

JAXA GPM Application Science

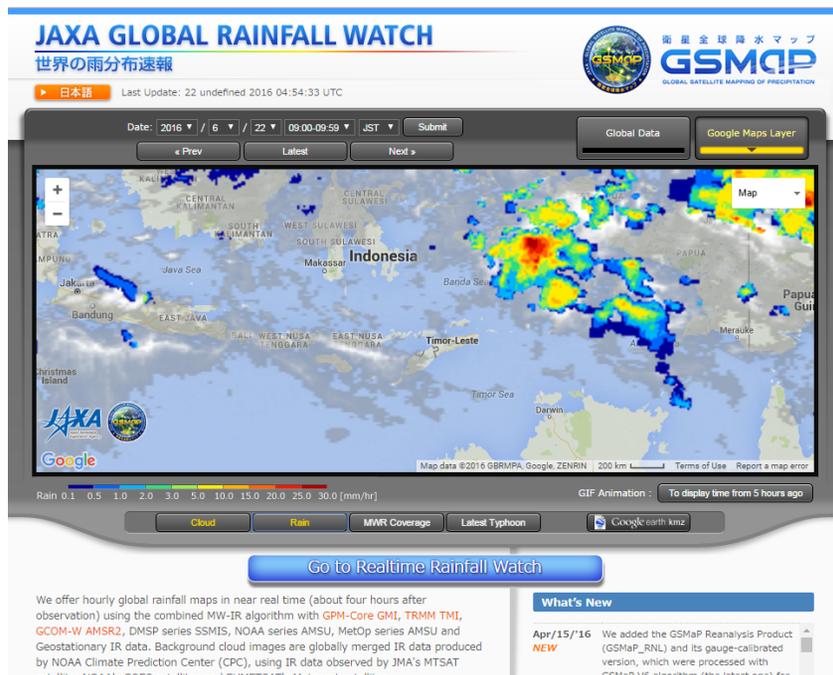
Takuji Kubota

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

Oct. 24, 2016

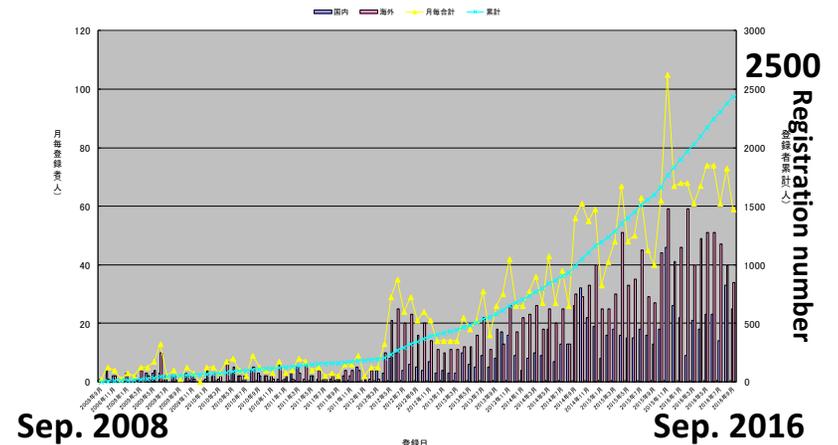
- The GPM/GSMaP data are freely available for all users with simple registration.
- Here, users registered in the JAXA/EORC site were briefly analyzed.

JAXA/EORC GSMaP website

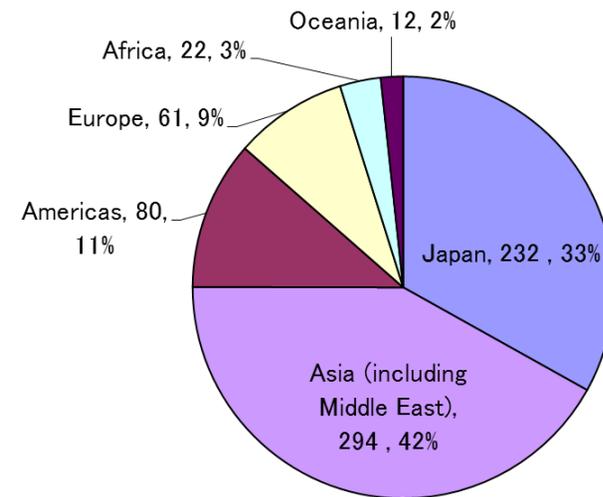


<http://sharaku.eorc.jaxa.jp/GSMaP/>

GSMaP registered users



About **2400** registered users and **92** countries as of 30 Sep. 2016

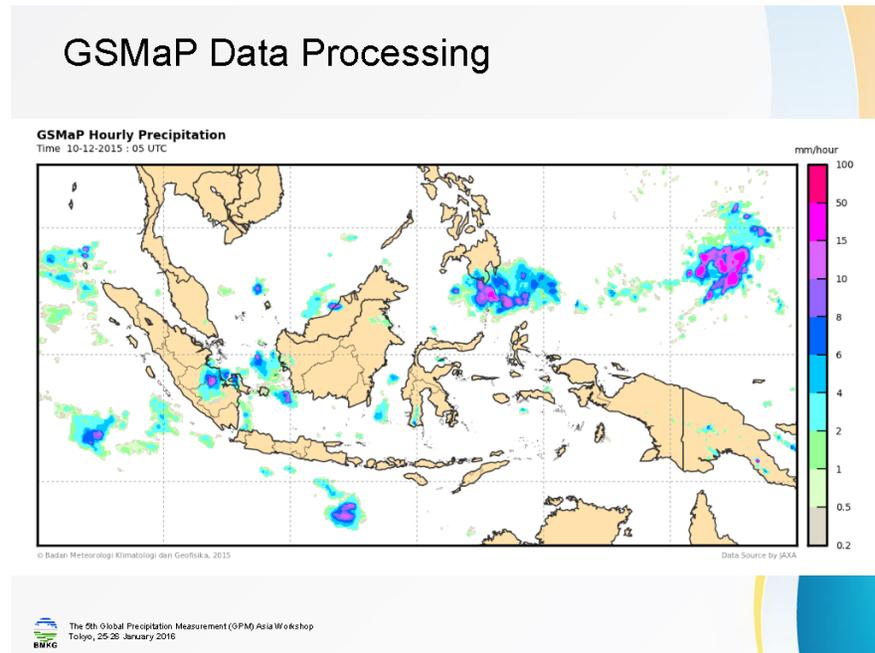
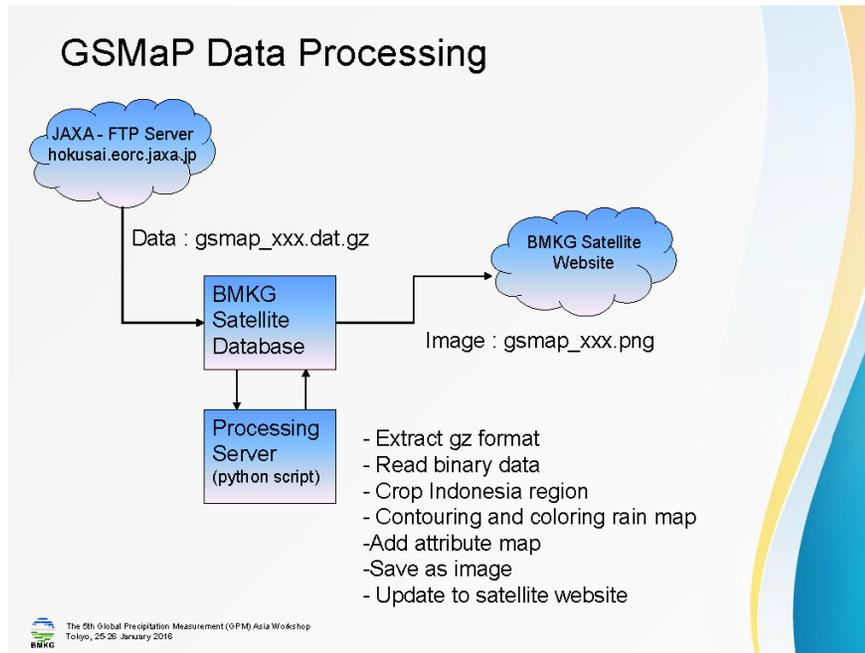


About **75%** users are originated from Asian countries.

- The 5th GPM Asia Workshop on Satellite Precipitation Data Utilization
 - Held in Tokyo on 25-26 January, 2016
- Purpose of the workshop:
 - To promote satellite precipitation data utilization in Asia, and move forward research activities related to GPM in each country in working-level.
 - To share early validation and utilization results of the GPM products in Asian countries.
 - To proceed future collaborations between Japan and Asian countries.
- 49 participants including 13 participants from 6 Asian countries.
 - Dr. Huffman could not come due to the snow storm, but he attended remotely.



- **“The Operational Use of GSMaP Data at BMKG Indonesia”** by Andersen Panjaitan (Satellite Data Management Sub Division, BMKG)
 - Presented at the 5th GPM Asia Workshop on Precipitation Data Application Technique during 25-26 January 2016, in Tokyo, Japan



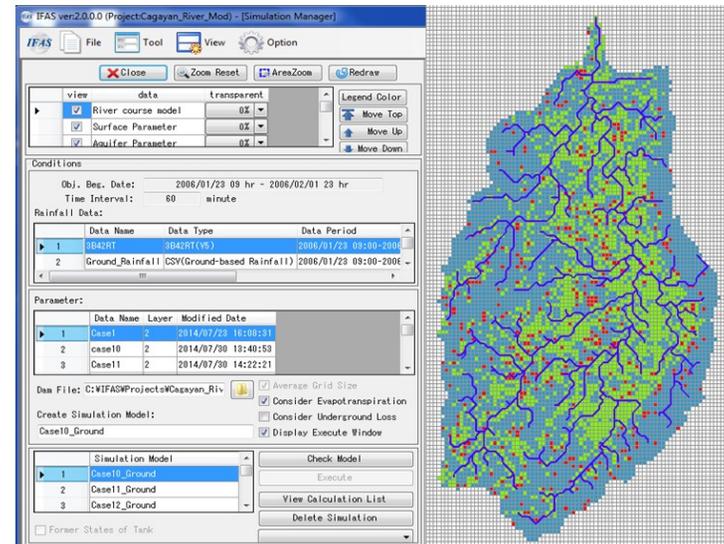
- **“UTILIZATION OF GSMaP in the PHILIPPINES”** by ROY A. BADILLA (Hydro-Meteorology Division, PAGASA-DOST)
 - Presented at the 5th GPM Asia Workshop on Precipitation Data Application Technique during 25-26 January 2016, in Tokyo, Japan

GSMaP APPLICATION



- Typhoon and Rainfall Monitoring
 - used for monitoring the spatial distribution during typhoon landfall (e.g. TY Sendong (*Washi 2011*), TY Pablo (*Bopha 2012*))
 - used as an additional tool for non-telemetered river basins
- Flood Analysis
 - used for flood analysis in identifying location of high rainfall occurrence
- River Basin Monitoring
 - integrated to IFAS (*IFAS with GSMaP Technologies*) - used for monitoring in order to forecast and manage floods in Cagayan River Basin (*ADB Project*)

IFAS with GSMaP



- Here I summarized JAXA activity for the GSMaP applications for following categories.
 - Rainfall monitoring
 - Hydrology
 - Drought monitoring
 - Agriculture
 - Public Health
- Most of these activities are coordinated by my colleagues, and so I present summaries based upon slides provided by them.

GSMaP applications for Rainfall monitoring

- Japan Meteorological Agency (JMA) operates ground radar network, but, remote islands such as Bonin Islands is located outside of the radar coverage.
- I visited Ogasawara Village Office in Bonin Islands on Feb. 2016, and received a welcome because the officers were unfamiliar to the satellite rainfall data.



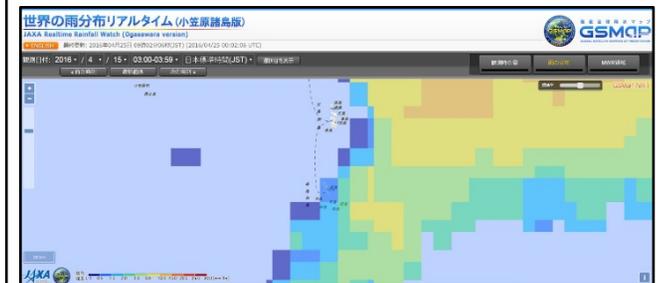


Utilization of Ogasawara Village (Bonin Islands) in Japan (2/2)

- After the meeting with the village officers, the Homepage of the Ogasawara Village started to link to the JAXA/EORC GSMaP Homepage on April 2016.

<http://www.vill.ogasawara.tokyo.jp/>

JAXA/EORC GSMaP Homepage



about 700 visits during
1month (Aug. 2016)



Utilization of GSMaP in Fiji

- Small islands are lack of rain observations and satellite data can be helpful for the Rainfall monitoring.
- Furukawa and Yamaji (JAXA) visited **Fiji Meteorological Service (FMS)**. After the meeting, the FMS started to link their website to the JAXA/EORC GSMaP website.

A building of Fiji Meteorological Service



Furukawa (JAXA GPM/DPR Project Manager)

Fiji Meteorological Service
RSMC Nadi-Tropical Cyclone Centre
"Official Source of reliable "first-level" information on tropical cyclones occurring in the South-West Pacific Ocean. All products on this site are on Fiji Standard Time = (UTC + 12HRS)
Fiji Daylight Saving Time(DST) = (UTC + 13HRS)
ISO 9001:2008 certified provider of Aviation Meteorological Services

Home | About Us | Services | Careers | Awareness & Education | Feedback

Current Warning
No Current Warnings

Fiji Weather Forecast
Public
Marine
Town Centers 3-days Forecast
7 Day Outlook
Rainfall Map
Observation Data

Regional Weather Bulletins
Niué | Tokelau
Tonga | Tuvalu
Kiribati | Cook Is
Nauru

South West Pacific Marine
ZLM Broadcasts Time & Frequencies

AVIATION CUSTOMER SURVEY
Survey Form

Current Vacancies
Vacancies

Media Release

Weather | Climate | Tropical Cyclone | Avia

Fiji Islands Map
Click here to view full map image

Fiji
View larger map

Current Cond
Town Forecast
Ba Fine. Cool
Labasa Fine. Cool
Lautoka Fine. Cool
Nabouwala Fine. Cool
Nadi Fine. Cool
Nausori Fine apart showers. night.
Rakira Fine apart showers. night.
Rotuma Fine apart from brief showers.
Gavusavu Fine apart from brief showers. Cool at night.
Sigatoka Fine. Cool at night. 20 30
Suva Fine apart from brief showers. Cool at night. 20 28
Taveuni Fine. Cool at night. 20 30
Tavua Fine. Cool at night. 18 30

11:03:39 PM

Radar | Satellite | Maps

GSMaP JAXA Realtime Rainfall Watch
Fiji Islands Rainfall

* External Link to JAXA Realtime Rainfall Watch that shows rainfall estimated from satellite-data .

GSMaP JAXA Realtime Rainfall Watch
Fiji Islands Rainfall

<http://www.met.gov.fj/>

*External Link to JAXA Realtime Rainfall Watch that shows rainfall estimated from satellite-data .

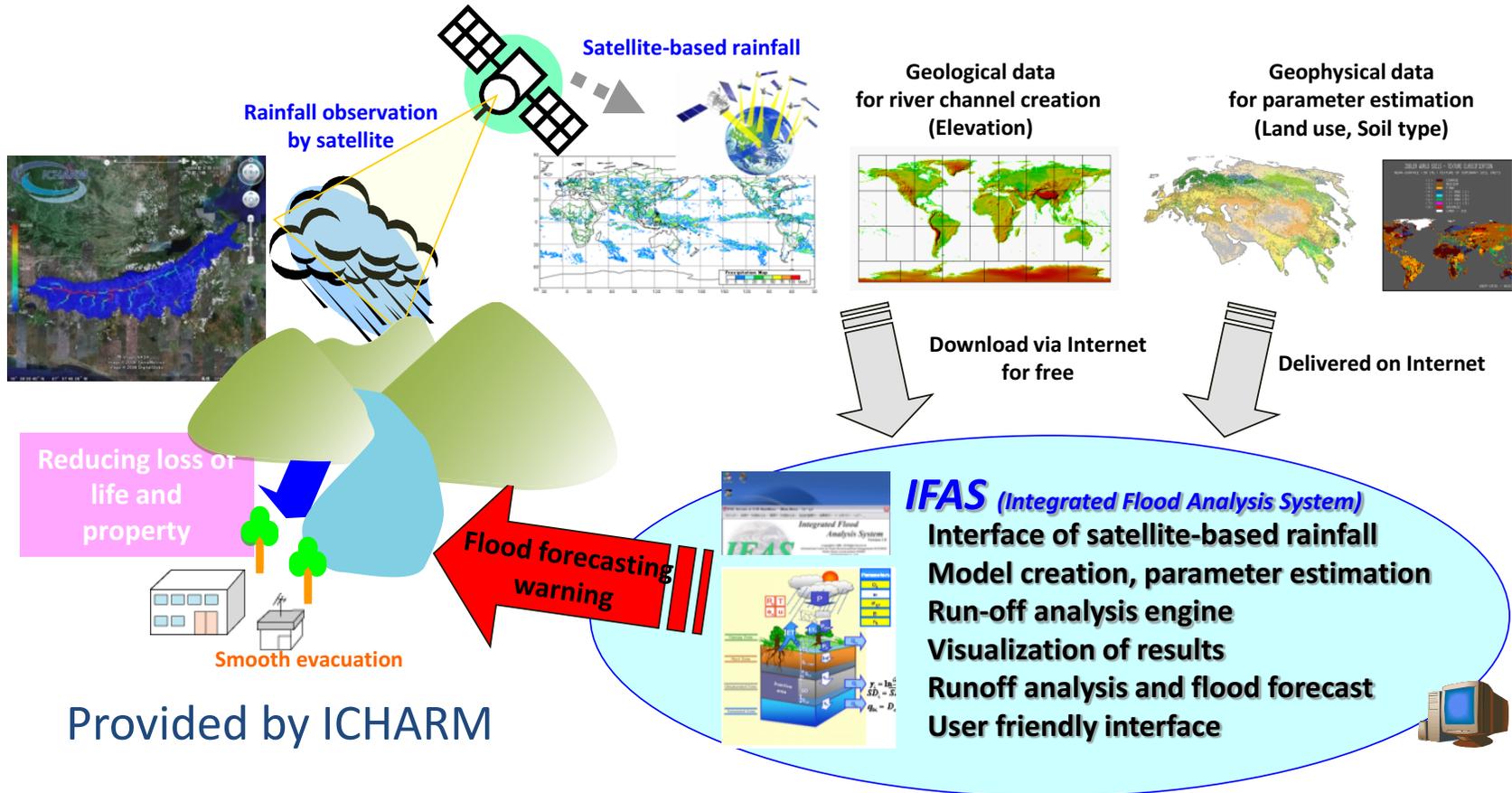
GSMaP applications for Hydrology



R. Tanabe (SAOC, JAXA)

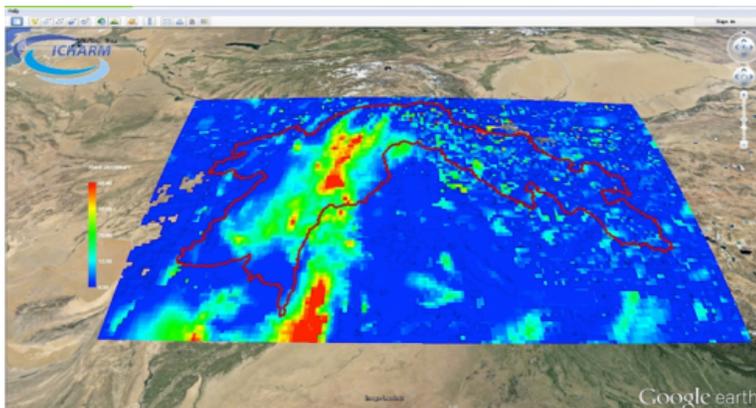
- Collaboration with JAXA and International Centre for Water Hazard and Risk Management (ICCHARM) since 2005.
 - Utilization of hourly GSMaP near-real-time data in their flood forecasting system, **Integrated Flood Analysis System (IFAS)**.

Flood Forecasting System Using Satellite-based Rainfall Information as a tool of GFAS-streamflow version



- Under UNESCO-IHP project, **JAXA**, **ICHARM** and **Pakistan Meteorological Department (PMD)** to develop operational flood analysis system.
- After calibration of **GSMaP product** with **ground-based stations** in Pakistan, correlation coefficients are increased from 0.5 to 0.7, and can be used in the Indus Integrated Flood Analysis System (Indus-IFAS) developed by ICHARM.
- The Indus-IFAS system is now in operation by the PMD, and a plan to extend the system to eastern river area is now underway.

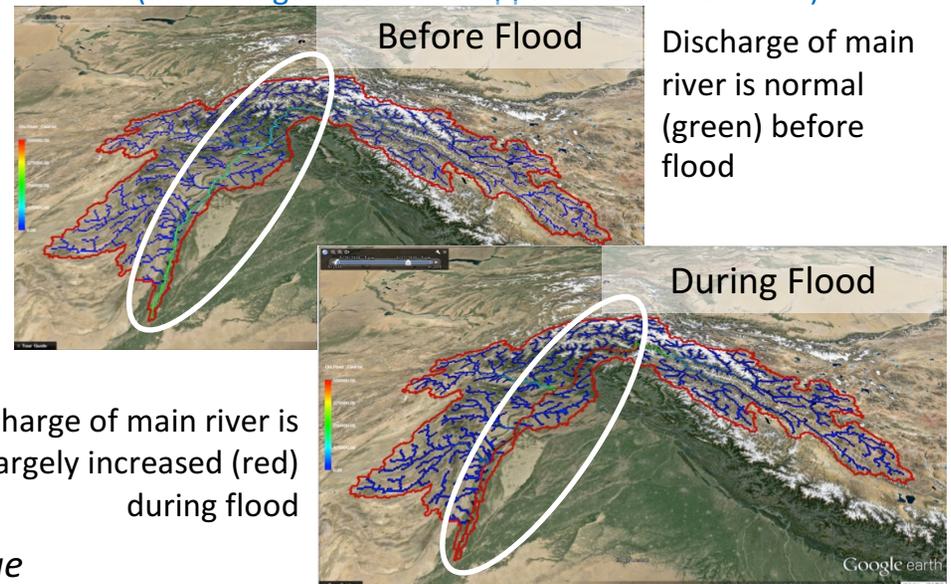
Rainfall by GSMaP



(Area within red line is Indus river basin)

INPUT

Indus_IFAS:River discharge output using GSMaP (increasing as rainfall in upper stream increased)

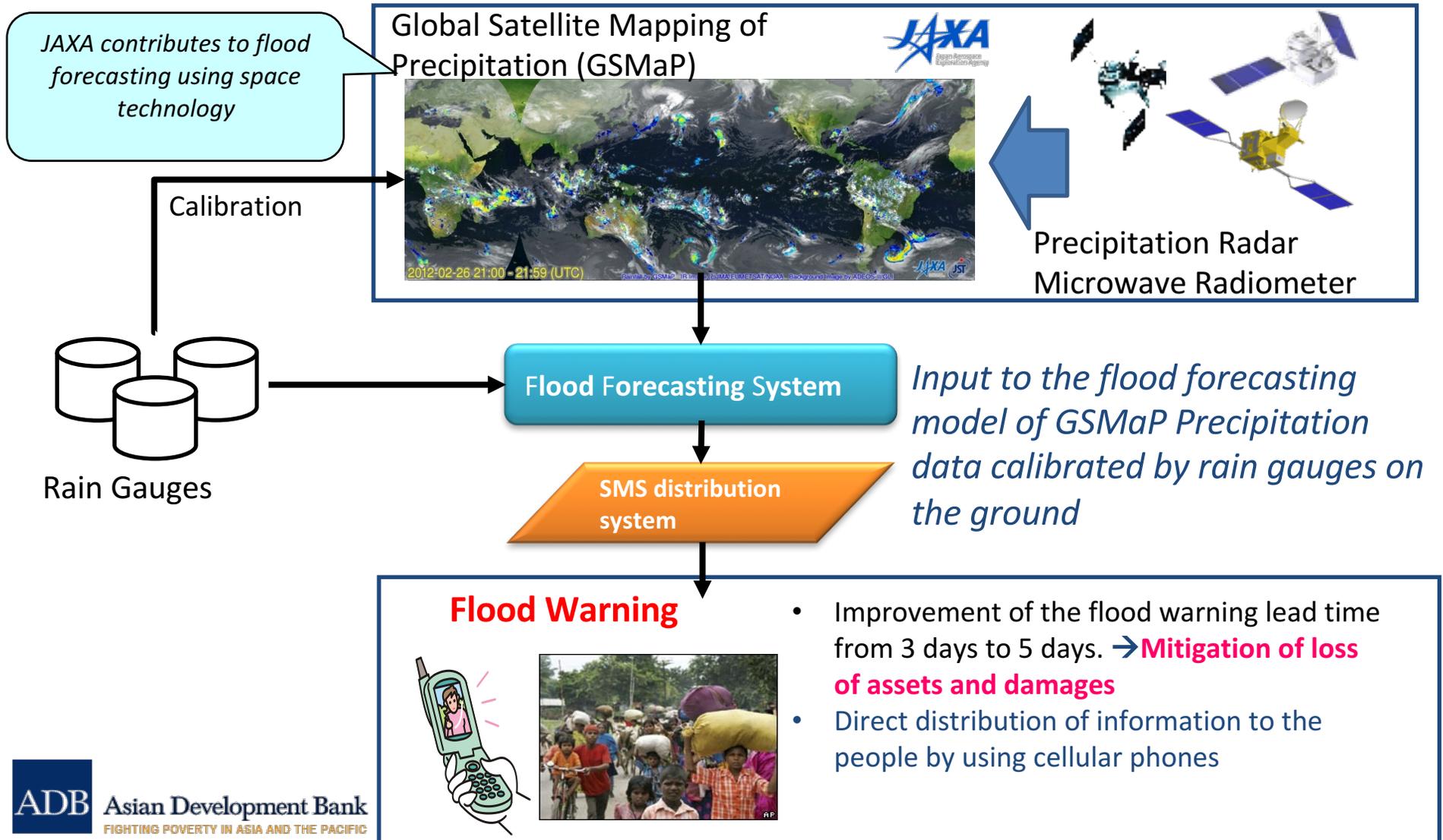


Before Flood
Discharge of main river is normal (green) before flood

During Flood
Discharge of main river is largely increased (red) during flood

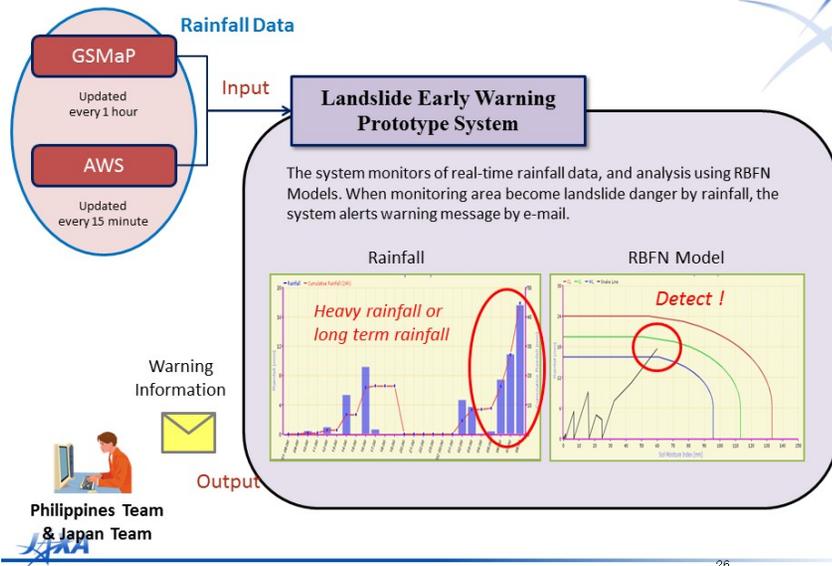
Example of Indus-IFAS in Pakistan (Image provided by ICHARM)

Target countries: Bangladesh, the Philippines, and Viet Nam

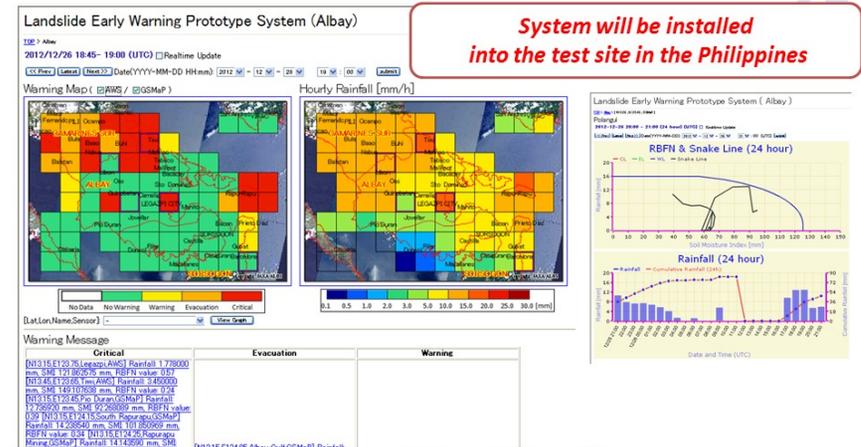


- Collaboration with JAXA and Philippine Institute of Volcanology and Seismology (PHIVOLCS)-DOST as “Sentinel Asia Success Story in the Philippines” project since 2009.
- Application of **GSMaP for Landslide Warning** has been studied in this project.
 - The system monitors of real-time GSMaP rainfall data, and analysis using RBFN Models. When monitoring area become landslide danger by rainfall, the system alerts warning message by e-mail.

Landslide Early Warning System



System operation



GSMaP applications for Drought monitoring



K. Hamamoto (EORC, JAXA)

- Prof. Takeuchi (Univ. of Tokyo) developed drought monitoring system using the GSMaP rainfall and land surface temperature from the Meteorological satellite and operates the website (<http://wtlab.iis.u-tokyo.ac.jp/DMEWS>).

Satellite-based drought monitoring and warning system
Institute of Industrial Science, University of Tokyo, Japan

About this site
This system is an application of space based technology (SBT) in the implementation of the Core Agriculture Support Program. The benefit of this system are to develop satellite-based drought monitoring and early warning system (DMEWS) for Asian Pacific counties using freely available data, and to develop capacity of policy makers in those countries to apply the developed system in policy making.

Explore by country

East Asia

- China
- Japan** (Click!)
- Mongolia
- Korea DPR
- Korea Rep.

Southeast Asia

- Cambodia
- Indonesia
- Lao PDR
- Malaysia
- Myanmar
- Philippines
- PapuaNewGuinea
- Thailand
- Viet Nam

South Asia

- Banladesh
- Bhutan
- India
- Nepal
- Pakistan
- Sri Lanka

Oceania

- Australia
- New Zealand

Our regional partners

- Indonesian Center for Agricultural Land Resources Research and Development (ICALRD, Indonesia)
- Geoinformatics Center, Asian Institute of Technology (GIC, AIT, Thailand)

Satellite-based drought monitoring and early warning system - Japan

Near-real time daily drought information of Japan (2016/07/12) (Download GIS data)

Drought warning statistics
• No drought is found.

Drought warning map
ENWG_Japan (2016/07/12)

Drought index anomaly map
ANIW_Japan (2016/07/12)

Monthly and annual drought information (Download GIS data)

Monthly drought index map | Monthly drought anomaly map | Annual drought anomaly map | Drought vulnerable area map

Provincial near-real time drought trend graphs
Chubu | Hokkaido | Kyusyu | Tohoku | Toyama |

Time-series drought trend graphs
Make plot at your area of interest

Related information

Rainfall map
GSMaP_Japan (2016/07/12)

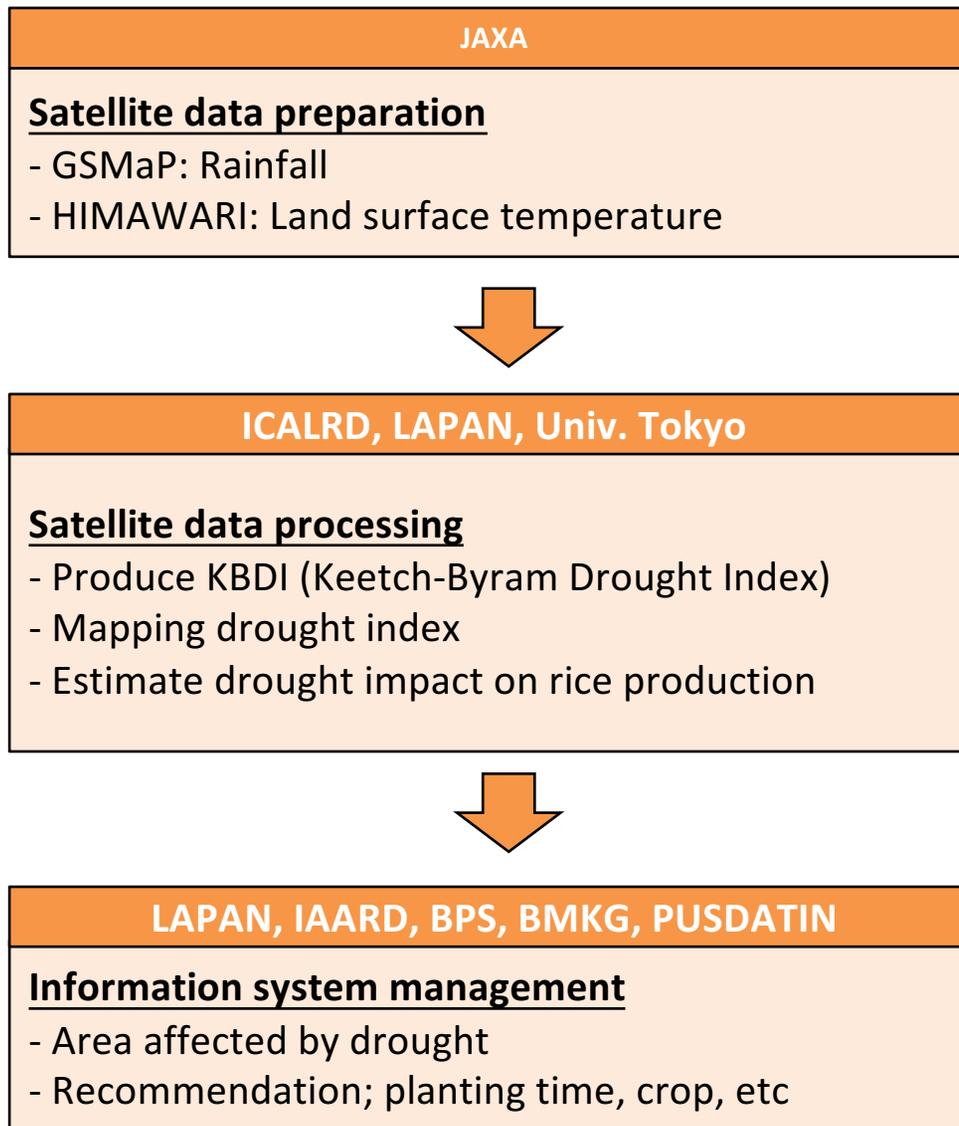
Drought index map
KDIT_Japan (2016/07/12)

Land surface temperature map
LST_Japan (2016/07/12)

Documents
How to use this system | Training material

Display drought index in addition to the rainfall amount

- The drought monitoring system based upon Univ. of Tokyo is operated in the Indonesia.



Web-GIS based information system



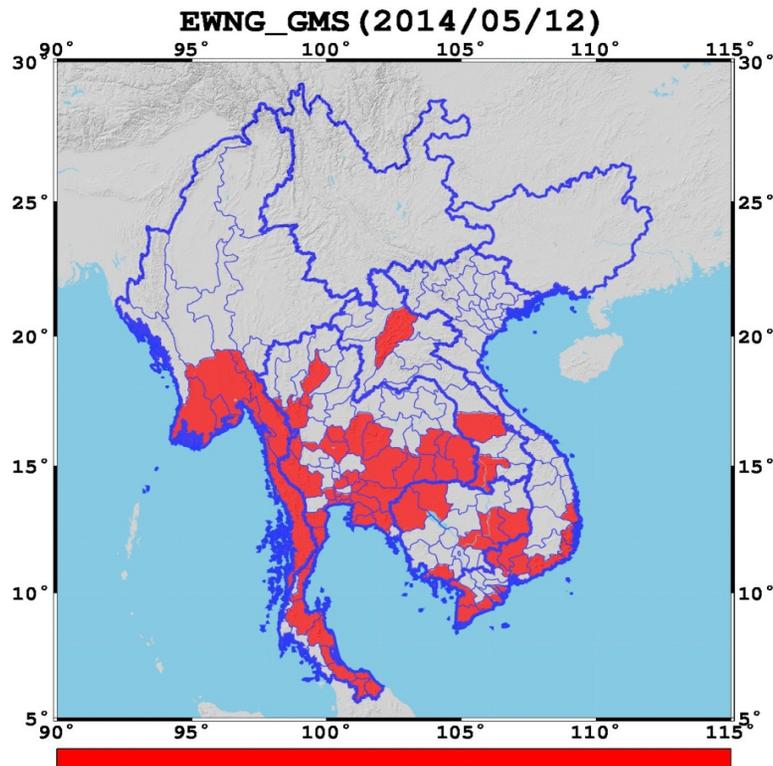
- This web-GIS system is sustainably operated by MOAI.
- The system is used by MOA for food security management.
- The developed index was utilized in ADB project in Lower Mekong Region.

MOA: Ministry of Agriculture
ICALRD: Indonesian Center for Agricultural Land Resources Research and Development

- Similar drought monitoring system is developed in the Greater Mekong Subregion by a fund from Asian Development Bank (ADB).

Target: Greater Mekong Subregion (GMS)

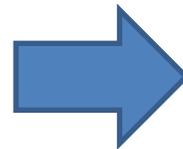
- Add free satellite-based drought information to GMS-AIN



Drought_early_warning_in_province_level

Drought Indices and alerts

-KBDI (Keetch-Byram Drought Index); daily, 10km




GMS-AIN (Great Mekong Subregion Agricultural Information Network)

Free data and automatically updated

-> No operational cost

GSMaP applications for Agriculture

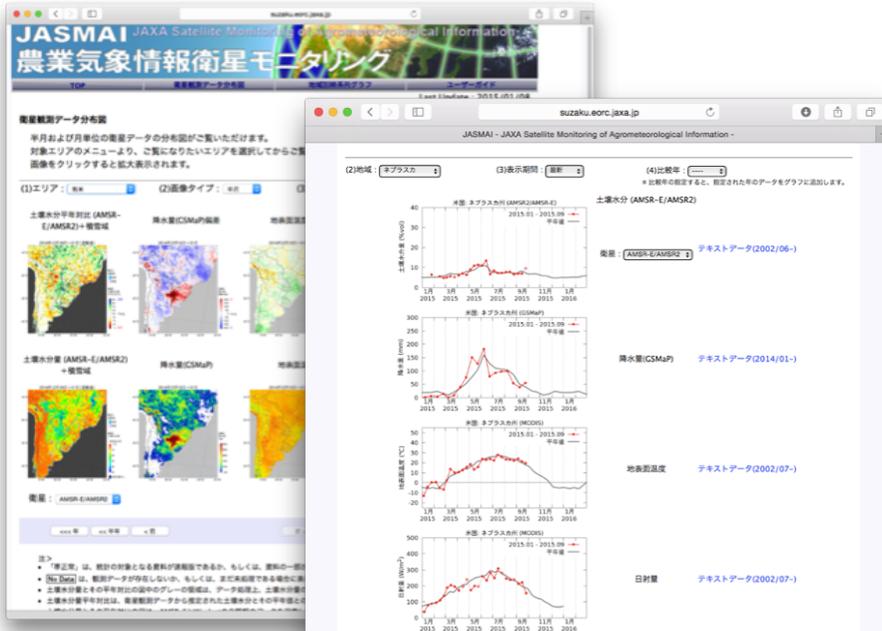


Dr. K. Oyoshi (EORC, JAXA)
[for JASMAI, JASMIN]

- Food self-sufficiency rate of Japan is only 40% and highly depend on food import.
- JAXA provides agro-met data including GSMaP to MAFF (Ministry of Agriculture, Forestry and Fisheries in Japan) for watching crop situation all over the world.

JASMAI

(JAXA Satellite Monitoring of Agrometeorological Information)



(Soil Moisture, Solar Radiation, Precipitation, LST, NDVI)

MAFF Monthly Report

【前給状況】 (詳細は右表を参照)

【米農務省の見通し】
 生産量は、収穫面積及び収穫がいずれも増加することから、前年度より増加し、17.0百万トンとなる見込み。
 消費量は、前年度より増加し、11.1百万トンとなる見込み。
 輸出量は、前年度より減少し、9.0百万トンとなる見込み。
 期末在庫量は、前年度より減少し、期末在庫率は16.5%に低下する見込み。
 なお、前月からの予測の改訂は、2015/16年度の期末在庫量で上方修正、輸出量で下方修正された。結果として、2016/17年度の期末在庫量が上方修正された。

【生育進捗状況及び作物】
 米国農務省(USDA)「WORLD AGRICULTURAL WEATHER HIGHLIGHTS」(2016.9.12)によれば、8月には、モンスーンによる平年並み～平年以上の降雨がインドシナ半島にもたらされた。この降雨は、雨季の栽培に十分な水量を供給するだけに止まらず、乾季米に使用する灌漑用水(ため池)の貯水量を十分なものにしていく(図-3)。

現地調査会社からの報告によると、タイ政府農業経済局による2016/17年度雨季作米の生産量予測(2016年6月現在)は、作付面積9.32百万ヘクタール、生産量25.3百万トン、単収2.69トン/ヘクタール(2015/16年度雨季米:作付面積9.17百万ヘクタール、生産量23.9百万トン、単収2.61トン/ヘクタール)と前年度より増加。これは、2015年のエルニーニョ現象の影響による干ばつから回復したため。2016年後半の雨量も2015年を上回り、稲の生育に十分な水が確保できる見込み。

【貿易情報・その他】
 国際穀物理事会(IGC)「Grain Market Report」(2016.8.25)によれば、2016年の輸出量は10.1百万トンと前年(9.8百万トン)をやや上回る見込み。一方、2017年の輸出量は9.5百万トンと、前年を下回る見込み。2015/16年度の期末在庫量は、政府が大量の在庫放出を続けたことから、2014/15年度対比40%以上減の5.9百万トンへ、急激に低下する見込み。直近のタイ産米市場の取引価格は、国際市場における需要の低下、2015/16年度の乾季米の市場への出回り、政府在庫の放出により、低値となっている(次ページ 図-5)。

世界の生産量シェア 6位(2016/17年度 3.5%)
輸出量シェア 2位(2016/17年度 22.0%)

表-3 タイの米需給(市場年度:翌年1月～翌年12月)
 (単位:百万トン)

年度	2014/15	2015/16 (見込み)	2016/17		前年対比 増減率(%)
			予測値、○はIGC	前月予測 からの変更	
生産量	18.8	15.8	17.0 (18.6)	-	7.6
消費量	10.6	10.8	11.1 (11.2)	-	2.8
輸出量	9.8	9.7	9.0 (9.5)	-	▲7.2
輸入量	0.3	0.3	0.3 (0.3)	-	▲16.7
期末在庫量	10.6	6.2	3.3 (4.2)	0.1	▲46.2
期末在庫率	51.9%	39.1%	16.5% (20.3%)	0.5	▲13.6

(参考)
 収穫面積(万ha) 10.27 9.44 9.55 (10.20)
 単収(t/ha) 2.77 2.53 2.70 (-)

資料: USA World Agricultural Supply and Demand Estimates, World Agricultural Production (12 September 2016), IGC Grain Market Report (25 August 2016)

図-3 2016年8月16～31日の降水量
 GSMaP 降水量(mm) 300 200 150 100 25

写真-2 タイ中部ナコンサワン県(2016年8月29日) 刈り取り期に降雨が続き、収穫間を待つ雨季米
 撮影: RIA Information Service Co., Ltd.

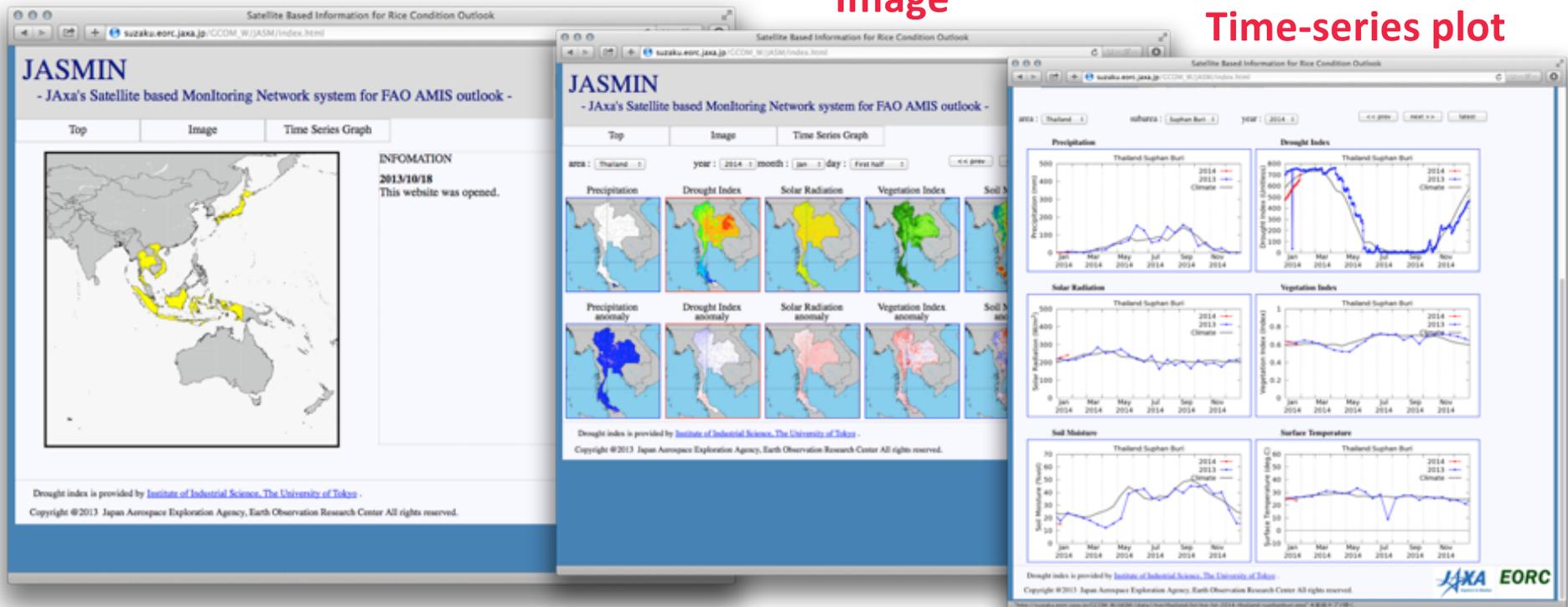
MAFF, Japan operationally utilizes these agro-met information in their practical work.

- **JASMIN** (JAXa's Satellite-based Monitoring Network system) provides GSMaP and satellite-based **drought index**, **solar radiation**, **land surface temperature**, **soil moisture**, and **vegetation index** (update twice a month).
- These information are used to generate **monthly rice growing outlook** which is reported to FAO(Food and Agriculture Organization of the United Nations) through GEOGLAM(GEO Global Agricultural Monitoring Initiative).

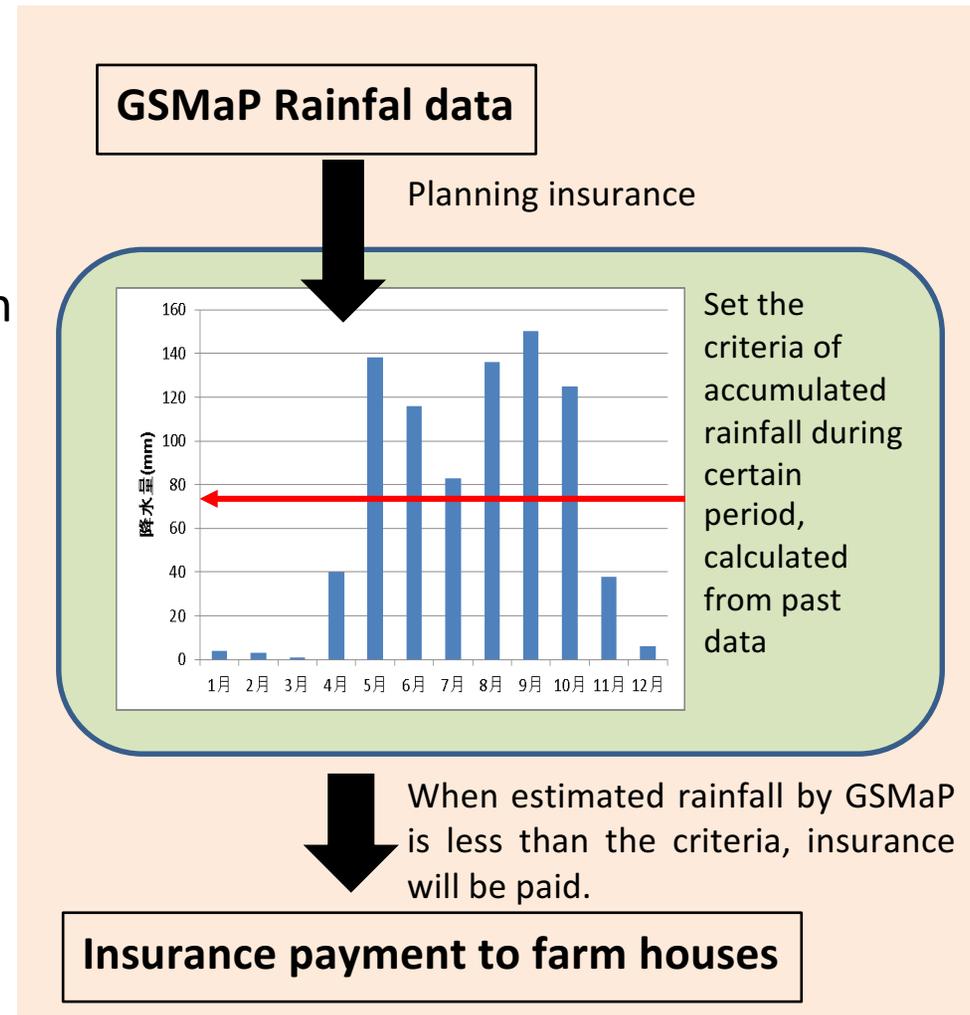
Top Page

Image

Time-series plot



- Japanese insurance company has developed Weather Index Insurance in Myanmar using GSMaP rainfall data, and plans to sell it.
- In Myanmar, agriculture makes up 40% of GDP, but natural disasters such as droughts happens often recently.
- Overview of the insurance
 - Assured persons: farm houses in the assured regions
 - Assured crops: rice, sesame
 - Assured regions: Arid regions in the central Myanmar
 - Assured risks: drought (risk of less rainfall in rainy season)
- Plan to expand the insurance to other disaster risks (cyclone, heavy rainfall) in Myanmar, and to other countries in South-East Asia



(from press release from Sompo Japan Nipponkoa & RESTEC in Dec. 2014)

GSMaP applications for Public Health



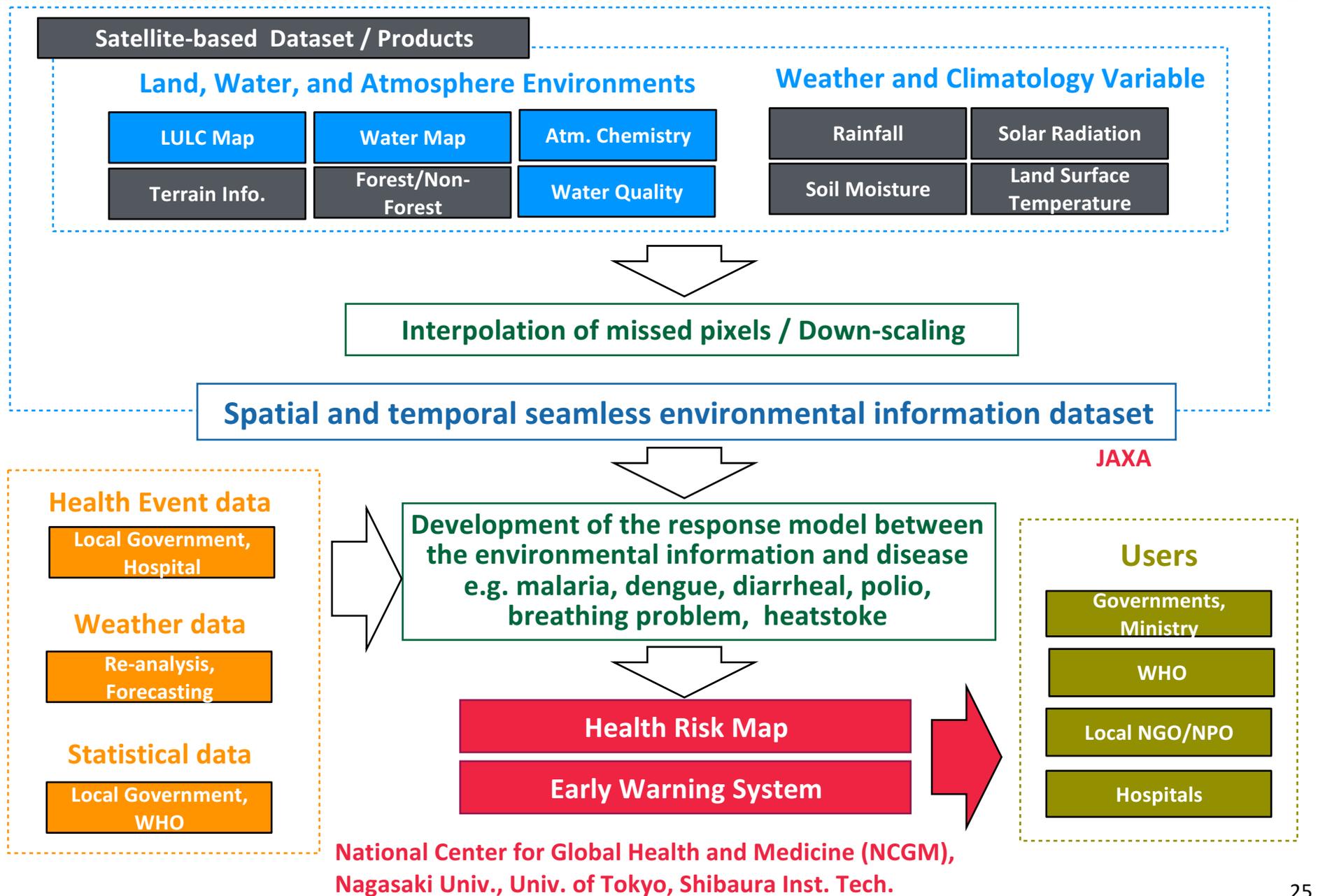
Dr. K. Oyoshi (EORC, JAXA)



Dr. T. Tadono (EORC, JAXA)



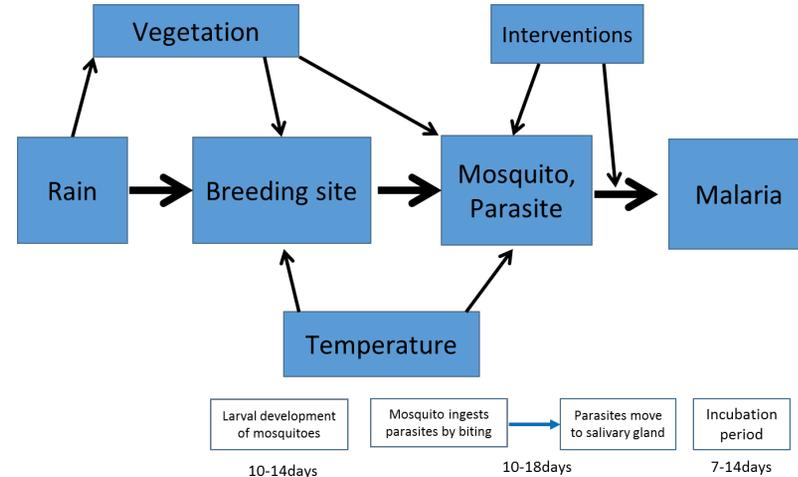
JAXA Application Research Activity in Public Health



- An joint work with Nagasaki University and JAXA
 - The association between environmental factors and malaria around the Lake Victoria in Kenya
 - Satellite data
 - NDVI, LST/SST, Rainfall (GSMaP)

Provided by Dr. Igarashi (RESTEC)

Environmental factors and Malaria
(assumed causal relationships)



Methods(1)

Study design: Cross-correlation analysis

Study area

Western Kenya, Nyanza County

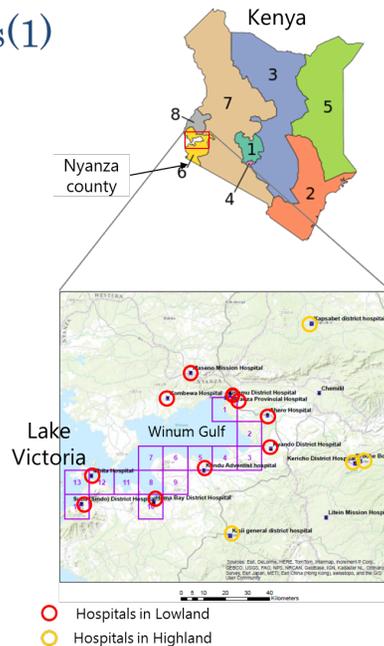
Area: 12,477km²

Population: 5.4million[Census 2009]

Lowland around the Lake Victoria
Highland(altitude>1500m) around Lowland

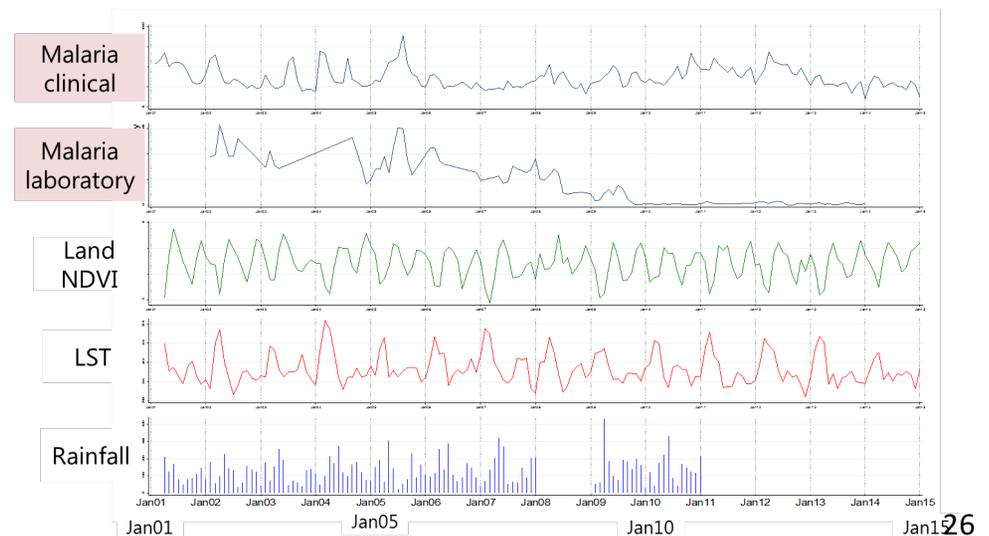
Rainy season: Mar.-May, Oct.-Nov.

Known as highly endemic area of malaria (Highland became endemic after late 1980s)

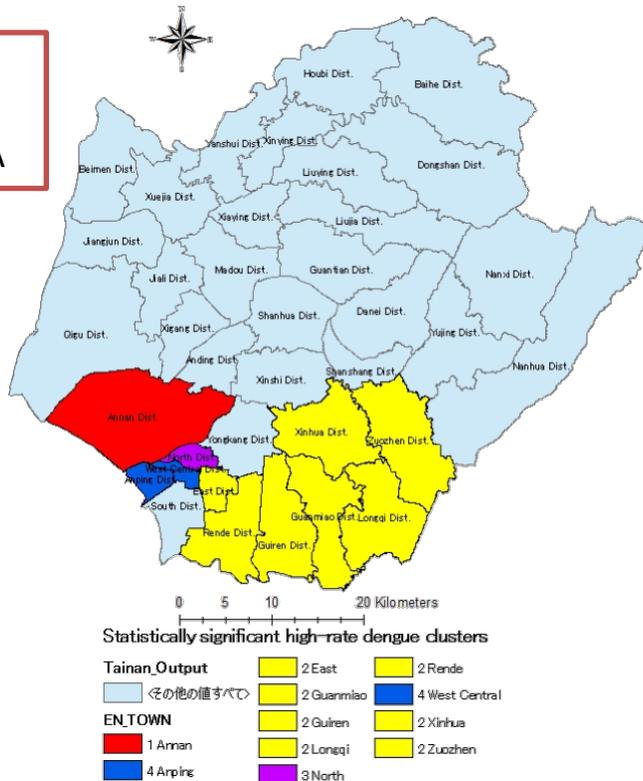


Results(2)

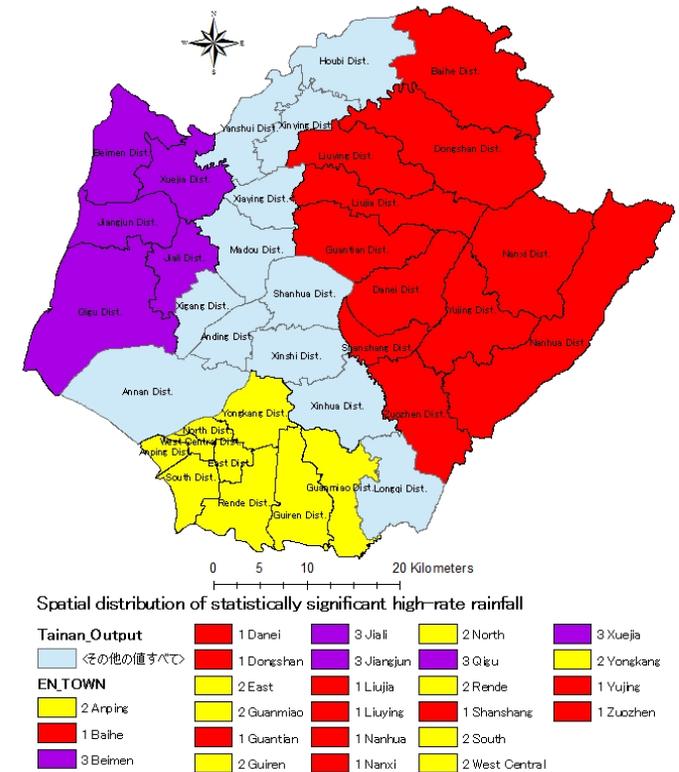
Monthly cases and environmental factors in Highland (Kisii 2001-2014)



An joint work with
Shibaura Institute of
Technology and JAXA



The result of the space-time clustering analysis of dengue cases in Tainan City, Taiwan.



The result of the space-time clustering analysis of rainfall rate.

Environmental information dataset:

- Monthly average rainfall rate from **GSMaP**
- Monthly average land surface temperature from **JASMES**

Health event data:

- Monthly numbers of clinically confirmed dengue cases in each district through the institutions in Taiwan.

Model analysis:

The Kulldorf method of retrospective space-time analysis and a space-time permutation probability model was applied to identify geographic areas and the time period of potential clusters with high disease rates.

- GPM/GSMaP registered users
 - About 2400 registered users and 92 countries as of 30 Sep. 2016
 - Currently about 75% users are originated from Asian countries.
- GPM Asia workshop
 - 5th workshop was held in Tokyo on Jan. 2016
- JAXA activity for the GSMaP applications
 - Rainfall monitoring
 - Drought monitoring
 - Hydrology
 - Agriculture
 - Public Health