Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA)

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Data Format Description for
Global Rainfall Map in Near Real Time (GSMaP_NRT) and Gauge-calibrated Rainfall Product (GSMaP_Gauge_NRT) Version 6 & 7

This document describes data format and information of Global Rainfall Map in Near Real Time (hereafter refers as GSMaP_NRT) for algorithm version 6 and 7 distributed from JAXA Global Rainfall Watch, and Gauge-calibrated Rainfall Product (GSMaP_Gauge_NRT), which was developed based on activities of the GSMaP (Global Satellite Mapping of Precipitation) project. Since 2007, GSMaP project activities are promoted by the JAXA Precipitation Measuring Mission (PMM) Science Team.

1. Product Overview

Table 1 Summary of GSMaP_NRT Products

No	Parameter [unit]	Data format	Coverage	Grid size	Horizontal resolution	Temporal resolution	FTP directory
1	Hourly Rain Rate [mm/hr]	4-byte float plain binary, little-endian	Global (60°N-60°S)	3600 x 1200	0.1 x 0.1 degree grid box	Hourly	Latest 24-hr: /realtime_ver/**VV**/latest/ Archive: /realtime_ver/**VV**/hourly/**YYYY**/**MM**/**DD**/ (same as /realtime_ver/**VV**/archive)
2	Satellite Information Flag	4-byte singed integer plain binary, little-endian					/realtime_ver/**VV**/sateinfo/**YYYY**/**MM**/**DD**/
3	Observation Time Flag	4-byte float plain binary, little-endian					/realtime_ver/**VV**/timeinfo/**YYYY**/**MM**/**DD**/
4	Reliability Flag	1-byte integer plain binary					/realtime_ver/**VV**/reliability/**YYYY**/**MM**/**DD**/
5	Hourly Gauge-calibrated Rain Rate [mm/hr]	4-byte float plain binary, little-endian					Latest 24-hr: /realtime_ver/**VV**/latest/ Archive: /realtime_ver/**VV**/hourly_G/**YYYY**/**MM**/**DD**/
6	Hourly Rain Rate & Gauge-calibrated Rain Rate in text format [mm/hr]	ASCII, CSV format	Divided to 15 areas	--			/realtime_ver/**VV**/txt/**XX_ZZZZZZ**/**YYYY**/**MM**/**DD**/
7	Daily Rainfall in 0.25-deg [mm/hr]	4-byte float plain binary, little-endian	Global (60°N-60°S)	1440 x 480	0.25 x 0.25 degree grid box	Daily (averaged from 00Z to 23Z of the specified day)	/realtime_ver/**VV**/daily/00Z-23Z/**YYYYMM**/
8						Daily (averaged from 12Z of	/realtime_ver/**VV**/daily/p12Z-11Z/**YYYYMM**/

						previous day to 11Z of the specified day)	
9	Gauge-calibrated Rainfall in 0.25-deg [mm/hr]	4-byte float plain binary, little-endian	Global (60°N-60°S)	1440 x 480	0.25 x 0.25 degree grid box	Daily (same as **7**)	/realtime_ver/**VV**/daily_G/00Z-23Z/**YYYYMM**/
10						Daily (same as **8**)	/realtime_ver/**VV**/daily_G/p12Z-11Z/**YYYYMM**/
11	Daily Rainfall in 0.1-deg [mm/hr]			3600 x 1200	0.1 x 0.1 degree grid box	Daily (same as **7**)	/realtime_ver/**VV**/daily0.1/00Z-23Z/**YYYYMM**/
12						Daily (same as **8**)	/realtime_ver/**VV**/daily0.1/p12Z-11Z/**YYYYMM**/
13	Gauge-calibrated Rainfall in 0.1-deg [mm/hr]					Daily (same as **7**)	/realtime_ver/**VV**/daily0.1_G/00Z-23Z/**YYYYMM**/
14						Daily (same as **8**)	/realtime_ver/**VV**/daily0.1_G/p12Z-11Z/**YYYYMM**/
15	Monthly Rainfall in 0.1-deg [mm/hr]					Monthly (averaged of the specified month)	/realtime_ver/**VV**/monthly/**YYYY**/
16	Monthly Gauge-calibrated Rainfall in 0.1-deg [mm/hr]						/realtime_ver/**VV**/monthly_G/**YYYY**/

Note: **YYYY**: 4-digit year, **MM**: 2-digit month, **DD**: 2-digit day, **XX_ZZZZZZ**: area name (9-digit), and **VV**: 2-digit Algorithm version.

2. Hourly Rainfall and Flag Files in Binary (products (1)-(4))

2.1. Basic Information

Hourly rain rate and some information flags of GSMaP_NRT for algorithm version 6 and 7.

Temporal resolution:	1 hour (hourly data)
Grid resolution:	0.1 degrees latitude/longitude grid (10km at the equator).
	Latitude and longitude of the first grid [1, 1] is [59.95°N, 0.05°E].
Domain:	Global (60°N-60°S)
Data latency:	4 hours after observation
Data archived period:	(Version 6) since 1 March 2000
	(Version 7) since 1 April 2017

** Please note that "Satellite Information Flag of GSMaP_NRT Version 6" has changed since 1 March 2014. The product until 28 February 2014 is same as Reanalysis Products (GSMaP_RNL) (/standard/v6/sateinfo).*

2.2. FTP Directory Information

Hourly Rain Rate data;

Latest 24 hours data:	/realtime_ver/**VV**/latest/
Archive:	/realtime_ver/**VV**/archive/**YYYY**/**MM**/**DD**/
	/realtime_ver/**VV**/hourly/**YYYY**/**MM**/**DD**/ *(same as archive)*
Satellite Information Flag;	/realtime_ver/**VV**/sateinfo/**YYYY**/**MM**/**DD**/
Observation Time Flag;	/realtime_ver/**VV**/timeinfo/**YYYY**/**MM**/**DD**/
Reliability Flag;	/realtime_ver/**VV**/reliability/**YYYY**/**MM**/**DD**/

where;

YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit day; and
VV: 2-digit Algorithm version.

2.3. File Naming Rules

Data and flag files are named according to the following rules;

Hourly Rain Rate data:	gsmap_nrt.**YYYYMMDD**.**HHNN**.dat
Satellite Information Flag:	gsmap_nrt.**YYYYMMDD**.**HHNN**.sateinfo.dat
Observation Time Flag:	gsmap_nrt.**YYYYMMDD**.**HHNN**.timeinfo.dat
Reliability Flag:	gsmap_nrt.**YYYYMMDD**.**HHNN**.reliability.dat

where;

YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit day;
HH: 2-digit hour; and
NN: 2-digit minute (currently fixed as 00).

2.4. Data Format

All binary files are produced in little-endian byte order platform, and archived with compressed using "gzip". Grid of those files consists of 3600 rows x 1200 lines, which are longitude-latitude elements corresponding to a 0.1° x 0.1° grid that covers the global region from 60°N to 60°S. The center longitude and latitude of the first pixel [1, 1] (left top corner) are [0.05°E, 59.95°N] (Figure 1).

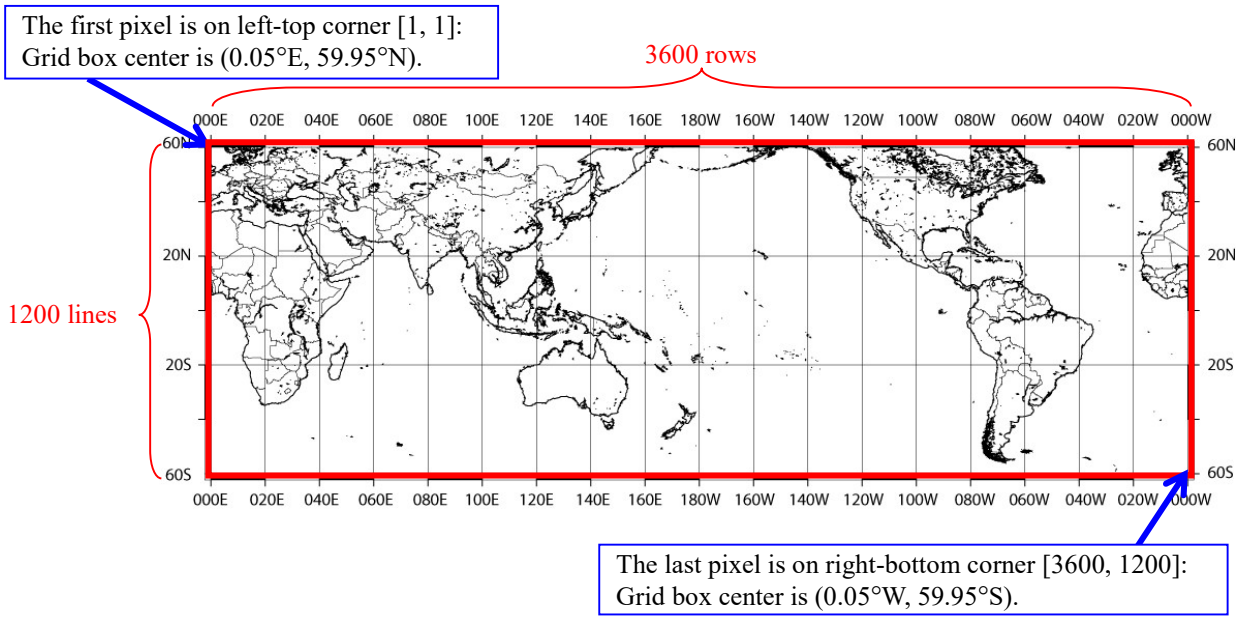

Figure 1 Data Coverage Map (Rain and Flag data)

2.5. Stored Values of Hourly Rain Rate

"Hourly Rain Rate" data are stored in 4-byte float plain binary format. Unit is [mm/hr]. Negative value denotes missing in observation data or no retrieval was done in microwave retrieval algorithm. Detailed description for missing data is shown in Table 2.

Table 2 Stored Values of Hourly Rain Rate

Value	Description
(positive)	Hourly rain rate [mm/hr].
−4	Missing due to sea ice in microwave retrieval algorithm.
-8	Missing due to low temperature in microwave retrieval algorithm.
−99	Missing due to no observation by IR and/or microwave.

2.6. Stored Values of Satellite Information Flag

2.6.1. Version 6

"Satellite Information Flag" data are stored in 4-byte integer plain binary format. Satellite and sensor name are assigned to each bit, and the flag indicates all satellite/sensor which are used in estimation of rainfall at each pixel during one-hour time period. If the flag shows 0, there is no satellite observation by both microwave and geo-stationary IR. If flag shows negative value, there is NO microwave radiometer observation. Following meanings are assigned to each bit in 32-bit integer. "Satellite Information Flag" has changed since 1 March

2014. The stored values until 28 February 2014 is shown is Table 3-A, and that since 1 March 2014 is shown in Table 3-B.

For example, until 28 February 2014, if the stored value is 1073743872, the value is the sum of "Merged IR data (1073741824)" and "NOAA-19 (2048)". Since 1 March 2014, the stored value is 1073741952 because of "NOAA-19 (128)".

Table 3-A Stored Values of Satellite Information Flag (Version 6: until 28 February 2014)

Pixel Value		Description	
Value	**Bit**	**Sensor Category**	**Satellite/Sensor**
1	0	Microwave radiometer (imager/sounder) aboard low orbital satellite	TRMM/TMI
2	1		Aqua/AMSR-E
4	2		DMSP-F13/SSM/I
8	3		DMSP-F14/SSM/I
16	4		DMSP-F15/SSM/I
32	5		DMSP-F16/SSMIS
64	6		DMSP-F17/SSMIS
128	7		NOAA-15/AMSU-A/B
256	8		NOAA-16/AMSU-A/B
512	9		NOAA-17/AMSU-A/B
1024	10		NOAA-18/AMSU-A/MHS
2048	11		NOAA-19/AMSU-A/MHS
4096	12		MetOp-A/AMSU-A/MHS
8192	13		DMSP-F18/SSMIS
16384	14		ADEOS-II/AMSR
32768	15		DMSP-F11/SSM/I
65536	16		GCOM-W/AMSR2
131072	17		MetOp-B/AMSH-A/MHS
262144	18		GPM-Core/GMI
524288	19		DMSP-F19/SSMIS
1048576 − 536870912	20-29		not used
1073741824	30	Infrared Imager aboard Geo-stationary meteorological satellite	NOAA/CPC Globally Merged IR data
−(negative)	31	No microwave radiometer observation	

Table 3-B Stored Values of Satellite Information Flag (Version 6: since 1 March 2014)

Pixel Value		Description	
Value	**Bit**	**Sensor Category**	**Satellite/Sensor**
1	0	Microwave imager and/or sounder aboard low orbital satellite	TRMM/TMI
2	1		Aqua/AMSR-E
4	2		DMSP-F13/SSM/I
8	3		DMSP-F14/SSM/I
16	4		DMSP-F15/SSM/I
32	5		DMSP-F16/SSMIS
64	6		DMSP-F17/SSMIS
128	7		NOAA-19/AMSU-A/MHS
256	8		MetOp-A/AMSU-A/MHS
512	9		DMSP-F18/SSMIS
1024	10		GCOM-W/AMSR2
2048	11		GPM-Core/GMI
4096	12		NOAA-18/AMSU-A/MHS
8192	13		MetOp-B/AMSU-A/MHS
16384	14		DMSP-F19/SSMIS
32768	15		MetOp-C/AMSU-A/MHS
65536	16	Infrared Imager aboard Geo-stationary meteorological satellite (before 22Z 28 Mar. 2012)	GOES-EAST
131072	17		GOES-WEST
262144	18		INDEX
524288	19		METEOSAT
1048576	20		MTSAT
2097152−536870912	21−29		not used
1073741824	30	Infrared Imager aboard Geo-stationary meteorological satellite (since 23Z 28 Mar. 2012)	
−(negative)	31	No microwave radiometer observation	

2.6.2. Version 7

"Satellite Information Flag" data are stored in 4-byte integer plain binary format. Satellite and sensor name are assigned to each bit, and the flag indicates all satellite/sensor which are used in estimation of rainfall at each pixel during one-hour time period. If the flag shows 0, there is no satellite observation by both microwave and geo-stationary IR. Following meanings are assigned to each bit in 32-bit integer (Table 3-C).

For example, if the stored value is 8388609, the value is the sum of "Merged IR data (1)" and "NOAA-19 (8388608)".

Table 3-C Stored Values of Satellite Information Flag (Version 7)

Pixel Value		Description	
Value	**Bit**	**Sensor Category**	**Satellite/Sensor**
1	0	Infrared Imager aboard Geo-stationary meteorological satellite	NOAA/CPC Globally Merged IR data
2	1	Microwave imager and/or sounder aboard low orbital satellite	TRMM/TMI
4	2		GPM-Core/GMI
8	3		Megha-Tropiques/MADRAS
16	4		Megha-Tropiques/SAPHIR
32	5		ADEOS-II/AMSR
64	6		Aqua/AMSR-E
128	7		GCOM-W1/AMSR2
256	8		GCOM-W2/AMSR2 f/o (TBD)
512	9		GCOM-W3/AMSR2 f/o (TBD)
1024	10		DMSP-F11/SSM/I
2048	11		DMSP-F13/SSM/I
4096	12		DMSP-F14/SSM/I
8192	13		DMSP-F15/SSM/I
16384	14		DMSP-F16/SSM/I
32768	15		DMSP-F17/SSM/I
65536	16		DMSP-F18/SSM/I
131072	17		DMSP-F19/SSM/I
262144	18		DMSP-F20/SSM/I
524288	19		NOAA-15/AMSU-A/B
1048576	20		NOAA-16/AMSU-A/B
2097152	21		NOAA-17/AMSU-A/B
4194304	22		NOAA-18/AMSU-A/B
8388608	23		NOAA-19/AMSU-A/B
16777216	24		NPP/ATMS
33554432	25		JPSS-1/ATMS
67108864	26		MetOp-A/AMSU-A/MHS
134217728	27		MetOp-B/AMSU-A/MHS
268435456	28		MetOp-C/AMSU-A/MHS
	29−31		Spare

2.7. Stored Values of Observation Time Flag

"Observation Time Information Flag" are in 4-byte float plain binary format. The Flag indicates relative time of latest microwave radiometer observation at each pixel, and 0 means start time of the file (**HH** in file name). Values are stored as indicated in Table 4.

Table 4 Stored Values of Observation Time Flag

Value	Description
$0 \leq X < 1$	If value is positive, microwave radiometer observation is available at the pixel during current one-hour period. X ($0 \leq X < 1$) indicates relative observation time of latest microwave radiometer, and is stored as differences from the start time of the file. For example, if UTC of the file (**HH**) = "01" and X = 0.2, observation time of the pixel will be 01:12 UTC.
$X \leq 0$	If value is negative, NO microwave radiometer observation is available at the pixel during time period of the file. X ($X \leq 0$) indicates relative observation time of latest microwave radiometer, and stored as differences from the start time of the file. For example, if UTC of the file (**HH**) = "01" and X = −2.5, latest observation time of microwave radiometer at the pixel will be 22:30 UTC of previous day.
X = −999	No microwave observation (Missing)

2.8. Stored Values of Reliability Flag

2.8.1. Version 6

"Reliability Flag" are in 1-byte integer plain binary format. The Flag indicates a reliability of the precipitation at each pixel in consideration of sensor and algorithm characteristics. Values range from 1 to 10 and these are stored as described in Table 5-A. Basically, 10 is the best and the 1 is the worst, and, higher values demonstrate higher reliability. Especially, please be careful to use the GSMaP data when the reliability flag is lower than 4.

Table 5-A Stored Values of Reliability Flag

Value	Description			
	Microwave radiometer observation		NO microwave radiometer observation	
	Over Land / Coast	Over Ocean	Over Land / Coast	Over Ocean
10		● not sounder		
9	●	● sounder		
8				● ~1 hour after obs.
7			● ~1 hour after obs.	
6				● 1~2 hour after obs.
5			● 1~2 hour after obs.	
4	● temperature < 2 deg C		● temperature < 2 deg C	● 2~3 hour after obs.
3			● 2~3 hour after obs.	
2			● 1~2 hour after obs. in lower temperature region	● 3~4 hour after obs.
1		● Freezing Level<500m	● 3~ hour after obs. or 2~ hour after obs. in lower temperature region	● 4~ hour after obs. or 0~ hour after obs. in lower freezing level region

2.8.2. Version 7

"Reliability Flag" are in 1-byte integer plain binary format. The Flag indicates a reliability of the precipitation at each pixel in consideration of sensor and algorithm characteristics. Values range from 1 to 10 and these are stored as described in Table 5-B. Basically, 10 is the best and the 1 is the worst, and, higher values demonstrate higher reliability. Especially, please be careful to use the GSMaP data when the reliability flag is lower than 4.

Table 5-B Stored Values of Reliability Flag

Value	Description			
	Microwave radiometer observation		NO microwave radiometer observation	
	Over Land / Coast	Over Ocean	Over Land / Coast	Over Ocean
10		● not sounder		
9	●	● sounder		
8				● ~1 hour after obs.
7			● ~1 hour after obs.	
6				● 1~2 hour after obs.
5			● 1~2 hour after obs.	
4	● temperature <2 deg C	● Freezing Level<500m	● temperature <2 deg C	● 2~3 hour after obs.
3			● 2~3 hour after obs.	
2			● ~1 hour after obs. in lower temperature region	● 3~4 hour after obs. or ~1 hour after obs. in lower freezing level region
1			● 3~ hour after obs. or 1~ hour after obs. in lower temperature region	● 4~ hour after obs. or 1~ hour after obs. in lower freezing level region

2.9. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Hourly Rain Rate data: /realtime_ver/**VV**/sample/GSMaP_NRT.hourly.rain.ctl
Satellite Information Flag: /realtime_ver/**VV**/sample/GSMaP_NRT.hourly.sat.ctl
Observation Time Flag: /realtime_ver/**VV**/sample/GSMaP_NRT.hourly.time.ctl
Reliability Flag: /realtime_ver/**VV**/sample/GSMaP_NRT.hourly.reliability.ctl

where;
VV: 2-digit Algorithm version.

2.10. File Size

Approximately 800 Kbyte (with gzip), and 17 Mbyte (uncompressed) for each file.

3. Hourly Gauge-calibrated Rain Rate in Binary (product (5))

3.1. Basic Information

Hourly rain rate of GSMaP_Gauge_NRT for algorithm version 6 and 7.

Temporal resolution:	1 hour (hourly data) averaged from 00-minute to 59-minute of the specified hour.
Grid resolution:	0.1 degrees latitude/longitude grid (10km at the equator). Latitude and longitude of the first grid [1, 1] is [59.95°N, 0.05°E].
Domain:	Global (60°N-60°S).
Data latency:	4 hours after observation
Data archived period:	(Version 6) since 1 April 2000 (Version 7) since 1 April 2017

3.2. FTP Directory Information

Hourly Gauge-calibrated Rain Rate data;
Latest 24 hours data: /realtime_ver/**VV**/latest/
Archive: /realtime_ver/**VV**/hourly_G/**YYYY**/**MM**/**DD**/

where;
YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit day; and
VV: 2-digit Algorithm version.

3.3. File Naming Rules

Data and flag files are named according to the following rules;

Hourly Gauge-calibrated Rain Rate data: gsmap_gauge.**YYYYMMDD**.**HHNN**.dat

where;

YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit day;
HH: 2-digit hour; and
NN: 2-digit minute (currently fixed as 00).

3.4. Data Format

Same as Hourly Rain Rate Data (product (1)). See Section 2.4.

3.5. Stored Value of Hourly Gauge-calibrated Rain Rate

Same as Hourly Rain Rate Data (product (1)). See Section 2.5.

3.6. File Size

Same as Hourly Rain Rate Data (product (1)). See Section 2.6.

4. Hourly Rain Rate & Gauge-calibrated Rain Rate in text format (product (6))

4.1. Basic Information

Hourly rain rate (GSMaP_NRT) and Gauge-calibrated rain rate (GSMaP_Gauge_NRT) are stored in the same line.

Temporal resolution:	1 hour (hourly data)
Grid resolution:	0.1 degrees latitude/longitude grid (10km at the equator).
Domain:	15 areas (see 4.4)
Data latency:	4 hours after observation
Data archived period:	(Version 6) since 1 April 2000
	(Version 7) since 1 April 2017

4.2. FTP Directory Information

Data files are archived at following directories;

Hourly Data: /realtime_ver/**VV**/txt/**XX_ZZZZZZ**/**YYYY**/**MM**/**DD**/

where;
YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit hour;
VV: 2-digit Algorithm version; and
XX_ZZZZZZ: 9-digit area name.

4.3. File Naming Rules

Data files are named according to following rules;

Hourly Data: gsmap_nrt.**YYYYMMDD_HH**00**_XX_ZZZZZZ**.csv

where;

YYYY: 4-digit year;
MM: 2-digit month;
DD: 2-digit day;
HH: 2-digit hour; and
XX_ZZZZZZ: 9-digit area name.

4.4. Area definition in text format

The 15 areas for Text format are defined as gray-shaded areas in Figure 2. In addition to the 15 areas, data for Island outside the defined areas is prepared in "island" directory.

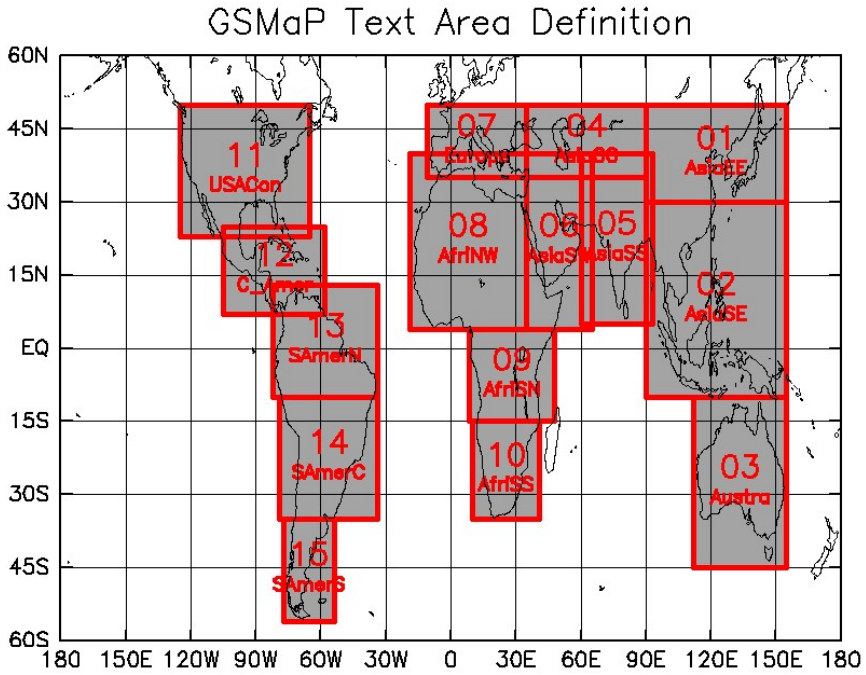

Figure 2 Definition of Text Area

Table 6 Corner latitude and longitude of each area

Area name	Longitude (W)	Longitude (E)	Latitude (S)	Latitude (N)	Description
01_AsiaEE	90	155	30	50	East Asia
02_AsiaSE	90	155	-10	30	South East Asia
03_Austra	112	155	-45	-10	Australia
04_AsiaCC	35	90	35	50	Central Asia
05_AsiaSS	60	93	5	40	South Asia
06_AsiaSW	35	65	4	40	Arabian Penisula and East Africa
07_Europe	-11	35	35	50	Europe
08_AfriNW	-19	35	4	40	North West and Central Africa
09_AfriSN	8.5	48	-15	4	Southern Africa (North)
10_AfriSS	10	41	-35	-15	Southern Africa (South)
11_USACon	-125	-65	23	50	USA (Contiguous)
12_C_Amer	-105	-58	7	25	Central America
13_SAmerN	-82	-34	-10	13	South America (North)
14_SAmerC	-79	-34	-35	-10	South America (Central)
15_SAmerS	-77	-54	-56	-35	South America (South)

4.5. Data Format

Text files are stored in CSV format (see Figure 3). Unit is [mm/hr]. Data with missing value are omitted.
All text files are archived with compressed using "zip".
This data format is available in the ArcGIS (ESRI ArcMap 10.0), verified by Mr. Fujioka (ICHARM).

Lat	Lon	RainRate	Gauge-calibratedRain
49.95	89.95	0	0
49.85	89.95	0	0
49.65	89.95	1.1	1.5
……			

Figure 3 Example of text format

4.6. File Size

Approximately 200 Kbyte (with zip), and 1.6 Mbyte (uncompressed) for each file.

5. Daily rainfall in 0.25-deg (products (7)-(8))

5.1. Basic Information

Daily averaged rain rate [mm/hr] with a 0.25 x 0.25 degree resolution of GSMaP_NRT.

Temporal resolution:	24 hours average (daily data) Two definitions of "daily": 00Z-23Z average: from 00Z to 23Z of the day 12Z-11Z average: from 12Z of the previous day to 11Z of the day
Grid resolution:	0.25 degrees latitude/longitude grid (25km at the equator)
Domain:	Global (60°N-60°S)
Data latency:	4 hours after the end of accumulation period
Data archived period:	(Version 6) since 1 March 2000 (Version 7) since 1 April 2017

5.2. FTP Directory Information

Data files are archived at following directories;

Daily data (00Z-23Z average): /realtime_ver/**VV**/daily/00Z-23Z/**YYYYMM**/
Daily data (12Z-11Z average): /realtime_ver/**VV**/daily/p12Z-11Z/**YYYYMM**/

where;
YYYY: 4-digit year;
MM: 2-digit month; and
VV: 2-digit Algorithm version.

5.3. File Naming Rules

Data files are named according to following rules;

Daily data (00Z-23Z average): gsmap_nrt.**YYYYMMDD**.0.25d.daily.00Z-23Z.dat
Daily data (12Z-11Z average): gsmap_nrt.**YYYYMMDD**.0.25d.daily.p12Z-11Z.dat

where;

YYYY: 4-digit year;
MM: 2-digit month; and
DD: 2-digit day.

5.4. Data Format

All binary files are produced in little-endian byte order platform, and archived with compressed using "gzip". Unit is [mm/hr]. Missing value is -999.9.

Grid of those files consists of 1440 x 480 pixels, which are longitude-latitude elements corresponding to a 0.25° x 0.25° grid that covers the global region from 60°N to 60°S. The center longitude and latitude of the first pixel [1, 1] (left top corner) is [0.125°E, 59.875°N].

5.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Daily data (00Z-23Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily.00Z-23Z.ctl
Daily data (12Z-11Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily.p12Z-11Z.ctl

where;

VV: 2-digit Algorithm version.

5.6. File Size

Approximately 800 Kbyte (with gzip), and 2.7 Mbyte (uncompressed) for each file.

6. Gauge-calibrated rainfall in 0.25-deg (products (9)-(10))

6.1. Basic Information

Daily averaged rain rate [mm/hr] with a 0.25 x 0.25 degree resolution of GSMaP_Gauge_NRT. Same as Daily rainfall in 0.25-deg (products (7)-(8)) except "Data archived period". See Section 5.1.

Data archived period: (Version 6) since 1 April 2000
(Version 7) since 1 April 2017

6.2. FTP Directory Information

Data files are archived at following directories;

Daily data (00Z-23Z average): /realtime_ver/**VV**/daily_G/00Z-23Z/**YYYYMM**/
Daily data (12Z-11Z average): /realtime_ver/**VV**/daily_G/p12Z-11Z/**YYYYMM**/

where;

YYYY: 4-digit year;
MM: 2-digit month; and
VV: 2-digit Algorithm version.

6.3. File Naming Rules

Data files are named according to following rules;

Daily data (00Z-23Z average): gsmap_gauge.**YYYYMMDD**.0.25d.daily.00Z-23Z.dat
Daily data (12Z-11Z average): gsmap_gauge.**YYYYMMDD**.0.25d.daily.p12Z-11Z.dat

where;
YYYY: 4-digit year;
MM: 2-digit month; and
DD: 2-digit day.

6.4. Data Format

Same as Daily rainfall in 0.25-deg (product (7)-(8)). See Section 5.4.

6.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Daily data (00Z-23Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily_G.00Z-23Z.ctl
Daily data (12Z-11Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily_G.p12Z-11Z.ctl

where;
VV: 2-digit Algorithm version.

6.6. File Size

Approximately 800 Kbyte (with gzip), and 2.7 Mbyte (uncompressed) for each file.

7. Daily rainfall in 0.1-deg (products (11)-(12))

7.1. Basic Information

Daily averaged rain rate [mm/hr] with a 0.1 x 0.1 degree resolution of GSMaP_NRT (product (1)).

Temporal resolution:	24 hours average (daily data) Two definitions of "daily": 00Z-23Z average: from 00Z to 23Z of the day 12Z-11Z average: from 12Z of the previous day to 11Z of the day
Grid resolution:	0.1 degrees latitude/longitude grid (10km at the equator)
Domain:	Global (60°N-60°S)
Data latency:	4 hours after the end of accumulation period
Data archived period:	(Version 6) since 1 March 2000 (Version 7) since 1 April 2017

7.2. FTP Directory Information

Data files are archived at following directories;

Daily data (00Z-23Z average): /realtime_ver/**VV**/daily0.1/00Z-23Z/**YYYYMM**/
Daily data (12Z-11Z average): /realtime_ver/**VV**/daily0.1/p12Z-11Z/**YYYYMM**/

where;
YYYY: 4-digit year;
MM: 2-digit month; and
VV: 2-digit Algorithm version.

7.3. File Naming Rules

Data files are named according to following rules;

Daily data (00Z-23Z average): gsmap_nrt.**YYYYMMDD**.0.1d.daily.00Z-23Z.dat
Daily data (12Z-11Z average): gsmap_nrt.**YYYYMMDD**.0.1d.daily.p12Z-11Z.dat

where;
YYYY: 4-digit year;
MM: 2-digit month; and
DD: 2-digit day.

7.4. Data Format

All binary files are produced in little-endian byte order platform, and archived with compressed using "gzip". Unit is [mm/hr]. Missing value is -999.9.

Grid of those files consists of 3600 rows x 1200 lines, which are longitude-latitude elements corresponding to a 0.1° x 0.1° grid that covers the global region from 60°N to 60°S. The center longitude and latitude of the first pixel [1, 1] (left top corner) is [0.05°E, 59.95°N].

7.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Daily data (00Z-23Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily0.1.00Z-23Z.ctl
Daily data (12Z-11Z average): /realtime_ver/**VV**/sample/GSMaP_NRT.daily0.1.p12Z-11Z.ctl

where;
VV: 2-digit Algorithm version.

7.6. File Size

Approximately 800 Kbyte (with gzip), and 17 Mbyte (uncompressed) for each file.

8. Gauge-calibrated rainfall in 0.1-deg (products (13)-(14))

8.1. Basic Information

Daily averaged rain rate [mm/hr] with a 0.1 x 0.1 degree resolution of GSMaP_Gauge_NRT (product (5)). Same as Daily rainfall in 0.1-deg (products (11)-(12)) except "Data archived period". See Section 7.1.

Data archived period: (Version 6) since 1 April 2000
(Version 7) since 1 April 2017

8.2. FTP Directory Information

Data files are archived at following directories;

Daily data (00Z-23Z average): /realtime_ver/**VV**/daily0.1_G/00Z-23Z/**YYYYMM**/
Daily data (12Z-11Z average): /realtime_ver/**VV**/daily0.1_G/p12Z-11Z/**YYYYMM**/

where;
YYYY: 4-digit year;
MM: 2-digit month; and
VV: 2-digit Algorithm version.

8.3. File Naming Rules

Data files are named according to following rules;

Daily data (00Z-23Z average): gsmap_gauge.**YYYYMMDD**.0.1d.daily.00Z-23Z.dat
Daily data (12Z-11Z average): gsmap_gauge.**YYYYMMDD**.0.1d.daily.p12Z-11Z.dat

where;
YYYY: 4-digit year;
MM: 2-digit month; and
DD: 2-digit day.

8.4. Data Format

Same as Daily rainfall in 0.1-deg (product (11)-(12)). See Section 7.4.

8.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Daily data (00Z-23Z average):
/realtime_ver/**VV**/sample/GSMaP_NRT.daily0.1_G.00Z-23Z.ctl
Daily data (12Z-11Z average):
/realtime_ver/**VV**/sample/GSMaP_NRT.daily0.1_G.p12Z-11Z.ctl

where;
VV: 2-digit Algorithm version.

8.6. File Size

Approximately 800 Kbyte (with gzip), and 17 Mbyte (uncompressed) for each file.

9. Monthly rainfall in 0.1-deg (products (15))

9.1. Basic Information

Monthly averaged rain rate [mm/hr] and the number of samples (≧ 0 mm/hr) per month of GSMaP_NRT.

Temporal resolution:	Monthly average
Grid resolution:	0.1 degrees latitude/longitude grid (10km at the equator)
Domain:	Global (60°N-60°S)
Data latency:	4 hours after the end of accumulation period
Data archived period:	(Version 6) since March 2000
	(Version 7) since April 2017

9.2. FTP Directory Information

Data files are archived at following directories;

Monthly data: /realtime_ver/**VV**/monthly/**YYYY**/

where;
YYYY: 4-digit year;
VV: 2-digit Algorithm version.

9.3. File Naming Rules

Data files are named according to following rules;

Monthly data: gsmap_nrt.**YYYYMM**.0.1d.monthly.dat

where;
YYYY: 4-digit year;
MM: 2-digit month.

9.4. Data Format

All binary files are produced in little-endian byte order platform, and archived with compressed using "gzip". In each monthly file, there are two global fields: monthly averaged rain rate; and numbers of valid pixel (≧ 0 mm) per month. The former unit is [mm/hr] and the missing value is -999.9. Multiplying of both layers gives the monthly total precipitation [mm/month].

Grid in each field consists of 3600 rows x 1200 lines, which are longitude-latitude elements corresponding to a 0.1° x 0.1° grid that covers the global region from 60°N to 60°S. The center longitude and latitude of the first pixel [1, 1] (left top corner) is [0.05°E, 59.95°N].

** Please note that the calculations for monthly products take into account not only quality of an hourly rain rate but also a ratio of missing values per month.*

9.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Monthly data: /realtime_ver/**VV**/sample/GSMaP_NRT.monthly.ctl

where;
VV: 2-digit Algorithm version.

9.6. File Size

Approximately 14 Mbyte (with gzip), and 34 Mbyte (uncompressed) for each file.

10. Monthly Gauge-calibrated rainfall in 0.1-deg (products (16))

10.1. Basic Information

Monthly averaged rain rate [mm/hr] and the number of samples (≧ 0 mm/hr) per month of GSMaP_Gauge_NRT. Same as section 9.1 except "Data archived period".

Data archived period: (Version 6) since April 2000
(Version 7) since April 2017

10.2. FTP Directory Information

Data files are archived at following directories;

Monthly data: /realtime_ver/**VV**/monthly_G/**YYYY**/

where;
YYYY: 4-digit year;
VV: 2-digit Algorithm version.

10.3. File Naming Rules

Data files are named according to following rules;

Monthly data: gsmap_gauge.**YYYYMM**.0.1d.monthly.dat

where;
YYYY: 4-digit year;
MM: 2-digit month.

10.4. Data Format

Same as section 9.4.

10.5. GrADS Control File

Sample control files of the Grid Analysis and Display System (GrADS) for each product are also available from ftp server. About usage of GrADS tool, please see GrADS home page (http://cola.gmu.edu/grads/grads.php).

Monthly data:
/realtime_ver/**VV**/sample/GSMaP_NRT.monthly_G.ctl

where;

VV: 2-digit Algorithm version.

10.6. File Size

Approximately 14 Mbyte (with gzip), and 34 Mbyte (uncompressed) for each file.

11. Algorithm and references

11.1. Algorithm

Details of the latest GSMaP algorithm are described in following documents and references in Section 11.2.

- Global Satellite Mapping of Precipitation (GSMaP) for GPM: Algorithm Theoretical Basis Document (ATBD)" (https://sharaku.eorc.jaxa.jp/GSMaP/faq/GSMaP_faq15.html).

11.2. References

Please refer the following paper:

- Kubota, T., K. Aonashi, T. Ushio, S. Shige, Y. N. Takayabu, M. Kachi, Y. Arai, T. Tashima, T. Masaki, N. Kawamoto, T. Mega, M. K. Yamamoto, A. Hamada, M. Yamaji, G. Liu and R. Oki 2020: Global Satellite Mapping of Precipitation (GSMaP) products in the GPM era, Satellite precipitation measurement, Springer, https://doi.org/10.1007/978-3-030-24568-9_20.

(Major papers related to GSMaP algorithms)

- Kubota, T., S. Shige, H. Hashizume, K. Aonashi, N. Takahashi, S. Seto, M. Hirose, Y. N. Takayabu, K. Nakagawa, K. Iwanami, T. Ushio, M. Kachi, and K. Okamoto, 2007: Global Precipitation Map using Satelliteborne Microwave Radiometers by the GSMaP Project : Production and Validation, *IEEE Trans. Geosci. Remote Sens.*, **45**, No. 7, 2259-2275, https://doi.org/10.1109/TGRS.2007.895337.

- Aonashi, K., J. Awaka, M. Hirose, T. Kozu, T. Kubota, G. Liu, S. Shige, S., Kida, S. Seto, N.Takahashi, and Y. N. Takayabu, 2009: GSMaP passive, microwave precipitation retrieval algorithm: Algorithm description and validation. *J. Meteor. Soc. Japan*, **87A**, 119-136, https://doi.org/10.2151/jmsj.87A.119.

- T. Ushio, T. Kubota, S. Shige, K. Okamoto, K. Aonashi, T. Inoue, N., Takahashi, T. Iguchi, M.Kachi, R. Oki, T. Morimoto, and Z. Kawasaki, 2009: A Kalman filter approach to the Global Satellite Mapping of Precipitation (GSMaP) from combined passive microwave and infrared radiometric data. *J. Meteor. Soc. Japan*, **87A**, 137-151, https://doi.org/10.2151/jmsj.87A.137.

- Mega, T., T. Ushio, M. T. Matsuda, T. Kubota, M. Kachi, and R. Oki, 2019: Gauge-adjusted global satellite mapping of precipitation. *IEEE Trans. Geosci. Remote Sens.*, **57.4**, 1928-1935, https://doi.org/10.1109/TGRS.2018.2870199.

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