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

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GSMaP RIKEN Nowcast (GSMaP_RNC)
Data Format Description

This document describes data format and information of Global Satellite Mapping of Precipitation (GSMaP) RIKEN Nowcast provided by RIKEN Data Assimilation Research Team (DA team) and distributed from JAXA.

The RIKEN DA Team performs cutting-edge research on weather forecasting by integrating computer simulations and observation data. Details of the technique are described in following paper.

- Otsuka, S., S. Kotsuki, and T. Miyoshi, 2016: Nowcasting with data assimilation: a case of Global Satellite Mapping of Precipitation. Wea. Forecasting, 31, 1409-1416.

Based on Otsuka et al. (2016)'s technique, they developed a precipitation nowcasting system that provides precipitation forecasts. Operation of the nowcast system involves hourly updates and accuracy verification, and results are used for research purposes.

NOTE:

Please note that the weather forecasts on this website can differ from weather forecasts provided by the Japan Meteorological Agency (JMA). Please give precedence to the latest warnings and advisories from the JMA.

Use of information or data from this website is undertaken at the user's own risk. JAXA and RIKEN takes no responsibility for any direct or indirect damage that may arise through the use of this information or data. Any part or all of this website may be changed, deleted, or removed without notice.

RIKEN acquired the weather forecasting license from the JMA for the area surrounding Japan defined by 0-60ºN and 100-180ºE, and provide the precipitation forecasts from 10 am to 5 pm on weekdays. Areas on the map shaded in gray indicate out-of-service locations.

Product Overview

Table 1 Summary of GSMaP_RNC Products

No	Parameter [unit]	Data format	Coverage	Grid size	Horizontal resolution	Temporal resolution	FTP directory
1	Hourly Rain Rate [mm/h] (masked)	4-byte float plain binary, little-endian	Global (60°N-60°S)	3600 x 1200 x13	0.1 degree grid box	Hourly	/riken_nowcast/masked/**YYYY**/**MM**/**DD**/
2	Hourly Rain Rate [mm/h] (raw)						/riken_nowcast/raw/**YYYY**/**MM**/**DD**/

Note: **YYYY**: 4-digit year, **MM**: 2-digit month, **DD**: 2-digit day, and **VV**: 2-digit Algorithm version

There are 13 layers in one file, which consist of the initial value (preprocessed GSMaP_NRT) and 12-hour forecast data.

The "masked" data are produced operationally, and the "raw" data are produced after checks of the East Asia-Pacific area by the Riken/AICS according to the Japanese domestic law.

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1. Hourly Rainfall and Flag Files in Binary

1.1. Basic Information

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: 6 hours after observation (masked)
about 7 hours after observation (raw)

1.2. FTP Directory Information

Hourly Rain Rate data;

masked: /riken_nowcast/masked/**YYYY**/**MM**/**DD**/
raw: /riken_nowcast/raw/**YYYY**/**MM**/**DD**/

where;

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

1.3. File Naming Rules

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

Hourly Rain Rate data (masked and raw): gsmap_rnc.**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).

1.4. 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 degree 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).

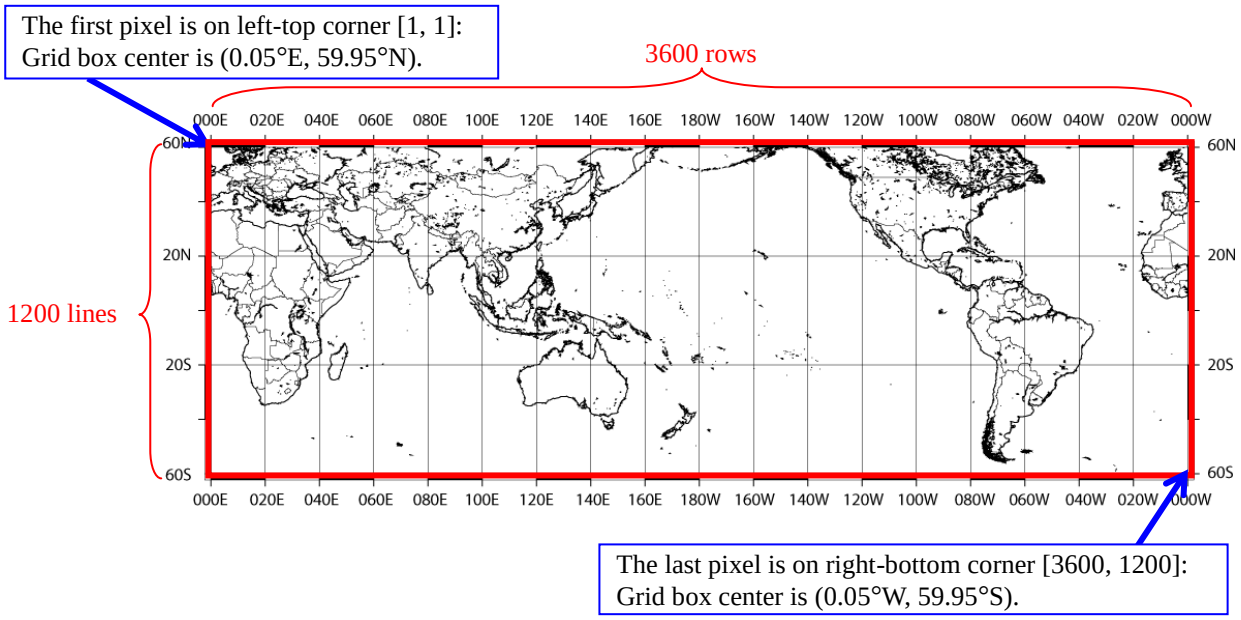

Figure 1 Data Coverage Map

1.5. 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].
−999	Masked due to no-check of the East Asia-Pacific area by the Riken/AICS

1.6. File Size

Approximately 10Mbyte (with gzip), and 221 Mbyte (uncompress) for each file.

2. Algorithm and references

2.1. Algorithm

The dataset of GSMaP RNC has been developed by RIKEN DA Team. Details of the forecasting system are described in following paper.

- Otsuka, S., S. Kotsuki, and T. Miyoshi, 2016: Nowcasting with data assimilation: a case of Global Satellite Mapping of Precipitation. Wea. Forecasting, 31, 1409-1416.

GSMaP_RNC algorithm uses the dataset of "Global Rainfall Map in Near Real Time". Details of the latest GSMaP algorithm are described in following documents and references in Section 2.2.

- Global Satellite Mapping of Precipitation (GSMaP) for GPM: Algorithm Theoretical Basis Document (ATBD)" (http://www.eorc.jaxa.jp/GPM/doc/algorithm_e.htm)..

2.2. References

Papers describing the GSMaP project and algorithm are as follows.

(About GSMaP project)

K. Okamoto, T. Iguchi, N. Takahashi, K. Iwanami and T. Ushio, 2005: The global satellite mapping of precipitation (GSMaP) project. *25th IGARSS Proceedings*, 3414-3416.

K. Okamoto, T. Iguchi, N. Takahashi, T. Ushio, J. Awaka, S. Shige, and T. Kubota, 2007: High precision and high resolution global precipitation map from satellite data. *ISAP 2007 Proceedings*, 506-509.

T. Kubota, 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(7)**, 2259-2275.

(About microwave imager algorithm)

K. Aonashi, 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.

A. Taniguchi, S. Shige, M. K. Yamamoto, T. Mega, S. Kida, T. Kubota, M. Kachi, T. Ushio, and K. Aonashi, 2013: Improvement of high-resolution satellite rainfall product for Typhoon Morakot (2009) over Taiwan. *J. Hydrometeor.*, **14**, 1859-1871.

S. Shige, M.K. Yamamoto, and A. Taniguchi, 2014. Improvement of TMI rain retrieval over the Indian Subcontinent. *Chapter for "Remote Sensing of the Terrestrial Water Cycle" (Edited by Venkat Lakshmi et al.)*, Wiley Online Library, DOI: 10.1002/9781118872086, 27-42.

M.K. Yamamoto, and S. Shige, 2015: Implementation of an orographic/nonorographic rainfall classification scheme in the GSMaP algorithm for microwave radiometers. *Atmos. Res.*, **163**, 36–47.

(About microwave sounder algorithm)

S. Shige, T. Yamamoto, T. Tsukiyama, S. Kida, H. Ashiwake, T. Kubota, S. Seto, K. Aonashi and K. Okamoto, 2009: The GSMaP precipitation retrieval algorithm for microwave sounders. Part I: Over-ocean algorithm. *IEEE Trans. Geosci. Remote Sens*, **47**, 3084-3097.

S. Kida, S. Shige, and T. Manabe, 2010: Comparison of rain fractions over tropical and sub-tropical ocean obtained from precipitation retrieval algorithms for microwave sounders. *J. Geophys. Res.*, **115**, D24101, doi:10.1029/2010JD014279.

S. Kida, T. Kubota, M. Kachi, S. Shige, and R. Oki, 2012: Development of precipitation retrieval algorithm over land for a satellite-borne microwave sounder. *Proc. of IGARSS 2012*, 342-345.

(About microwave imager/sounder algorithm)

T. Kubota, S. Shige, M. Kachi, and K. Aonashi. 2011: Development of SSMIS rain retrieval algorithm in the GSMaP project. *Proc 28th ISTS*, 2011-n-46.

(About microwave-IR combined algorithm)

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.

T. Ushio, T. Tashima, T. Kubota, and M. Kachi, 2013: Gauge Adjusted Global Satellite Mapping of Precipitation (GSMaP_Gauge), *Proc. 29th ISTS*, 2013-n-48.

(About NRT system)

M. Kachi, T. Kubota, T. Ushio, S. Shige, S. Kida, K. Aonashi, and K. Okamoto, 2011: Development and utilization of "JAXA Global Rainfall Watch" system. *IEEJ Transactions on Fundamentals and Materials*, **131**, 729-737. (In Japanese with English abstract)

T. Ushio, and M. Kachi, 2009: Kalman filtering application for the Global Satellite Mapping of Precipitation (GSMaP). *Chapter for "Satellite Rainfall Applications for Surface Hydrology" (Editedy by Mekonnen Gebremichael and Faisal Hossain)*, Springer, ISBN978-9048129140, 105-123.

Additional related papers are listed on the JST/CREST GSMaP Project Website
http://sharaku.eorc.jaxa.jp/GSMaP_crest/html/publications.html

3. Contact

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