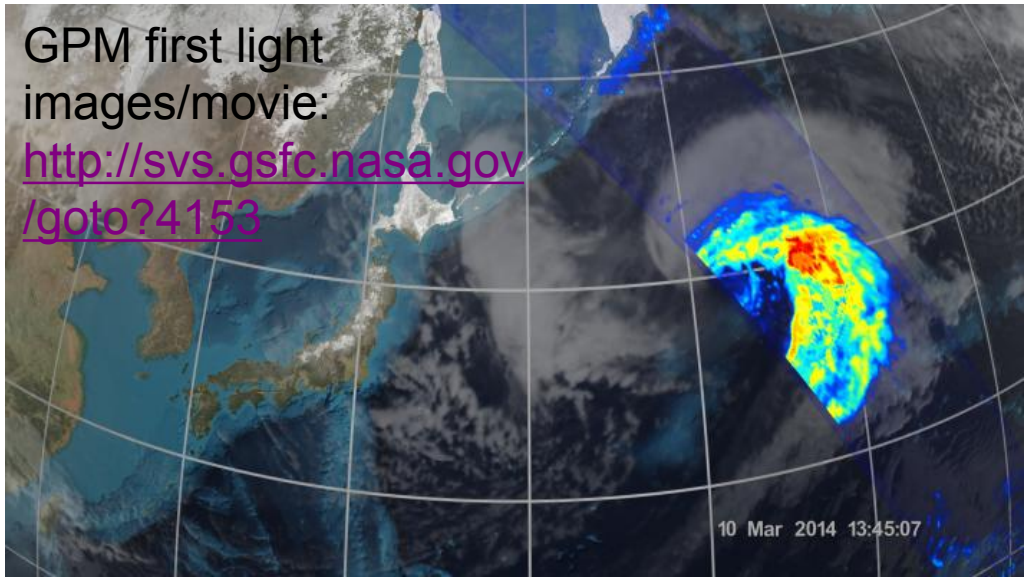
Launched at 1:37 p.m. EST, Feb 27, 2014

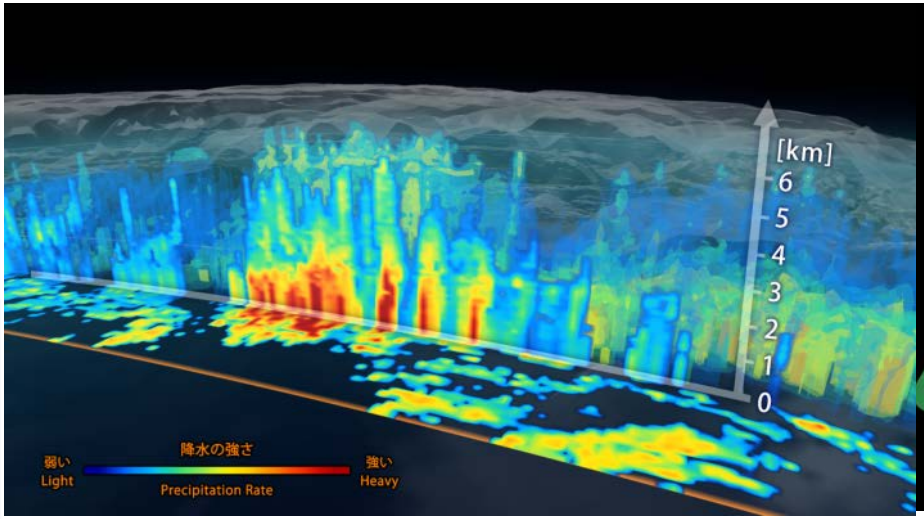
GPM launch video: http://svs.gsfc.nasa.gov/goto?11496

GPM First Light Imagery!

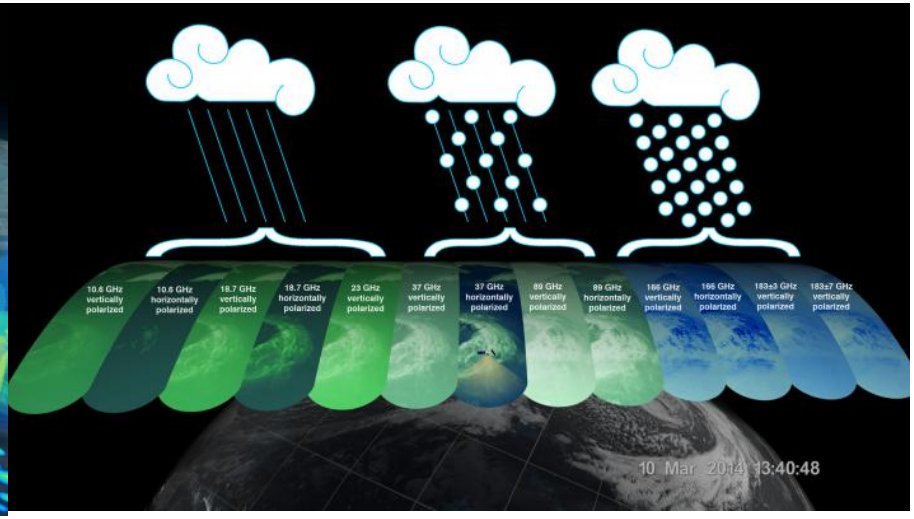
On March 10, the Core Observatory passed over an extra-tropical cyclone about 1055 mi (1700 km) due east of Japan's Honshu Island.

The storm contained heavy rain and snow and is the first time a satellite has been able to view an extratropical storm in 3D





Dual-frequency Precipitation Radar view inside the extra-tropical cyclone observed on March 10, 2014



GMI instrument showing 13 channels, each sensitive to different types of precipitation

GLOBAL PRECIPITATION MEASUREMENT

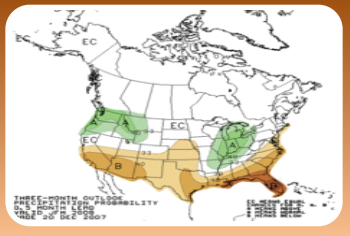
Societal Benefit Areas

Extreme Events and Disasters

- Landslides
- Tropical cyclones
- Floods
- Re-insurance

Water Resources and Agriculture

- Famine Early Warning System
- Water resource management
- Drought Monitoring
- Agricultural monitoring



Weather, Climate & Land Surface Modeling

- Numerical Weather Prediction
- Global Climate Modeling
- Land System Modeling

Public Health and Ecology

- Disease tracking
- Food Security
- Animal migration

GPM and TRMM applications: http://pmm.nasa.gov/applications

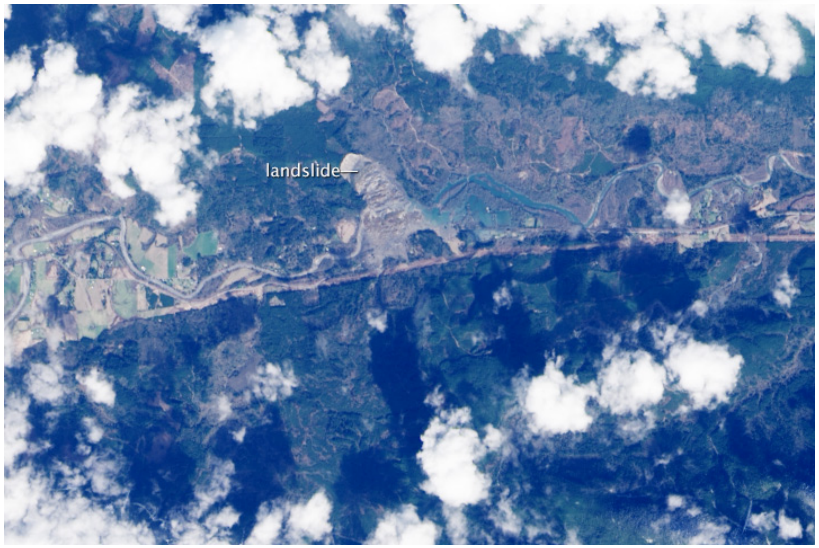
GLOBAL PRECIPITATION MEASUREMENT

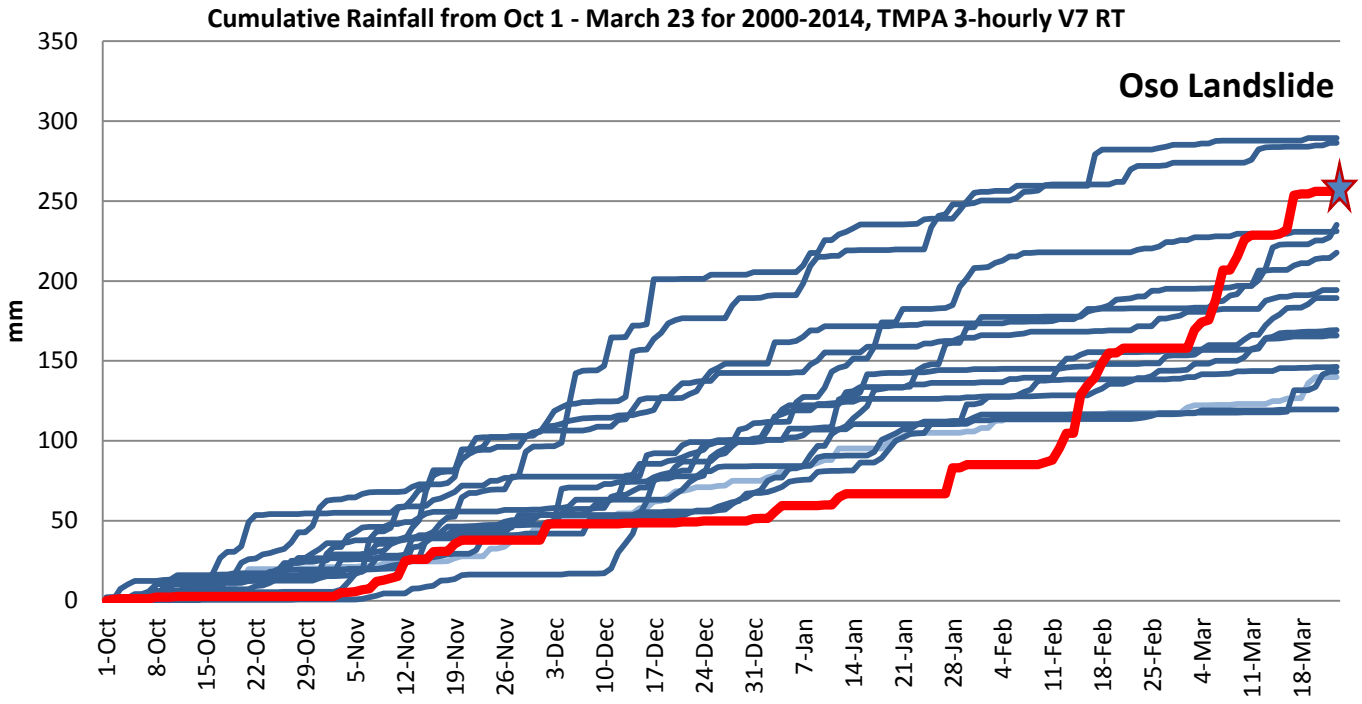
Severe Storms

Hurricane Katrina hot towers animation: http://svs.gsfc.nasa.gov/goto?3253

Landslide Hazard Forecasting

PHOTO BY TED S. WARREN /THE ASSOCIATED PRESS; GRAPHIC BY THE SEATTLE TIMES



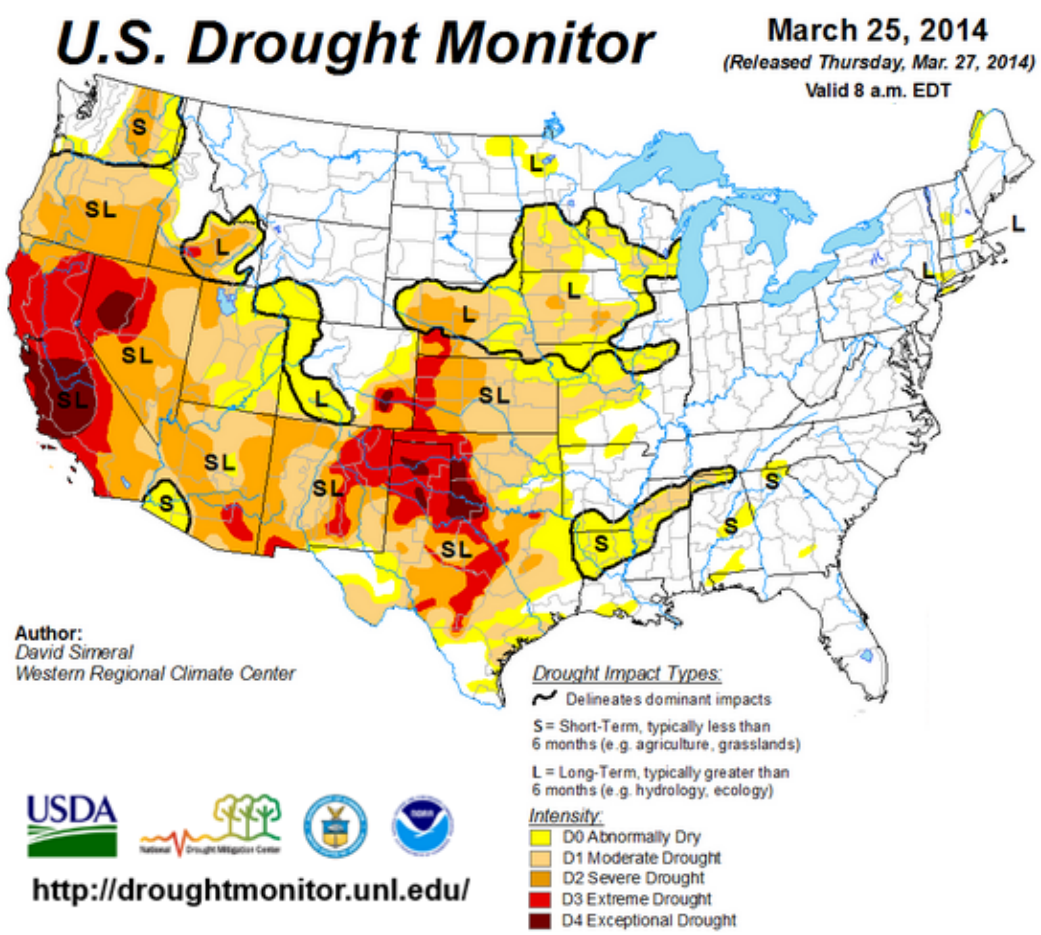


Above: Image from Landsat 8 pan-sharpened natural colour 15 m resolution data taken Sunday morning, March 23rd. Photo courtesy of Jesse Allan (Sigma Space Corp/NASA)

GLOBAL PRECIPITATION MEASUREMENT

Agriculture and Drought

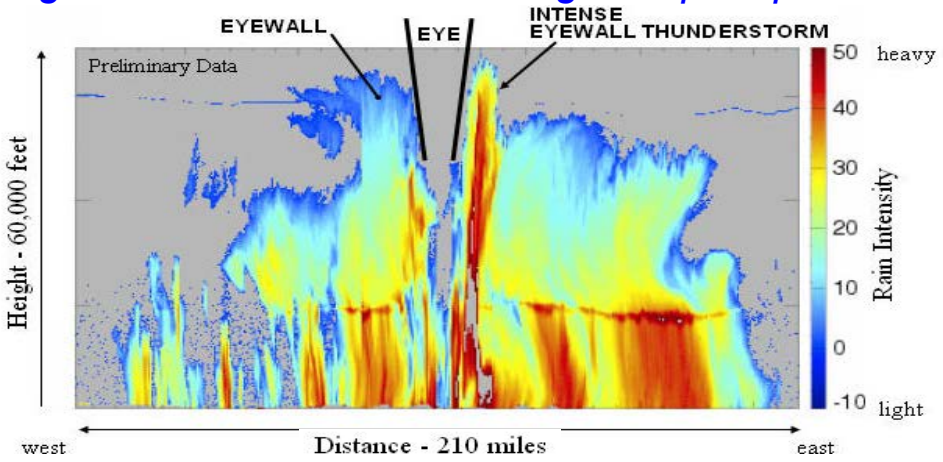
http://earthobservatory.nasa.gov/IOTD/view.php?id=83124



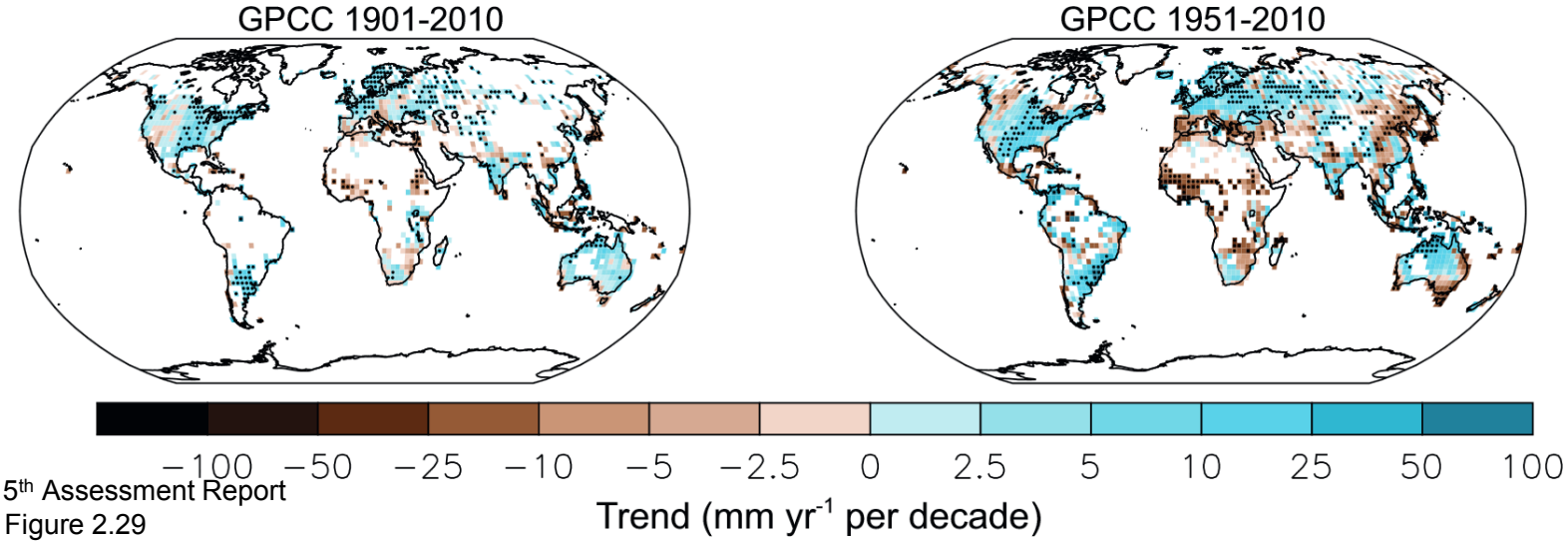
Impact of drought on California based on data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra and Aqua satellites, the map contrasts plant health from January 17 to February 1, 2014, against average conditions for the same period over the past decade.

Improved modeling capabilities

Improving Weather Forecasts through assimilation of accurate global precipitation data



Understanding precipitation's role in a changing climate

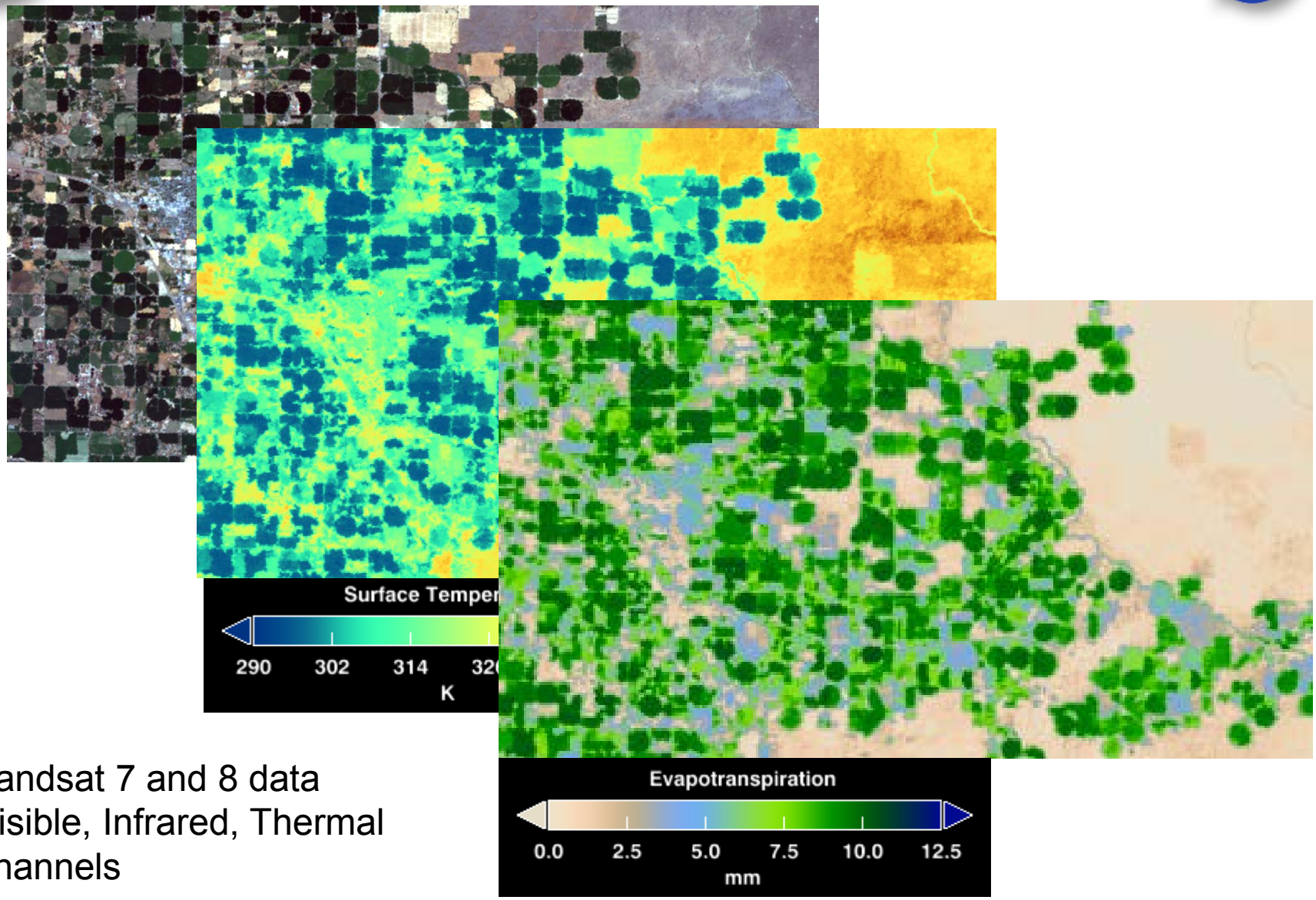


IPCC AR5 5th Assessment Report
Chapter 2, Figure 2.29

Global climate models predict significant changes in precipitation amount and intensity over the 21st century. We need global measurements to improve and validate these models.

GLOBAL PRECIPITATION MEASUREMENT

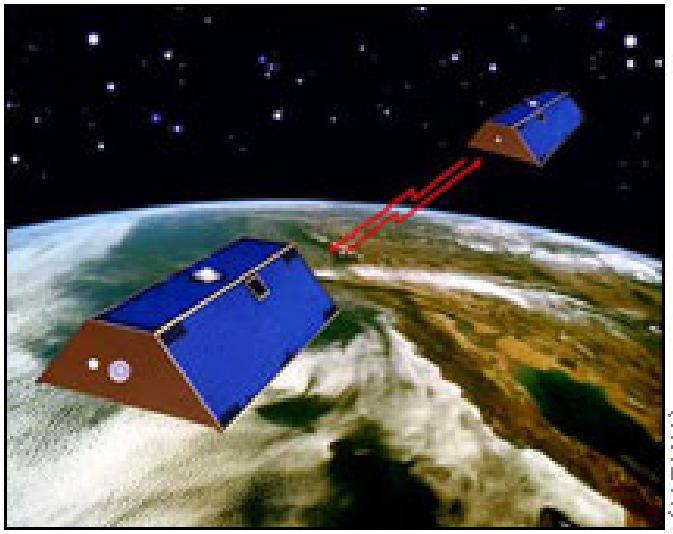
Measuring Evaporation From Space

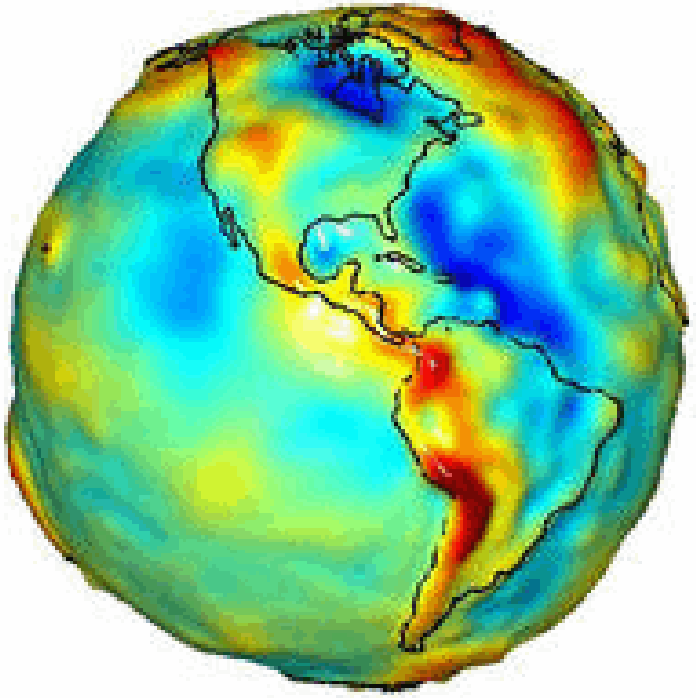


Landsat 7 and 8 data
Visible, Infrared, Thermal channels

Landsat: http://www.nasa.gov/landsat or http://landsat.usgs.gov/

- The Gravity Recovery and Climate Experiment (GRACE) is a joint satellite mission of NASA and German Aerospace Center (DLR) that can measure changes in total, column-integrated Terrestrial Water Storage (TWS) from space.
- GRACE is unique in its ability to monitor water at all levels, down to the deepest aquifer
- Provides a time-series of monthly time-variable gravity field estimates > mass changes in the ocean, of ice, and on land > affect the motion of all Earth satellites, including GRACE





http://www.nasa.gov/grace

Earth *Right* Now

In 2014, for the first time in more than a decade, five NASA Earth science missions are launching to space in a single year. The first, the GPM Core Observatory, launched on Feb. 27 (above).

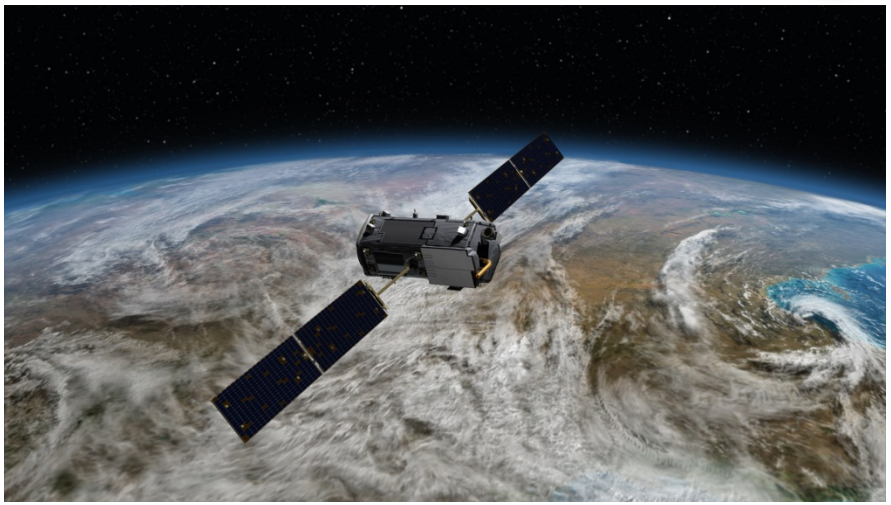
EARTH *RIGHT* NOW

www.nasa.gov/earthrightnow

http://www.nasa.gov/earthrightnow

Upcoming missions…

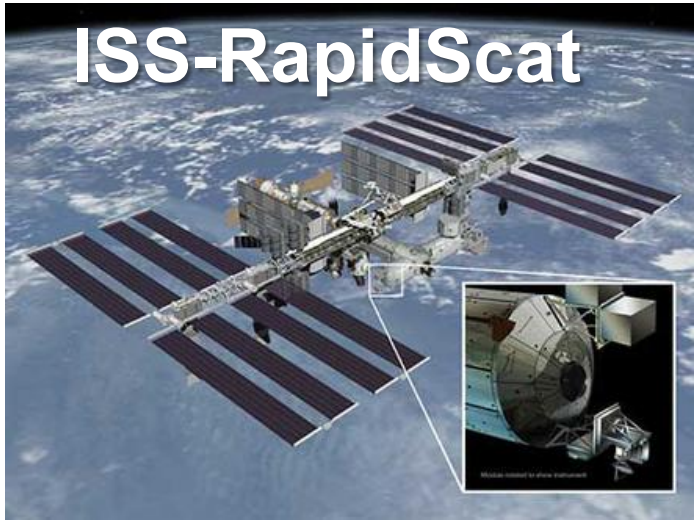
Orbiting Carbon Observatory-2 (OCO-2)



- Set to launch in July, 2014
- NASA's first dedicated remote sensing satellite to study atmospheric carbon dioxide
- Will be able to characterize CO_2 sinks and sources on a regional scale and quantify CO_2 seasonal variability

http://oco.jpl.nasa.gov/

ISS-RapidScat



- Set to launch in August (will be added to ISS)
- Measures ocean surface wind speed and direction
- To replace NASA's QuikScat satellite, which stopped collecting data in 2009

http://winds.jpl.nasa.gov/missions/RapidScat/

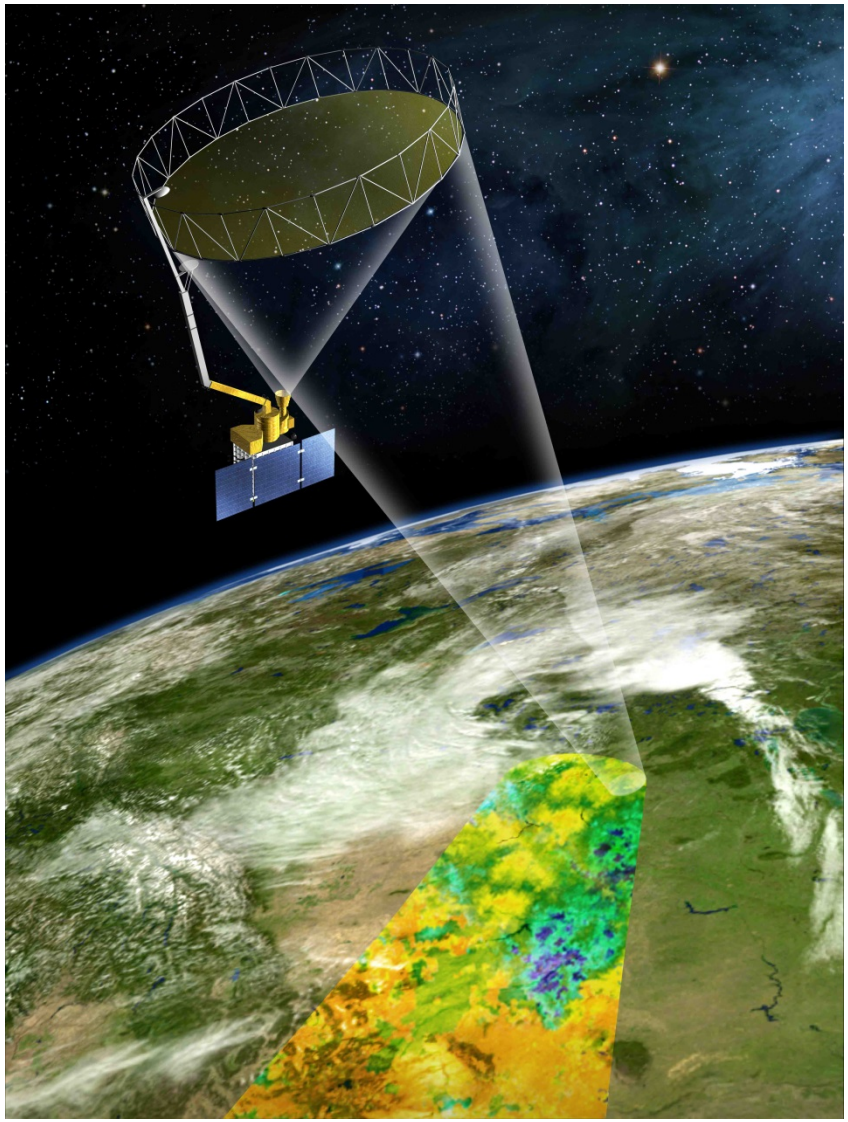
Cloud-Aerosol Transport System (CATS)

- Set to launch in September (will be added to the ISS)
- Measures the location, composition and distribution of pollution, dust, smoke, aerosols and other particulates in the atmosphere

http://www.nasa.gov/mission_pages/station/research/news/cats_in_space

Soil Moisture Active Passive (SMAP)

- Set to launch in November, 2014
- Global mapping of soil moisture and freeze/thaw state
- Soil moisture data will help scientists understand the processes that link the water, energy and carbon cycles, and improve weather and climate models and forecasting



http://smap.jpl.nasa.gov/

GLOBAL PRECIPITATION MEASUREMENT

www.nasa.gov/GPM

Twitter: @NASA_Rain

Facebook: NASA.Rain

More GPM videos, data visualizations, and animations:

http://svs.gsfc.nasa.gov/Gallery/GPM.html