



SENTINEL ASIA ANNUAL REPORT 2016

Secretariat of Sentinel Asia



Japan Aerospace Exploration Agency

Sentinel Asia

Annual Report 2016

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List of Emergency Observation Request 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 2016 for the member organizations and external relations.

1.2. Structure of the Document

This report is structured according to the following structure:

Chapter 1 - Introduction

Chapter 2 - Sentinel Asia and Major Disasters; Overview and target disaster event of Sentinel Asia

Chapter 3 - Emergency Observation Operation in 2016; Results of emergency observation activities in 2016

Chapter 4 - External Relations; Explaining 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; Providing an assessment of the overall impact of Sentinel Asia as a service in supporting disaster responses, of system performance, products and services.

Chapter 7 - Conclusions; Outlines the 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 Region 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
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
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	(Bhutan) Ministry of Works and Human Settlement
NARL	National Applied Research Laboratories
NCU	Center for Space and Remote Sensing Research, National Central University
NDMO	(Fiji) National Disaster Management Office
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 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 of large-scale, devastating disasters. Given the high level of population (about 3 billion), and the high frequency and calamity from natural disasters in the region, the 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 calamity, or as a means of managing large-scale natural hazards and disasters. In light of increasing frequency of natural disasters and elevated loss of lives and property from these events, SA, a collaborative, regional project, was conceptualized in 2005 and first began operation in 2007. It is engaged in activities to share and provide disaster-related information including earth observation satellite images via the internet to contribute to disaster management in the Asia-Pacific region. Space agencies of the member countries of the Asia-Pacific Region Space Agency Forum (APRSAF), including the Japan Aerospace Exploration Agency (JAXA), and the 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 July 2016, it consists of 102 member organizations, including 87 agencies from 26 countries/regions and 15 international organizations. JAXA has been serving as a secretariat of the JPT.

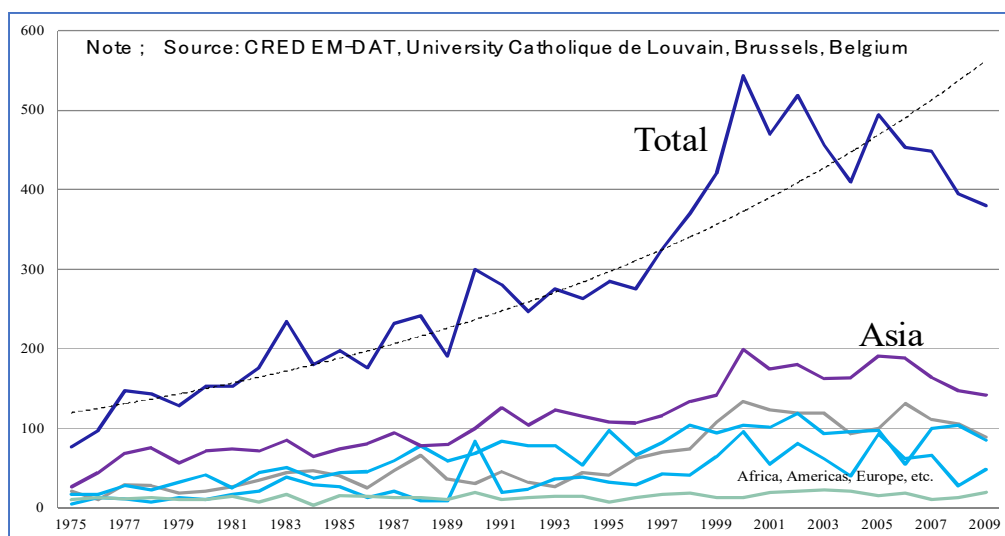


Figure 1 Incidence of natural disasters by region (In and after 1975)

A stepwise approach for implementation of data and information dissemination system 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)

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

During that time, the Sentinel Asia participated in the International Disaster Charter (IDC) in 2010 to expand its activities and cooperation on a global scale. Also, the Sentinel Asia established RSO of UN-SPIDER in 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

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 speed and accuracy of disaster preparedness and early warning systems, and (iii) minimize the number of victims and social, economic losses. To achieve these goals, various activities have been undertaken.

Main activities of the SA are summarized as follows:

- Emergency observation by earth observation satellites (e.g. ALOS, FORMOSAT, IRS, KOMPSAT, THEOS, VNREDSAT and X-SAT) in case of major disasters
- Acceptance of observation requests of major disasters in the Asia-Pacific region from ADRC member organizations and 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 utilization of satellite images for disaster management

The following are 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 extraction of stricken areas, 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) Space Community (APRSAF), (ii) International Community (e.g. UNESCAP, UNOOSA,

ASEAN, AIT) and, (iii) Disaster Reduction Community (ADRC and its member countries) as illustrated in the Figure 2. To promote the activities of SA, the Joint Project Team (JPT) was organized, which is open to all the APRSAF member countries, disaster prevention organizations and regional/international organizations who wish to participate in disaster information sharing activities.

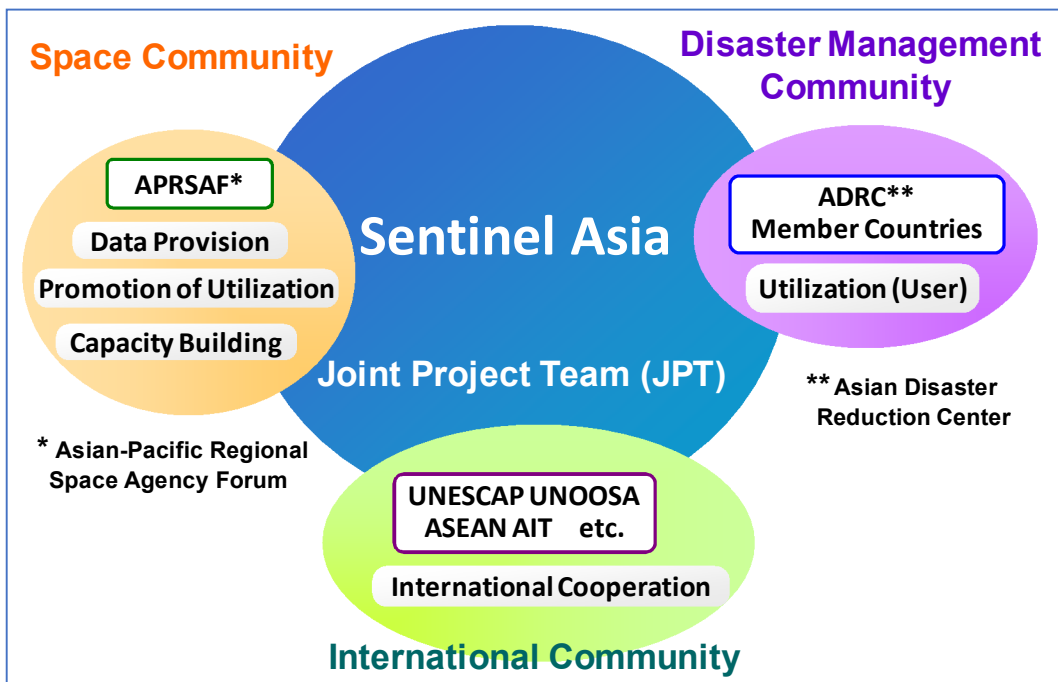


Figure 2 Framework of the Sentinel Asia

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 value added products and uploads and shares the result through the Sentinel Asia System (Figure 3). Between 2006 and 2016, about 270 EORs have been made or accepted, providing data and products to its members to support disaster management. The four WGs work for the establishment and improvement of early warning/forecasting systems, as well as

monitoring and planning for disaster management in their respective fields.

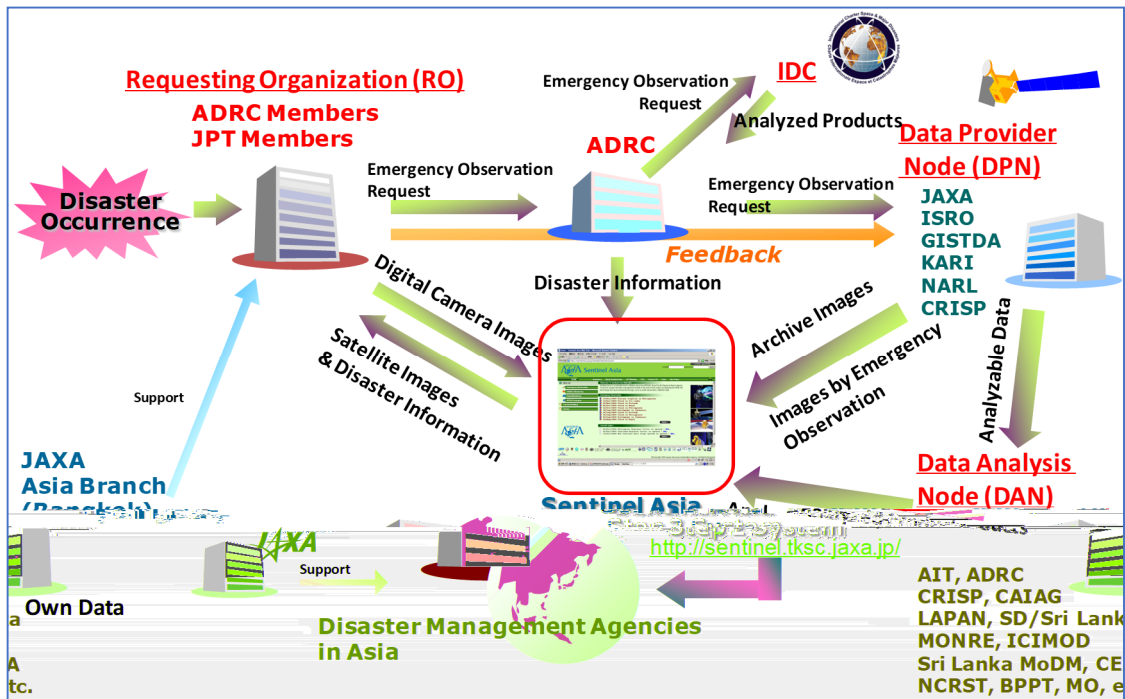


Figure 3 Flow of Sentinel Asia emergency observation

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

Out of three steps employed by Sentinel Asia, Steps 1 and 2 have already been declared as successfully complete. Step 3 began in 2013 with the definition of priority areas based on experiences in the earlier Steps and user requests leading to necessary actions as shown in the Figure 4.

Key features of Step 3 are:

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

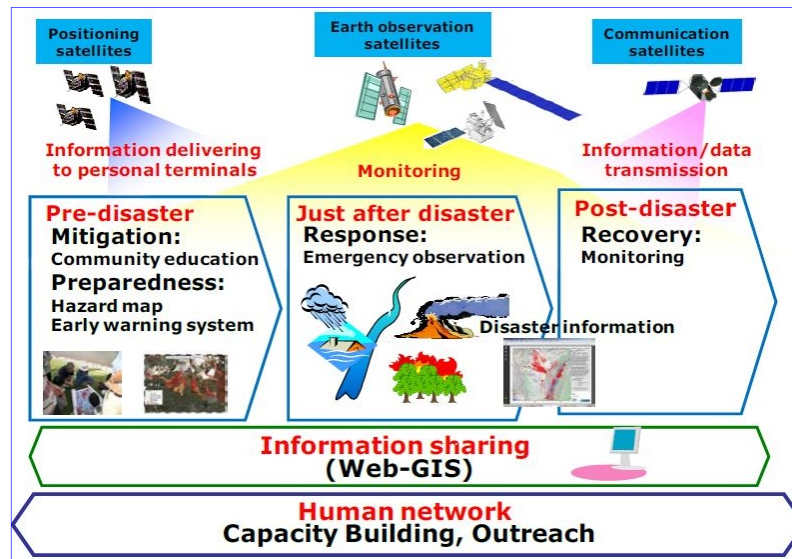


Figure 4 Current phase (Step 3) and actions of Sentinel Asia

2.2. Major Disasters in Emergency Observation (2007-2016)

Figure 5 and Figure 6 present the breakdown of emergency observations with requests and emergency observations with activation by disaster. Table 1 presents the number of requests, activations and rejections for each disaster. Floods represented the largest number of disasters, with 132 requests (48.9%), followed by earthquakes at 31 (11.5%), landslides at 21 (7.8%), typhoons at 20 (7.4%), forest fires and fires at 17 (6.3%), volcanic eruptions at 14 (5.2%), and cyclones at 10 (3.7%).

Generally, activation is made for around 80% to 90% of requests for most disasters, but the activation rate is 41.2% for forest fires and fires only. The reason for this is believed to be because forest fires affect a much broader region than other disasters, making it difficult to obtain accurate information from the disaster-affected areas.

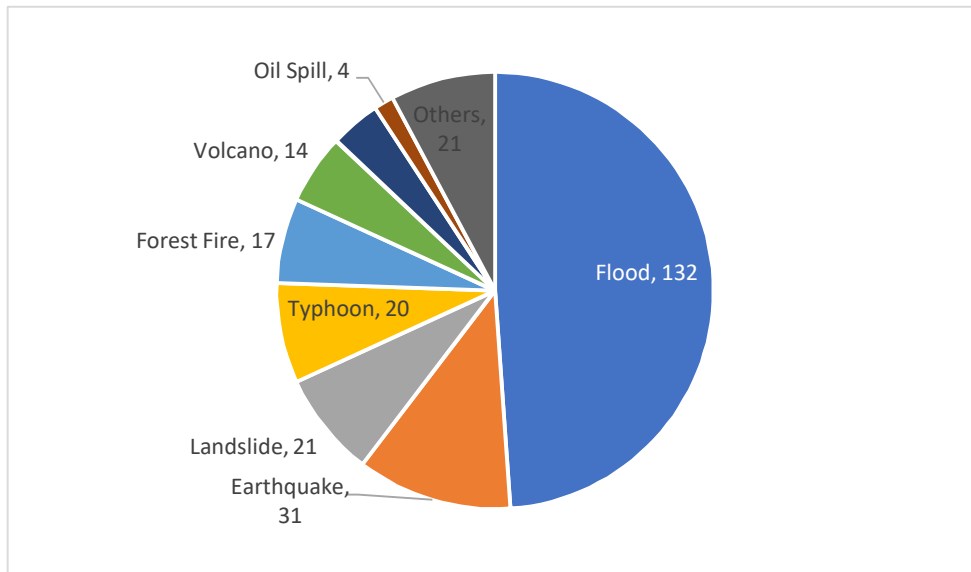


Figure 5 Breakdown of Emergency Observations by Disaster (2007 - 2016)
***Requests (N=270)**

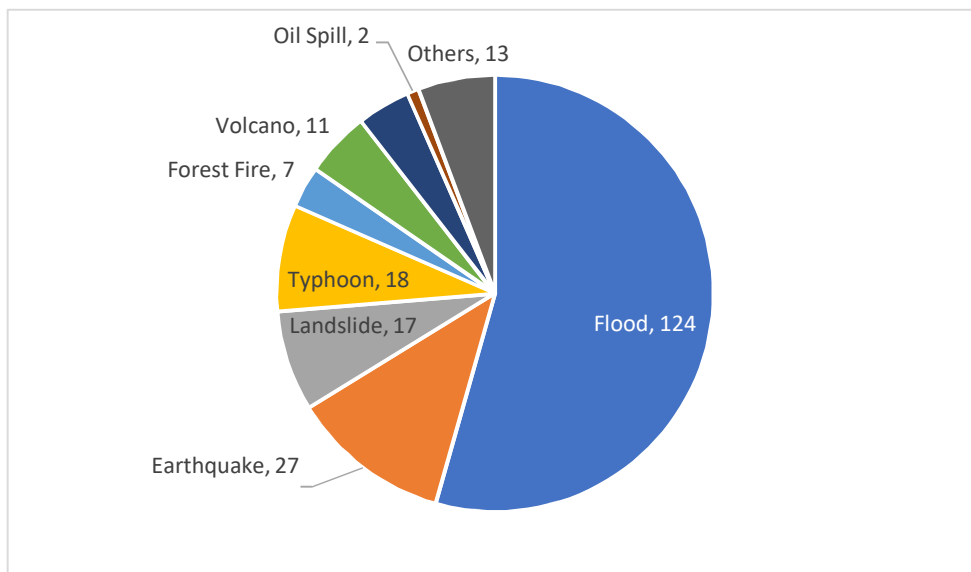


Figure 6 Breakdown of Emergency Observations by Disaster (2007 - 2016)
***Activations (N=228)**

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	132	124	8	93.9%
Earthquake	31	27	4	87.1%
Landslide	21	17	4	81.0%
Typhoon	20	18	2	90.0%
Forest Fire	17	7	10	41.2%
Volcano	14	11	3	78.6%
Cyclone	10	9	1	90.0%
Oil Spill	4	2	2	50.0%
Others	21	13	8	61.9%
Total	270	228	42	

3. Emergency Observation Operation in 2016

3.1. Emergency Observation Requests (EOR)

Figure 7 presents the number of requests, activations and rejections involving emergency observations over the past 10 years from 2007 to 2016. 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. This correlates to the period from the shutdown of ALOS from April 2011 to the launch of ALOS 2 in May 2014.

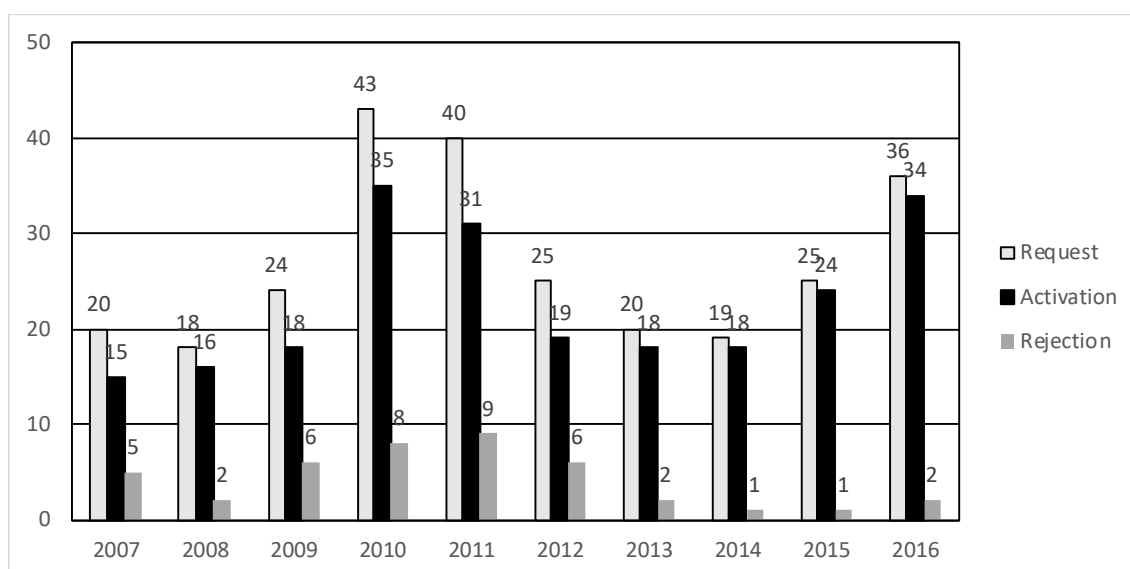


Figure 7 Comparison of the Number of Requests, Activations and Rejections for Emergency

All 2016 activations are listed in Table 2. In total, 36 requests were received in 2016. The following two requests were rejected due to a failure to keep in contact after the request was made.

- Activation No. 243, Country [Vietnam], Disaster type [Drought]
- Activation No. 244, Country [Myanmar], Disaster type [Earthquake]

Figure 8 and Figure 9 present the 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 12 requests (33.3%), followed by earthquakes at 5 (13.9%), landslides at 3 (8.3%), typhoons at 4 (11.1%), forest fires and fires at 1 (2.8%), volcanic eruptions at 1 (2.8%), cyclones at 4 (11.1%) and oil spill at 1 (2.8%).

Table 2 List of 2016 Activations

Activation Number	Country	Disaster Type	Activation Date	Requester
235	Taiwan	Earthquake	Feb-16	NARL
236	Myanmar	Flood	Feb-16	DMH
237	Fiji	Cyclone	Feb-16	NDMO
238	Indonesia	Flood	Mar-16	LAPAN
239	Indonesia	Flood	Mar-16	LAPAN
240	Taiwan	Oil spill	Apr-16	NARL
241	Philippines	Forest Fire	Apr-16	University of the Philippines
242	Pakistan	Landslide	Apr-16	SUPARCO
245	Pakistan	Landslide	Apr-16	SUPARCO
246	Japan	Earthquake	Apr-16	ADRC
247	Sri Lanka	Flood	May-16	IWMI
248	Indonesia	Volcanic Eruption	May-16	LAPAN
249	Bangladesh	Cyclone	May-16	SPARSSO
250	Indonesia	Landslide, Flood	Jun-16	LAPAN
251	Nepal	Flood, etc	Jul-16	Department of Hydrology and Meteorology
252	Taiwan	Typhoon	Jul-16	NARL
253	Bangladesh	Flood	Aug-16	SPARSSO
254	Bhutan	Flood	Aug-16	MOWHS(BT)
255	Myanmar	Flood	Aug-16	RRD
256	Laos	Flash Flood	Aug-16	UNESCAP / Ministry of Science and Technology
257	India	Flood	Aug-16	IWMI
258	Myanmar	Earthquake	Aug-16	MEC
259	Taiwan	Typhoon	Sep-16	NARL
260	Philippines	Tropical cyclone	Sep-16	PHIVOLCS
261	Indonesia	Landslide	Sep-16	LAPAN
262	Indonesia	Flash Flood	Sep-16	LAPAN
263	Taiwan	Typhoon	Sep-16	NARL
264	Vietnam	Flood	Oct-16	MONRE
265	Philippines	Typhoon	Oct-16	PAGASA
266	Vietnam	Flood	Nov-16	MARD, DMC(Vietnam)
267	Indonesia	Earthquake	Dec-16	LAPAN
268	India	Cyclone	Dec-16	ISRO
269	Nepal	Flash Flood	Dec-16	Department of Hydrology and Meteorology, Nepal
270	Philippines	Other	Dec-16	PHIVOLCS

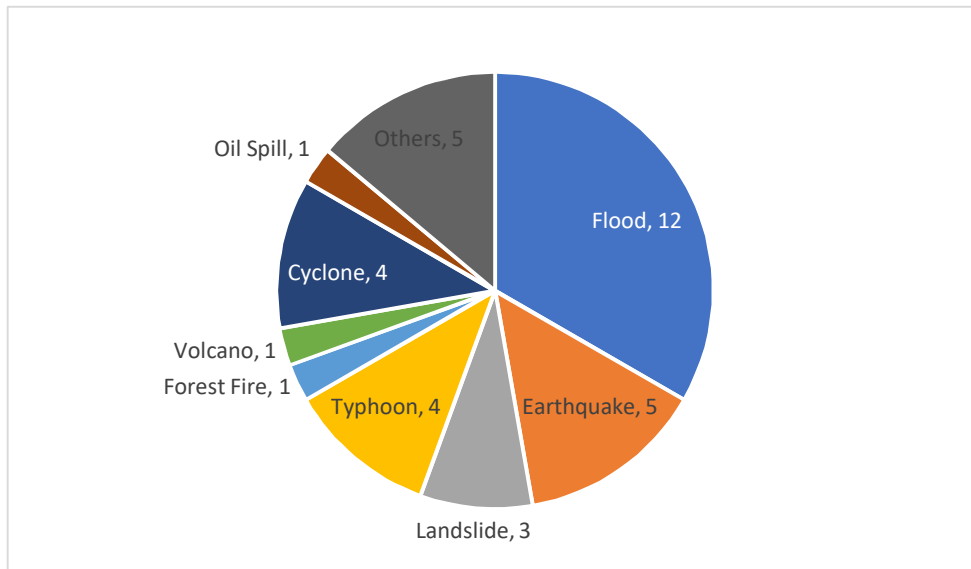


Figure 8 Breakdown of Emergency Observations by Disaster *Requests in 2016

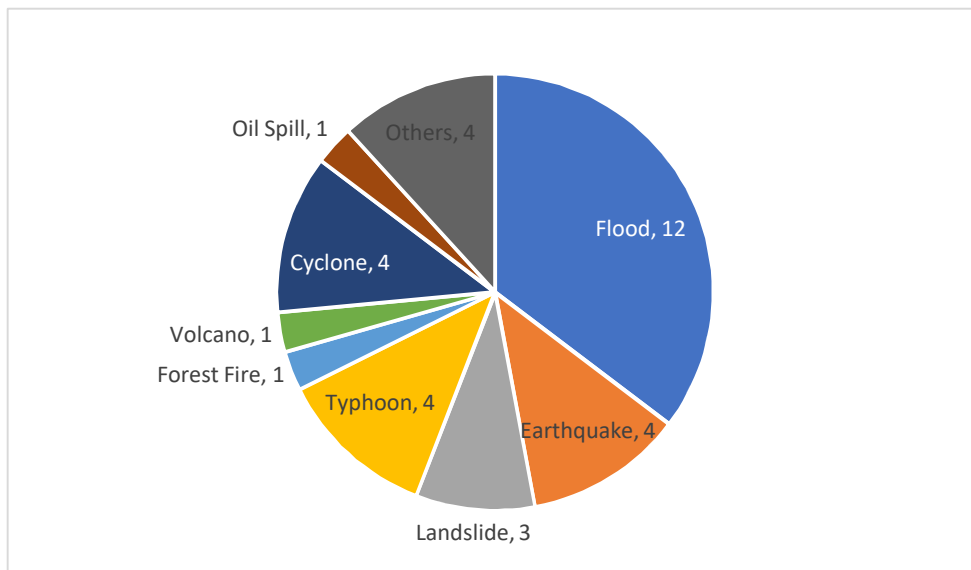


Figure 9 Breakdown of Emergency Observations by Disaster *Activations in 2016

3.2. Results of Emergency Observation

During 2016, the monthly average of activations was 2.8. Figure 10 shows the monthly distribution of activations throughout 2016. The highest number of activations occurred in April, August, and September corresponding to 47% of the total number. The remaining months of 2016 saw the number of activations vary from 0 to 4. Most of the activations in August and September were caused by water disasters such as floods and

typhoons.

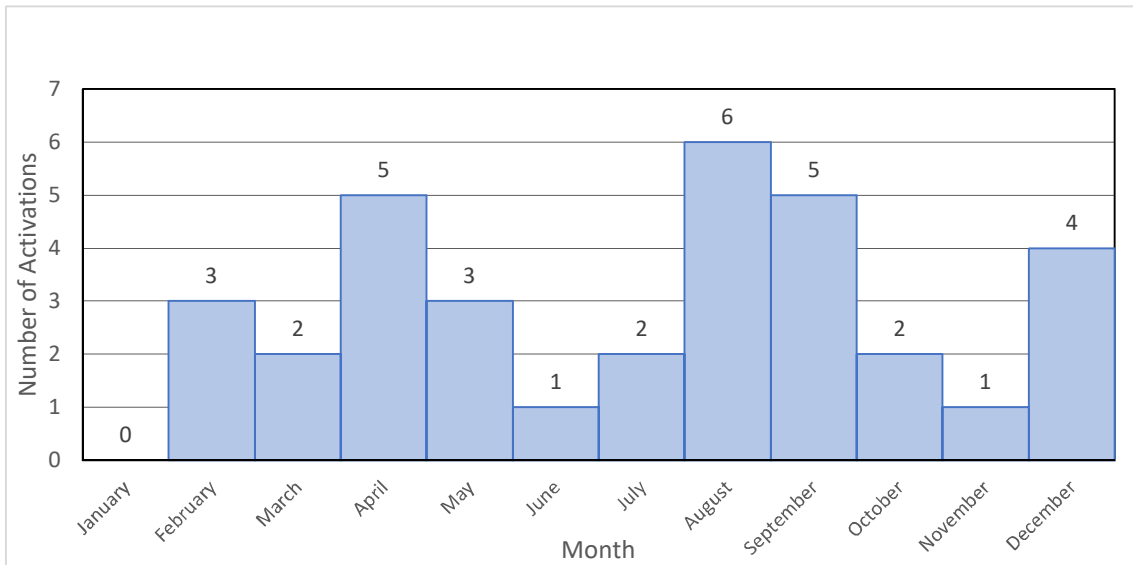


Figure 10 Number of monthly activations in 2016

Figure 11 presents the number of emergency observations by country. Countries and regions with a large number of requests are mostly located in Southeast Asia, including Indonesia, Taiwan, the Philippines and Myanmar.

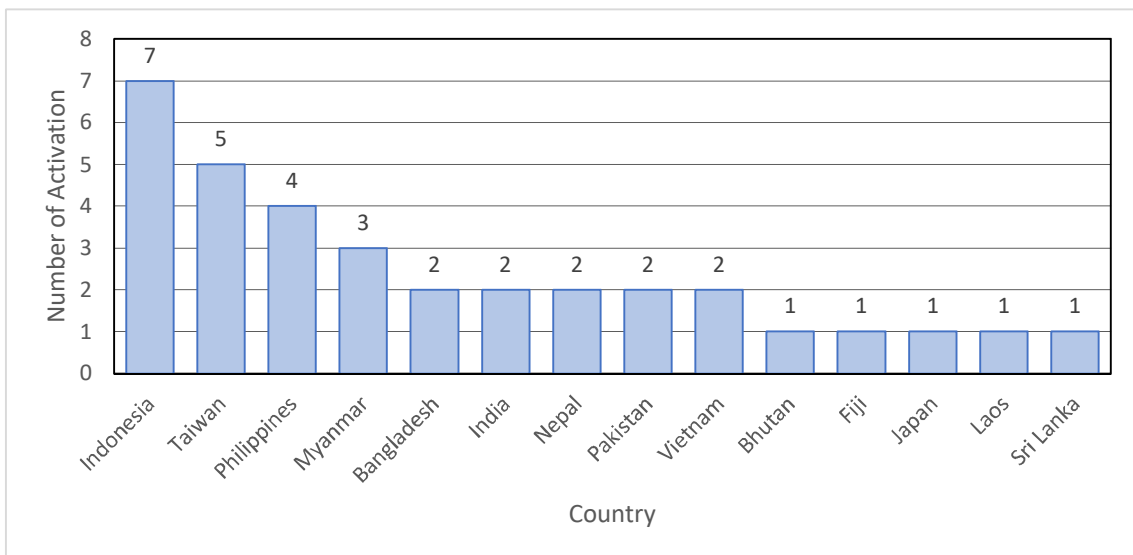


Figure 11 Number of activations by country in 2016

Figure 12 presents the number of implementations by DPN. In total, 81 were implemented in 2016, satellite data was provided to the requestors. The highest number

of implementations occupied by JAXA, ISRO and GISTDA corresponded to 86 % of the total number.

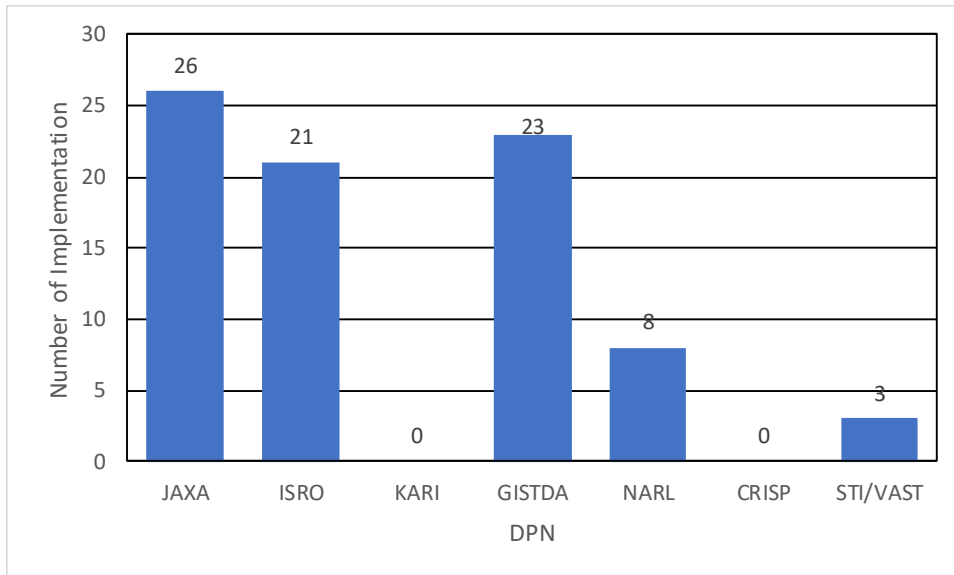


Figure 12 Number of responses by DPN in 2016

Figure 13 presents the number of optical and radar data by DPN. In 2016, a total of 2,317 were provided by DPN members. The breakdown of this total is archive data at 256 and new acquisition data at 2,061. GISTDA, NARL, JAXA and ISRO account for the majority of the data.

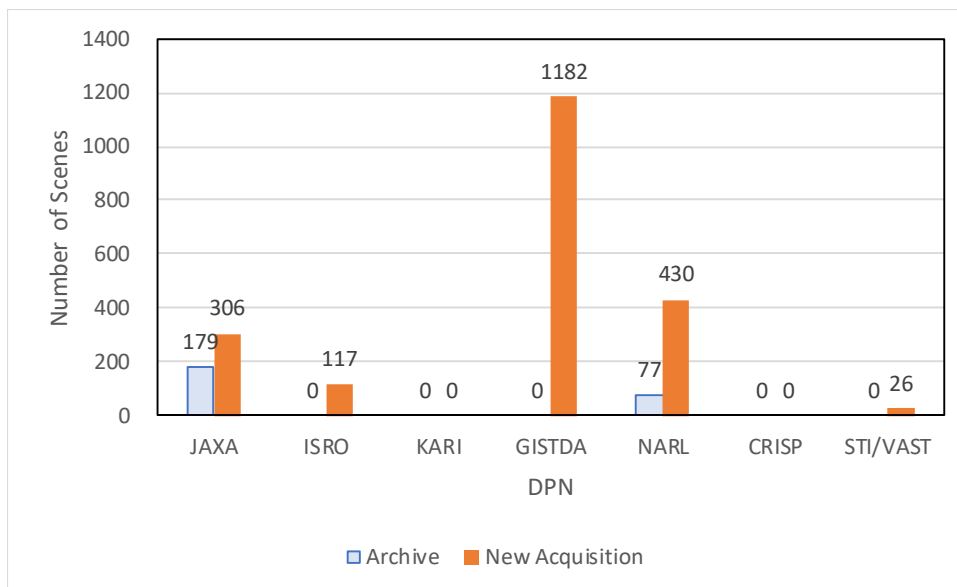


Figure 13 Data consumption (Archive and New Acquisition) by DPN in 2016

Figure 14 presents the number of implementations by DAN. In total, 51 were implemented in 2016, with archive data and analyzed products provided to the requestors. The ranks for the highest number of implementations were occupied by AIT and JAXA, corresponding to 69% of the total number.

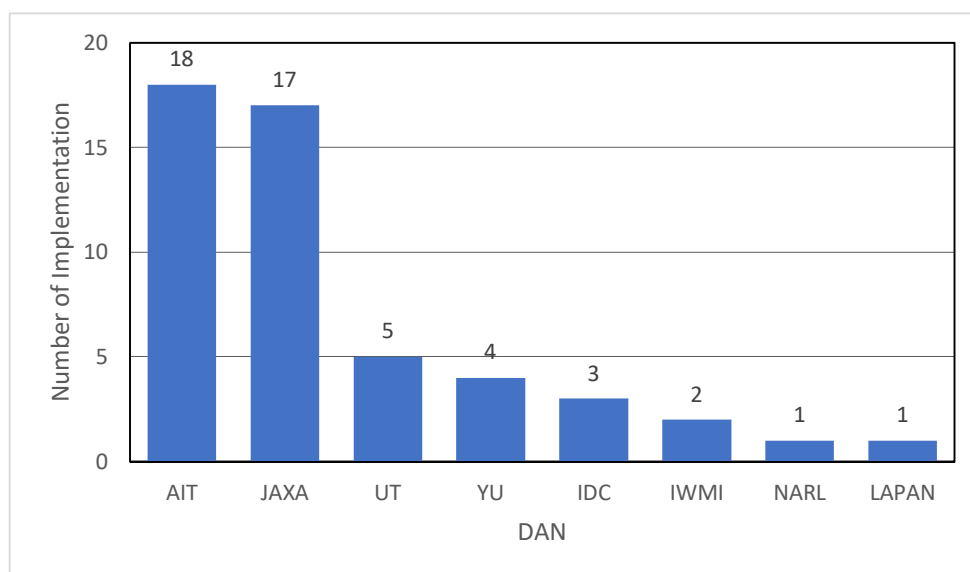


Figure 14 Number of responses by DAN in 2016

3.3. Good Practice Flood in 2016 (Sri Lanka)-

Following the devastating floods and landslides in May 2016, SA received (and accepted) EOR from IWMI, Colombo. Below is a brief description of the event and a good example of our collaborative work (data and information sharing) to support the Sri Lankan Government's efforts for disaster management.

On 15 May 2016, Sri Lanka was hit hard by a powerful tropical storm that caused widespread floods and landslides in 22 of the 25 districts in the country, destroying hundreds of homes and submerging entire villages (UNOCHA, 26 May 2016). At least 104 people were known to have died and 99 people were missing, the majority due to a landslide in Aranayake, Kegalle District, which destroyed three villages. An estimated 301,602 people had been affected by the disaster, including at least 21,484 people who were displaced from their homes.

In response, SA provided a large number of satellite images and map products: at least three pre-disaster and 122 post-disaster images, and 40 analyzed products. Figure 16 and Figure 17 show such an example of the satellite imagery and analyzed products provided.



Figure 15 Flooding in May 2016 (Photograph credit: DMC)

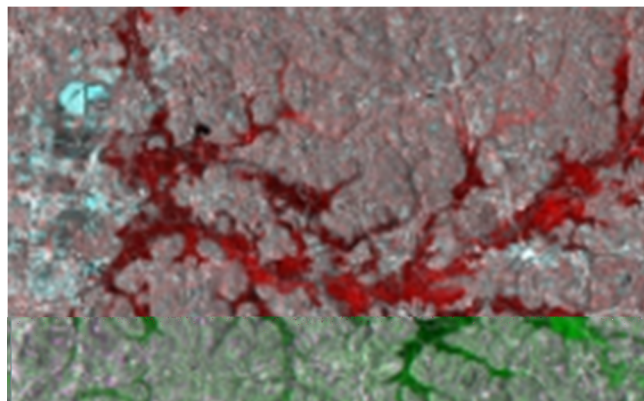


Figure 16 A part of a post-disaster satellite image (Terra SAR-X taken on 19 May 2016) depicting possible flood areas (in red)

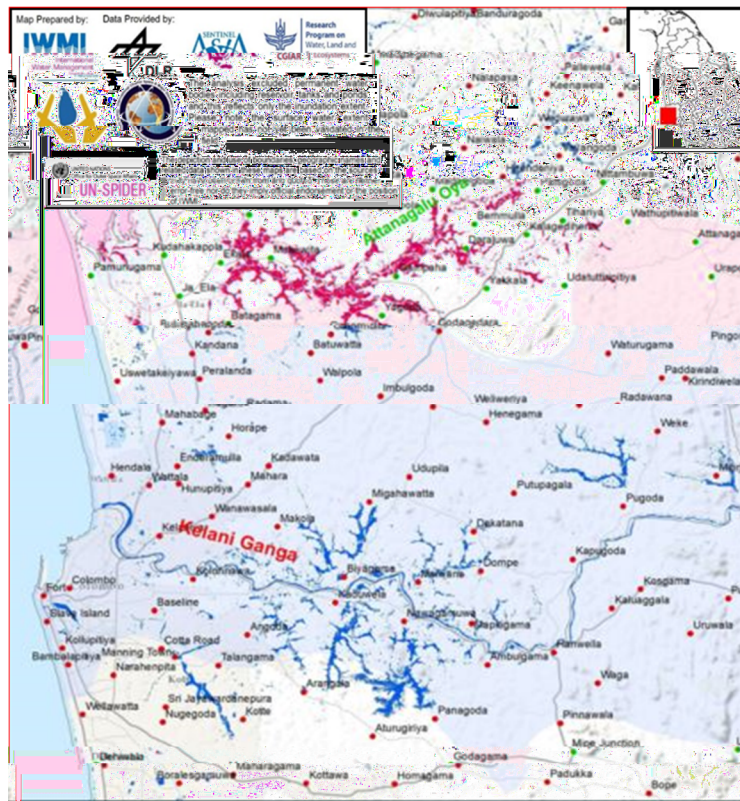


Figure 17 Map product depicting possible flood areas (in blue)

The DMC and IWMI officers said that the data and map products had been very useful for/during rescue and recovery operations, assessing the damaged areas, and advocacy to donors for assistance.

4. External relations

4.1. New Members Accession

In 2016, the following six organizations joined SA.

- Ministry of Works and Human Settlement (MoWHS), Bhutan [JPT]
- Survey for Seismic Protection (SSP), Ministry of Territorial Administration and Emergency Situation, Armenia [JPT]
- Department of Hydrology and Meteorology (DHM), Nepal [JPT]
- Asian Disaster Preparedness Center (ADPC) [DAN]
- National Disaster Centre, Papua New Guinea [JPT]
- National Research Institute for Earth Science and Disaster Resilience (NIED), Japan [JPT]

4.1.1. Asian Disaster Preparedness Center (ADPC)

(1) Outline of organization



Asian Disaster Preparedness Center (ADPC) is an independent regional non-profit organization that works to build the resilience of people and institutions to disasters and the impact of climate change in Asia and the Pacific.

Established in 1986 as a technical capacity building center, ADPC has grown and diversified its expertise across social and physical sciences to support sustainable solutions for risk reduction and risk management across a broad range of specialist areas. *(Source: ADPC HP)*

(2) Greeting from the Executive Director

Disasters indiscriminately affect all demographic groups in all parts of the globe. Given the rapid economic growth – much of which is not disaster-resilient – as well as its exposure to destructive hydro-meteorological and geological phenomena, such as floods, earthquakes, and tropical storms, Asia and the Pacific is highly vulnerable.



Damage and loss of lives caused by disasters can disrupt national economies and stall social development if countries are not well prepared.

Asian Disaster Preparedness Center (ADPC) promotes evidence-based solutions for disaster risk management. Space-based earth observation technology, as it is becoming more accessible, increasingly plays a major role in providing information needed for disaster risk management. Prior to a disaster, national disaster management organizations can use satellite images and data to understand the disaster and climate risks their countries face. As a disaster event happens, timely and up-to-date information on the disaster help practitioners understand the situation they are facing, guiding them to make informed decisions. Undertaking post-disaster needs assessments is faster and more accurate when guided and supplemented by remote sensing data, making recovery efforts more effective.

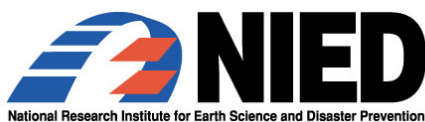
ADPC, as an active Data Analysis Node member of Sentinel Asia, would bring its experience that has been accumulated through working closely with governments to ensure that “useable space-based information” is made available to stakeholders in Asia and the Pacific. Our in-house experts including GIS and remote sensing specialists would stand ready to support Sentinel Asia and countries in preparing for and responding to disasters through space-based earth observation technology, while enhancing their technical capacity sustainably.

Hans Guttman

Executive Director, Asian Disaster Preparedness Center (ADPC)

4.1.2. National Research Institute for Earth Science and Disaster Resilience (NIED)

(1) Outline of organization



National Research Institute for Earth Science and Disaster Resilience (NIED) aims to protect people's lives and properties from natural

disasters and to prepare society to be resilient to natural disasters, through research on disasters caused by earthquakes, volcanoes, floods, landslides, meteorological changes, snow and ice damages. *(Source: NIED HP)*

(2) Greeting from the person in charge

I have been committed to promote the application of space-based technology, data and information products to disaster risk reduction operations through Sentinel Asia from its launching stage. The damage assessment information of affected areas is very critical for early stage response operations through the effective allocation of rescue resources. I believe Sentinel Asia is a very practical tool for the disaster management organizations in Asia and the Pacific by supporting their information based and knowledge based operations.



After its launch, Sentinel Asia has been evolving and expanding its operations. Now in Step 3, its operational coverage includes all disaster management phases, including emergency response, rehabilitation, recovery and preparedness. The system increased its capacity for strategic operations with the Steering Committee and they organized three Steering Committee meetings to discuss the Strategic Plan 2017-2027, which will be reported in the Joint Project Team Meeting in Taipei 2018.

One of the important aspects of the Strategic Plan is to enhance the initiatives of the participating organizations to promote their committed initiatives and projects for Sentinel Asia. Some of the participating organizations will be identified as leading agencies. In the Step 3 phase of Sentinel Asia, it is tasked to be more committed to the Sendai Framework for Disaster Risk Reduction 2015-2030, and to promote more communication and collaboration with international and regional organizations and donors.

It is a great honor to serve as a Co-Chair of the Sentinel Asia Steering Committee to advance its operations for disaster risk reduction in Asia and the Pacific.

Koji Suzuki,

Co-Chair, Steering Committee of Sentinel Asia

Executive Director, National Research Institute for Earth Science and Disaster Resilience

4.2. Collaboration and Cooperation with Other Organizations

The rollout to IDC began in February 2010 as necessary.

In 2016, ten disasters were escalated to Charter. Excluding escalations via other institutions, six disasters were escalated through SA. There was one response to an earthquake in Taiwan, one response to a flood in Sri Lanka, one response each to a volcanic eruption and earthquake in Indonesia, and two responses to a cyclone and flood in Bangladesh.

Table 3 List of Charter Escalation in 2016

Activation Number	Country	Disaster Type	Activation Date	Requester	Remarks column
235	Taiwan	Earthquake	Feb-16	NARL	
247	Sri Lanka	Flood	May-16	IWMI	
248	Indonesia	Volcanic Eruption	May-16	LAPAN	
249	Bangladesh	Cyclone	May-16	SPARSSO	
253	Bangladesh	Flood	Aug-16	SPARSSO	
257	India	Flood	Aug-16	IWMI	<i>Not escalation via Sentinel Asia</i>
262	Indonesia	Flash Flood	Sep-16	LAPAN	<i>Not escalation via Sentinel Asia</i>
265	Philippines	Typhoon	Oct-16	PAGASA	<i>Not escalation via Sentinel Asia</i>
267	Indonesia	Earthquake	Dec-16	LAPAN	
268	India	Cyclone	Dec-16	ISRO	<i>Not escalation via Sentinel Asia</i>

5. Communication and Conference

5.1. Conference

5.1.1. Third Joint Project Meeting Team for Sentinel Asia STEP3, Colombo, Sri Lanka, 19-21 Jan 2016

Date: 19 - 21 January 2016

Venue: Mt. Lavinia Hotel

Number of Participants: 70



Inauguration Ceremony

- (1) Major General L.B.R Mark, Director General DMC
- (2) Remark by Mr. Peter G. McCornick, Deputy Director General IWMI
- (3) Remarks by Mr. Michio Ito, Executive Secretariat Sentinel Asia, JAXA
- (4) Address by Mr. S.S. Miyanawala, Secretary of Ministry of Disaster Management
- (5) Key note speech by Dr. Lal Samarakoon, GIC/AIT

He talked about potential and opportunities of the use of space-based technologies for DRR to prevent and reduce hazard exposure and vulnerability to disasters, and to increase preparedness for response and recovery and thus to strengthen resilience. In addition, he also mentioned about IDC, Copernicus and Sentinel Asia related to space technology for emergency.

Session 1: Status Report

- (1) Adoption of agenda introduced by Dr. Giriraj, IWMI, and it is agreed by participants.
- (2) Overview of Sentinel Asia status: Mr. Michio Ito, JAXA
- (3) Dr. Abdul Muhari, MMAF introduced his self as new member of SA.
- (4) Overview of emergency observation: Mr. Makoto Ikeda, ADRC
- (5) Data provider Node (DPN) report
 - Mr. Bo Chen from Narlab mentioned about contribution of FORMOSAT to SA activities since 2010:
 - Dr. Pham Viet Hoa, STI, VAST, also mentioned about contribution of VNREDSat-1

to SA activities and UNESCAP.

(6) Primary Data Analysis Node (P-DAN) report

- Dr. Jagath Rajapaksha, GIC/AIT
- Dr. Masahiko Nagai, UT, Japan,

(7) Asia-Pacific Regional Space Agency Forum (APRSAF) - 22 Report, Mt Masanabu Tsuji, JAXA

Session 2: Sentinel Asia Step 3 Evolution Progress Report

(1) Secretariat report on Sentinel Asia Step 3 progress report: Mr. Takeshi Chiba, JAXA

(2) Term of reference (TOR) of Steering Committee: Ms. Rio Tanabe, JAXA

Session 3: Local Hosts Special Session

(1) Coordinated by DMC & IWMI

- Mr. Srimal Samasiri introduced geospatial information as a decision tool in Sri Lanka through Disaster Management Centre.
- Vladimir Smakhtin, Theme Leader-water availability, Risk and Resilience
- Eng. S. P. C. Sugeshwara, Chief Engineer (RM&DM), Irrigation Department
- Suranga, DRM Expert, World Bank.
- Open Discussion
- Last remark by Mayor General L.B.R. Mark, Director General DMC

Session 4: EOR Activities

(1) Emergency observation request activities report since JPTM2014 (6 events)

- Mr Yuji Takada mentioned about overview observation and explained about some examples of analysis results of EO in some disaster-affected areas.
- Dr. Giriraj Amarnath, IWMI explained about IWMI activities in 2015
- Mr. Sha Mohamma Mizanur, SPARRSO, provided a brief overview of the Bangladesh Space Agency and also mentioned about the disaster situation in Bangladesh.
- Mr. Suwarsono, LAPAN, briefly provided an overview about the Indonesia space agency (LAPAN) and the role of LAPAN in the field of remote sensing in Indonesia.
- Ms. Ma Flordeliza P. DelCastillo, MO, mentioned about the disaster situation in the Philippines, an area mostly concerned with storm disasters and about Manila Observatory activities.

- Mr. Than Zaw, DHM, mentioned about challenges faced by Myanmar on its river forecasting system and also mentioned about some activities for disaster mitigation in Myanmar.

Session 5: Project Management

- (1) Sentinel Asia System Operation, WINDS/Regional Server: Mr. Yuji Takada explained about Sentinel Asia system including data transfer way and speed up of data transfer and also explain access procedure to use SA system.
- (2) Member reports
 - Ms. Vinany Semgtianthrs, MONRE
 - Mr. Li-Yu Chang, NCU
 - Mr. Prasong Thammapala, DDPM
- (3) Others
 - New concept of regional Cooperation in Asia for water disaster management applying satellite precipitation measurement: Mr. Yusuke Muraki, JAXA

Session 6: Mitigation and Preparation

- (1) Capacity Development Activities
 - Sentinel Asia mini project report: Dr. Lal Samarkoon reported about mini project conducted by AIT sponsored by JAXA in regard to capacity building in terms of disaster management
- (2) Sentinel Asia Success Story Project: Ms. Rio Tanabe presented a Sentinel Asia success story in the Philippines in 2015 regarding activities implemented for the landslide warning system.

Session 7: Working Group

- (1) Strategy of working group activities: Mr. Michio Ito, JAXA
- (2) Water related disaster working group: represented by Dr. Giriraj Amarnath, IWMI
- (3) Wildfire Working Group: Dr. Koji Nakau, JAXA
- (4) Tsunami Working Group: Dr. Abdul Muhari, MMAF

Session 8: Emergency Response (IP sec4.3)

- (1) Emergency observation and response procedures: Mr. Makoto Ikeda explained about new format applied to emergency and response procedures, and good examples of EoR requests made by IWMI.

(2) Overview of enforcement of DAN's activities

- A system to enhance the DAN's DRR activities: Dr. Jagath Rajapaksha explained new system of PDAN and DAN.

5.1.2. APRSAF-23, Manila, the Philippine, 15-18 Nov 2016

Date: 15 - 16 November 2016

Venue: Sofitel Philippine Plaza Manila

Number of Participants: 263



APRSAF Activities

- SAFE Initiative Workshop
- Kibo-ABC Initiative Workshop
- New Cooperation Session
- Water Rocket Event and Can Satellite Competition
- Poster Contest
- 8th Multi-GNSS Asia (MGA) Conference
- APRSAF-23 Exhibition

Discussion on SA

(1) Summary Report

- Acknowledged a 10 year celebration of the Sentinel Asia initiative starting from APRSAF-12 (Kitakyushu, Japan) in 2005 with a joint project team since December 2006.
- With 102 organizations, confirm good contributions through 221 activations of

emergency Earth observation satellite operations, contributing to disaster mitigation and capacity development for the use of Earth observation satellite data in Asia-Pacific region.

- Confirm the fruitful progress of an ongoing project (named “Success story project”) to apply satellite based rainfall data (GSMaP) to landslide warning systems, and to validate its utility for local governments of the Philippines in practical operation.

(2) Steering Committee (SC)

- Roll of SC:

The SC is a high-level organization of Sentinel Asia responsible for studying, discussing and making decisions about various issues of Sentinel Asia.

- SC members (13):

DPN - ISRO, GISTDA, NARL, CRISP, VAST, JAXA,

P-DAN - AIT, UT **DMOs** - ADRC, PHIVOLCS

Persons who worked for initiation of Sentinel Asia.

CSIRO, Dr. Alexander Held/Director, NIED, Mr. Koji Suzuki/Executive Director,

Rep. of WGs - IWMI, Dr. Giriraj Amarnath Co-Chair, Water Dis WG

- Secretariat of SC: JAXA
- How to work: e-mail, web-conference, physical meeting
- Target:
 - i. To develop a long-term plan of Sentinel Asia, following the first long-term plan presented at APRSAF-12 in 2005
 - ii. To develop a short-term plan for the Step 3 phase of Sentinel Asia from the viewpoint of joint drive, end-user-oriented, and strategic management (Recommendation of APRSAF-21)

5.2. Press Releases and Articles

5.2.1. Press Releases and Articles

Secretariat of SA publishes monthly newsletter for member organizations. The following is topics of the newsletter issued in 2016.

January 2016

1. News and Announcement

- 1.1 JPTM2016
- 1.2 APRSAF-22
- 1.3 ALOS World Elevation Data
- 1.4 New User ID and Password for web site of Sentinel Asia Step2 System
- 1.5 Regional Server of Sentinel Asia Step2 System
- 1.6 Call for the update information from JPT Members
- 2. Capacity Development Activities
 - 2.1 JAXA/AIT Sentinel Asia Mini Project
- 3. Sentinel Asia System (SAS)
 - 3.1 Emergency Observation Request (EOR)

February 2016

- 1. News and Announcements
 - 1.1 Emergency Observation of Disasters occurred in February 2016
 - 1.2 New Member of Joint Project Team (JPT)
 - 1.3 JPTM2016
 - 1.4 APRSAF-22
 - 1.5 New User ID and Password for web site of Sentinel Asia Step2 System
 - 1.6 Regional Server of Sentinel Asia Step2 System
 - 1.7 Call for updated information from JPT Members
 - 1.8 Request matters relating to news mail delivery
- 2. Capacity Development Activities
 - 2.1 JAXA/AIT Sentinel Asia Mini Project
- 3. Sentinel Asia System (SAS)
 - 3.1 Emergency Observation Request (EOR)

March 2016

- 1. News and Announcement
 - 1.1 Emergency Observation of Disasters occurred in March 2016
 - 1.2 New Member of Joint Project Team (JPT)
 - 1.3 JPTM2016
 - 1.4 APRSAF-22

- 1.5 New User ID and Password for web site of Sentinel Asia Step2 System
- 1.6 Regional Server of Sentinel Asia Step2 System
- 1.7 Call for updated information from JPT Members
- 1.8 Request matters relating to news mail delivery
2. Capacity Development Activities
 - 2.1 JAXA/AIT Sentinel Asia Mini Project
3. Sentinel Asia System (SAS)
 - 3.1 Emergency Observation Request (EOR)

April 2016

1. [News] Emergency Observation of Disasters occurred in April 2016
2. [Announcement] Password Change: Sentinel Asia Step2 System, 21 June 2016
3. [Announcement] Regional Server of Sentinel Asia Step2 System
4. [Announcement] Emergency Observation Request (EOR)
5. [Announcement] Requests to JPT Members
6. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016/ 1st Announcement
JPTM 2016 at Colombo, Sri Lanka, January 19-21, 2016

May 2016

1. [News] Emergency Observation of Disasters occurred in May 2016
2. [Announcement] Password Change: Sentinel Asia Step2 System, 21 June 2016
3. [Announcement] Regional Server of Sentinel Asia Step2 System
4. [Announcement] Emergency Observation Request (EOR)
5. [Announcement] Requests to JPT Members
6. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016
JPTM 2016 at Colombo, Sri Lanka, January 19-21, 2016

June 2016

1. [News] Emergency Observation of Disasters occurred in June 2016
2. [News] New Member of Joint Project Team (JPT)
3. [News] Report from JPT Member - 7th UN-SPIDER Regional Support Offices (RSO) Meeting
4. [Announcement] User Password Changed: Sentinel Asia Step2 System

5. [Announcement] Digest Authentication Password Changed: Regional Server of Sentinel Asia Step2 System
6. [Announcement] Emergency Observation Request (EOR)
7. [Announcement] Requests to JPT Members
8. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016

July 2016

1. [News] Emergency Observation of Disasters occurred in July 2016
2. [News] New Member of Data Analysis Node (DAN)
3. [News] FORMOSAT-2 was Decommissioned after Twelve Years of Service
4. [Announcement] Digest Authentication Password Changed: Regional Server of Sentinel Asia Step2 System
5. [Announcement] Emergency Observation Request (EOR)
6. [Announcement] Requests to JPT Members
7. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016

August 2016

1. [News] Emergency Observation of Disasters occurred in August 2016
2. [News] At Emergency Observation Request (EOR), JAXA is planning to deliver Quick Analysis ALOS-2 Data on the Observation Day
3. [Announcement] Booklet “Good Practices of Sentinel Asia in past 10 years”
4. [Announcement] SAR Data Analysis Instructional Materials are available on the Sentinel Asia Website.
5. [Announcement] New Function was added to the “JAXA Realtime Rainfall Watch”
6. [Announcement] Regional Server of Sentinel Asia Step2 System
7. [Announcement] Emergency Observation Request (EOR)
8. [Announcement] Requests to JPT Members
9. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016

September 2016

1. [News] Emergency Observation of Disasters Occurred in September 2016
2. [Report from JPT Members] ADRC Participated in The 6th Annual UN-SPIDER Conference in

Beijing, China

3. [Announcement] Please Log-in The Central Server of Sentinel Asia before a Disaster
4. [Announcement] Regional Server of Sentinel Asia Step2 System
5. [Announcement] Emergency Observation Request (EOR)
6. [Announcement] Requests to JPT Members
7. [Events] APRSAF-23 at Manila, Philippines, November 15-18, 2016

October 2016

1. [News] Emergency Observation of Disasters Occurred in October 2016
2. [News] New Member of Joint Project Team (JPT)
3. [Announcement] Password Change: Sentinel Asia Step2 System, 21 December 2016
4. [Announcement] Sentinel Asia Server Services Temporally Stopped
5. [Announcement] Regional Server of Sentinel Asia Step2 System
6. [Announcement] Emergency Observation Request (EOR)
7. [Announcement] Requests to JPT Members
8. [Events] Sentinel Asia 10th Anniversary Event / JPTM2017 at Hanoi, Vietnam, March 7 – 9, 2017
APRSAF-23 at Manila, Philippines, November 15-18, 2016

November 2016

1. [News] Emergency Observation of Disasters Occurred in November 2016
2. [News] New Member of Joint Project Team (JPT)
3. [Announcement] E-mail Address Change: Sentinel Asia Project Office
4. [Announcement] User Password Changed: Sentinel Asia Step2 System
5. [Announcement] Regional Server of Sentinel Asia Step2 System
6. [Announcement] Emergency Observation Request (EOR)
7. [Announcement] Requests to JPT Members
8. [Events] Asia 10th Anniversary Event / JPTM2017 at Hanoi, Vietnam, March 7 – 9, 2017
APRSAF-23 at Manila, Philippines, November 15-18, 2016

December 2016

1. [News] Emergency Observation of Disasters Occurred in December 2016
2. [News] Sentinel Asia Twitter is Now Open

3. [Message] From New JPT Member
4. [Announcement] Request for Cooperation to “Sentinel Asia Member Questionnaire”
5. [Announcement] Regional Server of Sentinel Asia Step2 System
6. [Announcement] Emergency Observation Request (EOR)
7. [Announcement] Requests to JPT Members
8. [Events] Asia 10th Anniversary Event / JPTM2017 at Hanoi, Vietnam, March 7 – 9, 2017
APRSAF-23 at Manila, Philippines, November 15-18, 2016

5.2.2. Sentinel Asia 10th Anniversary

In commemoration of the 10th Anniversary of SA, the SA secretariat created a booklet centered on good practices in SA activities so far.

Booklet's Name: CONTRIBUTION of SPACE TECHNOLOGY for DRR
– Sentinel Asia's 10th Anniversary – Good Practices

Contents:

- An Overview of Sentinel Asia
 - Brief Background and History of Sentinel Asia
 - Overview on the Aims and Activities of Sentinel Asia
 - Framework and Emergency Observation Mechanisms of Sentinel Asia
 - Current Phase (Step 3) and Ongoing Actions of Sentinel Asia
- Good Practices
 - **Indonesia:** Widespread forest fires in 2015
 - **Myanmar:** Heavy rain and floods in June–Aug. 2015
 - **Philippines:** Volcanic eruption on 14 December 2009
 - **Sri Lanka:** Devastating floods in May 2016
 - **Vietnam:** Devastating floods in July/Aug. 2015
- Greeting Messages
 - GeoInformatics Center - Asian Institute of Technology (GIC/AIT)



- Indian Space Research Organization (ISRO)
- Center for Spatial Information Science, University of Tokyo (CSIS/UT)
- National Space Organization (NSPO)
- Asian Disaster Reduction Center (ADRC)

6. Assessment of Sentinel Asia Operation

6.1. Overall Impact

When natural disasters occur, such as floods, droughts and earthquakes in mainly Asian areas, ADRC releases information on the phenomena that trigger the disasters and the damages (<http://www.adrc.asia/latest/index.php>). In 2016 the total of natural disasters (excluding drought and snow hazards) collected by ADRC is 78. 34 natural disasters found in this data were covered by SA (43.6%).

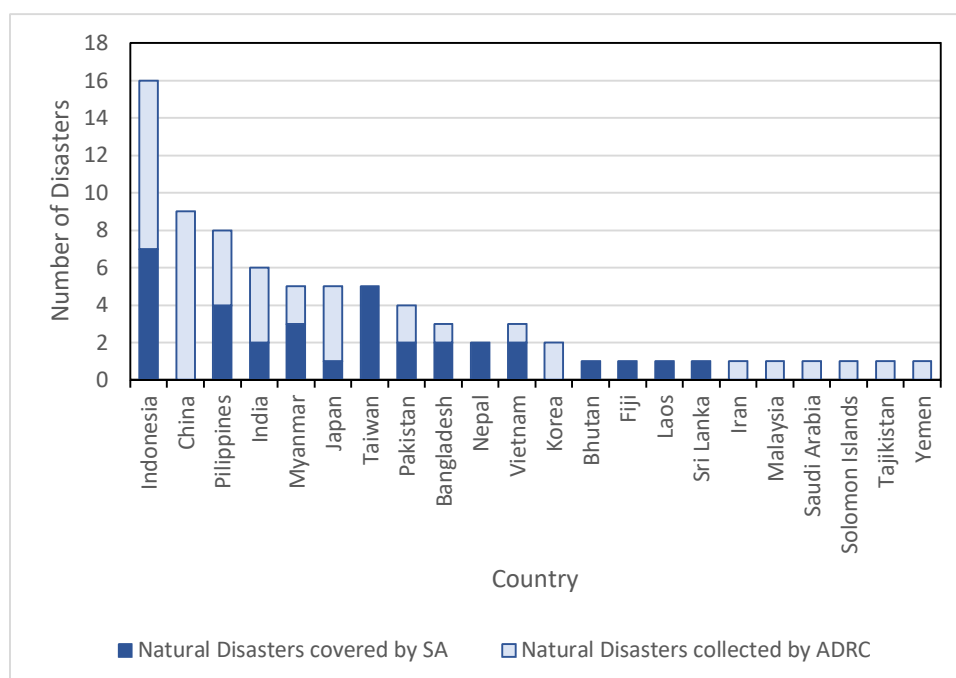


Figure 18 Breakdown by countries of major natural disasters collected by ADRC in 2016. In blue the ones covered by SA.

6.2. Analysis of Operational Performance

Figure 19 summarizes the number of days from disaster occurrence to request for each disaster and year. Overall, this shows it took a couple of days from disaster occurrence to request for the period between 2011 and 2016.

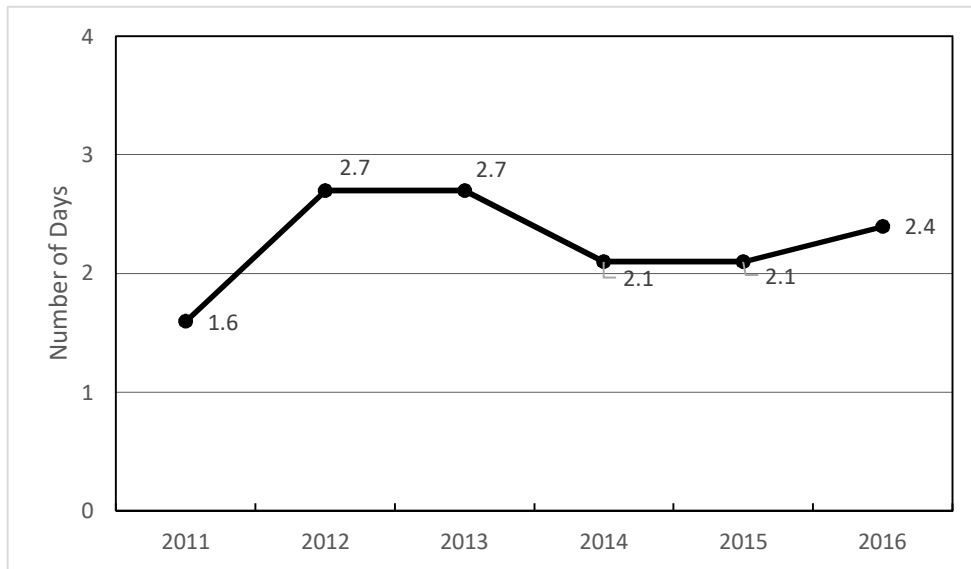


Figure 19 Number of Days Required from Disaster Occurrence to Request

Figure 20 presents the number of days 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 2016.

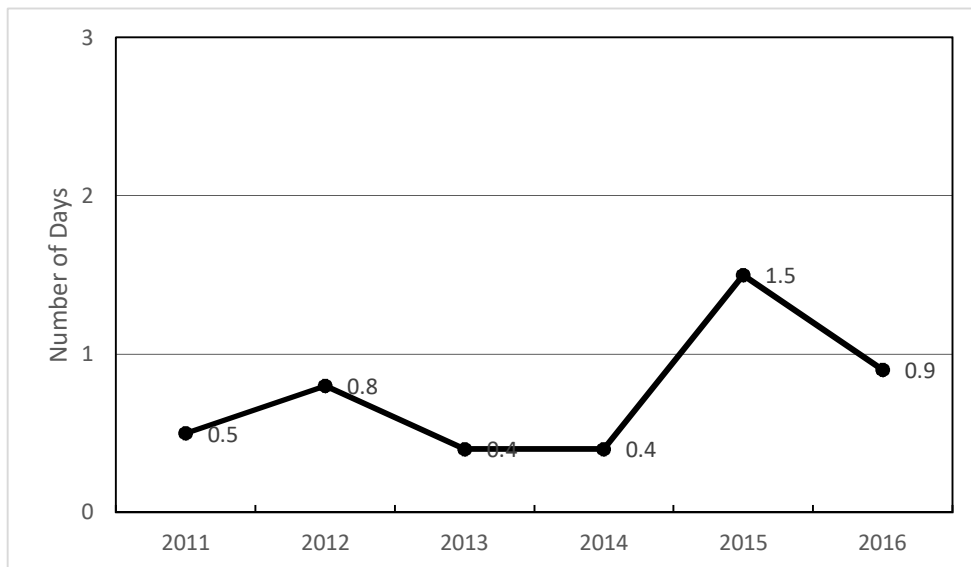


Figure 20 Number of Days Required from Request to Activation

Figure 21 to Figure 23 present the average number of days required to provide each data for each year and the percentage of completed data provisions. Figure 21's Archive Satellite Data indicated the percentage of provisions declined from 2015, totaling 61.8% in 2016, while the average number of days required for provision was 5.3 days. Figure

2's Satellite Data after Disaster showed the percentage of provisions increased sharply from 2014 onward, while the number of days required for data provision has declined in recent years. Figure 21's products were only provided in 73.5% of the cases in 2016.

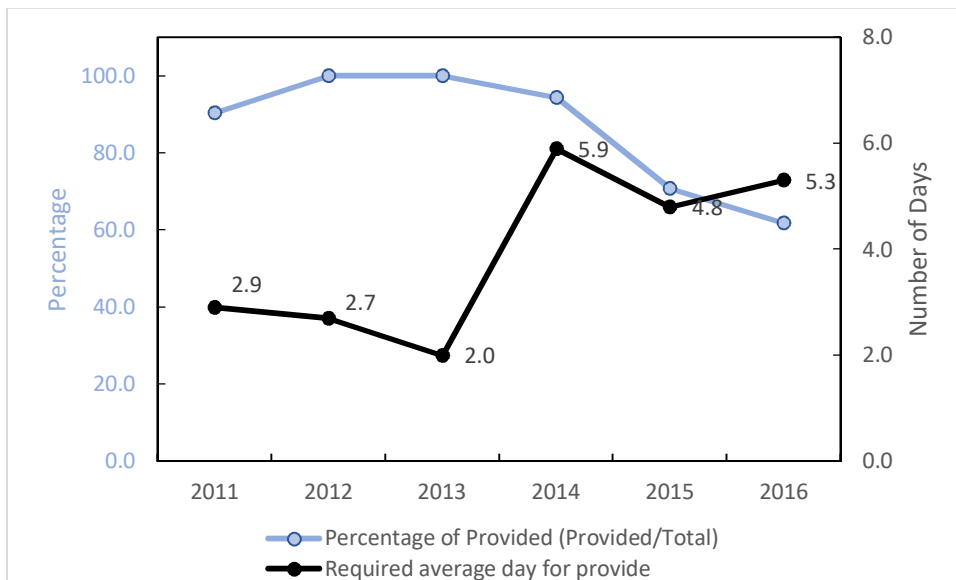


Figure 21 Average Number of Days Required to Provide Archive Satellite Data and Response Rate for Each Year

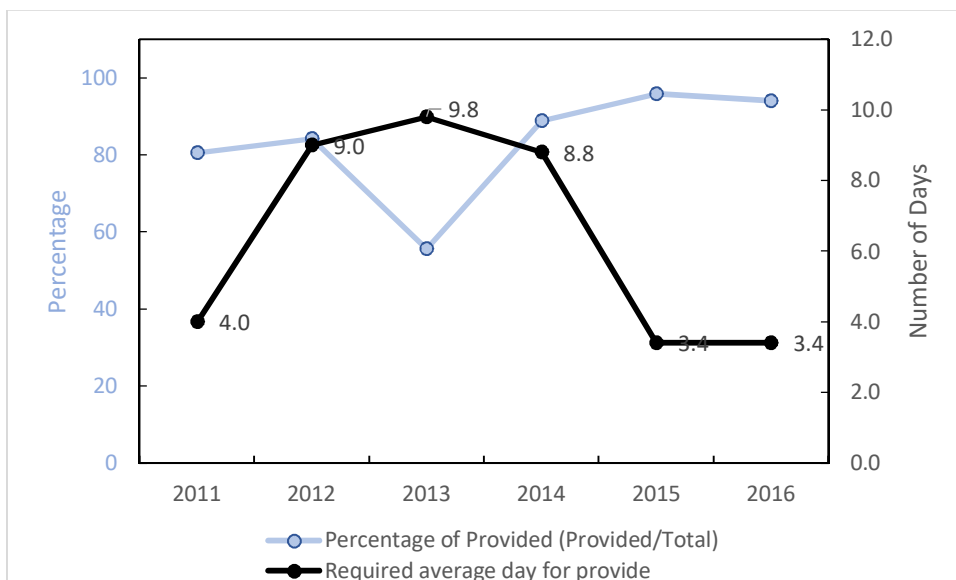


Figure 22 Average Number of Days Required to Provide Satellite Data after Disaster and Activation Rate for Each Year

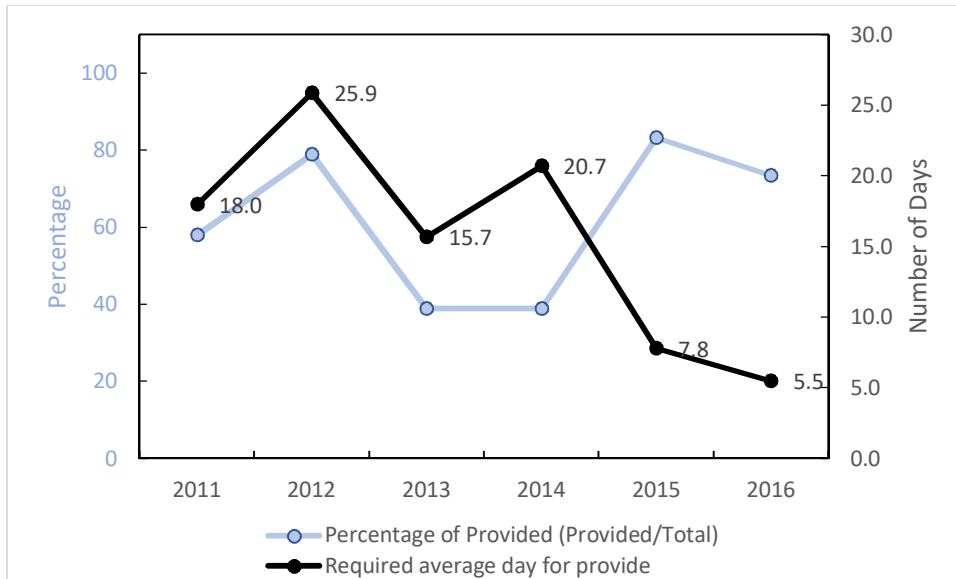


Figure 23 Average Number of Days Required to Provide Products and Activation Rate for Each Year

7. Conclusions

In 2016 SA celebrated its 10th anniversary. Since the start of 2007, we have conducted emergency observation activities of 270 natural disasters. This year, six organizations joined SA. The number of participating institutions in this activity has reached 102 now.

It is necessary to steadily advance the following recommendations discussed at APRSAF in the Philippines toward the future development of SA.

- Encourage the establishment of a system for rapid observation and sharing of analyzed information;
- Promote capacity development of disaster management using space technology;
- Support the utilization of the Philippine success story project to practical operation in the Philippines and encourage the sharing of successful results and knowledge;
- Encourage continuous active discussions in the Sentinel Asia Steering Committee towards sustainable and autonomous operation of Sentinel Asia;