CONTRIBUTION OF SPACE TECHNOLOGY FOR DRR

- Sentinel Asia's 10th Anniversary - Good Practices

An Overview of Sentinel Asia

The Sentinel Asia (SA) is a voluntary basis initiative led by the Asia-Pacific Regional Space Agency Forum (APRSAF) to support disaster management activity in the Asia-Pacific region by integrating and applying the Web-GIS technology and space based technology.

Brief Background and History of Sentinel Asia

Natural disasters have been on the rise worldwide including Asia-Pacific region. 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 levels of population (about 3 billions) and high frequency and calamity from natural disasters in the region, an integrated use of space technology such as earth observation satellite data and geographic information system can be an effective means to reduce the magnitude of the calamity or for their timely management in the event of a large-scale natural hazard and disasters. In light of increasing frequency of natural disasters and elevated loss of lives and properties from these events, SA, a collaborative, regional project, is 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 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 the Sentinel Asia. 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.

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

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 speed and accuracy of disaster preparedness and early warning, 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 Sentinel Asia to its members (i) satellite imagery (and data permitted by data provider) and value-added images with extraction of stricken 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.

Framework and Emergency Observation Mechanisms of Sentinel Asia

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 1. To promote 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.

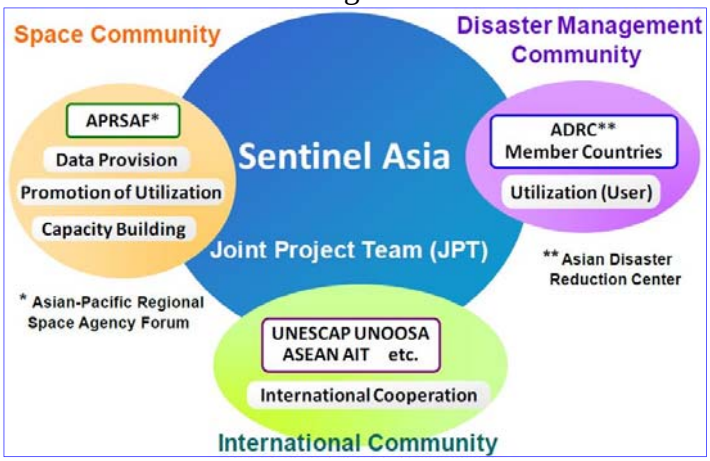

Figure 1. Framework of the Sentinel Asia

Figure 2. Mechanism of SA Emergency Observation

SA is composed of two Nodes (Data Provider, and Data Analysis) and four Working Groups (Wildfire, Flood, Glacier Lake Outburst Flood, and Tsunami). Data Provider Node (DPN) provides their own satellite imagery and other relevant data to JPT members upon the Emergency Observation Request (EOR) from JPT member to the extent permitted by the data policy of each DPN when disaster occurs, while Data Analysis Node (DAN) analyzes the satellite data provided by DPN, makes value added product and uploads and shares the result through the Sentinel Asia System. Between 2006 and August 2016, about 260 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.

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

Out of 3 Steps employed by Sentinel Asia, it already declared the successful completion of Steps 1 and 2. Step 3 has begun in 2013 and defined its priority areas based on experiences in the earlier Steps and user requests leading to necessary actions as shown in the Figure 3.

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

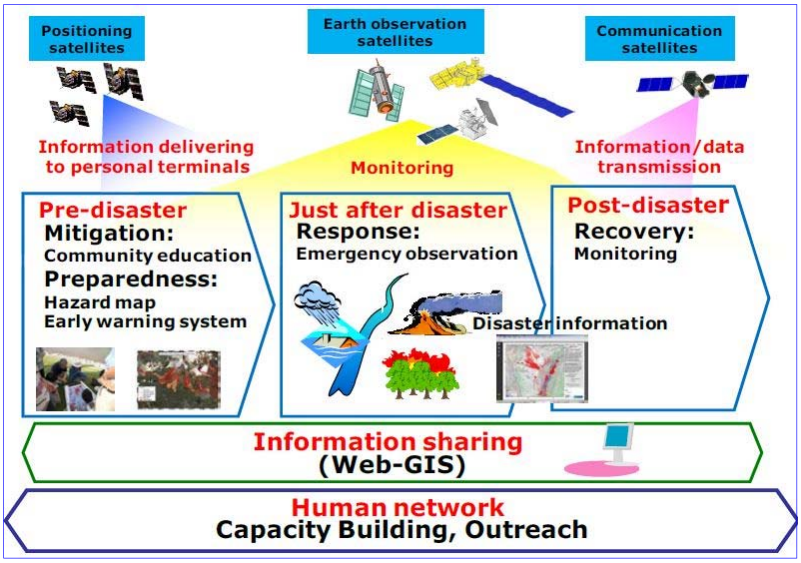

Figure 3. Current phase (Step 3) and actions of Sentinel Asia

Utilization of Satellite Data for Disaster and Risk Management in Indonesia

Lembaga Penerbangan dan Antariksa Nasional (LAPAN) i.e. National Institute of Aeronautics and Space joined Sentinel Asia in 2007 (?) and has been serving as a DAN of it. Since 2013 LAPAN has been a Regional Support Office (RSO) of UN-SPIDER and has participated for UN-SPIDER activities to develop Asian Mechanism on Disaster Emergency Response. We share data and products to BNPB in all the natural disasters and to Center of Volcanology and Geological Hazard Mitigation (PVBMG) in the event of volcanic disasters. The data and products of SA have been useful for evacuation, recovery and emergency activities. For instance, following the massive forest fires in 2015, LAPAN received satellite images and products from SA, which were shared to and utilized by national SAR (Search and Rescue) team to rescue disaster victims. While most of the activities of SA are running well and should be continued, one area of improvement, in my opinion, is to specify WGs' activities more clearly and distribute the outputs to member organizations. I congratulate SA on its 10th anniversary.

Dr. M. Rokhis Khomarudin
Director of Remote Sensing Application Center
LAPAN, Indonesia

Emergency Observation Request following the widespread forest fires in 2015

Requester: *Indonesian National Institute of Aeronautics and Space* (LAPAN)

The map attached here was analyzed/ produced by LAPAN

Data: ALOS-2/PALSAR-2
Date of observation: Oct. 2015 (post-disaster)

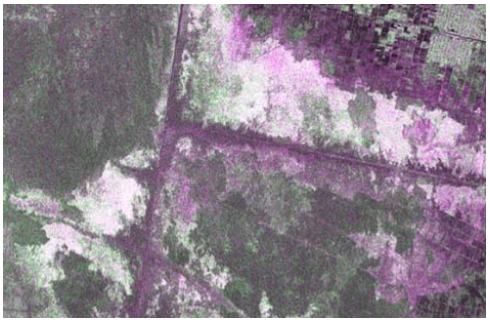

Figure 1. A part of a post-disaster satellite image depicting possible forest fire areas

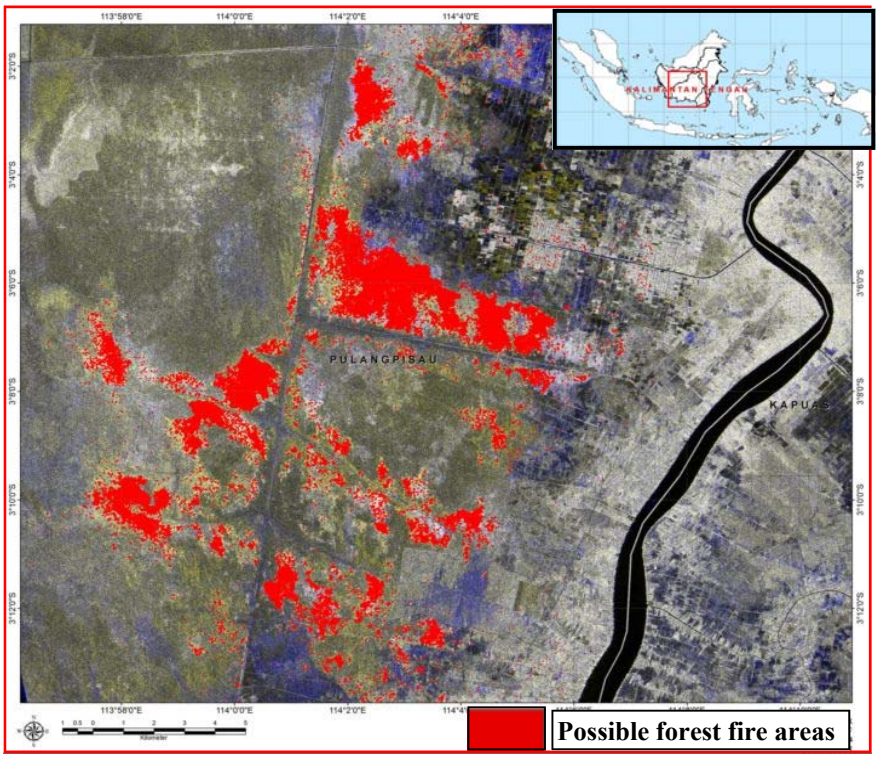

Figure 2. Possible forest fire areas

According to the International Federation of Red Cross and Red Crescent Societies (a report issued on 04 November 2015), forest fires that occurred in January (the fires continued for several months) in 2015 in Indonesia resulted in a very dense haze, spreading and affecting its seven provinces. The haze also affected neighboring countries such as Singapore, Malaysia, Thailand and the Philippines. Three people in Riau Province and one person in South Sumatra Province were reportedly died from the disaster. Indonesian officials evacuated infants and their mothers from Riau and Sumatra as levels of air pollution turned hazardous (CNN, 01 Oct. 2015). According to the news report, thick smog persisted for weeks and caused illness and limit visibility in the area. The air pollution index (API) in the region had hovered above 1,000 (>300 is deemed hazardous) for over a week, while visibility in several areas had also fallen below 100 meters on some days. More than 35,000 people had fallen ill from the disaster. Most of those were suffering from respiratory ailments, eye infections and skin irritation.

Indonesia

Badan Nasional Penanggulangan Bencana (BNPB) i.e. National Disaster Management Authority of Indonesia, with regard to utilization of space-based technology for disaster management in the country, works closely with LAPAN. One of the main keys to making fast and accurate disaster and risk assessment management is by using satellite images. To this end, Sentinel Asia (SA) has been helping us (BNPB), for instance by providing satellite data of Sinabung volcanic eruption, Banjarnegara flooding, widespread forest fires in 2015 and other disasters. The satellite images of before- and after the disasters enabled us to assess the impact of disaster. Satellite images and map products of SA had been used for emergency and recovery operations. Moreover, if we are offered high resolution data, BNPB would use those data during evacuation, and planning and reconstruction phases. We would like to express our sincere thanks to SA for its continued support and a warm greetings on its 10th anniversary. We believe our cooperation will deepen and broaden in the future for mutual benefit and humanitarian cause.

Dr. Sutopo Purwo Nugroho
Head of Data, Information and Public Relations Center
BNPB (National Disaster Management Authority), Indonesia

President Joko Widodo inspecting the forest fires and haze

Students walking in front of school buildings shrouded in smog

A firefighter spraying water into peat land forests

Photograph credit: LAPAN/UN-SPIDER

Country profile

Official name: Republic of Indonesia

General information: Indonesia is a country in Southeast Asia and Oceania. It consists an archipelago of about 17,500 islands between the Indian Ocean and the Pacific Ocean, with total land area of approximately 1,904,569 sq. km. The country shares land borders with Papua New Guinea, East Timor, and Malaysia. It has 34 provinces with population totaling 237.6 million (as of 2010 census), world's fourth most populous country. The capital is Jakarta. There are around 300 native ethnic groups in Indonesia. The largest ethnic group is the Javanese, who comprise 42% of the population. Indonesia has a tropical, humid climate, with two distinct seasons: monsoonal wet and dry.

Overview of disasters: Indonesia is exposed to multiple disasters, which include flood, forest fire, earthquake, tsunami, volcano, landslide and drought, with the former three being the most frequent disasters. The country is susceptible to various types of natural hazards due largely to its geographical location and physical environment as it is situated in the "Pacific Ring of Fire" between three tectonic plates (Indo-Australia, Eurasian and Pacific), whose movement makes the region home to frequent earthquakes and volcanic activity. Also, being located along the typhoon belt in the Pacific makes it vulnerable to extreme weather events. An average of 20–30 typhoons visits the country every year, with 5–7 of them being the most destructive ones. As a result, accompanying phenomena such as heavy rains, landslides, and floods are also common across the country. *Badan Nasional Penanggulangan Bencana,* best known as BNPB (English: National Disaster Management Authority) is the central-level, focal point dealing with disasters in Indonesia.

Major natural disasters of the last 3 years (Source: http://www.adrc.asia)

Date of occurrence	Type of disasters	Killed people	Affected/Evacuated people
18 June 2016	Flood, landslide	24	1,350
16 May 2016	Landslide	15	Not reported
03 Dec. 2015	Landslide	18	Not reported
Jan./March 2015	Forest fire, haze*	4	409,664
11 Dec. 2014	Landslide	95	577
13 Jan. 2014	Heavy rain, flood	31	53,672
04 Jan. 2014	Volcanic eruption	15	20,000

* indicates the disaster event described in this brochure as a good practice example for disaster risk management

Utilization of Satellite Data for Disaster and Risk Management in Myanmar

We highly appreciate Sentinel Asia (SA) for providing valued technical skills and expertise to us over the years. Once we received the maps and satellite images after the floods in July 2015, they were disseminated to or shared with concerned government ministries/departments as well as UN and other partner agencies for their response activities. Although the provided data were useful both for recovery and emergency response, those products were highly technical and difficult to understand for our resource persons, operation staffs and local people. We would like to launch mini-projects in collaboration with SA to strengthen the utilization of space-based technology in DRR. We expect that SA can assist us in our capacity building and research on space-based technology and disaster risk reduction, those activities will enhance not only our capacity to cope with disasters but also make our ties stronger. We extend our warm greetings for the 10th anniversary of Sentinel Asia. We believe that SA will be able to help make safer lives and higher resilience of the community through the best utilization of modern Space Technology and can contribute in all phases of disaster management cycle.

Dr. Ko Ko Naing
Director General
Relief and Resettlement Department (RRD)
Ministry of Social Welfare, Relief and Resettlement
Republic of the Union of Myanmar

Emergency Observation Request following heavy rain and floods in June–Aug. 2015

Requester: *Relief and Resettlement Department*

The maps attached here were produced by JAXA and RESTEC.

Data: ALOS-2/PALSAR-2

Date of observation: 09 Aug. 2015 (left)
28 July 2015 (right)

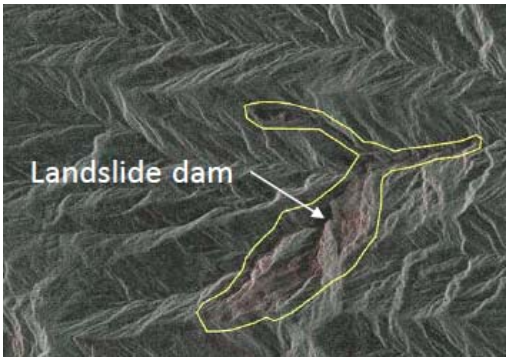

Figure 1. A landslide/landslide dam detected in satellite image

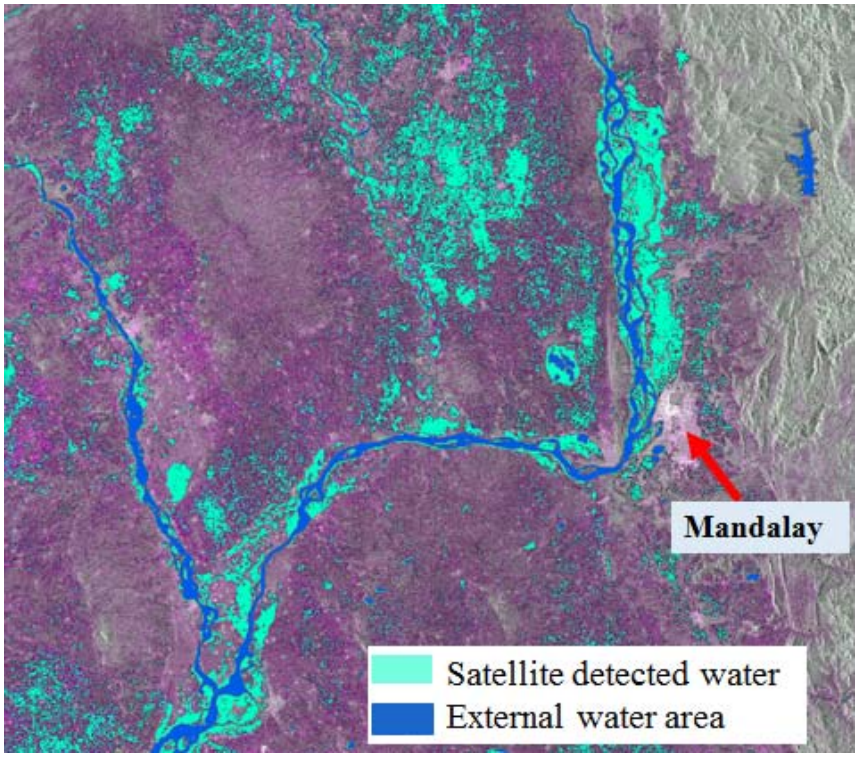

Figure 2. Possible flood areas (in cyan)

Torrential, heavy rainfall occurred across Myanmar since June to August 2015 (on 19 July it was particularly severe) that triggered floods and landslides in several parts of the country. According to the Situation Report 4 (released on 02 Sept. 2015) of National Natural Disaster Management Committee (NNDMC), 12 out of 15 states/regions were affected by the disaster. A total of 122 persons were killed, 1,616,761 were affected or displaced, 476,242 houses and 224 health facilities were damaged, and 841,620 acres of farmland was destroyed. A major concern remained on water contamination, as most villagers use water ponds for drinking water and many ponds were flooded and contaminated (UNOCHA, 04 Nov. 2015). Affected areas have suffered US$ 149 million direct economic losses, with heavy concentrations of the losses in Rakhine and Chin States.

Myanmar

Satellite images and map products provided by Sentinel Asia (SA) following the 2015 July floods were valuable resources. Original satellite images, in particular, were more useful as they were used to produce more detailed maps (e.g. inundation maps) by ourselves to communicate with communities, while map products of SA (less detailed) mainly utilized for advocacy and national-level planning. Summary report of SA was very useful and alarming for us as we were totally unaware of landslide dams and possible hazards from them, which were well documented in the report, an eye-opener piece of information for us. As we do not have a high level of expertize and state-of-the-art software for image processing, it would be more productive if we receive orth-orectified images rather than raw images.

I would like to congratulate Sentinel Asia on its 10th anniversary. We hope that we can work together in future as well for the better disaster management and humanitarian cause.

Mr. Nway Aung
GIS Manager
Myanmar Information Management Unit (MIMU)

Inundated Kale Town

Flood affected people in a shelter in Pantanaw, Ayeyarwaddy region

People on Wire Bridge (Tuin) to cross Sekyi stream (Chin state) after sweeping away the

Photograph credit: RRD and MIMU

Country profile

Official name: Republic of the Union of Myanmar
General information: Myanmar is located in the west of Indochina Island. It is bordered by Thailand, Lao PDR, China, Bangladesh and India, and has total land area of 676,578 sq. km. It has an estimated population of 54 million (as of 2011) in which about 70 percent population reside in rural areas. Bamar is the largest ethnic group (constituting about 70 percent population), while Myanmar is the home to over 100 ethnic population. Myanmar is divided into 15 states/regions including one Union Territory (Nay Pyi Taw). The capital is Nay pyi Taw, while Yangon (also known as Rangoon) is a former capital and the largest city in the country. Myanmar has tropical climate with three distinct seasons, namely rainy (mid-May to mid-October), winter (mid-October to mid-February) and summer (mid-February to mid-May).
Overview of disasters: Myanmar is exposed to multiple natural hazards which include fire, floods, cyclone, earthquake, tsunami, drought and landslide (Myanmar Country Report at ADRC, 2014). It is a country in danger of earthquake as it lies in a major earthquake zone, resulting from collision of Indo-Australia Plate and Eurasia Plate. Myanmar has a long coastline to the east of the Bay of Bengal, where about 10 tropical cyclones annually form in pre-monsoon (Apr.–May) and post-monsoon (Oct.–Nov.), a few of them become severe and cause significant damages to lives and property. Relief and Resettlement Department (RRD) under the Ministry of Social Welfare, Relief and Resettlement is the focal point for disaster management in Myanmar.

Most devastating natural disasters of the last 3 years (Source: http://www.adrc.asia)

Date of occurrence	Type of disasters	Killed people	Affected people
09 June 2016	Flash flood	14	280,000
19–25 Apr. 2016	Heavy rain	14	Not Reported
19 July–31 Aug. 2015	Heavy rain, flood*	122	1,616,761

* indicates the disaster event described in this brochure as a good practice example for disaster risk management

Utilization of Satellite Data for Disaster and Risk Management in Philippines

Our collaboration with Sentinel Asia (SA) has two modes namely Emergency (through EORs, using satellite images once a disaster happens) and Success Story (through research for the better understanding of the processes for the future preparedness and monitoring of hazards). Undoubtedly, both modes of collaboration are important for us, but I believe SA should pay more attention towards preparedness and monitoring of hazards. One disaster event I particularly mention here is the Mt. Mayon volcanic eruption in 2009 that can be regarded as a very successful collaboration with SA. After the eruption, we made an EOR to SA for satellite images. Received ALOS-derived DSM and ortho-images were extremely useful for creating Lahar Hazard Maps and monitoring the areas. It would be very helpful to us if SA and we work together to produce improved hazard maps (e.g. Lahar hazard map, rain-triggered landslide susceptibility map) and in monitoring ground subsidence due to volcanic eruptions by utilizing cutting-edge technology and knowledge that member organizations of SA have. Upon volcanic eruptions, landforms and topography alter, sometimes drastically that leads us to creating new topographic maps of the affected areas for which we want more assistance from and collaboration with SA. Over the years, SA has been providing satellite images on EORs, made strong advocacy for and contribution to disaster management in Asia Pacific region. Our collaborations have been very fruitful and must continue in the future as well. I congratulate SA on its 10th anniversary and wish it for a more successful and productive work ahead.

Dr. Renato U. Solidum, JR.
Director of Department of Science and Technology (DOST)
Philippine Institute of Volcanology and Seismology (PHIVOLCS)

Emergency Observation Request following volcanic eruption on 14 December 2009

Requester: *Philippine Institute of Volcanology and Seismology* (PHIVOLCS)

The maps attached here were produced by PHIVOLCS

Data: ALOS Pansharpen and ALOS-DSM

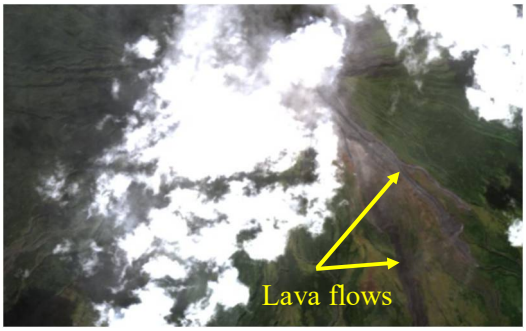

Figure 1. A part of a post-disaster satellite image depicting lava flows on Mt. Mayon

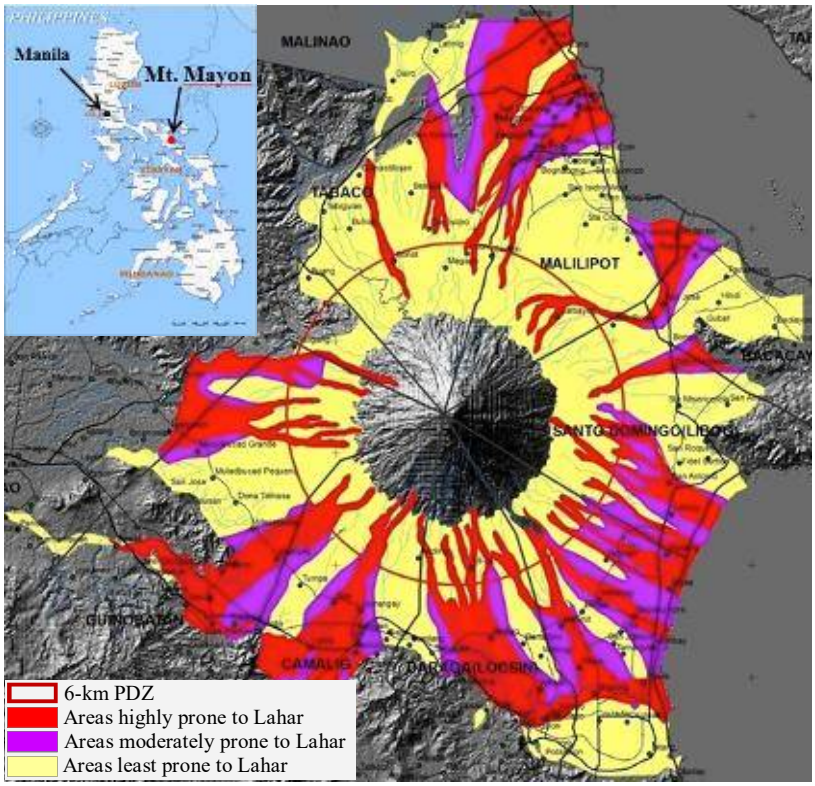

Figure 2. Lahar hazard maps of Mt. Mayon, Philippines

Mt. Mayon frequently erupts, spewing lava flows. Sometimes, ash explosion and pyroclastic flows travel up to 5 km downslope, causing huge devastation or needing massive evacuation and rescue operations. Eruption that commenced on 14 December 2009 was one in a series of disastrous volcanic eruptions of the mountain. According to the NDRRMC, the alert level for Mt. Mayon on that day was raised to level 3 after a series of ash explosion and lava flow. The alert level was later upgraded to level 4 (on 20 December), indicating that a hazardous, explosive eruption is possible within days. At alert level 3, PHIVOLCS-DOST recommended a 6-km radius Permanent Danger Zone (PDZ) around the volcano and an 7-km Extended Danger Zone (EDZ) on the southeast flank of the volcano, for freeing them from human activity or mandatory evacuation of households in all areas within the zones. As predicted, huge eruptions took place and lasted for several weeks. Forty-five schools were designated as evacuation centers, where 47,285 people from 9,946 families were evacuated. The overall cost of assistance provided by the Government and NGOs/other GOs, as of 02 Jan. 2016, was about PHP 61,288,654 (NDCC Update, 03 Jan. 2015).

Philippines

Office of Civil Defense (OCD) has multiple functions in case of a disaster, such as providing early warning information, launching emergency response, search, rescue and recovery activities. OCD and other relevant organizations share disaster information under the National Disaster Risk Reduction and Management Council (NDRRMC), which is the main body for disaster risk reduction in Philippines. When Mt. Mayon erupted in December 2009, maps of volcano affected areas were created and shared with NDRRMC, PHIVOLCS and local disaster management organizations. Additionally, satellite data were useful for producing hazard maps in pre-disaster phase. OCD distributes these maps to residents and local officers in hazard-prone areas for strengthening their capacity. Sentinel Asia can support us at multiple phases of natural disasters in Philippines. OCD would like to strengthen network with other agencies under NDRRMC. We congratulate Sentinel Asia on its 10-year anniversary.

Office of Civil Defense (OCD)

Glimpses of affected areas or damage caused by Mt. Mayon volcanic eruption/lava flows in 2009

Photograph credit: ADRC

Country profile

Official name: Republic of the Philippines
General information: The Republic of the Philippines is located in Southeast Asia, bordered by the Pacific Ocean to the east, the West Philippine Sea to the west, and the Celebes Sea to the south. The Philippines constitutes an archipelago of 7,109 islands with a total land area of approximately 299,764 sq. km. The Philippines has a tropical and maritime climate, and has two major seasons: the rainy season, from June to November, and the dry season, from December to May. The capital is Manila. The population is 88.57 million as of August 2007. The Filipino is basically of Malay stock with a sprinkling of Chinese, American, Spanish and Arab origin people, and other ethnic minorities.
Overview of disasters: Located along the typhoon belt in the Pacific, the Philippines is visited by an average of 20 typhoons every year, five of which are destructive. Further, being situated in the "Pacific Ring of Fire" makes it vulnerable to frequent earthquakes and volcanic eruptions. Its geographical location and physical environment also contributes to making it high-susceptibility to tsunami, sea level rise, storm surge, landslides, flood, and drought. National Disaster Risk Reduction and Management Council (NDRRMC), formerly known as National Disaster Coordinating Council (NDCC), administered by the Office of Civil Defense (OCD) is the focal point for disaster management in Philippines, while PHIVOLCS is a body that devotes its activities to mainly on volcanoes, earthquakes and tsunamis.

Most devastating natural disasters of the last 3 years (Source: http://www.adrc.asia)

Date of occurrence	Type of disasters	Killed/Missing people	Affected people
08–22 Aug. 2016	Heavy rain	19/7*	1,263,098
14 Dec. 2015	Typhoon	42/4*	287,227
18 Oct. 2015	Typhoon	48/4*	3,126,130
29 Dec. 2014	Storm, flood, landslide	66/6*	578,549
06 Dec. 2014	Typhoon	18	3,852,672
15 July 2014	Typhoon	106/5*	4,653,716
10 Jan. 2014	Heavy rain, flood, landslide	70/9*	1,148,621
08 Nov. 2013	Typhoon	6,293/1,039*	16,078,181
15 Oct. 2013	Earthquake	222/8*	3,221,248

Utilization of Satellite Data for Disaster and Risk Management in Sri Lanka

In May 2016, an EOR following floods and landslides in Sri Lanka was made and a lot of satellite images and products were received. We made the products open to public through DMC website, and official Facebook. The products were also shared to army, navy, air force and other concerned departments. We have been working together with relevant national and international agencies including government departments, IWMI, and UN-SPIDER. The data and products of Sentinel Asia (SA) were very useful for recovery and emergency activities. Overall, I have positive impression on our collaboration and activities of SA. However, we want to see more SA-supported mini-projects in Sri Lanka in coming years. Further, it would be highly supportive to us if SA helps us improve curriculum of our universities and build capacity of our staff including teachers/students in universities in remote sensing technology, especially in RADAR image processing and GIS.

Mr. Srimal Samansiri
Assistant Director, Research and Development
Disaster Management Center (DMC)
Ministry of Disaster Management, Sri Lanka

Emergency Observation Request following the devastating floods in May 2016

Requester: *International Water Management Institute (IWMI)*

Map Prepared by: IWMI International Water Management Institute

Data Provided by: DLR; SENTINEL ASIA; CGIAR Research Program on Water, Land and Ecosystems

The analysis excluded permanent water bodies including reservoir, tanks and ponds and this reflects only the inundation extent. Please note the surface water extent mapped has not yet been validated in the field.

UNITED NATIONS Office for Outer Space Affairs UN-SPIDER

The depiction and use of boundaries, geographic names and related data shown in these maps are based on the sources they have been drawn from and quoted. These are neither error-free nor do they imply official endorsement or the position of IWMI.

Data: TerraSAR-X Satellite imagery

Date of observations: 05 December 2008 (pre-disaster)
19 May 2016 (post-disaster)

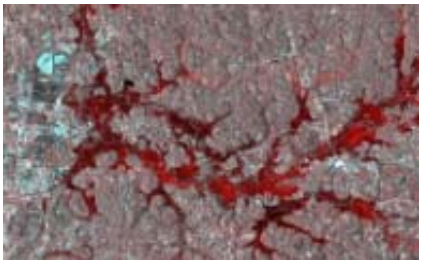

Figure 1. A part of a post-disaster satellite image

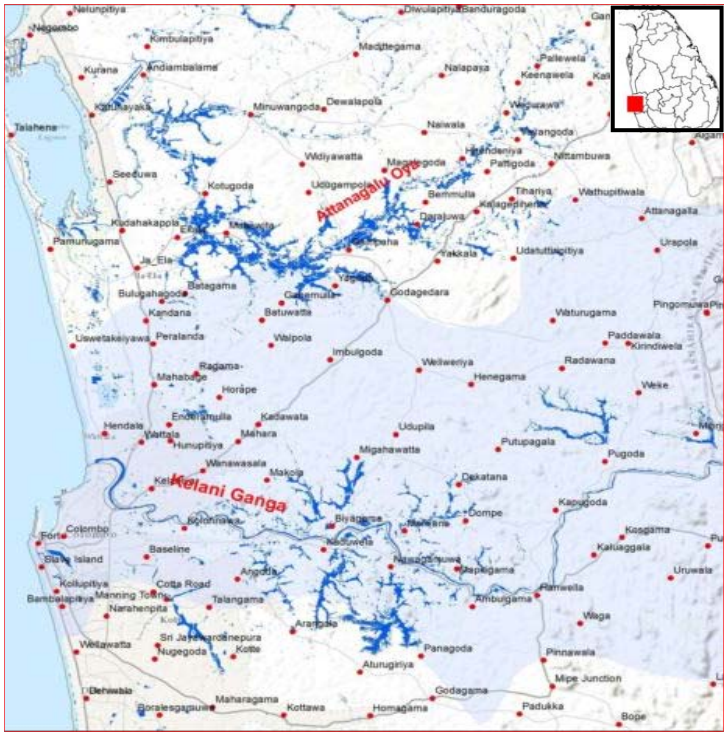

Figure 2. Possible flood areas (in blue)

On 15 May 2016, Sri Lanka was hard hit by a powerful tropical storm that caused widespread floods and landslides in 22 of 25 districts in the country, destroying hundreds of homes and submerging entire villages. 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 were displaced from their homes. As a result of the floods and landslides, 623 houses had been completely destroyed and 4,414 homes had been damaged. However, given that many affected locations remained underwater and others too dangerous to access due to the possibility of further landslides, it was likely that this number would rise once further assessments had been completed. On 25 May, the Government of Sri Lanka estimated that a total of 128,000 houses could have been impacted by the disaster, with 30,000 in need of reconstruction or rehabilitation (UNOCHA, 26 May 2016).

Sri Lanka

We have been collaborating with Sentinel Asia (SA) in the areas of flood and landslide disaster management in Sri Lanka. Following the flood and landslide disaster in May 2016, the data and products of SA were received and shared to relevant agencies including DMC, Irrigation Department, UN-SPIDER, ReliefWeb, UNOCHA, and Red Cross. We also posted the products and disaster information on IWMI website, and social media such as on Facebook and Twitter. They were very useful not only for rescuing people, knowing the damaged areas, and briefing disaster situation to media, diplomats and other stakeholders, but also for advocacy to donors and humanitarian organizations for assistance.

We would appreciate if Sentinel Asia incorporates training programs (for capacity building of member organizations) as one of its regular and integral activities. Additionally, we have to work towards reducing product duplication by DANs of Sentinel Asia, for instance by clearly specifying assigned tasks and responsibility of a DAN or DANs in a particular disaster.

Dr. Giriraj Amarnath
Sub-theme leader , Water-related Disaster Risk Management
International Water Management Institute (IWMI)

Floods in Sri Lanka

Inundated homes/village

Rescue activity

Photograph credit: DMC

Country profile

Official name: Democratic Socialist Republic of Sri Lanka

General information: Democratic Socialist Republic of Sri Lanka is located on the island of Ceylon, southeast of India, with land area of 65,607 sq. km. Plain land spreads in northern half of the country, whereas south part is mountainous, also comprising Mt. Pidurutalagala, which is surrounded by the coastal plain. The country is generally dominated by tropical climate, mostly hot and humid, yet cool and cold in the highlands. Basically, Sri Lanka is strongly influenced by monsoon (rainy season), which begins in May and ends in October. The capital city is Sri Jayawardenapura-Kotte. Out of the population of 20 million, about 73 percent are the Sinhala, 18 percent Tamil and 8 percent Sri Lankan Moors.

Overview of disasters: Major disasters in Sri Lanka are floods, landslides, cyclones, drought, lightning, coastal erosion, and Tsunami. Disaster Management Centre (DMC) is the leading agency for disaster management, which implements and coordinates national and sub-national level programs, while the National Council for Disaster Management (NCDM) is the executing agency and apex body for disaster management, which formulates the national policy and gives strategic direction to its sub-ordinate authorities.

Major natural disasters of the last 3 years (Source: http://www.adrc.asia)

Date of occurrence	Type of disasters	Killed/Missing people	Affected people
15 May 2016	Flood, landslide*	104/99	279,691
Dec. 2014	Flood, landslide	39	90,000
29 Oct. 2014	Landslide	38	Not Reported
01 June 2014	Flood	26/1	110,743
08 June 2013	Heavy rain	40	Not Reported

* indicates the disaster event described in this brochure as a good practice example for disaster risk management

Utilization of Satellite Data for Disaster and Risk Management in Vietnam

The map products and satellite images from Sentinel Asia (SA) have been one of the reference/data sources for us when a disaster takes place in Vietnam. On flood disaster in July 2015, the products from SA were transferred to local provinces and used for damage assessment by the local governments. Our collaboration has been fruitful. I would like to give some comments to further strengthen our cooperation. First, most of the times, data and products were received on time (i.e. soon after the EORs/disasters), but on some occasions it came late and could not be used during rescue operations, so we would expect speedy data sharing all the time. Second, I also propose sharing provided data directly to technical agencies such as STI and DMC so that they can produce disaster maps taking into account the knowledge of local landscape and ecology of disaster-hit areas. Third, pre-disaster satellite images are crucial for hazard and risk assessment and monitoring activities as a good disaster prediction is largely relied on pre-disaster data and circumstances. Therefore, it is important to accept/provide pre-disaster requests/satellite images as step3 activty.

Dr. Bui Trong Tuyen
Director
Space Technology Institute (STI)
Vietnam Academy of Science and Technology (VAST)

Emergency Observation Request following the devastating floods in July/Aug. 2015

Requester: *Ministry of Natural Resources and Environment* (MONRE)
The maps attached here were produced by JAXA, RESTEC, AIT and GIC.

Data: ALOS-2/PALSAR-2
Date of observation: 19 June 2015 (pre-disaster)

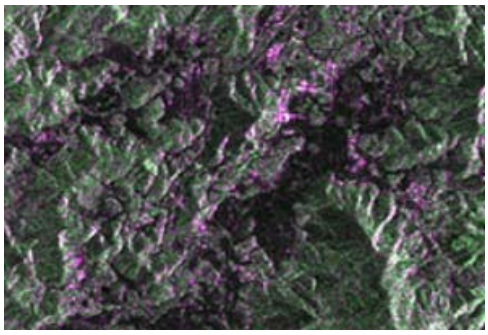

Figure 1. A part of a post-disaster satellite image depicting possible flood areas (in pink)

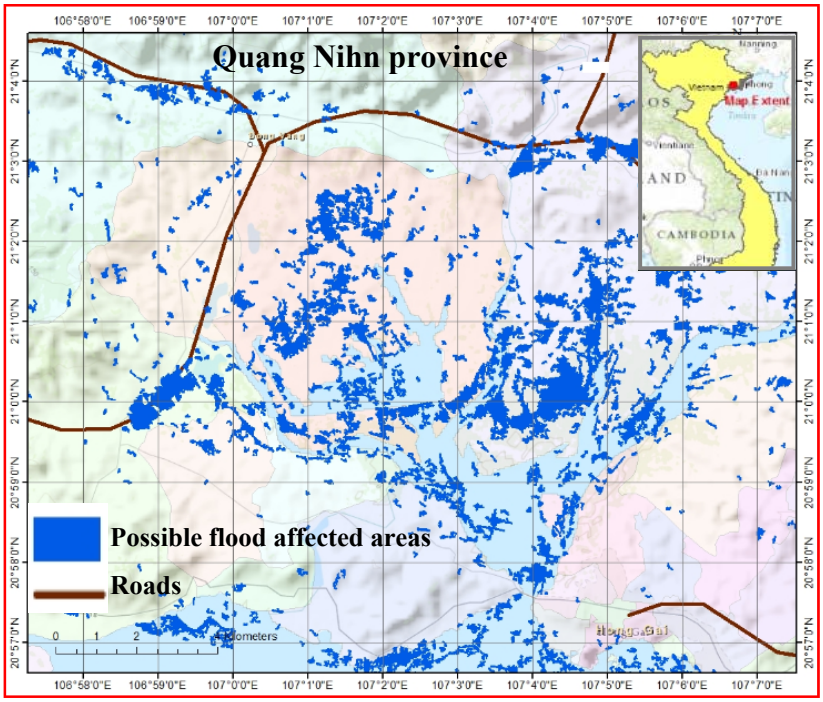

Figure 2. Possible flood areas (in blue)

Between 26 July and 03 August 2015, heavy rainfall occurred in the most of Northern Region of Vietnam including Quảng Ninh, Điện Biên, Lạng Sơn and Sơn La provinces. The rain-fall led to serious flooding in Northern Coastal areas, while flash floods and landslides affected the mountainous regions. Rainfall recorded during the period in a number of stations (e.g. 890 mm in Mong Cai and 1172 mm in Cua Ong) was significantly above the seasonal average. Quang Ninh was the most affected province that experienced worst ever flooding for 40 years. Thirty-three people were reportedly killed, three missing and 48 injured by the disaster. Approximately 8,000 houses, 18 schools, 15,414 ha agricultural areas and 55,877 m irrigation system were damaged, and at least 459,214 m^3 of national roads and 152,885 m^3 of provincial roads were eroded or swept away. Additionally, at least 91 pipe water systems and several protected open wells were damaged affecting about 50,000 people; the situation forced the people to use/drink un-sanitized surface and river water. According to the Central Committee for Natural Disaster Prevention and Control (CCNDPC), the flooding and landslides inflicted an estimated economic loss of US$108 million (UNOCHA, 07 Aug. 2015).

Vietnam

Satellite images and map products provided by Sentinel Asia (SA) after the July 2015 floods were very useful to us. Those data and maps were passed to central and provincial governments, and utilized during field and rapid assessment surveys. Presently, Remote Sensing Center (RSC) under Ministry of Natural Resources and Environment (MONRE) receives or has direct access to data provided by SA. DMC needs to ask to RSC for those data. As DMC is under different ministry (i.e. MARD), it often takes a while to make official procedures for receiving or sharing data/documents among inter-ministries. If this procedure is shortened or SA directly provides data to DMC, it would help us take quicker actions once disasters occur.

We wish to carry out some real project in practice in collaboration with SA that would help build capacity of our staff and contribute to our community. We express our best wishes to SA on the occasion of its 10th anniversary and hope for continuity of our collaboration.

Dr. Vu Kien Trung
Deputy Director
Disaster Management Center (DMC)
Ministry of Agriculture and Rural Development (MARD)

Coal waste dump following landslides

Flood killed 3 people in this home

Burst water pipe

Photograph credit: DMC

Country profile

Official name: Socialist Republic of Vietnam

General information: Vietnam, surface area of 329,241 sq. km, is located in easternmost part of Indochina Peninsula in Southeast Asia. It is bordered by China to the north, Lao PDR to the northwest and Cambodia to the southwest, and by South China Sea to the east. Administratively, the country is divided into 58 provinces and five municipalities. Southern part of the country has the Mekong Delta and plains; central part is mainly composed of mountains; and north part is largely mountainous and hilly except the area in Red River Delta in its south. The country is dominated by tropical climate in the south and temperate climate in the north. In Vietnam, April to October is rainy season, whereas October to March is dry season. Hanoi is the capital city while Ho Chi Minh is the largest city. Out of 85.2 million people, about 86% are from the Kinh ethnic group. The country is also the home to 53 other ethnic minorities.

Overview of disasters: Typhoon, flood, drought, landslides, and wildfires are the main disasters in Vietnam. The country is frequently hit by typhoons from May to January, triggering floods and landslides. Department of Dike Management & Flood & Storm Control, Ministry of Agriculture and Rural Development (MARD), the Disaster Management Center (DMC) under the Directorate of Water Resources are the leading agencies for disaster management. Recently (in 2015), the Central Steering Committee for Natural Disaster Prevention and Control (CSCNDPC) has been established, to be headed by Minister of Agriculture and Rural Development, aiming at coordinating inter-ministries, agencies in organizing and directing the work of natural disaster prevention, control as well as recovery works.

Major natural disasters of the last 3 years (Source: http://www.adrc.asia)

Date of occurrence	Type of disasters	Killed/Missing people	Evacuated/Affected people
26 July 2015	Flood*	32/3	Not Reported
19 July 2014	Typhoon	27	200,000
14 Nov. 2013	Flood	42/5	200,000
10 Nov. 2013	Typhoon	13	756,022
15 Oct. 2013	Typhoon	20	109,600
30 Sept. 2013	Typhoon	12/2	106,352
24 Sept. 2013	Typhoon, flood	24/6	Not reported
06 Sept. 2013	Flood, landslide	29	Not reported

* indicates the disaster event described in this brochure as a good practice example for disaster risk management

GREETING MESSAGES

GeoInformatics Center - Asian Institute of Technology (GIC/AIT)

The Geoinformatics Center (GIC) of the Asian Institute of Technology (AIT) was involved in a discussion on satellite data usage for Disaster Risk Reduction (DRR) during APRSAF 11, and while the Sentinel Asia was formally established the during the 2005 APRSAF held in Kita-Kyushu. Since then, GIC has been continuously providing technical support and assisting regional coordination as a Principal Data Analysis Node (PDAN). The use of SA is becoming widespread lately, and during last two years GIC was involved in over 30 activations as well as helping users with value added products. The strength of satellite data for emergency response is well acknowledged and accepted by disaster management agencies in the region, but as is the case for any system, there is still room for improvement. As the PDAN, it is the expectation of GIC to improve data analysis systems, product delivery systems, and end-users and local agency capacities in order to use data and products to assist DRR by closely working with JAXA and ADRC. While congratulating Sentinel Asia for its success in the past 10 years, GIC is looking forward to strengthening its partnership and collaboration with national disaster management agencies to take advantage of the SA system to enhance national disaster responses activities of all the countries.

Dr. Lal Samarakoon

Indian Space Research Organization (ISRO)

Indian Space Research Organization (ISRO) is closely associated with Sentinel Asia (SA) program for more than a decade, and has actively contributed in providing Indian Remote Sensing (IRS) series based satellite data products for addressing emergency observation requests (EOR's) in Asia Pacific region. It has supported Sentinel Asia in its endeavors of Step-1, Step-2 and Step-3 phases. The support extended to some of the major disasters such as Myanmar Cyclone "NARGIS" in 2008, Pakistan Floods in 2010, Great East Japan Earthquake in 2011, Typhoon "Bopha" Philippines in 2012, China Earthquake in 2014, Nepal Earthquake in 2015, and Taiwan Typhoon in 2016. The support to such major events was made possible with the continued support from Sentinel Asia.

Dr. S V Shivaprasad Sharma

Center for Spatial Information Science, University of Tokyo (CSIS/UT)

Center for Spatial Information Science, The University of Tokyo has participated in the Sentinel Asia through analysis activities of Sentinel Asia's data by Dr. Nagai, who had been seconded to Asian Institute of Technology (AIT). He promoted applications of earth observations in disaster management through lectures and exercises. In addition, He promoted understandings on importance of the Sentinel Asia for disaster emergency response through the hands-on experiences of satellite data analysis using emergency observation data. We would like to contribute to strengthening capacity of disaster management in Asia and Pacific based on the advantages of AIT, where the promising students are studying to be leaders in Asia and Pacific.

Dr. Hiroyuki Miyazaki

National Space Organization (NSPO)

Congratulations on 10 year anniversary of Sentinel Asia! It has been more than six years since the NSPO joined Sentinel Asia back in 2010 under the name of NARL. Since then NSPO has been providing free satellite images for humanitarian supports and contributed to fighting against natural disasters. At same time, NSPO also collaborates with NCDR to integrate multi-scale remote sensing data for domestic disaster mitigation. In recent years, remote sensing is rapidly emerging as one of the powerful technologies to monitor those environmental changes. Particularly, ever since FORMOSAT-2 retired from service in August 2016, the Sentinel Asia provided data have become the main source of satellite images offered to NCDR by NSPO before the FORMOSAT-5 operation.

Dr. Shih-Chieh Chou

Asian Disaster Reduction Center (ADRC)

Congratulations to Sentinel Asia on its 10th anniversary. Asian Disaster Reduction Center has been joining for Emergency observation Request and international conference such as JPTM. Natural disasters have been on the rise during the last half-century. It is expected that space technology including earth observation satellites can contribute greatly to disaster risk reduction. We, ADRC would like to support for Sentinel Asia via our network of disaster management organizations in Asian countries.

Professor. Masanori Hamada

Japan Aerospace Exploration Agency Space Applications and Promotion Center

Sentinel Asia Project Office

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