

## Sentinel Asia step 2 utilization for disaster management in Malaysia

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**Abstract.** With the installation of Wideband InterNetworking engineering test and Demonstration Satellite (WINDS) communication system in the National Space Centre, Banting; officially Malaysia is one of the twelve Sentinel Asia Step2 System Regional Servers in the Asia Pacific region. The system will be dedicated to receive and deliver images of disaster struck areas observed by Asia Pacific earth observation satellites by request of the Sentinel Asia members via WINDS satellite or 'Kizuna'. Sentinel Asia is an initiative of collaboration between space agencies and disaster management agencies, applying remote sensing and web-GIS technologies to assist disaster management in Asia Pacific. When a disaster occurred, participating members will make an Emergency Observation Request (EOR) to the Asian Disaster Reduction Centre (ADRC). Subsequently, the Data Provider Node (DPN) will execute the emergency observation using the participating earth observation satellites. The requested images then will be processed and analysed and later it will be uploaded on the Sentinel Asia website to be utilised for disaster management and mitigation by the requestor and any other international agencies related to the disaster. Although the occurrences of large scale natural disasters are statistically seldom in Malaysia, but we can never be sure with the unpredictable earth climate nowadays. This paper will demonstrate the advantage of using Sentinel Asia Step2 for local disaster management. Case study will be from the recent local disaster occurrences. In addition, this paper also will recommend a local disaster management support system by using the Sentinel Asia Step2 facilities in ANGKASA.

### 1. Introduction

A natural disaster is any event of force of nature that is caused by environmental factors that has catastrophic consequences. Natural disasters include: avalanches, earthquakes, floods, hurricanes, impact events, landslides, mudslides, tornadoes, tsunamis, tropical cyclones, typhoons, and volcanic eruptions. The result will be a large-scale loss of life or damage to property. It could be related to weather, geology, biology or even factors outside the Earth. Disease epidemics are sometimes considered natural disasters, but may be put into a different category. In some cases, natural and human factors may combine to produce a disaster.

According to Emergency Events Database (EM-DAT), 196 natural disasters occurred in 2011 worldwide, killing about 28,800 people and affecting over 85 million people. The estimated amount of economic damage came close to US\$290 billion. The year 2011 sees two large-scale disasters in Asia; the Great East Japan Earthquake and subsequent tsunami in Japan and flood in Thailand, which claimed 20,319 and 813 lives, affected over 400,000 and 9,500,000 people while bringing about economic damage worth US\$210 billion and US\$40 billion respectively.

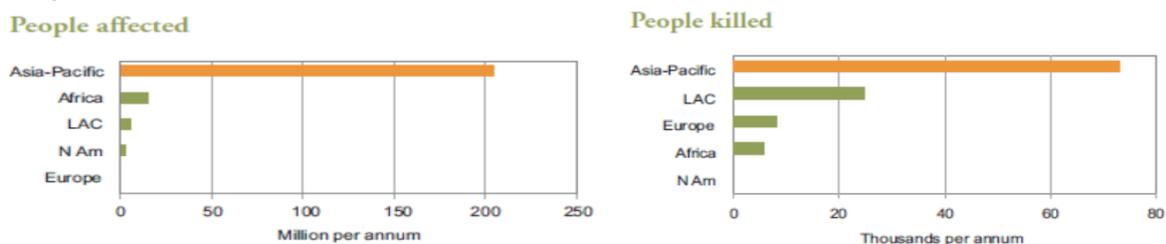
By region, Asia is the highest in the indices of disaster occurrences and number of people affected, and economic damage. Asia accounts for 44.4 percent, occurrences; number of people killed, 82.0 percent; number of affected people, 94.0 percent; and amount of economic damage, 88.7 percent.

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Worldwide disaster trends in composition of indices and top shares of impacts vary by disaster type. For instance, flood made up the largest share of 41.8 percent of all disaster occurrences; earthquake, 71.9 percent of number of people killed; flood, 56.7 percent of affected people; and earthquake, 75.9 percent of total amount of economic damage.

The indices show a similar trend within Asia in 2011, and to the past trend except for 2010 in the world in the long term. In all categories, hydro meteorological disasters such as flood, storm, and drought make up a substantial portion of the total occurrences and number of affected people. On the other hand, earthquake and storm bring about largest shares in number of people killed and economic damage.



**Figure 1.** Average annual population affected and killed by natural disasters, world regions, 2001-2010

## 2. Sentinel Asia

The Sentinel Asia (SA) is a voluntary initiative led by Asia-Pacific Regional Space Agency Forum (APRSAP). SA initiative is a collaboration between space agencies and disaster management agencies, applying remote sensing and Web-GIS technologies to assist disaster management in the Asia-Pacific region. It aims to:

- Improve safety in society by ICT (Information and Communication Technology) and space technology
- Improve the speed and accuracy of disaster preparedness and early warnings
- Minimize the number of victims and social/economic losses.

### 2.1 Sentinel Asia framework

SA is promoted with cooperation amongst the space community, the international community (UN ESCAP, UN OOSA, ASEAN, the Asian Institute of Technology (AIT), etc.), and the disaster reduction community (the Asian Disaster Reduction Center (ADRC) and its member organizations). To support the implementation of the SA project, a Joint Project Team (JPT) was organized. Membership in the JPT is open to all disaster prevention organizations and regional/international organizations that are prepared to contribute their experiences and technical capabilities and wish to participate in technical aspects of disaster information sharing activities. The Japan Aerospace Exploration Agency (JAXA) is the secretariat of the JPT.

### 2.2 Activities of Sentinel Asia

The main activities of SA are as follows:

- Emergency observation in case of major disasters by Earth observation satellites via observation requests of JPT and ADRC members
- Wildfire monitoring, flood monitoring, and glacial lake outburst (GLOF) monitoring
- Capacity building for utilization of satellite images and human resources development for disaster management



**Figure 2.** Flow of emergency observation

### 2.3 Sentinel Asia step 2

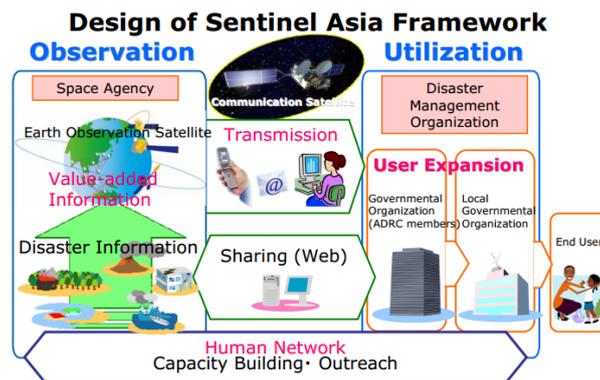
At APRSAF-14 held in Bangalore, India, in November 2007, the recommendation on SA Step 2 was adopted, and the new JPT meeting was held in Kobe, Japan, in June, 2008. Thus, the Sentinel Asia Step 2 project was initiated.

SA Step 2 has the following principles and objectives:

- A contribution from the space community (APRSAF) to disaster management in the Asia-Pacific region
- To promote utilization of disaster-related information obtained by space and remote sensing technologies in order to mitigate and prevent damage caused by natural disasters
- To strengthen and succeed Step 1, considering the findings and achievements of Step 1 and the users' needs
- A voluntary initiative through the new Joint Project Team

SA Step 2 was initiated in 2008, the concept of which is shown in Figure 3. The point of SA Step 2 are:

- making value-added information from satellite imagery
- transmitting the information to users using a communication satellite as well as sharing the information by the Internet in Step 1
- expanding the number of users



**Figure 3.** The concept of Sentinel Asia Step 2

### 3. Malaysia's involvement in Sentinel Asia step 2

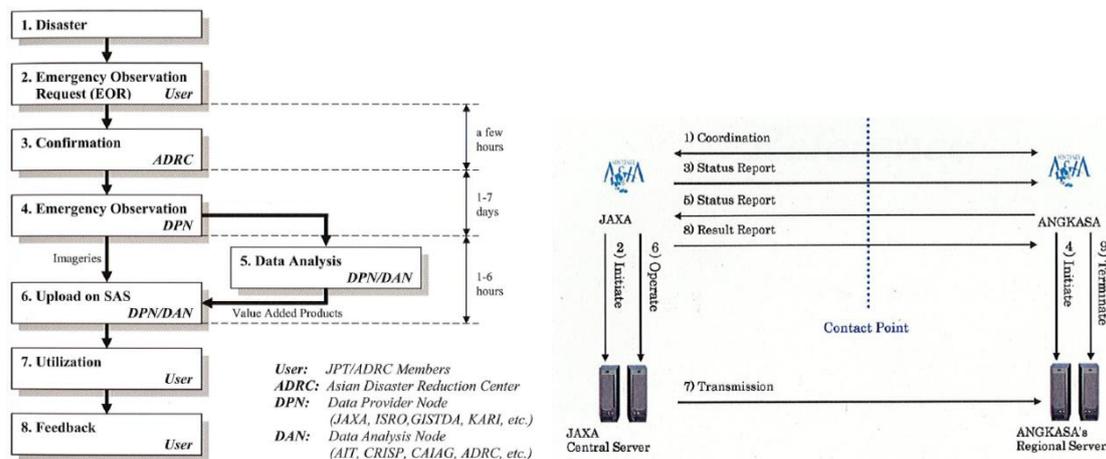
ANGKASA participated officially as a Data Analysis Node (DAN) in November 2012. As a DAN, ANGKASA is responsible to do analyse the data gathered from various participating earth observation satellite such as ALOS, IRS, THEOS and KOMPSAT. A very small aperture terminal (VSAT) was erected in The National Space Centre operated as a communication system with the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS). A high end server was also installed for fast dissemination of information and data archiving.



**Figure 4.** Outdoor unit; VSAT for Sentinel Asia Step2 in National Space Centre, Banting, Selangor

#### 4. Emergency phase operation

In a case when disaster struck in Malaysia or any other neighbouring countries, ANGKASA will sent out an emergency observation request (EOR) to the Sentinel Asia secretariat in Japan. The first step for requesting earth observation data is to submit full information of the requestor and the full details of the requested area. The critical details needed are disaster type, location coordinates, date/time of occurrence, disaster situation, sensor type, mode and other important remarks about the incident. JAXA then will allocate WINDS resource in line with the EOR and layout the satellite observation plan as soon as they received the message. Subsequently after the satellite completed the observation, the data will be transferred to ANGKASA via WINDS satellite. The data then will be processed, analysed and disseminate by ANGKASA for the relevant agencies or local government. On the other hand, the related organizations also could request the raw data from ANGKASA to be processed in house if the organization need to have different type of analysis done for disaster management purposes.



**Figure 5.** Model flow of basic EOR and communication between the central server and ANGKASA.

#### 5. Local disaster management support system

In the past few years, Malaysia has experienced several extreme weather and climatic events, ranging from freak thunderstorms to monsoonal floods which have caused havoc in the country. Monsoonal floods are an annual occurrence which varies in terms of severity, place and time of occurrences. The most recent flood, which happened back in 2010 in Kedah and Perlis, was among the worst flood ever experienced by the country. The total economic loss and the financial burden on the government were enormous. Other than flooding, the country also from time to time, experienced some man-made disasters, which caused considerable damage to properties and loss of lives.

### *5.1 The National Security Council*

In Malaysia, the National Security Council (NSC) is the principal policy making and coordinating body for disaster management. The NSC coordinates and plans all activities related to preparedness, prevention, response/relief operations and recovery/rehabilitation of disaster management. The National Security Council Directive No. 20 (NSC No. 20): The Policy and Mechanism for National Disaster and Relief Management is the main guideline for disaster management in Malaysia. The directive prescribes the mechanism on the management of disasters including the responsibilities and functions of related agencies under an integrated emergency management system. This is achieved through the establishment of the Disaster Management and Relief Committee at three different levels (federal, state and district levels) pending the severity of the disaster. At the Federal level, this committee is chaired by the Minister appointed by the Prime Minister. The directive is supported by other Standard Operating Procedures which outline the mechanism as well as roles and responsibility of various agencies for specific disasters, i.e. flood; open burning, forest fire, haze, industrial disasters etc. The Land Conservation Act; Environmental Protection Act; Town and Country Planning Act; Irrigation and Drainage Act; and Uniform Building by Law complement one another to form a comprehensive disaster mitigation framework.

### *5.2 Early Warning Systems and ICT in Malaysia towards disaster management*

Flood forecasting and early warning system are put in place to disseminate early warning to the public. This integrated system comprised of hundreds of rainfall and water level stations, manual sticks gauges, boards and sirens installed at strategic locations all over the country.

A National Tsunami Early Warning System has been developed by the Meteorological Department after 26 December 2004 to provide early warning on tsunami threat that may affect the country. With this system, the Government is able to forewarn the public of the possible occurrence of tsunami over the Indian Ocean, South China Sea or the Pacific Ocean. Early warnings are disseminated through sirens, short messaging system (SMS), telephone, telefax, webpage, mass media broadcasting system and public announcements. The dissemination of information in a timely manner is crucial to ensure that the vulnerable communities and responders are promptly informed to enable them to take necessary actions.

The ICT is also utilized to promote awareness and disseminate early warnings to the public via a Fixed-Line Disaster Alert System (FLAS). A separate system known as the Government Integrated Radio Network (GIRN) provides radio communication between responders during emergency or disaster. Disaster reporting is now more efficient with the centralized Malaysia Emergency Response System (MERS) emergency hotline: "999".

The mass media is an effective platform to disaster preparedness among the public. To fully realize this potential, the Ministry of Information, Communication and Culture has established a Disaster unit in the Department of Broadcasting Malaysia. This is coordinated at the regional level by the Asia-Pacific Broadcasting Union (ABU).

## **6. Recommendations**

The use of satellite data for response is now well-established for both natural and man-made disasters. Indeed, it is hard to imagine how response to such man-made catastrophes as the Deepwater Horizon oil spill in the Gulf of Mexico would be possible without the overview offered by satellite earth observation. Satellite imagery can be used to track the extent and direction of oil flows for containment and, over time, to identify coastal wetlands adversely affected by the accident.

In the immediate aftermath of a disaster, the primary issue is timeliness. Satellites can provide rapid situational awareness over a large area, typically on a daily basis. This objective, synoptic view of the theatre of operations offers the disaster risk management community a powerful tool to support recovery over the days and weeks that follow a major catastrophe. After the Asian Tsunami of 26 December 2004, the Indian, French and German authorities and the United Nations invoked the Charter and thousands of images from SPOT, Envisat, ERS, IRS, Radarsat, Landsat and US commercial satellites were acquired. Partners produced more than 300 Earth observation-based maps on scales ranging from 1:400 000 to 1:10 000 over Sri Lanka, the Indian coast, the Andaman islands, Africa, Myanmar, Thailand, Indonesia and even Malaysia. These mapping actions supported not only relief, but a host of recovery activities. Typically, needs can be as diverse as getting people back to

work, getting children back to school, supporting community-driven reconstruction, rebuilding houses, roads, bridges, ports and airports, and reconnecting people: electricity and telephones, reviving the economy, rebuilding irrigation systems, bringing clean water and sanitation, rebuilding health services, restoring damaged ecosystems and protecting the environment, restoring local and provincial governments, managing reconstruction transparently, and developing a disaster-mitigation strategy.

Malaysia could better mitigate the human and economic losses caused by disasters if data from current and planned earth observation satellites were used more effectively in disaster management support. Today, meteorological satellites are widely used to detect and track severe storms and to support other weather-driven events. However, operational application of data from these and other earth observation satellites to support management of other types of disasters (e.g., oil spills, earthquakes, forest fires) is significantly less common. And although there have been a great many research and operational demonstrations, which illustrate the potential usefulness of earth observation satellite data for other hazards, a thorough understanding of the requirements of the diverse range of users is needed as a first step toward planning for operational support services derived from earth observation satellite data.

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