

Recent status of the Dual-frequency Precipitation Radar (DPR) and the Global Satellite Mapping of Precipitation (GSMaP) in the Global Precipitation Measurement (GPM) mission

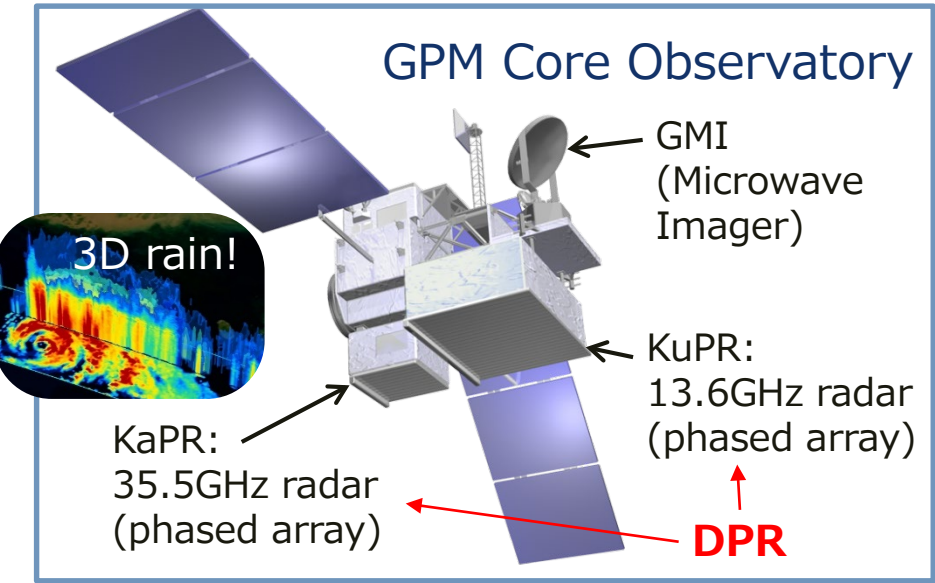
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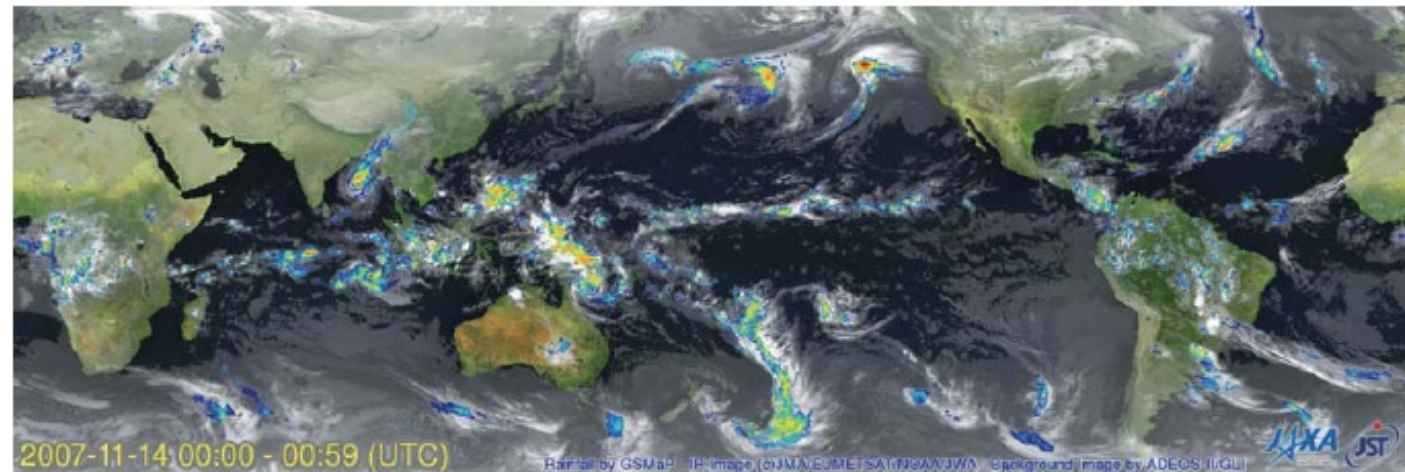
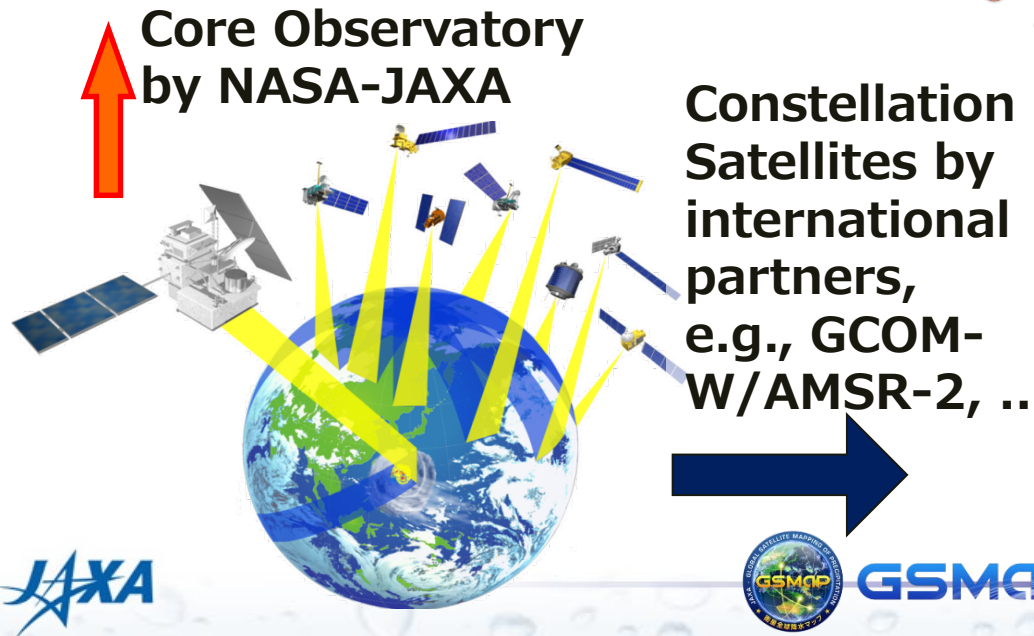
²*Nagoya University*

³*University of Tokyo*

Global Precipitation Measurement (GPM)



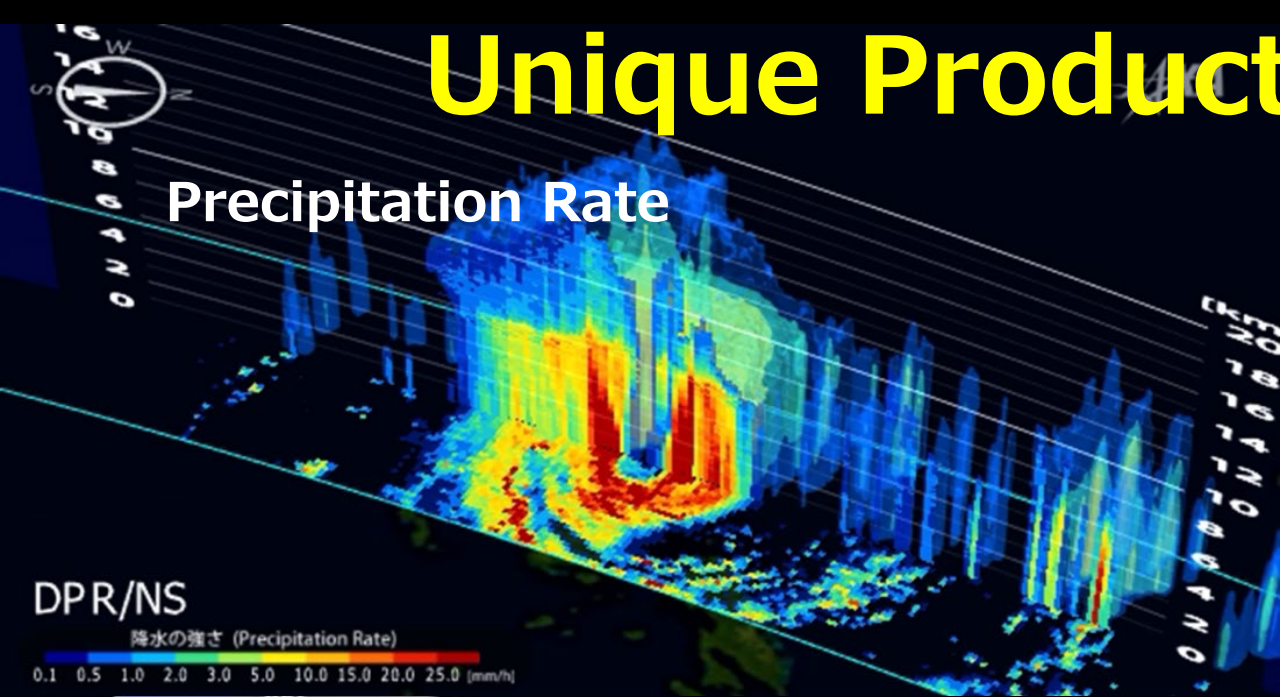
- GPM is an international mission consisting of the GPM Core Observatory and Constellation Satellites for high accurate and frequent global precipitation observation.
 - Core Observatory: developed under NASA and JAXA equal partnership.
 - Constellation satellites: provided by international partners (includes GCOM-W).
- Dual-frequency Precipitation Radar (DPR)
 - developed by JAXA and NICT
 - DPR is composed of two radars: KuPR & KaPR
- GPM Core Observatory was successfully launched at Tanegashima, Japan on Feb. 2014.



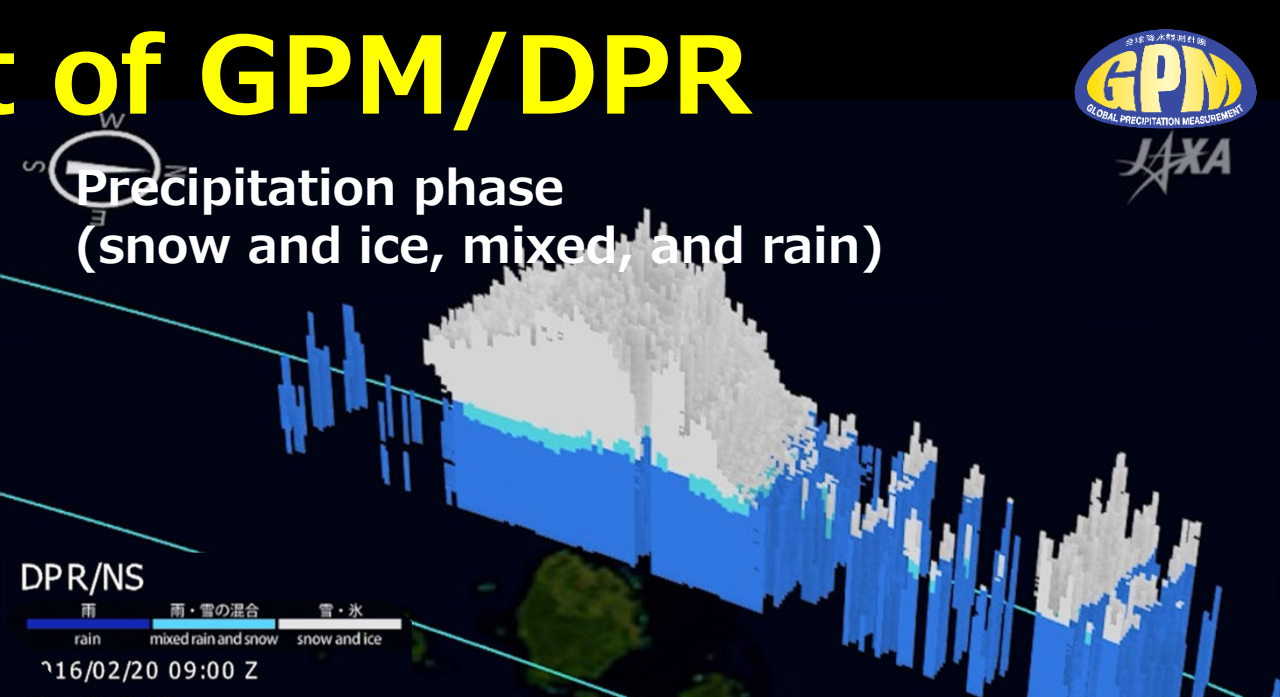
Unique Product of GPM/DPR



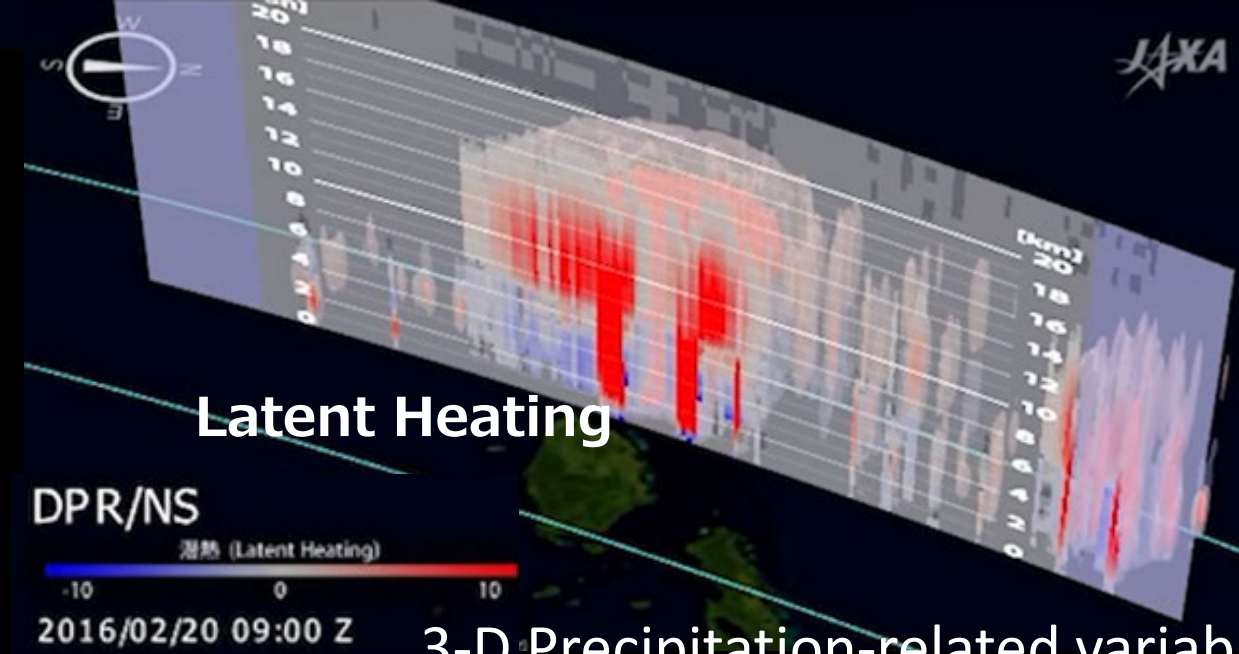
Precipitation Rate



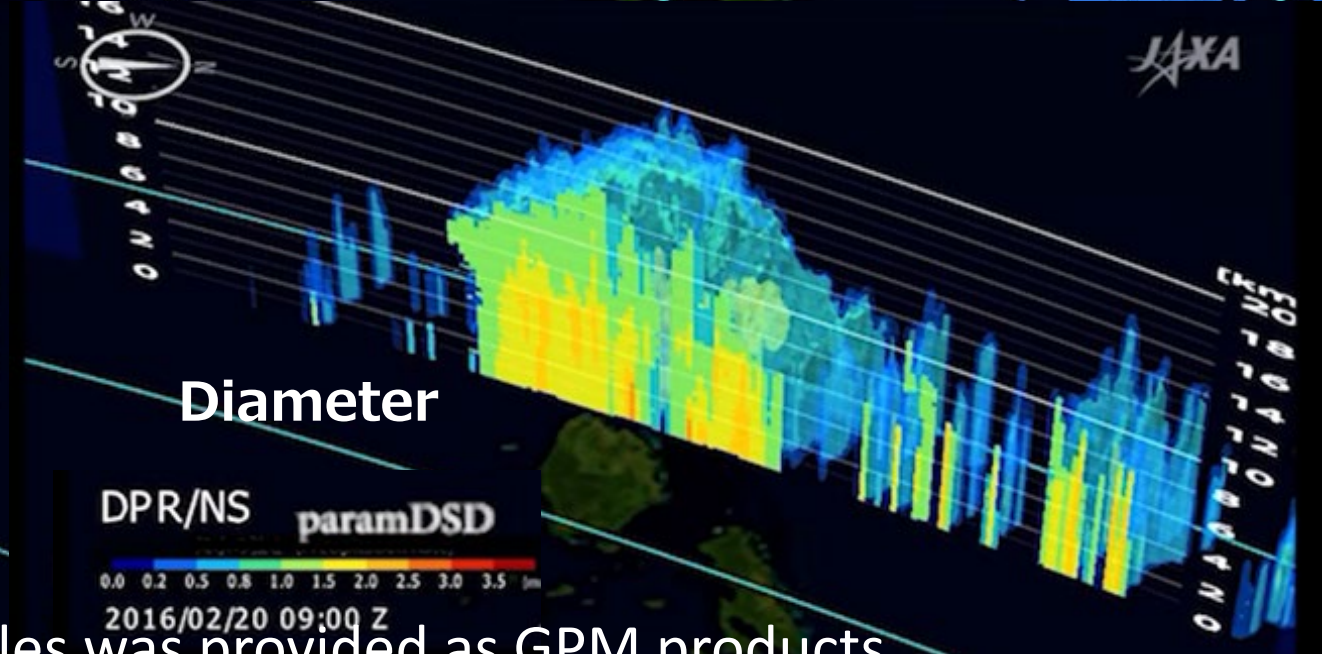
Precipitation phase
(snow and ice, mixed, and rain)



Latent Heating



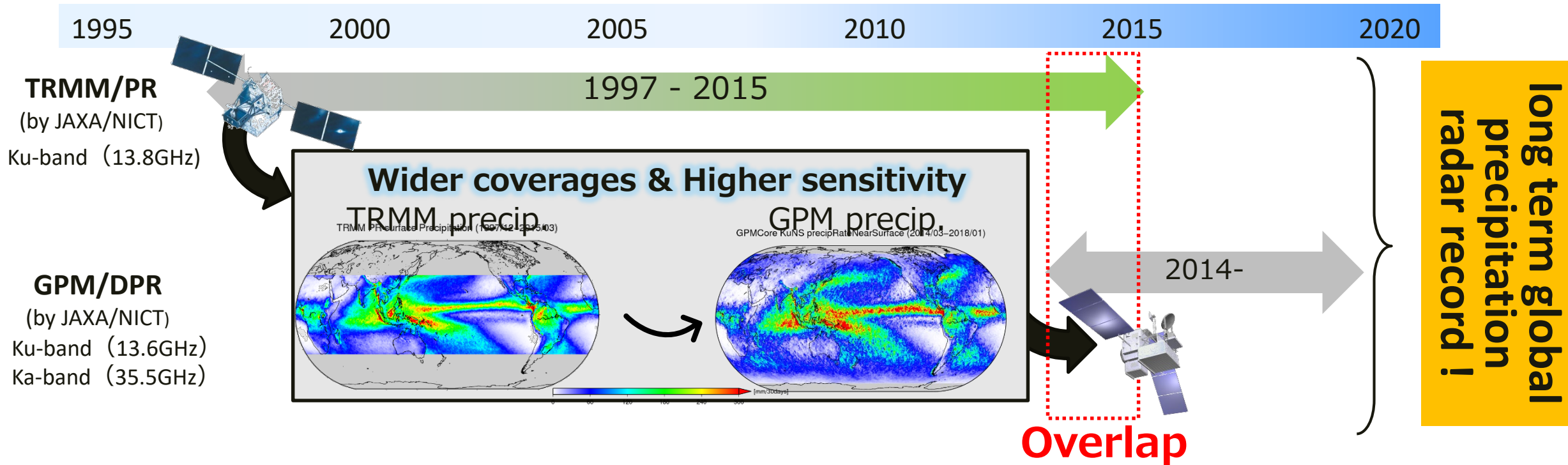
Diameter



3-D Precipitation-related variables was provided as GPM products.

<https://www.eorc.jaxa.jp/GPM/doc/product/format/en/03.GPM DPR L2 L3 Product Format Documentation V6 E.pdf>

Importance of long-term global precipitation radar record



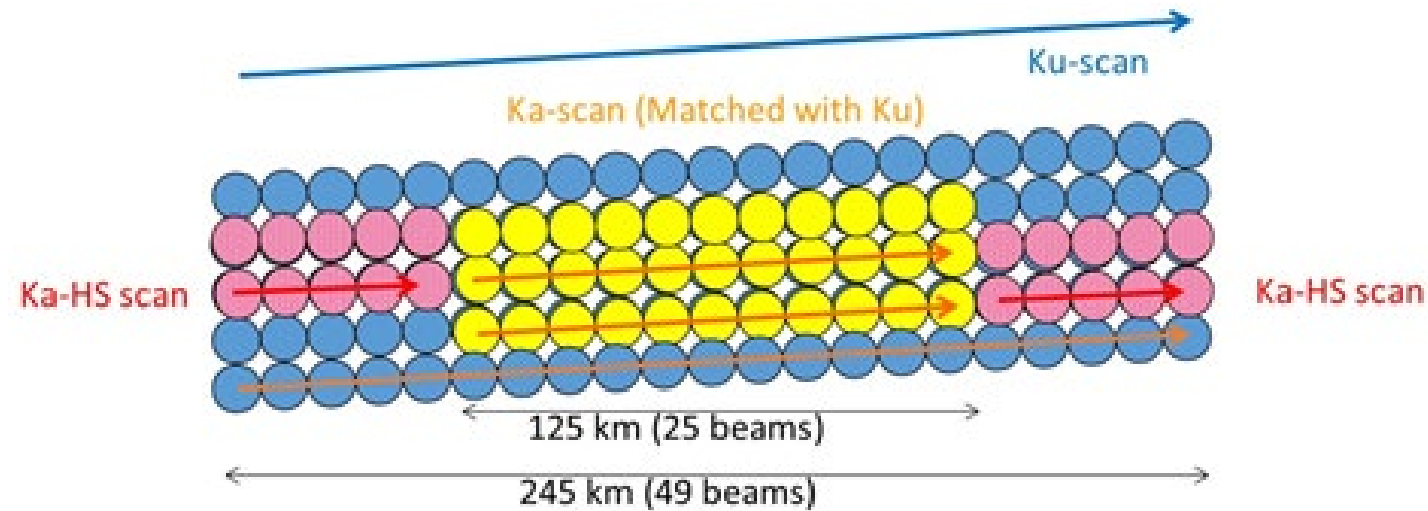
- TRMM/PR and GPM/DPR **Level-1 calibration factors** was changed in 2017 for **better continuity** between TRMM and GPM.
- Better continuity in Level 2/3 product was realized in the TRMM/GPM V06 released in 2018, by using common L2 algorithms between the TRMM/PR and GPM/KuPR. (Data format has also been common)

KaPR's scan pattern change (May 2018)

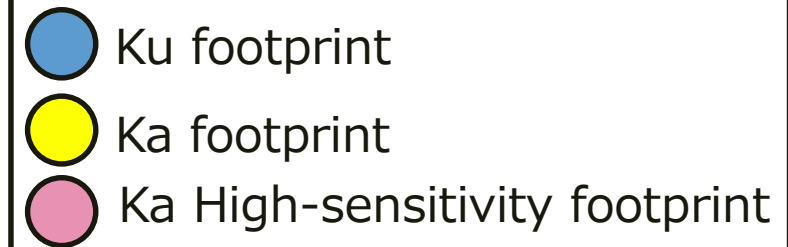
Before 21 May 2018



After 21 May 2018



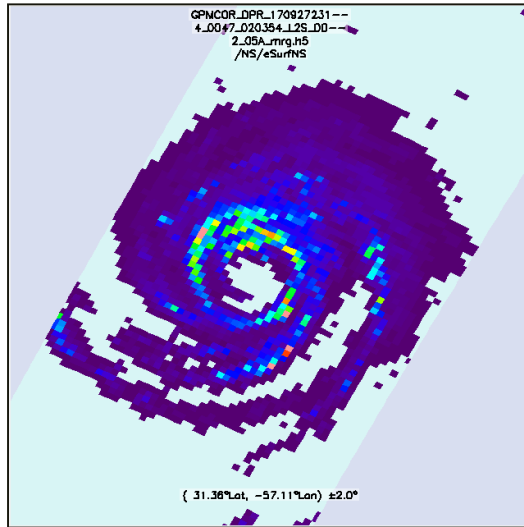
- The KaPR's scan pattern has been changed
 - to apply the dual-frequency technique to a full swath
 - to improve the beam matching between KuPR and KaPR
- **L2 experimental product applied to the scan pattern change will be released as Version 06X soon (June 2020).**
- **Next major version-up as V07 will be in 2021 (TBD)**



KaPR's scan pattern change; Experiment results

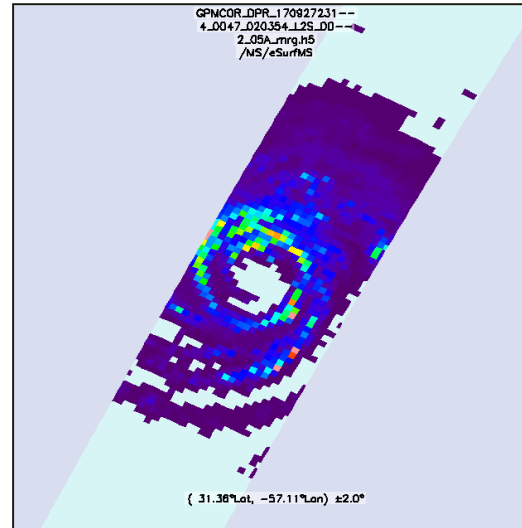
DPR L2 : precipRateESurface

KuPR

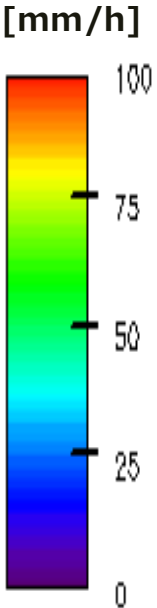
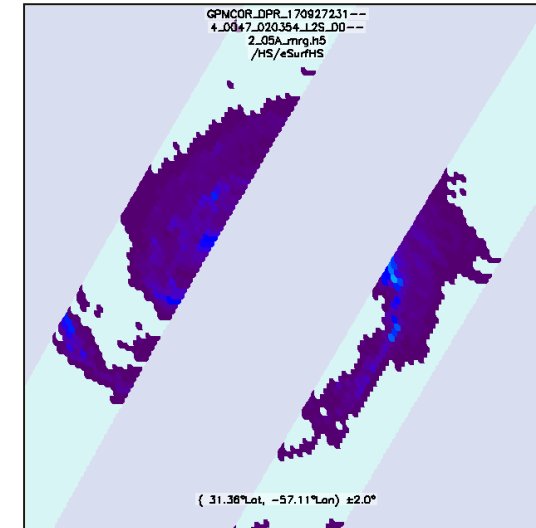


Experiment results: the current L2 algorithm is still in development phase.

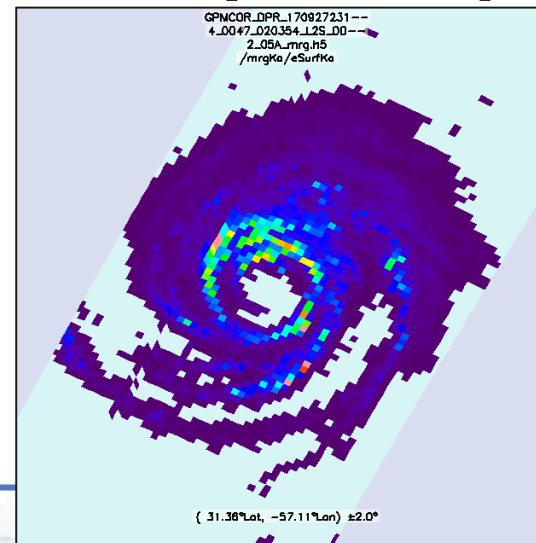
KaPR(MS)



KaPR(HS)



KaPR(MS/HS)



Sep 27th 2017 Hurricane LEE

Dual-frequency technique will be applied in a full swath, which can enable us more accurate estimates in the full swath.

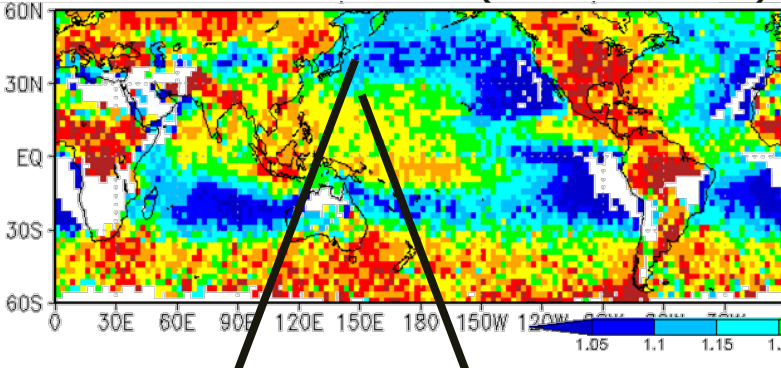
→ **L2 experimental product applied to the scan pattern change will be released as Version 06X soon (June 2020).**

Recent study by JAXA using DPR; Global Drop Size Distribution by GPM/DPR

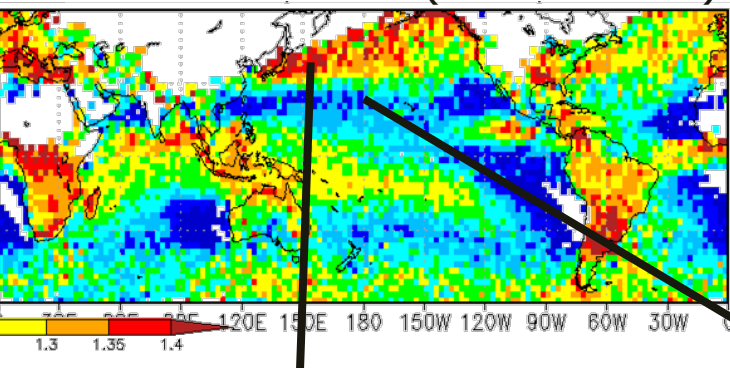
Yamaji et al. (2020, JMSJ)
http://jmsj.metsoc.jp/special_issues/editions/GPM.html



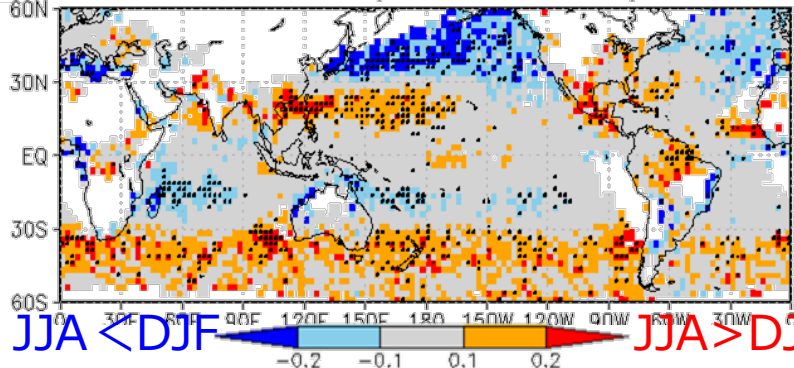
Diameter in **JJA** (2014-2018)



Diameter in **DJF** (2014-2018)



Diff. of Diameter in **JJA - DJF**



Dm showed statistically significant seasonal variations, which can be related to the changes in dominant precipitation systems.

Organized Precipitation System
(dominant in JJA)

High precipitation top height

Both **convective** and **stratiform**

0 deg level

#Baiu #Squall lines #tropical storms

Extratropical Frontal System
(dominant over mid-latitudes in DJF)

More **stratiform**

0 deg level

Large Diameter

#with ice particles in upper level

Shallow Convective System
(dominant over subtropics in DJF)

#Trade wind convections

Low precipitation top height

More **convective**

Small Diameter

GSMAP ; Global Satellite Mapping of Precipitation

Dual-Frequency
Precipitation Radar

Gauge-adjusted



cloud information by IR
imager on GEO satellite

Global
Precipitation
Measurement
Core satellite

GMI
Microwave
Imager

Providing reference standard

Constellation satellites

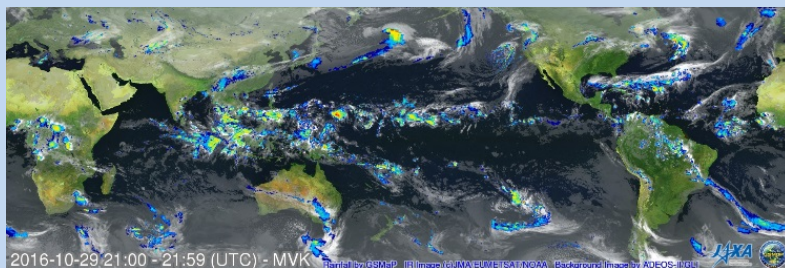
Precipitation Radar

Microwave Radiometer

IR Imager

Multi-satellite Rainfall Product

- hourly global rainfall data
- 0.1x0.1deg. lat/lon
- Various version such as **realtime** for monitoring or **long-term gauge-adjusted** for climatological purposes



distribution

- website
- CSV
- netCDF
- Binary
- GeoTIFF
- png



Updates on the realtime/near-realtime GSMaP



Real-time version, GSMaP_NOW has been extended to the whole globe since Jun. 2019!

*Data collection
by the JAXA-EUMETSAT MOU*



Nov.2015
Open to the public within Himawari region

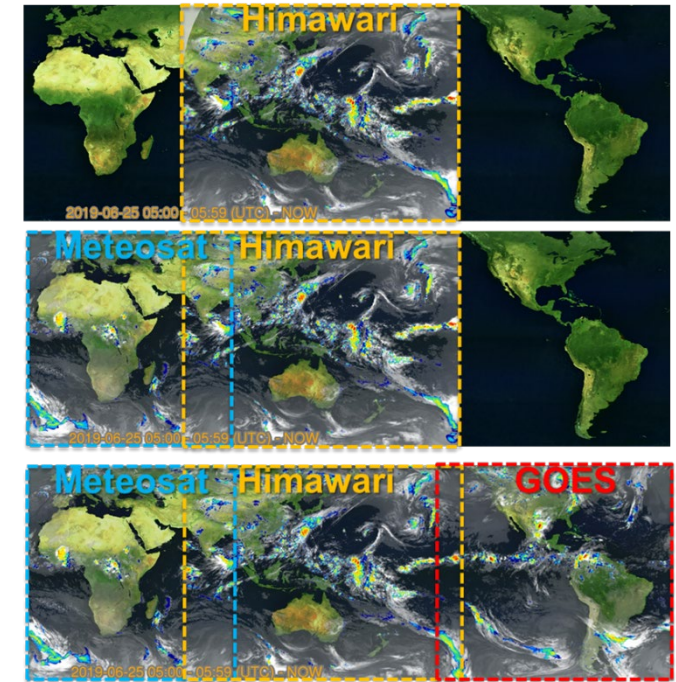
*Data collection
with the INPE, Chiba Univ. & JMA*



Nov.2018
Extended to Meteosat region

Jun.2019
Extended to GOES region

=Whole globe Rainfall data is available in realtime!



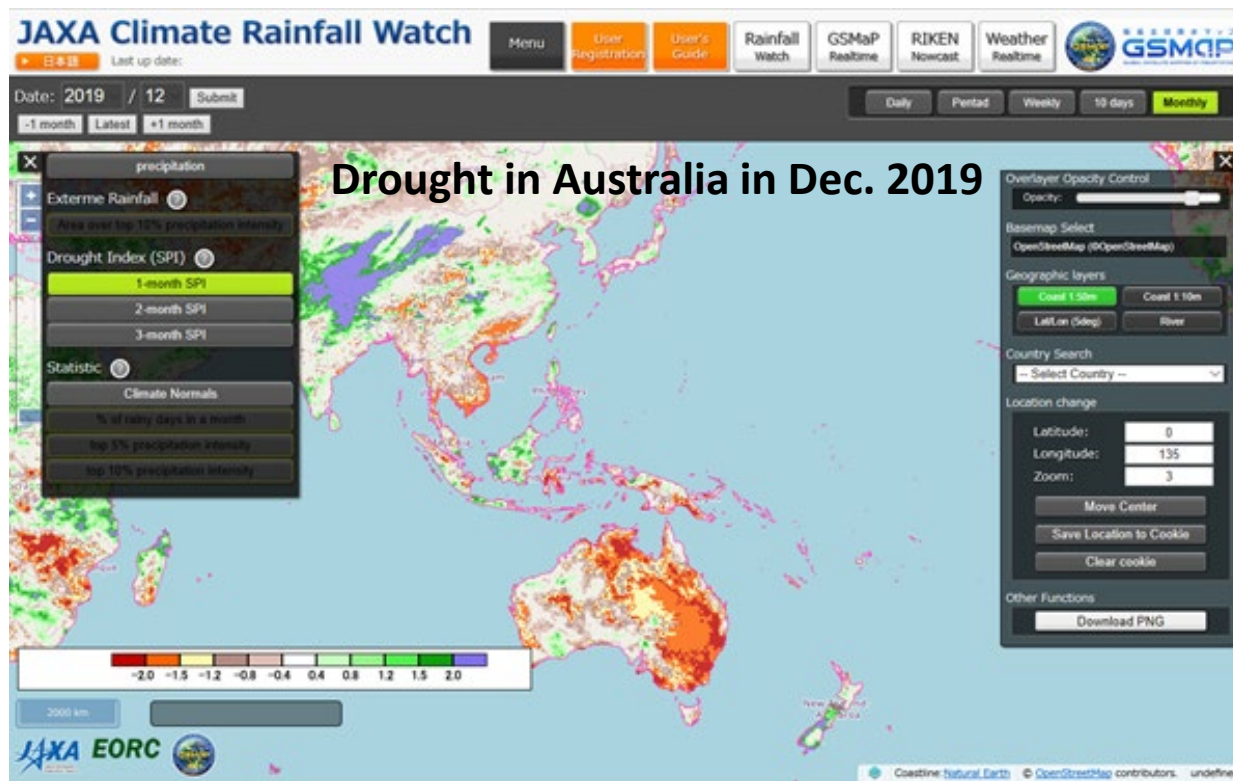
Gauge-adjusted Realtime/Near-Realtime version is available!

- ❁ Improved **NRT-basis Gauge-adjusted GSMaP** product was open to the public in Dec. 2018.
- ❁ Correction coefficients are calculated using past 30 days based upon Mega et al. (2019)'s method.
- ❁ Long-term data since March 2000 is available from ftp site.
- ❁ Newly **Gauge-adjusted GSMaP_NOW** has been open to the public since **Jun. 2019**.
- ❁ Correction method is mostly same as GSMaP_Gauge_NRT.

Extreme Heavy Rainfall and Drought by GSMaP

NEW website
Opened in Mar 2020

- **"JAXA Climate Rainfall Watch"**, which provides information about extreme heavy rainfall and drought over the world, is newly available.
- Easily monitor global extreme weather and climate by displaying accumulated rainfall in some temporal scale (daily, pentad, weekly, 10-days and monthly), indices related to Extreme heavy rainfall (percentiles) and Drought index (SPI).



Percentiles for extreme heavy rainfall,
and SPI for drought are used as indices.

Extreme heavy rain **Drought**



Heavy rain area is
colored with pink.
Darker pink indicates
heavier rain area.

Colors show:
Moderate drought
Severe drought
Extreme drought
Exceptional drought

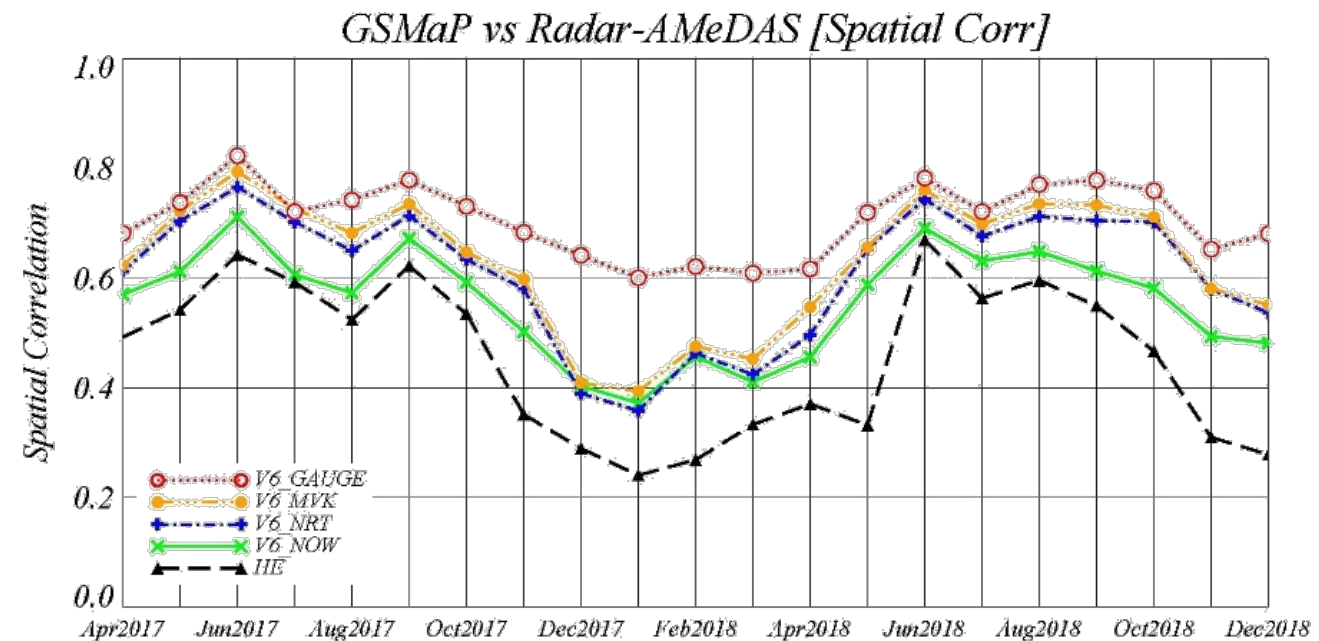
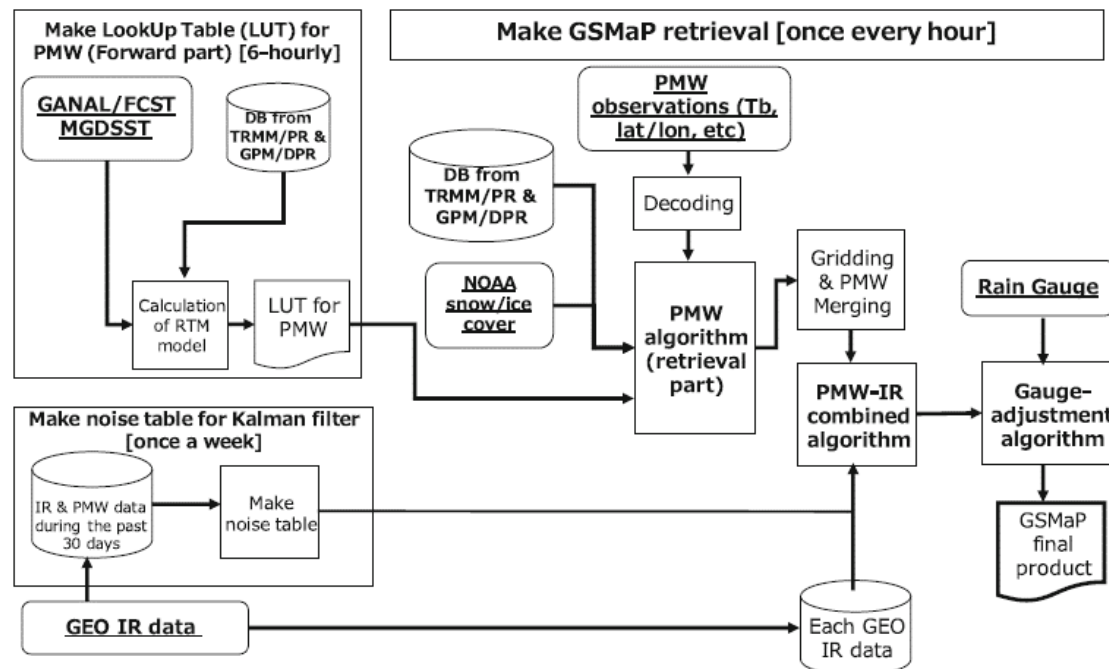
https://sharaku.eorc.jaxa.jp/GSMaP_CLM/

New reference paper of GSMaP in GPM era was published

● New reference paper of GSMaP in GPM era has been available:

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.

- The paper summarizes GSMaP products including the GSMaP_NOW and related algorithms in the GPM era and shows validation results.

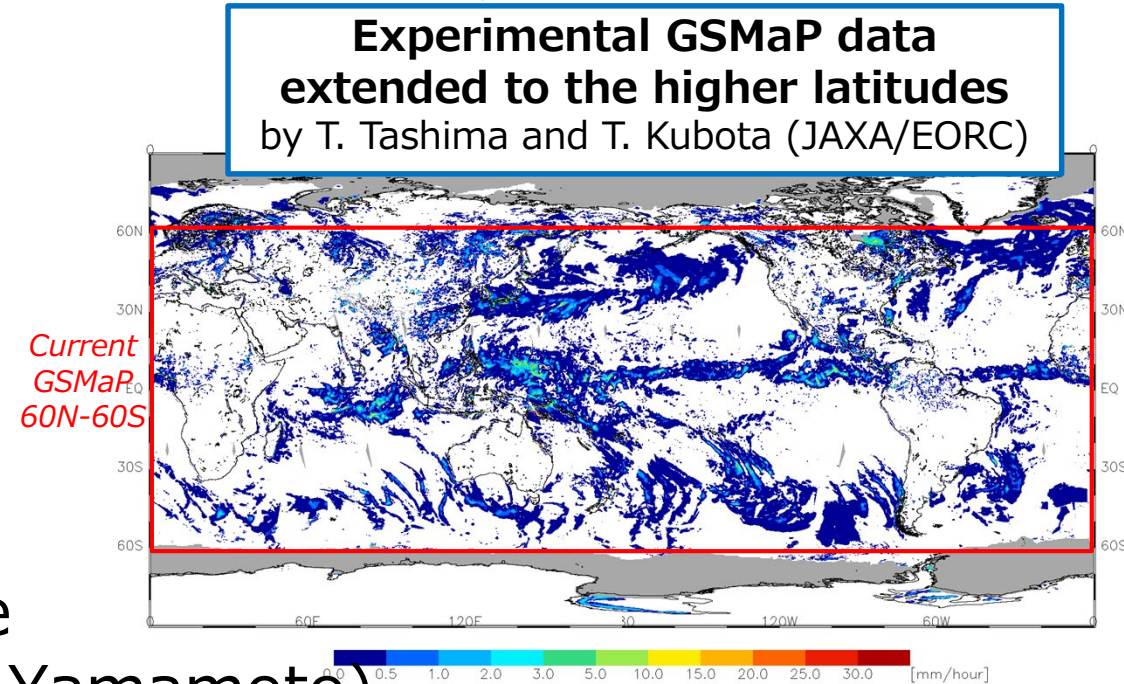


Plan for major version-up of GSMaP product

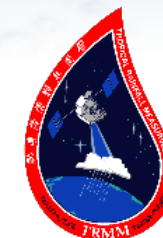


A new version (including reprocessing in past 20 years) of the GSMaP (Product version 05, algorithm version 8) will appear in Dec. 2020.

- Extend the PMW retrieval domain to the polar region.
- Improve the GSMaP PMW retrievals.
 - The database using GPM/DPR in the PMW retrievals
 - The scattering algorithm over the land (by Dr. Aonashi)
 - The method for orographic rainfall (by Prof. Shige)
- Install a normalization module among the PMW retrievals with the GMI/TMI (by Dr. Yamamoto)
- Improve the gauge-correction method and PMW-IR algorithm (by Prof. Ushio)



Summary



● GPM/DPR

- Better continuity was realized in the TRMM/GPM V06 released in 2018.
- L2 experimental product applied to the scan pattern change will be released as Version 06X soon (June 2020).

● GSMaP

- The domain of realtime product (GSMaP_NOW) was extended to the whole globe since Jun. 2019.
- Gauge-adjusted Near Realtime Product was improved and long-term data was open to the public in Dec. 2018.
- Indices related to extreme heavy rainfall and drought calculated by GSMaP is now available as both products and website since Mar 2020.
- A new version (including reprocessing in past 20 years) of the GSMaP (Product version 05, algorithm version 8) will appear in Dec. 2020.