Overview of Global Satellite Mapping of Precipitation (GSMaP)

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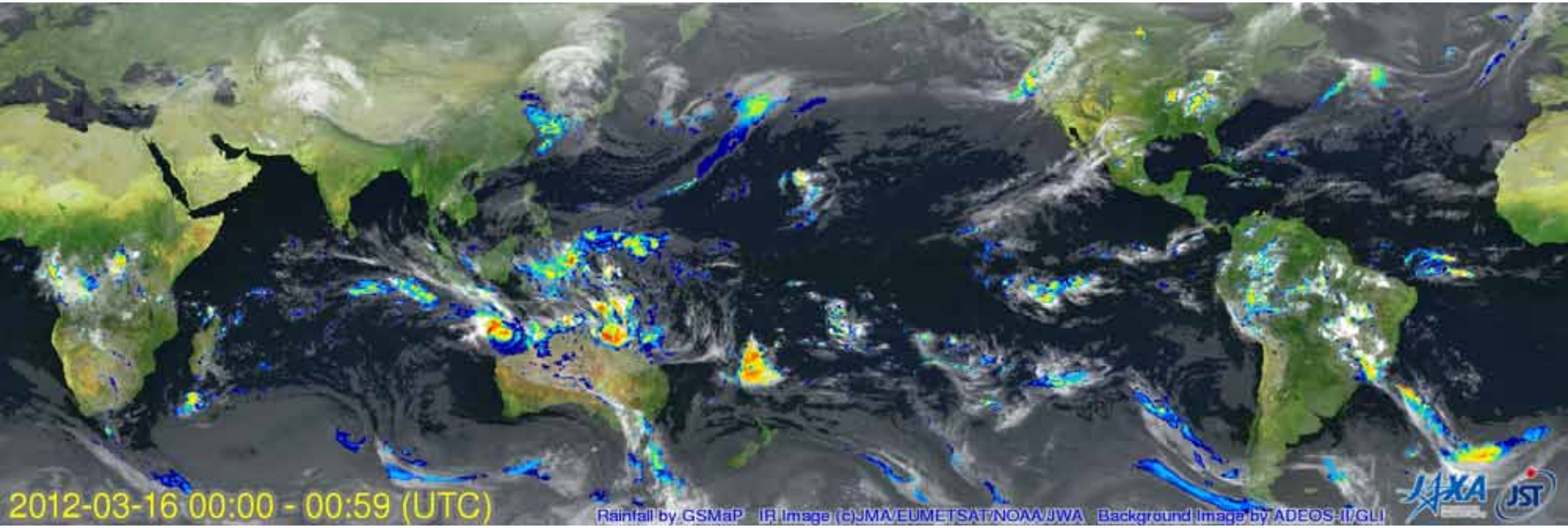
Today's Rainfall Distribution in the World

Rainfall and clouds in 00Z 16th March 2012 by GSMaP_NRT



I got this picture from our web site at 05Z of Today.

Precipitation Characteristics Observed by the Space Borne Instruments

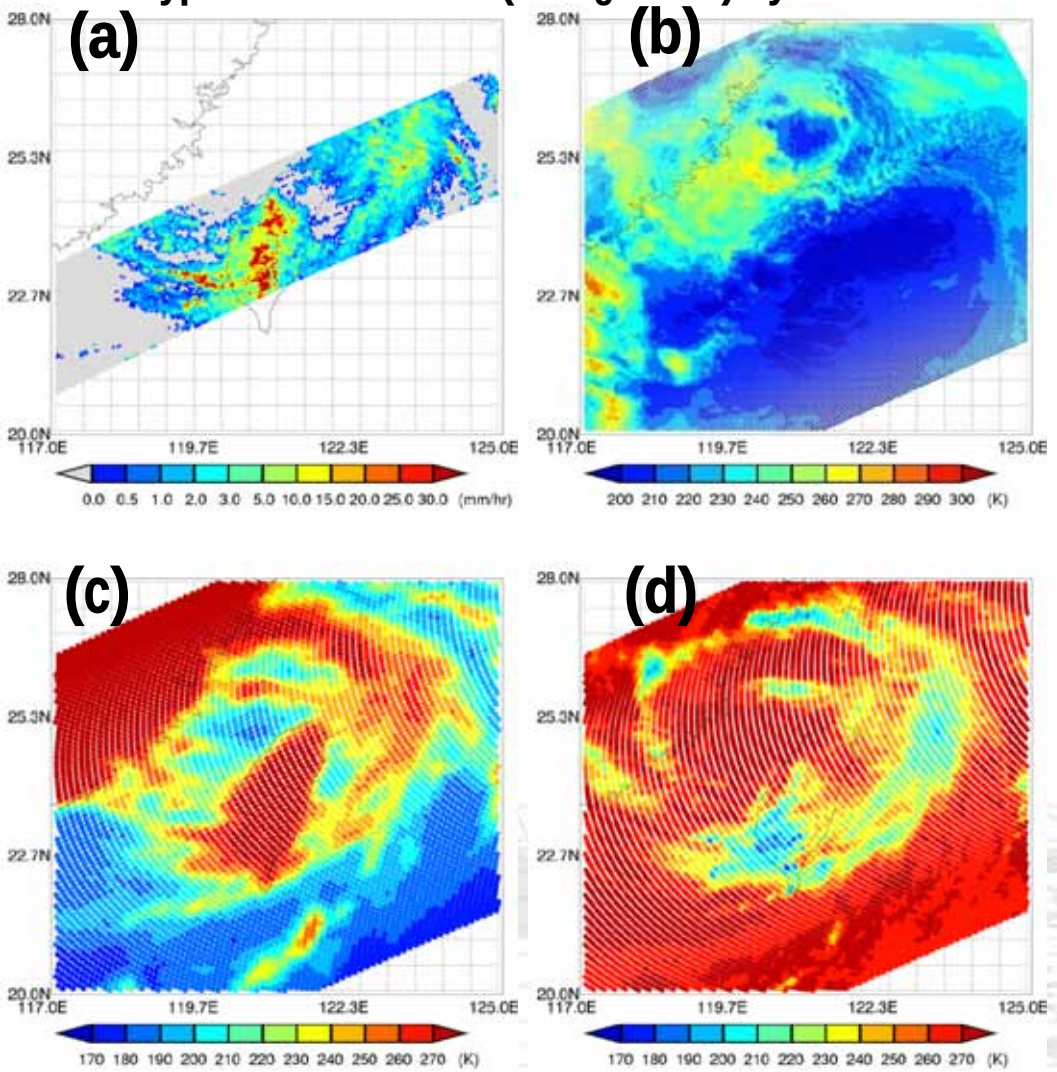
(a) Precipitation radar:
- Back scattering from rain drops
- High accuracy
- Narrow swath width

(b) Infrared radiometer:
- Cloud top information
- Not related to surface rain rates

(c) Microwave imager (19V):

(d) Microwave imager (85V):
- Directly measures emission from rainfall & scattering from snow/ice over the ocean
- Directly measures scattering from snow/ice over the land

Typhoon MORACOT (8 Aug. 2009) by TRMM



It is important to combine the data from different frequencies to retrieve precipitation

Production of "GSMaP" from Multi-satellite Data

GSMaP: Global Satellite Mapping of Precipitation

TRMM
TMI

Aqua
AMSR-E

DMSP
SSM/I, SSMIS

NOAA&MetOp
AMSU-A/MHS

Geostationary
Satellite

Rain models developed from PR observations

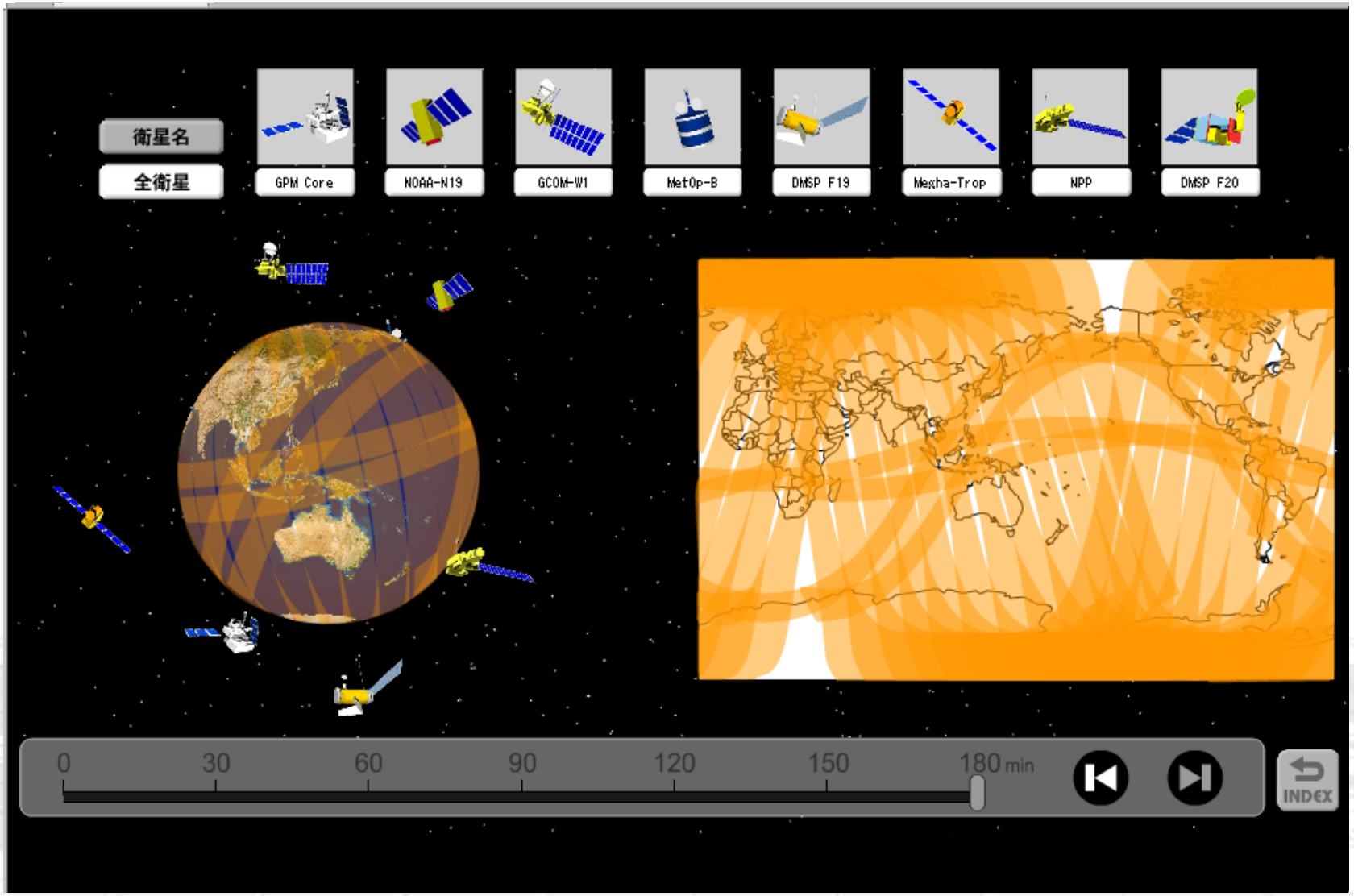
Rainfall data retrieved from each microwave imager and/or sounder

Hourly merged microwave rainfall map

Calculate cloud moving vectors

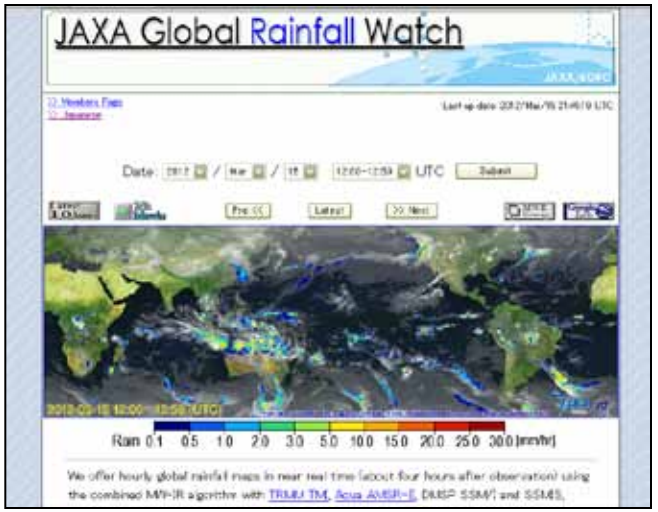
GSMaP rainfall in 0.1-deg grid and hourly

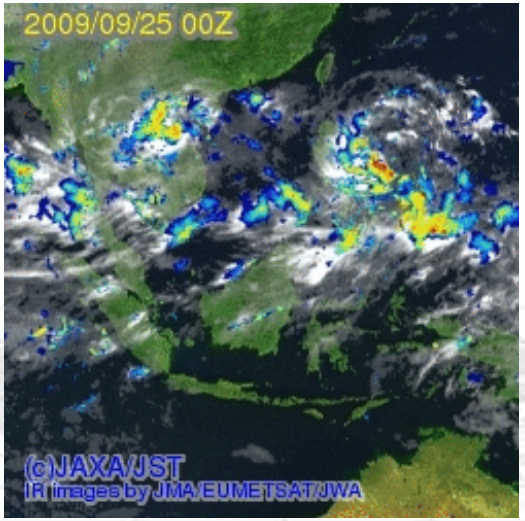
Why We Need “Multi” Satellite Data?



GSMaP and JAXA "Global Rainfall Watch"

- GSMaP
  - Originally funded by JST/CREST during 2002-2007, and by JAXA 2007-present.
  - MRI, Osaka Univ., Kyoto Univ., Univ. Tokyo
- Near-real-time version of GSMaP (JAXA Global Rainfall Watch) is distributed via internet
  - Binary and text data has been available since Oct. 2008 via password protected ftp site.
  - Recently introduced
    - SSMIS (F16, F17) since Jun. 2010.
    - AMSU-A/MHS (N19, MetOp-A) since Aug. 2011.
    - AMSU-A/B (N15, N16) and AMSU-A/MHS (N18) is in preparation
- Reanalysis data from Mar. 2000 - Nov. 2010 has been available since March 2012.

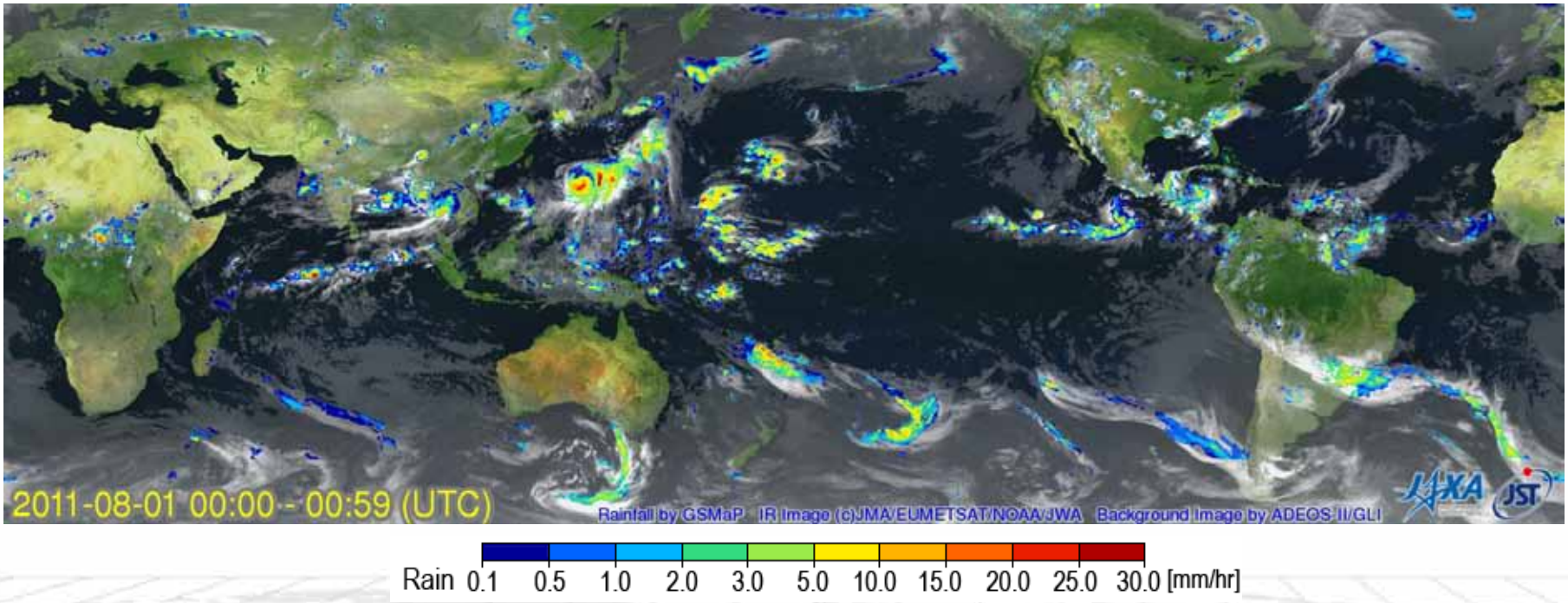




3-hourly animation of three typhoons (No.17-19) in 2009 by GSMaP_NRT.

JAXA/EORC Global Rainfall Watch

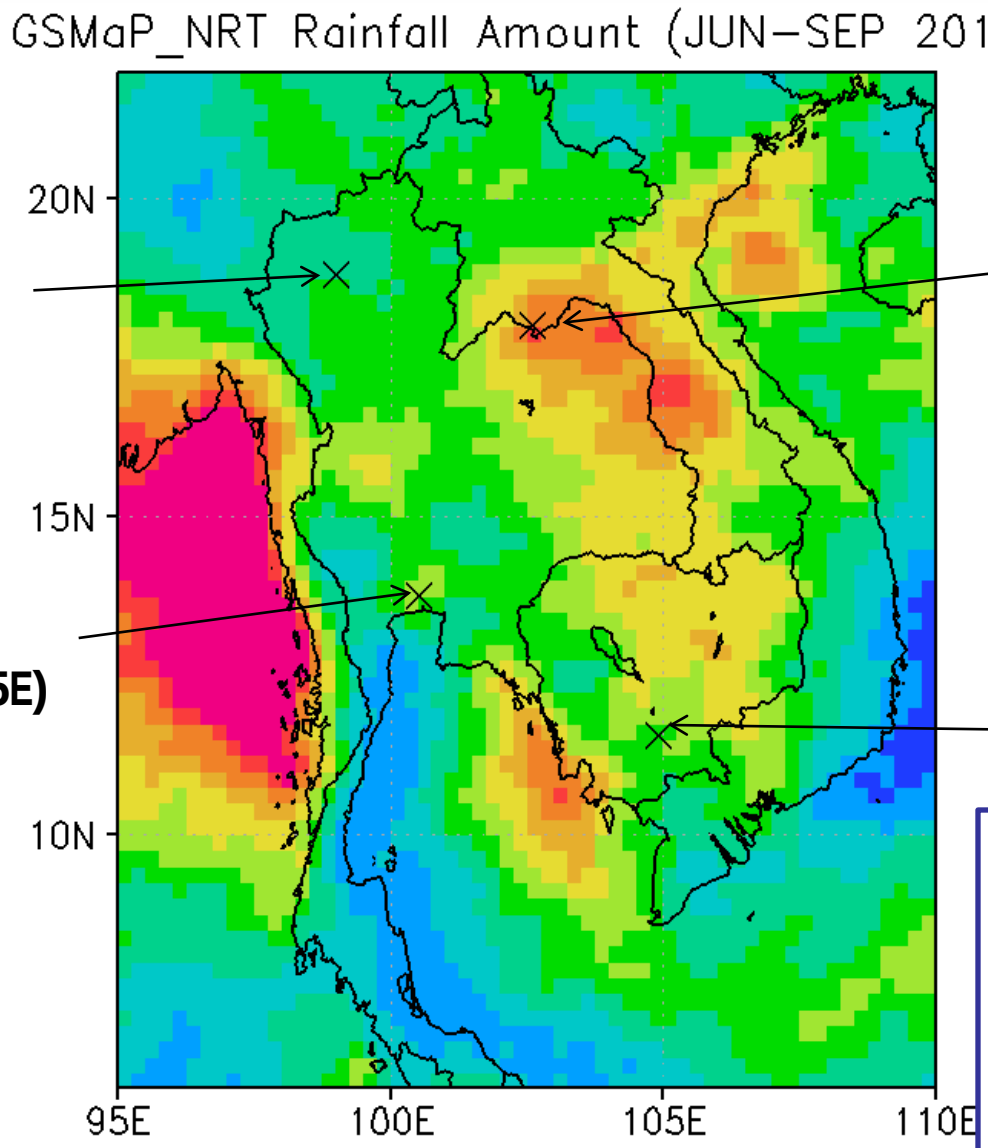
1-8 August 2011 (6-hourly) - Typhoon No.9 in 2011 “MUIFA” can be seen near Okinawa, Japan.



0.1-deg and hourly global rainfall product available 4-hour after observation via internet.

http://sharaku.eorc.jaxa.jp/GSMaP/

GSMaP Accumulated Rainfall Amount over Thailand during Jun-Sep 2011



Chiang Mai (18.8N, 99E) [Rain Gauge: 921mm]

Bangkok (13.75N, 100.5E) [Rain Gauge: 1251mm]

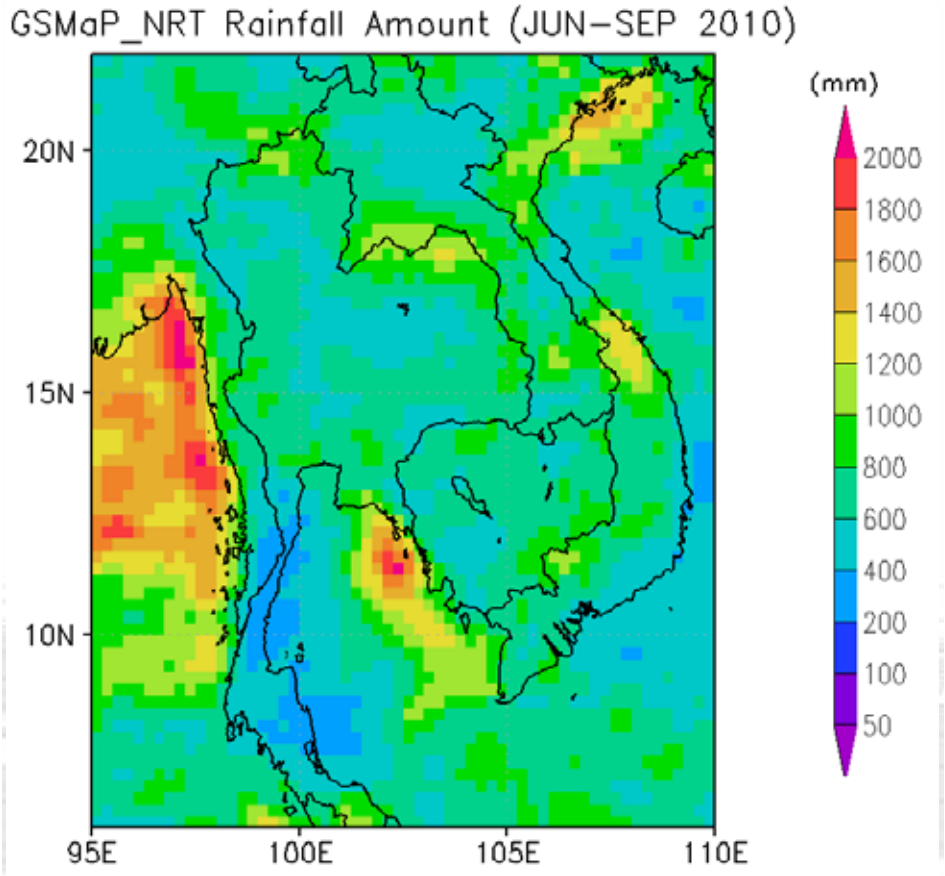
Vientian (18N, 102.6E) [Rain gauge: 1641mm]

Phnom Penh (11.55N,104.9E)

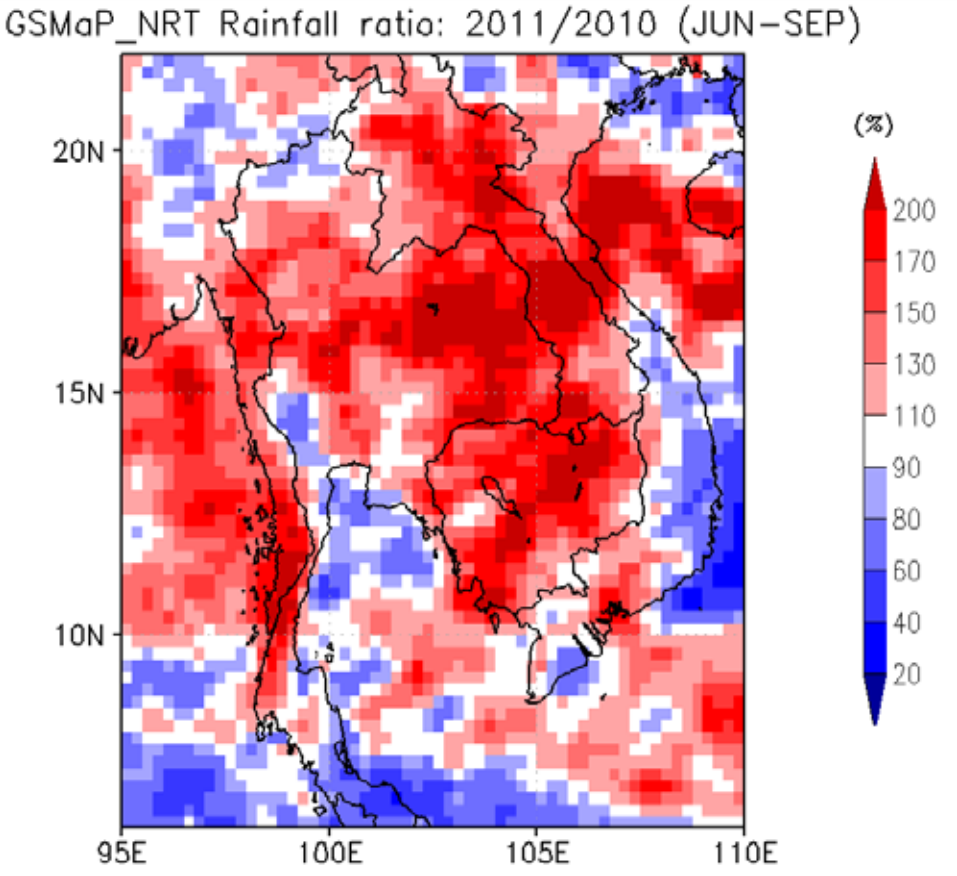
Accumulated rainfall amount by GSMaP_NRT was similar to those by rain gauges at Bangkok, Chiang Mai, and Vientian, provided by JMA .

Comparison to Rain Amount in 2010

Accumulated rainfall amount during Jun-Sep 2010



Ratio of R_{2011}/R_{2010} during Jun.-Sep.



International Precipitation Working Group (IPWG) Validation Program

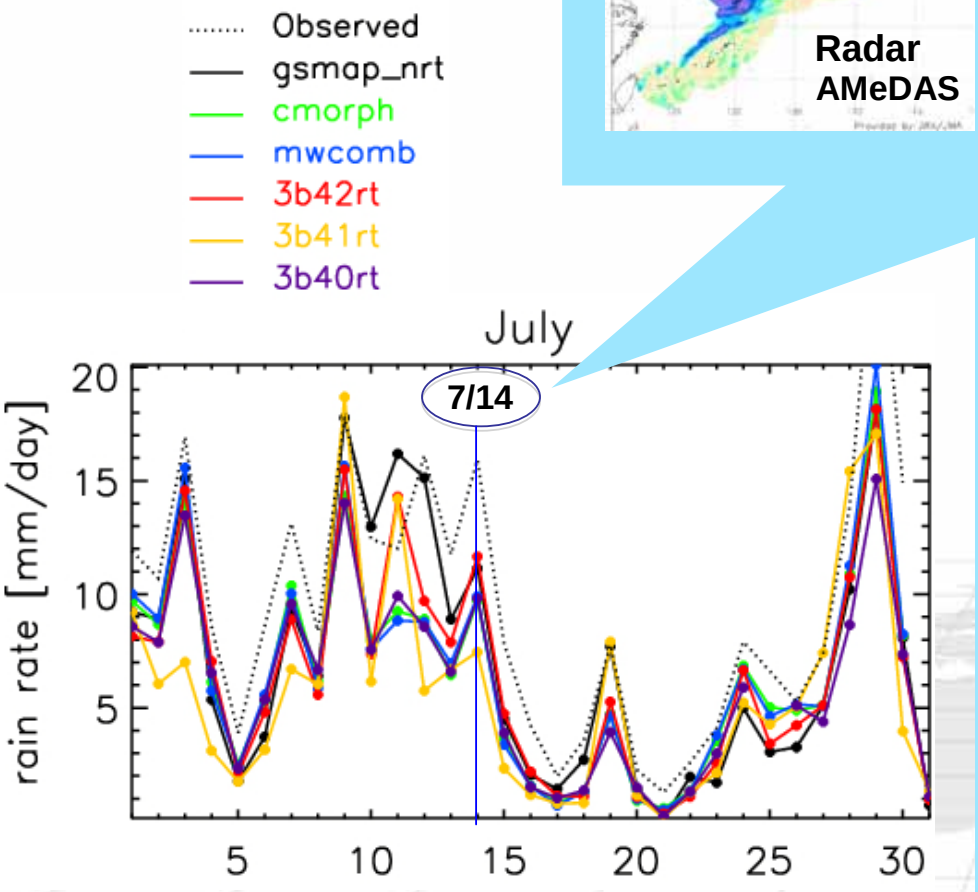
- Continental-scale validation (single number for entire domain) of satellite-based rainfall map
  - Some sites include NWP output rainfall as “data”
- Performed on daily totals
  - 12 – 12 UTC – N. America, S. America, Western Europe
  - 00 – 24 UTC – Australia, Japan
- Performed on 0.25-degree grid box
- Statistics and maps disseminated via web pages
- Rain gauge & radar (some) used as “truth”
- Currently 5 active validation “sites”
  - N. America, S. America, W. Europe, Australia, Japan

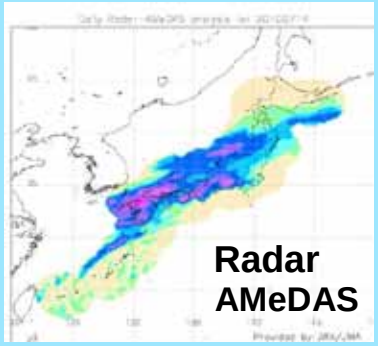
http://cawcr.gov.au/bmrc/SatRainVal/validation-intercomparison.html

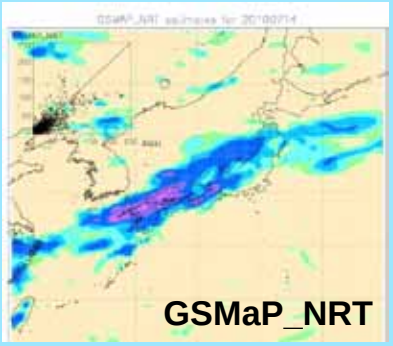
Japanese IPWG Validation Site by Kyoto Univ.

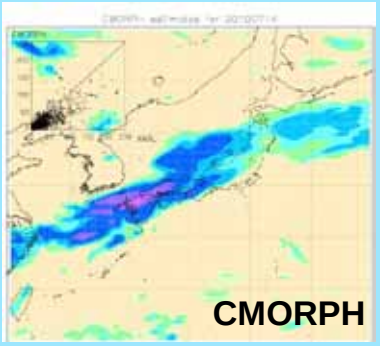
http://www-ipwg.kugi.kyoto-u.ac.jp/IPWG/sat_val_Japan.html

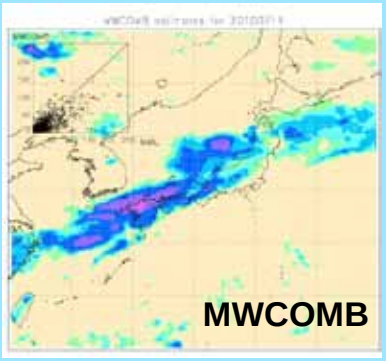
Example :
Heavy rain in 14 Jul 2010

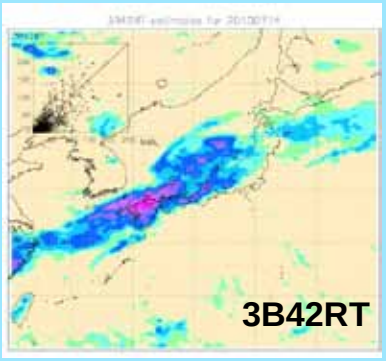


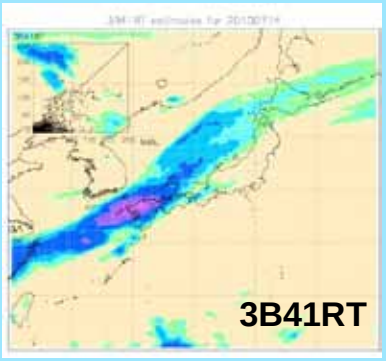


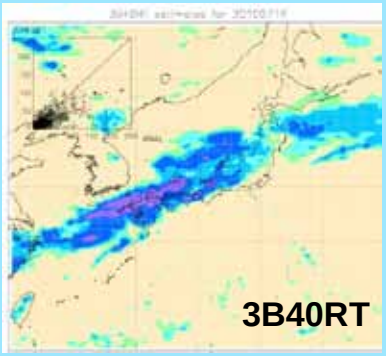






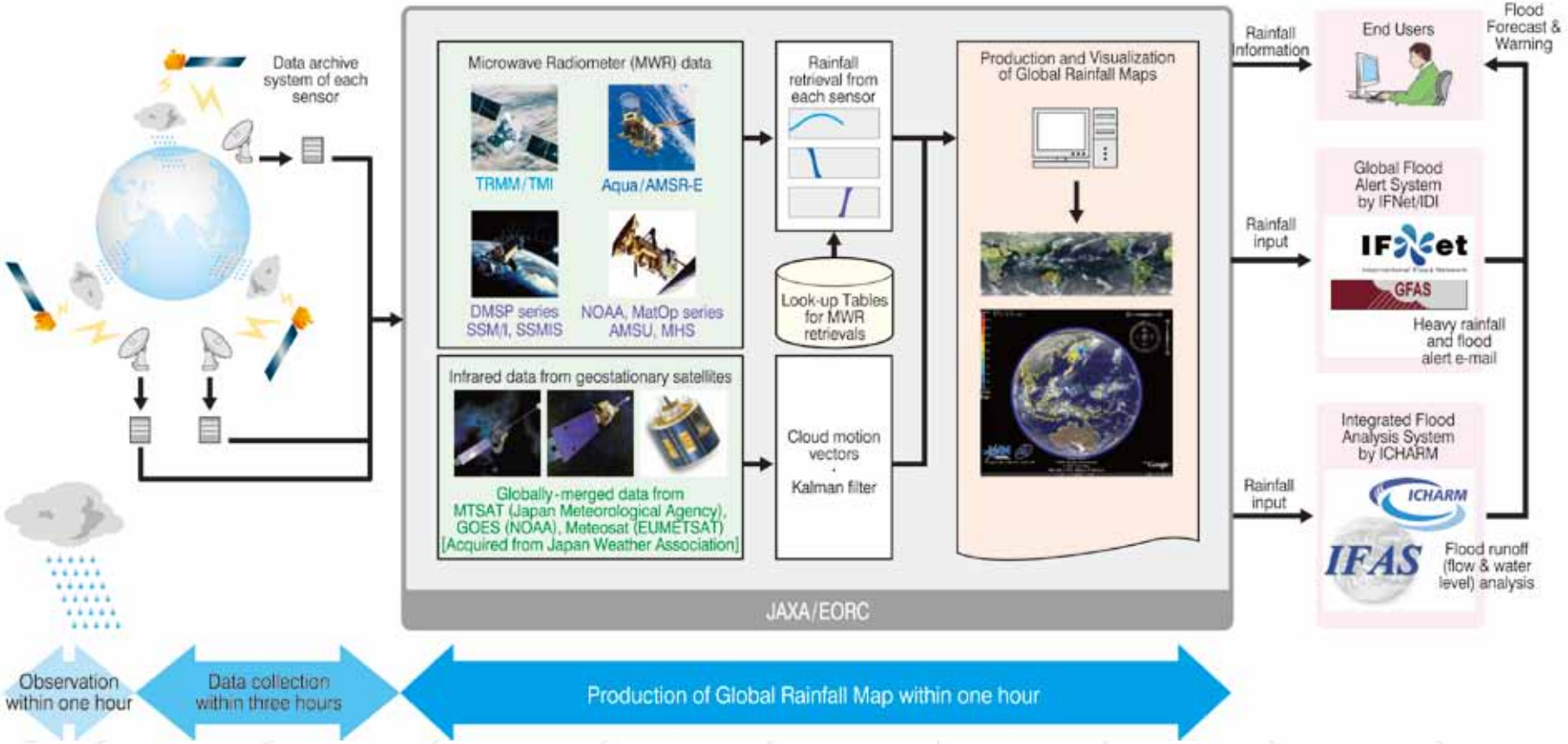






Collaboration with Flood Forecast/Warning Communities

- JAXA, ICHARM, and IFNet/IDI have studied possible application of satellite rainfall information to flood warning/forecast since 2003.
- GFAS operated by IFNet/IDI, and IFAS distributed by ICHARM use GSMaP and TRMM data as input rainfall data, and will contribute to flood forecast and early warning in poorly-gauged river basins.



GSMaP Data Utilization in Asian Countries (1/2)

- GPM Asia Workshop
  - Held every year in Japan since 2004, inviting 5-10 meteorological, hydrological or remote sensing agencies in Asian countries who are interesting in satellite precipitation.
  - Promote satellite precipitation data utilization in Asia.
  - Utilization of GSMaP and/or TRMM data and their comparison with ground-based data have started in Vietnam, Bangladesh, Philippines, Lao PDR, ICIMOD, Thailand, Indonesia, etc.

The 3rd GPM Asia Workshop on Precipitation Data Application Techniques, 7 & 9 Dec. 2011, Tokyo

GSMaP Data Utilization in Asian Countries (2/2)

- Following projects related to GSMaP are ongoing under JAXA and Asian countries. These projects focus on flood including river basin management and landslide (short-term events, debris flows, slope failures, etc).
  - ADB Technical Assistance - ‘Applying Remote Sensing Technology in River Basin Management’
    - Bangladesh, Vietnam, Philippines
  - THEOS Series and ALOS Series Cooperation
    - Thailand
  - Sentinel Asia Success Story in the Philippines

Global Precipitation Measurement (GPM)

- GPM Core Observatory and constellation of satellites will collaborate to realize global precipitation frequent observation with high accuracy.
- Dual-frequency Precipitation Radar (DPR) will calibrate GPM Microwave Imager (GMI), and GMI will calibrate microwave imagers and/or sounders onboard constellation satellites.

Constellation Satellites

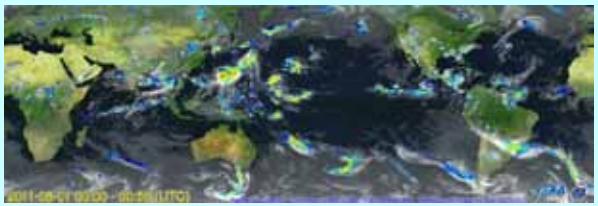
Objectives:

ü Observation frequency

ü Science, social applications

- Cooperation with constellation providers; JAXA (GCOM-W), NOAA (JPSS), CNES/ISRO (Megha-Tropiques) etc.
- 3 hourly observation of 80% of the globe.
- Launch around 2012-2015 by each organization
- Mainly sun-synchronous orbit with altitude 600~800km

image by NASA



Core Observatory

Objective:

ü Understanding the horizontal and vertical structure of precipitation system

ü Drop size distribution measurement

ü Improvement of precipitation rate accuracy with constellation satellites

- DPR (JAXA, NICT) (13.6, 35.5GHz)
- GMI (NASA)
- Launch in JFY 2013 by H-IIA rocket
- Non-Sun-synchronous orbit, inclination: 65deg, altitude: 407km

Generation and dissemination of global map of precipitation rate with high frequency and accuracy

Summary

- Production of GSMaP and GSMaP_NRT
  - JAXA and collaborative organizations has developed precipitation product, GSMaP, and distributed its near-real-time version 4-hrs after observation in hourly and 0.1-degree grid box. Reanalysis data of past period is also available.
  - Rainfall retrievals from available MWRs are merged, and moving vector information from five GEO IR data with Kalman filtering techniques is combined to fill temporal gaps
- Validation of multi-satellite products
  - International Precipitation Working Group compares various multi-satellite products in a same manner at five active sites, including North America, South America, Eastern Europe, Australia and Japan.
  - Japanese site operated by Kyoto Univ. in collaboration with JAXA to compare with JMA's Radar-AMeDAS (gauge calibrated radar rainfall).
- Collaboration with flood community and Asian countries
  - JAXA collaborates with ICHARM and IFNet/IDI in utilization of satellite rainfall data in flood warning/prediction.
  - JAXA also promotes GSMaP data utilization in Asia
- JAXA will continue and enhance production of GSMaP and collaborative activities toward GPM - Global Precipitation Measurement