



GSMaP
GLOBAL SATELLITE MAPPING OF PRECIPITATION

GSMaP Products for SWCEM-EAWP User Guide

April 2021



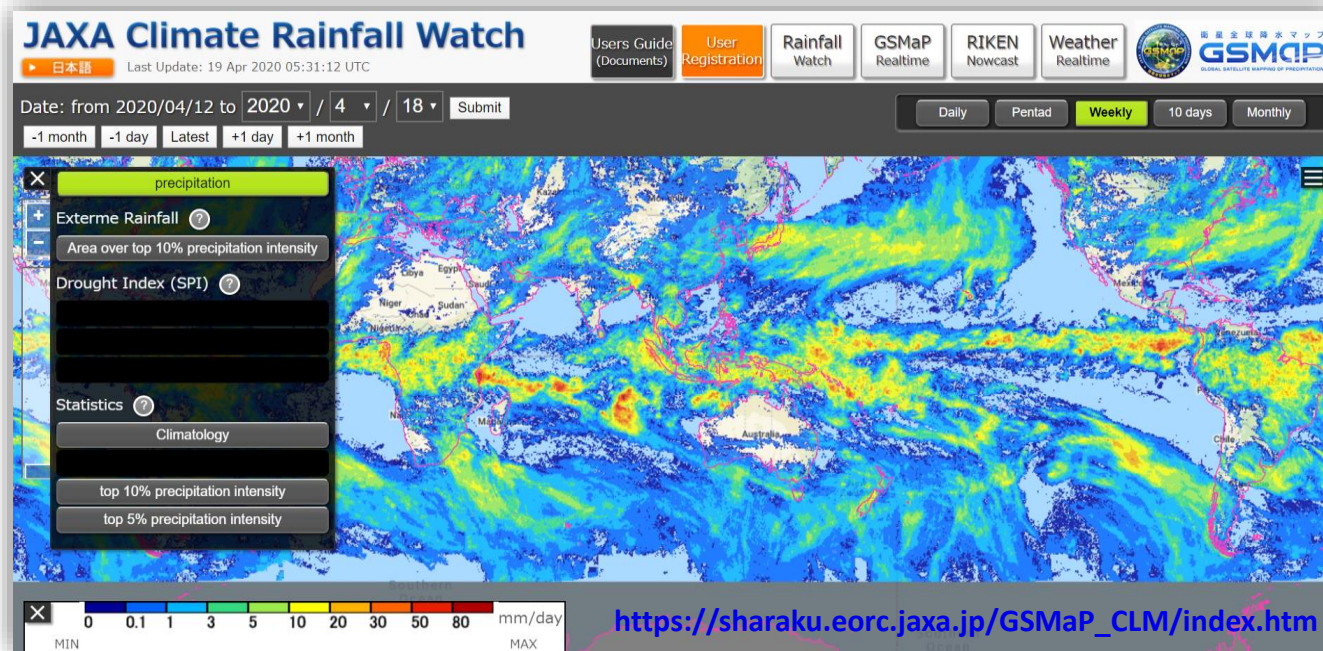
Activities of JAXA/EORC for SWCEM



SWCEM East Asia and Western Pacific regional operational subproject (SWCEM-EAWP)

JAXA/EORC has developed the **JAXA Global Satellite Mapping of Precipitation (GSMaP)** in the Global Precipitation Measurement (GPM) mission. We have participated in the SWCEM by providing the GSMaP Near-real-time Gauge-adjusted Rainfall Product version 6 (GNRT6) since October 2018. Based upon our experiences in the SWCEM, we have operated a website **“JAXA Climate Rainfall Watch”**, which provides information about extreme heavy rainfall and drought over the world using the GNRT6.

Here, GSMaP Products for SWCEM-EAWP are explained.



GSMaP Near-real-time Gauge-adjusted Rainfall Product



The GSMaP data are hourly precipitation products blended with satellite-borne passive microwave radiometers and infrared radiometers, and the horizontal resolution is 0.1 x 0.1 degree lat/lon grid. The data are mainly comprised of “*standard product*,” “*near-real-time product*,” “*real-time product*,” and “*reanalysis product*,” along with a classification of the latency.

The GSMaP Near-real-time Gauge-adjusted Rainfall Product version 6 (GSMaP_NRT_Gauge; GNRT6) is used for extremes monitoring, because shorter latency and higher accuracy are required. GNRT6 is the gauge-adjusted precipitation, provided within four hours after observation and updated at one-hour intervals, although its accuracy is clearly higher than that of the real-time product.

GNRT6 adjusts GSMaP Near-real-time Product version 6 (GSMaP_NRT; NRT6) using a system model with parameters calculated from data obtained during the past 30 days. Though the GSMaP Gauge-adjusted Rainfall Product (GSMaP_Gauge) with three-day latency is adjusted by the NOAA Climate Prediction Center (CPC) global rain gauge data, the CPC rain gauge data are not available in near-real-time processing (four-hour latency). The detail of system model for GNRT6 is described in *Tashima et al. (2020)*.

T. Tashima, T. Kubota, T. Mega, and T. Ushio, and R. Oki, 2020: Precipitation extremes monitoring using the near-real-time GSMaP product, IEEE J. Sel. Topics Appl. Earth Observ. Remote Sens. <https://doi.org/10.1109/JSTARS.2020.3014881>

Definition of Extreme Rainfall

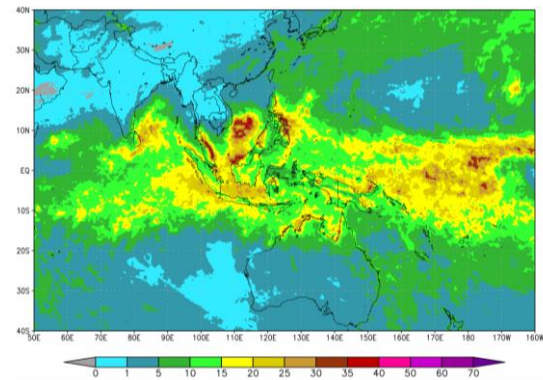
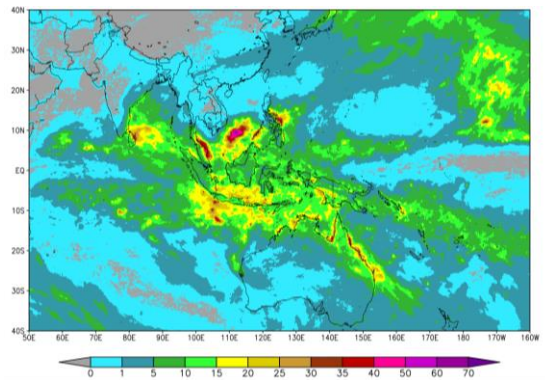


Extreme rainfall area is defined as an area where "the heavy rainfall criterion is 1 mm / day or more" and " mean rainfall exceeds the criterion". The criterion is the top 10% precipitation intensity (90th percentile) or more of the mean rainfall during the statistics period. The optimal threshold may vary from place to place.

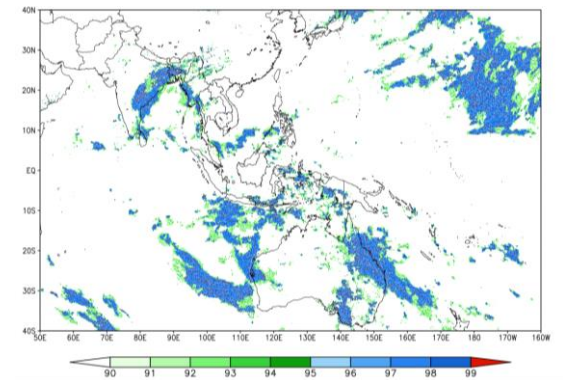
*Mean Rainfall
for a specified period*

*90th ~ 99th
Percentiles*

Extreme Rainfall



Percentiles



Definition of Drought



Drought is defined based on Standardized Precipitation Index (SPI) .

● What's SPI ?

It is based on **the probability of precipitation for any time scale**. The long-term precipitation record for a desired period is fitted to a probability distribution, which is then transformed into a normal distribution.

● Strengths

- Precipitation is the only input parameter.
- It can be computed for different time scales, **provide early warning of drought and help assess drought severity**.

● Weaknesses

- It can only quantify the precipitation deficit.
- Values based on preliminary data may change, and values change as the period of record grows.

● Desired Period

Ideally, one needs at least 20-30 years of monthly values, with 50-60 years (or more) being optimal and preferred.

Source: http://www.wamis.org/agm/pubs/SPI/WMO_1090_EN.pdf

Drought Classification



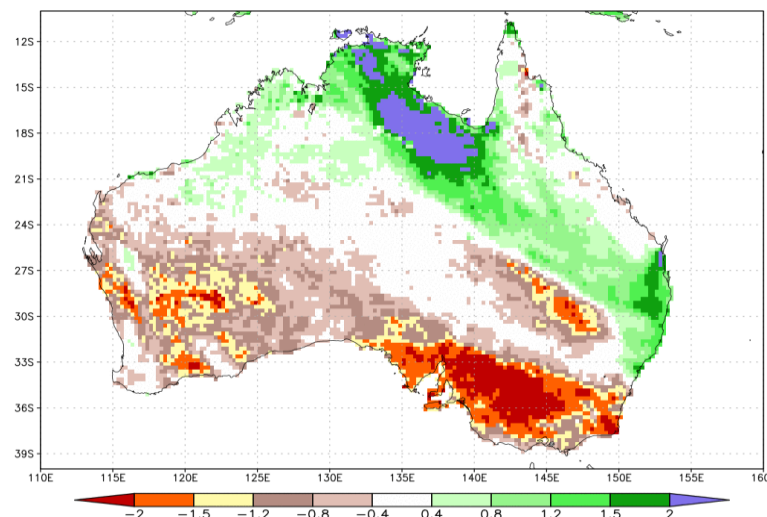
【Drought classification】

Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation.

classification	SPI range
Moderate Drought	-0.8 to -1.2
Severe Drought	-1.2 to -1.5
Extreme Drought	-1.5 to -2.0
Exceptional Drought	-2.0 or less

e.g. 1-Month SPI (GSMaP)

2007-08



【Reference】

NOAA/CPC Drought Indices Web site

<https://www.cpc.ncep.noaa.gov/products/Drought/Monitoring/spi.shtml>

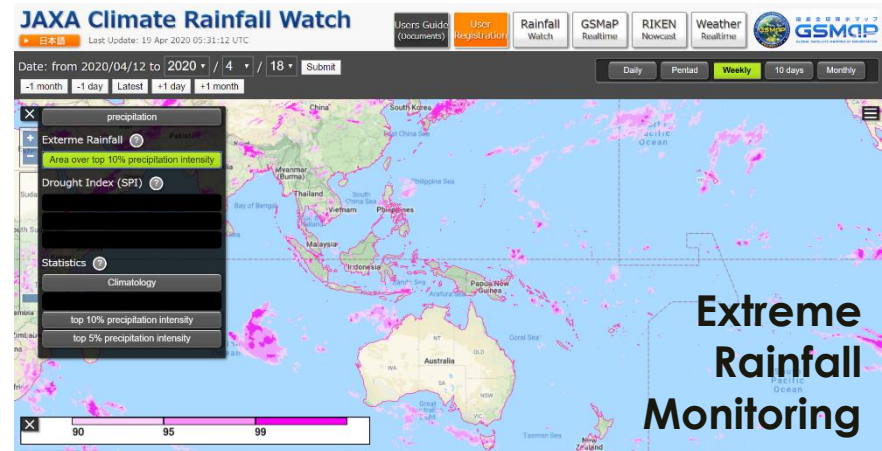
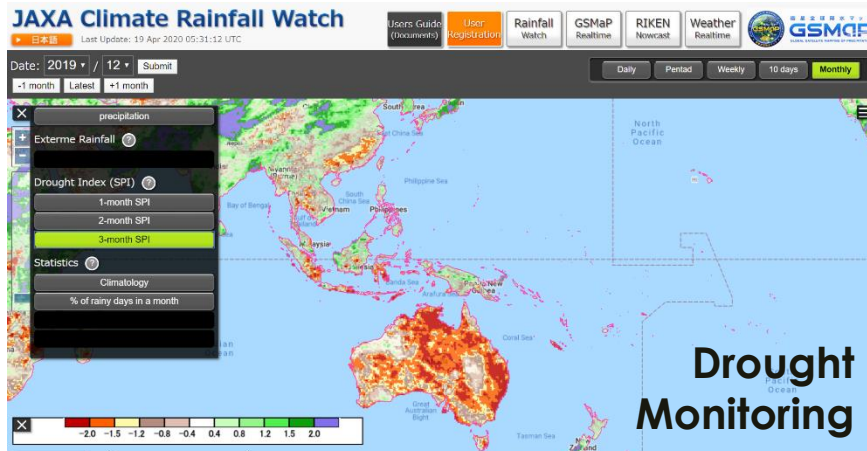
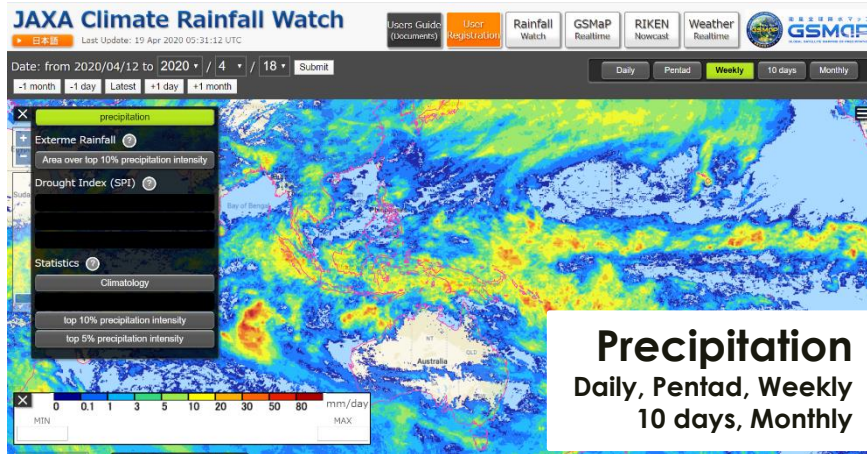
【Acknowledgment】

The SPI calculation program was provided by NOAA/CPC.

JAXA Climate Rainfall Watch



https://sharaku.eorc.jaxa.jp/GSMaP_CLM/index.htm

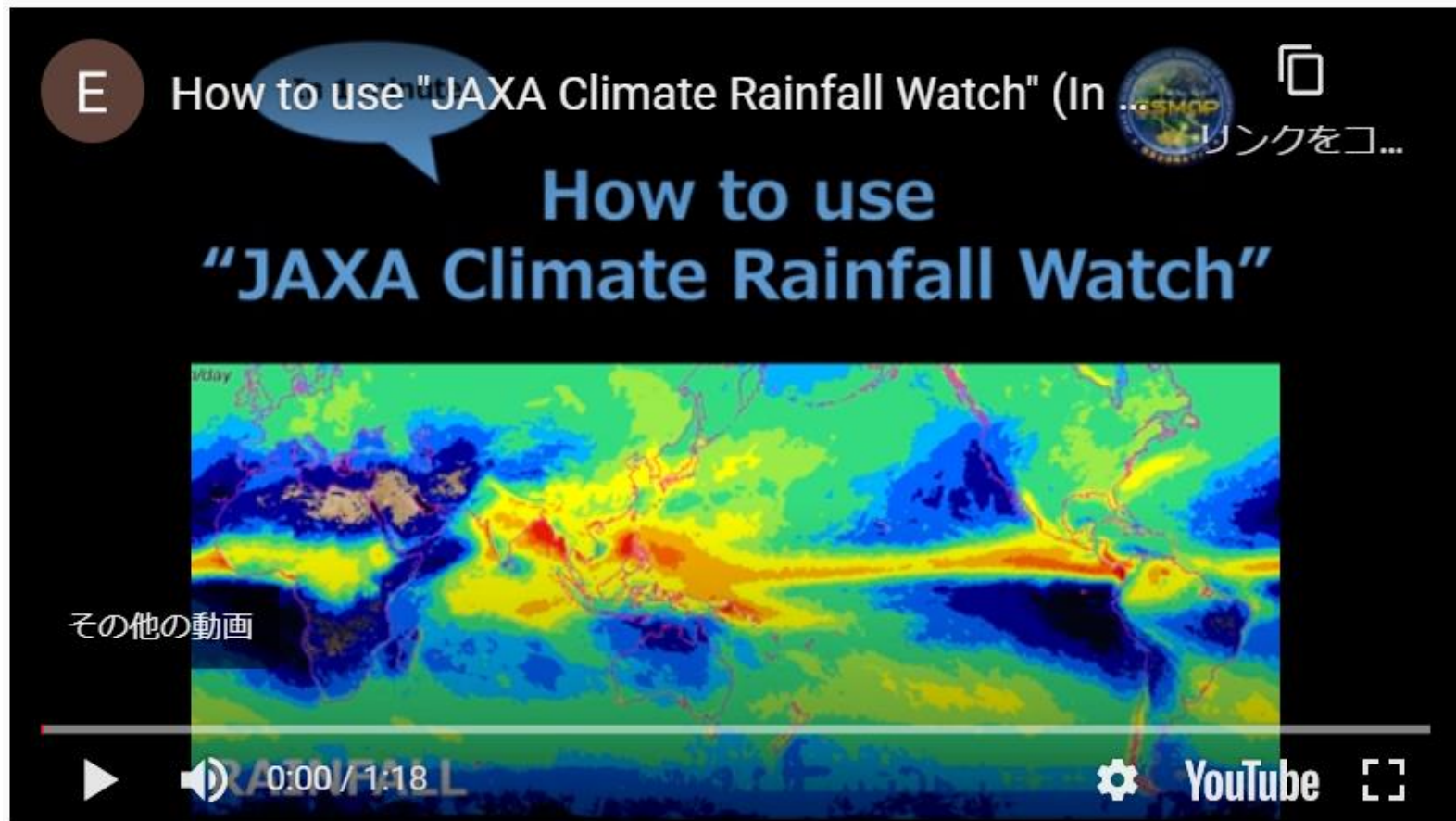


JAXA Climate Rainfall Watch



How to use the website “JAXA Climate Rainfall Watch”

<https://youtu.be/Jc0Z-o6fDPU>





Products available on FTP sites

Dataset
(NetCDF & binary format)

REVISION HISTORY



#	Date	Description
1	October 2018	Initial version (V1.0) domain : 50°E-160°W, 40°S-40°N statistical period : 18-yr (Apr. 2000 ~ Mar. 2018)
2	18 December 2018	Extended version of SEMDP-EAWP domain (V1.1) domain : 50°E-160°W, 45°S-40°N)
3	22 April 2019	Update statistical period statistical period : 19-yr (Apr. 2000 ~ Mar. 2019)
4	April 2020	Extended version of SWCEM-EAWP domain (V1.2) Update statistical period domain : 50°E-120°W, 45°S-40°N statistical period : 20-yr (Apr. 2000 ~ Mar. 2020) Change FTP Site ftp://sem_dp@hokusai.eorc.jaxa.jp → ftp://swcem@hokusai.eorc.jaxa.jp/EAWP
5	April 2021	Update statistical period statistical period : 21-yr (Apr. 2000 ~ Mar. 2021)

Mean Precipitation Data [NetCDF]



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/DATA/

#	Parameter [unit]	Grid size	Horizontal resolution	Temporal resolution	Variable	FTP directory / File Name
1	Hourly Rain Rate [mm/h]	1900 x 850	0.1° lat/lon grid box	Hourly	gsmap	YYYY/YYYYMM/ SEMDP_GSMaP_GNRT_0.10deg-HLY_YYYYMMDDHH.nc
2	Daily Rain Rate [mm/day]			Daily (00-23UTC)		YYYY/YYYYMM/ SEMDP_GSMaP_GNRT6_0.10deg-DLY_YYYYMMDD.nc
3	Pentad Rain Rate [mm/day]			Pentad (5-day)		YYYY/PEN/ SEMDP_GSMaP_GNRT6_0.10deg-PEN_YYYYPP.nc
4	Weekly Rain Rate [mm/day]			Weekly (Monday – Sunday)		YYYY/WLY/ SEMDP_GSMaP_GNRT6_0.10deg-WLY_SYYYYMMDD_EYYYYMMDD.nc
5	10-days Rain Rate [mm/day]			10-days		YYYY/YYYYMM/ SEMDP_GSMaP_GNRT6_0.10deg-10D_SYYYYMMDD_EYYYYMMDD.nc
6	Monthly Rain Rate [mm/day]			Monthly		YYYY/YYYYMM/ SEMDP_GSMaP_GNRT6_0.01deg-MON_YYYYMM.nc

*Spatial Domain: 45S-40N/50E-120W

YYYY: 4-digit year
MM: 2-digit month
DD: 2-digit day
HH: 2-digit hour
pp: 2-digit pentad



Statistics Data [NetCDF]



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/DATA/CLIMO/21yr_Apr2000-Mar2021/

#	Parameter [unit]	Grid size	Horizontal resolution	Temporal resolution	Variable	FTP directory / File Name
7	Daily Statistic	1900 x 850	0.1° lat/lon grid box	daily	precip percentile _rainy P90~p99	/DLY/SEMDP_GSMaP_GNRT_0.10deg -DLY_CLIMO.MMM.nc

*Spatial Domain: 45S-40N/50E-120W

● Statistical Period

Apr. 2000 to Mar. 2021

● Variables

- **precip** : monthly mean of daily precipitation estimates
- **percentile_rainy** : percentage of rainy (≥ 1 mm/day) days in a month
- **p9X** : 9Xth percentile of daily precipitation estimates

● Percentiles

Percentile curve constructed using data over a 3x3 grid boxes of the same surface type (land/ocean) domain centering at the target grid box in the target month.

Statistics Data [NetCDF]



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/DATA/CLIMO/21yr_Apr2000-Mar2021/

#	Parameter [unit]	Grid size	Horizontal resolution	Temporal resolution	Variable	FTP directory / File Name
8	Pentad Statistic	1900 x 850	0.1° lat/lon grid box	Pentad	precip P90~p99	/PEN/SEMDP_GSMaP_GNRT_0.10deg -PEN_CLIMO.Ppp.nc
9	Weekly Statistic			Weekly		/WLY/SEMDP_GSMaP_GNRT_0.10deg -WLY_CLIMO.SMMDD_EMMDD.nc

● Statistical Period

Apr. 2000 to Mar. 2021

*Spatial Domain: 45S-40N/50E-120W

● Variables

- **precip** : mean of precipitation amount on the target period
- **p9X** : 9Xth percentile of precipitation estimates during each period

NOTE 1: Maximum number of samples is

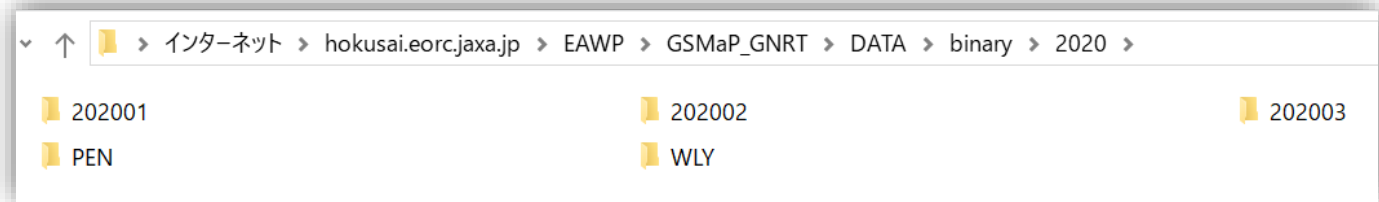
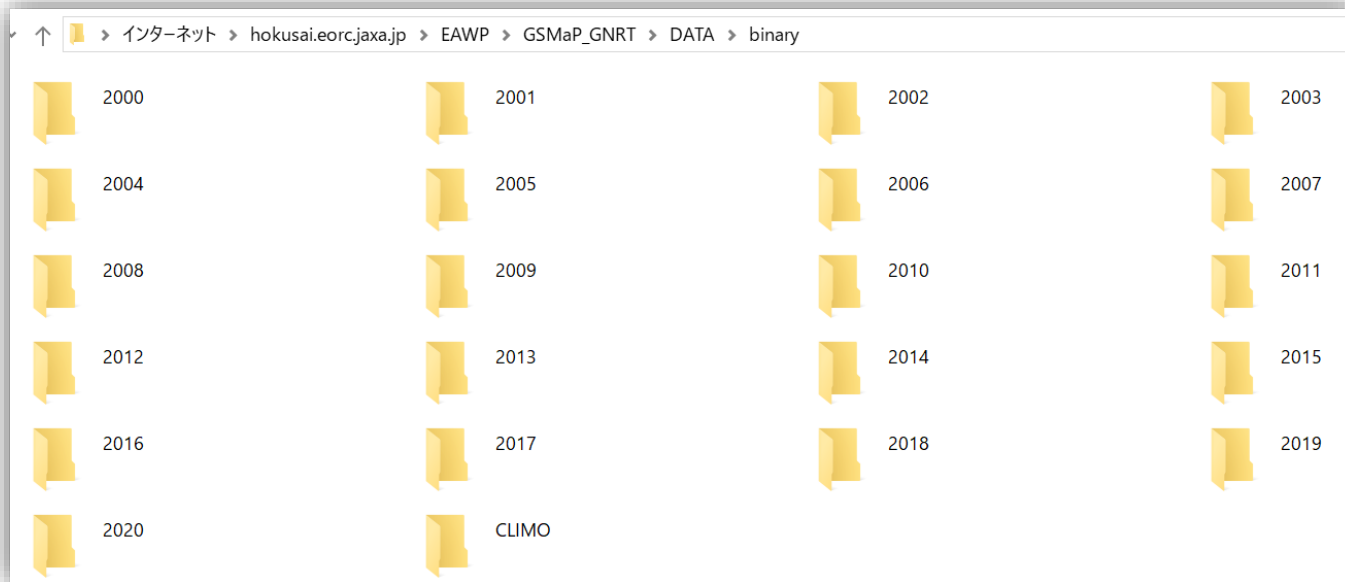
[pentad] 1,323 (7-pentad x 21-yr x 9-grids)

[weekly] 945 (5-weekly x 21-yr x 9-grids)

How to get binary format files



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/DATA/binary/



Directory structure and file naming convention are the same as NetCDF.

SPI Data [NetCDF & binary]



The one-month and three-month SPI values are derived from *GNRT6* for SWCEM.

- **Statistical Period**

until Mar. 2021: Apr. 2000 to Mar. 2021

since Apr. 2021: Apr. 2000 to Target Month

* It is possible that the SPI may have the statistical limitations.

- **Spatial Domain**

45S-40N/50E-120W

- **Archive**

(NetCDF files) ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/SPI/DATA/

(binary files) ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/SPI/DATA/binary

- Details of NetCDF files

Parameter [unit]	Grid size	Horizontal resolution	Temporal resolution	Variable	FTP directory / File Name
SPI	760 x 340	0.25° lat/lon grid box	Monthly	spi01 spi02 spi03	YYYY/SEMDP_SPI_GNRT6_0.25 deg-MON_YYYYMM



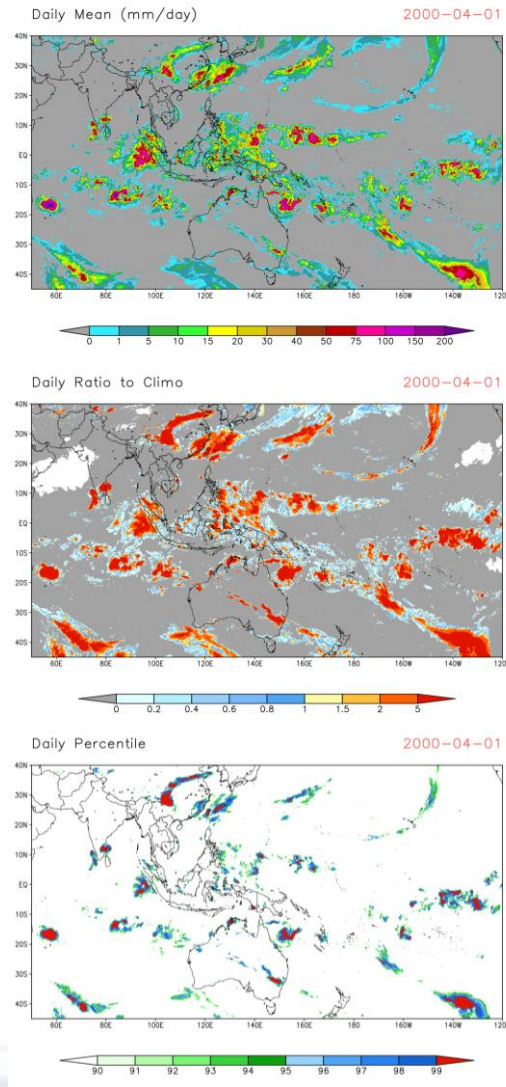
Products available on FTP sites

Image & Animation

Extreme Heavy Rainfall Monitoring



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/GIF/ClimateExtremes/



(top)
Mean precipitation (mm/day)
(middle)
Ratio to the 21-year mean
(bottom)
Precipitation percentiles (90th ~)

- **TARGET**
Extreme Heavy Rainfall

- **PERIOD**
Daily, Pentad, Weekly

- **GRID RESOLUTION**
0.1 degree lat/lon

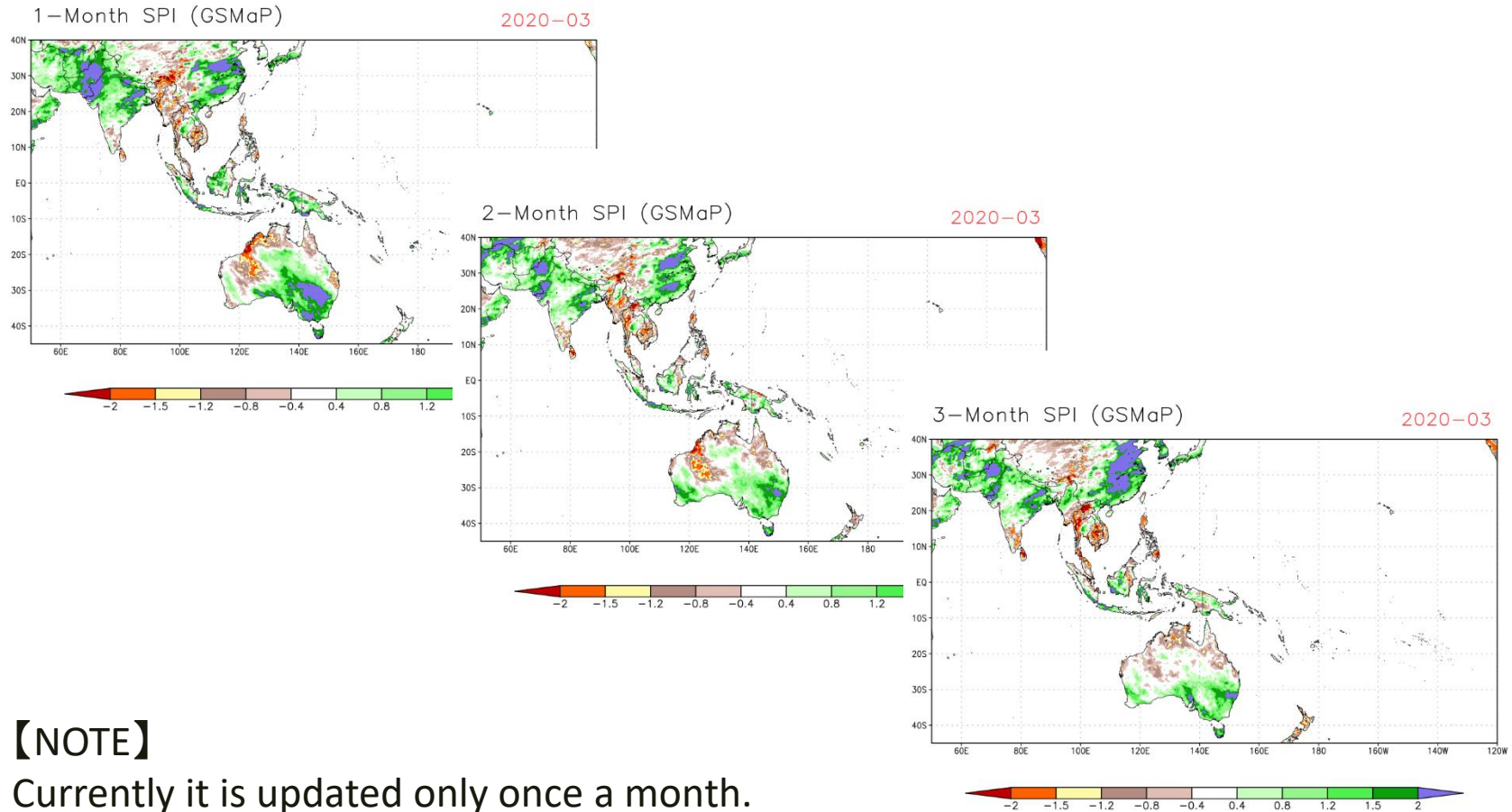
- **SPATIAL DOMAIN**
40N-45S/50E-120W

e.g. Daily (1 April, 2004)

Drought Monitoring



<ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/SPI/GIF/YYYY/>



【NOTE】

Currently it is updated only once a month.

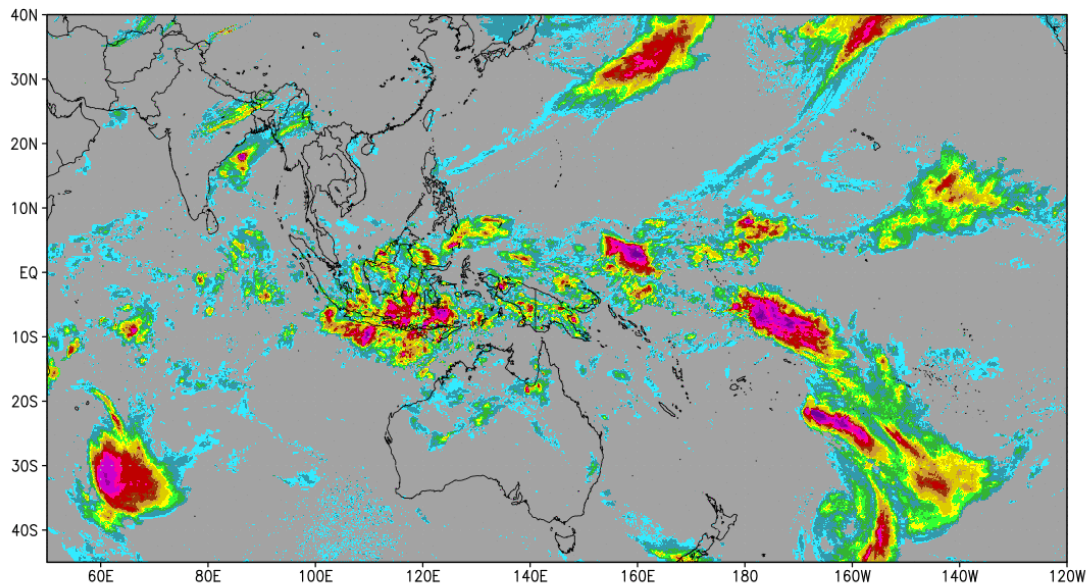
Quick Look (Realtime)



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/GIF/RealTime/

GSMaP (mm/day)

2020-01-01



- IMAGES

Recent hourly, daily and monthly precipitation

- ANIMATION

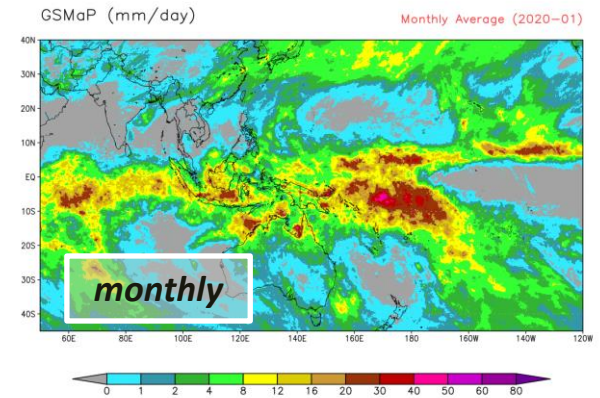
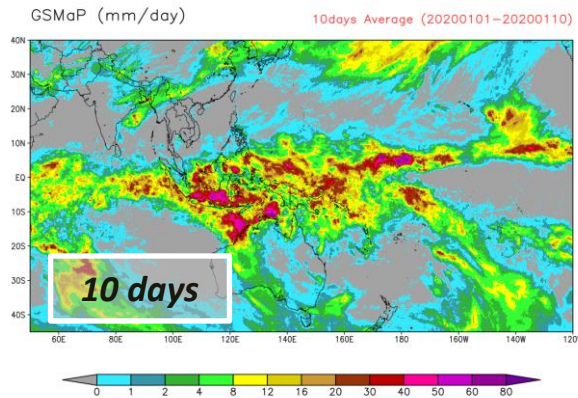
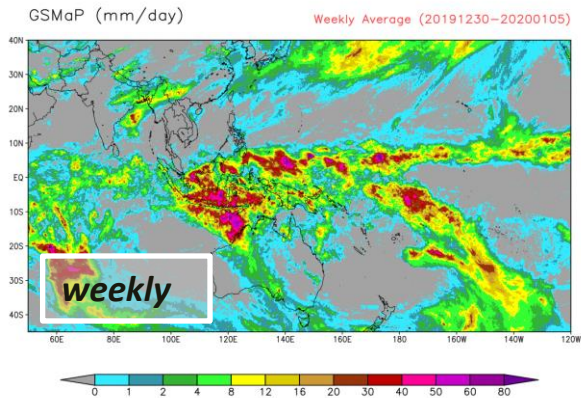
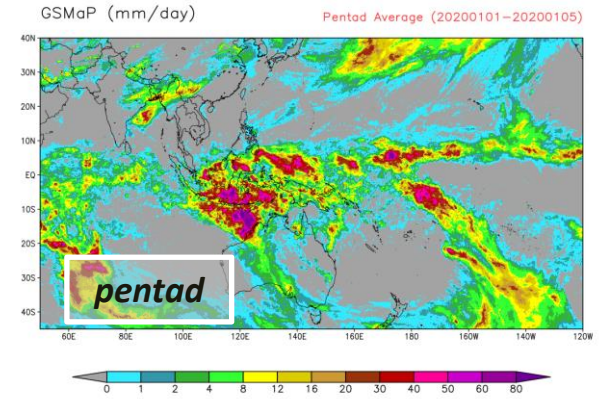
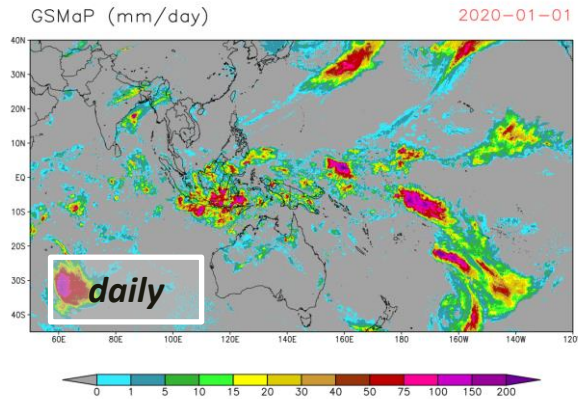
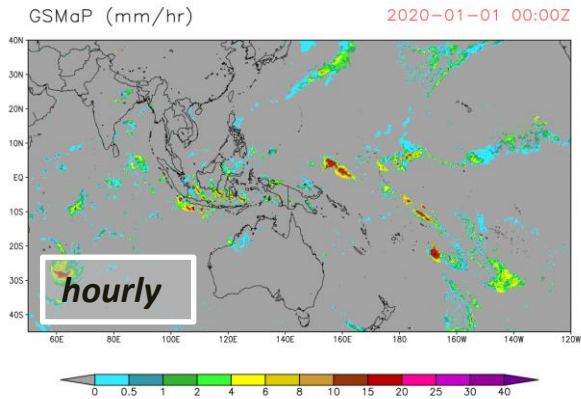
Daily precipitation for recent 30-days
Hourly precipitation for recent 48-hours

e.g. SEMDP_GSMaP_GNRT6_0.10deg-DLY_recent_30dy_animation.gif

Quick Look (Archive)



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/GIF/YYYY/



Quick Look (Statistics)



ftp://swcem@hokusai.eorc.jaxa.jp/EAWP/GSMaP_GNRT/GIF/CLIMO/21yr_Apr2000-Mar2021

