SENTINEL ASIA

ANNUAL REPORT 2021

Sentinel Asia

Annual Report 2021

Contents

1. Introduction

1.1. Purpose and Scope of the Document

This document describes the activities of Sentinel Asia (SA) in 2021 for member organizations and external relations.

1.2. Structure of the Document

This report follows the following structure:

Chapter 1 Introduction

Chapter 2 Sentinel Asia and Major Disasters: overview and target disaster events related to Sentinel Asia

Chapter 3 Emergency Observation Operations in 2021: results of emergency observation activities in 2021

Chapter 4 External Relations: explanation of the integration of new members, progress, external relationships and Cooperating Bodies

Chapter 5 Conference and Releases: reports on all communication activities undertaken throughout the reporting period

Chapter 6 Assessment of Sentinel Asia Operations: assessment of the overall impact of Sentinel Asia as a service in supporting disaster response, and of system performance, products and services.

Chapter 7 Conclusions: outline of significant achievements and conclusions throughout the reporting period.

1.3. List of Acronyms

ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
AHA Center	ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management
AIT	Asian Institute of Technology
ALOS	Advanced Land Observing Satellite
APRSAF	Asia-Pacific Regional Space Agency Forum
ASEAN	Association of South-East Asian Nations
CAIAG	Central-Asian Institute for Applied Geosciences
CRISP	Centre for Remote Imaging, Sensing and Processing
CU	Chiba University
DAN	Data Analysis Node
DPN	Data Provider Node
EOC	Earth Observatory of Singapore
EOR	Emergency Observation Request
GISTDA	Geo-Informatics and Space Technology Development Agency
ICIMOD	International Center for Integrated Mountain Development
ICT	Information and Communication Technology
IDC	International Disaster Charter
IRS	Indian Remote Sensing Satellite
ISRO	Indian Space Research Organization
IWMI	International Water Management Institute
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
JPTM	Joint Project Team Meeting
KARI	Korea Aerospace Research Institute
LAPAN	National Institute of Aeronautics and Space (Indonesia)
MBRSC	Mohammed Bin Rashid Space Centre
MO	Manila Observatory
NARLabs	National Applied Research Laboratories
NIED	National Research Institute for Earth Science and Disaster Resilience
NSPO	National Space Organization
RSO	Regional Support Offices
SA	Sentinel Asia

SAWG	Space Applications Working Group
SPC	Secretariat of the Pacific Community
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNOOSA	United Nations Office for Outer Space Affairs
VAP	Value Added Product
VIGMR	Vietnam Institute of Geosciences and Mineral Resources
WINDS	Wideband Internetworking engineering test and Demonstration Satellite
YU	Yamaguchi University

2. Sentinel Asia and Major Disasters

2.1. Outline of Sentinel Asia

2.1.1. Background and History of Sentinel Asia

Natural hazards have been on the rise worldwide, including the Asia-Pacific region (Figure 1). The Asia-Pacific region suffers from different types of natural hazards, such as earthquakes, cyclones/typhoons, floods, landslides, droughts, tsunamis, volcanic eruptions and forest fires. Several of them are large-scale, devastating disasters. Given the high population level (about 3 billion) as well as the high frequency and severity of natural hazards in the region, an integrated use of space technology, such as earth observation satellite data and geographic information systems, can be an effective means to reduce the magnitude of the severity, or provide timely management in the event of a large-scale natural hazard or disaster. In light of the increasing frequency of natural hazards and an elevated loss of lives and properties from these events, SA, a collaborative, regional project, was conceptualized in 2005, and began operation in 2007. It is engaged in activities to share and provide disaster-related information, including earth observation satellite images via the internet, in order to contribute toward disaster management in the Asia-Pacific region. Space agencies from the member countries of the Asia-Pacific Region Space Agency Forum (APRSAF), including the Japan Aerospace Exploration Agency (JAXA), and disaster risk reduction agencies in the Asia-Pacific region, such as the Asian Disaster Reduction Center (ADRC), cooperate in forming a Joint Project Team (JPT) and promoting SA. As of December 2021, it consists of 112-member organizations, including 95 agencies from 29 countries/regions, and 17 international organizations. JAXA has been serving as a secretariat of the JPT.

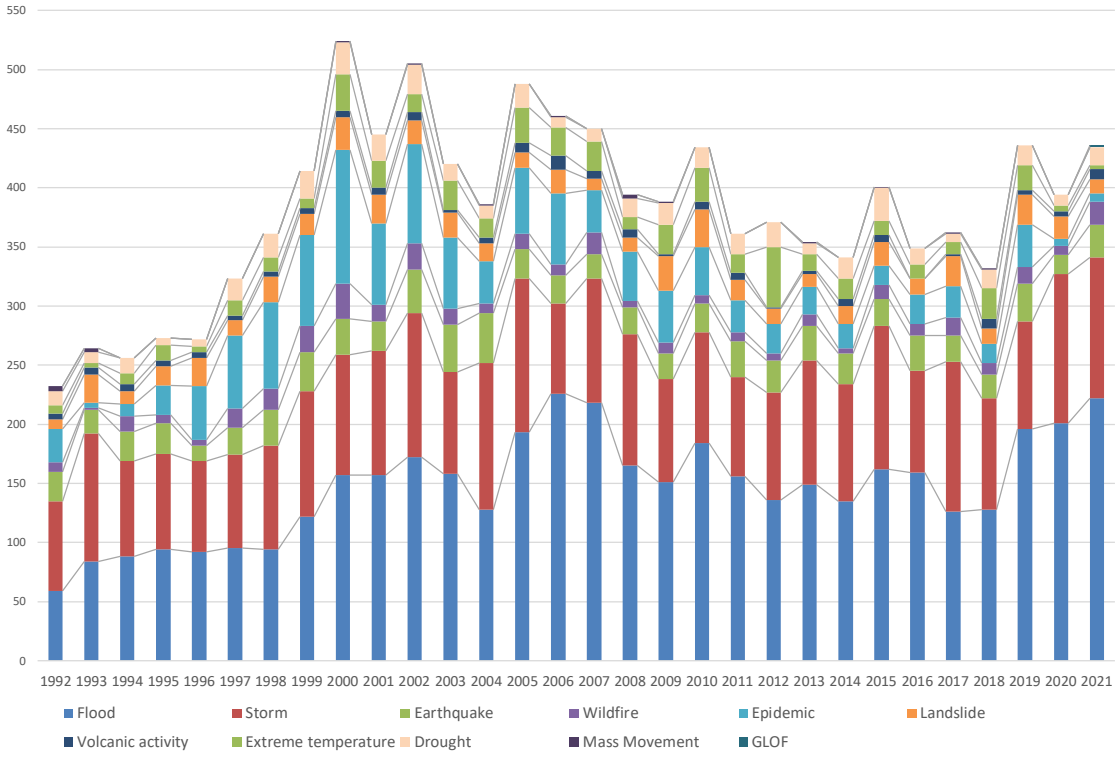


Figure 1: Incidence of Natural Hazards by Region (in and after 1990)

A stepwise approach for the implementation of data and information dissemination systems through SA as proposed by the APRSAF was as follows:

Step 1: Implementation of the backbone 'Sentinel Asia' data dissemination system and associated Nodes (Feb. 2006–Dec. 2007)

Step 2: Expansion of the dissemination backbone with new Satellite Communication Systems (2008–2012)

Step 3: Establishment of a comprehensive 'Disaster Management Support System' in the region (2013 onwards)

Sentinel Asia initiated an emergency observation request system in 2007 to provide image data (and analyzed images) acquired through the satellites operated by participating space agencies on the internet and via JAXA's Wideband Internetworking engineering test and Demonstration Satellite (WINDS), also known as Kizuna, in the event of a disaster in the Asia-Pacific region.

During that time, Sentinel Asia participated in the International Disaster Charter (IDC) in 2010 to expand its activities and cooperation on a global scale. Sentinel Asia also established the Regional Support Office (RSO) for the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) at the ADRC in June 2009, which serves as a contact (liaison) office for emergency observation requests, to expand the range of its activities and increase international interest.

2.1.2. Aims and Activities of Sentinel Asia in a Nutshell

The SA aims to: (i) improve safety in society with the use of modern Information and Communication Technology (ICT) and space-based technology; (ii) improve the speed and accuracy of disaster preparedness and early warning; and (iii) minimize the number of victims, as well as social and economic losses. To achieve these goals, various activities have been undertaken.

The main activities of the SA are summarized as follows:

- Emergency observation by earth observation satellites (e.g. ALOS-2, FORMOSAT-5, RESOURCESAT-2, OCEANSAT-2/OCM, IMS-1, CARTOSAT-1&2, RISAT-1, Thaichote, VNREDSAT, TeLEOS-1, and KHALIFASAT) in the event of major disasters
- Acceptance of observation requests for major disasters in the Asia-Pacific region from ADRC member organizations and the representative organizations of JPT members to support disaster management in the region
- Working Groups (WGs) for early warning and disaster monitoring: WGs on wildfires, floods, glacial lake outburst floods, and tsunamis are (formed and) in operation
- Capacity building of member organizations (e.g., through training) for the utilization of satellite images for disaster management

The following is an overview of the main data and products provided by SA to its members: (i) satellite imagery (and data permitted by data providers) and value-added

images with an extraction of the affected area, etc.; (ii) on-site digital camera images; (iii) wildfire hotspot information and data; (iv) rainfall (short-term and long-term) information and data; and (v) meteorological satellite imagery and data.

2.1.3. Framework and Emergency Observation Mechanisms of Sentinel Asia

SA is promoted under cooperation among the following three communities: (i) the Space Community (APRSAF); (ii) the International Community (e.g., UNESCAP, UNOOSA, ASEAN, AIT); and (iii) the Disaster Reduction Community (ADRC and its member countries), as illustrated in Figure 2. The JPT was established to promote the activities of SA, and it is open to all APRSAF member countries, disaster prevention organizations and regional/international organizations who wish to participate in disaster information sharing activities.

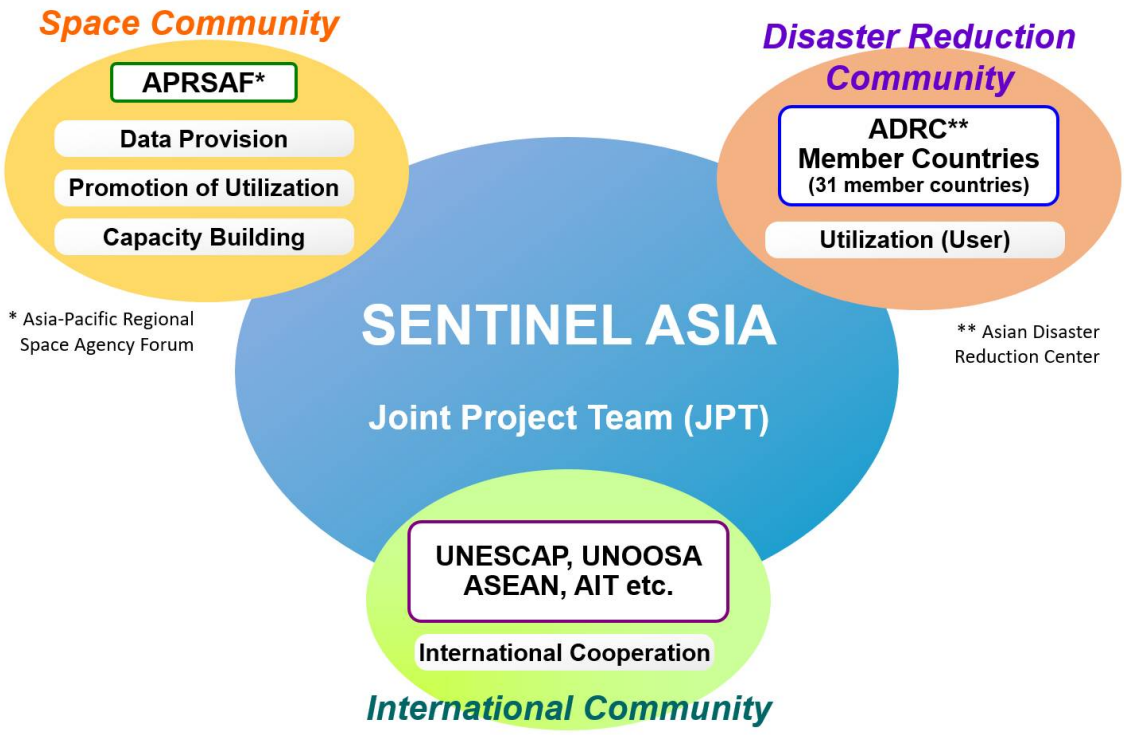


Figure 2: Framework of Sentinel Asia

SA is composed of two Nodes (Data Provider, and Data Analysis) and four Working Groups (Wildfire, Flood, Glacial Lake Outburst Flood and Tsunami). The Data Provider Node (DPN) provides their own satellite imagery and other relevant data to JPT

members upon an Emergency Observation Request (EOR) from a JPT member, to the extent permitted by the data policy of each DPN when a disaster occurs; while the Data Analysis Node (DAN) analyzes the satellite data provided by DPN, makes a value-added product and uploads and shares the result through the new Sentinel Asia EOR system "OPTEMIS", which started operation in 2019 (Figure 3). Between 2006 and 2021, about 423 EORs have been made or accepted, providing data and products to its members to support disaster management. The four WGs work toward the establishment and improvement of early warning/forecasting systems, as well as monitoring and planning for disaster management in their respective fields.

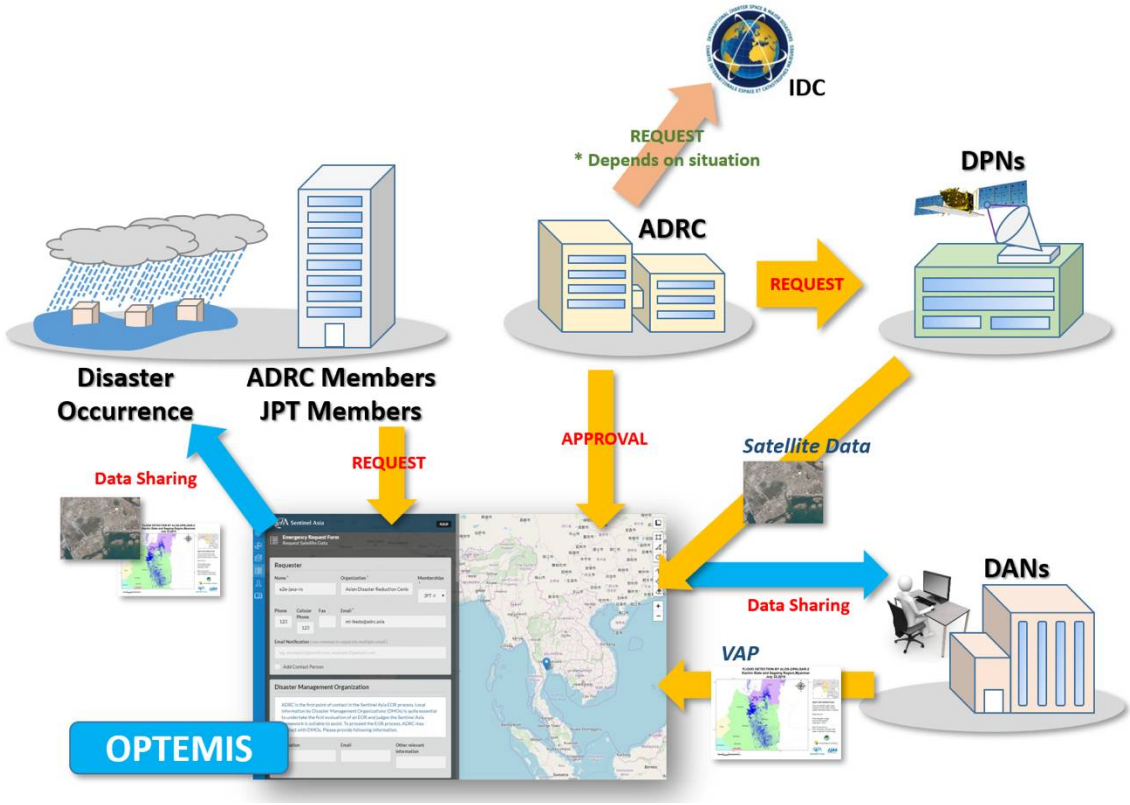


Figure 3: Flow of Sentinel Asia emergency observation

2.1.4. Current Phase (Step 3) and Ongoing Actions of Sentinel Asia

Out of the 3 Steps employed by Sentinel Asia, the successful completion of Steps 1 and 2 has so far been declared. Step 3 began in 2013, defining its priority areas based on experiences in the earlier Steps and user requests leading to necessary actions as

shown in Figure 4.

The key features of Step 3 are:

- Covering all phases in a disaster management cycle
- Employing a wide variety of satellites, including earth observation satellites, communication satellites and navigation satellites
- Being managed as a joint project by participating agencies, through the planned construction of a joint management system
- Promoting the use of services by expanding human networks through capacity development and outreach activities

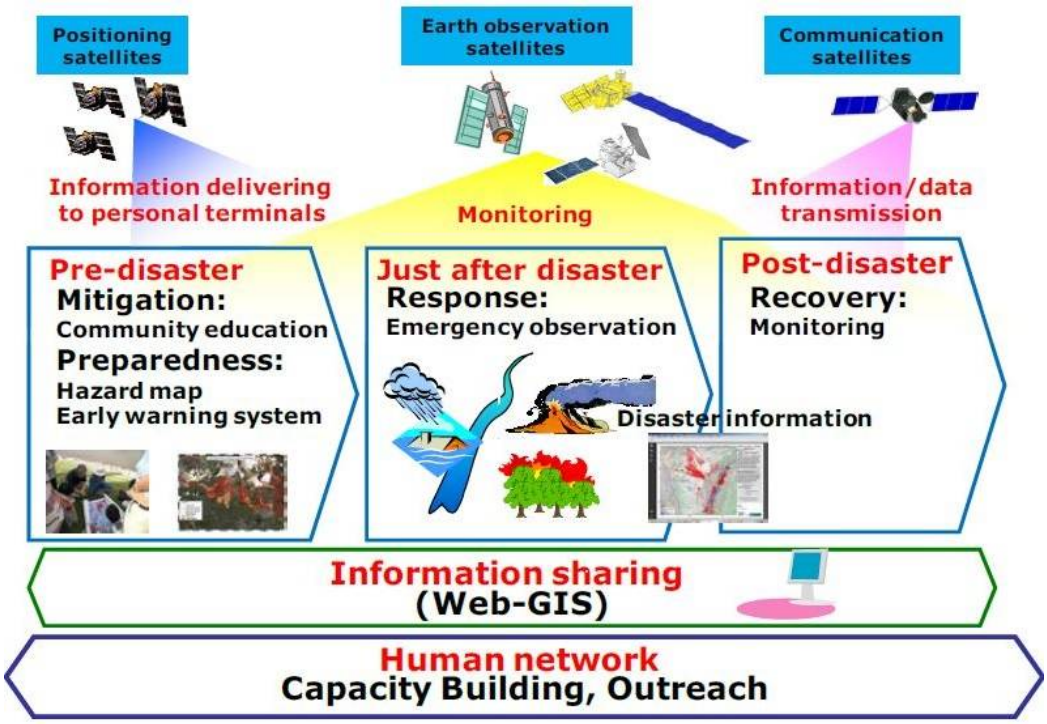


Figure 4: Current Phase (Step 3) and Actions of Sentinel Asia

2.2. Major Disasters with Emergency Observation (2007-2021)

Figures 5 and 6 show a breakdown of emergency observations with requests and emergency observations with activation by disaster. Floods represent the largest number of disasters with 212 requests (50.1%), followed by earthquakes at 54 (12.8%), landslides at 28 (6.6%), typhoons at 36 (8.5%), forest fires and fires at 18 (4.3%), volcanic eruptions at 22 (5.2%), and cyclones at 22 (5.2%). Generally, activation is made for around 88.9% of requests for most disasters.

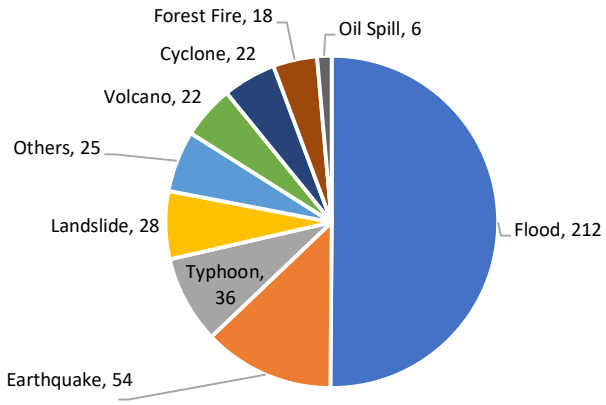


Figure 5: Breakdown of Emergency Observations by Disaster (2007 - 2021)
***Requests (N=423)**

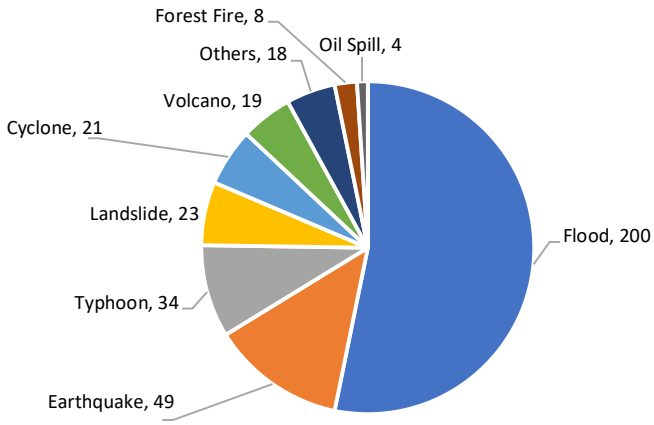


Figure 6: Breakdown of Emergency Observations by Disaster (2007 - 2021)
***Activations (N=376)**

Table 1 shows the number of requests, activations, and rejections for each type of disaster.

Requests related to floods, earthquakes, landslides, typhoons, volcanoes and cyclones are activated for more than 80% of all requests. However, the activation ratio regarding forest fires is 44.4%. The reasons are that it was difficult to accurately confirm the affected area and the breakdown of communication with the requesters. The activation ratio regarding oil spills is 66.7%. The rejected requests were submitted in 2011 and 2013; those oil spills were considered manmade disasters and outside of the scope of EOR activity. On the other hand, all of the requests regarding oil spills from 2015 onwards were accepted.

Table 1: Number of Requests, Activations, and Rejections for Emergency Observations by Disaster (2007 - 2021)

	Number of Request	Number of Activation	Number of Rejection	Activation/Request (%)
Flood	212	200	12	94.3%
Earthquake	54	49	5	90.7%
Landslide	28	23	5	82.1%
Typhoon / Storm	36	34	2	94.4%
Forest Fire	18	8	10	44.4%
Volcano	22	19	3	86.4%
Cyclone	22	21	1	95.5%
Oil Spill	6	4	2	66.7%
Others	25	18	7	72.0%
Total	**423**	**376**	**47**	

3. Emergency Observation Operations in 2021

3.1. Emergency Observation Requests

Figure 7 shows the number of requests, activations and rejections involving emergency observations from 2007 to 2021. The number of requests and activations peaked in 2010 and 2011, with the number declining subsequently thereafter, but the number increased once again from 2015 to 2016. The number has begun decreasing gradually once more since 2016. And 34 requests were submitted and activated in 2021.

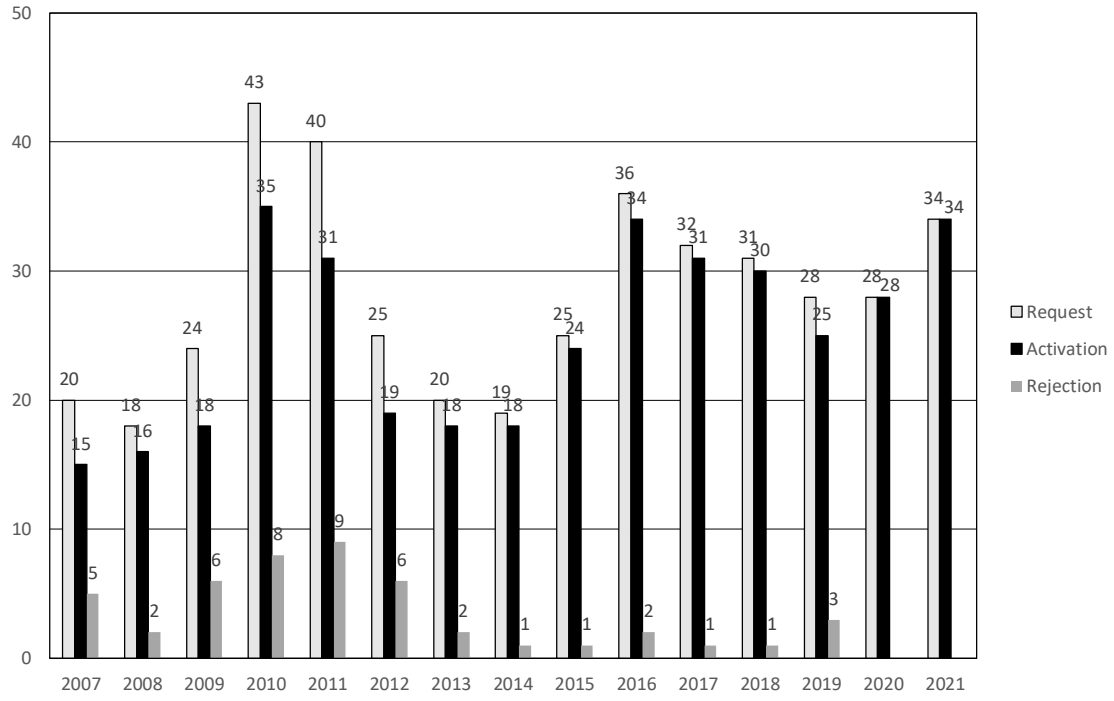


Figure 7: Comparison of the Number of Requests, Activations and Rejections for Emergency Observations

Figures 8 and 9 show a breakdown of emergency observations with requests and emergency observations with activation by disaster. On a request basis, floods represented the largest number of disasters, with 23 requests (67.6%), followed by volcanic eruptions at 3 (8.8%), and earthquakes and typhoons at 3 (5.9%).

Table 2: List of 2021 Activations

Activation Number	Country	Disaster Type	Implementation	Requester
390	Indonesia	Earthquake	2021/1/15	LAPAN, BNPB
391	Philippines	Tropical Depression	2021/2/22	MO
392	Indonesia	Flood, Landslide	2021/4/6	LAPAN, BNPB
393	East Timor	Flood, Landslide	2021/4/8	JICA, Secretary of State for Civil protection
394	Philippines	Flood	2021/5/14	MO
395	Tajikistan	Landslide	2021/5/14	CAIAG, CoES
396	India	Flood	2021/5/18	ISRO, DMS
397	India	Cyclone	2021/5/26	ISRO, DMS
398	Philippines	Typhoon	2021/6/2	MO
399	Sri Lanka	Oil spill	2021/6/4	DMC
400	Sri Lanka	Flood	2021/6/5	DMC
401	Nepal	Flood, Flash flood, Landslide	2021/6/16	Department of Hydrology and Meteorology (Nepal)
402	Tajikistan	Earthquake	2021/7/14	CAIAG
403	Kyrgyzstan	Flash Flood	2021/7/14	CAIAG
404	Uzbekistan	Flash Flood	2021/7/14	CAIAG
405	Kyrgyzstan	Flood and Other	2021/7/22	CAIAG
406	Philippines	Typhoon, Flood, Landslide	2021/7/25	MO
407	Myanmar	Flood	2021/7/27	AHA Center, DDM
408	Turkey	Flood	2021/8/13	AFAD
409	Japan	Flood and Landslide	2021/8/14	ADRC, MLIT
410	Philippines	Flood, Landslide, Storm	2021/9/8	MO
411	Vietnam	Flood, Landslide, Storm	2021/9/12	MONRE
412	Thailand	Flood	2021/9/29	GISTDA
413	Vietnam	Flood, Landslide, Storm	2021/10/7	MONRE
414	Vietnam	Flood, Landslide, Storm	2021/10/10	MONRE
415	Philippines	Flood, Landslide	2021/10/13	MO
416	India	Flood, Landslide, Storm	2021/10/17	ISRO, DMS
417	Japan	Volcanic Eruption	2021/10/20	ADRC, MLIT
418	Vietnam	Flood, Landslide	2021/10/25	MONRE
419	India	Flood	2021/11/9	ISRO, DMS
420	Sri Lanka	Flood, Landslide	2021/11/12	DMC
421	Philippines	Floating pumice stones & volcanic debris	2021/11/24	PHIVOLCS
422	Indonesia	Volcanic Eruption	2021/12/7	JICA, PUPR, AHA Center
423	Philippines	Flood, Landslide, Storm	2021/12/14	MO

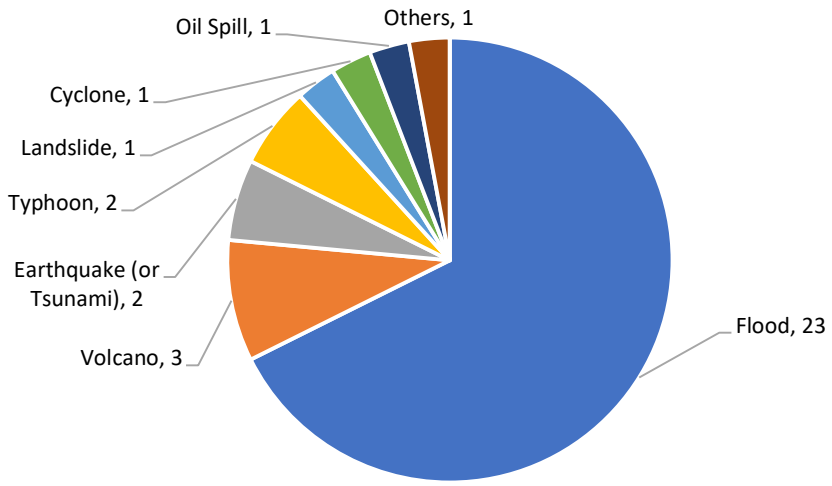


Figure 8: Breakdown of Emergency Observations by Disaster *Requests in 2021

***Requests (N=34)**

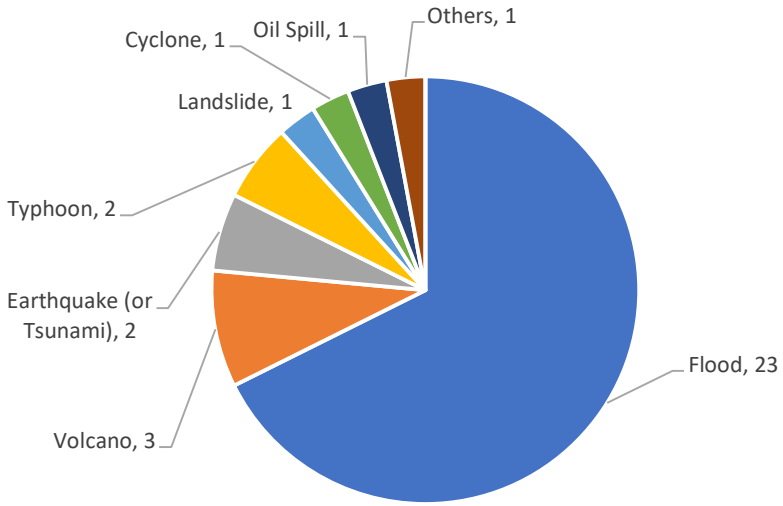


Figure 9: Breakdown of Emergency Observations by Disaster *Activations in 2021

***Activations (N=34)**

3.2. Results of Emergency Observations

During 2021, the monthly average of activations was 2.8. Figure 10 shows the monthly distribution of activations throughout 2021. The highest number of activations occurred in July and October, corresponding to 35.3% of the total number.

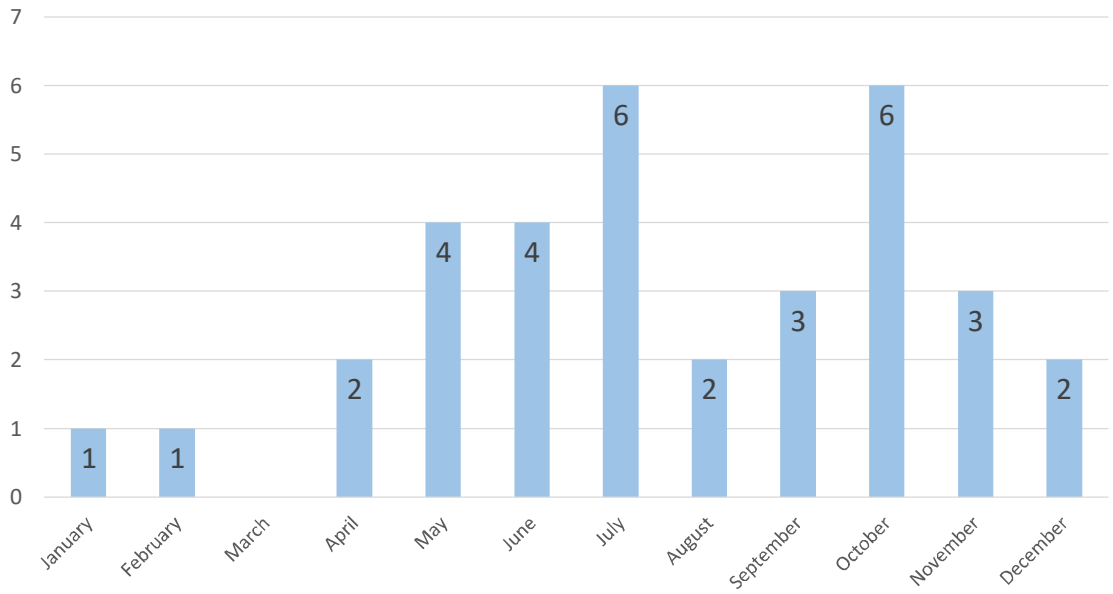


Figure 10: Number of Monthly Activations in 2021

Figure 11 shows the number of emergency observations by country. Countries and regions with a large number of requests are mostly located in Southeast Asia and South Asia, including the Philippines, India, Vietnam, Indonesia, and Sri Lanka. The country with the highest number of activations was the Philippines, at 8 activations.

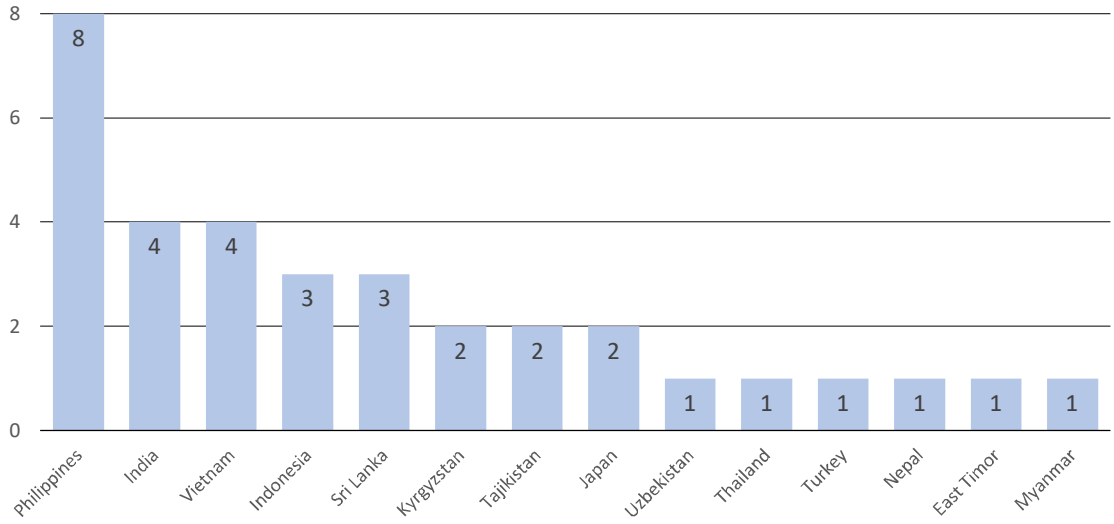


Figure 11: Number of Activations by Country in 2021

Figure 12 shows the number of implementations for providing Archive data and New Acquisition by DPN. In total, 34 implementations for providing Archive data and 90 implementations for providing New Acquisition were made in 2021.

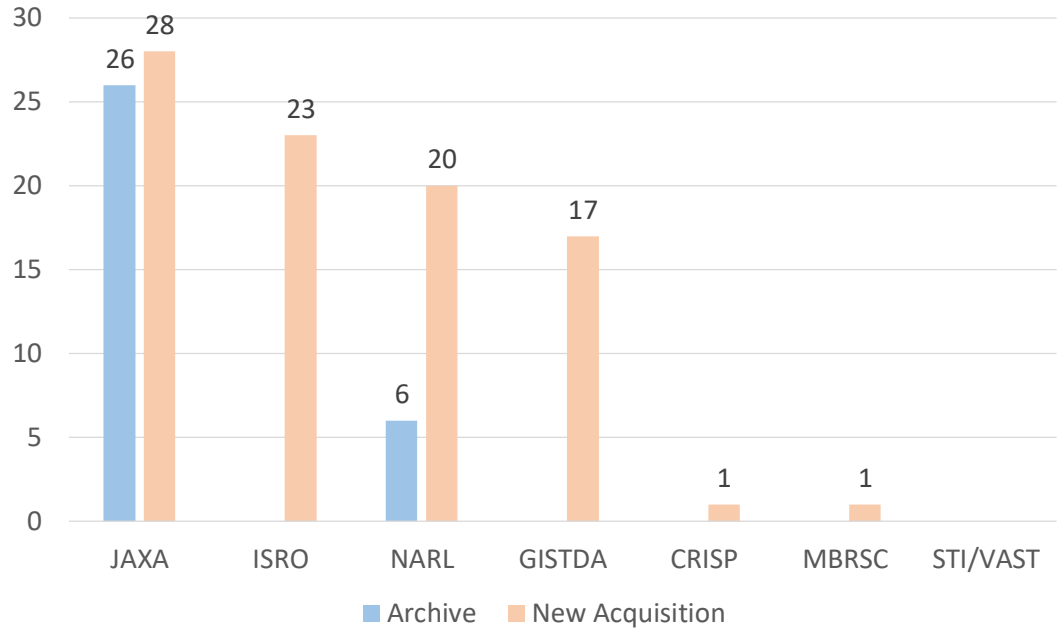


Figure 12: Number of Responses by DPN in 2021

DPN has been providing a lot of satellite images, including optical and radar data, when an EOR is activated. DAN have also been supportive by providing Value Added Products (VAP), including KMZ files and shapefiles for GIS. This data is uploaded to OPTEMIS and the SA website (https://sentinel-asia.org/index.html). Figure 13 shows the number of optical and radar data by DPN which were uploaded to the SA website.

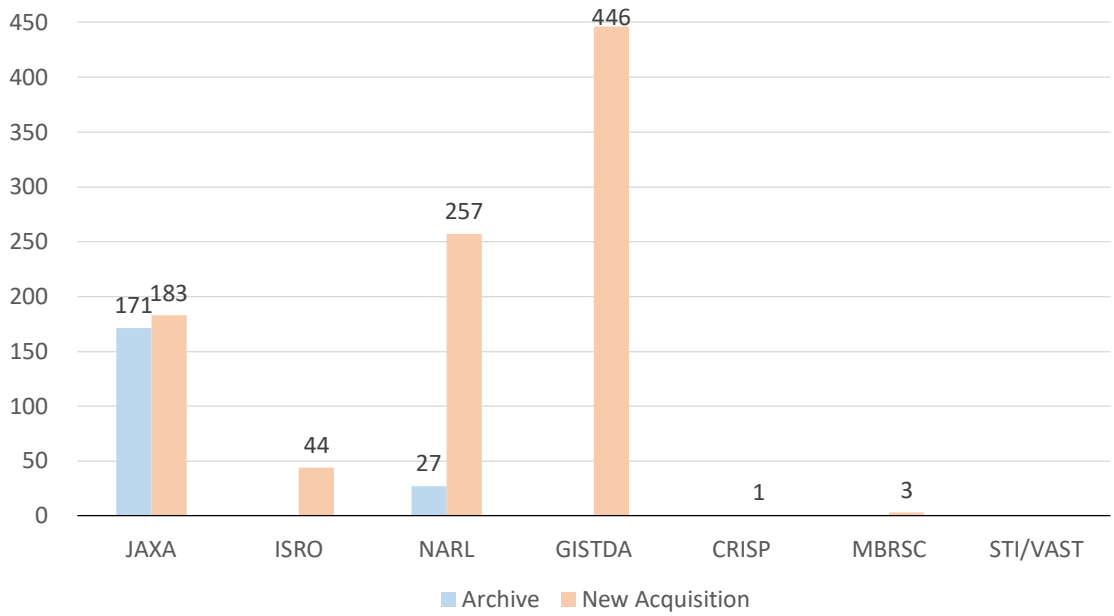


Figure 13: Data Consumption (Archive and New Acquisition) by DPN in 2021

Figure 14 shows the number of implementations by DAN in 2021. Figure 15 shows the number of provided VAP in 2020. In total, 30 were implemented, and 146 VAPs were provided to requesters.

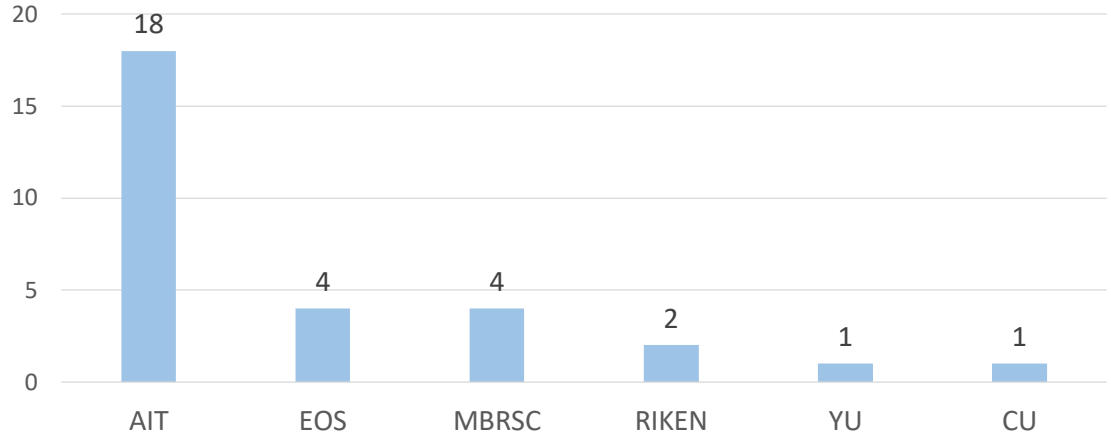


Figure 14: Number of responses by DAN in 2021

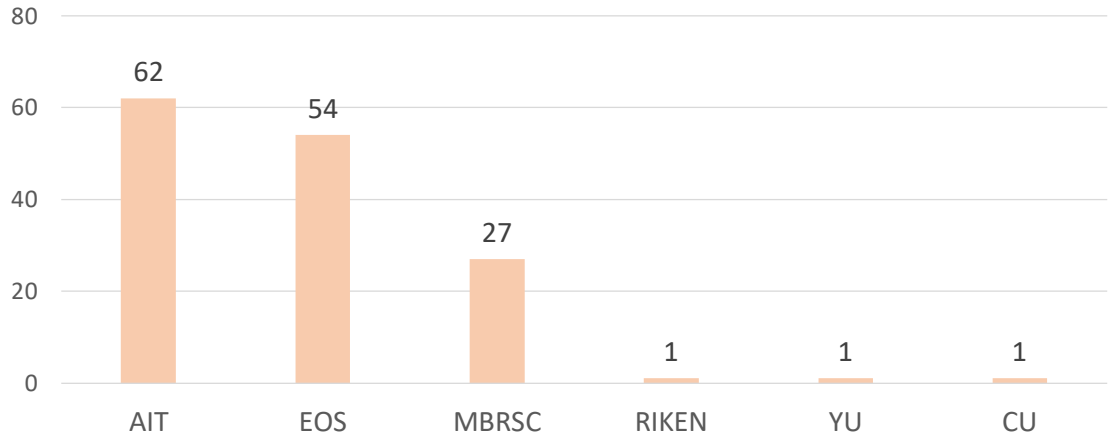


Figure 15: Number of VAP by DAN in 2021

3.3. Good Practices

3.3.1. Oil spill in Sri Lanka (June 2021)

[EOR Requestor] Disaster Management Center (DMC)

[SA website URL] https://sentinel-asia.org/EO/2021/article20210525LK.html

Sri Lanka being a small island in the Indian Ocean in the path of two monsoons is mostly affected by weather related hazards. It is surrounded by 1,340 kilometers of beach frontage and with an abundance of breathtaking inland waterways, including rivers, lakes, reservoirs and tanks. Floods mostly due to monsoonal rain or effects of low-pressure systems and droughts due to failure of monsoonal rain are the most common hazards experienced in Sri Lanka.

In 2009, Disaster Management Centre (DMC) initiated a hazard profiles development process in collaboration with the relevant technical agencies, which are responsible for the disaster mitigation activities of the country. Hence, it was decided to develop nine hazard profiles of the country, namely, Coastal Erosion, Drought, Floods, Landslides, Lightning, Sea Level Rise, Storm Surge, Tropical Cyclone and Tsunami. In addition to natural disasters, there have been many manmade disasters. In May 2021, large-scale oil spill and fire occurred, caused by a sunken container ship of the Singapore-registered X-Press Pearl. The Singapore-registered X-Press Pearl had been on fire for two weeks near the port of Colombo. Part of the hull settled on the seabed. Experts determined that hundreds of tons of oil in the ship's tanks could devastate nearby marine life and beaches. DMC decided to send an EOR related to this manmade disaster.

The ADRC received the EOR from DMC and transferred a DPN/DAN on June 4, 2021. The first satellite images from the DPN were provided on June 4. Finally, 76 satellite images were provided by ISRO, GISTDA, JAXA, and NARL, and the first VAP from the DAN was provided on June 4. Two VAPs were provided by AIT. A lot of valuable information was provided and it was utilized to inform the situation in the affected area of the oil spill. Also, JAXA provided a WEB-GIS service that allows users to compare satellite images before and after the disaster.

DMC used the data to understand the spatial distribution of the oil spill and possible oil leak emanating from the ship's hull. Mitigation Research & Development Division of DMC converted the satellite data into information in collaboration with National Oceanic Atmospheric Administration and shared with all the stakeholders involved in the response activities of the oil spill. This information was used with information on wind patterns, to take the decision to control the hazard as it provides information on the spreading of hazards. Furthermore, the information was very important to identify the damage and recovery process of disaster.

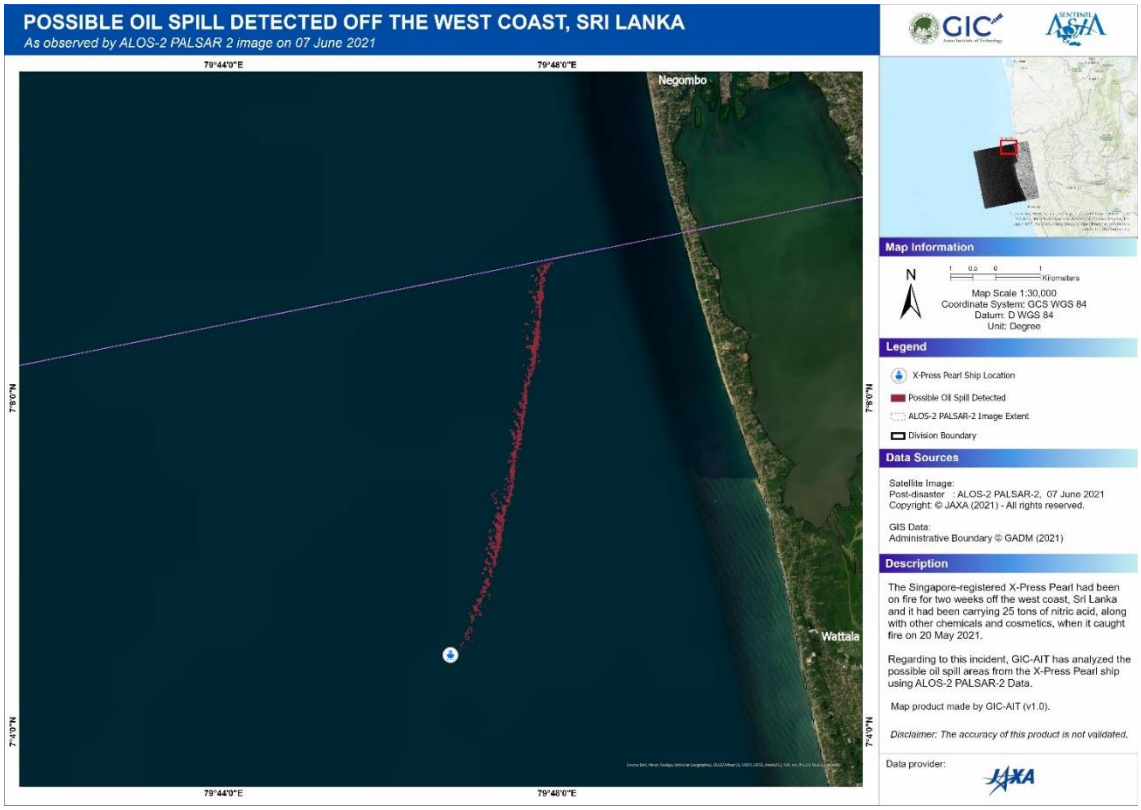


Figure 16: VAP (provided by AIT)

(ADRC: https://www.adrc.asia/)

3.3.2. Earthquake in Tajikistan (July 2021)

[EOR Requestor] Central Asian Institute of Applied Geosciences (CAIAG)
[SA website URL] https://sentinel-asia.org/EO/2021/article20210707TJ.html

Tajikistan is prone to many types of natural hazards, including floods, mudflows, landslides (mudslides), epidemics, drought, earthquakes, avalanches, insect infestation and windstorms. About 93% of the country's area is mountainous, which widely varies in height from several hundred meters to 6,000-7,000 meters above sea level. Earthquakes are typical for Tajikistan and represent a substantial threat in many parts of the country, specifically in urban environments like Dushanbe, where potential earthquake magnitudes can be as high as 8-9 on the Richter scale. Earthquakes in Tajikistan are seriously dangerous, since they cover broad areas and are able to cause considerable damage to reservoir dams, buildings and communications.

On July 10, 2021, a large-scale earthquake, Magnitude 5.8 at a depth of 17 km, hit in the Tojikobod District. The epicenter was located approximately 14 km southeast of Kalanak Town and 38 km east-southeast of Navobod village. Two aftershocks of Magnitude 4.6 have been recorded in the area, as reported by USGS. According to USGS PAGER, up to 5,000 people were exposed to strong shaking. Central Asian Institute of Applied Geosciences (CAIAG) submitted an EOR to ADRC on July 14.

The ADRC received the EOR from CAIAG and transferred a DPN/DAN on July 14, 2021. The first satellite images from the DPN were provided on July 19. Finally, 9 satellite images were provided by ISRO and JAXA, and the first VAP from the DAN was provided on July 21. Two VAPs were provided by AIT. Also, JAXA provided a WEB-GIS service that allows users to compare satellite images before and after the disaster.

CAIAG used the data for in consequence analysis assessment of influences of earthquake on activation of landslide hazards. All these got products was represented and shared between scientific reserchers for raising awareness in the community about opportunities used satellite images included in system of Sentinel Asia.

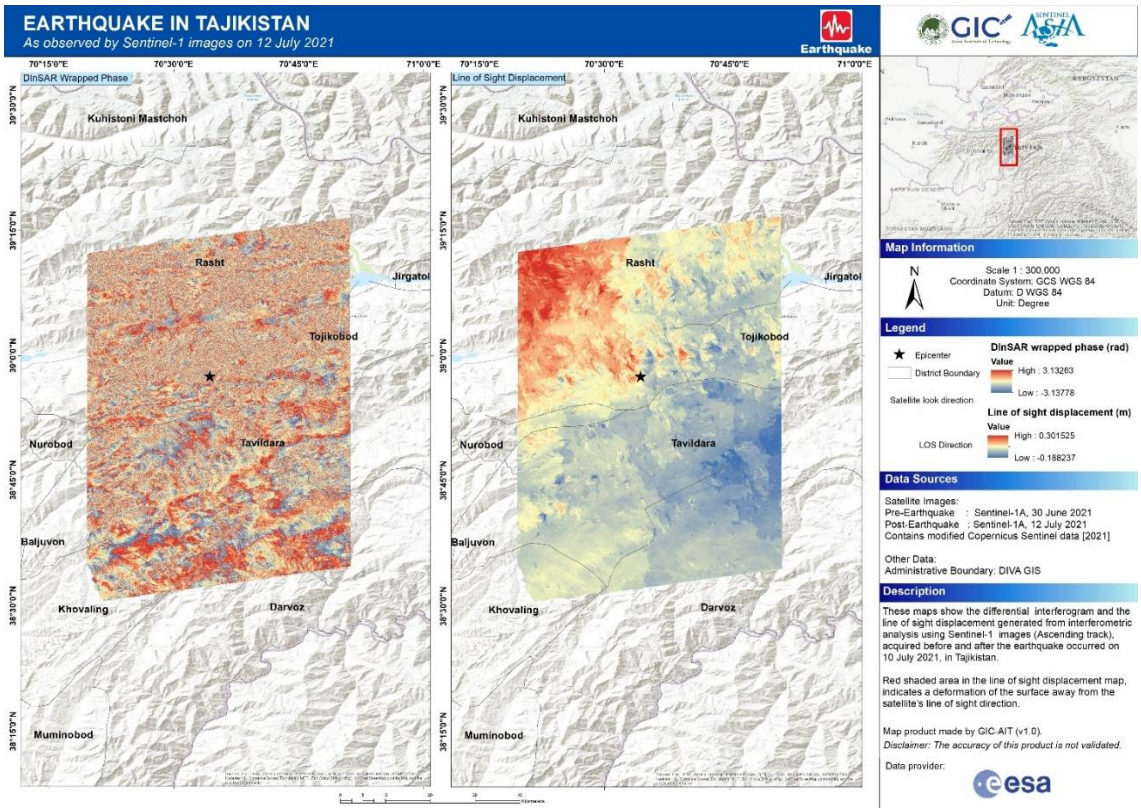


Figure 17: VAP (provided by AIT)

(ADRC:https://www.adrc.asia/view_disaster_en.php?NationCode=762&Lang=en&Key=2454
)

(UNOCHA: https://reliefweb.int/report/tajikistan/tajikistan-earthquake-gdacs-usgs-niat-echo-daily-flash-12-july-2021)

(USGS: https://earthquake.usgs.gov/)

3.3.3. Volcano eruption in Indonesia (December 2021)

[EOR Requestor] Japan International Cooperation Agency (JICA)
[SA website URL] https://sentinel-asia.org/EO/2021/article20211204ID.html

Indonesia is located in a disaster-prone area, and being susceptible to various types of natural hazards, it can be considered a kind of "laboratory of disasters" due to its geographical, geological and demographic condition. Indonesia is situated in the "Pacific Ring of Fire", an area located between three tectonic plates (Indo-Australia, Eurasian and Pacific) encircling the Pacific Ocean where frequent earthquakes and volcanic activity result from the movements of the tectonic plates. In particular, there are more than 120 active volcanoes in Indonesia, and volcanic eruptions frequently cause massive damage every year.

The Mt. Sumeru erupted in the East Java province of Indonesia on December 4, 2021. According to this eruption, pyroclastic flows and mud flow caused heavy damage in the surrounding area. According to the report by the Badan Nasional Penanggulangan Bencana (BNPB) as official National Disaster Management Agency, the death toll reached 57, and 23 residents are missing as of December 17, 2021. In light of this situation, the Japan International Cooperation Agency (JICA) decided to send an EOR related to the disaster through their strong network of a JICA long-term Expert and JICA Indonesia Office.

The ADRC received the EOR from JICA and transferred a DPN/DAN on December 4, 2021. The first satellite images from the DPN were provided on December 5, 1 day after the occurrence of the disaster. Finally, 29 satellite images were provided by ISRO, JAXA, and NARL, and the first VAP from the DAN was provided on December 5. Twenty VAPs were provided by EOS, MBRSC, and Yamaguchi University. A lot of valuable information was provided and it was utilized to inform the situation in the affected area. Also, JAXA provided a WEB-GIS service that allows users to compare satellite images before and after the disaster.

First, JICA shared the provided data with the Ministry of Public Works and Housing (PUPR) which is one of the ministries in Indonesia responsible for post-disaster emergency recovery.

PUPR and its field survey team used the data to determine the field survey locations

and routes which were conducted on December 9. The WEB-GIS system, provided by JAXA, could be contrasted with the information obtained from the field survey. In particular, VAPs provided by EOS were very useful to understand the overall picture of the damage because access to the affected area was limited in the early phase of the field survey. It was found out that this VAP showed topographic changes due to the volcanic deposits that occurred in December 2020 eruption and this time. Furthermore, the VAPs represented the distribution of the volcanic deposits which indicated a risk of debris flows that could not be ascertained by the early phase of the field survey. Finally, all of the material was also provided to the PUPR headquarters, its field offices and its technical office. This information is also important to review the existing Sabo (Erosion and Sediment Control) Master Plan of Mt. Sumeru, which JICA is planning to support next.

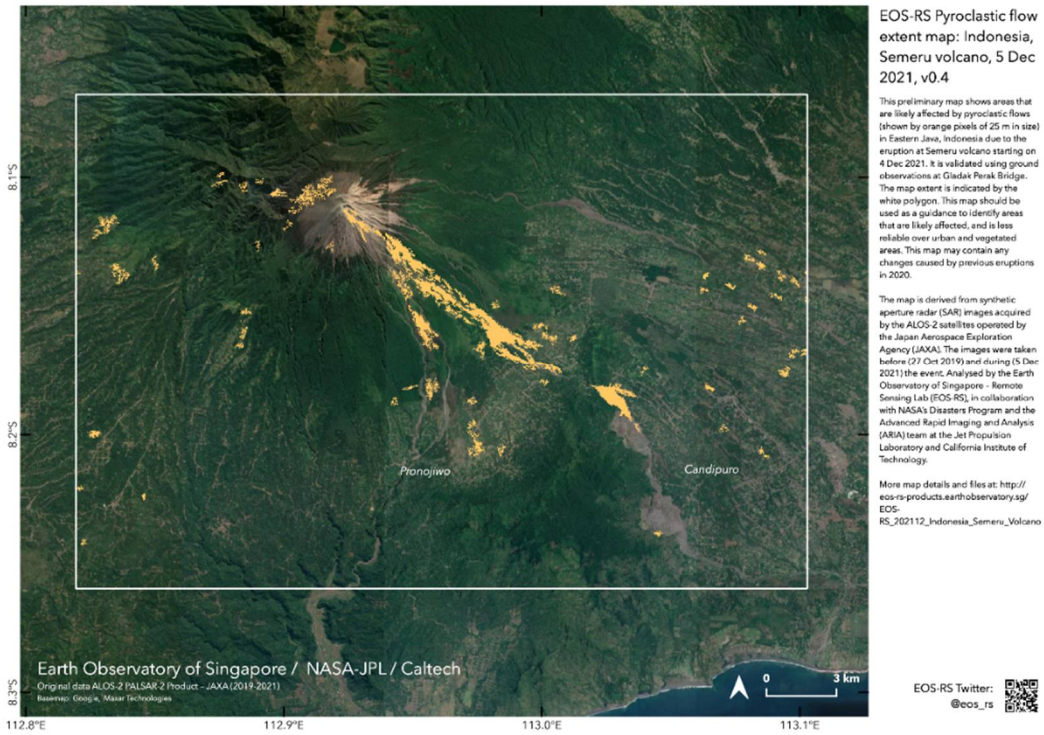


Figure 18: VAP (provided by EOS)

(UNOCHA: https://reliefweb.int/disaster/vo-2021-000194-idn)

3.3.4. Tropical Storm "Odette" in Philippines (December 2021)

[EOR Requestor] Manila Observatory (MO)

[SA website URL] https://sentinel-asia.org/EO/2021/article20211214PH.html

The Philippines is prone to almost all types of natural hazards because of its geographical location and geotectonic setting. In addition, the Philippines is situated along the highly-seismic Pacific Ring of Fire. This is the area where the Philippine Sea and Eurasian Tectonic Plates meet, and it is prone to occurrences of earthquakes, tsunamis, and volcanic eruptions. There are 300 volcanoes in the country, of which 24 are active. Meanwhile, major hydro-meteorological disasters experienced by the Philippines include tropical cyclones, landslides, and flooding.

On December 16, 2021, Super Typhoon "Odette" brought heavy rains and floods to the Visayas and Mindanao Islands in the Philippines. Based on the Disaster Response Operation Monitoring and Information Center (DROMIC) report, as of March 2022, the estimated total affected population in the Southern Leyte and Caraga Region is around 513,000 families (approximately 1,947,000 individuals). Fatalities reached 410 in total, with 80 missing. The Manila Observatory (MO) sent an emergency observation request or EOR on December 14 for Tropical Storm "Odette."

The ADRC received the EOR from the Manila Observatory (MO) as a Data Processing Node/Data Analysis Node (DPN/DAN) on December 14, 2021. According to an early request from MO, Sentinel Asia members could provide satellite data. The first satellite images were provided on December 17, when Tropical Storm "Odette" made landfall. Finally, 83 satellite images were provided by GISTDA, ISRO, JAXA, and NARL, and the first value-added product was provided on December 17, 2021. AIT, EOS, and MBRSC provided 42 VAPs. Much of this valuable information was provided and utilized to inform the stakeholders in the affected areas. Also, JAXA provided a WEB-GIS service that allowed users to compare satellite images before and after the disaster.

MO used the data processed by Earth Emergency Observatory of Singapore – Remote Sensing (EOS-RS). The processed data showed observed floods from ALOS-2 PALSAR-2 products provided by JAXA. The extent of the flooding was detected using the difference in pixel values of historical and post-disaster images observed on June 6,

2019, and December 16, 2021, respectively. In particular, the municipalities of Hilongos, Bato, Hindang, Baybay City, Javier, Abuyog, and Mahaplag in Leyte Island were flooded (figure 19). To assess the impact of Super Typhoon "Odette," the extracted flood was spatially overlaid with exposed elements such as critical infrastructure (figure 20), population density per province (figure 21), and land cover (figure 22).

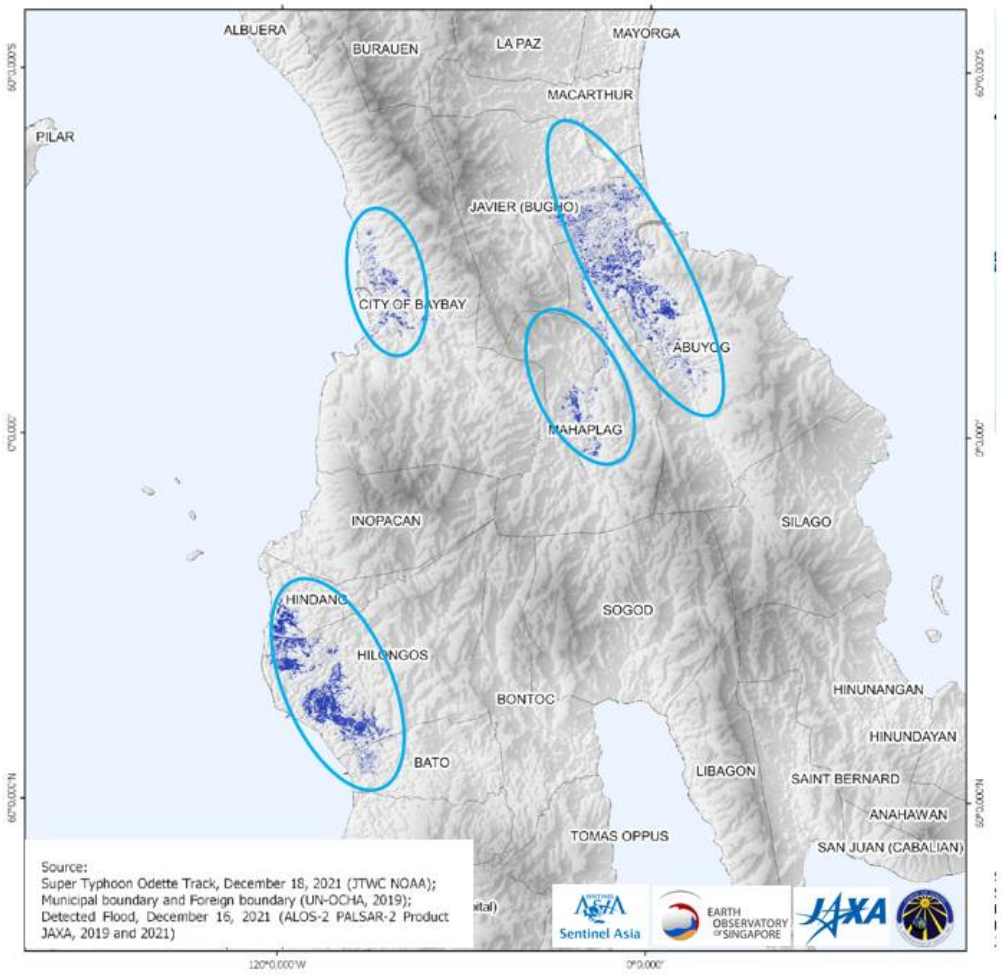


Figure 19: Detected Flood on Leyte Island (ALOS-2 PALSAR-2 Product from JAXA, December 16, 2021)

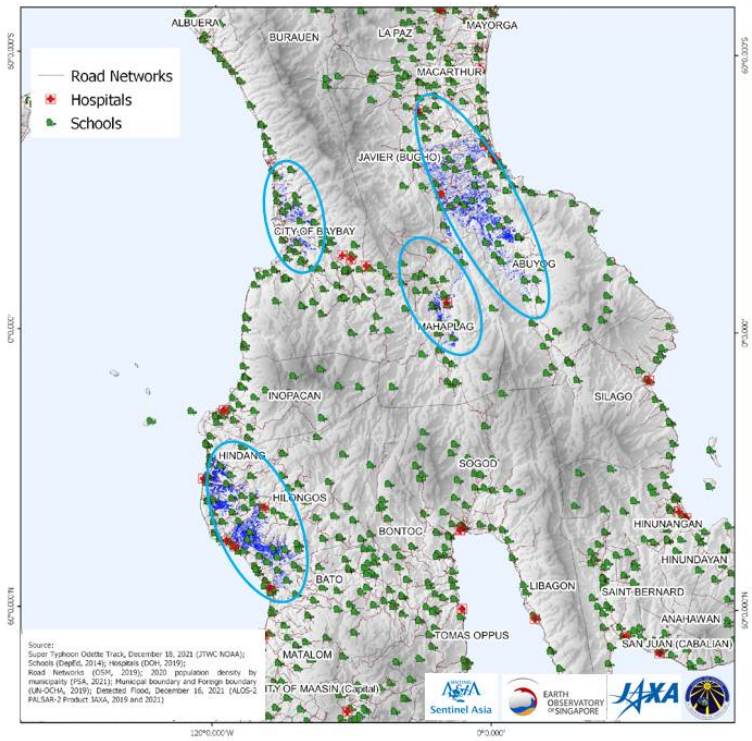


Figure 20: Exposed Critical Infrastructures to Flood on Leyte Island (December 16, 2021)

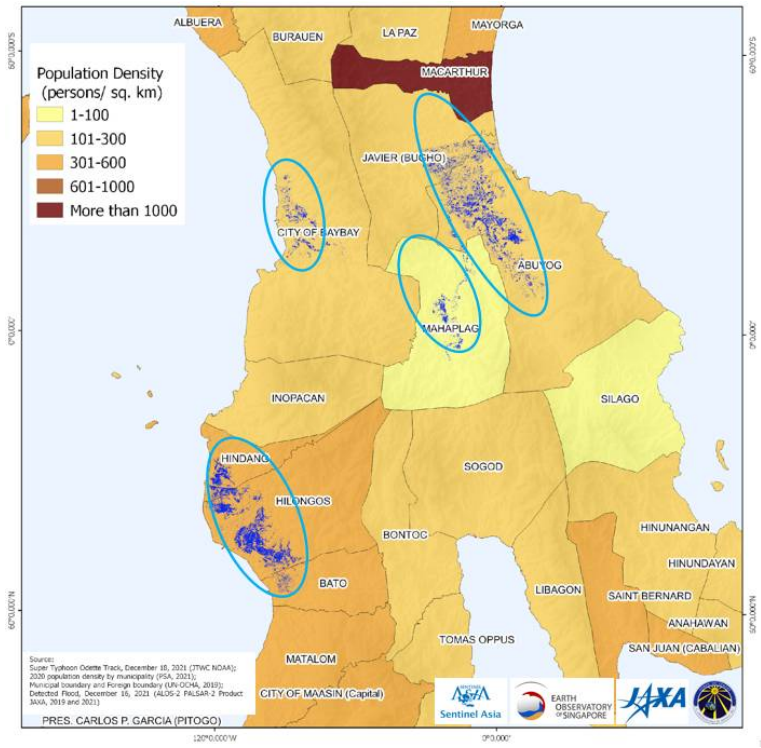


Figure 21: Exposed Population to Detected Flood on Leyte Island

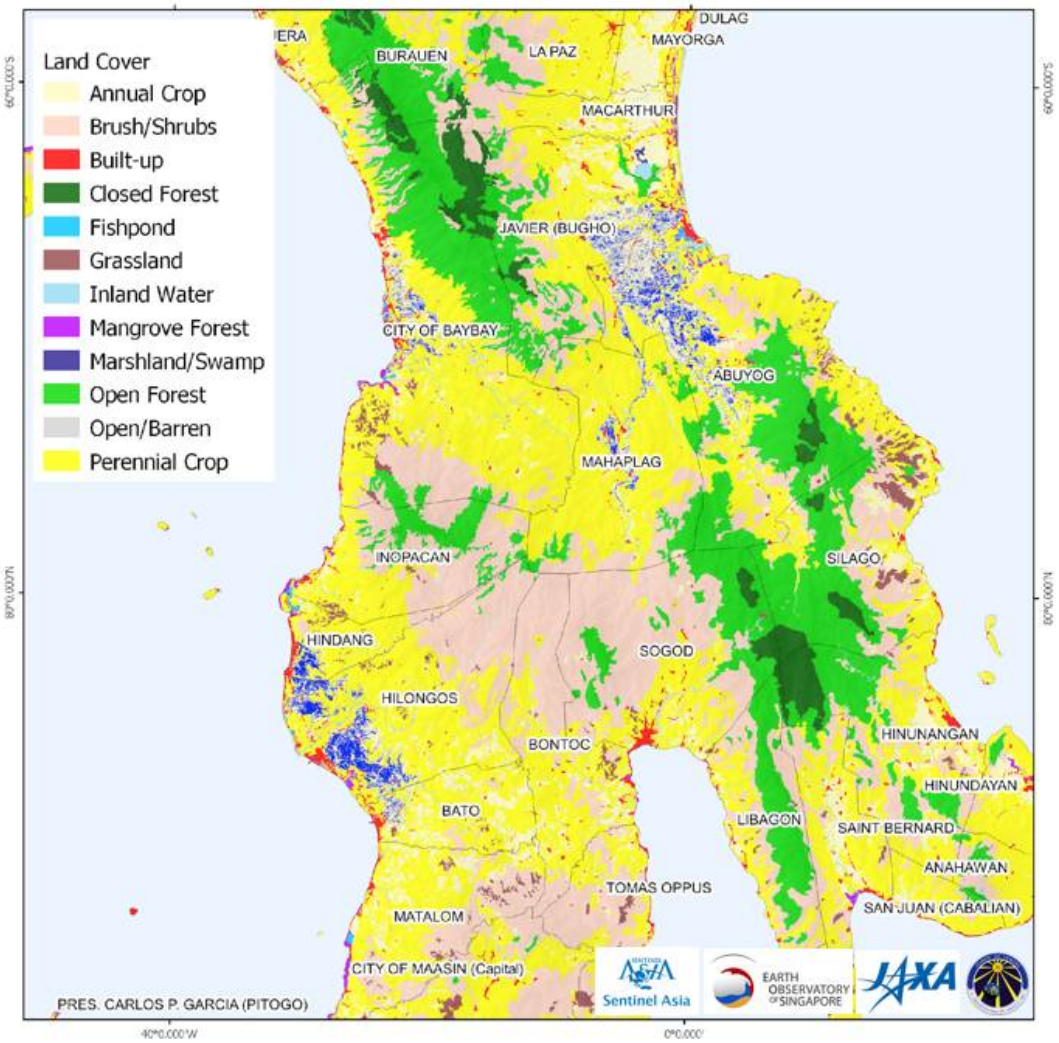


Figure 22: Exposed Land Cover to Flood on Leyte Island

(ADRC:https://www.adrc.asia/view_disaster_en.php?NationCode=&Lang=en&Key=2507)

(UNHCR: https://www.unhcr.org/ph/typhoon-rai-odette)

4. External Relations

4.1. Accession of New Members

**No new JPT members in 2021*

4.2. Collaboration and Cooperation

4.2.1 International Disaster Charter

The rollout to IDC began in February 2010 as required. Ten disasters were escalated through SA in 2021. This figure means that 10 out of 34 EORs, corresponding to 29.4%, were requested to IDC via Sentinel Asia.

Table 3 List of Charter Escalations in 2021

Activation Number	Country	Disaster Type	Activation Date	Requester	Project Manager
390	Indonesia	Earthquake	15-Jan-21	LAPAN, BNPB	LAPAN
391	Philippines	Tropical Depression	22-Feb-21	MO	-
392	Indonesia	Flood, Landslide	6-Apr-21	LAPAN, BNPB	LAPAN
393	East Timor	Flood, Landslide	8-Apr-21	JICA, Secretary of State for Civil protection	UNITAR/UNOSAT
399	Sri Lanka	Oil spill	4-Jun-21	DMC	DMC
400	Sri Lanka	Flood	5-Jun-21	DMC	CGIAR
409	Japan	Flood and Landslide	14-Aug-21	ADRC, MLIT	Yamaguchi University
420	Sri Lanka	Flood, Landslide	12-Nov-21	DMC	JAXA
421	Philippines	Floating pumice stones & volcanic debris	24-Nov-21	PHIVOLCS	PHIVOLCS
422	Indonesia	Volcanic Eruption	7-Dec-21	JICA, PUPR, AHA Center	AIT

5. Conferences and Press Releases

International conferences on space technology and Sentinel Asia's annual meetings have been held every year. However, almost all conferences were cancelled or conducted online due to the COVID-19 pandemic in 2021.

5.1. Conferences

5.1.1 Sentinel Asia Training Program on "Space Technology for Drought Risk Management" (19-20 July 2021)

The webinar on "Space Technology for Drought Risk Management" was held from 19 to 20 July 2021. The webinar was co-organized by the ISRO and the IWMI and was facilitated by the Sentinel Asia secretariat as part of Sentinel Asia's Capacity Building Program.

The objective of the program was to brief the participants from Sentinel Asia members on the potential and current status of utilization of EO technology for operational drought monitoring, in-season drought management, drought impacts assessments and long-term drought management. Advances in drought assessment with new datasets and emerging technologies also form part of this program.

The program consisted of expert presentations and an interactive session to make the message to be conveyed more impactful. Scope for enhancing technology utilization, need for customization of products and services, research gaps, as well as data and information sharing opportunities were planned and documented for future courses of action towards establishing a regional cooperation mechanism for drought risk management.

This webinar brought together around 50 experts and practitioners from the Sentinel Asia community. The inaugural session of the training program included the inaugural address by Dr. V. V. Rao, Deputy Director, Remote Sensing Applications, NRSC and brief remarks by (a) Dr. Shantanu Bhatwadekar, Director, Earth observation applications & Disaster management support Program Office (EDPO), ISRO Hq. (b) Dr. Raj Kumar, Director, NRSC (ISRO) (c) Dr. Rachael McDonnell, Deputy Director

General, IWMI, Sri Lanka and Mr. Takanori Miyoshi (Sentinel Asia Secretariat). This kind of capacity-building event in which Sentinel Asia members help each other build their capacities by making use of their respective experiences and expertise, was first organized by Asian Disaster Preparedness Center (ADPC) and Japan Aerospace Exploration Agency (JAXA) as part of the Joint Project Team Meeting (JPTM) in Bangkok in 2019, and this time, the ISRO and IWMI jointly took the lead to expand it further for the benefit of Sentinel Asia members. The Sentinel Asia community will continue to support and foster capacity-building among its members through mutual cooperation. Since drought is a large hydro-meteorological disaster causing huge economic losses with cascading effects, the need for using science-based evidence solutions for drought management has been well recognized. Therefore, the current training program was quite relevant to deepen the participant's understanding of the nature of drought and the scope for new technologies to minimize losses from such disaster. All the speakers in the inaugural session pointed out the need for organizing drought monitoring and management related capacity building programs more frequently for the benefit of Sentinel Asia member countries.

5.1.2 Sentinel Asia Webinar "Space Technology for Flood Forecast Modelling", organized by ISRO and IWMI (27-28 October 2021)

Capacity building is a powerful tool in disaster risk reduction and a very important element towards building a disaster-risk-resilient society. The objective of the program has been to appraise the participants from Sentinel Asia member countries/regions on the potential and current status of EO technologies in operational flood forecast modelling and spatial flood inundation modelling using hydrological and hydrodynamic modelling techniques.

This webinar program has consisted of expert presentations/lectures and an interactive session to make it more impactful. The scope for augmenting applications of technology, research data gaps, its limitations and information-sharing opportunities were planned and documented for the future course of action towards promoting the technology for flood disaster risk reduction.

Moreover, this webinar brought together a total of around 80 experts and practitioners from different Sentinel Asia member countries/regions. The inaugural Session of the training Program included a welcome by Dr. V. V. Rao, Deputy Director, Remote Sensing Applications, NRSC and brief remarks by (a) Mr. Miyoshi Takanori, Sentinel Asia Secretariat, (b) Dr. Mark Smith, Director General, IWMI, and (c) Dr. Raj Kumar, Director, NRSC. The 2-day webinar was conducted for the Asia Pacific region during October 27-28, 2021. This is the second webinar conducted by ISRO in association with IWMI in continuation to the Drought Webinar as part of the capacity-building event of this kind in which Sentinel Asia members mutually help build capacity with their respective experience and expertise. In this inaugural session, it was stressed that the Sentinel Asia community would continue to support and foster mutual capacity building among members through cooperation. The inaugural session was completed with a formal vote of thanks by Dr. K H V Durga Rao, NRSC, ISRO.

5.1.3 Special Session on Sentinel Asia "Sentinel Asia for the ASEAN Region" under the ACE Program (17 November 2021)

"The AHA Centre Executive Program (ACE Program)" is an over 4-month training course conducted by the ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) with a view to developing future leaders of national disaster management offices (NDMOs) in ASEAN countries. Started in 2014, this year marks the 7th batch of the program. As its vision states, many of the alumni of previous batches of ACE Program have been already representing and leading their NDMOs.

Prof. Mizan Bisri of Kobe University (JPT member organization based in Japan) had been appointed by the AHA Centre to facilitate liaison with Japanese-base resources for the program and organized the "Japan Disaster Risk Reduction (DRR) Online Course" from November 15 to 18, 2021, as part of the ACE Program. As part of the Japan DRR Online Course, an invitation was extended to the Sentinel Asia Secretariat for organizing a dedicated joint session composed of speakers from Japan-based Sentinel Asia JPT member organizations.

The joint session was held on November 17, 2021, with the title "Sentinel Asia: Space-based disaster risk management support for the benefit of the Asia-Pacific region ~Sentinel Asia for the ASEAN Region~". More than 30 future young leaders from 24 NDMOs (as well as AHA Centre staff members) attended the session. Experts from the Asian Disaster Reduction Center (ADRC), the University of Tokyo, and the JAXA/Sentinel Asia Secretariat gave lectures and hands-on training courses. The thematic topics of the training courses include "How to make Emergency Observation Requests (EORs) to Sentinel Asia"; "How to utilize the Web-GIS system for obtaining tangible damage information"; and "Extraction of building footprints from satellite data." At the end of the session, information on many other training opportunities by JPT members including those who were not at the session was also introduced, and participants whose organizations are not yet JPT members were strongly encouraged to make applications for membership.

The organizing team is convinced that, as the outcome of the session, participants have become familiar with the significance and benefits (including ones to be upgraded

in the future) of Sentinel Asia and how they can enjoy such benefits. Through this joint session with the AHA Centre and Kobe University, the partnership between NDMOs of ASEAN member states and Sentinel Asia has been further strengthened.

5.1.4 27th Asia-Pacific Regional Space Agency Forum, APRSAF (30 November to 3 December 2021)

The 27th session of the Asia-Pacific Regional Space Agency Forum (APRSAF-27) was held online from November 30 to December 3, 2021. The APRSAF-27 was co-organized by the Vietnam Academy of Science and Technology (VAST), the Ministry of Education, Culture, Science and Technology (MEXT) of Japan, and JAXA with the slogan "Expanding Space Innovation through Diverse Partnerships."

On December 1, a dedicated Sentinel Asia session was organized and hosted by the Sentinel Asia Secretariat in close collaboration with the Steering Committee members as part of Satellite Applications for Societal Benefit Working Group (SAWG) of the APRSAF-27. The session heard the following six presentations:

(1) "Sentinel Asia - Trends in Emergency Observation Requests" (ADRC)
(2) "Sentinel Asia Status Report" (JAXA)
(3) "NSPO-NARLabs Engagement in Sentinel Asia" (NARLabs/NSPO)
(4) "Integration of Satellite data and Crowdsourced information through a Mobile App for the Sentinel Asia" (GIC/AIT)
(5) "Development of Mirror Target Calibration for Optical Satellite Data" (Yamaguchi University)
(6) "Using Earth Observation to help Pacific countries managing disaster risk reduction and response" (Pacific Earth Observation Council)

Through the Sentinel Asia session itself and its report by the SAWG co-chair in the high-level segment of the APRSAF (Plenary Session), the APRSAF-27 witnessed the development of the Sentinel Asia Step-3 system, led by the Technical Team composed of GISTDA, NARLabs/NSPO with Academia Sinica, and JAXA. The APRSAF-27 noted that the Sentinel Asia community had significantly upgraded its activities to address the entire disaster management cycle, with contribution to the Sendai Framework in mind. Such activities included the establishment of "Standard Operating Procedures for making Emergency Observation Requests (EOR) to Sentinel Asia" in several countries, a mobile application for sharing in-situ disaster information developed by AIT, a project by Yamaguchi University aimed at enhancing the reliability of optical

satellite data, and an initiative by the University of Tokyo to extract building maps from satellite data. Finally, the APRSAF-27 appreciated that NARLabs/NSPO had expressed their intention to provide Sentinel Asia with Formosat-8 satellite data after its launch.

5.2. Documents, Press Releases and Papers

5.2.1 Standard Operating Procedures (SOPs) for making EORs in Myanmar, Thailand, and Vietnam

The Standard Operating Procedures (SOPs) for making Emergency Observation Requests (EOR) to Sentinel Asia were established in Myanmar, Thailand, and Vietnam in March 2021. The establishment of SOPs is the achievement made through online workshops aimed at better use of Sentinel Asia's EOR mechanism for each country's following stakeholders.

- For Myanmar (February 4): DDM, DMH, AHA Centre, AIT, ADRC, and JAXA
- Thailand (February 18): ADPC, GISTDA, DDPM, AIT, ADRC, and JAXA
- Vietnam (February 1): MARD, MONRE, VAST/STI, AIT, ADRC, and JAXA

The common highlights of each SOP include:

(i) the prior definition of organizations primarily responsible for making EORs in case of natural disasters

(ii) the prior definition of criteria under which the organizations (i) above will make EORs on an "in principle" basis

(iii) support by international organizations including ADRC to make EORs on behalf of the organizations (i) above, in case EORs are not made promptly or in an opportunity

(iv) the easy and real-time provision of local information on the disaster via web-based mobile application developed by AIT

(v) the institutionalized use of Global Satellite Mapping of Precipitation (GSMaP) for monitoring (reference information for making EORs)

In accordance with these SOPs, in case of natural disasters, stakeholders of each country will be able to make emergency observation requests to Sentinel Asia promptly, and utilize the information provided by Sentinel Asia for better response and recovery in an interactive manner. Likewise, the Sentinel Asia community will be able to provide better and effective support than before.

This is one of the good examples of Sentinel Asia which is mandated to address the

entire disaster management cycle, and it is a significant contribution to the Sendai Framework Priority 4 as well. This joint achievement has significantly enhanced the value of Sentinel Asia.

5.2.2 Commitment to the Sendai framework

The Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) was the first major agreement of the post-2015 development agenda, and it provides Member States with concrete actions to protect development gains from the risk of disaster. There are four priorities for action to prevent new and reduce existing disaster risks: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience, and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction. Around the world, countries have begun to implement initiatives based on the SFDRR.

The activities of Sentinel Asia were introduced as a contributor at the website of SFDRR. This is adapted for the Priority 1 and Priority 4 of SFDRR. For instance, publication of SOP, as mentioned in "5.2.1", is adapted for Priority 4, "Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction".

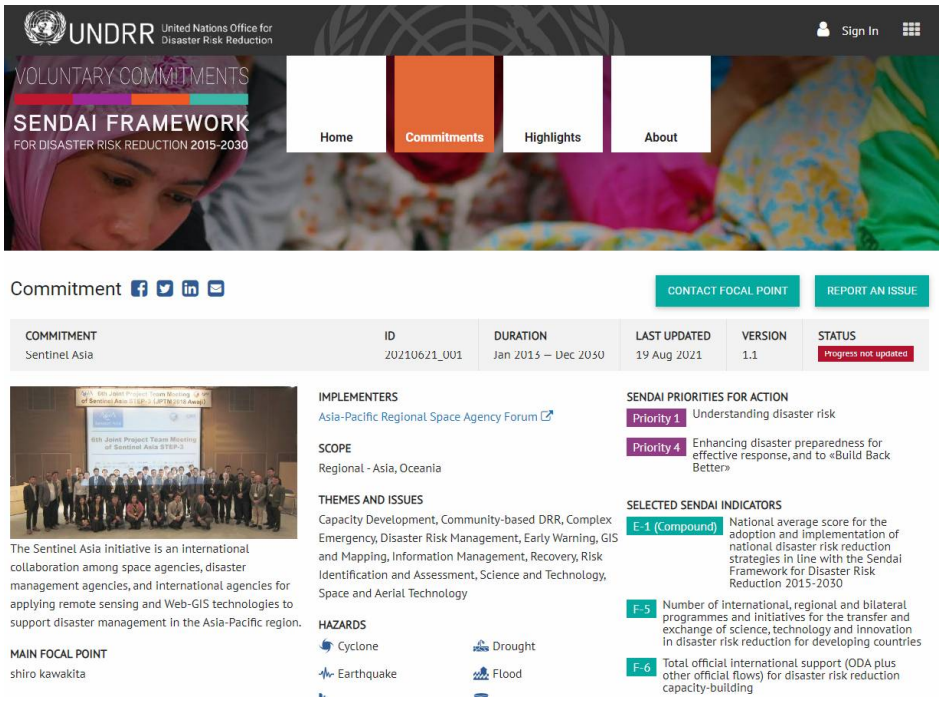


Figure 23: SFDRR website

https://sendaicommitments.undrr.org/commitments/20210621_001

6. Assessment of Sentinel Asia Operations

6.1. Analysis of Operational Performance

Figure 24 summarizes the number of days from the occurrence of a disaster to the request for each disaster and their respective years. Overall, this shows that it took a number of days from the first occurrence of the disaster to a request for the period between 2011 and 2021.

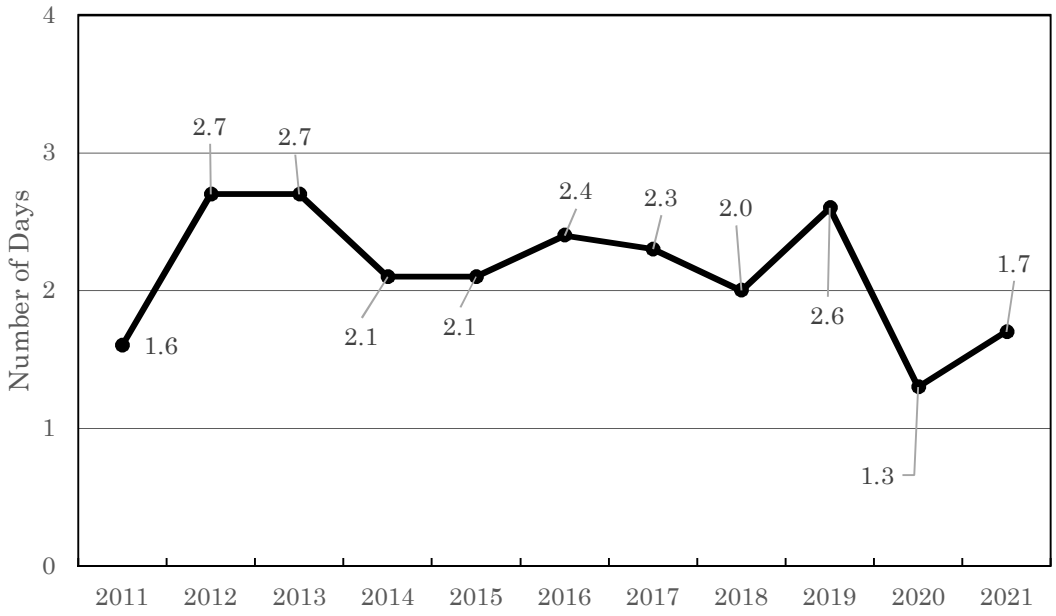


Figure 24: Number of Days Required from Disaster Occurrence to Request

Figure 25 shows the number of days that were required from the date the request is received to activation. Overall, it took 0.06 days from request to activation in 2021. This is an improvement over last year.

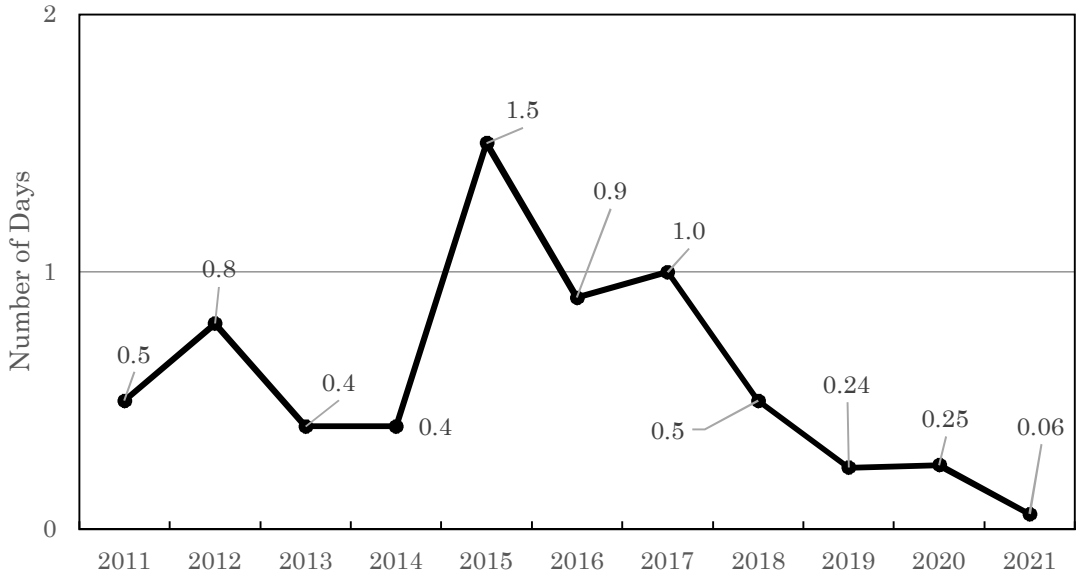


Figure 25: Number of Days Required from Request to Activation

Figure 26 shows the average number of days required to provide archive satellite data after activation (shown by the black line), and how often data could be provided relative to the total number of requests (shown by the blue line).

Figure 26's Archive Satellite Data indicates that the percentage of provisions improved from 2016 to 2020. However, this figure in 2021 was totaling 76.5%. And the average number of days required rose to 4.0 days from last year's 3.3.

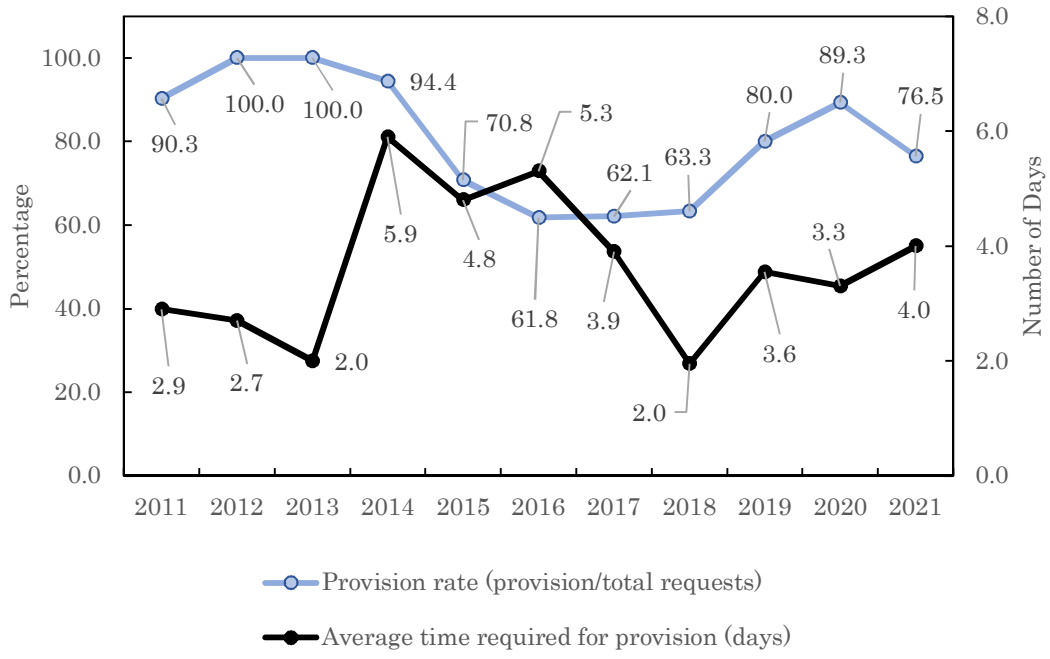


Figure 26: Average Number of Days Required to Provide Archive Satellite Data and Activation Rate for Each Year

Figure 27 shows the average number of days required to provide post-disaster satellite data after activation (shown by the black line), and how often data could be provided relative to the total number of requests (shown by the blue line).

Figure 27's Satellite Data after Disaster shows that the percentage of provisions increased sharply from 2014 onward, while the number of days required for data provision has decreased in recent years. The number of average days required for provision in 2021 was 2.9 days. And the average number of days required for provision was around 3.2 days over the past 5 years, from 2017 to 2021.

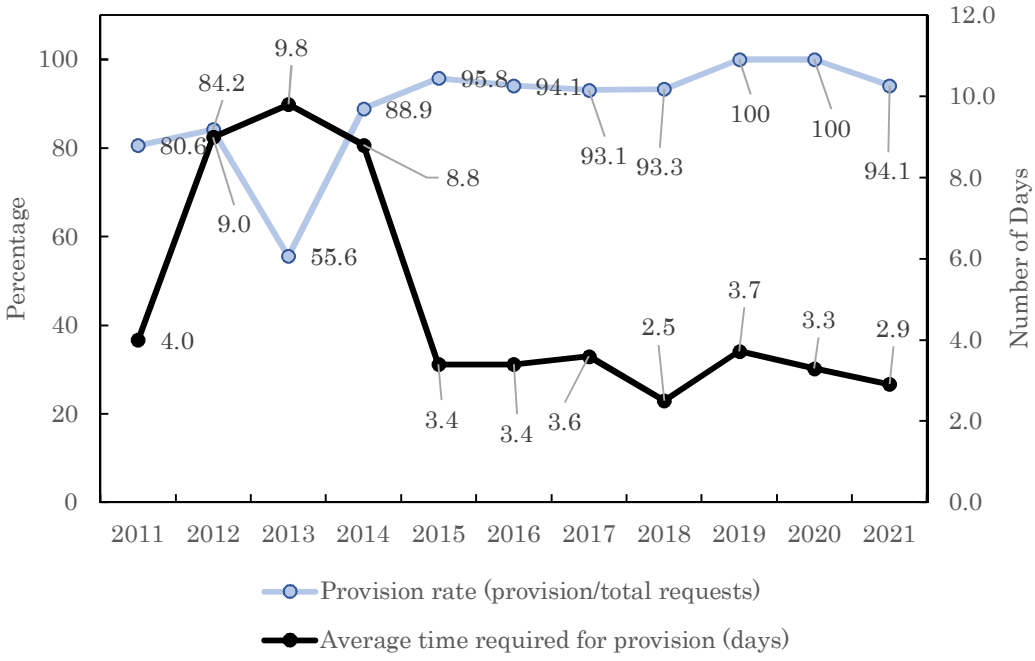


Figure 27: Average Number of Days Required to Provide Satellite Data After Disaster and Activation Rate for Each Year

Figure 28 shows the average number of days required to provide products after activation (shown by the black line), and the how often data could be provided relative to the total number of requests (shown by the blue line).

Figure 28 shows that the provision rate for products was 73.5% in 2021. Many DANs supported the provision of products for each EOR. The average number of days required for provision was 5.4 days in 2021 and 4.4 days over the past 5 years, from 2017 to 2021.

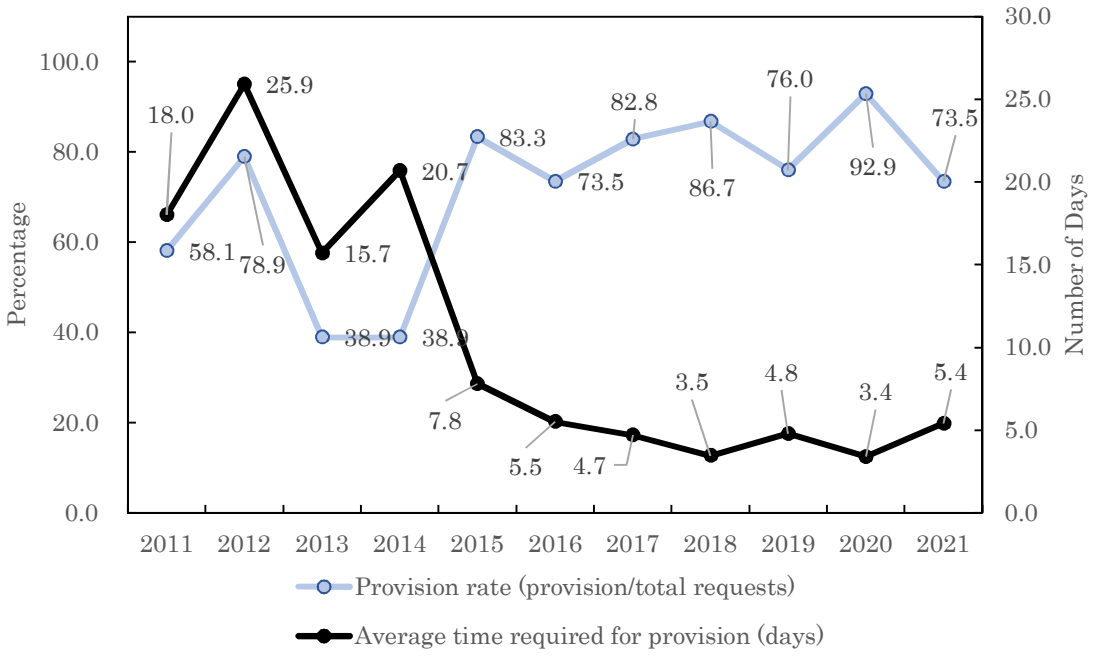


Figure 28: Average Number of Days Required to Provide Products and Activation Rate for Each Year

7. Conclusions

Since the start of 2007, we have accepted 423 EORs and activated 376. Sentinel Asia activities were particularly affected by the COVID-19 pandemic this year, but by taking advantage of remote sensing technology, Sentinel Asia were able to contribute their support by providing effective data even in times of disaster. And some JPT members conducted several online workshops for strengthen Sentinel Asia network, as shown in 5.1.1 and 5.1.2. Also, Sentinel Asia started to contribute for the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), as shown in 5.2.1 and 5.2.2. It is expected that Sentinel Asia forms a strong relationship with the community of DRR.

Lastly, Sentinel Asia accepted 34 EORs that were submitted, and 34 EORs were activated in 2021. The following points are conclusive statements based on activities in 2021.

- In 2021, Around 67.6% of the EORs were related to floods.
- The “Number of Days Required from Disaster Occurrence to Request” was 1.7 days in 2021. It was less than 2 days for two years in a row.
- Ten (10) out of thirty-four (34) Sentinel Asia activations were escalated to the IDCs in 2021. This is the highest number in SA’s history. Project managers of these escalated IDCs were nominated from JPT members and ADRC members (e.g., AIT, DMC, JAXA, PHIVOLCS, and Yamaguchi University).
- Through 34 EORs, DANs and DPNs have been provided with a lot of data set for requestors and utilized for their DRR activities. Thus, Sentinel Asia made contributions for JPT members during disaster situations amidst the COVID-19 pandemic by taking advantage of the remote sensing technology.

** January 2021 News from Sentinel Asia Project Office **

- * -

Topics:

1. [News] Emergency Observation of Disasters Occurring in January 2021
2. [Interview] Mohammed Bin Rashid Space Centre (MBRSC)
3. Information
4. How to send Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

- * -

1. [News] Emergency Observation of Disasters Occurring in January 2021. (as of 25 January)

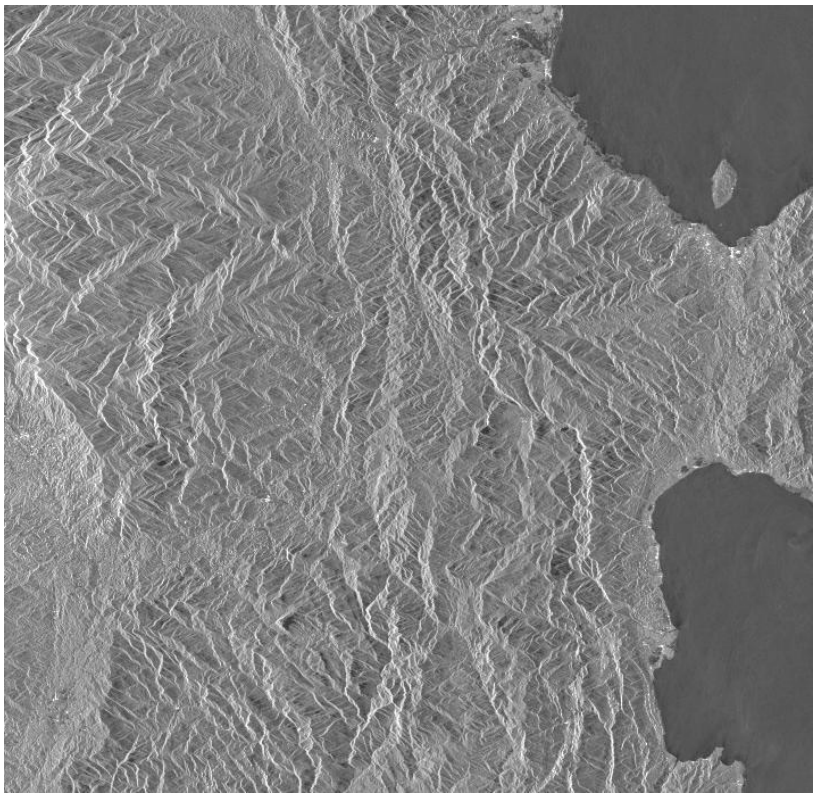
(1) Earthquake in Indonesia

A magnitude 6.2 earthquake occurred in Majene, Indonesia on 15 January 2021. National Board for Disaster Management (BNPB) reported that at least 42 people (34 in Mamuju and 8 in Majane) died, 189 people in Mamuju Regency were seriously injured, around 637 people suffered minor injured and 15,000 residents had been displaced. (https://www.bnpb.go.id/berita/-update-sebanyak-189-orang-dirawat-di-kabupaten-mamuju-pascagempa-m6-2-)

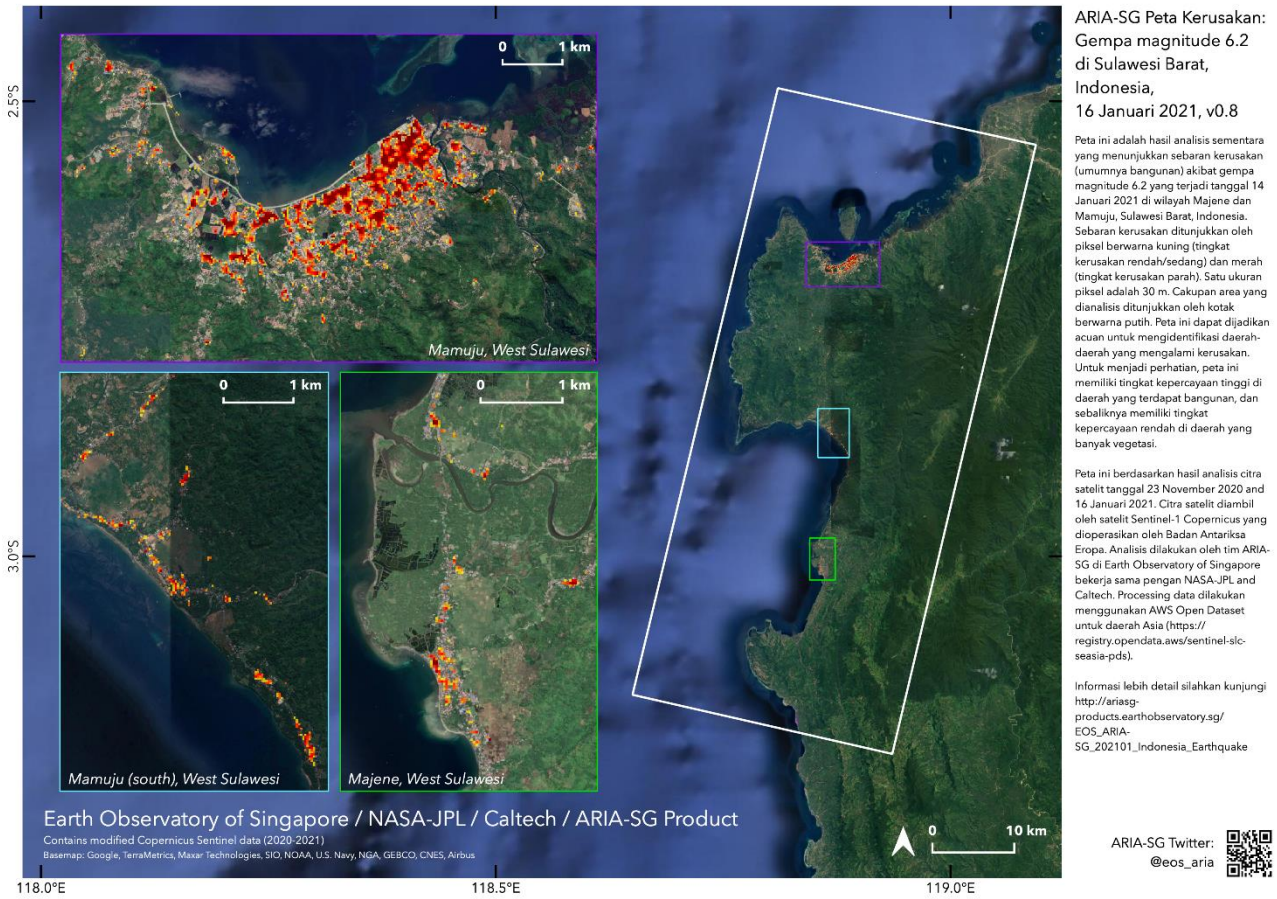
Indonesian National Institute of Aeronautics and Space (LAPAN) made an Emergency Observation Request (EOR) to Sentinel Asia on 15 January. This EOR was escalated to the International Disaster Charter. LAPAN assumed the role of Project Manager (PM) for this Disasters Charter activation. Among Data Provider Nodes (DPNs), Indian Space Research Organization (ISRO), Mohammed Bin Rashid Space Centre (MBRSC), National Applied Research Laboratories (NARL) and Japan Aerospace Exploration Agency (JAXA) provided their observation data. Among Data Analysis Nodes (DANs), Earth Observatory of Singapore (EOS) provided their VAPs. The information on the latest response by Sentinel Asia is available from the following link.

https://sentinel-asia.org/EO/2021/article20210115ID.html

Satellite image (KhalifaSat) provided by MBRSC



Satellite image (ALOS-2 PALSAR-2, L1.1) provided by JAXA



Product by EOS

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2. [Interview]

The Mohammed Bin Rashid Space Centre (MBRSC), founded in 2006, is home to the United Arab Emirates' National Space Program. MBRSC builds and operates earth observation satellites, offering imaging and data analysis services. MBRSC has been a member of Sentinel Asia since 2017. In addition to its contribution to supply its observation data as Data Provider Node (DPN), recently MBRSC has been supporting Emergency Observation Requests (EORs) as Data Analysis Node (DAN) as well, by providing many value-added products.

Commemorating MBRSC's first provision of KhalifaSat data in August 2020, the Sentinel Asia Secretariat (Dr. Shiro Kawakita, Mr. Takanori Miyoshi and staff members) interviewed Ms. Alia Mohammad Al Mekhyat and Ms. Shaikha Ahmed Albesher of MBRSC for their contribution to the Sentinel Asia.

Sentinel Asia Secretariat

On behalf of the secretariat, I warmly thank you for giving us this opportunity to interview you concerning your contribution and support for Sentinel Asia. Looking back on the history of the partnership between MBRSC and Sentinel Asia, we could cite the

milestone event, “the Steering Committee (SC) joint mission to MBRSC” in 2017 right after MBRSC joined Sentinel Asia as a DPN member. Colleagues from Asian Disaster Reduction Center (ADRC), Asian Institute of Technology (AIT), Geo-Informatics and Space Technology Development Agency (GISTDA), and JAXA visited you. Since then, MBRSC has been supporting Sentinel Asia activities, by providing Dubaisat-2 images and a lot of fruitful input as a SC member. I remember on the occasion of SC joint mission, MBRSC colleagues kindly showed us around facilities, such as a ground control room and a clean room in which a flight model of KhalifaSat was being assembled. After that, it was successfully launched with JAXA’s Greenhouse Gases Observing Satellite IBUKI-2 (GOSAT-2) on H-IIA launch vehicle. Then, at the SC meeting in June last year you expressed that you would register KhalifaSat as part of Sentinel Asia’s constellation, and then you did indeed provide the image! The first KhalifaSat image provided last August was so vivid and enabled us to capture the situation clearly and to support the requester. We are really pleased to see how the partnership has been strengthened and we are grateful for your dedicated commitment and support. Today, we would like to hear from you more detailed information on the data provision of KhalifaSat and your motivation.

MBRSC

We appreciate the nice words, as well as we are glad you visited us to witness the assembly of our third and most advanced satellite, KhalifaSat, and now after the successful launch, we are working with data acquired by KhalifaSat.

Firstly, speaking of Sentinel Asia, we are much honored to be part of this noble initiative. It is a great honor to help humankind by mitigating impacts of disasters using our space-based resources, whether through our satellite imagery or our value added products. From our side, I can assure you that our team has expanded from your last visit, which you can see on with the OPTEMIS system. In fact, we have updated the plan and the operation status. Thus, currently, once we receive any emergency observation requests, such requests are immediately directed to our mission planner. Then, the mission planner will immediately task the satellite to capture the area affected by the disaster. Of course, that depends on the availability of the satellite such as where the satellite is in orbit, as well as on the priority list we have. Subsequently, mission planners will place the order and task the satellite, whether it is using KhalifaSat or DubaiSat-2, and go ahead with the imaging whenever it is applicable. Once the satellites are tasked and the image is captured and downloaded successfully, the task will be handed over to another colleague at our Image Processing Section. Once the image is processed, it will be uploaded on the OPTEMIS server for Sentinel Asia colleagues so that they can benefit from the image, and distribute it to the concerned party. Previously, we had a different approach, it was one person handling all those tasks. Now as we have explained, we have one person dedicated to a specific task in order to simplify and speed

up the process. And we believe it has developed and improved our contribution and participation in the Sentinel Asia initiative.

Sentinel Asia Secretariat
We are really impressed that you have upgraded the whole workflow for Sentinel Asia. Now we can expect further support for the Sentinel Asia community. In terms of the EOR operation procedure including the system, is there anything that the secretariat should improve in order to facilitate your response to EORs?

MBRSC
Honestly, when we started using the system, it was an exceptionally smooth process. We even mentioned that in several emails to the team from Sentinel Asia, the system is super clear and simple. Uploading any imagery is quite simple and very easy, especially after the latest update. We could even demonstrate the usage of the system to our team members very easily. It is indeed efficient to work using this system. From our end, there is only one matter that we need to take into consideration, which is cloud coverage. In fact, since our satellites are optical satellites we find it difficult to provide data for disasters such us flooding with cloud coverage. Therefore, although we always try to respond to Sentinel Asia's EORs and indeed we do behind the scene tasking, it is not always that we are able to upload data on the system in such cases.

Sentinel Asia Secretariat
It is great to hear that MBRSC always tries to respond to Sentinel Asia's EORs, even if the DubaiSat and KhalifaSat data are not uploaded to OPTEMIS. Thank you very much again for your outstanding support to Sentinel Asia EORs. MBRSC satellites are always useful because the resolutions are high. As in the case of the recent EORs for Beirut and Izmir which you provided KhalifaSat images, the Sentinel Asia community would really appreciate your support. At the same time, as you mentioned, for optical satellites, cloud coverage is always a challenge. In this regard, in order to have more supports from your side, perhaps we could ask requesters to narrow down the area. In many cases, the area of interest stated by the requesters may be too large, and it might be difficult for you to task under cloud-free environment, but if requesters are able to narrow down the specific area of interest, and then it will become easier for you to proceed. Would that work?

MBRSC
Definitely, that will help us. If we have cloud coverage in the scene, we can specify the exact area in which the disaster occurred at. In addition, we can either upload the image even if it had cloud coverage, it might be of benefit. If the image is 90% cloudy but remaining 10% area is not affected and could benefit, and leave it up to end user to asses.

We hope this step will improve our contribution further.

Sentinel Asia Secretariat
Speaking of MBRSC's support, recently, MBRSC has been active not only as a DPN but also as a DAN. Could you tell us how you are working on generating value added products?

MBRSC
MBRSC was strongly motivated to contribute as a DAN member, and worked on placing a new process in order to participate as a DAN. Based on the requests placed on the system, we search and order the most suitable available data, and start on our analysis process to provide products as fast as possible.
This participation is helping us in utilizing present data sources, and developing MBRSC's geospatial analysis expertize to provide critical information for disaster stricken areas. We aim to provide an analytical assessment of disasters, such as floods or earthquakes, in order assess in taking vital and effective decisions to reduce or eliminate any fatal risks.

Sentinel Asia Secretariat
In terms of your activity as a DAN, I remember that the Director of MBRSC mentioned, during our joint visit mission to MBRSC three years ago, that MBRSC would like to contribute to EOR as DAN as well in the future. Now you are indeed supporting EOR as DAN, for which we are grateful to you.

MBRSC
Three years ago, we had only one person working on value added products. We have expanded the team and a member joined the team to support. So now after three years, we are pleased to further support Sentinel Asia, as both a DPN and DAN.

Sentinel Asia Secretariat
As you know, Sentinel Asia is not a small community. We have many agencies from the west to east. Do you have any expectation for future cooperation with the Sentinel Asia and its members?

MBRSC
From our side, of course, we are honored to support the Sentinel Asia for as many years as possible. And we hope for further partnerships and collaborations that will help and assist Sentinel Asia and to mitigate the effects of natural disasters, and hopefully we would like to help reduce any post disaster damage on humankind. Also, we will do our best to further support such great initiative.

Additionally, we have a new satellite currently under development, named “MBZ-Sat”. Although we will provide you with the further detailed information later once determined, we can tell you now that the satellite will be with an improved Image Capture resolution. MBZ-Sat will also have an improved performance regarding data processing and downloads.

Sentinel Asia Secretariat
We are really excited to hear that. Even current Dubaisat-2 and KhalifaSat provide very high-resolution images and with more enhanced capability, MBZ-Sat will be further benefit the Sentinel Asia community. Thank you very much for your kind offer. Finally, we thank you once again for giving us the opportunity to interview you. We are pleased with and really grateful for your support for Sentinel Asia.

Alia Mohammad Almekhyat
- Officer -
Business Development Section,
Remote Sensing Department

Shaikha Ahmed Albesher
- Engineer -
Remote Sensing Applications Unit, Remote Sensing Department

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3. [Information]
Sentinel Asia has uploaded the list of "ALL" emergency observation responses (over 300!) on the Sentinel Asia web portal.

https://sentinel-asia.org/EO/EmergencyObservation.html

You can browse, all VAPs (estimated flood maps and others provided by DANs), and thumbnails of satellite images on the site.
It would be great if they could help you understand our work, operation and efforts.

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4. How to send Emergency Observation Request

JPT member organizations are entitled to send Emergency Observation Request (EOR) for disasters in the Asia-Pacific region.
Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

The Sentinel Asia launched new operation system, OPTEMIS. Please refer to the website how to create the account of OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** February 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Latest Emergency Observations of Disasters
2. Information
3. How to send Emergency Observation Request
4. Using Sentinel Asia Operation System, OPTEMIS

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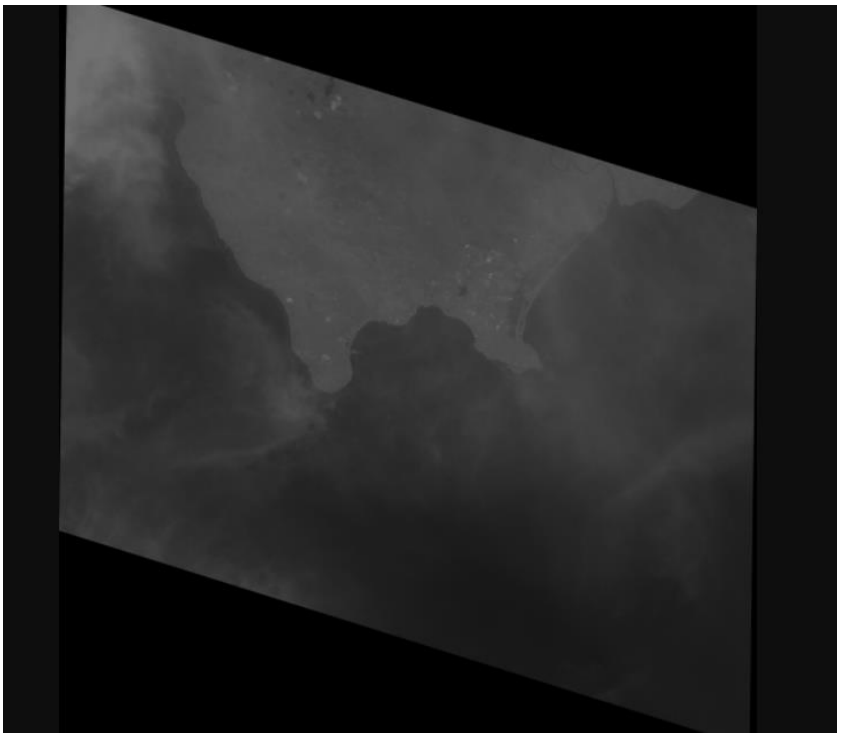
1. [News] Latest Emergency Observation of Disasters (as of 25 February)

(1) Earthquake in Indonesia

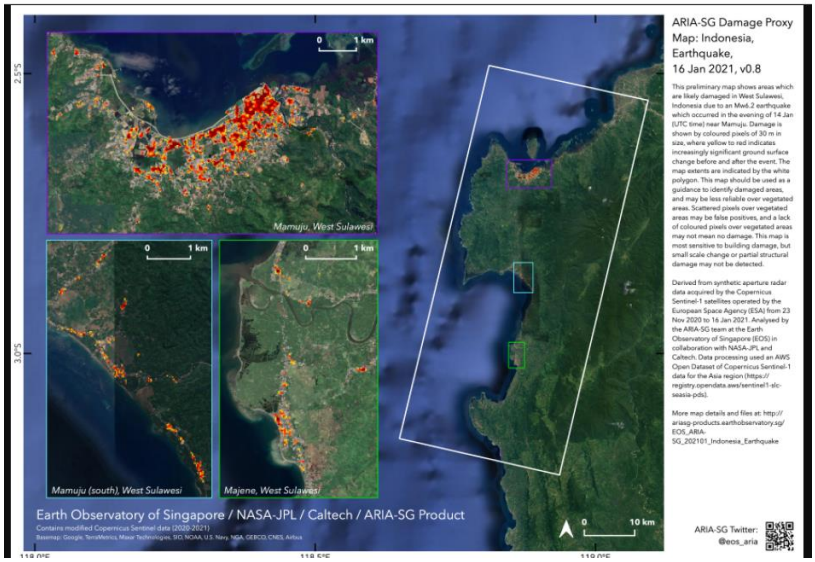
A magnitude 6.2 Earthquake occurred in Majene, Indonesia on 15 January 2021. At least eight people died, 637 were injured and 15,000 residents had been displaced, according to the country's National Board for Disaster Management (BNPB). Also, in the neighboring Mamuju area, an additional 26 deaths were reported (https://edition.cnn.com/2021/01/14/asia/indonesia-sulawesi-earthquake-intl-hnk/index.html)

Indonesian National Institute of Aeronautics and Space (LAPAN) made an Emergency Observation Request (EOR) to Sentinel Asia on 15 January. This EOR was escalated to the International Disaster Charter. LAPAN assumed the role of Project Manager (PM) for this Disasters Charter activation. Among Data Provider Nodes (DPNs), Indian Space Research Organization (ISRO), Centre for Remote Imaging, Sensing and Processing (CRISP), Mohammed Bin Rashid Space Centre (MBRSC) and Japan Aerospace Exploration Agency (JAXA) provided their observation data. Among Data Analysis Nodes (DANs), Earth Observatory of Singapore (EOS) provided their VAPs. The information on the latest response by Sentinel Asia is available from the following link.
https://sentinel-asia.org/EO/2021/article20210115ID.html



Satellite image (TeLEOS-1) provided by CRISP

Satellite image (KhalifaSat) provided by MBRSC



Value Added Product by EOS

(2) Flood, Landslide and Strom in Philippines

Tropical Storm "Auring" (international name: Dujuan) hit the Philippines on 21 February 2021, which induced floods and landslides. CNN Philippines reported that 2,000 families were already evacuated, and rice fields in the town were also submerged in flood, with damage to agriculture estimated.

Manila Observatory (MO) made an Emergency Observation Request (EOR) to Sentinel Asia on 21 February. This EOR was escalated to the International Disaster Charter. MO assumed the role of Project Manager (PM) for this Disasters Charter activation. The information on the latest response by Sentinel Asia is available from the following link.

https://sentinel-asia.org/EO/2021/article20210221PH.html

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2.[Information]

Sentinel Asia has uploaded the list of "ALL" emergency observation responses (over 300!) on the Sentinel Asia web portal.

https://sentinel-asia.org/EO/EmergencyObservation.html

You can browse, all VAPs (estimated flood maps and others provided by DANs), and thumbnails of satellite images on the site.

It would be great if they could help you understand our work, operation and efforts.

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3. How to send Emergency Observation Request

JPT member organizations are entitled to send Emergency Observation Request

(EOR) for disasters in the Asia-Pacific region.
Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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4. Using Sentinel Asia Operation System, OPTEMIS

The Sentinel Asia launched new operation system, OPTEMIS. Please refer to the website how to create the account of OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** March 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Additional Information for Flood, Landslide and Strom in Philippines
2. Standard Operating Procedures (SOPs) for making EORs to Sentinel Asia established!
3. Information
4. How to send Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

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1. [News] Latest Emergency Observation of Disasters (as of 29 March)

(1) (Additional Information)Flood, Landslide and Strom in Philippines

(Outline which already informed as February 2021 News)

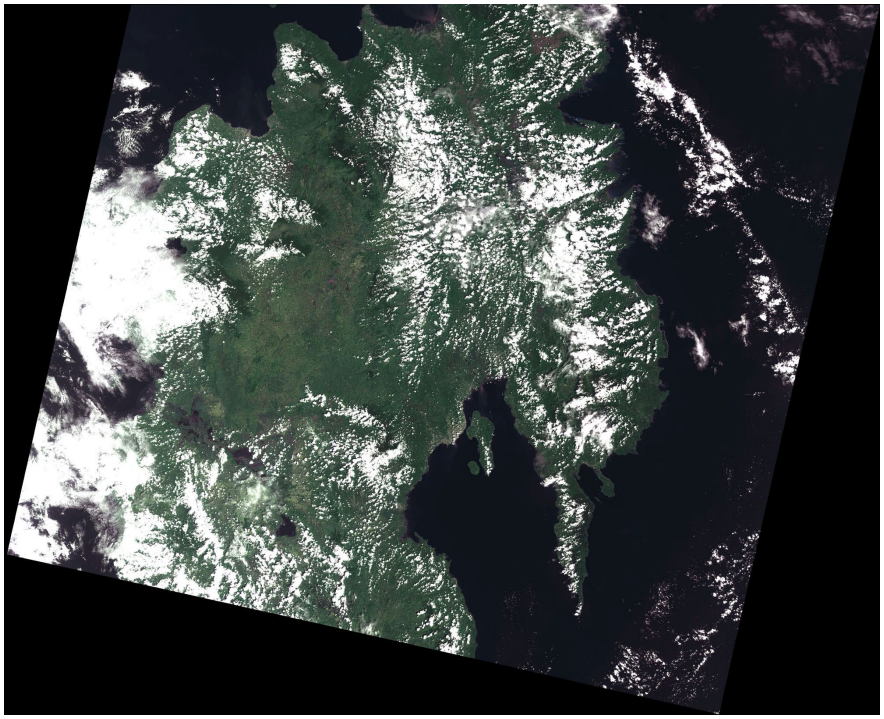
Tropical Storm "Auring" (international name: Dujuan) hit the Philippines on 21 February 2021, which induced floods and landslides. CNN Philippines reported that 2,000 families were already evacuated, and rice fields in the town were also submerged in flood, with damage to agriculture estimated.

Manila Observatory (MO) made an Emergency Observation Request (EOR) to Sentinel Asia on 21 February. This EOR was escalated to the International Disaster Charter. MO assumed the role of Project Manager (PM) for this Disasters Charter activation. The information on the latest response by Sentinel Asia is available from the following link.

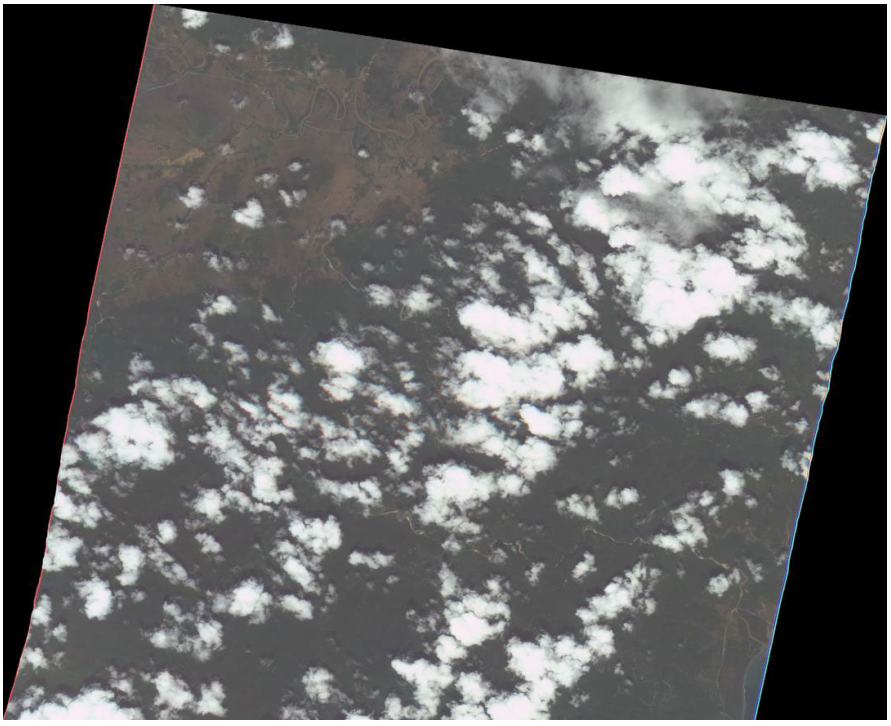
https://sentinel-asia.org/EO/2021/article20210221PH.html

(Additional Information)

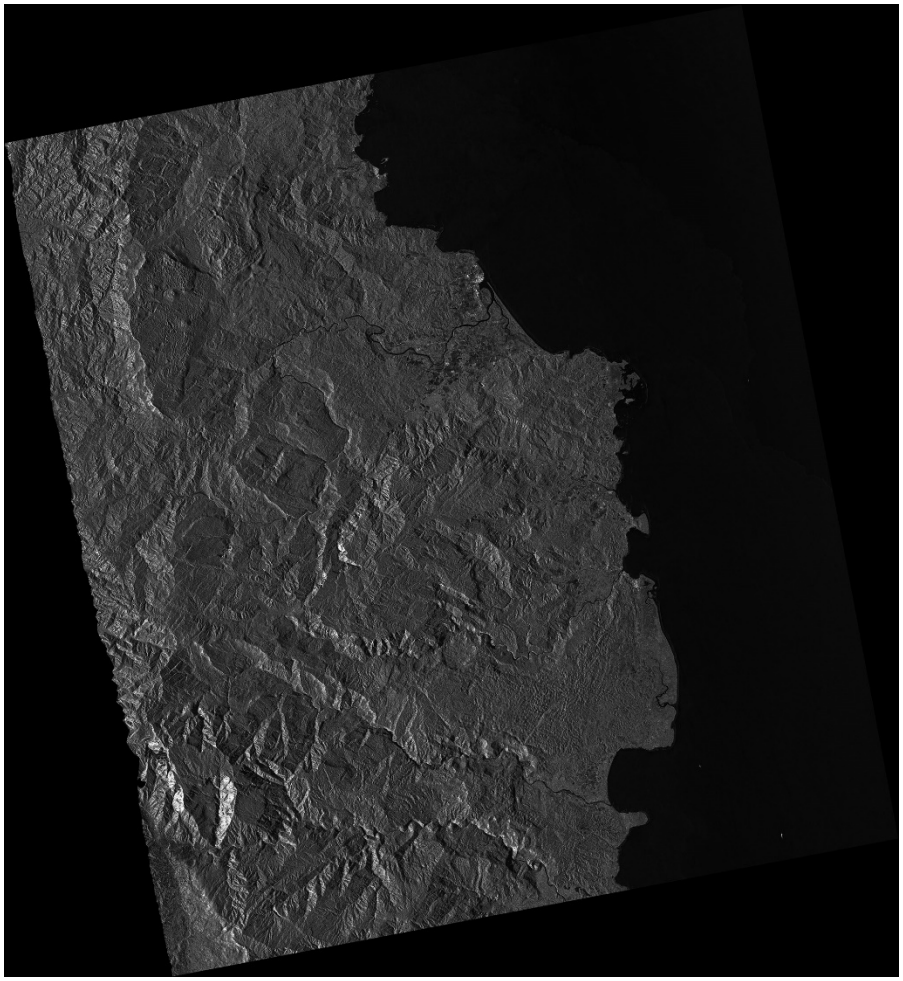
Among Data Provider Nodes (DPNs), Indian Space Research Organization (ISRO), National Applied Research Laboratories (NARL) and Japan Aerospace Exploration Agency (JAXA) provided their observation data. Among Data Analysis Nodes (DANs), Asian Institute of Technology (AIT), Manila Observatory (MO) provided their VAPs.



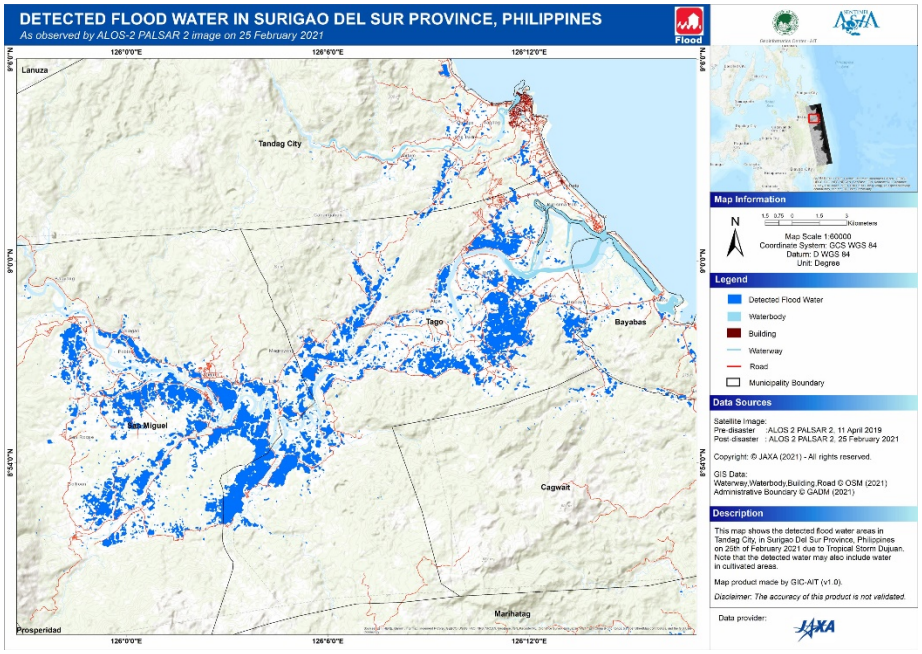
Satellite image (RESOURCESAT-2 AWiFS) provided by ISRO



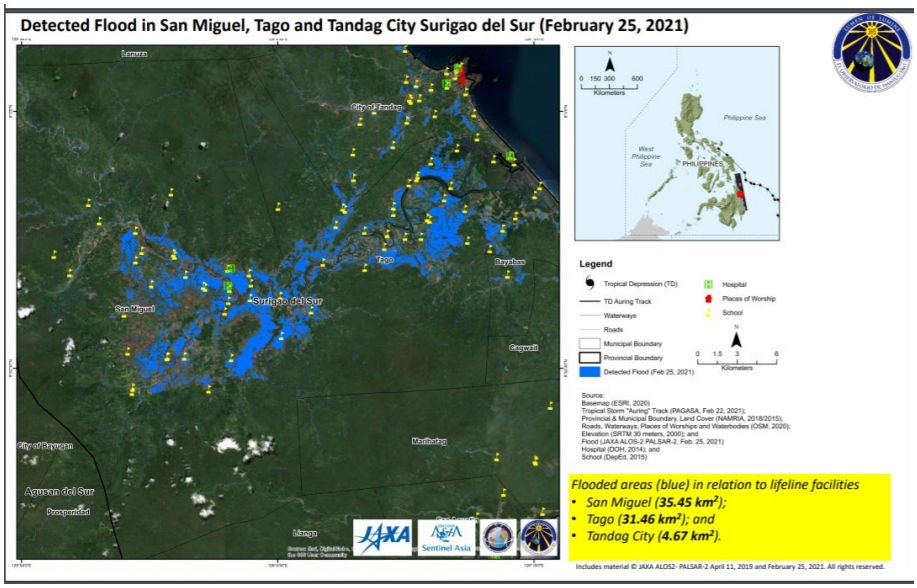
Satellite image (FORMOSAT-5) provided by NARL

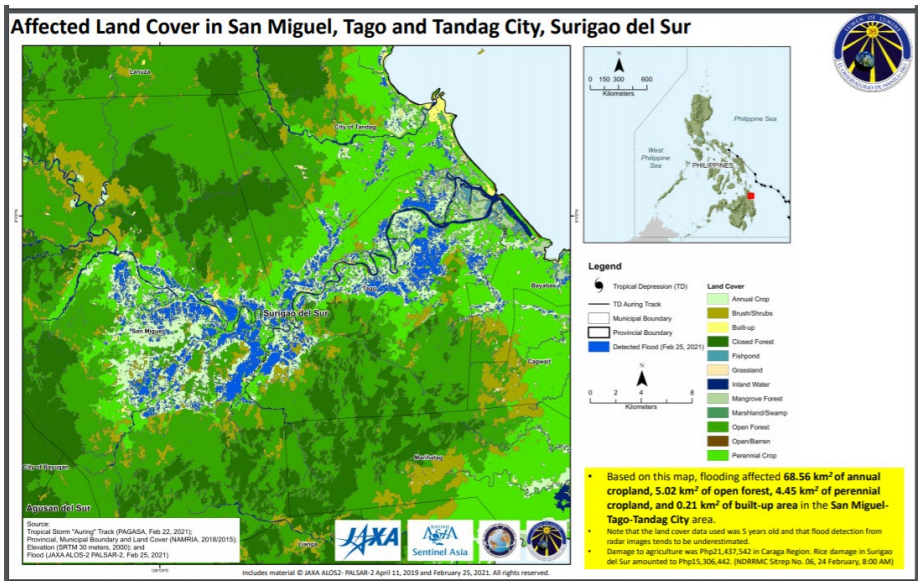


Satellite image (ALOS-2 PALSAR-2) provided by JAXA



Value Added Product by AIT





Value Added Product by MO
https://disasterscharter.org/documents/10180/9180185/vap-804-1-product.pdf

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2. Standard Operating Procedures (SOPs) for making EORs to Sentinel Asia established!

The Standard Operating Procedures (SOPs) for making Emergency Observation Request (EOR) to Sentinel Asia were established in Myanmar, Thailand, and Viet Nam in March 2021. The establishment of SOPs is the achievement made through online workshops aimed at better use of Sentinel Asia's EOR mechanism for each country's following stakeholders.

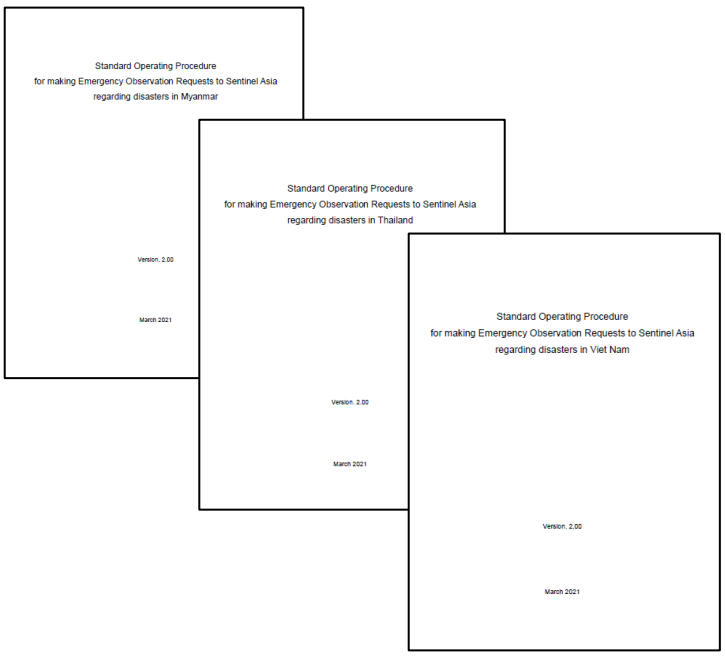
- For Myanmar (4 February): DDM, DMH, AHA Centre, AIT, ADRC, and JAXA
- Thailand (18 February): ADPC, GISTDA, DDPM, AIT, ADRC, and JAXA
- Viet Nam (1 February): MARD, MONRE, VAST/STI, AIT, ADRC, and JAXA

The common highlights of each SOP include, inter alia,
(i) the prior definition of organizations primarily responsible for making EORs in case of natural disasters
(ii) the prior definition of criteria under which the organizations (i) above will make EORs on "in principle" basis
(iii) support by international organizations including ADRC to make EORs on behalf of the organizations (i) above, in case EORs are not made promptly or in an opportune tine
(iv) the easy and real-time provision of local information on the disaster via web-based mobile application developed by AIT
(v) the institutionalized use of Global Satellite Mapping of Precipitation (GSMaP) for monitoring (reference information for making EORs)

In accordance with these SOPs, in case of natural disasters, stakeholders of each country will be able to make emergency observation requests to Sentinel Asia promptly, and utilize the information provided by Sentinel Asia for better response and recovery in an interactive manner. Likewise, the Sentinel Asia community will be able to provide better and effective support than before.

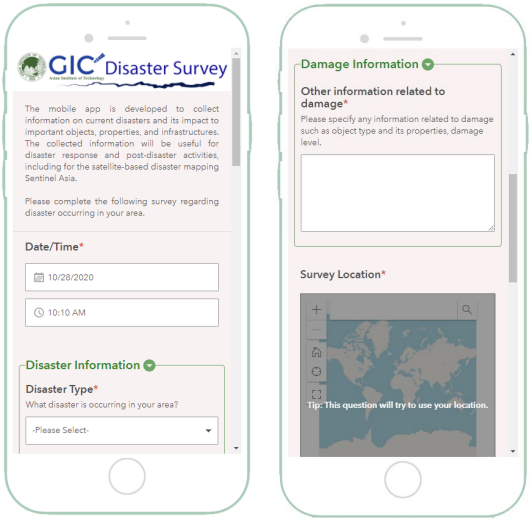
This is one of the good examples of Sentinel Asia which is mandated to address the entire disaster management cycle, and it is a significant contribution to the Sendai Framework Priority 4 (Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction) as well. This joint achievement has significantly enhanced the value of Sentinel Asia.

Standard Operating Procedures (SOPs)



Mobile application developed by AIT

- Web link: https://arcg.is/1HWGWX0
- QR Code:



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3.[Information]

Sentinel Asia has uploaded the list of "ALL" emergency observation responses (over 300!) on the Sentinel Asia web portal.

https://sentinel-asia.org/EO/EmergencyObservation.html

You can browse, all VAPs (estimated flood maps and others provided by DANs), and thumbnails of satellite images on the site.
It would be great if they could help you understand our work, operation and efforts.

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4. How to send Emergency Observation Request

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Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
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5. Using Sentinel Asia Operation System, OPTEMIS

The Sentinel Asia launched new operation system, OPTEMIS.　Please refer to the website how to create the account of OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** April 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. Interview
3. Sentinel Asia Annual Report 2019 Released
4. Information
5. How to Send an Emergency Observation Request
6. Using Sentinel Asia Operation System, OPTEMIS

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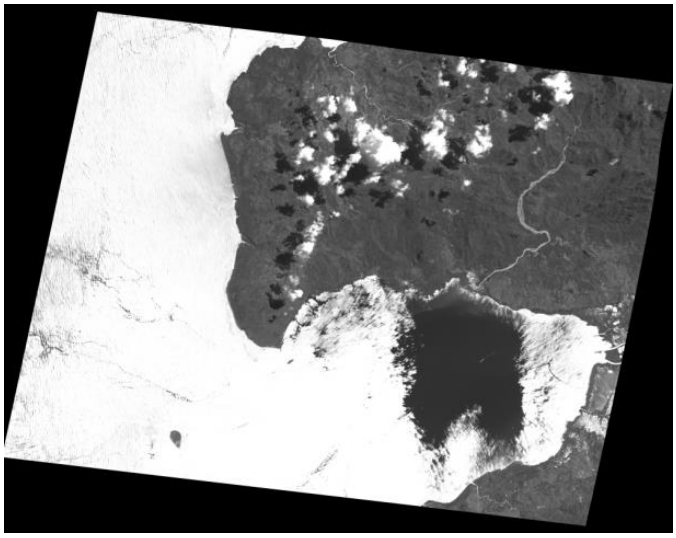
1. [News] Emergency Observation of Disasters (As of 27 April)

(1) Flood, Landslide in Indonesia

Tropical Cyclone Seroja hit southeast Indonesia on 4 April 2021, which induced floods and landslides. According to data from the National Agency for Disaster Countermeasure (BNPB) Operation Control Center, as of 5 April, a total of 2,019 families, or 8,424 people, took refuge and 1,083 families, or 2,683 people, were affected by the disaster.

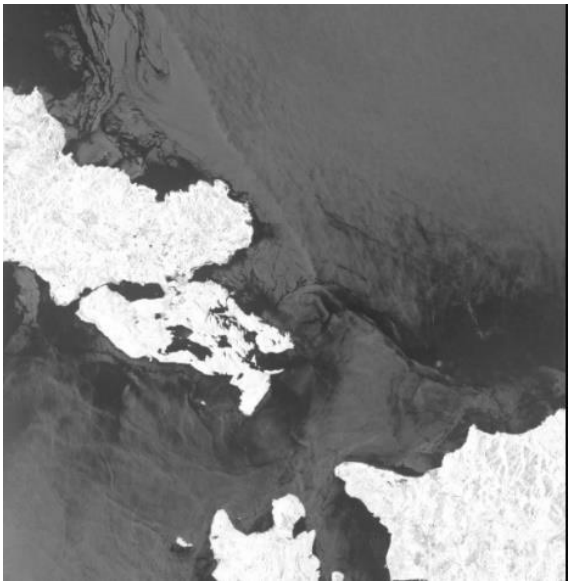
The Indonesian National Institute of Aeronautics and Space (LAPAN) made an Emergency Observation Request (EOR) to Sentinel Asia on 4 April. This EOR was escalated to the International Disaster Charter. LAPAN assumed the role of Project Manager (PM) for this Disasters Charter activation. Among Data Provider Nodes (DPNs), the Indian Space Research Organization (ISRO), the Geo-Informatics and Space Technology Development Agency (GISTDA), the National Applied Research Laboratories (NARL) and the Japan Aerospace Exploration Agency (JAXA) provided observation data. Among Data Analysis Nodes (DANs), the Earth Observatory of Singapore (EOS) provided its Value-Added Product (VAP). Information on the latest response by Sentinel Asia is available from the following link.

https://sentinel-asia.org/EO/2021/article20210404ID.html

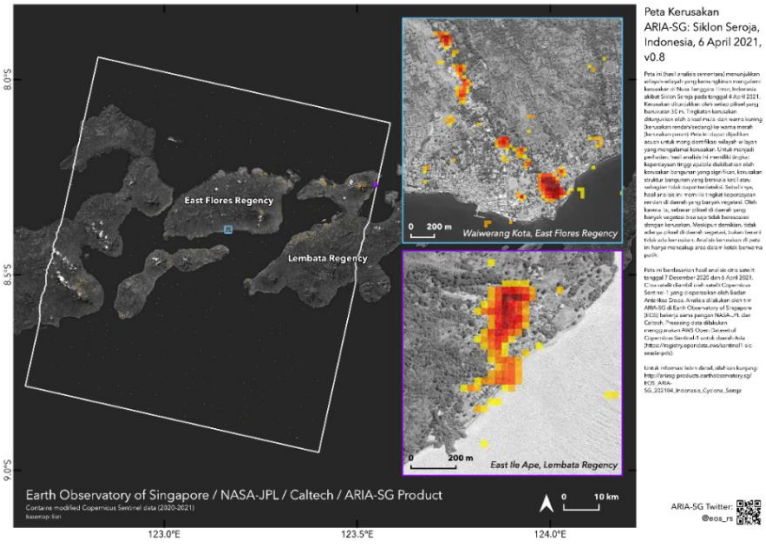


Satellite image (THEOS1) provided by GISTDA.

Satellite image (FORMOSAT-5) provided by NARL



Satellite image (ALOS-2) provided by JAXA



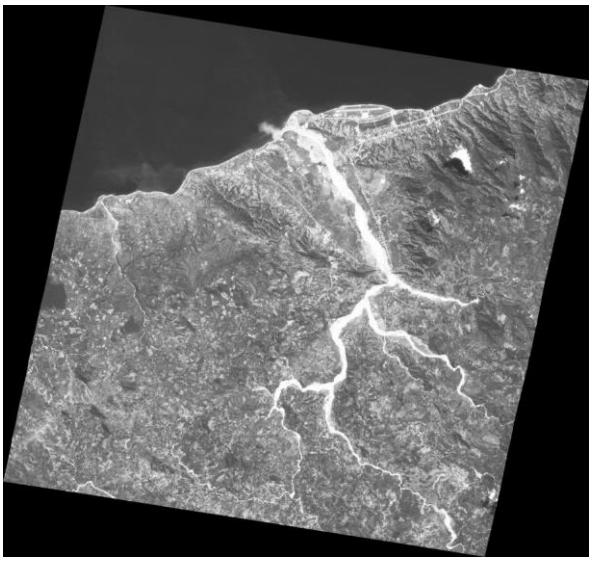
Value Added Product by EOS

(2) Flood, Landslide in Timor-Leste

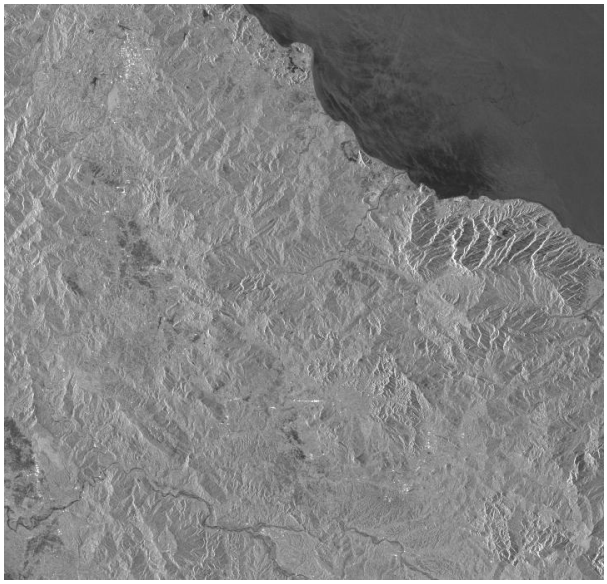
Tropical Cyclone Seroja hit Timor-Leste on 4 April 2021, which induced floods and landslides. According to data from the National Agency for Disaster, the latest official figures (as of 7 April) from the Secretariat of State for Civil Protection, a total of 2,375 households--or 9,779 people--were in the 18 official evacuation facilities in Dili. There were many more displaced in informal evacuation sites across the city. A total of 42 fatalities (including 13 people who were still missing and presumed dead) have been recorded.

The Japan International Cooperation Agency (JICA) made an EOR to Sentinel Asia on 4 April. This EOR was escalated to the International Disasters Charter. Among DPNs, ISRO, NARL and JAXA provided observation data. In addition, the Mohammed Bin Rashid Space Centre (MBRSC) and and the Centre for Remote Imaging, Sensing and Processing (CRISP) have planned to conduct emergency observations . Among DANs, the Asian Institute of Technology (AIT) and RIKEN provided their VAPs. Information on the latest response by Sentinel Asia is available from the following link.

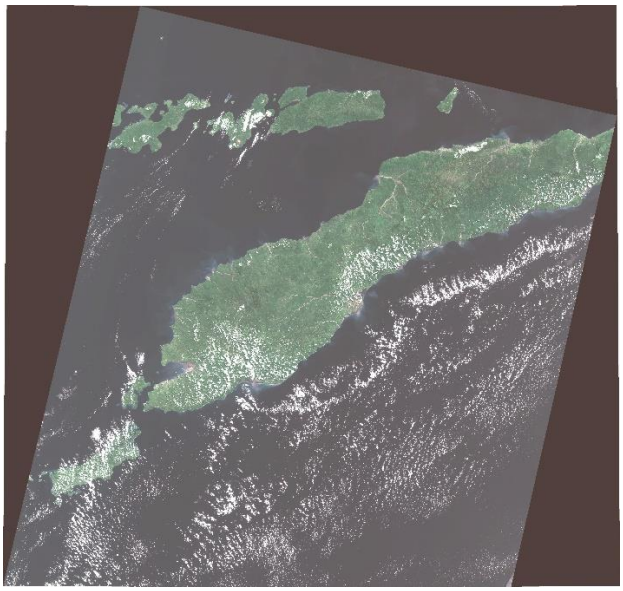
https://sentinel-asia.org/EO/2021/article20210404TL.html



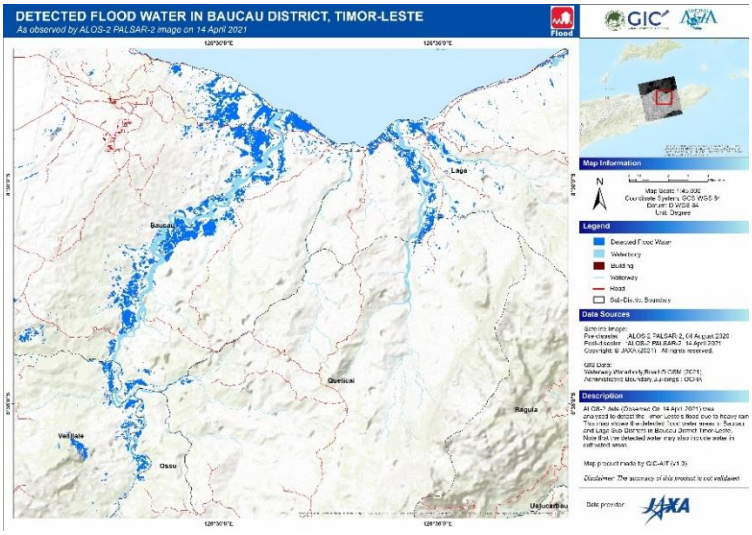
Satellite image (FORMOSAT-5) provided by NARL



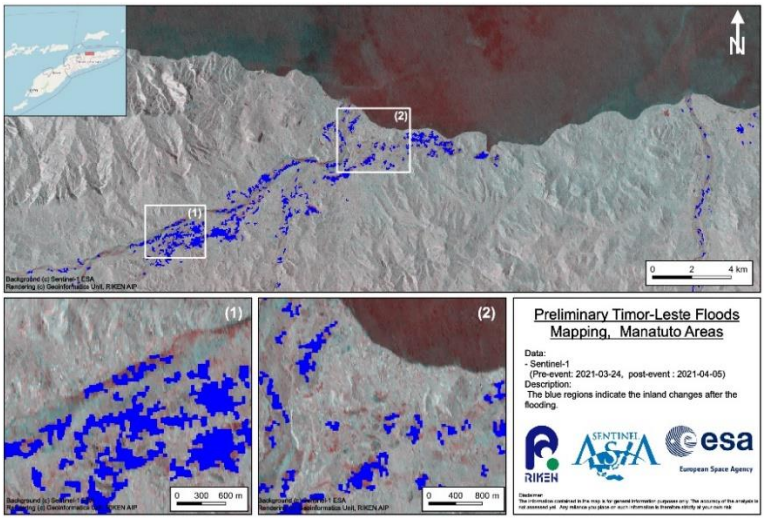
Satellite image (ALOS-2) provided by JAXA



Satellite image (Resourcesat-2A) provided by ISRO



Value Added Product by AIT



Value Added Product by RIKEN

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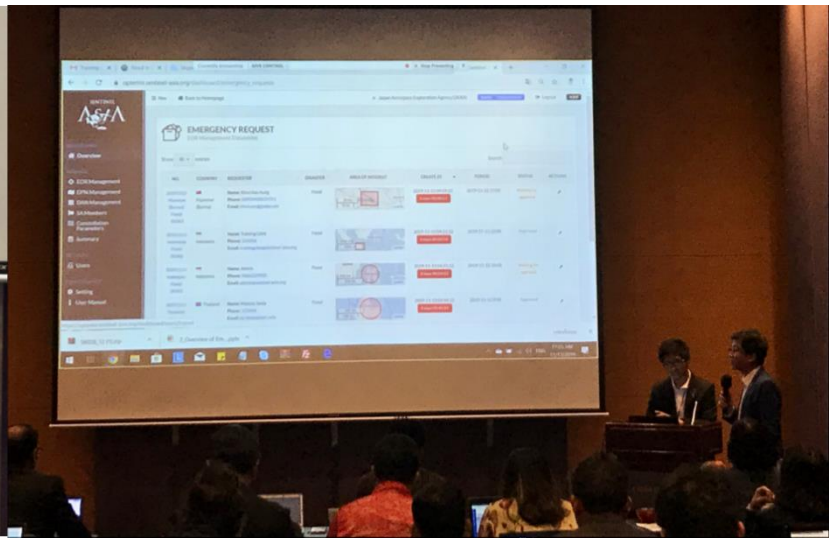
2. Interview

In 2019, Sentinel Asia introduced its new disaster data provision system called “Sentinel Asia Step-3 system”. Sentinel Asia Step-3 system is a joint project by GISTDA and NARLabs (NSPO) with Academia Sinica, and JAXA. Its integral component dedicated to Emergency Observation Requests is called the “Operation Planning Tool for Earth-Observation Mission,” or “OPTEMIS”. OPTEMIS was developed by GISTDA. The Sentinel Asia community witnessed the official launch of OPTEMIS during the Joint Project Team Meeting on 12 November 2019, hosted by ADPC in Bangkok, Thailand.

The Sentinel Asia Secretariat interviewed Mr. Wasanchai VONGSANTIVANICH and Mr. Panupat HORMA with the GISTDA OPTEMIS team regarding its development history and the way forward.

Inauguration Ceremony
chaired by Dr. Pakorn Apaphant
(GISTDA then- Board of Directors,
current Executive Director)



Training on the use of OPTEMIS
(by Mr. Wasanchai VONGSANTIVANICH
and Mr. Panupat HORMA)

Secretariat
Could you tell us about your motivation for developing OPTEMIS for the Sentinel Asia community?

GISTDA
About four or five years ago, I was working as satellite systems engineer and had a lot of chances to participate in many meetings and projects among different space agencies in the region. Through those experiences, I came to think that one government could not do everything alone since it is not sustainable in the long run. Satellite is an international platform by itself, even though many emerging space nations spend huge amount of budget for satellite program to mainly monitor their resource domestically, however the satellite orbits and overlooks everywhere around the world. With this fact, it would be great if we could find the optimal and efficient way for different countries to work together and encourage them to share their space resource to be able to use it at full potential. Thus, in GISTDA, I initiated a project to develop a mission planning system for multi-satellite operators whose objective is to create something that functions automatically to collect all factors and make use of satellites resource effectively. After we had finished the first phase of this project, Dr. Chaowalit SILPATHONG, who was our deputy director at that time and was also involved in Sentinel Asia, saw that there were links between our project and Sentinel Asia, so he invited me to the Sentinel Asia meeting. As you know, Sentinel Asia is a regional platform to coordinate and use Earth observation data for disasters in the Asia-Pacific region with the full chain end-to-end members from satellite operators, data analysis nodes up to the users. Coincidentally, what we want to do is to present a way in which people can use space technology more efficiently, so, from this perspective, Sentinel Asia was a great opportunity for us to bring our work to support regional collaborations and to bring the use of space to people which is our main goal. I believe this might also be a part to strengthen national space partnership in the Asia-Pacific. Since then, with the green light from Sentinel Asia steering committee, we have been continuously developing and improving OPTEMIS system to be one of the tools of Sentinel Asia to enhance the collaborations among the members. This is the story behind how and why I started to get involved in Sentinel Asia and OPTEMIS.

Secretariat
Have you encountered any challenges in this OPTEMIS project?

GISTDA
Of course, COVID-19 is one of the main challenges for everyone, however with the strong teamwork of Sentinel Asia technical steering committee, we can keep up our efforts and continue our work and improvements for Sentinel Asia at the same pace as before. More

importantly, since we are developing IT systems for different national users, we must concern and be careful about cyber security standards and practices. We could say that we have learned a lot and enjoy a lot on working on this project. Despite that GISTDA is now undergoing reorganization and the sponsorship for the project is being paused for a while, our research team is still voluntarily working and eager to continue to contribute to Sentinel Asia. We are fully committed to supporting and being a part to grow this meaningful Sentinel Asia collaboration.

Secretariat
How is it like for you to cooperate with Sentinel Asia members on the development of OPTEMIS?

GISTDA
Sentinel Asia technical team (JAXA, NSPO) is like our family, we enjoy a lot working with JAXA, Kawakita-san and his team always provides us kind support. Also, we have a remarkably close partnership with NARLabs/NSPO (Bo Chen, Jer Ling, Eric and Eddy) on the development of OPTEMIS and learned a lot from them. However, I would like to add that we feel close and eager to work with everyone in Sentinel Asia. Sentinel Asia community is fantastic and we feel like everyone is caring for each other, this might be because the aim of Sentinel Asia is to work together to support disaster relief. It is obvious from many past experiences that Sentinel Asia could be the first steppingstone and this great collaborative scheme could continue and extend to other domains as well.

Secretariat
Now every Sentinel Asia member uses your system.

GISTDA
We are immensely proud and keen to continue to contribute to Sentinel Asia, trying to bring space closer to people and to bring technology to help people. That is one of our motivations to improve OPTEMIS.

Secretariat
Do you have any future plans for OPTEMIS?

GISTDA
Data Provider Nodes (DPNs) and Data Analysis Nodes (DAN) are already using the system and we continuously develop and improve according to their comments and recommendations. For future modules, I think there are still rooms to improve, and we will be able to make it better. One thing we want to improve is to expand the benefit to people in affected areas and to enhance satellite data with more useful information. We

are now considering a project implementing more sensors, including drones, and crowd-sourcing data for disaster management. We have tried this in Thailand for wildfire applications, and if this is successful, we are willing to contribute and open it to every member. This is a matter of data fusion and AI, so it might be beyond Sentinel Asia, but this is very interesting point for us because satellite data on its own is sometimes not enough.

Secretariat
How would you like to enhance the collaboration with Sentinel Asia in the future?

GISTDA
We believe that the more effectively and timely Sentinel Asia provides information for assists disaster response in the affected area, the stronger the community it will be. For our part, we could potentially assist in terms of providing a useful multilateral platform to support everyone to work together closely and dynamically. In addition to the good collaboration, we should consider making this community sustainable, this could be done through getting involve participation from every member to make Sentinel Asia community strong in the long run.

Mr. Wasanchai VONGSANTIVANICH (right) and Mr. Panupat HORMA (left)
at the Sentinel Asia café exhibition corner during the JPTM 2019 hosted by ADPC

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3. Sentinel Asia Annual Report 2019 Released

Sentinel Asia Annual Report 2019 has been published on the Sentinel Asia website. (https://sentinel-asia.org/reports/Reports/SA_Annual_Report_2019.pdf). Activities by each of the organizations of Sentinel Asia are covered in the report. It is highly appreciated that the report could be published thanks to your support on behalf of the organizations' sessions of the Joint Project Team Meeting (JPTM), even although JPTM itself had to be canceled due to the difficulties caused by the COVID-19 pandemic.

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4. How to send Emergency Observation Request

JPT member organizations are entitled to send Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

The Sentinel Asia launched new operation system, OPTEMIS. Please refer to the website how to create the account of OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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FAX: +81-3-5777-1580

** May 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Additional Information on Floods, Landslides and Storm in Timor-Leste
2. [News] Emergency Observation of Disasters
3. Interview - Dr. Giriraj Amarnath, International Water Management Institute (IWMI)
4. How to Send an Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

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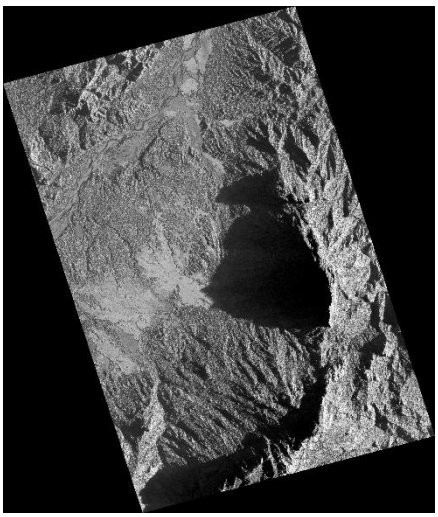
1. [News] Additional Information on Floods, Landslides and Storm in Timor-Leste
(Outline was given in the April 2021 Newsletter)

Tropical Cyclone Seroja hit Timor-Leste on 4 April 2021, which induced floods and landslides. According to the United Nations, latest official figures showed that a total of 33,835 households (as of 19 May) have been affected by the floods across the country and fatalities counts 44 (as of 21 May).

The Japan International Cooperation Agency (JICA) made an Emergency Observation Request (EOR) to Sentinel Asia on 4 April. This EOR was escalated to the International Disasters Charter. Among Data Provider Nodes (DPNs), the Centre for Remote Imaging, Sensing and Processing (CRISP), the Geo-Informatics and Space Technology Development Agency (GISTDA), the Indian Space Research Organisation (ISRO), the Japan Aerospace Exploration Agency (JAXA) and the National Applied Research Laboratories (NARL) provided observation data. Among Data Analysis Nodes (DANs), the Asian Institute of Technology (AIT) and RIKEN provided their Value Added Products (VAPs). Information on the latest response by Sentinel Asia is available from the following link:

https://sentinel-asia.org/EO/2021/article20210404TL.html



Satellite image (TELEOS-1) provided by CRISP

Satellite image (THEOS1) provided by GISTDA

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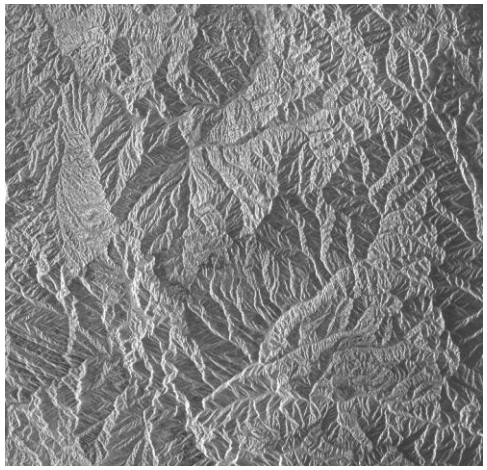
2. [News] Emergency Observation of Disasters (as of 28 May)

(1) Landslides and Mudflows in Tajikistan

Landslides and Mudflows occurred in Tajikistan on 11 May 2021. According to Radio Free Europe / Radio Liberty (RFE / RL), at least 9 people died. Houses and infrastructures such as roads and bridges were damaged in 15 districts. (https://rus.ozodi.org/a/31250786.html)

The Central Asian Institute of Applied Geosciences (CAIAG) made an EOR to Sentinel Asia on 14 May. Among DPNs, JAXA and NARL provided their observation data. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210511TJ.html



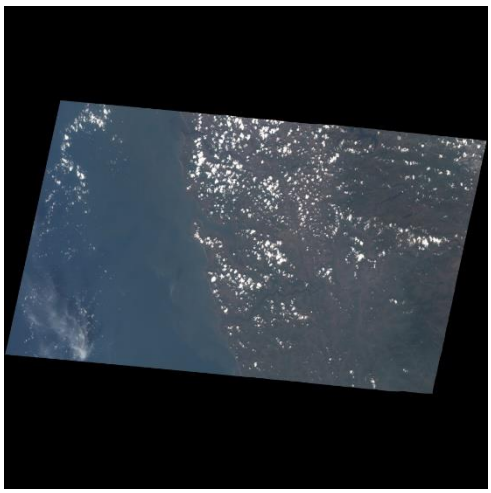
Satellite image (ALOS-2) provided by JAXA

Satellite image (FORMOSAT-5) provided by NARL

(2) Floods and Storm in India

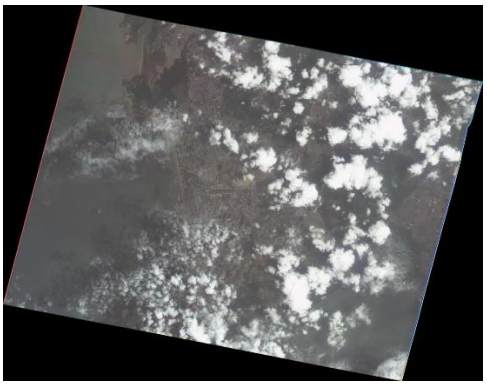
Cyclone Tauktae attacked several states on the western coast of India on 17 May 2021. New Delhi Television Limited (NDTV) said that at least 6 people were killed, and several people were injured in Maharashtra. Eight people died in cyclone-affected coastal Karnataka. Thousands of people were evacuated in Gujarat, Kerala, Daman and Diu.
(https://www.ndtv.com/india-news/cyclone-tauktae-live-updates-very-severe-cyclonic-storm-likely-to-intensify-further-warns-weather-office-2443064)

ISRO made an EOR to Sentinel Asia on 14 May. Among DPNs, GISTDA, JAXA and NARL provided observation data. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210517IN.html



Satellite image (THEOS1) provided by GISTDA

Satellite image (ALOS-2) provided by JAXA



Satellite image (FORMOSAT-5) provided by NARL

(3) Cyclone YAAS in India

Cyclone YAAS attacked West Bengal, Odisha, Bihar and Bengal of India on 27 and 28 May 2021. The Times of India and ABC News said that 2 people died, and more than 1.1 million people had evacuated.

The Time of India
https://timesofindia.indiatimes.com/city/kolkata/cyclone-yaas-live-tracking-odisha-west-bengal-brace-for-severe-cyclonic-storm/liveblog/82962051.cms

ABC News
https://www.abc.net.au/news/2021-05-26/india-cyclone-yaas-causes-mass-evacuation/100168472

ISRO made an EOR to Sentinel Asia on 26 May. Among DPNs, JAXA provided observation data. In addition, NARL has planned to conduct emergency observations. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210526IN.html

Satellite image (ALOS-2) provided by JAXA

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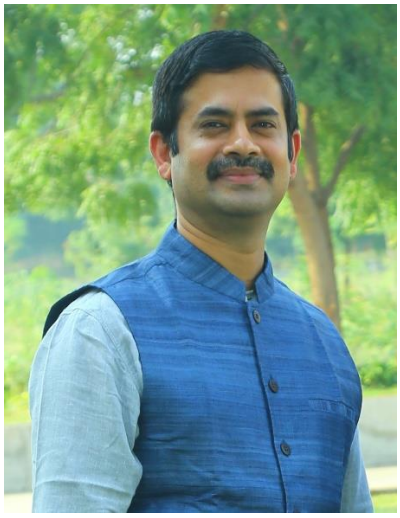
3. Interview

3. Interview - Dr. Giriraj Amarnath, International Water Management Institute (IWMI)

This interview is also posted on the Sentinel Asia Website: https://sentinel-asia.org/interview/interview.html

The International Water Management Institute, or IWMI, is a research-for-

development (R4D) organization, with offices in 13 countries and a global network of scientists operating in more than 30 countries, and is a member of the Consultative Group on International Agricultural Research (CGIAR), whose mandate is “a water-secure world,” and which addresses the water and land management challenges faced by poor communities in developing countries. IWMI promotes demand-based innovative and scientifically tested water management solutions for sustainable development and is a longtime member of Sentinel Asia. Dr. Giriraj Amarnath from IWMI has been one of the leading supporters of Sentinel Asia and won the World Geospatial Excellence Award in 2020. The Sentinel Asia Secretariat interviewed Dr. Amarnath about how he has worked with Sentinel Asia and his future plans in the Sentinel Asia community.



Dr. Giriraj Amarnath, Research Group Leader
Water Risks to Development and Resilience

- (Sentinel Asia Secretariat) Please introduce yourself to the readers of Sentinel Asia and tell us about your experiences with Sentinel Asia:

(Dr. Giriraj Amarnath)
Thank you for this great opportunity to share my memories about Sentinel Asia. I recall my first involvement was back in 2009 while I was working for the International Centre for Integrated Mountain Development (ICIMOD) in Nepal. At that time, I attended my first Sentinel Asia meeting and I developed a great interest in matters, including the establishment of emergency observation and data transmission via WINDS satellite* communications for rapid satellite data access. Then, I moved to IWMI in 2011 and strengthened the use of space technology in Disaster Risk Reduction with input and support from Sentinel Asia and development partners. Basically, I lead a research group on water risk and disaster recently, and look after programs managing floods and droughts in Asia and Africa.

* WINDS, or Wideband InterNetworking engineering test and Demonstration Satellite, is a satellite to demonstrate high-speed internet technology operated by JAXA from 2008 till 2019.

- How do you think Sentinel Asia can contribute to regional collaboration, particularly in terms of flood management?

When we look back some years ago, Sentinel Asia implemented Step 1 and then Step2. This is when the Flood Working Group was established. At that time, many colleagues led this initiative as their responsibility and brought best practices from member states in Asia and the Pacific. We have to thank the Asia-Pacific Regional Space Agencies Forum (APRSAF) for this excellent initiative to bring together diverse stakeholders. Through Sentinel Asia, we can present best practices on disaster risk management at Sentinel Asia's JPT (Joint Project Team) meeting, which can help countries prepare and respond to crisis management. Though the initiatives are voluntary, they promote innovative knowledge products and tools among member states in building resilience and managing climate shocks.

- Could you tell us about the current activities and responsibilities of IWMI?

IWMI is basically a water management institute that promotes a water-secure world. Crucial areas we work on in our strategic program are Water, Climate Change, and Resilience (WCCR), to promote improved climate change adaptation and mitigation with greater resilience to natural disasters. The projects we lead in Africa and Asia look at four pillars of Disaster Risk Management, that is: Prevention, Preparedness, Response, and Recovery, and guiding countries in strategic climate investments. This is where risk transfer comes into the picture. We have several projects looking at how we understand the risk, and what levels of disaster risk governance are critically important to help communities manage the climate crisis. We also look at areas of how development partners like the World Bank and the Asia Development Bank could promote evidence-based investment in disaster resilience. In a way, we look at consolidating research priorities across disaster risk management and aligning the implementation steps of the Sendai Framework. For example, the project in Sri Lanka looks at how climate adaptations are critically important in managing droughts and floods among smallholder farmers and building a resilient economy through the use of open access data and disruptive technologies.

- IWMI covers a broad area of water issues. Could you tell us more details and what is the main application of your activities?

As an example, in South Asia, we have laid a foundation for promoting and integrating a drought management program, and innovations in promoting drought monitoring and an early warning system using multi-mission satellite data aided by the cloud platform. We use subseasonal and short-term weather forecast data from Global Forecast System (GFS) data of the National Oceanic and Atmospheric Administration (NOAA) and the Indian Institute of Tropical Meteorology (IITM) to provide drought forecasts. Then, we use satellite data such as MODIS data from NASA's Terra and Aqua satellites and Sentinel satellite images from the European Copernicus Programme to monitor the drought and flood situation. We monitor water bodies using Sentinel-1 data and share the data through a bulletin. The bulletin is being used by an agriculture extension and agrarian development agencies to promote timely drought response strategy among farming communities. Importantly, we are working in Sri Lanka with the UN World Food Programme (WFP) to prepare a joint bulletin with all members and departments. The information is not limited to disaster management, it is being used across different sectors as well. Space technology is very beneficial in building a regional drought monitoring system that counties can share and utilize the data. IWMI's significant contribution in this field led to the recognition of the World Geospatial Excellence Award in 2020.

- Congratulations on winning the World Geospatial Excellence Award in 2020! Could you tell us the story? What was the situation when the system started and what was the key point to winning?

We really take pride in having done this work in South Asia since 2005. When we established it, we had a lot of challenges on access to satellite data, information processing, limited computation capabilities and institutional coordination. In 2014, in collaboration with World Meteorological Organization (WMO) and the Global Water Partnership (GWP) through the Integrated Drought Management Programme (IDMP), Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) and the CGIAR Research Program on Water, Land and Ecosystems (WLE) highlighted the importance of a regional drought mechanism in South Asia.　IWMI initiated regional efforts with government partners in South Asia to promote access to drought knowledge products for timely early warnings for early action. Today, the platform is being used by member states in South Asia as well as by various institutes, not just for knowing about the drought situation but also about how we promote drought resilient among

agricultural systems against climate change. The key point is that the monitoring system has been continuing as of today, and we have been ensuring that countries get the right information to make timely decisions at the field level, some information is used practically even at the farmer level. With the success in South Asia, we are expanding the activities in Africa through the Water Secure Africa Initiative (WASA) and Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). We are getting quite good recognition from African stakeholders to promote broader drought resilience initiatives among drought-affected communities. We are also implementing a similar framework in the Middle East and North Africa. Lastly, our recent activities include developing a drought risk profile among the southern African region with assistance from the World Bank to promote wider drought investment for better preparedness among various sectors.

Dr. Amarnath and his team © IWMI

- Drought contains three meanings, Meteorological, Hydrological, and Agricultural. Do you cover all of them?

Yes, drought is a very complex phenomenon. It is difficult to quantify the impact from one type of drought, for example, understanding the rainfall and soil moisture deficit and the crop condition can help policymakers determine the extent of severity for drought relief and provide a guide for timely drought response plans. We developed the first Google Cloud-based early warning system for Afghanistan with assistance from the World Bank to promote a near real-time drought early warning tool (AF-DEWS) for more than 35 drought indices across meteorological, hydrological, and agricultural droughts. We would like to share such knowledge products in our Sentinel Asia platform so that member countries can develop a low-cost early warning system without the need for larger investment in hardware and physical-based computers in the future.

- How about your recent activities in IWMI under COVID-19? How do you sustain your key businesses to keep each project and component active?

In my opinion, COVID is not a never-ending problem, but it is a very challenging issue today in addition to the climate crisis. Last year, during the time of COVID, we had a major cyclone called “Burvei” that caused a few casualties and severe damage. Therefore, we requested support from Sentinel Asia and the International Disasters Charter via Sentinel Asia to prepare a response map. We all worked online due to travel restrictions and used social platforms like WhatsApp and Twitter to share what was happening. We used weather forecast data on likely landfalls to ensure the space community can provide satellite images of the target areas for damage analysis. These days, we have increasingly seen how digital platforms are quite innovative and helpful. A crisis can always be managed if we work collectively as a team and use digital tools successfully.

- As you mentioned, dialogues with member countries of Sentinel Asia are one of the key points, but communication is sometime not easy. Do you have any cases in which member countries request from you more information than the data you provided?

We are looking at working with partners in disaster management, meteorology, agriculture, and water resources in all those countries. We did need an assessment to identify gaps and constraints regarding the Sentinel Asia Step 3 implementation on the four priorities of the Sendai Framework for Disaster Risk Reduction. One of the initiatives we looked at was using satellite data information with field validations to bring more ownership on how we they interpret our knowledge products and how we make use of the data in drought management and measures. We are doing a lot of trials, I would not say they are completely successful, but we are co-designing with stakeholders including farmers.

- From the lessons you have learned, do you have any suggestions for Sentinel Asia to get good feedback from members?

I am very confident that the IWMI initiatives can fit very well with the four priorities of the Sendai Framework that also link to the Step 3 implementation of Sentinel Asia. For example, when it comes to monitoring and early warning about priority one—understanding the disaster risk—if you generate useful disaster information, the policymakers and donors can invest in disaster risk reduction strategies. I think the practical achievements we have done so far at IWMI on various activities can contribute directly to the users of Sentinel Asia. It is important to promote best

practices among member states on new innovations, tools and knowledge products so they find opportunities to build resilient societies. We need to highlight the impact of climate change on local communities, urban systems, and improving water resources to accelerate action and support adaptation solutions. I think Sentinel Asia members can adopt our knowledge and solutions to mitigate current and future climate risks. In summary, I would say we need to communicate more and to build more awareness among members in achieving the Sendai Framework as well as SDGs by 2030. With the Sentinel Asia Secretariat, we should work more with countries to share our findings more than we have done to date.

- Another key word is donors to keep Sentinel Asia activities sustainable as you mentioned. What kind of activities should the Sentinel Asia community do more to increase appeal?

I think one of the reasons Sentinel Asia has been successful over years is partnership and cooperation among member states. It is all about the members actively participating in Sentinel Asia initiatives. One of my suggestions is to work with new partners including universities, NGOs, and some private sectors in achieving Step 3 implementation. In times of COVID, people are moving online more, so it would be good to organize more webinars. We need to ensure disaster management professionals are aware of the usefulness of Sentinel Asia, which is not only the responsibility of the Secretariat but also of the members. Reporting best practices on the use of space technology in flood and risk management is critically important for the success of Sentinel Asia. Guiding countries to promote regional information platforms might be the next step and reaching out to donors to support such initiatives in achieving the global commitments. I do not think any other initiative on disaster risk management exists in the Asia-Pacific region other than Sentinel Asia. Capacity development is also very important to ensure the future human resources that will advance in using new technologies. In fact, jointly with volunteer Sentinel Asia experts including the Indian Space Research Organisation (ISRO) and the Sentinel Asia Secretariat. we are planning to organize webinars dedicated to Sentinel Asia colleagues. Particularly, from our part, we will be organizing specific training webinars on flood and drought monitoring and its application.

- Do you have any comments on a longer-term perspective?

We need to keep reaching out to Sentinel Asia member states to highlight the role of space technologies in disaster risk management. Individuals always think satellite

data are only for emergency mapping. However, for example, we can use the same data to transfer risks from farmers or local communities to insurance companies in building resilience and sustainable development. Sentinel Asia is a good place to present best practice including our innovation on Index Based Flood Insurance, which is being recognized by the Group of Earth Observation (GEO), as we won the 2020 GEO Sustainable Development Goals (SDG) Award.

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4. How to send Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** June 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. Sentinel Asia Webinar on Space Technology for Drought Risk Management to be co-organized by ISRO and IWMI
3. How to Send an Emergency Observation Request
4. Using Sentinel Asia Operation System, OPTEMIS

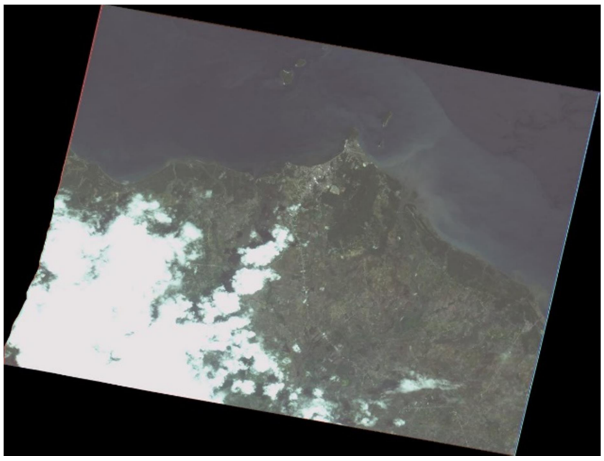
- * - *-

1. [News] Emergency Observation of Disasters (As of 30 June)

(1) Typhoon Choi-wan (Dante) in Philippines

Typhoon Choi-wan (Dante) struck the southern and central Philippines on 2 June 2021. According to the Voice of America (VOA), at least three people died and more than 2,600 people were displaced, mostly due to floods, in 18 southern villages, including about 600 villagers who moved to evacuation centers. (https://www.voanews.com/east-asia-pacific/storm-kills-3-displaces-thousands-philippines)

The Manila Observatory (MO) made an Emergency Observation Request (EOR) to Sentinel Asia on 2 June. Among Data Provider Nodes (DPNs), the National Applied Research Laboratories (NARL) provided their observation data. Information on the latest response by Sentinel Asia is available from the following link: https://sentinel-asia.org/EO/2021/article20210602PH.html



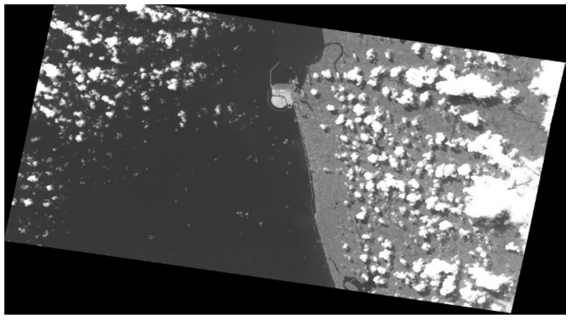
Satellite image (FORMOSAT-5) provided by NARL

(2) Oil spill emergency in Sri Lanka

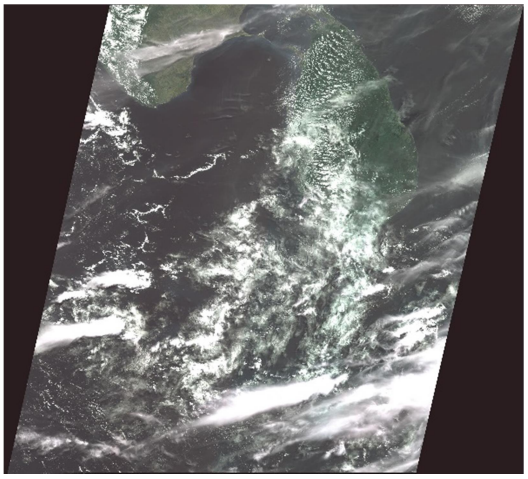
An oil spill emergency occurred in Sri Lanka on 25 May. BBC News reported that Sri Lankan authorities were preparing for an oil spill from a sunken container ship after efforts to tow the vessel into deeper waters failed. The ship had been on fire for two weeks near the port of Colombo. Part of the hull has settled on the seabed. Experts fear hundreds of tons of oil in the ship's tanks could devastate nearby marine life and beaches.

The ship had been carrying 25 metric tons of nitric acid, along with other chemicals and cosmetics, when it caught fire on 20 May. Many of the ship's 1,486 containers tumbled into the sea before the huge blaze was put out. Pollution from the ship - including millions of plastic pellets which are the raw material for shopping bags - had already coated stretches of Sri Lanka's western coastline.
(https://www.bbc.com/news/world-asia-57343139)

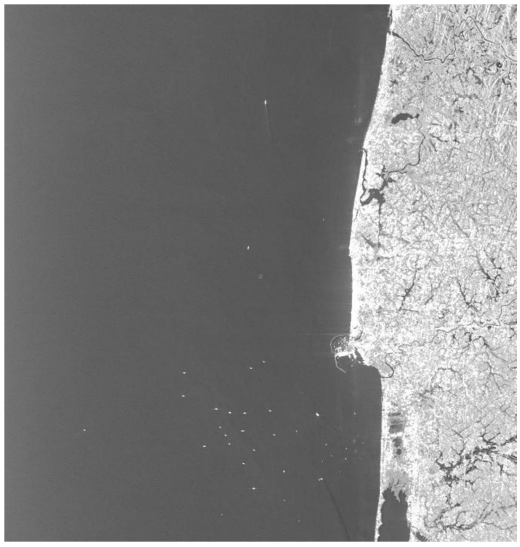
The Disaster Management Centre (DMC) of Sri Lanka made an EOR to Sentinel Asia on 4 June. This EOR was escalated to the International Disasters Charter on the request of DMC, which assumed the role of Project Manager (PM) for this Charter activation. Among DPNs, the Geo-Informatics and Space Technology Development Agency (GISTDA), the Indian Space Research Organisation (ISRO), the Japan Aerospace Exploration Agency (JAXA), and NARL provided observation data. Among Data Analysis Nodes (DANs), the Asian Institute of Technology (AIT) provided their Value Added Products (VAPs). Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210525LK.html



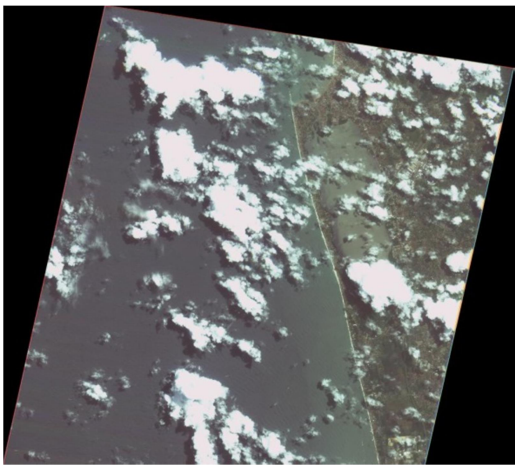
Satellite image (THEOS1) provided by GISTDA



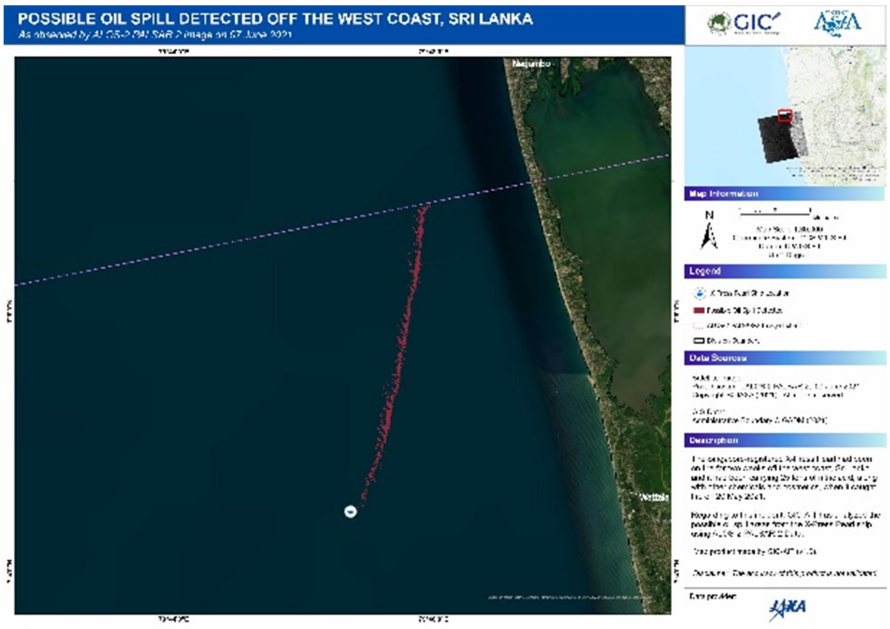
Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA



Satellite image (FORMOSAT-5) provided by NARL

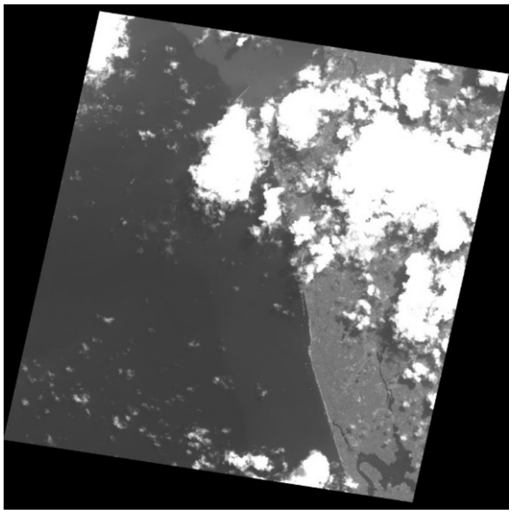


Value Added Product by AIT

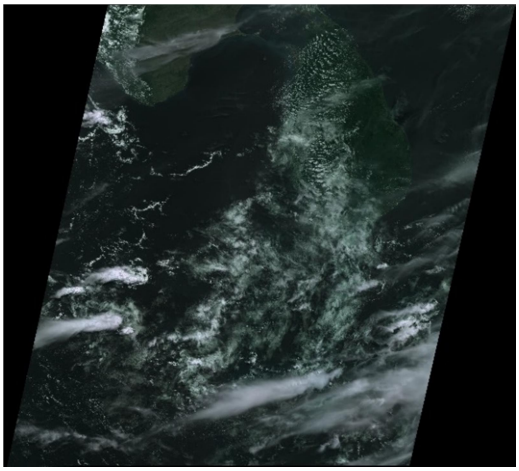
(3) Flood in Sri Lanka

A flood occurred in Sri Lanka on 3 June. ABC News said that at least six people had died and five were still missing. Figures released by the government showed that more than 5,000 people had moved to temporary shelters and more than 600 houses had been damaged.
(https://abcnews.go.com/International/wireStory/floods-mudslides-kill-sri-lanka-5000-displaced-78099927)

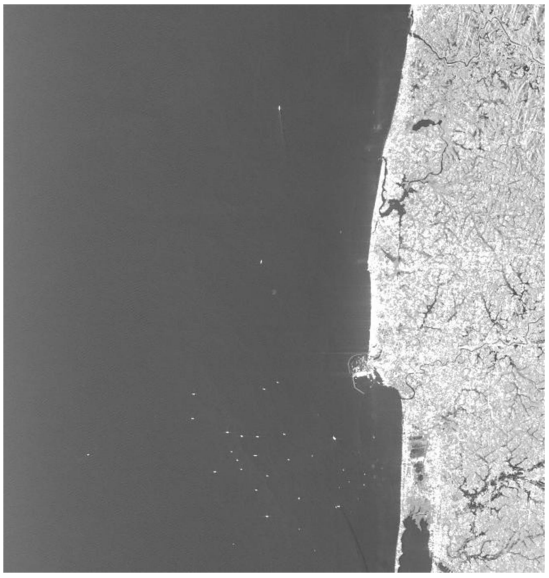
The DMC of Sri Lanka made an EOR to Sentinel Asia on 5 June. This EOR was escalated to the International Disasters Charter and International Water Management Institute (IWMI) assumed the role of PM for this Charter activation. Among DPNs, GISTDA, ISRO, and JAXA provided observation data. Among DANs, AIT provided their VAPs. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210603LK.html



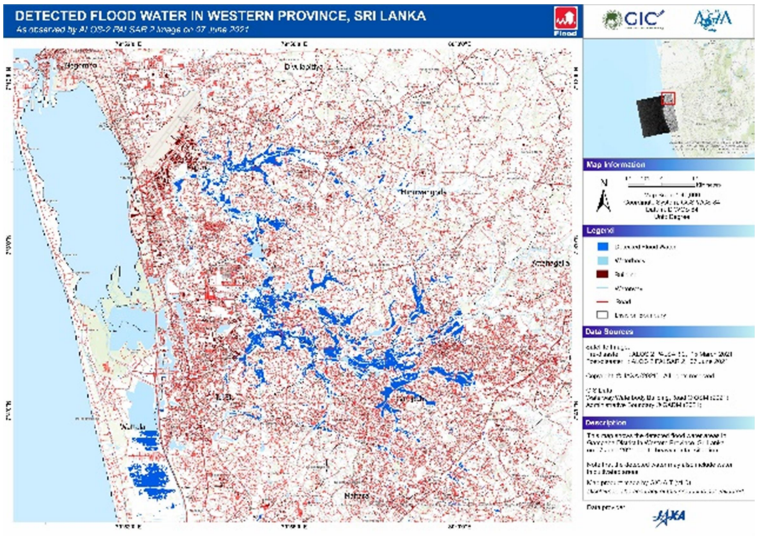
Satellite image (THEOS1) provided by GISTDA



Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA

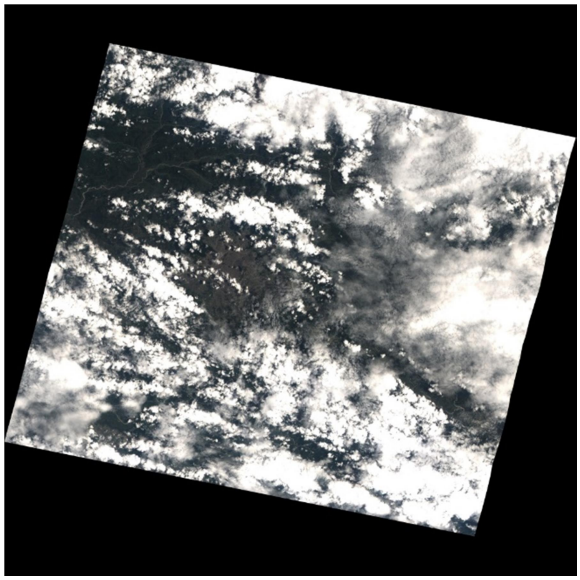


Value Added Product by AIT

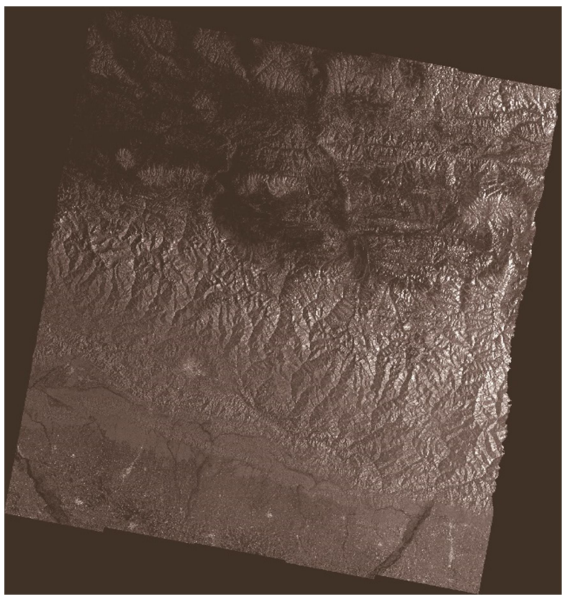
(4) Flood, Landslide in Nepal

A flood and a landslide occurred in Nepal on 15 June and caused tremendous damage in the Helambu area. Nepal Republic Media Pvt Ltd. reported that more than 50 people were missing in massive flooding of the Melamchi River, 39 of whom were workers at the Melamchi Drinking Water Project. (https://myrepublica.nagariknetwork.com/news/more-than-50-people-missing-in-melamchi-flood/?categoryId=81)

The Department of Hydrology and Meteorology of Nepal made an EOR to Sentinel Asia on 16 June. Among DPNs, ISRO, GISTDA, and JAXA provided observation data. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210615NP.html



Satellite image (THEOS1) provided by GISTDA



Satellite image (ALOS-2) provided by JAXA

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2. Sentinel Asia Webinar on Space Technology for Drought Risk Management to be co-organized by ISRO and IWMI

Recalling that several countries in the Asia-Pacific region severely suffer from droughts and that space-based remote sensing technologies could provide a solution, experts from ISRO and IWMI are co-organizing a dedicated webinar for the benefit of JPT members titled “Space Technology for Drought Risk Management”. The webinar is planned to take place on 19 and 20 July (TBC) from 10:00 (Hyderabad time) and will address, inter alia, theories of drought risk management and the introduction and demonstration of the use of drought management platforms and will include an interactive open discussion on regional cooperation mechanism for drought management and the way forward. This webinar is exclusive to JPT members and those who are interested in participating in the webinar are requested to register by 10 July. The dedicated registration link as well as a brochure giving details were sent to all JPT members by the Sentinel Asia Secretariat on 29 June. Many registrations from JPT members would be appreciated.

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3. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:

Asian Disaster Reduction Center (ADRC)

HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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4. Using Sentinel Asia Operation System, OPTEMIS
Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS.
https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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TEL: +81-3-6435-6785
FAX: +81-3-5777-1580

** July 2021 News from Sentinel Asia Project Office **

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Topics:

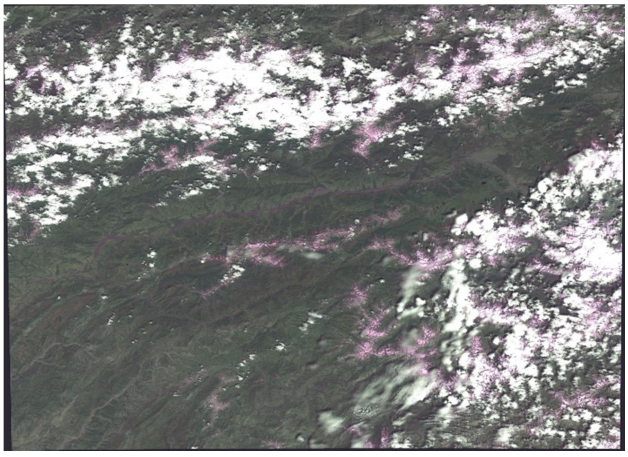
1. [News] Emergency Observation of Disasters
2. [Interview] Mr. Hans Guttman, Executive Director of the Asian Disaster Preparedness Center (ADPC)
3. [Event] Sentinel Asia Webinar on Drought Risk Management hosted by ISRO and IWMI
4. How to Send an Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

- * -

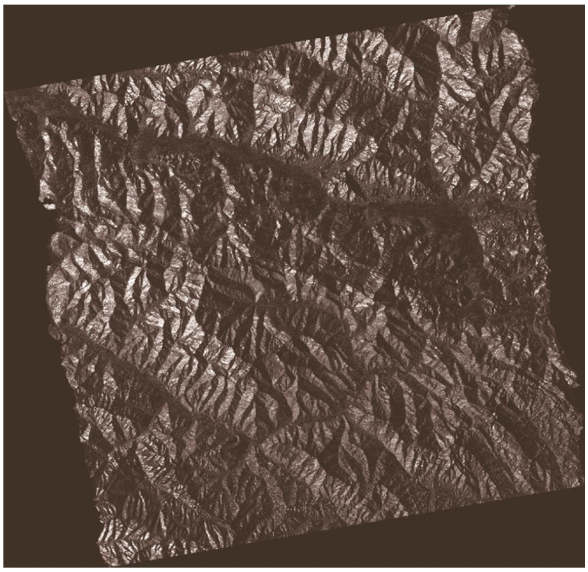
1. [News] Emergency Observation of Disasters (as of 29 July)

(1) Earthquake in Tajikistan (GLIDE Number: EQ-2021-000081-TJK)
A magnitude 5.9 earthquake struck 27 km east of the Rasht district in Tajikistan on 10 July 2021. Al Jazeera reported that at least five people have died, according to authorities in the mountainous country. (https://www.aljazeera.com/news/2021/7/10/at-least-five-killed-in-tajikistan-quake)

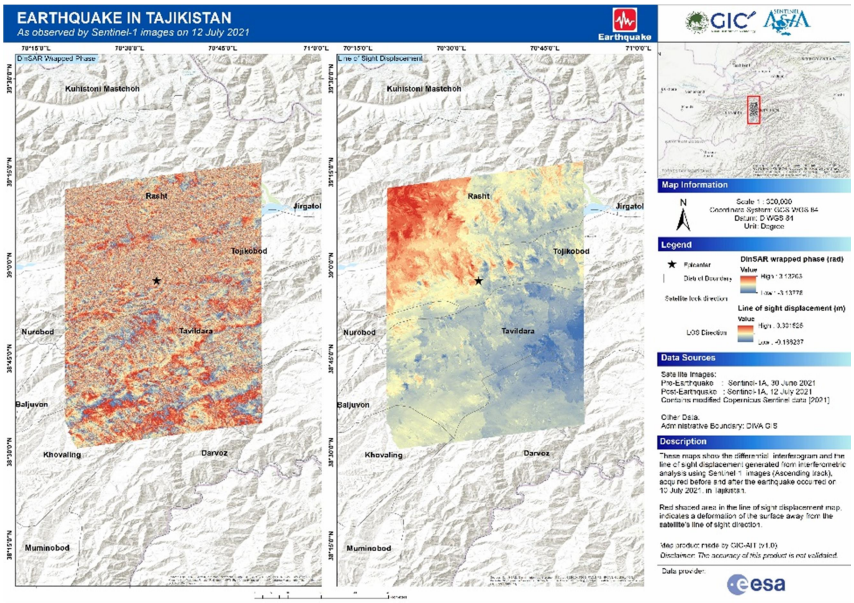
The Central Asian Institute of Applied Geosciences (CAIAG) made an Emergency Observation Request (EOR) to Sentinel Asia on 14 July. Among Data Provider Nodes (DPNs), the Indian Space Research Organization (ISRO) and Japan Aerospace Exploration Agency (JAXA) provided their observation data. Among Data Analysis Nodes (DANs), the Asian Institute of Technology (AIT) provided their Value Added Products (VAPs). Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210707TJ.html



Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA



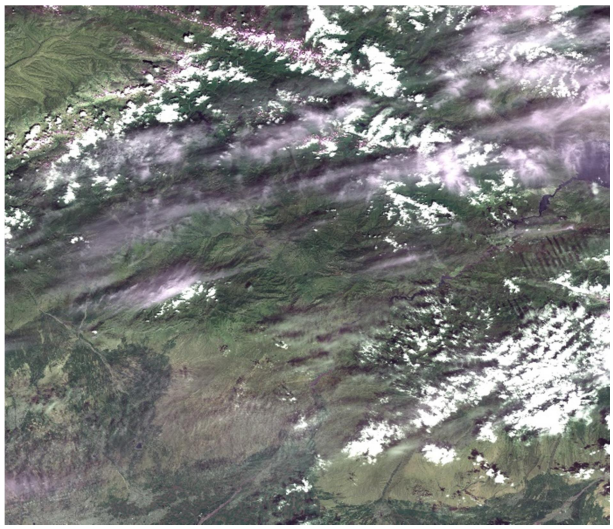
Value Added Product by AIT

(2) Flood in Kyrgyzstan (GLIDE Number: MS-2021-000082-KGZ)

A flood occurred in Kyrgyzstan on 12 July 2021. According to the FloodList, floods and mudslides caused by heavy rains swept away houses in two villages in the Aksy district in Jalal-Abad Region of western Kyrgyzstan, close to the border with Uzbekistan. At least seven people have died as a result. (https://floodlist.com/asia/kyrgyzstan-uzbekistan-floods-july-2021)

CAIAG made an EOR to Sentinel Asia on 14 July. Among DPNs, ISRO provided observation data. In addition, the Geo-Informatics and Space Technology Development Agency (GISTDA) planned to provide data. Information on the latest response by Sentinel Asia is available from the following link:

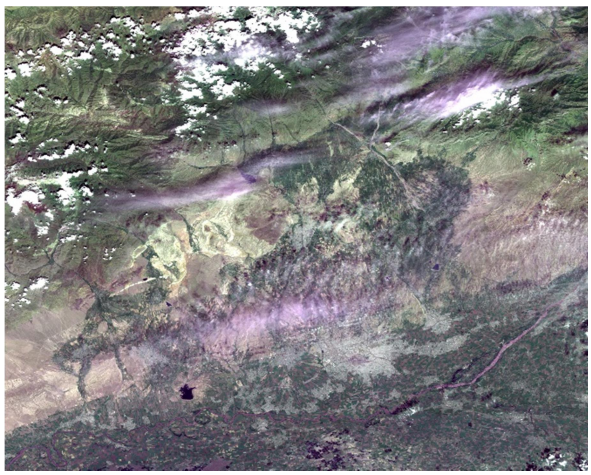
https://sentinel-asia.org/EO/2021/article20210712KG.html



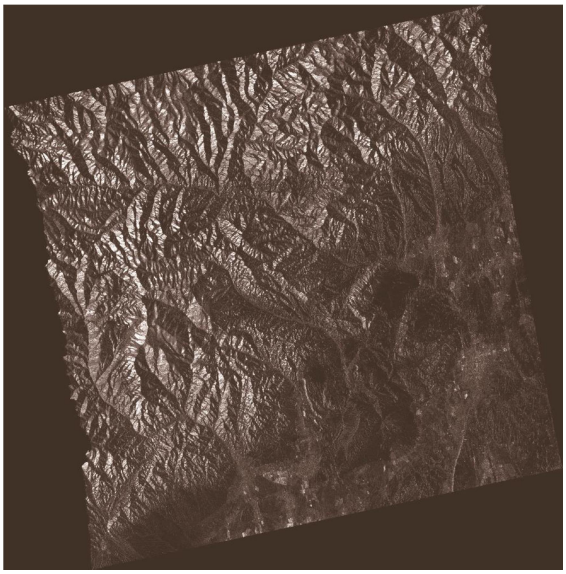
Satellite image (Resourcesat-2) provided by ISRO

(3) Flood in Uzbekistan (GLIDE Number: MS-2021-000082-UZB)
A flood occurred in Uzbekistan on 13 July. The Ministry of Emergency Situations of the Republic of Uzbekistan reported that the mudslide and floods flowed from neighboring Kyrgyzstan and into the Kosonsoy district of Namangan region of Uzbekistan, causing severe damage. As of 13 July, eight people had died and six were injured.
(https://floodlist.com/asia/kyrgyzstan-uzbekistan-floods-july-2021)

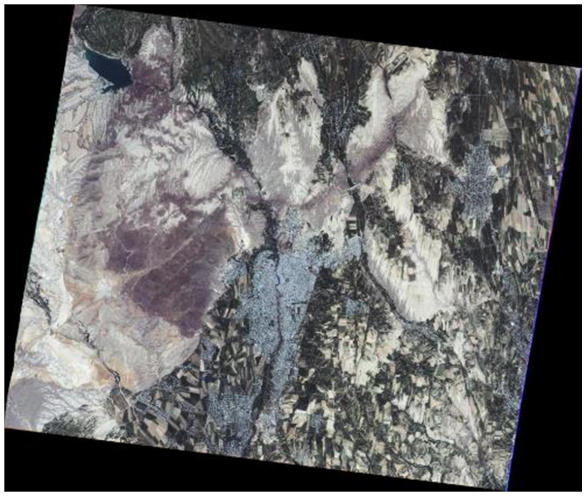
CAIAG made an EOR to Sentinel Asia on 14 July. Among DPNs, ISRO, JAXA, GISTDA, and National Applied Research Laboratories (NARL) provided observation data. Among Data Analysis Nodes (DANs), AIT provided their VAP. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210713UZ.html



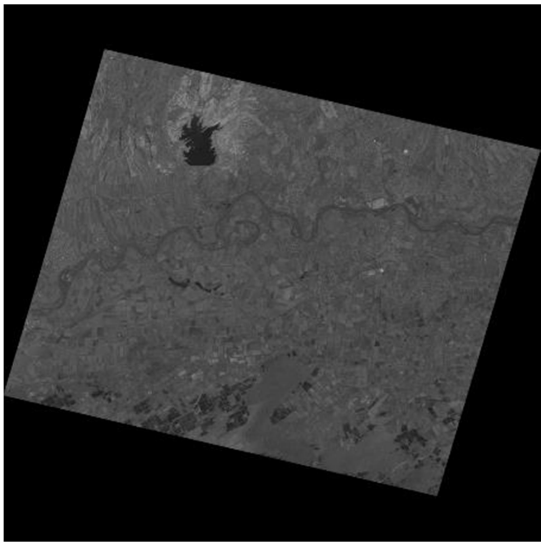
Satellite image (Resourcesat-2) provided by ISRO



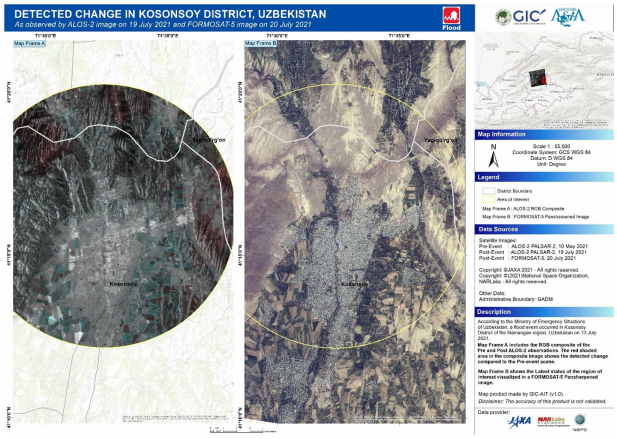
Satellite image (ALOS-2) provided by JAXA



Satellite image (FORMOSAT-5) provided by NARL



Satellite image (THEOS1) provided by GISTDA

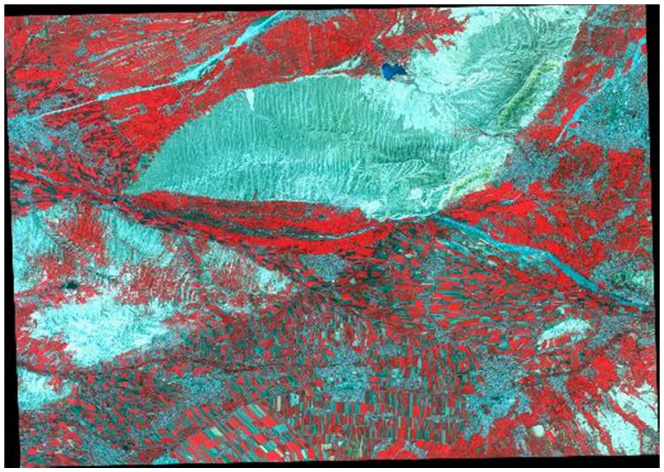


Value Added Product by AIT

(4) Flood and Mudflow in Kyrgyzstan (GLIDE Number: FF-2021-000087-KGZ)
A flood occurred in Suzak district Jalal-Abad region in Kyrgyzstan in 20 July and caused mudflow in Changyr-Tash and Dostuk villages.
(https://akipress.com/news:660784:6yo_girl_killed_by_mudflow_in_Jalal-Abad_region/)

CAIAG made an EOR to Sentinel Asia on 22 July. Among DPNs, ISRO and GISTDA provided observation data. In addition, the Mohammed Bin Rashid Space Centre (MBRSC) planned to provide data. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210720KG.html

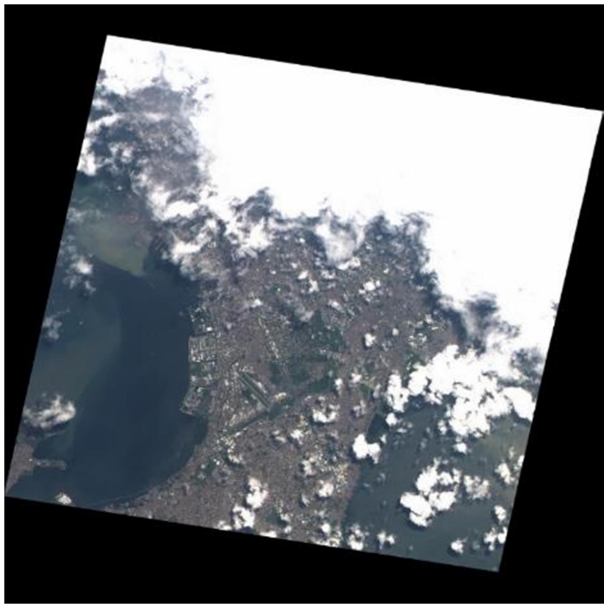
Satellite image (THEOS1) provided by GISTDA



Satellite image (Resourcesat-2) provided by ISRO

(5) Typhoon Fabian in Philippines (GLIDE Number: FL-2021-000091-PHL)
Typhoon Fabian (In-fa) hit the Philippines and caused heavy rain.
(https://mb.com.ph/2021/07/24/tropical-cyclone-fabian-tracker/)

The Manila Observatory (MO) made an EOR to Sentinel Asia on 25 July. Among DPNs, GISTDA provided observation data. In Addition, NARL planned to provide the data. Information on the latest response by Sentinel Asia is available from the following link: https://sentinel-asia.org/EO/2021/article20210725PH.html



Satellite image (THEOS1) provided by GISTDA

(6) Flood in Myanmar (GLIDE Number: FL-2021-000095-MMR)
A flood occurred in Myanmar on 26 July. The Radio Free Asia reported that heavy rains battered the southern states of Kayin and Mon and Tanintharyi region beginning on 25 July,

impacting as many as 3,000 people. More than 100 people in Kayin's Hlaingbwe had to be evacuated, according to a relief official from the area.
(https://www.rfa.org/english/news/myanmar/flooding-07262021205343.html)

The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) made an EOR to Sentinel Asia on 27 July. Among DPNs, NARL planned to provide the data. Information on the latest response by Sentinel Asia is available from the following link: https://sentinel-asia.org/EO/2021/article20210727MM.html

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2. [Interview] Mr. Hans Guttman, Executive Director of the Asian Disaster Preparedness Center (ADPC)

The Asian Disaster Preparedness Center (ADPC) is an autonomous international organization that works to build the resilience of people and institutions to disasters and the impacts of climate change in Asia and the Pacific. Established in 1986, it provides comprehensive technical services across social and physical sciences to countries in the region to support sustainable solutions for risk reduction and climate resilience.
Since joining in 2014, ADPC has also been an active member of Sentinel Asia. ADPC has supported the disaster management activities of the Sentinel Asia community, and notably co-organized and hosted the last Joint Project Team Meeting in 2019. The Sentinel Asia Secretariat interviewed Mr. Hans Guttman, the executive director of ADPC.

(Sentinel Asia Secretariat)
We would like to ask you to introduce ADPC's mission. We understand that ADPC defines its vision as "Safer communities and sustainable development through disaster risk reduction."

(Mr. Hans Guttman)
Speaking more specifically, the ADPC Mission is that "ADPC is the premier international organization for cooperation in and implementation of disaster risk reduction and building climate resilience in Asia and the Pacific." This underscores the role of ADPC through its international charter to support disaster risk reduction (DRR) and climate resilience (CR) actions throughout Asia and the Pacific. For the past three decades, ADPC has provided support to actors in Asia and the

Pacific to reduce the impact of and increase the ability to respond to disasters. ADPC is also committed to continuing to contribute to DRR and CR at the global level with other international partners. I think it is important to recognize from our side at least that international cooperation and partnerships form the basis for achieving our mission.

(Sentinel Asia Secretariat)
Could you tell us what motivation you had when you joined Sentinel Asia and what it has been like to work in the Sentinel Asia community since then?

(Mr. Hans Guttman)
ADPC joined Sentinel Asia in 2014. The timing of our joining Sentinel Asia was when ADPC significantly enhanced its satellite data processing capacity through our Geospatial Information Department. By combining that satellite data processing capacity with ADPC's knowledge on disaster risk management and the connections with mandated national disaster management agencies, ADPC was in a very good position to contribute to the Sentinel Asia community in a significant way. Since then, ADPC has been actively participating in meetings and contributing to the Sentinel Asia community. For example, as one of Sentinel Asia Data Analysis Nodes (DAN), ADPC provided technical support in analyzing remotely sensed data for the dam-break flooding in Lao PDR in 2018, as well as several more floods in Myanmar in 2019. The analyses were done in collaboration not only with Sentinel Asia partners, but also with NASA and others. More importantly, through ADPC's connection with the National Disaster Management Office of Lao PDR, we were able to confirm that the maps provided to them by Sentinel Asia were used for the relief efforts. Another contribution to the Sentinel Asia community was ADPC hosting the 7th Joint Project Team Meeting for Sentinel Asia (JPTM 2019) in Bangkok, together with JAXA – for which we received very positive feedback from Sentinel Asia members. ADPC looks forward to continuing to play a very active role in the Sentinel Asia community.

(Sentinel Asia Secretariat)
We are convinced ADPC's contribution to Sentinel Asia at JPTM 2019 was immense. In particular, the training workshop hosted by ADPC was quite effective. It was the first such endeavor in Sentinel Asia's history in which JPT members mutually trained JPT members with their own strengths and expertise. The successful outcomes, thanks to the training workshop, include an upgraded DAN membership (in the case of the Myanmar Information Management Unit, MIMU) and opportune Emergency Observation Requests (EORs) from several JPT members who had previously been unable to make requests. Could you recall the event yourself and share your thoughts about it with us?

(Mr. Hans Guttman)
As mentioned earlier, the Joint Project Team Meeting in 2019 in Bangkok was successful – and I would add that this was supported by JAXA to a large degree as co-organizer. It provided an opportunity for the members to discuss country-level progress on the use of satellite data for disaster response. We saw the best practices from member countries as well as other experts such as the Earth Observatory of Singapore. We also were made aware of a tool developed by Thailand's Geo-Informatics and Space Technology Development Agency (GISTDA) for Sentinel Asia.

I think it is important to note that despite the successes in many countries, the JPT meeting also revealed the need for several Sentinel Asia members to enhance their capacities in order to reap the full benefit of the satellite data that the Sentinel Asia community can provide. There remains a gap between data providers such as space agencies and the disaster practitioners in countries.

It is clear to ADPC that we have a role in addressing this gap, given that ADPC has a great understanding of both the data providers and the disaster management users. ADPC is committed in working with Sentinel Asia to close this gap for countries in Asia and the Pacific.

(Sentinel Asia Secretariat)
You have mentioned the need to enhance capacity despite the previous successes in the Sentinel Asia community and the need to continue our efforts to close the gap to enable Sentinel Asia colleagues to make full use of space-based technology. Our Sentinel Asia colleagues, the Indian Space Research Organization (ISRO) and the International Water Management Institute (IWMI) have volunteered to jointly organize a dedicated capacity-building webinar session on space-based drought monitoring for the benefit of SA, which will be happening in two weeks*. This is actually something inspired by the last training workshop in 2019 hosted by ADPC.
*Note: Thanks to ISRO and IWMI, this webinar was held successfully on 19 and 20 July, attended by many JPT members.

(Mr. Hans Guttman)
That is very good to hear and very encouraging. Hopefully, we can see additional initiatives of a similar nature as we are moving forward, and ADPC will be happy to contribute to such initiatives. Perhaps the gap in the provision of information and tools, as well as the actual appearance of it, is an area that ADPC sees as one that needs to be addressed in order to fully leverage the capacities that now exists in remote sensing data, specifically satellite information. This is nothing new. We work closely with you and UNESCAP and their center on disaster information and they have identified a similar thing across the board of information. As I mentioned, disaster management agencies sometimes are not aware of what can be done and how it can be done, or that they do not have the capacity. So I think it is great to hear that this partner learning is expanding within them. I also think that ADPC would be keen to assist in ensuring that this level of capacity is increased. Then, people at the country level or even at the local level will be more capable and be technical able to use the information. But there is also another route by which we are looking at providing tools to assist users, that is pre-processing that they still have to ultimately modify the information. It is useful to have specific purposes, but lowering the threshold of technical competence in order to be able to do so is also important. I think those two elements need to be merged in order to fully appreciate these applications.

(Sentinel Asia Secretariat)
In terms of ADPC's contribution, at the operational level, ADPC has been also supporting Emergency Observation Requests – whether as a DAN member or as a requestor on behalf of JPT members significantly. In the newly established "Standard Operating Procedure (SOP) for making Emergency Observation Requests (EORs) concerning disasters in Thailand," ADPC is officially designated as a member supporting disasters in Thailand. Could you elaborate on your activities in this respect?

(Mr. Hans Guttman)
I think we have to recognize that Thailand is uniquely positioned to demonstrate the success of using satellite data to support disaster management. Thailand has its own satellites operated by GISTDA and is highly capable of analyzing and providing data to support emergency response and relief. But more importantly, Thailand is also ready to take a lead in helping other countries to enhance their capacity through the Sentinel Asia community. ADPC is an autonomous international organization officially hosted by the Ministry of Foreign Affairs of Thailand. Thailand is also a founding member of ADPC, and ADPC is mandated to provide technical support to Thailand and other members. ADPC works closely with Thailand's Department of Disaster Prevention and

Mitigation (DDPM). But despite all the advancements made by DDPM, it needs to increase the use of technology such as satellite data to assist their disaster management planning and response. Through the SOPs for making EORs for Thailand, ADPC will work with JAXA and the Sentinel Asia Secretariat to make the connection between GISTDA and DDPM even stronger and will demonstrate the successes of the SOPs in future meetings of Sentinel Asia's JPT Meeting. In this context, we aim to replicate the success in other countries.

(Sentinel Asia Secretariat)
As we have just heard from you, you have provided great support to Sentinel Asia. Now, from your side, what do you expect in terms of Earth observation using space technologies for Disaster Risk Reduction, especially with respect to Sentinel Asia?

(Mr. Hans Guttman)
Satellite-derived information is becoming more available to users. For ADPC, it is important that the uses of such technology can support countries to strategically implement global frameworks such as the Agenda 2030 for Sustainable Development and the Sendai Framework for Disaster Risk Reduction. Satellite-based data will continue to generate evidence-based information that will supplement data collected on the ground that will support decision making. ADPC expects that, as the technology continues to advance, satellite-based data will become close to being real-time while gaining higher resolution and better remote observation accuracy. These are important elements to finding new applications, enhancing the current use and building the confidence of users such as national disaster management organizations. ADPC also expects that the capacity of countries to use such satellite-based data will not stop at the national level. It is prudent that local authorities, or even people in communities, have access to the same information and also have the capacity to process and use the information, preferably in an assisted way. They are the front-line team who will be faced with disaster situations and need accurate and timely data in order to make informed decisions to save lives. With this vision, it is critical that the Sentinel Asia community addresses the capacity gap observed in the disaster management community. Many developing countries do not have the capacity to access, analyze and use satellite-derived data. Through the long-standing framework of the Sentinel Asia Initiative, ADPC and its partners could bring together space agencies, national and local disaster management organizations to address these challenges

(Sentinel Asia Secretariat)
Speaking of challenges, the world – including the entire Sentinel Asia community – has been facing the COVID-19 pandemic. How are you trying to maintain ADPC's contributions to disaster monitoring while the COVID-19 pandemic continues to constrain activities?

(Mr. Hans Guttman)
Firstly, we have to recognize COVID-19 itself is a huge disaster. It is true that the COVID-19 pandemic has disrupted in-person interaction between teams and between countries, even within countries, but it further highlights the need by users to be able to gain insights on disasters remotely, without having to visit the places affected by the disasters. Satellite data suits this need perfectly. ADPC continues to monitor disasters such as floods, droughts, and tropical storms through remotely sensed data and hydro-meteorological models. Our disaster data has been used by international partners such as the Mekong River Commission and the United Nations World Food Programme. We are not a mandated organization, but we do provide supplementary support or direct support when requested. Even in the COVID-19 situation, ADPC maintains its connection with national governments through its country offices and country representatives. You can see our staff presence in Sri Lanka, Bangladesh, Nepal, Pakistan, Vietnam, Myanmar, Lao PDR, Cambodia, the Philippines, Indonesia, and Thailand and they support the governments and other actors whenever

there are disasters in the countries, in which they have been quite successful and have made online interactions from Bangkok and other places.

(Sentinel Asia Secretariat)
We see that ADPC has an extensive network and connections with disaster management organizations, which we believe have contributed to your extensive support. Having been engaged in Sentinel Asia activities yourself, have you found anything to feed back to the space community and could you tell us what you would like to contribute to Sentinel Asia's activities in the future?

(Mr. Hans Guttman)
Disaster management aims to lessen the impact of disasters, minimizing losses of life and property damage. Although satellite-based technologies have proven to be a useful tool in supporting disaster management, the capacity to fully benefit from such data has been lacking from the disaster management side in many countries in Asia. ADPC offers to be a conduit between the satellite data providers and the disaster management organizations. The satellite data providers and the Data Analysis Nodes of Sentinel Asia need to provide action-ready information such as flood extent maps that are clearly labeled. At the same time, ADPC can help disaster management organizations enhance their technical capacity to interpret and make good use of the maps, while improving the awareness of decision makers. ADPC thinks that we are well suited to work with Sentinel Asia to bring the data providers and the disaster management organizations closer to each other so they are able to reap the benefits of this technology.

ADPC will continue to provide our technical contribution as an active Data Analysis Node (DAN), and we would like to work with Sentinel Asia and some members of Sentinel Asia to develop demonstration projects with external funding. The demonstration project will serve as a platform on how a country can maximize uses of the Sentinel Asia mechanism and sustain the capacity to use the mechanism in the long term. ADPC would like to showcase such a project to other members of Sentinel Asia during a future JPT meeting. We hope for full support from Sentinel Asia in developing and implementing such demonstration projects.

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3. [Event] Sentinel Asia Webinar on Drought Risk Management hosted by ISRO and IWMI

The Sentinel Asia Webinar "Space Technology for Drought Risk Management" was held on 19 and 20 July 2021. The webinar was co-organized by the Indian Space Research Organization (ISRO) and the International Water Management Institute (IWMI) as part of Sentinel Asia activities. This webinar brought together around 50 experts and practitioners from the community and addressed, among other things, theories of drought risk management, the introduction and demonstration of drought management platforms, presentations by participants. In addition, the participants had an interactive open discussion on regional cooperation mechanism for drought management and the way forward. Capacity-building events of this kind in which Sentinel Asia members mutually help build capacity with their respective experience and expertise were first organized by ADPC and JAXA as part of the Joint Project Team Meeting (JPTM) in Bangkok in 2019, and this time ISRO and IWMI jointly took the lead to expand the concept further for the benefit of Sentinel Asia members. The Sentinel Asia community will continue to support and foster mutual capacity-building among members through cooperation.

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4. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region.

Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS.

https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** August 2021 News from the Sentinel Asia Project Office **

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Topics:

1. [News] Additional Information on Typhoon Fabian in the Philippines and on Flood in Myanmar
2. [News] Emergency Observation of Disasters
3. [Event] Report on Sentinel Asia Training Programme on “Space Technology for Drought Risk Management” (*_contributed article from ISRO and IWMI_*)
4. How to Send an Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

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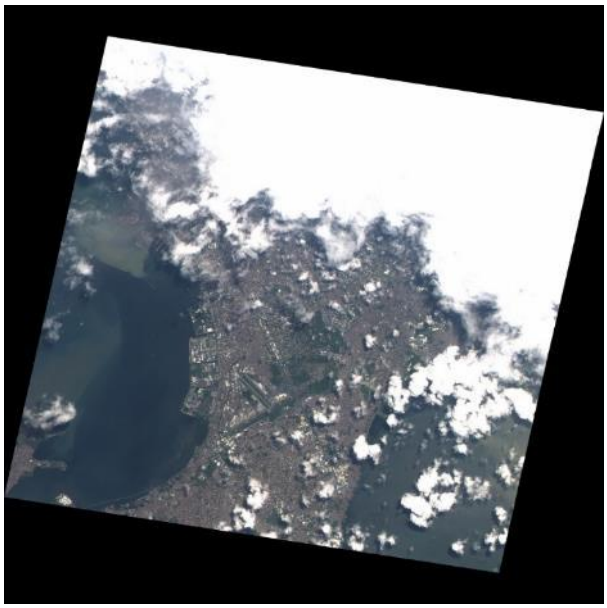
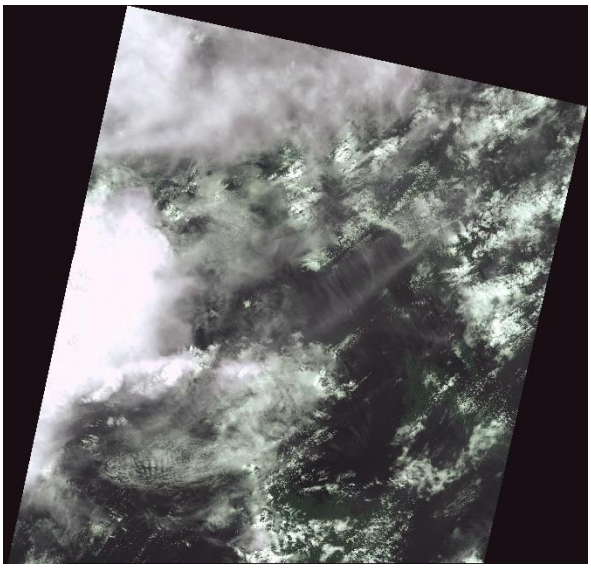
1. [News] Additional Information on Typhoon Fabian in the Philippines and on Flood in Myanmar (The outline was given in the July 2021 Newsletter)

   (1) Typhoon Fabian in the Philippines (GLIDE Number: FL-2021-000091-PHL)
   Typhoon Fabian (In-fa) hit the Philippines and caused heavy rain. According to FloodList, over 80,000 people had to evacuate their homes in the Philippines after severe weather brought by the southwest monsoon, was further intensified by Typhoon Fabian. At least three people had died and five had been injured as a result of falling trees or lightning strikes. (https://floodlist.com/asia/philippines-floods-typhoon-infa-july-2021)

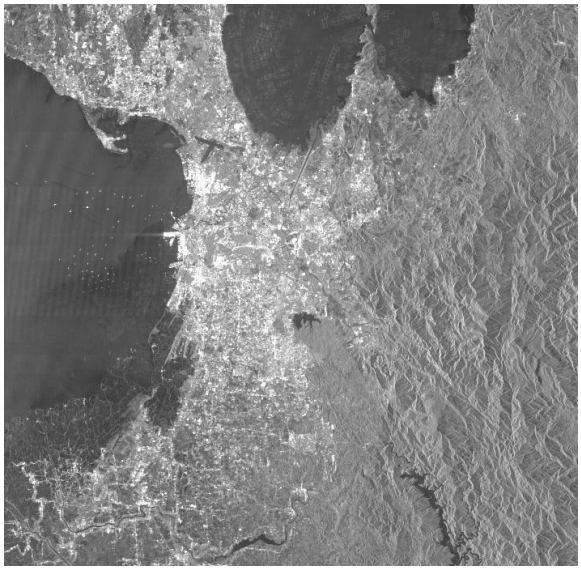
   The Manila Observatory (MO) made an EOR to Sentinel Asia on 25 July. Among Data Provider Nodes (DPNs), the Geo-Informatics and Space Technology Development Agency (GISTDA), the Indian Space Research Organization (ISRO), the Japan Aerospace Exploration Agency (JAXA) and the National Applied Research Laboratories (NARL) provided observation data. Among Data Analysis Nodes (DANs), the Asian Institute of Technology (AIT) provided their Value Added Products (VAPs). Information on the latest responses by Sentinel Asia is available from the following link:
   https://sentinel-asia.org/EO/2021/article20210725PH.html



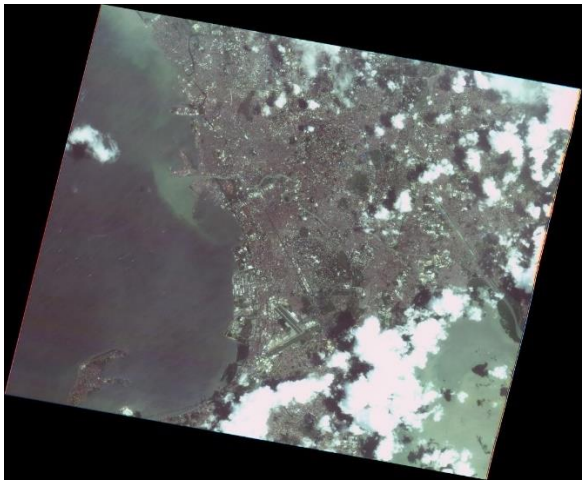
Satellite image (THEOS1) provided by GISTDA



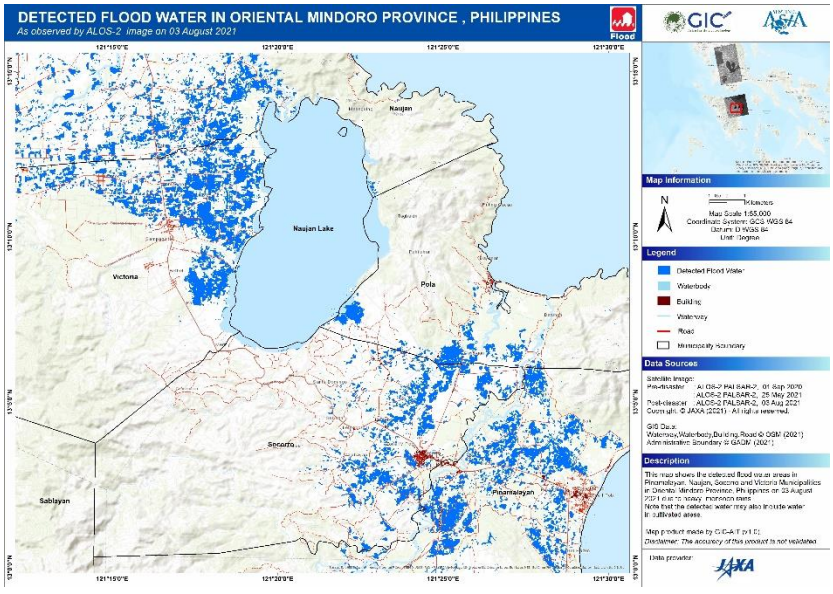
Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA



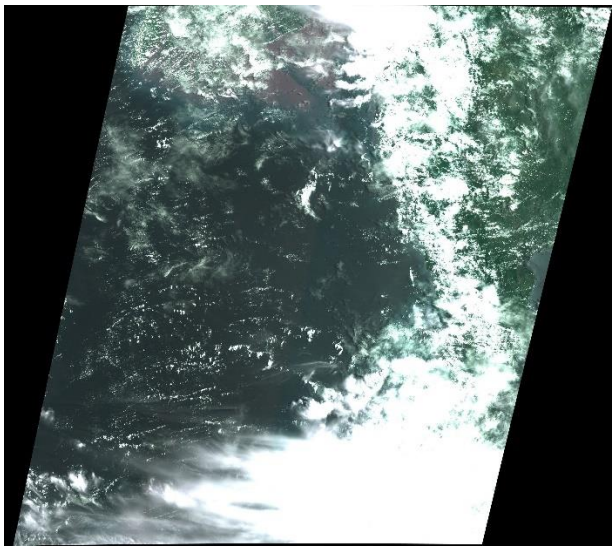
Satellite image (FORMOSAT-5) provided by NARL



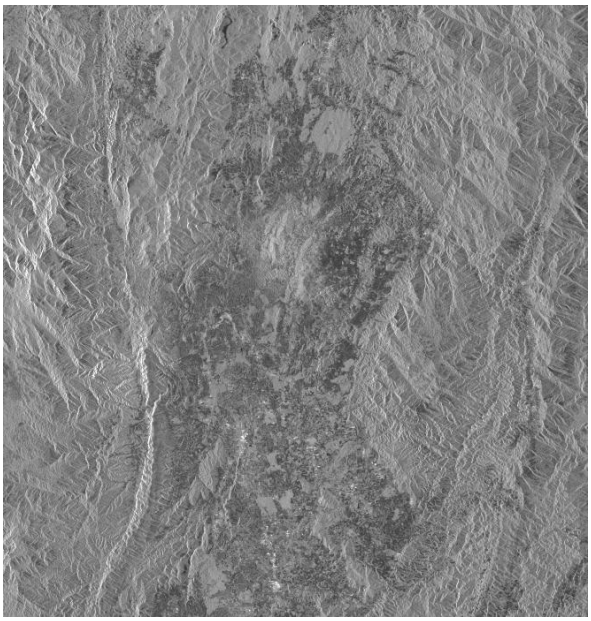
Value Added Product by AIT

(2) Flood in Myanmar (GLIDE Number: FL-2021-000095-MMR)
A flood occurred in Myanmar on 26 July. The Radio Free Asia reported that heavy rains battered the southern states of Kayin and Mon and Tanintharyi region beginning on 25 July, impacting as many as 3,000 people. More than 100 people from Hlaingbwe in the state of Kayin had to evacuate, according to a relief official from the area.
(https://www.rfa.org/english/news/myanmar/flooding-07262021205343.html)

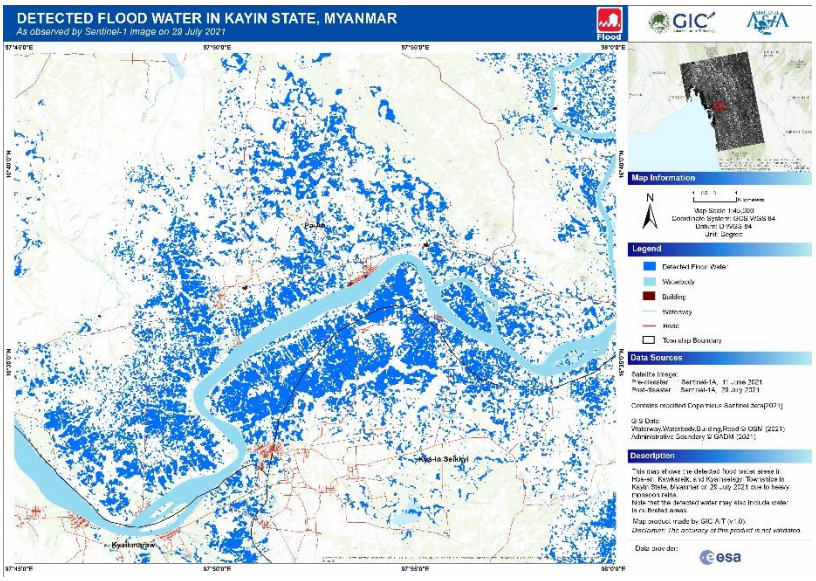
The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) made an EOR to Sentinel Asia on 27 July. Among DPNs, ISRO and JAXA provided their data. In addition, GISTDA and NARL also planned to provide their data. Among DANs, AIT provided their VAPs. Information on the latest responses by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210727MM.html



Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA



Value Added Product by AIT

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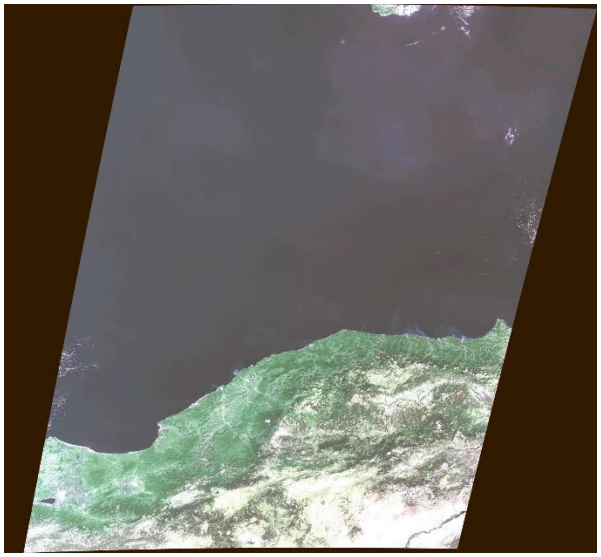
2. [News] Emergency Observation of Disasters

(1) Flood and Landslide in Turkey (GLIDE Number: FL-2021-000113-TUR)

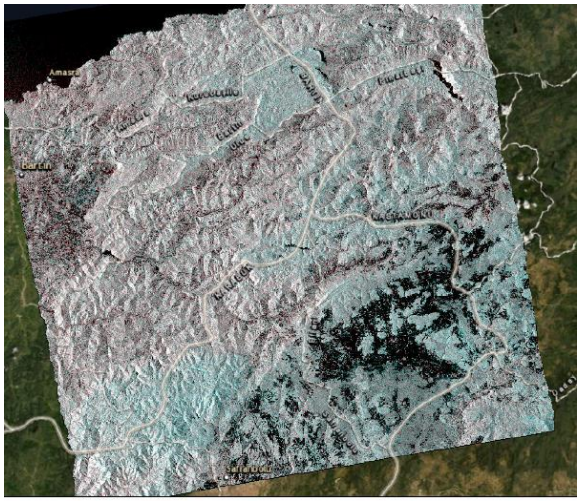
Floods and landslides occurred in Turkey on 11 August. According to FloodList, severe floods and landslides had caused major damages in several provinces of Turkey‘s Black Sea Region after heavy rain on 10 August 2021. Six people had died and one person had gone missing. (https://floodlist.com/asia/turkey-black-sea-floods-update-august-2021)

The Disaster & Emergency Management Presidency of Turkey (AFAD) made an EOR to Sentinel Asia on 13 August. Among DPNs, GISTDA, ISRO, JAXA and NARL provided their data. Information on the latest responses by Sentinel Asia is available from the following link: https://sentinel-asia.org/EO/2021/article20210811TR.html

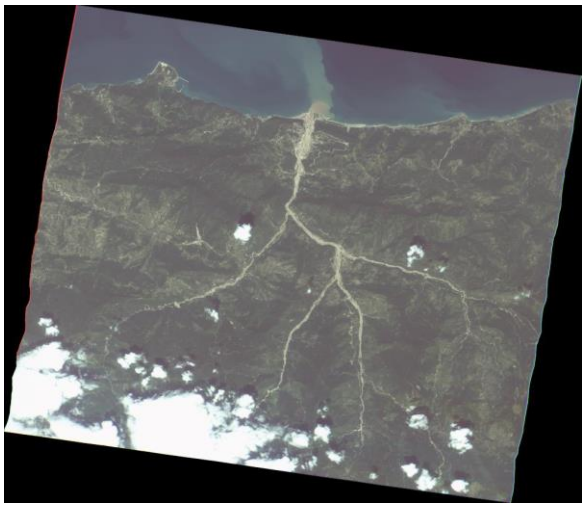
Satellite image (THEOS1) provided by GISTDA



Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA



Satellite image (FORMOSAT-5) provided by NARL

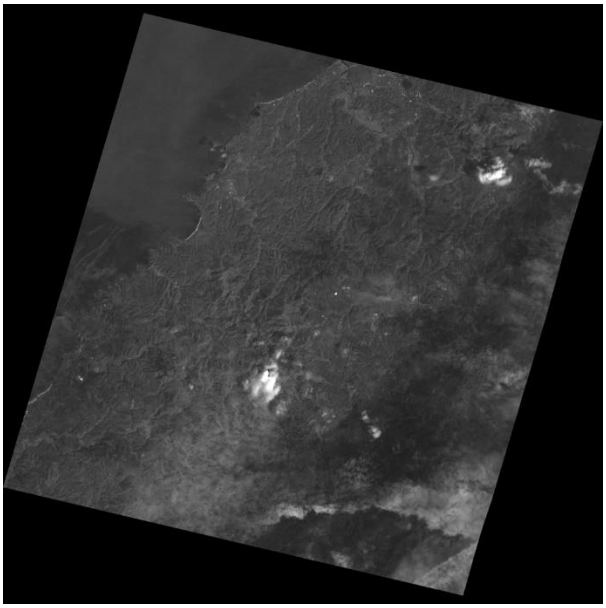
(2) Flood and Landslide in Japan (GLIDE Number: LS-2021-000114-JPN)

Floods and landslides occurred in Japan on 14 August. According to the Kyodo News, more rain had been forecasted to hit areas from the western to northern parts of the country as a stationary front was expected to move north along the Japanese archipelago. In the next 24 hours, up to 200 millimeters of rainfall had been forecasted in the southern Kyushu region, up to 180 mm in the Shikoku region in western Japan, and up to 150 mm in the Tokai region in central Japan. At least eight people had died so far.

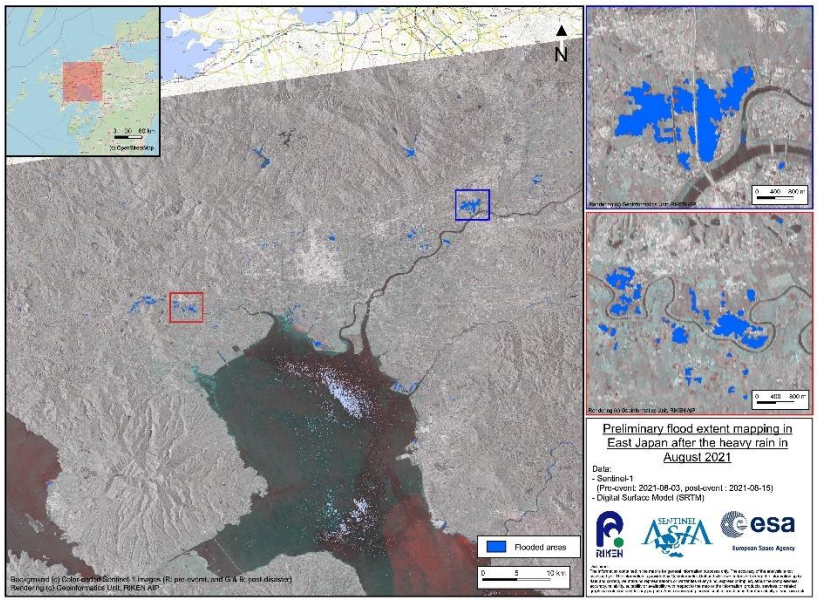
(https://english.kyodonews.net/news/2021/08/6745d8bbde4f-more-rain-disaster-warnings-in-japan-as-death-toll-rises-to-8.html)

The Asian Disaster Reduction Center (ADRC) made an EOR to Sentinel Asia on 13 August. This EOR was escalated to the International Disasters Charter. Yamaguchi University assumed the role of Project Manager (PM) for this Charter activation. Among DPNs, GISTDA provided the data. In addition, NARL planned to provide its data. Among DANs, RIKEN and Chiba University

provided their VAPs. Information on the latest responses by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210814JP.html



Satellite image (THEOS1) provided by GISTDA



Value Added Product by RIKEN

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3. [Event] Report on the Sentinel Asia Training Programme on “Space Technology for Drought Risk Management” (**article contribution from ISRO and IWMI*)

On 19 and 20 July, the webinar on “Space Technology for Drought Risk Management” was held. The webinar was co-organized by the Indian Space Research Organisation (ISRO) and the International Water Management Institute (IWMI) and was facilitated by the Sentinel Asia secretariat as part of Sentinel Asia’s Capacity Building Programme. ISRO and IWMI jointly contributed the following report:

Background

Sentinel Asia is an international cooperation initiative established by the Asia-Pacific Regional Space Agency Forum (APRSAF), to demonstrate the potential value and impact of using Earth observation technologies, combined with near-real-time information dissemination methods and Web-GIS mapping tools for disaster management support in the Asia-Pacific region. The Sentinel Asia community has long recognized the need for capacity-building towards strengthening its activities. In order to address this need, at the Joint Project Team Meeting in Bangkok in 2019, a specific Training Workshop was organized for the first time in which member organizations trained together by sharing their respective expertise and knowledge. In the Training Workshop, ISRO and IWMI conducted training programmes on “topological and hydrological modelling”, and “emergency response mapping using multisource satellite data,” respectively. Following the Training Workshop in 2019, the ISRO and IWMI jointly proposed to expand its achievements, by volunteering themselves to provide capacity-building workshops for the benefit of the Sentinel Asia community. To begin with, the following capacity building programmes were proposed:

1. Space Technology for Drought Risk Management by the National Remote Sensing Centre / Indian Space Research Organization (NRSC/ISRO), India, in association with the International Water Management Institute (IWMI) on 19-20 July, 2021
2. Spatial Flood Early Warning by the NRSC/ISRO in October 2021
3. Emergency Response Mapping and Crisis Management by the IWMI in association with the Asian Disaster Reduction Center (ADRC), NRSC/ISRO in December 2021

These training programmes will be coordinated by the Sentinel Asia Secretariat. The first training programme on Space Technology for Drought Risk Management has been jointly organised by NRSC/ISRO and IWMI. About 60 participants from 11 Sentinel Asia countries / regions, ISRO and IWMI have already participated in the programme.

Drought Risk Management

Drought is a serious hydro-meteorological disaster limiting agricultural production worldwide. Drought management is closely linked to sustainable agriculture and food security. Challenges in drought management are ever increasing because drought is the manifestation of complex interactions between weather, soils, crops and human actions. Data centric technologies like satellite remote sensing, GPS, field instrumentation and mobile phones coupled with new techniques of data analysis are providing new data, information and knowledge for achieving an efficient and effective drought

management. Reliable drought indices available from satellite observations such as the Normalized Different Vegetation Index (NDVI), Land Surface Water Index (LSWI), Shortwave Angle Slope Index (SASI) and radar backscatters, as well as biophysical products like land surface temperature, soil moisture and rainfall remote sensing technology, are playing a key role in drought detection, monitoring and impact assessments. Satellite based resource maps and high-resolution satellite images are useful for developing, implementing and performing impact assessment of long-term drought management measures. Abundantly available satellite data, an increasing network of weather observatories, mobile-based fast and efficient field data collection systems, easily accessible and advanced techniques of data analysis etc., signify that there is huge scope for establishing decision support systems for drought management. Such systems would further strengthen agro-advisories, crop risk management, disaster relief, crop insurance and drought prevention strategies, among others.

Scope of the training programme

The objective of the programme was to brief the participants from Sentinel Asia members on the potential and current status of utilisation of EO technology for operational drought monitoring, in-season drought management, drought impacts assessments and long-term drought management. Advances in drought assessment with new datasets and emerging technologies also form part of this programme.

The programme consisted of expert presentations and an interactive session to make the message to be conveyed more impactful. Scope for enhancing technology utilisation, need for customisation of products and services, research gaps, as well as data and information sharing opportunities were planned and documented for future courses of action towards establishing a regional cooperation mechanism for drought risk management.

Proceedings of the 2-day training programme (19-20 July 2021)

This webinar brought together around 50 experts and practitioners from the Sentinel Asia community. The inaugural session of the training programme included the inaugural address by Dr. V. V. Rao, Deputy Director, Remote Sensing Applications, NRSC and brief remarks by (a) Dr. Shantanu Bhatwadekar, Director, Earth observation applications & Disaster management support Programme Office (EDPO), ISRO Hq. (b) Dr. Raj Kumar, Director, NRSC (ISRO) (c) Dr. Rachael Mcdonnell, Deputy Director General, IWMI, Sri Lanka and Mr. Takanori Miyoshi (Sentinel Asia Secretariat). This kind of capacity-building event in which Sentinel Asia members help each other build their capacities by making use of their respective experiences and expertise, was first organized by Asian Disaster Preparedness Center (ADPC) and Japan Aerospace Exploration Agency (JAXA) as part of the Joint Project Team Meeting (JPTM) in Bangkok in 2019, and this time, the ISRO and IWMI jointly took the lead to expand it further for the benefit of Sentinel Asia members. The Sentinel Asia community will continue to support and foster capacity-building among its members through mutual cooperation. Since drought is a large hydro-meteorological disaster causing huge economic losses with cascading effects, the need for using science-based evidence solutions for drought management has been well recognised. Therefore, the current training programme was quite relevant to deepen the participant's understanding of the nature of drought and the scope for new technologies to minimise losses from such disaster. All the speakers in the inaugural session pointed out the need for organising drought monitoring and management related capacity building programmes more frequently for the benefit of Sentinel Asia member countries.

Technical Session – 1 had four presentations. It started with a brief presentation on "Understanding drought disaster and its management" by the NRSC, which set the platform for rest of the

presentations. Drought is not an event like floods/cyclones. It is a complex phenomenon interlinked with meteorological, hydrological and agricultural variables. Therefore, drought monitoring and management are multidisciplinary in nature involving many institutions.

The second presentation in this session was on drought monitoring indicators. It covered extensively all the meteorological, hydrological and agricultural indicators. Satellite based indicators of precipitation, soil moisture and crop conditions were emphasised. This was followed by a demonstration on crop condition assessment using optical, thermal and microwave datasets.

The third presentation in this session was on drought monitoring practices in India with recent examples. It covered the genesis, evolution and the current status of the satellite-based drought monitoring project, namely, the "National Agricultural Drought Assessment and Monitoring System" conceptualised and started in 1989. Satellite-based drought monitoring has become one of the most successful remote sensing applications in India. The discussion then centred on the Manual for Drought Management of 2016, which is being followed in India for objective drought assessment, and highlighting the adoption of an integrated approach with multiple drought indicators. It also covered recent examples on utilisation of SAR data for drought detection, contingency crop planning developed by some states and agriculture monitoring systems being developed. Effective drought monitoring systems of some of the states were mentioned to draw the attention of the participants to the best practices on remote sensing technology utilisation for drought management.

With reliable NDVI, LSWI, IDSI, SASI and radar backscatter indices available in moderate spatial and temporal resolutions and with geospatial products on soil moisture and rainfall, geospatial technology has contributed new information and knowledge for improving drought-related assessment, emergency declarations and management in the country.

The fourth presentation in this session was on the South Asia Drought Monitoring System developed by the IWMI which is now under implementation. It covered various datasets and clues for drought assessment, decision support system, customised products, dissemination of information etc., under this project. It was also mentioned that the information on drought generated in this project was being effectively used for taking drought management actions in Afghanistan.

The second day of the webinar included Technical Session-2 and the wrap-up. In this session, there were three presentations. The first presentation was on the agro-advisory system of the Indian Meteorological Department to support farmers. It covered various information products on current and forecast weather parameters and utilisation of these data collection equipment for developing farmer advisories, and presented the institutional structure for developing and expanding them. Effective utilisation of digital technologies in terms of web tools, web portals, mobile apps, etc., for dissemination and end-use of advisories was highlighted. Feedback collection from farmers and the economic benefits as a result of the advisories were also part of the presentation, and finally, the scope for strengthening the advisories system was highlighted.

The second presentation in this session was on space technology supporting long-term drought management. Concepts for long-term drought management, hazards, vulnerabilities and risks were discussed, followed by a demonstration on using time series data on weather, satellite indicators and bio-physical parameters for drought vulnerability mapping. It was also explained to the participants that satellite-based maps of resources and high-resolution satellite images were being used to develop, implement and perform impact assessment of long-term drought management measures in India, by showing them the use of satellite and mobile technologies for monitoring and evaluating long-term drought management interventions. Smart phone-based monitoring of crop level assets has become a successful technology application in India. Overall, these crop protection mechanisms have been strengthened to become effective tools for drought risk mitigation.

The third presentation in this session was on the drought management efforts by the IWMI. Collaborative efforts between the IWMI and the private sector to develop comprehensive solutions for drought risk management and the impact of such efforts were presented, highlighting the need to develop new tools and information products, establish multi-institutional collaboration, and the role of private sector in these efforts, etc.

The brief session on interactive presentations, consisted of two presentations by participants from India and Taiwan. The first was a presentation by the Mahalanobis National Crop Forecasting Centre (MNCFC) of the Ministry of Agriculture and Farmers Welfare, Government of India, which covered the current drought monitoring system in the country using various indicators and the increasing role of space technology for drought assessment.

The second was a presentation by the National Space Organization (NSPO) of National Applied Research Laboratories (NARL) of Taiwan, which showcased the repository of satellite data being used for disaster management. Analysis ready data products are made available to the stakeholders in the form of Open Data Cubes, in public domain.

Some of the participants interacted with the experts on specific aspects of drought occurrence in their regions and the scope for developing customised information products.

Concluding remarks

The Sentinel Asia Secretariat extended his gratitude to the ISRO and IWMI for organizing this webinar, by reiterating the significance of capacity-building activities and recalling the previous achievements at the Training Workshop, which was part of the JPTM, jointly organized by ADPC and JAXA. Moreover, Mr. Miyoshi expressed his wishes for the expansion of these efforts for the benefit of the Sentinel Asia community.

The ISRO and IWMI indicated that with several open-access satellite data, an increasing network of weather observatories, mobile-based fast and efficient field data collection systems, as well as easily accessible and advanced technologies such as cloud platforms, it is now possible to develop robust drought monitoring and management systems that allow taking timely action to reduce drought risks.

It was also concluded that the regional cooperation mechanism among the Sentinel Asia member countries needed to be further strengthened in order to share the drought-related analysis ready data, as well as the knowledge and expertise for enhancing drought management capabilities.

Annexe

Schedule of the Capacity Building Programme

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5. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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6. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** September 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. [News] Sentinel Asia has been invited by the UNDRR to make voluntary commitments to the Sendai Framework
3. Sentinel Asia Webinar "Space Technology for Flood Forecast Modelling" to be co-organized by ISRO and IWMI
4. How to Send an Emergency Observation Request
5. Using Sentinel Asia Operation System, OPTEMIS

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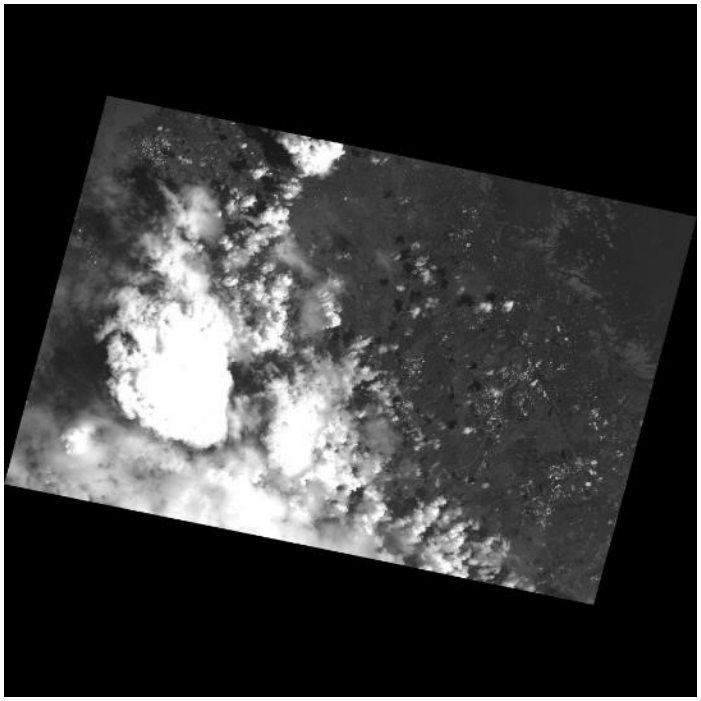
1. [News] Emergency Observation of Disasters

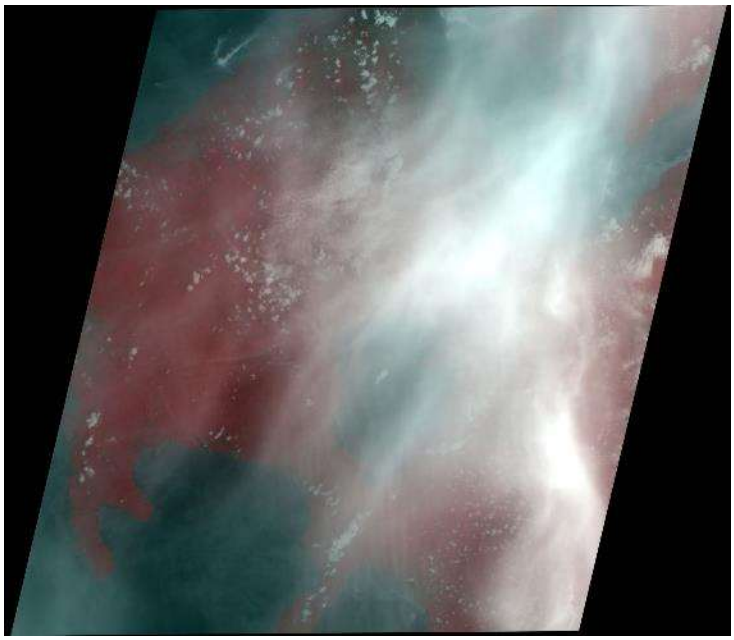
(1) Tropical Storm Jolina (Conson) in the Philippines (GLIDE Number: TC-2021-000136-PHL)

Tropical Storm Jolina (Conson) made landfall on the Philippines on 6 September. According to ReliefWeb, the Philippines National Disaster Risk Reduction and Management Council (NDRRMC), it caused at least 17 fatalities, 24 injured individuals, and seven missing people, more than 29,830 people were displaced across 181 evacuation centers and up to 313,373 people have been affected.
(https://reliefweb.int/report/viet-nam/vietnam-philippines-tropical-cyclone-conson-update-gdacs-jtwc-aha-centre-ndrrmc)

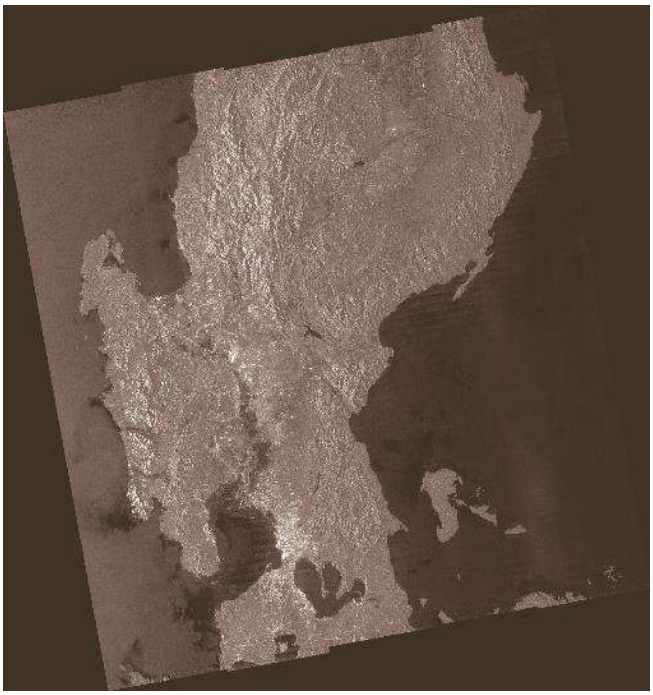
The Manila Observatory (MO) made an EOR to Sentinel Asia on 8 September. Among DPNs, the Indian Space Research Organisation (ISRO), the Geo-Informatics and Space Technology Development Agency (GISTDA), the Japan Aerospace Exploration Agency (JAXA), and the National Applied Research Laboratories (NARL) provided data. Among DANs, the Asian Institute of Technology (AIT) and the Mohammed Bin Rashid Space Centre (MBRSC) provided their VAPs. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210908PH.html



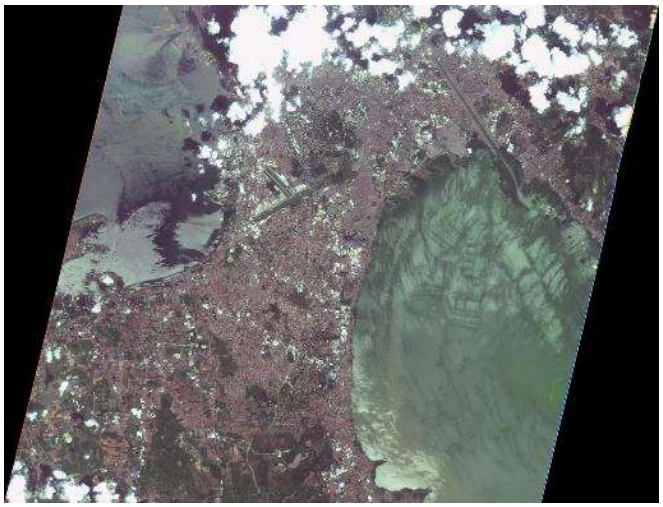
Satellite image (THEOS1) provided by GISTDA



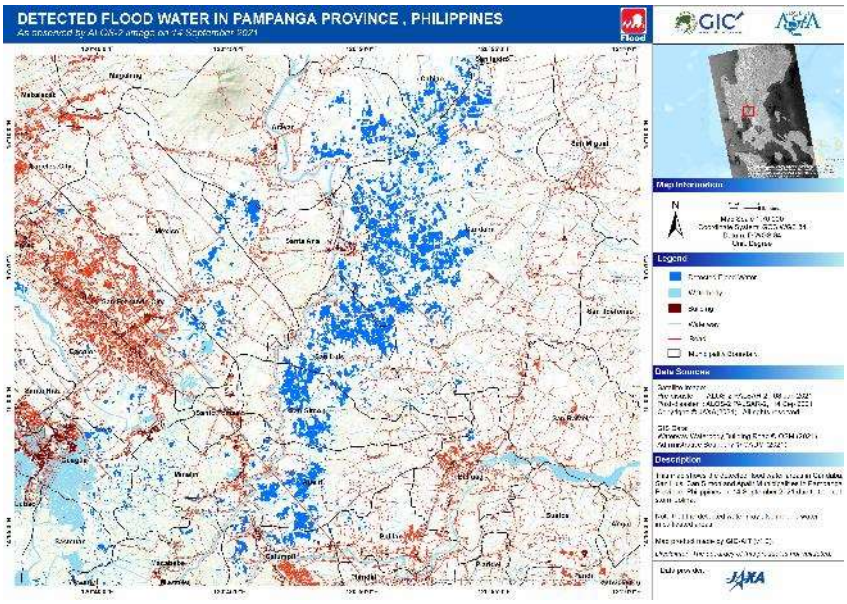
Satellite image (Resourcesat-2) provided by ISRO



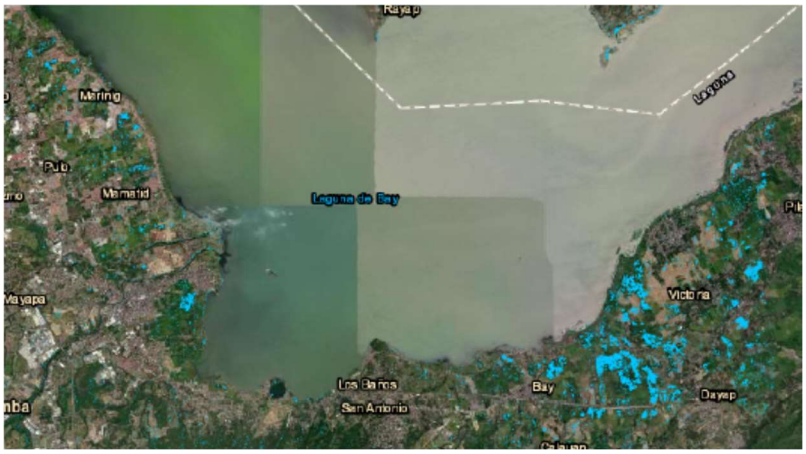
Satellite image (ALOS-2) provided by JAXA



Satellite image (FORMOSAT-5) provided by NARL



Value Added Product by AIT

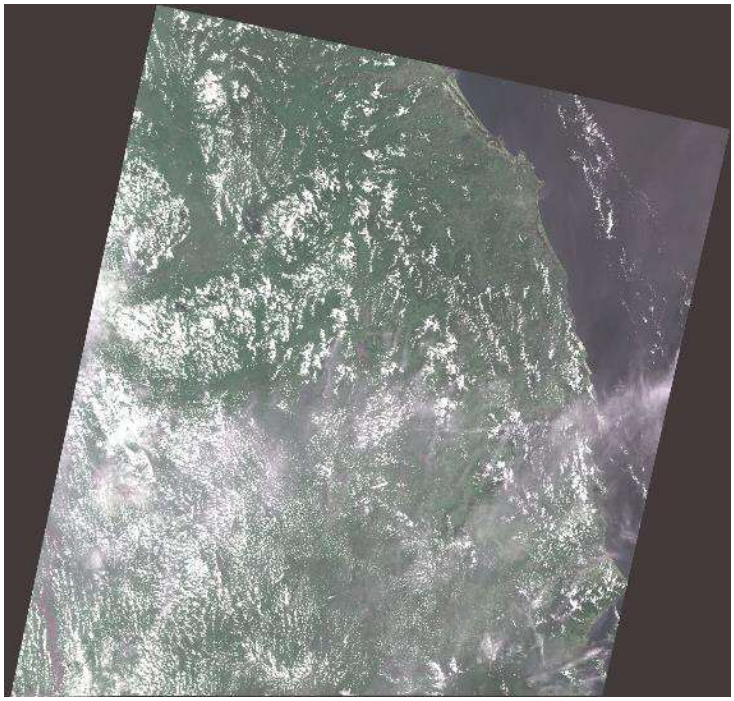


Value Added Product by MBRSC

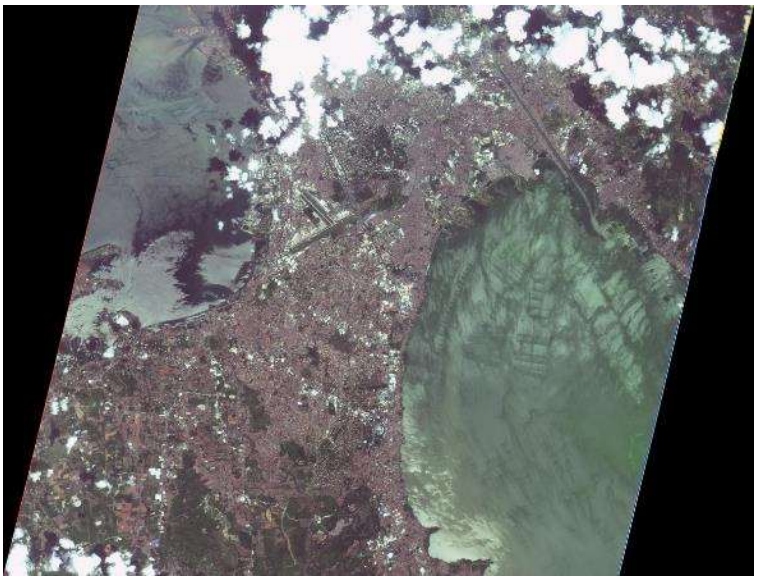
(2) Typhoon Conson in Vietnam (GLIDE Number: TC-2021-000136-PHL)

After passing over the Philippines, tropical storm Conson made landfall over Vietnam. ReliefWeb reported that according to the AHA Centre and media, two people died and 18 people were rescued and at least 62 houses were damaged in Vietnam. (https://www.cnbc.com/2021/09/13/vietnam-warns-of-floods-and-landslides-after-storm-weakens.html)

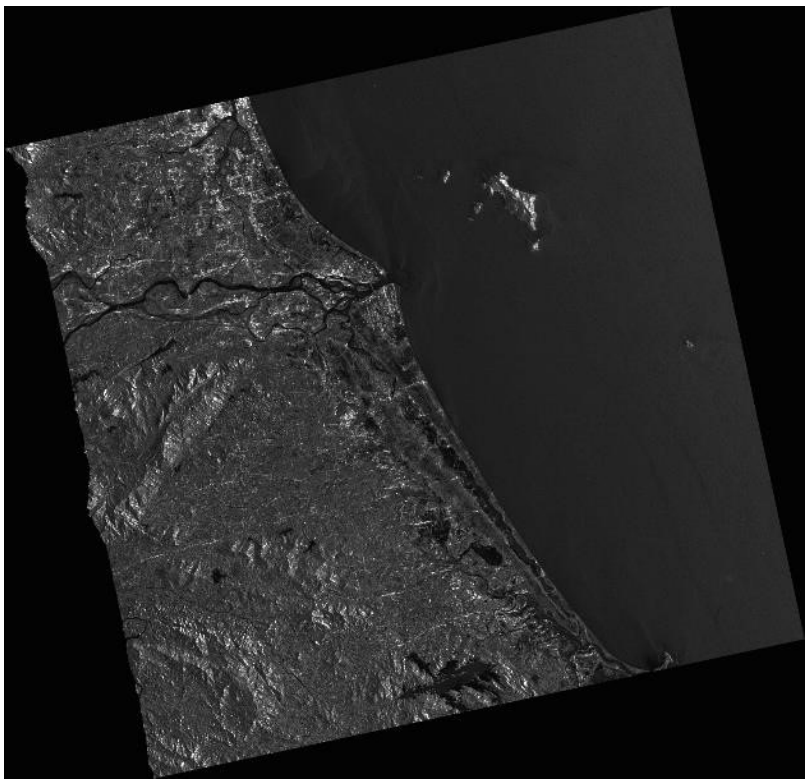
The Ministry of Natural Resources and Environment (MONRE) of Vietnam made an EOR to Sentinel Asia on 13 September. Among DPNs, ISRO, JAXA, and NARL provided data. Among DANs, AIT provided their VAPs. Information on the latest response by Sentinel Asia is available from the following link:
https://sentinel-asia.org/EO/2021/article20210913VN.html



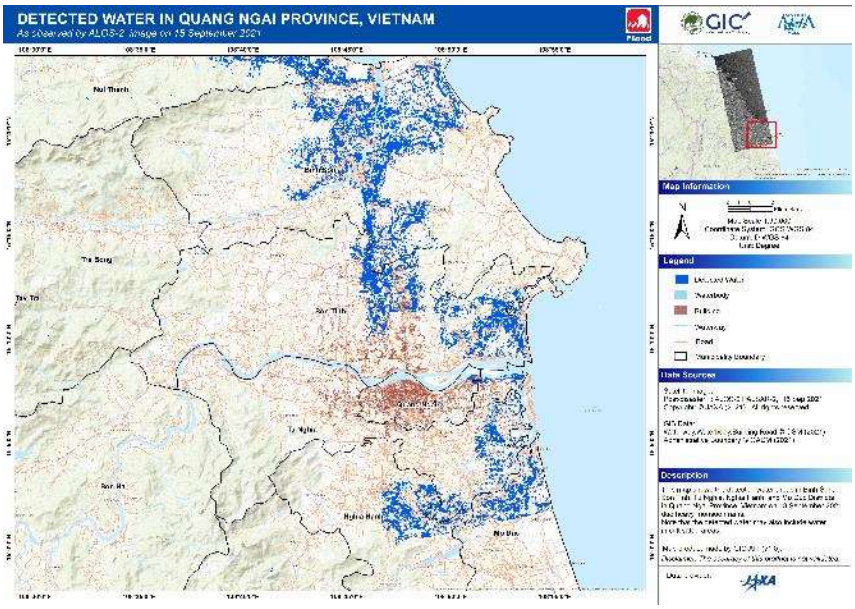
Satellite image (Resourcesat-2) provided by ISRO



Satellite image (FORMOSAT-5) provided by NARL



Satellite image (ALOS-2) provided by JAXA



Value Added Product by AIT

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2. [News] Sentinel Asia has been invited by the UNDRR to make voluntary commitments to the Sendai Framework

   As circulated on 6 September as an extra edition of Sentinel Asia Newsletter, in light of the partnership between the United Nations Office for Disaster Risk Reduction (UNDRR) and Sentinel Asia as well as of the achievements of Sentinel Asia, and the enhanced recognition of Sentinel Asia in the global disaster management community, Sentinel Asia has been invited by the UNDRR to submit its commitments to the Sendai Framework Voluntary Commitments (SFVC).

   Currently, Sentinel Asia's SFVC are about Emergency Observation Requests (EORs). Sentinel Asia will make its best efforts to offer support in terms of disaster assessment and response planning, and to activate supporting agencies as required. An EOR represents an appeal for assistance from a disaster-affected country and is the fundamental instrument around which the Sentinel Asia framework is organized and executed. While publishing the initial SFVC, Sentinel Asia will further update and upgrade the SFVC in the future and will continue to be committed to implementing the Sendai Framework through cooperation among Sentinel Asia member organizations.

   ＊The detailed story is posted on the Sentinel Asia website: https://sentinel-asia.org/event/20210906/Sentinel_Asia_has_been_invited_by_the_UNDRR_to_make_voluntary_commitments_to_the_Sendai_Framework.pdf

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3. Sentinel Asia Webinar "Space Technology for Flood Forecast Modelling" to be co-organized by ISRO and IWMI

   Flooding constitutes the most prevalent and costly natural disaster in the world. Particularly, the Asia-Pacific region suffers the most. While a variety of mitigation measures can be implemented to minimize the impact of flooding, satellite technology can play a vital role. In this regard, experts from ISRO and IWMI have volunteered to co-organize a dedicated webinar as part of Sentinel Asia activities for the benefit of JPT members. The webinar is titled "Space Technology for Flood Forecast Modelling" and is planned to take place on 27 and 28 October from 10:00 (Hyderabad time).

   This webinar is a follow-on of the webinar on space-based drought risk management co-organized by ISRO and IWMI on 19 and 20 July, and will address, just as its predecessor, among other things, general theories, experts' lectures, and an interactive session. It is expected to contribute to deepening the understanding of participants on this thematic topic and helping them

take future actions toward mitigating flood risks and responding better to floods.

This webinar is exclusive to JPT members and those who are interested in participating in this webinar are requested to register via dedicated link. The link as well as the brochure giving details on this webinar will be sent to all JPT members by the Sentinel Asia Secretariat. Many registrations from JPT members would be appreciated.

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4. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** October 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. [Interview] Dr. Raj Kumar, Outstanding Scientist, Director, National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO)
3. [Event] Sentinel Asia Webinar
4. How to Send an Emergency Observation Request
5. Using the Sentinel Asia Operation System, OPTEMIS

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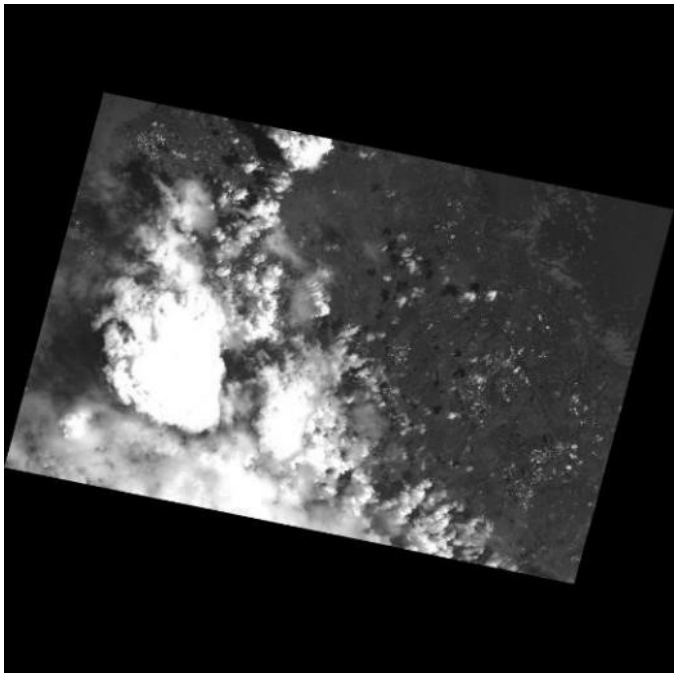
1. [News] Emergency Observation of Disasters (as of 28 October, 2021)

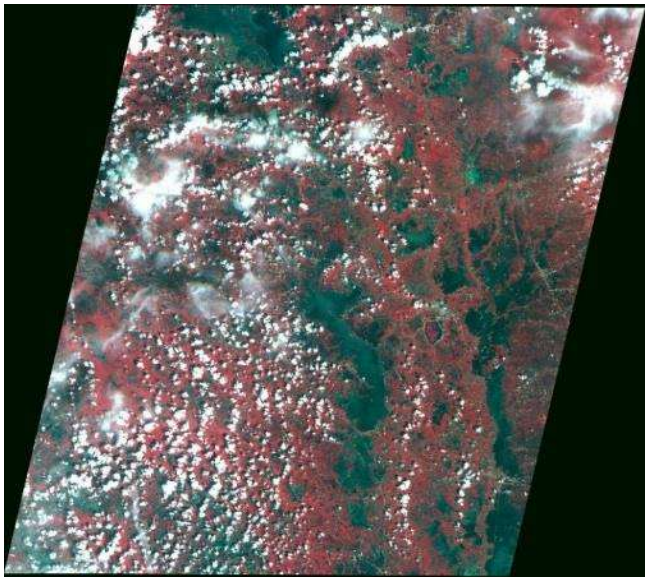
(1) Tropical Storm Dianmu Flood in Thailand (GLIDE Number: FL-2021-000147-THA)

Tropical storm Dianmu caused flood in 32 provinces in Thailand. According to the Bangkok Post, as of 5 October, eight people died and one remains missing. (https://www.bangkokpost.com/thailand/general/2192803/storm-dianmu-floods-linger-in-18-provinces)

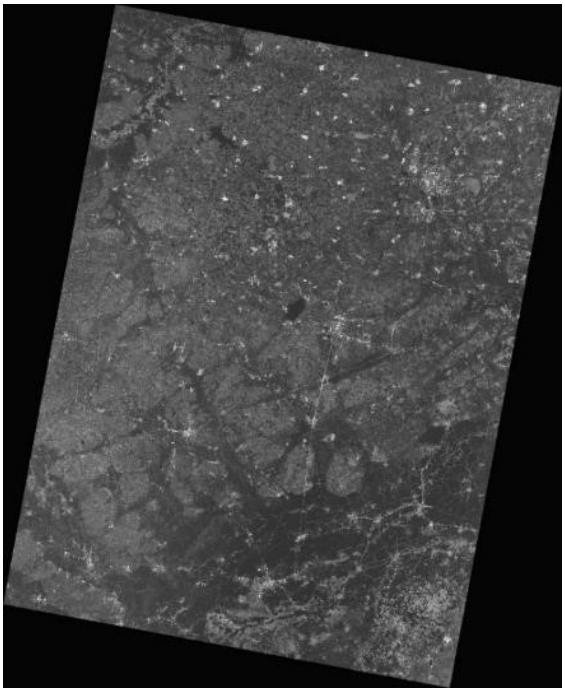
The Geo-Informatics and Space Technology Development Agency (GISTDA) made an EOR to Sentinel Asia on 29 September. Among DPNs, the Indian Space Research Organisation (ISRO), the Japan Aerospace Exploration Agency (JAXA) and the National Applied Research Laboratories (NARL) provided data. Among DANs, the Asian Institute of Technology (AIT) provided its VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211001TH.html



Satellite image (THEOS1) provided by GISTDA

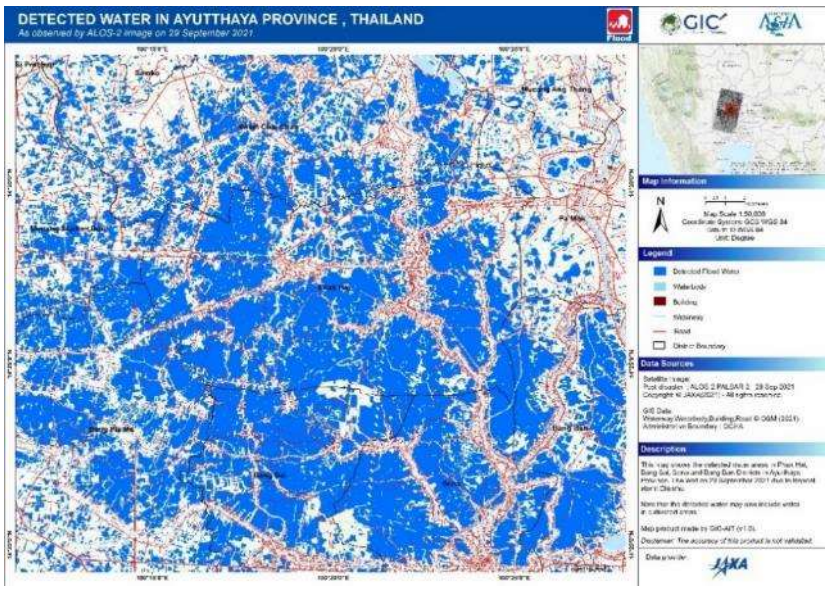


Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA

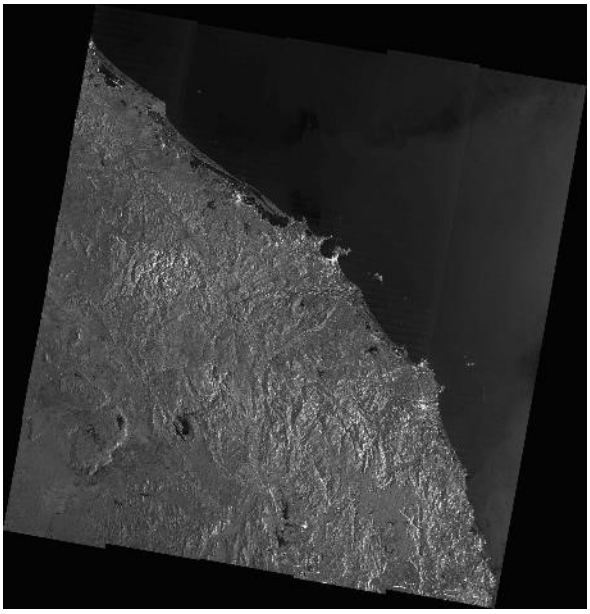
Satellite image (FORMOSAT-4) provided by NARL



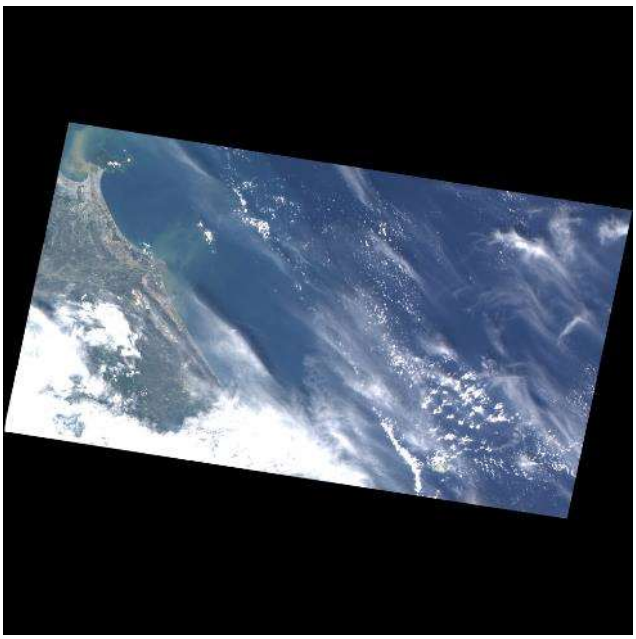
Value-Added Product by AIT

(2) Flood, Landslides and Storm in Vietnam (GLIDE Number: FL-2021-000158-PHL)
Heavy rain was expected in northern and central Vietnam. Tuoi Tre News reported the risk of flashfloods and landslides.
(https://tuoitrenews.vn/news/society/20211006/tropical-depression-to-bring-downpours-to-central-vietnam/63434.html)

The Ministry of Natural Resources and Environment (MONRE) made an EOR to Sentinel Asia on 7 October. Among DPNs, JAXA and GISTDA provided data. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211006VN.html



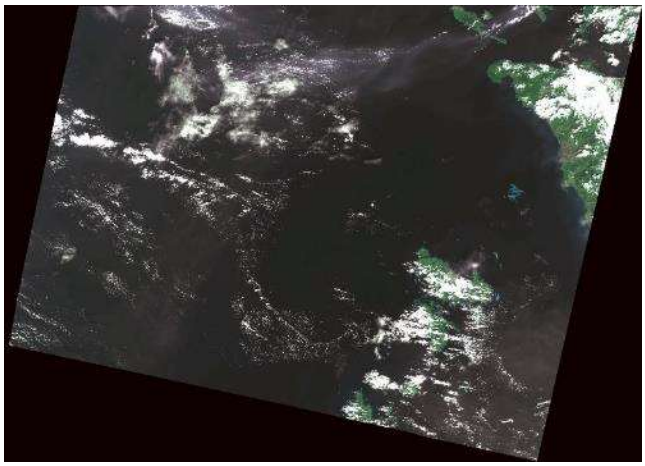
Satellite image (ALOS-2) provided by JAXA



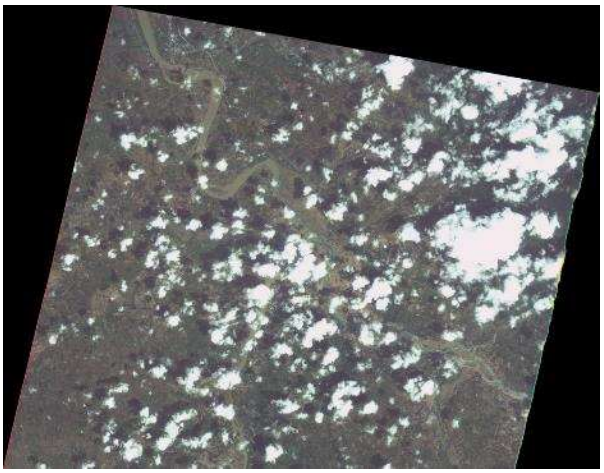
Satellite image (THEOS1) provided by GISTDA

(3) Flood and Landslides in the Philippines (GLIDE Number: FL-2021-000158-PHL)
Tropical storm Maring (Kompasu) made landfall in the vicinity of Fuga Island, the Philippines, on 11 October and crossed the Philippine Area of Responsibility (PAR). According to CNN, the National Disaster Risk Reduction and Management Council announced that the death toll was at least 23 as of 17 October.
(https://www.cnnphilippines.com/news/2021/10/16/Maring-death-toll-October-16.html)

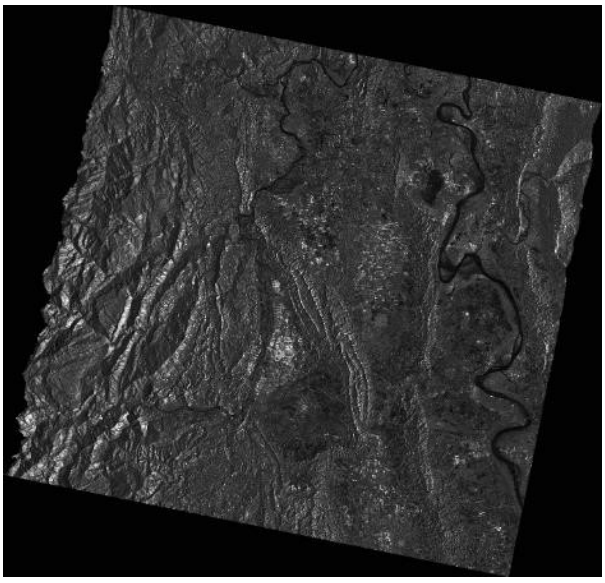
The Manila Observatory (MO) made an EOR to Sentinel Asia on 13 October. Among DPNs, JAXA, GISTDA, ISRO and NARL provided data. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211012PH.html



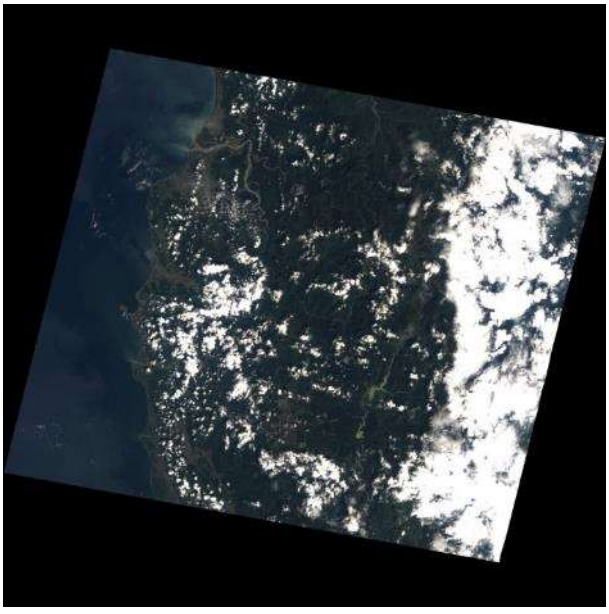
Satellite image (Resourcesat-2) provided by ISRO



Satellite image (FORMOSAT-5) provided by NARL



Satellite image (ALOS-2) provided by JAXA

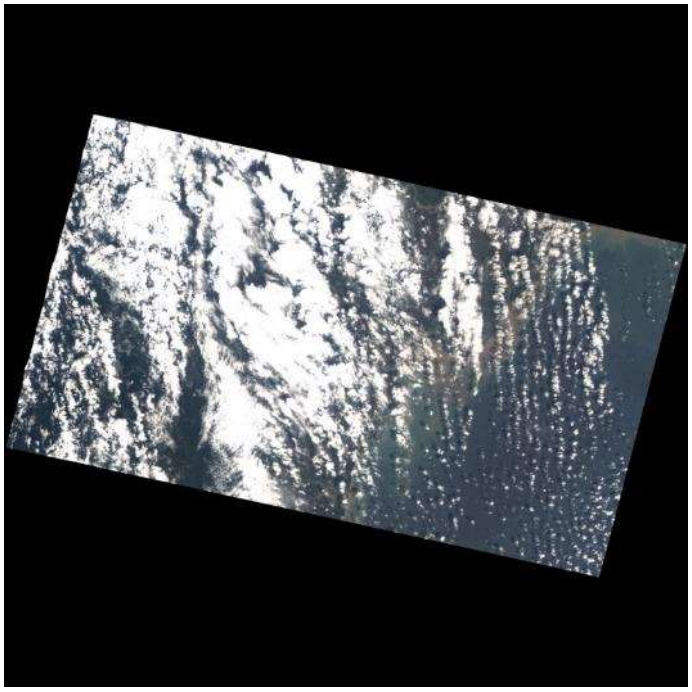


Satellite image (THEOS1) provided by GISTDA

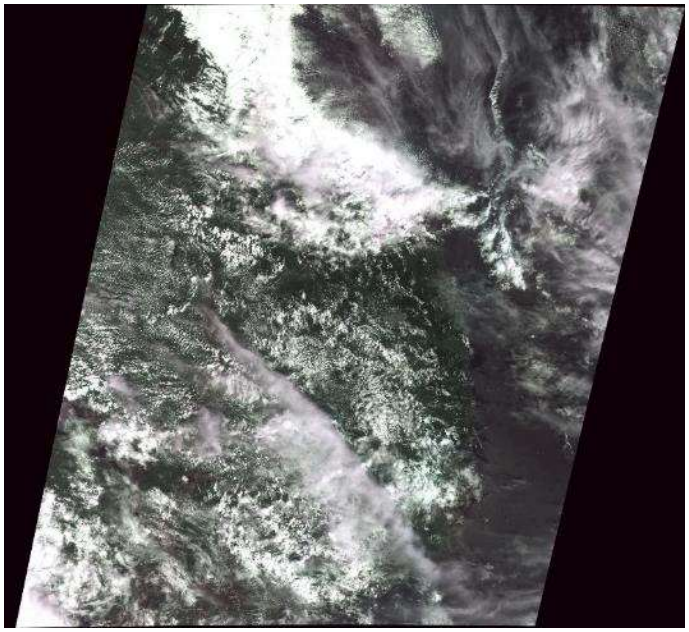
(4) Typhoon Kompasu in Vietnam (GLIDE Number: FL-2021-000158-PHL)

After passing over the Philippines, Typhoon Kompasu (Maring) approached Vietnam. According to the AHA Centre, the National Disaster Management Authority (VNDMA) reported that 2,144 houses were damaged and 2,669 ha of rice fields, 1,042 ha of other crops and 3,044 livestock were lost.
(https://ahacentre.org/wp-content/uploads/2021/10/FlashUpdate_03_20Oct2021-TC-KOMPASU-PHLVNMTHL.pdf)

MONRE made an EOR to Sentinel Asia on 10 October in anticipation of the disaster. Among DPNs, GISTDA and ISRO provided data. In addition, NARL planned to provide its data. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211012PH.html



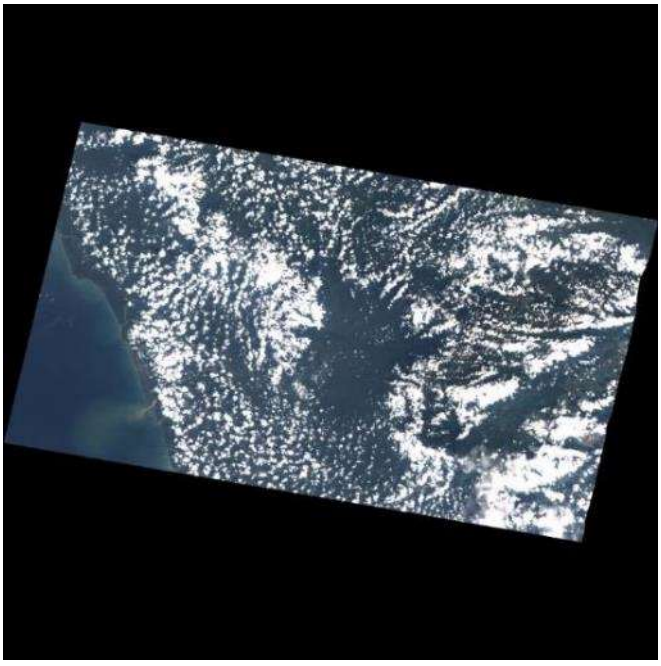
Satellite image (THEOS1) provided by GISTDA



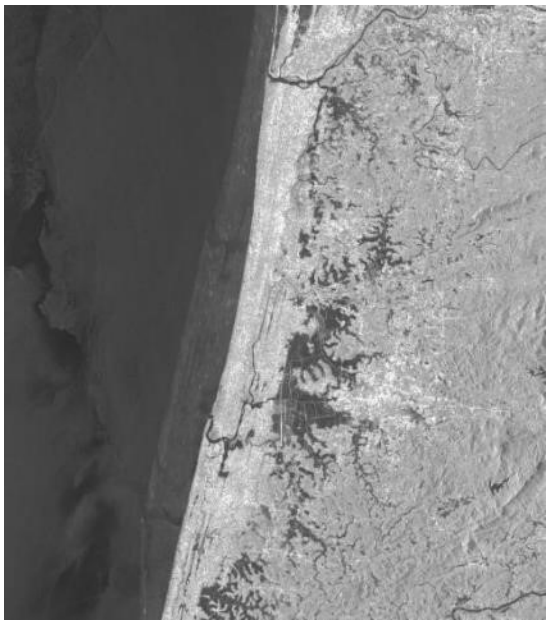
Satellite image (Resourcesat-2) provided by ISRO

(5) Flood, Landslides and Storm in India (GLIDE Number: FL-2021-000161-IND)
Heavy rain over Kerala state in India caused landslides and floods. CNN reported that at least 27 people were killed.
(https://edition.cnn.com/2021/10/18/india/kerala-rains-flooding-intl-hnk/index.html)

ISRO made an EOR to Sentinel Asia on 17 October. Among DPNs, GISTDA and JAXA provided data. In addition, NARL planned to provide its data. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211016IN.html



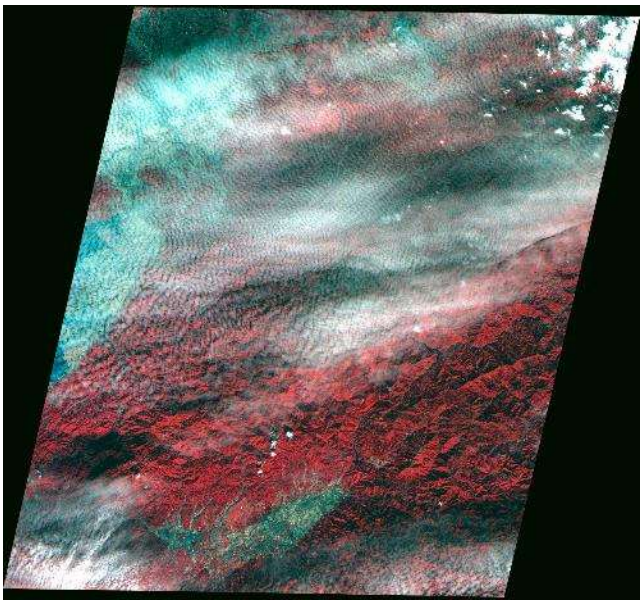
Satellite image (THEOS1) provided by GISTDA



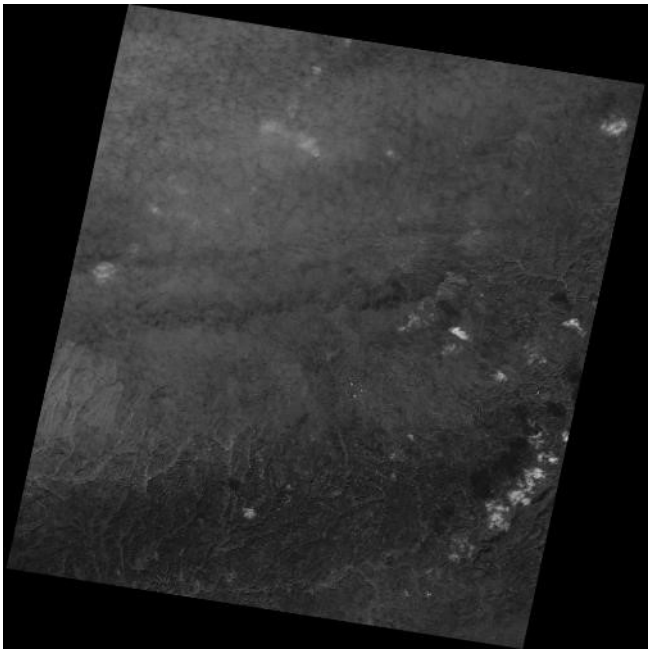
Satellite image (ALOS-2) provided by JAXA

(6) Volcanic eruption in Japan (GLIDE Number: VO-2021-000163-JPN)
A volcanic eruption was observed at Mt. Aso in southwestern Japan on 20 October. Kyodo News reported that Mt. Aso's volcanic alert level was raised to 3 on a scale of 5, with people urged not to approach the mountain.
(https://english.kyodonews.net/news/2021/10/fcaf30350266-urgent-mt-aso-in-southwest-japan-erupts-alert-level-raised.html)

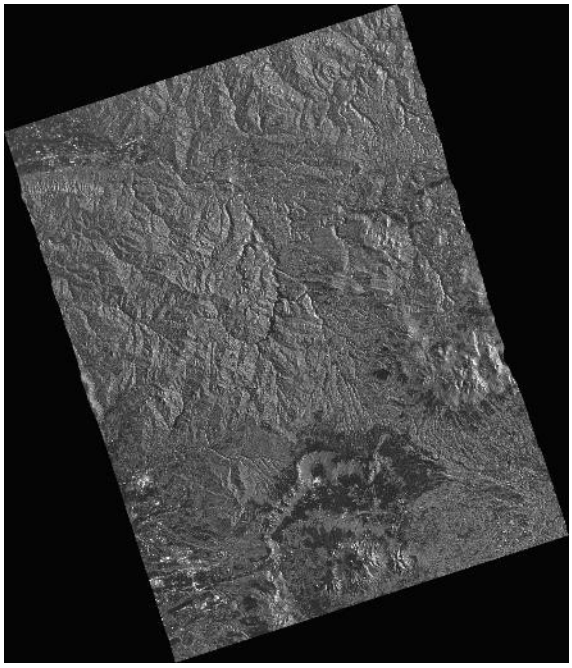
Asian Disaster Reduction Center (ADRC) made an EOR to Sentinel Asia on 20 October. Among DPNs, ISRO, GISTDA and JAXA provided data. In addition, MBRSC and NARL planned to provide their data.. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211020JP.html



Satellite image (Resourcesat-2) provided by ISRO



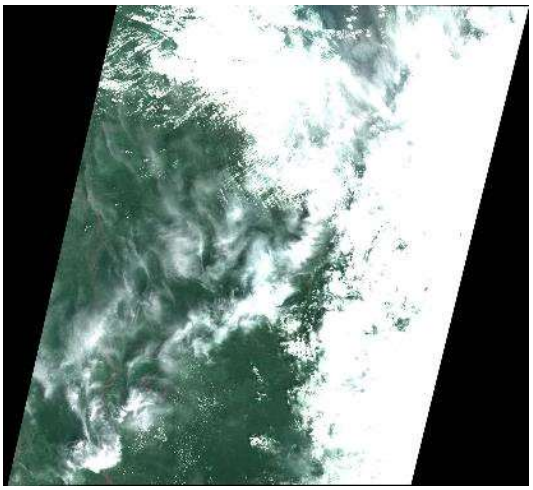
Satellite image (THEOS1) provided by GISTDA



Satellite image (ALOS-2) provided by JAXA

(7) Flood and Landslides in Vietnam (GLIDE Number: FL-2021-000166-VNM)
From 22 to 25 October, heavy rainfall was recorded in Vietnam, causing widespread floods. VNExpress reported that 11,000 houses were submerged, one person was killed and three others were missing.
(https://e.vnexpress.net/news/news/record-rainfall-deluges-central-vietnam-province-4376382.html)

MONRE made an EOR to Sentinel Asia on 25 October. Among DPNs, ISRO provided data. In addition, GISTDA planned to provide its data. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211020JP.html



Satellite image (Resourcesat-2) provided by ISRO

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2. [Interview] Dr. Raj Kumar, Outstanding Scientist, Director, National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO)

Dr. Raj Kumar
Outstanding Scientist
Director, National Remote Sensing Centre (NRSC)
Indian Space Research Organisation (ISRO)

The National Remote Sensing Centre (NRSC) of the Indian Space Research Organisation (ISRO) has been one of the leading supporters of the Sentinel Asia community so far and is strengthening its support to Sentinel Asia. The centre provides satellite observation for Emergency Observation Requests (EORs) from members of Sentinel Asia and contributes to the operation of Sentinel Asia. The Sentinel Asia secretariat interviewed Dr. Raj Kumar, Outstanding Scientist and Director, NRSC, to introduce the centre's activities regarding Sentinel Asia.

Dr. Raj Kumar currently leads a team of scientists and engineers from various disciplines, with a mandate of establishing ground stations, generation of data products, dissemination to users, development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students. His research is mainly focused on effective utilization of space technology, especially microwave remote sensing, for studies of ocean, atmosphere and climate to benefit society. He also leads the Indian Science Team for NASA-ISRO joint mission (NISAR) as Project Scientist.

Sentinel Asia Secretariat
ISRO is a major space agency and its brilliant achievements in recent years are well known. At the same time, its large scale makes it difficult to understand the roles of each department. Can you tell us about the role of NRSC, an ISRO core division, in the context of disaster management?

Dr. Raj Kumar
National Remote Sensing Centre (NRSC) is one of the major centres of Indian Space Research Organisation (ISRO), Department of Space (DOS), and has a mandate of establishing ground

stations for receiving satellite data, data product generation, dissemination to users, development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students.

ISRO has established the Decision Support Centre (DSC) at NRSC under ISRO's Disaster Management Support (DMS) Programme. It is a single-window delivery mechanism of space- and aerial-based information to accommodate various needs during all phases of disasters in India. The DSC provides space-based inputs in near real time regarding various disasters to the central and state DMS organizations in the country. These products are being used for relief and rescue operations, damage assessment and as input in disaster management by state and central DMS organisations in the field. NRSC, ISRO also provides Indian remote sensing satellite data support to various Emergency Observation Requests (EORs) received through Sentinel Asia and the International Charter regarding various disasters worldwide. We are also actively involved in capacity building programmes on "Space Technology Utilisation for Disaster Management and DRR" in the country and in Sentinel Asia region.

ISRO has established the National Database for Emergency Management (NDEM) at the behest of the Ministry of Home Affairs (MHA), India, which is a state-of-art facility. NDEM is a multi-scale geospatial database repository coupled with decision support system tools at a national level. It is a unique, homogenous database that serves the entire country with essential database elements for addressing emergency/disaster management with a structured framework and multi-institutional participation to assist disaster managers of India. NDEM disseminates all disaster-specific products via a geospatial platform named "Bhuvan" in near real time, in addition to maintaining a disaster-specific historical database.

Sentinel Asia Secretariat

The Sentinel Asia secretariat appreciates ISRO's contribution to Sentinel Asia as a Data Provider Node (DPN) for more than a decade now. Could you introduce some of NRSC's major activities in recent years relating to Sentinel Asia, including EOR response?

Dr. Raj Kumar

ISRO has been part of all of Sentinel Asia's three-step activities and has been contributing to various EORs by providing IRS-series satellite datasets since its inception. Apart from satellite datasets, NRSC/ISRO has volunteered the role of Data Analysis Node (DAN) to extend its expertise in generating value-added products and special reports for Cyclone "NARGIS" (Myanmar) – 2008, Pakistan floods – 2010, Japan Tsunami – 2011, Sri Lanka Floods – 2017 & 2018, Indonesia Tsunami – 2018.

In recent years, 2018-2021 (until August), about 67 EORs were supported with the help of 159 Indian Remote Sensing (IRS) satellite datasets in addressing various disasters in member

countries. These datasets include data from ResourceSat series, RISAT-1, Cartosat series, etc.

Sentinel Asia Secretariat

In addition to your contributions as a DPN, we appreciate your engagement as a Sentinel Asia Steering Committee (SC) member. In January 2020, ISRO hosted for the first time an SC meeting in Hyderabad. Could you tell us about your motivation or background reason for hosting this meeting and the result?

Dr. Raj Kumar

The 10th Steering Committee (SC) meeting was hosted by ISRO for the first time during 21 and 22 January, 2020, in Hyderabad in close association with the Japan Aerospace Exploration Agency (JAXA) as the Sentinel Asia Secretariat. About 17 international participants from SC member organizations participated in the meeting.

ISRO hosted this SC meeting in understanding of the requirements of Sentinel Asia member countries to gain exposure regarding the technologies utilized in addressing disaster management in respective countries and to have open-ended discussions on various aspects of disaster management. This has benefited both ISRO as well as Sentinel Asia in general in terms of the effectiveness of its approach to the Step 3 disaster risk reduction phase of Sentinel Asia. The following important actions emerged during the course of the meeting;

- Improving Sentinel Asia operations from the viewpoint of DPN and DAN.
- Strengthening user interaction within the Sentinel Asia community.
- Capacity building programmes on various disaster-specific themes were proposed after thorough discussions, and ISRO proposed to organize/contribute regarding three programmes: Drought Risk Management, Spatial Flood Early Warning, and Emergency Response Mapping and Crisis Management
- Existing Sentinel Asia working groups and related roles and responsibilities, as well as recommendations for future directions
- Strategies on the private sector's involvement in Sentinel Asia activities were discussed

Sentinel Asia Secretariat

It is a significant achievement in Sentinel Asia Step 3 that international collaboration to operate OPTEMIS developed by GISTDA with other members was realized. We would like to aim for the next level of collaboration among systems used by other members. In this regard, as you mentioned earlier, we understand that NRSC launched and operates the sophisticated "Bhuvan" platform. Could you tell us more about it and advise on possibilities for its use by Sentinel Asia members?

Dr. Raj Kumar

Bhuvan is an Indian geo-platform of ISRO. It provides a host of wide-ranging services covering visualization of multi-date, multi-platform, multi-sensor satellite data & thematic maps, query and analysis, free data & products download, near-real-time support to disaster services, mobile apps for crowdsourcing, and diverse geospatial applications, for utilization by citizens and government agencies. It serves as a Geospatial Governance platform by hosting applications of various ministries/departments of central/state governments for planning, monitoring and evaluation.

One of the important components of Bhuvan is disaster services. Disaster Management Information Support services are hosted on Bhuvan for six types of natural disasters: Flood, Cyclone, Drought, Forest Fire, Earthquake and Landslide. Information support ranging from prediction, early warning, alerts and aiding decision makers for post-disaster damage assessment, hazard zonation and rehabilitation plan. Bhuvan disseminates the information via SMS, e-mail and feeds to users. Bhuvan's rich administrative datasets and thematic datasets besides the core disaster ones comprise a single-window system and platform for users and decision makers to realize effective disaster mitigation and preparation plans.

All applications and services through Bhuvan are developed using open-source solutions and Open Geospatial Consortium (OGC) compliant and restricted to Indian territory. The Bhuvan framework can be customized and used for any disaster application as a collaborative effort with proper administrative arrangements by Sentinel Asia member countries. The geo-spatial database has to be provided by the member countries concerned. Of course, in order to induce interests and make such active participation from the part of member countries possible and fruitful, we will be pleased to raise awareness of Bhuvan, reaching out to the Sentinel Asia community by ourselves as well and we may also discuss specific plans to customize Bhuvan in close collaboration with member countries. Also, ISRO can provide technical support in strengthening the existing system developed by GISTDA.

Sentinel Asia Secretariat

On 19 and 20 July, 2021, ISRO organized and hosted a webinar called "Space Technology for Drought Risk Management" with IWMI, as a capacity building program with Sentinel Asia. Among the themes, "drought" is different from other disasters in terms of time frame (speed of progress). How should the Sentinel Asia community tackle such "slow-onset" disasters? And what can we expect ISRO's contribution to be on this issue?. Could you also advise us of your plan for future capacity building programs for Sentinel Asia, if any?

Dr. Raj Kumar

The occurrence and progression of drought are slow. It is a hydro-meteorological or environmental disaster. Drought monitoring and impact assessment is multi-disciplinary in nature

and includes meteorological, hydrological, agricultural and socio-economic indicators. Drought management requires a strong system for monitoring and timely assessment of impact. Recent advances in data-centric technologies such as remote sensing, mobiles and weather instrumentation and data analytics offer enormous opportunities for objective assessment of the drought situation leading to its effective management.

NRSC (ISRO) is an active partner in UNESCAP's regional cooperation mechanism for drought risk management. NRSC has developed automation tools for satellite data analysis in drought monitoring in Myanmar and Sri Lanka under this mechanism. Similarly, NRSC organised capacity building programmes for various countries, identified by UNESCAP. Such initiatives may also be taken up for Sentinel Asia member countries on drought risk management and monitoring. Development of automation tools for satellite data analysis in drought monitoring, organisation of customised capacity building programmes, and exchange of knowledge and methodologies are some of the activities that can be planned for Sentinel Asia.
Also, other than the "Space Technology for Drought Risk Management" webinar, as an active partner of Sentinel Asia, ISRO is planning to organize the following two capacity building training programmes:

1. Spatial Flood Early Warning by NRSC/ISRO with IWMI in October 2021
2. Emergency Response Mapping and Crisis Management by IWMI in association with ADRC, NRSC/ISRO in winter (TBC)

In addition to these, ISRO will support and be associated with any other capacity building programmes envisaged under Sentinel Asia in the near future.

Sentinel Asia Secretariat
We understand that ISRO is preparing for a NISAR project, an ISRO–NASA collaboration for a SAR satellite, which has cutting-edge sensors. Could you introduce this mission, including its possible contribution to Sentinel Asia?

Dr. Raj Kumar
ISRO and NASA JPL are jointly developing a state-of-the-art L- and S-band SweepSAR (NISAR), planned to be launched by India. The NISAR mission has been conceptualized to provide L- and S-band space-borne SAR data with high repeat cycle, high resolution and larger swath with capability of full-polarimetric and interferometric modes of operation. This science mission is expected to provide an impetus to the understanding of various processes for land, oceans and cryosphere in regional to global scales. NISAR data will address the critical issues of disaster management such as floods, forest fire, landslides, volcanoes, oil spills, earthquakes, glacier melt, etc. apart from many other applications. The data will be freely available and will be made available to Sentinel Asia users in addressing various disasters in member countries.

Sentinel Asia Secretariat

Lastly, what can you contribute to Sentinel Asia's activities in the future and what do you expect from Sentinel Asia?

Dr. Raj Kumar

ISRO has been supporting Sentinel Asia and other international commitments, by providing all the necessary Indian Remote Sensing satellite data as a DPN, based on the role ISRO has played as a DAN for specific disaster events. ISRO has organized several international meetings and symposia under Sentinel Asia, APRSAF, and the International Charter. Also, ISRO has contributed significantly to capacity building on various disaster themes for the national and international community. ISRO is firmly committed to working towards achieving the goals of Sendai Framework for Disaster Risk Reduction 2015-2030 in building a society resilient to disaster risks. ISRO ensures that it will extend similar support to Sentinel Asia member countries in the near future.

As ISRO requires satellite data from more space missions in microwave and optical regions from member countries to address disasters in India, Sentinel Asia may facilitate the provision of such data. ISRO would look forward to collaborative research on disaster risk modelling and risk reduction with expertise available among member countries on various disaster themes

<About Dr. Raj Kumar >

Dr. Raj Kumar received his master's and Ph.D. degrees in physics from Lucknow University. He has more than 100 publications in peer-reviewed journals of international repute and leading many young researchers towards their Ph.D. Dr. Raj Kumar also plays a pivotal role in propelling collaborations with international space agencies through various forums such as the Committee on Earth Observation Satellites (CEOS), the Coordination Group for Meteorological Satellites (CGMS), and the International Ocean Vector Winds Science Team (IOVWST). He currently co-leads the CEOS COAST team with the National Oceanic and Atmospheric Administration (NOAA).

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3. [Event] Sentinel Asia Webinar "Space Technology for Flood Forecast Modelling" co-organized by ISRO and IWMI was successfully held.

The webinar "Space Technology for Flood Forecast Modelling" was held on 27 and 28 October, jointly organized by ISRO and IWMI.

This webinar is a follow-on of the webinar on space-based drought risk management co-organized by ISRO and IWMI on 19 and 20 July, and featured, like its predecessor, general theories, experts' lectures and an interactive session, among others. Stakeholders, engineers and researchers participated in this webinar.

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4. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** November 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. [Interview] Dr. Kuang-Chong Wu, President of National Applied Research Laboratories (NARLabs), and Dr. Jong-Shinn Wu, Director General of National Space Organization (NSPO)
3. [News] Special Session on Sentinel Asia “Sentinel Asia for the ASEAN Region” under the AHA Centre Executive Programme held on 17 November 2021
4. How to Send an Emergency Observation Request
5. Using the Sentinel Asia Operation System, OPTEMIS

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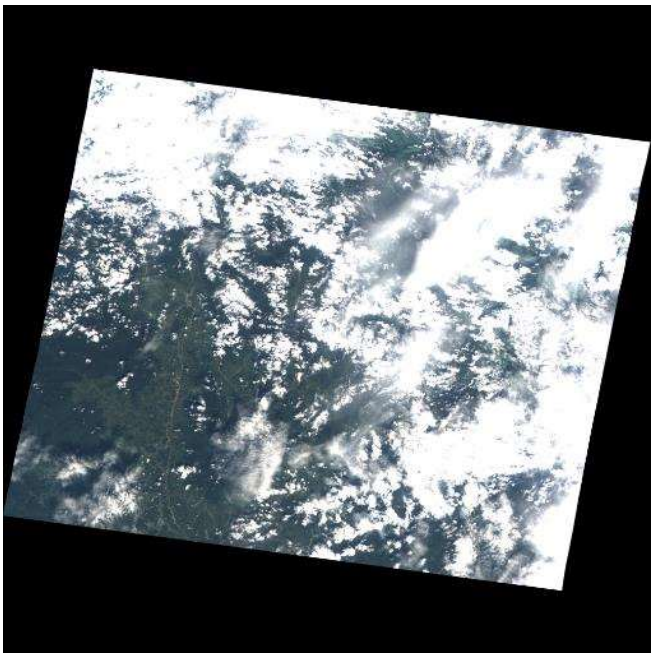
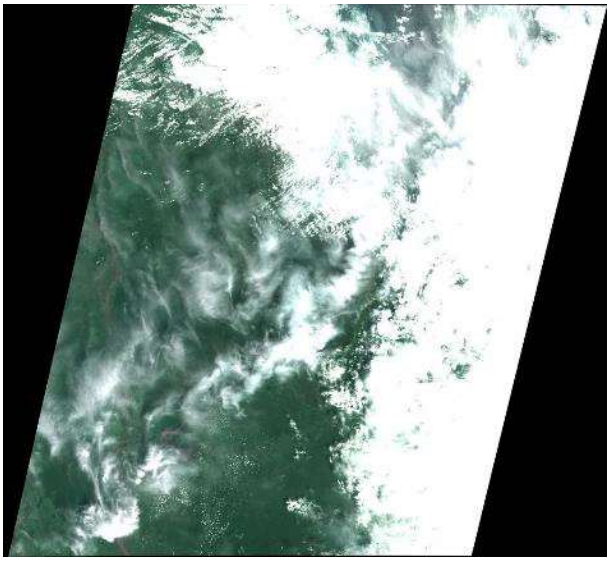
1. [News] Emergency Observation of Disasters (as of 25 November 2021)

(1) Floods and Landslides in Vietnam (GLIDE Number: FL-2021-000166-VNM)
From 22 to 25 October, heavy rainfall was recorded in Vietnam, causing widespread floods. “VNExpress” reported that 11,000 houses were submerged, one person was killed and three others were missing.
(https://e.vnexpress.net/news/news/record-rainfall-deluges-central-vietnam-province-4376382.html)

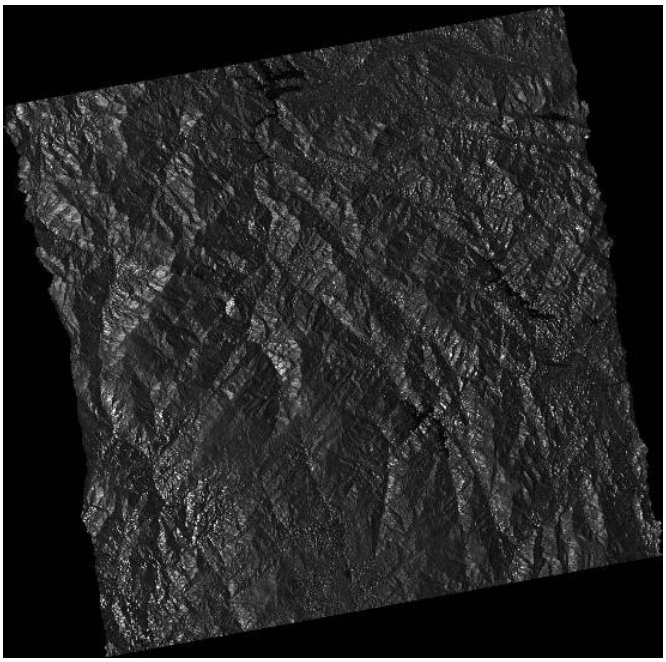
The Ministry of Natural Resources and Environment (MONRE) of Vietnam made an EOR to Sentinel Asia on 25 October. Among Data Provider Nodes (DPNs), the Japan Aerospace Exploration Agency (JAXA), the Indian Space Research Organization (ISRO), and the Geo-Informatics and Space Technology Development Agency (GISTDA) provided data. Among DANs, the Asian Institute of Technology (AIT) provided its VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211022VN.html



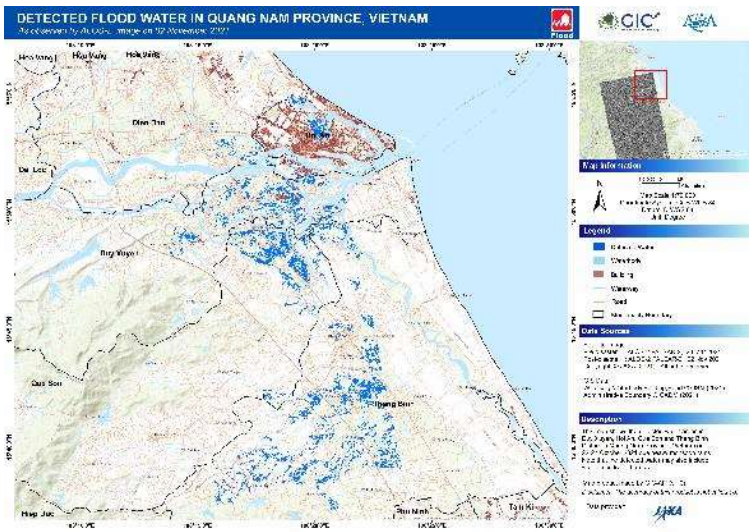
Satellite image (THEOS1) provided by GISTDA



Satellite image (Resourcesat-2) provided by ISRO



Satellite image (ALOS-2) provided by JAXA

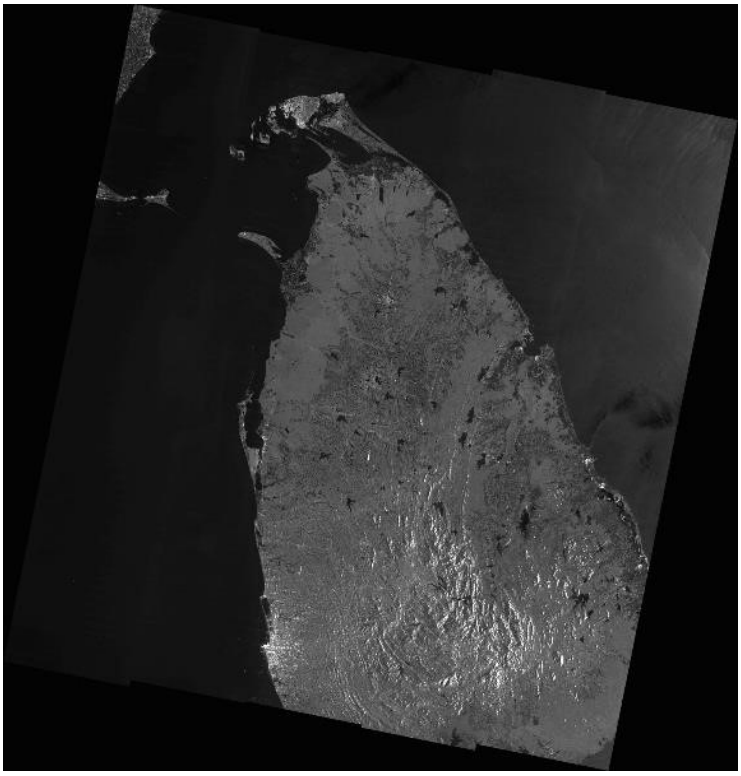


Value-Added Product by AIT

(2) Floods and Landslides in Sri Lanka (GLIDE Number: FL-2021-000188-LKA)
Heavy rain from the north-east monsoon in Sri Lanka caused floods and landslides. “India Today” reported that at least 26 people have been killed and over 230,000 others affected as of 12 November.
(https://www.indiatoday.in/world/story/people-killed-affected-extreme-weather-conditions-sri-lanka-1876063-2021-11-12)

The Disaster Management Center (DMC) of Sri Lanka made an EOR to Sentinel Asia on 15 November. This EOR was escalated to the International Disasters Charter. AIT assumed the role of Project Manager for this Charter activation. Among Data Provider Nodes (DPNs),

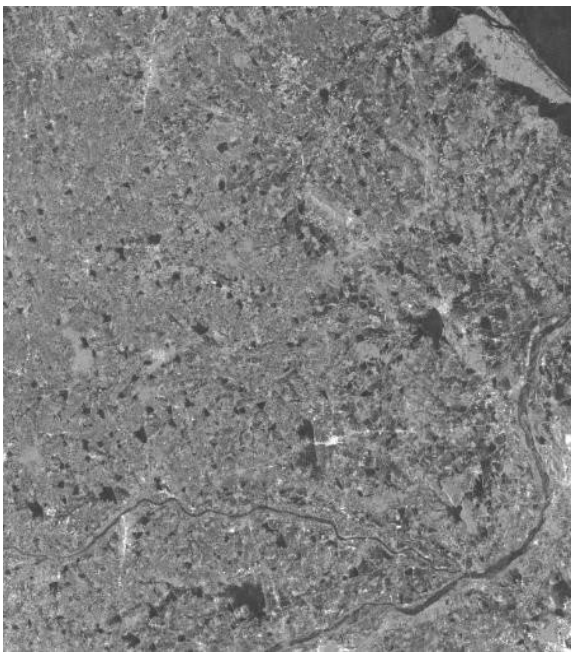
JAXA provided data. Among DANs, AIT provided its VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211105LK.html



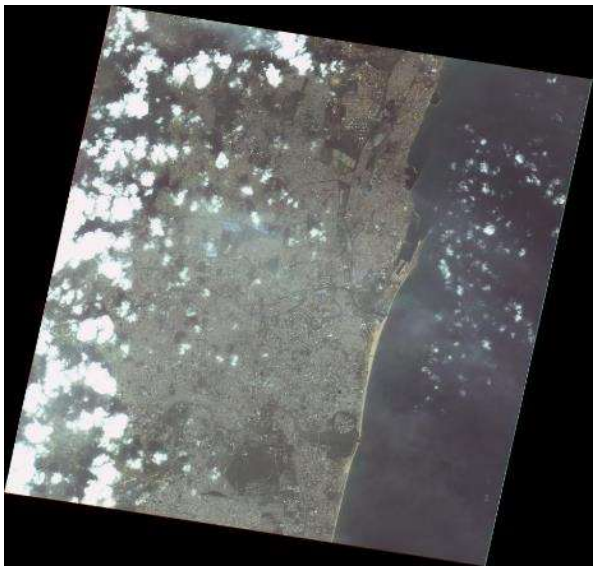
Satellite image (ALOS-2) provided by JAXA

(3) Floods in India (GLIDE Number: FL-2021-000172-IND)
Heavy overnight rain led to flooding in several areas of southern India including the city of Chennai. CNN reported that there was more than 20 centimeters of rainfall in Chennai, the heaviest since 2015. (https://edition.cnn.com/2021/11/07/india/chennai-india-rain-flood-intl-hnk/index.html)

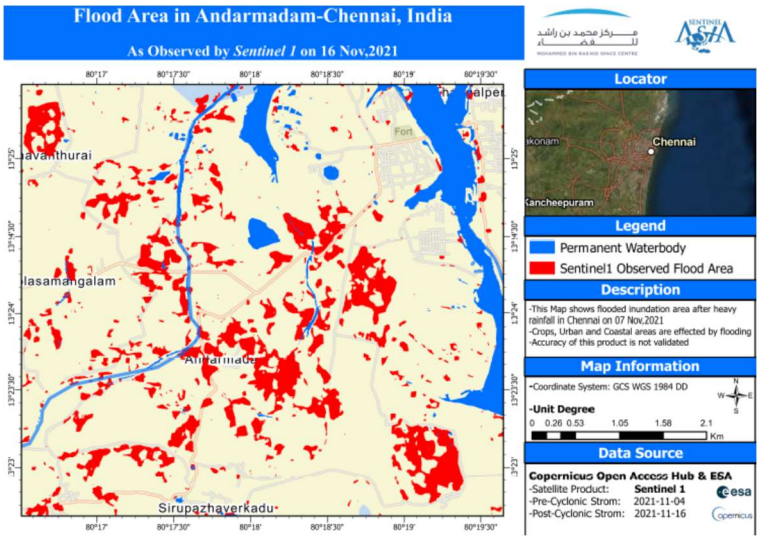
ISRO made an EOR to Sentinel Asia on 15 November. Among Data Provider Nodes (DPNs), JAXA and the National Applied Research Laboratories (NARL) provided data. Among DANs, AIT and the Mohammed Bin Rashid Space Centre (MBRSC) provided their VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211107IN.html



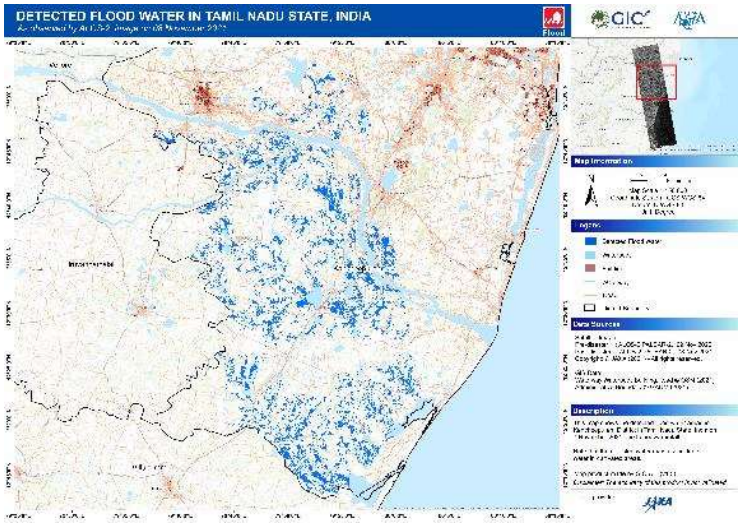
Satellite image (ALOS-2) provided by JAXA



Satellite image (Formosat-5) provided by NARL



Value-Added Product by MBRSC



Value-Added Product by AIT

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2. [Interview] Dr. Kuang-Chong Wu, President of National Applied Research Laboratories (NARLabs), and Dr. Jong-Shinn Wu, Director General of National Space Organization (NSPO)

The National Applied Research Laboratories (NARLabs) of Taiwan joined Sentinel Asia (SA) in 2010. Since then, NARLabs, along with the National Space Organization (NSPO), one of the institutes under NARLabs, continues to provide its satellite data to SA. Recently, they contributed to the realization of SA operation system OPTEMIS in collaboration with Academia Sinica from Taiwan and Geo-Informatics and Space Technology Development Agency (GISTDA). They are also working with the newly developed Taiwan Data Cube (TWDC) on the further application of Earth observation data. The SA secretariat interviewed Dr. Kuang-Chong Wu, President of NARLabs, and Dr. Jong-Shinn Wu, Director General of NSPO, to ask about their connection to SA and related contributions, past and future.

Dr. Kuang-Chong Wu, President of National Applied Research Laboratories (NARLabs)

Dr. Jong-Shinn Wu, Director General of National Space Organization (NSPO)

Sentinel Asia Secretariat

NARLabs and NSPO are long-time SA members in addition to being major players in this region. Could you introduce the missions and roles of each organization to readers?

Dr. Kuang-Chong Wu, NARLabs

NARLabs, the National Applied Research Laboratories, is the largest R&D organization under Taiwan's Ministry of Science and Technology. We have four major missions: to establish R&D platforms, to support academic research, to promote frontier science and technology, and to foster high-tech manpower. There are eight research centers under the umbrella of NARLabs, including NSPO, the National Space Organization, TORI, the Taiwan Ocean Research Institute, and NCREE, the National Center for Research on Earthquake Engineering.

Taiwan has a "2030 Science and Technology Vision," which is to create an innovative, inclusive, and sustainable society. With our earth and environment technology, NARLabs is ready to support the Sendai Framework in building a disaster-resilient society. That's why NARLabs as a whole, not only NSPO, volunteered to join Sentinel Asia in 2010. In the past decade, NARLabs has also invited partners from Taiwan's Academia Sinica and National Central University to collaborate with the Sentinel Asia family. Looking back at the evolution

of Sentinel Asia, NSPO has made many contributions. NARLabs has more to offer when we expand our work from disaster response to preparedness/mitigation and the recovery phase.

Dr. Jong-Shinn Wu/NSPO
NSPO is the only national space research organization in Taiwan. We have nearly 300 employees working for national missions, most of which are satellite projects, and are very happy to cooperate with the Sentinel Asia.

Secretariat
You mentioned that NARLabs had also invited partners from the National Central University to join Sentinel Asia. Does NARLabs collaborate with universities and other institutes under NARLabs for SA activities?

NARLabs
Universities are not under NARLabs, but all of our centers work very closely with them. Also, there are other institutes for ocean research, earthquake engineering, and supercomputing that we work with. They are not SA members, but our data are on the Open Data Cube, which we cooperate on. We will continue to find future opportunities to engage in discussions with such institutes and bring them into our framework of cooperation when needed.

Secretariat
The Sentinel Asia Secretariat appreciates Team Taiwan for its long-time support to SA as a DPN and a DAN. Could you highlight some of your contributions to past EORs?

Dr. Jong-Shinn Wu/NSPO
The most significant effort, I think, is that related to the Great East Japan Earthquake and tsunami in 2011. In that tragic disaster, NSPO worked very closely with JAXA to schedule joint observation by FORMOSAT-2 and ALOS-2 of the disaster for a one-month period. The first image captured by FORMASAT-2 after the tsunami struck was shown on the front page of the SA website.

In 2010 and 2021, NSPO has contributed to Sentinel Asia activities as a Data Provider Node. NSPO as a DPN has successfully responded to various Emergency Observation Requests (EORs) pertaining to 23 countries and 173 major disaster relief activities with FORMOSAT-2 and FORMOSAT-5 satellite datasets comprising before and after events.

Secretariat
The Secretariat also appreciates your support to the Sentinel Asia Step 3 system. We think it is a significant achievement in SA Step 3 activities that this system is operated under multinational cooperation, combined with OPTEMIS provided by GISTDA. What role did you have in the

OPTEMIS operation?

Dr. Jong-Shinn Wu/NSPO

The Sentinel Asia Step 3 system was developed by the SA Step 3 technical team, which consists of Japan Aerospace Exploration Agency (JAXA) of Japan, GISTDA of Thailand, NARLabs, and Academia Sinica Grid-computing Centre (ASGC) of Taiwan. The Step 3 system is a cloud-based system that aims to improve the data efficiency and security of the previous generation SA system. In this system, the GISTDA-provided OPTEMIS is used as the operational interface and the system is hosted on NARLabs/ASGC using cloud infrastructure. The tech team was organized in April 2019, and resulting system development activities were conducted at three different sites and through monthly Web meetings and a face-to-face meeting in June 2019 in Taipei. Finally, the SA Step 3 system was released online and announced operational in October 2019 as planned. The new system provides up-to-date functionalities from an ICT technical point of view for Sentinel Asia disaster relief and mitigation activities. The more important achievement is the mechanism of multinational cooperation and the process of distributed implementation, which can serve as a success story for future cooperation.

Secretariat

Indeed, this is a success story. Sentinel Asia has evolved stepwise from the pilot project phase into the current operational phase, “Step 3,” and in this phase, Sentinel Asia aims at “joint implementation,” whereby each member of JPT-3 is recommended to share its resources in order to achieve more effective and sustainable operation. This contribution by NSPO and Academia Sinica perfectly matches this ideal.
Could you tell us how this cooperation started?

Dr. Jong-Shinn Wu/NSPO

After 10 years of working closely with Sentinel Asia as a core DPN, we thought we could contribute further by providing Taiwan’s famous ICT and cloud services. In January 2019, NSPO represented NARLabs and signed an agreement with SA Step 3 Joint Project Team to provide cloud service for the SA Step 3 system. The selected cloud service provider ASGC in Taiwan is a long-term partner of NSPO, and helps to bring FORMOSAT data from Svalbard receiving station back to Taiwan. They are both technically capable and familiar with the FORMOSAT operational environment, which can be integrated into the system development team efficiently. The later successful experience of implementing the Step 3 system on time demonstrates this. The Step 3 system has been operational now for more than two years, with an availability of 99.9%. NSPO, NARLabs, and ASGC will provide further necessary assistance to fulfill SA’s future operational needs in order to contribute to regional disaster humanitarian relief.

Secretariat

Recently, you started operation of Taiwan Data Cube. Could you introduce this system, and how do you evaluate its benefit to the Sentinel Asia Community?

Dr. Jong-Shinn Wu/NSPO

Currently Taiwan Data Cube (TWDC) has been established in NSPO to manage and operate analysis-ready data acquired by FORMOSAT series satellites and other open-source, remote-sensing satellites. The features of TWDC are:

- Provision of analysis-ready data for FORMOSAT-2 and FORMOSAT-5 and other open satellite data;
- High-performance cloud computing environment maintained by National Center for High-performance Computing;
- Development and execution of data analysis in a cloud computing environment;
- Provision of public and private cubes, with authorized users able to access data of various cubes.

It is not free for all use cases. For large commercial users, we charge only management cost because it is mostly built with open sources.

For the latter question, we evaluate its benefit by two major points:

- Taiwan Data Cube applications are showcased to highlight the value of Earth Observation for SDGs. They properly connect data and users.
- Value-added products can be easily made available to the stakeholders in the form of open data cubes, in the public domain.

Secretariat

Could you tell us about past and future contributions of the FORMOSAT satellite series, related to disaster monitoring and early recovery, to the SA community?

Dr. Jong-Shinn Wu/NSPO

First, one of the characteristics of the FORMOSAT satellite series is its short repeat cycle orbit. This means that the imagery data are especially suited for regular monitoring of rapidly changing situations, such as in effective response in the aftermath of a disaster. We follow emergency management planning guides to process the EOR in the response stage to support the SA community for disaster management. In the past 10 years, FORMOSAT satellites have supported time series observations to help disaster agencies in the Asia-Pacific region assess the extent of damage, facilitating early recovery. The data have been applied in various types of EOR during the early phases of crises. Examples include object-based image classification using change detection to obtain damage assessment data and detection of flooding areas from multispectral data.

Second, Formosat-2 and Formosat-5 data can be used in satellite image artificial intelligence correction research; the training data sets can be applied in AI applications such as compiling maps and rice field detection programs.

Finally, in the future remote sensing program, we are considering Formosat-8, for which there are plans to develop six remote sensing satellites, constructing a constellation, for global coverage and multiple local revisits. It will be able to acquire data more frequently, with high spatial coverage. Furthermore, it is also expected to achieve not only more abundant spectral information but also higher spatial resolution. We believe that this program can contribute further benefits to overall disaster assessment for the SA community.

To be more specific, and for your information, Formasat-8 will have 1-meter resolution for panchromatic and 2-meter resolution for multi-spectral, with 12-kilometer swath. It was originally planned to be launched in 2023, but now it will be in 2024 due to the COVID-19 pandemic. Formasat-8 consists of six satellites, A to F, and the constellation enables us to shorten the revisit time, which is three times per day for the Taiwan area. We are now planning the orbit but some of them will observe in morning and others will do so in afternoon, which will contribute to disaster monitoring.

Secretariat
Could you tell us what you expect from Sentinel Asia and about your future plans to support it?

Dr. Kuang-Chong Wu/NARLabs
Recently I have seen that Sentinel Asia is proactively working on several strategic plans in the Step 3 phase. The efforts are aimed at several important issues such as improving efficiency and building private–public partnerships. Among the goals set in the SDGs' agenda, "Leave no one behind" is the first thing that I expect from Sentinel Asia. We in the Asia-Pacific region, including Taiwan, are constantly facing various threats from natural hazards, so I am very glad we joined Sentinel Asia. During the past decade, we provided assistance to others who needed it, and conversely, we received assistance when we needed it through the Sentinel Asia community. I hope that we did not leave any one behind, especially those who do not own technology and do not have resources to reach out for help. The second is that I'd like to see Sentinel Asia in the global picture. The community could establish mechanisms to exchange experiences with other regional/global communities so that they can learn from each other.

About future plans to support it, earlier this year, Taiwan passed the "Space Development Act." Since then, the Ministry of Science and Technology has focused on completing related regulations including those for "Establishing the National Space Center as an Executive Legal Entity," in order to lay a long-lasting foundation for Taiwan's space development. Then,

sometime in the next year, NARLabs and NSPO will become separate entities. As I had mentioned earlier, in addition to NSPO's capabilities, NARLabs has more to offer in Step 3, especially when Sentinel Asia expands research from disaster response to the preparedness, mitigation, and recovery phases. Among these capabilities, the most important one is the establishment of a regional Open Data Cube. We have proposed this platform to the Steering Committee for a decision. If it is adopted as an infrastructure, I believe the interoperability will significantly improve the operational efficiency. In addition, we recently encouraged NCREE to join Sentinel Asia. NCREE and National Taiwan University are combining AI and satellite remote-sensing data to conduct landslide susceptibility analysis. Moreover, TORI has developed an Ocean Bottom Seismometer Observation system. In a joint research project with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the observation data provided better understanding of the science of tectonic evolution and the dynamics of multi-subduction zones. Building on the success of what we have achieved together in the past decade, we will, with all our efforts, support and safeguard our homeland with all partners in the Sentinel Asia community.

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3. [News] Special Session on Sentinel Asia "Sentinel Asia for the ASEAN Region" under the AHA Centre Executive Programme held on 17 November 2021

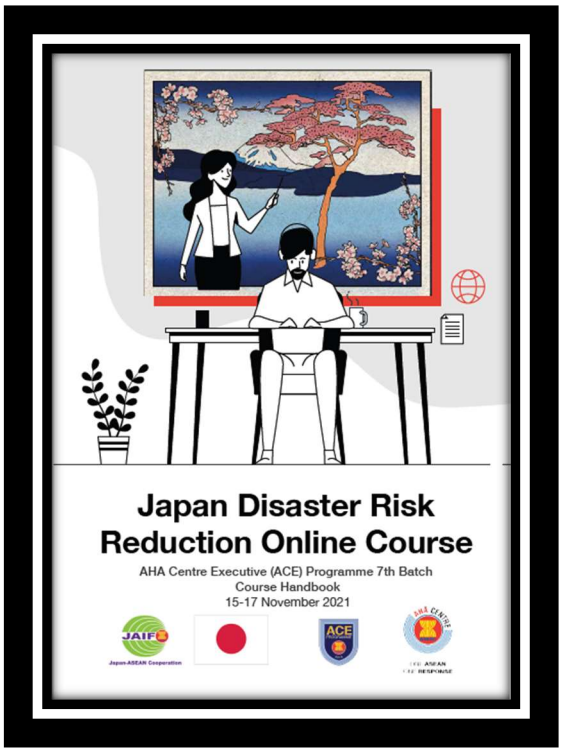
"The AHA Centre Executive Programme (ACE Programme)" is an over 4-month training course conducted by the ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) with a view to developing future leaders of national disaster management offices (NDMOs) in ASEAN countries. Started in 2014, this year marks the 7th batch of the programme. As its vision states, many of the alumni of previous batches of ACE Programme have been already representing and leading their NDMOs.

Prof. Mizan Bisri of Kobe University (JPT member organization based in Japan) had been appointed by the AHA Centre to facilitate to liaise with Japanese-base resources for the programme and organized the "Japan Disaster Risk Reduction (DRR) Online Course" from 15 to 18 November 2021, as part of the ACE Programme. As part of the Japan DRR Online Course, an invitation was extended to the Sentinel Asia Secretariat for organizing a dedicated joint session composed of speakers from Japan-based Sentinel Asia JPT member organizations.

The joint session was held on 17 November 2021, with the title "Sentinel Asia: Space-based disaster risk management support for the benefit of the Asia-Pacific region ~Sentinel Asia for the ASEAN Region~". More than 30 future young leaders from 24 NDMOs (as well as AHA Centre staff members) attended the session. Experts from the Asian Disaster Reduction Center (ADRC), the University of Tokyo, and the JAXA/Sentinel Asia Secretariat gave lectures and hands-on training courses. The thematic topics of the training courses include "How to make Emergency

Observation Requests (EORs) to Sentinel Asia"; "How to utilize Web-GIS system for obtaining tangible damage information"; and "Extraction of building footprints from satellite data." At the end of the session, information on many other training opportunities by JPT members including those who were not at the session was also introduced, and participants whose organizations are not yet JPT members were strongly encouraged to make applications for membership.

The organizing team is convinced that, as the outcome of the session, participants have become familiar with the significance and benefits (including ones to be upgraded in the future) of Sentinel Asia and how they can enjoy such benefits. Through this joint session with the AHA Centre and Kobe University, the partnership between NDMOs of ASEAN member states and Sentinel Asia has been further strengthened.



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4. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia

FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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5. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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** December 2021 News from Sentinel Asia Project Office **

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Topics:

1. [News] Emergency Observation of Disasters
2. [Event] Summary report of the Sentinel Asia session at the APRSAF-27
3. [Report] Brief Report on Sentinel Asia Training Programme on "Space Technology for Flood Forecast Modelling" organized by NRSC (ISRO), and IWMI under Sentinel Asia (*article contribution from ISRO and IWMI)
4. [Report] Sentinel Asia Annual Report 2020 has been published!
5. How to Send an Emergency Observation Request
6. Using the Sentinel Asia Operation System, OPTEMIS

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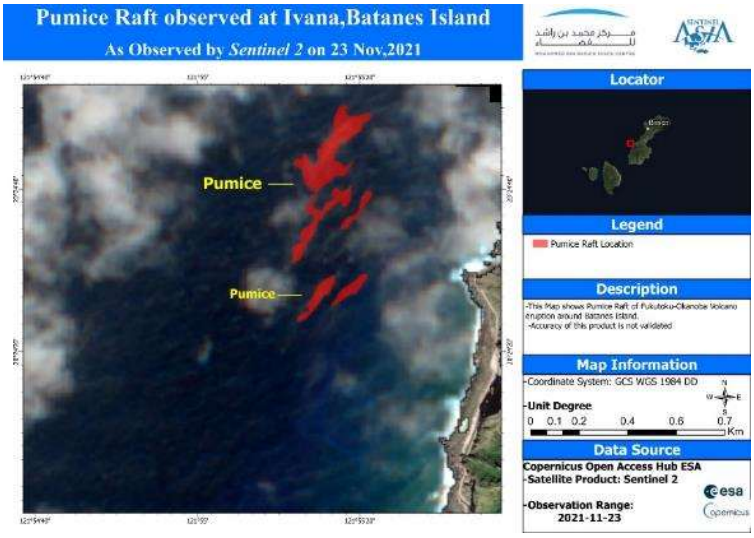
1. [News] Emergency Observation of Disasters (as of 27 December 2021)

(1) Volcanic eruption influence in the Philippines (GLIDE Number: VO-2021-000191-PHL)
In August 2021, Fukutoku Okanoba volcano, an underwater volcano in Japanese territory, erupted and ejected a huge amount of pumice stones and debris. These stones floated on the sea surface and a portion of them reached the Philippine coast.
(https://mb.com.ph/2021/11/23/pumice-stones-debris-spewed-by-japans-underwater-volcano-reach-batanes-shores/)

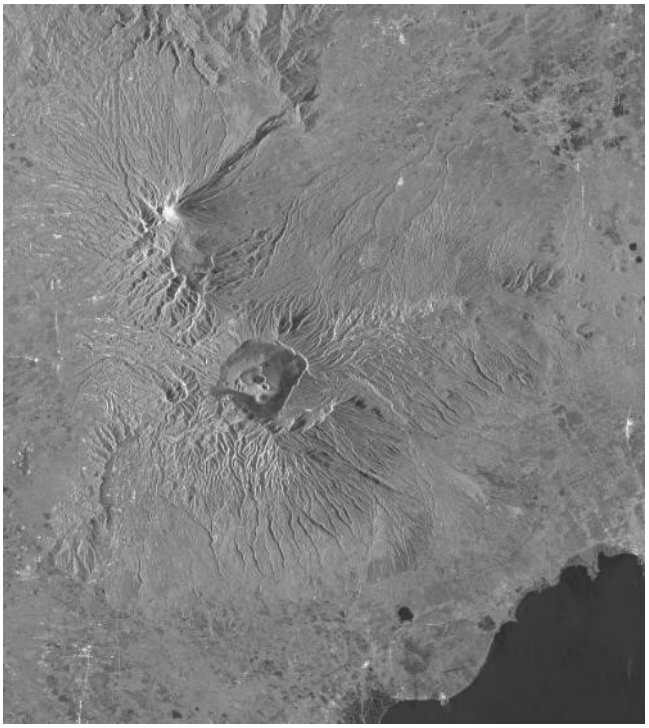
The Philippine Institute of Volcanology and Seismology (PHIVOLCS) made an EOR to Sentinel Asia on 24 November. This EOR was escalated to the International Disasters Charter. PHIVOLCS assumed the role of Project Manager for this Charter activation. Among Data Analysis Nodes (DANs), the Mohammed Bin Rashid Space Centre (MBRSC) provided its VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211123PH.html



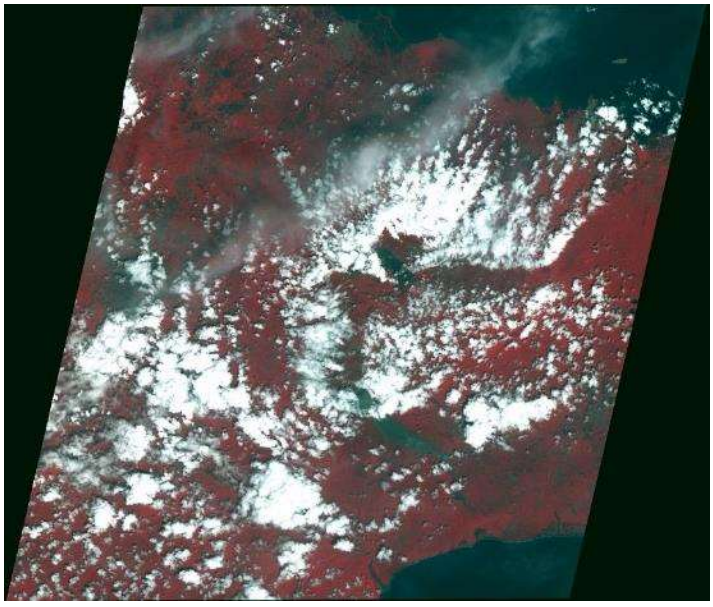
Value-Added Product by MBRSC

(2) Volcanic eruption in Indonesia (GLIDE Number: VO-2021-000194-IDN)
On 4 December 2021, Mount Semeru volcano in Indonesia erupted and produced a hot cloud avalanche with volcanic materials and heavy ashfall. According to ReliefWeb, the Indonesian National Board for Disaster Management (BNPB) reported that the number of fatalities had increased to 15, with 27 people missing and 169 injured. More than 1,700 people were displaced across 19 refugee posts, and 5,205 people and 2,970 houses were affected. (https://reliefweb.int/disaster/vo-2021-000194-idn/)

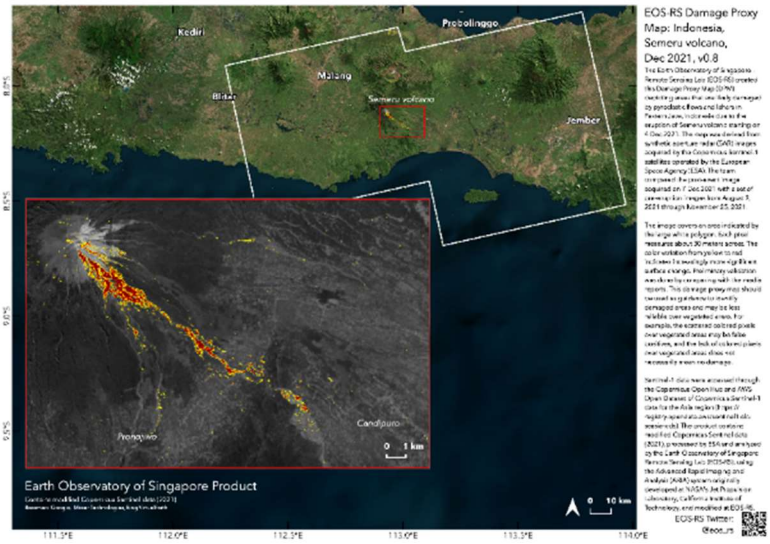
The Japan International Cooperation Agency (JICA) made an EOR to Sentinel Asia on 7 December. This EOR was escalated to the International Disasters Charter. The Asian Institute of Technology (AIT) assumed the role of Project Manager for this Charter activation. Among Data Provider Nodes (DPNs), the Japan Aerospace Exploration Agency (JAXA), the Indian Space Research Organization (ISRO), and the National Applied Research Laboratories (NARL) provided data. Among DANs, the Earth Observatory of Singapore (EOS), Yamaguchi University, and MBRSC provided their VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211123PH.html



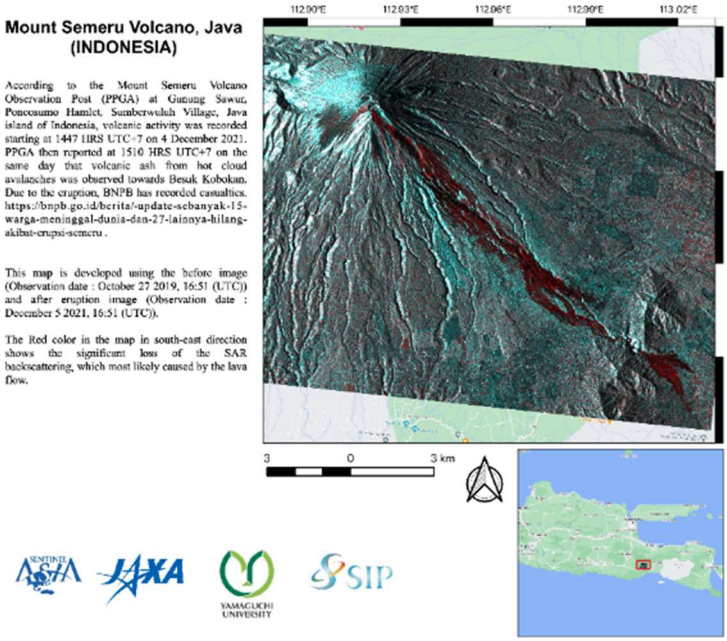
Satellite image (ALOS-2) provided by JAXA



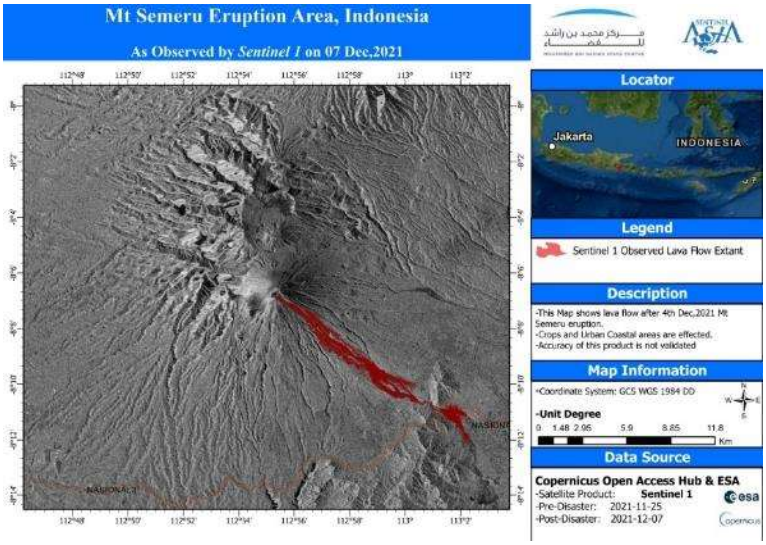
Satellite image (Resourcesat-2) provided by ISRO



Value-Added Product by EOS



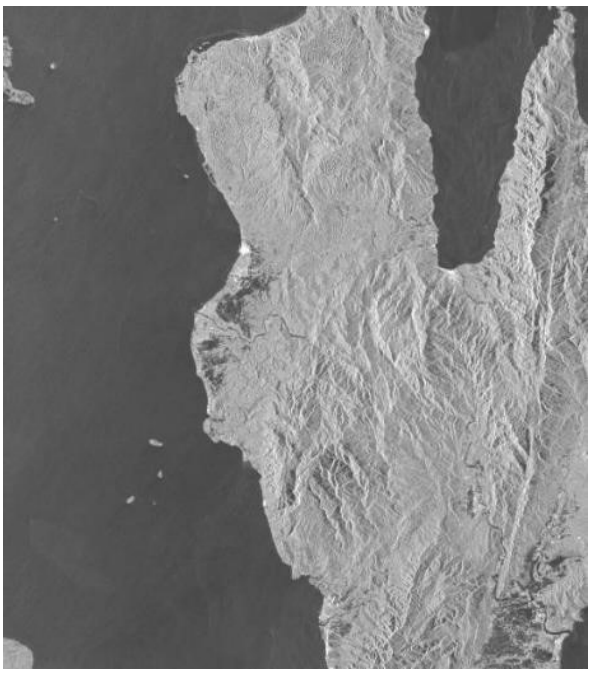
Value-Added Product by Yamaguchi University



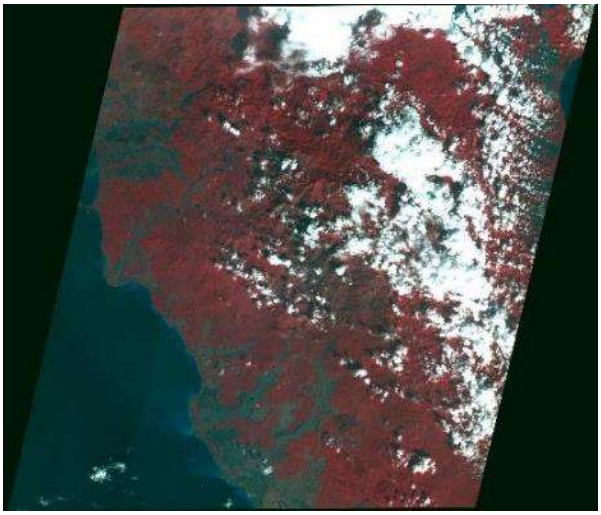
Value-Added Product by MBRSC

(3) Tropical Storm Odette in the Philippines (GLIDE Number: TC-2021-000202-PHL)
Super Typhoon Rai (Odette) made landfall on the Philippines on 16 December 2021. ReliefWeb reported that according to the National Disaster Risk Reduction and Management Council (NDRRMC) and the Department of Social Welfare and Development (DSWD), it killed at least 258 people, injuring 568 people and displacing 631,000 people as of 23 December.

Manila Observatory (MO) made an EOR to Sentinel Asia on 15 December anticipating the approach of the typhoon. Among Data Provider Nodes (DPNs), JAXA, ISRO, NARL, and the Geo-Informatics and Space Technology Development Agency (GISTDA) provided data. Among DANs, EOS and AIT provided their VAPs. Information on the latest response by Sentinel Asia is available at the following link:
https://sentinel-asia.org/EO/2021/article20211123PH.html

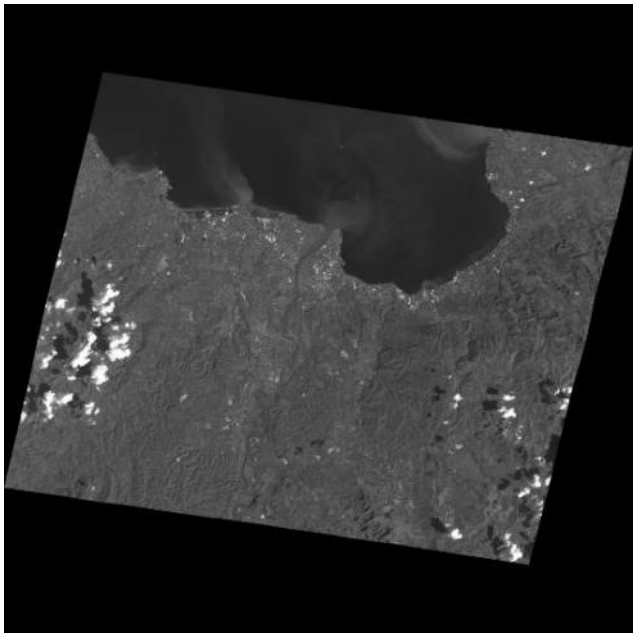


Satellite image (ALOS-2) provided by JAXA

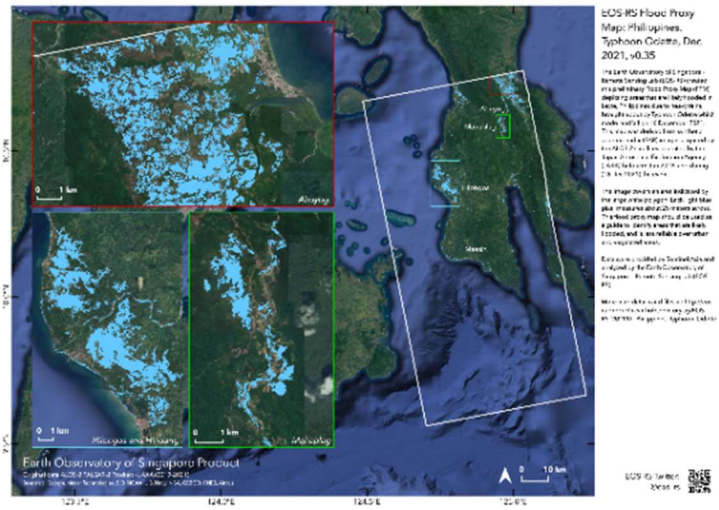


Satellite image (Resourcesat-2A) provided by ISRO

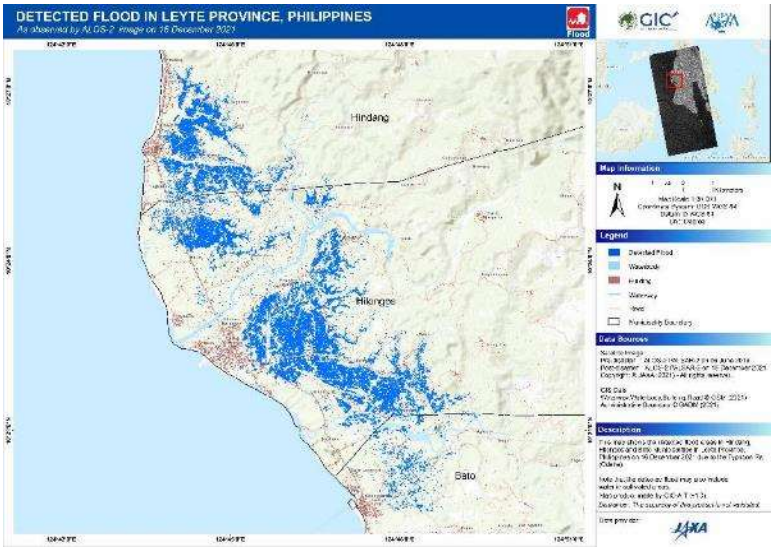
Satellite image (Formosat-5) provided by NARL



Satellite image (Theos-1) provided by GISTDA



Value-Added Product by EOS



Value-Added Product by AIT

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2. [Event] Summary report of the Sentinel Asia session at the APRSAF-27

The 27th session of the Asia-Pacific Regional Space Agency Forum (APRSAF-27) was held online from 30 November to 3 December 2021. The APRSAF-27 was co-organized by the Vietnam Academy of Science and Technology (VAST), the Ministry of Education, Culture, Science and Technology (MEXT) of Japan, and JAXA with the slogan "Expand Space Innovation through Diverse Partnerships."

On 1 December, a dedicated Sentinel Asia session was organized and hosted by the Sentinel Asia Secretariat in close collaboration with the Steering Committee members as part of Satellite Applications for Societal Benefit Working Group (SAWG) of the APRSAF-27. The session heard the following six presentations:

(1) "Sentinel Asia - Trend of Emergency Observation Request" (ADRC)
(2) "Sentinel Asia Status Report" (JAXA)
(3) "NSPO-NARLabs Engagement in Sentinel Asia" (NARLabs/NSPO)
(4) "Integration of Satellite data and Crowdsourced information through a Mobile App for the Sentinel Asia" (GIC/AIT)
(5) "Development of Mirror Target Calibration for Optical Satellite Data" (Yamaguchi University)
(6) "Using Earth Observation to help Pacific countries managing disaster risk reduction and response" (Pacific Earth Observation Council)

Through the Sentinel Asia session itself and its report by the SAWG co-chair in the high-level segment of the APRSAF (Plenary Session), the APRSAF-27 witnessed the development of the Sentinel Asia Step-3 system, led by the Technical Team composed of GISTDA, NARLabs/NSPO with Academia Sinica, and JAXA. The APRSAF-27 noted that the Sentinel Asia community had significantly upgraded its activities to address the entire disaster management cycle, with the contribution to the Sendai Framework in mind. Such activities included the establishment of "Standard Operating Procedure for making Emergency Observation Request (EOR) to Sentinel Asia" in several countries, a mobile application for sharing in-situ disaster information developed by AIT, a project by Yamaguchi University aimed at enhancing the reliability of optical satellite data, and an initiative by the University of Tokyo to extract building map from satellite data. Finally, the APRSAF-27 appreciated that NARLabs/NSPO had expressed their intention to provide Sentinel Asia with Formosat-8 satellite data after its launch.

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3. [Report] Brief Report on Sentinel Asia Training Programme on “Space Technology for Flood Forecast Modelling” organized by NRSC (ISRO), and IWMI under Sentinel Asia (*article contribution from ISRO and IWMI)

Background

Sentinel Asia is an international cooperation platform in which space agencies, disaster management agencies, and international organizations collaborate to combat natural disasters in the Asia-Pacific region on voluntary basis by using earth observation satellite data and Web-GIS technologies. Towards building a disaster-resilient society, the Sentinel Asia community has envisaged capacity-building programmes in strengthening of Sentinel Asia activities. To address such need, at the Joint Project Team Meeting in Bangkok in 2019, a specific Training Workshop was organized for the first time in which member organizations mutually train with their respective expertise and knowledge. In the Training Workshop, Indian Space Research Organisation (ISRO) and International Water Management Institute (IWMI) conducted training programmes on “topological and hydrological modelling”, and “emergency response mapping using multisource satellite data”. During the Sentinel Asia steering committee (SC) meeting organised in 2020 in Hyderabad, India, further discussions took place on strengthening the capacity-building programmes under Sentinel Asia. Following the SC meeting in 2020, ISRO and IWMI jointly proposed to expand the achievements, by volunteering themselves in providing capacity building for the benefit of the Sentinel Asia community. To begin with, the following capacity-building programmes were envisaged under Sentinel Asia:

(1) Space Technology for Drought Risk Management by National Remote Sensing Centre (NRSC)/ISRO, India in association with IWMI during 19-20 July, 2021
(2) Space Technology for Flood Forecast Modelling by NRSC/ISRO in association with IWMI during 27-28 October, 2021
(3) Emergency Response Mapping and Crisis Management by IWMI in association with ADRC and NRSC/ISRO in February 2022 (TBC).

Following the successful completion of the first capacity-building programme, the second Asia Pacific webinar on Space Technology for Flood Forecasting has been jointly organised by NRSC/ISRO and IWMI. About 80 participants from 13 Sentinel Asia countries/regions including ISRO and IWMI have participated in the programme. The training programme was coordinated by the Sentinel Asia Secretariat.

Flood Forecasting and Space Technology

In recent decades, flood damage trends have been increasing exponentially across the globe. This is a consequence of change in climatic conditions, changes in upstream land use and a

continuously increasing concentration of population and assets in flood-prone areas. A variety of mitigation measures can be implemented to minimize the impact of flooding. Satellite technology can provide vital information on the hydrology and topography of the catchment that plays a major role in spatial flood early warning. Flood forecasting is one of the best non-structural methods of flood damage mitigation being adopted globally. Remote sensing satellites provide key data for monitoring floods and cyclones in near real time. While spatial flood forecast modelling forms the keystone during the preparedness phase, flood forecasting provides an edge by proving the information well before the occurrence of the event. This flood forecasting is one of the best non-structural methods of flood damage mitigation methods that can give spatial flood alerts well in advance of the event. Due to the availability of high-resolution digital terrain models, as well as advanced hardware and software, early warnings and alerts for spatial floods are gaining importance in recent years. Satellite technology can provide vital information on the hydrology and topography of the catchment that plays a major role in spatial flood early warning.

Scope of the training programme

Capacity building is a powerful tool in disaster risk reduction and a very important element towards building a disaster-risk-resilient society. The objective of the programme has been to appraise the participants from Sentinel Asia member countries/regions on the potential and current status of EO technologies in operational flood forecast modelling and spatial flood inundation modelling using hydrological and hydrodynamic modelling techniques.

The programme has consisted of expert presentations/lectures and an interactive session to make it more impactful. The scope for augmenting applications of technology, research data gaps, its limitations and information-sharing opportunities were planned and documented for the future course of action towards promoting the technology for flood disaster risk reduction.

Proceedings of the 2-day training programme (27-28 Oct 2021)

This webinar brought together a total of around 80 experts and practitioners from different Sentinel Asia member countries/regions. The inaugural Session of the training Programme included a welcome by Dr. V. V. Rao, Deputy Director, Remote Sensing Applications, NRSC and brief remarks by (a) Mr. Miyoshi Takanori, Sentinel Asia Secretariat, (b) Dr. Mark Smith, Director General, IWMI, and (c) Dr. Raj Kumar, Director, NRSC. The 2-day webinar was conducted for the Asia Pacific region during 27-28 October, 2021. This is the second webinar conducted by ISRO in association with IWMI in continuation to the Drought Webinar as part of the capacity-building event of this kind in which Sentinel Asia members mutually help build capacity with their respective experience and expertise. In this inaugural session, it was stressed that the Sentinel Asia community would continue to support and foster mutual capacity building among members through cooperation. The inaugural session was completed with a formal vote of thanks by Dr. K H V Durga Rao, NRSC, ISRO.

During the key remarks, experts emphasized that floods are an important hydro-meteorological disaster causing huge economic losses with cascading effects, hence the need for using space-based inputs as a solution coupled with institutional partnership and the importance of community awareness in bringing effective flood disaster risk reduction was highlighted. The ever-increasing flood frequency and magnitude of disastrous flood events especially in South Asia and Southeast Asia is a major cause of concern. Therefore, this current training programme was quite relevant to develop understanding among the participants of the nature of disasters and the scope for new technologies to minimise/mitigate losses from such disasters using space technology for predicting and forecasting flood events in advance to enable sufficient lead time to respond. All the speakers in the inaugural Session have indicated the need for organising flood management-related capacity-building programmes, more frequently for the benefit of Sentinel Asia member countries/regions.

Fig 1: Inaugural Session of 2-day Webinar on Space Technology for Flood Forecasting & Modelling on Oct 27, 2021 (Virtual Mode)

Technical Session – 1: In this session, four presentations were given. It started with a brief presentation on “Hydrological Modelling” by NRSC, setting the base for the rest of the presentations. The presentation highlighted the importance of flood forecasting, different methods of flood forecasting, routing methods and deriving the hydrological and hydrodynamic parameters for flood forecasting using space-based inputs.

The second presentation in this Session was a demo on Flood Forecasting Modelling by NRSC, ISRO. The demo was addressed in introducing the participants to Hydrological Modelling

using open-source modelling software of HEC-HMS (Hydrological Engineering Centre-Hydrological Modelling System) and its utility. Topographic parameter extraction using satellite-based inputs like DEM (Digital Elevation Model), LULC (Land Use and Land Cover), and Soils were demonstrated. Preparation of meteorological models and integration with basin models was discussed. Flood forecast hydrograph computation, its calibration and validation were also demonstrated.

The third presentation in this Session was on Flood Inundation Simulation Modelling using a high-resolution Digital Terrain Model (DTM) by NRSC, ISRO. The presentation highlighted the stark differences between satellite-based flood mapping and flood inundation simulation using hydrological and hydrodynamic inputs with DEM as a primary input. It has brought out the need for flood inundation simulation and different models being used globally for deriving inundation simulation followed by the data requirements. The presentation also brought out the advantages and disadvantages of both 1D and 2D approaches and their relevance for simulation under different flow conditions.

Day 1 of the technical session concluded with a demo on flood inundation simulation using open-source software (HEC-RAS) by NRSC, ISRO. The demo showcased the creation of a terrain model, geometric mesh, boundary conditions and running the simulation in 2D unsteady flow condition for one of the reaches of Sabari River, India, as a case study. The demo concluded with results showing the water depth, velocity, etc. and an animation showing the flood progression and recession in an interactive session with the participants.

Technical session 2: In this session, there were six presentations. The day started formally with a recap of Day 1 and a discussion on the various presentations delivered on Day 1 by Dr. K H V Durga Rao. Subsequently, the first presentation of Day 2 was an invited lecture on Cyclogenesis, Forecasting Systems and Extreme Rainfall events by an expert speaker from the India Meteorological Department. The presentation gave good insight into the approaches followed in India and elsewhere on genesis, formation, prediction of landfall and dissipation of cyclonic systems and various aspects related to cyclone-based impacts on weather systems. The presentation highlighted technical elements related to forecasting systems on cyclones and storm surges and the impact of extreme rainfall events on land processes.

The second presentation in this session was on flood forecasting and early warning system in the cloud framework by IWMI Sri Lanka. The presentation focused on the importance of cloud-based services for flood forecasting and early warning systems for large basins and their importance in reducing computation time and storage requirements. Further, the presentation showcased the success stories of risk transfer/flood insurance in the Bagmati basin of Nepal and has ascertained the importance of flood insurance as a land-use regulation practice and incentivising people. It also showcased the success story of the Zambezi basin case study in

West Africa.

The third presentation in this session was an invited lecture on urban flood modelling by Indian Institute of Technology (IIT), Bombay. The presentation discussed at length the concepts of hazard, risk and vulnerability in urban floods. It clearly brought out the different types of vulnerabilities and how to derive various parameters to derive flood risk maps. The presentation concluded with case studies of urban flood modelling of Mumbai city, deriving of flood risk assessment maps for the Mithi river and part of the Mahanadi basin, Odisha State, and also introduced the participants to various models that can be implemented to address urban flood modelling.

The fourth presentation of the day was on an operational flood early warning system - case studies by NRSC, ISRO. The presentation covered the development of spatial flood forecast model for the Tapi and Godavari River Basins, India, using space-based inputs. It also covered spatial flood inundation simulation models using a high-resolution digital terrain model and web-enabled spatial flood early warning system. Real-time operation using IMD rainfall data was presented during the session.

In the brief session on interactive presentations, there were two presentations by participants from the Philippines and Singapore. The presentation by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) showcased the disaster profile of their country, frequency and magnitudes of floods and cyclones, measures for mitigating / responding to various disasters, disaster management in their country, satellite-derived ready-data products, flood inundation modelling, etc.

The presentation by Earth Observatory of Singapore (EOS) included a brief presentation on microwave data analysis for flood response and intricacies in analysing the microwave data to derive flood inundation layers. The presentation also comprised case studies related to flood mapping and monitoring in their country.
Some of the participants interacted with the experts on specific aspects of drought occurrence in their regions and the scope for developing customised information products.

Concluding remarks
The Sentinel Asia Secretariat extended its gratitude to ISRO and IWMI for organizing this webinar, by reiterating the significance of capacity-building activities and recalling the previous webinar on drought management conducted by ISRO and IWMI in July 2021. He expressed his wishes and continued support to expand this endeavor for the benefit of the Sentinel Asia community.

ISRO and IWMI indicated that with the availability of open-access satellite data and easily

accessible advanced techniques such as cloud platforms, it is possible to develop robust flood monitoring and management systems for timely action to reduce flood risks. It was also concluded that a regional cooperation mechanism among the Sentinel Asia member countries/regions needed to be established further to share the analysis-ready flood-related data, knowledge and expertise for enhancing flood disaster risk-reduction capabilities.

Webinar brochure with details of technical presentations

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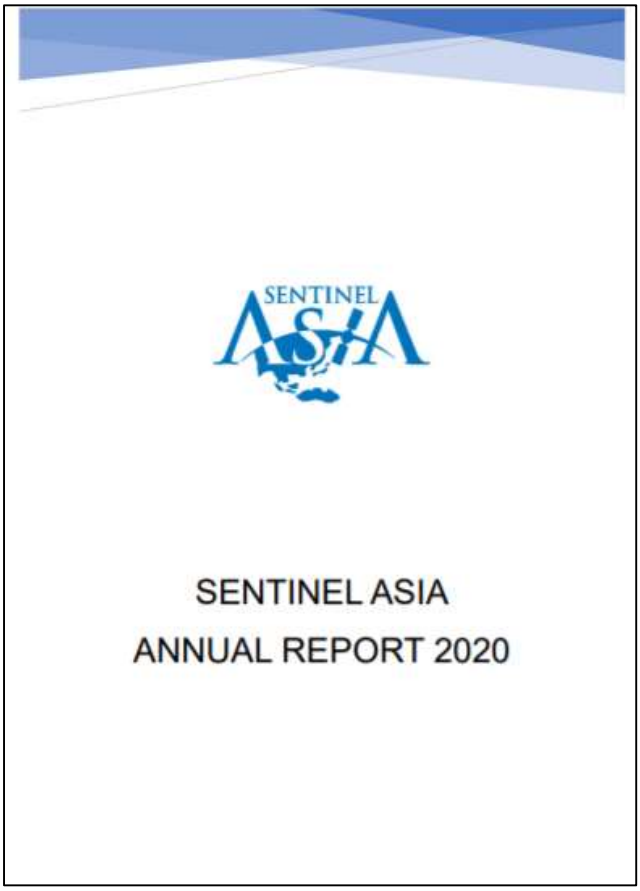
4. [Report] Sentinel Asia Annual Report 2020 has been published!

Sentinel Asia's activity report for the year 2020 has been published. The report features, among others, (i) a detailed review on EORs conducted in 2020 including good practices. (ii) external relations such as news, publications, and reports on conferences, and (iii) an analytical survey of Sentinel Asia's operations.

In 2020, Sentinel Asia's annual general meeting "Joint Project Team Meeting (JPTM)" was forced to be called off due to the COVID-19 pandemic. In this regard, this Annual Report provided JPT members with an alternative opportunity to report their Sentinel Asia-related activities, which would have been provided as part of the JPTM. In response to the invitation by the Sentinel Asia secretariat team, 24 JPT members contributed their activity reports, which are printed in the Appendix section of the Annual Report.

The Annual Report is available on the Sentinel Asia webpage at
https://sentinel-asia.org/reports/Reports/SA_Annual_Report_2020.pdf



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5. How to send an Emergency Observation Request

JPT member organizations are entitled to send an Emergency Observation Request (EOR) for disasters in the Asia-Pacific region. Please refer to https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html.

EOR Order Desk:
Asian Disaster Reduction Center (ADRC)
HP: http://www.adrc.asia/
E-mail: sarequest@adrc.asia
FAX: +81-78-262-5546,
TEL: +81-78-262-5540

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6. Using Sentinel Asia Operation System, OPTEMIS

Sentinel Asia launched a new operation system, OPTEMIS. Please refer to the website on how to create an account for OPTEMIS. https://sentinel-asia.org/e-learning/Emergency_Observation_Request.html

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Sentinel Asia Project Office
Satellite Applications and Operations Center (SAOC)
Japan Aerospace Exploration Agency (JAXA)
Ochanomizu Sola City, 4-6 Kandasurugadai, Chiyoda-ku, Tokyo 101-8008 Japan
E-mail: Z-SENTINEL.ASIA@ml.jaxa.jp
TEL: +81-3-6435-6785
FAX: +81-3-5777-1580

List of JPT Members

(94 organizations from 28 countries/regions and 17 international organizations)

No.	Country / Region	No.	Organization	Data Provider Node (DPN)	Data Analysis Node (DAN)
1	Armenia	1	Ministry of Emergency Situation (MES)		
2	Australia	2	CSIRO Office of Space Science and Applications (COSSA)		
		3	Geoscience Australia (GA)		
		4	Bureau of Meteorology (BOM)		
3	Bangladesh	5	Bangladesh Space Research and remote Sensing Organization (SPARRSO)		
4	Bhutan	6	Department of Disaster Management, Ministry of Home and Cultural Affairs		
		7	National Land Commission		
		8	Sherubtse College, Royal University of Bhutan		
		9	Department of Geology and Mines (DGM)		
		10	Ministry of Works and Human Settlement (MoWHS)		
5	Brunei	11	Survey Department (SD), Ministry of Development		✔
6	Cambodia	12	Ministry of Land Management, Urban Planning and Construction		
		13	National Committee for Disaster Management (NCDM)		
7	China	14	National Disaster Reduction Center of China (NDRCC), Ministry of Civil Affair		
		15	College of Disaster and Emergency Management, Beijing Normal University (BNU)		
		16	Institute of Geology, China Earthquake Administration (CEA)		✔
		17	Sichuan University		✔
		18	The Chinese University of Hong Kong (CUHK)		✔
		19	Institute of Mountain Hazards and Environment (IMHE), Chinese Academy of Sciences (CAS)		✔
8	Fiji	20	National Disaster Management Office, FIJI (NDMO)		
9	India	21	Indian Space Research Organization (ISRO)	✔	✔
		22	University of Kashmir		
		23	Gauhati University		
		24	Symbiosis Institute of Geoinformatics (SIG) , Symbiosis International University (SIU)		✔
10	Indonesia	25	National Disaster Management Agency (BNPB)		
		26	Indonesian National Institute of Aeronautics and Space (LAPAN)		✔
		27	Institute of Technology Bandung (ITB)		
		28	Universitas Jenderal Achmad Yani (UNJANI)		
		29	Center for Remote Sensing and Ocean Sciences (CReSOS) Udayana University		✔
		30	Center of Technology for Natural Resources Inventory (PTISDA - BPPT)		✔
		31	Ministry of Marine Affairs and Fisheries		✔

11	Japan	32	Keio University		
		33	Japan Aerospace Exploration Agency (JAXA)	✔	✔
		34	Infrastructure Development Institute (IDI) Japan (IFNet)		
		35	Hokkaido University		
		36	Yamaguchi University		✔
		37	Chubu University		✔
		38	Chiba University		✔
		39	Hiroshima Institute of Technology		✔
		40	Tokyo Institute of Technology (TIT)		✔
		41	International Research Institute of Disaster Science, Tohoku University		✔
		42	University of Tokyo		✔
		43	National Research Institute for Earth Science and Disaster Resilience (NIED)		✔
		44	Japan International Cooperation Agency (JICA)		
		45	RIKEN		✔
		46	Kobe University		✔
12	Kazakhstan	47	National Center of Space Researches and Technologies (NCSRT)		✔
13	Korea	48	Korea Aerospace Research Institute (KARI)	✔	✔
		49	National Disaster Management Research Institute (NDMI)		✔
14	Kyrgyz	50	Central Asian Institute of Applied Geosciences (CAIAG)		✔
15	Lao P.D.R.	51	Ministry of Labor and Social Welfare		
		52	Natural Resources and Environment Institute (NREI), Ministry of Natural Resources and Environment (MONRE)		
16	Malaysia	53	National Security Division, Prime Minister's Department		
		54	Malaysian National Space Agency (ANGKASA)		✔
17	Mongolia	55	Information And Research Institute Of Meteorology, Hydrology And Environment (IRIMHE)		
18	Myanmar	56	Department of Meteorology and Hydrology (DMH)		
		57	Relief and Resettlement Department (RRD)		
		58	Myanmar Earthquake Committee (MEC) , Myanmar Engineering Society (MES)		
19	Nepal	59	Survey Department (SD)		
		60	Department of Water Induced Disaster Management (DWIDM), Ministry of Irrigation		
		61	Land Management Training Centre		
		62	Department of Hydrology and Meteorology (DHM), Ministry of Population & Environment		

20	Pakistan	63	Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)		✔
21	Papua New Guinea	64	National Disaster Centre (NDC)		
22	Philippines	65	Office of Civil Defense (OCD), National Disaster Risk Reduction and Management Council (NDRRMC)		
		66	National Mapping and Resource Information Authority (NAMRIA)		✔
		67	Bureau of Soils and Water Management (BSWM), Department of Agriculture		
		68	Mines and Geoscience Bureau (MGB), Department of Environment and Natural Resources		
		69	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)		✔
		70	Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD)		
		71	Philippine Institute of Volcanology and Seismology (PHIVOLCS)		✔
		72	Manila Observatory (MO)		✔
		73	NOAH Center of the University of the Philippines Resilience Institute		✔
23	Singapore	74	Centre for Remote Imaging, Sensing and Processing (CRISP)	✔	✔
		75	Earth Observatory of Singapore (EOS)		✔
24	Sri Lanka	76	Survey Department of Sri Lanka		✔
		77	Ministry of Disaster Management		✔
25	Taiwan	78	National Applied Research Laboratories (NARL)	✔	✔
		79	Center for Space and Remote Sensing Research, National Central University (CSRSR, NCU)		✔
26	Thailand	80	Geo-Informatics and Space Technology Development Agency (GISTDA)	✔	✔
		81	Department of Disaster Prevention and Mitigation (DDPM)		
		82	Department of Water Resources (DWR)		
		83	Royal Forest Department (RFD)		
		84	National Park, Wildlife and Plant Conservation Department		
		85	Royal Irrigation Department (RID)		
		86	Land Development Department (LDD)		
		87	Andaman Environment and Natural Disaster Research Center, Prince of Songkla University (ANED, PSU)		✔

27	United Arab Emirates	88	Mohammed Bin Rashid Space Centre (MBRSC)	✔	✔
28	Vietnam	89	Vietnamese Academy of Science and Technology (VAST)	✔	✔
		90	Ministry of Agriculture and Rural Development (MARD)		
		91	Ministry of Natural Resources and Environment (MONRE)		✔
		92	Cartography Department, Ministry of Defense (MOD)		
		93	Ministry of Science and Technology (MOST)		
		94	Vietnam Institute of Geosciences and Mineral Resources (VIGMR)		
29	International Organization	95	Asian Institute of Technology (AIT)		✔
		96	The ASEAN Secretariat		
		97	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)		
		98	United Nations Office for Outer Space Affairs (UNOOSA)		
		99	International Center for Integrated Mountain Development (ICIMOD)		✔
		100	CSIRO Office of Space Science and Applications (COSSA)		
		101	International Centre for Water Hazard and Risk Management (ICHARM)		
		102	Asian Disaster Reduction Center (ADRC)		✔
		103	Secretariat of the Pacific Community (SPC/SOPAC)		✔
		104	The World Bank (WB)		
		105	International Water Management Institute (IWMI)		✔
		106	Asian Development Bank (ADB)		✔
		107	ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)		
		108	World Wide Fund for Nature (WWF) - Pakistan		
		109	Asian Disaster Preparedness Center (ADPC)		✔
		110	Myanmar Information Management Unit (MIMU)		✔
		111	UN World Food Programme (WFP)		✔
				8	53

as of Dec 2020

Emergency Observation Requests (2007 – 2021)

	Request	Activation	Rejection	Percentage of Activation	Number of requested EOR (by year)																Number of requested EOR (by each disaster)															
					2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	Flood		Earthquake		Landslide		Typhoon		Forest fire		Volcanic Eruption		Cyclone		Oil Spill		others	
					Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.	Num.		Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)	Num.	(%)
Indonesia	60	53	7	88.3	7	2	5	9	2	4	2	4	2	7	3	4	2	4	3	60	22	36.7	14	23.3	4	6.7			2	3.3	13	21.7					5	8.3
Vietnam	56	50	6	89.3	2	2	4	7	2	1	2		2	3	12	6	4	5	4	56	42	75.0	0	0.0	1	1.8	9	16.1	1	1.8					2	3.6	1	1.8
Philippine	50	48	2	96.0	1	1	6	1	4	4	3	1	2	4	4	2	5	4	8	50	15	30.0	9	18.0			15	30.0	1	2.0	4	8.0	2	4.0			4	8.0
India	32	28	4	87.5			1	4	3	1	2	2	1	2	1	3	3	5	4	32	19	59.4	1	3.1			1	3.1	1	3.1			7	21.9			3	9.4
Japan	26	26	0	100.0		2		1	4	1	3	3	2	1		2	3	2	2	26	12	46.2	5	19.2	3	11.5	2	7.7			4	15.4						
Nepal	22	21	1	95.5	1	2	2	1	2	1	1	1	4	2	2		2		1	22	14	63.6	2	9.1	2	9.1	1	4.5	1	4.5							2	9.1
Sri Lanka	16	15	1	93.8			1	2	2	1		1	1	1	1	2		1	3	16	12	75.0			1	6.3							2	12.5	1	6.3		
Taiwan	15	15	0	100.0				2	1				2	5	3	2				15	4	26.7	2	13.3	1	6.7	6	40.0							1	6.7	1	6.7
Thailand	15	13	2	86.7	2	3		1	2	1	1				1	2	1		1	15	13	86.7	1	6.7											1	6.7		
Myanmar	15	13	2	86.7		1			2		1		2	4		3	1		1	15	9	60.0	4	26.7	1	6.7							1	6.7				
Pakistan	12	8	4	66.7	1	2		3	1		1		2	2						12	5	41.7	2	16.7	4	33.3											1	8.3
China	11	9	2	81.8		2		1	1	2	1	1			2		1			11	2	18.2	5	45.5	3	27.3			1	9.1								
Bangladesh	10	10	0	100.0	3			1					1	2	2			1		10	5	50.0			2	20.0							3	30.0				
Tajikistan	9	9	0	100.0	1			2	1	1		1	1						2	9	4	44.4	2	22.2	2	22.2											1	11.1
Kyrgyzstan	8	5	3	62.5				1	3	1							1		2	8	3	37.5	1	12.5	2	25.0											2	25.0
Bhutan	7	5	2	71.4				2		1			2	1			1			7	4	57.1							3	42.9								
Kazakhstan	6	4	2	66.7				1	2	3										6	3	50.0							2	33.3							1	16.7
Mongolia	6	0	6	0.0	1		2	2	1											6	2	33.3							3	50.0							1	16.7
Australia	5	5	0	100.0		1	3		1											5	3	60.0					1	20.0	1	20.0								
Brunei	5	3	2	60.0					3	1		1								5	4	80.0													1	20.0		
Cambodia	4	4	0	100.0				2	1									1		4	4	100.0																
Lao PDR	4	4	0	100.0		1								1		1	1			4	3	75.0															1	25.0
Solomon	3	3	0	100.0	1						1	1								3	1	33.3	1	33.3													1	33.3
Malaysia	3	3	0	100.0							2	1								3	2	66.7							1	33.3								
Korea	3	3	0	100.0											1	1	1			3			2	66.7					1	33.3								
Fiji	3	3	0	100.0						1				1			1			3	1	33.3					1	33.3					1	33.3				
Turkey	4	4	0	100.0													1	2	1	4	1	25.0	2	50.0	1	25.0												
Tonga	2	2	0	100.0								1				1				2											2	100.0						
PNG	2	2	0	100.0						1						1				2					1	50.0			1	50.0								
Vanuatu	2	2	0	100.0									1					1		2											2	100.0						
New Zealand	1	1	0	100.0					1											1			1	100.0														
Iran	1	1	0	100.0														1		1	1	100.0																
Lebanon	1	1	0	100.0														1		1																	1	100.0
United Arab Emirates	1	1	0	100.0												1				1											1	100.0						
Timor-Leste	1	1	0	100.0															1	1	1	100.0															0.0
Uzbekistan	1	1	0	100.0															1	1	1	100.0															0.0
Afghanistan	1	0	1	0.0								1								1	1	100.0																
Total	423	376	47	-	20	19	24	43	39	25	20	19	25	36	32	31	28	28	34	423	213	-	54	-	28	-	36	-	18	-	22	-	21	-	6	-	25	-

JPT member report “Sentinel Asia Activity in 2021”

1	ADRC	- AHA Centre Executive (ACE) Programme - The 27th session of the Asia-Pacific Regional Space Agency Forum (APRSAF-27)
2	AFAD	Summary of Floods and Landslides in Turkey on 11 August, 2021 through SA system activation
3	AHA Center	AHA Centre Disaster Monitoring and Analysis Briefing for Myanmar Flooding, July 2021
4	CAIAG	Emergency Observation Request
5	Chiba University	EMERGENCY RESPONSE OF THE AUGUST 2021 JAPAN FLOODS
6	DMC	Emergency Observation Request, EOR
7	EOS	EOR Responses and Publications from EOS as a Data Analysis Node
8	GIC/AIT	Activities carried out as Principal Data Analysis Node (P-DAN) for Sentinel Asia
9	GISTDA	GISTDA continue in supporting Disaster Management
10	ISRO	Support to Sentinel Asia
11	JAXA	Support from the Sentinel Asia community in response to the “Heavy rain of August, Reiwa 3”
12	MBRSC	Date support of KHALIFSAT for EOR (2021)
13	MO	Summary of 2021 results through SA system Activation
14	MONRE	Summary of 2021 results through SA system activation
15	NSPO	Satellite Imagery Support to Sentinel Asia
16	PHIVOLCS	EOR
17	RIKEN	Predicting Flood Inundation Depth Based-on Machine Learning and Numerical Simulation
18	Tohoku University	Estimation of flood depth using SAR data and DEM
19	University of Tokyo	R&D on satellite-based building footprint mapping using FORMOSAT-2 satellite images
20	Yamaguchi University	Contribution VAPs for EOR activities

Organization	**Asian Disaster Reduction Center (ADRC)**
Title	**Participation for international conferences**
Type of Activity	**International Conference**
Date	**-**

1. AHA Centre Executive (ACE) Programme

On 17 November 2021, ADRC participated in an AHA Centre Executive (ACE) Programme, which was organized by the AHA Centre and Kobe University. This webinar was held in an online format, and reported on the latest DRR technology transfers among related DRR organizations. ADRC gave a presentation that included the following case studies: (i) Outline of the Sentinel Asia, (ii) Trend of an Emergency Observation Request, and (iii) How to register disaster information into the OPTEMIS which is a system for making EOR.

Session on Sentinel Asia:
"Space-based disaster risk management support for the benefit of the Asia-Pacific region"

Time (JST)	Agenda Item	Speaker/Moderator	Annotation
15:00- 15:05	Opening	Dr. Ramanditya Wimbardana	➢ opening and introduction of speakers
15:05- 15:20	Keynote Presentation	Mr. MIYOSHI (Sentinel Asia Secretariat)	➢ significance of space technologies for disaster management ➢ explanation on "Sentinel Asia" ➢ support from Japan-based JPT members *including those who are not at this session* (membership, their pivotal roles)
15:20- 15:40	Hands-on Session: "Sentinel Asia Web-GIS"	Ms. TAKAKURA (JAXA)	➢ overview of Web-GIS based products (comparison between a bare VAP and a VAP combined with Web-GIS)
15:40- 15:50	How to make an Emergency Observation Request (EOR) to Sentinel Asia	Dr. IKEDA (ADRC)	➢ explanation on the flow of EOR ➢ how to make an EOR (including how to determine the AOI and fill in the form) ➢ invitation to the simulation training program on EOR using Sentinel Asia's system "OPTEMIS" to be schedule on 19 November (from 16:30~JST) for those who are currently or might be responsible for making EORs
15:50- 16:20	Extraction of building footprints from satellite data ~ theory and hands-on practice~	Prof. MIYAZAKI (University of Tokyo)	➢ usefulness of building footprints for assessing damages caused by natural disasters ➢ general theory: how to extract building footprints from satellite data ➢ demonstration of an application, followed by hands-on session using the application ➢ Sentinel Asia's plan for this initiative (including possible cooperation with NSPO) ➢ invitation for participants in the session to join this initiative (citing prerequisites, terms and conditions as well)

2. The 27th session of the Asia-Pacific Regional Space Agency Forum (APRSAF-27)

The 27th Session of the Asia-Pacific Regional Space Agency Forum (APRSAF) was held from 30 November to 3 December 2021 by Online. It was co-organized by the Vietnam Academy of Science and Technology, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Japan Aerospace Exploration Agency (JAXA).

APRSAF was established in 1993 to enhance space activities in the Asia-Pacific region. Attended by space agencies, governments, and international organizations such as the United Nations as well as companies, universities and research institutes, this forum is the largest space-related conference in the Asia Pacific region. APRSAF has four Working Groups: the (1) Space Applications Working Group (SAWG), (2) Space Technology Working Group (STWG), (3) Space Environment Utilization Working Group (SEUWG), and (4) Space Education Working Group (SEWG). APRSAF participants share information about their activities and future plans for their countries and regions in each working group. APRSAF also supports international projects designed to find solutions to common issues such as disaster management and environmental protection.

ADRC joined the Space Applications Working Group (SAWG) and reported on trends in Sentinel Asia emergency observation requests and its future action plans.

Satellite Applications for Societal Benefit
Working Group (SAWG)

November 30th-December 1st, 2021
12:00 – 16:15 in Vietnam Time (UTC+7)
14:00 – 18:15 in Japan Time (UTC+9)

AGENDA

Co-Chair:
Dr. Vu Anh Tuan, Vice Director General, Vietnam National Space Center (VNSC, VAST)
Mr. HIRABAYASHI Takeshi, Senior Chief Officer of Earth Observation Missions (JAXA)

DAY 2: December 1st	
TIME	**SESSION / TITLE**
12:00-13:30	**Sentinel Asia for Disaster Management Session** **Co-Chair: Dr. KAWAKITA Shiro**
12:00[15min]	• Sentinel Asia - Trend of Emergency Observation Request -, Mr. IKEDA Makoto (ADRC)
12:15[15min]	• Sentinel Asia Status Report, Mr. TAKEI Goro (JAXA)
12:30[15min]	• NSPO-NARLabs Engagement in Sentinel Asia, Dr. Franz Ming-Chih Cheng (NARLasbs)
12:45[15min]	• Integration of Satellite data and Crowdsourced information through a Mobile App for the Sentinel Asia, Dr. Manzul Kumar Hazarika (GIC/AIT)
13:00[15min]	• Development of Mirror Target Calibration for Optical Satellite Data, Prof. NAGAI Masahiko (Yamaguchi University)
13:15[15min]	• Using Earth Observation to help Pacific countries managing disaster risk reduction and response, Dr. Kargren Rafael (Pacific Earth Observation Council)

Organization	**Disaster & Emergency Management Authority in Turkey (AFAD)**
Title	**Summary of Floods and Landslides in Turkey on 11 August, 2021 through SA system activation**
Type of Activity	**EOR** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**13/08/2021**

Floods and landslides heavily affected Kastamonu, Sinop and Bartın provinces in the Western Black Sea region on August 11, 2021 and following days. Disaster resulted from excessive precipitation in the region according to the General Directorate of Meteorology, the amount of precipitation per square meter in some regions of Kastamonu, Sinop and Bartın between 10-12 August was recorded as 2/3 of the total precipitation in a year (for example, total precipitation amount in 48 hours in Mamatlar village of Bozkurt was measured as 420.6 kg/m2). Unfortunately, 82 citizens (71 Kastamonu, 10 Sinop, 1 Bartın) lost their lives due to the floods and debris flows.

Information technologies and Telecommunication Department of AFAD informed national authorities that has ability to get satellite and aerial imagery / video (e.g. General Directorate of Mapping, Secutity) and first streaming video data was released on 12th of August and clear weather VHR satellite imagery was shared on 13th of August so most of mapping efforts related with affected area mapping, damage assessment mapping were performed by the help of this data.

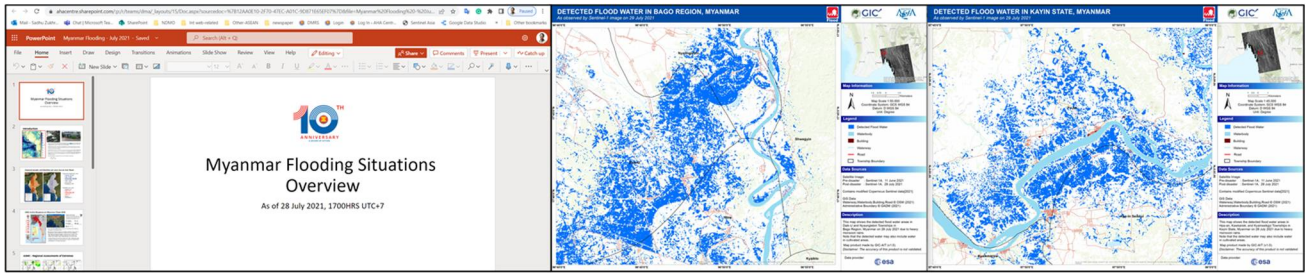
AFAD was not a JPT member at this time but submitted an EOR to Sentinel Asia on 13th of August 2021. This request has been approved by Sentinel Asia and some satellite data / analysis results was shared through Sentinel Asia's Optemis Geo-portal between 15 – 28 August 2021. All of this useful data was used to compare and correct the previous results / mapping efforts. Data was shared with AFAD's Response Department and all remotely sensed data and analysis are used for preliminary damage estimation, evaluation of the severity of the disaster and extent of the affected area.

Mapping of the evaluation of the severity of the disaster and extent of the affected area

SA provided data was mainly used for compare and correct the previous results / mapping efforts

Organization	**The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)**
Title	**AHA Centre Disaster Monitoring and Analysis Briefing for Myanmar Flooding, July 2021**
Type of Activity	**Providing satellite data for disaster emergency situations** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**27/07– 30/07 2021**

The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre) is an inter-governmental organization which aims to facilitate cooperation and coordination among the ASEAN Member States and with the United Nations and international organizations for disaster management and emergency response in the ASEAN region. One of the main responsibilities for the AHA Centre is to conduct disaster monitoring and analysis in the ASEAN Region. When a significant disaster occurs in one or more of the ASEAN Member States, the AHA Centre carries out emergency response operations. Prior to the emergency response operations, the AHA Centre through the Disaster Monitoring and Analysis (DMA) unit is required to analyse disasters as well as coordinate with the Emergency Operation Centre (EOC) of the concerned/affected ASEAN Member State. On 26 July 2021, Myanmar's Department of Disaster Management (DDM) reported severe localised storms and flooding (AHADID: AHA-ST-2021-000588-MMR). Following its mandate to facilitate cooperation and coordination, the AHA Centre has made an Emergency Observation Request (EOR) to Sentinel Asia through the OPTEMIS dashboard. The AHA Centre utilised the products (data from Data Provider Nodes (DPN) and Data Analysis Nodes(DAN)) provided through the Sentinel ASIA EOR to conduct further analysis to estimate the impacts and damages. The AHA Centre then conducted an internal briefing and sent its analyses to the DDM to support them in responding to the disasters. According to the ASEAN Disaster Information Network (ADINet), this disaster has resulted in the loss of 4 (four) lives and affected 30K families (134K persons) in Karen State, Mon State, and Rakhine State of Myanmar. Reports of damages include 6.8K houses.



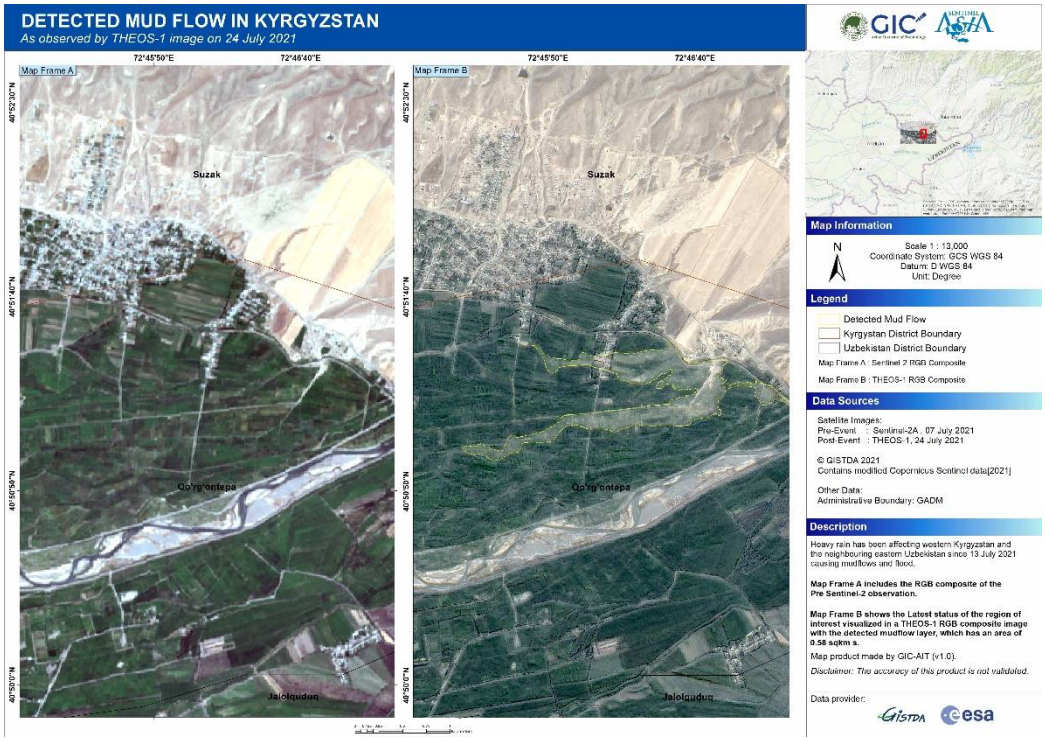
Sentinel ASIA product for the AHA Centre Disaster Monitoring and Analysis, July 2021

Organization	**Central Asian Institute of Applied Geosciences (CAIAG)**
Title	**Emergency Observation Request**
Type of Activity	EOR activity
Date	**-**

CAIAG is an independent non-profit organization and was founded in 2002 under Cooperative agreement between the Government of Kyrgyz Republic and the German GeoForschungs Zentrum, Potsdam, Germany. The main purpose of CAIAG is carrying out the scientific research in the field of Geosciences: Geodynamics and geocatastrophes; Climate, water and geoecology; Use and protection of resources.

CAIAG submitted following EORs in 2021. CAIAG used the data for in consequence analysis assessment of influences.

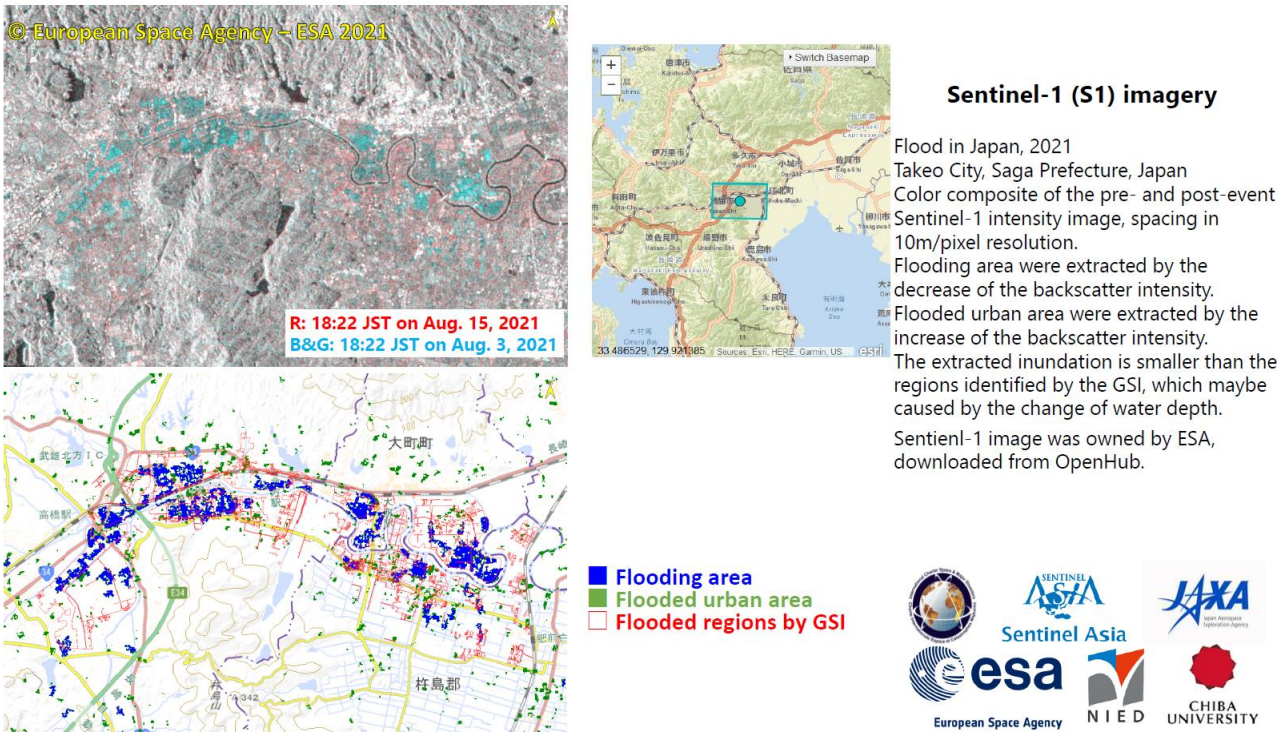
1. Landslide, Mudflows in Tajikistan on 11 May, 2021
2. Earthquake in Tajikistan on 7 July, 2021
3. Flood in Kyrgyzstan on 12 July, 2021
4. Flood in Uzbekistan on 13 July, 2021
5. Flood and Mudflow in Kyrgyzstan on 20 July, 2021



VAP for Flood and Mudflow in Kyrgyzstan

Organization	**Chiba University, Japan**
Title	**EMERGENCY RESPONSE OF THE AUGUST 2021 JAPAN FLOODS**
Type of Activity	**EOR** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**14/08/2021**

A heavy rainfall hit Western Japan from August 11 to 21, 2021. Due to the record-breaking rainfall, inundations occurred in 68 rivers and caused extensive damages. The International Charter Space and Major Disasters (Charter) and Sentinel Asia was activated for this event on August 14, 2021, in response to a request from the Japanese Government. Several synthetic-aperture radar (SAR) satellite images were provided through the website. Our group attended the EOR from August 14. We downloaded several pre- and post-event SAR intensity images to grasp the affected area. We generated the color composites of temporal SAR images in the Kyushu Region. The expansion of water regions had been observed in Takeo and Kurume Cities. For Takeo City, the inundations were extracted by the differences in the backscatter intensity of Sentinel-1 images. Flat areas of 3.5 km^2 and urban areas of 3.5 km^2 were estimated as flooded at 18:21 August 15, 2021.



Estimation of inundation using pre- and post Sentinel-1 intensity images in Takeo City, Saga Prefecture, Japan

Organization	**Disaster Management Centre**
Title	**Emergency Observation Request, EOR**
Type of Activity	REQUEST
Date	**-**

Disaster Management Centre (DMC) is the leading agency for disaster management in Sri Lanka. It is mandated with the responsibility of implementing and coordinating national and sub-national level programmes for reducing the risk of disasters with the participation of all relevant stakeholders.
DMC was established as per the provisions of the Sri Lanka Disaster Management Act No. 13 of 2005 as the executing agency of the National Council for Disaster Management (NCDM).

The main activities of the Disaster Management Centre (DMC) are Research and Development, Mitigation, Planning Preparedness, Dissemination of Early Warning for the vulnerable population, Emergency Response, Coordination of Relief and Post Disaster Activities in collaboration with other key agencies.

DMC requested EORs in 2021. Thank you for your cooperation.

- *Oil spill emergency / May 2021*
- *Flood / June 2021*
- *Flood and Landslide / November 2021*

Organization	**Earth Observatory Singapore (EOS), Nanyang Technological University**
Title	**EOR Responses and Publications from EOS as a Data Analysis Node**
Type of Activity	**EOR and Publication**
Date	**Year of 2021**

In 2021, the Earth Observatory of Singapore (EOS) established a fully dedicated EOS Remote Sensing (EOS-RS) Lab; expanding its current team with more members and funding committed to exploring and developing algorithms for disaster response and monitoring natural hazards. Our disaster response operations will also be expanded. From these initiatives, EOS will be able to contribute more to maximize the potential applications of satellite-remote sensing data, especially for disasters.

Alongside this re-organization, as a Data Analysis Node (DAN), the EOS-RS team has responded to a total of ***6*** Emergency Observation Requests (EORs) in 2021 (Figure 1). These responses include floods, typhoons, volcanoes, and earthquakes in the region. Besides publishing our products over OPTEMIS, our products are also publicized and disseminated rapidly over Twitter (https://twitter.com/eos_rs/) and https://eos-rs-products.earthobservatory.sg/.

Recent improvements in our workflows to attain speed-ups for damage mapping has also enabled us to create our improved damage maps in an unprecedented scale. In December 2021 Super Typhoon Odette made landfall across the Philippines archipelago, causing severe damage over Central and Southern Philippines. Due to the widespread nature of the event, satellite radar data acquired over 6 orbital tracks by ALOS-2 and Sentinel-1 were used, covering an approximate area of 418,700 km^2 – creating a total of 2 Flood Proxy Maps (FPMs) and 6 Damage Proxy Maps (DPMs) (Figure 2). This sets a precedence for the most mapping products created for the largest areas covered for any event we have responded to thus far. Subsequently, ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Center) have used our FPM for reference in their Situation Updates, whilst the World Food Programme provided valuable feedback, which we immediately addressed, and the resulting updated maps were forwarded to their local partners in the Philippines.

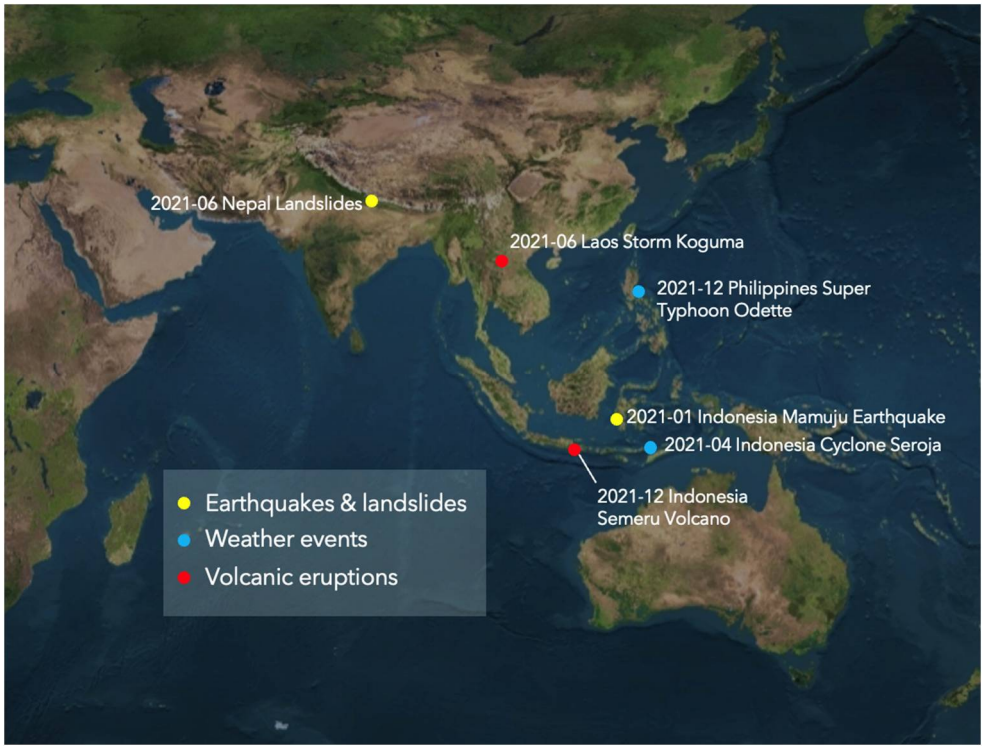


Figure 1: Map of Sentinel-Asia EORs the Earth Observatory of Singapore has responded to in 2021.

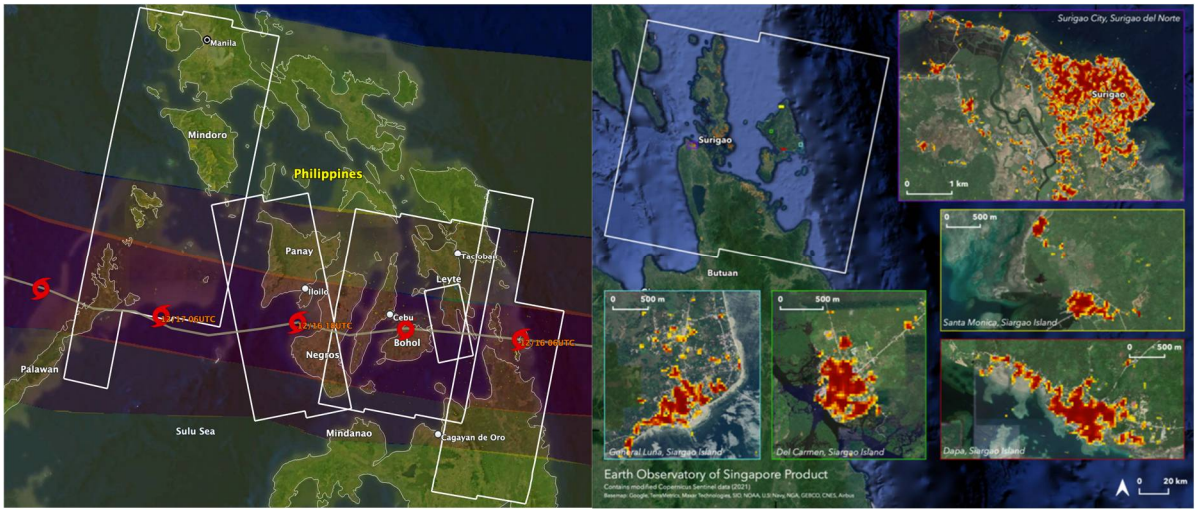


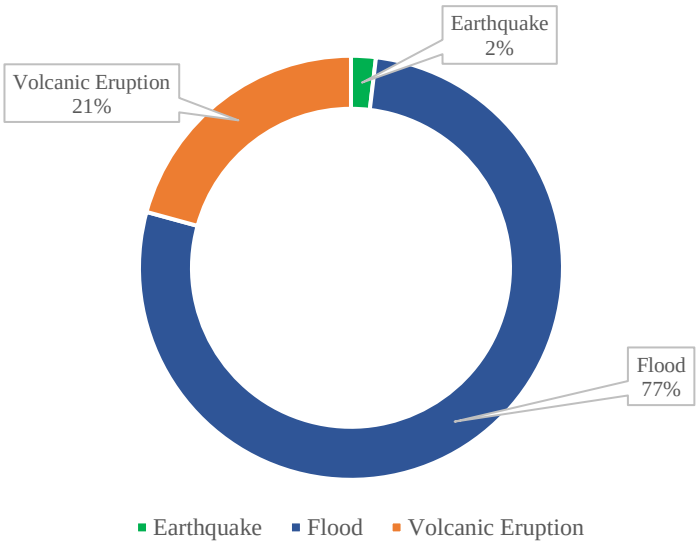
Figure 2. (Left) Spatial coverage of DPMs and FPMs by EOS-RS overlayed with the path of Super Typhoon Odette across the Philippines and (Right) blow-ups of one of the Damage Proxy Maps of the worst-hit areas of Siargao Island and Surigao City.

Organization	**Geoinformatics Center, Asian Institute of Technology**
Title	**Activities carried out as Principal Data Analysis Node (P-DAN) for Sentinel Asia.**
Type of Activity	**Value-Added Product Generation for Disaster Activations**
Date	**24/06/2021 - 28/02/2022**

As the Principal Data Analyses Node (P-DAN) of Sentinel Asia, the Geoinformatics Center of the Asian Institute of Technology (GIC/AIT) produces Value Added Products (VAP) right after disaster occurrences to support disaster response activities of the Sentinel Asia Community.

Since June 24th, 2021, GIC-AIT has worked on 24 emergency observation requests until February 28th, 2022, and thirteen countries submitted requests in the Asia Pacific region. Most of the requests were sent by the Philippines (5 activations; 20.8%), followed by Vietnam (4 activations; 16.7%). India, Kyrgyzstan, Thailand, and Japan requested two activations each (33.2%). The rest of the requests (29.3%) were submitted by Tajikistan, Indonesia, Myanmar, Sri Lanka, Turkey, Uzbekistan, and Tonga, each with one request for activation.

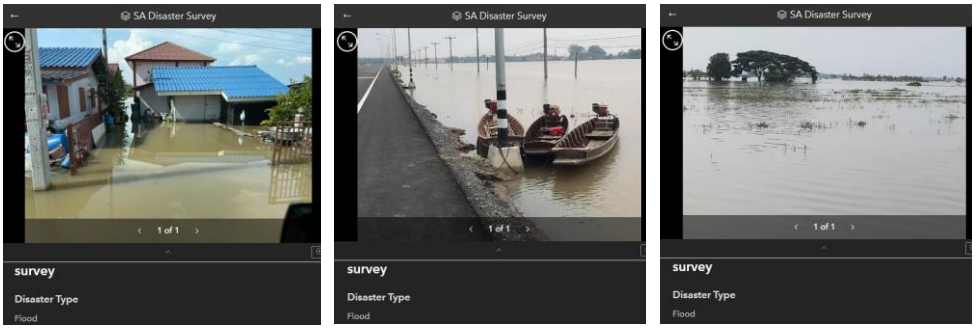
Regarding Project Management (PM) activities, The GIC/AIT had undertaken PM activities for two events, including a Volcanic eruption in Indonesia (December 4th, 2021) and Flooding in Sri Lanka (December 10th, 2021).



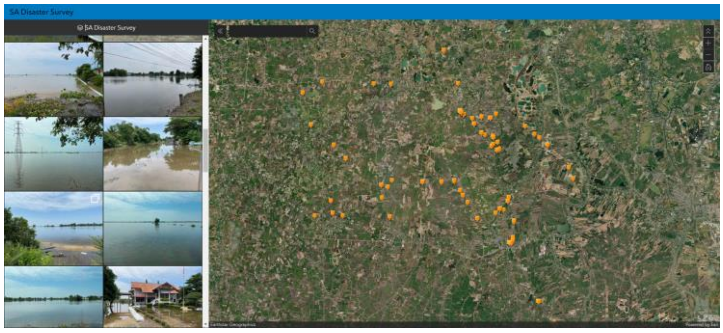
Disaster wise VAP creation by GIC-AIT (2021/06-2022/02)

Disaster authorities in Thailand report dozens of provinces in the country have been affected by flooding after heavy rain brought by Tropical Storm Dianmu. Thailand's Disaster Prevention and Mitigation Department (DDPM) reported that flooding had affected 58,977 households across 27 provinces. Some affected areas had already seen flooding from 16 September brought by the Southwest Monsoon.

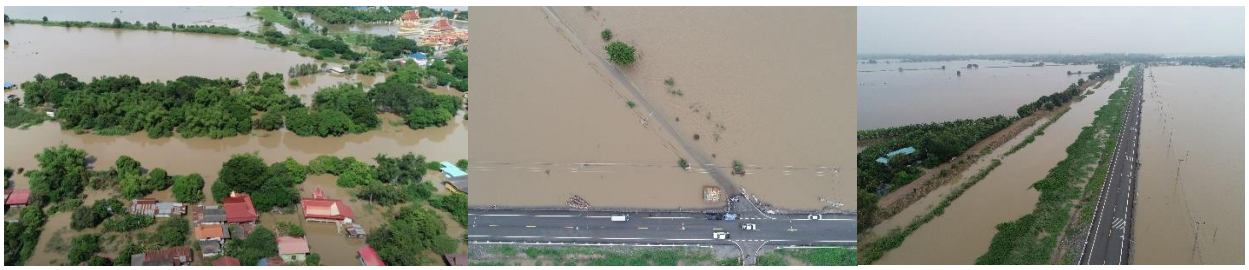
GIC-AIT conducted a field survey for this Thailand flood on 8th October 2021. We surveyed over a hundred locations using this application and developed a dedicated web application to visualize our ground data and the validated product layers.



Ground photographs collected through the GIC-Disaster Survey application in Thailand



Web application for visualizing ground data collected through GIC-Disaster Survey Application

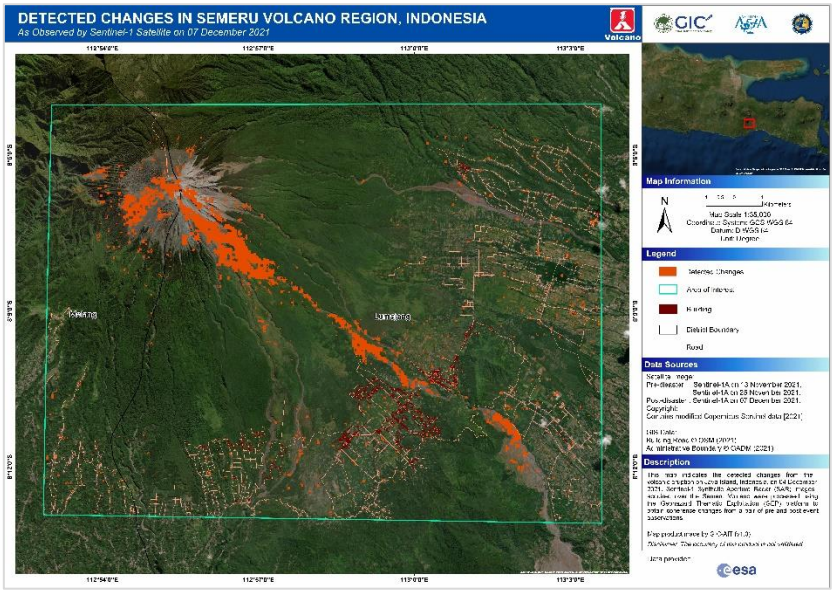


Drone survey

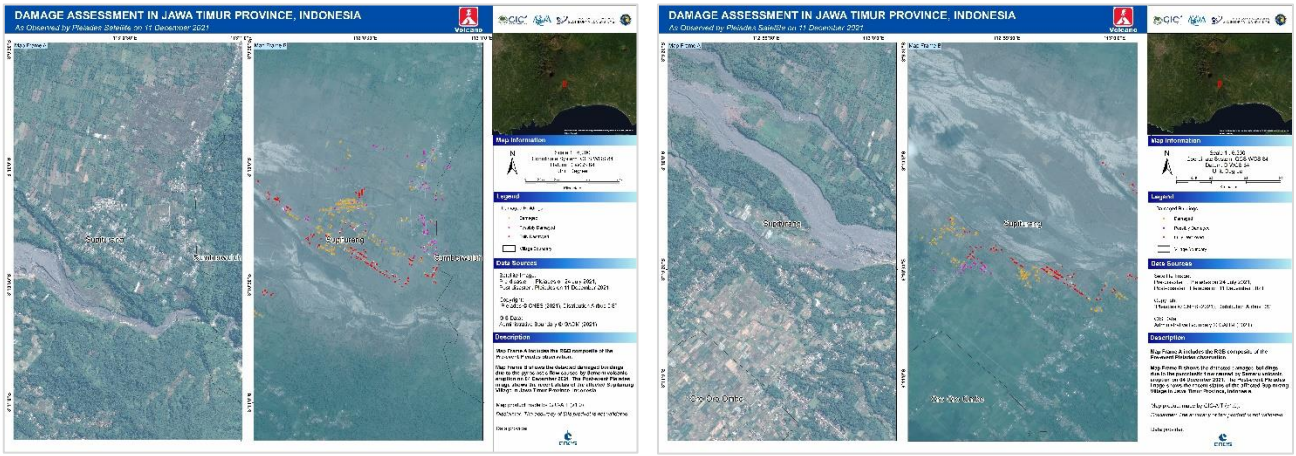
Ground survey

On 4 December 2021, the Mount Semeru volcano in Lumajang Regency, East Java Province, had its largest eruption

in recent history and produced a hot cloud avalanche with volcanic materials and heavy ashfall. As of 6 December, the Government has reported 34 people killed, 17 unaccounted for, and 5,205 people directly affected, including some 3,697 displaced within the regency. The eruption has damaged 2,970 houses and has affected 24 schools and 3,888 students. So, GIC-AIT produced Value Added Products (VAPs) from Sentinel-1 data (observed on 7th December 2021) for detecting changes, and GIC-AIT created VAPs using Pleiades data (observed on 11th December 2021) for damage assessment.



Map detailing the new emergence of a lava flow following the 7 December 2021 collapse at Semeru Volcano, Indonesia



Damage Assessment in Jawa Timur Province, Indonesia

Organization	**Geo-Informatics and Space Technology Development Agency (GISTDA)**
Title	**GISTDA continue in supporting Disaster Management**
Type of Activity	**Provide Satellite data and images**
Date	**2021**

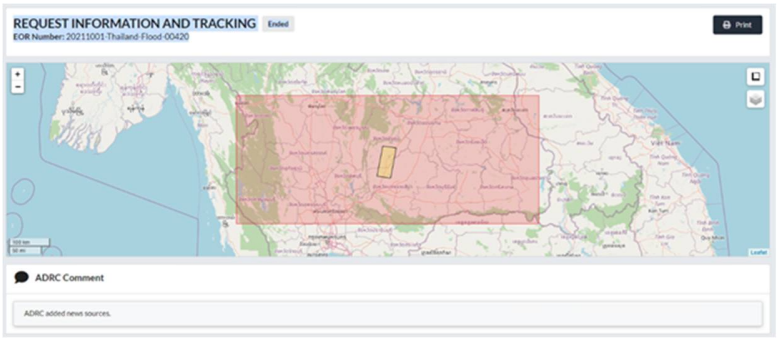
GISTDA supported the disaster management activities by

1. Provide satellite images in total of 596 images consisting of 171 Multispectral images, 422 Panchromatic images and 3 Pan sharpened images as followed;

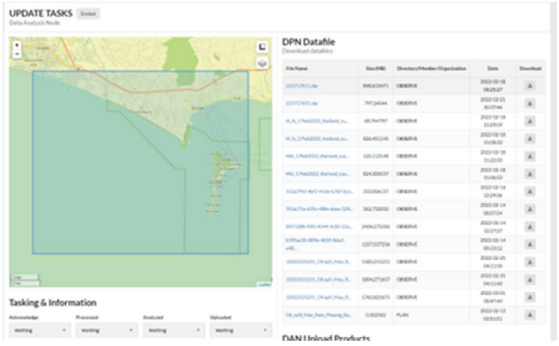
Summary of cooperation SA-GISTDA to contribute Thaichote 1 Satellite

No	ACQ date	Country	Disaster Type	MS	PAN	PS	Mosaic	No. of images
	20/01/2021	Indonesia	Earthquake	2	4			6
	24/01/2021	Indonesia	Earthquake	2	3			5
	24/01/2021	Indonesia	Earthquake	2	4			6
	8/02/2021	India	Flood (glacier)	6	10			16
	10/02/2021	India	Flood (glacier)	2	7			9
	11/02/2021	India	Flood (glacier)	3	6			9
	8/04/2021	Indonesia	Flood	4	7			11
	9/04/2021	Indonesia	Flood	4	8			12
	10/04/2021	Indonesia	Flood	2	6			8
	11/04/2021	Timor	Flood	2	4			6
	13/04/2021	Timor	Flood	8	15			23
	20/05/2021	India	Flood	12	31			43
	24/05/2021	India	Flood	3	9			12
	25/05/2021	India	Flood	3	7			10
	11/06/2021	Sri Lanka	Oil spill	2	6			8
	14/06/2021	Sri Lanka	Oil spill	2	6			8
	21/06/2021	Napal	Flood	4	4			8
	22/06/2021	Napal	Flood	5	8			13
	26/07/2021	Uzbekistan	Flood	2	6			8
	26/07/2021	Kyrgyzstan	LandSlide	2	5			7
	26/07/2021	Philippines	Flood	2	3	1		6
	30/07/2021	Philippines	Flood	4	11			15
	31/07/2021	Philippines	Flood	15	32			47
	14/08/2021	Japan	Flood	2	7			9
	14/08/2021	Turkey	Flood	2	5			7
	16/08/2021	Japan	Flood	4	10	1		15
	17/08/2021	Japan	Flood	4	10			14
	18/08/2021	Japan	Flood	4	10			14
	09/09/2021	Philippines	Flood	2	7	1		10
	10/09/2021	Philippines	Flood	2	7			9
	11/09/2021	Philippines	Flood	1	2			3
	FY 2565							
	08/10/2021	Vietnam	Flood	4	11			15
	09/10/2021	Vietnam	Flood	4	13			17
	12/10/2021	Vietnam	Flood	3	9			12
	17/10/2021	Philippines	Flood and Landslide	6	17			23
	18/10/2021	Philippines	Flood and Landslide	3	10			13
	20/10/2021	India	Flood	5	12			17
	22/10/2021	Japan	Volcanic	2	5			7
	23/10/2021	India	Flood	3	8			11
	23/10/2021	Japan	Volcanic	2	6			8
	24/10/2021	India	Flood	2	6			8
	24/10/2021	Japan	Volcanic	2	6			8
	30/10/2021	Vietnam	Flood and Landslide	1	5			6
	20/12/2021	Philippines	Flood and Landslide	8	23			31
	20/12/2021	Philippines	Flood and Landslide	8	20			28
	23/12/2021	Philippines	Flood and Landslide	2	6			8
	24/12/2021	Philippines	Flood and Landslide	2	5			7
Total				171	422	3		596

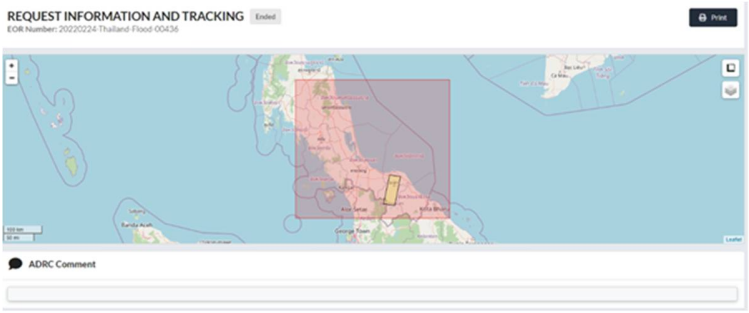
2. GISTDA requested satellite data for Emergency situation in Thailand as followed;
    a. 1st October 2011: Thailand have flood in the Northern and Northeastern region



    b. 10th February 2022: Oil unintentionally left in pipeline off Rayong for Thursday's new spill



    c. 24 February 2022: Flooding in Southern Region of Thailand from Feb, 24-27 2022.



Organization	**INDIAN SPACE RESEARCH ORGANISATION (ISRO)**
Title	**Support to Sentinel Asia**
Type of Activity	**Providing Satellite data as Data Provider Node (DPN)** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**31/12/2021**

During 2021, ISRO has contributed in the Sentinel Asia activities as Data Provider Node. ISRO has successfully responded to 20 disaster events spread across 11 countries with the help of 43 Indian Remote Sensing (IRS) satellite datasets comprising of Resourcesat – 2/2A and Cartosat series. NRSC/ISRO has attended all meetings organized by Sentinel Asia during this period. On request from Sentinel Asia, a detailed presentation was made on National Database for Emergency Management to the Steering Committee Members of Sentinel Asia.

ISRO Support to Sentinel Asis EOR's during 2021

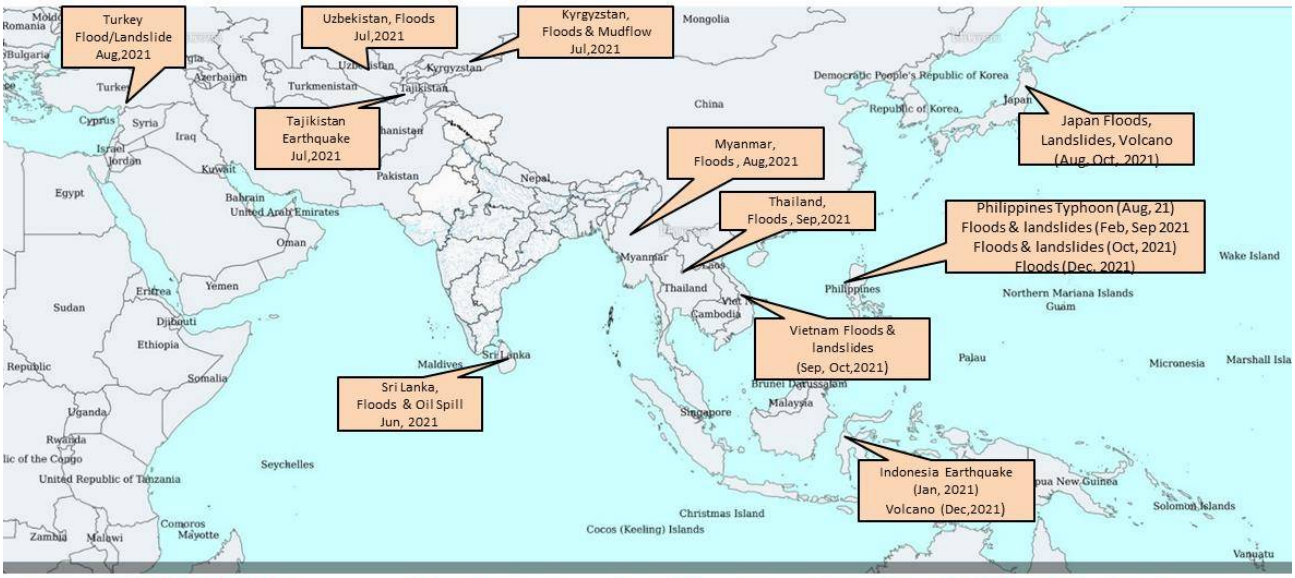


Fig 1: EOR's responded during 2021

Towards strengthening capacity building activities of Sentinel Asia, ISRO in association with IWMI has organised two 2-day webinars on Drought Risk Management and Flood forecasting and Modeling during July and October, 2021 respectively for the benefit of Sentinel Asia member countries as part of Disaster Risk Reduction initiative. About 65 and 110 delegates from Sentinel Asia Member countries have participated in these two webinars respectively. NRSC/ISRO has taken a lead role in organizing these two webinars. The details of webinars is given in the brochures. In

addition, ISRO has represented in various telecom meetings, steering committee meetings and has also demonstrated the Bhuvan Geo-portal.

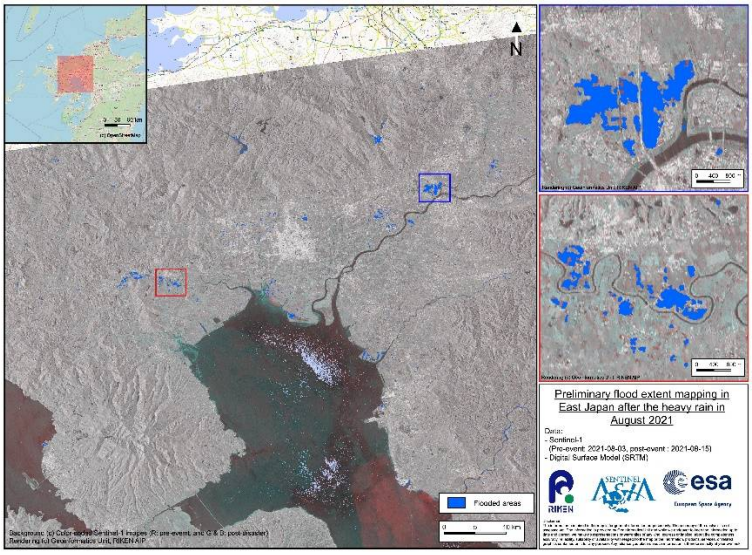
Flood forecasting Webinar

Drought Risk Webinar

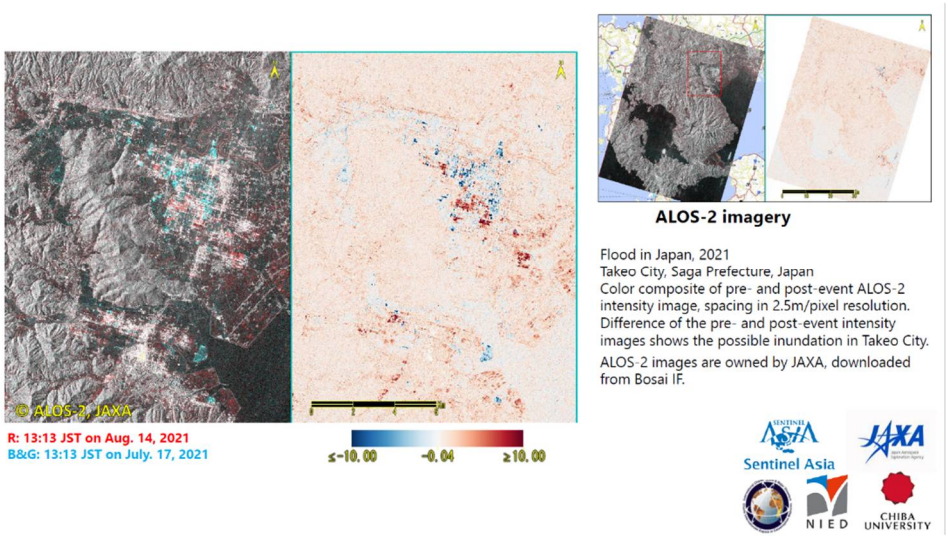
Towards addressing disasters in India, ISRO has activated sentinel Asia towards support to Uttarakhand Flash floods, Cyclones 'TAUKTAE', 'YAAS', 'NIVAR', 'BUREVI' and for the floods of Assam an Bihar floods-2021, and as part of it has received data from ALOS PALSAR-2 and THEOS-1 satellite datasets.

Organization	**Japan Aerospace Exploration Agency (JAXA)**
Title	**Support from the Sentinel Asia community in response to the "Heavy rain of August, Reiwa 3"**
Type of Activity	**EOR** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**14/08/2021**

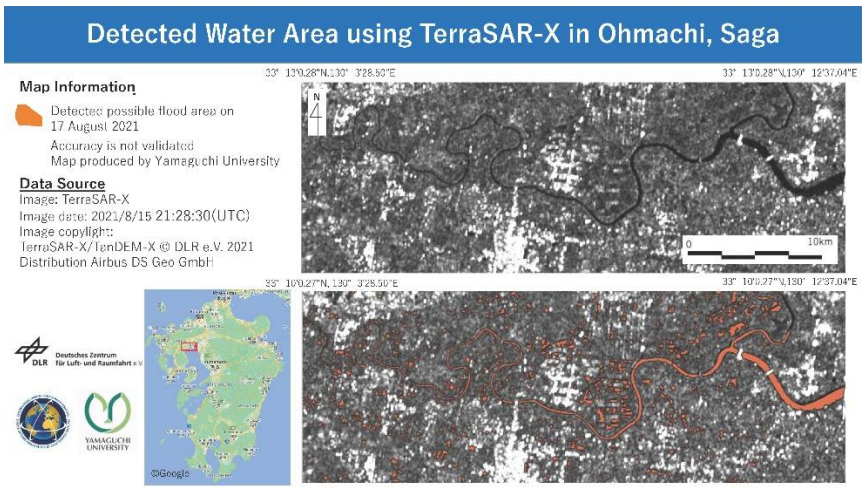
While JAXA as DPN member supports almost always EORs from the Sentinel Asia community, JAXA itself benefits greatly from the Sentinel Asia community as well. After 11 August 2021, torrential heavy rains hit the southern island of Japan, "Kyushu region" western, and eastern Japan. 13 persons died and 17 persons injured, and 8,209 houses are affected after the heavy rain.
Japan Meteorological Agency issued heavy rain and mudslide warnings for several areas.
On 12 August 2021, upon request from disaster management authorities, "Ministry of Land, Information, Transport and Tourism (MLIT) and upon subsequent consultation from JAXA, **ADRC** made an emergency observation request (EOR) to Sentinel Asia. Following the request, DPN members – **GISTDA, ISRO**, JAXA, - conducted emergency observation with their respective satellites. The satellite data were provided to DAN members via Sentinel Asia's system, OPTEMIS, developed by **GISTDA**. Then, DAN members, such as, **Chiba University**, **NIED**, **RIKEN**, and **Yamaguchi University** generated estimated damage maps from the satellite data. The estimated damage maps were provided to disaster management authorities.
Also, through **ADRC**, the EOR has been escalated to the International Disaster Charter, as "**Sentinel Asia Escalation**". In this context as well, an expert from **Yamaguchi University** supported the call by playing the role of Project Manager to coordinate space agencies regarding emergency observation plan and generate estimated damage maps.
On behalf of the Japanese people, we would like to take this opportunity to extend our sincere gratitude to all Sentinel Asia members who have supported us.



Preliminary flood extent mapping in East Japan after the heavy rain in Japan in August 2021 provided by RIKEN



Possible inundation in Takeo City, Saga Prefecture, Japan provided by Chiba University and NIED



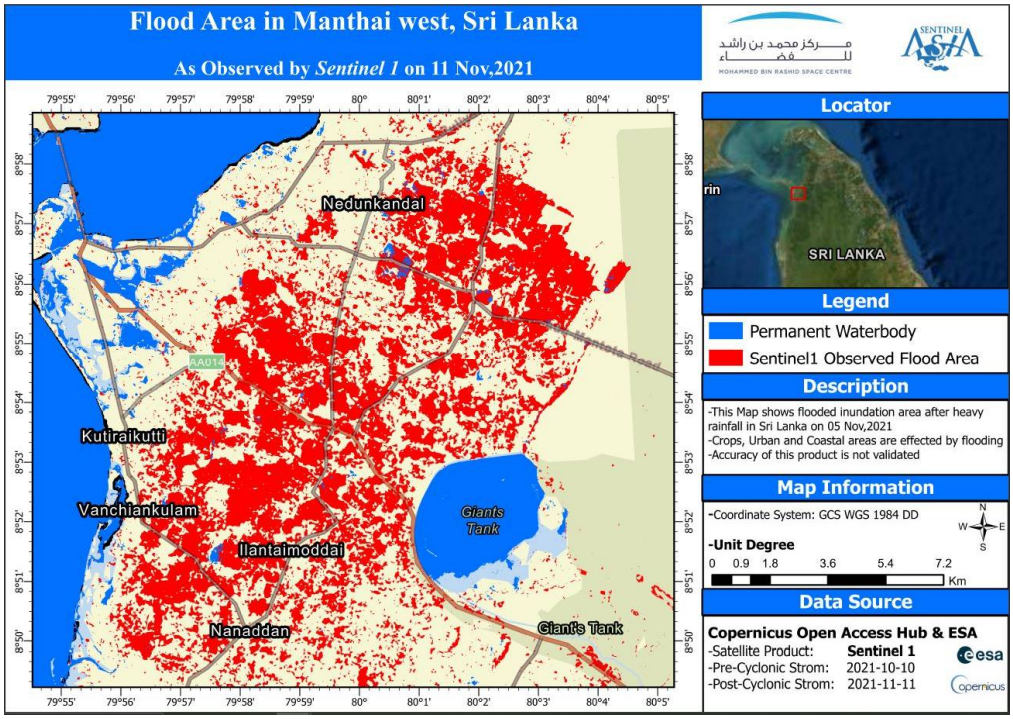
Detected Water Area using TerraSAR-X in Ohmachi, Saga, Japan provided by Yamaguchi University

Organization	**Mohammed Bin Rashid Space Centre (MBRSC)**
Title	**Date support of KHALIFSAT for EOR (2021)**
Type of Activity	**Sharing satellite images and Value-Added Products for EOR**
Date	**2021**

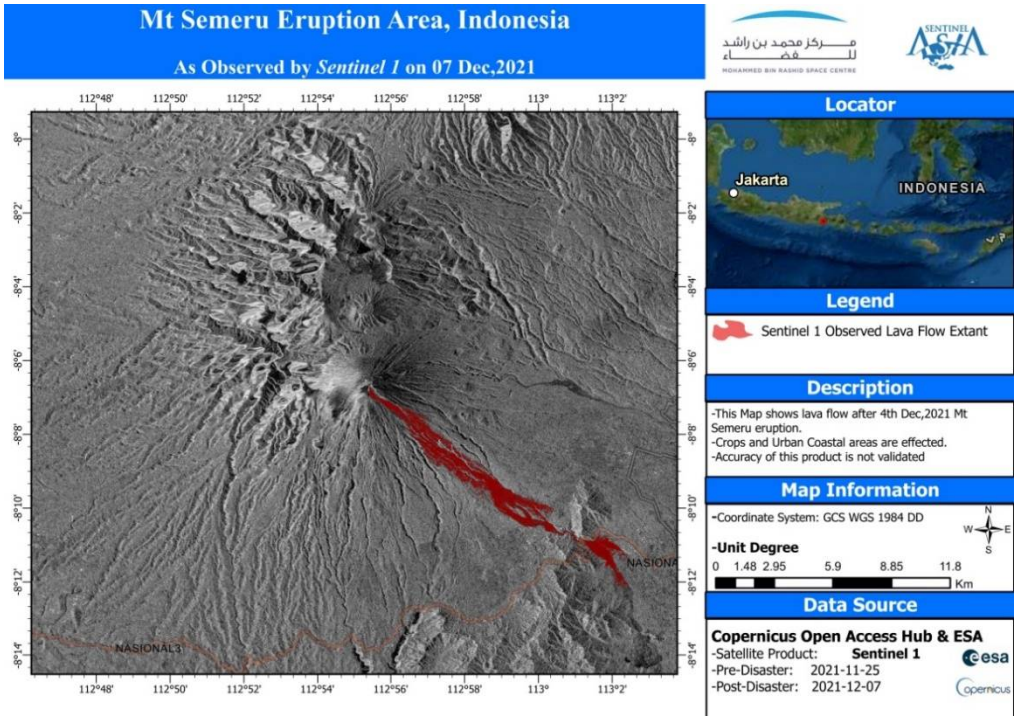
The Mohammed Bin Rashid Space Centre (MBRSC) is a Dubai government organization working on the UAE National Space Programme, which includes various earth observation satellite projects, the UAE Astronaut Programme, the Emirates Mars Mission, and the Emirates Lunar Rover. MBRSC launched its third earth observation satellite, named "KHALIFSAT", in October 2018. KHALIFSAT is one of the world's most technologically advanced remote sensing observation satellites with a resolution of 0.7 Meter, and is the first 100% designed and manufactured satellite in the United Arab Emirates (UAE). MBRSC has supported Sentinel Asia with satellite images and VAPs for the following EORs in 2021.

MBRSC shared VAPs as follows:

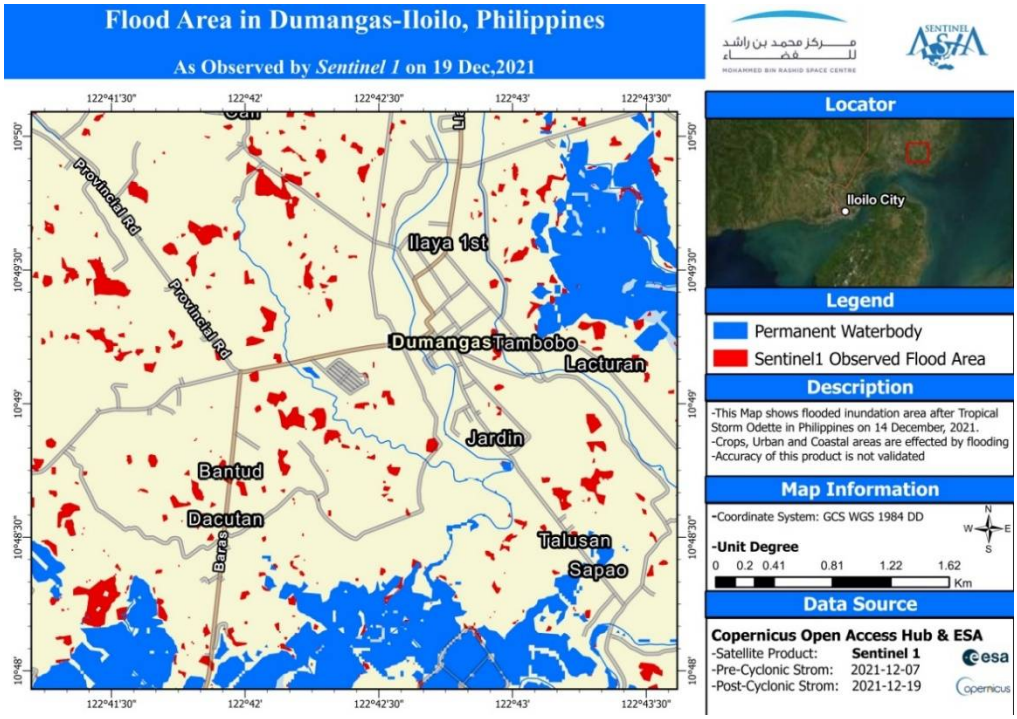
- ✓ Flood and Landslide (Sri Lanka), November 2021
- ✓ Volcanic eruption (Philippines), November 2021
- ✓ Volcanic eruption (Indonesia), December 2021
- ✓ Tropical Storm Odette (Philippines), December 2021



VAP [Flood and Landslide (Sri Lanka)]



VAP [Volcanic eruption (Indonesia)]



VAP [Tropical Storm Odette (Philippines)]

Organization	**Manila Observatory – Geomatics for Environment and Development laboratory**
Title	**Summary of 2021 results through SA system Activation**
Type of Activity	**EOR for Extreme Weather Bulletins (EWBs)**
Date	**21/02/2021** **02/06/2021** **25/07/2021** **08/09/2021** **12/10/2021** **14/12/2021**

Introduction

21/02/2021

Several areas in Southern Philippines experienced accumulated 24-hour rainfall exceeding 150 mm during the onslaught of Tropical Depression Dujuan (Auring). It entered the Philippine Area of Responsibility (PAR) on February 17, 2021 as a tropical storm. It remained as a tropical depression (TD) and weakened as it traversed the Dinagat Island. On February 22, 2021 it made landfall over Batag Island, Northern Samar (Figure 1) and downgraded to a low pressure area.

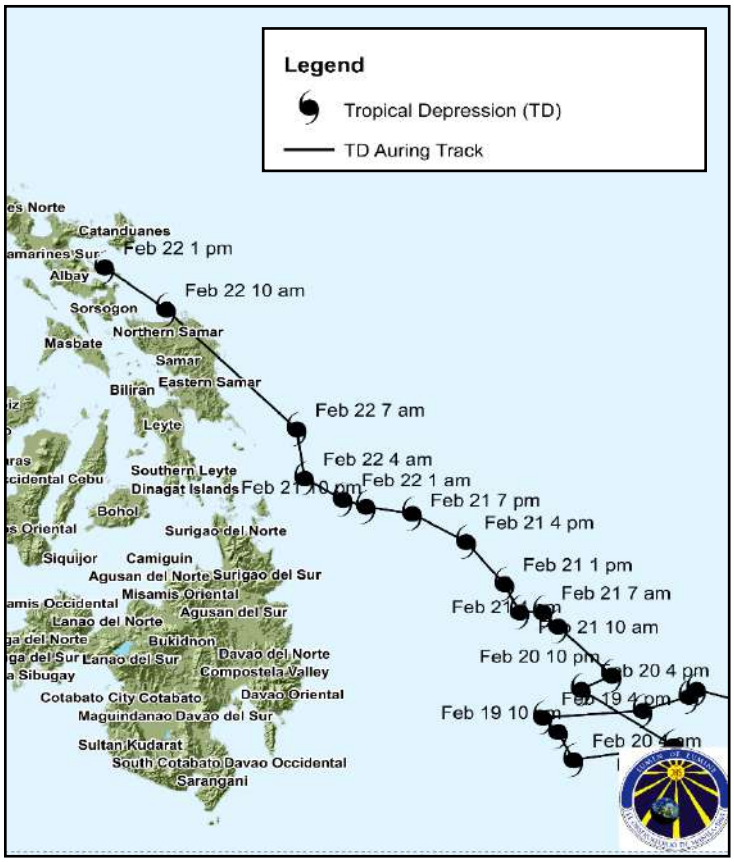
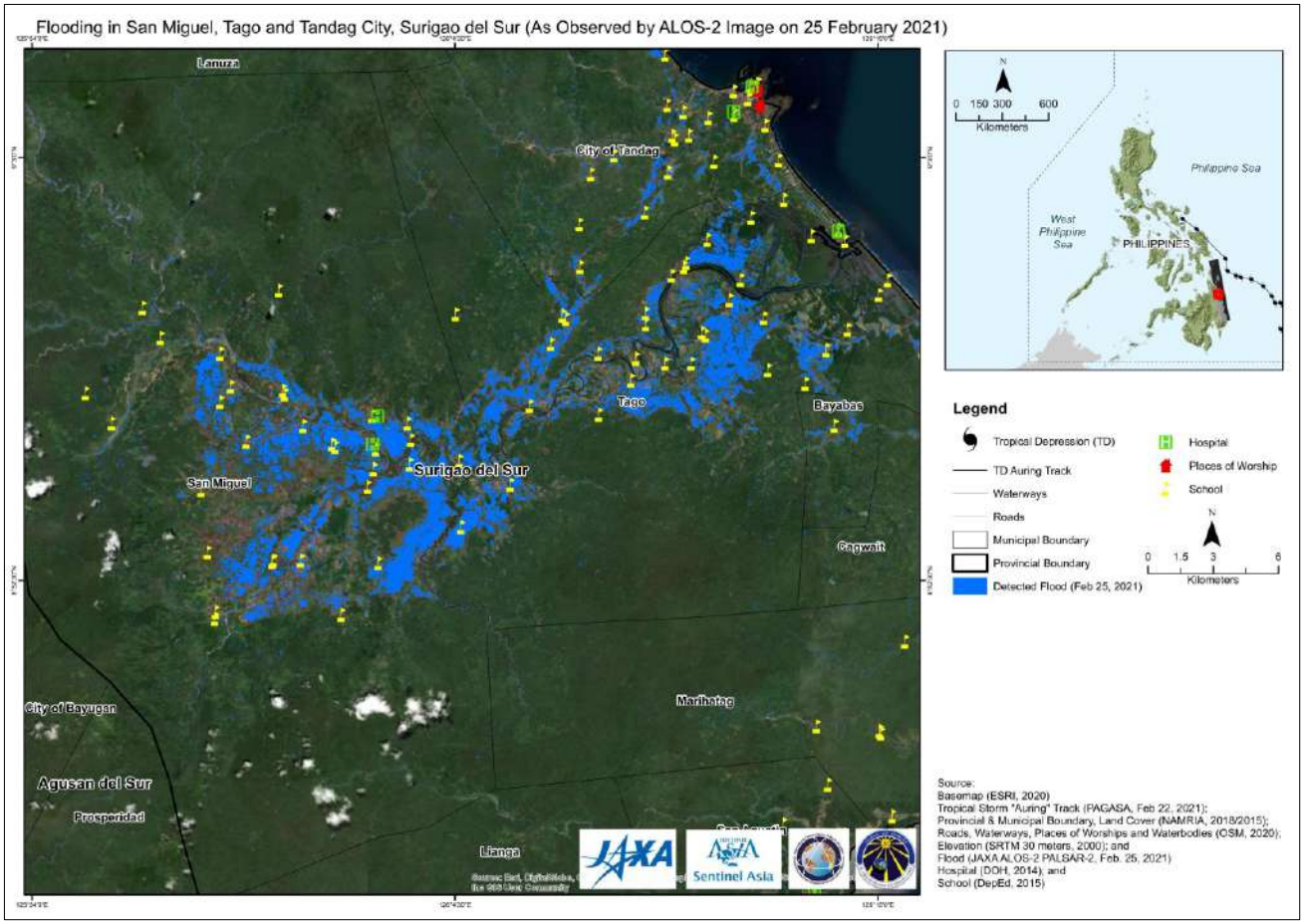


Figure 1. Tropical depression Auring track over the Philippines

Multi-temporal Synthetic Aperture Radar images (SAR) specifically ALOS-2 PALSAR-2 pre-disaster scene observed on April 11, 2019 and post-disaster scene observed on February 25, 2021, provided by JAXA through Sentinel Asia, were utilized to detect flood in the Municipalities of San Miguel, Tago, and the City of Tandag in the province of Surigao del Sur (Figure 2). The map generated map shows affected land cover (Figure 3) by TD



Auring.

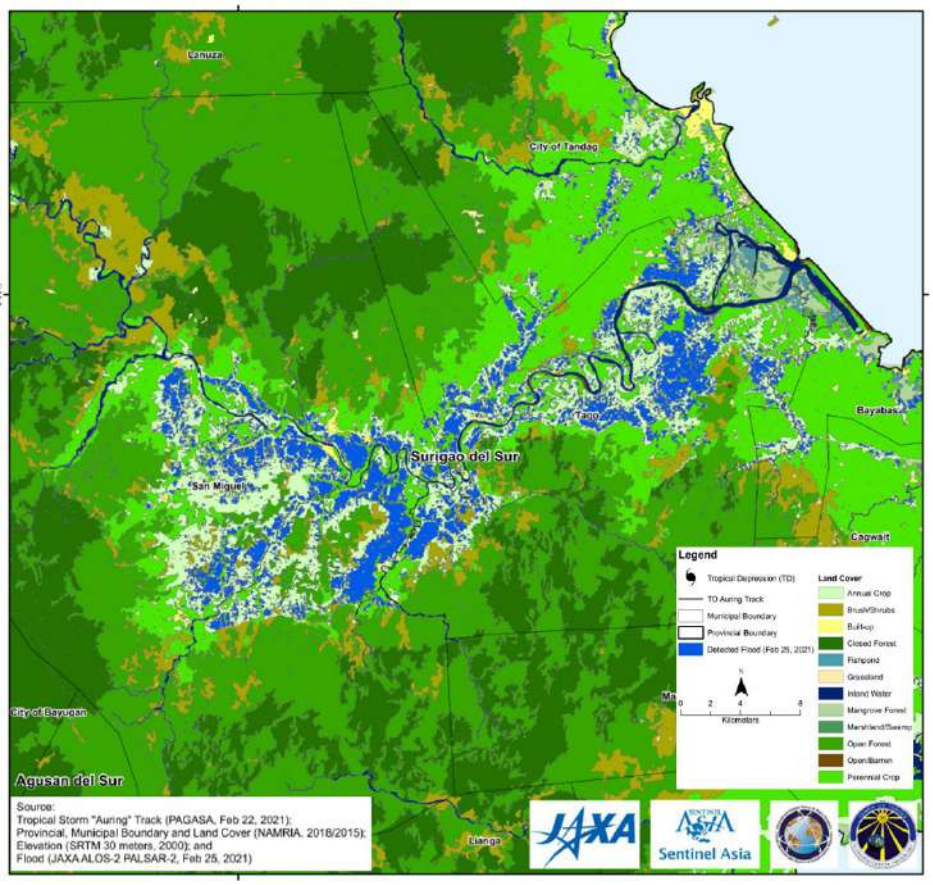


Figure 3. Affected Land Cover in San Miguel, Tago and Tandag City, Surigao del Sur

02/06/2021

Tropical storm Choi-wan (Dante) made several landfalls in the islands of Visayas to south west Luzon on June 1 to 3, 2021. To estimate the impact of Choi-wan, the NARL provides a post disaster multispectral scene specifically FORMOSAT-5 observed on June 4, 2021. The data was used to detect flood in the Province of Oriental Mindoro particularly in the City of Calapan and Municipality of Nuajan (Figure 4). The detected flood was overlaid with exposure elements such as lifeline utilities (Figure 5), critical infrastructure (Figure 6), and built-up areas (Figure 7).

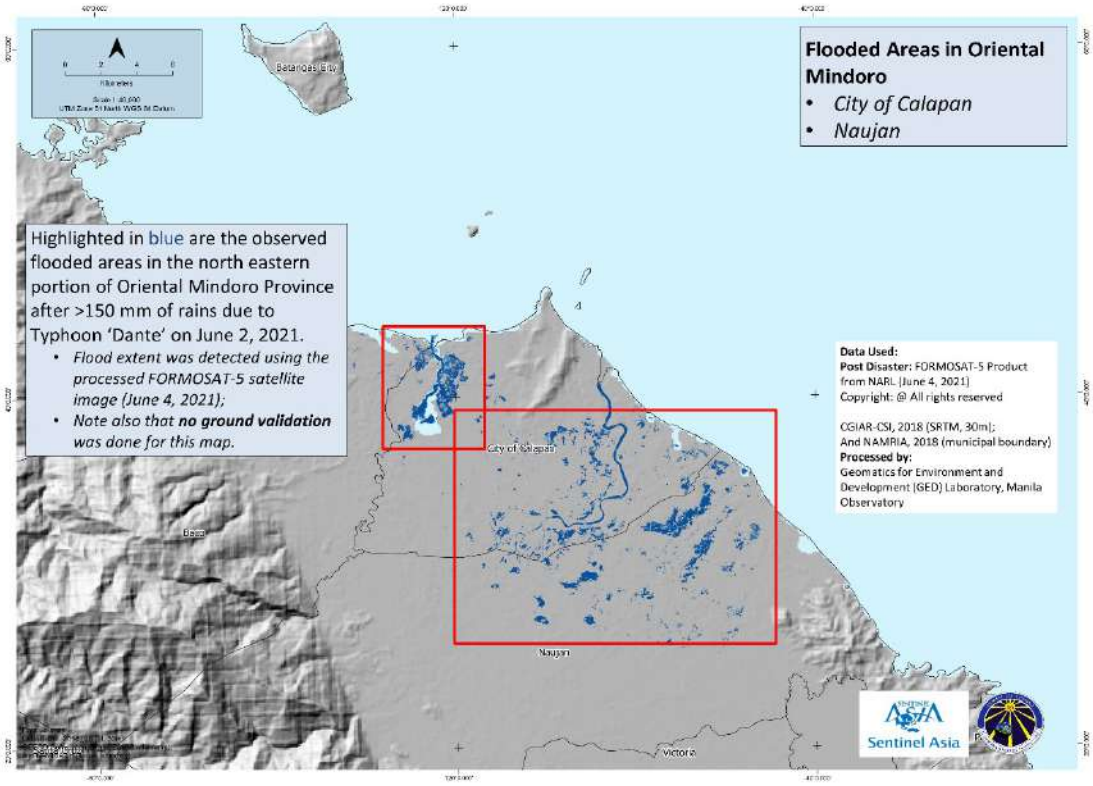


Figure 4. Detected flood in Oriental Mindoro province extracted from FORMOSAT-5 observed on June 4, 2021

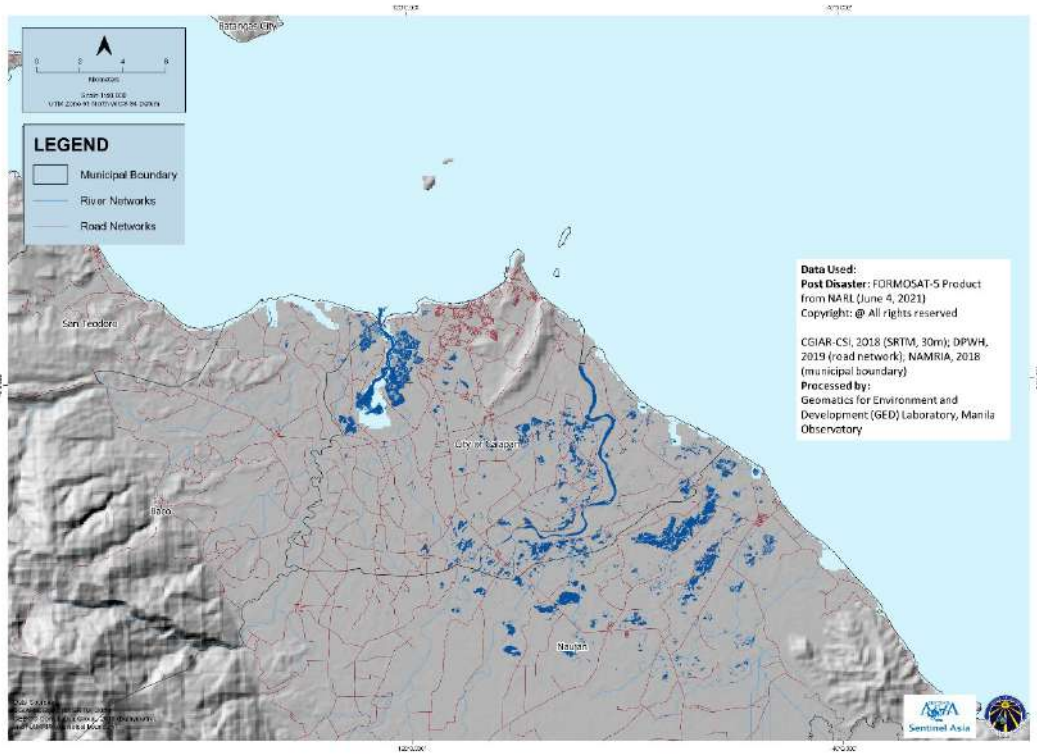


Figure 5. Exposed lifeline utilities in Oriental Mindoro

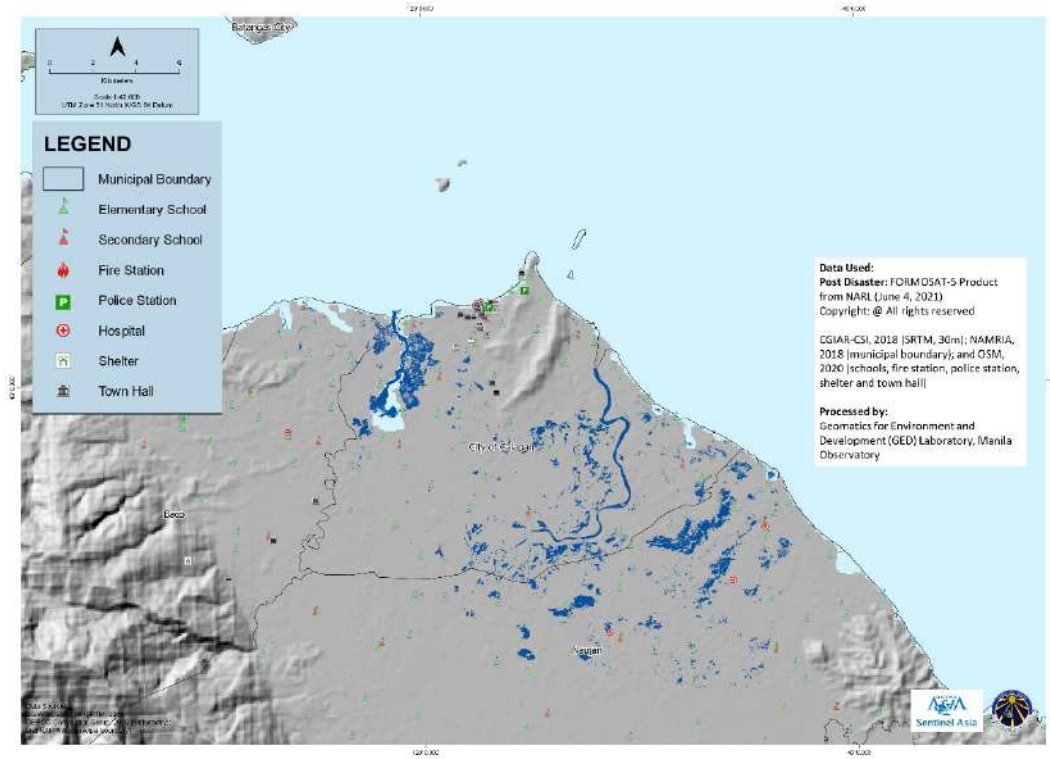


Figure 6. Exposed critical infrastructure in Oriental Mindoro

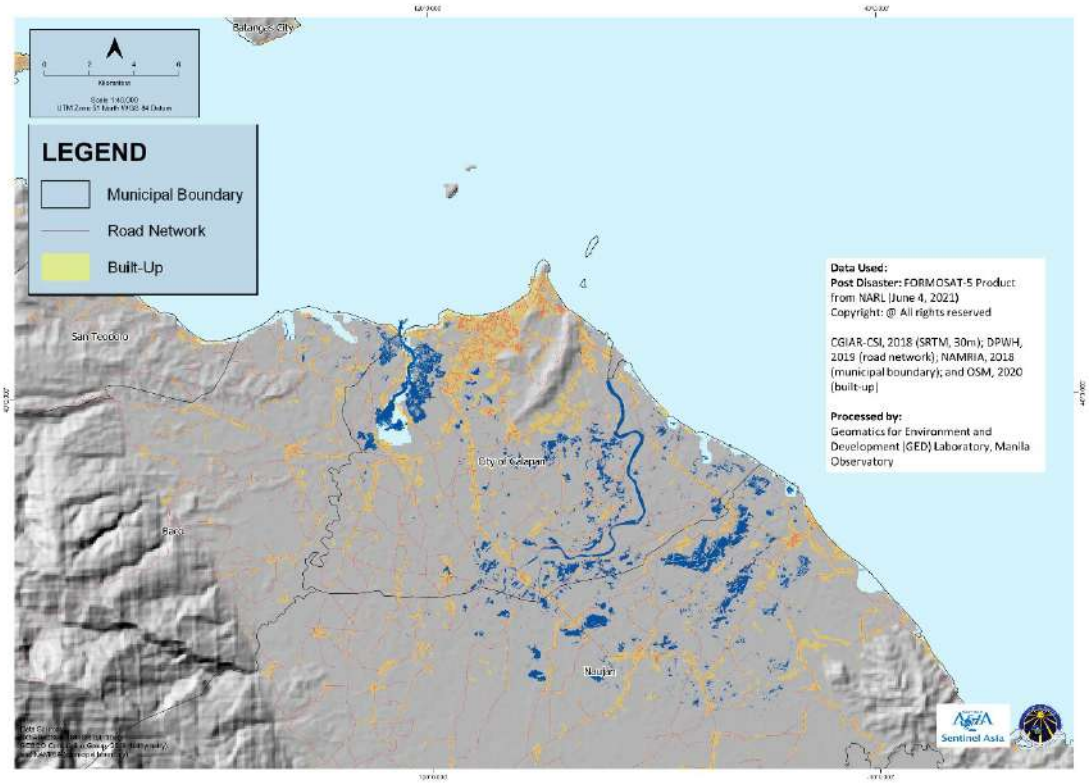


Figure 7. Exposed population in Oriental Mindoro

25/07/2021

The northern and southern Luzon regions in Philippines experienced accumulated 24-hour rainfall exceeding 250 mm during the onslaught of Typhoon 'Fabian' on July 24-25, 2021. To assess the impact of Typhoon Fabian, JAXA provided ALOS-2 PALSAR-2 scenes, one pre-disaster image observed on September 1, 2020 and another on May 25, 2021 as well as post-disaster image observed on August 3, 2021. These multi-temporal RADAR imageries were applied to detect inundation in the provinces of Laguna (Figure 8) and Oriental Mindoro (Figure 9). Maps showing affected population (Figure 10), lifeline utilities (Figure 11), critical infrastructures (Figure 12), and land cover (Figure 13) were also generated.

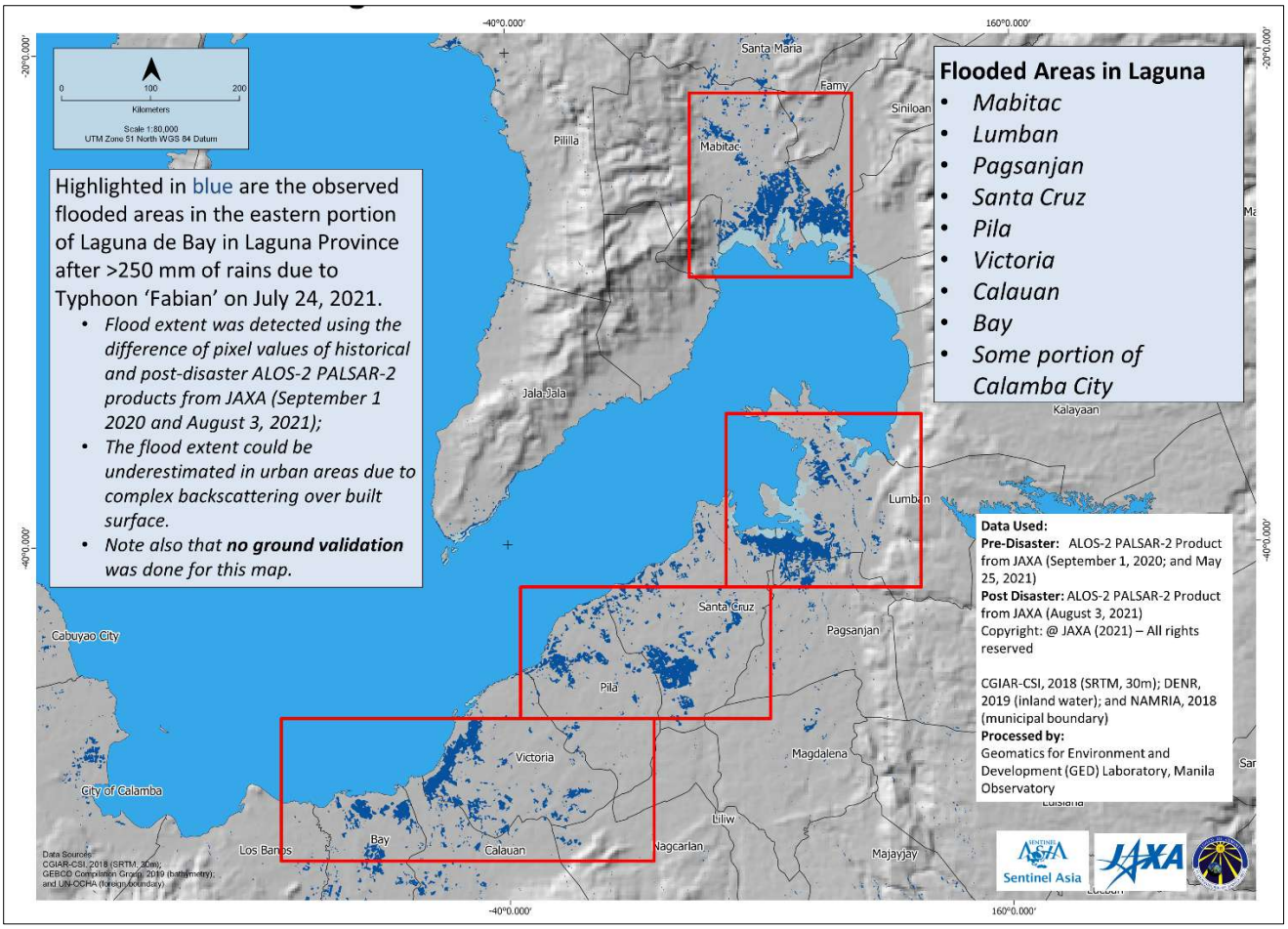


Figure 8. Detected Flood in Laguna extracted from ALOS-2 PALSAR-2 satellite imageries.

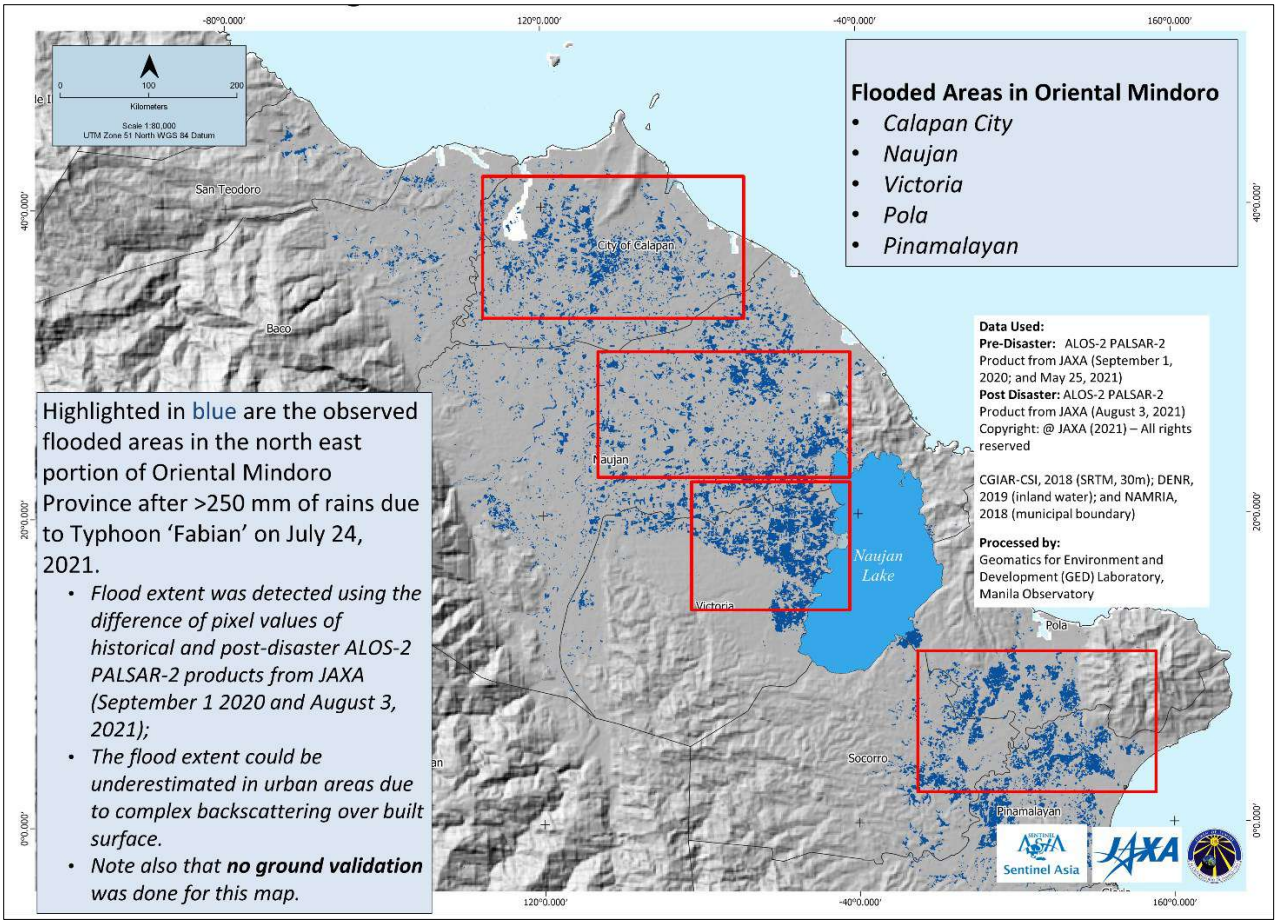
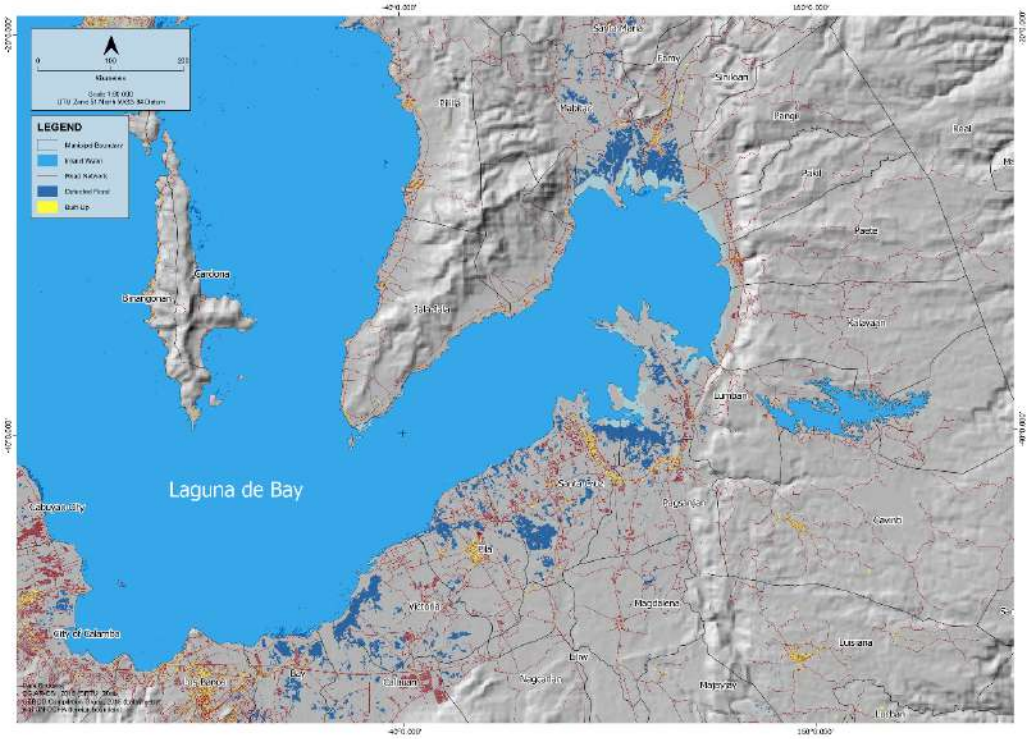


Figure 9. Detected Flood in Oriental Mindoro extracted from ALOS-2 PALSAR-2 satellite imageries.

Exposed Population to Flood in Laguna



Exposed Population to Flood in Oriental Mindoro

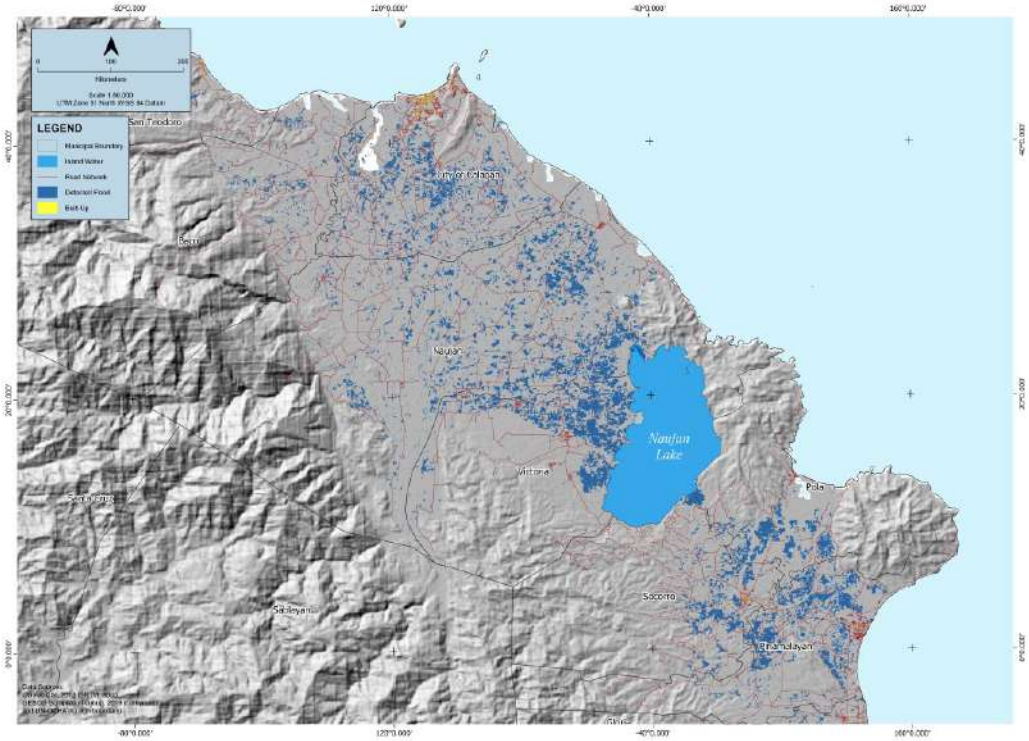
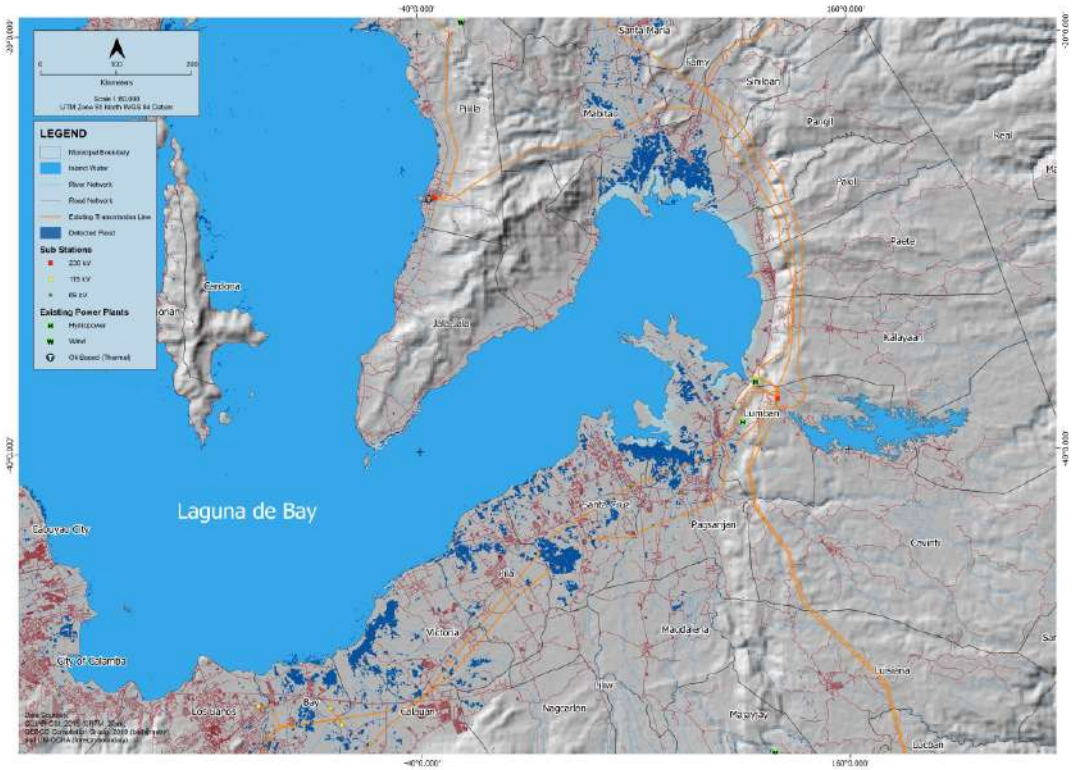


Figure 12. Exposed population to detected flood.

Exposed Lifeline Utilities to Flood in Laguna



Exposed Lifeline Utilities to Flood in Oriental Mindoro

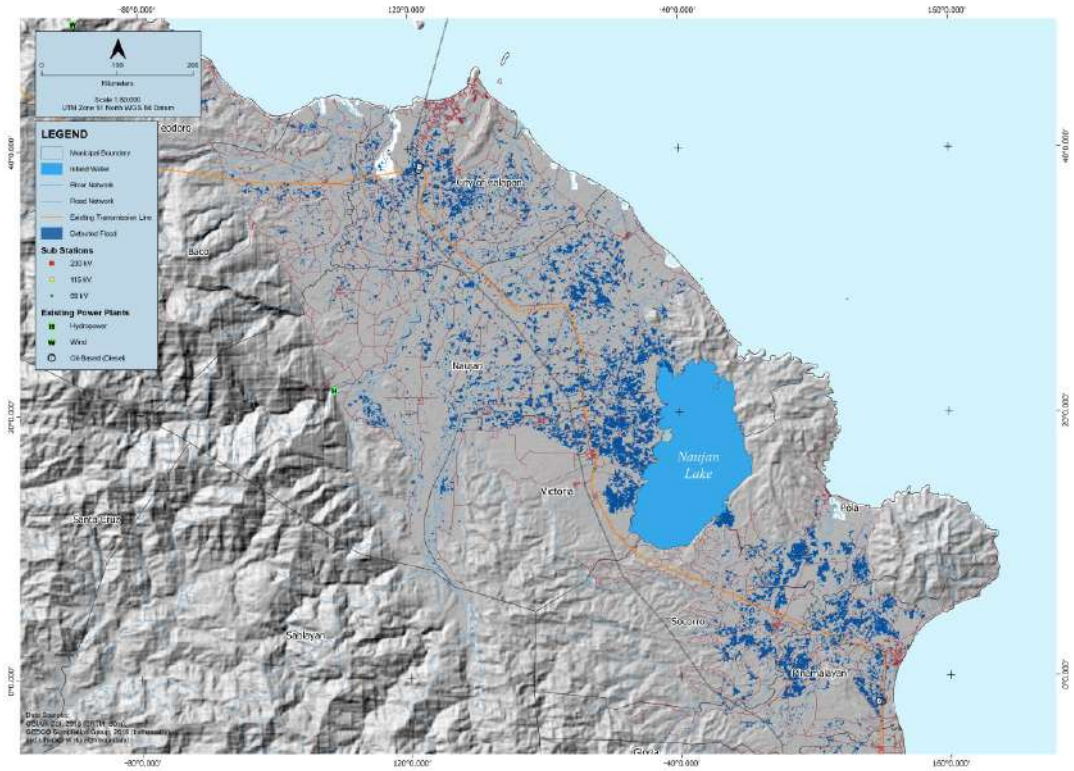


Figure 11. Exposed lifeline utilities to detected flood.

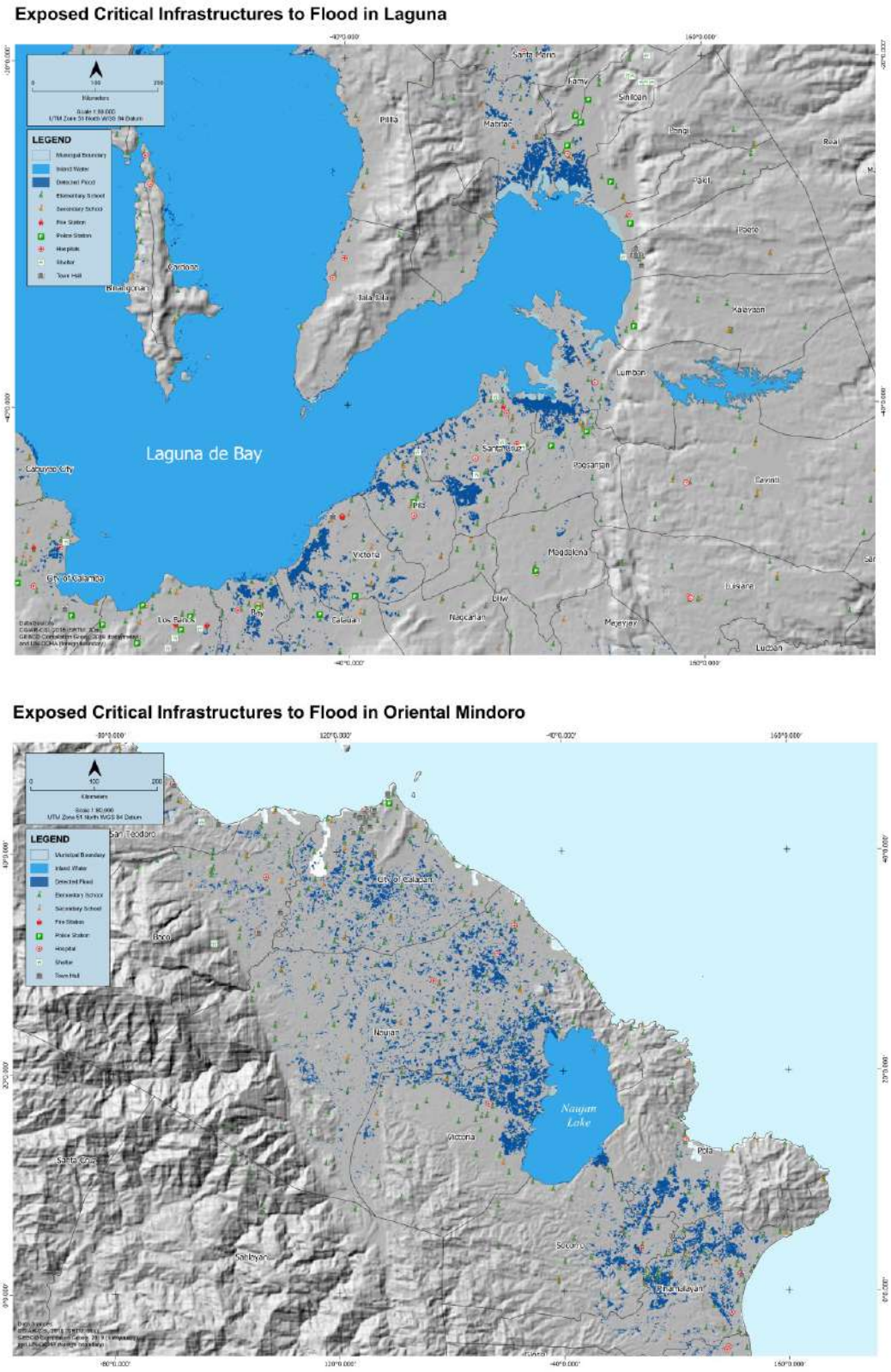


Figure 12. Exposed critical infrastructure to detected flood.

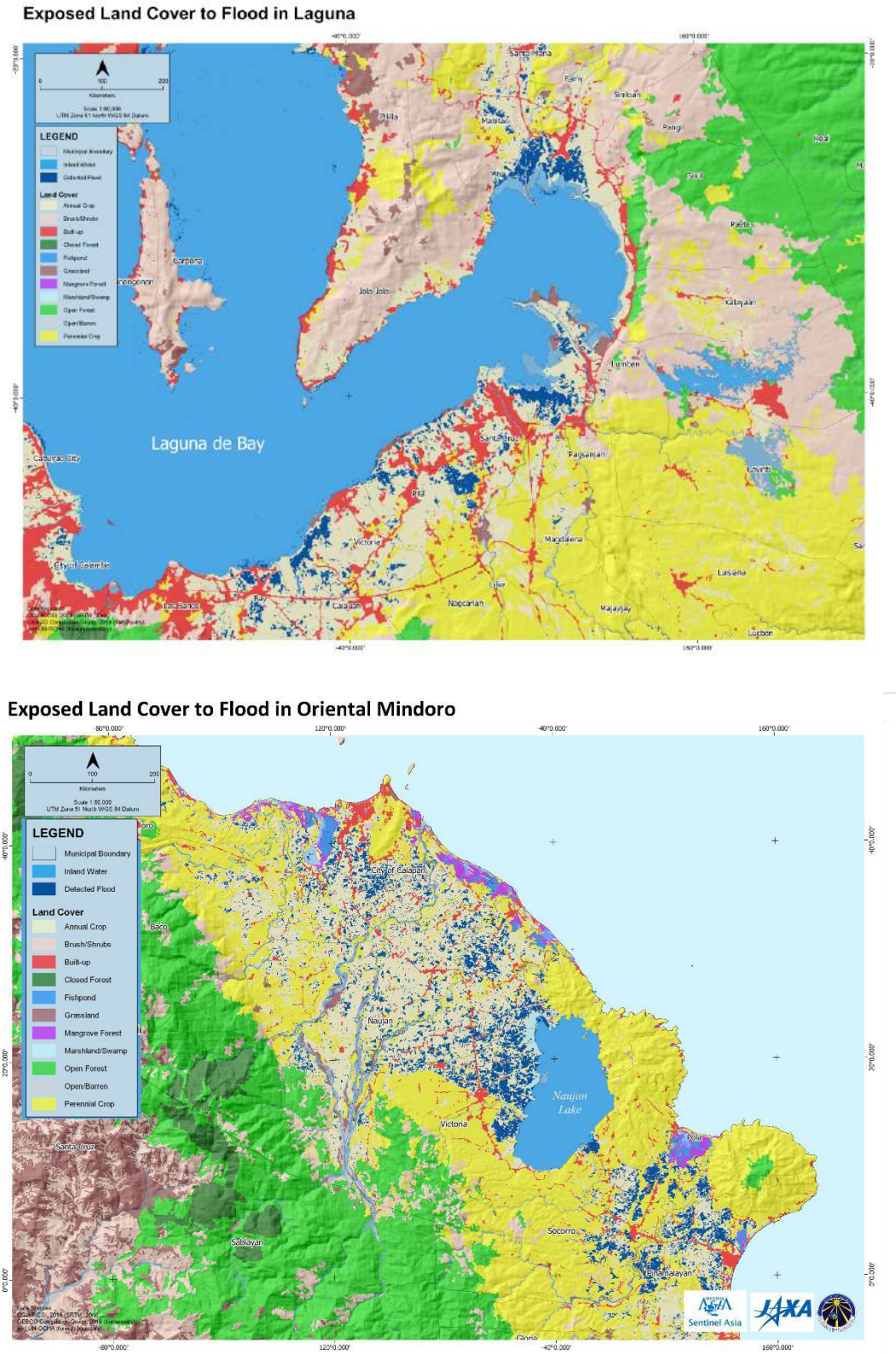


Figure 13. Exposed land cover to detected flood.

08/09/2021

On September 6 to 7, 2021 the tropical storm with international name 'Conson' and local name 'Jolina' passed by several areas in central Luzon, Philippines. The storm poured greater than 150 mm accumulated 24-hour of rainfall. Sentinel Asia provided before and after disaster satellite imageries to evaluate the effects of tropical storm. Pre- and post-disaster RADAR imageries specifically ALOS-2 PALSAR-2 observed on June 8, 2021 and September 14, 2021 from JAXA together with THEOS-1 image observed on September 9, 2021 were processed to identify flooded areas. Flood was detected in provinces of Laguna, Tarlac, and Pampanga (Figure 14). To evaluate the impact of tropical storm Jolina, the detected flood was overlaid with exposures such as lifelines utilities (Figure 15), critical infrastructure (Figure 16), population (Figure 17), and land cover (Figure 18).

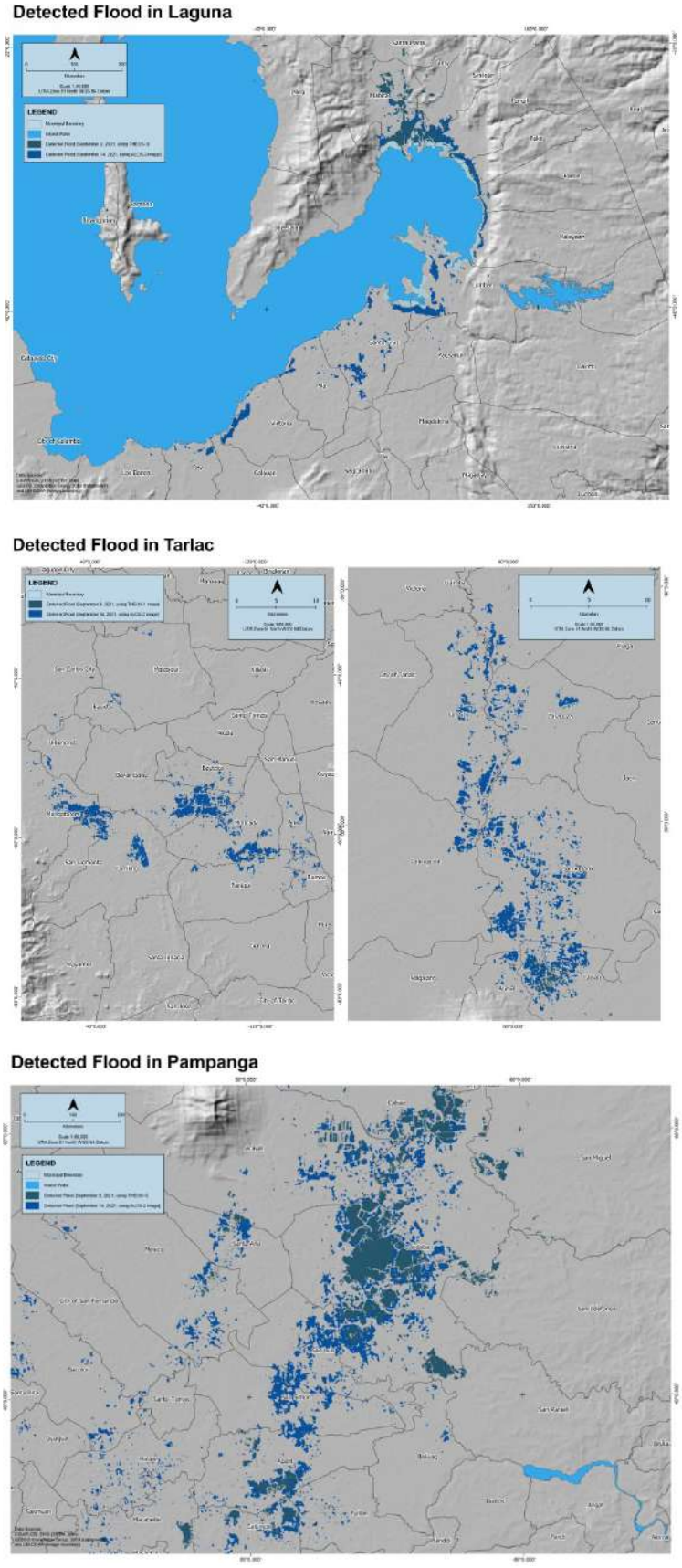


Figure 14. Detected flood in Laguna (top), Tarlac (middle), and Pampanga (bottom).

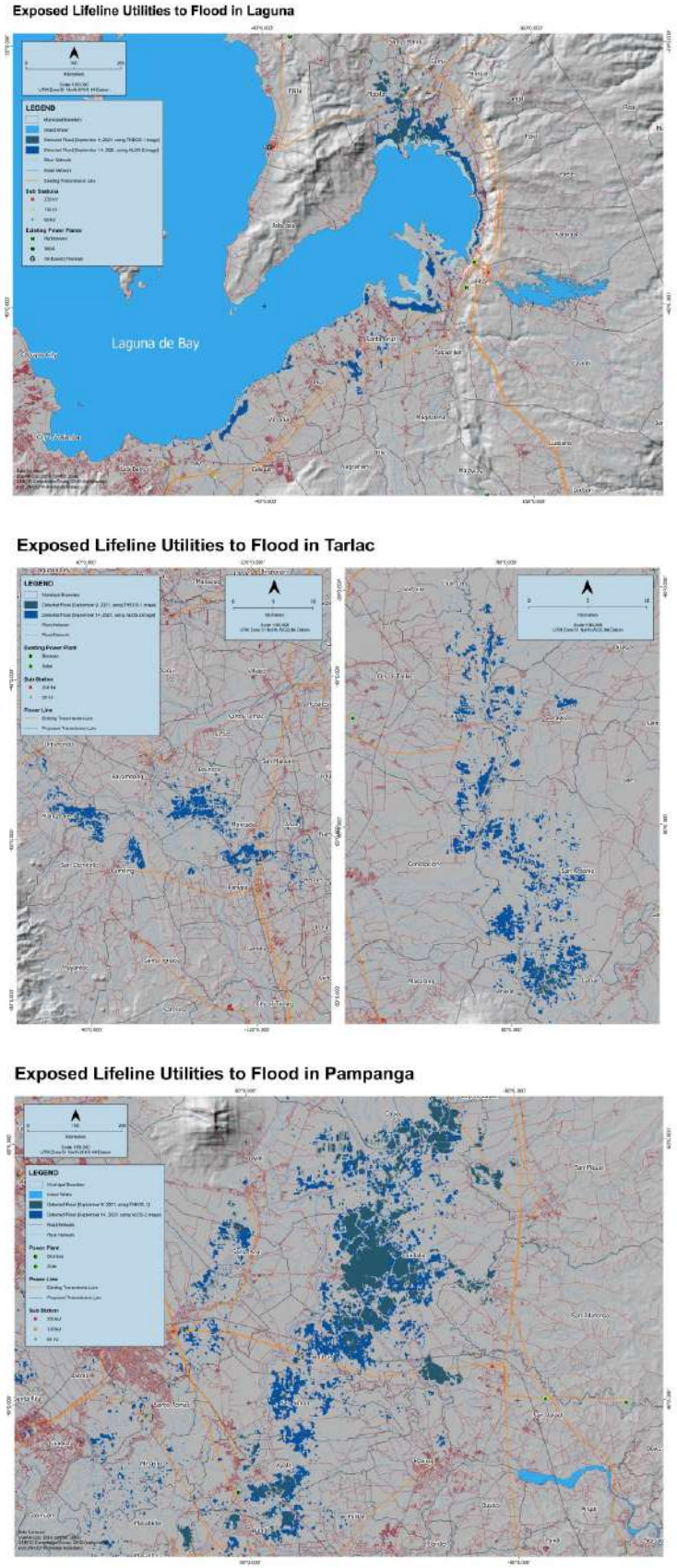


Figure 15. Exposed lifeline utilities to flood caused by tropical storm Jolina.

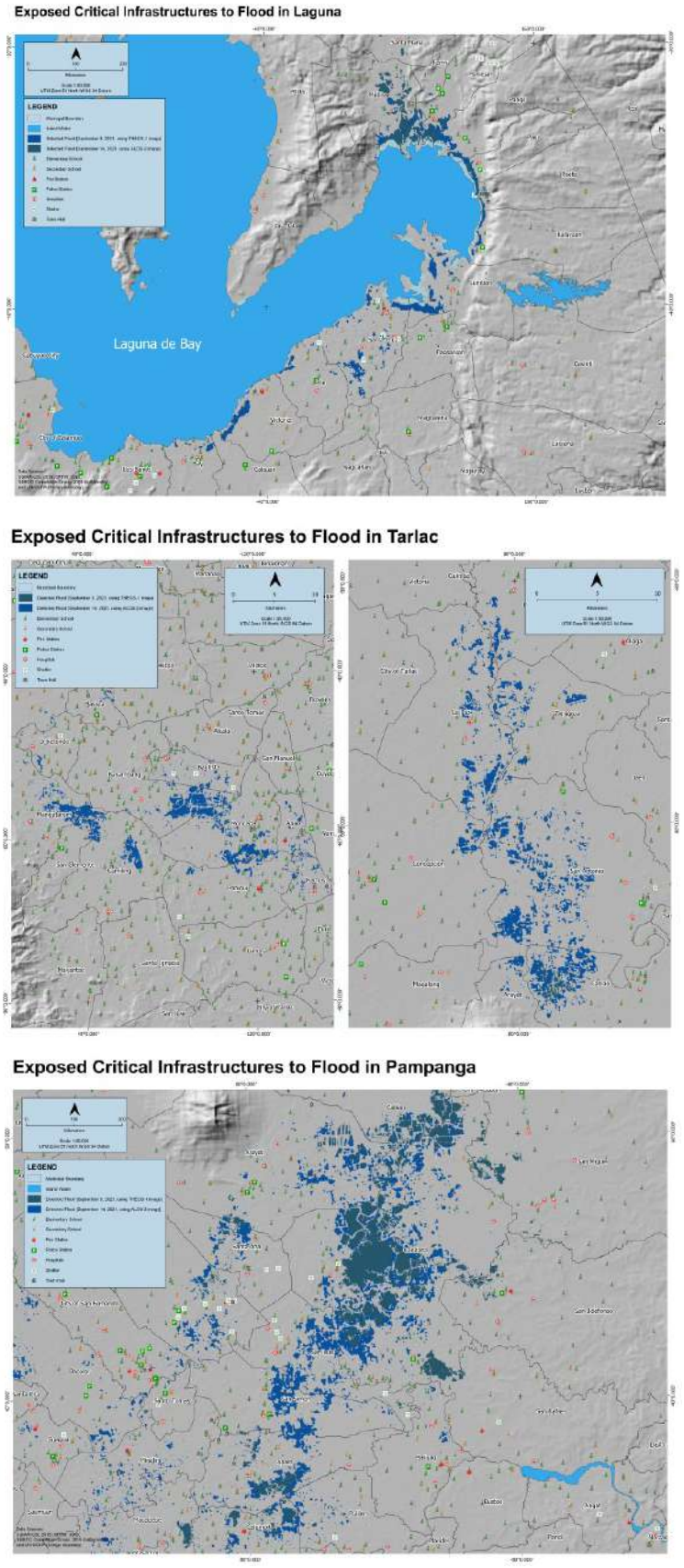


Figure 16. Exposed critical infrastructure to flood caused by tropical storm Jolina.

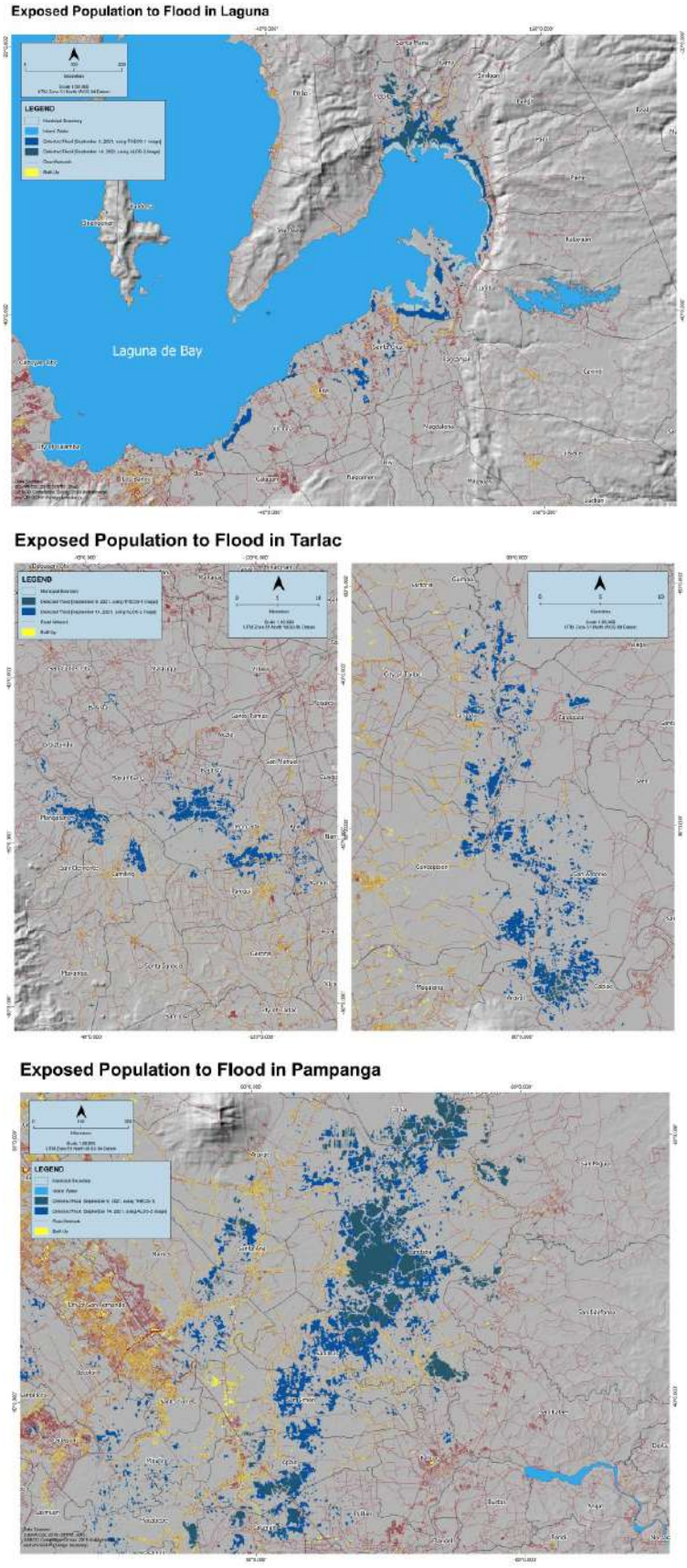


Figure 17. Exposed population to flood caused by tropical storm Jolina.

Figure 18. Exposed land cover to flood caused by tropical storm Jolina.

12/10/2021

Tropical depression Maring brought moderate to heavy rain in northern Luzon specifically Batanes, Cagayan Valley, Cordillera Administrative Region, and Ilocos Region on October 11 to 12, 2021. According to the Philippines Department of Social Welfare and Development (DSWD) Office report as of October 28, 2021 there were 290,802 families or 1,134,980 persons in northern Luzon affected by Maring. To estimate the impact of typhoon Maring the Manila Observatory requested emergency observation in Sentinel Asia. We received pre and post disaster scenes such as THEOS-1 from GISTDA, ResourceSat-2 from ISRO, and ALOS-2 PALSAR-2 products from JAXA.

14/12/2021

Tropical storm Odette (Rai) entered the Philippine Area of responsibility or PAR on December 14, 2021. It intensified into a typhoon on December 15, 2021 and continued to move westward. It made landfall on December 16, 2021 over Siargao Island, Surigao del Norte. Rai slightly weakened when it reached central Visayas towards Palawan and exited in the Kalayaan Group of Island on December 18, 2021. The typhoon brought an amount of more than 150 mm of accumulated 24-hour rainfall. To estimate the consequences of rainfall, observed flood from the ALOS-2 PALSAR-2 product processed by Earth Emergency Observatory of Singapore – Remote Sensing (EOS-RS) was mapped (Figure 19). Exposed elements such as critical infrastructure (Figure 20), affected population (Figure 21), and land cover (Figure 22) were overlaid to observed flood.

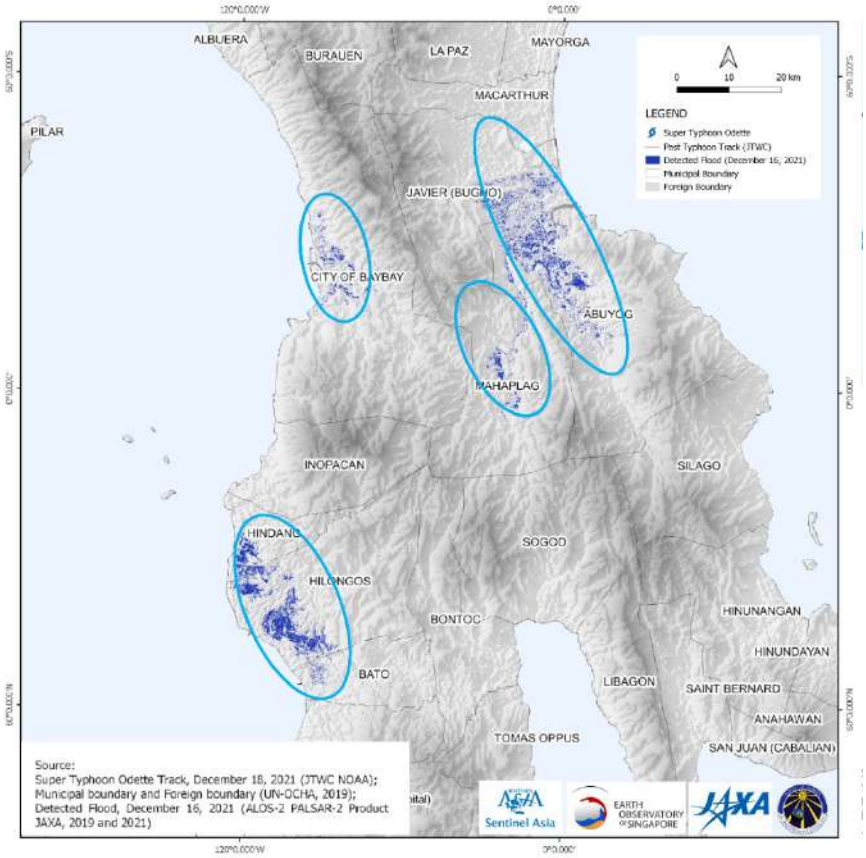


Figure 19. Detected flood in Leyte Island extracted from ALOS-2 PALSAR-2 product of JAXA observed on December 16, 2022

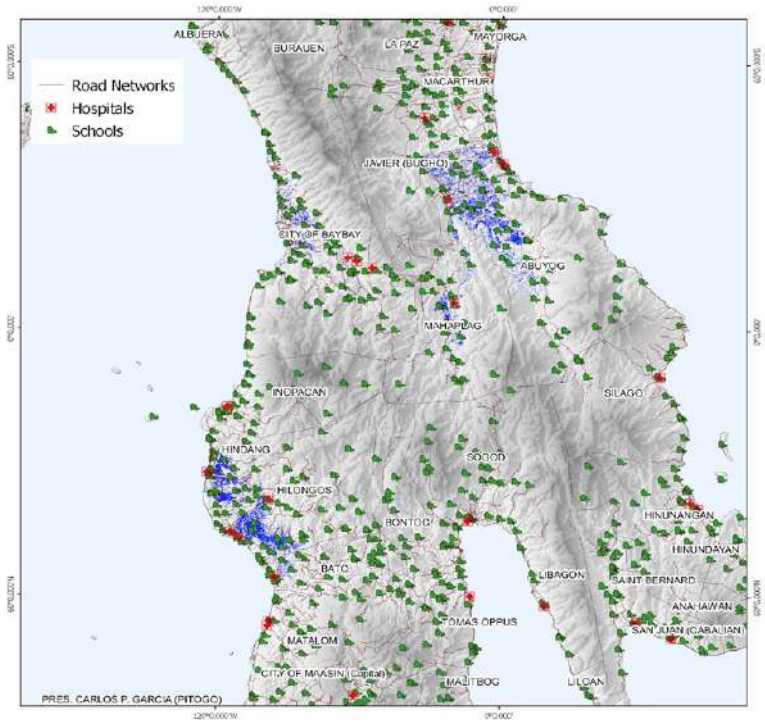


Figure 20. Exposed critical infrastructures to detected flood in Leyte Island

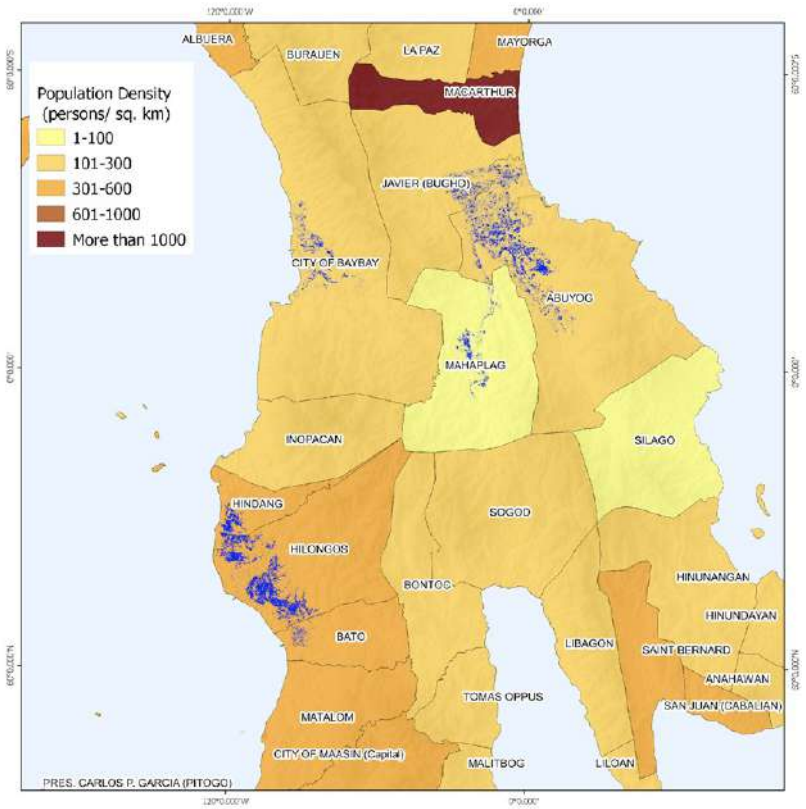


Figure 21. Exposed population to detected flood in Leyte Island

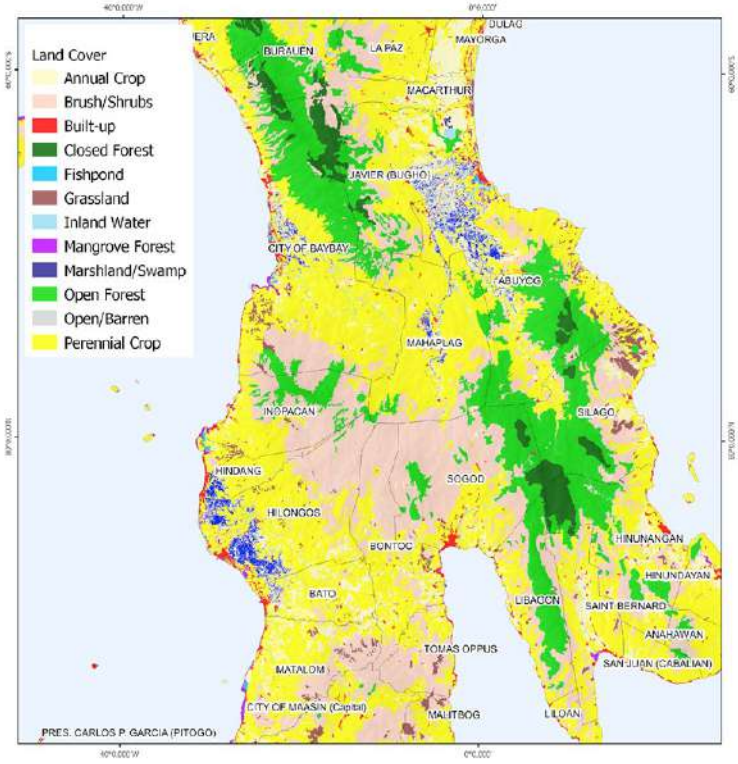


Figure 22. Exposed land cover to detected flood in Leyte Island

Organization	**Department of national remote sensing – VietNam Ministry of natural resources and environment**
Title	**Summary of 2021 results through SA system activation**
Type of Activity	**EOR** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**13/09/2021: EOR** **07/10/2021: EOR** **10/10/2021: EOR** **25/10/2021: EOR**

Through four activation sessions we have received timely support for satellite observation data as well as other value-added products. With the processing of satellite data and other supporting documents, we have provided 22 floods map for agencies to use data to respond to natural disasters in Vietnam. Details of the duties are listed below.

13/09/2021:

According to the forecast of the National Center for Hydro-Meteorological Forecasting, it is likely that on the night of September 8, tropical Storm ConSon will enter the East Sea, becoming the storm No. 5, likely to be the strongest when reaching the Hoang Sa archipelago; forecast can reach level 11, jerk level 13. Receive forecast information on the impact of tropical Storm ConSon which will cause heavy rain and flooding in central provinces. We immediately activated the system to request the support of Sentinel Asia, Through timely support from data providers and application organizations, we have received the following satellite image materials and value-added products:

+ 06 ALOS-2 after-disaster scenes (03 scenes in level 1.1, 03 scenes in level 2.1)
+ 04 detected flood water map of AOI and 01 detected Flood Water in Vietnam in SHP file format from AIT
+ 04 FORMOSAT-5 Level4 after-disaster scenes

07/10/2021:

Due to the influence of the tropical convergence band combined with a tropical depression that is likely to strengthen into a hurricane, from now Oct 06 – 08, 2021 in the area from Quang Binh to Phu Yen and the North - Central Highlands will have heavy rain with total rainfall in the area from Quang Binh to Quang Ngai, Kon Tum is common 300-500mm, especially in the area from Thua Thien Hue to Quang Ngai, there are places with very heavy rain with rainfall above 600mm. The area from Binh Dinh to Phu Yen, Gia Lai is popular from 100-300mm, there are places over 350mm.

From October 9-12, heavy rain expands to the North Central provinces and the Northern Delta. We have activated the system and received the following valuable support:

+ 01 ALOS-2 pre-disaster scenes and 01 ALOS-2 after-disaster scenes from JAXA
+ 08 THEOS1 after-disaster scenes from GISTDA
+ 01 detected flood water map in Thu thien- Hue province of Vietnam and Detected Flood Water in Vietnam in SHP file format from AIT

10/10/2021:

According to the forecast, KOMPASU storm will make landfall in Vietnam, directly affecting the provinces from Thanh Hóa to Quang Nam. We have activated the system and received the following valuable support::

+ 03 THEOS1 after-disaster scenes from GISTDA
+ 01 RESOURCESAT-2 after-disaster scenes from ISRO
+ 02 FORMOSAT-5 after-disaster scenes from NARL

25/10/2021:

From October 22, the area from Thua Thien Hue to Binh Dinh provice has very heavy rain with the total amount of rain over 700mm.There is a high risk of flash floods and landslides, flooding in low-lying mountainous provinces in the North and North Central regions. we have activated the system and received the following valuable support:

+ 04 ALOS-2 pre-disaster scenes and 04 ALOS-2 after-disaster scenes from JAXA
+ 01 RESOURCESAT-2 after-disaster scenes from ISRO
+ 01 detected flood water map in Quang Nam province, Vietnam and Detected Flood Water in Vietnam in SHP file format from AIT
+ 06 THEOS1 after-disaster scenes from GISTDA

Figure 1. Quick monitoring map of flooding in Hoi An city, Quang Nam province on September 15, 2021 (inundated area information is extracted from satellite image ALOS PALSAR 2).

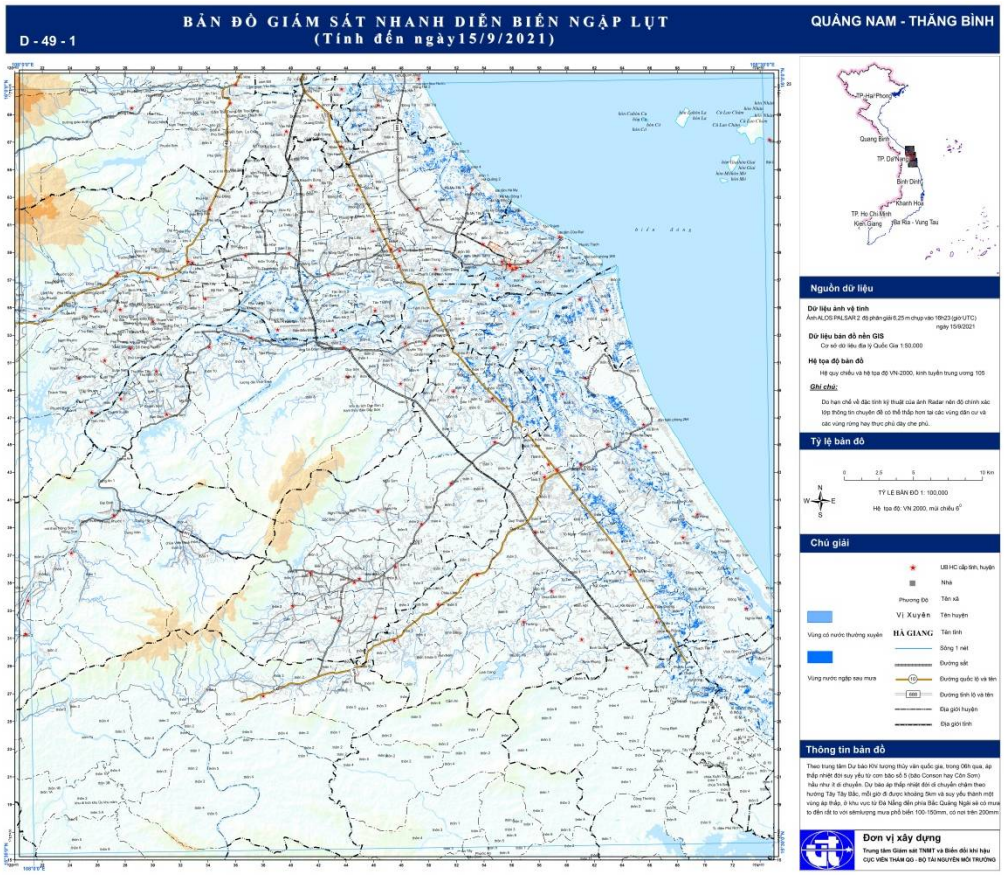
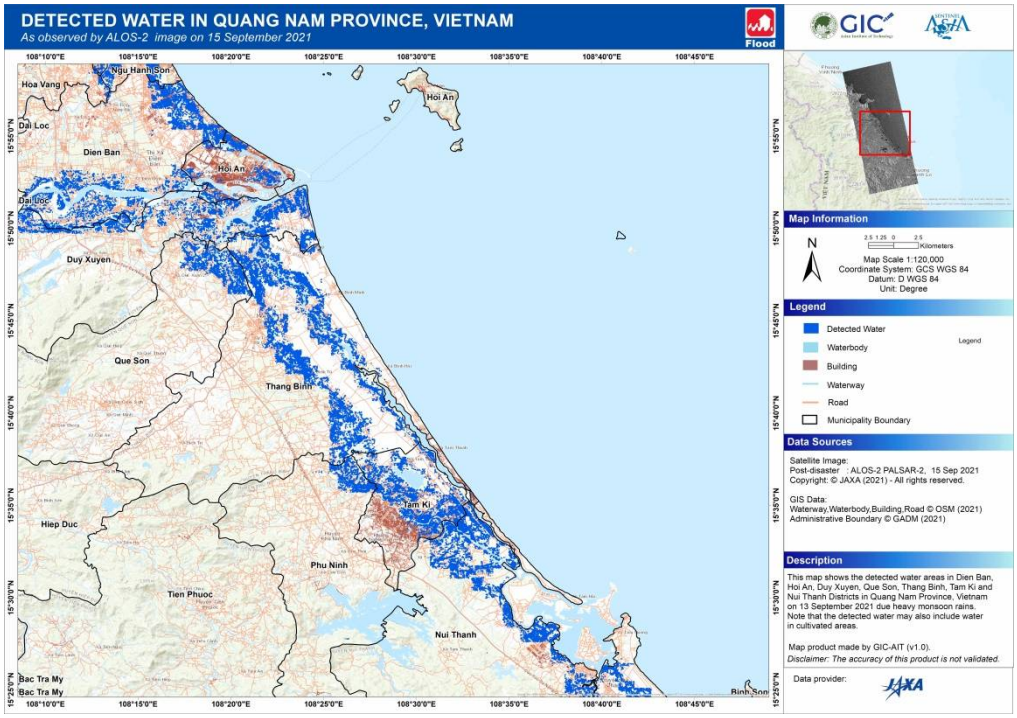
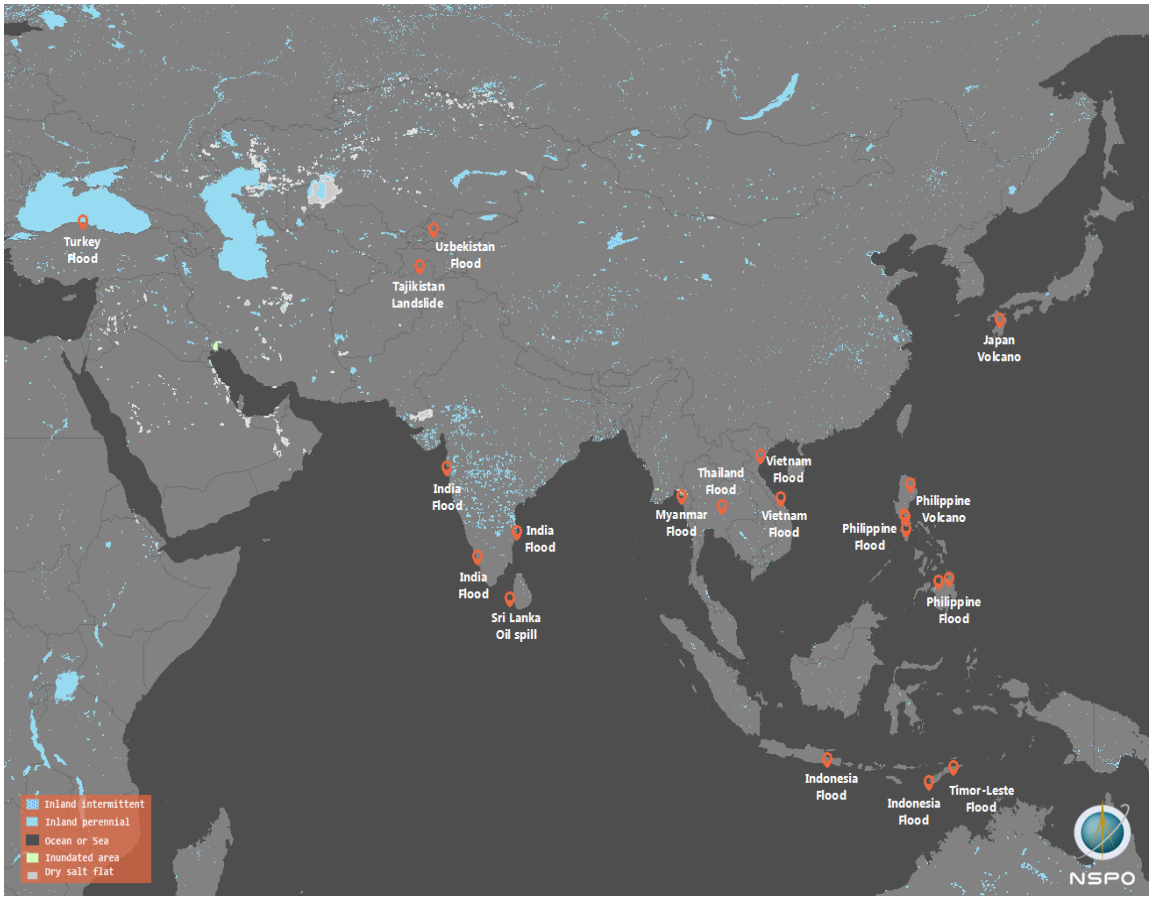


Figure 2. The value-added products are deteced water in Hoi An city made by AIT and shared on the portal of SA (September 15, 2021).



Organization	**National Space Organization, National Applied Research Laboratories (NSPO-NARLabs)**
Title	**Satellite Imagery Support to Sentinel Asia**
Type of Activity	**Responses to EOR (Providing Satellite Data as Data Provider Node)**
Date	**Year of 2021**

During 2021, NSPO has contributed to the Sentinel Asia activities as Data Provider Node. NSPO has successfully responded to Emergency Observation Requests (EOR's) pertaining to12 countries ranging from East Asia to South Asia in 21 events with FORMOSAT-5 satellite datasets comprising of pre- and post-disaster events. All these satellite image products were provided right after we acquired cloudless images. According to the statistics, FORMOSAT-5 satellite image products supported various types of applications such as storm and flood relief. At the same time, it has also given disaster response assistance to India, Indonesia, the Philippines, and Vietnam for more than one event. It's worth noting that NSPO also provided Value-Added Products to assist stakeholders in the rescue, which enabled decision makers to understand the extent and scope of the disaster in intuitive manner.



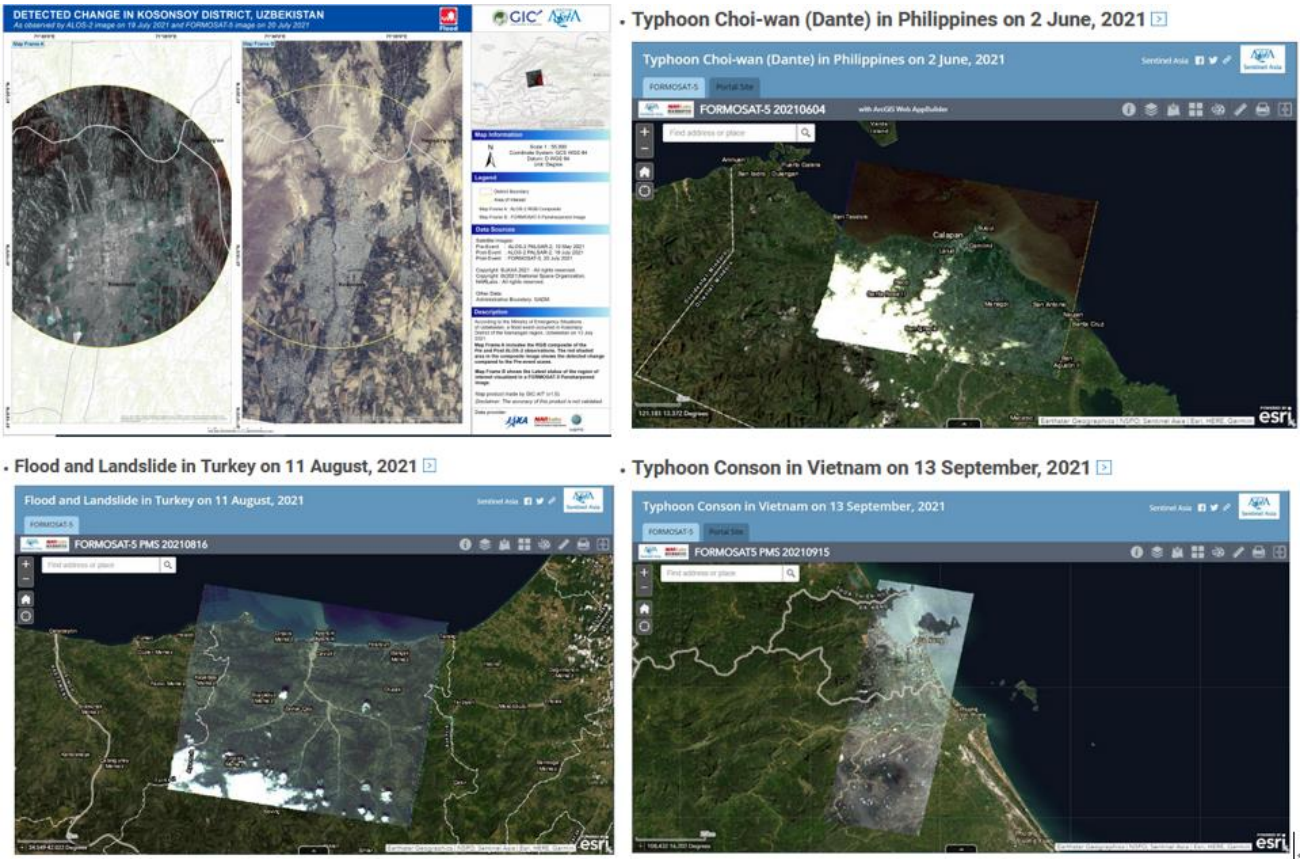


Fig 1 NSPO Support to Sentinel Asia Emergency Observation Requests During 2021.

Organization	Academia Sinica Grid Computing Center (ASGC) and NSPO-NARLabs
Title	Sentinel Asia JPT-3 Cloud Services
Type of Activity	Cloud Server Service
Date	Year of 2021

Academia Sinica Grid Computing Center (ASGC) and NSPO, in collaboration with Sentinel Asia Tech Team, supported Sentinel Asia Emergency Observation (EO) online workflow and the integration of WebGIS, EO pipeline, data access of DAN and DPN, as well as distributed cloud platform since Feb. 2020. Reliability of the JPT-3 cloud services is higher than 99.9% on average in year 2021. Around 173GB data is downloaded by about 393 accesses from Sentinel Asia members and applications on a monthly average from Feb. 2020 to Dec. 2021. The total download data scale has been more than 1.9 Terabyte (TB) during 2021. NSPO together with Sentinel Asia Tech Team reviewed the status of SA services and technical issues periodically. In the future, NSPO will work with the SA technical team to advance the values of satellite resources on disaster management and their applications by designing and prototyping spatiotemporal infrastructures such as Open Data Cube, token-based authentication and authorization infrastructure.

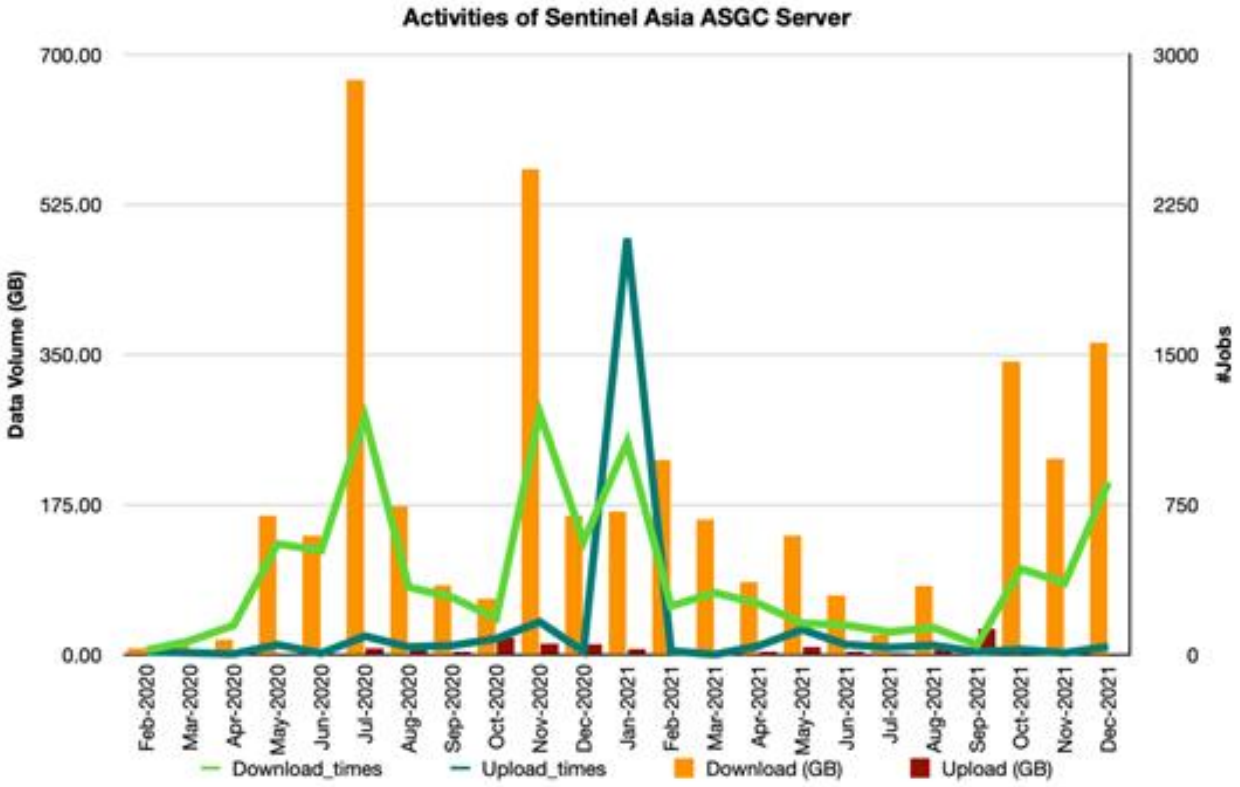


Fig 2 Summary of Sentinel Asia JPT-3 Cloud Services in 2020 to 2021.

Organization	NSPO-NARLabs and JAXA
Title	APRSAF-27 Side Event: Building Resilience Using Open Data Cube (ODC) in Post-COVID Era
Type of Activity	Workshop and Conference meeting
Date	2021-11-29

NSPO-NARLabs and JAXA co-hosted Side Event on "Building Resilience Using Open Data Cube (ODC) in Post-COVID Era" in APRSAF-27. The objective of this Side Event is to share various countries/regions development status, and to exchange experiences in applying Open Data Cube (ODC) to different societal benefit areas. Invited speakers are from Australia, Japan, Taiwan, Thailand, the US, Vietnam, and international organizations: Committee on Earth Observation Satellites (CEOS) and Asian Development Bank (ADB). In this event, Australia, Taiwan, Thailand, and Vietnam shared their experiences on the national level development as well as applications to SDG of Data Cube. International Organizations of CEOS and ADB presented the development of Open Data Cube and recent Remote Sensing projects from a global point of view.

There are approximately 40 participants from Taiwan, Japan, Australia, Thailand, Vietnam, and U.S. This event concluded with a concept to establish a regional Data Cube as an infrastructure to support building a resilient society in post-Covid era. This concept facilitates a starting point for the APRSAF community, especially Sentinel Asia and SAFE within SAWG, to consider the feasibility of a joint effort. Therefore, this event facilitates as the first step in establishing ODC for future APRSAF initiatives. In this cooperation platform, we could work together towards contributions in SDGs.

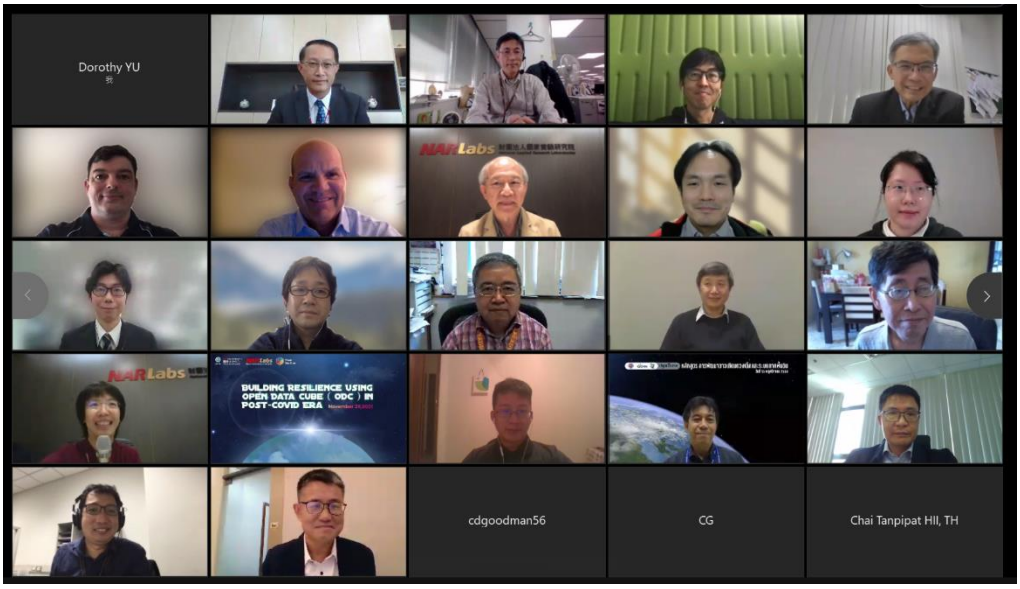


Fig 3. Group Photo of APRSAF Side Event:
Building Resilience Using Open Data Cube (ODC) in Post-COVID Era

Organization	**C The Philippine Institute of Volcanology and Seismology (PHIVOLCS)**
Title	**EOR**
Type of Activity	**EOR**
Date	**November/2021**

The Philippine Institute of Volcanology and Seismology (PHIVOLCS) is a service institute of the Department of Science and Technology (DOST) that is principally mandated to mitigate disasters that may arise from volcanic eruptions, earthquakes, tsunami and other related geotectonic phenomena.

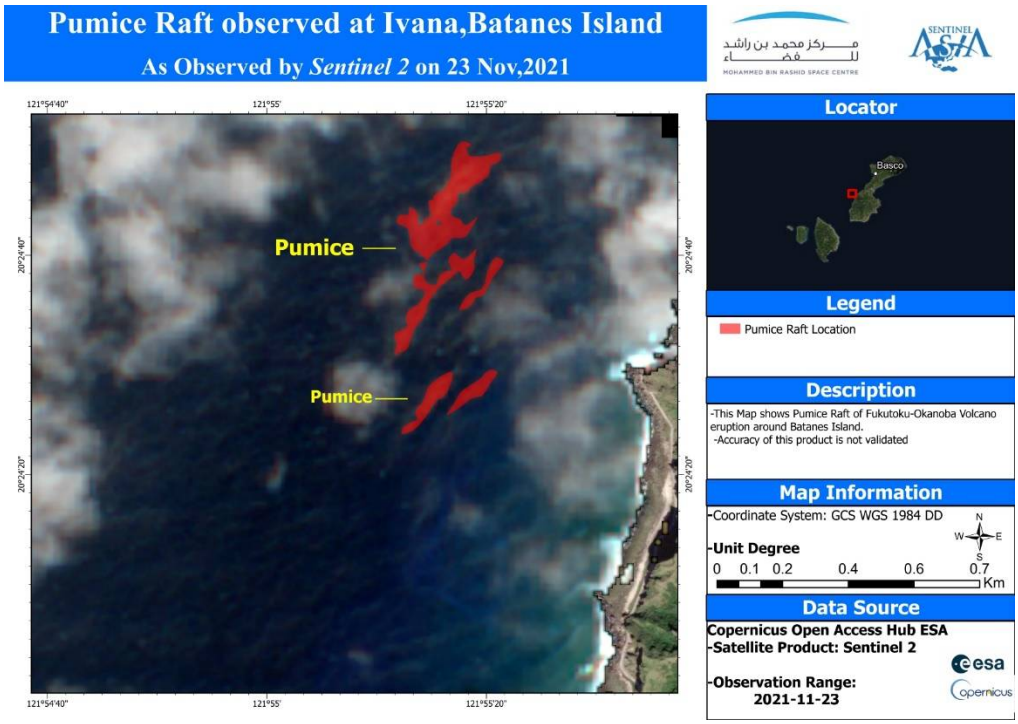
Our vision is;

A leading global science and technology institution of empowered men and women helping develop communities safe from and resilient to volcanic eruptions, earthquakes, tsunamis and other related hazards

And our mission is;

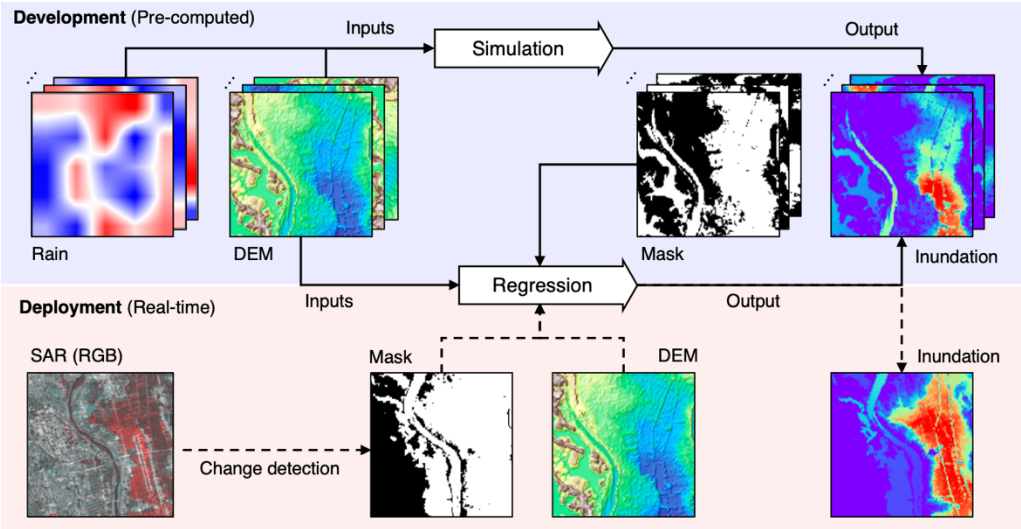
We provide timely, quality and socially-inclusive information and services for warning, disaster preparedness and mitigation. This we do through the development and application of technologies for the monitoring and accurate prediction of, and determination of areas prone to, volcanic eruptions, earthquakes, tsunamis and other related hazards, and gender-responsive capacity enhancement for comprehensive disaster risk reduction.

In the framework of Sentinel Asia, PHIVOLCS requested for volcanic eruption influence in Philippines which hit was in November 2021. Provided VAP were utilized for our DRR activities.



Organization	**Geoinformatics Unit, RIKEN Center for Advanced Intelligence Project (AIP)**
Title	**Predicting Flood Inundation Depth Based-on Machine Learning and Numerical Simulation**
Type of Activity	**Conference** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**21/10/2022**

Recent advances in earth observation and machine learning have enabled rapid estimation of flooded areas following catastrophic events such as torrential rains and riverbank overflows. However, estimating the actual inundation depth remains a challenge since it often requires detailed numerical simulation. This paper presents a methodology for predicting the inundation from remote sensing derived information by coupling deep learning and numerical simulation. We generate a large dataset of flood depth inundations considering several heavy rain conditions in four independent target areas. We propose a CNN-based regression framework. Our experiment demonstrates that our methodology can predict inundation depth on a separate target area not included during training, demonstrating great generalization ability.



Predicting Flood Inundation Depth Based-on Machine Learning and Numerical Simulation

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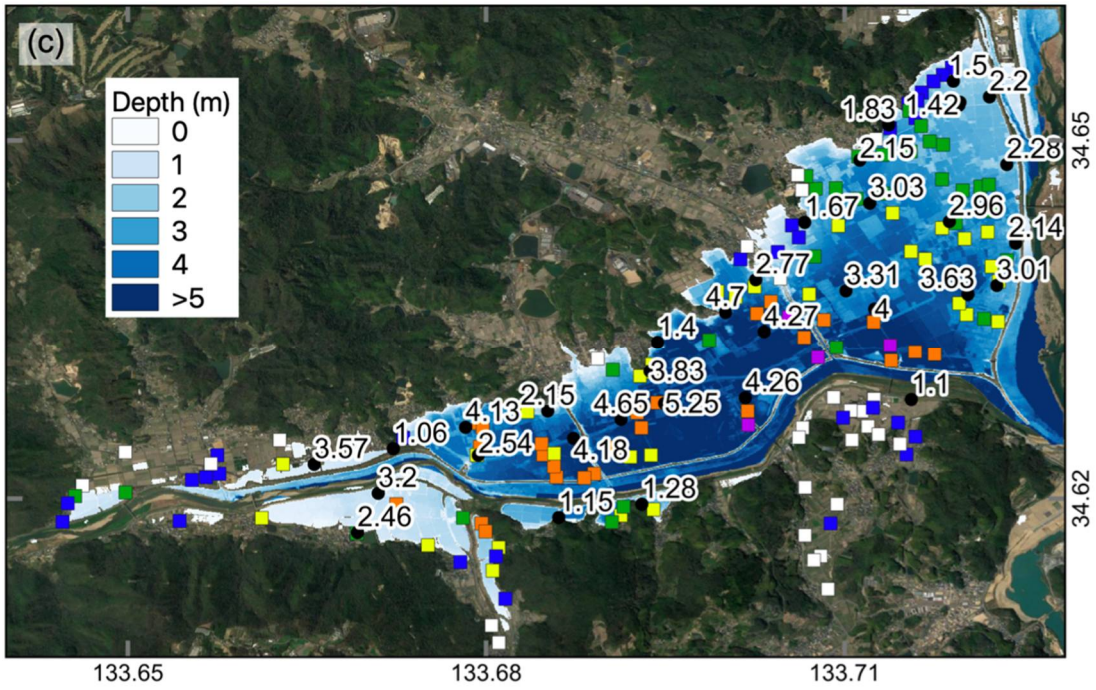
Proceedings of the 2nd CDCEO Workshop, IJCAI-ECAI, 2022

Organization	**International Research Institute of Disaster Science, Tohoku University**
Title	**Estimation of flood depth using SAR data and DEM**
Type of Activity	**Research**
Date	**31/08/2022**

Rapid information about the affected area and understanding impacts are critical for early response and recovery from disasters. For example, remote sensing data analysis has been applied to identifying the extent of flood. In fact, remote sensing data has become the only tool that can identify the extent of a major flood within hours or days after its occurrence. Here, we attempt to determine inundation depth from remote sensing data. Inundation depth is useful for identifying areas in need of assistance during evacuations, road disruption, and damage. To achieve this, we propose practical application of sparse representation integrating SAR-based flood binary maps and digital elevation models to estimate inundation depth. We assume that floods can be modeled as a combination of water bodies at rest. A dictionary of water bodies computed under the potential flood level is constructed from the digital elevation models. The actual flood extent is then represented as a sparse linear combination of the water body dictionaries. Each water body in the linear combination related to the inundation level is used to estimate the inundation depth. To evaluate the proposed procedure, we estimated the inundation depths for the flood event of 2008 in Okayama Prefecture, Japan. The results showed remarkable agreement with field survey results.



Estimated inundation depths for the flood event of 2008 in Okayama Prefecture, Japan

Organization	**The University of Tokyo**
Title	**R&D on satellite-based building footprint mapping using FORMOSAT-2 satellite images**
Type of Activity	**Research and development for data preparedness** (e.g., Conference, Workshop, Meeting, Training, EOR, Providing satellite data or VAP)
Date	**Through the year in 2021**

The University of Tokyo proceeded on research and development of building footprint mapping from satellite images, aiming capacity development of participating organizations. We performed pilots with use of FORMOSAT-2 satellite image data for Tainan and Bangkok provided by NSPO. We processed model training for semantic segmentation by Unet with training dataset collected through visual interpretation of Google Maps' high-resolution satellite images[1]. The model training performed well for Tainan although training dataset did not cover the areas. We trained a model for Bangkok and tested it on FORMOSAT-2 observation data for 2005, 2007, 2010, 2011, 2012, and 2015. The testing results showed impact of color contrast differences to accuracy. For the future works, we will compile the developed codes into workshop materials for capacity development programs.

Figure 1. Examples of building footprint identified by the trained model for Tainan

[1] https://ieee-dataport.org/open-access/dataset-detecting-buildings-containers-and-cranes-satellite-images

Figure 2. Examples of building footprint identified by the trained model for Bangkok. Left: 2012; right: 2015

Organization	**Center for Research and Application for Satellite Remote Sensing, Yamaguchi University**
Title	**Contribution VAPs for EOR activities**
Type of Activity	**EOR activity (Volcanic eruption in Indonesia)**
Date	**December 2021**

Yamaguchi University, Center for Research and Application of Satellite Remote Sensing, was established in February 2017. There are 4 missions at this center; (1) to promote world-class research in satellite remote sensing, (2) to cultivate human resources capable of promoting a wide range of research in satellite remote sensing and space technology, (3) to contribute to disaster information analysis and improve public safety and security, and (4) to promote local industry and create new industry/business for space utilization technology. Yamaguchi university provided VAPs for the event of Volcanic eruption which occurred in December 2021.