

ARSET

Applied Remote Sensing Training

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Remote Sensing of Precipitation

Overview of Global Precipitation Measurement (GPM) and Tropical Rainfall
Measurement Mission (TRMM)

Amita Mehta

Amita.v.mehta@nasa.gov

Learning Objectives for this Session

- Understand the basics of remote sensing of precipitation
- Identify NASA satellites and sensors used for deriving precipitation
 - describe precipitation data available from these sensors
 - describe data used to track heavy or extreme precipitation and flood monitoring

Presentation Outline

- Precipitation Remote Sensing
 - *Advantages*
- Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurements (GPM) Mission
- TRMM and GPM Data Products
- TRMM/GPM Data Access
 - Demonstration Precipitation Processing System – STORM
 - Demonstration of Giovanni

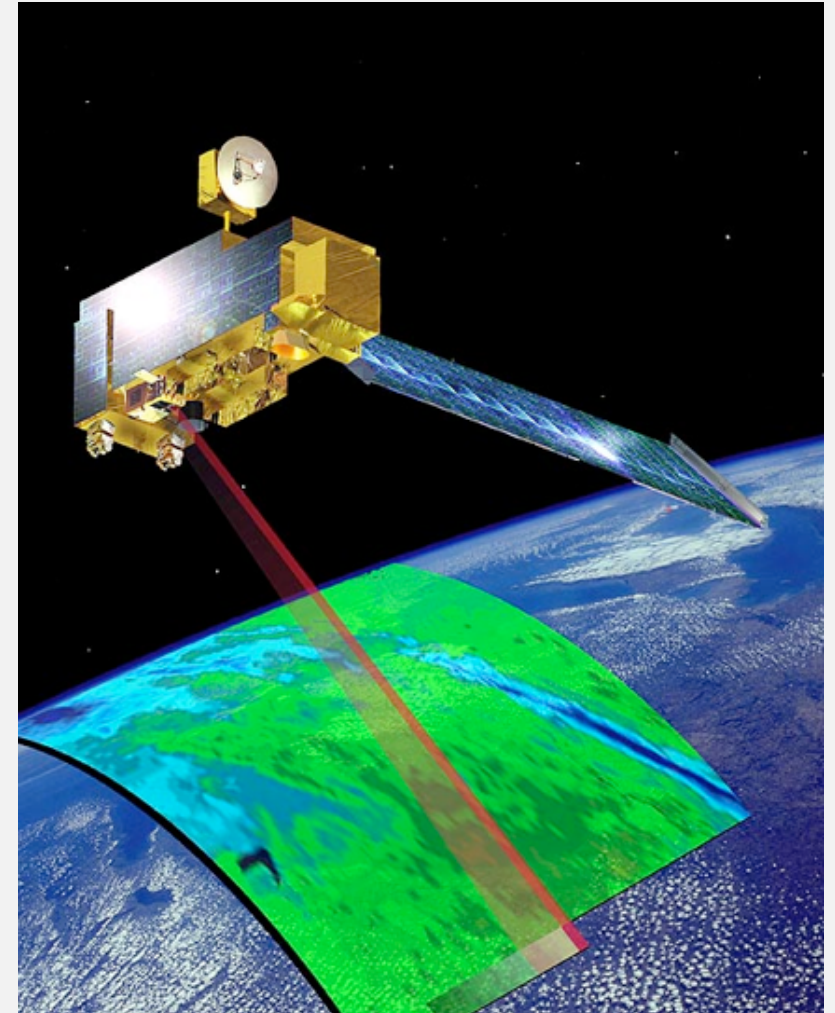
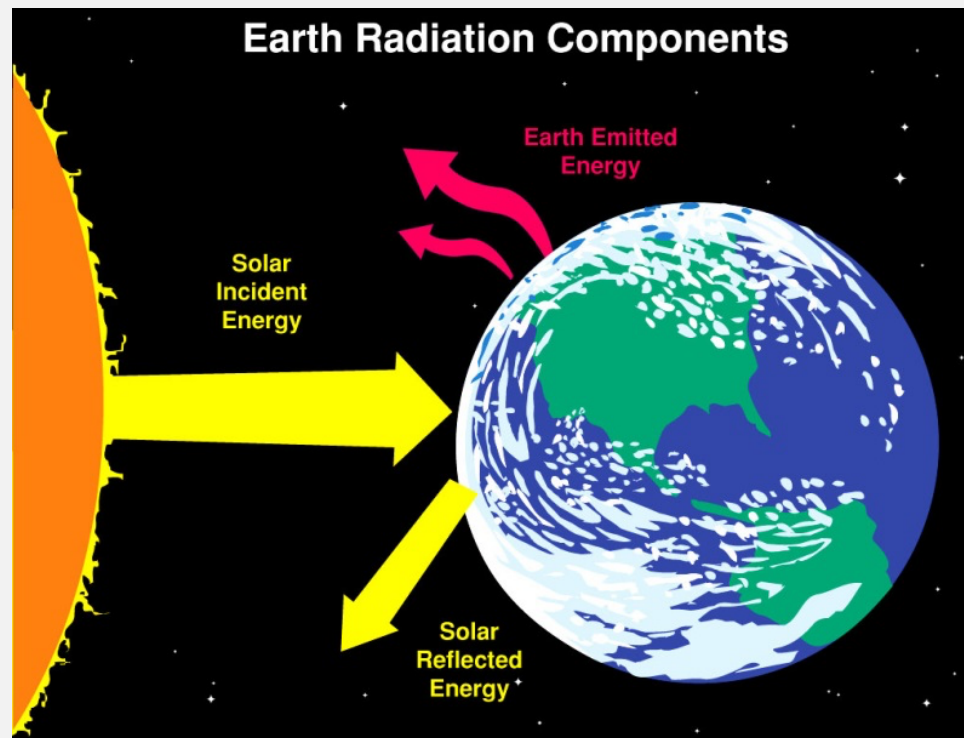
A topographic map showing terrain elevation with a color gradient from green (low elevation) to brown (high elevation). A river system is visible, winding through the landscape. A semi-transparent white rectangular box is overlaid on the map, containing the text 'Precipitation Remote Sensing' and a horizontal line below it.

Precipitation Remote Sensing

Satellite Remote Sensing

<http://arset.gsfc.nasa.gov/webinars/fundamentals-remote-sensing>

Satellites carry instruments or sensors that measure **electromagnetic radiation** coming from the Earth-atmosphere system



Electromagnetic Spectrum

<http://arset.gsfc.nasa.gov/webinars/fundamentals-remote-sensing>

Earth-Ocean-Land-Atmosphere System:

- Reflects solar radiation back to space
- Emits infrared and microwave radiation to space
- The intensity of reflected and emitted radiation to space is influenced by surface and atmospheric conditions
- Satellite measurements contain information about both the surface and atmospheric conditions

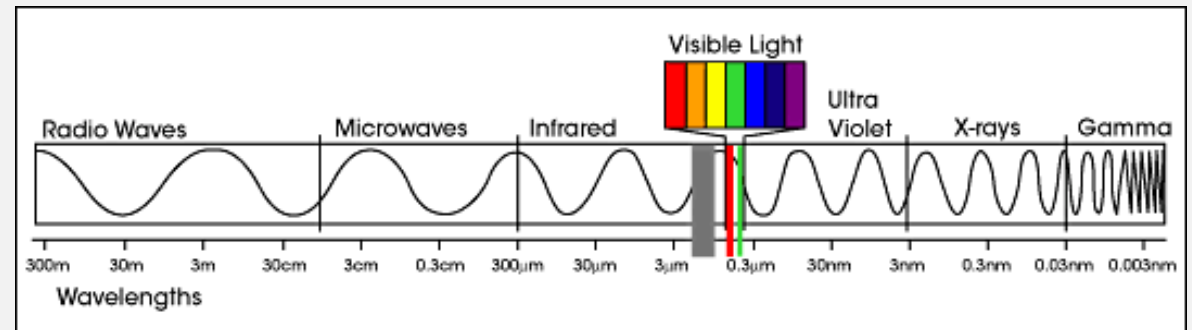
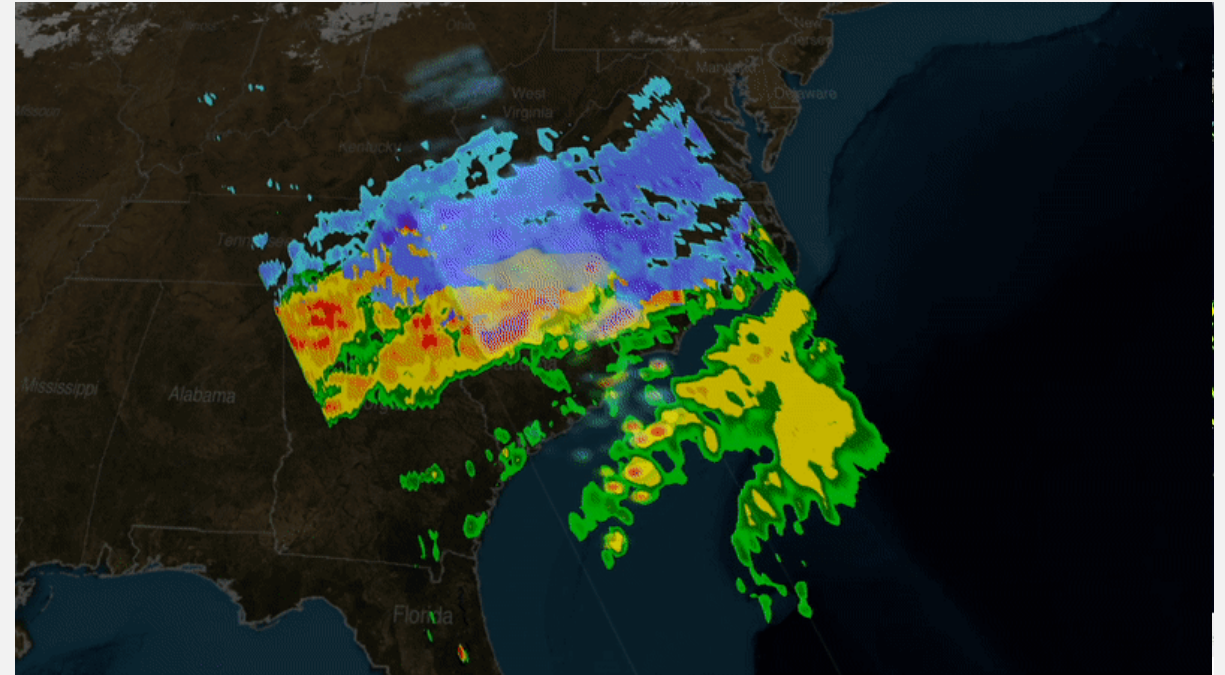


Image Credit: UCAR COMET, comet.ucar.edu

Advantages of Remote Sensing

- Provides information where surface-based measurements are not available and augments existing measurements
- Provide global and near-global coverage with consistent observations
- Provides large-scale perspective compared to point measurements



An April 2014 global map of precipitation and snowfall, provided by the Global Precipitation Measurement (GPM) mission. Animation depicting a Feb 2015 snowstorm over Kentucky, West Virginia, Virginia, and North Carolina. A slicing plane reveals the inside of the storm, showing where the precipitation switches from rain (yellow, green, and red) to snow and ice (light blue and purple)

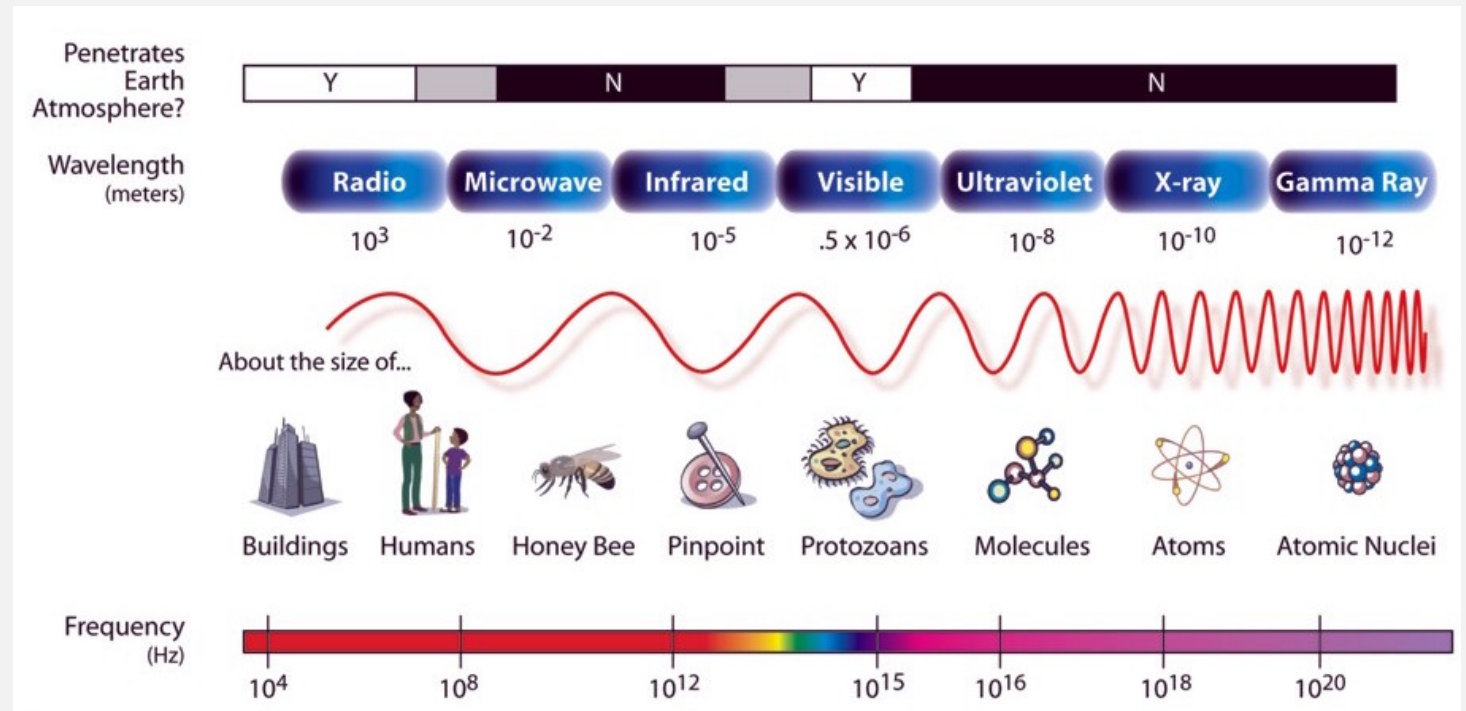
Record Drier than Average Much Drier than Average Near Average Wetter than Average Much Wetter than Average Record Wettest

Wed Jan 13 12:35:36 EST 2016

The dots on the global map above show land-based rain gauges.
Image Credit: NOAA

Precipitation Remote Sensing

- Derived from:
 - reflected visible radiation (0.5 to 0.6 micrometer wavelength)
 - emitted infrared radiation (10-12 micrometer wavelength)
 - emitted microwave radiation (10 to 183 GHz frequency or mm to cm wavelength)



Precipitation Remote Sensing

Passive Remote Sensing: Inferred indirectly from emitted infrared (IR) radiation by clouds

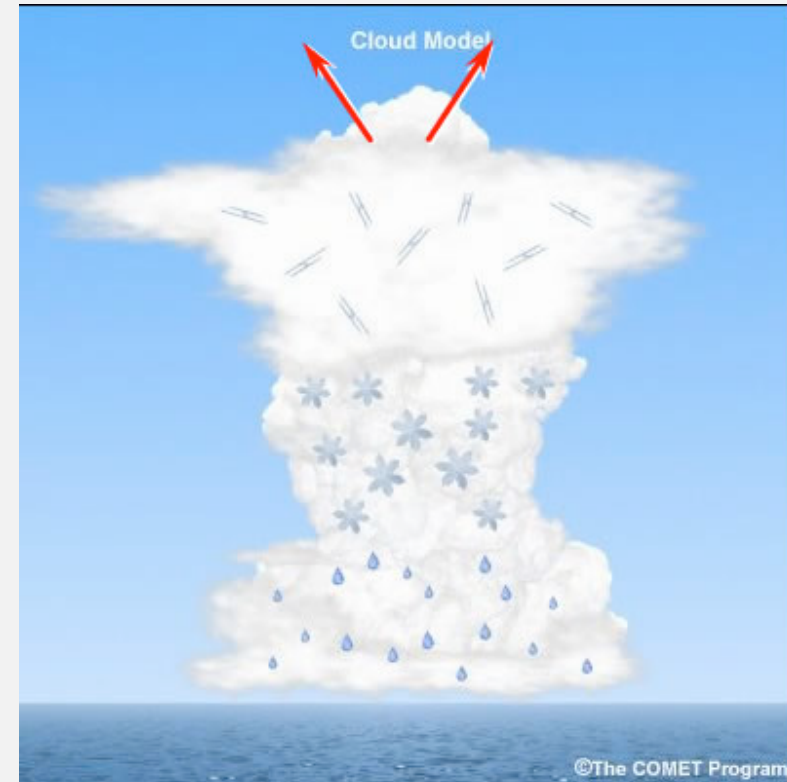
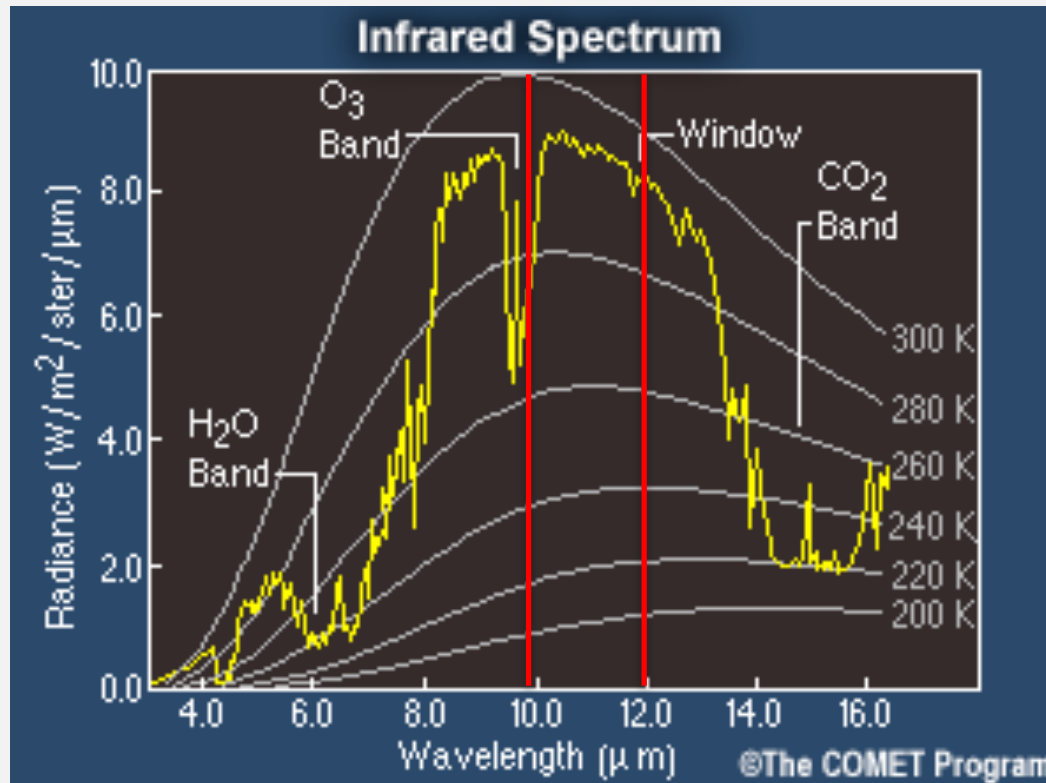


Image Credit (Left): UCAR COMET, comet.ucar.edu

Precipitation Remote Sensing

Passive Remote Sensing: Inferred indirectly from reflected solar visible (VIS) radiation by clouds

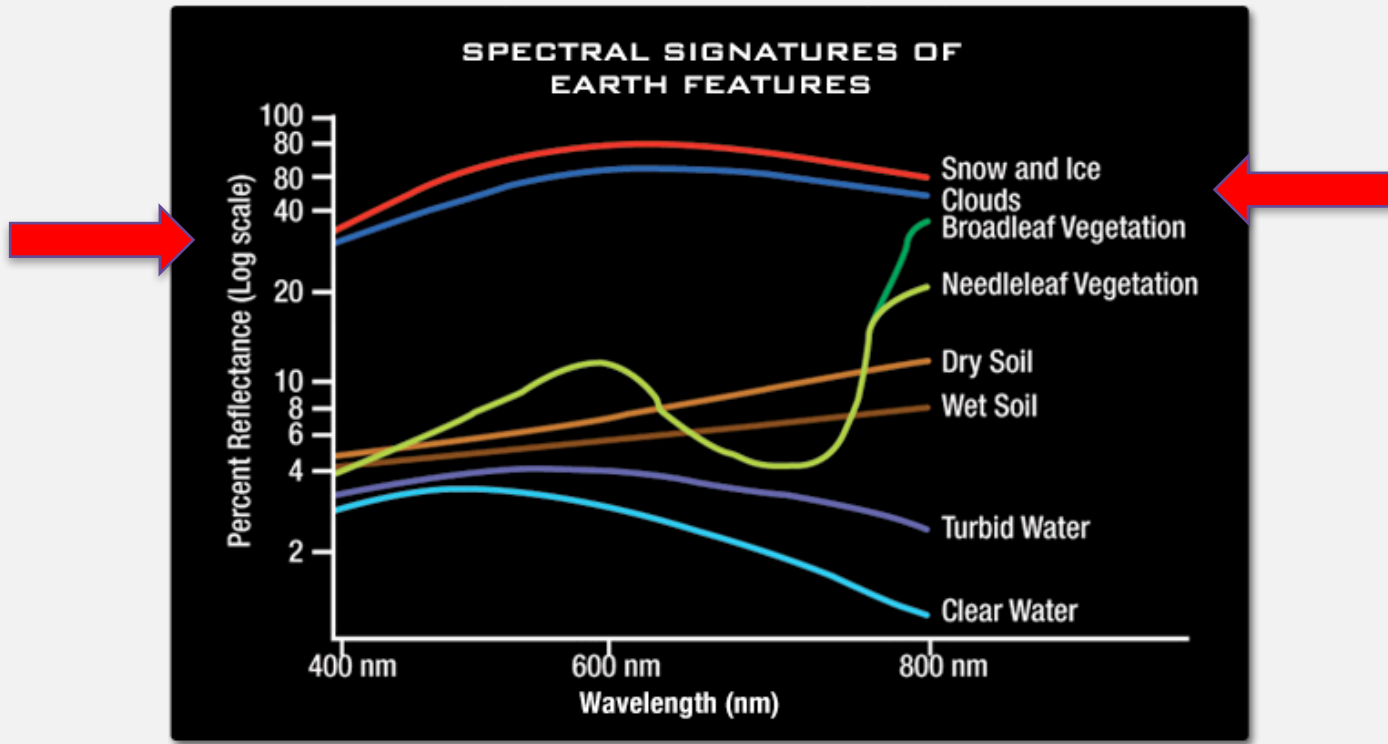
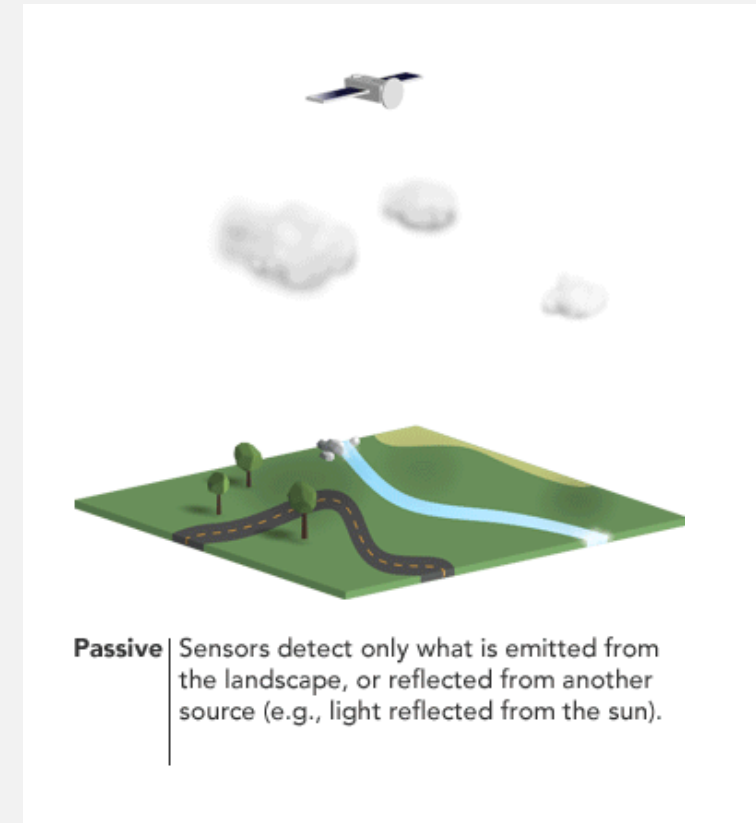
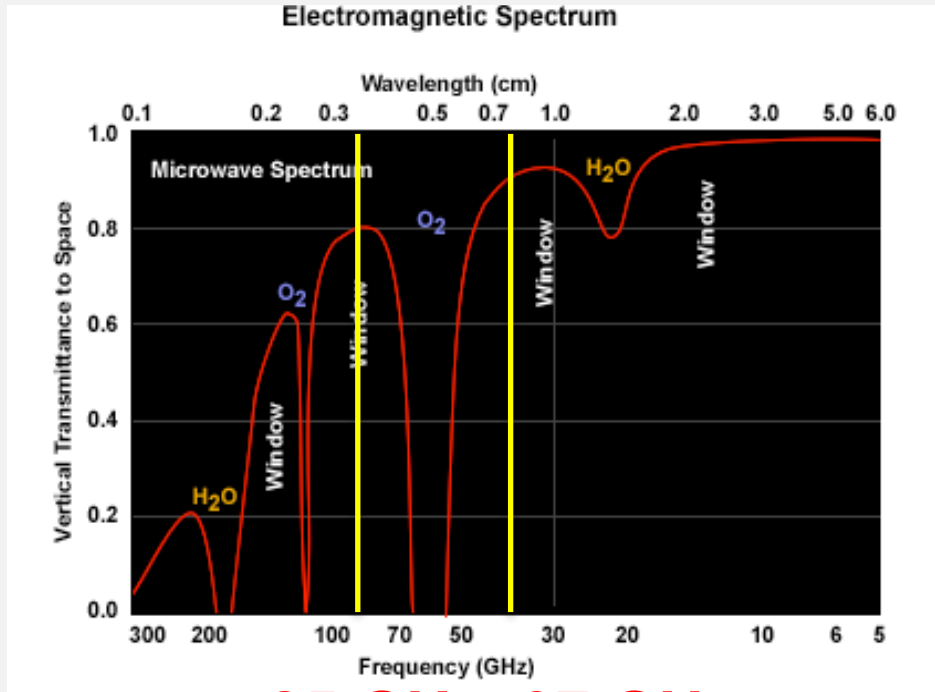


Image Credit (Left): UCAR COMET, comet.ucar.edu



Precipitation Remote Sensing

Passive Remote Sensing: Estimated from microwave radiation emitted or scattered by precipitation particles



85 GHz 37 GHz

- The lower frequencies, referred to as “emissions channels,” measure precipitation mainly from energy emitted by raindrops (37 GHz)
- The higher frequencies, or “scattering channels,” gather energy scattered by ice particles above the freezing level (85 GHz)

Image Credit (Left): UCAR COMET, comet.ucar.edu

Precipitation Remote Sensing

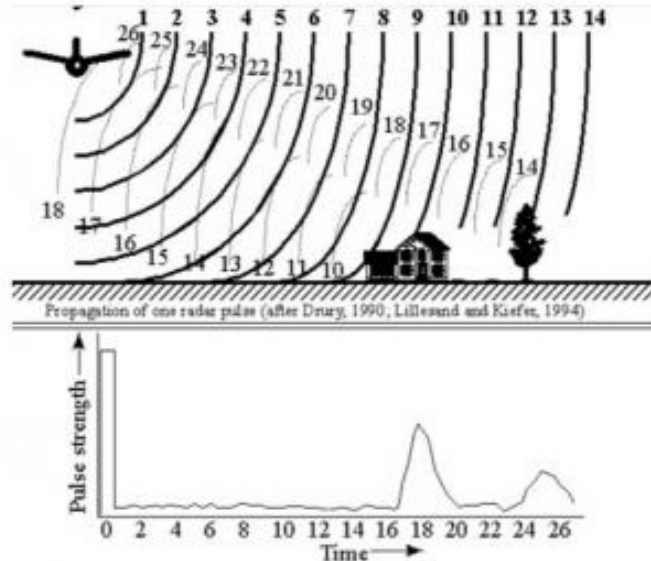
Active Remote Sensing: Estimated from back-scattered microwave radiation transmitted by radars



Active | Instruments emit their own signal and the sensor measures what is reflected back. Sonar and radar are examples of active sensors.

Active Remote Sensing

Source: Instrument pulse,
Needs power to operate



- NASA Satellites TRMM and GPM use K-band radar
- K-band generally has a frequency range within 27-40 GHz and 12-18 GHz

A topographic map showing a river system. The map uses a color gradient from green (low elevation) to brown (high elevation) to represent terrain. A prominent river flows from the top right towards the bottom right, with several tributaries. A semi-transparent white rectangular box is overlaid on the center of the map, containing the title text.

TRMM and GPM Precipitation Data

Tropical Rainfall Measurement Mission (TRMM)

<http://trmm.gsfc.nasa.gov>

- The first satellite dedicated to measuring tropical and subtropical rainfall
- Launched November 27, 1997, and ended April 15, 2015
- First satellite to carry a microwave precipitation radar
- Predecessor to Global Precipitation Measurement (GPM) Mission
- Joint mission between NASA and JAXA (the Japanese Space Agency)

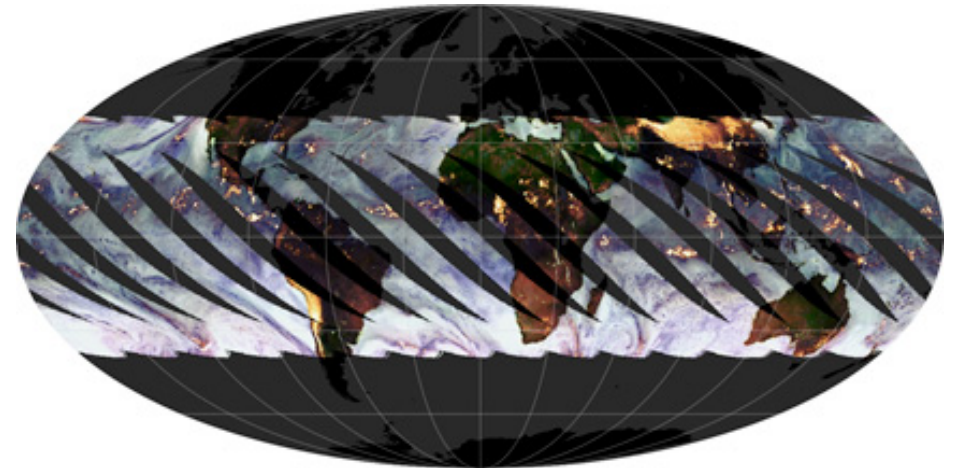


TRMM Satellite & Sensors

<http://trmm.gsfc.nasa.gov>

- In a non-polar, low-inclination orbit
- Altitude of approximately 350 km, raised to 403 km after August 23, 2001
- Spatial Coverage
 - 16 TRMM orbits a day covering global tropics between 35°S – 35°N latitude
- Sensors:
 - TRMM Microwave Imager (TMI)
 - Precipitation Radar (PR)
 - Visible and Infrared Scanner (VIRS)
 - Lightning Imaging Sensor (LIS)
 - Clouds and the Earth's Radiant Energy System (CERES)

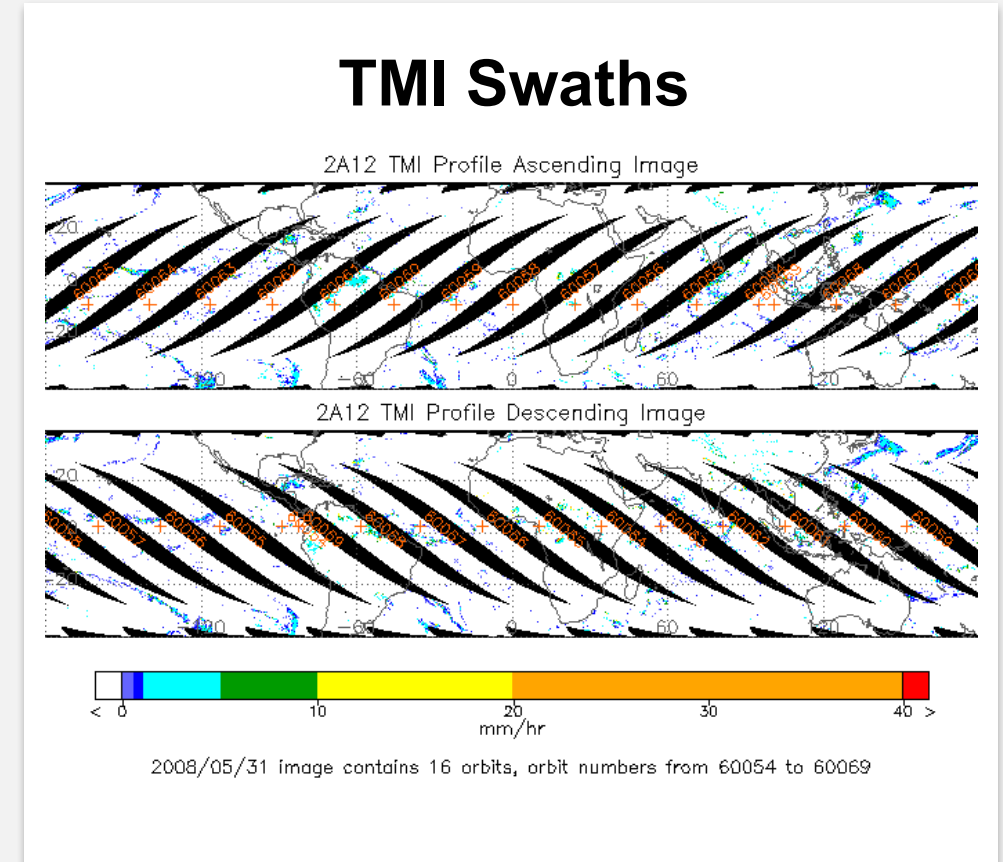
TRMM Orbits



TRMM Microwave Imager (TMI)

<http://pmm.nasa.gov/TRMM/TMI>

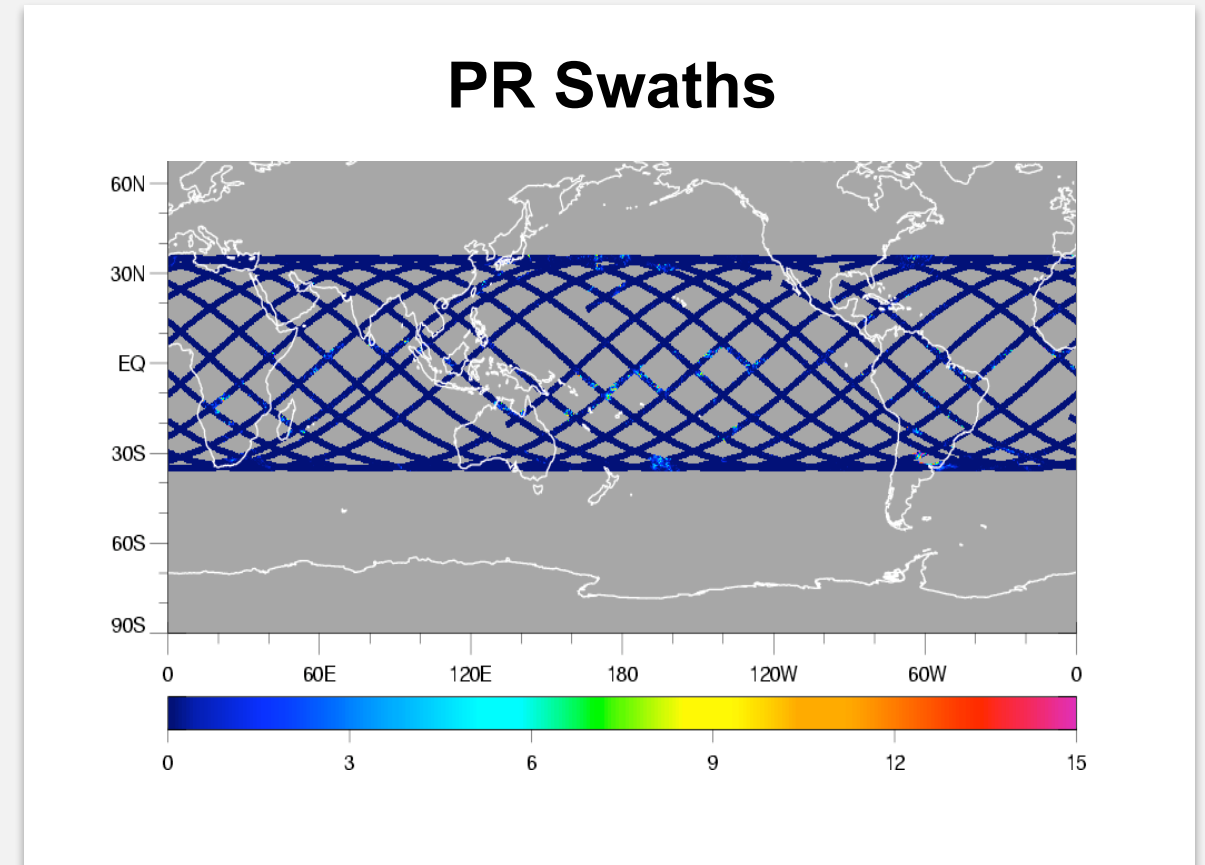
- Spatial Coverage and Resolution:
 - Coverage: -180° – 180° , 35°S – 35°N
 - Swath: 760 km (878 km after 8/2001)
 - Vertical Resolution:
 - 0.5 km from surface – 4 km
 - 1.0 km from 4-6 km
 - 2.0 km from 6-10 km
 - 4.0 km from 10-18 km
- Temporal Coverage and Resolution:
 - November 27, 1998 - April 15, 2014
 - 16 orbits per day
- Chanel Frequencies
 - 10.7, 19.4, 21.3, 37, 85.5 GHz



Precipitation Radar (PR)

<http://pmm.nasa.gov/TRMM/PR>

- Spatial Coverage and Resolution:
 - Coverage: 35°S – 35°N
 - Swath: 215 km (247 after 8/2001)
 - Spatial Resolution: 4.3 km (5 km)
 - Vertical Resolution: 250 m (from 0-20 km)
- Temporal Coverage and Resolution:
 - November 27, 1998 – October 7, 2014
 - ~16 orbits per day
- Frequency:
 - 13.6 GHz

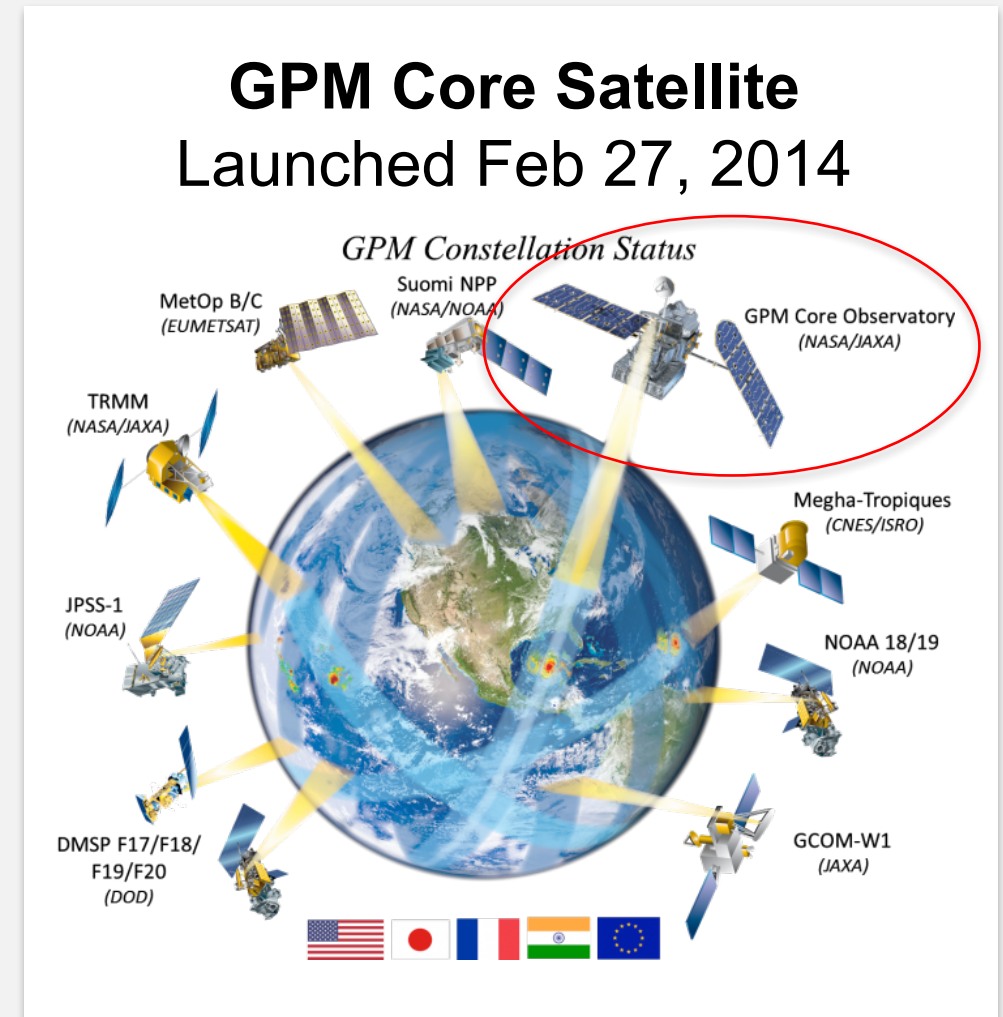


Kummerow, C., et. al, 1998: The tropical rainfall measuring mission (TRMM) sensor package, J. Atmos. Oceanic Technol., 15, 809-817.

GPM Satellite & Sensors

<http://pmm.nasa.gov/GPM>

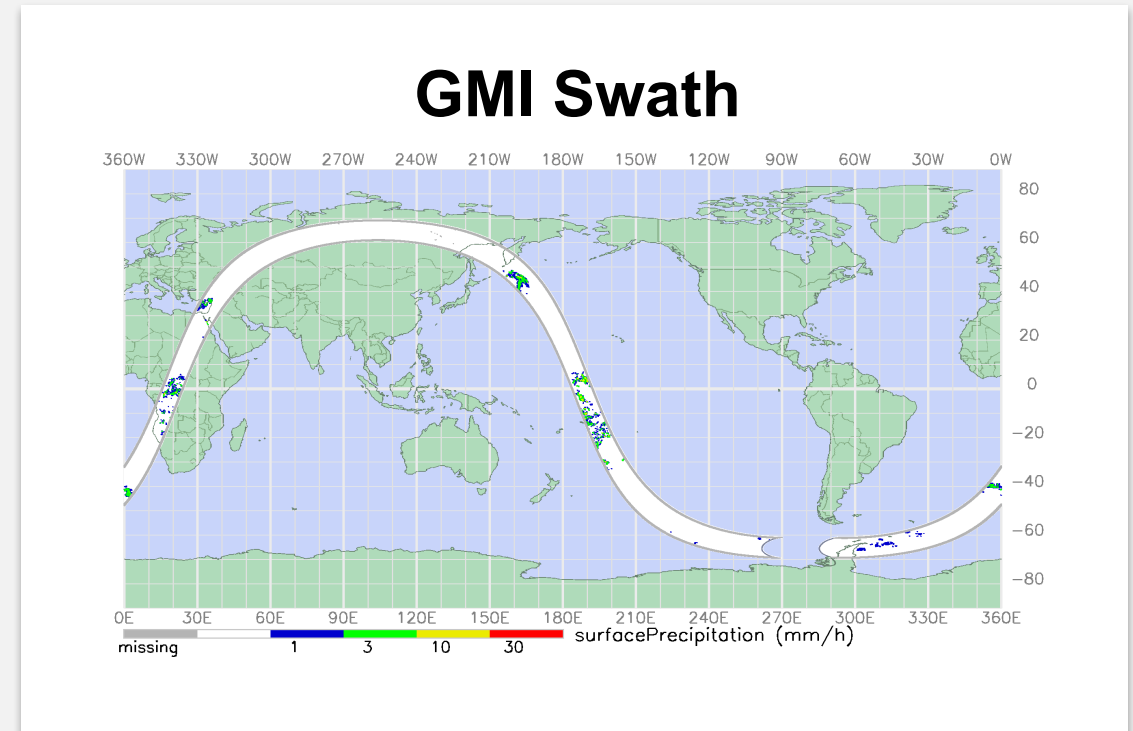
- GPM core satellite is in a non-polar, low inclination orbit
 - Altitude: 407km
- Spatial Coverage:
 - 16 T orbits a day covering global tropics, between 65°S-65°N
- Along with constellation of satellites, GPM has revisit time of 2-4 hrs. over land
- Sensors:
 - GMI (GPM Microwave Imager)
 - DPR (Dual Frequency Precipitation Radar)



GPM Microwave Imager (GMI)

<http://pmm.nasa.gov/GPM/flight-project/GMI>

- Spatial Coverage and Resolution:
 - Coverage: -180° - 180° , 65° S - 65° N
 - Swath: 885 km
 - Spatial Resolution: 4.4-32 km
 - Vertical Resolution:
 - 0.5 km from surface – 4 km
 - 1.0 km from 4-6 km
 - 2.0 km from 6-10 km
 - 4.0 km from 10-18 km
 - Temporal Coverage and Resolution
 - Feb 2014 – present
 - ~2-4 hr observations

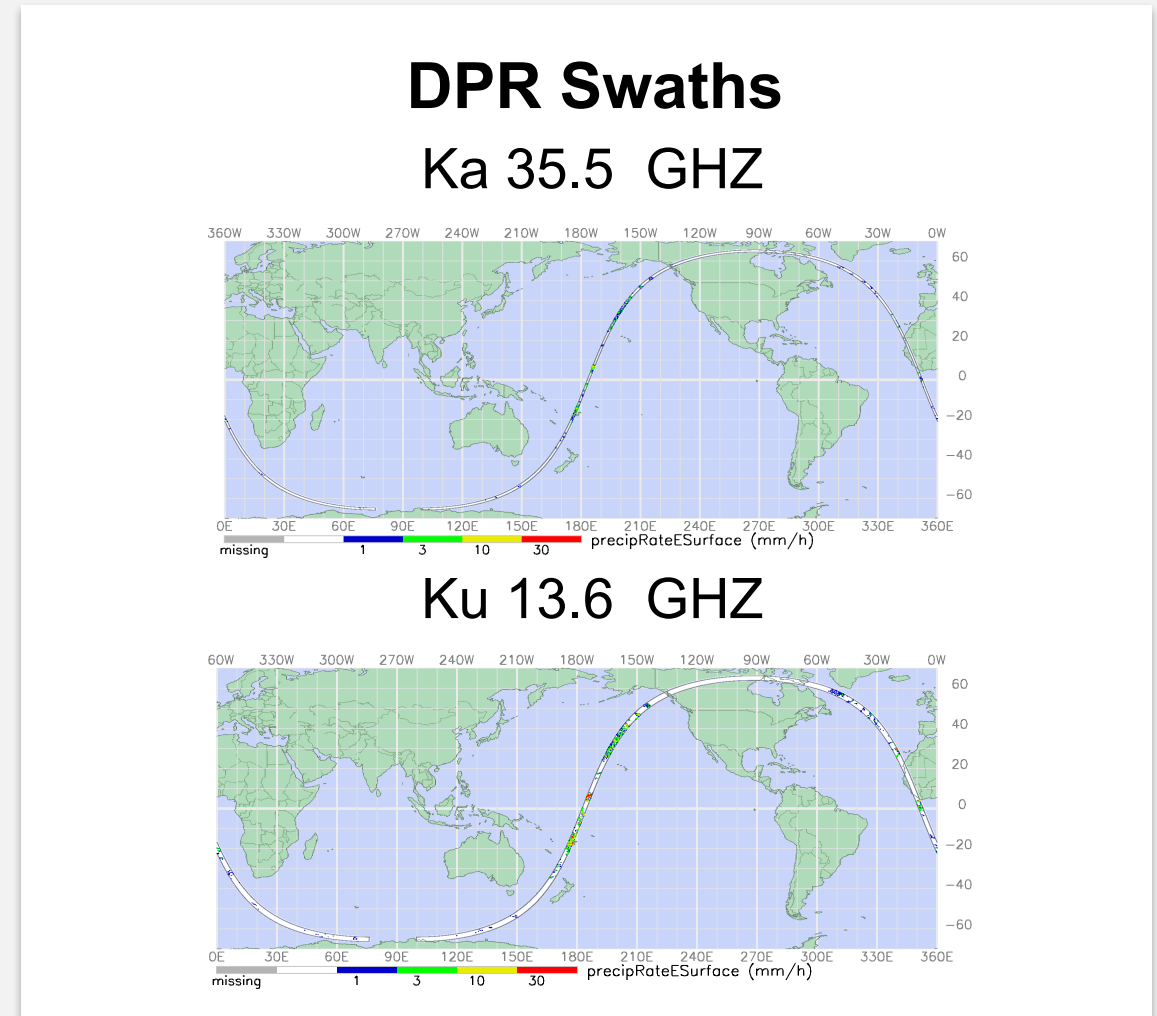


- Channel Frequencies:
 - 10.6, 18.7, 23.8, 36.5, 89, 166, 183 GHz

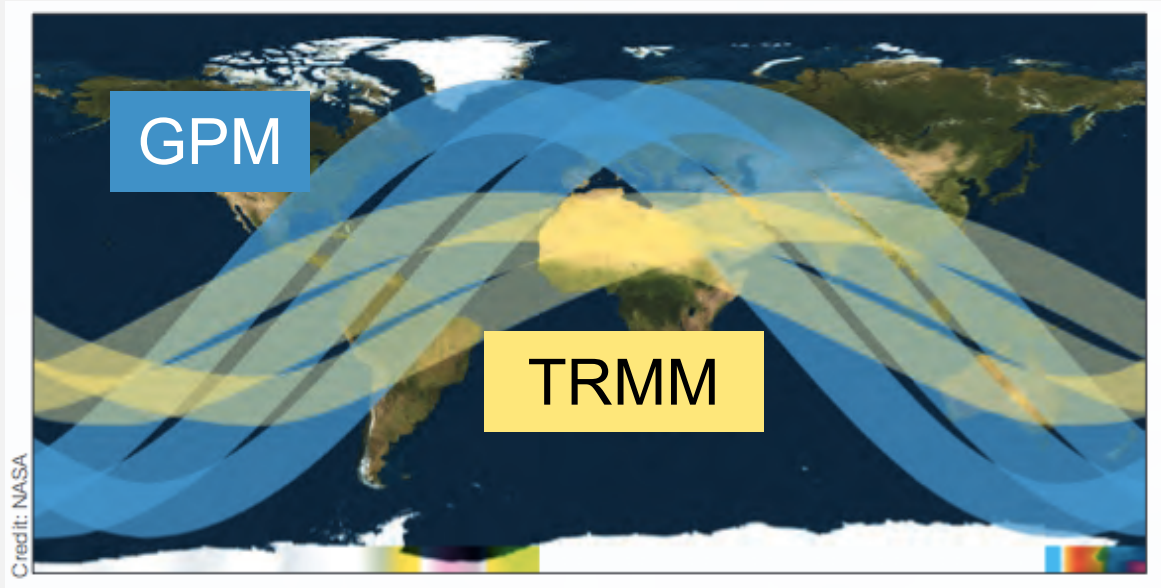
Dual Precipitation Radar (DPR)

<http://pmm.nasa.gov/GPM/flight-project/DPR>

- Spatial Coverage and Resolution:
 - Coverage: -180° - 180° , 65° S- 65° N
 - Swath: 120km (Ka) and 245km (Ku)
 - Spatial Resolution: 5.2km
 - Vertical Resolution: 250m (from 0-20km)
- Temporal Coverage and Resolution:
 - Feb 27, 2014 – present
 - ~2-4 hr observations
- Frequency:
 - 13.6 and 35.5 GHz



TRMM and GPM Comparison



- TRMM measurements are limited to the tropics
- GPM measurements span middle and high latitudes

- GMI & DPR
 - provide improved reference standards for inter-calibration of constellation precipitation measurements
 - better accuracy measurements
- GMI has a higher spatial resolution than TMI
- Improved light rain and snow detection in GMP
- DPR has better identification of liquid, ice, mixed-phase precipitation particles

Importance of TRMM Data Products

- TRMM provided high resolution precipitation data for 17 years
 - Useful for detecting and understanding climate variability and change
- Many applications are developed from TRMM data and still have to transition to using GPM data
 - extreme rain, flood, and drought monitoring and mapping
 - agriculture
 - health
- GPM algorithms are conceptually similar
 - **TRMM and GPM data will be inter-calibrated to provide a combined long-term precipitation record**

Precipitation Algorithms for TRMM and GPM

<http://pmm.nasa.gov/science/precipitation-algorithms>

There are four major algorithms used to obtain precipitation estimates from GPM/TRMM observations:

1. Radar Algorithms
2. Radiometer Algorithms
3. Combined Radar + Radiometer Algorithms
4. Multi-Satellite Algorithms
 - TRMM and GPM Core are used as calibrators for multiple national and international constellation satellites

Summary of TRMM Level-2 Precipitation Products

Sensor/Product Name	Spatial Resolution & Coverage	Temporal Resolution	Data Format
PR only: 2A25	<ul style="list-style-type: none"> • 5km x 5km • Single orbit • 16 orbits/day (35°S-35°N) 	<ul style="list-style-type: none"> • 7-day latency for Near Real-Time • 3-hour, 2-day, 5-day 	HDF4
TMI only: 2A12	<ul style="list-style-type: none"> • 5km x 5km • Orbital • 16 orbits/day (38°S-38°N) 	<ul style="list-style-type: none"> • 3-hour, 2-day, 15-day 	
Combined TMI & PR: 2B31	<ul style="list-style-type: none"> • 5km x 5km • Orbital • 16 orbits/day (38°S-38°N) 	<ul style="list-style-type: none"> • 7-day latency for Near Real-Time • 3-hour, 2-day, 5-day 	

Summary of TRMM Level-3 Precipitation Products

Sensor/Product Name	Spatial Resolution & Coverage	Temporal Resolution	Data Format
TMPA: 3B42RT & Final 3B42	<ul style="list-style-type: none"> • 0.25° x 0.25° • 50°S x 50°N 	<ul style="list-style-type: none"> • RT is NRT with 8 hr latency • 3-hourly 	<ul style="list-style-type: none"> • RT data in binary and OpenDAP
TMPA: 3B43		<ul style="list-style-type: none"> • Monthly • 2 month latency 	<ul style="list-style-type: none"> • HDF4 • NetCDF
PR only: 3A12	<ul style="list-style-type: none"> • 0.5° x 0.5° and 5° x 5° • 37°S x 37°N 	<ul style="list-style-type: none"> • Monthly 	<ul style="list-style-type: none"> • HDF4 • OpenDAP
TMI only: 3A12	<ul style="list-style-type: none"> • 0.5° x 0.5° • 38°S x 38°N 	<ul style="list-style-type: none"> • Monthly 	
TMI-PR Combined: 3B31	<ul style="list-style-type: none"> • 5° x 5° • 40°S x 40°N 	<ul style="list-style-type: none"> • Monthly 	

Summary of GPM Level-2 Precipitation Products

Sensor/Product Name	Spatial Resolution & Coverage	Temporal Resolution	Data Format
DPR Ku-only: 2A-Ku	<ul style="list-style-type: none"> • 5.2km x 125m • Single orbit • 16 orbits/day (70°S-70°N) 	<ul style="list-style-type: none"> • 20-120 minutes • 24 hrs 	<ul style="list-style-type: none"> • HDF5 • OpenDAP
DPR Ka-only: 2A-Ka			
DPR Ku & Ka: 2A-DPR			
GMI/2A-GPROF	<ul style="list-style-type: none"> • 4km x 4km • Orbital • 16 orbits/day (70°S-70°N) 	<ul style="list-style-type: none"> • 2-40 hrs 	
Combined GMI+DPR:2A-CMB	<ul style="list-style-type: none"> • 5km x 5km • Orbital (70°S-70°N) • Coincident Ku-Ka GMI footprints 	<ul style="list-style-type: none"> • 3-40 hrs 	

Summary of GPM Level-3 Precipitation Products

Sensor/Product Name	Spatial Resolution & Coverage	Temporal Resolution	Data Format
IMERG	<ul style="list-style-type: none"> • 0.1° x 0.1° • 90°S-90°N 	<ul style="list-style-type: none"> • 30 min (NRT) • 6 hr, 16 hr, & 3 month latency 	<ul style="list-style-type: none"> • HDF4 • NetCDF • OpenDAP • ASCII • .gif, .png • KML (Google Earth)
Combined GMI + DPR Rainfall Averages: 3-CMB	<ul style="list-style-type: none"> • 0.1° x 0.1° • 70°S-70°N 	<ul style="list-style-type: none"> • Monthly 	
DPR Rainfall Averages: 3-DPR	<ul style="list-style-type: none"> • 0.25° x 0.25° • 5.0° x 5.0° • Daily: 67°S-67°N • Monthly: 70°S-70°N 	<ul style="list-style-type: none"> • Daily & Monthly 	
GMI Rainfall Averages: 3-GPROF	<ul style="list-style-type: none"> • 0.25° x 0.25° • 90°S-90°N 	<ul style="list-style-type: none"> • Daily & Monthly 	

Multi-Satellite Algorithms for TRMM and GPM

<http://pmm.nasa.gov/science/precipitation-algorithms>

- TRMM & GPM Core satellites are used to calibrate microwave observations from a constellation of national and international satellites
- Allow improved spatial and temporal coverage of precipitation data
- TRMM Multi-satellite Precipitation Analysis (**TMPA**)
- Widely used for applications
- TMPA will be extended to match Integrated Multi-satellite Retrievals for GPM (**IMERG**)

TRMM Multi-satellite Precipitation Analysis (TMPA)

http://precip.gsfc.nasa.gov/trmm_comb.html

- TMPA combines PR & TMI rain rates
- Inter-calibrates passive rain rates from other satellite sensors
 - TMI, SSM/I, AMSR, AMSU-B, MHS, IR radiometers*
- Inter-calibrates with national and international geostationary and NOAA low-earth orbiting satellites infrared measurements by using VIRS
- Final rain product is calibrated with rain gauge analyses on a monthly time scale

*AMSR: Advanced Microwave Scanning Radiometer - onboard NASA Aqua Satellite

AMSU: Advanced Microwave Sounding Unit – onboard NOAA operational satellite

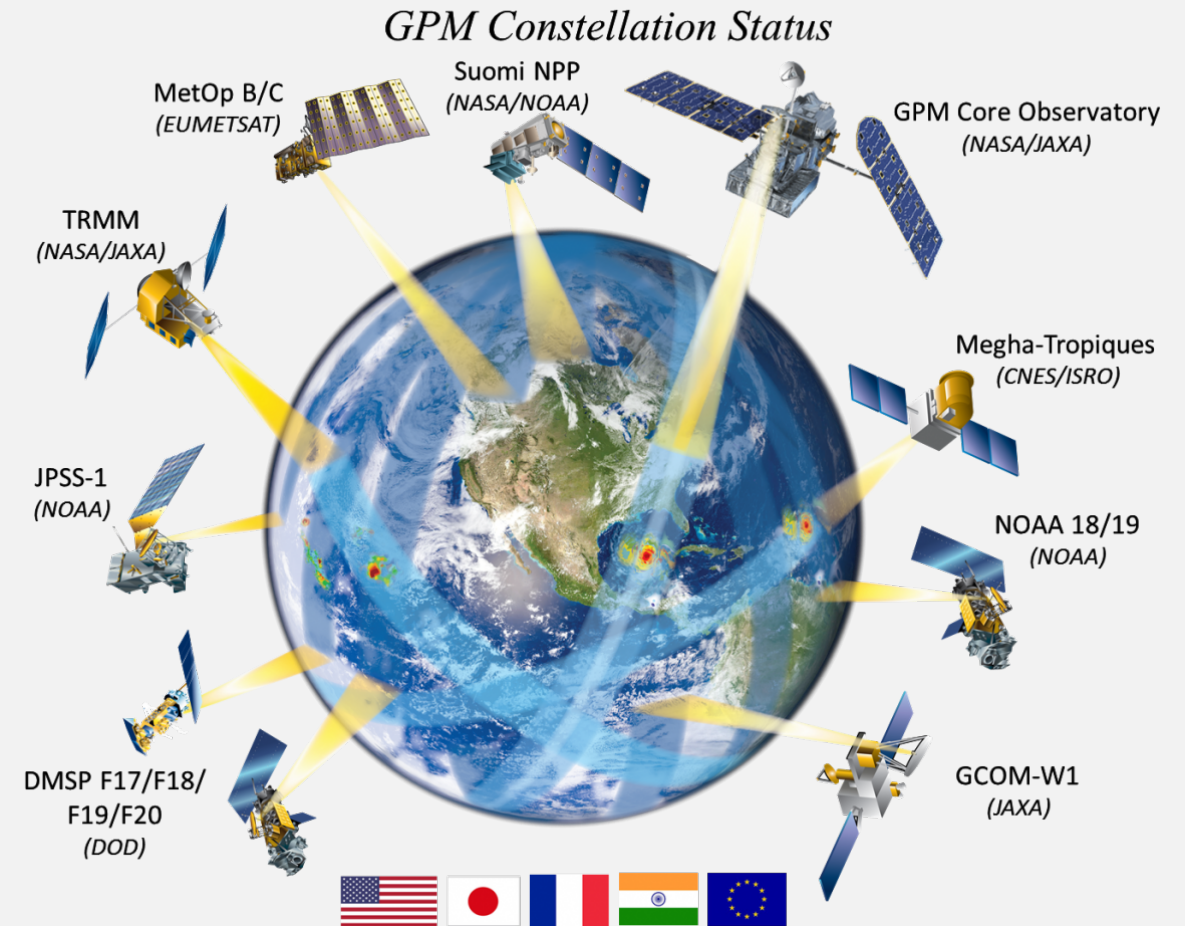
SSM/I: Special Sensor Microwave Imager

MHS: Microwave Humidity Sounder

Integrated Multi-satellite Retrievals for GPM (IMERG)

http://pmm.nasa.gov/sites/default/files/document_files/IMERG_ATBD_V4.5.pdf

- Conceptually similar to TMPA
- GPM constellation satellites include:
 - GCOM-W
 - DMSP
 - Megha-Tropiques
 - MetOp-B
 - NOAA-N'
 - NPP
 - NPOESS
- Final rain product is calibrated with rain gauge analyses on monthly time scale



Integrated Multi-satellite Retrievals for GPM (IMERG)

http://pmm.nasa.gov/sites/default/files/document_files/IMERG_ATBD_V4.5.pdf

- **Multiple runs accommodate different user requirements for latency and accuracy**
 - “Early” – now 5 hours (flash flooding) – will be 4 hours
 - “Late” – now 15 hours (crop forecasting) – will be 12 hours
 - “Final” – 3 months (research data)
- **Native time intervals are half-hourly and monthly (final only)**
 - Value-added products at 3 hrs, 1, 3, and 7 days - .tiff will be available
 - Initial release covers 60°N-60°S – will be 90°N-90°S

TMPA and IMERG

	TMPA	IMERG
Spatial Resolution	0.25° x 0.25°	0.1° x 0.1°
Spatial Coverage	Global, 50° S-50°N	Global, 60°S-60°N (will be extended from pole to pole)
Temporal Resolution	3 hours	30 minutes
Temporal Coverage	12/1997 – Present*	2/27/2014 – Present ⁺

* After April 8, 2015, TRMM climatological calibration is being used to generate TMPA

⁺ TMPA and IMERG combined data will be available in early 2018 at IMERG data resolution

TRMM and GPM Data Type Convention

<http://pps.gsfc.nasa.gov/Documents/FileNamingConventionForPrecipitationProductsForGPMMissionV1.4.pdf>

Type	Description
1A	Instrument count, geolocated, at instantaneous field of view (IFOV).
1B	Geolocated, calibrated T_b or radar power at IFOV.
1C	Intercalibrated brightness temperatures T_c at IFOV.
2A	Geolocated geophysical parameters at IFOV from a single instrument.
2B	Geolocated geophysical parameters at IFOV from multiple instruments.
3A	Space/time averaged geophysical parameters from a single instrument.
3B	Space/time averaged geophysical parameters from multiple instruments.
4	Combined satellite, ground and/or model data.

Trade-Offs Between Level 2 and Level 3 Precipitation Data Products

- IMERG and TMPA have lower spatial resolutions than Level 2 data
 - e.g. 2A12, 2A25, 2B31, 2A-GPROF, 2A-2DPR, 2BCMB
- IMERG and TMPA have better spatial coverage with no orbit gaps compared to Level 2 and Level 3 radar, imager, and radar/imager combined data
- IMERG and TMPA:
 - are uniformly gridded
 - have uniform temporal resolution to cover diurnal variations
 - are available in multiple formats

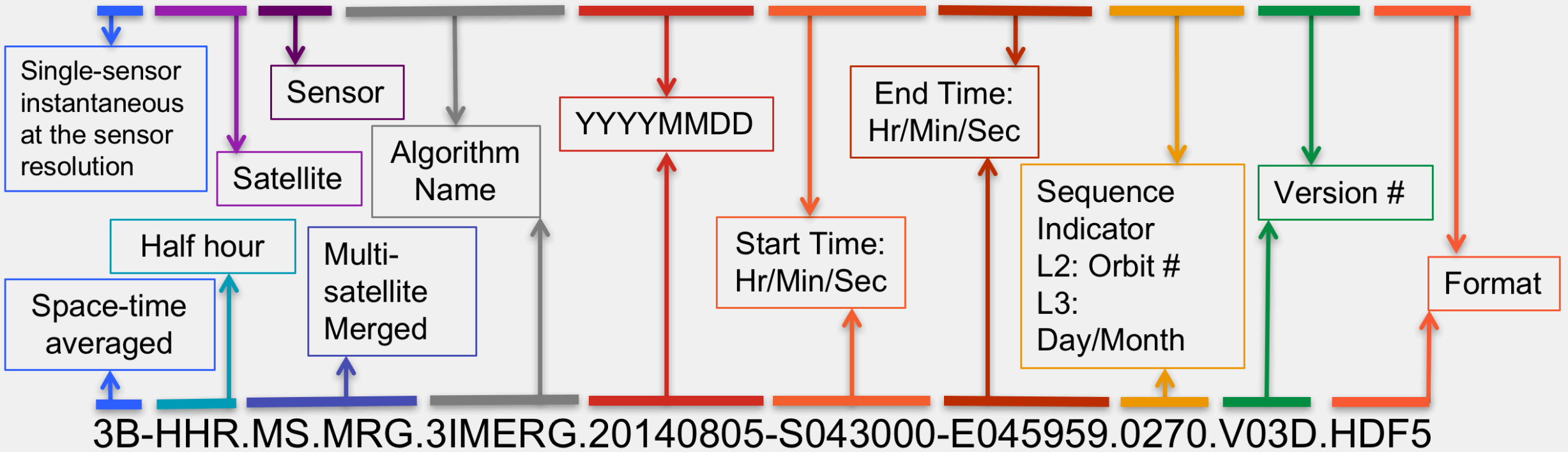
Used by Flood Monitoring Tools

GPM File Name Convention

<http://pps.gsfc.nasa.gov/Documents/FileNamingConventionForPrecipitationProductsForGPMMissionV1.4.pdf>

Level 2 File Name

2A.GPM.GMI.GPROF2008.20131101-S235152-E012400.000352.V03C.HDF5



Level 3 File Name

A topographic map showing a river system with a semi-transparent white text box overlaid in the center. The map uses a color gradient from green to brown to represent elevation, with a prominent river winding through the landscape.

TRMM and GPM Data Access

Precipitation Data Access Tools

Tools	Data & Format	Features
<p>PPS/STORM http://storm.pps.eosdis.nasa.gov/storm/</p>	<ul style="list-style-type: none"> • Rain Rate (TRMM, GPM) • HDF, PNG 	<ul style="list-style-type: none"> • Orbital and Gridded Data Search • Spatial/Temporal Subsetting • Individual Data and FTP Batch Download • Images and Interactive Data Viewer
<p>Giovanni http://giovanni.gsfc.nasa.gov</p>	<ul style="list-style-type: none"> • Rain Rate (TRMM, GPM) • NetCDF, GeoTIFF, PNG, KMZ, CSV (time series only) 	<ul style="list-style-type: none"> • Spatial/Temporal Subsetting • Analysis: <ul style="list-style-type: none"> • Time-averaged maps, animation, time series, scatter plots, map correlations, vertical profiles, time-averaged differences • Visualization: <ul style="list-style-type: none"> • Maps, time series, scatter plots, histograms • Near Real-Time Rain Rate Access
<p>Mirador http://mirador.gsfc.nasa.gov</p>	<ul style="list-style-type: none"> • Rain Rate (TRMM, GPM) • HDF, OPenDAP (select data can be converted into ASCII, binary, NetCDF) 	<ul style="list-style-type: none"> • Spatial/Temporal Subsetting • Individual Data File Download • Batch Download

Precipitation Measurement Missions

<https://pmm.nasa.gov/>

NASA NATIONAL AERONAUTICS AND SPACE ADMINISTRATION | GODDARD SPACE FLIGHT CENTER

Search

PRECIPITATION MEASUREMENT MISSIONS

Home | GPM | TRMM | Science | Applications | Meetings | Data Access | Resources | Education

The Art of Creating Digital Hurricanes

Every day, scientists at NASA work on creating better hurricanes – on a computer screen. At NASA’s Goddard Space Flight Center in Greenbelt, Maryland, a team of scientists spends its days incorporating millions of atmospheric observations, sophisticated graphic tools and lines of computer code to create computer models simulating the weather and climate conditions responsible for hurricanes. Scientists use these models to study the complex...

FEATURED ARTICLES 1 2 3 4 5

TRMM

TROPICAL RAINFALL MEASURING MISSION

TRMM operated from 1997 - 2015 and carried the first on-orbit active/passive instruments to study tropical rainfall. **3B42* data will continue through mid-2017 ...more**

GPM

GLOBAL PRECIPITATION MEASUREMENT

An international satellite mission launched by NASA and JAXA on Feb. 27, 2014, that is setting new standards for precipitation measurements worldwide using a network of satellites united by the GPM Core Observatory. [Get data](#)

LATEST HALF-HOURLY PRECIPITATION

EXTREME WEATHER NEWS

- Home of all information related to TRMM and GPM
- Links to data documentation and access

Precipitation Measurement Missions: Data Access

<https://pmm.nasa.gov/data-access>

Data Access

- Extreme Weather News
- ▼ Data Downloads & Documentation
 - TRMM
 - GPM
 - Ground Validation
- Data Sources
- Data Recipes
- Data News
- Google Earth
- NASA Worldview
- Using the PPS FTP
- Training
- Data FAQ

Connect With Us

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- Youtube

Need Help?

- View Frequently Asked Questions
- View the PMM Glossary

How to Access TRMM & GPM Precipitation Data

Precipitation data from the GPM and TRMM missions is made available free to the public in a variety of formats from several sources at NASA Goddard Space Flight Center. This section outlines the different types of data available, the levels of processing, the sources to download the data, and some helpful tips for utilizing precipitation data in your research.

- **GPM Data Downloads & Documentation**
- TRMM Data Downloads & Documentation
- Explanation of GPM & TRMM Data Sources
- Data Processing "Recipes"
- Precipitation Data in Google Earth
- Frequency Asked Questions (FAQ)

GET DATA
GLOBAL PRECIPITATION MEASUREMENT

New Users Start Here

Use of the PPS FTP and STORM requires you to first register your email address. Click here to register.

- All about TRMM and GPM data
 - Including updates, news, and FAQ
- Quick data access links and user registration

Precipitation Measurement Missions: Data Sources

<https://pmm.nasa.gov/data-access/data-sources>

PRECIPITATION MEASUREMENT MISSIONS

Home GPM **TRMM** Science Applications Meetings Data Access Resources Education

Data Access

- Extreme Weather News
- ▼ Data Downloads & Documentation
 - TRMM
 - GPM
 - Ground Validation
- Data Sources**
- Data Recipes
- Data News
- Google Earth
- NASA Worldview
- Using the PPS FTP
- Training
- Data FAQ

Data Sources

This section outlines the primary sources for downloading [GPM](#) and [TRMM precipitation](#) data from archive sites at Goddard Space Flight Center, including basic instructions for using each source.

NOTE: Use of the [PPS FTP](#) and [STORM](#) requires you to first register your email address. [Click here to register.](#)

- [FTP \(PPS\)](#)
- [STORM](#)
- [Mirador](#)
- [Giovanni \(GES DISC\)](#)
- [OPeNDAP](#)
- [FTP \(GES DISC\)](#)
- [GrADS Data Server \(GDS\)](#)
- [GPM Ground Validation Data Portal](#)

QUICK DATA LINKS

- [TRMM Downloads](#)
- [GPM Downloads](#)
- [Precipitation Processing System \(PPS\) Home](#)
- [GES DISC Home](#)
- [Giovanni TOVAS Data Viewer](#)

KEYWORDS

[data](#)
[GPM](#)
[TRMM](#)
[downloads](#)
[PMM Science Team](#)

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Precipitation Processing System (PPS) FTP

A topographic map showing a river system. The river is highlighted in a dark blue color, winding through a landscape of varying elevations. The terrain is color-coded by elevation, with greens and yellows representing lower elevations and browns and oranges representing higher elevations. The river starts from the top right and flows towards the bottom left, with several meanders and tributaries.

PPS & STORM

<http://storm.pps.eosdis.nasa.gov/storm>

Precipitation Processing System: STORM

<https://storm.pps.eosdis.nasa.gov/storm/>

Home

PPS is currently undergoing transition from GPM V03 to V04. Certain products and orders may be delayed or temporarily unavailable during this period. For updates on transition progress, click [here](#).
Update 6/16/16: PPS has begun reprocessing of V04A Level 2-3 GPROF SSMIS and AMSR2 climatology products. Reprocessing will start with March 1, 2014 data.

PPS Data Access - to search for GPM and TRMM data, order custom subsets and set up subscriptions.

PPS Public Archive - to access GPM and TRMM standard products via online ftp.

These are the products available to the public. To retrieve data go to [PPS Data Access](#) or [PPS Public Archive](#).

Data Type	Algorithm	Satellite	Instrument	Primary Content
1A	1A01	TRMM	VIRS	Counts
1A	1A11	TRMM	TMI	Counts
1A	1A21	TRMM	PR	Counts
1A	1AGMI	GPM	GMI	Counts
1B	1B01	TRMM	VIRS	Radiance
1B	1B11	TRMM	TMI	Brightness Temperature
1B	1B21	TRMM	PR	Radar Power
1B	1BGMI	GPM	GMI	Brightness Temperature
1B	1BKa	GPM	DPR_KA	Radar Power
1B	1BKu	GPM	DPR_KU	Radar Power
1C	1C21	TRMM	PR	Reflectivity
1C	1CAMSR2	GCOMW1	AMSR2	Brightness Temperature
1C	1CATMS	NPP	ATMS	Brightness Temperature

Need Help?

- [STORM User Guide](#)
- [Help Desk](#)

News

6/1/2016 - Parameter Categories are now available in STORM. Make faster parameter subsetting requests by using the preselected categories available in the dropdown at the top of the file tree interface. Let us know if you have any suggestions for other categories that would be useful.

5/13/2016 - STORM Virtual Globe (STORM VG) and an enhanced satellite-satellite coincidence map are now available to improve user

- All TRMM and GPM data products can be downloaded from STORM
- Data images and HDF5 data viewer are available in STORM

A topographic map showing a river system. The river is highlighted in a dark blue color, winding through a landscape of varying elevations. The terrain is color-coded by elevation, with greens and yellows representing lower elevations and browns and oranges representing higher elevations. The river flows from the top right towards the bottom left, with several meanders and tributaries.

Giovanni

<http://giovanni.gsfc.nasa.gov/>

GIOVANNI

The Bridge Between Data and Science v 4.21.6 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)

Giovanni transition to https... [1 of 3 messages] [Read More](#)

Select Plot

Maps: Time Averaged Map ▾
 Comparisons: Select... ▾
 Vertical: Select... ▾
 Time Series: Select... ▾
 Miscellaneous: Select... ▾

Analysis/Plot Options

Select Date Range (UTC)

YYYY-MM-DD. HH:mm
 - : to - :

Valid Range: 1948-01-01 to 2017-03-13

Select Region (Bounding Box or Shapefile)

Format: West, South, East, North

Temporal & Spatial Search

Map & Shapefile selection for various countries or U.S. States

Select Variables

▼ Disciplines

- Aerosols (179)
- Atmospheric Chemistry (53)
- Atmospheric Dynamics (322)
- Cryosphere (15)
- Hydrology (1004)
- Ocean Biology (44)

Number of matching Variables: 0 of 1639 Total Variable(s) included in Plot: 0

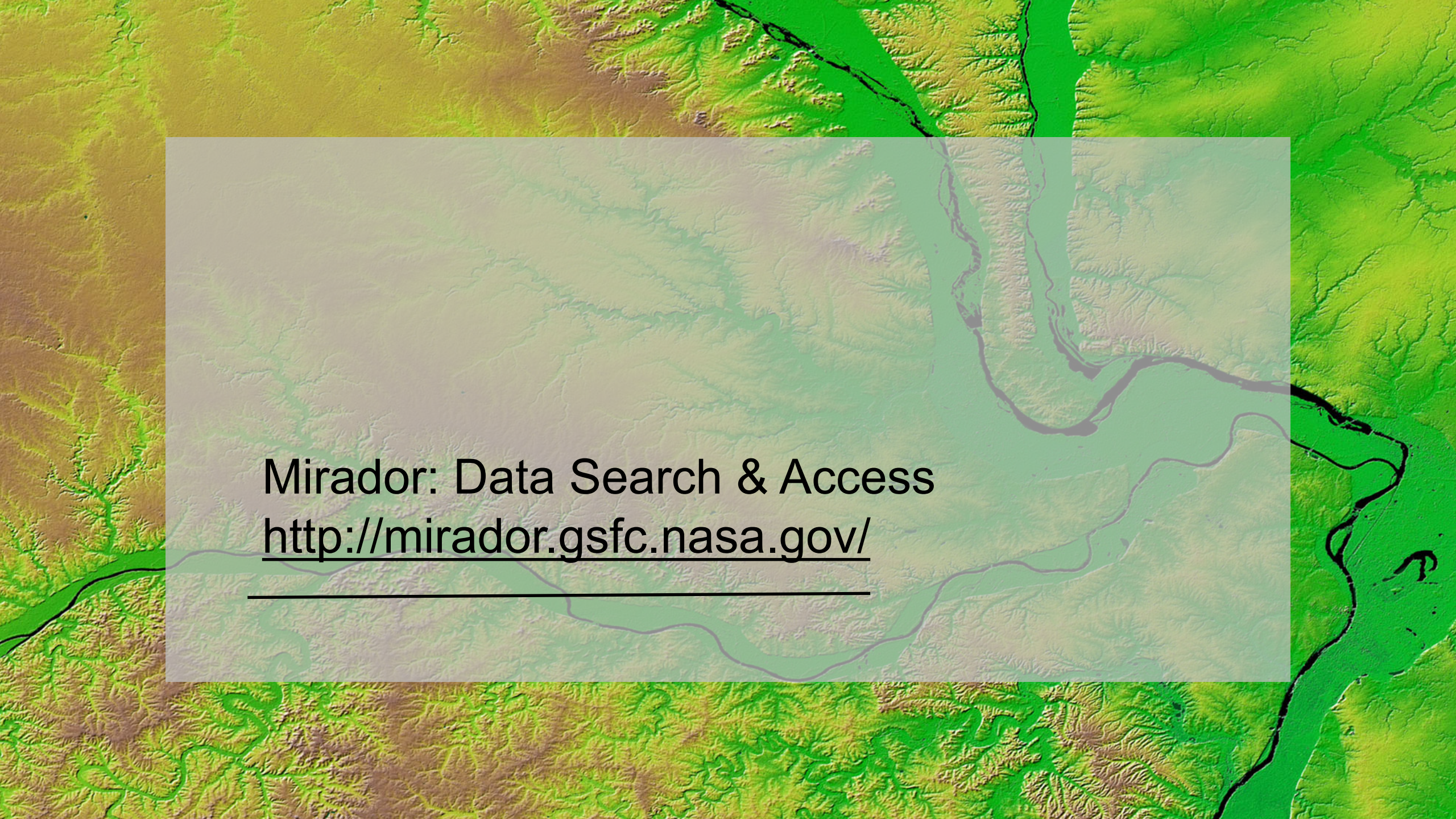
Keyword :

Search data by Keyword

Plot Data



- Iron (2)
- Irradiance (6)
- Latent Heat Flux (5)
- Latent Heat (1)
- Mixed Layer Depth (2)
- NO2 (2)
- Nitrate (2)
- OLR (11)
- Organic Carbon (8)
- Ozone (19)
- Particulate Matter (41)
- Phytoplankton (16)
- Precipitation (118)
- Quality Info (1)
- Radiation, Net (59)
- Reflectivity (25)
- Runoff (61)
- SO2 (4)
- SO4 (4)
- Scattering Angle (4)
- Sea Salt (5)

A topographic map showing a river system. The map uses a color gradient from green to brown to represent elevation. A prominent river flows from the top right towards the bottom right, with several tributaries branching off to the left. The terrain is rugged with many small ridges and valleys.

Mirador: Data Search & Access
<http://mirador.gsfc.nasa.gov/>



Data Services

Mission Portals

Science Portals

Info

Mirador
Data Access Made

- + OVERVIEW
- + HELP CENTER
- + DATA HOLDINGS
- + VIEW CART
- Additional Features**
- + News
- + Restricted Data
- + Feedback
- + FAQ

- Analyze Data with Giovanni
- Search for Data with Mirador
- Simple Subset Wizard
- Data Cookbook
- GDS
- NetCDF
- OGC Web Map Server
- OPeNDAP

Search data by Keyword

Temporal Selection

Spatial selection by latitude-longitude

Spatial Selection from Map

Keyword Projects Science Areas

Keyword: Time Span: To:

Location:



gazetteer locations such as Kansas or Ice Shelf; OR
 a bounding box: (minLat,minLon),(maxLat,maxLon) (LL),
 (UR) (Mirador will choose smallest area)
 OR 80N 20s 120east 20wes OR
 a partial Lat/Lon: of 22n is equivalent to (22,180),(-90,-180)

Search field
 sub-setting services
 sensors (e.g. MODIS, AIRS, OMI and MLS), GLDAS, GOCART, GPM, HIRDLs, LIMS, LPRM, MEASUREs, MERRA, MERRA-2, MSU, MLS, NEESPI, NEWS, NLDAS, OCO-2, OMI, SORCE, TOVS, UARS

Location Gazetteer data from:
 Events Gazetteer data from:

National GeoSpatial Information Agency
 Unisys, EPA and Smithsonian Global Volcanism Program

LATEST NEWS
[+ Mirador News Archive](#)





Keyword:

IMERG

More Search Options ▾

Search GES-DISC

+ OVERVIEW

+ HELP CENTER

+ DATA HOLDINGS

+ VIEW CART (96)

Additional Features

+ News

+ Restricted Data

+ Feedback

+ FAQ

You are here: [Keyword Search](#) » [Data sets from IMERG search](#) » File Listing [Your Cart](#) » Checkout

Shopping Cart - By Data Set Name

Keyword

Projects

Science Areas

Your cart contains 96 items (239.51 MB)

Sort by: Data Set ▾

Continue Searching

Checkout

Delete

 GPM L3 IMERG Final Half Hourly 10 x 10 km Precipitation V03 (GPM_3IMERGHH v.03) 96 Items

Empty Entire Cart

Page: 1

Download data by using
these scriptsYou are here: [Keyword Search](#) » [Data sets from IMERG search](#) » File Listing [Your Cart](#) » Checkout

Basic Download

More Download Options

Your cart will automatically be emptied when you select any download option unless you choose to keep the items.

 Keep items in the cart after selecting a download option

Download Data (with wget, curl, etc.)

[URL List \(Data\)](#)[URL List \(Metadata\)](#)[URL List \(Data and Metadata\)](#)

Instructions:

wget:

Save the list of URLs in one of the above links to your local workstation as myfile.dat

On your command line:

```
wget -i myfile.dat
```

a UNIX curl example:

Save the list of URLs in one of the above links to your local workstation as myfile.dat

On your command line:

```
xargs -n 1 curl -O < myfile.dat
```

[More Options...](#)

A topographic map of a river basin, showing a network of rivers and streams. The map uses a color gradient from green (low elevation) to brown (high elevation) to represent terrain. A semi-transparent white rectangular box is overlaid on the map, containing the text "Demonstration of STORM and Giovanni".

Demonstration of STORM and Giovanni

A topographic map showing a river system. The map uses a color gradient from green to brown to represent elevation. A semi-transparent white rectangular box is overlaid on the map, containing text. The text is centered within the box and is in a black, sans-serif font. A horizontal line is positioned below the text.

Next

Hands-on Exercise: Precipitation Data
Access & Analysis in QGIS
