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Goddard Earth Science Data Information and

README Document for the GPM Data

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1.0 Introduction

This document provides basic information for using Global Precipitation Measurement (GPM) data products.

The GPM mission is an international network of satellites that provide the next-generation global observations of rain and snow. Building upon the success of the Tropical Rainfall Measuring Mission (TRMM), the GPM concept centers on the deployment of a “Core” satellite carrying an advanced radar / radiometer system to measure precipitation from space and serve as a reference standard to unify precipitation measurements from a constellation of research and operational satellites.

The GPM Core Observatory design is an extension of TRMM which focused primarily on heavy to moderate rain over tropical and subtropical oceans. It carries the first space-borne Ku/Ka-band Dual-frequency Precipitation Radar (DPR) and a multi-channel GPM Microwave Imager (GMI). The DPR instrument, which will provide three dimensional measurements of precipitation structure over 78 and 152 mile (125 and 245 km) swaths, consists of a Ka-band precipitation radar (KaPR) operating at 35.5 GHz and a Ku-band precipitation radar (KuPR) operating at 13.6 GHz. The GMI instrument is a conical-scanning multi-channel microwave radiometer covering a swath of 550 miles (885 km) with thirteen channels ranging in frequency from 10 GHz to 183 GHz.

1.1 Mission Instrument Description

The Global Precipitation Measurement (GPM) mission is an international network of satellites that provide the next-generation global observations of rain and snow. Building upon the success of the Tropical Rainfall Measuring Mission (TRMM), the GPM concept centers on the deployment of a “Core” satellite carrying an advanced radar / radiometer system to measure precipitation from space and serve as a reference standard to unify precipitation measurements from a constellation of research and operational satellites. Through improved measurements of precipitation globally, the GPM mission will help to advance our understanding of Earth's water and energy cycle, improve forecasting of extreme events that cause natural hazards and disasters, and extend current capabilities in using accurate and timely information of precipitation to directly benefit society. GPM, initiated by NASA and the Japan Aerospace Exploration Agency (JAXA) as a global successor to TRMM, comprises a consortium of international space agencies, including the Centre National d’Études Spatiales (CNES), the Indian Space Research Organization (ISRO), the National Oceanic and Atmospheric Administration (NOAA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), and others. The GPM Core Observatory launched on February 27, 2014 at 1:37pm EST from Tanegashima Space Center, Japan.

Illustration of the GPM satellite constellation.

Building upon TRMM's Legacy

The Tropical Rainfall Measuring Mission (TRMM), launched by NASA and JAXA in 1997, uses both active and passive microwave instruments to measure rainfall in the tropics. It also provides a foundation for merging rainfall information from other satellites. TRMM has shown the importance of taking observations from a non-Sun-synchronous orbit at different times of the day, between observations by polar orbiting sensors at fixed times of the day, to improve near real-time monitoring of hurricanes and accurate estimation of time-accumulation of rain volume. The GPM Core Observatory will continue this sampling from a non-Sun-synchronous orbit and extend coverage to higher latitudes to provide a global view of precipitation.

The GPM Core Observatory design is an extension of TRMM's highly successful rain-sensing package, which focused primarily on heavy to moderate rain over tropical and subtropical oceans. Since light rain and falling snow account for significant fractions of precipitation occurrences in middle and high latitudes, a key advancement of GPM over TRMM is the extended capability to measure light rain (< 0.5 mm hr-1), solid precipitation and the microphysical properties of precipitating particles. This capability drives the designs of both the active and passive microwave instruments on GPM. The Core Observatory will then act as a reference standard for the precipitation estimates acquired by the GPM constellation of sensors.

GPM Core Observatory

The GPM Core Observatory will carry the first space-borne Ku/Ka-band Dual-frequency Precipitation Radar (DPR) and a multi-channel GPM Microwave Imager (GMI). The DPR instrument, which will provide three dimensional measurements of precipitation structure over

78 and 152 mile (125 and 245 km) swaths, consists of a Ka-band precipitation radar (KaPR) operating at 35.5 GHz and a Ku-band precipitation radar (KuPR) operating at 13.6 GHz. Relative to the TRMM precipitation radar, the DPR is more sensitive to light rain rates and snowfall. In addition, simultaneous measurements by the overlapping of Ka/Ku-bands of the DPR can provide new information on particle drop size distributions over moderate precipitation intensities. In addition, by providing new microphysical measurements from the DPR to complement cloud and aerosol observations, GPM is expected to provide further insights into how precipitation processes may be affected by human activities.

The GMI instrument is a conical-scanning multi-channel microwave radiometer covering a swath of 550 miles (885 km) with thirteen channels ranging in frequency from 10 GHz to 183 GHz. The GMI uses a set of frequencies that have been optimized over the past two decades to retrieve heavy, moderate and light precipitation using the polarization difference at each channel as an indicator of the optical thickness and water content.

GPM Science and Applications

GPM will provide global precipitation measurements with improved accuracy, coverage and dynamic range for studying precipitation characteristics. GPM is also expected to improve weather and precipitation forecasts through assimilation of instantaneous precipitation information. Relative to TRMM, the enhanced measurement and sampling capabilities of GPM will offer many advanced science contributions and societal benefits:

- Improved knowledge of the Earth’s water cycle and its link to climate change
- New insights into storm structures and large-scale atmospheric processes
- New insights into precipitation microphysics
- Advanced understanding of climate sensitivity and feedback processes
- Extended capabilities in monitoring and predicting hurricanes and other extreme weather events
- Improved forecasting abilities for natural hazards, including floods, droughts and landslides.
- Enhanced numerical prediction skills
- Improved agricultural crop forecasting and monitoring of freshwater resources

1.1.1 GMI

The Global Precipitation Measurement (GPM) Microwave Imager (GMI) instrument is a multi-channel, conical- scanning, microwave radiometer serving an essential role in the near-global-coverage and frequent-revisit-time requirements of GPM.

The instrumentation enables the Core spacecraft to serve as both a precipitation standard and as a radiometric standard for the other GPM constellation members.

The GMI is characterized by thirteen microwave channels ranging in frequency from 10 GHz to 183 GHz. In addition to carrying channels similar to those on the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI), the GMI carries four high frequency, millimeter-wave, channels about 166 GHz and 183 GHz.

With a 1.2 m diameter antenna, the GMI will provide significantly improved spatial resolution over TMI.

Scan Geometry

The off-nadir-angle defining the cone swept out by the GMI is set at 48.5 degrees which represents an earth-incidence-angle of 52.8 degrees. To maintain similar geometry with the predecessor TMI instrument, the-earth-incidence angle of GMI was chosen identical to that of the TMI. Rotating at 32 rotations per minute, the GMI will gather microwave radiometric brightness measurements over a 140 degree sector centered about the spacecraft ground track vector. The remaining angular sector is used for performing calibration; i.e. observation of cold space as well as observation of a hot calibration target.

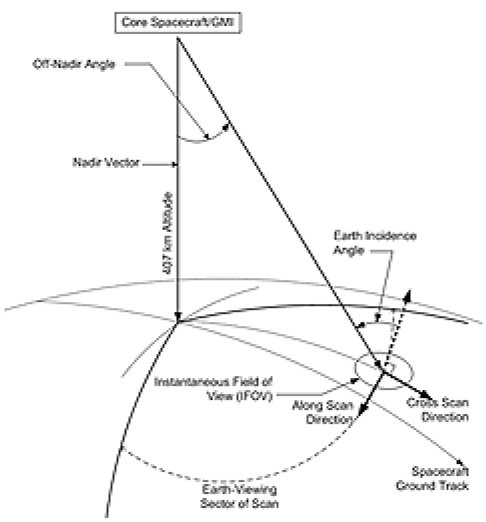

Diagram of the conical scanning geometry.

The 140 degree GMI swath represents a swath of 904 km (562 miles) on the Earth's surface. For comparison, the DPR instrument is characterized by cross-track swath widths of 245 km (152 miles) and 120 km (75 miles), for the Ku and Ka-band radars respectively. Only the central portions of the GMI swath will overlap the radar swaths (and with approximately 67 second duration between measurements due to the geometry and spacecraft motion). These measurements within the overlapped swaths are important for improving precipitation retrievals, and in particular, the radiometer-based retrievals.

1.1.2 DPR

One of the prime instruments for the GPM Core Observatory is called the Dual-frequency Precipitation Radar (DPR). The DPR consists of a Ku-band precipitation radar (KuPR) and a Ka-band precipitation radar (KaPR). The KuPR (13.6 GHz) is an updated version of the highly successful unit flown on the TRMM mission (shown below). The KuPR and the KaPR will be co-aligned on the GPM spacecraft bus such that that the 5 km (3.1 mile) footprint location on the earth will be the same.

Data collected from the KuPR and KaPR units will provide 3-dimensional observations of rain and will also provide an accurate estimation of rainfall rate to the scientific community. The DPR instrument will be allocated 190 Kbps bandwidth over the 1553B spacecraft data bus.

DPR Instrument Details

The DPR is a spaceborne precipitation radar capable of making accurate rainfall measurements. The DPR is expected to be more sensitive than its TRMM predecessor especially in the measurement of light rainfall and snowfall in high latitude regions. Rain/snow determination is expected to be accomplished by using the differential attenuation between the Ku-band and the Ka-band frequencies. The variable pulse repetition frequency (VPRF) technique is also expected to increase the number of samples at each IFOV to realize a 0.2 mm/h sensitivity.

The KuPR and KaPR, together with GMI, are the primary instruments on the GPM spacecraft. These Earth-pointing KuPR and KaPR instruments will provide rain sensing over both land and ocean, both day and night.

Top-level general design specifications are as follows:

Item	**KuPR**	**KaPR**
Swath Width	245 kilometers (km)	120 kilometers (km)
Range Resolution	250 meters (m)	250/500 meters (m)
Spatial Resolution	5 km (Nadir)	5 km (Nadir)
Beam Width	0.71 degrees	0.71 degrees
Transmitter	128 Solid State Amplifiers	128 Solid State Amplifiers
Peak Transmit Power	1013 Watts (W)	146 Watts (W)

Pulse Repetition Freq. (In nominal operations mode)	4100 to 4400 Hertz	4100 to 4400 Hertz
Pulse Width	two 1.667 microseconds (µs) pulses	two 1.667 microseconds (µs) pulses in matched beams two 3.234 microseconds (µs) pulses in interlaced scans
Beam Number	49	49 (25 in matched beams and 24 in interlaced scans)

2.0 Data Organization

The logical format of a data product consists of the names, types, dimensions, and organization of the data. The physical format is the implementation of the logical format with an underlying format such as Hierarchical Data Format (HDF). The bulk of this document consists of the logical format of each GPM data product.

GPM data products contain metadata and data. Metadata are small text strings containing label information such as the name, date, and time of the data products. Metadata are often organized into metadata groups.

Data are arrays or scalers. Data are often organized into swath structures or grid structures. Some products have groups outside or inside swath structures or grid structures.

Data Product File Naming Conventions

The general format is as follows:
dataType.satellite.instrument.algorithmName.startDate-SstartTime-EendTime.
sequenceIndicator.VdataVersion.extension

For example:
1C.GPM.GMI.XCAL2014-N.20110401-S224944-E002206.076201.V00D.HDF5

Additional details on GPM file naming conventions can be found in PPS_610.2_P550, V1.4.3, File Naming Convention for Precipitation Products or the GPM Mission.

2.1 Swath Structure

The swath structure stores satellite data which are organized by scans. Swath structures are implemented in Levels 1A, 1B, 1C, 2A, and 2B. The swath structure is contained in a group. In this swath group is the metadata group SwathHeader, data group ScanTime, data arrays Latitude and Longitude and other data arrays. In some products there are additional data groups under the swath group. The contents of the metadata group SwathHeader are explained in Metadata for GPM Products.

2.2 Grid Structure

The grid structure stores earth located grids. Each grid is an array of grid boxes, rather than grid points. Grid structures are implemented in Level 3A and 3B products. The grid structure is contained in a grid group. In this group is the metadata group GridHeader and data arrays. In some products there are additional data groups under the grid group. The contents of the metadata group GridHeader are explained in Metadata for GPM Products.

2.3 Physical Format

The logical format of GPM data products is written in an underlying format such as HDF. The logical array or scalar is implemented in HDF as a Scientific Data Set. Each SDS contains the data array and additional information as attributes: names of dimensions, units, scale, offset, and scale description. Each metadata group is implemented in HDF as an attribute. Elements within a group are implemented as
ElementName=ElementValue;

If the element has a list of values, the values are separated with a comma:
ElementName=Value1,Value2,...,ValueN;

2.4 Formatting Conventions

2.4.1 File Structure Figure

Each data product section has a file structure figure and file contents. The file structure figure show the organization of the data within the file. The File is on the left. Under the file are circles showing swaths or grid structures or boxes showing metadata, groups, or arrays. Group boxes are shaded. Array boxes contain the size of one element with the dimensions to the right of the box. A group has an additional figure showing the contents of the group.

2.4.2 File Contents

Each array or scaler is described with name in bold, then parenthesis containing the data type and dimensions, and then a description.

2.4.3 Missing Data and Empty Granules

Missing data are denoted by values equal to -9999.9, -9999.9, -9999, -9999, -9999, -99, 65535, 4294967295, 255, and NULL for for 8-byte float, 4-byte float, 8-byte integer, 4-byte integer, 2-byte integer, 1-byte integer, 2-byte unsigned integer, 4-byte unsigned integer, 1-byte character, and variable length string. Any exceptions to the use of the above standard values are explicitly notes in the description.

If an entire granule is missing, an empty granule may be created. An empty granule is defined by the metadata element EmptyGranule in the metadata group FileHeader. Software reading a granule should check EmptyGranule first. Swath data or grid data may be empty.

2.4.4 Array Dimension Order

In the definition of array dimensions, e.g. npixel x nscan, the first dimension (npixel) is the most rapidly varying index and the last dimension (nscan) is the least rapidly varying index. To implement the format in FORTRAN, declare an array with the dimensions as they appear in this document. To implement the format in C, declare an array with the dimensions reversed from their appearance in this document.

2.4.5 Granule definition

For orbital products, the beginning and ending time are defined as the time the sub-satellite track reaches its southernmost latitude. A scan is included in a granule when its ScanTime is greater than or equal to the Granule start time and less than the Granule end time.

For time-averaged products, the beginning time is the first millisecond of the period and the ending time is the last millisecond.

3.0 Data Contents and Products

3.1 Metadata

The Precipitation Processing Group has provided a document that defines the metadata structure for the GPM data products. You can view this document at the following location:

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

3.2 Data Product Descriptions

The Precipitation Processing Group has provided a detailed document that includes an introduction to the GPM data products. This document includes the purpose of each data product or grouping, a brief description, any caveats and/or limitations and a list of references. You can view this document at the following location:

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

3.3 Products

***NOTE: Products archived at the GES DISC will be prefixed with "GPM_"

Shortname	Long Name	Processing Level
Level 1 Data Products		
1AGMI	GMI unpacked packet data	1A
1AGMI_BR	Browse	1A
1BGMI	GMI Brightness Temperatures	1B
1BGMI_BR	Browse	1B
PRL1KA	Ka Power	1B
PRL1KA_BR	Browse	1B
PRL1KU	Ku Power	1B
PRL1KU_BR	Browse	1B
1CGCOMW1AMSR2	Common Calibrated Brightness Temperature	1C
1CGCOMW1AMSR2_BR	Browse	1C
1CAQUAAMSRE	Common Calibrated Brightness Temperature	1C
1CAQUAAMSRE_BR	Browse	1C
1CNPPATMS	Common Calibrated Brightness Temperature	1C
1CNPPATMS_BR	Browse	1C
1CGPMGMI	GPM Common Calibrated Brightness Temperature	1C
1CGPMGMI _BR	Browse	1C
1CMETOPAMHS	Common Calibrated Brightness Temperature	1C
1CMETOPAMHS_BR	Browse	1C
1CNOAA18MHS	Common Calibrated Brightness Temperature	1C
1CNOAA18MHS_BR	Browse	1C
1CNOAA19MHS	Common Calibrated Brightness Temperature	1C
1CNOAA19MHS_BR	Browse	1C
1CMETOPBMHS	Common Calibrated Brightness Temperature	1C
1CMETOPBMHS_BR	Browse	1C
1CMT1SAPHIR	Common Calibrated Brightness Temperature	1C
1CMT1SAPHIR_BR	Browse	1C
1CF16SSMIS	Common Calibrated Brightness Temperature	1C
1CF16SSMIS_BR	Browse	1C

1CF17SSMIS	Common Calibrated Brightness Temperature	1C
1CF17SSMIS_BR	Browse	1C
1CF18SSMIS	Common Calibrated Brightness Temperature	1C
1CF18SSMIS_BR	Browse	1C
1CTRMMTMI	GPM Common Calibrated Brightness Temperature	1C
1CTRMMTMI_BR	Browse	1C
1CCORIOLISWINDSAT	Common Calibrated Brightness Temperature	1C
1CCORIOLISWINDSAT_BR	Browse	1C
Level 2 Data Products		
2ADPRENV	DPR Environment	2A
2ADPRENV_BR	Browse	2A
2ADPR	DPR Precipitation	2A
2ADPR_BR	Browse	2A
2AGPROFGCOMW1AMSR2	Radiometer Profiling	2A
2AGPROFGCOMW1AMSR2_BR	Browse	2A
2AGPROFAQUAAMSRE	Radiometer Profiling	2A
2AGPROFAQUAAMSRE_BR	Browse	2A
2AGPROFNPPATMS	Radiometer Profiling	2A
2AGPROFNPPATMS_BR	Browse	2A
2AGPROFGPMGMI	Radiometer Profiling	2A
2AGPROFGPMGMI_BR	Browse	2A
2AGPROFNOAA18MHS	Radiometer Profiling	2A
2AGPROFNOAA18MHS_BR	Browse	2A
2AGPROFNOAA19MHS	Radiometer Profiling	2A
2AGPROFNOAA19MHS_BR	Browse	2A
2AGPROFMT1SAPHIR	Radiometer Profiling	2A
2AGPROFMT1SAPHIR_BR	Browse	2A
2AGPROFF16SSMIS	Radiometer Profiling	2A
2AGPROFF16SSMIS_BR	Browse	2A
2AGPROFF17SSMIS	Radiometer Profiling	2A
2AGPROFF17SSMIS_BR	Browse	2A
2AGPROFF18SSMIS	Radiometer Profiling	2A
2AGPROFF18SSMIS_BR	Browse	2A
2AGPROFMETOPAMHS	Radiometer Profiling	2A

2AGPROFMETOPAMHS_BR	Browse	2A
2AGPROFMETOPBMHS	Radiometer Profiling	2A
2AGPROFMETOPBMHS_BR	Browse	2A
2AGPROFTRMMTMI	Radiometer Profiling	2A
2AGPROFTRMMTMI_BR	Browse	2A
2AKaENV	Ka Environment	2A
2AKaENV_BR	Browse	2A
2AKa	Ka Precipitation	2A
2AKa_BR	Browse	2A
2AKaTMP	Ka Temporary	2A
2AKaTMP_BR	Browse	2A
2AKuENV	Ku Environment	2A
2AKuENV_BR	Browse	2A
2AKu	Ku Precipitation	2A
2AKu_BR	Browse	2A
2AKuTMP	Ku Temporary	2A
2AKuTMP_BR	Browse	2A
2BCMB	Level-2 DPR and GMI Combined	2B
2BCMB_BR	Browse	2B
2BCMBU	User Level-2 DPR and GMI Combined	2B
2BCMBU_BR	Browse	2B
2HCSH	Convective Stratiform Heating	2B
2HCSH_BR	Browse	2B
2HSLH	Spectral Latent Heating	2B
2HSLH_BR	Browse	2B
Level 3 Data Products		
3CMB	Combined Precipitation	3
3CMB_BR	Browse	3
3CMB_DAY	Daily Combined Precipitation	3
3CMB_DAY_BR	Browse	3
3DPRD	DPR Daily Product; Ascending and Descending Arrays	3
3DPRD_BR	Browse	3
3DPR	DPR Full Product Monthly	3
3DPR_BR	Browse	3
3DPR_ASC	DPR Ascending Daily	3
3DPR_ASC_BR	Browse	3
3DPR_DES	DPR Descending Daily	3
3DPR_DES_BR	Browse	3
3GCSH	Gridded Orbital Convective Stratiform Heating from Combined	3
3GCSH_BR	Browse	3
3GMI	Monthly GMI Profiling	3
3GMI_BR	Browse	3
3GPROFAQUAAMSRE	Monthly GPROF Profiling	3

3GPROFAQUAAMSRE_BR	Browse	3
3GPROFAQUAAMSRE_DAY	Daily GPROF Profiling	3
3GPROFAQUAAMSRE_DAY_BR	Browse	3
3GPROFF16SSMIS	Monthly GPROF Profiling	3
3GPROFF16SSMIS_BR	Browse	3
3GPROFF16SSMIS_DAY	Daily GPROF Profiling	3
3GPROFF16SSMIS_DAY_BR	Browse	3
3GPROFF17SSMIS	Monthly GPROF Profiling	3
3GPROFF17SSMIS_BR	Browse	3
3GPROFF17SSMIS_DAY	Daily GPROF Profiling	3
3GPROFF17SSMIS_DAY_BR	Browse	3
3GPROFF18SSMIS	Monthly GPROF Profiling	3
3GPROFF18SSMIS_BR	Browse	3
3GPROFF18SSMIS_DAY	Daily GPROF Profiling	3
3GPROFF18SSMIS_DAY_BR	Browse	3
3GPROFGCOMW1AMSR2	Monthly GPROF Profiling	3
3GPROFGCOMW1AMSR2_BR	Browse	3
3GPROFGCOMW1AMSR2_DAY	Daily GPROF Profiling	3
3GPROFGCOMW1AMSR2_DAY_BR	Browse	3
3GPROFGPMGMI	Monthly GPROF Profiling	3
3GPROFGPMGMI_BR	Browse	3
3GPROFGPMGMI_DAY	Daily GPROF Profiling	3
3GPROFGPMGMI_DAY_BR	Browse	3
3GPROFMETOPAMHS	Monthly GPROF Profiling	3
3GPROFMETOPAMHS_BR	Browse	3
3GPROFMETOPAMHS_DAY	Daily GPROF Profiling	3
3GPROFMETOPAMHS_DAY_BR	Browse	3
3GPROFMETOPBMHS	Monthly GPROF Profiling	3
3GPROFMETOPBMHS_BR	Browse	3
3GPROFMETOPBMHS_DAY	Daily GPROF Profiling	3
3GPROFMETOPBMHS_DAY_BR	Browse	3
3GPROFMT1SAPHIR	Monthly GPROF Profiling	3
3GPROFMT1SAPHIR_BR	Browse	3
3GPROFMT1SAPHIR_DAY	Daily GPROF Profiling	3
3GPROFMT1SAPHIR_DAY_BR	Browse	3
3GPROFNOAA18MHS	Monthly GPROF Profiling	3
3GPROFNOAA18MHS_BR	Browse	3
3GPROFNOAA18MHS_DAY	Daily GPROF Profiling	3
3GPROFNOAA18MHS_DAY_BR	Browse	3
3GPROFNOAA19MHS	Monthly GPROF Profiling	3
3GPROFNOAA19MHS_BR	Browse	3
3GPROFNOAA19MHS_DAY	Daily GPROF Profiling	3
3GPROFNOAA19MHS_DAY_BR	Browse	3
3GPROFNPPATMS	Monthly GPROF Profiling	3
3GPROFNPPATMS_BR	Browse	3
3GPROFNPPATMS_DAY	Daily GPROF Profiling	3
3GPROFNPPATMS_DAY_BR	Browse	3

3GPROFTRMMTMI	Monthly GPROF Profiling	3
3GPROFTRMMTMI_BR	Browse	3
3GPROFTRMMTMI_DAY	Daily GPROF Profiling	3
3GPROFTRMMTMI_DAY_BR	Browse	3
3GSLH	Gridded Orbital Spectral Latent Heating	3
3GSLH_BR	Browse	3
3GTRAIN	TRAIN Gridded Orbital Heating	3
3GTRAIN_BR	Browse	3
3HCSH	Monthly Convective Stratiform Heating from Combined	3
3HCSH_BR	Browse	3
3HSLH	Monthly Spectral Latent Heating	3
3HSLH_BR	Browse	3
3HTRAIN	TRAIN Monthly Heating	3
3HTRAIN_BR	Browse	3
3IMERGHH	I-MERG 30-minute	3
3IMERGHH_BR	Browse	3
3IMERGM	IMERG monthly	3
3IMERGM_BR	Browse	3

4.0 Options for Reading the Data

There are many tools and visualization packages (free and commercial) for viewing and dumping the contents of HDF5 files. Libraries are available in several programming languages for writing software to read HDF5 files. A few simple to use command-line and visualization tools, as well as programming languages for reading the MZM HDF5 data files are listed in the sections below. For a comprehensive list of HDF5 tools and software, please see the HDF Group's web page at http://www.hdfgroup.org/products/hdf5_tools/.

4.1 Command Line Utilities

4.1.1 h5dump (free)

The h5dump tool, developed by the HDFGroup, enables users to examine the contents of an HDF5 file and dump those contents, in human readable form, to an ASCII file, or alternatively to an XML file or binary output. It can display the contents of the entire HDF5 file or selected objects, which can be groups, datasets, a subset of a dataset, links, attributes, or datatypes. The h5dump tool is included as part of the HDF5 library, or separately as a stand-alone binary tool at:
http://www.hdfgroup.org/HDF5/release/obtain5.html

4.1.2 ncdump (free)

The ncdump tool, developed by Unidata, will print the contents of a netCDF or compatible file to standard out as CDL text (ASCII) format. The tool may also be used as a simple browser, to display the dimension names and lengths; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables. To view HDF5 data files, version 4.1 or higher is required. The ncdump tool is included with the netCDF library. **NOTE: you must include HDF5 support during build.**
http://www.unidata.ucar.edu/downloads/netcdf/

4.1.3 H5_PARSE (IDL/commercial)

The H5_PARSE function recursively descends through an HDF5 file or group and creates an IDL structure containing object information and data values. You must purchase an IDL package, version 8 or higher, to read the MZM HDF5 data files.
https://www.harrisgeospatial.com/docs/home.html

4.1.4 PPS Science Algorithm Input/Output Toolkit

The Toolkit provides: 1) a set of commonly used routines and constants for algorithm developers and researchers and 2) seamless integration of Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurement (GPM) algorithms into the PPS environment.

ftp://pps.gsfc.nasa.gov/pub/PPStoolkit/GPM/

4.2 Tools/Programming

Any application that supports the HDF5 file format can be used to read our data. If you are new to HDF5 or to our data, the following tools might be useful starting points.

- HDFView (http://www.hdfgroup.org/hdf-java-html/hdfview/index.html)
- Panoply **(**http://www.giss.nasa.gov/tools/panoply/)
- https://disc.gsfc.nasa.gov/information/howto?title=How to View Remote Data in OPeNDAP with Panoply

For more advanced users or programmers:

- IDL (https://www.harrisgeospatial.com/docs/home.html)
- Matlab (http://www.mathworks.com/products/matlab/)
- GrADS (http://cola.gmu.edu/grads/)
- Python (http://h5py.alfven.org/)
- Java (http://www.hdfgroup.org/)
- HDF5 (http://www.hdfgroup.org/HDF5/)

4.2.1 HDFView (free)

HDFView, developed by the HDFGroup, is a Java-based graphic utility designed for viewing and editing the contents of HDF4 and HDF5 files. It allows users to browse through any HDF file, starting with a tree view of all top-level objects in an HDF file's hierarchy. HDFView allows a user to descend through the hierarchy and navigate among the file's data objects. Editing features allow a user to create, delete, and modify the value of HDF objects and attributes. For more info see: http://www.hdfgroup.org/hdf-java-html/hdfview/

4.2.2 Panoply (free)

Panoply, developed at the Goddard Institute for Space Studies (GISS), is a cross-platform application which plots geo-gridded arrays from netCDF, HDF and GRIB dataset required. The tool allows one to slice and plot latitude-longitude, latitude-vertical, longitude-vertical, or time-latitude arrays from larger multidimensional variables, combine two arrays in one plot by differencing, summing or averaging, and change map projections. One may also access files remotely into the Panoply application.
http://www.giss.nasa.gov/tools/panoply/

4.2.3 Orbit Viewer THOR (free)

Orbit Viewer THOR is a tool for displaying TRMM and GPM satellite data files. THOR stands for Tool for High-resolution Observation Review. This viewer enables you to display TRMM and GPM observations at the full instrument resolution.

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

4.2.4 H5_BROWSER (IDL/commercial)

The H5_BROWSER function presents a graphical user interface for viewing and reading HDF5 files. The browser provides a tree view of the HDF5 file or files, a data preview window, and an information window for the selected objects. The browser may be created as either a selection dialog with Open/Cancel buttons, or as a standalone browser that can import data to the IDL main program. You must purchase an IDL package, version 8 or higher to view the MZM HDF5 data files. https://www.harrisgeospatial.com/docs/home.html

4.3 Programming Languages

Advanced users may wish to write their own software to read HDF5 data files. The following is a list of available HDF5 programming languages:
Free:

- C/C++ (http://www.hdfgroup.org/HDF5/release/obtain5.html)
- Fortran (http://www.hdfgroup.org/HDF5/release/obtain5.html)
- Java (http://www.hdfgroup.org/)
- Python (http://alfven.org/wp/hdf5-for-python/)
- GrADS (http://cola.gmu.edu/grads)

Commercial:

- IDL (https://www.harrisgeospatial.com/docs/home.html)
- Matlab (http://www.mathworks.com/products/matlab/)

5.0 Data Services

5.1 Mirador

GES DISC provides basic temporal and advanced (event) searches through its search and download engine, **Mirador:**
http://mirador.gsfc.nasa.gov/

Mirador offers various download options that suit users with different preferences and different levels of technical abilities. Users can start from a point where they don't know anything about these particular data, its location, size, format, etc.., and quickly find what they need by just providing relevant keywords, like “GSSTF3”, or “flux”, or “turbulence”, or just “Heat”.

5.2 OPeNDAP

OPeNDAP stands for “Open-source Project for a Network Data Access Protocol”. OPeNDAP is a framework that simplifies all aspects of scientific data networking. It provides simple means for parameter and spatial subset. The spatial subset is actually a subset by array index - array being the grid data. In the most simplistic case, OPeNDAP can be used to convert data from HDF-EOS5 to ASCII. The data directory hierarchy, as served by OPeNDAP, can be viewed in any browser.

6.0 More Information

6.1 Further Reading

6.1.1 GPM ATBD (Algorithm Theoretical Basis Documents)

GPM/DPR Level-2 Algorithm Theoretical Basis Document

GPM Combined Radar-Radiometer Precipitation Algorithm Theoretical Basis Document (Draft 2)

DPR_L2_variables_20101128

DPR_L2_variables_20101128STDonly

GPM Microwave Imager (GMI) Level 1B (L1B) Algorithm Theoretical Basis Document (ATBD)

GPM Level 1C Algorithms (L1C) Algorithm Theoretical Basis Document (ATBD)

GPM GPROF (Level 2) Algorithm Theoretical Basis Document.

GPM Integrated Multi-satellite Retrievals for GPM (I-MERG)

GPM Geolocation Toolkit Algorithm Theoretical Basis Document (ATBD)

6.1.2 GPM Preliminary Documents

Introduction to PPS Data Products (Guide)

PPS File Naming Convention for Precipitation Products for The Global Precipitation Measurement (GPM) Mission

PPS/Global Precipitation Measurement File Specification for GPM Products

PPS/Global Precipitation Measurement Metadata for GPM Products

PPS/Global Precipitation Measurement Science Data Management Plan

6.2 Frequent Asked Questions

https://disc.gsfc.nasa.gov/information/faqs

6.2 Point of Contact

Name: GES DISC Help Desk URL: http://disc.gsfc.nasa.gov/ E-mail: gsfc-help-disc@lists.nasa.gov Phone: 301-614-5224 Fax: 301-614-5228 Address: Goddard Earth Sciences Data and Information Services Center Attn: Help Desk Code 610.2 NASA Goddard Space Flight Center Greenbelt, MD 20771, USA

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-Precipitation Measurement Mission (PMM)

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