Japan's contribution to disaster management in the Asia and the Pacific region through international cooperation by applying Global Satellite Mapping of Precipitation ("GSMaP")

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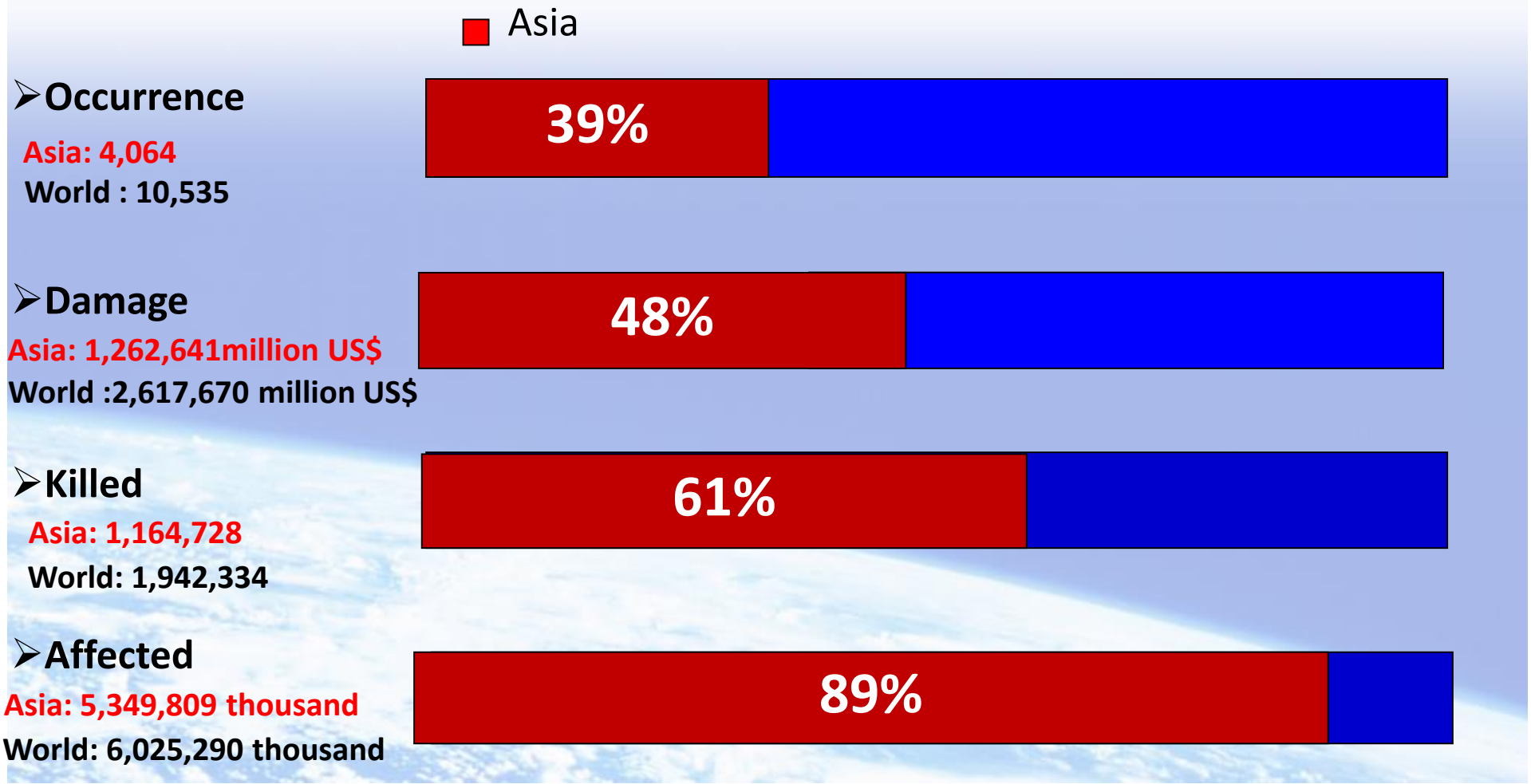
1. Introduction

Asia and Disasters

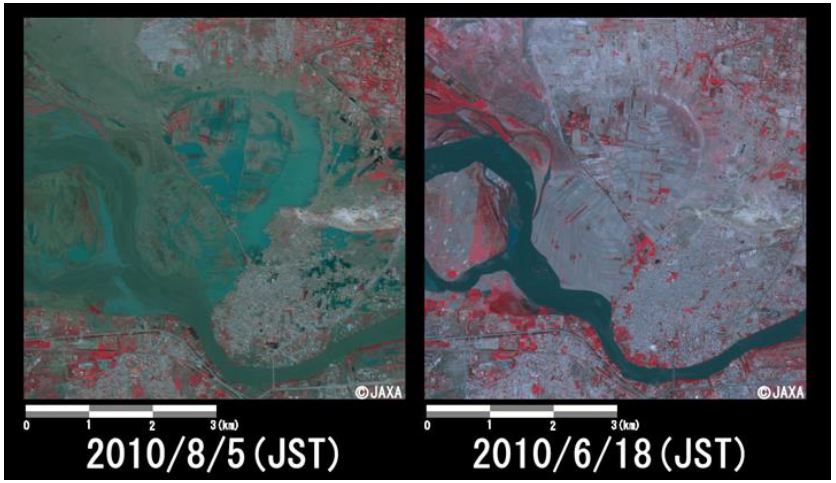
Asia has been seriously damaged by natural disasters over the last 30 years (1986-2015).

Source: 'ADRC-Natural Disasters Data Book 2015' originated in EM-DAT: The OFDA/CRED International Disaster Database – http://www.emdat.be/, Université Catholique de Louvain, Brussels (Belgium)

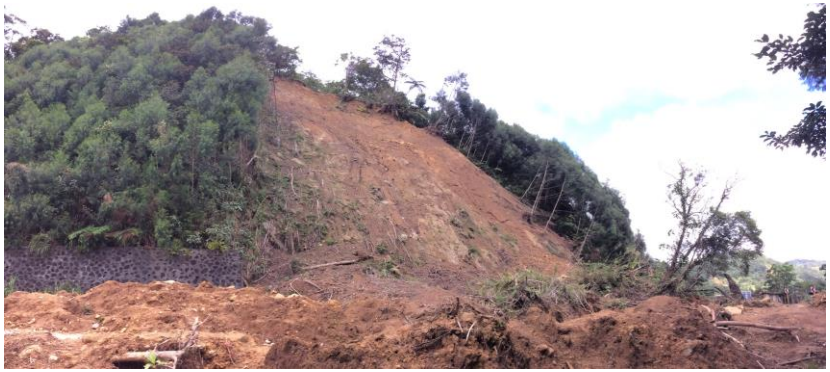


Water-related natural hazards and Asia

- Water-related hazards account for 90 per cent of all natural hazards, and their frequency and intensity is generally rising (4th UN World Water Development Report, 2012).
- By 2050, rising populations in flood-prone lands, climate change, deforestation, loss of wetlands and rising sea levels are expected to increase the number of people vulnerable to flood disaster to 2 billion (UNESCO, 2012).
- **Information on precipitation that may induce water-related disaster is crucially important.**



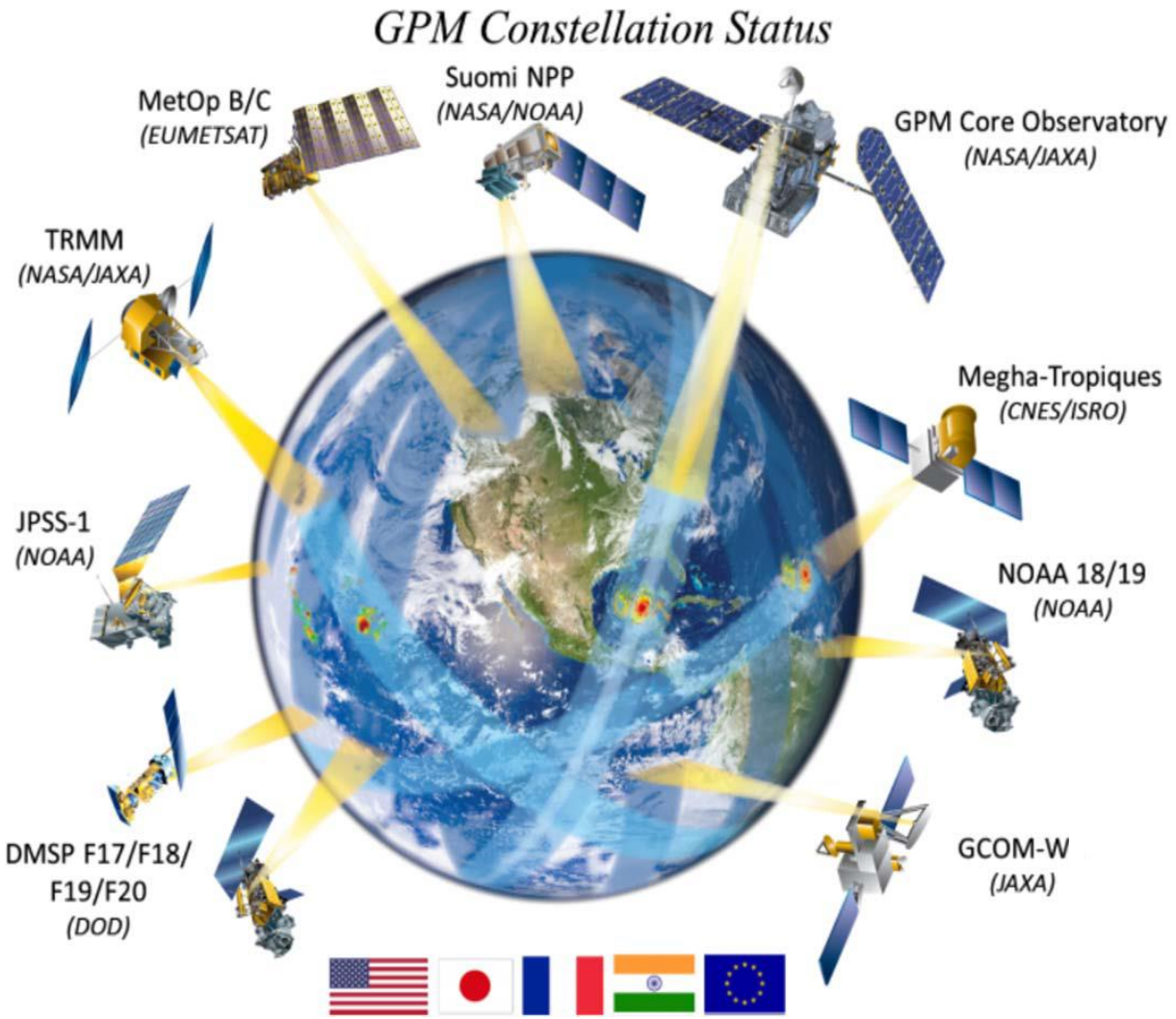
Floods in Pakistan in 2010 (before and after)
©JAXA



Landslide in the Philippines caused by the typhoon Nona in 2015
©PHIVOLCS

Global Precipitation Measurement (GPM) Mission

- **International Cooperation jointly led by NASA and JAXA**
- **Aimed at establishing accurate and frequent global precipitation observation system**
- **GPM mission consists of GPM Core Observatory and constellation satellites. The Core Observatory was developed jointly by NASA and JAXA.**
- **NASA and JAXA launched the GPM Core Observatory Satellite on 27 February 2014.**
- **Constellation satellites with microwave radiometers were developed by various organisations.**



© NASA

GSMaP Global Satellite Mapping of Precipitation

Dual-Frequency Precipitation Radar

Providing reference standard

GPM Microwave Imager

Global Precipitation Measurement Core satellite

Gauge for calibration

IR imager by Geostationary satellite

Constellation satellites

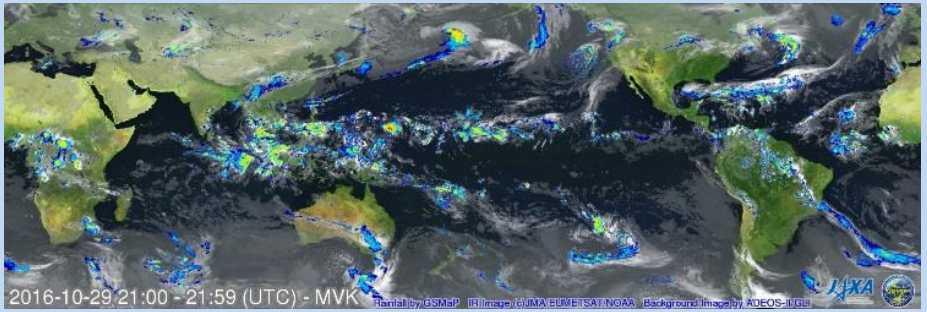
Precipitation Radar

Microwave Radiometer

IR Imager

Multi-satellite Rainfall Product

- hourly global rainfall data
- 0.1x0.1deg. lat./lon.
- some kinds of GSMaP for various purposes (near-real time, long-term reanalysis etc..)



Distribute in some data format via FTP site or website

2. Application of GSMaP to disaster management ~Sentinel Asia~

Sentinel Asia

Started in 2006 based on recommendations from APRSAF,
Sentinel Asia is an international collaboration to support disaster management in the Asia-Pacific region.

Asia-Pacific Regional Space Agency Forum

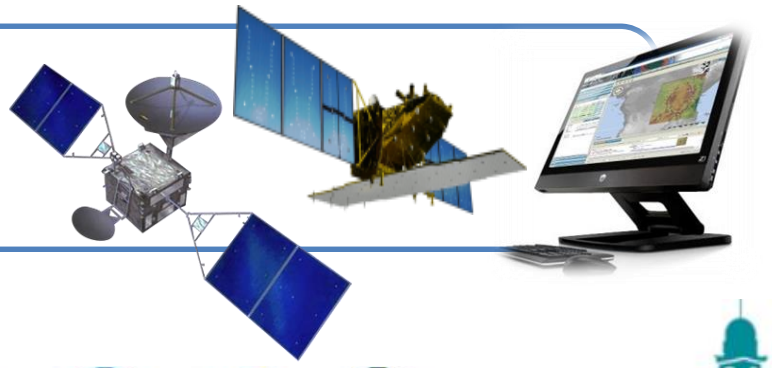
Sentinel Asia

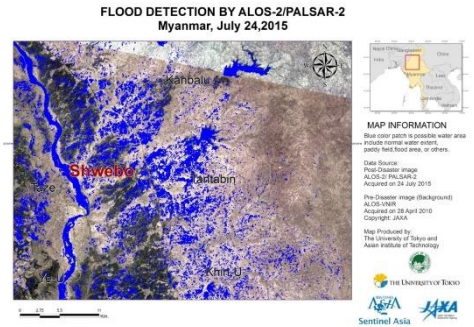
Participants

- Space agencies, disaster management agencies, international organizations...

Technology

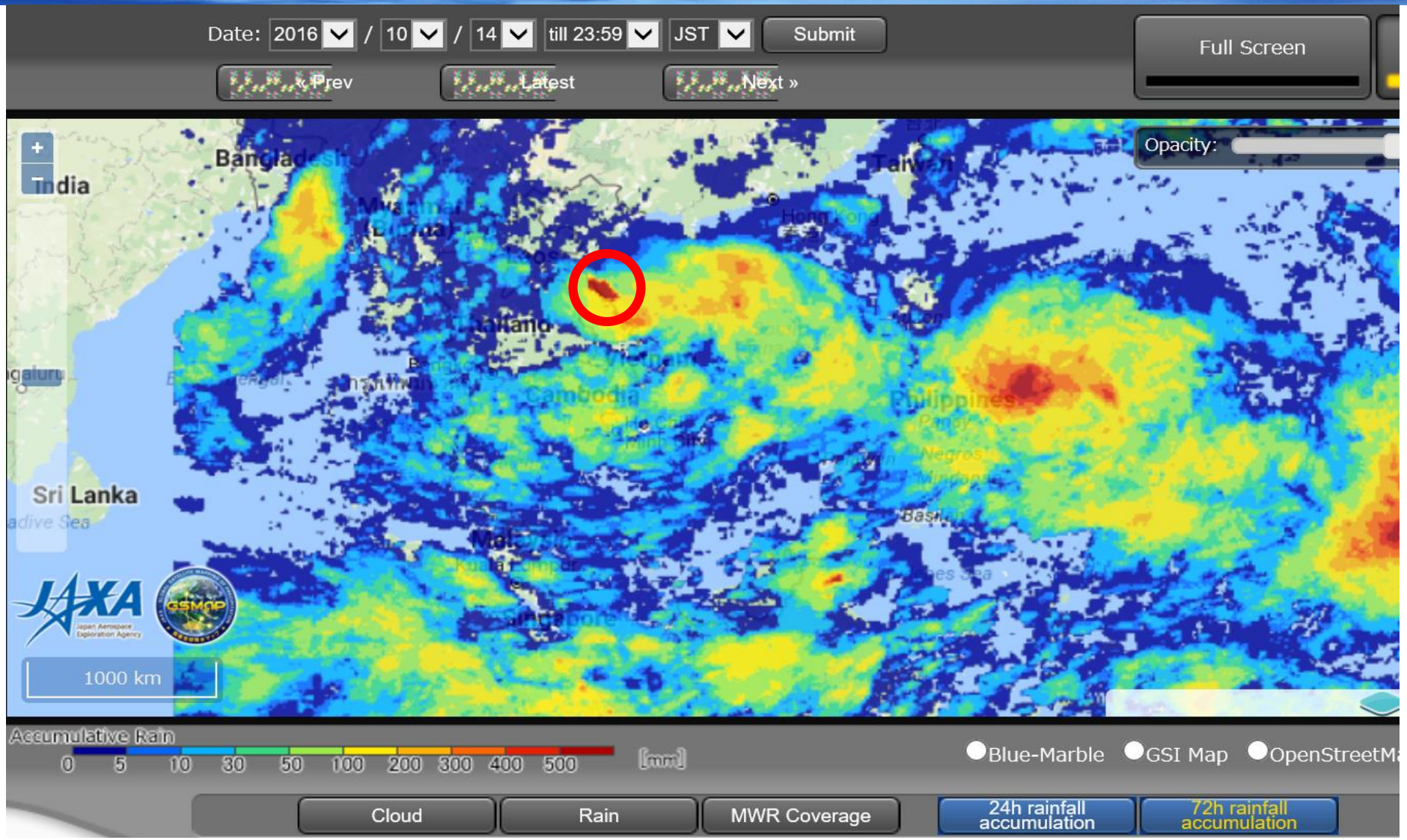
- Remote sensing
- Web-GIS





Emergency Observation Flow

Effective use of GSMaP for prompt emergency observation



- **Flood in Viet Nam Quang Binh Province in October 2016**
- **72-hour (12 to 14 Oct.) accumulated rainfall according to GSMaP**
- **Emergency Observation Request was made promptly to Sentinel Asia on 16 October 2016**

3. Application of GSMaP to disaster management ~UNESCO Pakistan Flood Project~

UNESCO Pakistan flood project

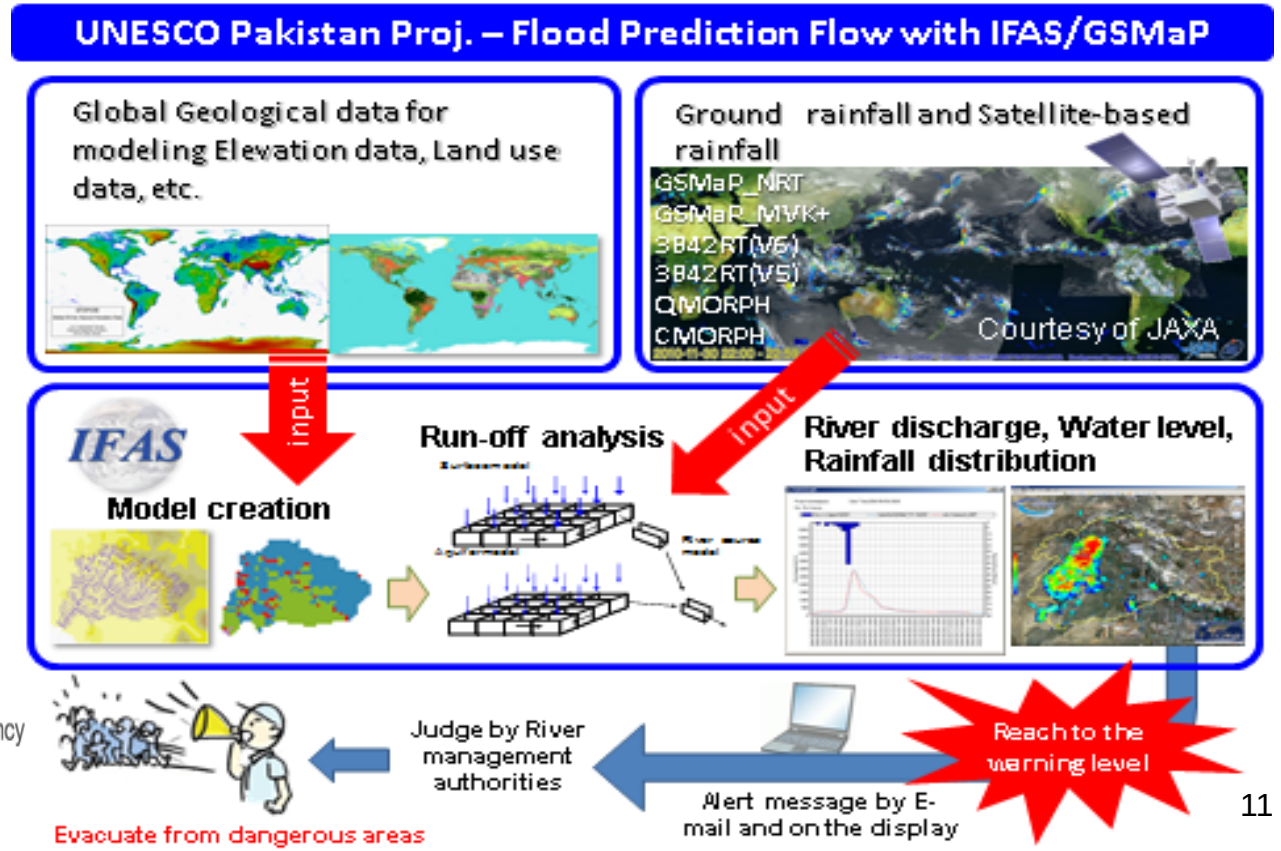
"Strategic Strengthening of Flood Warning and Management Capacity"

- Funded by the Japan International Cooperation Agency (JICA)
- Implementing Agency: UNESCO
- Agencies involved: Pakistani Stakeholders (Planning Commission Pakistan, FFD, PMD, SUPARCO, WAPDA, NDMA NUST, PCRWR, SAWCRI), ICHARM, and JAXA

- Main Activities:

(a) flood early warning system development using ICHARM's Integrated Flood Analysis System (IFAS)

(b) capacity-building in Pakistan to manage the floods



United Nations Educational, Scientific and Cultural Organization

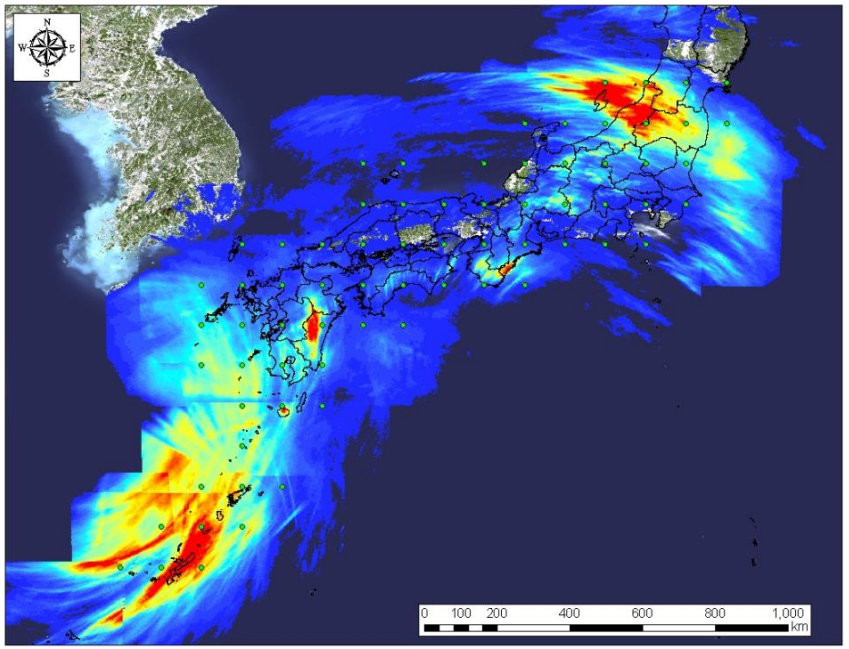
Japan International Cooperation Agency

Acknowledgement: UNESCO and JICA

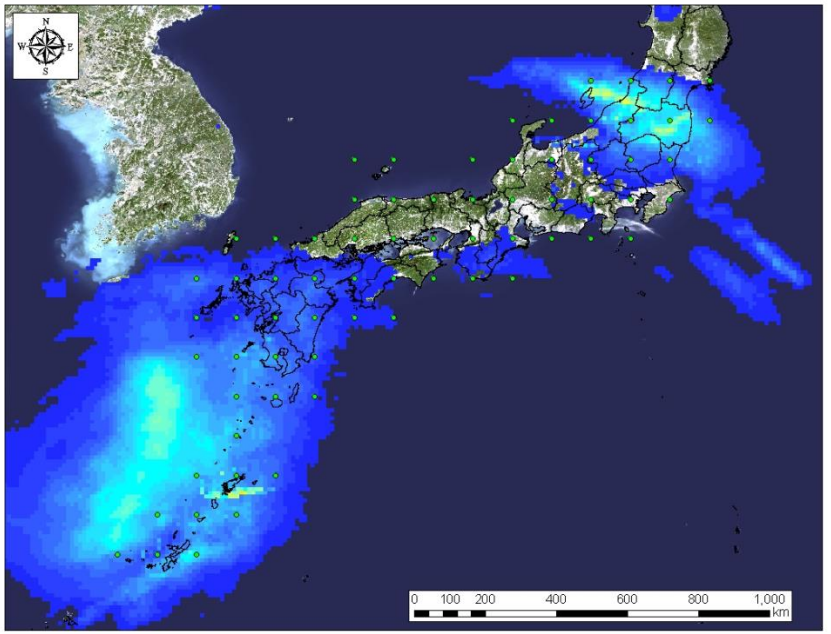
Accuracy enhancement of GSMaP for practical use 1

GSMaP original data tend to underestimate the amount of precipitation.

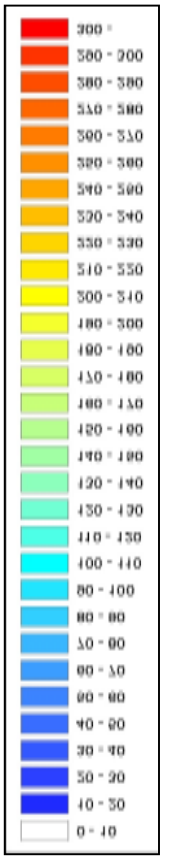
Ground Truth
(corrected ground radar)



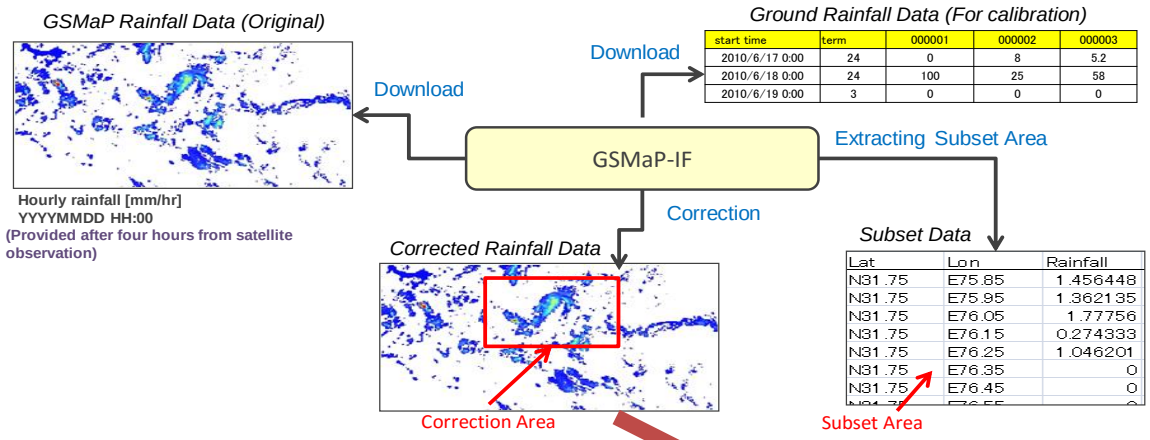
GSMaP original data



mm/day



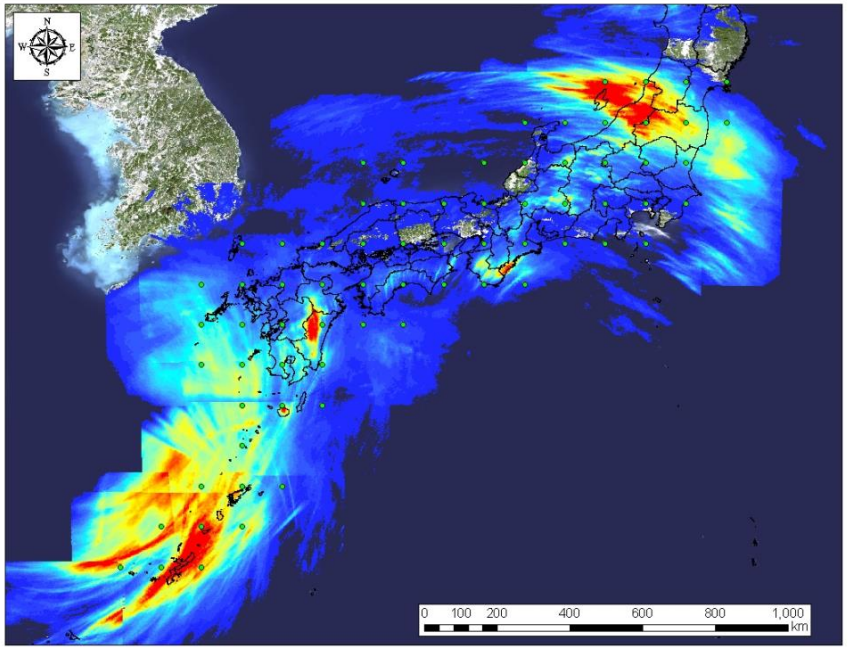
Accuracy enhancement of GSMaP for practical use 2



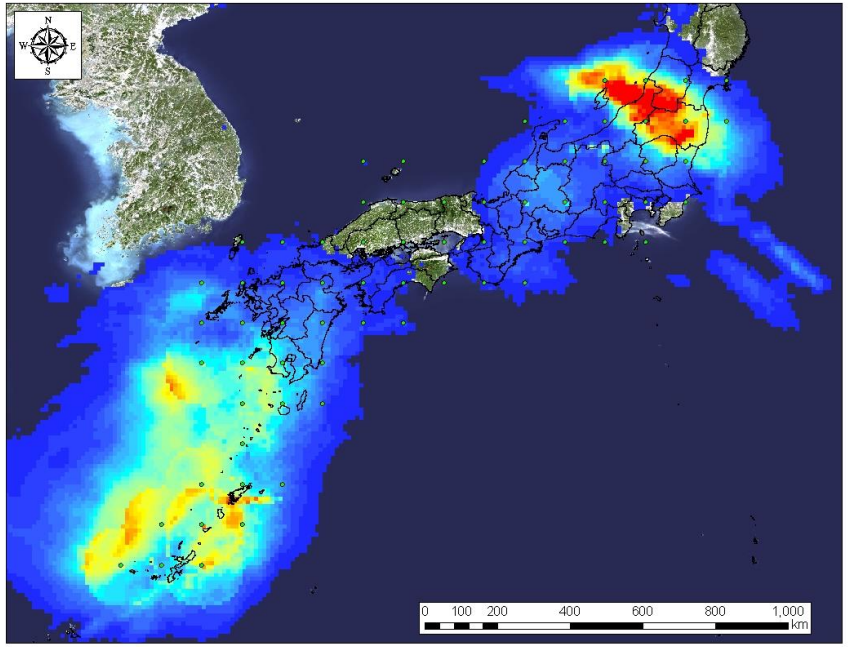
JAXA developed and has been upgrading a specific software entitled “GSMaP IF” to correct the amount of precipitation provided by GSMaP.

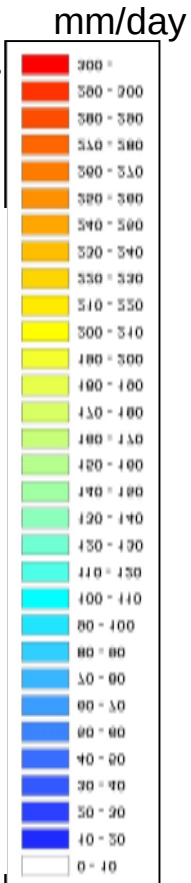
By using “GSMaP IF”, the accuracy of GSMaP enhances.

Ground Truth
(corrected ground radar)

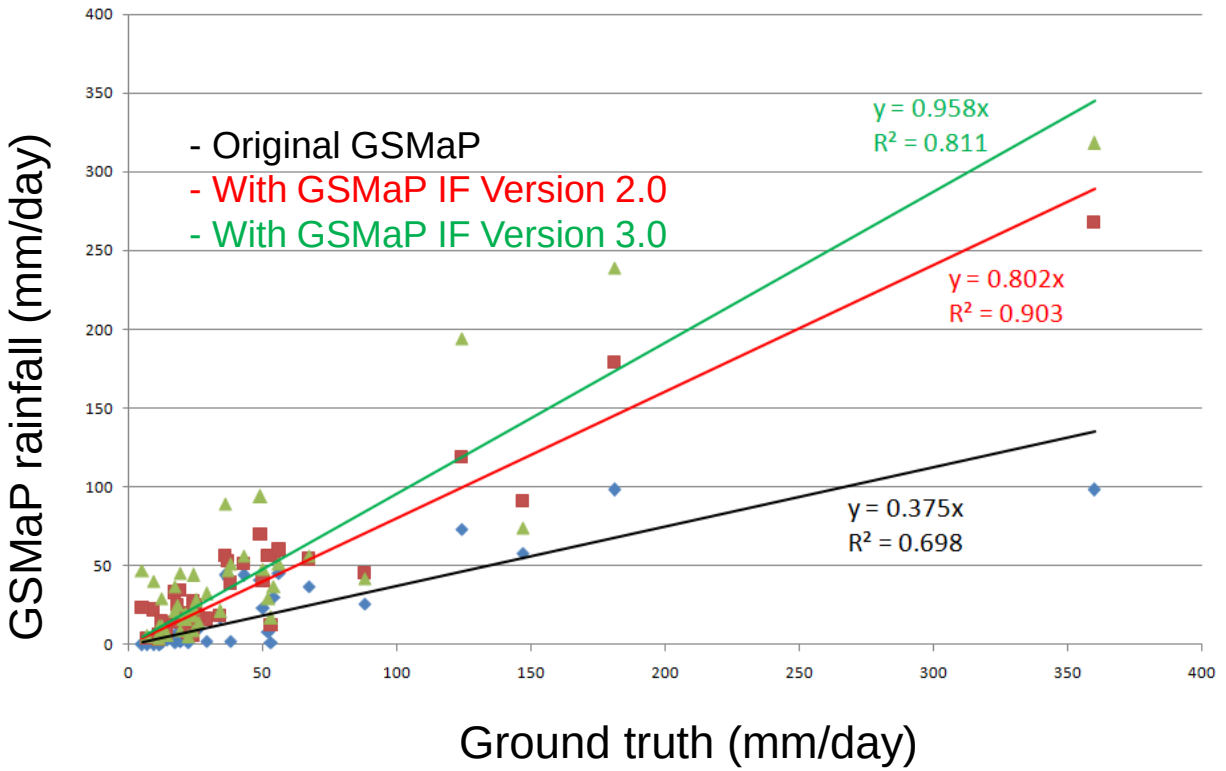


GSMaP IF result
(corrected by version 3.0)





Toward the practical use of GSMaP for flood management



- Capacity-building on the use of GSMaP IF
- Back-to-back with UNESCO workshop
- 20 December 2017

Improved accuracy of GSMaP data with GSMap IF

JAXA will address further improvement of GSMaP accuracy.
Under UNESCO project, an additional online capacity-building session is planned in July.
GSMaP data are expected to be operationally used for flood management in Pakistan soon.

4. Application of GSMaP to disaster management ~Sentinel Asia Success Story in the Philippines~

Hybrid of UNESCO Pakistan project (spin-off) and Sentinel Asia

Application of GSMaP to landslides

“GSMaP-based Landslide Warning System (GLAWS)”

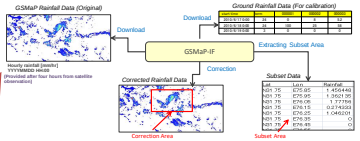
- Pilot project of Sentinel Asia to address activities in the pre-disaster phase
- Spin-off of technologies developed through UNESCO Pakistan flood project (GSMaP IF)
- Use of demonstrated landslides monitoring technologies in Japan (“Radial Basis Function Network)

Rainfall monitoring

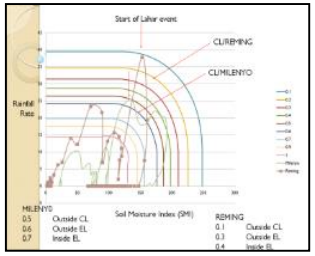
GSMaP

Ground-based rainfall data

Calibrated rainfall data via GSMaP IF



Model preparation

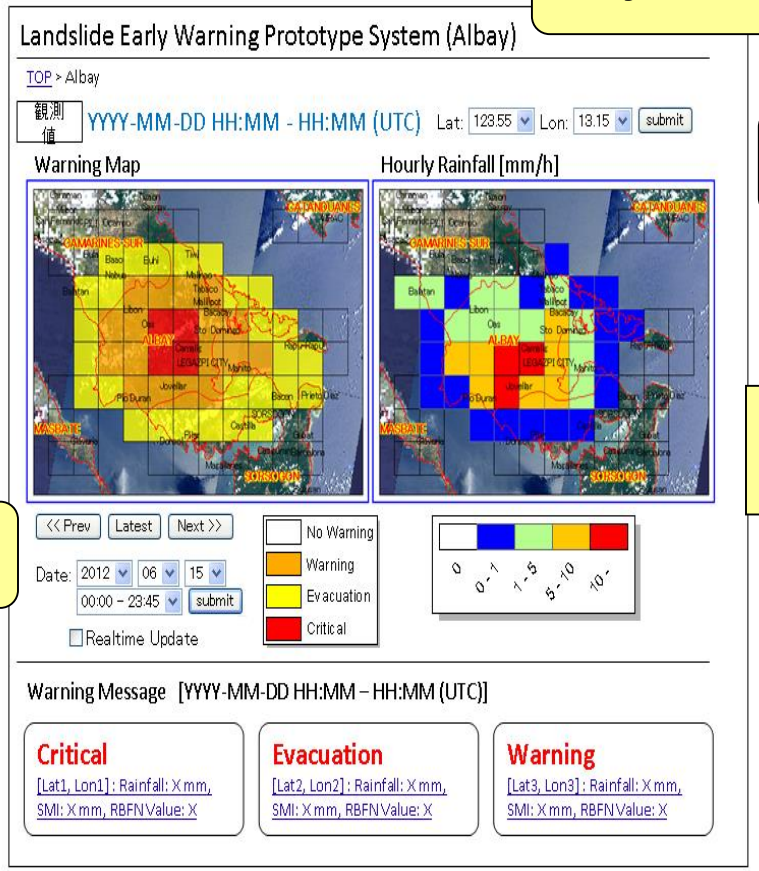


Warning criteria

Hazard maps, Criteria

Automatic prediction

System

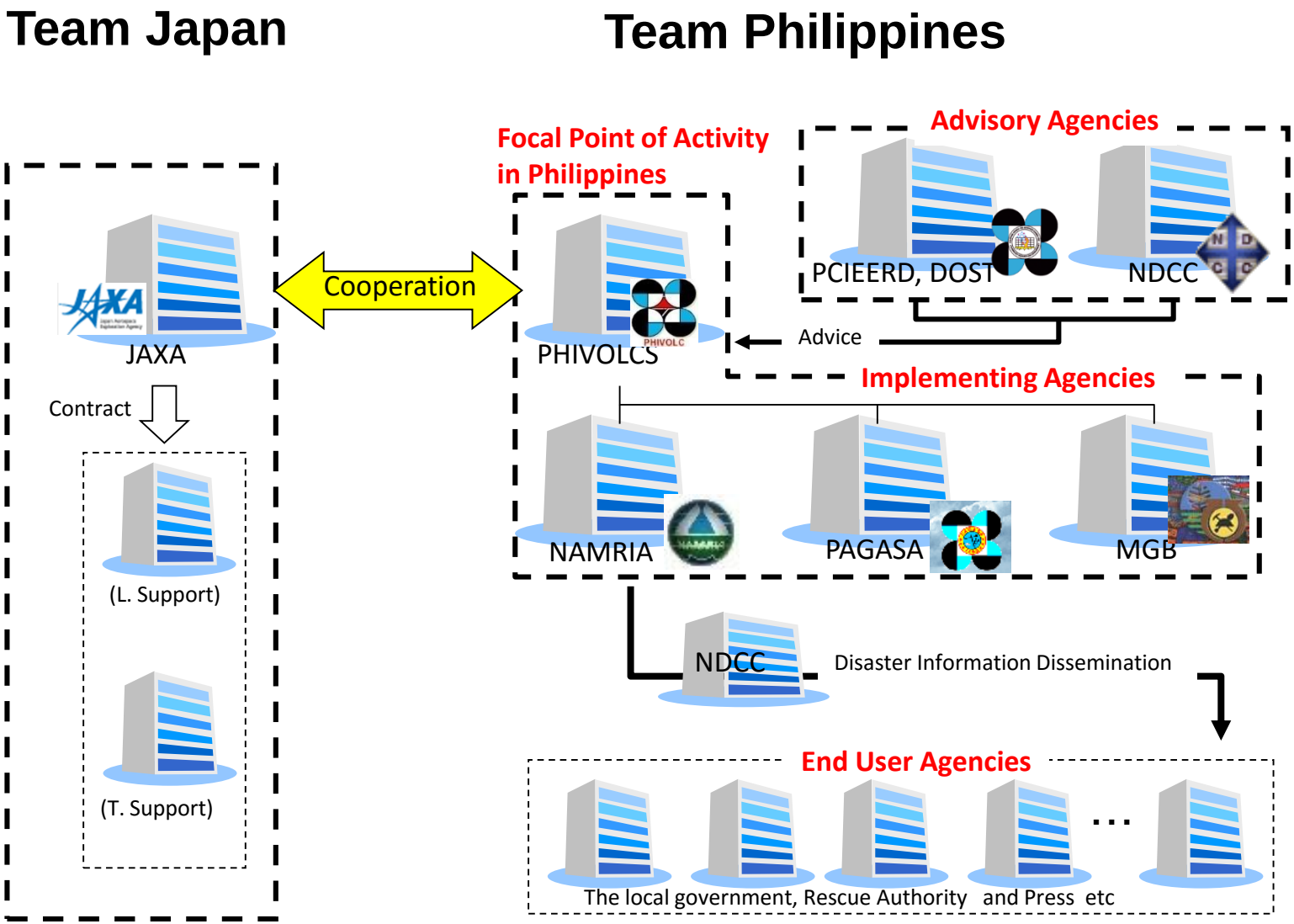


Application

Analysis / warning

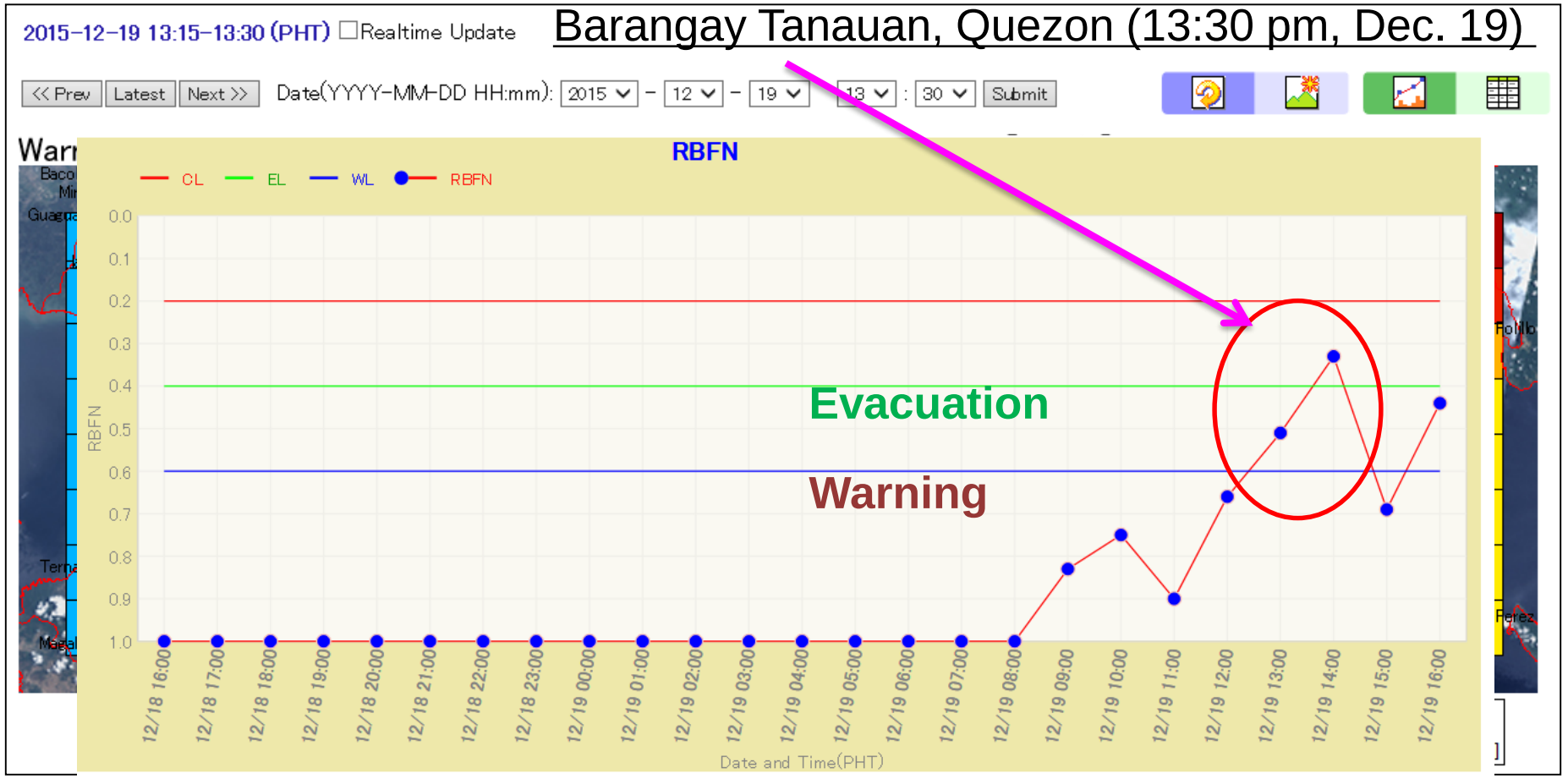
Agency / Local gov.

Framework of Sentinel Asia Success Story in the Philippines



Case Study (Typhoon NONA)

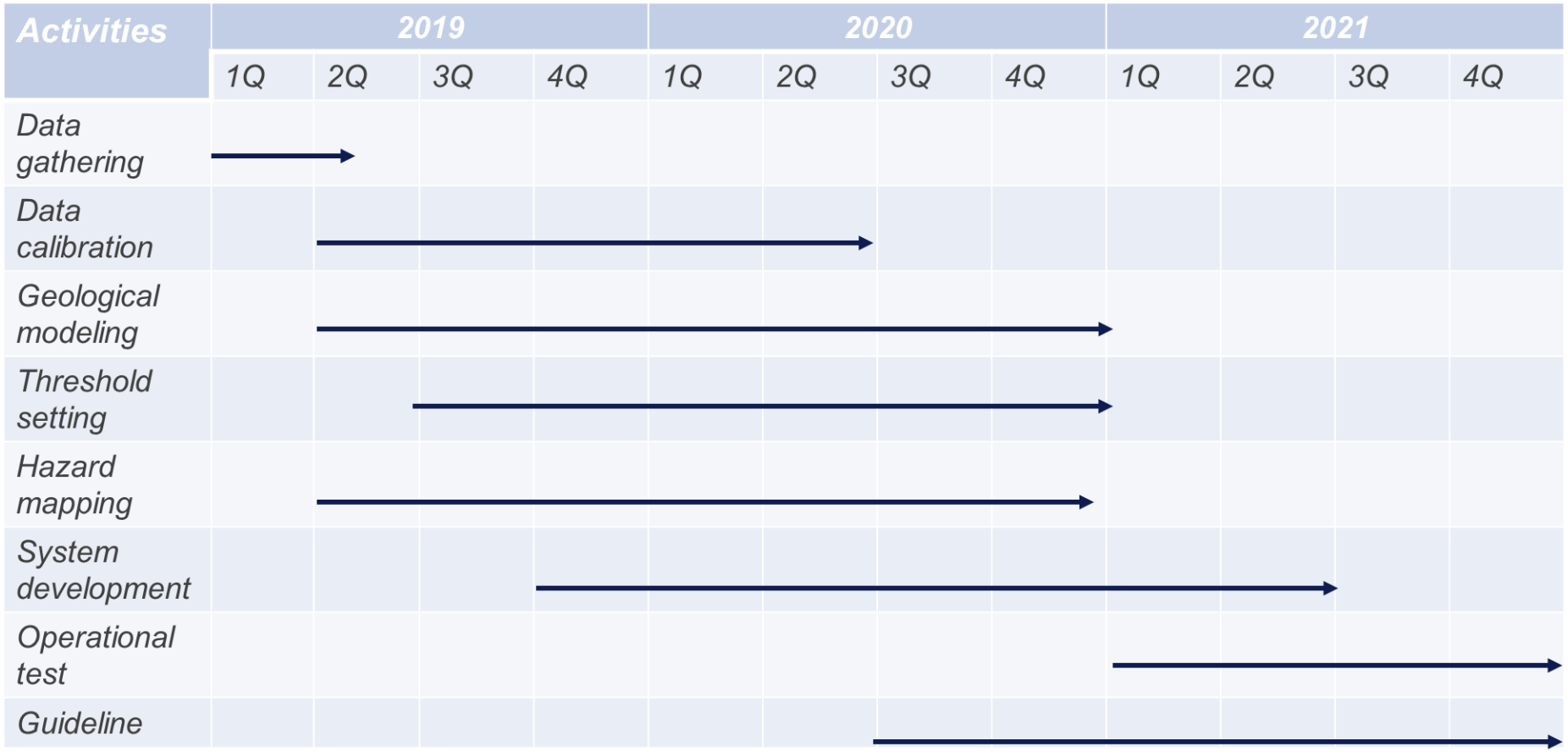
Typhoon Nona, a powerful tropical cyclone, struck the Luzon island in December 2015, causing several big landslides destroying houses, roads and other facilities. GLAWS issues an alert on the very moment when the devastating landslide occurred.



Local Provincial DRR Office reported that ***landslide occurred at about 1:30 p.m. on 19 December 2015***

Future Plan

- Based on the success of prototype “GSMaP-based Landslide Warning System (GLAWS)”, the Team Philippines are planning to make it operational in wide areas.
- PAGASA will be the leady by bringing together all the stakeholders.
- JAXA will provide technical support with regard to rainfall data calibration.



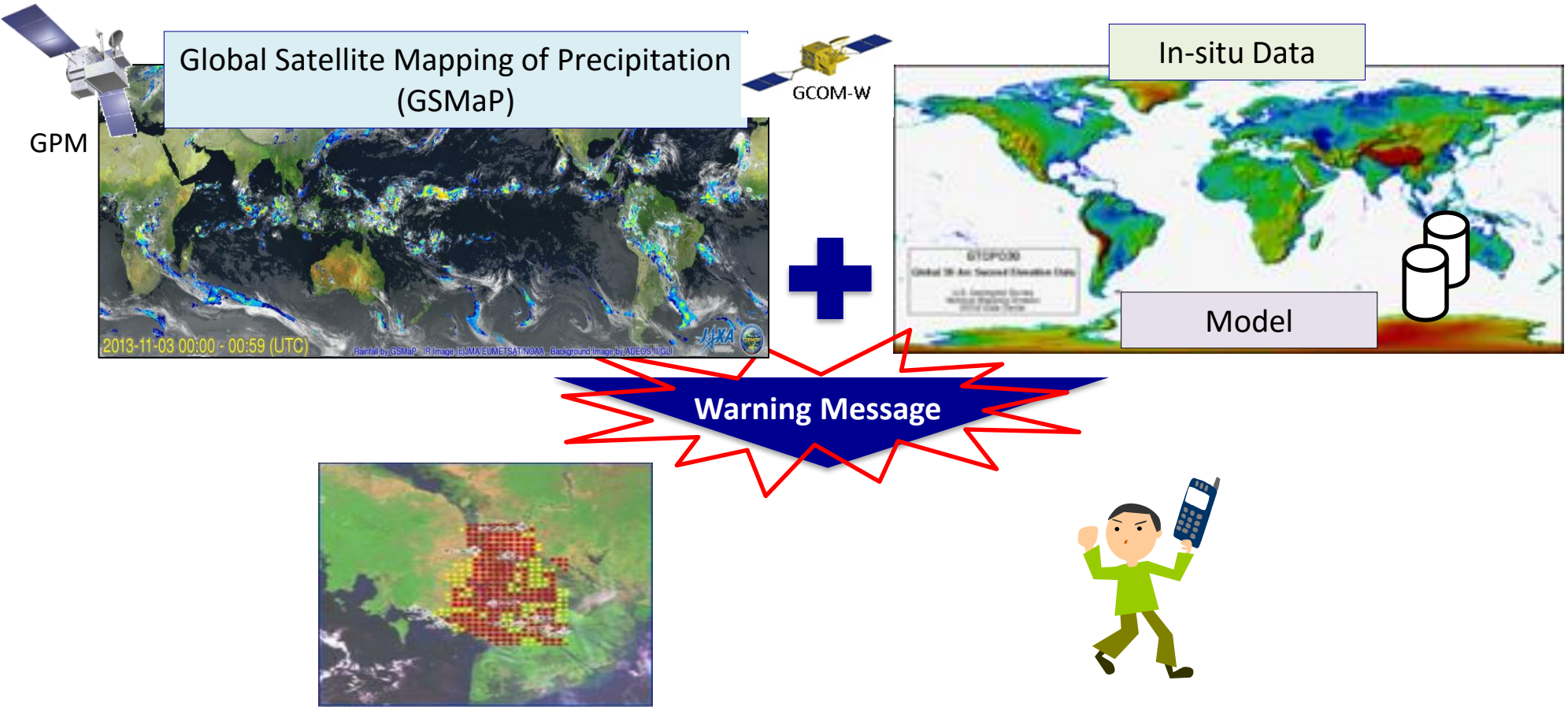
5. The way forward

Sustainable Development Goals (SDGs)

"Transforming our World, the 2030 agenda for Sustainable Development"

- Agreed at UN General Assembly in Sep 2015
- To assists countries to measure, manage and monitor progress on economic, social and environmental sustainability.
- Basic principle of the 2030 Agenda: **"No one is to be left behind".**

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable



Disaster mitigation through flood early warning system using GSMaP in partnership with such as UNESCO and local stakeholders has been registered at Japan's Sustainable Development Goals (SDGs) Promotion Headquarters as one of the priority subjects!

Sendai Framework and space technologies

Priority 1. Understanding disaster risk

National and local levels

24 (f) To promote real time access to reliable data, mak
situ information, including geographic information systems (GIS), and use information and communications technology innovations to enhance measurement tools and the collection, analysis and dissemination of data

Global and regional levels

25 (c) To promote and enhance, through international cooperation, including technology transfer, access to and the sharing and use of non-sensitive data and information, as appropriate, communications and geospatial and space-based technologies and related services; maintain and strengthen in situ and remotely-sensed earth and climate observations; and…

Sendai Framework and Sentinel Asia Strategic Plan

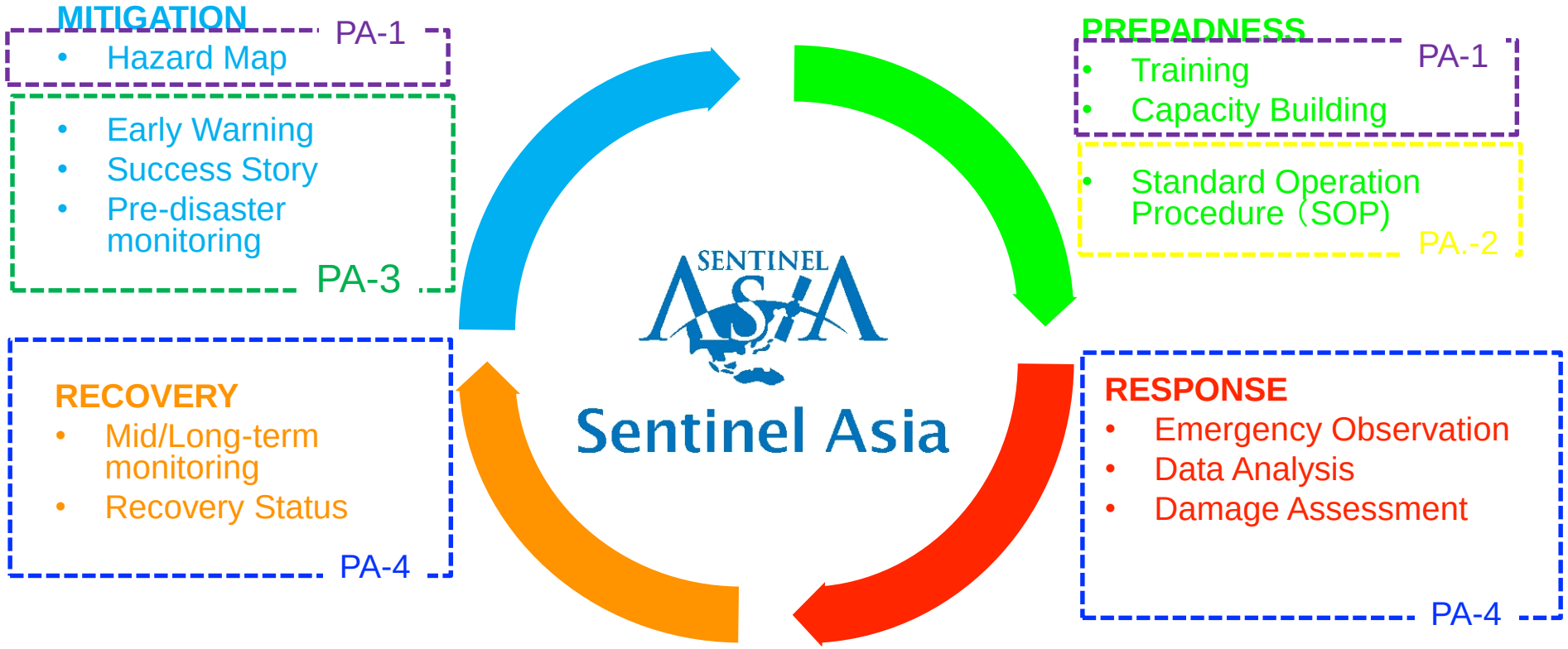
Four specific priorities for action;

Priority Action-1(PA-1); Understanding disaster risk

Priority Action-2(PA-2); Strengthening disaster risk governance to mange disaster risk

Priority Action-3(PA-3); Investing in disaster risk reduction

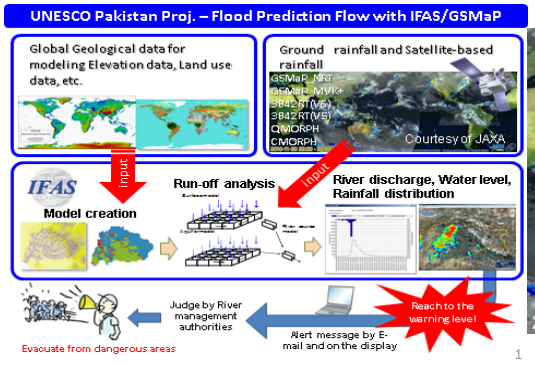
Priority Action-4(PA-4); Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

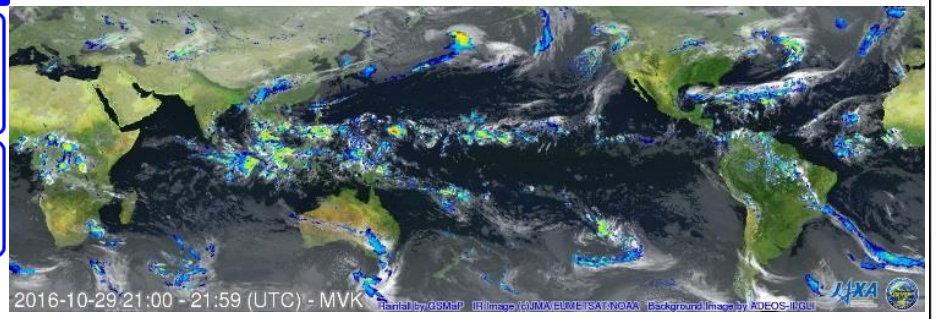


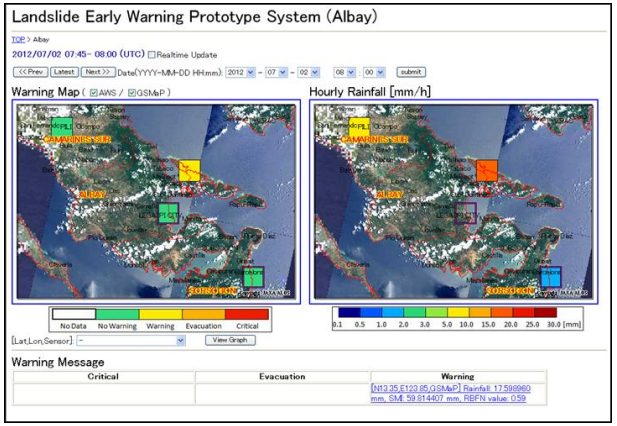
Sendai Framework and Sentinel Asia
Mitigation/Preparedness

- Sendai Framework observed that the mitigation and preparedness phases of the entire disaster management cycle are significant in reducing the impacts, losses, damages of disasters

- Sentinel Asia will further address activities in the mitigation and preparedness phases in particular, early warning, such as the expansion of the GSMaP based landslide monitoring and flood monitoring demonstrated as part of UNESCO Pakistan Project and the Success Story in the Philippines







Conclusions

- GSMaP is one of JAXA's standard products for GPM Mission jointly led by NASA and JAXA.

- GSMaP can be a useful tool for disaster management.

- Japan has been contributing to disaster management by applying GSMaP:

- refence information for Sentinel Asia emergency observation

-flood management project (for UNESCO Pakistan project)

-landslides monitoring project (Sentinel Asia Success Story in the Philippines)

- In the context of global agenda (SDGs, Sendai Framework), such activities are good examples. GSMaP is expected to be further operationally used.

Thank you for your attention!