National Aeronautics and Space Administration Goddard Earth Science Data Information and Services Center (GES DISC)

README Document for the Tropical Rainfall Measurement Mission (TRMM) Version 7

Last Revised July 6, 2017

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Revision History

Revision Date	***Changes***	***Author***
August 31, 2015	This document was first created.	Kyle MacRitchie
December 8, 2015	Fixed some typos and missing information.	Kyle MacRitchie
December 16, 2015	Fixed some typos.	Kyle MacRitchie
July 6, 2017	Changes to section 1.2, p10	G. Huffman, D. Bolvin

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1.0 Introduction

This document provides basic information for using Tropical Rainfall Measurement Mission (TRMM) products.

The TRMM datasets consist of products generated for studying precipitation in the tropics. These products include observations of radiances, microwave temperature, radar reflectivity, rainfall rate, vertical rainfall profile, and convective and stratiform heating.

TRMM was launched on November 27, 1997 and decommissioned on April 15, 2015. It re-entered Earth's atmosphere in June 2015.

1.1 Dataset/Mission Instrument Description

Each of the TRMM datasets listed below is created using algorithms that are explained in more detail in section 1.2.

Applicable Data Products

Table 1 below provides an overview of the 18 TRMM products discussed in this document.

	Product ID	Product Name	Temporal Resolution	Horizontal Resolution (x and y)
Orbital	**1B01**	Visible and Infrared Scanner (VIRS) Level 1 Raw and Calibrated Radiance Products	16 orbits / day	2.2 km
	1B11	TRMM Microwave Imager (TMI) Level 1 Raw and Calibrated Radiance Product	16 orbits / day	4.4 km, 5.1 km
	1B21	TRMM Precipitation Radar (PR) Level 1 Power and Reflectivity Products	16 orbits / day	4.3 km, 5.0 km
	1C21	TRMM Precipitation Radar (PR) Level 1 Power and Reflectivity Products	16 orbits / day	4.3 km, 5.0 km
	2A12	TRMM Microwave Imager (TMI) Level 2 Hydrometeor Profile Product	16 orbits / day	4.4 km, 5.1 km
	2A21	TRMM Precipitation Radar (PR) Level 2 Surface Cross-Section Product	16 orbits / day	4.3 km, 5.0 km
	2A23	TRMM Precipitation Radar (PR) Level 2 Rain Characteristics Product	16 orbits / day	4.3 km, 5.0 km
	2A25	TRMM Precipitation Radar (PR) Level 2 Rainfall Rate and Profile Product	16 orbits / day	4.3 km, 5.0 km
	2B31	TRMM Combined Precipitation Radar (PR) and TRMM Microwave Imager (TMI) Rainfall Profile Product	16 orbits / day	4.3 km, 5.0 km
Gridded	**3A11**	TRMM Microwave Imager (TMI) Gridded Oceanic Rainfall Product	Monthly	5.0°
	3A12	TRMM Microwave Imager (TMI) Level 3 Monthly 0.5 degree x 0.5 degree Profiling V7	Monthly	0.5°
	3A25	TRMM Precipitation Radar (PR) Gridded Rainfall Product	Monthly	0.5° and 5.0°
	3A26	TRMM Precipitation Radar (PR) Gridded Surface Rain Total Product	Monthly	5.0°
	3B31	TRMM Combined Precipitation Radar (PR) and TRMM Microwave Imager (TMI) Gridded Rainfall Product	Monthly	0.5°
	3A46	TRMM Monthly 1 x 1 Degree SSM/I Rain Data V2	Monthly	1.0°
	3B42	TRMM/TMPA 3-Hourly 0.25 deg. TRMM and Others Rainfall Estimate Data	3 hourly	0.25°
	3B43	TRMM/TMPA and Other Sources Monthly Rainfall Product	Monthly	0.25°
	CSH	TRMM Level 3 Monthly 0.5 degree x 0.5 degree Convective and Stratiform Heating CSH	Monthly	0.5°

Table 1. All horizontal resolutions are identical in the x and y directions (e.g. 2.2 km means 2.2 km x 2.2 km). Multiple resolutions refer to pre-boost (before 2001-08-07) and post-boost (after 2001-08-24) values respectively. Details on all these datasets can be found in Section 3.3.

1.1.1 Dataset/Instruments

The Tropical Rainfall Measurement Mission (TRMM) is a collaborative effort between NASA and the Japanese Aerospace Exploration Agency (JAXA). The TRMM observatory, which housed the first-ever precipitation radar in space, was launched in 1997 into a near circular orbit of approximately 350 kilometers with a period of 92.5 minutes (15.6 orbits per day). During the period of 2001/8/7 to 2001/8/14, the average operating altitude changed from 350 km to 403 km (referred to also as TRMM Boost).The datasets described in this document were created using data from the TRMM observatory and its partner satellites.

Multiple instruments are used throughout the TRMM satellite constellation. They are described briefly below.

Precipitation Radar (PR): The PR was the first spacebourne instrument designed to provide three-dimensional plots of storm structure. It has a horizontal resolution of about 5 km and a swath width of 247 km. It can provide vertical profiles of rain and snow from the surface to a height of 20 km and is sensitive to light rain rates as low as 0.5 mm/hr.

TRMM Microwave Imager (TMI): The TMI is a passive microwave sensor based on the Special Sensor Microwave/Imager (SSM/I). It measures the intensity of radiation at 10.7, 19.4, 21.3, 37, and 85.5 GHz.

Visible Infrared Scanner (VIRS): The VIRS senses radiation in the visible and infrared wavelengths of 0.63, 1.6, 10.8, and 12 micrometers. The VIRS has a horizontal resolution of 2.4 km and a swath width of about 833 km.

Below is a table summary of the instrument specifications adapted from the NASA Precipitation Measurement Missions website.

	PR	**TMI**	**VIRS**
Frequencies	13.8 GHz	10.7, 19.4, 21.3, 37, 85.5 GHz	Wavelengths: 0.63, 1.6, 10.8, 12 μm
Resolution	5 km horizontal, 250 m vertical	11 km x 8 km at 37 GHz	2.4 km
Scanning	Cross-track	Conical	Cross-track
Swath Width	247 km	878 km	833 km

Table 2. Summary of instrument specifications.

1.2 Algorithm Background

This section describes how each dataset is created.

1B01: The TRMM Visible and Infrared Scanner (VIRS) Level 1B Calibrated Radiance Product contains calibrated radiances and auxiliary geolocation information from the five channels of the VIRS instrument for each pixel of each scan. The EOSDIS "swath" structure is used to accommodate the actual geophysical data arrays. Sixteen files of VIRS 1B01 data are produced each day.

For channels 1 and 2, Level 1B radiances are derived from the Level 1A (1A01) sensor counts by computing calibration parameters (gain and offset) derived from the counts registered during space and solar and/or lunar views. New calibration parameters are produced every one to four weeks. Channels 3, 4, and 5 are calibrated using the internal blackbody and the space view. These calibration parameters, together with a quadratic term determined pre-launch, are used to generate a counts vs. radiance curve for each band, which is then used to convert the earth-view pixel counts to spectral radiances.

Geolocation and channel data are written out for each pixel along the scan, whereas the time stamp, scan status (containing scan quality information), navigation, calibration coefficients, and solar/satellite geometry are specified on a per-scan basis. There are in general 18,026 scans along the orbit pre-boost and 18,223 post-boost, with each scan consisting of 261 pixels. The scan width is about 720 km pre-boost and 833 km post-boost.

1B11: This is the TRMM Microwave Imager (TMI) LEVEL 1B calibrated Brightness Temperature (T_b) data product. The TMI calibration algorithm (1B11) converts the radiometer counts to antenna temperatures by applying a linear relationship of the form $T_a = c_1 + c_2$ x count. The coefficients are provided by the instrument contractor. Antenna temperatures are corrected for cross-polarization and spill over to produce brightness temperatures (T_b), but no antenna beam pattern correction or sample to pixel averaging are performed. Temperatures are provided at 104 scan positions for the low frequency channels and 208 scan positions at 85 GHz. There are four samples per pixel (3 dB beam width) at 10 GHz, two samples at 19, 22, and 37 GHz, and one sample per pixel for the 85 GHz.

1B21: The PR calibration algorithm (1B21) converts the counts of radar echoes and noise levels into engineering values (power) and outputs the radar echo power and noise power separately. The algorithm also detects and flags the range bin with return power that exceeds a pre-determined threshold value.

1C21: The PR reflectivity algorithm (1C21) converts the power and noise estimates from 1B21 to radar reflectivity factors (Z-factors). In order to reduce output data volume, only pixels with power that exceeds the minimum echo detected in 1B21 are converted and stored.

2A12: This product contains surface rainfall and vertical hydrometeor profiles on a pixel-by-pixel basis from the TMI brightness temperature data using the Goddard Profiling algorithm GPROF2008. Because the vertical information comes from a radiometer, it is not written in independent vertical layers like the TRMM PR. Instead, the output references the 100 typical structures for each hydrometeor or heating profile. These vertical structures are referenced as clusters in the output structure. Vertical hydrometeor profiles can be reconstructed to 28 layers by knowing the cluster number (i.e. shape) of the profile and a scale factor that is written for each pixel.

2A21: This is the sigma zero algorithm, which inputs the PR power (1B21) and computes estimates of the path attenuation and its reliability by using the surface as a reference target. It also computes the spatial and temporal statistics of the surface scattering cross section and classifies the cross sections into land/ocean and rain/no rain categories.

2A23: This dataset contains PR (13.8 GHz) precipitation characteristics at 5 km horizontal resolution over a 247 km swatch including rain/no-rain decision and freezing level.

2A25: The average rainfall rate between the two pre-defined altitudes is calculated for each beam position. Other output data include parameters of Z-R relationships, integrated rain rate of each beam, range bin numbers of rain layer boundaries, and many intermediate parameters.

2B31: This combined rainfall product is derived from vertical hydrometeor profiles using data from the PR radar and TMI. It also includes computed correlation-corrected, mass-weighted, mean drop diameter and its standard deviation, and latent heating.

3A11: This is the TMI Monthly 5° x 5° Oceanic Rainfall Product. Algorithm 3A11 estimates monthly rain from the histogram of the brightness temperatures obtained from TMI calibration (1B11). This histogram is matched to a log-normally distributed rain rate distribution via a rain rate-brightness temperature relation. A beam-filling correction is applied to account for the non-uniformly filled field-of-view of the TMI sensor. Outputs are monthly surface rain rates and freezing heights for 5° x 5° grid boxes.

3A12: This is a monthly version of the 2A12 data product.

3A25: This product consists of monthly statistics of the PR measurements at both a low (5° x 5°) and a high (0.5° x 0.5°) horizontal resolution. The low resolution grids are in the Planetary Grid 1 structure and include 1) mean and standard deviation of the rain rate, reflectivity, path-integrated attenuation (PIA), storm height, Xi, bright band height and the NUBF (Non-Uniform Beam Filling) correction; 2) rain fractions; 3) histograms of the storm height, bright-band height, snow-ice layer, reflectivity, rain rate, path-attenuation and NUBF correction; 4) correlation coefficients. The high resolution grids are in the Planetary Grid 2 structure and contain mean rain rate along with standard deviation and rain fractions.

3A26: This dataset contains PR monthly surface rainfall. These data were derived from rain rate statistics and include the estimated values of the probability distribution function of the space-time rain rates at four levels (2 km, 4 km, 6 km, and path-averaged) and the mean, standard deviation, and probability of rain derived from these distributions. Three different rain rate estimates are used as input to the algorithm: (1) the standard Z-R (or 0^{th}-order estimate having no attenuation correction); (2) the Hitschfield-Bordan (H-B); and (3) the rain rates taken from 2A25.

3A46: This rainfall product contains data derived from the monthly SSM/I data averaged over 1° x 1° boxes each month. These data are used as input to the 3B43 monthly product described below.

3B31: This is a combined rainfall product. 3B31 uses the high quality retrievals done for the narrow swath in 2B31 to calibrate the wide swath retrievals generated in 2A12. For each 0.5° x 0.5° box and each vertical layer, an adjustment ratio is calculated for the swath overlap region for one month. Only TMI pixels with 2A12 pixelStatus equal to zero are included in monthly averages, which effectively removes sea ice.

3B42: The data product consists of TRMM Multi-Satellite Precipitation Analysis (TMPA) Rainfall Estimate Product 3B42 Version 7 (V7), which merges satellite rainfall estimates (S) with gauge data (G). First, all non-TRMM microwave precipitation estimates The 3B42 algorithm first combines microwave precipitation estimates from multiple low-earth-orbiting satellites are calibrated to the TRMM Microwave Imager precipitation (TMI; TRMM product 2A12) and then calibrated to the TRMM Combined Instrument precipitation (TCI; TRMM product 2B31). These are merged to produce a 3 hourly microwave-only best estimate. The infrared precipitation estimates (from multiple geosynchronous satellites) are then calibrated to the microwave estimate and used to fill in the regional gaps in the merged microwave field to produce a combined satellite rainfall estimate every 3 hours. These 3-hourly combined satellite estimates are then summed to the monthly scale and recalibrated with a monthly precipitation gauge analysis to provide the final SG-merged precipitation estimate as a Level 3 (L3) 3 hourly 0.25° x 0.25° quasi-global (50°N-S) gridded SG-rainfall database. Estimates of root-mean-square (RMS) precipitation error are also provided.

3B43: The data product consists of TRMM Multi-Satellite Precipitation Analysis (TMPA) Rainfall Estimate Product 3B43 Version 7 (V7), which merges satellite rainfall estimates (S) with gauge data (G) into gridded estimates on a calendar month temporal resolution and a 0.25° by 0.25° spatial resolution global band extending from 50°S to 50°N latitude. This algorithm is executed once per calendar month to produce the average best-estimate precipitation rate and RMS precipitation-error estimate field (3B43) described in 3B42 prior to recalibration of the 3 hourly product.

CSH: This is the convective and stratiform heating product. Convective and stratiform heating profiles are separated by comparing heating profiles from TRMM sensors to a lookup table of heating profiles mostly generated by the Goddard Cumulus Ensemble Cloud Resolving Model.

1.3 Data Disclaimer

1.3.1 Acknowledgement

If you use these data in publications, please acknowledge the Tropical Rainfall Measuring Mission (TRMM) as well as the Goddard Earth Sciences Data and Information Services Center (GES DISC) for the dissemination of the data. The standard for data citation can be found under the “Data Citation” tab on any of the TRMM product pages:

https://disc.gsfc.nasa.gov/datasets?project=TRMM

1.3.2 Contact Information

If you need assistance or wish to report a problem please use the following contact information:

Email: gsfc-dl-help-disc at mail.nasa.gov
Voice: 301-614-5268
Fax: 301-614-5268

Address:
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2.0 Data Organization

All datasets are stored in files that correspond to their temporal resolution. For example, the 3-hourly 3B42 data are stored in eight files per day at 00 UTC, 03 UTC, 06 UTC, etc. and monthly files are stored in separate files for each month.

2.1 File Naming Convention

File names involve some combination of the following attributes:

- <date> The date is always in a format with the last 2 digits of the year following by the month and the day, always with a leading zero. An example for 4 August 2009 would be: *090804*.
- <orbit_number> This is the 5 digit orbit number.
- <product_version> This is the product version. The most recent version is 7.

Product ID	File Naming Convention	Format
1B01	1B01.<date>.<orbit_number>.<product_version>.HDF	HDF4
1B11	1B11.<date>.<orbit_number>.<product_version>.HDF	HDF4
1B21	1B21.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
1C21	1C21.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
2A12	2A12.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
2A21	2A21.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
2A23	2A23.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
2A25	2A25.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
2B31	2B31.<date>.<orbit_number>.<product_version>.HDF.Z	Compressed HDF4
3A11	3A11.<date>.<product_version>.HDF.Z	Compressed HDF4
3A12	3A12.<date>.<product_version>.HDF.Z	Compressed HDF4
3A25	3A25.<date>.<product_version>.HDF.Z	Compressed HDF4
3A26	3A26.<date>.<product_version>.HDF.Z	Compressed HDF4
3B31	3B31.<date>.<product_version>.HDF.Z	Compressed HDF4
3A46	3A46.<date>.<product_version>.HDF.Z	Compressed HDF4
3B42	3B42.<date>.<hour>.<product_version>.HDF.Z	Compressed HDF4
3B43	3B43.<date>.<product_version>.HDF.Z	Compressed HDF4
CSH	CSH.<date>.<product_version>.HDF	HDF4

Table 3. File naming conventions.

2.2 File Format and Structure

TRMM files are in the Hierarchical Data Format Version 4 (HDF-4), developed at the National Center for Supercomputing Applications (https://www.hdfgroup.org). These extensions facilitate the creation of Grid, Point, and Swath data structures, depending on whether the data are orbital or gridded.

Orbital (levels 1 and 2) data are stored in HDF-4 files that use the swath structure.

The variables within the orbital TRMM files (the product IDs that begin with a "1" or a "2") contain Swath data structures with dimensions of (nscan x nray). The gridded variables have dimensions of (longitude x latitude). Three-dimensional variables, found in the gridded files, have a third dimension of height above the surface, measured in kilometers.

Missing data are represented by values that are less than or equal to -99, -9999, -9999, -9999.9, and -9999.9 corresponding to 1-byte integers, 2-byte integers, 4-byte floats, and 8-byte floats.

Array dimensions are ordered so that the first dimension has the most rapidly varying index and the last dimension has the least rapidly varying index, which is sometimes called column-major ordering. Languages such as Fortran, MATLAB, and R use column-major ordering naturally. If you use row-major languages such as C++ and Python, it is recommended that you reverse the order of the dimensions of the arrays for optimal performance.

2.3 Key Science Data Fields

Below are the variables, and the products in which they are found, that we expect to be the most popular.

Product ID	Variable Name	Description	Dimensions	Units
3A12 Monthly Data	surfaceRain	Surface Rainfall Rate	lat x lon	mm hr^{-1}
	convectPreciptiation	Surface Convective Rain Rate	level x lat x lon	mm hr^{-1}
	surfacePrecipitation	Surface Precipitation Rate	lat x lon	mm hr^{-1}
	cldIce	Cloud Ice Water Content	level x lat x lon	g m^{-3}
	cldWater	Cloud Liquid Water Content	level x lat x lon	g m^{-3}
	snow	Snow Liquid Content	level x lat x lon	g m^{-3}
	graupel	Graupel Liquid Water Content	level x lat x lon	g m^{-3}
	latentHeat	Latent Heat Release	level x lat x lon	K hr^{-1}
3B42 3-Hourly Data	precipitation	Surface Precipitation Estimate	lat x lon	mm hr^{-1}
	HQprecipitation	Microwave Precipitation Estimate*	lat x lon	mm hr^{-1}
	IRprecipitation	Infrared Precipitation Estimate*	lat x lon	mm hr^{-1}
	relativeError	Random Error Estimate	lat x lon	mm hr^{-1}
3B43 Monthly Data	precipitation	Surface Precipitation Estimate	lat x lon	mm hr^{-1}
	relativeError	Random Error Estimate	lat x lon	mm hr^{-1}

Table 4. Description of popular variables.
*Variables marked with a * are only found in version 7, not version 6.*

3.0 Data Contents

3.1 Dimensions

The dimensions of the variables within the files vary by processing level, which refers to the “1”, “2”, or “3” at the beginning of the product ID. A summary of the dimensionality of the most common variables is given below. See section 3.3 for more details on each individual dataset.

Level 1 Data: 1XXX

Most of these variables have dimensions of *nscan* x *nray*. *nscan* refers to the number of scans in each granule, which varies by file. The second dimension, *nray* refers to the number of angle bins in each scan, which is always 49.

Level 2 Data: 2XXX

These variables have various numbers of dimensions made up of the ones listed below.

ncluster: number of clusters at each freezing height, always 100
nlayer: number of profiling layers, always 28
npixel: number of pixels in each scan, always 208
nfindex: number of freezing height indices, always 13
nspecies: number corresponding to the hydrometeor species. Table 5 below lists the species.

Species Number	Description	Units
1	Cloud liquid water content	g m^{-3}
2	Rain water content	g m^{-3}
3	Cloud ice water content	g m^{-3}
4	Snow water content	g m^{-3}
5	Graupel water content	g m^{-3}
6	Latent heating	K h^{-1}

Table 5. Description of hydrometeor species.

Level 3 Data: 3XXX

These variables are on geographic grids and have various combinations of the dimensions listed below.

nlat: number of latitudes
nlon: number of longitudes
nlayer: number of vertical layers denoting the height above the surface. There are 28 vertical layers beginning at 0.5 km and increasing in 0.5 km intervals to 10 km and then 1 km intervals to 18 km.
All 32-bit variables have *units* attributes to make them COARDS-compliant.

Resolution

TRMM data are available on a variety of grids depending on the products chosen. Table 1 shows the temporal and horizontal resolutions associated with each TRMM product.

Temporal resolutions vary between 16 orbits/day (90 minutes), 3-hourly, and monthly. 3-hourly data exist at the synoptic and intermediate synoptic times of 00, 03, 06, 09, 12, 15, 18, and 21 UTC. Sub-daily data represent observations taken at that instant whereas monthly data represent monthly averages.

The orbital data products (1XXX and 2XXX) have latitude and longitude variables contained within the HDF files to allow proper swath mapping. Gridded files (3XXX) do not have explicit latitude and longitude information. Instead, the gridded files contain the *LatitudeResolution*, *LongitudeResolution*, *NorthBoundingCoordinate*, *SouthBoundingCoordinate*, *EastBoundingCoordinate*, *WestBoundingCoordinate* metadata and generally span 50°S to 50°N and 180°W to 180°E. Some products only span 38°S to 38°N, see section 3.3 for specific details.

Gridded TRMM products use the center of grid boxes for their latitude and longitude coordinates. For example, the TRMM 3B42 dataset, which spans 50°S to 50°N and 180°W to 180°E has a grid that goes from 49.875°S TO 49.875°N and 179.875°W to 179.875°E. Consult the sample code in Section 4 of this Readme for specific examples.

Detailed information on data resolution can be found in the PPS File Specification document cited at the end of this Readme document.

3.2 Global Attributes

In addition to SDS arrays containing variables and dimension scales, global metadata are also stored in the files. Some metadata are required by standard conventions, some are present to meet data provenance requirements, and others as a convenience to users of TRMM products. A summary of global attributes present in all files is shown in Table 6.

Global Attribute	**Description**
AlgorithmID	The algorithm that generated the product.
AlgorithmVersion	The version of the algorithm specified as the AlgorithmID.
FileName	The file name.
GenerationDateTime	The date and time the granule was generated.
StartGranuleDateTime	The start time of the data in the granule.
StopGranuleDateTime	The stop time of the data in the granule.
GranuleNumber	The granule number.
NumberOfSwaths	The number of swaths in the granule.
NumberOfGrids	The number of grid structures in the granule.
GranuleStart	The granule's orbit starting place.
TimeInterval	The time interval covered by the granule. Possible values are: ORBIT, HALFORBIT, HOUR, 3_HOUR, DAY, MONTH, and CONTACT.
ProcessingSystem	The name of the processing system.
ProductVersion	The data version assigned by ProcessingSystem.
MissingData	The number of missing scans.

Table 6. Description of global attributes.

Name	Type	Description
FillValue	float32	Floating-point value used to identify missing data. Will normally be set to 1e15. Not included in every TRMM file.
Units	string	The units of the variable. Must be a string that can be recognized by UNIDATA's Udunits package.
Scale_factor	float32	If variable is packed as 16-bit integers, this is the scale_factor for expanding to floating-point.

Table 7. Key Metadata Items

A list of key metadata fields can be found in Table 7. Global attributes in a **Data Set Name** file can be viewed with the *ncdump* software: ncdump –h -c <TRMM file>.

3.3 Products and Variables

1B01: Visible and Infrared Radiance

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Horizontal Resolution	2.2 km	2.4 km
Scan Characteristics	Swath Width: 720 km Pixels/Scan: 261 Scans/Second (SS): 2*98.5/60 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 18026 nscan = SS*SO	Swath Width: 833 km Pixels/Scan: 261 Scans/Second (SS): 2*98.5/60 Seconds/Orbit (SO): 5490 Average Scans/Orbit: 5550 = 18223 nscan = SS*SO
Average File Size	≈ 137 MB	≈ 138 MB

1B01 Data Format Structure						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specifications for the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with each scan	Vdata Table	8	nscan	-	-	-
Latitude Latitude information	Float SDS	4	261*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	261*scan	-	-	degree
Scan Status Status of each scan	Vdata Table	19	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Solar Cal Solar unit vector in Geocentric Inertial Coordinates and the Sun-Earth distance	Vdata Table	32	nscan	-	-	-
Calibration Counts Raw calibration counts data	Integer SDS	2	5*2*3*nscan	-	-	-
Temperature Counts Primary and redundant temperatures for the black body, radiant cooler, and the electronics module	Integer SDS	2	6*nscan	-	0 – 4095	counts
Local Direction Angles to the satellite and sun from the IFOV pixel position on the earth	Float SDS	4	2*2*27*nscan	-	-	degree
Channels Scene data for the five channels	Float SDS	4	5*261*nscan	depends	depends	mW cm^{-2}µm^{-1} sr^{-1}

Solar Unit Vector		
Name	**Format**	**Description**
Solar Position	3 * 8-byte float	Sun Unit Vectors: x-, y-, and z-components
Distance	8-byte float	Sun-Earth Distance (m)

Raw Calibration Counts Data	
Dimension	**Data Stored**
1	Channel number
2	Data word
3	Blackbody, space view, solar diffuser
4	Number of scans

Local Direction Angles		
Dimension	**Data Stored**	**Description**
1	zenith, azimuth	The zenith angle is measured between the local pixel geodetic zenith and the direction to the satellite. The azimuth angle is measure clockwise from the local north direction toward the local east direction.
2	object	The object to which the directions point, namely the satellite and the sun.
3	pixel number	Angles are given only for every tenth pixel along a scan: e.g. pixels 1, 11, 21,..., 261.
4	scan number	Scan line number

VIRS Range and Accuracy					
Channel	**Minimum mW $cm^{-2}\mu m^{-1}$ sr^{-1}**	**Maximum mW $cm^{-2}\mu m^{-1}$ sr^{-1}**	**Accuracy**	**Spectral Region**	**Wavelength (µm)**
1	0	65.5	10%	Visible	0.63
2	0	32.7	10%	Near IR	1.60
3	0	0.111	2%	Near IR	3.75
4	0	1.371	2%	Near IR	10.80
5	0	1.15	2%	IR	12.00

1B11: Microwave Brightness Temperature (TMI)

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Spatial Resolution	4.4 km at 85.5 GHz	5.1 km at 85.5 GHz
Scan Characteristics	Swath Width: 760 km Pixels/Scan: 104 (low resolution) 208 (high resolution) Scans/Second (SS): 36.100/60 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 2991 nscan = SS * SO + 100	Swath Width: 878 km Pixels/Scan: 104 (low resolution) 208 (high resolution) Scans/Second (SS): 36.100/60 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 3023 nscan = SS * SO + 100
Average File Size	≈ 16 MB	≈ 16 MB

1B11 Data Format Structure						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with each scan	Vdata Table	9	nscan	-	-	-
Latitude Latitude information	Float SDS	4	208*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	208*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	21	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Calibration Calibration	Vdata Table	95	nscan	-	-	-
Calibration Counts Calibration measurement, in counts. Dimensions are: samples, load, channel, and nscan.	Integer SDS	2	16*2*9*nscan	-	-	-
Satellite Local Zenith Angle Angle between the local pixel geodetic zenith and the direction to the satellite. This angle is given for every 20th high resolution pixel along a scan: pixel 1, 21, 41,.., 201, 208.	Float SDS	4	12*nscan	-	-	degree
Low Resolution Channels Low resolution channels bright temperature	Integer SDS	2	7*104*nscan	(T-100)*100	-	K
High Resolution Channels High resolution channels bright temperature	Integer SDS	2	2*208*nscan	(T-100)*100	-	K

TRMM 1B11 Scan Time		
Name	**Format**	**Description**
Year	2-byte integer	4-digit year, e.g., 1998
Month	1-byte integer	The month of the year
Day of Month	1-byte integer	The day of the month
Hour	1-byte integer	The hour (UTC) of the day
Minute	1-byte integer	The minute of the hour
Second	1-byte integer	The second of the minute
Day of Year	2-byte integer	The day of the year

TRMM 1B11 Channels			
Channel	**Frequency**	**Polarization**	**Resolution**
1	10 GHz	Vertical	Low
2	10 GHz	Horizontal	Low
3	19 GHz	Vertical	Low
4	19 GHz	Horizontal	Low
5	21 GHz	Vertical	Low
6	37 GHz	Vertical	Low
7	37 GHz	Horizontal	Low
8	85 GHz	Vertical	High
9	85 GHz	Horizontal	High

TRMM 1B11 Calibration		
Name	**Format**	**Range**
Hot Load Temperature	3 x 2-byte integer	0 – 400 K
The physical temperatures, in degrees Kelvin, for the 3 temperature sensors attached to the hot load. This temperature is reduced by 80 K, multiplied by 100, and stored in the file as a 2-byte integer. Stored value = (T - 80) * 100.		
Hot Load Bridge	2-byte integer	0 – 4095
The positive bridge voltage of the hot load bridge reference.		
Hot Load Bridge Reference near Zero Voltage	2-byte integer	4 - 4095
The near zero voltage of the hot load bridge reference.		
85.5 GHz Receiver Temperature	2-byte integer	-273.15 – 126.85°C
The receiver shelf temperature of the 85.5 GHz channel. This temperature is increased by 200, multiplied by 100, and stored in the file as a 2-byte integer.		
Top Radiator Temperature	2-byte integer	-273.15 – 126.85°C
The temperature of the top of the radiator channel. This temperature is increased by 200, multiplied by 100, and stored in the file as a 2-byte integer.		
Automatic Gain Control	9 x 1-byte integer	0 – 15
Automatic gain control for the 9 channels in counts.		
Calibration Coefficient A		
Calibration coefficient A (degrees Kelvin / counts) for the 9 channels. Coefficient A for each channel is used in the following equation to convert counts, C, to antenna temperature, T_A: $T_A = A*C + B$		
Calibration Coefficient B		
Calibration coefficient B (degrees Kelvin) for the 9 channels. Coefficient B for each channel is used in the following equation to convert counts, C, to antenna temperature, T_A: $T_A = A*C + B$		

1B21: Precipitation Radar Power

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Horizontal Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 67 MB	≈ 79 MB

1B21 Data Format Structure: Part 1						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
PR Cal Coef Calibration coefficients for the PR. The records consist of: Transmission coefficient (unitless, 1 record), Reception coefficient (unitless, 1 record), and FCIF I/O Characteristics (unitless, 16 records). Descriptions are TBD by NASDA.	Vdata Table	4	18	-	-	-
Ray Header Information about each ray (angle bin) that is constant for every scan. The record number represents the angle bin number. Each record describes one ray and is defined in Ray Header Table.	Vdata Table	60	49	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with the scan, expressed as 8-byte float UTC second of the day.	Vdata Table	8	nscan	-	-	-
Latitude Latitude information	Float SDS	4	nray*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	nray*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	15	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Powers Radar transmission power and transmitted pulse width	Vdata Table	6	nscan	-	-	-
System Noise System Noise (dBm) is an average of the 4 measured system noise values. Missing data are given the value of -32,734.	Integer SDS	2	nray*nscan	100	-120 ~ -20	dBm
System Noise Warning Flag System Noise Warning Flag indicates possible contamination of lower window noise by high towers of rain. 1 means possible contamination; 0 means no possible contamination.	Integer SDS	1	nray*nscan	-	-	-

1B21 Data Format Structure: Part 2						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
Minimum Echo Flag	Integer SDS	1	nray*nscan	-	-	-
Minimum echo flag indicates the presence of rain in the ray (angle bin).						
Bin Storm Height	Integer SDS	2	2*nray*nscan	-	-	-
Bin storm height is the range bin number of the storm top.						
Satellite Local Zenith Angle	Float SDS	4	nray*nscan	-	-	-
Angle, in degrees, between the local zenith and the beam's center line. The local (geodetic) zenith at the intersection of the ray and the earth ellipsoid is used.						
Spacecraft Range	Integer SDS	4	nray*nscan	-	-	m
Distance between the spacecraft and the center of the footprint of the beam on the earth ellipsoid.						
Bin Start of Oversample	Integer SDS	2	2*29*nscan	-	-	-
Starting range bin number of the oversample (either surface or rain) data, counting from the top down.						
Land/Ocean Flag	Integer SDS	2	nray*nscan	-	-	-
Land or ocean information. The values of the flag are: 0 = water, 1 = land, 2 = coast, 3 = water (w/ large attenuation), 4 = land/coast (w/ large attenuation).						
Surface Detect Warning Flag	Integer SDS	2	nray*nscan	-	-	-
Definition TBD by NASDA.						
Bin Surface Peak	Integer SDS	2	nray*nscan	-	-	-
Range bin number of the peak surface echo. This peak is determined by the post observation ground processing, not by the on board surface detection. The range bin number is defined in this volume in the section on Precipitation Radar, Instrument and Scan Geometry.						
Bin Ellipsoid	Float SDS	2	nray*nscan	-	-	-
Range bin number of the earth ellipsoid.						
Bin Clutter Free Bottom	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the lowest clutter free bin. Clutter free bin numbers are given for clutter free certain and possible, respectively. The clutter free certain bin is always less than or equal to the clutter free possible bin number.						
Bin DID Average	Integer SDS	2	nray*nscan	-	-	-
Mean range bin number of the DID surface elevation in a 5 km x 5 km box centered on the IFOV.						
Bin DID Top	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the maximum DID surface elevation in a box centered on the IFOV. The first dimension is the box size, with sizes of 5 km x 5 km and 11 km x 11 km.						
Bin DID Bottom	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the minimum DID surface elevation in a box centered on the IFOV. The first dimension is the box size, with sizes of 5 km x 5 km and 11 km x 11 km.						
Normal Sample	Integer SDS	2	140*nray*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the normal sample. Since each ray has a different size, the elements after the end of each ray are filled with a value of -32767. Other bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. The size of each ray is specified in Ray Header, with an accuracy of 0.9 dBm.						
Surface Oversample	Integer SDS	2	5*29*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the surface echo oversample for the central 29 rays (rays #11-39), with an accuracy of 0.9 dBm. Bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. In the CrossTrack dimension, Offset = -10 and Increment = 1.						
Rain Oversample	Integer SDS	2	28*11*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the rain echo oversample for the central 11 rays (rays #20-30), with an accuracy of 0.9 dBm. Bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. In the CrossTrack dimension, Offset = -19 and Increment = 1.						

PR Powers	
Name	**Format**
Radar Transmission Power	2-byte integer
Total (sum) power of 128 SSPA elements corrected with SSPA temperature in orbit, based on temperature test data of SSPA transmission power. The units are dBm * 100. For this variable, the TSDIS Toolkit does not provide scaling.	
Transmitted Pulse Width	4-byte float
Transmitted pulse width (s) corrected with FCIF temperature in orbit, based on temperature test data of FCIF.	

Minimum Echo Flag	
Value	**Mean**
0	No Rain
10	Rain Possible
11	Rain Possible (echo greater than rain threshold #1 in clutter range)
12	Rain Possible (echo greater than rain threshold #2 in clutter range)
20	Rain Certain

1B21 Bin Storm Height Description

Bin Storm Height is Range Bin Number of the storm top. The first dimension is threshold, with values of possible rain threshold and certain rain threshold in that order. The Bin Storm Heights are generated in the procedure to determine the Minimum Echo Flag. The Bin Storm Height is the top range bin of the portion of consecutive range bins that flagged the ray as rain possible or rain certain. The range bin number is defined in this volume in the section on Precipitation Radar, Instrument and Scan Geometry.

1B21 Bin Start of Oversample Description

The first dimension is the Bin Start of Oversample and Surface Tracker Status. The second dimension is the ray. The number of rays is 29 because this information only applies to the rays that have oversample data (rays #11 to #39). The third dimension is the scan. The Surface Tracker Status has the value of 0 (Lock) or 1 (Unlock), where Lock means that (1) the on board surface detection detected the surface and (2) the surface detected later by processing on the ground fell within the oversample bins. Unlock means that Lock was not achieved. The range bin number is defined in this volume in the section on Precipitation Radar, Instrument and Scan Geometry.

1C21: Precipitation Radar Reflectivity

Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Horizontal Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 44 MB	≈ 44 MB

1C21 Data Format Structure: Part 1

Name	Type	Record Size (bytes)	Dim Size (# of records)	Scaled by	Range	Unit
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
PR Cal Coef Calibration coefficients for the PR. The records consist of: Transmission coefficient (unitless, 1 record), Reception coefficient (unitless, 1 record), and FCIF I/O Characteristics (unitless, 16 records). Descriptions are TBD by NASDA.	Vdata Table	4	18	-	-	-
Ray Header Information about each ray (angle bin) that is constant for every scan. The record number represents the angle bin number. Each record describes one ray and is defined in Ray Header Table.	Vdata Table	60	49	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with the scan, expressed as 8-byte float UTC second of the day.	Vdata Table	8	nscan	-	-	-
Latitude Latitude information	Float SDS	4	nray*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	nray*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	15	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Powers Radar transmission power and transmitted pulse width	Vdata Table	6	nscan	-	-	-
System Noise System Noise (dBm) is an average of the 4 measured system noise values. Missing data are given the value of -32,734.	Integer SDS	2	nray*nscan	100	-120 ~ -20	dBm
System Noise Warning Flag System Noise Warning Flag indicates possible contamination of lower window noise by high towers of rain. 1 means possible contamination; 0 means no possible contamination.	Integer SDS	1	nray*nscan	-	-	-

1C21 Data Format Structure: Part 2

Name	Type	Record Size (bytes)	Dim Size (# of records)	Scaled by	Range	Unit
Minimum Echo Flag	Integer SDS	1	nray*nscan	-	-	-
Minimum echo flag indicates the presence of rain in the ray (angle bin).						
Bin Storm Height	Integer SDS	2	2*nray*nscan	-	-	-
Bin storm height is the range bin number of the storm top.						
Satellite Local Zenith Angle	Float SDS	4	nray*nscan	-	-	-
Angle, in degrees, between the local zenith and the beam's center line. The local (geodetic) zenith at the intersection of the ray and the earth ellipsoid is used.						
Spacecraft Range	Integer SDS	4	nray*nscan	-	-	m
Distance between the spacecraft and the center of the footprint of the beam on the earth ellipsoid.						
Bin Start of Oversample	Integer SDS	2	2*29*nscan	-	-	-
Starting range bin number of the oversample (either surface or rain) data, counting from the top down.						
Land/Ocean Flag	Integer SDS	2	nray*nscan	-	-	-
Land or ocean information. The values of the flag are: 0 = water, 1 = land, 2 = coast, 3 = water (w/ large attenuation), 4 = land/coast (w/ large attenuation).						
Surface Detect Warning Flag	Integer SDS	2	nray*nscan	-	-	-
Definition TBD by NASDA.						
Bin Surface Peak	Integer SDS	2	nray*nscan	-	-	-
Range bin number of the peak surface echo. This peak is determined by the post observation ground processing, not by the on board surface detection. The range bin number is defined in this volume in the section on Precipitation Radar, Instrument and Scan Geometry.						
Bin Ellipsoid	Float SDS	2	nray*nscan	-	-	-
Range bin number of the earth ellipsoid.						
Bin Clutter Free Bottom	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the lowest clutter free bin. Clutter free bin numbers are given for clutter free certain and possible, respectively. The clutter free certain bin is always less than or equal to the clutter free possible bin number.						
Bin DID Average	Integer SDS	2	nray*nscan	-	-	-
Mean range bin number of the DID surface elevation in a 5 km x 5 km box centered on the IFOV.						
Bin DID Top	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the maximum DID surface elevation in a box centered on the IFOV. The first dimension is the box size, with sizes of 5 km x 5 km and 11 km x 11 km.						
Bin DID Bottom	Integer SDS	2	2*nray*nscan	-	-	-
Range bin number of the minimum DID surface elevation in a box centered on the IFOV. The first dimension is the box size, with sizes of 5 km x 5 km and 11 km x 11 km.						
Normal Sample	Integer SDS	2	140*nray*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the normal sample. Since each ray has a different size, the elements after the end of each ray are filled with a value of -32767. Other bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. The size of each ray is specified in Ray Header, with an accuracy of 0.9 dBm.						
Surface Oversample	Integer SDS	2	5*29*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the surface echo oversample for the central 29 rays (rays #11-39), with an accuracy of 0.9 dBm. Bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. In the CrossTrack dimension, Offset = -10 and Increment = 1.						
Rain Oversample	Integer SDS	2	28*11*nscan	100	-120 ~ -20	dBm
Return power (dBm) of the rain echo oversample for the central 11 rays (rays #20-30), with an accuracy of 0.9 dBm. Bins where data is not written due to a transmission, calibration, or other problem, including an entire scan of missing bins, have the value of -32734. In the CrossTrack dimension, Offset = -19 and Increment = 1.						

See TRMM 1B21 information (p. 23) for minimum echo flag and bin storm height information.

2A12: TMI Hydrometeor Profile

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Vertical Coverage	Surface – 18 km	Surface – 18 km
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Spatial Resolution	4.4 km at 85.5 GHz	5.1 km at 85.5 GHz
Vertical Resolution	0.5 km from surface to 4 km 1.0 km from 4 km to 6 km 2.0 km from 6 km to 10 km 4.0 km from 10 km to 18 km	0.5 km from surface to 4 km 1.0 km from 4 km to 6 km 2.0 km from 6 km to 10 km 4.0 km from 10 km to 18 km
Scan Characteristics	Swath Width: 760 km Pixels/Scan: 208 Scans/Second (SS): 36.100/60 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 2991 nscan = SS * SO + 100	Swath Width: 878 km Pixels/Scan: 208 Scans/Second (SS): 36.100/60 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 3023 nscan = SS * SO + 100
Average File Size	≈ 11 MB	≈ 11 MB

2A12 Data Format Structure: Part 1						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with each scan	Vdata Table	9	nscan	-	-	-
Latitude Latitude information	Float SDS	4	208*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	208*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	21	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Data Flag Indicates the quality of the data	Integer SDS	1	npixel*nscan	-	-	-
Rain Flag Indicates if rain is possible. ≥0 = rain is possible, < 0 = no rain	Integer SDS	1	npixel*nscan	-	-	-

2A12 Data Format Structure: Part 2						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
Surface Flag	Integer SDS	1	npixel*nscan	-	0-3	-
Indicates the type of surface: 0 = ocean, 1 = land, 2 = coast, 3 = other						
Surface Rain	Float SDS	4	npixel*nscan	-	0 – 3000	mm h^{-1}
Instantaneous rain rate at the surface for each pixel.						
Convective Precipitation	Float SDS	4	npixel*nscan	-	0 – 3000	mm h
Instantaneous convective precipitation rate at the surface for each pixel.						
Confidence	Float SDS	4	npixel*nscan	-	0 – 300	K
Associated with the surface rain, and measured as an rms deviation in temperatures.						
Cloud Water	Float SDS	4	nlayer*npixel*nscan	see array	0 – 10	degree
Cloud water content for each pixel at 28 layers.						
Rain Water	Float SDS	4	nlayer*npixel*nscan	see array	0 – 10	degree
Rain water content for each pixel at 28 layers.						
Cloud Ice	Vdata Table	4	nlayer*npixel*nscan	see array	0 – 10	g m^{-3}
Cloud ice content for each pixel at 28 layers.						
Snow Water	Vdata Table	4	nlayer*npixel*nscan	see array	0 – 10	g m^{-3}
Snow water content for each pixel at 28 layers.						
Graupel Water	Integer SDS	4	nlayer*npixel*nscan	see array	0 – 10	g m^{-3}
Graupel water content for each pixel at 28 layers.						
Latent Heating	Integer SDS	-256 – 256	nlayer*npixel*nscan	see array	0 – 10	g m^{-3}
Latent heating release for each pixel at 28 levels.						

TRMM 2A12 Scan Time		
Name	**Format**	**Description**
Year	2-byte integer	4-digit year, e.g., 1998
Month	1-byte integer	The month of the Year
Day of Month	1-byte integer	The day of the Month
Hour	1-byte integer	The hour (UTC) of the Day
Minute	1-byte integer	The minute of the Hour
Second	1-byte integer	The second of the Minute
Day of Year	2-byte integer	The day of the Year

TRMM 2A12 Data Flag Specific Viewer		
Value	**Description**	**Value**
0	Good data quality	0
-9	Channel brightness temperature outside valid range	-9
-15	The neighboring 5 x 5 pixel array is incomplete due to edge or bad data quality	-15
-21	Surface type invalid	-21
-23	Date time invalid	-23
-25	Latitude or longitude invalid	-25

2A21: Precipitation Radar Surface Cross-Section

Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Horizontal Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 11 MB	≈ 11 MB

2A21 Data Format Structure

Name	Type	Record Size (bytes)	Dim Size (# of records)	Scaled by	Range	Unit
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specification of the swath geometry	Other Attribute	5,000	-	-	-	-
Scan Time Time associated with the scan, expressed as 8-byte float UTC second of the day.	Vdata Table	5,000	-	-	-	-
Latitude Latitude information	Float SDS	4	nray*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	nray*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	15	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Sigma-zero Normalized surface cross section	Float SDS	4	nray*nscan	-	-50 – 50	dB
Pat Attenuation Estimate of positive 2-way integrated attenuation dB when rain is present.	Float SDS	4	nray*nscan	-	-50 – 50	dB
Reliability Flag Various reliability information in the form of single digit flags.	Integer SDS	2	nray*nscan	-	-	-
Reliability Factor Ratio of the estimated value of path attenuation to standard deviation associated with the mean value of the reference estimate.	Float SDS	4	nray*nscan	-	-10 – 10	-
Incident Angle System Noise Warning Flag indicates possible contamination of lower window noise by high towers of rain. 1 means possible contamination; 0 means no possible contamination.	Float SDS	4	nray*nscan	-	-30 – 30	degree
Rain Flag Rain flag. 0 = no rain, 1 = rain present	Integer SDS	2	nray*nscan	-	-	0 or 1

2A23: Precipitation Radar (PR) Rain Characteristics

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Spatial Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 7 MB	≈ 7 MB

2A23 Data Format Structure: Part 1						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with each scan	Vdata Table	9	nscan	-	-	-
Latitude Latitude information	Float SDS	4	208*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	208*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	21	nscan	-	-	-
Navigation Spacecraft geocentric information	Vdata Table	88	nscan	-	-	-
Rain Flag Identical to minimum echo flag of 1C21. 0 = no rain; 10, 11, 12, 13, 15 = rain possible; 20 = rain certain	Integer SDS	1	nray*nscan	-	-	-
Rain Type Rain type flag, -88 is a missing value for no rain and -99 means data are missing. See table on next page.	Integer SDS	2	nray*nscan	-	-	-

2A23 Data Format Structure: Part 2						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
Shallow Rain Flag	Integer SDS	1	nray*nscan	-	-	-
The warm rain flag is set as follows: 10 = maybe shallow, isolated; 11 = confidence in shallow, isolated; 20 = maybe shallow but not isolated; 21 = confidence in shallow but not isolated; 0 = not shallow; < 0 = rain not certain or missing						
Status Flag	Integer SDS	1	nray*nscan	-	-	-
Indicates whether the data are obtained over sea or land, and the confidence in the data						
Height of Bright Band	Integer SDS	2	nray*nscan	-	-	-
A positive height of bright band is defined in meters above mean sea level. Negative values are defined as: -1111 = no bright band, -8888 = no rain, -9999 = data missing						
Bright Band Intensity	Integer SDS	4	nray*nscan	-	-	-
The maximum value of the bright band.						
Bright Band Peak Bin	Integer SDS	2	nray*nscan	-	-	-
A positive range bin number that corresponds to the peak of the bright band.						
Bright Band Boundary	Integer SDS	2	2*nray*nscan	-	-	-
Positive bin number of the boundary of the bright band. The first index indicates the bottom.						
Bright Band Width	Integer SDS	2	nray*nscan	-	-	m
The width of the bright band.						
Bright Band Status	Integer SDS	2	nray*nscan	-	-	-
Indicates the status of the bright band detection. The flag is a composite of three internal status flags.						
Height of Freezing Level	Integer SDS	2	nray*nscan	-	-	m
A positive height of freezing level is the height of the 0°C isotherm above mean sea level, estimated from climatological surface temperature data. Negative numbers are defined as: -5555 = error occurred in estimation of height of freezing level, -8888 = no rain, -9999 = missing data						
Height of Storm	Integer SDS	2	nray*nscan	-	-	m
A positive Height of Storm is the height of the storm top above mean sea level in meters. A positive Height of Storm is given only when rain is present with a high degree of confidence in 1C21 (i.e., the Minimum Echo Flag in 1C21 has the value of 2 [rain certain]). Negative values are defined as: -1111 = Height of Storm not calculated because rain is not present with a high level of confidence in 1C21, -8888 = No rain, -9999 = Data missing						
Spare	Float SDS	2	nray*nscan	-	-	-
Spare will characterize the width of the bright band. Since this characterization requires much research, the meaning is not disclosed.						

TRMM 2A23 Rain Type Flag

Value	Meaning	Conditions
100	Stratiform certain	When R_type_V = T_stra; (BB exists) and R_type_H = T_stra;
110	Stratiform certain	When R_type_V = T_stra; (BB exists) and R_type_H = T_others;
120	Probably stratiform	When R_type_V = T_others; and R_type_H = T_stra;
130	Maybe stratiform	When R_type_V = T_stra; (BB detection certain) and R_type_H = T_conv;
140	Maybe stratiform or maybe transition or something else	When R_type_V = T_others; (BB hardly expected) and R_type_H = T_stra;
152	Maybe stratiform	Shallow isolated (type of warm rain) is detected. When R_type_V = T_others; R_type_H = T_stra; and shallowRain = 20 or 21;
160	Maybe stratiform, rain hardly expected near surface	BB may exist but is not detected when R_type_V = T_others; R_type_H = T_stra;
170	Maybe stratiform, rain hardly expected near surface	BB hardly expected. Maybe cloud only. When R_type_V = T_others; R_type_H = T_stra;
200	Convective certain	When R_type_V = T_conv; (no BB) and R_type_H = T_conv;
210	Convective certain	When R_type_V = T_others; and R_type_H = T_conv;
220	Convective certain	When R_type_V = T_conv; and R_type_H = T_others;
230	Probably convective	When R_type_V = T_conv; (BB exists) and R_type_H = T_conv;
240	Maybe convective	When R_type_V = T_conv; and R_type_H = T_stra;
251	Convective	Shallow isolated is detected. When R_type_V = T_conv, R_type_H = T_conv and shallowRain = 10 or 11;
252	Convective	Shallow rain (non-isolated) is detected. When R_type_V = T_conv, R_type_H = T_conv and shallowRain = 20 or 21;
261	Convective	Shallow isolated is detected. When R_type_V = T_conv; R_type_H = T_others; and shallowRain = 10 or 11;
262	Convective	Shallow rain (non-isolated) is detected.When R_type_V[i] = T_conv, R_type_H[i] = T_others; and shallowRain[i] = 20 or 21;
271	Convective	Shallow isolated is detected. When R_type_V = T_others; R_type_H = T_conv; and shallowRain = 10 or 11;
272	Convective	Shallow isolated is detected. When R_type_V = T_others; R_type_H = T_conv; and shallowRain = 20 or 21;
281	Convective	Shallow isolated is detected. When R_type_V = T_conv; R_type_H = T_stra; and shallowRain = 10 or 11;
282	Convective	Shallow rain (non-isolated) is detected.When R_type_V[i] = T_conv, R_type_H[i] = T_stra; and shallowRain[i] = 20 or 21;
291	Convective	Shallow isolated is detected. When R_type_V = T_others; R_type_H = T_stra; and shallowRain = 10 or 11;
300	Others	When R_type_V = T_others; and R_type_H = T_others;
312	Others	Shallow rain (non-isolated) is detected. When R_type_V = T_others, R_type_H = T_others; and shallowRain = 20 or 21;
313	Others	If sidelobe clutter were not rejected, shallow isolated would be detected. When R_type_V = T_others, R_type_H = T_others; and shallowRain = 20 or 21;

where R_type_V: rain type classified by the V-profile method; R_type_H: rain type classified by the H-pattern method.

The above assignment of numbers has the following meaning:
(merged) Rain Type / 100 = 1: stratiform; 2: convective; 3: others.
(merged) Rain Type Flag % 100 = sub-category
(merged) Rain Type Flag % 10 = 0: usual; 1: shallow isolated; 2: shallow non-isolated; 3: sidelobe clutter only
where Rain Type Flag % 10 means MOD.

TRMM 2A23 Status Flag		
Value	**Meaning**	**Where**
0	good	over ocean
10	BB detection may be good	over ocean
20	R-type classification may be good (BB detection is good or BB does not exist)	over ocean
30	Both BB detection and R-type classification may be good	over ocean
50	not good (because of warnings)	over ocean
100	bad (possible data corruption)	over ocean
1	good	over land
11	BB detection may be good	over land
21	R-type classification may be good (BB detection is good or BB does not exist)	over land
31	Both BB detection and R-type classification may be good	over land
51	not good (because of warnings)	over land
101	bad (possible data corruption)	over land
2	good	over coastline
12	BB detection may be good	over coastline
22	R-type classification may be good (BB detection is good or BB does not exist)	over coastline
32	Both BB detection and R-type classification may be good	over coastline
52	not good (because of warnings)	over coastline
102	bad (possible data corruption)	over coastline
4	good	over inland lake
14	BB detection may be good	over inland lake
24	R-type classification may be good (BB detection is good or BB does not exist)	over inland lake
34	Both BB detection and R-type classification may be good	over inland lake
54	not good (because of warnings)	over inland lake
104	bad (possible data corruption)	over inland lake
9	may be good	land/sea unknown
19	BB detection may be good	land/sea unknown
29	R-type classification may be good (BB detection is good or BB does not exist)	land/sea unknown
39	Both BB detection and R-type classification may be good	land/sea unknown
59	not good (because of warnings)	land/sea unknown
109	bad (possible data corruption)	land/sea unknown

When the status flag is "no rain" or "data missing", status flag contains -88 for no rain and -99 for missing data. Assignment of the above numbers are based on the following rules:

(Status/10) % 10	Meaning
0	good, may be good when status < 100 and not good when status ≥ 100
1	BB detection not so confident
2	R-type classification not so confident (but BB detection is good or doesn't exist)
3	BB detection and R-type classification both not confident
5	Overall quality of the processed data is not good
Status % 10	
0	over ocean
1	over land
2	over coastline
4	over inland lake
9	land/sea unknown

In other words, if the Status Flag is ≥ 100, the data are untrustworthy; between 10 and 100 then the data are not confident, equal to 9 then the data may be good; and between 0 and 9 then the data are good.

2A25: Precipitation Radar (PR) Rainfall Rate and Profile

	Pre-boost (before 7 Aug 2001)	Post-boost (after 24 Aug 2001)
Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Spatial Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 16 MB compressed, 253 MB original	≈ 16 MB compressed, 256 MB original

2A25 Data Format Structure: Part 1

Name	Type	Record Size (bytes)	Dim Size (# of records)	Scaled by	Range	Unit
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Clutter Flag Mainlobe Clutter Edge and Sidelobe Clutter Range	Vdata Table	4	49	-	-	-
Swath Structure Specification of the swath geometry.	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with the scan, expressed as 8-byte float UTC second of the day.	Vdata Table	8	nscan	-	-	-
Latitude Latitude information	Float SDS	4	nray*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	nray*nscan	-	-	degree
scLocalZenith Spacecraft local zenith angle.	Float SDS	4	nray*nscan	-	-	degree
Scan Status Status of each scan.	Vdata Table	15	nscan	-	-	-
Navigation Spacecraft geocentric information.	Vdata Table	88	nscan	-	-	-
Rain Rate Estimate of rain rate at the radar range gates from 0 to 20 km along the slant range. A value of -88.88 mm/hr (stored as -889) means ground clutter.	Integer SDS	2	80*nray*nscan	100	0.0 ~ 300	mm/h
Reliability For estimated rain rates at the radar range gates from 0 to 20 km.	Integer SDS	1	80*nray*nscan	-	0 ~ 255	-

2A25 Data Format Structure: Part 2						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
Corrected Z-factor	Integer SDS	2	80*nray*nscan	100	0 ~ 80	dBZ
Attenuation corrected reflectivity factor (Z) at the radar range gates from 0 to 20 km along the slant range. Values of reflectivity less than 0.0 dBZ are set to 0.0 dBZ. A value of -88.88 dB (stored as -8888) is a ground clutter flag, -9999 is for missing data in reflectivity profile.						
Parameter Node	Integer SDS	2	5*nray*nscan	-	0 ~ 79	-
Range bin numbers of the nodes at which the values of Attenuation and Z-R Parameters are given (see below). The values of the parameters between the nodes are linearly interpolated.						
Attenuation Parameter α	Float SDS	4	5*nray*nscan	-	0.00010 ~ 0.00200	-
It relates the attenuation coefficient, k (dB/km) to the Z-factor: $k = \alpha^{\beta}$. α is computed at ncell2(5) radar range gates for each ray.						
Attenuation Parameter ß	Float SDS	4	nray*nscan	-	0.5 ~ 2.0	-
It relates the attenuation coefficient, k (dB/km) to the Z-factor: $k = \alpha * Z^{\beta}$. β is computed for each ray.						
Z-R Parameter a	Float SDS	4	5*nray*nscan	-	0.0050 ~ 0.2000	-
Parameter a for Z-R relationship ($R=aZ^b$) is determined from the rain type and the height relative to the freezing level, the non-uniformity parameter (ζ) and the correction factor (ε) for the surface reference technique.						
Z-R Parameter b	Float SDS	4	5*nray*nscan	-	0.5 ~ 1.0	-
Parameter a for Z-R relationship ($R=aZ^b$) is determined from the rain type and the height relative to the freezing level, the non-uniformity parameter (ζ) and the correction factor (ε) for the surface reference technique.						
Precipitation Water Parameter A	Float SDS	4	5*nray*nscan	-	-	-
Parameter A in the M = AZ^B relationship.						
Precipitation Water Parameter B	Float SDS	4	5*nray*nscan	-	-	-
Parameter B in the M = AZ^B relationship.						
Precipitation Water Parameter Sum	Float SDS	4	2*nray*nscan	-	-	-
Vertically integrated value of sum precipitation water content calculated from Ze at each range bin. The first index is the precipitation liquid water content from the freezing height to the actual surface. The second index is the sum of precipitation ice content from the top of the storm to the freezing height. Units are gkm/m3(kg/m2) and it ranges from 0.0 to 50.0.						
Maximum Z	Float SDS	4	nray*nscan	-	0 ~ 100	dBZ
Maximum value of measured reflectivity factor at each IFOV.						
Rain Flag	Integer SDS	2	nray*nscan	-	-	-
Rain Flag indicates rain or no rain status and the rain type assumed in rain rate retrieval. The default value is 0 (no rain). Bit 0 is the least significant bit (i.e., if bit i=1 and other bits =0, the unsigned integer value is 2^i).						
Range Bin Numbers	Integer SDS	2	5*nray*nscan	-	0 ~ 79	-
Range Bin Number of various quantities for each ray in every scan. The Range Bin Numbers in this algorithm are different from the NASDA definition of Range Bin Number described in the ICS, Volume 3. The Range Bin Numbers in the algorithm range from 0 to 79 and have an interval of 250m. The earth ellipsoid is defined as range bin 79.						
Averaged Rain Rate	Float SDS	4	2*nray*nscan	-	(1)0.0 ~ 3000.0 (2)0.0 ~ 300.0	mm/h
There are two kinds of Average Rain Rate. The first one is the average rain rate for each ray between the two predefined heights of 2 and 4 km. The second one is the integral of rain rate from rain top to rain bottom.						

2A25 Data Format Structure: Part 3						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
Precipitable Water Sum	Float SDS	4	2*nray*nscan	-	0 – 50	g km m^{-3}
Vertically integrated value of sum precipitation water content calculated from Ze at each range bin. The first index is the precipitation liquid water content from the freezing height to the actual surface. The second index is the sum of precipitation ice content from the top of the storm to the freezing height.						
Method Flag	Integer SDS	2	nray*nscan	-	-	-
Method Flag indicates which method is used to derive the rain rate. The default value is 0 (including no rain case). Bit 0 is the least significant bit (i.e., if bit i =1 and other bits =0, the unsigned integer value is 2^i).						
Epsilon	Float SDS	4	nray*nscan	-	0.0 ~ 100.0	-
Correction factor for the surface reference.						
Epsilon_0	Float SDS	4	nray*nscan	-	0.0 ~ 100.0	-
The adjustment parameter computed from the filtered surface reference PIA (2A21 algorithm).						
Zeta	Float SDS	4	2*nray*nscan	-	0.0 ~ 100.0	-
Roughly represents the rain rate integrated along the ray using two different methods.						
Zeta_mn	Float SDS	4	2*nray*nscan	-	0.0 ~ 100.0	-
Average of zeta in the vicinity of each beam position (average over three scans and three IFOVs). It is calculated using two methods.						
Zeta_sd	Float SDS	4	2*nray*nscan	-	0.0 ~ 100.0	-
Standard deviation of zeta in the vicinity of each beam position (using three scans and three IFOVs). It is calculated using two methods.						
Xi	Float SDS	4	2*nray*nscan	-	0.0 ~ 99.0	-
Normalized standard deviation defined as Zeta_sd/Zeta_mn. When Zeta_mn takes on small values (or zero) Xi is set to 99.0. It is calculated using two methods.						
NUBF Correction Factor	Float SDS	4	3*nray*nscan	-	1 ~ 10	-
The Non-Uniform Beam Filling (NUBF) Correction Factor is used as a correction to reflectivity and attenuation calculations. It's range is between 1.0 and 10.0 and is unitless.						
Quality Flag	Integer SDS	2	nray*nscan	-	0 ~ 32767	-
See note #1 below.						
Near Surface Rain	Float SDS	4	nray*nscan	-	0 ~ 3000	mm hr^{-1}
Rainfall rate near the surface. A value of -99.99 mm hr^{-1} is a missing flag.						
Near Surface Z	Float SDS	4	nray*nscan	-	0.0 ~ 100.0	dBZ
Reflectivity near the surface. A value of -99.99 dBZ is a missing flag.						
Estimated Surface Rain	Float SDS	4	nray*nscan	-	0 ~ 3000	mm hr^{-1}
Reflectivity near the surface. A value of -99.99 mm hr^{-1} is a missing flag.						
PIA	Float SDS	4	3nray*nscan	-	-	-
Path Integrated Attenuation (PIA)[two-way] estimates for three cases: (1) The final adjusted PIA estimate (2) The difference between the PIA at the surface and near surface range bins (3) The PIA estimate from 2A21						
Error Rain	Float SDS	4	nray*nscan	-	-	dB
Error in Near Surface Rain Rate.						
Error Z	Float SDS	4	nray*nscan	-	0.0 ~ 100.0	dBZ
Error in Near Surface Z.						
Spares	Float SDS	4	2*nray*nscan	-	-	-
Contents and ranges are not public.						
Height of Freezing Level	Float SDS	4	nray*nscan	-	-	m
A positive Height of Freezing Level is the height of the 0°C isotherm above mean sea level in meters. estimated from climatological surface temperature data. Negative values are defined as in 2A23.						
Sigma-zero	Float SDS	4	nray*nscan	-	-50 – 20	dB
The normalized surface cross section. This field is copied from the 2A21 product file.						

Note #1: Quality Flag Description	
The default value is 0 (normal). Bit 0 is the least significant bit (i.e., if bit i =1 and other bits =0, the unsigned integer value is 2**i). The following meanings are assigned to each bit in the 16-bit integer if the bit = 1.	
Correction Factor	**Meaning**
0	normal
1	unusual situation in rain average
2	NSD of zeta (xi) calculated from less than 6 points
4	NSD of PIA calculated from less than 6 points
8	NUBF for Z-R below lower bound
16	NUBF for PIA above upper bound
32	epsilon not reliable, epsi_sig less than or equal to 0.0
64	2A21 input data not reliable
128	2A23 input data not reliable
256	range bin error
512	sidelobe clutter removal
1024	probability=0 for all tau
2048	pia_surf_ex less than or equal to 0.0
4096	const Z is invalid
8192	reliabFactor in 2A21 is NaN
16384	data missing

TRMM PR 2A25 Clutter Flags		
Name	**Format**	**Description**
Mainlobe Clutter Edge	1-byte integer	Absolute value of the difference in Range bin Numbers between the detected surface and the edge of the clutter from the mainlobe.
Sidelobe Clutter Range	3 x 1-byte integer	Absolute value of the difference in Range Bin Numbers between the detected surface and the clutter position from the sidelobe. A zero means no clutter indicated in this field since less than 3 bins contained significant clutter.

TRMM 2A25 Reliability	
Bit	**Meaning if bit=1**
0	rain possible
1	rain certain
2	bright band
3	large attenuation
4	weak return (Zm < 20 dBZ)
5	estimated Z < 0 dBZ
6	main-lobe clutter or below surface

TRMM 2A25 Rain Flag	
Bit	**Meaning if bit=1**
0	rain possible
1	rain certain
2	Zeta^ Beta > 0.5 [Path Integrated Attenuation (PIA) larger than 3 dB]
3	large attenuation (PIA larger than 10 dB)
4	stratiform
5	convective
6	bright band exists
7	warm rain
8	rain bottom above 2 km
9	rain bottom above 4 km
10 - 13	not used
14	data missing between rain top and bottom
15	not used

TRMM 2A25 Method Flag	
If all bits 0: no rain. Otherwise:	
Bit	**Meaning when set (except bit 1)**
1	0: over ocean 1: over land
2	over coast, river, etc.
3	OIA from constant-Z-near-surface assumption
4	spatial reference
5	temporal reference
6	global reference
7	hybrid reference
8	good to take statistics of epsilon
9	HB method used, SRT totally ignored
10	very large pia_srt for given zeta
11	very small pia_srt for given zeta
12	no ZR adjustment by epsilon
13	no NUBF correction because NSD unreliable
14	surface attenuation > 60 dB
15	data partly missing between rain top and bottom

2B31: Combined Rainfall Profile

Temporal Coverage	Start Date: 1997-12-08 Stop Date: 2001-08-07	Start Date: 2001-08-24 Stop Date: 2015-04-08
Geographic Coverage	Latitude: 38°S – 38°N Longitude: 180°W – 180°E	Latitude: 38°S – 38°N Longitude: 180°W – 180°E
Temporal Resolution	≈ 91.5 min/orbit = ≈ 16 orbits/day	≈ 92.5 min/orbit = ≈ 16 orbits/day
Horizontal Resolution	4.3 km	5.0 km
Scan Characteristics	Swath Width: 215 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5490 Average Scans/Orbit: nscan = 9150 nscan = SS*SO	Swath Width: 247 km Rays/Scan: nray = 49 Scans/Second (SS): 1/0.6 Seconds/Orbit (SO): 5550 Average Scans/Orbit: nscan = 9250 nscan = SS*SO
Average File Size	≈ 11 MB compressed	≈ 11 MB compressed

2B31 Data Format Structure: Part 1

Name	Type	Record Size (bytes)	Dim Size (# of records)	Scaled by	Range	Unit
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
Swath Structure Specification of the swath geometry	Char Attribute	5,000	-	-	-	-
Scan Time Time associated with each scan	Vdata Table	9	nscan	-	-	-
Latitude Latitude information	Float SDS	4	208*nscan	-	-	degree
Longitude Longitude information	Float SDS	4	208*nscan	-	-	degree
Scan Status Status of each scan	Vdata Table	21	nscan	-	-	-
Navigation Longitude information	Vdata Table	88	nscan	-	-	-
D-hat Correlation-corrected mass-weighted mean drop diameter.	Integer SDS	2	nray x nscan	100	0.7 – 1.8	mm**
Sigma D-hat RMS uncertainty in D-Hat. The accuracy is 0.01 "normalized" mm.	Integer SDS	2	nray x nscan	100	0.0 – 2.0	mm**
Graupel graupel is defined as frozen hydrometeors with a density of 600 Kg m^{-3}	Integer SDS	2	nradarrange x nray x nscan	1000	0 – 10	g m^{-3}
snow snow is defined as frozen hydrometeors with a density of 100 Kg m^{-3}.	Integer SDS	2	nradarrange x nray x nscan	1000	0 – 10	dBm
prSurf The surface precipitation rate (liquid plus solid). The accuracy is 0.1 mm hr^{-1}.	Integer SDS	1	nray*nscan	-	0 – 500	mm hr^{-1}

** indicates normalized units. A normalized unit, Y, is defined as Y = X * $R^{0.37}$R such that Y is a normalized version of X. R represents rain rate.
The dimension *nradarrange* represents the number of radar range gates, up to about 20 km from the earth ellipsoid. The gates range from 0 to 79 and each gate is 250 m apart.

2B31 Data Format Structure: Part 2						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
R-hat	Integer SDS	2	nradarrange * nray*nscan	10	0 – 500	mm hr^{-1}
Instantaneous rain rate at the radar range gates. The accuracy is 0.1 mm hr^{-1}.						
Sigma R-hat	Integer SDS	2	nradarrange * nray*nscan	10	-125 – 125	mm hr^{-1}
RMS uncertainty in the R-hat estimated at the radar range gates. (The negative sign indicating estimates based on a "rain-possible" detection by the radar rather than the "rain-certain" associated with positive values). The values -125 and 125 are reserved for cases where the RMS uncertainty could not be accurately estimated. The accuracy is 0.5 mm/hr.						
RR-Surf	Float SDS	4	nray*nscan	-	0 – 500	mm hr^{-1}
Surface rain rate.						
Sigma RR-Surf	Integer SDS	2	nray*nscan	100	-125 – 125	mm hr^{-1}
RMS uncertainty in RR-Surf. (The negative sign indicating estimates based on a "rain-possible" detection by the radar rather than the "rain-certain" associated with positive values). The values -125 and 125 are reserved for cases where the RMS uncertainty could not be accurately estimated. The accuracy is 0.5 mm/hr.						
latentHeadHH	Float SDS	4	nlayer*nray *nscan	-	-	K hr^{-1}
The "hydrometeor heating" calculated from the vertical fluxes of the different hydrometeor species and using average archival temperature/ pressure/humidity soundings which depend on longitude and latitude only. In V7 all the precipitation is assumed to be liquid. Heating is listed for 13 layers.						
spare	Float SDS	4	4*nray*nscan	-	-	-
Contents and ranges are not public.						

TRMM 2B31 Geolocation

Geolocation is the earth location of the center of the IFOV at the altitude of the earth ellipsoid. The first dimension is latitude and longitude, in that order. The next dimensions are numbers of pixels and scans. Values are represented as floating point decimal degrees. Off-earth is represented as -9999.9. Latitude is positive north, negative south. Longitude is positive east, negative west. A point on the 180° meridian is assigned to the western hemisphere.

TRMM 2B31 D-hat Description

D-hat is the correlation-corrected mass-weighted mean drop diameter. The accuracy is 0.01 "normalized" mm (the value 0 indicates no rain or bad data). The average value of dHat is around 1.1 "normalized" mm, a unit which comes from the fact that dHat is related to the true mass-weighted mean drop diameter D* mm by the formula dHat = D*rHat-0.155 (with rHat in mm/hr).

Layers and lower and upper boundaries used for calculating latent heat (specified as height above earth ellipsoid)

Layer 1: 16 km – 18 km
Layer 2: 14 km – 16 km
Layer 3: 12 km – 14 km
Layer 4: 10 km – 12 km
Layer 5: 8 km – 10 km
Layer 6: 7 km – 8 km
Layer 7: 6 km – 7 km
Layer 8: 5 km – 6 km
Layer 9: 4 km – 5 km
Layer 10: 3 km – 4 km
Layer 11: 2 km – 3 km
Layer 12: 1 km – 2 km
Layer 13: 0 km – 1 km

3A11: Monthly Oceanic Rainfall

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 40°S – 40°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	5° x 5°; nlat = 16, nlon = 72
Average File Size	≈ 23 KB compressed

3A11 Data Format Structure						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-	-
Monthly Rainfall The Monthly Rainfall is the surface rainfall over oceans in 5° x 5° boxes from 40°N x 40°S.	Float SDS	4	nlat*nlon	-	0 – 3000	mm
Number of Samples The number of samples over the oceans in each 5° x 5° box for one month.	Integer SDS	4	nlat*nlon	-	0 – 500,000	-
Chi Square Fit Indicates how well the histogram of brightness temperatures fits the lognormal distribution function.	Integer SDS	4	nlat*nlon	-	$1 – 10^9$	0
Freezing Level Estimated height of the 0°C isotherm.	Float SDS	4	nlat*nlon	-	0 – 6	km
T_0 The mean of non-raining brightness temperatures.	Float SDS	4	nlat*nlon	-	160- 180	K
r_0 Logarithmic mean rain rate.	Float SDS	4	nlat*nlon	-	0 – 15	mm h^{-1}
Sigma_r Standard deviation of the logarithmic rain rate.	Float SDS	4	nlat*nlon	-	0 – 1	mm h^{-1}
Probability of Rain Probability of rain in each 5° x 5° box.	Float SDS	4	nlat*nlon	-	0 – 1	-
Quality Indicators 1 - 3	Integer SDS	2	nlat*nlon	-	-	
Spare	Integer SDS	2	nlat*nlon	-	-	
Note that this product only includes data over oceans. Data over land are assigned the missing value of -9999.						

3A12: Mean 2A12 Profile and Surface Rainfall

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 40°S – 40°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	0.5° x 0.5°; nlat = 160, nlon = 720
Average File Size	≈ 56 MB compressed

3A12 Data Format Structure						
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Scaled by**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-	-
SurfaceRain Monthly mean of the instantaneous rain rate for each grid box.	Float SDS	4	nlat*nlon	-	0 – 3000	mm h^{-1}
SurfacePrecipitation Monthly mean of the instantaneous precipitation rate at the surface for each grid box.	Float SDS	4	nlat*nlon	-	0 – 3000	mm h^{-1}
ConvectPrecipitation Monthly mean of the instantaneous convective rain rate at the surface for each grid box.	Float SDS	4	nlat*nlon	-	0 – 3000	mm h^{-1}
CldWater Monthly mean cloud liquid water content for each grid box.	Float SDS	4	nlat*nlon*nlayer	-	0 – 10	g m^{-3}
RainWater Monthly mean precipitation water content for each grid box.	Float SDS	4	nlat*nlon*nlayer	-	0 – 10	g m^{-3}
CldIce Monthly mean cloud ice water content for each grid box.	Float SDS	4	nlat*nlon*nlayer	-	0 – 10	g m^{-3}
Snow Monthly mean snow liquid water content for each grid box.	Float SDS	4	nlat*nlon*nlayer	-	0 – 10	g m^{-3}
Graupel Monthly mean graupel liquid water content for each grid box.	Float SDS	4	nlat*nlon*nlayer	-	0 – 10	g m^{-3}
LatentHeat Monthly mean latent heating release.	Float SDS	4	nlat*nlon*nlevel	-	-256 – 256	K h^{-1}
NpixTotal Monthly number of pixels with pixelStatus equal to zero for each grid, used to remove sea ice.	Integer SDS	4	nlat*nlon	-	0 – 10,000	-
NpixPrecipitation Monthly number of pixels with surfacePrecipitation greater than zero for each grid box. Over the oceans, each pixel is also required to have a probabilityOfPrecipitation greater than 50%.	Integer SDS	4	nlat*nlon	-	0 – 10,000	-
Notes: *nlevel* represents the number of latent heating levels (28) per grid box and *nlayer* represents the number of profiling layers per grid box.						

3A25: Spaceborne Radar Rainfall

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 40°S – 40°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	5° x 5° and 0.5° x 0.5°
Average File Size	≈ 38 MB compressed

3A25 Data Structure: Part 1

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
rzStratPix2	Integer SDS	2	nlath*nlonh*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts conditioned on stratiform rain for near-surface and 2km heights over 0.5° x 0.5° boxes for one month.					
rzConvPix2	Integer SDS	2	nlath*nlonh*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts conditioned on convective rain for near-surface and 2km heights over 0.5° x 0.5° boxes for one month.					
rzPix2	Integer SDS	2	nlath*nlonh*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts for near-surface and 2km heights over 0.5° x 0.5° boxes for one month.					
surfRainStratPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of non-zero near-surface rain conditioned on stratiform rain over 0.5° x 0.5° boxes for one month.					
surfRainConvPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of non-zero near-surface rain conditioned on convective rain over 0.5° x 0.5° boxes for one month.					
e_surfRainStratPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of non-zero estimated surface rain conditioned on stratiform rain over 0.5° x 0.5° boxes for one month.					
e_surfRainConvPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of non-zero estimated surface rain conditioned on convective rain over 0.5° x 0.5° boxes for one month.					
e_surfRainPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of non-zero estimated surface rain over 0.5° x 0.5° boxes for one month.					
shallowRainPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of shallow rain over 0.5° x 0.5° boxes for one month.					
shallowIsoPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of shallow isolated rain over 0.5° x 0.5° boxes for one month.					
epsilon0StratPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of epsilon0 conditioned on stratiform rain and use of 2A21 SRT over 0.5° x 0.5° boxes for one month.					
epsilon0ConvPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of epsilon0 conditioned on convective rain and use of 2A21 SRT over 0.5° x 0.5° boxes for one month.					
epsilonStratPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of epsilon conditioned on stratiform rain and use of 2A21 SRT over 0.5° x 0.5° boxes for one month.					
epsilonConvPix2	Integer SDS	2	nlath*nlonh	0 to 2,000,000	-
Counts of epsilon conditioned on convective rain and use of 2A21 SRT over 0.5° x 0.5° boxes for one month.					
Strat. Rain Pixel Number 2	Integer SDS	4	nlath*nlonh*nh3	0 to 2,000,000	-
The number of non-zero rain rate pixels for stratiform rain over 0.5° x 0.5° boxes for one month.					
Conv. Rain Pixel Number 2	Integer SDS	4	nlath*nlonh*nh3	0 to 2,000,000	-
The number of non-zero rain rate pixels for convective rain over 0.5° x 0.5° boxes for one month.					
Rain Pixel Number 2	Integer SDS	4	nlath*nlonh*nh3	0 to 2,000,000	-
The Rain Pixel Number 2 is the monthly number of non-zero rain rate pixels for path-averaged rainfall and rainfall at the fixed heights of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° boxes.					

<table>
<tr><th colspan="6">3A25 Data Structure: Part 2</th></tr>
<tr><th>Name</th><th>Type</th><th>Record Size (bytes)</th><th>Dim Size (# of records)</th><th>Range</th><th>Unit</th></tr>
<tr><td>surfRainPix2</td><td>Integer SDS</td><td>4</td><td>nlath*nlonh</td><td>0 to 2,000,000,000.</td><td>-</td></tr>
<tr><td colspan="6">Near-surface rain counts at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>Bright Band Pixel Number 2</td><td>Integer SDS</td><td>4</td><td>nlath*nlonh</td><td>0 to 2,000,000</td><td>-</td></tr>
<tr><td colspan="6">The number of bright band counts over each 0.5° x 0.5° box for one month</td></tr>
<tr><td>Total Pixel Number 2</td><td>Integer SDS</td><td>4</td><td>nlath*nlonh</td><td>0 to 2,000,000</td><td>-</td></tr>
<tr><td colspan="6">The Total Pixel Number 2 is the number of total pixels over 0.5° x 0.5° boxes for one month.</td></tr>
<tr><td>rzStratB2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on stratiform rain. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>rzStratA2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on stratiform rain. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>rzConvB2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on convective rain. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>rzConvA2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on convective rain. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>rzB2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>rzA2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh*2</td><td>0.0 to 1.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs. Computed for near-surface and 2km heights at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>surfRainStratDev2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Standard deviation of non-zero near-surface rain conditioned on stratiform rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>surfRainStratMean2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Mean of non-zero near-surface rain conditioned on stratiform rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>surfRainConvDev2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Standard deviation of non-zero near-surface rain conditioned on convective rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>surfRainConvMean2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Mean of non-zero near-surface rain conditioned on convective rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>e_surfRainStratdev2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Standard deviation of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) conditioned on stratiform rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>e_surfRainStratMean2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Mean of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) conditioned on stratiform rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>e_surfRainConvdev2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Standard deviation of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) conditioned on convective rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>e_surfRainConvMean2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Mean of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) conditioned on convective rain at a horizontal resolution of 0.5° x 0.5°</td></tr>
<tr><td>e_surfRaindev2</td><td>Float SDS</td><td>4</td><td>nlath*nlonh</td><td>0.0 to 400.0</td><td>$mm\ h^{-1}$</td></tr>
<tr><td colspan="6">Standard deviation of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) at a horizontal resolution of 0.5° x 0.5°</td></tr>
</table>

3A25 Data Structure: Part 3					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
e_surfRainMean2	Float SDS	4	nlath*nlonh	0.0 to 400.0	mm h^{-1}
Mean of non-zero estimated surface rain below clutter (see 2A25 algorithm user guide) at a horizontal resolution of 0.5° x 0.5°					
shallowRaindev2	Float SDS	4	nlath*nlonh	0.0 to 3,000.0	mm h^{-1}
Standard deviation of shallow rain at a horizontal resolution of 0.5° x 0.5°					
shallowRainMean2	Float SDS	4	nlath*nlonh	0.0 to 3,000.0	mm h^{-1}
Mean of shallow rain at a horizontal resolution of 0.5° x 0.5°					
shallowIsoRaindev2	Float SDS	4	nlath*nlonh	0.0 to 3,000.0	mm h^{-1}
Standard deviation of shallow isolated rain at a horizontal resolution of 0.5° x 0.5°					
shallowIsoRainMean2	Float SDS	4	nlath*nlonh	0.0 to 3,000.0	mm h^{-1}
Mean of shallow isolated rain at a horizontal resolution of 0.5° x 0.5°					
epsilon0StratDev2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Standard deviation of epsilon0 conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilon0StratMean2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Mean of epsilon0 conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilon0ConvDev2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Standard deviation of epsilon0 conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilon0ConvMean2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Mean of epsilon0 conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilonStratDev2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Standard deviation of epsilon conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilonStratMean2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Mean of epsilon conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilonConvDev2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Standard deviation of epsilon conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
epsilonConvMean2	Float SDS	4	nlath*nlonh	0.0 to 5.0	-
Mean of epsilon conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 0.5° x 0.5°					
bbHeightDev2	Float SDS	4	nlath*nlonh	0.0 to 20,000.0	m
Standard deviation of bright band height at a horizontal resolution of 0.5° x 0.5°					
stormHeightDev2	Float SDS	4	nlath*nlonh*2	0.0 to 20,000.0	m
Standard deviation of storm height at a horizontal resolution of 0.5° x 0.5°					
sdepthDev2	Float SDS	4	nlath*nlonh	0.0 to 20,000.0	m
Standard deviation of snow depth at a horizontal resolution of 0.5° x 0.5°					
sdepthMean2	Float SDS	4	nlath*nlonh	0.0 to 20,000.0	m
Mean of snow depth at a horizontal resolution of 0.5° x 0.5°					
bbZmaxDev2	Float SDS	4	nlath*nlonh	0.0 to 100	dBZ
Mean of maximum reflectivity in bright band at a horizontal resolution of 0.5° x 0.5°					
bbZmaxMean2	Float SDS	4	nlath*nlonh	0.0 to 100.0	dBZ
Mean of maximum reflectivity in bright band at a horizontal resolution of 0.5° x 0.5°					
surfRainDev2	Float SDS	4	nlath*nlonh	0.0 to 3000.0	mm h^{-1}
Standard Deviation of non-zero near-surface rain rate at a horizontal resolution of 0.5° x 0.5°					
surfRainMean2	Float SDS	4	nlath*nlonh	0.0 to 3000.0	mm h^{-1}
Mean of non-zero near-surface rain rate at a horizontal resolution of 0.5° x 0.5°					
BB Height Mean	Float SDS	4	nlath*nlonh	0.0 to 20,000.0	m
BB Height Mean gives the monthly means of bright-band height over grid boxes of 0.5° x 0.5°					
Storm Height Mean	Float SDS	4	nlath*nlonh*2	0.0 to 20,000.0	m
Storm Height Mean gives the monthly means of the storm height, unconditioned and conditioned for stratiform and convective rain over 0.5° x 0.5° grid boxes.					

3A25 Data Structure: Part 4					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
Strat. Zt Mean 2	Float SDS	4	nlath*nlonh*nh3	0.1 to 80	dBZ
The monthly means of the corrected reflectivity of stratiform rain over 0.5° x 0.5° grid boxes.					
Conv. Zm Mean 2	Float SDS	4	nlath*nlonh*nh3	0.1 to 80.0	dBZ
Conv. Zm Mean 2 gives the monthly means of the corrected reflectivity of convective rain at the fixed heights of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° grid boxes.					
Zt Mean 2	Float SDS	4	nlath*nlonh*nh3	0.1 to 80.0	dBZ
Zt Mean 2 gives the monthly means of the corrected reflectivity at the fixed heights of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° grid boxes.					
Strat. Zm Mean 2	Float SDS	4	nlath*nlonh*nh3	-20.0 to 80.0	dBZ
Strat. Zm Means gives the monthly means of the measured reflectivity of stratiform rain at the fixed heights of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° grid boxes.					
Conv. Zm Mean 2	Float SDS	4	nlath*nlonh*nh3	-20.0 to 80.0	dBZ
Conv. Zm Mean 2 gives the monthly means of the measured reflectivity of convective rain at the fixed height levels of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° grid boxes.					
Zm Mean 2	Float SDS	4	nlath*nlonh*nh3	-20.0 to 80.0	dBZ
Zm Mean 2 gives the monthly means of the measured reflectivity at the fixed height levels of 2 km, 4 km, 6 km, and path average over 0.5° x 0.5° grid boxes.					
Strat. Rain Rate Dev. 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Strat. Rain Rate Dev. 2 gives standard deviations of non-zero rain rates for stratiform rain over 0.5° x 0.5° boxes for one month. The rain rates are determined in 2A-25 and evaluated at the Strat. Rain Rate Mean 2.					
Strat. Rain Rate Mean 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Strat. Rain Rate Mean 2 gives means of non-zero rain rates for stratiform rain over 0.5° x 0.5° boxes for one month. The rain rates are determined in 2A-25 and evaluated at the fixed heights of 2 km, 4 km, 6 km, and path average.					
Conv. Rain Rate Dev. 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Conv. Rain Rate Dev. 2 gives standard deviations of non-zero rain rates for convective rain over 0.5° x 0.5° boxes for one month. The rain rates are determined in 2A-25 and evaluated at the fixed heights of 2 km, 4 km, 6 km, and path average.					
Conv. Rain Rate Mean 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Conv. Rain Rate Mean 2 gives means of non-zero rain rates for convective rain over 0.5° x 0.5° boxes for one month. The rain rates are determined in 2A-25 and evaluated at the fixed heights of 2 km, 4 km, 6 km, and path average.					
Rain Rate Dev. 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Rain Rate Dev. 2 gives standard deviations of non-zero rain rates over 0.5 x 0.5 boxes for one month. The rain rates are determined in 2A-25 and evaluated at the fixed heights of 2 km, 4 km, 6 km, and path average.					
Rain Rate Mean 2	Float SDS	4	nlath*nlonh*nh3	0.0 to 3000.0	mm h^{-1}
Rain Rate Mean 2 gives means of non-zero rain rates over 0.5° x 0.5° boxes for one month. The rain rates are determined in 2A-25 and evaluated at the fixed heights of 2 km, 4 km, 6 km, and path average.					
GridStructure	Char Attribute	5,000	-	-	-
GridStructure gives the specification of the geometry of the grids.					
PIAs Corr. Coef.	Float SDS	4	nlat*nlon*nang*3	-1.000 to 1.000	-
This is the correlation coefficient of three path-integrated attenuations (SRT, HB, and 0th order PIAs) at angles of 0, 5, 10 and 15 for a 5° x 5° box for one month.					
Strat. RR Corr. Coef.	Float SDS	4	nlat*nlon*3	-1.000 to 1.000	-
These are correlation coefficients of non-zero rain rates for stratiform rain between 3 heights (i.e., correlation coefficient of rain rates at 2 km vs 4 km, 2 km vs 6 km, and 4 km vs 6 km) for a 5° x 5° box for one month.					
Conv. RR Corr. Coef.	Float SDS	4	nlat*nlon*3	-1.000 to 1.000	-
These are correlation coefficients of non-zero rain rates for convective rain between 3 heights (i.e., correlation coefficient of rain rates at 2 km vs 4 km, 2 km vs 6 km, and 4 km vs 6 km) for a 5° x 5° box for one month.					
3A25 Data Structure: Part 5					

<table>
<tr><th>Name</th><th>Type</th><th>Record Size (bytes)</th><th>Dim Size (# of records)</th><th>Range</th><th>Unit</th></tr>
<tr><td>RR Corr. Coef.</td><td>Float SDS</td><td>4</td><td>nlat*nlon*3</td><td>-1.000 to 1.000</td><td>-</td></tr>
<tr><td colspan="6">These are correlation coefficients of non-zero rain rates between 3 heights (i.e., correlation coefficient of rain rates at 2 km vs 4 km, 2 km vs 6 km, and 4 km vs 6 km) for a 5° x 5° box for one month. They are calculated under convective condition, stratiform condition or both.</td></tr>
<tr><td>surfRainH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of near-surface rain rate at a horizontal resolution of 5 x 5</td></tr>
<tr><td>epsilon0StratH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of epsilon0 conditioned on stratiform rain and use 2A21 SRT at a horizontal resolution of 5° x 5°</td></tr>
<tr><td>epsilon0ConvH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of epsilon0 conditioned on convective rain and use 2A21 SRT at a horizontal resolution of 5° x 5°</td></tr>
<tr><td>epsilonStratH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of epsilon conditioned on stratiform rain and use 2A21 SRT at a horizontal resolution of 5° x 5°</td></tr>
<tr><td>epsilonConvH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of epsilon conditioned on convective rain and use 2A21 SRT at a horizontal resolution of 5° x 5°</td></tr>
<tr><td>bbZmaxH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,000</td><td>-</td></tr>
<tr><td colspan="6">Histogram of maximum Zt in bright band at a horizontal resolution of 5° x 5°</td></tr>
<tr><td>NUBF Hist.</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">NUBF (Non-Uniform Beam Filling) Hist. gives the histogram of the NUBF correction for Z-factor and rain rate of 30 different categories over 5° x 5° grid boxes.</td></tr>
<tr><td>Xi Hist.</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">The Xi Histograms is the histogram of non-uniformity parameter determined in 2A-25 for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>pia2A25H</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">These are histograms of path-attenuation as determined by 2A25 at 4 incidence angles (0, 5, 10 and 15) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>PIA 0th Hist.</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">PIA 0th Hist. is the histogram of the 0th order path-integrated attenuation with a horizontal resolution of 5° x 5°. This histogram is calculated for 30 categories at 4 different incident angles (0 , 5, 10 and 15).</td></tr>
<tr><td>PIA hb Hist.</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">These are histograms of path-attenuation using an estimate derived from measured reflectivity (Zm) and a k-Z relationship at 4 incidence angles (0, 5, 10 and 15) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>PIA srt Hist.</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">PIA srt Hist. gives histograms of path-attenuation as determined by the surface reference technique (SRT) at 4 incidence angles (0, 5, 10 and 15) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>pia2a25ssH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">Histogram in counts of final PIA from 2A25 subsetted 2A25 method flag at 5 angles (0, 5, 10, 15, and all 49 angle bins) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>pia0ssH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">Histogram in counts of PIA from 0th-order method subsetted 2A25 method flag at 5 angles (0, 5, 10, 15, and all 49 angle bins) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>piaHbssH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">Histogram in counts of PIA from HB method subsetted 2A25 method flag at 5 angles (0, 5, 10, 15, and all 49 angle bins) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>piaSrtssH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2*nang</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">Histogram in counts of PIA from SRT subsetted 2A25 method flag at 5 angles (0, 5, 10, 15, and all 49 angle bins) for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td>SurfRainStratH</td><td>Integer SDS</td><td>2</td><td>nlat*nlon*ncat2</td><td>0 to 32,767</td><td>-</td></tr>
<tr><td colspan="6">Histogram in counts of non-zero near-surface rainfall conditioned on stratiform rain for 30 categories over a 5° x 5° box for one month.</td></tr>
<tr><td colspan="6">3A25 Data Structure: Part 6</td></tr>
</table>

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
SurfRainConvH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of non-zero near-surface rainfall conditioned on convective rain for 30 categories over a 5° x 5° box for one month.					
e_surfRainStratH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of non-zero estimated surface rain conditioned on stratiform rain for 30 categories over a 5° x 5° box for one month.					
e_surfRainConvH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of non-zero estimated surface rain conditioned on convective rain for 30 categories over a 5° x 5° box for one month.					
e_surfRainH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of non-zero estimated surface rain for 30 categories over a 5° x 5° box for one month.					
bbNadirZmaxH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of maximum Z in bright band from nadir ray for 30 categories over a 5° x 5° box for one month.					
bbNadirWidthH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of bright band width from nadir ray for 30 categories over a 5° x 5° box for one month.					
bbNadirHH	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
Histogram in counts of bright band heights from nadir ray for 30 categories over a 5° x 5° box for one month.					
Strat. Rain Rate Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
These are histograms of non-zero rain rate pixels for stratiform rain at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Conv. Rain Rate Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
These are histograms of non-zero rain rate pixels for convective rain at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Rain Rate Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
These are histograms of non-zero rain rate pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Strat. Zt Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Stratiform Zt Histograms are histograms of corrected reflectivity factors for stratiform rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Conv. Zt Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Convective Zt Histograms are histograms of corrected reflectivity factors for convective rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Zt Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Zt Histograms are histograms of corrected reflectivity factors i for rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Strat. Zm Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Stratiform Zm Histograms are histograms of measured reflectivities of stratiform rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Conv. Zm Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Convective Zm Histograms are histograms of measured reflectivities of convective rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box for one month.					
Zm Hist.	Integer SDS	2	nlat*nlon*ncat2*nh1	0 to 32,767	-
The Zm Histograms are histograms of measured reflectivities of rain pixels at five heights (2, 4, 6, 10 and 15 km) and path-average for 20 categories over a 5° x 5° box i for one month.					
Snow-ice Layer Hist.	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
These are histograms of the depth of snow-ice layer for 30 categories over a 5° x 5° box for one month. The depth of snow-ice layer is defined as the difference between effective storm height and estimated height of 0C isotherm.					

3A25 Data Structure: Part 7

Name	Type	Record Size	Dim Size	Range	Unit

		(bytes)	(# of records)		
BB Height Hist.	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
These are histograms of the bright-band heights for 30 categories over a 5 x 5 box for one month, given that the bright band is detected.					
Strat. Storm Height Hist.	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
These are histograms of the 'effective' storm heights for stratiform rain for 30 categories over a 5° x 5° box for one month.					
Conv. Storm Height Hist.	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
These are histograms of the 'effective' storm heights for convective rain for 30 categories over a 5° x 5° box for one month.					
Storm Height Hist.	Integer SDS	2	nlat*nlon*ncat2	0 to 32,767	-
These are histograms of the 'effective' storm heights for 30 categories over a 5° x 5° box for one month.					
epsilon0StratPix1	Integer SDS	4	nlat*nlon	0 to 32,767	-
Counts of epsilon0 conditioned on stratiform rain and use of 2A21 SRT at the 3 heights at a horizontal resolution of 5° x 5°					
epsilon0ConvPix1	Integer SDS	4	nlat*nlon	0 to 32,767	-
Counts of epsilon0 conditioned on convective rain and use of 2A21 SRT at the 3 heights at a horizontal resolution of 5° x 5°					
epsilonStratPix1	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of epsilon conditioned on stratiform rain and use of 2A21 SRT at the 3 heights at a horizontal resolution of 5° x 5°					
epsilonConvPix1	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of epsilon conditioned on convective rain and use of 2A21 SRT at the 3 heights at a horizontal resolution of 5° x 5°					
convCCoefPix	Integer SDS	2	nlat*nlon*3	0 to 32,767	-
Counts for correlation coefficients of rain conditioned on convective rain at the 3 heights at a horizontal resolution of 5° x 5°					
stratCCoefPix	Integer SDS	2	nlat*nlon*3	0 to 32,767	-
Counts for correlation coefficients of rain conditioned on stratiform rain at the 3 heights at a horizontal resolution of 5° x 5°					
rainCCoefPix	Integer SDS	2	nlat*nlon*3	0 to 32,767	-
Counts for correlation coefficients of rain at the 3 heights at a horizontal resolution of 5° x 5°					
pia2a25ssPix	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of final PIA from 2A25 for sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide) at a horizontal resolution of 5° x 5°					
pia0ssPix	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of PIA using 0th-order method for sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide) at a horizontal resolution of 5° x 5°					
piaHbssPix	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of PIA using HB method for sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide) at a horizontal resolution of 5° x 5°					
piaSrtssPix	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of PIA using SRT method for sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide) at a horizontal resolution of 5° x 5°					
rzStratPix1	Integer SDS	4	nlat*nlon*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts for stratiform rain near-surface and 2km heights, at a horizontal resolution of 5° x 5°					
rzConvPix1	Integer SDS	4	nlat*nlon*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts for convective rain near-surface and 2km heights, at a horizontal resolution of 5° x 5°					
rzPix1	Integer SDS	4	nlat*nlon*2	0 to 2,000,000	-
The number of R-Z coefficient pixel counts for near-surface and 2km heights, at a horizontal resolution of 5° x 5°					
e_surfRainStratPix1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of non-zero estimated surface rain pixel counts conditioned on stratiform rain, at a horizontal resolution of 5° x 5°					
e_surfRainConvPix1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of non-zero estimated surface rain pixel counts conditioned on convective rain, at a horizontal resolution of 5° x 5°					

3A25 Data Structure: Part 8

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit

e_surfRainPix1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of non-zero estimated surface rain pixel counts at a horizontal resolution of 5° x 5°					
surfRainStratPix1	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of Near-surface rain fall conditioned on stratiform rain at a horizontal resolution of 5° x 5°					
surfRainConvPix1	Integer SDS	2	nlat*nlon	0 to 32,767	-
Counts of Near-surface rain fall conditioned on convective rain at a horizontal resolution of 5° x 5°					
surfRainPix1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
Near-surface rain counts at a horizontal resolution of 5° x 5°					
Rain Angle Pixel Number 1	Integer SDS	2	nlat*nlon*nang	0 to 30,000	-
Rain Angle Pixel Number 1 is the total number of non-zero rain rate pixels over each 5° x 5° latitude-longitude grid box for a month. This parameter is accumulated at four different angles (i.e., 0, 5, 10, and 15).					
Total Angle Pixel Number 1	Integer SDS	2	nlat*nlon*nang	0 to 30,000	-
Total Angle Pixel Number 1 is the total number of pixels over each 5° x 5° latitude-longitude grid box for a month. This parameter is accumulated at four different angles (i.e., 0, 5, 10, and 15).					
Strat. Rain Pixel Number 1	Integer SDS	4	nlat*nlon*nh1	0 to 2,000,000	-
The Stratiform Rain Pixel Number 1 is the number of non-zero rain rate pixels for stratiform rain at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes for one month.					
Conv. Rain Pixel Number 1	Integer SDS	4	nlat*nlon*nh1	0 to 2,000,000	-
The number of non-zero rain rate pixels for convective rain at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes for one month					
Rain Pixel Number 1	Integer SDS	4	nlat*nlon*nh1	0 to 2,000,000	-
The number of non-zero rain rate pixels at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes for one month					
bbNadirPix1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of bright band nadir pixel counts over each 5° x 5° box					
Bright Band Pixel Number 1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of bright band counts over each 5° x 5° box for one month					
Total Pixel Number 1	Integer SDS	4	nlat*nlon	0 to 2,000,000	-
The number of total pixels over 5° x 5° boxes for one month					
rzStratB1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on stratiform rain. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
rzStratA1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on stratiform rain. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
rzConvB1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on convective rain. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
rzConvA1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs conditioned on convective rain. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
rzB1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The B parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
rzA1	Float SDS	4	nlat*nlon*2	0.0 to 1.0	mm h^{-1}
The A parameter in rainfall-reflectivity relation R = AZ^B from fitting of instantaneous R, Z pairs. Computed for near-surface and 2km, at a horizontal resolution of 5° x 5°					
e_surfRainDev1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Standard deviation of non-zero estimated surface rain below clutter conditioned on stratiform rain at a resolution of 5° x 5°					

3A25 Data Structure: Part 9

Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
e_surfRainStratMean1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Mean of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) conditioned on stratiform rain at a horizontal resolution of 5° x 5°					
e_surfRainConvDev1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Standard deviation of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) conditioned on convective rain at a horizontal resolution of 5° x 5°					
e_surfRainConvMean1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Mean of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) conditioned on convective rain at a horizontal resolution of 5° x 5°					
e_surfRainDev1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Standard deviation of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) at a horizontal resolution of 5° x 5°					
e_surfRainMean1	Float SDS	4	nlat*nlon	0.0 to 400.0	mm h^{-1}
Mean of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) at a horizontal resolution of 5° x 5°					
sdepthDev1	Float SDS	4	nlat*nlon	0.0 to 20,000.0	m
Standard deviation of snow depth at a horizontal resolution of 5° x 5°					
sdepthMean1	Float SDS	4	nlat*nlon	0.0 to 20,000.0	m
Mean of snow depth at a horizontal resolution of 5° x 5°					
bbZmaxDev1	Float SDS	4	nlat*nlon	0.0 to 100.0	dBZ
Standard Deviation of maximum reflectivity in bright band at a horizontal resolution of 5° x 5°					
bbZmaxMean1	Float SDS	4	nlat*nlon	0.0 to 100.0	dBZ
Mean of maximum reflectivity in bright band at a horizontal resolution of 5° x 5°					
surfRainStratDev1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Standard deviation of non-zero near-surface rain rate conditioned on stratiform rain at a horizontal resolution of 5° x 5°					
surfRainStratMean1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Mean of non-zero near-surface rain rate conditioned on stratiform rain at a horizontal resolution of 5° x 5°					
surfRainConvDev1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Standard deviation of non-zero near-surface rain rate conditioned on convective rain at a horizontal resolution of 5° x 5°					
surfRainConvMean1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Mean of non-zero near-surface rain rate conditioned on convective rain at a horizontal resolution of 5° x 5°					
surfRainDev1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Standard deviation of non-zero near-surface rain rate at a horizontal resolution of 5° x 5°					
surfRainMean1	Float SDS	4	nlat*nlon	0.0 to 3000.0	mm h^{-1}
Mean of non-zero near-surface rain rate at a horizontal resolution of 5° x 5°					
epsilon0StratDev1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Standard deviation of epsilon0 conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilon0StratMean1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Mean of epsilon0 conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilon0ConvDev1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Standard deviation of epsilon0 conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilon0ConvMean1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Mean of epsilon0 conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilonStratDev1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Standard deviation of epsilon conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilonStratMean1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Mean of epsilon conditioned on stratiform rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
epsilonConvDev1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Standard deviation of epsilon conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					

3A25 Data Structure: Part 10

epsilonConvMean1	Float SDS	4	nlat*nlon	0.0 to 5.0	-
Mean of epsilon conditioned on convective rain and use of 2A21 SRT at a horizontal resolution of 5° x 5°					
bbNadirZmaxDev1	Float SDS	4	nlat*nlon	0.0 to 70.0	dBZ
Standard deviation of maximum Z in bright band from nadir ray at a horizontal resolution of 5° x 5°					
bbNadirZmaxMean1	Float SDS	4	nlat*nlon	0.0 to 70.0	dBZ
Mean of maximum Z in bright band from nadir ray at a horizontal resolution of 5° x 5°					
bbNadirWidthDev1	Float SDS	4	nlat*nlon	0.0 to 10,000	m
Standard deviation of bright band from nadir ray at a horizontal resolution of 5° x 5°					
bbNadirWidthMean1	Float SDS	4	nlat*nlon	0.0 to 10,000	m
Width of bright band from nadir ray at a horizontal resolution of 5° x 5°					
bbNadirHtDev1	Float SDS	4	nlat*nlon	0.0 to 20,000	m
Standard deviation of bright band from nadir ray at a horizontal resolution of 5° x 5°					
bbNadirHtMean1	Float SDS	4	nlat*nlon	0.0 to 20,000	m
Height of bright band from nadir ray at a horizontal resolution of 5° x 5°					
BB Height Dev.	Float SDS	4	nlat*nlon	0.0 to 20,000	m
Monthly deviation of the bright band height at a horizontal resolution of 5° x 5°					
BB Height Mean	Float SDS	4	nlat*nlon	0.0 to 20,000	m
Monthly means of the bright band height at a horizontal resolution of 5° x 5°					
NUBF Correction Factor Dev.	Float SDS	4	nlat*nlon	0.0 to 2.0	-
Monthly standard deviation of the NUBF correction for Z-factor and Rain Rate at a horizontal resolution of 5° x 5°					
NUBF Correction Factor Mean	Float SDS	4	nlat*nlon	0.0 to 2.0	-
Monthly mean of NUBF correction for Z-factor and Rain Rate at a horizontal resolution of 5° x 5°					
Xi Dev.	Float SDS	4	nlat*nlon	0.0 to 99.0	-
Monthly standard deviation of the horizontal non-uniformity parameter of the rain field within a ray at a horizontal resolution of 5° x 5°					
Xi Mean	Float SDS	4	nlat*nlon	0.0 to 99.0	-
Monthly means of the horizontal non-uniformity parameter of the rain field within a ray at a horizontal resolution of 5° x 5°					
Storm Height Dev.	Float SDS	4	nlat*nlon*3	0.0 to 20,000.0	m
Standard deviation of the storm height for conditions of stratiform rain, convective rain and unconditional rain					
Storm Height Mean	Float SDS	4	nlat*nlon*3	0.0 to 20,000.0	m
Monthly mean of the storm height for conditions of stratiform rain, convective rain and unconditional rain					
pia2a25ssDev	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Standard deviation of final PIA (path-integrated attenuation, one-way) from 2A25 for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
pia2a25ssMean	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Mean of final PIA (path-integrated attenuation, one-way) from 2A25 for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
pia0ssMean	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Standard deviation of PIA (path-integrated attenuation, one-way) for 0th-order method for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
pia0ssMean	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Mean of PIA (path-integrated attenuation, one-way) for 0th-order method for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
piaHbssDev	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Standard deviation of PIA (path-integrated attenuation, one-way) for HB method for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
piaHbssMean	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Mean of PIA (path-integrated attenuation, one-way) for HB method for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					

3A25 Data Structure: Part 11

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit

piaSrtssDev	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Standard deviation of PIA (path-integrated attenuation, one-way) for SRT for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
piaSrtssMean	Float SDS	4	nlat*nlon	0.0 to 100.0	dB
Mean of PIA (path-integrated attenuation, one-way) for SRT for a sub-set of data where the 2A25 method flag has been set (see 2A25/3A25 algorithm users guide). It has a horizontal resolution of 5° x 5°.					
pia2a25Dev.	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly standard deviation of 2A25 path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
pia2a25Mean	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly means of 2A25 path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
PIA 0th Dev.	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly standard deviation of the 0th-order path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5 x 5.					
PIA 0th Mean	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly means of the 0th-order path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
PIA hb Dev.	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly standard deviation of HB path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
PIA hb Mean	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly means of HB path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
PIA srt Dev.	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly standard deviation of SRT path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
PIA srt Mean	Float SDS	4	nlat*nlon*nang	0.0 to 100.0	dB
Monthly means of SRT (surface reference technique) path-integrated attenuation calculated at four fixed incidence angles. It has a horizontal resolution of 5° x 5°.					
Strat. Zt Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 80.0	dBZ
Monthly standard deviations of corrected radar reflectivity for stratiform rain at a horizontal resolution of 5° x 5°. The path-averaged standard deviation and those at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 2A-25.					
Strat. Zt Mean 1	Float SDS	4	nlat*nlon*nh1	0.1 to 80.0	dBZ
Monthly means of measured radar reflectivity for stratiform rain at a horizontal resolution of 5° x 5°. The path-averaged mean and means at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 2A-25.					
Conv. Zt Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 80.0	dBZ
Monthly standard deviations of corrected radar reflectivity for convective rain at a horizontal resolution of 5° x 5°. The path-averaged standard deviation and those at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 2A-25.					
Conv. Zt Mean 1	Float SDS	4	nlat*nlon*nh1	0.1 to 80.0	dBZ
Monthly means of corrected radar reflectivity for convective rain at a horizontal resolution of 5° x 5°. The path-averaged mean and means at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 2A-25.					
Zt Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 80.0	dBZ
Monthly standard deviations of corrected radar reflectivity factors at the fixed heights of 2, 4, 6, 1 0 and 15 km and for path-average over 5° x 5° boxes using data from 2A-25					
Zt Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 80.0	dBZ
Monthly means of corrected radar reflectivity factors at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes for one month using data from 2A-25					

3A25 Data Structure: Part 12

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
Strat. Zm Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ

Monthly standard deviations of measured radar reflectivity for stratiform rain at a horizontal resolution of 5° x 5°. The path-averaged standard deviation and those at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 1C-21.					
Strat. Zm Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ
Monthly means of measured radar reflectivity for stratiform rain at a horizontal resolution of 5° x 5°. The path-averaged mean and means at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 1C-21.					
Conv. Zm Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ
Monthly standard deviations of measured radar reflectivity for convective rain at a horizontal resolution of 5° x 5°. The path-averaged standard deviation and those at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 1C-21.					
Conv. Zm Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ
Monthly means of measured radar reflectivity for convective rain at a horizontal resolution of 5° x 5°. The path-averaged mean and means at the fixed heights of 2, 4, 6, 10 and 15 km are calculated using data from 1C-21.					
Zm Dev.1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ
Monthly standard deviations of measured radar reflectivity at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes using data from 1C-21					
Zm Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 100.0	dBZ
Monthly means of measured radar reflectivity at the fixed heights of 2, 4, 6, 10 and 15 km and for path-average over 5° x 5° boxes using data from 1C-21					
Strat. Rain Rates Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly standard deviations of non-zero rain rates for stratiform rain over 5° x 5° boxes					
Strat. Rain Rates Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly means of non-zero rain rates for stratiform rain over 5° x 5° boxes					
Conv. Rain Rates Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly standard deviations of non-zero rain rates for convective rain over 5° x 5° boxes					
Conv. Rain Rate Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly means of non-zero rain rates for convective rain over 5° x 5° boxes					
Rain Rates Dev. 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly standard deviations of non-zero rain rates over 5° x 5° boxes					
Rain Rate Mean 1	Float SDS	4	nlat*nlon*nh1	0.0 to 3000.0	mm h^{-1}
Monthly means of non-zero rain rates over 5° x 5° boxes					
GridStructure	Char Att.	5,000	-	-	-
GridStructure gives the specification of the geometry of the grids.					
PS Metadata	Char Att.	10,000	-	-	-
Product Specific Metadata					
ECS Core Metadata	Char Att.	10,000	-	-	-
ECS Core Metadata					

Notes:

- The "scale by" column was omitted because none of the 3A25 variables are scaled.
- Missing data are given a value of -9999.
- The *nlat* and *nlon* dimensions refer to the 5° latitude and longitudes, respectively, whereas the *nlath* and *nlonh* dimensions refer to the 0.5° latitude and longitude dimensions, respectively.
- The dimension *nh1* refers to the number of fixed heights about the earth ellipsoid, in order: 2, 4, 6, 10, and 15 km.
- The dimension *nh3* refers to the number of fixed heights above the earth ellipsoid, in order: 2, 4, and 6 km.
- The dimension *nang* refers to the number of crossed incidence angles at 0, 5°, 10°, and 15°, respectively.
- The dimension *ncat2* refers to the second number of categories for histograms (a total of 30).

3A26: Surface Rain Total

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 40°S – 40°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	5° x 5°; nlat = 16, nlon = 72
Average File Size	≈ 6 MB compressed

3B31: Combined Rainfall

3A26 Data Format Structure					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Att.	10,000	-	-	-
PS Metadata Product specific metadata	Char Att.	10,000	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Att.	5,000	-	-	-
Total Counts Total number of counts (measurements) per month at each 5° x 5° boxes.	Integer SDS	4	nlat*nlon	0 – 2,147,483,647	-
Rain Counts Total number of rain counts (measurements) per month at each 5° x 5° boxes. This is computed at 2km, 4km, 6km, and for the path-average.	Integer SDS	4	nlat*nlon*nh2	0 – 2,147,483,647	-
Zero Order pDf Probability distribution function (cumulative) in counts of the zeroth order rain rate estimate at each 5° x 5° boxes. The pDf is computed at 2km, 4km, 6km, and for the path-average.	Integer SDS	4	nlat*nlon*ncat3*nh2*nthrsh	1 – 2,147,483,647	-
HB pDf Probability distribution function (cumulative) in counts of the Hitschfield-Bordan (HB) rain rate estimate at each 5° x 5° boxes. The pDf is computed at 2km, 4km, 6km, and for the path-average.	Integer SDS	4	nlat*nlon*ncat3*nh2*nthrsh	1 – 2,147,483,647	-
pDf2A25 Probability distribution function (cumulative) in counts of the Surface Reference Technique (SRT) rain rate estimate at each 5° x 5° boxes. The pDf is computed at 2km, 4km, 6km, and for the path-average.	Float SDS	4	nlat*nlon*ncat3*nh2*nthrsh	1 – 2,147,483,647	-
Zero Order Fit The mean, variance, and probability of rain parameters for the log-normal model obtained from the zeroth order pDf. Fitting parameters are given at 2km, 4km, 6km, and for the path-average. In addition, 5 thresholds are used.	Float SDS	4	nlat*nlon*nh2*3*nthrsh	1 – 2,147,483,647	-
HB Fit The 3 fitting parameters for the log-normal model obtained from the HB pDf. Fitting parameters are given at 2km, 4km, 6km, and for the path-average. In addition, 5 thresholds are used.	Float SDS	4	nlat*nlon*nh2*3*nthrsh	-	-
fit2A25 The 3 fitting parameters for the log-normal model obtained from the SRT pDf. Fitting parameters are given at 2km, 4km, 6km, and for the path-average.	Float SDS	4	nlat*nlon*nh2*3*nthrsh	-	-
Reliability 0^{th} Order Fit Reliability parameter for the 0th order fit.	Float SDS	4	nlat*nlon*nh2*nthrsh	-	-
Reliability HB Fit Reliability parameter for the HB fit.	Float SDS	4	nlat*nlon*nh2*nthrsh	-	-
Reliability 2A25 Fit Reliability parameter for the SRT fit.	Float SDS	4	nlat*nlon*nh2*nthrsh	-	-
rainMeanTH The mean monthly unconditioned rain rate (mm/h) as determined from the threshold method (in particular, it is determined from the fitting parameters fro the '-th-order method' using a single 'Q' threshold for each height level).	Float SDS	4	nlat*nlon*nh3	0 – 3000	mm h^{-1}

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 40°S – 40°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	0.5° x 0.5°; nlat = 160, nlon = 720
Average File Size	≈ 37 MB compressed

3B31 Data Format Structure

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
ECS Core Metadata	Char Attribute	10,000	-	-	-
ECS core metadata					
PS Metadata	Char Attribute	10,000	-	-	-
Product specific metadata					
GridStructure	Char Attribute	5,000	-	-	-
GridStructure gives the specification of the geometry of the grids.					
surfacePrecipTMI	Float SDS	4	nlat*nlon	0 – 3000	mm
Surface rain from 2A12 accumulated in each 0.5° x 0.5° box					
convectPrecipTMI	Float SDS	4	nlat*nlon	0 – 3000	mm
Convective surface rain from 2A12 accumulated in each 0.5° x 0.5° box					
rainWaterTMI	Float SDS	4	nlat*nlon*nlayer	0 – 10	$g\ m^{-3}$
Monthly mean rain water content from 2A12 at each vertical layer in each 0.5° x 0.5° box					
snowTMI	Float SDS	4	nlat*nlon*nlayer	0 – 10	$g\ m^{-3}$
Monthly mean snow liquid content from 2A12 at each vertical layer in each 0.5° x 0.5° box					
graupelTMI	Float SDS	4	nlat*nlon*nlayer	0 – 10	$g\ m^{-3}$
Monthly mean graupel liquid content from 2A12 at each vertical layer in each 0.5° x 0.5° box					
npixTotalTMI	Integer SDS	4	nlat*nlon	1 – 10000	-
The monthly number of pixels with pixelStatus equal to zero for each grid. The major effect of the pixelStatus requirement is to remove sea ice. npixTotalTMI is used to compute the monthly means described above.					
surfacePrecipCOMB	Float SDS	4	nlat*nlon	0 – 3000	mm
Surface rain from 2B31 accumulated in each 0.5° x 0.5° box					
rainWaterCOMB	Float SDS	4	nlat*nlon*nlayer	0 – 10	$g\ m^{-3}$
Rain water content at each vertical layer from 2B31 accumulated in each 0.5° x 0.5° box					
snowCOMB	Float SDS	4	nlat*nlon*nlayer	0 – 10	$g\ m^{-3}$
Snow water content at each vertical layer from 2B31 accumulated in each 0.5° x 0.5° box					
graupelCOMB	Float SDS	4	nlat*nlon*nlayer	0 – 10	g m-3
Graupel water content at each vertical layer from 2B31 accumulated in each 0.5° x 0.5° box					
npixTotalCOMB	Integer SDS	4	nlat*nlon	1 – 10000	-
The monthly number of pixels npixTotalCOMB is used to compute the monthly means described above.					
surfAdjRatio	Float SDS	4	nlat*nlon	-	-
The ratio of 2B31 to 2A12 surface rainfall, calculated from the swath overlap region for each 0.5° x 0.5° box					
surfAdjRatiooverlap	Float SDS	4	nlat*nlon	-	-
The ratio of 2B31 to 2A12 surface rainfall, calculated from the swath overlap region for each 0.5° x 0.5° box					

Notes:

- The "scale by" column was omitted because none of the 3B31 variables are scaled.
- The dimension *nlayer* represents the number of profiling layers per grid box. There are 28 vertical layers (nlayer) that span from 0.5 km to 10 km by 0.5 km and then from 10 km to 18 km by 1 km.

3A46: Special Sensor Microwave Imager Rainfall

Temporal Coverage	Start Date: 1997-12-01 Stop Date: 2015-03-31
Geographic Coverage	Latitude: 90°S – 90°N Longitude: 0° – 360°
Temporal Resolution	Monthly
Horizontal Resolution	1° x 1°; nlat = 80, nlon = 360
Average File Size	≈ 300 KB uncompressed

3A46 Data Format Structure					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-
SSMIdata	Float SDS	4	180*360*2	0 – 100 (1st variable) 0 – 10^9 (2nd variable)	mm hr^{-1}
SSM/I data averaged over 1° x 1° grid boxes and one month. The first variable is Precipitation Rate (mm/hr); the range is 0 to 100. The second variable is Number of Observations; the range is 0 to one billion.					

Note that the grids in SSM/I data are different than the standard TSDIS grids in the following ways:

- the longitude dimension precedes the latitude dimension;
- the longitude index begins at the Greenwich meridian;
- the latitude index begins at the northernmost row;
- the latitude range is -90° to +90°;
- Missing data are given the value of -9999.

3B42: TRMM and Other Satellites Precipitation

Temporal Coverage	Start Date: 1997-12-01 Stop Date: to present
Geographic Coverage	Latitude: 50°S – 50°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	0.25° x 0.25°; nlat = 400, nlon = 1440
Average File Size	≈ 0.71 MB compressed, ≈ 11 MB uncompressed

3B31 Data Format Structure

Name	Type	Record Size (bytes)	Dim Size (# of records)	Range	Unit
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-
precipitation TRMM Multi-satellite precipitation analysis (TMPA) precipitation estimate	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
relativeError TMPA random error estimate	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
satPrecipitationSource Flag to show source of data in each box	Float SDS	4	nlat*nlon	-	-
HQprecipitation Pre-gauge-adjusted microwave precipitation estimate in each grid box.	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
IRprecipitation Pre-gauge-adjusted infrared precipitation estimate in each grid box.	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
satObservationTime Satellite observation time minus the time of the granule in each grid box.	Integer SDS	1	nlat*nlon	-90 – 90	minute

Notes:

- Missing data are given the value of -9999.9.

3B43: TRMM and Other Sources Precipitation

Temporal Coverage	Start Date: 1997-12-01 Stop Date: to present
Geographic Coverage	Latitude: 50°S – 50°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	0.25° x 0.25°; nlat = 400, nlon = 1440
Average File Size	≈ 4.95 MB compressed, ≈ 4.95 MB uncompressed

3B31 Data Format Structure					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-
precipitation Satellite/gauge precipitation estimate	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
relativeError Satellite/gauge random error estimate	Float SDS	4	nlat*nlon	0 – 100	mm hr^{-1}
gaugeRelativeWeighting Gauge relative weighting	Integer SDS	1	nlat*nlon	0 – 100	percent

CSH: Convective and Stratiform Heating

Temporal Coverage	Start Date: 1997-12-01 Stop Date: to present
Geographic Coverage	Latitude: 50°S – 50°N Longitude: 180°W – 180°E
Temporal Resolution	Monthly
Horizontal Resolution	0.5° x 0.5°; nlat = 148, nlon = 720
Average File Size	≈ 8.0 MB uncompressed

3B31 Data Format Structure					
Name	**Type**	**Record Size (bytes)**	**Dim Size (# of records)**	**Range**	**Unit**
ECS Core Metadata ECS core metadata	Char Attribute	10,000	-	-	-
PS Metadata Product specific metadata	Char Attribute	10,000	-	-	-
GridStructure GridStructure gives the specification of the geometry of the grids.	Char Attribute	5,000	-	-	-
LatentHeating Satellite/gauge precipitation estimate	Float SDS	4	nlat*nlon*nlayer	-50 – 100	K hr^{-1}

Note that the layers are the same as those described for 3B31.

4.0 Options for Reading the Data

Examples that show how to read TRMM data files are shown throughout section 4. For the sake of consistency, each example will use TRMM 3B42 3-hourly data from 24 August 2012 at 12 UTC. The name of this file is *3B42.20120824.12.7.HDF.Z* and is described on page 55. This document will focus on the *HQprecipitation* variable. This tutorial assumes that the file is uncompressed, so its name ends in .HDF.

To uncompress the file on a UNIX-based system (including Mac OS X), use the following command: *uncompress 3B42.20120824.12.7.HDF.Z*.

Note that most of the gridded TRMM files do not include latitude or longitude metadata. The bounds for each product are specified in the preceding pages of this README as well as in the descriptions of each HDF file. TRMM data are stored as the center of grid boxes, so for example, 3B42 data that has latitude and longitude bounds of 50°S – 50°N and 180°W – 180°E, respectively, can be represented by a latitude array from -49.875 to +49.875 and a longitude array of -179.875 to +179.875, both with a grid spacing of 0.25.

4.1 Command Line Utilities and Programs

4.1.1 GrADS

The Grid Analysis and Display System (GrADS) is well-suited for the visualization of TRMM data. However, since the TRMM files do not have embedded latitude and longitude data, they are not considered "self-describing". This means that latitude and longitude information must be specified in a separate file for GrADS to correctly interpret the data.

A data descriptor file must be created that tells GrADS information about the latitude and longitude data within the TRMM 3B42 data file. Below are the contents of a sample data descriptor file.

Note that the example below only includes the *precipitation* variable. Simply list other variables underneath (or instead of) the *precipitation* variable to read in different data.

```
DSET 3B42.20120824.12.7.HDF
UNDEF -9999.9
XDEF nlon 1440 LINEAR -179.875 0.25
YDEF nlat  400 LINEAR  -49.875 0.25
TDEF nlat 1 LINEAR 12z24Aug2012 3hr
VARS 1
precipitation=>precip 0 3B42_Precipitation
ENDVARS
```

The following assumes that the contents above are saved in a file called *precip.ctl*. To open GrADS, type *grads* at the system prompt and then choose landscape or portrait mode.

At the GrADS prompt (ga->):

ga->xdfopen precip
Scanning Descriptor File: precip
SDF file 3B42.20120824.12.7.HDF is open as file 1
LON set to 0 360
LAT set to -49.875 49.875
LEV set to 0 0
Time values set: 2012:8:24:12 2012:8:24:12
E set to 1 1

The GrADS output should be the same as the text above in red.

To view an image of the precipitation data, type:
ga-> d precip

To have GrADS shade the data instead of contouring, type:
ga-> gxout shaded
ga-> d precip

If you've already plotted the data with contours, you can clear before plotting the shaded data:
ga-> clear graphics

There are numerous options for customizing plots in GrADS. For more information on using GrADS, or more information on Grads visit http://cola.gmu.edu/grads/.

4.1.2 MATLAB

MATLAB can be used to load, manipulate, and view TRMM precipitation data. To load the *precipitation* variable from the aforementioned TRMM file into MATLAB type:

>> precip = permute(hdfread('3B42.20120824.12.7.HDF','precipitation'),[2 1]);

This will load the data into a matrix called *precip*. Missing data are represented by *-9999.9*, but MATLAB doesn't know that this value refers to missing data. The simplest way to replace the missing numeric values with MATLAB's not-a-number (NaN) values, is to type:

>> precip(precip < 0) = NaN;

It is okay to set all values less than zero to NaN since precipitation rate is a positive quantity. Users with the Mapping Toolbox can plot the precipitation data on a map using the following code:

```
figure;
axesm('MapProjection','eqdcylin','maplatlimit',[-50 50],'maplonlimit',[-180 180],...
   'ParallelLabel','on','PlabelMeridian','west','MeridianLabel','on','MLabelParallel','south',...
   'FontSize',6,'FontWeight','bold','PLineLocation',20,'MLineLocation',20);
latitudes = -49.875:0.25:49.875; % These must be explicitly defined since they are not in the file.
longitudes = -179.875:0.25:179.875;
[latGrid, lonGrid] = meshgrat(latitudes,longitudes);
geoshow(latGrid,lonGrid,double(precip),'DisplayType','texturemap');

caxis([0 5]);

% There are lots of color maps to choose from, run the command "doc colormap" to see them
colormap(flipud(hot(21)));
chandle = colorbar('Location','EastOutside','FontSize',6,'FontWeight','bold'); % This line places the colorbar
set(get(chandle,'ylabel'),'String','Rain Rate (mm/hr)','FontSize',10,'FontWeight','Bold'); % Set the colorbar's label
set(chandle,'YTick',0:5);

% You should plot the continent boundaries after the shading is done.
states = geoshape(shaperead('landareas', 'UseGeoCoords', true));
geoshow(states,'DefaultFaceColor','none','DefaultEdgeColor','k');
tightmap
title('24 August 2012 1200 UTC Rain Rate','FontSize',8,'FontWeight','bold');
print -dpng sampleTRMMmap.png
```

The code above should save a .png file that looks like Figure 1 below.

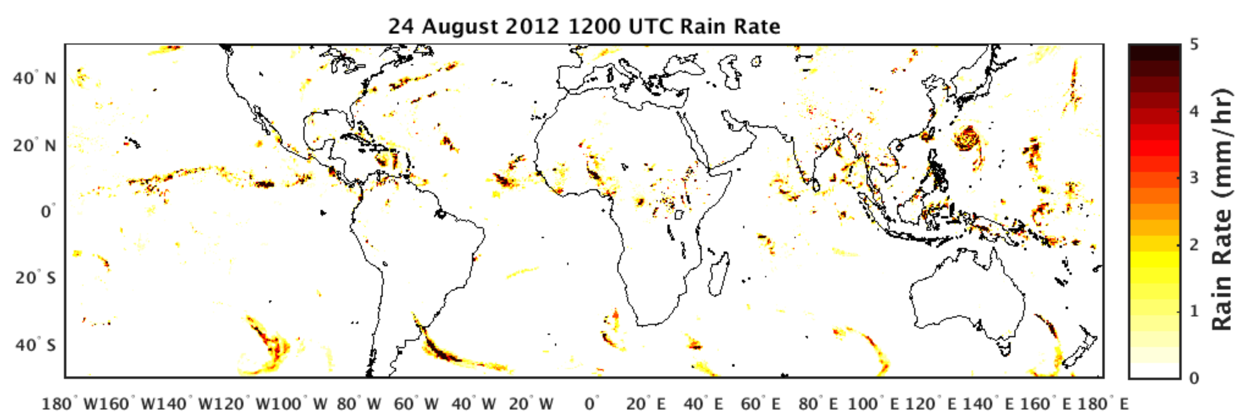

Figure 1. Sample map created in MATLAB showing TRMM 3B42 precipitation data.

4.1.3 Python

Like GrADS and MATLAB, Python can be used to read, manipulate, and plot data. Below is a script that can be used as-is within Python to read and plot the TRMM data. It was written to be as similar to the aforementioned MATLAB script as possible. Please note that you must have the free numpy, matplotlib, basemap, and pyhdf packages to use this script.

```
# This is a test script that reads and plots the TRMM 3B42 3-hourly data.
from mpl_toolkits.basemap import Basemap, cm
import matplotlib.pyplot as plt
import numpy as np
from pyhdf.SD import SD, SDC

dataset = SD('/path/to/3B42.20120824.12.7.HDF', SDC.READ)

precip = dataset.select('precipitation')
precip = precip[:]
precip = np.transpose(precip)

theLats = np.arange(-49.875,50,0.25)
theLons = np.arange(-179.875,180,0.25)

# Set all the missing values less than 0 to NaNs
np.putmask(precip,precip<0,np.nan)

# Plot the figure, define the geographic bounds
fig = plt.figure(dpi=300)
latcorners = ([-50,50])
loncorners = ([-180,180])

m = Basemap(projection='cyl',\
llcrnrlat=latcorners[0],urcrnrlat=latcorners[1],llcrnrlon=loncorners[0],urcrnrlon=loncorners[1])

# Draw coastlines, state and country boundaries, edge of map.
m.drawcoastlines()
m.drawstates()
m.drawcountries()

# Draw filled contours.
clevs = np.arange(0,5.01,0.5)

# Define the latitude and longitude data
x, y = np.float32(np.meshgrid(theLons, theLats))
cs = m.contourf(x,y,precip,clevs,cmap=cm.GMT_drywet,latlon=True)

parallels = np.arange(-50.,51,25.)
m.drawparallels(parallels,labels=[True,False,True,False])
meridians = np.arange(-180.,180.,60.)
m.drawmeridians(meridians,labels=[False,False,False,True])
```

```
# Set the title and fonts
plt.title('24 August 2012 1200 UTC Rain Rate')
font = {'family' : 'normal', 'weight' : 'bold', 'size' : 6}
plt.rc('font', **font)

# Add colorbar
cbar = m.colorbar(cs,location='right',pad="5%")
cbar.set_label('mm/h')

plt.savefig('testTRMMmap.png',dpi=300)
```

The map shown below as Figure 2 results from the Python code above:

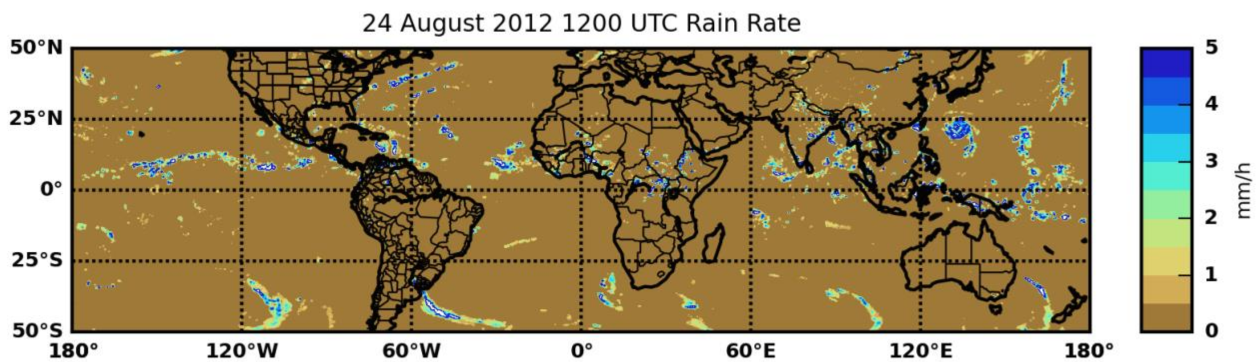

Figure 2. Sample map created in Python using TRMM 3B42 precipitation data.

4.1.4 hdp and ncdump

The HDF Toolkit ships with two binary executables, *hdp* and *ncdump*, that can be used to extract values from any HDF file. These are also available as standalone executable from the utilities folders found within each operating system at: ftp://ftp.hdfgroup.org/HDF/HDF_Current/bin.

ncdump can only read HDF files if your local copy of netCDF was originally compiled with HDF support.

To dump the entire file: *hdp <filename>* or *ncdump <filename>*

To get just the header information: *hdp dumpsds -h <filename>* or *ncdump -h <filename>*

A partial example of output from *hdp dumpsds -h 3B42.20120824.12.7.HDF* is given below. (The *ncdump -h* output is similar.)

```
File attributes:
        Attr0: Name = FileHeader
                Type = 8-bit signed char
                Count= 357
                Value = AlgorithmID=3B42;\012AlgorithmVersion=3B4
               2_7.0;\012FileName=3B42.20120824.12.7.HDF
               ;\012GenerationDateTime=2012-10-26T14:07:
               33.000Z;\012StartGranuleDateTime=2012-08-
               24T10:30:00.000Z;\012StopGranuleDateTime=
               2012-08-24T13:29:59.999Z;\012GranuleNumbe
               r=;\012NumberOfSwaths=0;\012NumberOfGrids
               =1;\012GranuleStart=;\012TimeInterval=3_H
               OUR;\012ProcessingSystem=PPS;\012ProductV
               ersion=7;\012MissingData=;\012
        Attr1: Name = FileInfo
                Type = 8-bit signed char
                Count= 253
                Value = DataFormatVersion=m;\012TKCodeBuildVersio
               n=1;\012MetadataVersion=m;\012FormatPacka
               ge=HDF Version 4.2 Release 4, January 25,
                2009;\012BlueprintFilename=TRMM.V7.3B42.
               blueprint.xml;\012BlueprintVersion=BV_13;
               \012TKIOVersion=1.6;\012MetadataStyle=PVL
               ;\012EndianType=LITTLE_ENDIAN;\012
        Attr2: Name = GridHeader
                Type = 8-bit signed char
                Count= 231
                Value = BinMethod=ARITHMETIC_MEAN;\012Registratio
               n=CENTER;\012LatitudeResolution=0.25;\012
               LongitudeResolution=0.25;\012NorthBoundin
               gCoordinate=50;\012SouthBoundingCoordinat
               e=-50;\012EastBoundingCoordinate=180;\012
               WestBoundingCoordinate=-180;\012Origin=SO
               UTHWEST;\012

Variable Name = precipitation
        Index = 0
        Type= 32-bit floating point
        Ref. = 2
        Compression method = NONE
        Rank = 2
        Number of attributes = 1
        Dim0: Name=nlon
                Size = 1440
                Scale Type = number-type not set
                Number of attributes = 0
        Dim1: Name=nlat
                Size = 400
                Scale Type = number-type not set
                Number of attributes = 0
        Attr0: Name = units
                Type = 8-bit signed char
```

Count= 5
Value = mm/hr

... and so on ... This will list all of the variables in the same manner.

4.2 Tools/Programming

This section briefly explains some programs and websites that can be used for TRMM data access, manipulation, and viewing.

ncdump

The ncdump tool can be used as a simple browser for HDF data files, to display the dimension names and sizes; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables in a netCDF file. The most common use of ncdump is with the –h option, in which only the header information is displayed.

Command line syntax: ncdump [-c|-h] [-v ...] [[-b|-f] [c|f]] [-l len] [-n name] [-d n[,n]] filename
Options/Arguments:
[-c] Coordinate variable data and header information
[-h] Header information only, no data
[-v var1[,...]] Data for variable(s) <var1>,... only data
[-f [c|f]] Full annotations for C or Fortran indices in data
[-l len] Line length maximum in data section (default 80)
[-n name] Name for netCDF (default derived from file name)
[-d n[,n]] Approximate floating-point values with less precision filename File name of input netCDF file

Note: the ncdump tool will only display variables whose ranks are great than 1. In other words, you will not see one dimensional vectors such as *satheight* using this tool.
The ncdump program can be found in bin directory of the HDF installation area. Consult your local computer system administrator for the specifics.

hdp

The hdp utility is a HDF dumper developed by HDF group at NCSA.

Command line syntax: hdp [-H] command [command options] <filelist>
-H Display usage information about the specified command.
If no command is specified, -H lists all commands.
Commands:
list lists contents of files in <filelist>

dumpsds displays data of SDSs in <filelist>
dumpvd displays data of vdatas in <filelist>.
dumpvg displays data of vgroups in <filelist>.
dumprig displays data of RIs in <filelist>.
dumpgr displays data of RIs in <filelist>.

Giovanni

TRMM data can be found on NASA's data visualization website called Giovanni at https://giovanni.gsfc.nasa.gov/giovanni/. Giovanni allows users to create maps, animations, hovmöller diagrams, vertical cross sections, and more using a number of TRMM products including the 3B42, 3B43, and 3A12 products.

HDFView

HDFView is a Java based graphical user interface created by the HDF Group, which can be used to browse TRMM HDF files. HDFView allows users to view all objects in the HDF file hierarchy, which is represented as a tree structure. It also allows users to browse the data within each variable.

HDFView download and documentation can be found at: https://www.hdfgroup.org/products/java/hdfview/.

5.0 Data Services

You can familiarize yourself with TRMM data at: https://disc.gsfc.nasa.gov/datasets?project=TRMM.

Once you know which data you want, you can use the following services:

OPeNDAP

Many TRMM products can be found on the GES DISC OPeNDAP website: https://disc2.gesdisc.eosdis.nasa.gov/opendap/. OPeNDAP allows users to access and manipulate subsets of data without downloading the entire files.

If you need assistance or would like to report a problem:

Email: gsfc-dl-help-disc at mail.nasa.gov
Voice: 301-614-5224
Fax: 301-614-5268

Address:
Goddard Earth Sciences Data and Information Services Center
NASA Goddard Space Flight Center
Code 610.2
Greenbelt, MD 20771 USA

6.0 More Information

The TRMM mission website is located at: https://pmm.nasa.gov/trmm.

Information on the TRMM instruments can be found at: https://pmm.nasa.gov/TRMM/trmm-instruments.

The GES DISC TRMM information portal can be found at:

https://disc.gsfc.nasa.gov/information/glossary?title=TRMM

TRMM Version 7 File Specifications:
https://pps.gsfc.nasa.gov/Documents/filespec.TRMM.V7.pdf

TRMM Anomalous Granule Table:
ftp://gpmweb2.pps.eosdis.nasa.gov/tsdis/AB/docs/anomalous.html

Other TRMM documents: http://pps.gsfc.nasa.gov/ppsdocuments.html

J. Simpson, Adler, R.F., and North, G.R., 1988: A proposed tropical rainfall measuring mission (TRMM) satellite. *Bull. Amer. Meteor. Soc.*, **69**, 278–295. (Link)

C. Kummerow, Barnes, W., Kozu, T., Shiue, J., Simpson, J, 1998: The tropical rainfall measuring mission (TRMM) sensor package. *J. Atmos. Oceanic Technol.*, **15**, 809–817. (Link)

Liu, Z. D. Ostrenga, W. Teng and S, Kempler, 2012, Tropical Rainfall Measuring Mission (TRMM) Precipitation Data Services for Research and Applications, Bulletin of the American Meteorological Society, doi: http://dx.doi.org/10.1175/BAMS-D-11-00152.1 (Link)

7.0 Acknowledgements

The distribution of the TRMM dataset is funded by NASA's Science Mission Directorate.

Much of the information in this Readme document is from the Precipitation Measurement Mission (https://pmm.nasa.gov/) and the Precipitation Processing System (https://pps.gsfc.nasa.gov/) websites.