SENTINEL ASIA

ANNUAL REPORT 2017

Sentinel Asia

Annual Report 2017

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List of Emergency Observation Requests by each country

List of JPT Members

1. Introduction

1.1. Purpose and Scope of the Document

This document describes the activities of Sentinel Asia (SA) in 2017 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 2017; results of emergency observation activities in 2017

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.

Chapter 8 - 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
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)
DMH	Department of Meteorology and Hydrology (Myanmar)
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
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
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

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
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

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 2017, it consists of 104 member organizations, including 89 agencies from 28 countries/regions and 15 international organizations. JAXA has been serving as a secretariat of the JPT.

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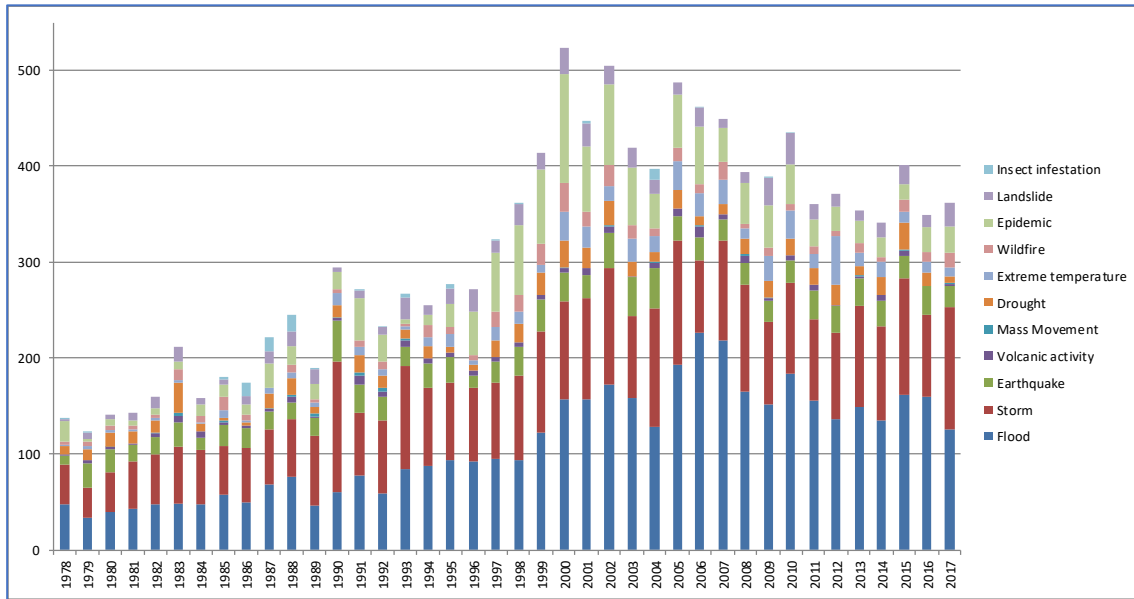
Figure 1: Incidence of natural disasters by region (In and after 1978)

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[1]) 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.

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[1] The Mohammed Bin Rashid Space Centre (MBRSC) in the UAE became a Sentinel Asia Member as a Data Provider Node in 2017

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.
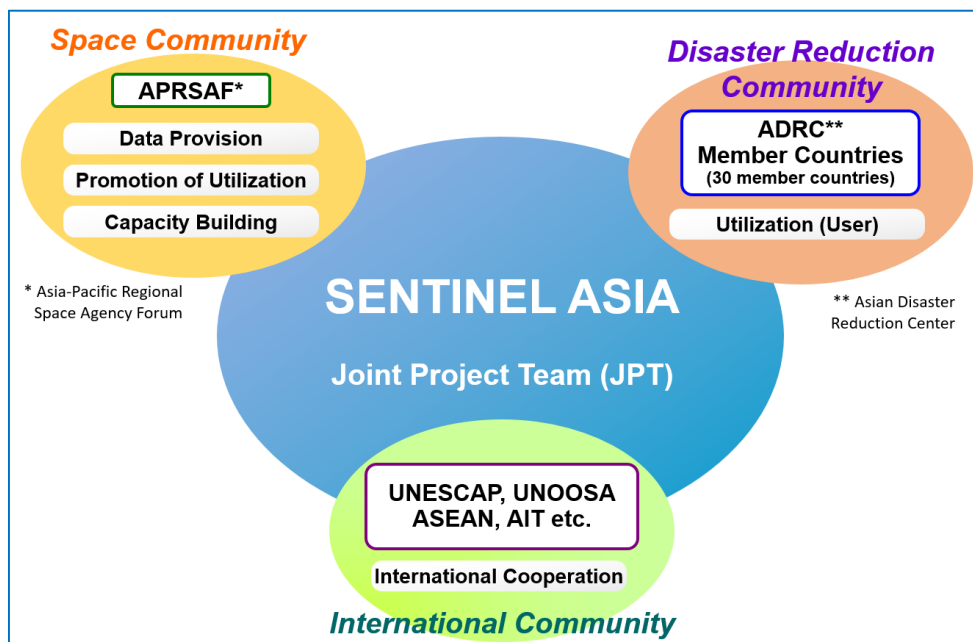
Figure 2: Framework of Sentinel Asia

  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 2017, about 302 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.
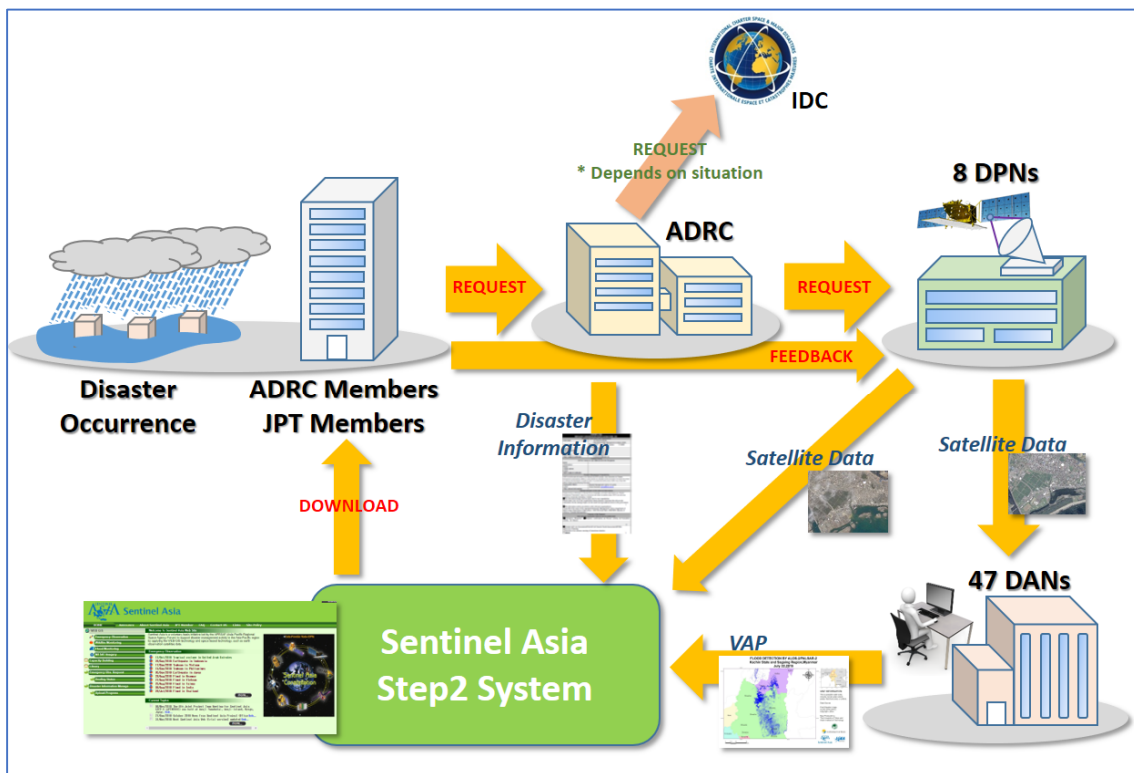
Figure 3: Flow of Sentinel Asia emergency observation

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,

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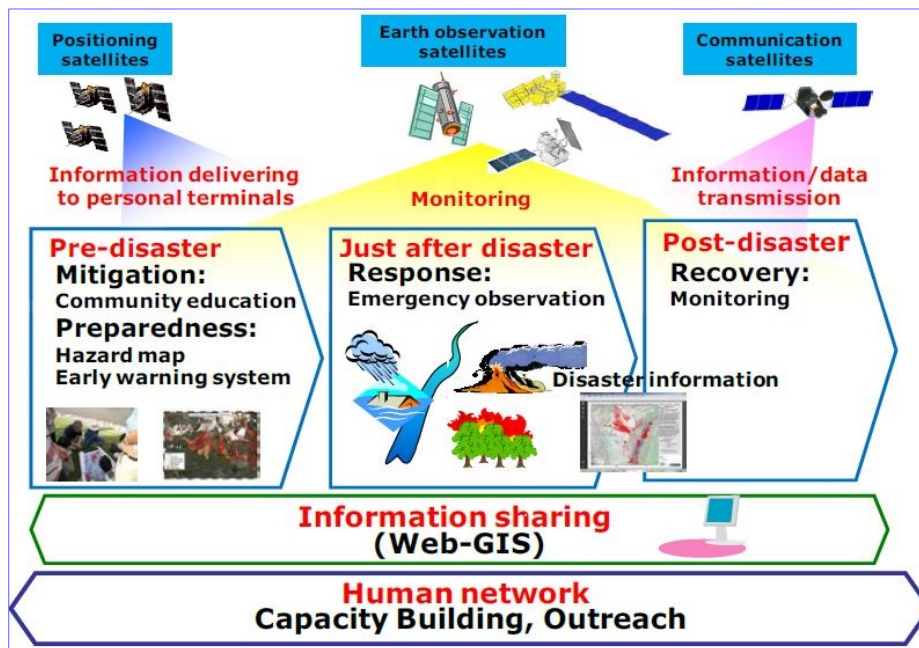
Figure 4: Current phase (Step 3) and actions of Sentinel Asia

2.2.   Major Disasters with Emergency Observation (2007-2017)

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 150 requests (51.0%), followed by earthquakes at 35 (11.6%), landslides at 23 (7.6%), typhoons at 21 (7.0%), forest fires and fires at 17 (5.6%), volcanic eruptions at 15 (5.0%), and cyclones at 10 (3.3%).

Generally, activation is made for around 80% to 90% of requests for most disasters. There is 94.8% 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 - 2017)

*Requests (N=302)
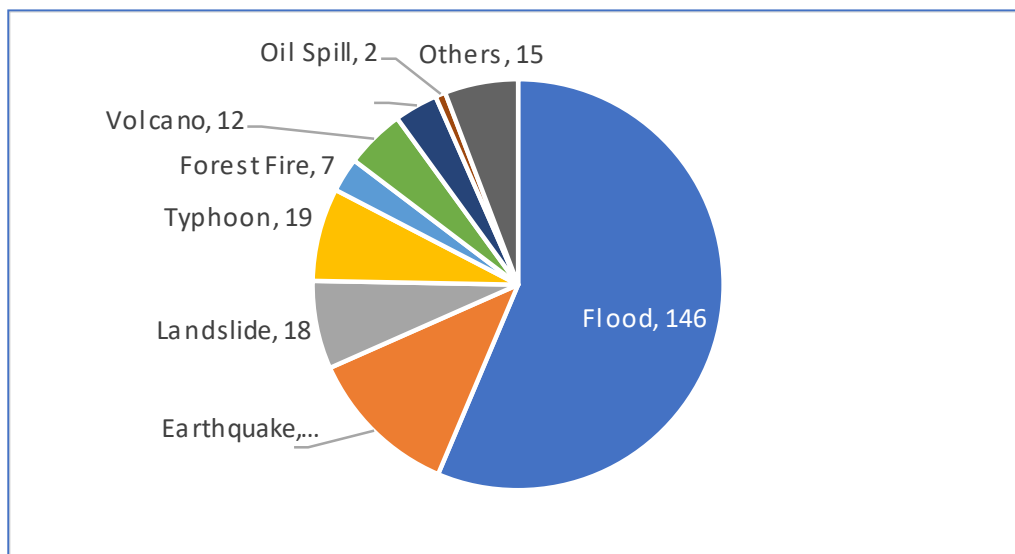
Figure 6: Breakdown of Emergency Observations by Disaster (2007 - 2017)

*Activations (N=259)

Table 1: Number of Requests, Activations, and Rejections for Emergency Observations by Disaster

	Number of Request	Number of Activation	Number of Rejection	Activation/Request (%)
Flood	154	146	8	94.8%
Earthquake	35	31	4	88.6%
Landslide	23	18	5	78.3%
Typhoon	21	19	2	90.5%
Forest Fire	17	7	10	41.2%
Volcano	15	12	3	80.0%
Cyclone	10	9	1	90.0%
Oil Spill	4	2	2	50.0%
Others	23	15	8	65.2%
Total	**302**	**259**	**43**	

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3. Emergency Observation Operations in 2017

3.1. Emergency Observation Requests

Figure 7 shows the number of requests, activations and rejections involving emergency observations from 2007 to 2017. 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.
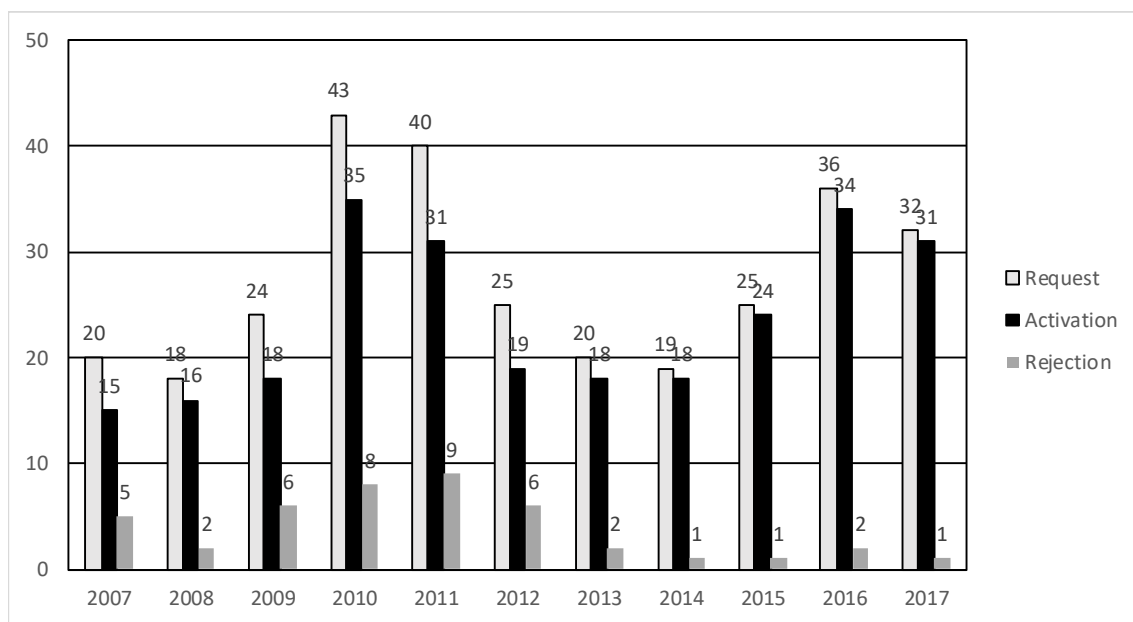
Figure 7: Comparison of the Number of Requests, Activations and Rejections for Emergency Observations

All 2017 activations are listed in Table 2. In total, 32 requests were received in 2017. The following single request was rejected after confirmation with the requester:

- Activation No. 275, Country [Indonesia], Disaster type [Landslide]

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 22 requests (68.8%), followed by earthquakes at 4 (12.5%), landslides at 2 (6.3%), typhoons at 1 (3.1%), and volcanic eruptions at 1 (3.1%).

Table 2: List of 2017 Activations

Activation Number	Country	Disaster Type	Activation Date	Requester
271	Thailand	Flood	2017/01/11	GISTDA
272	Philippines	Flood	2017/01/24	PAGASA
273	Philippines	Earthquake	2017/02/12	PHIVOLCS
274	Indonesia	Flood	2017/02/21	LAPAN
275	Indonesia	Landslide	2017/02/22	Udayana Univ
276	Nepal	Other (GLOF)	2017/04/24	DHM
277	Sri Lanka	Flood	2017/05/27	DMC/IWMI
278	Taiwan	Flood	2017/06/05	NARL
279	Bangladesh	Flood	2017/06/16	DDM
280	China	Landslide	2017/06/24	CEA
281	Philippines	Earthquake	2017/07/07	PHIVOLCS
282	Vietnam	Typhoon	2017/07/17	MONRE
283	Vietnam	Flood	2017/07/25	MONRE
284	Taiwan	Flood	2017/07/31	NARL
285	Vietnam	Flood	2017/08/05	MONRE
286	China	Earthquake	2017/08/09	CEA
287	Nepal	Flood	2017/08/16	ICIMOD
288	Bangladesh	Flood	2017/08/24	DDM
289	Vietnam	Flood	2017/08/27	MARD
290	Vietnam	Flood	2017/09/15	MARD
291	Vietnam	Flood	2017/10/11	MONRE
292	Vietnam	Flood	2017/10/12	MONRE
293	Vietnam	Flood	2017/10/14	MONRE
294	Taiwan	Flood	2017/10/15	NARL
295	Philippines	Flood	2017/10/20	BMG
296	Vietnam	Flood	2017/11/02	MONRE/DMPTC
297	Vietnam	Flood	2017/11/06	MONRE/DMPTC
298	Korea	Earthqueke	2017/11/17	NDMI
299	Vietnam	Flood	2017/11/19	MONRE/DMPTC
300	Indonesia	Volcanic Eruption	2017/11/27	LAPAN/BNPB
301	India	other	2017/12/08	ISRO
302	Vietnam	Flood	2017/12/25	DMPTC

*275 was rejected

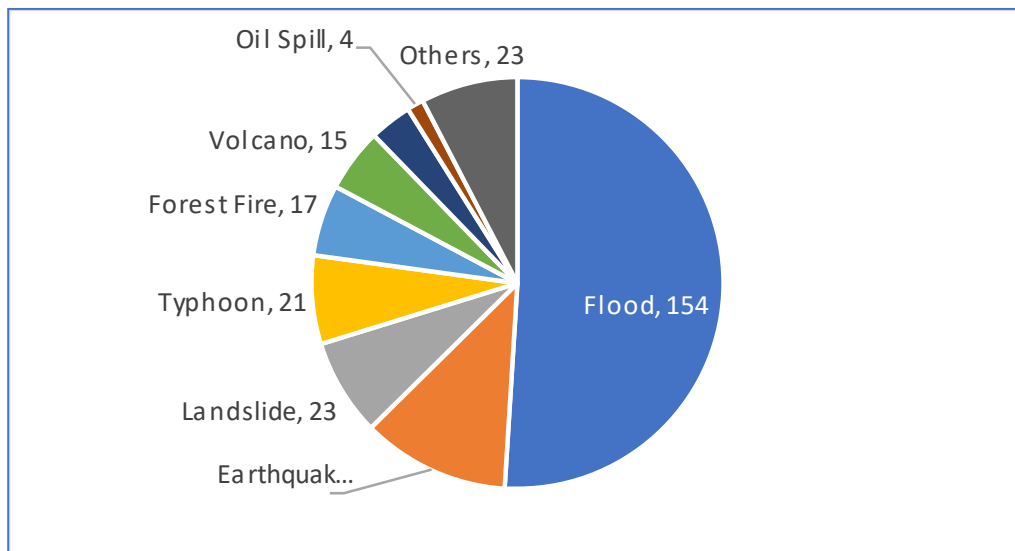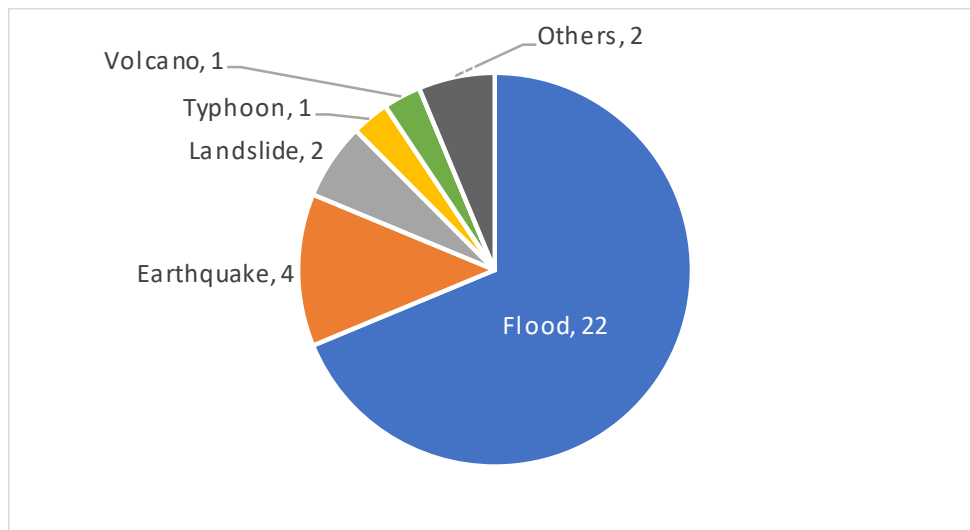**Figure 8: Breakdown of Emergency Observations by Disaster *Requests in 2017**
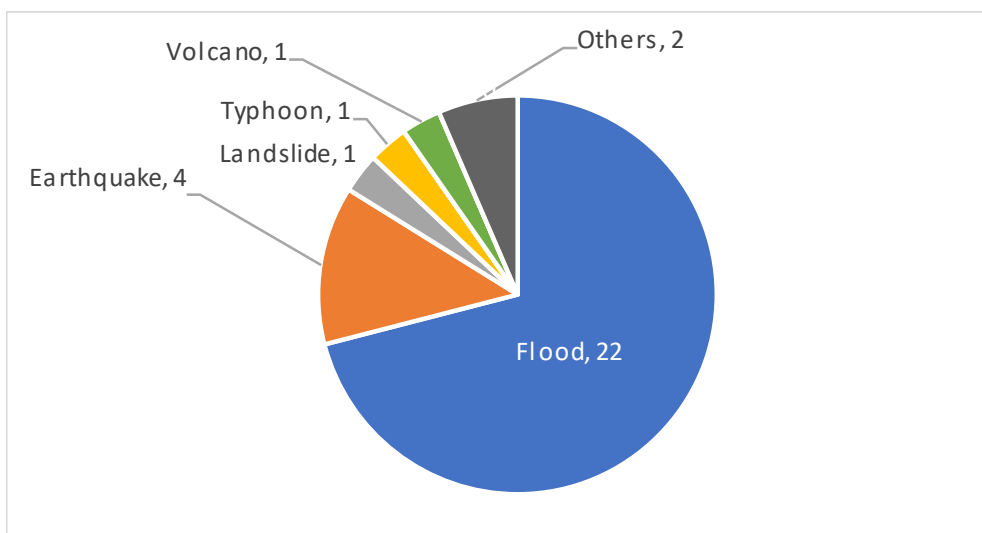
Figure 9: Breakdown of Emergency Observations by Disaster *Activations in 2017

3.2.   Results of Emergency Observations

During 2017, the monthly average of activations was 2.6. Figure 10 shows the monthly distribution of activations throughout 2017. The highest number of activations occurred in August, October and November, corresponding to 48.4% of the total number. The remaining months of 2017 saw a number of activations that varied from 0 to 4. Most of the activations were caused by water disasters such as floods and typhoons.
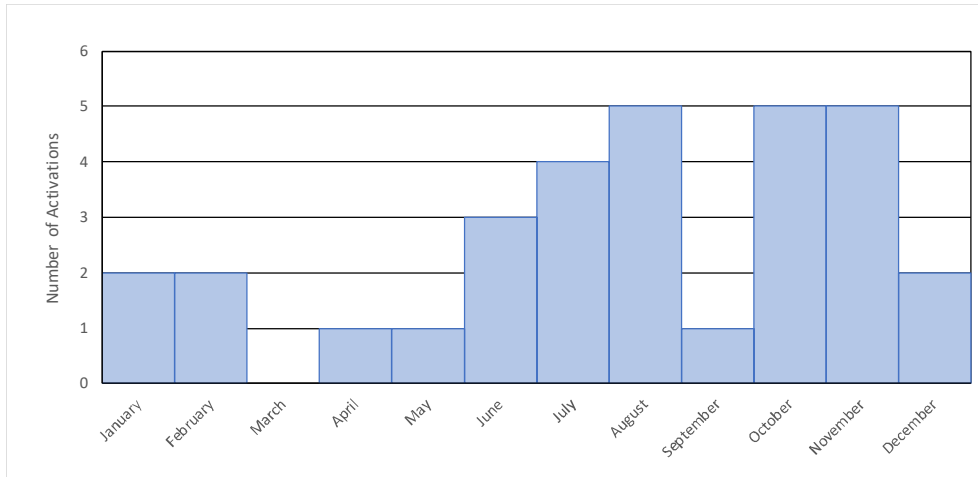
Figure 10: Number of monthly activations in 2017

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, the Philippines and Taiwan. The highest number of activations was Vietnam.
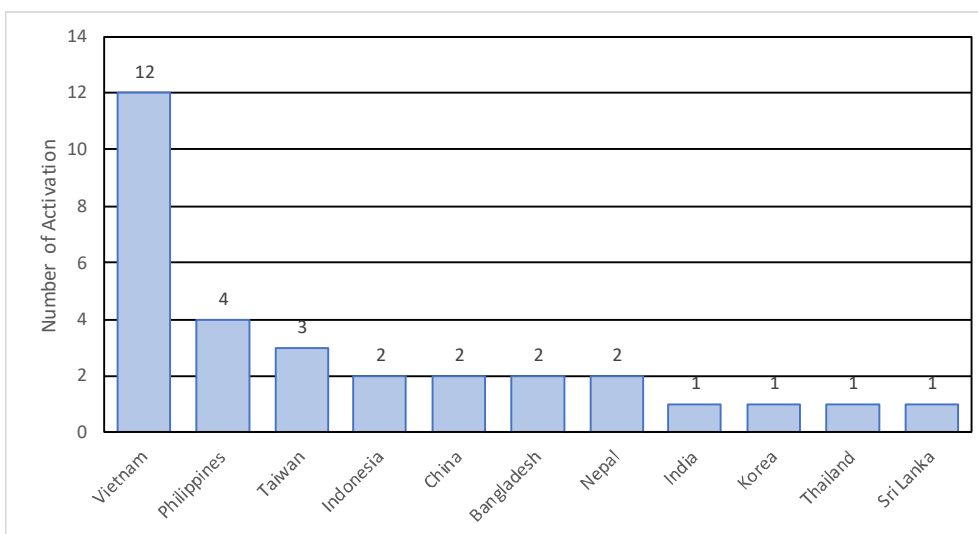
Figure 11: Number of activations by country in 2017

Figure 12 shows the number of implementations by DPN. In total, 75 implementations were made in 2017, and satellite data was provided to the requesters. The highest number of implementations were made by JAXA, ISRO and GISTDA, corresponding to 96% of the total number.
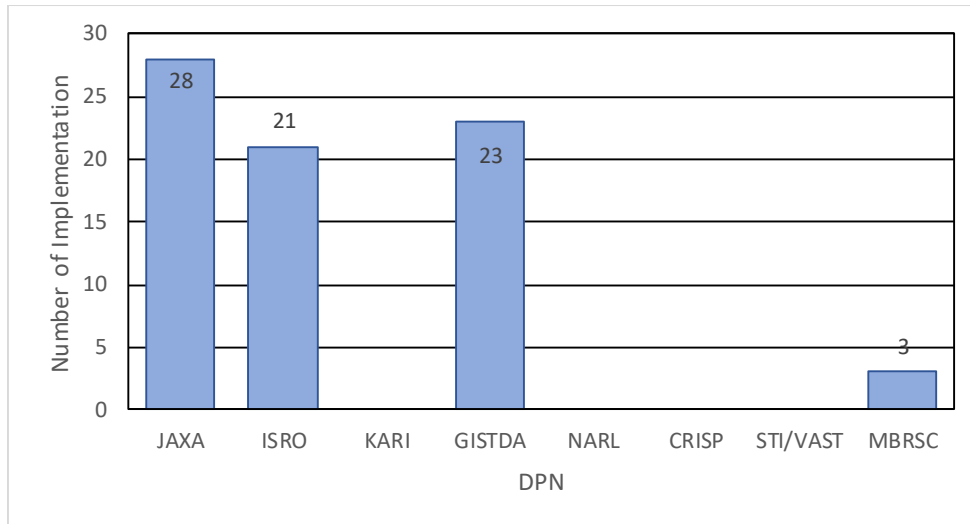
Figure 12: Number of responses by DPN in 2017

Figure 13 shows the number of optical and radar data by DPN. In 2017, a total of 1,265 scenes were provided by DPN members. The total can be broken down into archives (149) and new acquisitions (1,116). The highest data numbers are occupied by JAXA, ISRO, GISTDA and MBRSC.
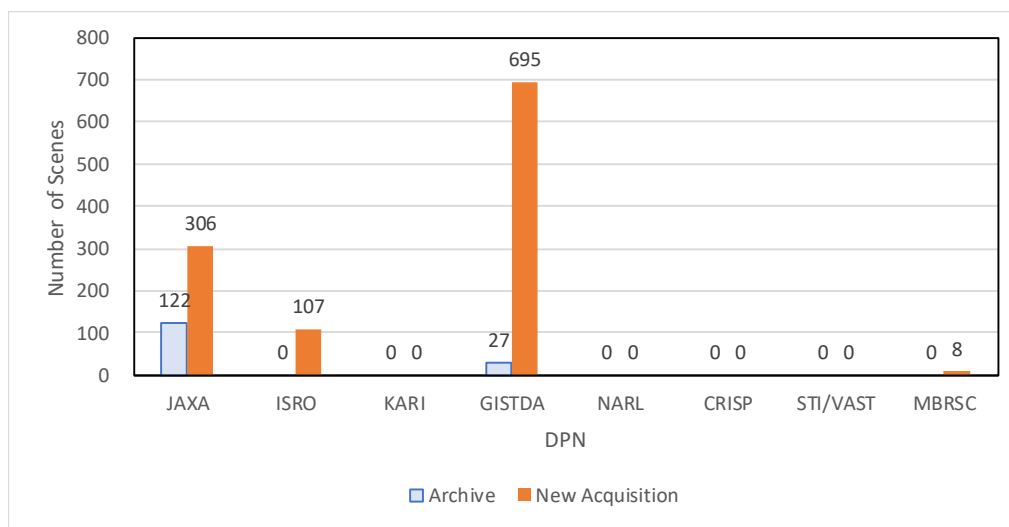
Figure 13: Data consumption (Archive and New Acquisition) by DPN in 2017

Figure 14 shows the number of implementations by DAN. In total, 156 were implemented in 2017, and archive data and analyzed products were provided to requesters. The highest number of implementations were made by AIT and JAXA, corresponding to 90.4% of the total number.
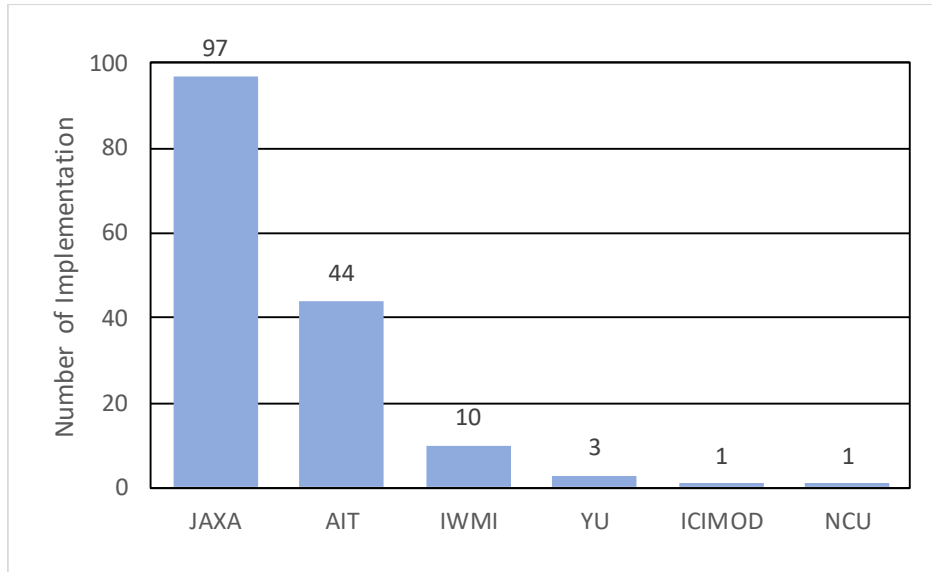
Figure 14: Number of responses by DAN in 2017

3.3.   Web GIS Support

The secretariat of Sentinel Asia provides a Web-GIS Service when an EOR is activated. Requesters and disaster management organizations can confirm provided satellite images and analyzed data by using this service.
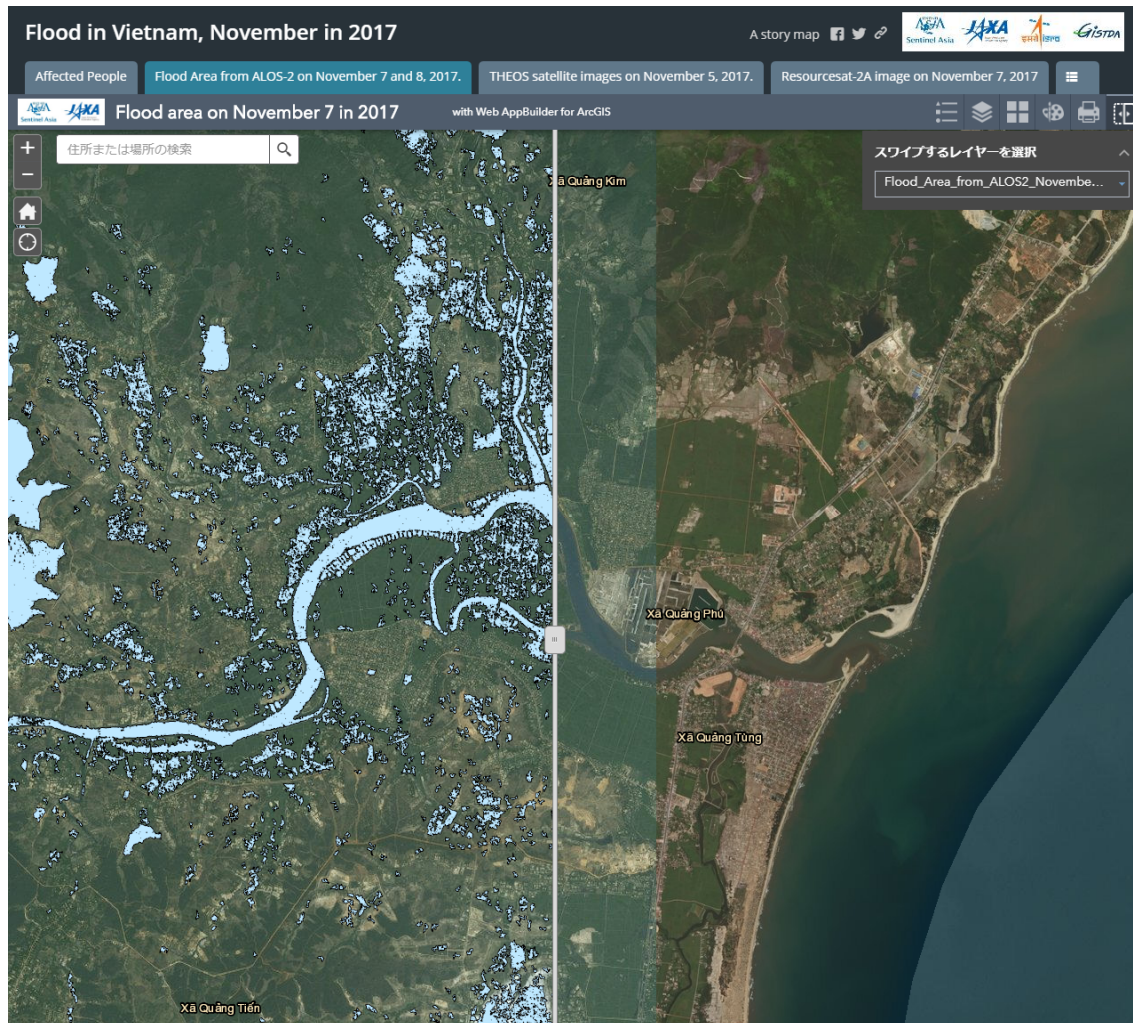
Figure 15: Data consumption (Archive and New Acquisition) by DPN in 2017

3.4.   Good Practice – Volcanic eruption in November 2017 (Indonesia)

After volcanic Mount Agung erupted in November 2017, SA received and accepted an EOR from the Indonesian National Institute of Aeronautics and Space (LAPAN). Below is a brief description of the event and a good example of our collaborative work (data and information sharing) to support the Indonesian government's effort toward disaster management.

On Saturday, 25 November 2018, the Indonesian Volcanology and Geological Disaster Mitigation Center (PVMBG) raised the alert level of Mount Agung from level III to level IV, where the eruptions of Mount Agung had shifted from phreatic to magmatic ones, as red glow was seen from the peak of the Mount Agung. The eruption produced thick ash continuously at a height of between 2,000 and 3,400 meters from the top of the crater. The danger zone had been expanded from 6km to 8km from the top of volcano, and people residing within a 10km radius were evacuated. The Indonesian Disaster Management Agency (BNPB) also asked 25,000 people to be evacuated from the slope of Mount Agung to hundreds of shelters.

In response, SA provided a large number of satellite images and map products: 3 satellite images from before the disaster, 30 satellite images from after the disaster and 3 value-added products. Figure 17 shows an example of one of the value-added products provided by SA.

LAPAN officers expressed that the data and map products had been shared with national/local disaster management organizations, and utilized for emergency response and assessment of the damaged areas.

Figure 16: Volcanic Eruption of Mount Agung in 2017 (Photograph credit: PVMBG)
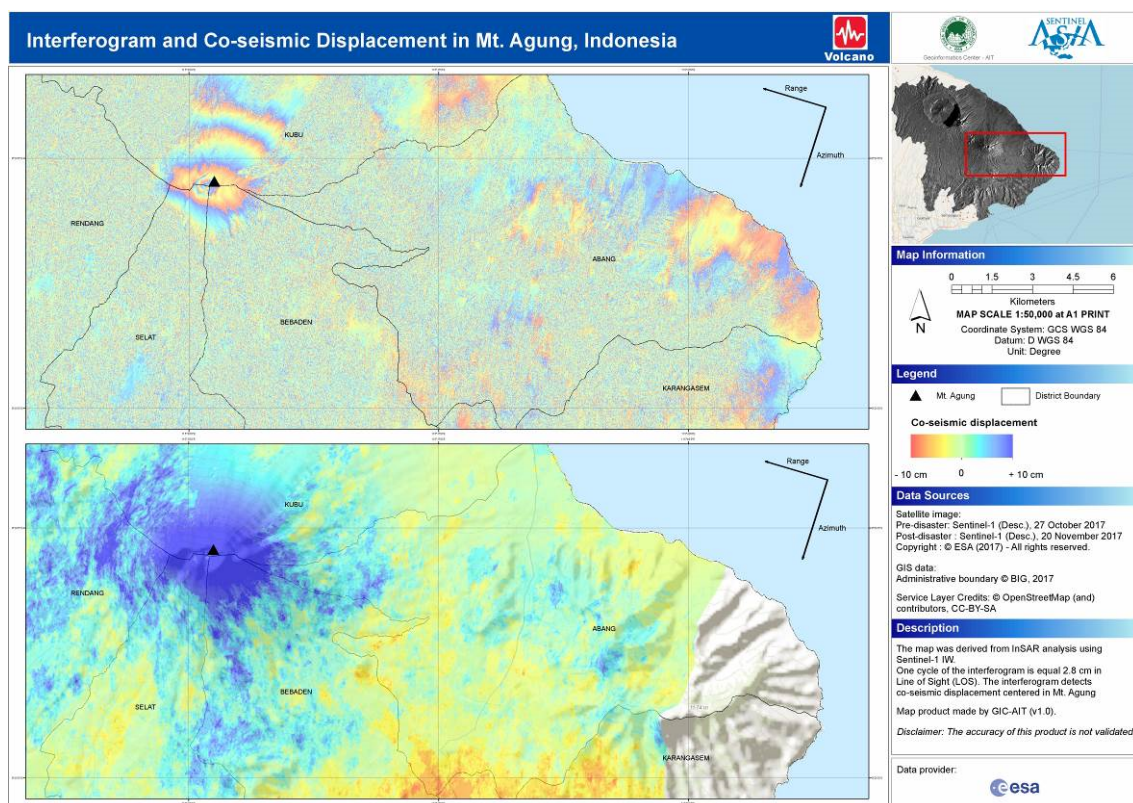
Figure 17: Example of Value-Added Product

4. External Relations

4.1. Accession of New Members

In 2017, the following six organizations joined SA. Introductions from the MBRSC and EOS are shown as follows.

- **Earth Observatory of Singapore (EOS) Nanyang Technological University, Singapore [JPT, DAN]**
- **Mohammed Bin Rashid Space Centre (MBRSC), UAE [JPT, DPN]**
- Center for Remote Sensing and Ocean Sciences (CReSOS) Udayana University, Indonesia [DAN]
- Ministry of Marine Affairs and Fisheries, Indonesia [DAN]
- Pakistan Space & Upper Atmosphere Research Commission (SUPARCO), Pakistan [DAN]

4.1.1. Earth Observatory of Singapore (EOS) Nanyang Technological University, Singapore

(1) Outline of organization

The Earth Observatory of Singapore (EOS) conducts fundamental research on earthquakes, volcanic eruptions, tsunamis and climate change in and around Southeast Asia, in an effort toward establishing safer and more sustainable societies. Launched in 2009, EOS has the dual goals of acquiring scientific knowledge on natural hazards in the region, and passing this knowledge on to communities and decision makers so they can use the knowledge effectively.

(2) Greeting from Dr. Emma Hill, Principal Investigator of Geodesy (Earth Observatory of Singapore) and Associate Professor (Asian School of the Environment, Nanyang Technological University)

EOS is proud, honored and excited to become a Data Analysis Node of Sentinel Asia. We believe that Sentinel Asia has the potential to save many lives, by providing critical and timely information for disaster response and recovery. We have been very impressed by Sentinel Asia's efficient and effective framework for communication and

information sharing between agencies across the region.

At EOS we have a talented and passionate team dedicated to building and operating systems for automated processing of Synthetic Aperture Radar (SAR) data for hazards monitoring and disaster response. Our goal is to be able to automatically generate SAR interferograms showing ground deformation, SAR-based maps of flood extent, and SAR-based maps of building damage from earthquakes, volcanic eruptions, typhoons, fires, and landslides.

To meet our goal, we are collaborating with Caltech and the NASA Jet Propulsion Laboratory, who developed the Advanced Rapid Imaging and Analysis (ARIA) system. We have successfully cloned the ARIA system to Singapore, and hope that in the near future we will be able to use it for automated monitoring of natural hazards and response to regional disasters. We also hope to continue to innovate the processing algorithms, to achieve ever more accurate and timelier response products.

Photo 18: Team of Earth Observatory of Singapore (EOS)
(from left to right: Alok Bhardwaj, Emma Hill, Nina Lin, Shi Tong Chin, and Ziyue Pan)

4.1.2. MBRSC

(1) Outline of organization

  The Mohammed Bin Rashid Space Centre (MBRSC) is integral to the strategic initiative put in place by the Dubai government to inspire scientific innovation, technological advancement, and to advance sustainable development in the United Arab Emirates.

  The center was originally established in 2006 as the Emirates Institution for Advanced Science & Technology (EIAST), accumulating knowledge, recruiting engineers, and launching advanced scientific projects, until the MBRSC was established in 2015 by Sheikh Mohammed bin Rashid.

  The establishment decree saw EIAST integrated with the newly founded MBRSC, which would now take charge of the UAE's advanced science and technology projects, and take responsibility for contributing towards the UAE's move into a knowledge-based economy.

  The Centre's main line of business includes research and development in the area of outer space, manufacture of satellites and development of systems, space imaging and applications development, and ground station services and support to satellite missions.

Photo 2: Mohammed Bin Rashid Space Centre (MBRSC)

(2) Greeting from Dr. Alia Almekhyat, Remote Sensing Department, Mohammed Bin Rashid Space Centre (MBRSC)

The Mohammed Bin Rashed Space Centre (MBRSC) is honored to have been accepted to participate as a member of JPT in Sentinel Asia. This membership gave us the opportunity to apply our remote sensing capabilities to reduce disaster risk and support disaster management in the Asia-Pacific region.

H.E. Yousuf Al Shaibani, Director General of MBRSC, stated: "Joining the Sentinel Asia International Initiative is in line with the UAE's vision in providing humanitarian support in various forms, to face global disaster challenges. It also reflects the approach of giving and humanitarian support, in line with 2017's initiative – the 'Year of Giving'. Coordination and cooperation between the agencies and centers operating remote sensing satellites is an important step to help in the anticipation and management of potential crises."

He added: "What distinguishes the remote sensing technique is its capability to overcome geological barriers and natural hazards, in addition to the ability to plan properly ahead, to have comprehensive preparedness to face any disaster."

Photo 3: DubaiSat-2

4.2. Collaboration and Cooperation with Other Organizations

  The rollout to IDC began in February 2010 as required. In 2017, eight disasters were escalated to Charter. Excluding escalations via other institutions, two disasters were escalated through SA. There was one response to an earthquake in the Philippines, and one response to a flood in Vietnam.

Table 3 List of Charter Escalation in 2017

Activation Number	Country	Disaster Type	Activation Date	Requester	Remarks column
273	Phillipnes	Earthquake	12-Feb-17	PHIVOLCS	
277	Sri Lanka	Flood	27-May-17	IWMI	*Not escalation via Sentinel Asia*
280	China	Landslide	24-Jun-17	China Earthquake Administration	*Not escalation via Sentinel Asia*
285	Vietnam	Flood	5-Aug-17	MONRE	
287	Nepal	Flood	16-Aug-17	ICIMOD	*Not escalation via Sentinel Asia*
288	Bangladesh	Flood	24-Aug-17	Department of Disaster Management	*Not escalation via Sentinel Asia*
297	Vietnam	Flood	6-Nov-17	MONRE	*Not escalation via Sentinel Asia*
298	Korea	Earthqueke	17-Nov-17	NDMI	*Not escalation via Sentinel Asia*

5.   Communication and Conferences

5.1.   Conferences

5.1.1.   Asia-Pacific Regional Space Agency Forum (APRSAF-24), Bengaluru, India

Organizer: Department of Space (DOS) India, Indian Space Research Organization (ISRO), Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT), and Japan Aerospace Exploration Agency (JAXA)

Date: 14 - 17 November 2017

Venue: Sheraton Grand Bangalore Hotel at Brigade Gateway

Number of Participants: 539 participants from 31 countries and regions, and ten international organizations

Photo 4: Group Photo

(https://www.aprsaf.org/annual_meetings/aprsaf24/meeting_details.php)

APRSAF has four working groups: (i) the Space Applications Working Group (SAWG); (ii) the Space Technology Working Group (STWG); (iii) the Space Environment Utilization Working Group (SEUWG); and (iv) the Space Education Working Group (SEWG).

Sentinel Asia had a session in the Space Applications Working Group (SAWG) on 15 November. Several members of Sentinel Asia gave a report on their latest activities.

5.1.2.   Asian Conference on Disaster Reduction (ACDR2017), Baku, Azerbaijan

ACDR2017 was jointly organized by the Government of Azerbaijan, the Government of Japan and the Asian Disaster Reduction Center, ADRC from 2 to 3 October, 2017 in Baku, Azerbaijan. One session, "Advanced Technologies facilitating DRR and CCA", was held at this conference, where JAXA and RESTEC gave a report on applying space-based technology, including the application of remote sensing and web-based GIS technologies, regarding Sentinel Asia.

Photo 5: Group Photo

5.1.3.   World Bosai Forum, Sendai, Japan

World Bosai Forum 2017 was held in Sendai from 25 to 28 November, 2017. JAXA participated in a session entitled "A Synergy Framework for the Integration of Earth Observation Technologies into Disaster Risk Reduction". The report consisted of a range of notable practices that included provided satellite imagery and analyzed data on past emergency observation requests. There was also a topic that provided an explanation about Sentinel Asia's Step-3 policy, which focuses on linkage with the Sendai Framework for Disaster Risk Reduction.

5.2. Communication

5.2.1. Press Releases and Articles

The secretariat of SA publishes a monthly newsletter for member organizations. The following are the topics covered by the newsletters issued in 2017.

<u>January 2017</u>

1. [News] Emergency Observation of Disaster Occurred in January 2017

2. [Announcement] Preparing Flood in Your Area

3. [Announcement] Regional Server of Sentinel Asia Step2 System

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Events]

<u>February 2017</u>

1. [News] Emergency Observation of Disaster Occurred in February 2017

2. [Announcement] Sentinel Asia 10th Anniversary and JPTM2017 was Successfully Held

3. [Announcement] Termination of the Operation of the Regional Servers and WINDS

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Events]

<u>March 2017</u>

1. [News] Emergency Observation of Disaster Occurred in March 2017

2. [Announcement] Survey on International Disaster Charter

3. [Announcement] Termination of the Operation of the Regional Servers and WINDS

4. [Announcement] Emergency Observation Request (EOR)

5. [Announcement] Requests to JPT Members

6. [Events]

<u>April 2017</u>

1. [News] Emergency Observation of Disaster Occurred in April 2017

2. [Announcement] Termination of the Operation of the Regional Servers and WINDS

3. [Announcement] Password Change: Sentinel Asia Step2 System, 22 June 2017

4. [Announcement] JAXA's P-Tree System

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Requests to JPT Members

7. [Events]

May 2017

1. [News] Emergency Observation of Disaster Occurred in May 2017

2. [News] New Member of Joint Project Team (JPT)

3. [New] Sri Lanka Floods: "Emergency Response Data Viewer"

4. [Announcement] User Password Changed: Sentinel Asia Step2 System

5. [Announcement] Termination of the Operation of the Regional Servers and WINDS

6. [Announcement] Result of EOR Web-based Questionnaire

7. [Announcement] Requests to JPT Members

8. [Events]

June 2017

1. [News] Emergency Observation of Disaster Occurred in June 2017

2. [News] New Member of Joint Project Team (JPT) as a Data Provider Node (DPN)

3. [Announcement] Sentinel Asia Implementation Training (SAIT) from 10 to 17 July 2017

4. [Announcement] Termination of the Operation of the Regional Servers and WINDS

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Requests to JPT Members

7. [Events]

July 2017

1. [News] Emergency Observation of Disaster Occurred in July 2017

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

3. [Announcement] "GSMaP RIKEN Nowcast" is Now Available

4. [Announcement] Sentinel Asia Implementation Training (SAIT) was Successfully Completed

5. [Announcement] Termination of the Operation of the Regional Servers and WINDS

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Requests to JPT Members

8. [Events]

<u>August 2017</u>

1. [News] Emergency Observation of Disaster Occurred in August 2017

2. [News] FORMOSAT-5 was Successfully Launched

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

4. [Announcement] Termination of the Operation of the Regional Servers and WINDS

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Requests to JPT Members

7. [Events]

<u>September 2017</u>

1. [News] Emergency Observation of Disaster Occurred in September 2017

2. [News] New Member of Joint Project Team (JPT) as a Data Analysis Node (DAN)

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

4. [Announcement] Termination of the Operation of the Regional Servers and WINDS

5. [Announcement] Emergency Observation Request (EOR)

6. [Announcement] Requests to JPT Members

7. [Events]

<u>October 2017</u>

1. [News] Emergency Observation of Disaster Occurred in October 2017

2. [Announcement] Result of the APRSAF24

3. [Announcement] Result of the SC joint mission to MBRSC (photo attached)

4. [Announcement] AOGS2018

5. [Announcement] Password Change: Sentinel Asia Step2 System, 19 December 2017

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

7. [Announcement] Termination of the Operation of the Regional Servers and WINDS

8. [Announcement] Emergency Observation Request (EOR)

9. [Announcement] Requests to JPT Members

10. [Events]

November 2017

1. [News] Emergency Observation of Disaster Occurred in November 2017

2. [Announcement] User Password Changed: Sentinel Asia Step2 System

3. [Announcement] JPTM2018, 22 – 24 January, 2018

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

5. [Announcement] Termination of the Operation of the Regional Servers and WINDS

6. [Announcement] Emergency Observation Request (EOR)

7. [Announcement] Requests to JPT Members

8. [Events]

December 2017

1. [News] Emergency Observation of Disaster Occurred in December 2017

2. [Announcement] New International Service Himawari Request

3. [Announcement] JPTM2018 was Successfully Held

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] Termination of the Operation of the Regional Servers and WINDS

7. [Announcement] Emergency Observation Request (EOR)

8. [Announcement] Requests to JPT Members

9. [Information] Regional Workshop on "Near Real Time Flood Monitoring Service"

10. [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 2017 the total number of natural disasters (excluding drought and snow hazards) collected by ADRC was 54. 14 of these disasters were covered by SA (25.9%).
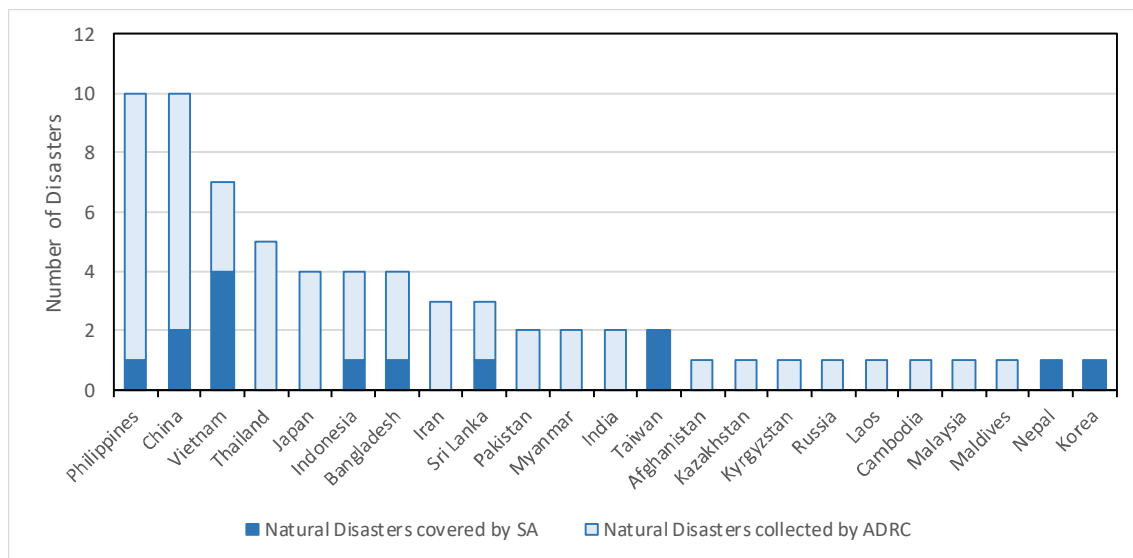
Figure 19: Breakdown by countries of major natural disasters collected by ADRC in 2017. Dark blue indicates disasters covered by SA.

6.2.   Analysis of Operational Performance

Figure 20 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 2017.
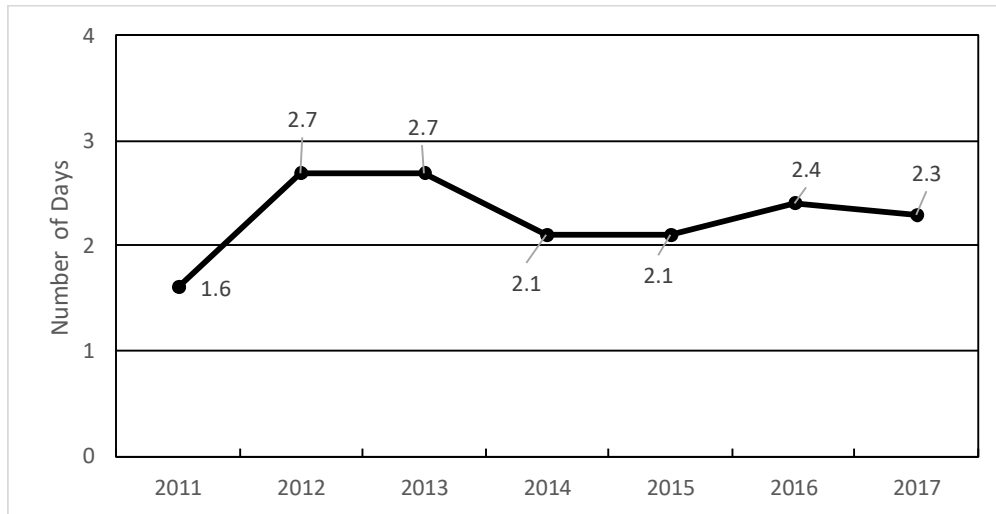
Figure 20: Number of Days Required from Disaster Occurrence to Request

Figure 21 shows the number of days that were required from the date the request is received to activation. Overall, it took an average of 0.8 days from request to activation for the period between 2011 and 2017.
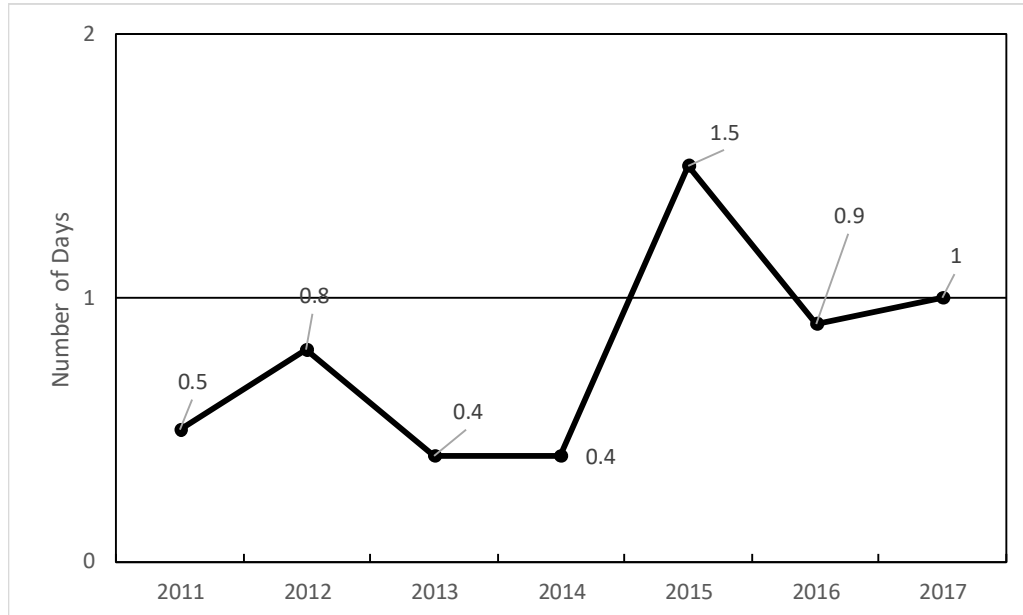
Figure 21: Number of Days Required from Request to Activation

Figure 22 to Figure 24 indicate the average number of days required to provide each data for each year, and the percentage of completed data provisions. Figure 22's Archive Satellite Data indicates that the percentage of provisions declined from 2015, totaling

33

62.1% in 2017, while the average number of days required for provision was 3.9 days.
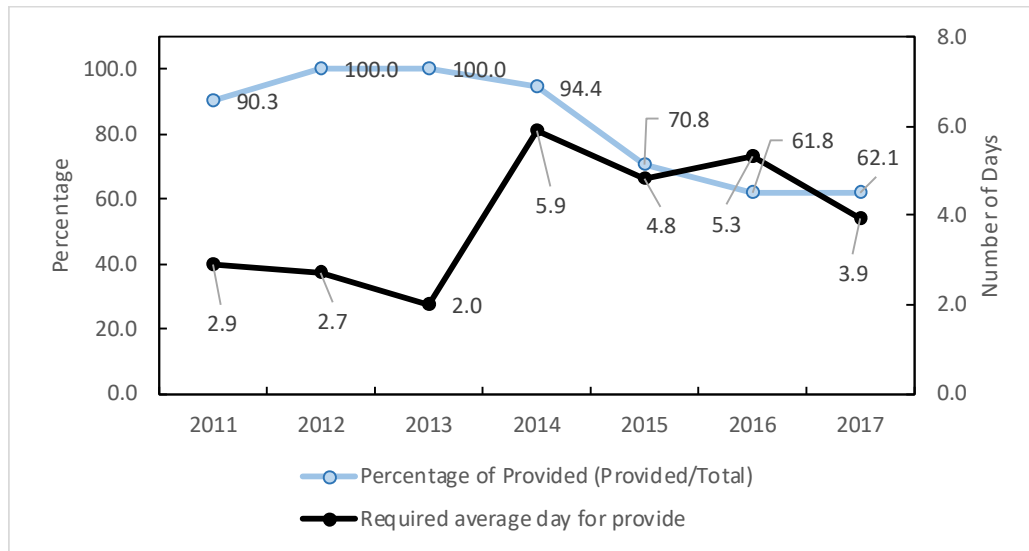
Figure 22: Average Number of Days Required to Provide Archive Satellite Data and Response Rate for Each Year

Figure 23'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 3.5 days over the past 3 years, from 2015 to 2017.
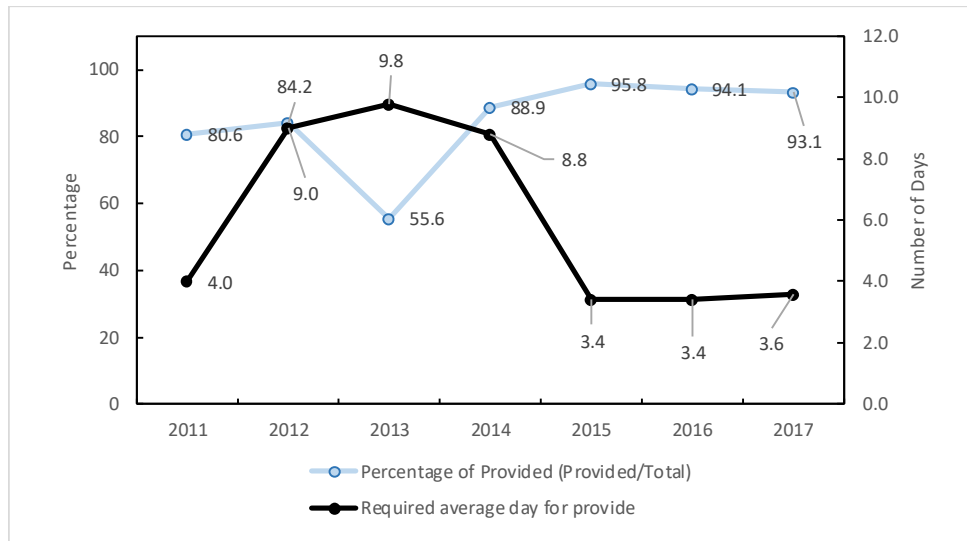
Figure 23: Average Number of Days Required to Provide Satellite Data After Disaster and Activation Rate for Each Year

Figure 24's products were 82.8% in 2017. It was an improvement over 2016's 73.5%, and the average number of days required for provision was 4.7 days – the shortest so far.
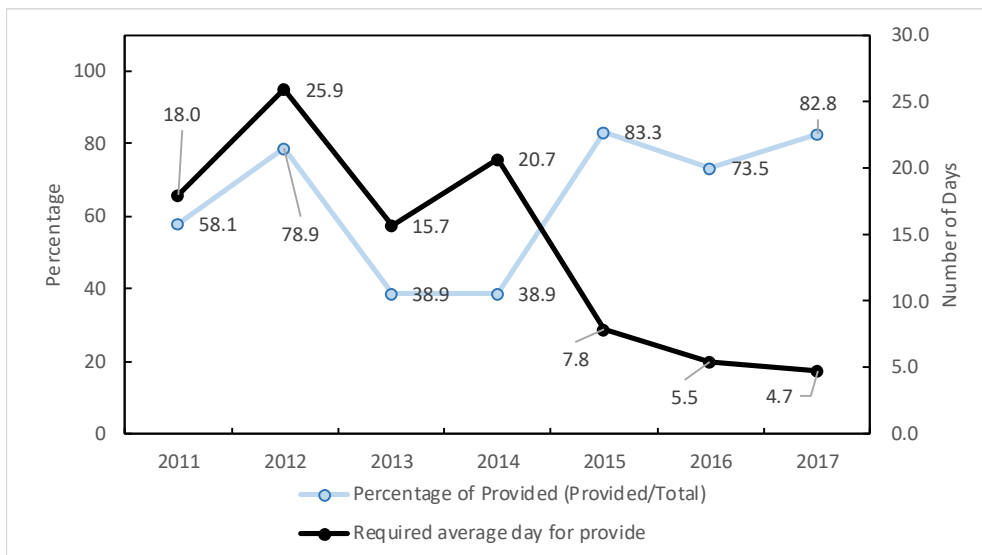
Figure 24: Average Number of Days Required to Provide Products and Activation Rate for Each Year

7. Conclusions

Since the start of 2007, we have conducted emergency observation activities for 302 natural disasters, and five organizations joined SA as new members during 2017. The number of participating institutions in the initiative has now reached 108.

We feel that it is necessary to continue to make gradual progress in the following matters discussed at APRSAF in India, toward the future development of SA.

- Encourage the establishment of a new Web-GIS system for rapid observation and sharing of analyzed information;
- Encourage the establishment of a new EOR system, named "OPTEMIS", to provide an easier way to make a request;
- Promote the development of a Standard Operation Procedure (SOP) for Sentinel Asia in Thailand, Vietnam and Myanmar;
- Encourage continuous active discussions in the Sentinel Asia Steering Committee towards the sustainable and autonomous operation of Sentinel Asia.

List of Emergency Observation Request by each country

Number of EOR (by year)

Country	Request	Activation	Rejection	Percentage of Activation	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Indonesia	47	40	7	85.1	7	2	5	9	2	4	2	4	2	7	3	47
Philippine	31	29	2	93.5	1	1	6	1	4	4	3	1	2	4	4	31
Vietnam	37	32	5	86.5	2	2	4	7	2	1	2		2	3	12	37
Japan	17	17	0	100.0		2		1	4	1	3	3	2	1		17
Nepal	19	19	0	100.0	1	2	2	1	2	1	1	1	4	2	2	19
India	17	14	3	82.4			1	4	3	1	2	2	1	2	1	17
Pakistan	12	8	4	66.7	1	2		3	1	1	1		2	2		12
Thailand	11	9	2	81.8	2	3		1	2	1	1				1	11
Taiwan	13	13	0	100.0				2	1				2	5	3	13
Myanmar	10	9	1	90.0		1			2		1		2	4		10
Sri Lanka	10	9	1	90.0			1	2	2	1		1	1	1	1	10
China	10	8	2	80.0		2		1	1	2	1	1			2	10
Tajikistan	7	7	0	100.0	1			2	1	1		1	1			7
Bangladesh	9	9	0	100.0	3			1	2				1	2	2	9
Kazakhstan	6	4	2	66.7				1	2	3		1				6
Bhutan	6	4	2	66.7			2	2	1	1		1	2	1		6
Mongolia	6	0	6	0.0	1		2	2	1							6
Australia	5	5	0	100.0		1	3		1							5
Kyrgyzstan	5	2	3	40.0				1	3	1						5
Brunei	5	3	2	60.0					3	1		1				5
Cambodia	3	3	0	100.0				2	1							3
Solomon	3	3	0	100.0	1						1	1				3
Malaysia	3	3	0	100.0							2	1				3
Fiji	2	2	0	100.0						1				1		2
Lao PDR	2	2	0	100.0		1						1		1		2
Afghanistan	1	0	1	0.0								1				1
Tonga	1	1	0	100.0					1							1
New Zealand	1	1	0	100.0					1							1
Korea	1	1	0	100.0											1	1
Vanuatu	1	1	0	100.0									1			1
PNG	1	1	0	100.0						1						1
Total	302	259	43	-	20	19	24	43	39	25	20	19	25	36	32	302

Number of EOR (by each disaster)

Country	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	16	34.0	8	17.0	4	8.5			2	4.3	12	25.5					5	10.6
Philippine	11	35.5	4	12.9			9	29.0	1	3.2	1	3.2	2	6.5			3	9.7
Vietnam	29	78.4	0	0.0			4	10.8	1	2.7					2	5.4	1	2.7
Japan	9	52.9	4	23.5	2	11.8					2	11.8						
Nepal	12	63.2	2	10.5	2	10.5			1	5.3							2	10.5
India	10	58.8	1	5.9			1	5.9	1	5.9			1	5.9			3	17.6
Pakistan	5	41.7	2	16.7	4	33.3											1	8.3
Thailand	10	90.9	1	9.1														
Taiwan	3	23.1	1	7.7	1	7.7	6	46.2							1	7.7	1	7.7
Myanmar	5	50.0	3	30.0	1	10.0							1	10.0				
Sri Lanka	8	80.0			1	10.0							1	10.0				
China	2	20.0	4	40.0	3	30.0			1	10.0								
Tajikistan	4	57.1	1	14.3	1	14.3											1	14.3
Bangladesh	5	55.6			2	22.2							2	22.2				
Kazakhstan	3	50.0							2	33.3							1	16.7
Bhutan	3	50.0							3	50.0								
Mongolia	2	33.3							3	50.0							1	16.7
Australia	3	60.0					1	20.0	1	20.0								
Kyrgyzstan	1	20.0	1	20.0	1	20.0											2	40.0
Brunei	4	80.0													1	20.0		
Cambodia	3	100.0																
Solomon	1	33.3	1	33.3													1	33.3
Malaysia	2	66.7							1	33.3								
Fiji	1	50.0											1	50.0				
Lao PDR	1	50.0	1	50.0														
Afghanistan	1	100.0																
Tonga													1	100.0				
New Zealand			1	100.0														
Korea			1	100.0														
Vanuatu													1	100.0				
PNG					1	100.0												
Total	154	-	35	-	23	-	21	-	17	-	15	-	10	-	4	-	23	-

List of JPT Members

(89 organizations from 28 countries/regions and 15 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		✔

		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		✔
11	Japan	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)	✔	✔
14	Kyrgyz	45	Central Asian Institute of Applied Geosciences (CAIAG)		✔
15	Lao P.D.R.	46	Ministry of Labor and Social Welfare		
		47	Natural Resources and Environment Institute (NREI), Ministry of Natural Resources and Environment (MONRE)		
16	Malaysia	48	National Security Division, Prime Minister's Department		
		49	Malaysian Remote Sensing Agency (ARSM)		
		50	Malaysian National Space Agency (ANGKASA)		✔
17	Mongolia	51	Information And Research Institute Of Meteorology, Hydrology And Environment (IRIMHE)		
18	Myanmar	52	Department of Meteorology and Hydrology (DMH)		
		53	Relief and Resettlement Department (RRD)		
		54	Myanmar Earthquake Committee (MEC) , Myanmar Engineering Society (MES)		
19	Nepal	55	Survey Department (SD)		
		56	Department of Water Induced Disaster Management (DWIDM), Ministry of Irrigation		
		57	Land Management Training Centre		
		58	Department of Hydrology and Meteorology (DHM), Ministry of Population & Environment		
20	Pakistan	59	Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)		✔
21	Papua New Guinea	60	National Disaster Centre (NDC)		

22	Philippines	61	Office of Civil Defense (OCD), National Disaster Risk Reduction and Management Council (NDRRMC)		
		62	National Mapping and Resource Information Authority (NAMRIA)		✔
		63	Bureau of Soils and Water Management (BSWM), Department of Agriculture		
		64	Mines and Geoscience Bureau (MGB), Department of Environment and Natural Resources		
		65	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)		✔
		66	Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD)		
		67	Philippine Institute of Volcanology and Seismology (PHIVOLCS)		✔
		68	Manila Observatory (MO)		✔
		69	NOAH Center of the University of the Philippines Resilience Institute		✔
23	Singapore	70	Centre for Remote Imaging, Sensing and Processing (CRISP)	✔	✔
		71	Earth Observatory of Singapore (EOS)		✔
24	Sri Lanka	72	Survey Department of Sri Lanka		✔
		73	Ministry of Disaster Management		✔
25	Taiwan	74	National Applied Research Laboratories (NARL)	✔	✔
		75	Center for Space and Remote Sensing Research, National Central University (CSRSR, NCU)		✔
26	Thailand	76	Geo-Informatics and Space Technology Development Agency (GISTDA)	✔	✔
		77	Department of Disaster Prevention and Mitigation (DDPM)		
		78	Department of Water Resources (DWR)		
		79	Royal Forest Department (RFD)		
		80	National Park, Wildlife and Plant Conservation Department		
		81	Royal Irrigation Department (RID)		
		82	Land Development Department (LDD)		
		83	Andaman Environment and Natural Disaster Research Center, Prince of Songkla University (ANED, PSU)		✔
27	United Arab Emirates	84	Mohammed Bin Rashid Space Centre (MBRSC)	✔	✔

28	Vietnam	85	Vietnamese Academy of Science and Technology (VAST)	✔	✔
		86	Ministry of Agriculture and Rural Development (MARD)		
		87	Ministry of Natural Resources and Environment (MONRE)		✔
		88	Cartography Department, Ministry of Defense (MOD)		
		89	Ministry of Science and Technology (MOST)		
29	International Organization	90	Asian Institute of Technology (AIT)		✔
		91	The ASEAN Secretariat		
		92	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)		
		93	United Nations Office for Outer Space Affairs (UNOOSA)		
		94	International Center for Integrated Mountain Development (ICIMOD)		✔
		95	CSIRO Office of Space Science and Applications (COSSA)		
		96	International Centre for Water Hazard and Risk Management (ICHARM)		
		97	Asian Disaster Reduction Center (ADRC)		✔
		98	Secretariat of the Pacific Community (SPC/SOPAC)		✔
		99	The World Bank (WB)		
		100	International Water Management Institute (IWMI)		✔
		101	Asian Development Bank (ADB)		✔
		102	ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre)		
		103	World Wide Fund for Nature (WWF) - Pakistan		
		104	Asian Disaster Preparedness Center (ADPC)		✔
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