ESCAP Technical Paper
Information and Communications Technology and
Disaster Risk Reduction Division

Space Applications for Improving Disaster Management

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Abbreviations

ADRC	The Asian Disaster Reduction Center
ADB	Asian Development Bank
ADBI	Asian Development Bank Institute
ACTED	Agency for Technical Cooperation and Development
AP	Access Point
BCPR	Bureau for Crisis Prevention and Recovery
BNSC	British National Space Centre
CONAE	Argentine Space Agency
CNSA	China National Space Administration
DHNetwork	Digital Humanitarian Network
DLR	German Aerospace Center
DMCii	DMC International Imaging
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	The United Nations Food and Agricultural Organisation
GDACS	Global Disasters Alerts and Coordination System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFMC	Global Fire Monitoring Center
GIEWS	Global Information Early Warning Service
GLOF	Glacial Lake Outburst Flood
HFA	Hyogo Framework for Action
ICC	International Criminal Court
IDP	Internally Displaced Person
IGMASS	International Global Monitoring Aerospace System
IHL	International Humanitarian Law
IMO	The International Maritime Organisation
INPE	National Institute For Space Research - Brazilian Institute
IP	Internet Protocol
ISC	International Seismological Centre
ISRO	Indian Space Research Organization
JAXA	Japan Aerospace Exploration Agency
JRC	European Commission Joint Research Centre
KARI	Korea Aerospace Research Institute
MOA	Memorandum of Agreements
MoU	Memorandum of Understanding
MVV	Mobile VSAT Vehicles
NGO	Non Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
OCHA	The United Nations Office for the Coordination of Humanitarian Affairs
PTWC	The Pacific Tsunami Warning Center
RESAP	Regional Space Applications Programme for Sustainable Development
ROSCOSMOS	Russian Federal Space Agency

SAARC	South Asian Association for Regional Cooperation
SLA	Service Level Agreement
SNS	Social Networking Service
SOPAC	Applied Geoscience and Technology Division of the Secretariat of the Pacific Community
SOPs	Standard Operating Procedures
SPC	Secretariat of the Pacific Community
SBTF	Standby Volunteer Taskforce
TSR	Tropical Storm Risk
TEWS	Tsunami Early Warning system
UAV	Unmanned Aerial Vehicle
UKSA	UK Space Agency
UN-GIMM	United Nations initiative on Global Geospatial Information Management
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
UNCCD	The United Nations Convention to Combat Desertification
UNCSD	United Nations Conference on Sustainable Development
UNDAC	United Nations Disaster and Assessment and Coordination
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNITAR	United Nations Institute for Training and Research
UNOHCHR	United Nations Office of the High Commissioner for Human Rights
UNOOSA	United Nations Office for Outer Space Affairs
UNOSAT	The Operational Satellite Applications Programme of the United Nations Institute for Training and Research
USGS	The United States Geological Survey
V&TC	Volunteer and Technical Community
VOIP	Voice over Internet Protocol
WHO	World Health Organization
WMO	World Meteorological Organisation

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1. Introduction

The Asia-Pacific region is by far the most disaster-prone region in the world. A multitude of meteorological and geological hazards have persistently ravaged the region causing, in many cases, devastation, catastrophe and regression to livelihoods, economies and development gains. These hazards can range from extreme weather conditions such as drought, ice, rain, snow, varying temperatures and wind, as well as earthquakes, floods, forest fires, hurricanes, mudslides and volcanic eruptions. There is a growing concern for complex emergencies which can occur as a result of multiple and compound disasters in addition to vulnerable in-country situations which can exacerbate on-going relief and response efforts. The use of space applications can improve disaster management through operational support provided by member States and United Nations entities as well as the development of capacity in monitoring and early warning; disaster mitigation and preparedness; emergency relief and response; and recovery, rehabilitation and long term sustainable development.

As of 2012, 88% of people affected by natural disasters reside in the Asia-Pacific region, where nearly 40% of the world's natural disasters occur (ADB 2013, Chapter 1). The risks faced by populations in Asia and the Pacific over the last four decades are increasing. As an indication, the average number of people exposed to annual floods has increased from 29.5 million to 63.8 million, and population figures in cyclone-prone areas have gone up from 71.8 million to 120.7 million (APDR, 2012).

In terms of the economic impact of losses from disasters, much of this is concentrated in the Asia-Pacific region. As an example, the total global annual average loss from earthquakes is estimated at more than US$100 billion. Of this figure, approximately 76% is concentrated in Asia, 9% in Europe, 8% in North America and 5% in Latin America. The global annual average losses from cyclonic winds are estimated to be over US$80 billion. From this figure, approximately 80% is concentrated in Asia, 13% in North America, 4% in Latin America and about 2% in the Caribbean (UNISDR 2013, pp.55).

Space applications encompass many different space based technologies, tools and techniques. These can range from the use of Earth Observation (EO) satellites for obtaining satellite imagery, Geospatial Information (GI) or integrated location based data along with socio-economic data, Global Navigation Satellite Systems (GNSS) such as positioning systems, Remote Sensing (RS) and imagery analysis, Unmanned Aerial Vehicles (UAV) for aerial photography etc. This paper will discuss ways to improve disaster management through the use of space applications.

The structure of this paper is essentially in two parts, looking at both policy and practice levels within the context of space applications for disaster management. The introductory section will firstly establish the growing need for space applications in addressing disaster management, by highlighting the identified priorities and gaps in disaster risk reduction and disaster management over the last decade, which relate to technologies associated with space applications. Subsequently, in the first section, space applications for improving disaster management will be identified and introduced within the contexts of frameworks and institutional issues. This can help in identifying and leveraging the overarching mandates for pursuing space applications at the policy level and understanding programming motivations. This section will further identify international and regional cooperation mechanisms. This can lead to stakeholder mapping and visualisation of the different actors in space applications and disaster management to better align objectives, identify programming entry points and ensure synergy across the sector and region.

The second section, will highlight trends in focus and priorities over the last several years, with a particular focus on operational activities. Consequently, good examples of operational activities in the different phases of the disaster management cycle, for improving disaster management through space applications will be showcased. These examples will cover the areas of monitoring and early warning; disaster mitigation and preparedness; emergency relief and response; and recovery, rehabilitation and long term sustainable development, in both natural disaster and complex emergency contexts. Additionally, the paper will touch on coordination efforts and opportunities, in space applications at the different levels which can feed into regional coordination mechanisms for improving disaster management. Finally, recommendations will be provided at both the policy and practice levels for improving disaster management through the use of space applications.

1.1. Identified priorities and gaps

Over the last decade, numerous studies have attempted to take stock, understand the scope and potential and identify capacities and limitations, of the different aspects of technology and disaster management. The demand and significance of space applications can be better understood in today's disaster management environment, when considering the recommendations of some of those studies to help identify gaps for improving disaster management. Retrospectively, much of this can be seen as an increasing realisation and the evolution, of the use of space applications in disaster management. Over the years, identified priorities and gaps have shifted accordingly, with overall development thinking and sectoral trends. Strategically, the need to integrate disaster management into long-term sustainable development has always remained but additionally there is now a stronger focus on climate change adaptation within this context, new emerging and compounded threats and sharing the burden of risk and potential for economic value through strengthened public and private commitments. Operationally, the trend has moved from the need to simply extend early warning systems for multi-hazards, identifying national focal points and establishing institutional links, to promoting wider cooperation within and across regions, countries and provincial boundaries, the availability of integrated climate and socio-economic data systems and broader and more seamless information and knowledge sharing networks. The use of space applications for humanitarian response is already well established, integrating space applications into a broader disaster management context remains the challenge.

Considering space applications from an information management perspective, the evolution and technological expectations of information management systems or integrated and holistic technology systems, have significantly changed. Such information management systems have now evolved to ultimately serve decision support. This is most evident in the concept of ‘dashboard’ systems, which essentially provide a snapshot view for decision makers at different levels within an organisational hierarchy. One such example is the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) humanitarian dashboard, although this is used as an assessment and coordination tool where information is still gathered and compiled manually, it provides an opportune example of potentially moving such dashboard concepts within an information management and decision support system (UN OCHA, 2013). These concepts can be integrated into a type of disaster dashboard, using space based information as additional inputs into broader systems for disasters managers.

Within dashboard decision support systems, decision makers get essential information presented to them, within a personalised view, which is appropriate for their day-to-day and exceptional decision making needs. This eliminates information overload which can become a common problem with any information management system and approaches the use of technology from a user’s perspective. This type of usage scenarios or ‘use cases’ as they are known technically, provide an inward looking perspective to designing and using technology systems, rather than an outward perspective, which is often the case. Technological (information) infrastructure is usually already in place but disparate. The creation of such decision support systems, often becomes much smaller and less complex than anticipated if done from a use case perspective. The task of supporting decisions, from the user perspective, can be broken down into individual decisions. Working backwards, information which is required to support that decision can then be realigned from an information systems perspective, if already existing, additional information systems can be developed for information which does not exist within information management systems, and disparate systems integrated to create the necessary information architecture and information management infrastructure to seamlessly provide ‘dashboard’ decision support to end users.

2. Frameworks and cooperation mechanisms for disaster management

Finding the political motivation for pursuing space applications and disaster management can be achieved through various mandates, frameworks and mechanisms. Looking at the trend of identified priorities and gaps in disaster risk reduction and disaster management, over the last decade, it is clear that key drivers of change have emerged in the area of