

Biennial HFA Progress Review 2007-2009

Space Technology Applications for Disaster Risk Reduction

Prepared by

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
Asian Disaster Reduction Center (ADRC)

Introduction

Effectiveness of disaster risk reduction relies greatly on the effectiveness and efficiency of collection, process, analysis and utilization of related information. Space technology offers many capabilities for disaster risk reduction for decision-makers at all levels, from top-level governmental and international officials, to local communities, even to individual family members.

Although someone may still think space technology a combination of expensive advanced technologies that are not accessible and affordable to most developing countries, their rapid development and broad applications have made their applications and services more accessible and affordable to many least developed countries. Satellite-based information and communications tools have become critical in providing socio-economic benefits for communities and individuals, including poverty and risk reduction from potentially tragic consequences of disasters. Supported by other information and communication technologies, particularly geographic information systems (GIS) based information handling and decision making tools, space information have been widely used by most countries in the world for almost all disaster management stages, from disaster risk assessment and zonation, mitigation and response planning, monitoring and early warning, emergency response, damage estimation, to rehabilitation and reconstruction planning.

Space technology may contribute to disaster risk reduction in following major fields:

1. Earth observation (EO) satellites may provide imagery of the Earth's surface taken in visible, infrared and microwave parts of the electromagnetic spectrum.

With different spatial resolution from sub-meter to hundred meters and re-visit interval from hours to days, they are widely used for disaster risk assessment and planning, early warning, monitoring, mitigation, response and recovery. Such applications in many countries (including in some developing countries) have been operationalized. But for most developing countries, they remain at experimental or pilot stages. While some EO satellites are operated fully on commercial bases, a lot of such satellites are operated by government bodies.

Meteorological satellites are a specialized category of EO satellites, and are a major source of information for daily weather forecasts, particularly in warning about tropical cyclones, tornadoes, severe storms, drought and extreme temperatures. Their global coverage and consistency make them ideal for monitoring the global climate, including regular events such as El Niño and longer-term phenomena like global climate change. Under the framework of the World Meteorological Organization – as well as through fraternal relationships among that bond many national meteorological and EO agencies, such satellites are operated by some government bodies as contribution to the world disaster reduction efforts. Most of their data are broadcasted from the satellites for free reception, and some data are also on-line accessible for countries having not direct receiving capacities.

There are many other global environment study oriented EO satellites that may also provide useful information for disaster reduction related researches, such as microwave sounders and sensors for global monitoring and forecasting precipitation, and sea surface height. Experimental satellite was proposed for detecting the changes in Earth electro-magnetic field that may be closely related to tectonic earthquakes – although in physical terms this still remains a challenge.

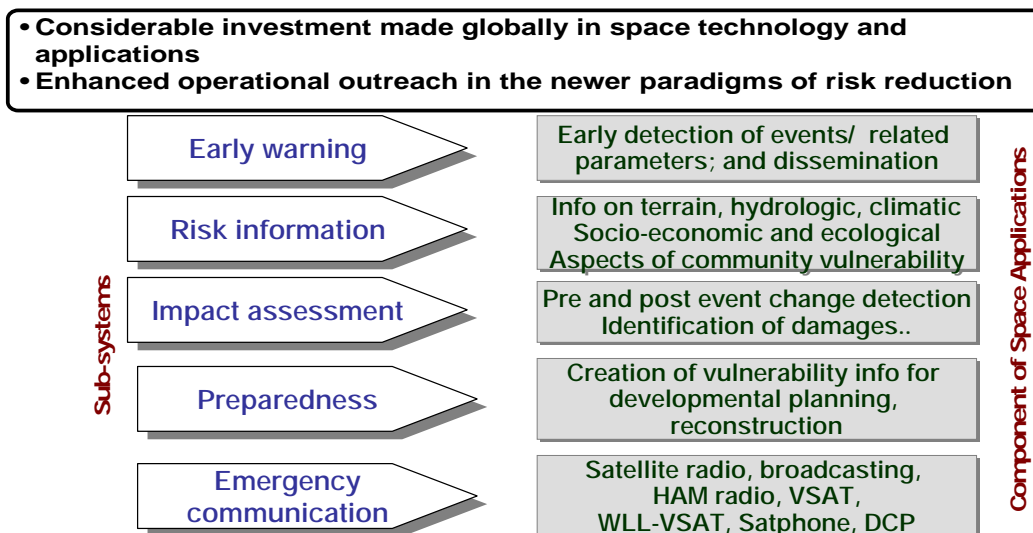
2. Satellite communications (satcom) can support globally universal provisions of satellite telephone, Internet, and broadcasting services which can deliver vital data and warning message for disaster managers. Satcom may provide backup redundancy to replace failed terrestrial infrastructure destroyed by major disasters, and may be the primary or only means of communications support during rescue and relief actions in some disaster hit areas. Satcom is also highly scalable (in terms of ground connectivity) and rapidly deployable to

impacted areas – providing urgent adaptation to the post-disaster increase in needs for communications. Users can range from top governmental officials to communities and individuals. While most such services are provided by international/regional commercial operators, there are also many countries have their own national satellites for both commercial and government subsidized services and applications. Some EO satellites equipped data collection platforms are playing important role in relaying ground observed hydrological and meteorological data to relevant data/information centers.

3. In addition to provide positioning and navigating supports to field rescue and relief teams during major disasters, satellite-based positioning technology has also been widely used to monitor the movement of Earth crust plates at a precision of centimeter even millimeter level, that assists recognize risk areas to volcano earthquake and tectonic earthquake.

Space technology, even within the limited extent of operationalization especially in developing countries of the Asia-Pacific region, has demonstrated operationally a variety of critical applications in risk assessment, monitoring and early warning, impact mapping, mitigation planning and monitoring, and emergency communication. The near real-time ability of EO satellites to capture natural disaster information and to gather information on the terrain, geophysical and weather-related factors pertaining to vulnerability and risk makes it a powerful and indispensable tool for production of knowledge products. It is also a powerful tool for the enrichment of the knowledge base that a country should have to manage its efforts towards natural disaster reduction. In practical terms, however, in some instances a mismatch remains between the potential and existing capability of these technologies, on the one hand, and the less developed institutional, policy and technological frameworks in developing countries of the region, on the other. The Intergovernmental Panel on Climate Change, while highlighting the increasing vulnerability of the region, indicated the growing trend towards weather and geological disasters. It is important that large-scale operationalization of space technology in risk assessment and disaster reduction be promoted.

Operationally demonstrated role of space technology in disaster reduction



This report focuses mainly on the progress in space technology resources applicable for disaster risk reduction in the Asia-Pacific region, and the progress in institutionalization of regional cooperation in recent years.

Trends in country progress

Earth observation satellite resources

Many space capable countries in the Asia-Pacific region have launched many kinds of Earth observation satellites, and most of them are used for disaster risk reduction.

Geostationary meteorological satellites that are currently serve the Asia-Pacific countries are operated by China (FY-2C, -2D), India (INSAT-3A), Japan (MTSAT-1R and -2), Russian Federation (GOMS-N, in stand-by status), USA (GOES-11), and European EUMETSAT (Meteosat-6 and -7)¹. These work-horses typically produce

¹ Mainly based on information from <http://www.wmo.ch/pages/prog/sat/GOSgeo.html>

hourly or half-hourly images of about one third of the Earth under their orbit locations. They are used to support numerical weather forecast modeling. Although each country's system is somewhat different, the systems are also used for integrated global assessments and forecasting. Recent development in this category in the region includes:

- China's launch of FY-2D on 8 December 2006 that may work with FY-2C in a dual-satellite mode to provide intensified observation capacity in every 15 minutes during flood period and major events such as Olympic Games 2008.
- Japan launched a new generation of geostationary meteorological satellites of MTSAT in February 2005 by the Japan Meteorological Agency.
- Republic of Korea has a plan to launch COMS in 2009 to join the geostationary meteorological satellite fleet.

Operational civilian sun-synchronous meteorological satellites, which provide worldwide coverage of cloud images and other atmospheric information twice a day as initial data for numerical forecasting, are operated by China (FY-1D, -3A), USA (NOAA-17, -18), and European EUMETSAT (METOP-A). Such satellite data are also used for monitoring renewable resources and drought disasters, and are playing the key role for weather forecasts over areas at high latitudes where geostationary meteorological satellites can not cover effectively. Recent development in the Asia-Pacific region in this catalog is the launch of a new generation polar-orbit meteorological satellite FY-3A on 27 May 2008 by China.

As contribution of the countries and intergovernmental organizations that operating meteorological satellites to the global disaster risk reduction efforts, most data gathered by meteorological satellites are broadcasted for free access by any country with receiving facilities. Some such data are also available on-line for free access by users having not such receiving capacities. Most countries, including some least developed countries, in the Asia-Pacific region have established capacity for receiving data from meteorological satellites and MODIS data of US Earth Observation System satellites, which are broadcasted for free reception as well. Considering the huge demand of many local users for such information and relevant products and to avoid duplication in building such receiving and procession facilities, China is using communication satellite to broadcast such received data and some kinds of value-added products to thousands users, including some in its neighboring countries with receiving facilities granted by China.

There are tens of other EO satellites, generally called remote sensing satellites, working today in the low earth orbit for environment and resources management and disaster reduction purposes. Among them, many were launched by Asia-Pacific countries.

- China launched the CBERS-2 (launched 21 Oct. 2003) and CBERS-2B (10 Jan. 2007), which were jointly developed with Brazil, and also operates the ocean satellites HY-1B (11 April 2007) and a small satellite Beijing-1 (27 Oct. 2005), which is a member of the Disaster Monitoring Constellation (DMC) promoted and operated by Surrey Satellite Technology Ltd. To better meet the timeliness requirement of monitoring and early warning major disasters and to ensure the observation over cloud-covered areas, China proposed and is developing an environment and disaster monitoring constellation comprising of 4 optical and 4-radar satellites. Towards its first phase, 2 optical satellites were launched on 5 September 2008, and 1 radar satellite will be launched in 2009. China expressed its intention to cooperate with other countries for full deployment of the constellation and for its long-term services over the world.
- Indian IRS series operated since 1980s is the largest remote sensing satellite constellation for civilian use in operation today in the world: IRS-1D (launched 29 Sept 1997), OCEANSAT-1 (IRS P-4, launched 27 May 1999), Technology Experiment Satellite (TES, 22 October 2001), RESOURCESAT-1 (IRS-P6, 17 Oct. 2007), CARTOSAT-1 (IRS P-5, 5 May 2005), CARTOSAT-2 (IRS P-7, 10 Jan. 2007), CARTOSAT-2A (28 April 2008) and IMS-1 (28 April 2008).² All these are placed in polar sun-synchronous orbit and provide data in a variety of spatial, spectral and temporal resolutions to enable a variety of applications, including for disaster management.
- Japan launched its Advanced Land Observing Satellite (ALOS) on 24 Jan. 2006, and plans to develop a disaster management dedicated satellite in coming years.
- Republic of Korea launched KOMPSAT-2 in 2006, and plans to launch KOMPSAT-3 and -5 in 2010 and 2011, and a satellite for ocean and meteorological services in 2009.
- The Russian Federation is operating Monitor-E and Resurs-DK satellites, and is developing its next-generation remote sensing satellites.
- Thailand will launch its Earth observation satellites THEOS in 2008 or 2009, depending on launching arrangement with relevant countries.

² http://en.wikipedia.org/wiki/Indian_Remote_Sensing_satellite

Many countries in the Asia-Pacific region, such as China (including Hong Kong Special Administrative Region and Taiwan province), India, Malaysia, Japan, Russia, Singapore, Thailand and Viet Nam, have established operational systems to receive and process data from remote sensing satellites. These receiving stations are mostly operated by governmental and academic bodies. The Republic of Korea is to operate its receiving station in 2009.

All these countries expressed their intention in providing their satellite information to the countries in the region for disaster risk reduction, and agreed to develop a regional platform under the United Nations to share the information harmonically.

There are also many remote sensing satellites, such as ENVISAT, LANDSAT, SPOT, RADARSAT, IKONOS and QUICKBIRD, commercially available to serve most countries in the world. Many commercial data distribution networks for different kinds of remote sensing satellites of both public and private ones are active in the region for countries without, or with limited, receiving capacities to access relevant satellite services. These satellite data are also widely used by the regional countries in disaster management.

Major issues related to operational use of space information for disaster management

Effective access and utilization of space information for disaster management involves many technical sectors and components, and it also involves issues related to policy frameworks, institutional arrangement and capacity building: 1) upon requests of the users of disaster managers, satellite operators will plan the satellites to acquire the information and transmit them to the ground stations in the shortest time; 2) the received data will be timely processed by the operators or information providers into standardized, sometimes value-added, products, and delivered to the technical support teams of the disaster hit countries; 3) local technical service providers will further analyze received space information with locally available information and local disaster management practices and produce proper products and services for disaster managers' decision making.

Timely information products and services is crucial for understanding the situation of the disaster impacts and to organize effective and efficient mitigation and rescue/relief

actions to save the lives and reduce the property losses. Timeliness equals to the significance that space information is expected to contribute. Timely provision of remote sensing satellite information depends on many factors:

- Availability of satellite resources. Each EO satellite has its own mission objectives, which defined the characters of its orbit and onboard remote sensors. For example, optical remote sensors can not get the information of cloud covered areas, but radar sensors can. These characters determine how quick a satellite may fly over the target area to acquire the information, and how frequently it may re-visit the same area – it may take 3 to 15 days for remote sensing satellites. Large number of satellites may complement and supplement each other, and to improve the timeliness substantively in information acquisition. In this connection, international cooperation to share all available satellite resources is crucial. From such cooperation, all contributory countries are as well the beneficiaries since they also need the information from other satellites.
- Receiving capacity. Satellite data need to be transmitted to a ground receiving station that should be within a direct-viewing distance (2000-2500 km) to the satellite. When the data storage capacity of a satellite is not strong enough, such transmission should be made during the satellite is acquiring the ground information. Though the progress in on-board data storage has reduced the limitation, cooperation among satellite receiving facilities is still a key element to improve the timeliness. While many commercial satellite operators have established receiving network over the world, and China, India and Japan are making efforts to build new receiving facilities, and to reach receiving agreements with existing receiving stations outside their countries.
- Delivery means. Delivery of satellite information, which is received and processed by satellite operators, to service providers of the disaster impacted countries is realized through broadband Internet currently. However, many developing countries, especially least developed countries can not ensure enough bandwidth to make the delivery efficient, particularly in the situation that the information remains in its original format with large volume. Delivery of value-added products may greatly reduce the volume and release the bandwidth limitation. Japan's space agency plans to use its experimental communication satellite to provide broadband connection between the information service center and some local users that can not access to necessary bandwidth.
- Processing capacity. Technical capacities and institutional arrangements in many

countries are not sufficient for a timely provision of proper products and services from technical support teams to disaster management authorities. Most small economies have not the financial and technical ability, and may have not the necessity, to develop a fully equipped technical system. It's more practical for them to develop a minimum capacity to focus on the final tasks that could be done only locally, with some kinds of value-added space information products provided by information providers through well institutionalized cooperation mechanisms.

Cost of commercial satellites' data is always a big obstacle for less developed countries' operational use of space information for disaster management. For most Asian countries that operating government invested remote sensing satellites, the governments assess the success of their satellite programmes mainly by evaluating their contributions to assisting address their major national concerns, in such fields like disaster, environment and natural resources management, national spatial information infrastructure, and development planning. While the governments do not expect to recoup their investment through sales of satellite data, the cost for national institutions' access to relevant satellite information are kept quite low, or almost free of charge. In addition to serve their national needs, China, India and Japan also offered to share their space information resources with other countries, particularly in the field of disaster risk reduction, and have been implementing relevant initiatives to made related arrangements. The Republic of Korea and Thailand also expressed their intention to support such initiatives with their future satellites.

Most developing countries, particularly least developed countries, have not the capacity to establish and maintain stable and effective data request and delivery channels with various satellites information sources, and when the data policy of these non-commercial satellites are not clear, their requirements for remote sensing information rely mainly on available commercial satellites, via commercial data distribution networks. Operational access to non-commercial satellites data for disaster management depends on national high-level commitments of both contributory and beneficiary countries, and the availability of long-term operational cooperation arrangements at policy, institutional and technical aspects. Actually, all the contributory countries are beneficiary ones as well, since there is not any one country may say that it does not needs the information source of other satellites.

Current remote sensing satellites are launched for different purposes, with different technical specifications and data formats. Though relevant satellite owner countries have developed their application methodologies and product models, most space information service providers supporting disaster management, particular those of least developed countries, lack the capacity to deal with so large a verity of data characters from different information sources, and process them into proper products and services for disaster management decision making. When meaningful uses of satellite information should be supported by other locally available information and databases, such as disaster management information systems, it is not possible for outside satellite operators to provide such products and services to meet the requirements of disaster managers of different countries. The governments must have their technical support teams, which could be either some technical team inside the disaster management authorities or contracted local service providers, which may access to local information and local disaster management practices and produce end user needed decision making support products and services. It is the responsibility for the governments to establish institutional arrangements between local services providers and disaster managers, and to establish appropriate technical capacities.

It may not be practical to request the governments to establish fully equipped facilities and technical capacity to deal with different satellite data directly and to produce relevant products and services for their end-users, though a few countries can do so. One solution is to encourage the information providers to develop, based on their knowledge on their satellites, some kinds of value-added interim products for the local service providers, for their easy incorporating local information and practices to timely provide needed decision-supporting products and services.

Disaster management information systems are the mostly needed information maneuver platforms to accommodate and integrate all relevant information, including topographical, meteorological, hydrological, geological, demographical, economic, social information, and historical records and knowledge bases related to local disasters. On such information platform, comprehensive and effective decision supporting tools for disaster management could be developed, and space information could be used as a major input towards their effectiveness and efficiency. Satellite remote sensing may contribute to the establishment and periodic updates of the information systems, and inversely such information systems provide crucial supports to effective process and use of satellite information for disaster management. Most Asia-Pacific countries have

established their disaster management information systems at different levels, though at different stages in different countries.

Applications of space information have demonstrated their great contribution to the success and timeliness of the emergency responses to the catastrophic earthquake that occurred on 12 May 2008 with epicenter in Wenchuan, Sichuan Province of China. The Richet-8.0 earthquake had affected an area about 100,000 Km². There were near 89,000 dead or missing, more than 374,000 injured, 15 million displaced, and 46 million affected. More than 11 million square meter building totally collapsed. To understand the disaster situation in such large area and to provide concrete dynamic information to support relevant mitigation and relief actions, satellite information are indispensable. Within 2 hours after the quake, the National Disaster Reduction Center of China (NDRCC) produced the first map based on archived satellite image and other information within its national disaster reduction information database. The map indicated the epicenter of the earthquake and basic information about surrounding areas, such as the distribution of villages and population, and was presented to the highest decision-makers for response planning. Thereafter, at all high-level decision-making occasions, more than 120 satellite derived monitoring and assessment reports and thematic maps, including identification of most severe disaster affected areas, situation of ruined roads, bridges and their restoring progress, risk assessment of secondary geological hazards, and monitoring of dangerous quake-lakes, were widely referred as concrete evidences for relevant decision-making and planning, and also used to support some key field actions. To produce such information, around 1300 satellite images acquired by 23 satellites were used. Among them, 290 scenes were provided by 17 foreign satellites, including 120 through the channel of the International Charter on Space and Major Disasters, which was responded by major space agencies like European Space Agency, Indian Space Research Organization, Japan Aerospace Exploration Agency, and US Geology Survey.

When the Wenchuan earthquake has demonstrated the value of space information in supporting emergency response, the more significant contributions of satellite information to disaster risk reduction are their potential in supporting pre-disaster preparedness, in such fields of risk assessment and zonation, mitigation and response planning, monitoring and early warning. When meteorological satellites have been operationally used for monitoring and early warning extremely weather events over the world, many countries in the Asia-Pacific region have use other space information to

cope with other disasters. China and India have been using space information for agriculture drought monitoring and early warning for many years, and they expressed strong intention to share their relevant technology and experience with other countries through enhanced regional cooperation, including exploring the possibility to extend their national services to other requested countries.

China is cooperating with some countries like Canada, France and USA in developing space information-based technical models to track the changes of migration routes of major avian flue virus carrying migrating birds, through analyzing relevant ecological and agricultural factors derived from space information, and since indicating the risky areas exposure to such cross-boundary disease, which threatened many Asia-pacific countries in last years.

Nevertheless many countries in the Asia-Pacific region have operationally used space information in their disaster management practices, many successful technical and institutional models and experiments have been accumulated, most developing countries' operational utilization of such powerful technical tools relies heavily on the establishment of well institutionalized regional cooperation. To make such technical tools accessible, affordable and practically useful, above discussed issues should be addressed at policy, institutional and technical levels through effective regional cooperative mechanisms. It is notable that substantive progress towards this objective has been achieved, thanks to the efforts made by all space faring countries in the region.

Communication satellite resources

Many communication satellites covering the Asia-Pacific region are being used to support disaster management related communication needs, providing voice, Internet, conference services during emergency, in addition to TV and broadcasting services that may bring the disaster warning to the public. When most communication satellites are used for traditional TV transmission, voice and data services, new satellites are built for broadband Internet and satellite mobile services.

Most communication satellites are operated commercially. While most communication satellites are operated for international or regional market, some are mainly or absolutely for domestic services by national entities. Several Asian-Pacific countries

operate communications satellites, which may be essential components of disaster communications prior to, and in response to, disasters.

- Indonesia is the first developing country to have its own communications satellites, and has operated the Palapa system since the 1970s. Developed mostly around workhorse (modest bandwidth but best-available reliability in rain storms) C-band technology. It is also introducing broadband Ku-band Palapa D series, expected to be launched in 2009.
- India first experimented with space-based communications in 1975, then with its own systems in 1982, and began full operations with INSAT 1B in 1984. Today, the INSAT series represents the largest system in Asia, with 199 transponders in C and Ku bands. The INSAT platform also carries India's geostationary meteorological payloads, in a special configuration that is to be imitated by the Republic of Korea by launching its COMS in 2009.
- China first launched an experimental communications satellite in 1984, and began full-time commercial satellite operations two years later. Two Chinese companies are operating 5 domestic satellites, and tens of transponders are provided by other regional satellite operators. The Chinese satellite communications industry has advanced to the point that it designed, constructed and launched a communication satellite as a package for Nigerian in 2007, and is doing the similar business with Venezuela.
- Optus, an Australian communications company currently a subsidiary of Singapore's Singapore Telecommunications, first operated communications satellites in 1985. Currently the operating Optus satellites offer a suite of C and Ku-band transponders.
- Two Japanese communications satellite companies have been operating satellites since the late 1980s, having launched and operated about 20 satellites since then. In August 2008, Japan launched its first completely home-grown commercial communications satellite.
- Thailand's communications satellite company, Thaicom, began services with Thaicom 1 in 1993. Currently, the company offers C and Ku-band services, as well as pioneering (in the region) Internet Protocol broadband services to most of Asia and the western Pacific on its IPSTAR satellite.
- Turkey has operated communications satellites since Turksat 1B and 1A, in 1994. Currently, with Turksat 1C added to the constellation, this series offers C and Ku-band services.
- Malaysia started national satellite communications with Measat 1 in 1996. The

- current Measat 3, launched in 2006, provides C and Ku-band transponders.
- The Philippines has operated communications satellites since Agila 2, operated by Mabuhay Satellite since 1997 with C and Ku-band services.
 - Singapore Telecommunications also operates the ST-1 satellite, launched in 1998, in partnership with Chunghwa Telecom located in Taipei, China. This satellite carries C and Ku-band transponders.
 - With the launch of its first communications satellite in April 2008, Vietnam has joined the Asian-Pacific community of satellite operators. Vinasat 1 has 12 Ku and 8 C-band transponders.

Most countries in the Asia-Pacific region are users of international communication satellite operators, such as Intelsat, APT Satellite and AsiaSat. In addition, satellite mobile phone operators INMARSAT, Iridium, Globalstar and Thuraya offer coverage to most (in some cases to all) of Asia and the Pacific. These mobile systems can be keys for readily available deployable capacity to support disaster emergency responses. Such phones need no ground infrastructure, can be solar-charged thus operable away from the electricity grid or generators, and some may be used for accessing low to medium speed Internet services. New models of satellite mobile handsets may also access to both satellite mobile and local cellular mobile services.

It is worth noting that Japan recently launched the experimental Wideband InterNetworking engineering test and Demonstration Satellite (WINDS), and offered its capacity for experimental transmission of remote sensing satellite information to some users difficult to access enough bandwidth for disaster management.

The practice in response to Wenchuan earthquake of China demonstrated the importance of satellite communications in support emergency disaster responses. When the earthquake made a direct loss more than 1 billion US Dollars in telecommunications facilities, and made all communication facilities interrupted for more than 30 hours in 8 mostly damaged counties, the only means to establish telecommunication linkages among headquarters and action teams was satcom. 133 emergency telecommunication vehicles were deployed, and most of them were equipped with satcom facilities though they could not reach most seriously hit areas due to the damages to road systems. More than 2,300 satellite mobile handsets were used through three major satellite mobile service providers. 1394 satellite IDR and VSAT terminals were deployed to support service restoration of cellar phones and broadband Internet, and to provide connection

to various private networks, teleconferences and medical services.

Trends in Global Progress

The rapid development of space technology and its successful applications for disaster risk reduction at national levels around the world has stimulated the desires of space faring countries to better serve the world through international and regional cooperation. Many international and regional initiatives were under implementation to assist all countries' easier and affordable access to relevant space technical and information resources for effective disaster management.

The implementation of the International Charter on Space and Major Disasters, which is a cooperative efforts of major space agencies of the world, and the operation of the UNOSAT to complement the Charter, have delivered invaluable satellite information, in some recent cases value-added products, for monitoring disasters and their impacts – to quickly guide response and recovery. This good example has stimulated broader in-depth cooperation carrying out by many other initiatives, involving not only space agencies.

Several components of the United Nations system treat disaster risk reduction by using space technology based tools. The Office for the Coordination of Humanitarian Affairs is in charge of coordinating UN-related responses to disasters. Funds and programmes such as the Food and Agriculture Organization (agricultural hazard monitoring and support for rural agro-populations), International Telecommunication Union (telecommunications), United Nations Institute for Training and Research (which runs UNOSAT - coordinated with the International Charter on Space and Major Disasters to obtain and deliver space-derived data and information supporting disaster response), World Health Organization (health-related disaster risk reduction and response), World Meteorological Organization (weather, climate, and related disaster forecasting), and World Food Programme (famine response) play specialized roles. The Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations, managed by OCHA and ITU, is intended to facilitate the international deployment of disaster response telecommunications facilities to help disaster-struck communities/countries.

In end 2006, the United Nations Assembly adopted the resolution 61/110 that initiated the programme of United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN SPIDER), to assist its member States to equally access to space based technical tools. Under this programme, the United Nations Office for Outer Space Affairs (OOSA) would set up a programme office in Vienna, and two offices in Bonn and Beijing for organizing relevant activities. It was agreed that the Asia-Pacific regional component of the UN SPIDER will be jointly developed by OOSA and ESCAP. Under this cooperation, ESCAP and OOSA have co-organized two activities: the UN/China Regional UN-SPIDER Workshop, 3-5 December 2007, Shenzhen, China, jointly with the China National Space Administration; and the United Nations Regional UN-SPIDER Workshop: Building Upon Regional Space-based Solutions for Disaster Management and emergency Response for the Pacific Region, 16-19 September 2008, Suva, Fiji, Jointly with the South Pacific Applied Geoscience Commission (SOPAC). In the coming years, ESCAP's efforts in development of regional cooperative mechanisms on use of space technology for disaster management will contribute to the establishment and operation of the global UN SPIDER platform with its effective Asia-Pacific component.

ESCAP and OOSA also jointly organized a Regional Expert Meeting on Using Space Technology for Avian Influenza Monitoring and Early Warning in Asia, 1-3 August 2007, Bangkok, Thailand. The Expert Meeting agreed to establish a working group to further develop operational models for avian influenza monitoring and early warning by use of remote sensing and GIS technologies, and to develop a network mechanism of national avian influenza control authorities and technical supporting institutions for provision of in situ information, including historical ones, for support the development of such technical tools and for its future operation, as a technical basis for establishment and service of an information system for avian influenza in the global/regional/sub-regional levels. The participants from WHO and FAO expressed their supports to this effort by provision of their relevant data and information. ESCAP will work with OOSA to support the work of the working group and the network for the coming years.

In cooperation with OOSA, ESCAP hosted the 4th UN-Wide Meeting on the Use of Space Technologies for Emergency Response and Humanitarian Assistance in Bangkok on 27 November 2007. This meeting was held back-to-back with the Eighth United Nations Geographic Information Working Group Plenary Meeting which was organized by OCHA as chairs of the working group and UNHCR and co-sponsored by ESCAP in

Bangkok on 28-30 November 2007.

The International Telecommunication Union (ITU), in its efforts promoting disaster management communications, has established partnership with ESCAP in the Asia-Pacific region, and jointly organized the ITU/ESCAP Joint Regional Workshop on Disaster Communications, 12-15 December 2006, Bangkok, Thailand. ESCAP will continue its cooperation with ITU to further promote regional cooperation in the important technical supporting field, with its expertise in satellite communication applications, and its connection with national disaster management authorities, and to explore the feasibility of establishing institutionalized regional cooperative mechanisms to provide stronger technical support to their member States in the Asia-Pacific region.

Trends in Regional Progress

ESCAP

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has worked for several decades to help Asia and the Pacific to prepare for, and respond to, disasters of various types. It has contributed to the creation of the Mekong River Commission, the Typhoon Committee and the Panel on Tropical Cyclones (the latter two co-convened with the WMO), and during this decade has promoted the formation of regional cooperation mechanisms in use of space technology for disaster management.

There are many regional initiatives promoting regional cooperation in using space technology for disaster management, and all of them expressed strong intention to develop a harmonized regional platform with under the United Nations for the countries' easier access and affordable use of these space technology based tools for more effective disaster management.

ESCAP's Space Applications Programme for Sustainable Development for Asia the Pacific (RESAP) has been placing emphasis on increased contributions of space technology applications, including GIS technology, for sustainable development and improved quality of life in Asia and the Pacific, and disaster management has been one of its priorities. It does this through policy research and advocacy, capacity building

at policy, institutional and technical levels, covering the fields of Earth observation and satellite communications. This mandate was given by the first and second Ministerial Conferences on Space Applications for Sustainable Development in Asia and the Pacific, held in Beijing and New Delhi in 1994 and 1999 respectively, and the sessions of the United Nations Economic and Social Commission for Asia and the Pacific.

As recommended by its resolution 64/1 in May 2008, ESCAP restructured its secretariat and established the Information and Communication Technology and Disaster Risk Reduction Division, the RESAP is since implemented under the newly created Division, with disaster risk reduction as its focus. The mandates of the Division include:

- Policy options and strategies on multi-hazard disaster risk reduction and mitigation;
- Regional cooperation mechanisms for disaster risk management, including space and other technical support systems;
- Multi-hazard assessment, preparedness, early warning and response to disaster risks;
- Information and communication technology applications for disaster risk reduction.

ESCAP also established a joint task force with the Asia-Pacific Office of the International Strategy for Disaster Reduction (ISDR) for a cooperative and coordinated approach to serve the Asia-Pacific region in affairs related to disaster risk reduction.

Space technology applications for disaster management are addressed by ESCAP in both sectoral and multi-sectoral approaches. In addition to major contributory fields of Earth observation and satellite communications, the issue of disaster management is as well addressed through the applications of space-based distance education, tele-health and empowerment of people through community e-centers.

Since 2002 a series of activities have been organized by the ESCAP secretariat on the use of space technology for disaster management. These are part of ESCAP's goal of helping to prepare the region for pursuing the development of improved regional cooperative mechanisms for disaster management, incorporating (but not constrained to) space technology. With substantial financial support of France, Japan, the Republic of Korea, and in-kind contribution of China, India, Indonesia, Malaysia, Singapore and Thailand, these activities discussed broad technical, institutional and policy issues

related to the operational use of space-based information in effective disaster management practice. Through the studies on policy framework for regional cooperative mechanisms on space technology applications for disaster management, and on policy framework on space information products and services for disaster management, ESCAP has made clear its strategic direction in promoting a scientifically sound, diplomatically acceptable and politically relevant, harmonized regional cooperation platform for member States' easy access, affordable and effective use of space information for disaster management.

The ESCAP secretariat has organized meetings on disaster management communications through partnership with organizations, such as ITU and the Asia-Pacific Satellite Communications Council (APSCC). It is also promoting and supporting recent initiative, Tampere Convention, entering into force for the development and affordable/sustainable implementation of deployable satcom-enriched disaster response capabilities. ESCAP believes that each country would benefit from having disaster management emergency communication capacities, and the fact that satellite-enhanced deployable systems have demonstrated their capabilities for supporting response activities to the recent tsunami and earthquake disasters in Asia and hurricane disaster in America. ESCAP is working with others to help countries establish such capacities.

Responding to the request of Pacific leaders, ESCAP conducted a study on Pacific connectivity in 2006 -2007, in cooperation of ITU, Pacific Island Forum Secretariat (PIFs). When recommended options in technical, financial, institutional and commercial aspects, including the development of a dedicated satellite communication system for the Pacific island countries, the study also emphasized the importance of communication to disaster management in the Pacific countries. Follow-up efforts are planned to explore actions in satellite communication applications for delivery of disaster related information to the Pacific countries, in particular the satellite based information.

Under the ESCAP Regional Space Applications Programme, China, India and Indonesia have been providing training opportunities to developing countries, particularly least developed countries, in the region on use of space technology and GIS technology for development. Recently, such training activities have been directed to the use of space information and GIS for disaster management. To support such activities, under its South-South cooperation framework ESCAP have been providing fellowship of travel cost to the trainees to participate the training, and the host governments cover all local

costs of the training activities. In coming years, these training will be continued and more focused to meet capacity building requirements of least developed countries in their participation in and benefit from the regional cooperative mechanisms.

With supports of China, India, Thailand and FAO, ESCAP is promoting regional cooperative mechanism on space information for drought disaster monitoring and early warning. A series of discussion were conducted, and a manual on space information products and services for drought disaster monitoring and early warning is under compilation. It is expected that the manual, after discussion among and further improvement by participating countries, would be used as the technical basis for establishment of the cooperation mechanism. The possible modalities of the mechanism were suggested include exchange of experience in technical development and institutionalized operational services, development of local service models, training and on-the job train, and possible extension of national services to requested neighboring countries.

APRSAF and Sentinel Asia:

The Sentinel Asia (SA) initiative is 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 and space technology
- Improve speed and accuracy of disaster preparedness and early warning
- Minimize the number of victims and social/economic losses

SA is a voluntary initiative and best-efforts-basis led by the Asia-Pacific Regional Space Agency Forum (APRSAF) to share disaster information across the Asia-Pacific region, using primarily the Digital Asia (Web-GIS) platform. Its architecture is designed to operate initially as an internet-based, node-distributed information distribution backbone, eventually distributing relevant satellite and in situ spatial information on multiple hazards in the Asia-Pacific region.

SA is promoted with cooperation amongst the space Community (APRSAF), the international community (UN ESCAP, UN OOSA, ASEAN, Asian Institute of Technology (AIT) etc.), the disaster reduction community (Asian Disaster Reduction Center (ADRC) and its member countries) and the Digital Asia Community (Keio University etc.).

To support the implementation of the SA, a Joint Project Team (JPT) was organized.

Membership of the JPT is open to all the APRSAF member countries, disaster prevention organizations and regional/international organizations that are prepared to contribute their experience and technical capabilities, and that wish to participate in technical aspects of disaster information sharing activities.

A step-by-step approach for implementation of this dissemination system was adopted as follows:

- Step 1: Implementation of the backbone Sentinel Asia data dissemination system as a pilot project, to showcase the value and impact of the technology using standard internet dissemination systems (2006-2007)
- Step 2: Expansion of the dissemination backbone with new satellite communication systems (2008-2012)
- Step 3: Establishment of a comprehensive disaster management support system (2013 onwards)

SA Step1 has achieved its overall goals. The Sentinel Asia website has operated since October 2006. It has served as a good demonstrator project, to share disaster-related information obtained by several Earth observation satellites such as Advanced Land Observing Satellite (ALOS), Indian Remote Sensing Satellites (IRS), Multi-functional Transport Satellite 1R (MTSAT-1R), Terra and Aqua. It also demonstrates recent advances in web-mapping technologies and ICT systems.

SA Step 2 has recently been initiated with 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 technology in order to mitigate and prevent damage caused by natural disasters
- To strengthen and succeed Step1, considering the findings and achievements of Step 1 and users' needs
- A voluntary initiative through the new Joint Project Team

The results of the emergency observation in Nov 2007-Jly 2008 are given in the table-1, the table-2, the table-3.

The cyclone and typhoon, the flood and landslide, the earthquake are 3 times emergency observations each other in the table-1.

Indonesia and Japan, Bangladesh requested 2 times each other in the table-2.

The detail of disaster that the emergency observation was requested is given in the table-3.

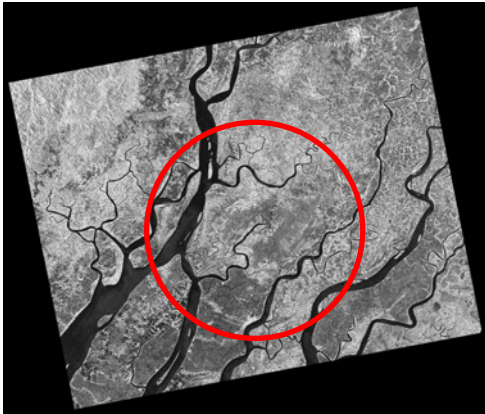
Several imagery in Myanmar and Indonesia are given in the figure-1 and the figure-2 as the example distributed imagery

Table-1 Frequency by category

Event	request frequency	obsavation frequency
Cyclone and typhoon	4	3
Flood and Landslide	3	3
Earthquake	3	3
Snow avalanch	1	0
Storm Surge	1	1
total	12	10

Table-2 Frequency by country

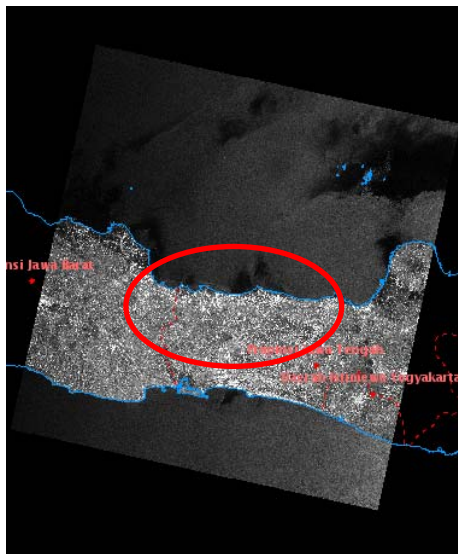
country	request frequency	obsavation frequency	comments
Australia	1	1	
Bangladesh	2	1	
China	1	1	request from SA Secretariat
Indonesia	2	2	
Japan	2	2	
Myanmar	1	1	Request from Austlaria
Pakistan	1	0	
Philippines	1	1	
Viet nam	1	1	
total	12	10	



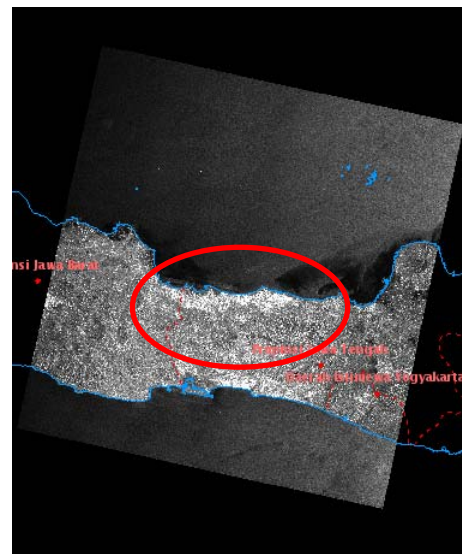
Before(PALSAR2008/3/28)
Figure-1 Example imagery in



After(PALSAR 2008/5/7)
Myanmar



Before (PALSAR 2008/1/9)
Figure-2 Example imagery in Indonesia



After (PALSAR 2008/2/24)

Table -3 Result of the emergency observation (Nov 2007-Jly 2008)

Date of request	Duration	Country	Event	Disaster scale	Practice of observation	Comments
2007/ 11/ 7	2007/ 10/ 28	Viet nam	Flood,Flash Flood	Flash floods killed at least 13 people and injured 31 in central Vietnam this week and more heavy rain over the next few days could add to the damage, the government said on 1 November 2007.	normal observation	
2007/ 11/ 15	2007/ 11/ 15	Bangladesh	Tropical Cyclone	Thousands of families have been evacuated from their homes in over a dozen coastal districts of Bangladesh as a severe cyclone Sidr heads in from the Bay of Bengal, officials said on 15 November, 2007. As of 26 November, the Government of Bangladesh (GoB) official reports indicated that more than 7 million people were affected by Cyclone Sidr, with a death toll of 3,243 people, with a further 880 missing and 34,708 injured	emergency observation	
2007/ 11/ 26	2007/ 11/ 23	Bangladesh	Tropical Cyclone	-----	-----	Hevy hazard didn't occur
2008/ 1/ 11	-----	Pakistan	Snow avalanch	-----	-----	Event didn't occur
2008/ 1/ 24	2008/ 1/ 14	Australia	Flood	The flood started on 14 January 2008 has caused 3200 displaced in Queensland, Australia	emergency observation	
2008/ 2/ 26	2008/ 2/ 7	Indonesia	Flood, Landslide	Two people were killed and five more were missing after heavy rainfall triggered a landslide on the Indonesian island of Java, an official said.	normal observation	
2008/ 5/ 7	2008/ 5/ 2	Myanmar	Cyclone	A tropical cyclone has killed at least 22,500 people in Myanmar and 41,000 people are missing	emergency observation	Austlaria requested
2008/ 5/ 13	2008/ 5/ 12	China	Earthquake	On 12 May 2008, an earthquake of magnitude 7.9 and depth 19km occurred in China (Sichuan).	emergency observation	Japan requested
2008/ 6/ 4	1900/ 1/ 0	Indonesia	Storm Surge	Residents in the Indonesian capital, Jakarta, braced for further flooding after a high tide of over 2 metres resulted in flooding in parts of the city on Wednesday (4 June 2008).	normal observation	
2008/ 6/ 14	2008/ 6/ 14	Japan	Earthquake	12 people were killed and 10 people are missing, and 353 were injured Saturday morning when a magnitude 7.2 earthquake struck northeastern Japan, Japanese officials said.	emergency observation	
2008/ 6/ 25	2008/ 6/ 21	Philippines	Typhoon	Typhoon Fengshen has killed 155 people in the Philippines in a torrent of flashfloods and landslides, the head of the Philippines Red Cross, Richard Gordon, told local radio on Sunday.	emergency observation	
2008/ 7/ 24	2008/ 7/ 24	Japan	Earthquake	A magnitude 6.8 earthquake struck northeastern Japan on 24 July 2008 injuring 95 people	emergency observation	

]

Major enhancement/expansion items from SA Step1 to SA Step2 are follows:

1° Participation of various satellites

In addition to Step 1's Earth observation satellites such as ALOS (JAXA), MTSAT-1R (JMA) and IRS (ISRO), new Earth observation satellites such as the Korean Multi-purpose Satellite (KOMPSAT, KARI), Thai Earth Observation System (THEOS, GISTDA), and communications satellites such as the wideband Internetworking Engineering Test and Demonstration Satellite (WINDS, JAXA) etc. are expected to join.

2° Improvement of accessibility to information

In addition to data sharing via the Internet in Step 1, information transmission to facilitate access to disaster-related information through various means including demonstration of the use of new-generation communication satellites will be introduced.

3° Value-added data

A new framework of satellite data analysis is organized to provide analyzed images and easily comprehensible interpretations from images.

4° Expansion of disaster scope

SA is expected to contribute to the mitigation of global warming through strengthening its contribution to wildfire management, which has a substantial influence on global warming.

5° User expansion

An expansion plan of the user-base will be developed to include local disaster authorities in cooperation with organizations such as UNESCAP.

6° Enrichment of outreach and capacity building

A new framework to promote outreach and capacity building will be organized. JAXA, ISRO, AIT and ADRC are expected to be among the organizations that join the framework.

(Descriptions of this “APRSAF and Sentinel Aisa” portion are provided by JAXA.)

AP-MCSTA and the Asia-Pacific Space Cooperation Organization (APSCO)

Asia-Pacific Multilateral Cooperation in Space Technology and Applications (AP-MCSTA) was initiated by China, Pakistan and Thailand in 1992, with the objective to promote multilateral cooperation in space technology and applications in the Asia-Pacific Region. In April 1998, a Memorandum of Understanding was signed jointly by China, Iran, Republic of Korea, Mongolia, Pakistan and Thailand for “Cooperation in Small Multi-Mission Satellite (SMMS) Project and Other Related Activities”, and Bangladesh joined this Group in July 1999. Now the small satellite was launched on 5 September 2008 in China, as one optical satellite under the first stage of the environment and disaster monitoring constellation, as proposed by China.

Under AP-MASTA, a series of workshops and training activities were organized, including some on the applications of space technology for disaster management. Among them, some training opportunities were offered to ESCAP as support to the implementation of the Regional Space Applications Programme.

Now AP-MCSTA is going to be institutionalized as the Asia-Pacific Space Cooperation Organization with the APSCO Convention being signed by 9 countries of Bangladesh, China, Indonesia, Iran, Mongolia, Pakistan, Peru, Thailand and Turkey. It is expected that the small satellite constellation for environment and disaster monitoring will be the core field for the cooperation activities among its members. Major members of AP-MCSTA have expressed their strong intention

to cooperate with ESCAP in the field of space technology applications for disaster management, with its major technical resources of the disaster monitoring constellation, and to support the establishment of regional cooperation platform on space technology applications for disaster management under the United Nations.

ADRC

The Asian Disaster Reduction Center (ADRC) was established in July 1998, with a mandate to facilitate multinational cooperation for disaster reduction in the Asian region. Along with 27 member countries, ADRC pursues activities leading to further prosperity and safe, peaceful, and comfortable lives in Asia.

ADRC also addresses issues of concern related to disaster reduction from a global perspective, in cooperation with international organizations and initiatives, such as the International Strategy for Disaster Reduction (UN/ISDR), the United Nations Office for the Coordination of Humanitarian Affairs (UN/OCHA), UNESCO, the United Nations University (UNU), the United Nations Economic and Social Commission for Asia and the Pacific (UN/ESCAP), World Meteorological Organization(WMO), and the World Health Organization Regional Office for the Western Pacific(WHO/WPRO).

One of the services of Sentinel Asia is the emergency observation by the satellite for the disaster affected area. According to request from the organization in disaster affected country, the emergency observation is implemented. This emergency observation service started form Oct 2006.

The follow chart to the distribution of the imagery of emergency observation from the emergency observation request is given in the figure-3.

Now ADRC is only gate way for the emergency observation request at SA, and only ADRC member and the JPT member can request the emergency observation.

ADRC receives the emergency observation request, and requests the emergency observation to Date Provider Nodes (DPNs) such as JAXA and ISRO.

According to request from ADRC, DPNs implement the emergency observation.

Then ADRC announces the results of the emergency observation to the requester by the Sentinel Asia webpage or E-Mail etc.

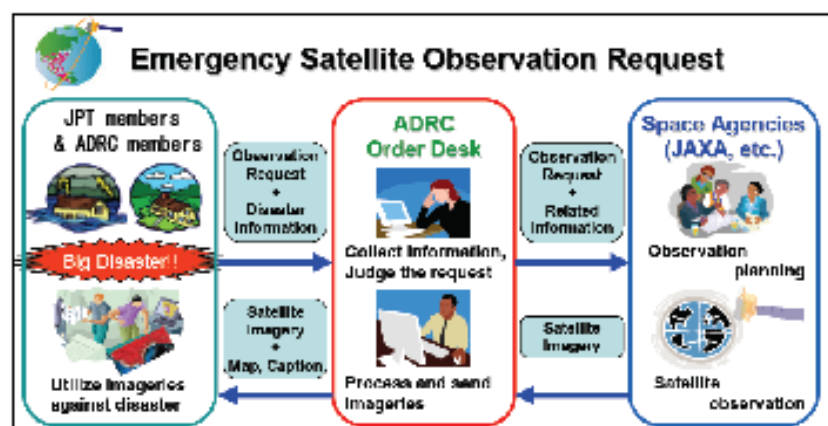


figure-3 Emergency Satellite observation Request

Other sub-regional initiatives

There are many sub-regional initiatives are promoting the use of space information and GIS for disaster management.

Under the framework of the South Asian Association for Regional Cooperation (SAARC), the Disaster Management Centre was established in October 2006 in New Delhi. Through this center, Pakistan, Bangladesh, Afghanistan and other SAARC countries may access to free-of-cost remote sensing data collected by various satellites launched by the Indian Space Research Organization (ISRO) during major disasters in its member countries.

Limited by the economic scales and technical capacity, the Pacific Islands Applied Geo-science Commission has been playing the role of gateway for Pacific island countries' access to space information products and services, including in the field of disaster risk reduction.

Recommendations

Space technology based tools are indispensable for effective disaster management. When most space faring countries expressed intention to share their relevant technical and information resources to support other countries' disaster risk reduction efforts, major actions should be focused on

- 1) Further study on relevant policy issues for most developing countries' easy access and affordable and effective use of such technical tools, and provide relevant options towards institutionalized cooperative mechanisms.
- 2) Development of a scientifically sound, diplomatically acceptable and politically relevant, harmonized regional cooperation platform, as a the regional component of the global platform;
- 3) Commitment of contributory countries on provision of value-added products to less capable countries;
- 4) Harmonization of common agreed space information products among different initiatives;
- 5) Development of data policy of space faring countries on provision of space information for pre-disaster preparedness purpose.
- 6) Commitment of capable countries and development aiding agencies to support the long-term provision of such services.

Contact Person / Focal Point

Mr. Xuan Zengpei, Chief, Information and Communication Technology and Disaster Risk Reduction Division, ESCAP

Mr. Wu Guoxiang, Section Chief, Information and Communication Technology and Disaster Risk Reduction Division, ESCAP

Mr. Koji Suzuki, Executive Director, ADRC