SENTINEL ASIA

ANNUAL REPORT 2018

Sentinel Asia

Annual Report 2018

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List of JPT Members

List of Emergency Observation Requests by each country

1. Introduction

1.1. Purpose and Scope of the Document

This document describes the activities of Sentinel Asia (SA) in 2018 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 of Sentinel Asia

Chapter 3 Emergency Observation Operation in 2018; results of emergency observation activities in 2018

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

Chapter 5 Communication and Conference; reports on all communication activities undertaken throughout the reporting period

Chapter 6 Assessment of Sentinel Asia Operations; provides an 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; outlines significant achievements and conclusions throughout the reporting period.

Appendix; data related to this report

1.3. List of Acronyms

ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
AIT	Asian Institute of Technology
ALOS	Advanced Land Observing Satellite
AMCDRR	Asian Ministerial Conference on Disaster Risk Reduction
APRSAF	Asia-Pacific Regional Space Agency Forum
ASEAN	Association of South-East Asian Nations
CRISP	Centre for Remote Imaging, Sensing and Processing
CSIS/UT	Center for Spatial Information Science, University of Tokyo
DAN	Data Analysis Node
DDM	Department of Disaster Management
DDPM	Department of Disaster Prevention and Mitigation (Thailand)
DHM	Department of Hydrology and Meteorology (Nepal)
DMC	Disaster Management Center (Sri Lanka)
DMH	Department of Meteorology and Hydrology (Myanmar)
DMPTC	Disaster Management Policy and Technology Center (Vietnam)
DPN	Data Provider Node
EO	Emergency Observation
EOC	Earth Observatory of Singapore
EOR	Emergency Observation Request
GISTDA	Geo-Informatics and Space Technology Development Agency
IDC	International Disaster Charter
IRS	Indian Remote Sensing Satellite
ISRO	Indian Space Research Organization
IWMI	International Water Management Institute
JAXA	Japan Aerospace Exploration Agency
JPT	Joint Project Team
JPTM	Joint Project Team Meeting
KARI	Korea Aerospace Research Institute
LAPAN	National Institute of Aeronautics and Space (Indonesia)
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MBRSC	Mohammed Bin Rashid Space Centre
MEC	Myanmar Earthquake Committee
MIMU	Myanmar Information Management Unit (Myanmar)

MMAF	Ministry of Marine Affairs and Fisheries (Indonesia)
MO	Manila Observatory
MONRE	Ministry of Natural Resources and Environment (Vietnam)
MoWHS	Ministry of Works and Human Settlement (Bhutan)
NARL	National Applied Research Laboratories
NCU	Center for Space and Remote Sensing Research, National Central University
NDMI	National Disaster Management Research Institute (Korea)
NDMO	National Disaster Management Office (Fiji)
NIED	National Research Institute for Earth Science and Disaster Resilience
NSPO	National Space Organization
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PHIVOLCS	Philippine Institute of Volcanology and Seismology
RRD	Relief and Resettlement Department (Myanmar)
RSO	Regional Support Offices
SA	Sentinel Asia
SPC	Secretariat of the Pacific Community
STI/VAST	Space Technology Institute / Vietnam Academy of Science and Technology
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
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
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
VIGMR	Vietnam Institute of Geosciences and Mineral Resources (Vietnam)
VNREDSAT	Vietnam Natural Resources, Environment and Disaster Monitoring Satellite

2. Sentinel Asia and Major Disasters

2.1. Outline of Sentinel Asia

2.1.1. Background and History of Sentinel Asia

Natural disasters have been on the rise worldwide, including the Asia-Pacific region (Figure 1). The Asia-Pacific region suffers from different types of natural disasters, 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 disasters 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 disasters and an elevated loss of lives and properties from these events, SA, a collaborative, regional project, was conceptualized in 2005, and begun to operate in 2007. It is engaged in activities to share and provide disaster-related information, including earth observation satellite images via the internet, 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 2018, it consists of 107 member organizations, including 91 agencies from 28 countries/regions and 16 international organizations. JAXA has been serving as a secretariat of the JPT.
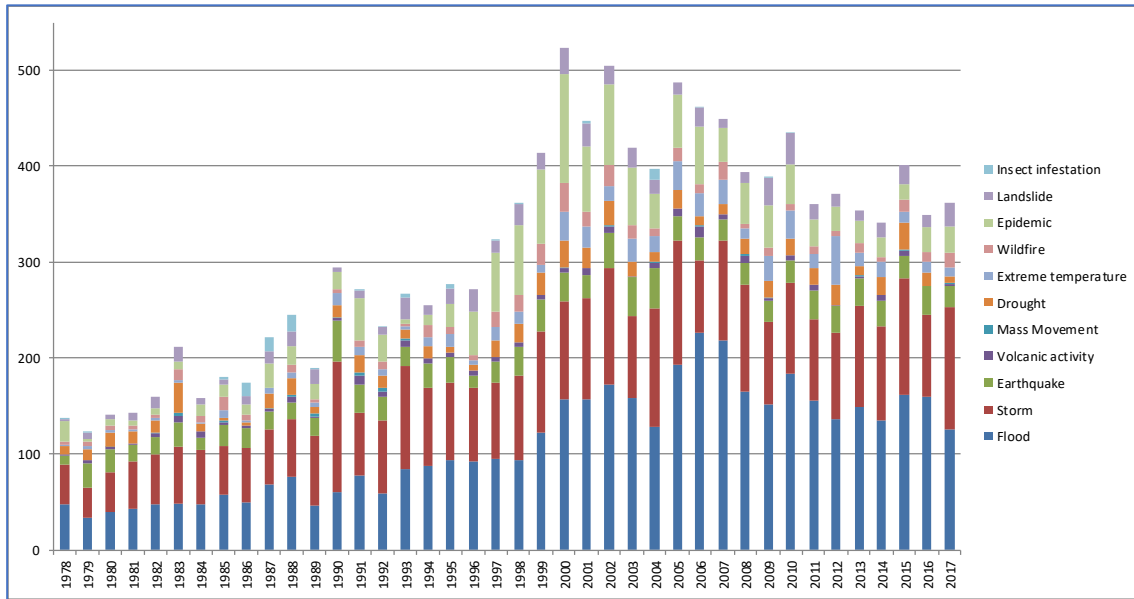
Figure 1: Incidence of natural disasters by region (In and after 1978)

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 RSO for 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, FORMOSAT, IRS, KOMPSAT, THEOS, VNREDSAT, X-SAT and DUBAISAT) in the event of major disasters

· Acceptance of observation requests of 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. To promote the activities of SA, the Joint Project Team (JPT) was organized, which is open to all APRSAF member countries, disaster prevention organizations and regional/international organizations who wish to participate in disaster information sharing activities.
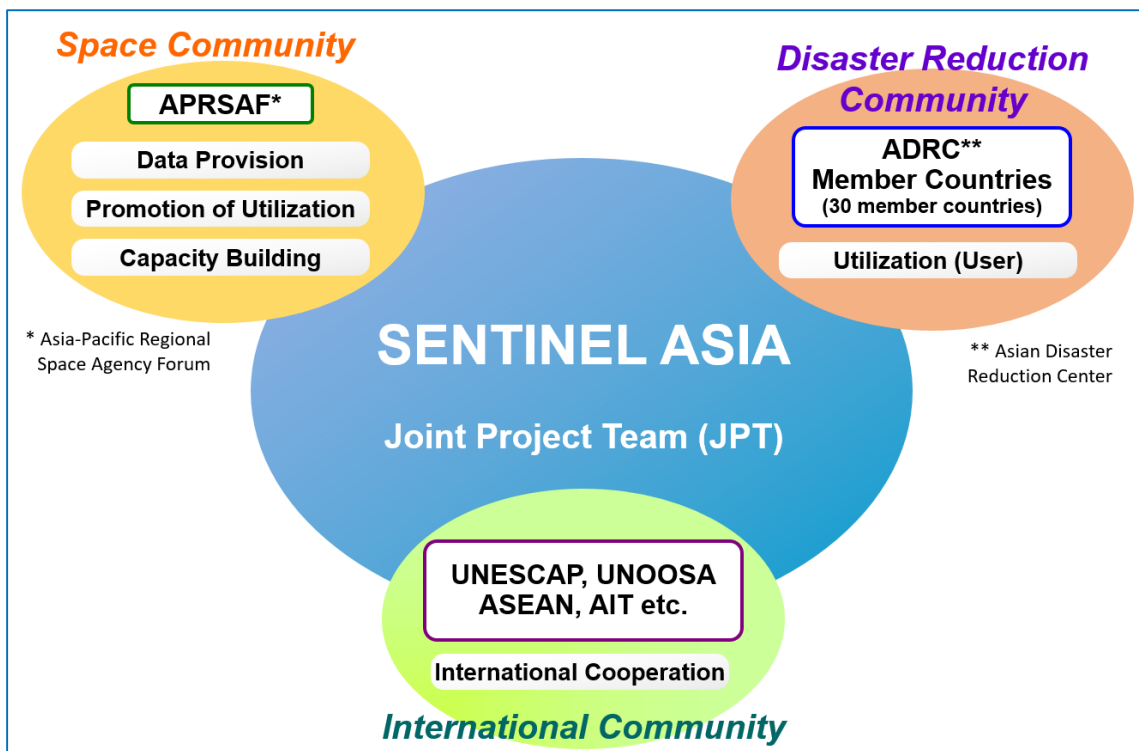
Figure 2: Framework of Sentinel Asia

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 Sentinel Asia

System (Figure 3). Between 2006 and 2018, about 333 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.
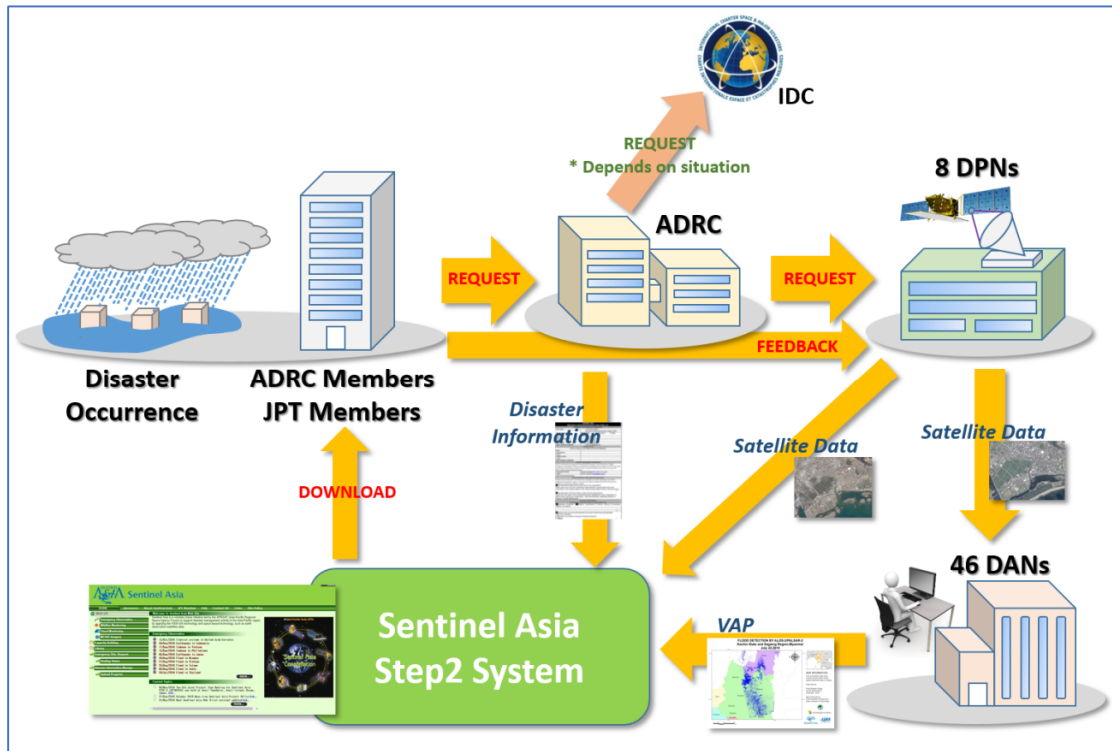
Figure 3: Flow of Sentinel Asia emergency observation

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

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- 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
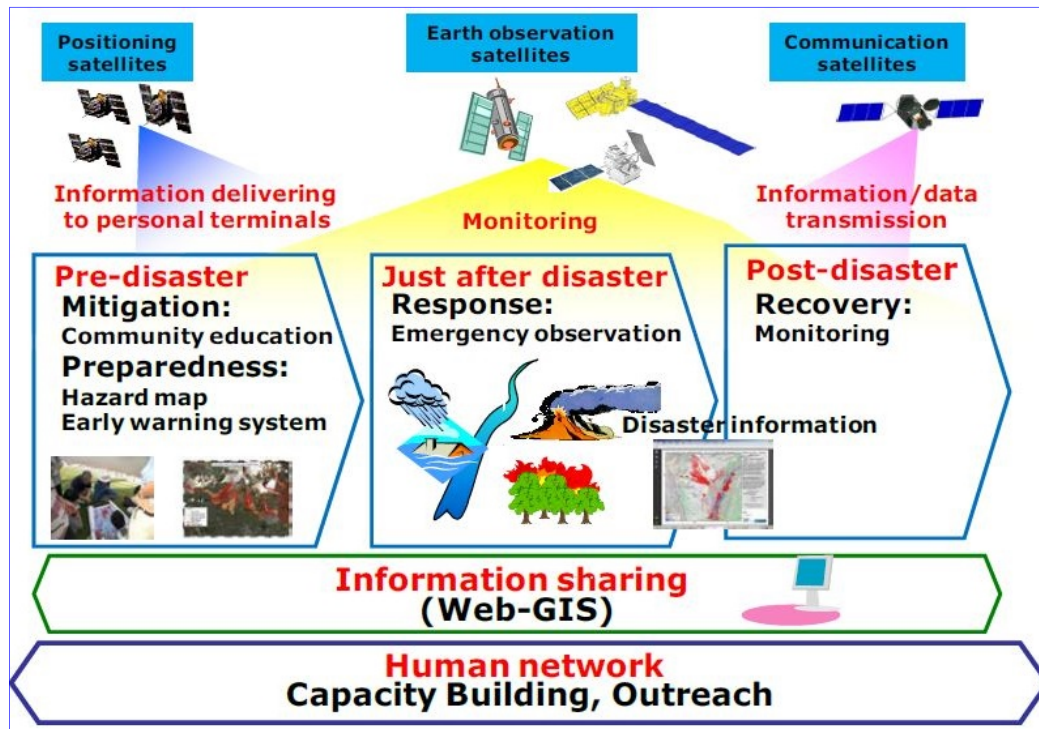
Figure 4: Current phase (Step 3) and actions of Sentinel Asia

2.2.   Major Disasters with Emergency Observation (2007-2018)

Figures 5 and 6 show a breakdown of emergency observations with requests and emergency observations with activation by disaster. Table 1 shows the number of requests, activations and rejections for each disaster. Floods represent the largest number of disasters with 164 requests (49.2%), followed by earthquakes at 43 (12.9%), landslides at 25 (7.5%), typhoons at 25 (7.5%), forest fires and fires at 17 (5.1%), volcanic eruptions at 17 (5.1%), and cyclones at 14 (4.2%).

Generally, activation is made for around 80% to 90% of requests for most disasters. There is 95.1% activation for flood, but the activation rate is 41.2% for forest fires and fires only.
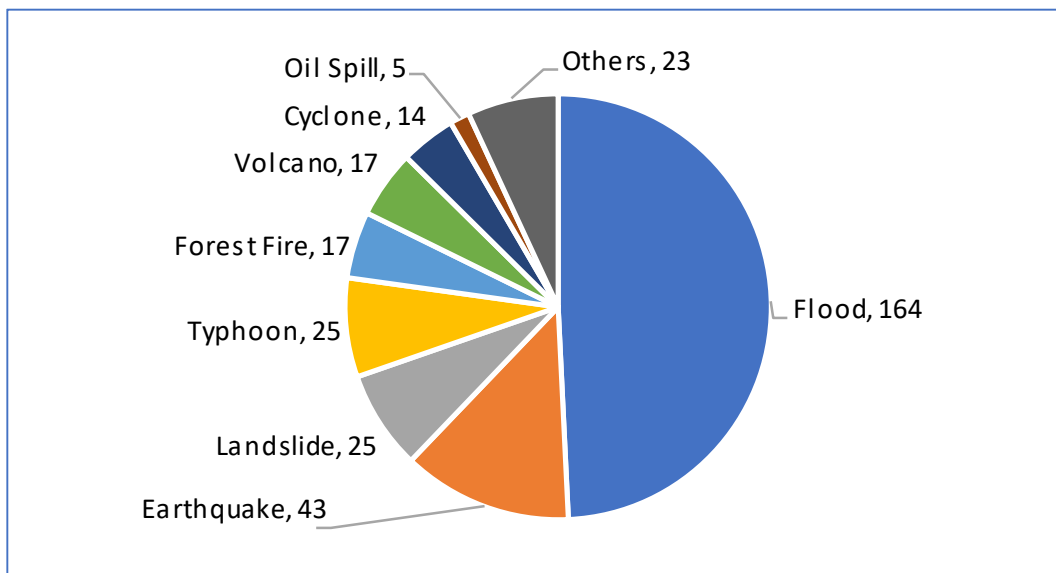
Figure 5: Breakdown of Emergency Observations by Disaster (2007 - 2018)

*Requests (N=333)
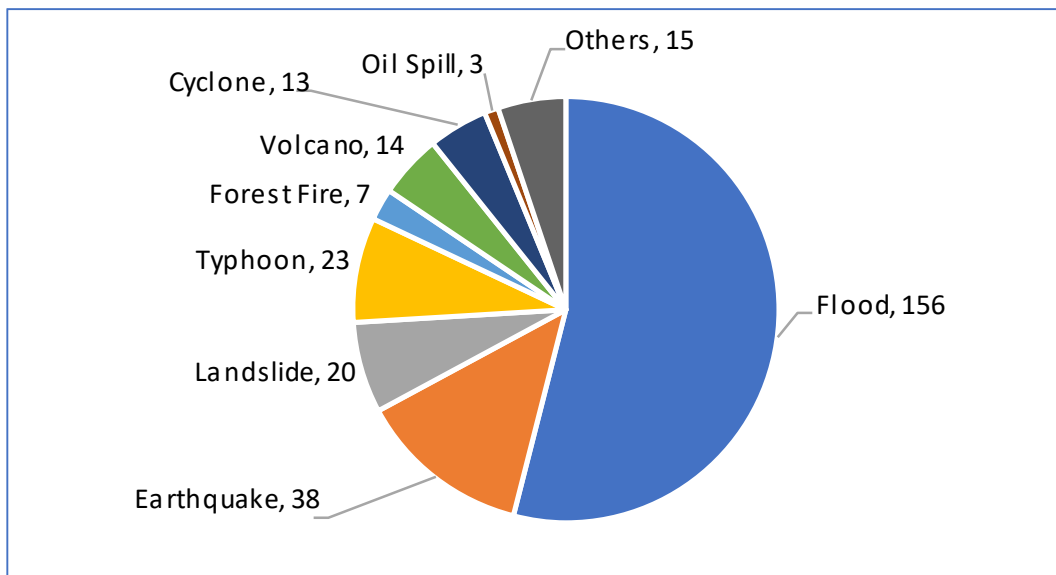
Figure 6: Breakdown of Emergency Observations by Disaster (2007 - 2018)

*Activations (N=289)

Table 1: Number of Requests, Activations, and Rejections for Emergency Observations by Disaster (2007 - 2018)

	Number of Request	Number of Activation	Number of Rejection	Activation/Request (%)
Flood	164	156	8	95.1%
Earthquake	43	38	5	88.4%
Landslide	25	20	5	80.0%
Typhoon	25	23	2	92.0%
Forest Fire	17	7	10	41.2%
Volcano	17	14	3	82.4%
Cyclone	14	13	1	92.9%
Oil Spill	5	3	2	60.0%
Others	23	15	8	65.2%
Total	**333**	**289**	**44**	

3. Emergency Observation Operations in 2018

3.1. Emergency Observation Requests

Figure 7 shows the number of requests, activations and rejections involving emergency observations from 2007 to 2018. 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.
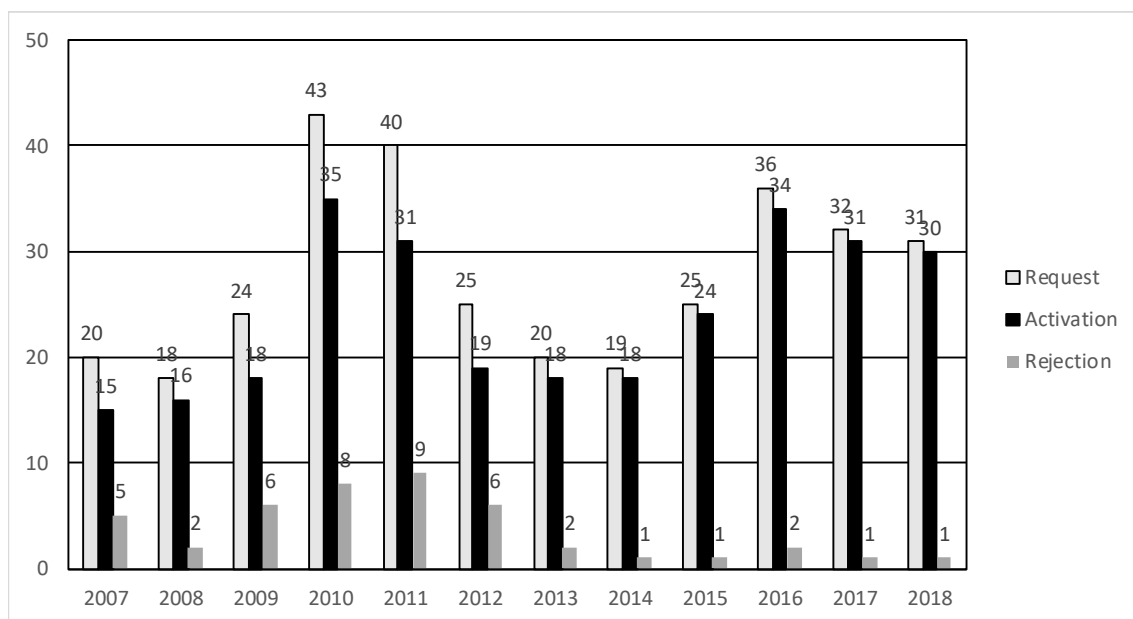
Figure 7: Comparison of the Number of Requests, Activations and Rejections for Emergency Observations

All 2018 activations are listed in Table 2. In total, 31 requests were received in 2018. The following single request was rejected after confirmation with the requester:

- Activation No. 308, Country [Myanmar], Disaster type [Earthquake]

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 10 requests (32.3%), followed by earthquakes at 8 (25.8%), cyclone at 4 (12.9%), typhoons at 4 (12.9%), volcanic eruptions at 2 (6.5%) and landslide at 2 (6.5%).

Table 2: List of 2018 Activations

| Activation Number	Country	Disaster Type	Activation Date	Requester
303	Philippines	Volcanic Eruption	2018/01/15	PHIVOLCS
304	PNG	Volcanic Eruption	2018/01/20	DMC
305	Taiwan	Earthquake	2018/02/07	NARL
306	Korea	Earthquake	2018/02/13	NDMI
307	Tonga	Cyclone	2018/02/12	SPC
308	Myanmar	Earthquake		
309	Sri Lanka	Flood	2018/05/22	DMC
310	Vietnam	Landslide	2018/06/25	MONRE/DMPTC
311	Japan	Landslide	2018/07/07	JAXA/CAO
312	Thailand	Oil spill	2018/07/10	GISTDA
313	Vietnam	Flood	2018/07/20	MONRE/DMPTC
314	Laos	Flood	2018/07/25	ADPC/DSW
315	Myanmar	Flood	2018/07/29	RRD
316	Indonesia	Earthquake	2018/07/30	LAPAN/BPBD
317	Indonesia	Earthquake	2018/08/06	AHA CENTER
318	Thailand	Flood	2018/08/06	GISTDA/DDPM
319	India	Flood	2018/08/11	ISRO/DMO
320	Taiwan	Flood	2018/08/27	NARL/NCDR
321	Vietnam	Flood	2018/08/29	MONRE/DMPTC
322	Myanmar	Flood	2018/08/31	RRD/DDM
323	Japan	Earthquake	2018/09/06	JAXA/MLIT
324	Philippines	Typhoon	2018/09/13	AHA Center/ NDRRMC/MO
325	Vietnam	Typhoon	2018/09/17	MONRE/DMPTC
326	Indonesia	Earthquake	2018/09/29	AHA Center/ BNPB/LAPAN
327	United Arab Emirates	Cyclone	2018/10/10	MBRSC/NCEMA
328	India	Cyclone	2018/11/16	ISRO/DMO
329	Vietnam	Typhoon	2018/11/19	MONRE/DMPTC
330	Vietnam	Typhoon	2018/11/24	MONRE/DMPTC
331	India	Cyclone	2018/12/18	ISRO/DMO
332	Indonesia	Tsunami	2018/12/24	LAPAN/BNPB
333	Sri Lanka	Flood	2018/12/26	MODM

*ID 308 was rejected
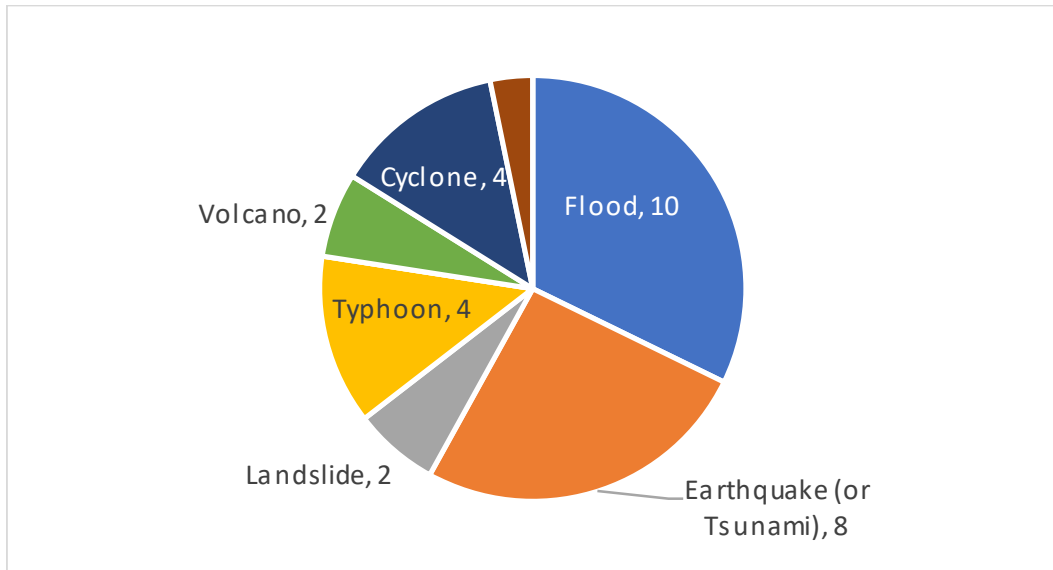
Figure 8: Breakdown of Emergency Observations by Disaster *Requests in 2018

***Requests (N=31)**
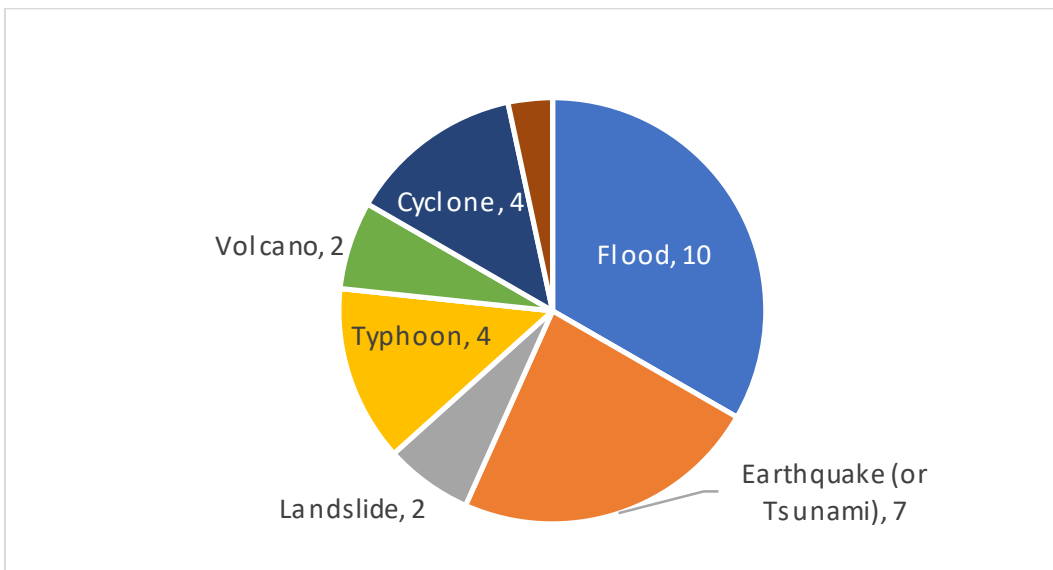
Figure 9: Breakdown of Emergency Observations by Disaster *Activations in 2018

***Activations (N=30)**

3.2.   Results of Emergency Observations

During 2018, the monthly average of activations was 2.5. Figure 10 shows the monthly distribution of activations throughout 2018. The highest number of activations occurred in July and August, corresponding to 40.0% of the total number. The remaining months of 2018 saw a number of activations that varied from 0 to 4. Most of the activations were caused by water disasters such as floods and earthquake.
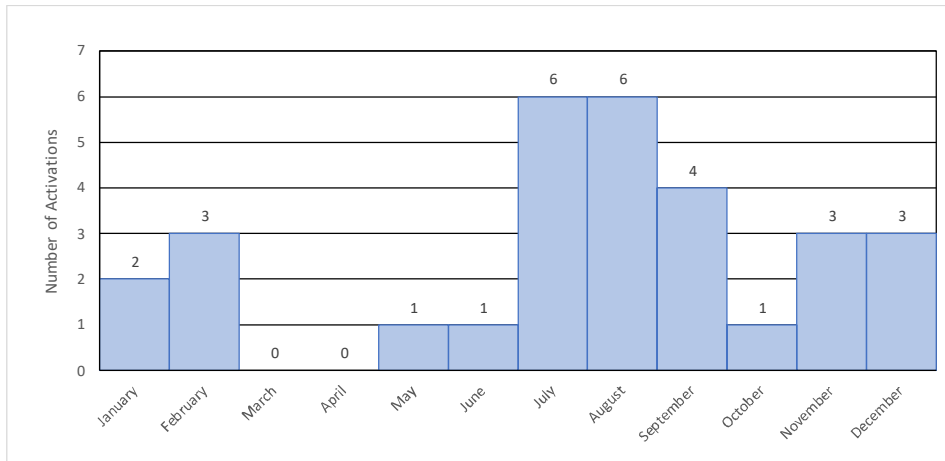
Figure 10: Number of monthly activations in 2018

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, including Vietnam, Indonesia, Thailand, Myanmar and Philippines. The highest number of activations was Vietnam at 6 activation. Request from the United Arab Emirates was accepted first time.
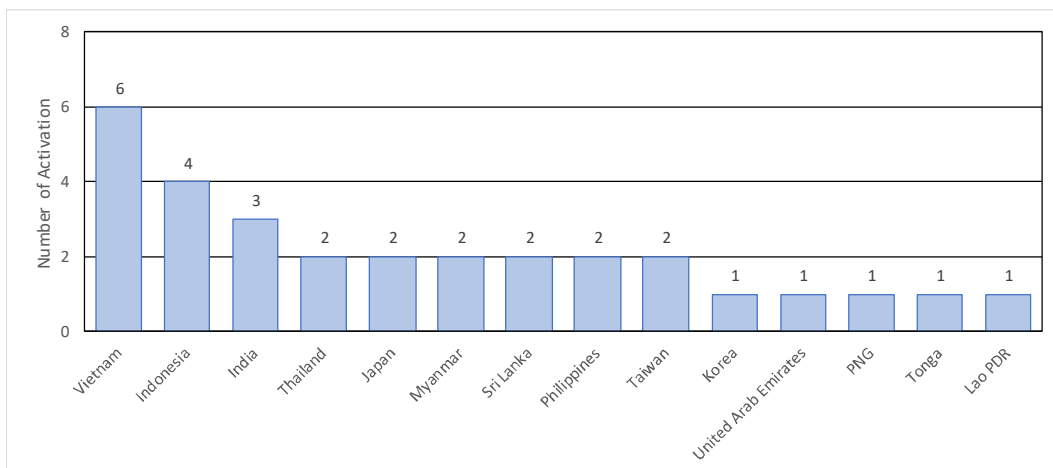
Figure 11: Number of activations by country in 2018

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Figure 12 shows the number of implementations by DPN. In total, 69 implementations were made in 2018, and satellite data was provided to the requesters. The highest numbers of implementations were made by JAXA and ISRO, corresponding to 75.3% of the total number.
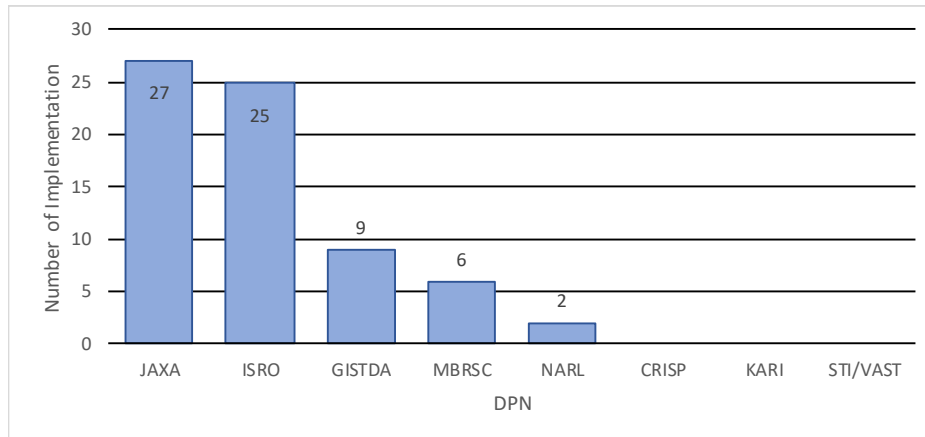
Figure 12: Number of responses by DPN in 2018

Figure 13 shows the number of optical and radar data by DPN. In 2018, a total of 820 scenes were provided by DPN members. The total can be broken down into archives (277) and new acquisitions (543). The highest data numbers are occupied by JAXA, ISRO and GISTDA.
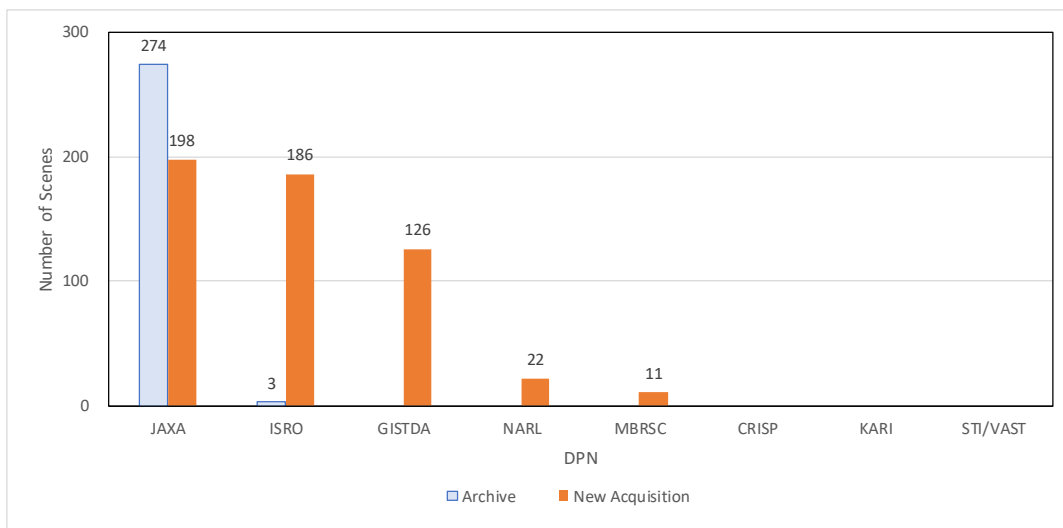
Figure 13: Data consumption (Archive and New Acquisition) by DPN in 2018

Figure 14 shows the number of implementations by DAN in 2018. In total, 69 were implemented, and Value Added Product (VAP) were provided to requesters. The highest numbers of implementations were made by AIT and JAXA, corresponding to 59.4% of the total number. And
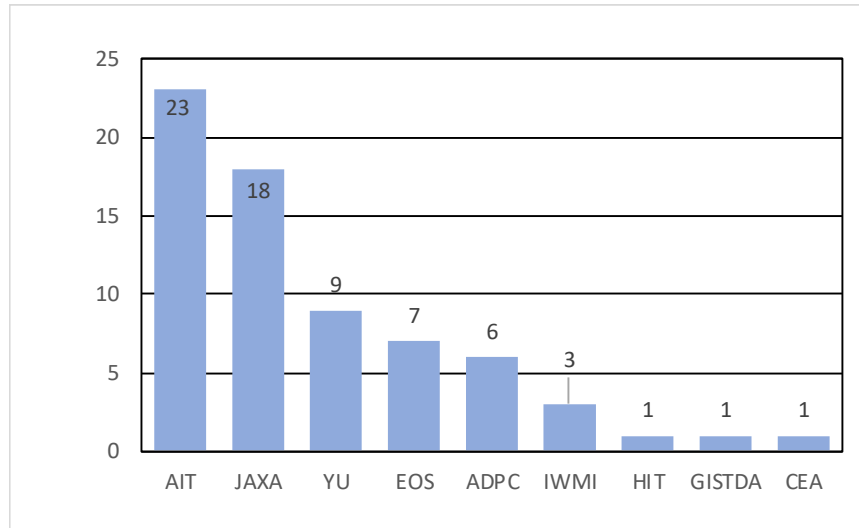
Figure 14: Number of responses by DAN in 2018

Figure 15 shows the number of provided VAP in 2018. In total, 328 VAPs were provided to requesters. The highest number of implementations was made by AIT and JAXA, corresponding to 56.1% of the total number. And more than 30 VAPs were provided by Yamaguchi University (YU), Earth Observatory of Singapore (EOS), Asian Disaster Preparedness Center (ADPC) and International Water Management Institute (IWMI).

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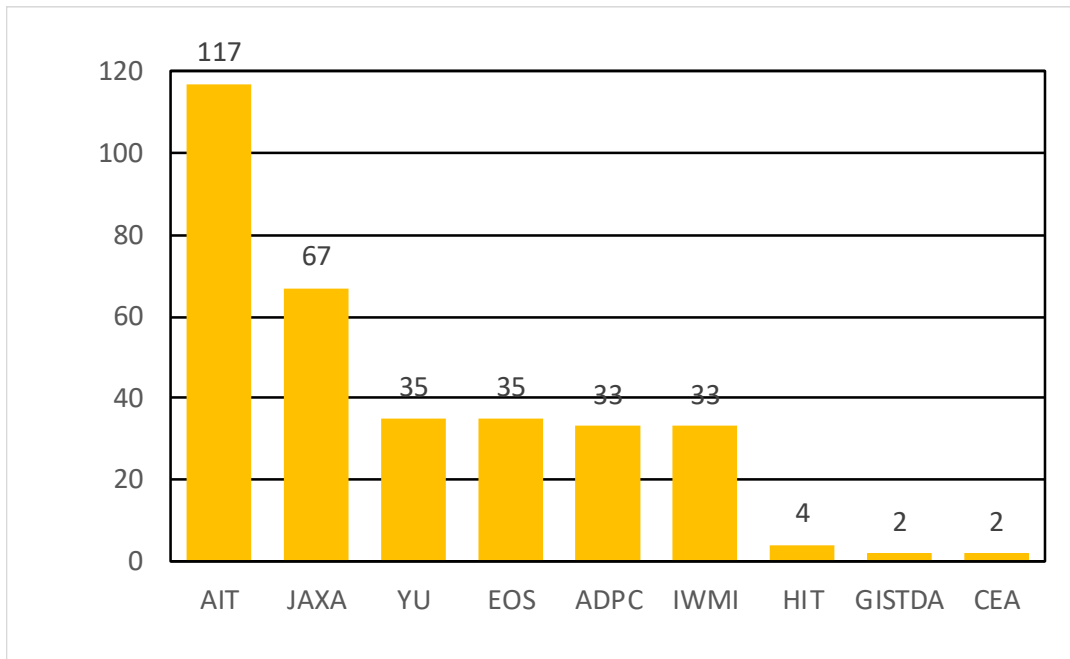
Figure 15: Numver of VAP by DAN in 2018

[Comment of ISRO as great effort of DPN in 2018]

During 2018, ISRO has responded to 25 EOR's spread across 13 countries with the help of 65 multi-temporal and multi-sensor satellite datasets. The year 2018 was most disaster affected in South- East Asia. The most devastating disasters to name were Indonesia Earthquake, Japan Earthquake, Indonesia Tsunami and Sri Lanka Floods.

3.3. Good Practices

3.3.1. Flood in Myanmar (July 2018)

A monsoon tragically hit the east part of Kayin State in July 2018, generating a flood in the area. According to the OCHA report, it is estimated that at least eleven people died and about 122,000 people were temporarily evacuated to safer locations. Evacuees were either sheltering in one of the 288 evacuation sites or staying with relatives and host families as of the 30th of July.

Sentinel Asia received an EOR from the AHA center on the 29th of July and provided satellite data received from DPNs during the following days. Several VAPs were also developed and provided by ADPC, AIT, Yamaguchi University and the Earth Observatory of Singapore. The provided VAPs were shared with the Relief and Resettlement Department (RRD) in Myanmar, a national disaster management organization, and utilized for the estimation of damage and emergency response activities.

News source;

(https://reliefweb.int/report/myanmar/asia-and-pacific-weekly-regional-humanitarian-snapshot-24-31-july-2018)
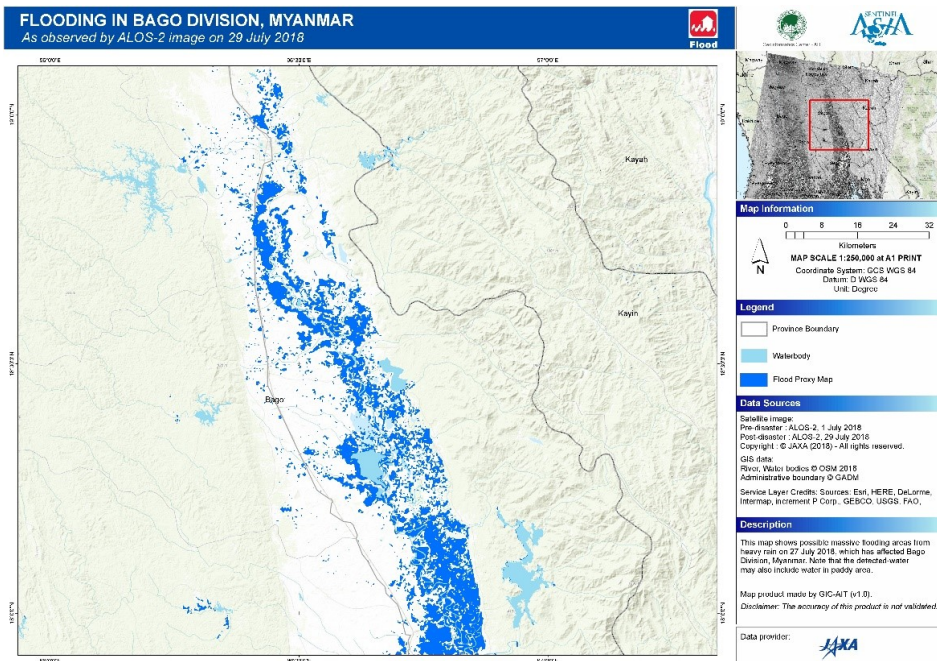
Figure 16: VAP (provided by AIT)

3.3.2.   Flood in Lao PDR (July 2018)

Heavy rainfall hit several states in the southern part of the Lao PDR (Laos) in July 2018. As a result of the rainfall, the Xepien-Xenamnoyu dam collapsed on the 22nd of July. OCHA reported that more than 5,600 people had been affected in the Stung Treng Province in northern Cambodia as of the 31st of July.

Sentinel Asia received an EOR from ADPC on the 25th of July and began providing satellite data received from DPNs after 26 July. Several VAPs were also developed and provided by JAXA, ADPC, IWMI, Yamaguchi University, AIT and the Earth Observatory of Singapore. The provided VAPs were shared with disaster management organizations in Lao PDR and utilized for DRR activities in affected area.

News source;

(https://reliefweb.int/disaster/ff-2018-000118-lao)
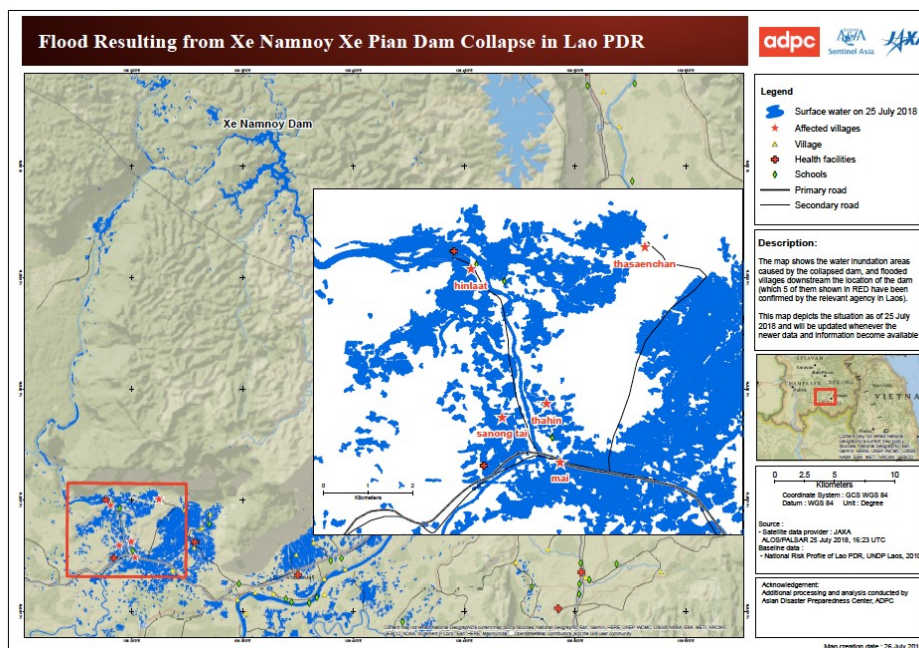
Figure 17: VAP (provided by ADPC)

3.3.3. Earthquake in Japan (September 2018)

  A magnitude 6.7 earthquake struck the Iburi region, Hokkaido of Japan on the 6th of September 2018. According to the report made by the Fire and Disaster Management Agency in Japan, 782 people suffered major injuries and 43 died as a result of the disaster.

  Sentinel Asia received an EOR from the Ministry of Land, Infrastructure, Transport and Tourism and JAXA, and began providing satellite data received from DPNs on the same day of occurrence. Several VAPs were also developed and provided by Yamaguchi University, AIT, the Institute of Geology, the China Earthquake Administration and the Earth Observatory of Singapore. The provided VAPs were shared with disaster management organizations in Japan.
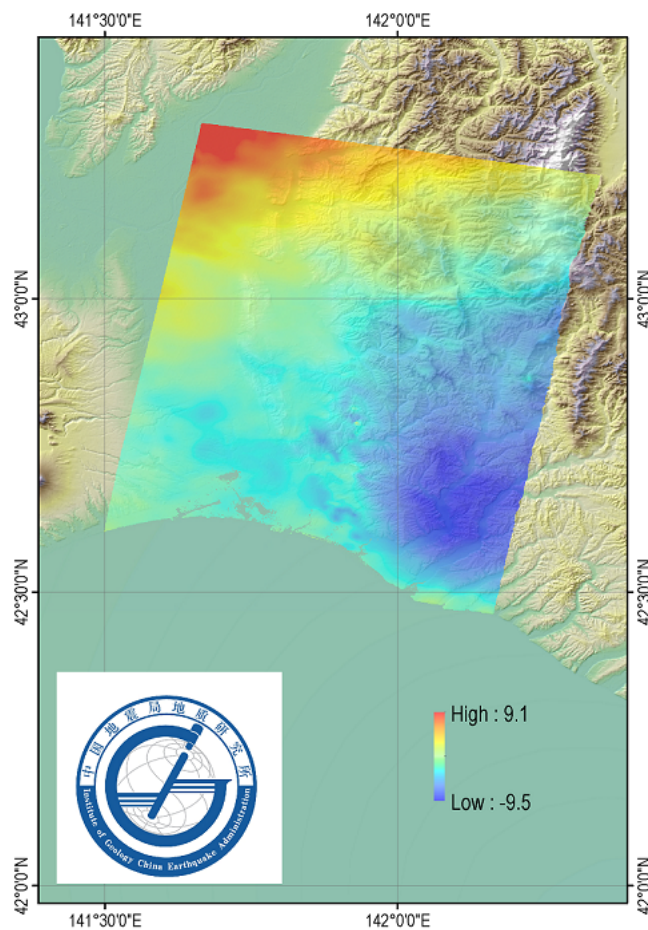
Figure 18: VAP (provided by the Institute of Geology, China Earthquake Administration (CEA))

3.3.4.   Earthquake and Tsunami in Indonesia (September 2018)

Magnitude 7.4 earthquake struck off Central Sulawesi, Indonesia on Friday, 28 September 2018. This earthquake generates large scale tsunami and hit in this region. According to final report of the national disaster management agency's (BNPB) in Indonesia, there were 206494 dispatched, 4438 major injured, 2081 died and 1309 missing.

BNPB, LAPAN and AHA Center submitted EOR form on 29 September, one day later of the earthquake. ADRC received this EOR form and confirmed a requested information on this day. After that ADRC activated this EOR and requested to provide satellite images and VAP to DPN and DAN. And this request was escalated to the International Disaster Charter. It was coordinated within 24 hours after request.

First satellite images were provided by JAXA and ISRO on 2 October, 3 days later after request. Also VAPs were provided by EOS, AIT, Yamaguchi University and JAXA on 2 October. Totally, 71 archive data and 84 satellite image after disaster were provided. And 33 VAPs by DANs were provided. One VAP provided by Yamaguchi University shows a reification phenomenon in the affected area as shown in figure 19.

AIT/GIS dispatched some staffs to the site and confirmed provided data was utilized in Army Central Commando Station in Sigi and others for emergency response activity as shown in photo 1. And information from Sentinel Asia was shared to report of AHA center.
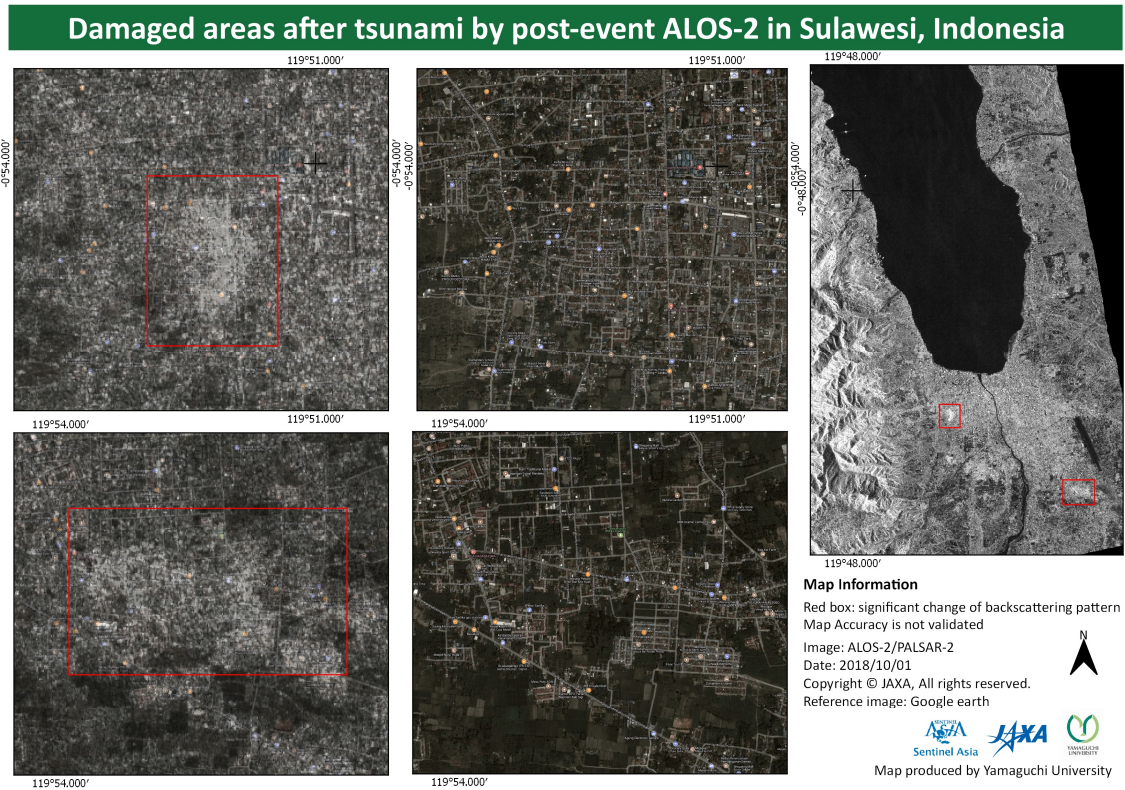
Figure 19: VAP (provided by Yamaguchi University)

Photo 1: Army Central Commando Station in Sigi (AIT/GIC report)

4. External Relations

4.1. Accession of New Members

In 2018, the following three organizations joined SA. An introduction from the Myanmar Information Management Unit (MIMU) is shown as follows.

- National Disaster Management Research Institute (NDMI)
- Vietnam Institute of Geosciences and Mineral Resources (VIGMR)
- **Myanmar Information Management Unit (MIMU)**

4.1.1. Myanmar Information Management Unit (MIMU)

(1) Outline of organization

The Myanmar Information Management Unit (MIMU) was originally established in 2007. This service under the Office of the United Nations Resident and Humanitarian Coordinator supports humanitarian, development and peace-focused activities in Myanmar. Its purpose is to improve the capacity for analysis and decision making in Myanmar by a wide variety of stakeholders - including Myanmar's government, the United Nations, non-governmental organizations, donors, and academic and research sectors- through strengthening the coordination, collection, processing, analysis and dissemination of information.

(2) Greeting from MIMU

MIMU is honored to have been accepted to participate as a member of Joint Project Team in Sentinel Asia. By providing critical and timely information for disaster response and recovery, we believe that Sentinel Asia is instrumental to support disaster management in Asia-Pacific region.

In disaster management, MIMU supports gathering, collation, processing, analysis and dissemination of geospatial and other data relevant to affected populations. Based on hazard proxy maps produced by Data Analysis Node members (DAN), MIMU creates value-added products and analysis of the affected areas to support decision-making and operational response. MIMU is also a key provider of capacity development to government, development and humanitarian actors through its many trainings in GIS,

data and information management. MIMU has also engaged with the academic sector in Myanmar to review the evolving geospatial needs in Myanmar and capacities to meet those needs.

As Joint Project Team member for Sentinel Asia, MIMU adds value through its unique position and extensive links with responders and donors in Myanmar which enable us to share the result of Sentinel Asia Activation from the users point of view report to the Secretariat and other JPT-3 Member organizations. In doing so, MIMU hopes to actively contribute to refine user requirements to support Sentinel Asia data provision and analysis in a timely manner.

Photo 2: Team of Myanmar Information Management Unit (MIMU)

4.2. Collaboration and Cooperation

4.2.1   International Disaster Charter

The rollout to IDC began in February 2010 as required. Six disasters were escalated through SA in 2018.

Table 3 List of Charter Escalation in 2018

Activation Number	Country	Disaster Type	Activation Date	Requester	Project Manager
303	Phillipnes	Volcanic Eruption	15-Jan-18	PHIVOLCS	Philippine Institute of Volcanology and Seismology (PHIVOLCS) - DOST
304	PNG	Volcanic Eruption	20-Jan-18	DMC	Asian Institute of Technology (AIT)
314	Lao PDR	Flood	25-Jul-18	ADPC/DSW	UNITAR / UNOSAT
317	Indonesia	Earthqueke	6-Aug-18	AHA Center/BNPB	Asian Institute of Technology (AIT)
324	Phillipnes	Typhoon	13-Sep-18	AHA Center/NDRRMC/MO	Philippine Institute of Volcanology and Seismology (PHIVOLCS) - DOST
326	Indonesia	Earthqueke	29-Sep-18	AHA Center/BNPB/LAPAN	Asian Institute of Technology (AIT)

5.　Conferences and Press Releases

5.1.　Conferences

5.1.1.　5th Joint Project Team Meeting (JPTM2018)

Organizer: National Applied Research Laboratories (NARLabs) and Japan Aerospace Exploration Agency (JAXA)

Date: 23-24, January, 2018

Venue: Howard Civil Service International House, Taiwan

Nine sessions were set on this conference. For instance, "Sentinel Asia Strategic Plan for the next 10 years" was reported from JAXA and agreed by participants. Also three new members NDMI, MBRSC and EOS were introduced. In closing, ADRC as next host organization showed Awaji-island in Japan where it will be held next JPTM.

Photo 3: Group Photo

5.1.2. Workshop on coordination improvement on emergency mapping support, sharing, and communication of Sentinel Asia Activity (Myanmar)

Organizer: AIT/GIC, GISTDA, Asian Disaster Reduction Center (ADRC) and Japan Aerospace Exploration Agency (JAXA), Relief and Resettlement Department (RRD), Myanmar, Department of Meteorology and Hydrology

Date: 30 January, 2018

Venue: Horizon Lake View Resort, Nay Pyi Taw, Myanmar

Myanmar has large number of hazards in past. Sentinel Asia received lots of EORs from Myanmar and activated their requests. This workshop aims to strengthen network with related organization in Myanmar such as RRD, DMH and MIMU as new member in 2018. Participants confirmed more close communication in case of disaster for Sentinel Asia Activity. After this workshop, a training for young staffs of RRD and DMH was held from 31 January to 2 February. AIT conducted this training with having several practices and lectures.

Photo 4: Group Photo

Photo 5: Training

5.1.3. Workshop on coordination improvement on emergency mapping support, sharing, and communication of Sentinel Asia Activity (Thailand)

Organizer: AIT/GIC, GISTDA, Asian Disaster Reduction Center (ADRC) and Japan Aerospace Exploration Agency (JAXA)

Date: 22 February, 2018

Venue: Wayupak Convention Center, Bangkok, Thailand

 GISTDA and AIT/GIC had big contribution for Sentinel Asia. A role of these organization is quite important for SA activity. This workshop aims to strengthen network with other organization in Thialand such as DDPM as disaster management organization in Thailand. After this workshop, a training for young staffs was held from 26 to 28 February. AIT conducted this training with having several practices and lectures.

Photo 6: Group Photo

Photo 7: Group Photo

5.1.4. Workshop on coordination improvement on emergency mapping support, sharing, and communication of Sentinel Asia Activity (Vietnam)

Organizer: AIT/GIC, Asian Disaster Reduction Center (ADRC) and Japan Aerospace Exploration Agency (JAXA), STI

Date: 19-20 March, 2018

Venue: Space Technology Institute (STI), Vietnam Academy of Science and Technology, Hanoi, Vietnam

JPT members in Vietnam have been requested a lots of EOR in past. A relationship is well-organized between disaster management organizations and space agency in Vietnam. This workshop held for more advanced cooperation in this country. For instance, Mr. An Quang Hung from DMPTC suggested to make a swift sharing system of VAP with STI and MONRE.

Photo 8: Group Photo

5.1.5. Asian Ministerial Conference on Disaster Risk Reduction 2018

Organizer: Government of Mongolia, UNISDR

Date: 3-6 July, 2018

Venue: Ulaanbaatar, Mongolia

Asian ministerial conference for disaster risk reduction (AMCDRR) is an intergovernmental conference held to discuss latest issue and share an information on DRR. Mr. Suzuki, co-chair of Sentinel Asia, had a presentation regarding summery of Sentinel Asia on pre-conference. Also Secretariat of Sentinel Asia set booth for promoting to participants.

Photo 9: Group Photo

5.1.6.　69th International Astronautical Congress Bremen 2018

Date: 1-5 October 2018

Venue: Messe Bremen, Germany

  The International Astronautical Congress (IAC) consists of a scientific conference program and a space exhibition. It is the one annual opportunity for around 4,000 specialists in space-related fields from all over the world come together. Global, multidisciplinary, and covering all space sectors and topics, it offers everyone the latest space information and above all new contacts and potential partnerships.

Mr. Wasanchai Vongsantivanich, from the Geo-Informatics and Space Technology Development Agency (GISTDA) in Thailand, gave a presentation related to GISTDA's recent efforts, entitled "Using space for disaster management in emerging space states: a critical assessment" during the session "Is Space R&D Truly Fostering a Better World for Our Future?".

(Source: https://www.iac2018.org/about/)

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5.1.7.   Asian Conference on Disaster Reduction 2018

Organizer: Government of Japan, Asian Disaster Reduction Center

Date: 30 October - 1 November 2018

Venue: Awaji Yumebutai, Awaji-island, Japan

Photo 10: Session 4 on ACDR

  The ACDR2018 was attended by 118 participants from 26 countries including Turkey as the latest member country, as well as representatives of international and regional organizations, the academic community, and the private sector. In the session 4, entitled "Space-based technology and Affordable solutions facilitating DRR", AIT and JAXA reported latest Sentinel Asia activity such as emergency response for the 2018 Tsunami in Sulawesi, Indonesia.

5.1.8.   6th Joint Project Team Meeting for Sentinel Asia STEP3

Organizer: Japan Aerospace Exploration Agency, Asian Disaster Reduction Center

Date: 1-2, November, 2018

Venue: Awaji Yumebutai, Awaji-island, Japan

This JPTM was held to collaborate with Asian Conference on Disaster Reduction (ACDR2018). About 40 participants including representatives of satellite agencies, disaster management organizations, and academic institutions in Japan attended the meeting. Some of participants from ACDR joined and reported about DRR for utilization space technology in each countries (Cambodia, Lao PDR and Malaysia). Also DANs and DPNs had a presentation about each activity. And MIMU as new member was welcomed in Sentinel Asia.

Photo 11: Group Photo

5.1.9.   25th Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-25)

Organizer: Singapore Space and Technology Association, Ministry of Education, Culture, Sports, Science and Technology, Japan Aerospace Exploration Agency

Date: 6 to 9 November, 2018

Venue: Sheraton Towers Singapore, Singapore

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 the 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.

5.2. Documents, Press Releases and Papers

5.2.1. Sentinel Asia Strategic Plan

Sentinel Asia (SA) is a voluntary basis initiative led by the Asia-Pacific Regional Space Agency Forum (APRSAF) to support disaster management activity in the Asia-Pacific region by integrating and applying Web-GIS and space-based technology. Throughout Sentinel Asia's history, the following steps in particular were conducted after 2006.

Step 1: Implementation of the backbone 'Sentinel Asia' data dissemination system and associated Nodes (2006 - 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)

We are working toward pushing the activity outlined in Step 3 further toward a more strengthened SA network in 2018. This Step 3 will be finalized in 2019, and plans for the next stages of the activity for 2020 and after will then need to be formulated. In consideration of this, the SA Strategic Plan was proposed and shared with JPT members in 2017.

The goal of the strategic plan is to develop procedures for improvements and operations to achieve Sentinel Asia's vision for the next 10 years (2020 onward). The document was reviewed and updated to reflect the comments, advice and discussion from the members of Steering Committee in 2017. Steering Committee members gave various constructive ideas and proposals to improve effective use of the Sentinel Asia initiative for DRR. The ideas tabled can be categorized into five "main challenges" as described below:

I.   Satellite Data Provisions and Systems

II.   Value Added Product (VAP)

III.   End-user Enhancement

IV.   Step-3 Activities (address the complete DRR cycle)

V.   Communication, Collaboration and Cooperation

  These items were summarized and shared with SC members to identify possible contributions that could be made by our partners, and the time frame required to achieve them. Leading agencies for the 5 main challenges were suggested, and are required to communicate and collaborate with all other DPNs, DANs, and user agencies to achieve the best possible solution for their allocated challenge.

This Strategic Plan will be discussed in the next SC and JPT meeting for the better modification.

5.2.2.   Standard Operation Procedure

  As shown in previous chapters, Sentinel Asia initiated an emergency observation request (EOR) system in 2007 used to provide image data (and analyzed images) acquired through satellites operated by participating space agencies. Sentinel Asia has used this EOR system to accept 333 requests and activate 289 requests as of December 2018.

  On several occasions, however, it took a considerable amount of time to receive and activate EORs – one of the possible reasons for this is a lack of a Standard Operation Procedure (SOP). Thus, a SOP for EORs was developed for Joint Project Team (JPT) members and Disaster Management Organizations (DMOs), in Myanmar, Thailand and Vietnam in 2018.

These SOP put objectives as following;
  1. Strengthen network between JPT members and DMOs in Thailand
  2. Strengthen network between JPT members in Thailand and Secretariat of SA
  3. Confirmation of detail procedure for EOR
  4. Capacity building for JPT members of SA and DMOs in Thailand
  5. Time management for the better EOR activity (Request and Activation)

The SOP also includes a specific explanation about the EOR procedure, including additional information such as contact telephone numbers, e-mails, etc. Figure 20 is the flowchart of an EOR when used in Thailand, which shows a simple breakdown of request procedures for JPT members and DMOs.
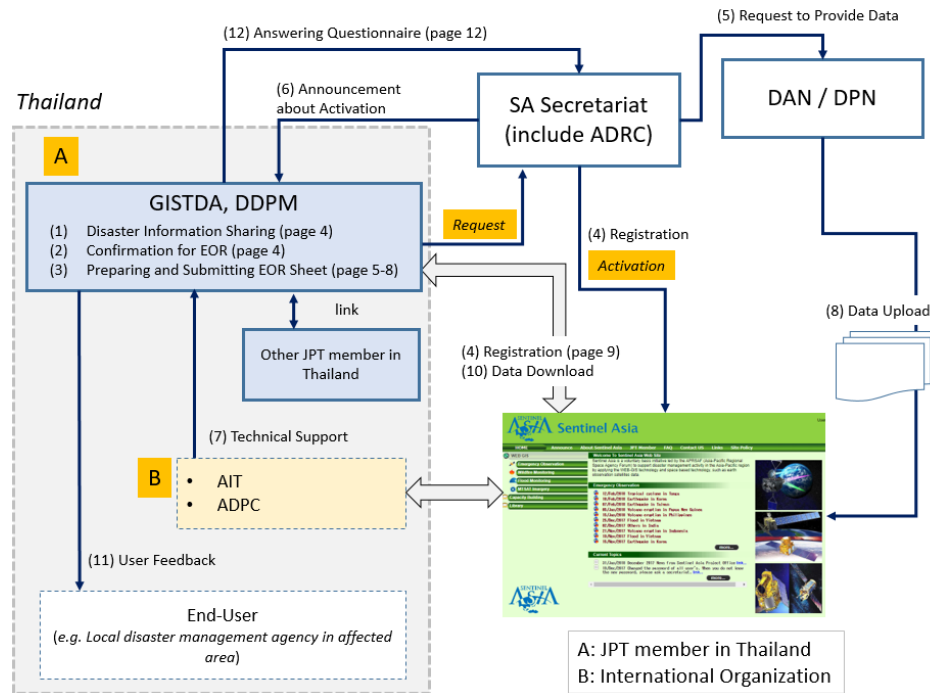
Figure 20: Flowchart of EOR (Thailand)

5.2.3. Newsletter

The secretariat of SA publishes a monthly newsletter for member organizations. The following are the topics covered by the newsletters issued in 2018.

January 2018

1. [News] Emergency Observation of Disaster Occurred in January 2018

2. [Announcement] Result of the JPTM2018

3. [Announcement] Sentinel Asia Annual Report 2016

4. [Announcement] Using Cloud System on Sentinel Asia Web Portal for the NEXT STEP

5. [Announcement] Enhanced Security of Sentinel Asia Central Server

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Revision of documents

8. [Announcement] Requests to JPT Members

9. [Events]

February 2018

1. [News] Emergency Observation of Disaster Occurred in February 2018

2. [Announcement] Questionnaire on Web-GIS service for Sentinel Asia Members

3. [Announcement] Using Cloud System on Sentinel Asia Web Portal for the NEXT STEP

4. [Announcement] End of the Old E-mail Accounts

5. [Announcement] Enhanced Security of Sentinel Asia Central Server

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Revision of Documents

8. [Announcement] Requests to JPT Members

9. [Events]

March 2018

1. [News] Emergency Observation of Disaster Occurred in March 2018

2. [Announcement] Questionnaire on Web-GIS service for Sentinel Asia Members

3. [Announcement] Enhanced Security of Sentinel Asia Central Server

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Events]

April 2018

1. [News] Emergency Observation of Disaster Occurred in March 2018

2. [Announcement] New address of Sentinel Asia Project Office

3. [Announcement] Enhanced Security of Sentinel Asia Central Server

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Announcement] Data Provision 2nd speed test

7. [Events]

May 2018

1. [News] Emergency Observation of Disaster Occurred in April 2018

2. [Announcement] All Passwords for Access to Sentinel Asia Web Page to be changed in June

3. [Announcement] All observation data prepared for effective utilization

4. [Announcement] New address of Sentinel Asia Project Office

5. [Announcement] Enhanced Security of Sentinel Asia Central Server

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Requests to JPT Members

8. [Announcement] Data Provision 2nd speed test

9. [Events]

June 2018

1. [News] Our New Members

2. [News] JAXA GSMaP Websites Renewal

3. [News] Emergency Observation of Disaster Occurred in May 2018

4. [Announcement] All Passwords for Access to Sentinel Asia Web Page changed on 25 June

5. [Announcement] All observation data prepared for effective utilization

6. [Announcement] New address of Sentinel Asia Project Office

7. [Announcement] Enhanced Security of Sentinel Asia Central Server

8. [Announcement] Emergency Observation Request (EOR)

9. [Announcement] Requests to JPT Members

10. [Announcement] Data Provision 2nd speed test

11. [Events] Next JPTM etc

July 2018

1. [News] Message from Our New Members

2. [News] Emergency Observation of Disaster Occurred in June 2018

3. [Announcement] New address of Sentinel Asia Project Office

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Events] Upcoming Events

August 2018

1. [News] Welcome New Member

2. [News] 2018 Asian Ministerial Conference on Disaster Risk Reduction

3. [News] Emergency Observation of Disaster Occurred in July 2018

4. [Announcement] New address of Sentinel Asia Project Office

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Request for Cooperation to "Sentinel Asia Member Questionnaire"

7. [Announcement] Requests to JPT Members

8. [Announcement] Tips for a data registration on SA Web

9. [Announcement] Collection of Good Practice in Disaster Emergency Observation by ALOS-2 "DAICHI 2"

10. [Events] Upcoming Events

September 2018

1. [News] 2018 Asian Ministerial Conference on Disaster Risk Reduction

2. [News] Emergency Observation of Disaster Occurred in July 2018

3. [Announcement] New address of Sentinel Asia Project Office

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Request for Cooperation to "Sentinel Asia Member Questionnaire"

6. [Announcement] Requests to JPT Members

7. [Announcement] Tips for a data registration on SA Web

8. [Announcement] Collection of Good Practice in Disaster Emergency Observation by ALOS-2 "DAICHI 2"

9. [Events] Upcoming Events

October 2018

1. [Announcement] Latest Agenda of JPTM2018 and ACDR2018, Awaji Island, Japan

2. [News] Emergency Observation of Disaster Occurred in September 2018

3. [Announcement] Emergency Observation Request (EOR)

4. [Announcement] Request for Cooperation to "Sentinel Asia Member Questionnaire"

5. [Announcement] Collection of Good Practice in Disaster Emergency Observation by ALOS-2 "DAICHI 2"

6. [Announcement] Revision of Document (TOR for JPT)

7. [Announcement] Requests to JPT Members

8. [Events] Upcoming Events

November 2018

1. [News] Emergency Observation of Disasters Occurring in October 2018

2. [News] Results of JPTM2018 & ACDR2018

3. [News] Sentinel Asia Step3 System will Start Next Year

4. [News] United Nations International Conference on Space-based Technologies for Disaster Risk Reduction, "Enhancing Disaster Preparedness for Effective Emergency Response"

5. [Announcement] Password Change on 25 December (Sentinel Asia Step2 System)

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Requests to JPT Members

8. [Events] Upcoming Events

December 2018

1. [News] Emergency Observation of Disasters Occurring in November 2018

2. [News] New Member of DAN

3. [News] Sentinel Asia Step3 System Commence from Next Year

4. [Announcement] Password Changed on 25 December (Sentinel Asia Step2 System)

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Requests to JPT Members

7. [Events]

6.   Assessment of Sentinel Asia Operations

6.1.   Overall Impact

When natural disasters common to mainly Asian areas – such as floods, droughts and earthquakes – occur, ADRC releases information on the phenomena that trigger the disasters in addition to the damages incurred *(http://www.adrc.asia/latest/index.php)*. In 2018 the total number of natural disasters (excluding drought and snow hazards) collected by ADRC was 57. 18 of these disasters were covered by SA (31.2%).
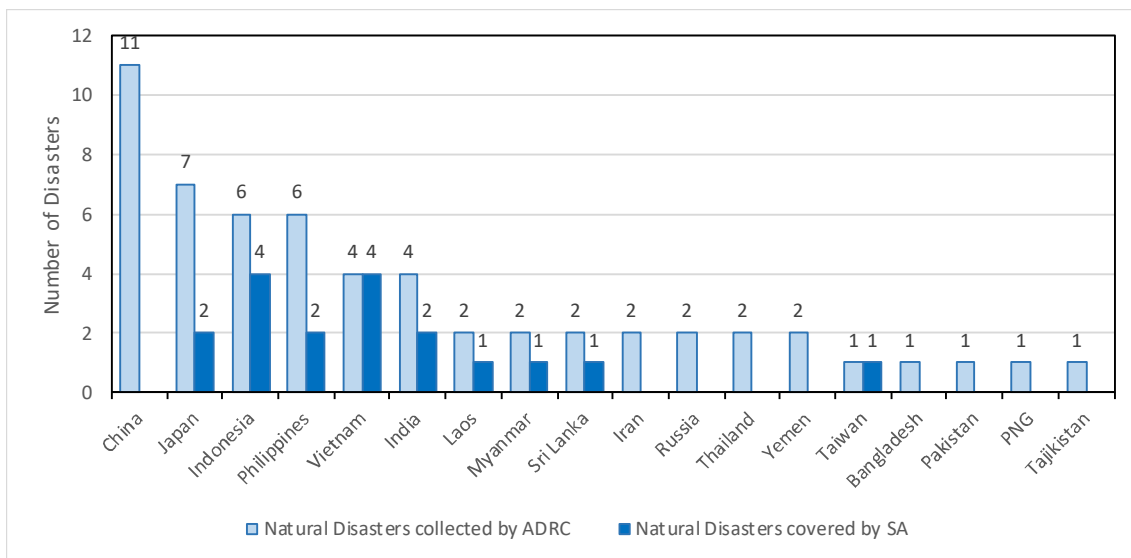
Figure 21: Breakdown by countries of major natural disasters collected by ADRC in 2018. Dark blue indicates disasters covered by SA.

6.2.   Analysis of Operational Performance

Figure 22 summarizes the number of days from the occurrence of the 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 2018.
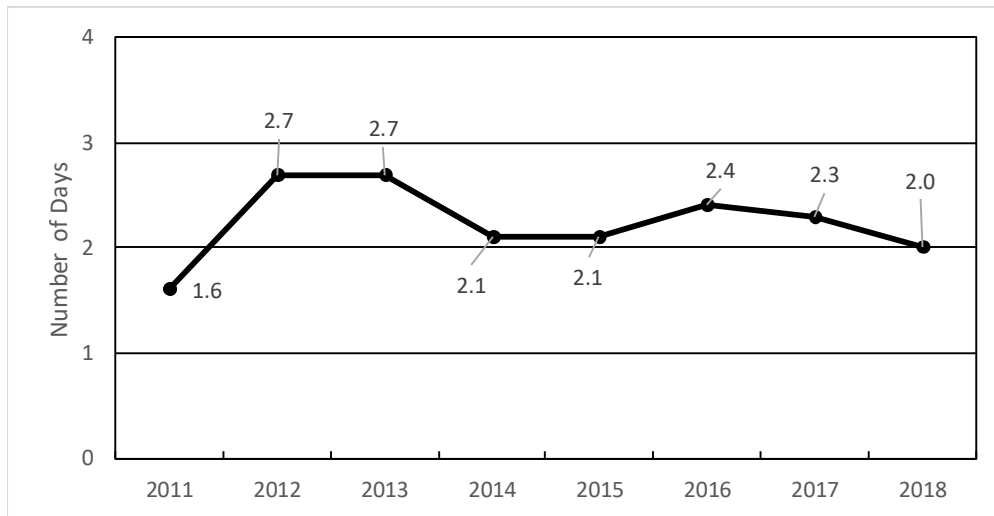
Figure 22: Number of Days Required from Disaster Occurrence to Request

Figure 23 shows the number of days that were required from the date the request is received to activation. Overall, it took 0.5 days from request to activation in 2018. It was improved from last year.
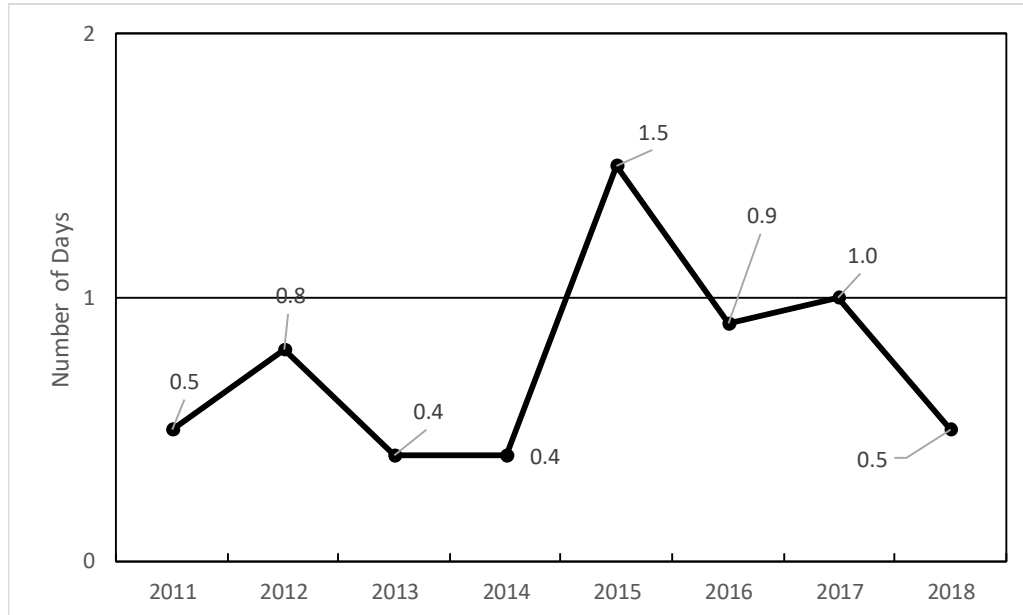
Figure 23: Number of Days Required from Request to Activation

Figure 24 to Figure 25 indicate the average number of days required to provide each data for each year, and the percentage of completed data provisions. Figure 24's Archive Satellite Data indicates that the percentage of provisions declined from 2015, totaling

63.3% in 2018, while the average number of days was improved to 2.0 days from last year.
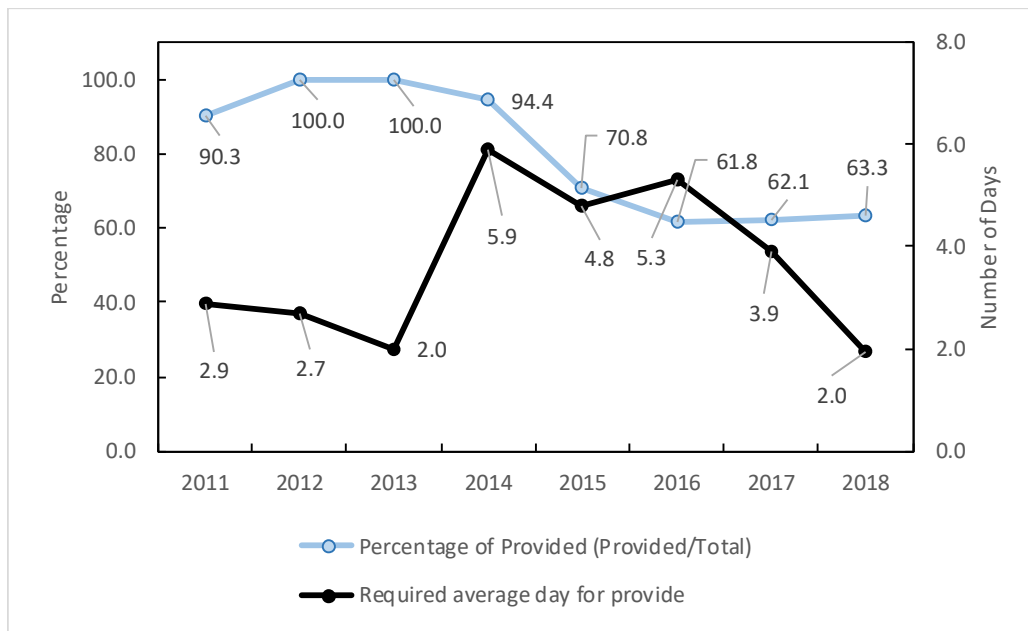
Figure 24: Average Number of Days Required to Provide Archive Satellite Data and Response Rate for Each Year

Figure 25'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 declined in recent years. The average number of days required for provision was 3.2 days over the past 3 years, from 2016 to 2018.
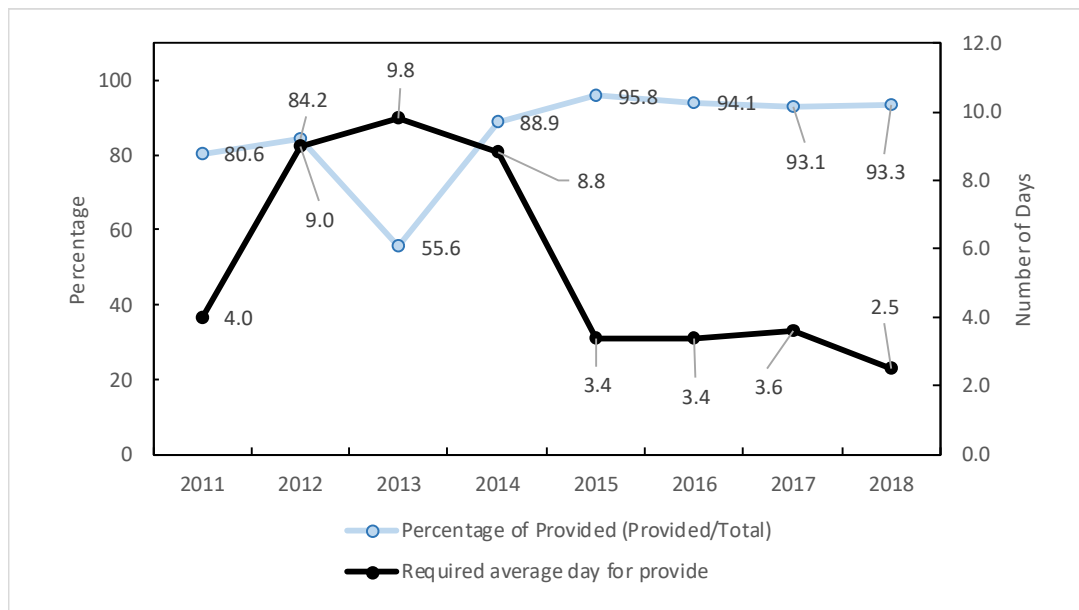
Figure 25: Average Number of Days Required to Provide Satellite Data After Disaster and Activation Rate for Each Year

Figure 26's products were 86.7% in 2018. It is getting better since 2016. And the average number of days required for provision was 3.5 days. This is also it is getting better since 2014.
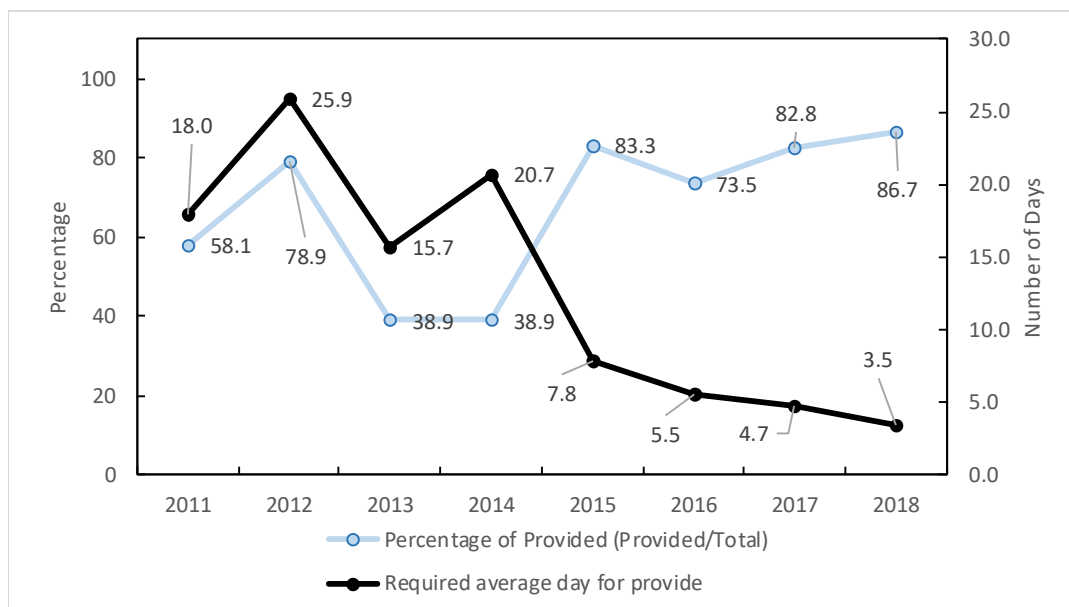
Figure 26: Average Number of Days Required to Provide Products and Activation Rate for Each Year

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7. Conclusions

Since the start of 2007, we have conducted emergency observation activities for 333 natural hazards, and three organizations joined SA as new members during 2018. The number of participating institutions in the initiative has now reached 107 including 8 DPNs and 46 DANs.

Followings are conclusion based on activities in 2018 and suggestions toward for 2019.

- In 2018, 31 EOR were submitted and 30 EOR were activated. Around 58 % of EOR was related to Flood, Earthquake and Tsunami.
- Submitted EORs were concentrated from July to September as rainy season in Asian countries. It is expected that similar trend will be occur after 2019.
- Strengthen network was confirmed at workshop in Myanmar, Thailand and Vietnam. And Standard Operation Procedure was developed for these countries. It should be spread to other countries for the better activity of Sentinel Asia.
- In several conferences, JPTM in Taiwan/Awaji and Steering Committee in Thailand, it was proposed a new system "OPTEMIS" and confirmed more strong linkage between space agency and disaster management organization.
- Sentinel Asia Strategic Plan was confirmed by JPT member in 2018.

List of JPT Members

(91 organizations from 28 countries/regions and 16 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		
10	Indonesia	24	National Disaster Management Agency (BNPB)		
		25	Indonesian National Institute of Aeronautics and Space (LAPAN)		✔
		26	Institute of Technology Bandung (ITB)		
		27	Universitas Jenderal Achmad Yani (UNJANI)		
		28	Center for Remote Sensing and Ocean Sciences (CReSOS) Udayana University		✔
		29	Center of Technology for Natural Resources Inventory (PTISDA - BPPT)		✔
		30	Ministry of Marine Affairs and Fisheries		✔

11	Japan	31	Keio University		
		32	Japan Aerospace Exploration Agency (JAXA)	✔	✔
		33	Infrastructure Development Institute (IDI) Japan (IFNet)		
		34	Hokkaido University		
		35	Yamaguchi University		✔
		36	Chubu University		✔
		37	Chiba University		✔
		38	Hiroshima Institute of Technology		✔
		39	Tokyo Institute of Technology (TIT)		✔
		40	International Research Institute of Disaster Science, Tohoku University		✔
		41	University of Tokyo		✔
		42	National Research Institute for Earth Science and Disaster Resilience (NIED)		
12	Kazakhstan	43	National Center of Space Researches and Technologies (NCSRT)		✔
13	Korea	44	Korea Aerospace Research Institute (KARI)	✔	✔
		45	National Disaster Management Research Institute (NDMI)		✔
14	Kyrgyz	46	Central Asian Institute of Applied Geosciences (CAIAG)		✔
15	Lao P.D.R.	47	Ministry of Labor and Social Welfare		
		48	Natural Resources and Environment Institute (NREI), Ministry of Natural Resources and Environment (MONRE)		
16	Malaysia	49	National Security Division, Prime Minister's Department		
		50	Malaysian Remote Sensing Agency (ARSM)		
		51	Malaysian National Space Agency (ANGKASA)		✔
17	Mongolia	52	Information And Research Institute Of Meteorology, Hydrology And Environment (IRIMHE)		
18	Myanmar	53	Department of Meteorology and Hydrology (DMH)		
		54	Relief and Resettlement Department (RRD)		
		55	Myanmar Earthquake Committee (MEC) , Myanmar Engineering Society (MES)		
19	Nepal	56	Survey Department (SD)		
		57	Department of Water Induced Disaster Management (DWIDM), Ministry of Irrigation		
		58	Land Management Training Centre		
		59	Department of Hydrology and Meteorology (DHM), Ministry of Population & Environment		
20	Pakistan	60	Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)		✔
21	Papua New Guinea	61	National Disaster Centre (NDC)		

22	Philippines	62	Office of Civil Defense (OCD), National Disaster Risk Reduction and Management Council (NDRRMC)		
		63	National Mapping and Resource Information Authority (NAMRIA)		✔
		64	Bureau of Soils and Water Management (BSWM), Department of Agriculture		
		65	Mines and Geoscience Bureau (MGB), Department of Environment and Natural Resources		
		66	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)		✔
		67	Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD)		
		68	Philippine Institute of Volcanology and Seismology (PHIVOLCS)		✔
		69	Manila Observatory (MO)		✔
		70	NOAH Center of the University of the Philippines Resilience Institute		✔
23	Singapore	71	Centre for Remote Imaging, Sensing and Processing (CRISP)	✔	✔
		72	Earth Observatory of Singapore (EOS)		✔
24	Sri Lanka	73	Survey Department of Sri Lanka		✔
		74	Ministry of Disaster Management		✔
25	Taiwan	75	National Applied Research Laboratories (NARL)	✔	✔
		76	Center for Space and Remote Sensing Research, National Central University (CSRSR, NCU)		✔
26	Thailand	77	Geo-Informatics and Space Technology Development Agency (GISTDA)	✔	✔
		78	Department of Disaster Prevention and Mitigation (DDPM)		
		79	Department of Water Resources (DWR)		
		80	Royal Forest Department (RFD)		
		81	National Park, Wildlife and Plant Conservation Department		
		82	Royal Irrigation Department (RID)		
		83	Land Development Department (LDD)		
		84	Andaman Environment and Natural Disaster Research Center, Prince of Songkla University (ANED, PSU)		✔
27	United Arab Emirates	85	Mohammed Bin Rashid Space Centre (MBRSC)	✔	✔

28	Vietnam	86	Vietnamese Academy of Science and Technology (VAST)	✔	✔
		87	Ministry of Agriculture and Rural Development (MARD)		
		88	Ministry of Natural Resources and Environment (MONRE)		✔
		89	Cartography Department, Ministry of Defense (MOD)		
		90	Ministry of Science and Technology (MOST)		
		91	Vietnam Institute of Geosciences and Mineral Resources (VIGMR)		
29	International Organization	92	Asian Institute of Technology (AIT)		✔
		93	The ASEAN Secretariat		
		94	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)		
		95	United Nations Office for Outer Space Affairs (UNOOSA)		
		96	International Center for Integrated Mountain Development (ICIMOD)		✔
		97	CSIRO Office of Space Science and Applications (COSSA)		
		98	International Centre for Water Hazard and Risk Management (ICHARM)		
		99	Asian Disaster Reduction Center (ADRC)		✔
		100	Secretariat of the Pacific Community (SPC/SOPAC)		✔
		101	The World Bank (WB)		
		102	International Water Management Institute (IWMI)		✔
		103	Asian Development Bank (ADB)		✔
		104	ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)		
		105	World Wide Fund for Nature (WWF) - Pakistan		
		106	Asian Disaster Preparedness Center (ADPC)		✔
		107	Myanmar Information Management Unit (MIMU)		
				8	46

as of Dec 2018

List of Emergency Observation Request by each country

	Request	Activation	Rejection	Percentage of Activation	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	Flood Num	Flood %	Earthquake Num	Earthquake %	Landslide Num	Landslide %	Typhoon Num	Typhoon %	Forest fire Num	Forest fire %	Volcanic Eruption Num	Volcanic Eruption %	Cyclone Num	Cyclone %	Oil Spill Num	Oil Spill %	others Num	others %
Indonesia	51	44	7	86.3	7	2	5	9	2	4	2	4	2	7	3	4	51	16	31.4	12	23.5	4	7.8			2	3.9	12	23.5					5	9.8
Vietnam	43	38	5	88.4	2	2	4	7	2	1	2		2	3	12	6	43	31	72.1	0	0.0	1	2.3	7	16.3	1	2.3					2	4.7	1	2.3
Philippine	33	31	2	93.9	1	1	6	1	4	4	3	1	2	4	4	2	33	11	33.3	4	12.1			10	30.3	1	3.0	2	6.1	2	6.1			3	9.1
India	20	17	3	85.0			1	4	3	1	2	2	1	2	1	3	20	11	55.0	1	5.0			1	5.0	1	5.0			3	15.0			3	15.0
Japan	19	19	0	100.0		2		1	4	1	3	3	2	1		2	19	9	47.4	5	26.3	3	15.8					2	10.5						
Nepal	19	19	0	100.0	1	2	2	1	2	1	1	1	4	2	2		19	12	63.2	2	10.5	2	10.5			1	5.3							2	10.5
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	13	11	2	84.6	2	3		1	2	1	1				1	2	13	11	84.6	1	7.7													1	7.7
Myanmar	13	11	2	84.6		1		2		1		2	4			3	13	7	53.8	4	30.8	1	7.7							1	7.7				
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
Sri Lanka	12	11	1	91.7			1	2	2	1		1	1	1	1	2	12	10	83.3			1	8.3							1	8.3				
China	10	8	2	80.0		2		1	1	2	1	1			2		10	2	20.0	4	40.0	3	30.0			1	10.0								
Bangladesh	9	9	0	100.0	3			1				1	2	2			9	5	55.6			2	22.2							2	22.2				
Tajikistan	7	7	0	100.0	1			2	1	1		1	1				7	4	57.1	1	14.3	1	14.3											1	14.3
Kazakhstan	6	4	2	66.7				1	2	3							6	3	50.0							2	33.3							1	16.7
Bhutan	6	4	2	66.7				2		1		2	1				6	3	50.0							3	50.0								
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								
Kyrgyzstan	5	2	3	40.0				1	3	1							5	1	20.0	1	20.0	1	20.0											2	40.0
Brunei	5	3	2	60.0					3	1		1					5	4	80.0													1	20.0		
Cambodia	3	3	0	100.0				2	1								3	3	100.0																
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								
Lao PDR	3	3	0	100.0		1							1			1	3	2	66.7															1	33.3
Korea	2	2	0	100.0											1	1	2			2	100.0														
Fiji	2	2	0	100.0						1				1			2	1	50.0											1	50.0				
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						
Afghanistan	1	0	1	0.0								1					1	1	100.0																
New Zealand	1	1	0	100.0						1							1			1	100.0														
Vanuatu	1	1	0	100.0									1				1													1	100.0				
United Arab Emirates	1	1	0	100.0												1	1													1	100.0				
Total	333	289	44	-	20	19	24	43	39	25	20	19	25	36	32	31	333	164	-	43	-	25	-	25	-	17	-	17	-	14	-	5	-	23	-

Number of requested EOR (by year)

Number of requested EOR (by each disaster)