Welcome to
Global Precipitation Measurement (GPM) Mission Applications Webinar Series

Webinar 3: Demonstration of GPM Data Import in GIS

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NASA Applied Remote Sensing Training (ARSET)
http://arset.gsfc.nasa.gov

Webinar Objective

- This webinar series is designed to facilitate GPM precipitation data usage in environmental research, applications, and environmental decision support activities

Outline of the Webinar Series

1. Overview of GPM Mission, Data Products, and Data Access Tools (12/8/2015)

2. GPM Data Products Updates and Demonstration of Web-tools for Data Search, Analysis, Visualization, and Download (3/15/2016)

3. Demonstration of GPM Data Import and Analysis in GIS (QGIS) **(6/14/2016)**

4. Tutorial on Using Python Scripts for Reading GPM Data **(9/13/2016)**

Webinar-3 Agenda

- Review of Webinars 1&2
- GPM Products Updates
- **Step-by-step Instruction to import GPM data into QGIS**
- Information about additional GIS layers including Weather, Vegetation, Terrain, and Socio-economic Data for GPM Applications

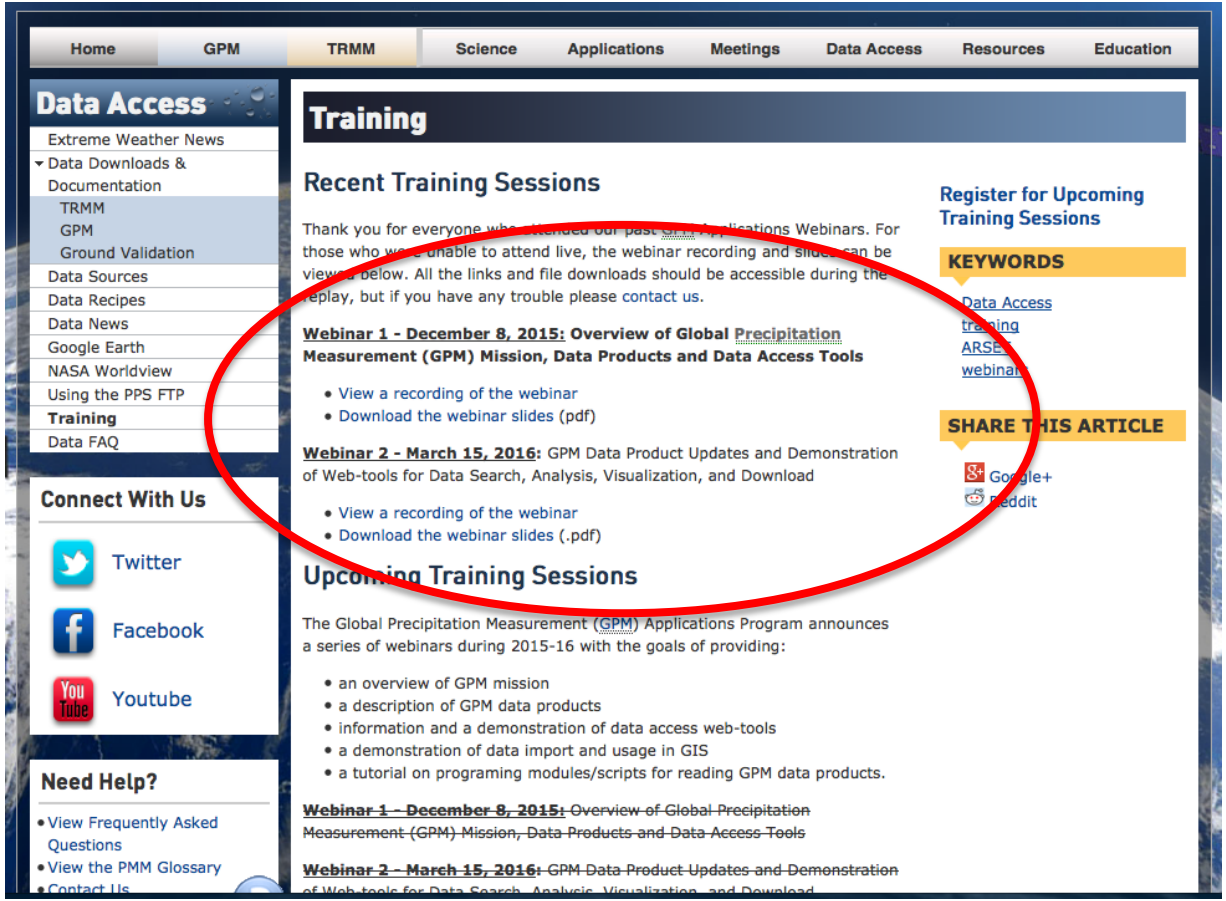
Webinar-3 Agenda

- Summary of Webinars 1&2
- GPM Products Updates
- **Step-by-step Instruction to import GPM data into QGIS**
- Information about additional GIS layers including Weather, Vegetation, Terrain, and Socio-economic Data for GPM Applications

Summary of Webinars 1 & 2

Access to GPM Training Webinars

http://pmm.nasa.gov/training

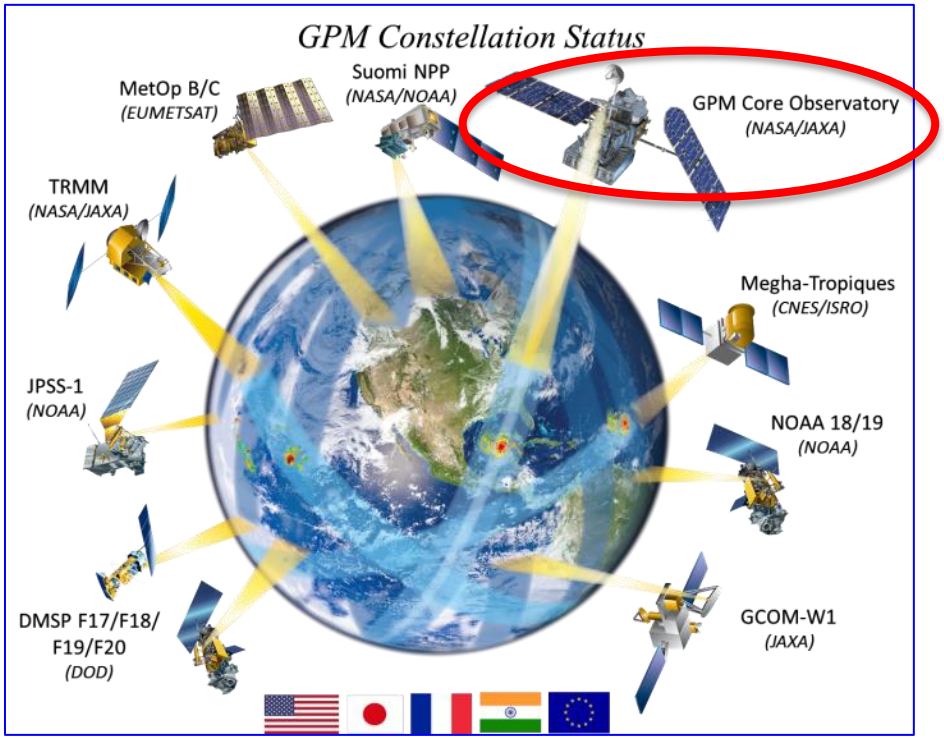


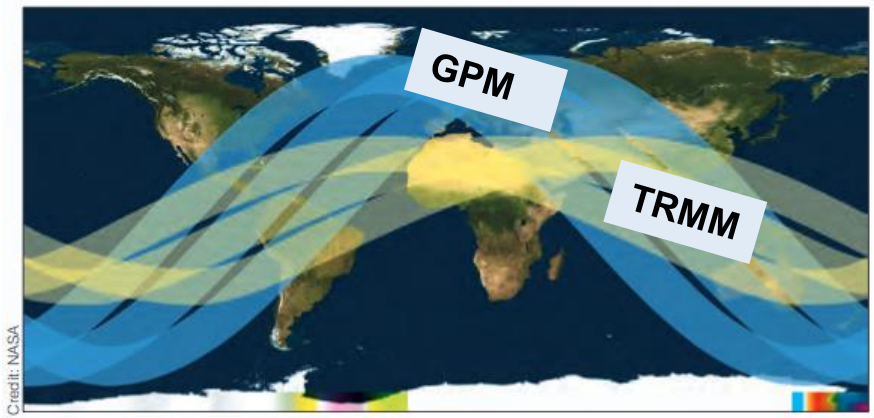
Presentation slides and recordings of the first two webinars are available from GPM Training Web page

GPM Core and Constellation Satellites

http://pmm.nasa.gov/GPM

GPM Core satellite was launched on February 27th, 2014



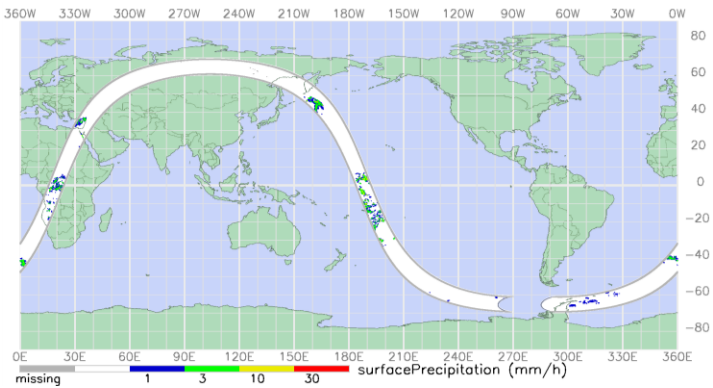


The area covered by three TRMM orbits [yellow] versus orbits of the GPM Core Observatory [blue]

GPM measurements span middle and high latitudes

GPM Sensors

GMI



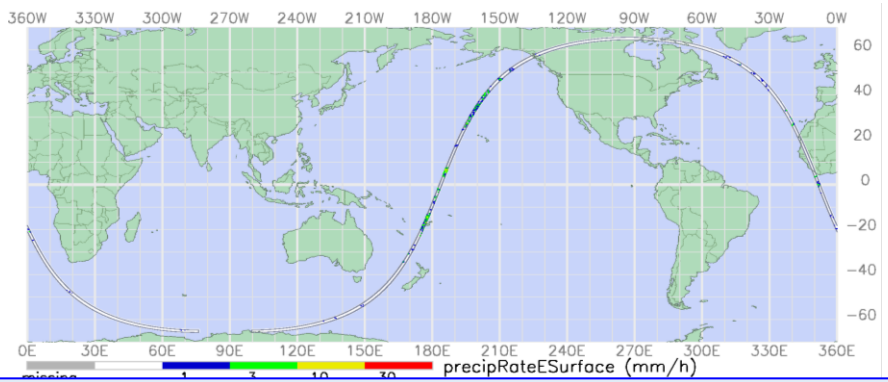
GMI Frequencies:
10.6,18.7,23.8,36.5,89,166 & 183 GHz

Swath width 885 km

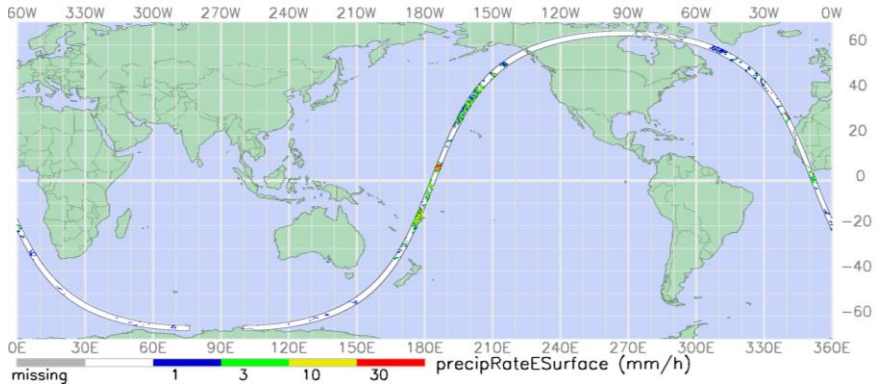
Resolution: 19.4km x 32.2km (10 GHz)
to 4.4km x 7.3km (183 GHz)

Higher spatial resolutions than TRMM TMI
High frequencies help measure snow

DPR



Ka 35.5 GHz, Swath Width 120 km, Resolution 5.2 km



Ku 13.6 GHZ, Swath Width 245 km, Resolution 5.2 km

GPM Algorithms

http://pps.gsfc.nasa.gov/atbd.html

Details of the algorithms can be found from the Precipitation Processing System (PPS)

GPM ATBD (Algorithm Theoretical Basis Documents)

GPM/DPR Level-2 Algorithm Theoretical Basis Document

GPM GPROF (Level 2) Algorithm Theoretical Basis Document.

GPM Combined Radar-Radiometer Precipitation Algorithm Theoretical Basis Document (

US Integrated Multi-satellite Retrievals for GPM (IMERG)

Summary of GPM Level-2 Precipitation Products

Sensor/Product Name	Spatial Resolution and Coverage	Temporal Resolution	Data Format
DPR Ku-only/ 2A-Ku DPR Ka-only/2A-Ka DPR KU & Ka/ 2A-DPR	5.2 km x125 m Single Orbit and 16 orbits per day (70°S-70°N)	20-120 minutes 24 hours	HDF5 and OPenDAP
GMI/2A-GPROF	4 km x 4 km Orbital and 16 orbits per day (70°S-70°N)	2 – 40 hours	
Combined GMI and DPR/2A-CMB	Orbital (70°S-70°N) 5 km x 5 km, Coincident Ku-Ka-GMI footprints	3 – 40 hours	

*In addition to surface rainfall rate in mm//hour, vertical precipitation profiles and latent heating are available in these data products

Summary of GPM Level-3 Precipitation Products

Sensor/Product Name	Spatial Resolution and Coverage	Temporal Resolution	Data Format
IMERG	0.1°x0.1° (90°S-90°N)	30-minutes(Near Real Time) with 6-hour latency, 16-hour latency and 3-months latency	HDF5, NetCDF, OPenDAP, ASCII GIF, PNG Images KML for Google Earth
3-CMB Combined GMI + DPR rainfall Averages	0.1°x0.1° (70°S-70°N)	Monthly	
3-DPR rainfall Averages	0.25°x0.25° 5.0°x5.0° (67°S-67°N) for Daily (70°S-70°N) for Monthly	Daily and Monthly Daily and Monthly	
3-GPROF GMI rainfall Averages	0.25°x0.25° (90°S-90°N)	Daily and Monthly	

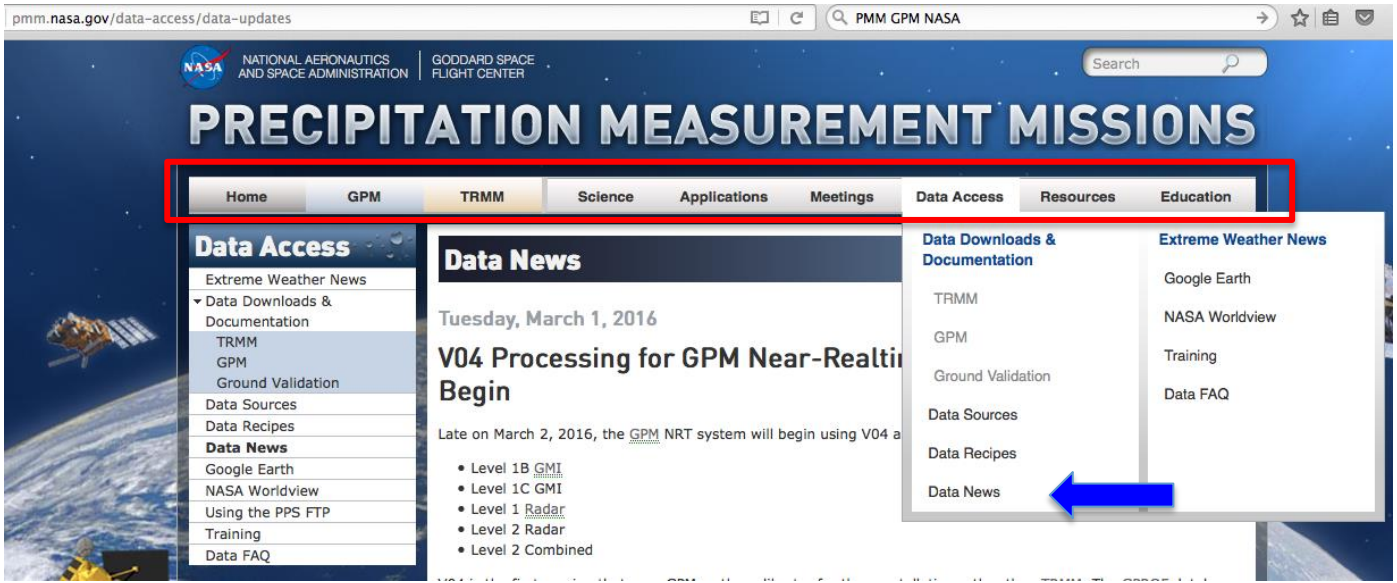
*In addition to surface rainfall rate in mm//hour, vertical precipitation profiles and latent heating are available in these data products

Widely used GPM Data Products Based on the Users FTP Requests

- IMERG ← **For a variety of environmental applications**
- 2AGPROF rainfall swath estimates for GMI and constellation radiometers
- 1C calibrated brightness temperature for GMI and constellation radiometers
- 2A DPR rainfall swath estimates

GPM Data Products Updates

Precipitation Measurement Mission (PMM)



Home of all information about GPM/TRMM for:

- *Data Access and Updates*
- *Research and Applications*

Data Product Updates

Many Near-real Time GPM data products are based on version-4 (V04) algorithms (as of March 2016)

[Level 1B GMI, Level 1C GMI, Level 1 Radar, Level 2 Radar, Level 2 Combined]

- V04 is the first version that uses GPM as the calibrator for the constellation measurements rather than TRMM.
- GMI is extremely well calibrated and the brightness temperatures in 1B and 1C are an important improvement over those in V03.
- V04 has improved retrievals in the Ku, Ka, and DPR level 2 products.
- GMI/DPR Combined product has also made retrieval improvements in V04.
- **GPROF is using V04 as of May 2, 2016.**
- **IMERG is still using V03 because the constellation radiometers are still using V03 -- but all will be updated to V04 in near future**

IMERG Updates and Future Plans

Multiple runs accommodate different user requirements for latency and accuracy

- "Early" – now 5 hours (flash flooding) → 4 hours
- "Late" – now 15 hours (crop forecasting) → 12 hours
- "Final" – 3 months (research data)

Native time intervals are half-hourly and monthly (Final only)

- value-added products at 3 hours,1, 3, 7 days → precipitation phase in geo-TIFFs; additional support for shapefile-based area averaging

0.1° global CED grid

- PPS and GES DISC provide subsetting by parameter and location
- initial release covers 60° N-S → 90° N-S

Courtesy: George Huffman

IMERG Updates and Future Plans

Current (Version 3) data record starts April 2014 (Final), March 2015 (Early), April 2015 (Late)

Version 4 IMERG will be instituted soon (~ August 2016)

- "Initial Processing" with new data
- "Retrospective Processing" for recorded data during the GPM era (from April 2014)

In late 2017 or early 2018 Version 5 IMERG will be instituted

- covers the TRMM and GPM era (from January 1998, or at least February 2000)
- seeking to run an "Interim" reprocessing in Spring 2017 (using V.4)

TMPA, TMPA-RT continue to be run

- done to provide a consistent long record until IMERG covers the TRMM era
- shut down about 3 months after IMERG is extended
- could end early if key inputs are ended

Courtesy: George Huffman

GPM Data Access

http://pmm.nasa.gov/data-access/data-sources#register

Registering to Download Data (required)

In order to download data from the PPS FTPs you must first register your email address with the Precipitation Processing System, using this page: http://registration.pps.eosdis.nasa.gov/registration/

Once you submit this form you will receive an email requesting you to verify your email address. Click the link in this email to complete the registration process. You will then receive a second email confirming your registration.

You can now log in to any of the PPS FTP servers (outlined below) using your email address as the username and password.

NOTE: Although direct links to the FTP are included on these pages, it is recommended to use a dedicated FTP client to access the PPS FTP. Certain web browsers are also able to browse the FTP, but some users have experienced errors with this method.

GPM Data Servers

http://pmm.nasa.gov/data-access/

FTP Servers

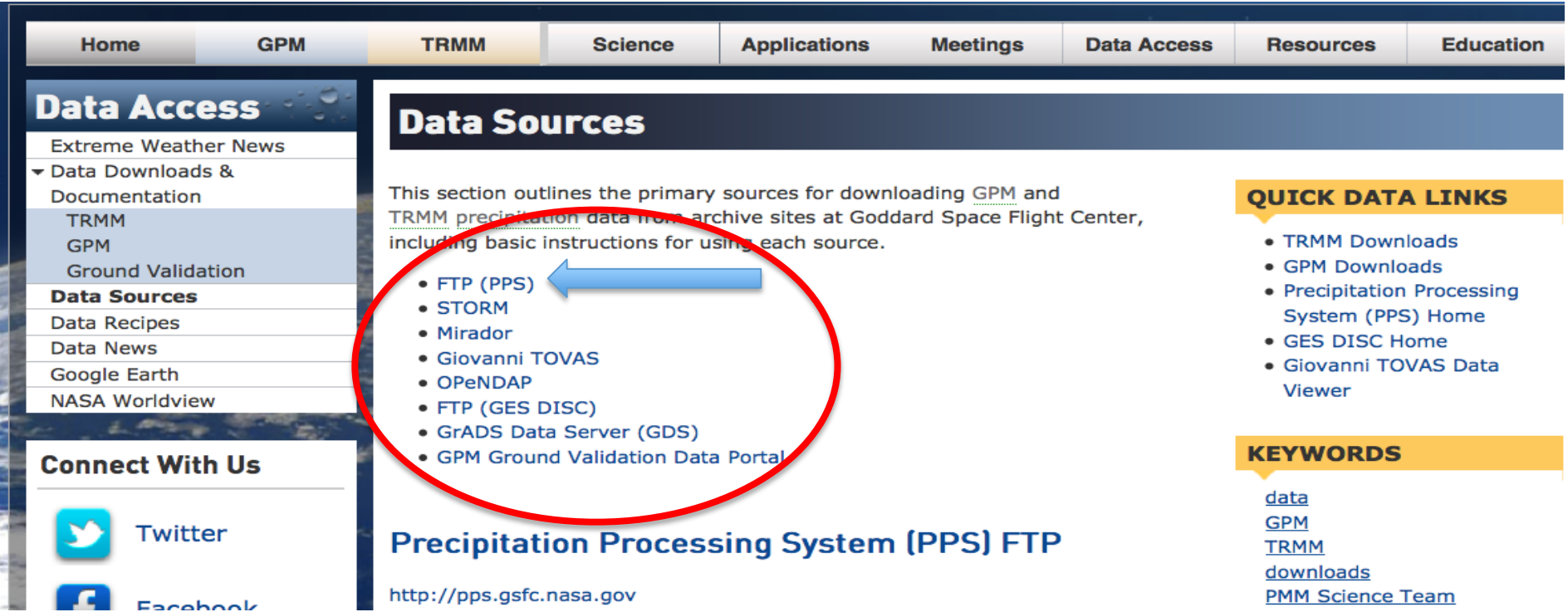
The Precipitation Processing System hosts several FTP servers to access the different types of TRMM and GPM data:

- **ftp://arthurhou.pps.eosdis.nasa.gov**: New server for Production (PROD) TRMM and GPM data.
  - **Click here for an outline of the directory structure for production GPM data.**
- **ftp://jsimpson.pps.eosdis.nasa.gov**: New server for Near-Realtime (NRT) TRMM and GPM data.
  - **Click here for an outline of the directory structure for realtime GPM data.**
- **ftp://trmmopen.pps.eosdis.nasa.gov**: Old server for "Production" TRMM data. Does not contain GPM data, but may be maintained to preserve access to the popular 3B42RT algorithm.
- **ftp://pps.gsfc.nasa.gov**: Old server for "Realtime" TRMM data. Will be decommissioned in the near future, pending full transfer of files.

Click here to learn the difference between "Production" and "Realtime" data sources.

GPM Data Access

http://pmm.nasa.gov/data-access/data-sources#register



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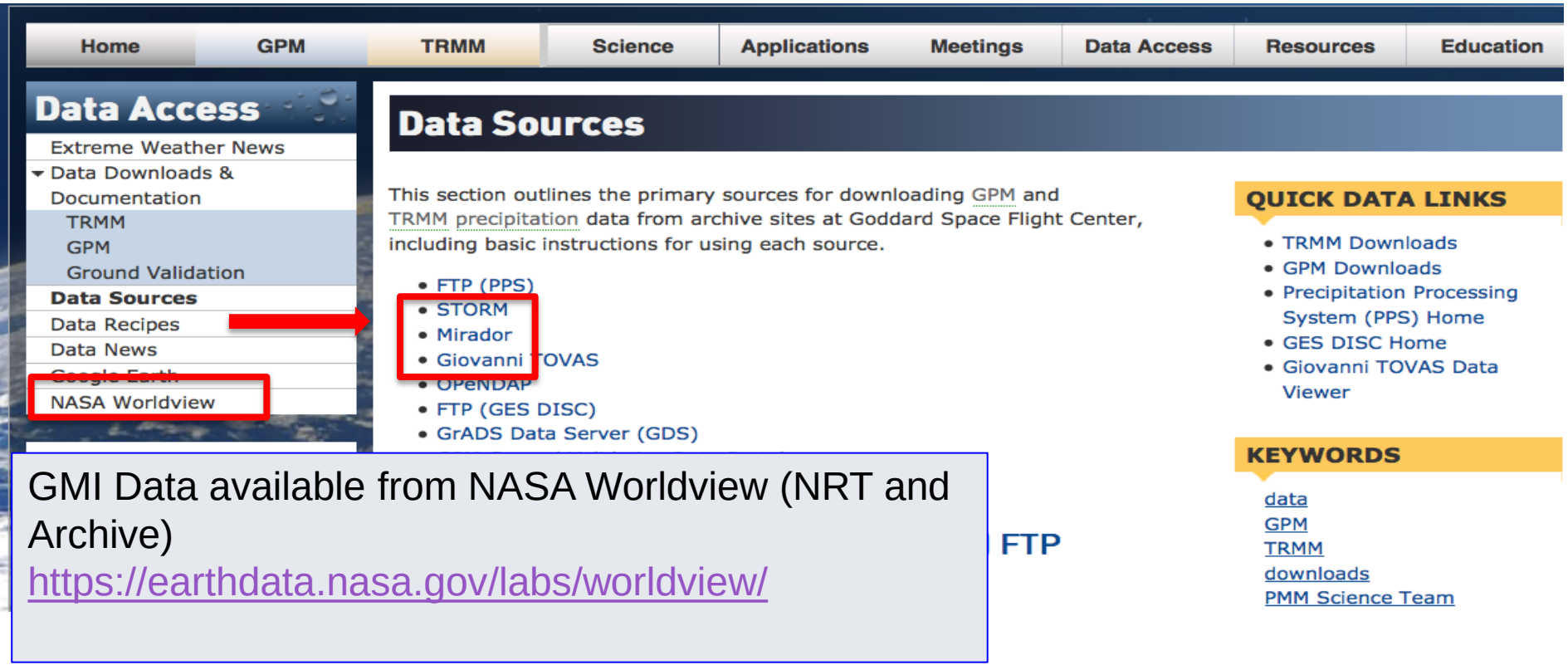


GMI Data available from NASA Worldview (NRT and Archive)
https://earthdata.nasa.gov/labs/worldview/

GPM Data Access Using Selected Web-tools

Tools	Data Products and Formats	Analysis and/or Visualization	Data Download
Mirador http://mirador.gsfc.nasa.gov	L1B, L2, and L3 GMI-GPROF IMERG Half-hourly, Monthly Orbital and Gridded Daily, Monthly HDF5, [Selected products in OPenDAP -- can be converted to ASCII, Binary, NetCDF]	N/A	Download by Select and Click on Data Files OR Batch Download of Multiple Files
Giovanni http://giovanni.gsfc.nasa.gov/giovanni/	IMERG Half-hourly, Monthly NetCDF, GeoTIFF, PNG	Visualization: Map, Time Series, Scatter Plot Histogram Analysis: Time-averaged Maps, Time Series, Scatter Plot, Map Correlations, Vertical Profiles, Time-averaged Differences	Download by Select and Click on Data Files
PPS/STORM https://storm.pps.eosdis.nasa.gov/storm	L1B and 1C, L2, L3 GMI, DPR, GMI-DPR Combined Data, Orbital and Gridded Daily, Monthly IMERG Half-hourly, Monthly HDF5, PNG	Map Visualization, Interactive Latitude/Longitude Point Data Value Display	FTP

GPM Data Access Using Selected Web-tools

Tools	Comments
Mirador http://mirador.gsfc.nasa.gov	Useful for searching data and downloading multiple data files GPM L1, L2, and L3 Data are available from Mirador Data Latency of ~days/month for some products
Giovanni http://giovanni.gsfc.nasa.gov/giovanni/	Useful for downloading IMERG data(early, late, and final products) in multiple formats Very convenient for data analysis and visualization
PPS/STORM https://storm.pps.eosdis.nasa.gov/storm	Dedicated to access and visualization of GPM and TRMM data Level-2 (orbital) and Level-3 (gridded) data easily accessible THOR can be used to view HDF files

Instruction/Demonstration to Import GPM Data into GIS

1) Demonstration to Import IMERG in QGIS
2) Procedure to Import GPM Level-2 Data in ArcGIS

QGIS: Quantum Geographic Information System

http://www.qgis.org/

- QGIS is a free and open software
- Many of the important features of ESRI ArcGIS are available in QGIS
- QGIS works on Windows, Mac, and Linux Operating Systems
- For the tutorial on how to download and install QGIS please see Applied Remote Sensing Training web page:

http://arset.gsfc.nasa.gov/sites/default/files/disasters/Advanced2016/QGIS_Download%20and%20Install.pdf

GPM Data Formats and GIS

- All GPM data files have native format of HDF5 but QGIS has difficulty working with HDF5!
- GPM IMERG(Level-3, gridded) data products are available in NetCDF, format that is recognized by QGIS, from the data access tools (Giovanni, Mirador) mentioned earlier
- Giovanni and GPM ftp data servers also provide IMERG data in GeoTIFF format that can be used in QGIS
- GPM Level-2 (swath data), available only in HDF5, can not recognized by QGIS without appropriate transformation using GDAL/Python
- GPM Level-2 data can be used with ArcGIS with coordinate transformation

IMERG Data Import into QGIS Demonstration

- Sub-set IMERG data using Giovanni
- Download data as NetCDF file
- Import the data in QGIS
- Note: Global GeoTiFF images for IMERG data are available from ftp://jsimpson.pps.eosdis.nasa.gov/data/imerg/gis

Please find details and step-by-step instruction in the document available from the file-pod

Procedure to Import GPM Level-2 Data in ArcGIS

- Use PPS/GPM ftp servers or Mirador to select and download Level-2 swath data

- Procedures to import Level-3 data into ArcMAP are given on:

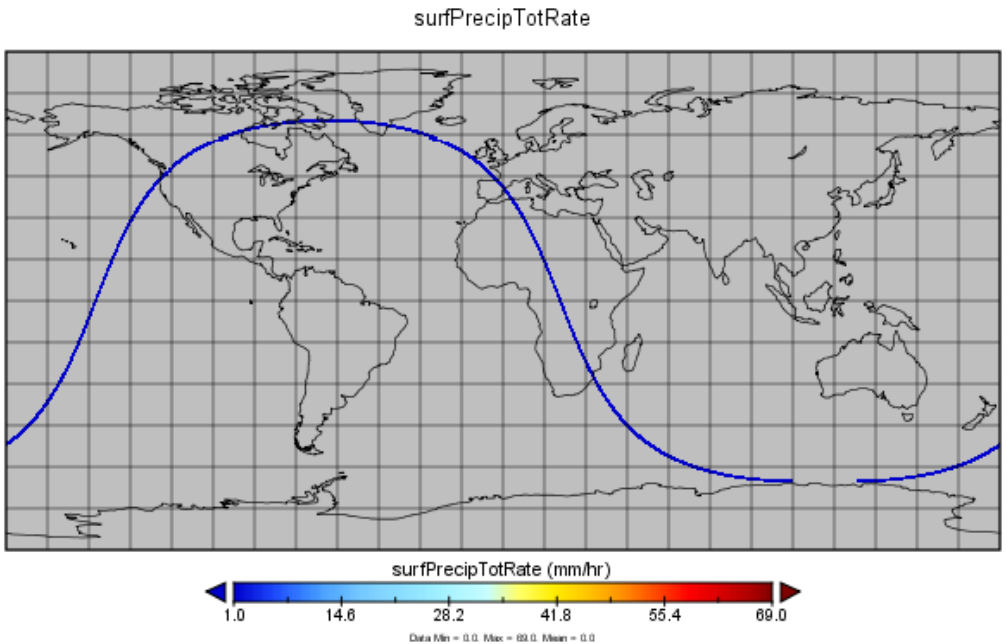
http://disc.sci.gsfc.nasa.gov/recipes/?q=recipes/How-to-Import-HDF5-formatted-IMERG-GPM-Precipitation-Data-into-ArcGIS

- This procedure can be modified to import any HDF-5 data into ArcMAP. An example of importing Level-2 Combined GMI and DPR surface rain rate swath is available on the file pod

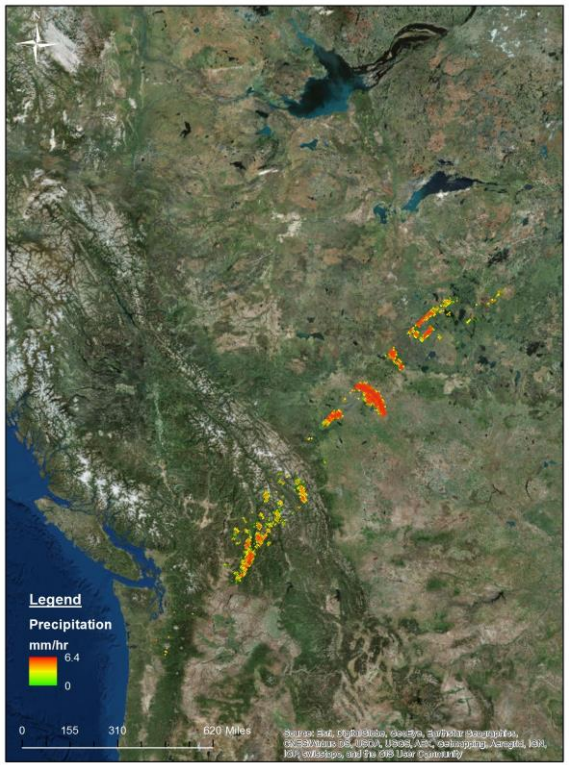
- Importing Level-2 HDF5 formatted data in QGIS will be available soon

Procedure to Import GPM Level-2 Data in ArcGIS

2BCMB Rain Rate Swath for 11 June 2016



Imported in ArcMAP and Zoomed on Washington State



Additional Useful Layers for GPM Data Applications

- Terrain data from Shuttle Radar Topography Mission (SRTM)
- http://srtm.csi.cgiar.org/

See:http://arset.gsfc.nasa.gov/sites/default/files/disasters/Advanced2016/SRTM_TX.pdf for details about getting SRTM data in to QGIS

- Socioeconomic Data and Applications Center (SEDAC) online repository:
- http://sedac.ciesin.columbia.edu

(Population Density, Roads, Coast Line, Urban Areas, Land Cover)

See: http://arset.gsfc.nasa.gov/sites/default/files/disasters/Advanced2016/SEDAC_TX.pdf for details about getting SEDAC data in to QGIS

Next Webinar

GPM Data Validation Overview and Tutorial for Reading GPM Levels- 2 & 3 Products by using Python Scripts

(9/13/2016)

Thank You!

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