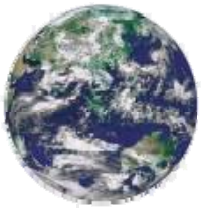
The 3rd ASIAN WATER CYCLE Symposium
December 2-4, 2007, Beppu, Oita, JAPAN



HIGH PRECISION AND HIGH RESOLUTION GLOBAL PRECIPITATION MAP FROM SATELLITE DATA

GSMaP(Global Satellite Mapping of Precipitation)

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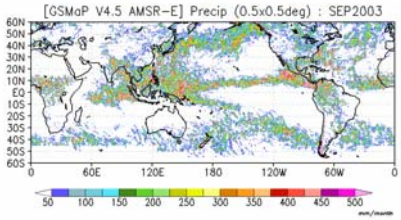
(3) National Research Inst. for Earth Science and Disaster Prevention, Japan
(4) Meteorological Research Institute, Japan
(5) Japan Aerospace Exploration Agency

Research Goals

Global Precipitation Map



1hr, 0.1˚×0.1˚ resolution

Production of high precision and high resolution global precipitation map by using satelliteborne microwave radiometer data
- Microwave radiometer
- TRMM/PR
- GEO's IR

Microwave Radiometer Data


AMSR-E, AMSR


SSM/I×3


TMI/TMI, PR

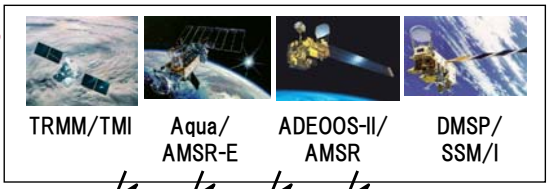

AMSU-A, B

Evaluation, dissemination, utilization of precipitation map
- Contribution to the IPWG/PEHRPP
- Application to flood prediction and warning
- GPM


GPM satellites

Development of reliable microwave radiometer algorithm
- Production of precipitation physical model by using TRMM PR data
- Algorithm consistent with PR

Four pillars of the research

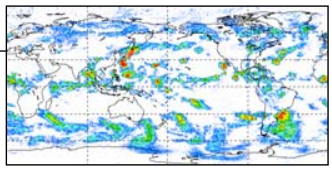


GEO meteorological satellite

IR data

Cloud motion vector algorithm

Production of global precipitation maps



High temporal resolution map

Precipitation map database

Improvement of algorithm

Feedback

Algorithm development

Observation data

Estimation of rain rate

Look-up table

Internet

Data dissemination

Radiative transfer equation

Ground radar observation

COBRA data

Local precipitation map

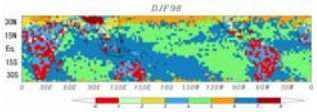
Global precipitation map by TRMM/PR

Database of precipitation structure

TRMM/PR

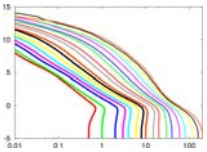
Observation by TRMM/PR

Precipitation physical model development



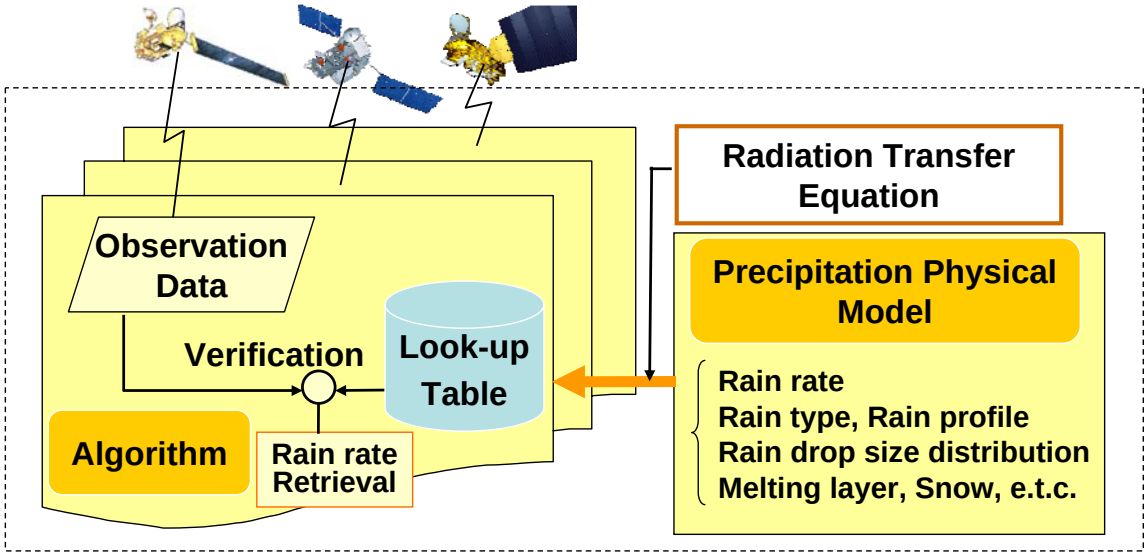
Rain type classification

- Precipitation profile
- DSD
- Melting layer
- Snow



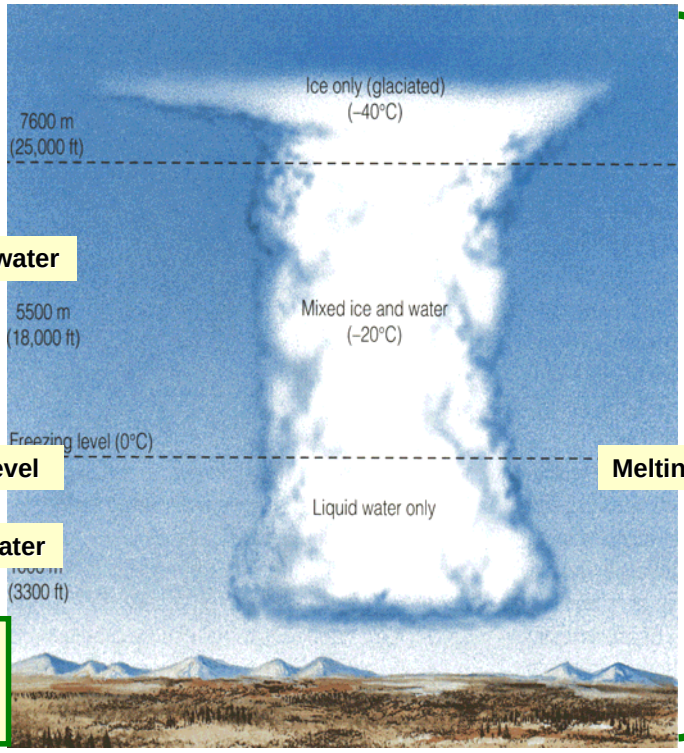
Precipitation profile

Basis of Rain Rate Retrieval by Microwave Radiometers



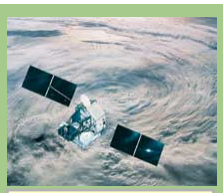
- Satellites observe the brightness temperature, integration of radiation and scattering power.
- The relation between rain rate and brightness temperature is tabulated by assuming precipitation physical model and calculating the radiative transfer equation. The rain rates giving the nearest brightness temperature values to the observed ones are considered to be the most appropriate estimation.

Developments of Precipitation Physical Model



- Improvement of scattering algorithm
- Mixed ice and water
- Snow Particle Model
- Freezing Level
- Liquid water
- Rain drop size distribution (DSD) model
- Precipitation profile model
- Classification of Rain Types
- Melting Layer
- Melting layer model

Composition of GSMaP Products


TRMM TMI

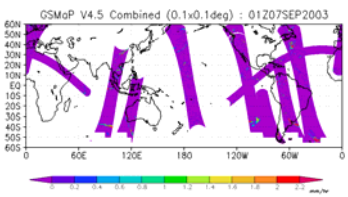

Aqua AMSR-E


ADEOS-II AMSR


DMSP SSM/I × 3

GSMaP Microwave Radiometer Algorithms

Rain rates retrieved by each satellite microwave radiometer



1-hour data by TRMM/TMI, Aqua/AMSR-E, ADEOS-II/AMSR, DMSP/SSMI (F13, 14, 15)


Geostationary Satellite

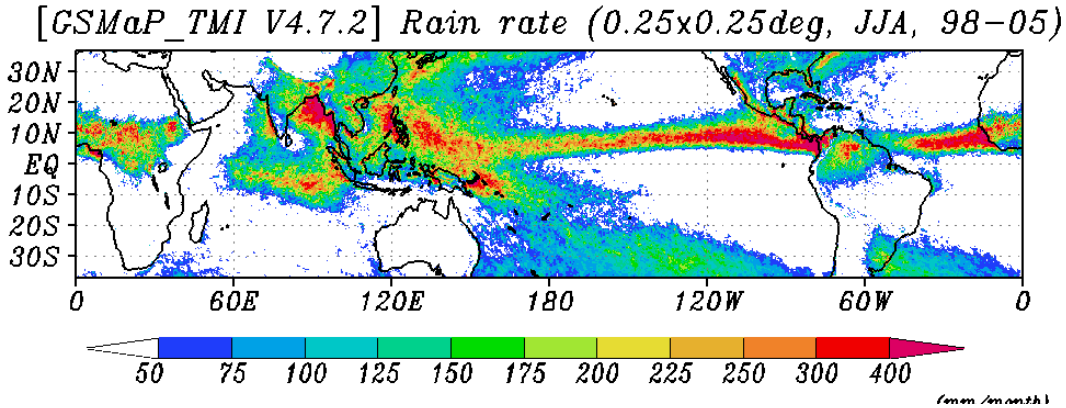
Combination

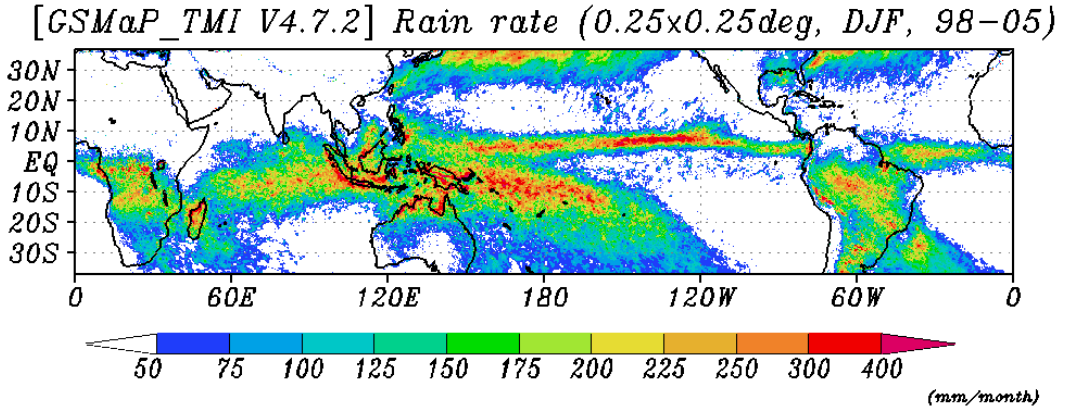
IR Cloud Motion Vector

Combined Product 0.25° grid { 6 hours, 1 day, 1 month }

Combined IR/ Microwave Radiometer Products 0.1° grid·1 hour

Global Precipitation Map by GSMaP_TMI, JJA, DJF(1998-2005)





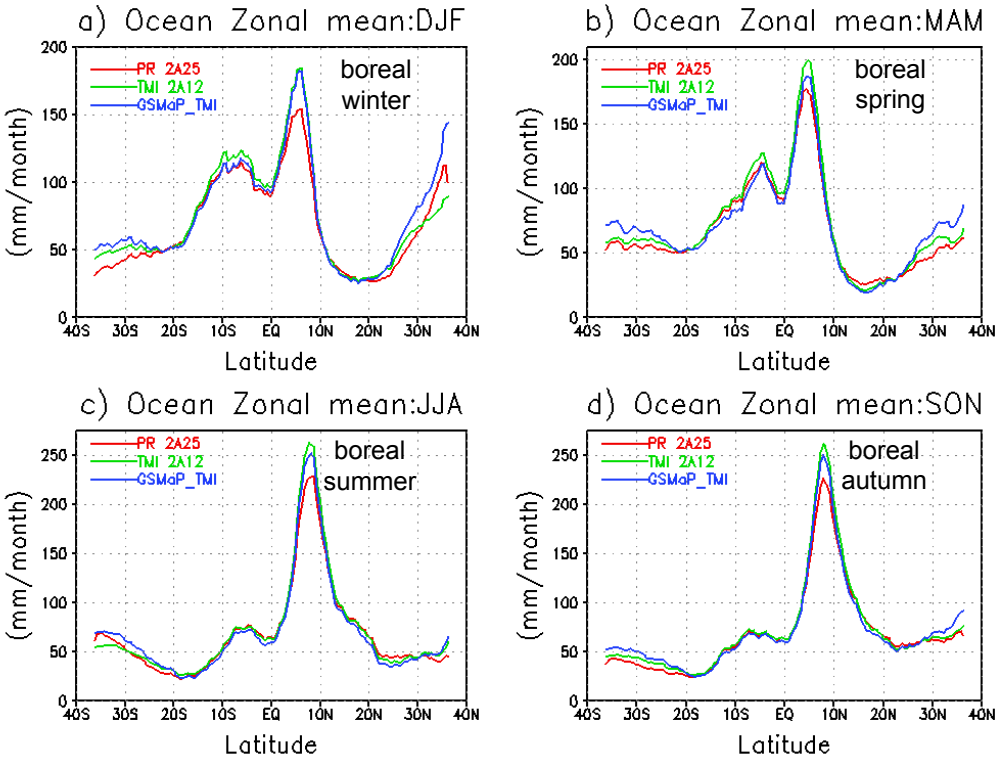
Comparison of TRMM rain rates by using TRMM/PR, TMI/GPROF, TMI/GSMaP algorithms (1998-2006)

Ocean

PR 2A25V6
TMI 2A12 V6
GSMaP_TMI V4.8.4

1998-2006 average

PR swath only



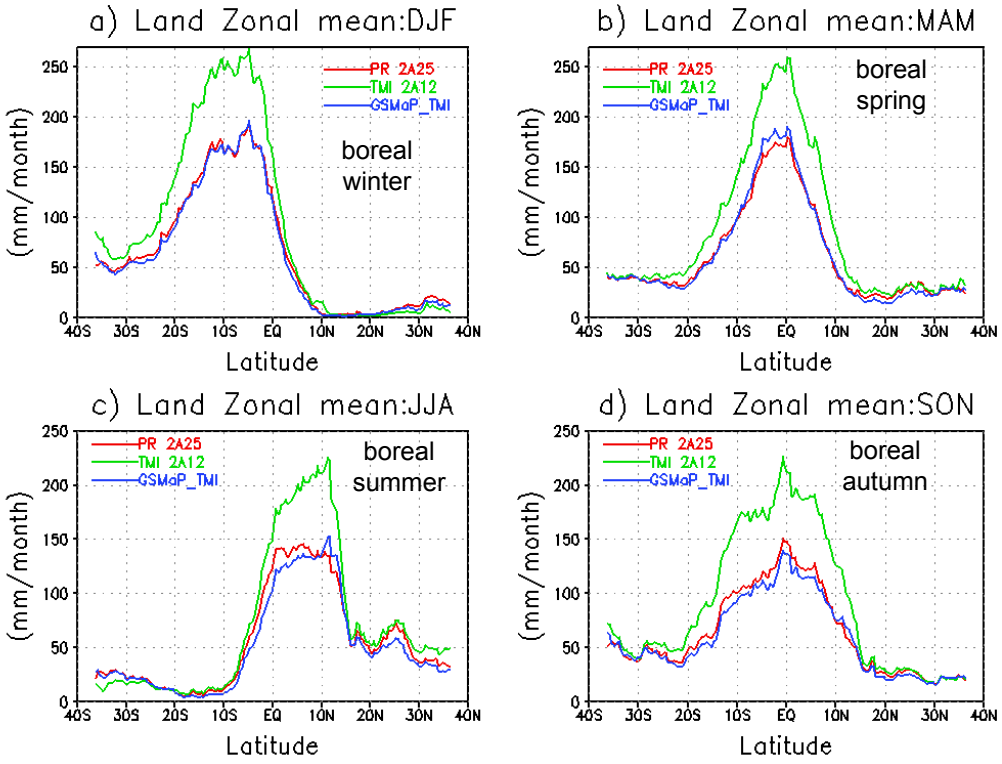
Comparison of TRMM rain rates by using TRMM/PR, TMI/GPROF, TMI/GSMaP algorithms (1998-2006)

Land

PR 2A25V6
TMI 2A12 V6
GSMaP_TMI V4.8.4

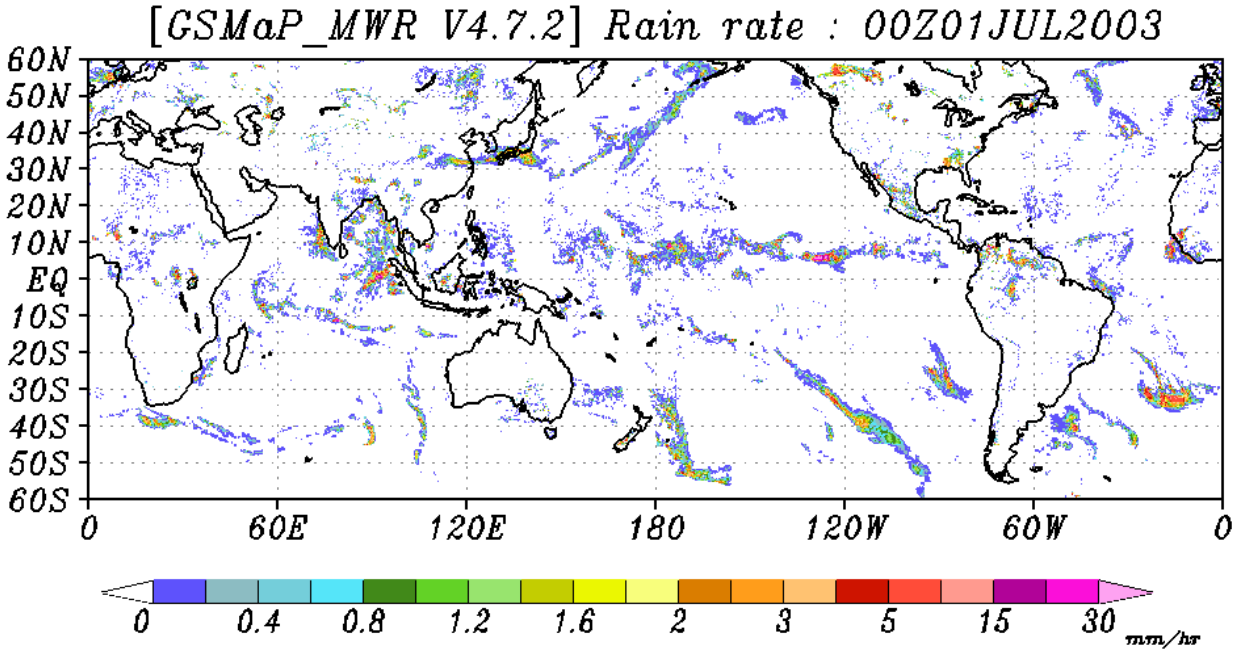
1998-2006 average

PR swath only

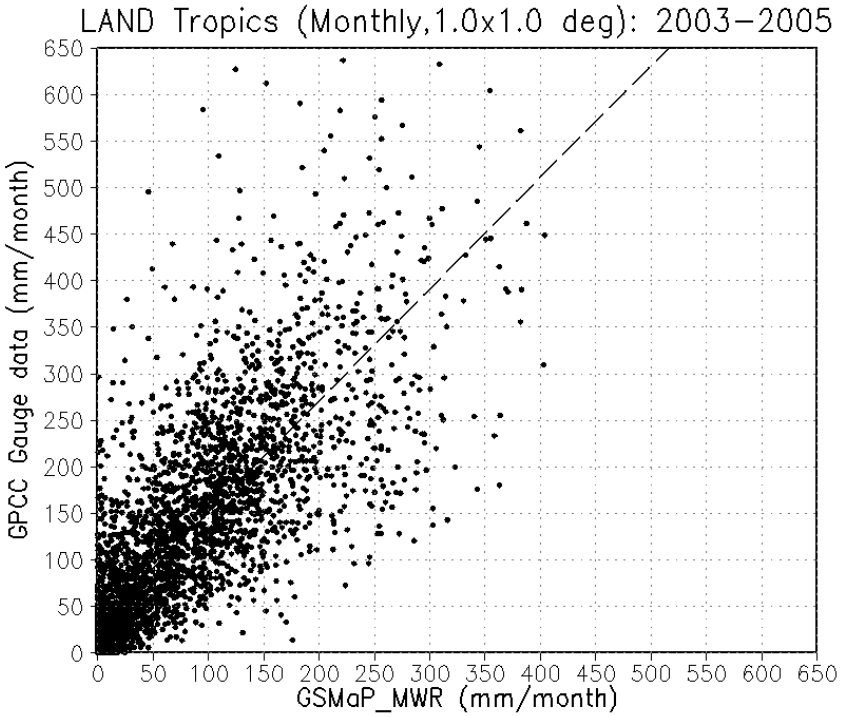


Integrated 6-hour microwave radiometer precipitation map (GSMaP_MWR)

MWR(TMI+AMSR+AMSR-E+F13, 14, 15 SSM/I)



Comparison of monthly rain rates by ground-based rain gauge (GPCC) with GSMaP_MWR



● GPCC Monthly Precipitation (Monitoring) Product（Rudolf et al. 2005）

- ground-based rain gauge
- about 7000 rain gauges in the world
- 1.0° ×1.0°
- monthly average

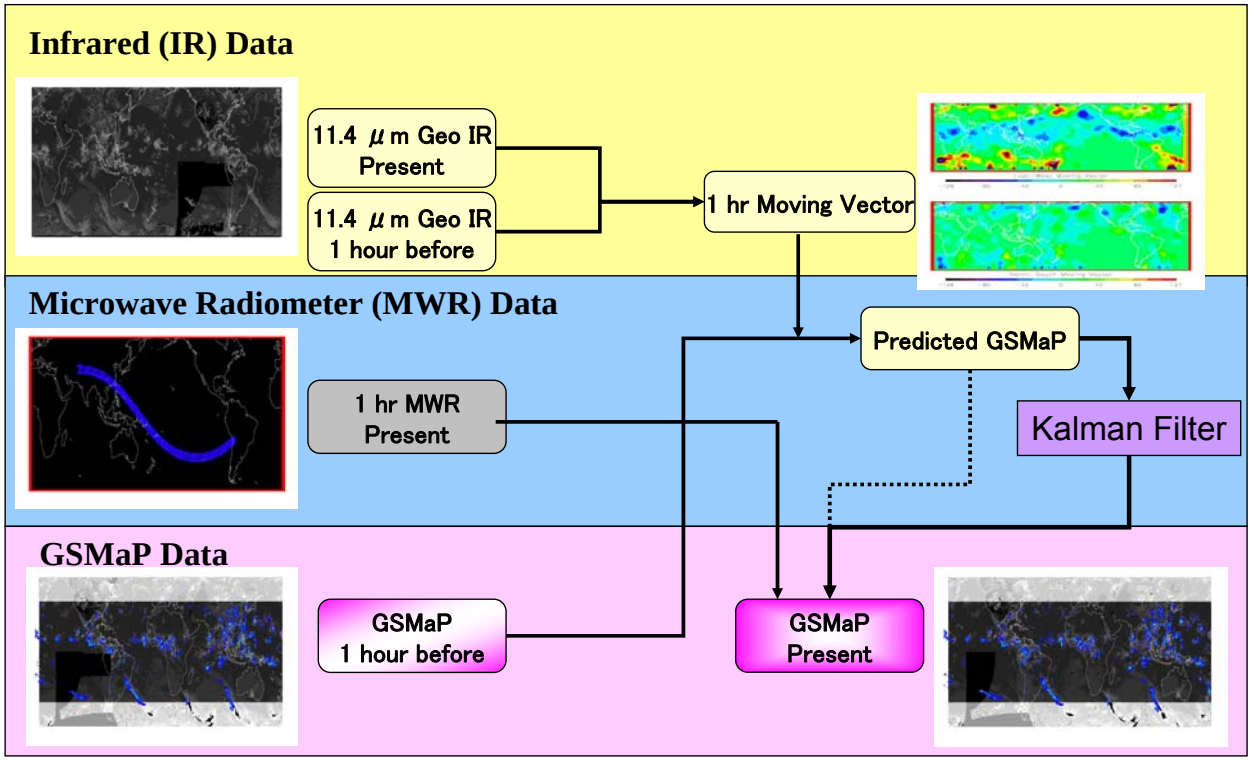
● Analysis method

- Tropical Area（20S～20N）
- There are at least 2 rain gauges in the 1.0° ×1.0°
- 2003-2005

Regression line : y=1.20 x + 30.8 (mm/month)　Correlation coefficient : 0.79

Production of high temporal (1 hr)/high spatial (0.1°×0.1°) resolution precipitation map (GSMaP)

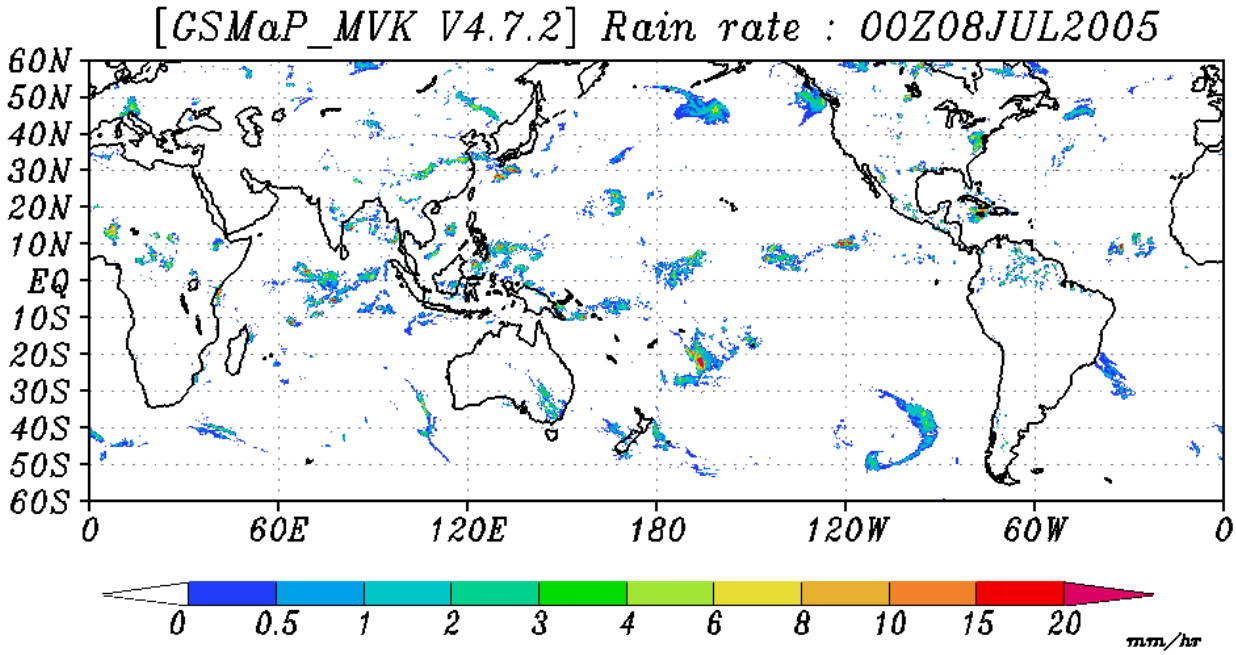
Algorithm flow to predict the movement of raining areas by applying the cloud motion vector of the past 1 hour estimated from the IR cloud image



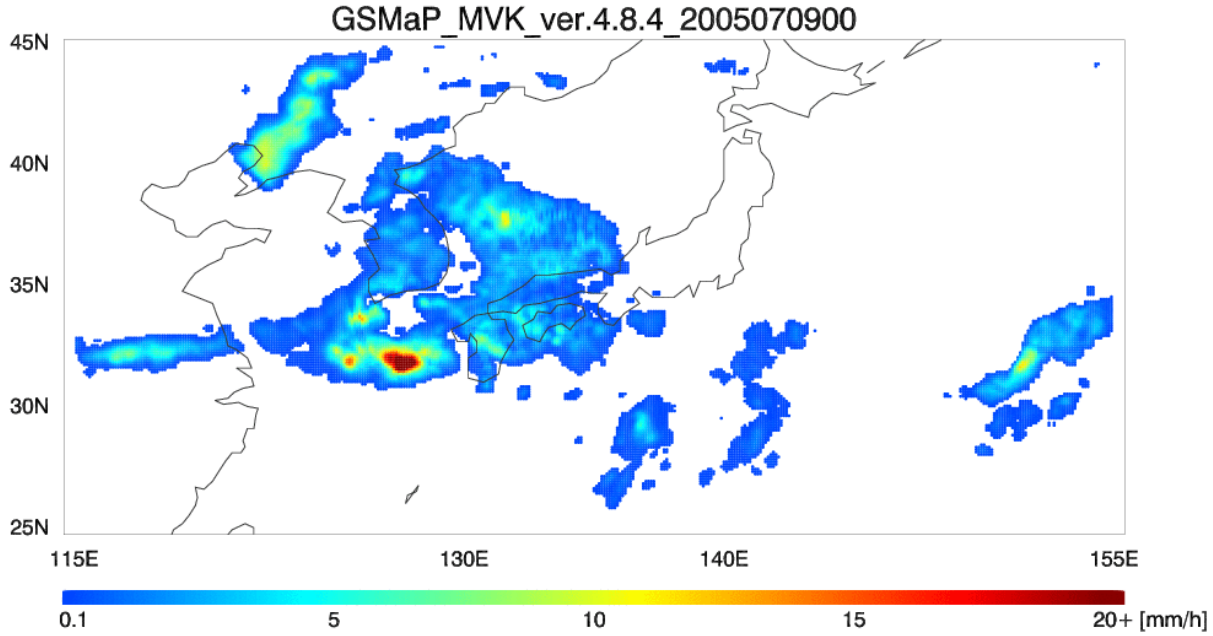
Combined global precipitation map

-MW radiometer + cloud motion vector with Kalman filter- (0.1˚, 1 hour, 8-10 July 2005)

MVK: MWR(TMI+AMSR+AMSR-E+F13, 14, 15 SSM/I) +IR Cloud Motion Vector +Kalman Filter



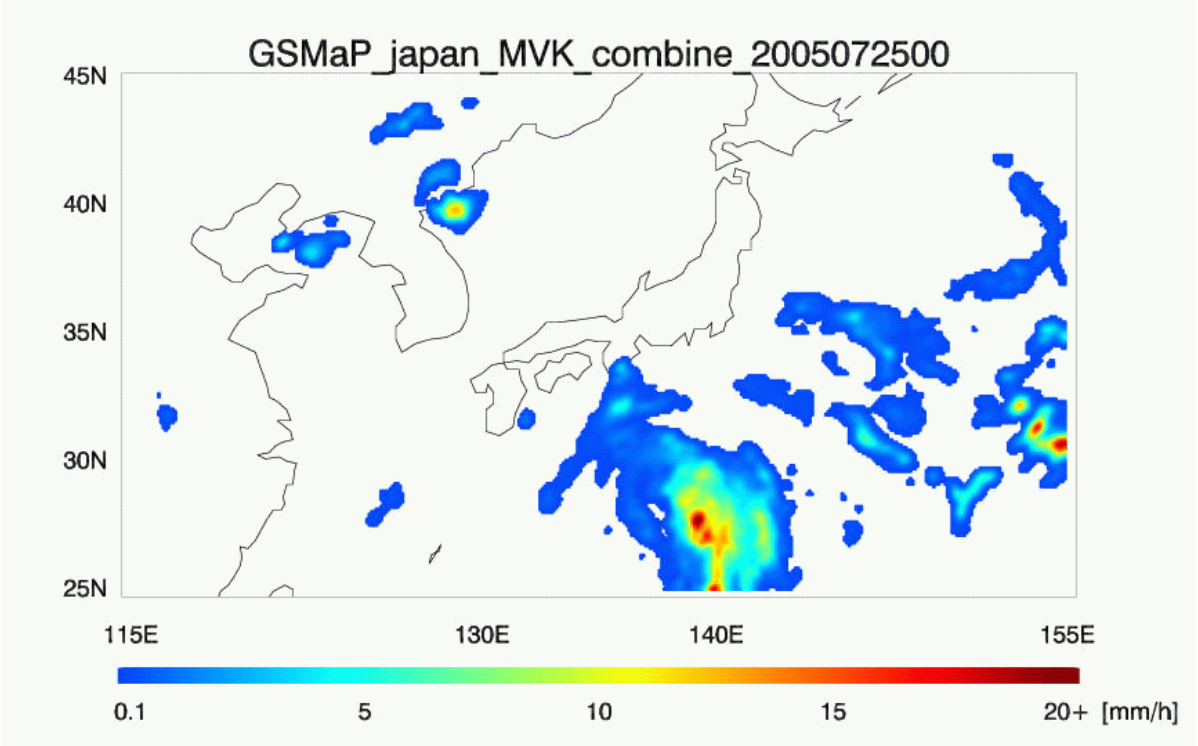
Combined precipitation map around Japan -MW radiometer + cloud motion vector with Kalman filter- (0.1 ˚, 1 hour, 9-10 July 2005)



Combined Typhoon Banyan's precipitation map

-MW radiometer + cloud motion vector with Kalman filter-

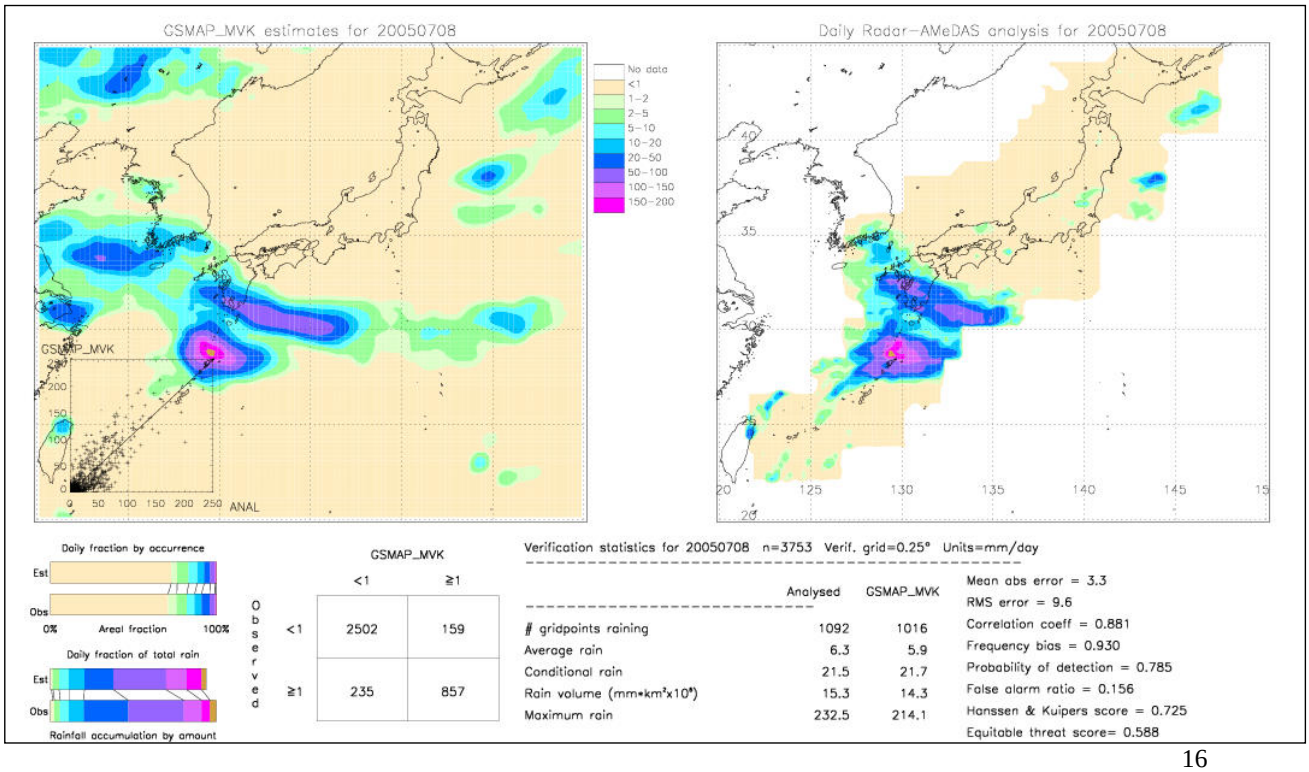
(0.1˚, 1 hour, 25 July 2005)



Example of validation of GSMaP_MVK using Radar-AMeDAS (8 July 2005)

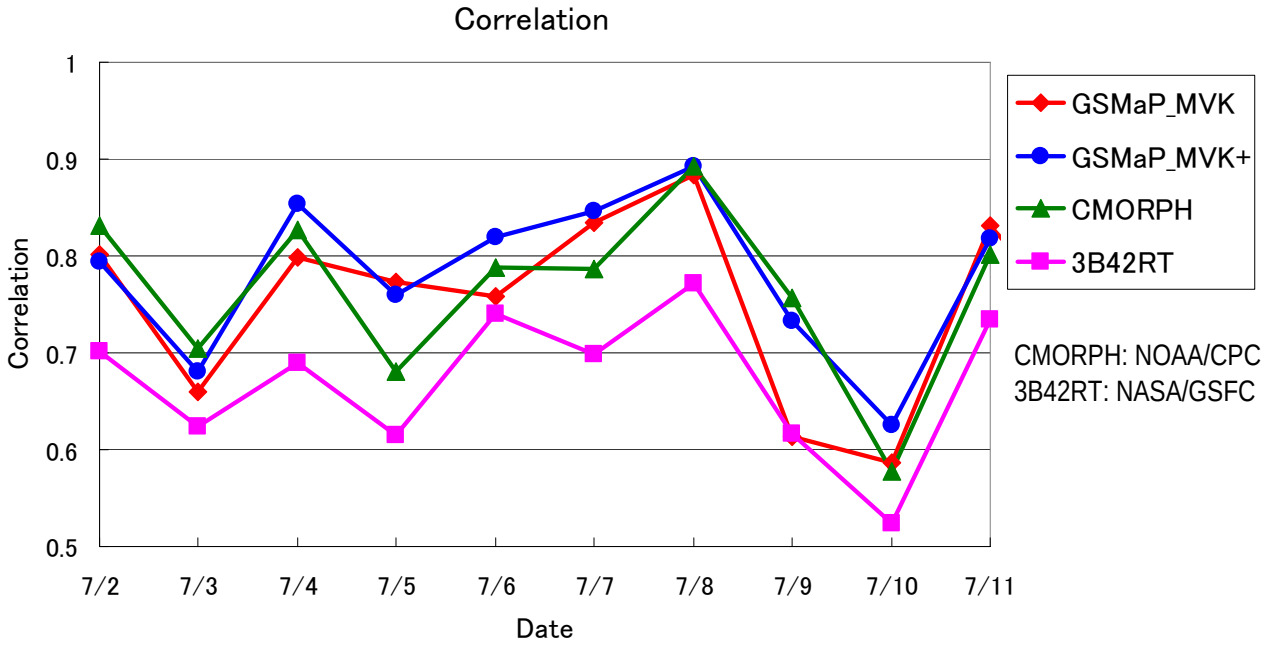
GSMaP_MVK

Radar-AMeDAS



Evaluation of various high resolution precipitation map using Radar-AMeDAS rain map

Daily variation of correlation coefficient (0.25˚×0.25˚)) July, 2005

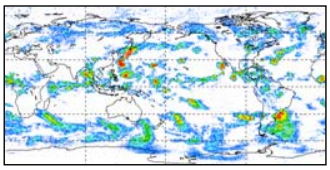


CMORPH: NOAA/CPC
3B42RT: NASA/GSFC

GSMaP_MVK shows high correlation with Radar-AMeDAS throughout the period.
GSMaP_MVK+, produced by adding NOAA AMSU rain rates to GSMaP_MVK, shows particularly high correlation.

Dissemination of research products

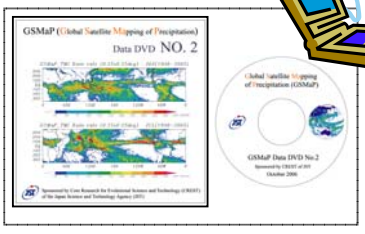
Global precipitation map



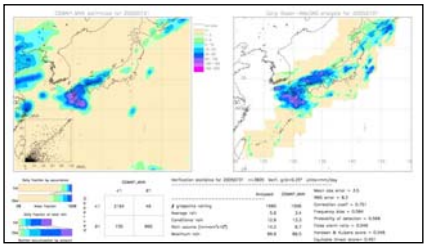
Application to the flood prediction and warning

Dissemination of GSMaP data

- DVD-R
- Data release via the Internet



GSMaP Precipitation data



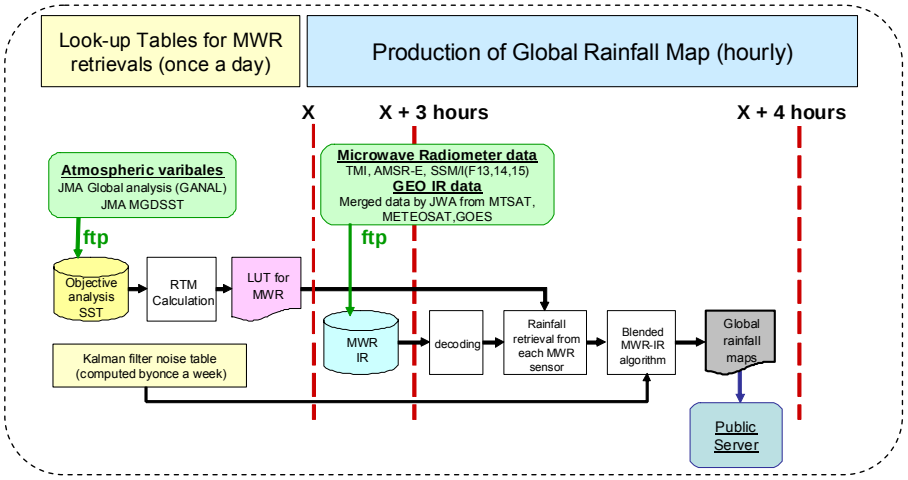
Participation in the international project

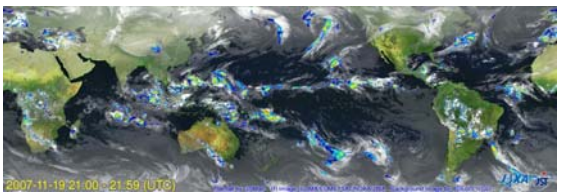
IPWG (International Precipitation Working Group) /PEHRPP (Pilot Evaluation of High Resolution Precipitation Product)

IPWG/PEHRPP

Construction of System for Near-Real-Time Global Rainfall Maps by GSMaP algorithms

JAXA/EORC has started to release global rainfall data in near real time (about four hours after observations) on the Internet using GSMaP algorithms.





GSMaP NRT System in JAXA/EORC

Global Rainfall Map in Near Real Time by JAXA/EORC
http://sharaku.eorc.jaxa.jp/GSMaP/

Summary

- Academic contributions
  - Microwave radiometer rain retrieval algorithm
  - Combined microwave and IR radiometer algorithm
  - Production and validation of the global precipitation maps
- International contributions
  - GPM project
  - Participation in the PEHRPP/IPWG
- Social contributions
  - Construction of System for Near-Real-Time Global Rainfall Maps by GSMaP algorithms(JAXA)
  - Contribution to the joint research by Public Works Research Institute and JAXA to use satellite rain data for the flood prediction and warning system especially in Asian countries.