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).


- **Occurrence**
  - Asia: 4,064
  - World: 10,535
  - 39%

- **Damage**
  - Asia: 1,262,641 million US$
  - World: 2,617,670 million US$
  - 48%

- **Killed**
  - Asia: 1,164,728
  - World: 1,942,334
  - 61%

- **Affected**
  - Asia: 5,349,809 thousand
  - World: 6,025,290 thousand
  - 89%
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.
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.
Global Satellite Mapping of Precipitation

Dual-Frequency Precipitation Radar

Providing reference standard

GPM Microwave Imager

Precipitation Radar

Microwave Radiometer

IR Imager

Gauge for calibration

IR imager by Geostationary satellite

Global Precipitation Measurement

Core satellite

Constellation satellites

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

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

Technology
- Remote sensing
- Web-GIS
Emergency Observation Flow

Disaster Occurrence

Requesting Organization (RO)
- ADRC members
- JPT members

Disaster Management Agencies in Asia

Support

JAXA (JPT Secretariat)

Satellite Images & Disaster Info

Disaster Info

ADRC

Emergency Observation Request, Disaster Info

Communication on status of disaster, observation, etc.

Feedback

Disaster Info

Emergency Observation Request

International Disaster Charter

Data Provider Node (DPN)
- Data Analysis Node (DAN)
- Own Data

JAXA

Support

Disaster Occurrence

Sentinel Asia Web System

http://sentinel.tksc.jaxa.jp/

Analyzed Products

Images by Emergency Observation

Archive Images

Analyzeable Data

Analyzed Products

Support

JAXA (JPT Secretariat)

Disaster Management Agencies in Asia
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

Acknowledgement: UNESCO and JICA
GSMaP original data tend to underestimate the amount of precipitation.
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.
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.

- Original GSMaP
- With GSMaP IF Version 2.0
- With GSMaP IF Version 3.0

Improved accuracy of GSMaP data with GSMaP IF

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

- Calibrated rainfall data via GSMaP IF
- Ground-based rainfall data

Automatic prediction System

- Landslide Early Warning Prototype System (Albay)
- Hourly Rainfall [mm/h]

Model preparation

- Hazard maps, Criteria
- Warning criteria

Application

- Analysis / warning
- Agency/ Local gov.

GSMaP Rainfall Data (Original)

- Hourly rainfall [mm/hr]
- YYYYMMDD HH:00
- GSMaP-IF
- (Provided after four hours from satellite observation)

Download Corrected Rainfall Data Subset Area Correction start term

<table>
<thead>
<tr>
<th>Date</th>
<th>Hour</th>
<th>Rainfall (mm)</th>
</tr>
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<tbody>
<tr>
<td>2010/6/17</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>2010/6/18</td>
<td>100</td>
<td>58</td>
</tr>
<tr>
<td>2010/6/19</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Download Ground Rainfall Data (For calibration)
Framework of Sentinel Asia Success Story in the Philippines

Team Japan

JAXA

Contract

(L. Support)

(T. Support)

Team Philippines

Focal Point of Activity in Philippines

PHIVOLCS

Advisory Agencies

PCIEERD, DOST

NDCC

Implementing Agencies

NAMRIA

PAGASA

MGB

NDCC

Disaster Information Dissemination

End User Agencies

The local government, Rescue Authority, and Press, etc.

Advice

Cooperation

…
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.
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.

<table>
<thead>
<tr>
<th>Activities</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
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<tbody>
<tr>
<td></td>
<td>1Q</td>
<td>2Q</td>
<td>3Q</td>
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<tr>
<td>Data gathering</td>
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<td>Data calibration</td>
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<td>Geological modeling</td>
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<td>Threshold setting</td>
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<td>Hazard mapping</td>
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<td>System development</td>
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<td>Operational test</td>
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<td>Guideline</td>
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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 assist 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**.”

<table>
<thead>
<tr>
<th>No</th>
<th>Goal</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>No Poverty</strong></td>
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<td>2</td>
<td><strong>Zero Hunger</strong></td>
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<td>3</td>
<td><strong>Good Health and Well-Being</strong></td>
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<td>4</td>
<td><strong>Quality Education</strong></td>
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<td>5</td>
<td><strong>Gender Equality</strong></td>
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<td>6</td>
<td><strong>Clean Water and Sanitation</strong></td>
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<td>7</td>
<td><strong>Affordable and Clean Energy</strong></td>
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<td>8</td>
<td><strong>Decent Work and Economic Growth</strong></td>
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<td>9</td>
<td><strong>Industry, Innovation and Infrastructure</strong></td>
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<td>10</td>
<td><strong>Reduced Inequalities</strong></td>
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<td>11</td>
<td><strong>Sustainable Cities and Communities</strong></td>
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<td>12</td>
<td><strong>Responsible Consumption and Production</strong></td>
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<td>13</td>
<td><strong>Climate Action</strong></td>
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<td>14</td>
<td><strong>Life Below Water</strong></td>
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<td>15</td>
<td><strong>Life on Land</strong></td>
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<td>16</td>
<td><strong>Peace, Justice and Strong Institutions</strong></td>
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<td>17</td>
<td><strong>Partnerships for the Goals</strong></td>
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</tbody>
</table>
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!
Priority 1. Understanding disaster risk

National and local levels

24 (f) To promote real time access to reliable data, make 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...
Four specific priorities for action;

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

Priority Action-2 (PA-2); Strengthening disaster risk governance to manage 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 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:
  - reference 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!