GPM precipitation feature database

Description Version 1.0

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1. Introduction

The Global Precipitation Mission (GPM, Hou et al., 2014) is a joint mission between NASA and the National Space Development Agency (NASDA) of Japan designed to monitor and study global precipitation. Onboard instruments including Dual frequency Precipitation Radar (DPR) and GPM Microwave Imager (GMI) provide invaluable measurements of precipitation and atmosphere.

One direction of our research is to generalize the Precipitation Features (PFs) from satellite measurements and study the radar and passive microwave characteristics of precipitating systems on Earth. The idea of PF was first introduced in late 1990s by using the passive microwave brightness temperature observations from SSMI satellites (Mohr and Zipser, 1996). Later, using observations from Tropical Rainfall Measuring Mission (Kummerow et al. 1998), a more descriptive database was created (Nesbitt et al. 2000) and then upgraded (Liu et al. 2008). The TRMM PF database has been widely used in scientific research, including rainfall estimates validation (Nesbitts et al., 2004), diurnal cycle of precipitation systems (Nesbitt and Zipser, 2003), global distribution of storms with LIS-detected lightning (Cecil et al., 2005), deep convection reaching the tropical tropopause layer (Liu and Zipser, 2005), rainfall production and convective organization (Nesbitt et al. 2006), and the categorization of extreme thunderstorms by their intensity proxies (Zipser et al., 2006) etc. Current version of TRMM PF database is the newest development based on the TRMM product version 7 that reprocessed in 2012. Following the same research track, a similar database from GPM observations has been built.

After the successful launch in February 2014, GPM satellite has been collecting observations globally. Following the heritage of the TRMM PF database, the GPM precipitation feature database has been developed at Texas A&M –Corpus Christi in collaboration with Dr. Zipser at the University of Utah and Dr. Cecil at NASA MSFC. This database includes GPM DPR and GMI precipitation estimates and radar vertical structure inside and outside the DPR swath in precipitation features. This document describes the GPM precipitation database construction procedures and output parameters in two levels of processing as shown in Figure 1.

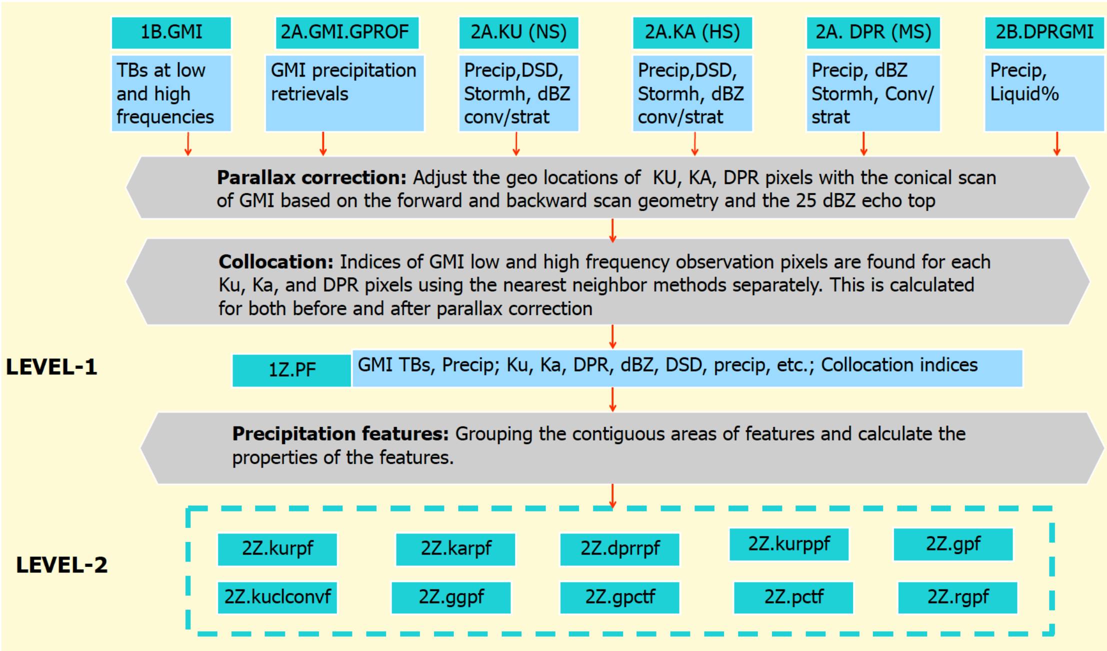

Figure 1. Flow chart of three levels of the GPM precipitation feature database.

2. Level-1

As shown in Figure 1, level-1 data are produced with a combination of six various GPM products from Ku, Ka, DPR and GMI in orbital granules after GMI-DPR parallax correction and GMI-Ku-Ka-DPR nearest neighbor collocation. Where precipitation rate in DPRGMI combined algorithm is also incorporated. The output data is saved in compressed HDF-4 format for each satellite orbit. The details of these procedures and calculated parameters are introduced in this section.

2.1 Collocation between GMI and Ku, Ka, and DPR

The orbital brightness temperature data stored in 1B.GMI have two sets of geo-locations. One is on the low frequency at 10, 19, 21, 36, 89 GHz channels. Another is on the high frequency at 165 and 183 channels. Since Ku, Ka and DPR has three different geo-locations for swaths at normal swath (Ku), matched swath (Ku, DPR) and high resolution swath (Ka only), the collocation is quite complicated between GMI and DPR. We performed six different collocations from GMI-high vs. Ku, GMI-low vs. Ku, GMI-high vs. Ka, GMI-low vs. Ka, GMI-high vs. DPR, and GMI-low vs. DPR. The collocations between DPR and GMI are performed only inside DPR swath. The idea is not interpolating the pixels to DPR coordinates. Rather, we assign a GMI pixel to each DPR pixel. The method of “ the nearest neighbor” is applied to assign these GMI pixels. As the result, each DPR pixel has a corresponding GMI pixel. Then we save the indices of these GMI pixels for future use. Since we have six different collocations, six sets of collocation indices are saved in a data struction Colo.

2.2 Parallax correction

Because GMI scans with 52° conical angle and DPR scans nadir, there could be a problem if the microwave scattering signals are from elevated hydrometeors, such as high convective cells. For this reason, in the past approach (before 2008), we used a simple parallax correction method that simply move the GMI data coordinates data backwards for one scan shown as Figure 2. After this correction, there are better correspondences between DPR and GMI measurements for high convective cells. However, the correspondences between DPR and GMI for shallow precipitations become worse because of the overcorrection. This could lead to problems when calculate the microwave scattering properties inside a shallow precipitation system defined by DPR surface precipitation area. So in the current version, the parallax correction only made for the pixels with DPR ku echo top height > 5 km and path integrated attenuation > 0.4 dBZ. In this way, the overcorrection for the shallow precipitations is avoided.

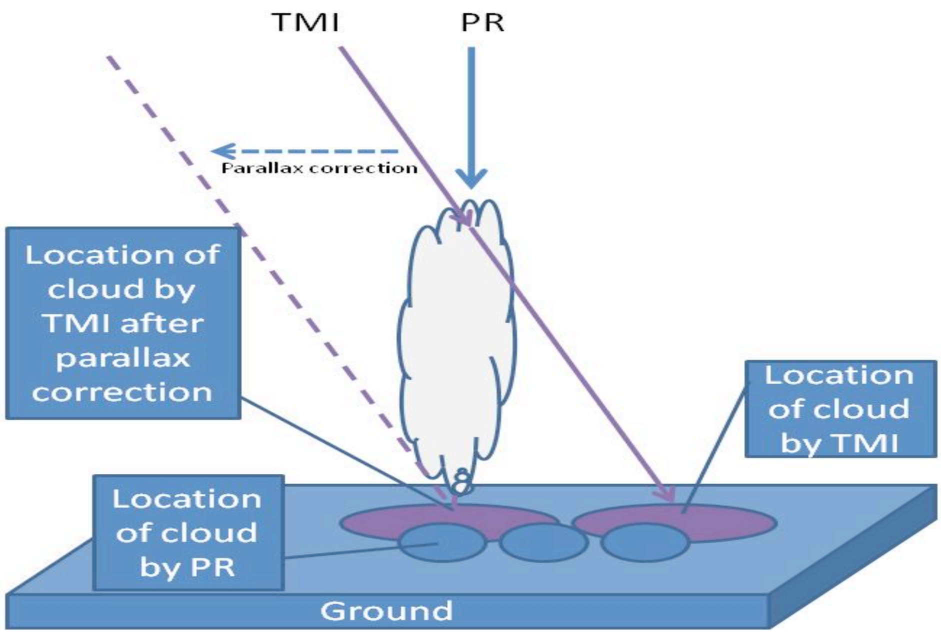

Figure 2. Schematic diagram of parallax correction for TRMM. The similar scenario applies for GPM DPR and GMI as well.

2.3 Re-collocation after the parallax correction

After the parallax correction, we redo the collocation to make the matching between passive microwave and radar more realistic. To make this flexible to the users, current version includes both collocation indices before and after the parallax correction.

2.4 Output parameters

We have chosen some interesting parameters from 1B.GMI, 2A.GMI, 2A.DPR, 2A.Ku, 2A.Ka, 2B.DPRGMI, and some derived parameters for storing into the level-1 products. These parameters include:

Parameters from 1B.GMI and 2A.GMI

LAT	FLOAT	Array[221, 2961]	Latitude of low freq TBs
LON	FLOAT	Array[221, 2961]	Longitude of low freq TBs
TB	FLOAT	Array[9, 221, 2961]	TBs at low frequency
DAY	BYTE	Array[2961]	Day
HOUR	BYTE	Array[2961]	Hour
MINUTE	BYTE	Array[2961]	Minute
MONTH	BYTE	Array[2961]	Month
SECOND	BYTE	Array[2961]	Second
YEAR	INT	Array[2961]	YEAR
ORIENT	INT	Array[2961]	Orientation
QUALITY	BYTE	Array[2961]	Quality of TBs
HITB	FLOAT	Array[4, 221, 2961]	High frequency TBs
HIQUALITY	BYTE	Array[2961]	Quality of high freq TBs
HILAT	FLOAT	Array[221, 2961]	Latitude of high freq TBs
HILON	FLOAT	Array[221, 2961]	Longitude of high freq TBs
PCT85	FLOAT	Array[221, 2961]	Polarization Corrected 89 GHz
PCT37	FLOAT	Array[221, 2961]	Polarization correction 37 GHz
PRECIP	FLOAT	Array[221, 2961]	Surface precipitation retrieval
FRLIQ	FLOAT	Array[221, 2961]	Fraction of liquid
PROB	FLOAT	Array[221, 2961]	Probability of Precip
IWP	FLOAT	Array[221, 2961]	Ice water Path
RWP	FLOAT	Array[221, 2961]	Rain water path
CWP	FLOAT	Array[221, 2961]	Cloud water path
FRCONV	FLOAT	Array[221, 2961]	Convective fraction
SFCTYPE	BYTE	Array[221, 2961]	Surface type
MLPRECIP	FLOAT	Array[221, 2961]	Melting level Precip
RETRQUAL	BYTE	Array[221, 2961]	retrieval quality

Parameters from 2A.Ku

LAT	FLOAT	Array[49, 7930]	Latitude
LON	FLOAT	Array[49, 7930]	Longitude
PRECIPTYPE	LONG	Array[49, 7930]	Precipitation type
STORMHT	FLOAT	Array[49, 7930]	Echo top height
DSD	FLOAT	Array[2, 176, 49, 7930]	DSD parameter
PHASE	BYTE	Array[49, 7930]	Phase
PIA	FLOAT	Array[49, 7930]	Path integrated attenuation
PRECIP	FLOAT	Array[176, 49, 7930]	Precipitation retrievals
ESPRECIP	FLOAT	Array[49, 7930]	Estimated surface precip
NSPRECIP	FLOAT	Array[49, 7930]	Near surface precip
DBZ	FLOAT	Array[176, 49, 7930]	Reflectivity profiles

NSZ	FLOAT	Array[49, 7930]	Near surface reflectivity
DAY	BYTE	Array[7930]	
HOUR	BYTE	Array[7930]	
MINUTE	BYTE	Array[7930]	
MONTH	BYTE	Array[7930]	
SECOND	BYTE	Array[7930]	
YEAR	INT	Array[7930]	
QUALITY	BYTE	Array[7930]	Quality of the retrieval

Parameters from 2A.Ka

LAT	FLOAT	Array[24, 7930]	Latitude
LON	FLOAT	Array[24, 7930]	Longitude
PRECIPTYPE	LONG	Array[24, 7930]	Precipitation type
STORMHT	FLOAT	Array[24, 7930]	Echo top height
DSD	FLOAT	Array[2, 88, 24, 7930]	DSD parameters
PHASE	BYTE	Array[24, 7930]	water phase
PIA	FLOAT	Array[24, 7930]	Path integrated attenuation
PRECIP	FLOAT	Array[88, 24, 7930]	Precipitation retrieval
ESPRECIP	FLOAT	Array[24, 7930]	estimated surface precip
NSPRECIP	FLOAT	Array[24, 7930]	Near surface precip
DBZ	FLOAT	Array[88, 24, 7930]	reflectivity profile
NSZ	FLOAT	Array[24, 7930]	near surface reflectivity
DAY	BYTE	Array[7930]	
HOUR	BYTE	Array[7930]	
MINUTE	BYTE	Array[7930]	
MONTH	BYTE	Array[7930]	
SECOND	BYTE	Array[7930]	
YEAR	INT	Array[7930]	
QUALITY	BYTE	Array[7930]	Quality of the retrieval
MS_NSZ	FLOAT	Array[25, 7930]	matched swath near surface Z
MS_NSPRECIP	FLOAT	Array[25, 7930]	matched swath near surface precip
MS_ESPRECIP	FLOAT	Array[25, 7930]	matched swath estimate surf precip
MS_PIA	FLOAT	Array[25, 7930]	matched swath PIA
MS_PRECIPTYPE	LONG	Array[25, 7930]	matched swath precip type
MS_STORMHT	FLOAT	Array[25, 7930]	matched swath echo top height
MS_PHASE	BYTE	Array[25, 7930]	matched swath phase
MS_PRECIP	FLOAT	Array[176, 25, 7930]	matched swath Ka precip
MS_DSD	FLOAT	Array[2, 176, 25, 7930]	matche swath ka DSD

Parameters from 2A.DPR and 2B.DPRGMI :

LAT	FLOAT	Array[25, 7930]	Latitude
LON	FLOAT	Array[25, 7930]	Longitude
PRECIPTYPE	LONG	Array[25, 7930]	Precip type

```
DSD            INT      Array[5, 25, 7930]   DSD parameter
STORMHT        FLOAT    Array[25, 7930]   Echo top height
PHASE          BYTE     Array[25, 7930]   phase
PIA            FLOAT    Array[25, 7930]   path integrated attenuation
ESPRECIP       FLOAT    Array[25, 7930]   Estimated surface precip
NSPRECIP       FLOAT    Array[25, 7930]   Near surface precip
DBZ            FLOAT    Array[176, 25, 7930]   reflectivity profiles
NSZ            FLOAT    Array[25, 7930]   near surface reflectivity
DAY            BYTE     Array[7930]
HOUR           BYTE     Array[7930]
MINUTE         BYTE     Array[7930]
MONTH          BYTE     Array[7930]
SECOND         BYTE     Array[7930]
YEAR           INT      Array[7930]
QUALITY        BYTE     Array[7930] Quality of the retrievals
PRECIP2B       FLOAT    Array[25, 7930]  2B.DPRGMI combined precip
FRLIQ2B        FLOAT    Array[25, 7930]  fraction of liquid from 2B.DPRGMI
```

*Detail description of the each parameter see File specification for GPM product version 1.07 TKIO 3.60.4

Parameters from colo and colohi share the same data structure, but one for collocation to the low frequencies (10-89 GHz), colohi is for collocation to the high frequencies (165, 183 GHz)

```
KU             LONG     Array[49, 7931]  collocation to Ku pixels
KA             LONG     Array[24, 7931]  collocation to Ka pixels
DPR            LONG     Array[25, 7931]  Collocation to matched DPR pixels
PKU            LONG     Array[49, 7931] Colo to Ku after the parallax correction
PKULON         FLOAT    Array[49, 7931]  new lon after parallax correction
PKULAT         FLOAT    Array[49, 7931]  new lat after parallax correction
PKA            LONG     Array[24, 7931] colo to Ka afer the parallax correction
PKALON         FLOAT    Array[24, 7931]  new lon after parallax correction
PKALAT         FLOAT    Array[24, 7931]  new lat after parallax correction
PDPR           LONG     Array[25, 7931] colo to matched pixel after P correct
PDPRLON        FLOAT    Array[25, 7931]  new lon after parallax correction
PDPRLAT        FLOAT    Array[25, 7931]  new lat after parallax correction
```

Above parameters are saved into "HDF4" format with naming rules as "1Z.GPM.DPRGMI.PF.yymmdd-starttime-endtime.orbit.version.HDF", and there is an IDL program "hdf_2_struct.pro" for access these level-1 files.

3. Level-2

The first step to create the level-2 data is to define the features. The definitions of the precipitation features are either based on the DPR swath or GMI swath (Figure 2).

	Definitions of precipitation features
Kurpf	area with Ku near surface precipitation rate > 0 (Normal Swath)
karpf	area with Ka near surface precipitation rate > 0 (High Resolution Swath)
dprrpf	area with DPR near surface precipitation rate > 0 (Matched swath)
kurppf	area with Ku dBZ > 10 dBZ in the column (Ku normal swath)
gpf	area with GMI precipitation rate > 0.1 mm/hr (Ku normal swath)
kuclconvf	area with Ku convective precipitation (Normal swath)
rgpf	area with either Ku precipitation rate > 0 or GMI precipitation rate > 0.1 mm/hr (Ku NS)
ggpf	area with GMI precipitation rate > 0.1 mm/hr (GMI swath)
gpctf	area with GMI 85 GHz Polarization corrected temperature < 250 K (GMI swath)

Figure 2. Definitions of GPM precipitation features

3.1 Definitions

Figure 2 lists current precipitation feature definitions. Kurpf, Karpf, and DPRrpf are defined based on the contiguous pixels with non zero precipitation rate (here > 0.1mm/hr is used) from Ku, Ka, and DPR retrievals. Kurppf is based on the projected area with any radar echo in the column. gpf is based on the GMI precipitation inside Ku swath. Rgpf and kuclconf are designed to assess the performance of retrievals and the convective regions for storms. Ggpf is the GMI precipitation feature in GMI swath. Gpctf is defined with area of GMI 89GHz Polarization Corrected Temperature (PCT, Spence et al., 1989) colder than 250 K.

3.2 Parameters

After grouping the pixels with different criteria, the indices of pixels for each feature are identified within PF swath from collocated level-1 data. Using these indices, the total number of pixels, maximum echo tops, and minimum brightness temperatures inside features are calculated and saved as level-2 product.

	Properties for each precipitation feature
Geo location	Location, time, size
Precipitation	Volumetric precipitation from Ku, Ka, DPR, GMI. Maximum precipitation rate
Intensity	Maximum 20, 30, 40 dBZ echo top heights; Minimum 37, 85 GHz PCT, 183 TB etc.
Vertical structure	Maximum reflectivity at 40 levels with 0.5 km interval, number of pixels with > 20, 30, 40 dBZ at 16 levels with 1 km interval
Morphology	Ellipse fit to the feature, center location, major, minor axis, orientation, solidity

The parameters for each feature in level-2 product are listed below:

For features defined in radar swath:

Orbit	Orbit number
Grpnum	Group number in the orbit
Year	Year
Month	Month
Day	Day
Hour	Float number of hour in UTC
Lat	Geographical center latitude (degree)
Lon	Geographical center longitude (degree)
Altrk	Along track center location (# pixels)
actrk	Cross track center location (#pixels)
Elev	Ground elevation (m)
Npixels	Number of radar pixels with precipitation (#)
Npixels_20dbz	Number of radar pixels with 20dbz (#)
Npixels_gmi	Number of GMI pixels (#)
Nrainpixels_dpr	Number of DPR pixels with precip (#)
Nrainpixels_ku	Number of Ku pixels with precip (#)
Nrainpixels_ka	Number of Ka pixels with precip (#)
Nrainpixels_gmi	Number of GMI pixels with precip (#)
Volrain_DPR	Volumetric precip from DPR (km^2mm/hr)
Volrain_Ku	Volumetric precip from Ku (km^2mm/hr)
Volrain_Ka	Volumetric precip from Ka (km^2mm/hr)
Volraines_DPR	Estimate surfaceVol precip from DPR (km^2mm/hr)
Volraines_Ku	Estimate surface Vol precip from Ku (km^2mm/hr)
Volraines_Ka	Estimate surface Vol precip from Ka (km^2mm/hr)
Volrain_20dBZ	Volumetric precip from 20 dBZ area (km^2mm/hr)
Volrain_GMI	Volumetric precip from GMI inside PF (km^2mm/hr)
Min85pct	Minimum 89 GHz polarization correction TB (K)
Min85pctlat	Latitude at the min value location
Min85pctlon	Longitude at the min value location
Min37pct	Minimum 37 GHz polarization correction TB (K)
Min37pctlat	Latitude at the min value location
Min37pctlon	Longitude at the min value location
Min1833	Minimum 183+-3 GHz TB (K)
Min1838	Minimum 183+-8 GHz TB (K)
Min165H	Minimum 165 GHz H polarization TB (K)
Min165V	Minimum 165 GHz V polarization TB (K)
V23atmin37	23 GHz TB at min 37 PCT location (K)
V19atmin37	19V GHz TB at min 37 PCT location (K)
H19atmin37	19H GHz TB at min 37 PCT location (K)
V10atmin37	10V GHz TB at min 37 PCT location (K)
H10atmin37	10H GHz TB at min 37 PCT location (K)

Nlt275	Number of radar pixels with 89 GHz PCT < 275 K (#)
Nlt250	Number of radar pixels with 89 GHz PCT < 250 K (#)
Nlt225	Number of radar pixels with 89 GHz PCT < 225 K (#)
Nlt200	Number of radar pixels with 89 GHz PCT < 200 K (#)
Nlt175	Number of radar pixels with 89 GHz PCT < 175 K (#)
Nlt150	Number of radar pixels with 89 GHz PCT < 150 K (#)
Nlt125	Number of radar pixels with 89 GHz PCT < 125 K (#)
Nlt100	Number of radar pixels with 89 GHz PCT < 100 K (#)
Maxnsz	Maximum near surface reflectivity (dBZ)
Maxnsprecip	Maximum near surface precip rate (mm/hr)
Maxnsz_Ku	Maximum Ku near surface reflectivity (dBZ)
Maxnsz_Ka	Maximum Ka near surface reflectivity (dBZ)
Maxnsprecip_Ku	Maximum Ku near surface precip rate (mm/hr)
Maxnsprecip_Ka	Maximum Ka near surface precip rate (mm/hr)
Maxnsz_lon	Longitude of location with maximum NSZ
Maxnsz_lat	Latitude of location with maximum NSZ
N20dbz	Profile of number of 20 dBZ in PF (#)
N25dbz	Profile of number of 25 dBZ in PF (#)
N30dbz	Profile of number of 30 dBZ in PF (#)
N35dbz	Profile of number of 35 dBZ in PF (#)
N40dbz	Profile of number of 40 dBZ in PF (#)
N45dbz	Profile of number of 45 dBZ in PF (#)
N50dbz	Profile of number of 50 dBZ in PF (#)
Maxdbz	Profile of Maximum reflectivity (dBZ)
Maxht	Maximum height with 15 dBZ echo (km)
Maxhtlon	Longitude of maxht location
Maxhtlat	Latitude of maxht location
Maxht15	Maximum height with 15 dBZ echo (km)
Maxht20	Maximum height with 20 dBZ echo (km)
Maxht20lon	Longitude of maxht20 location
Maxht20lat	Latitude of maxht20 location
Maxht30	Maximum height with 30 dBZ echo (km)
Maxht30lon	Longitude of maxht 30 location
Maxht30lat	Latitude of maxht30 location
Maxht40	Maximum height with 40 dBZ echo (km)
Maxht40lon	Longitude of maxht40 location
Maxht40lat	Latitude of maxht40 location
Landocean	0: over ocean. 1: over land
Nstrat_dpr	Number of pixels with stratiform rainfall (#)
Nconv_dpr	Number of pixels with convective rainfall (#)
Rainstrat_dpr	Stratiform volumetric rain (km^2mm/hr)
Rainconv_dpr	Convective volumetric rain (km^2mm/hr)
Nstrat_ku	Number of pixels with stratiform rainfall (#)

Nconv_ku	Number of pixels with convective rainfall (#)
Rainstrat_ku	Stratiform volumetric rain (km^2mm/hr)
Rainconv_ku	Convective volumetric rain (km^2mm/hr)
Nstrat_ka	Number of pixels with stratiform rainfall (#)
Nconv_ka	Number of pixels with convective rainfall (#)
Rainstrat_ka	Stratiform volumetric rain (km^2mm/hr)
Rainconv_ka	Convective volumetric rain (km^2mm/hr)
R_lon*	Center location longitude of fitted ellipse
R_lat	Center location latitude of fitted ellipse
R_major	Major axis of ellipsis (km)
R_minor	Minor axis of ellipsis (km)
R_orientation	Orientation angle (degree)
R_solid	Percentage filled by rainfall area

The morphology of the feature can be represented by major, minor axes, orientation angle of fitted ellipse. Here R_xxx are the parameters fitted for whole feature

All the calculated parameters for each one of PFs are saved in a Level-2 product file in "HDF format" for each orbit with naming rules as "2Z.GPM.DPRGMI.yymmdd-starttime-endtime.orbit.version.HDF". There is an IDL program "read_sds.pro" for accessing these level-2 files.

Because there are about 15 orbits per day, it is difficult to build statistics by accessing many files at the same time. The orbital level-2 files were combined monthly for convenience. The monthly combined files are compatible to the level-2 products and can be accessed through the same reading program.

3.8 Parameters from ERA-Interim analysis

Because of better reputation and higher horizontal resolution of ERA-Interim analysis, we have decided to use ERA-Interim analysis to provide the large scale environment for precipitation features in the algorithm. The vertical profiles are temporally interpolated from 6 hourly ERA-Interim data, then the nearest neighbor method is used to pick the profiles from closest grid. The parameters include:

T	Temperature
HGT	Geopotential height
RH	Relative humidity
U	U
V	V
W	Omega
SFC_SP	Surface pressure
SFC_TCWV	Total column water vapor

SFC_10U	10 m U wind
SFC_10V	10 m V wind
SFC_2T	2 m temperature
SFC_2D	2 m dew point
SFC_TCO3	Total column ozone
SFC_SKT	Skin temperature

The 10 levels of profiles are selected from original 38 levels. The pressure levels are: 1000,975,925,850,700,500,400,300,200,100. Currently only profiles for Kurpf are available. However, more will be added to other definitions in the future

4. Level-3

One important application of level-2 feature data is to generate the climatology of precipitation, convective intensity etc. Level-3 product is just an example and application of generating the physically meaningful statistics from GPM precipitation features. This dataset is still under development at the moment.

Acknowledgements

Courtesy of Dr. Erich Stocker, all level-1 and old level-2 PF are being processed by PPS in near real time. The monthly combination, ERA-Interim reanalysis profiles extraction, and level-3 data processing are completed at Texas A&M University-Corpus Christi.

5. References

Recent literatures using the GPM PF database:

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Liu, C., and E. Zipser, 2015: The global distribution of largest, deepest and strongest precipitation systems, *Geophys. Res. Lett.*, **42**, doi:10.1002/2015GL063776.

Past literatures related to TRMM PF database:

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Nesbitt, S.W., and E.J.Zipser, 2003: The diurnal cycle of rainfall and convective intensity according to three years of TRMM measurements. J. Climate, 16 (10), 1456-1475

Nesbitt, S.W., E.J. Zipser, and C.D. Kummerow, 2004: An examination of Version-5 rainfall estimates from the TRMM Microwave Imager, Precipitation Radar, and rain gauges on global, regional, and storm scales. *J. Appl. Meteor.,* **43**, 1016-1036.

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Spencer, R. W., H. G. Goodman, and R. E. Hood, 1989: Precipitation retrieval over land and ocean with the SSM/I: identification and characteristics of the scattering signal. *J. Atmos. Oceanic Tech.*, **6**, 254-273.

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6. Appendix

A. Website and access

There is an old website providing access the level-2 products of TRMM databse during 1998-2014
http://trmm.chpc.utah.edu/

A new website has been built and provides access to all the dataset described above.
http://atmos.tamucc.edu/trmm/

All TRMM and GMP PF data are available at:
http://atmos.tamucc.edu/trmm/data/

B. Reading programs

hdf_2_struct.pro
This program reads Level-1 GPM PF data.
Usage:
IDL > hdf_2_struct,'1Z.GPM.DPRGMI.xxxxxxxxx.xxxxxx.x.HDF',f
Here f is a structure storing all the level-1 variables.

Read_sds.pro
This program reads all the science data from HDF-4 format file and save into a structure. This program can be used to access level-2 products with new definitions and all level-3 products.
Usage example:
IDL> read_sds,'example.HDF',f ; f is a structure variable with all the parameters

Read_sds_one.pro
This program reads in one variable from HDF-4 format file
Usage:
IDL> read_sds_one,'example.HDF','var1',var

All these IDL programs can be downloaded at:
http://atmos.tamucc.edu/trmm/software/