International Programs and Initiatives on Space for Disaster Management

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Abstract

All countries are vulnerable to natural disasters. While this may not be avoidable the impacts on affected populations can be minimized through implementing an efficient disaster management policy. This is particularly significant given that the cost to human life and the economy rises each year, regardless of how many natural disasters occur per annum.

The tropical region of South Asia with non-linear processes need denser network of observations. What is presently available in South Asia is hardly 20-30% of these requirements. An extremely high-risk region is in fact poorly populated by the observational networks. The idea is of a common satellite in South Asian Association for Regional Co-operation (SAARC) whose members are Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. All South Asian countries share common geophysical, meteorological and oceanographic factors. Space-based platforms can provide trans-boundary perspectives invaluable for more accurate weather forecasting, disaster risk reduction, crop harvest projections and other purposes.

Many challenges still remain before these satellite applications can be made widely accessible to all nations for disaster management. This paper identifies ongoing challenges in space policy and law, correlating remote sensing practices, and data sharing issues for humanitarian relief following natural disasters. This paper concludes that, a new policy framework should be developed specific to the application of satellite technologies for real time sharing of regional satellite data is especially critical in disaster risk reduction.

I. South Asia and Disasters:

South Asia is highly exposed to a variety of natural as well as human induced hazards. SAARC Member States in the last one and a half decades have experienced major disasters, which caused great human and economic losses. In

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2010, Pakistan was hit by the worst floods in its history rendering 20 million people homeless and bringing one-fifth of the country under water. The 2010 and later 2011 floods (in Sindh) also drew attention to the patterns of natural disasters occurring in South Asia and the response mechanisms of the respective states, and local and international humanitarian agencies.

This also brought into the spotlight the extreme vulnerabilities that South Asia as a region, being a climate change red zone faces. The SAARC region is home to more than one-fifth of the world population. With a large population of 1.75 billion which accounts for 34% of Asia's and 22% of the world's population and with a surface area which comprises roughly 10% of Asia's and 2.4% of the world's land surface, the vulnerability of the region to natural disasters acquires significance on a global level. The high rates of population growth and natural resource degradation, with continuing high rates of poverty and food insecurity make South Asia one of the most vulnerable regions to the impact of climate change. Land use, land degradation, urbanization and pollution affect the ecosystems in this region directly and indirectly through their effects on climate. These drivers can operate either independently or in association with one another.

The region which is home to more than 1.5 billion people has around 600 million people living below the poverty line, in other words, more than 40% of the world's poor. Over 37% of the adult population is illiterate. Over 62% of the population is without access to basic sanitation. More than 50% of the women are illiterate and more than 40% of the children under five are malnourished. This part of the population is most vulnerable to the risk of any disaster, be it natural or man-made.

As per the global database of natural disasters, South Asia faced as many as 1333 natural disasters over the last four decades (1970-2009) that took the lives of 9,80,000 people affected 24,13,100 individuals and damaged assets worth US$ 105 billion.[1] A total of 291 natural disasters, which occurred in South Asia, constituted about 96.5% of the total global natural disasters.[2] The costs of hydro-meteorological disasters have increased sharply since the 1980s and the average costs peak at just below US$ 100 billion.[3] While there is a gradual reduction in the number of deaths reported, the number of people reported to be affected increased rapidly in the last 40-50 years, and has averaged at more than 300 million by 2010.[4]

The major reasons for the increasing vulnerability of the population and the countries in the region are largely related to demographic conditions, rapid technological and socioeconomic changes, lower level of human development

1 Emergency Data Base (EM-DAT) on natural disasters, Centre for Research on Epidemiology of Disasters, Leuven, www.em-dat.net/.
2 EM-DAT, South Asia Disaster Report, 2011.
3 EM-DAT, 2011, a, b.
4 EM-DAT, 2011, a, b; Djalante & Thomalla, 2012.

and rapid urbanization. In addition, the region is also particularly sensitive and exposed to the impact of climate change and variability. Every analysis and projection indicates that the vulnerability of the general population will increase in natural disasters in South Asia due to the impacts of climate change and rapid urbanisation; with its consequent migration of poor households to urban areas that the region is witnessing at an unprecedented scale. Climate change will impact food security, nutritional standards and human health, negatively affecting the segment of the human population which is most vulnerable in the event of a natural disaster.

Natural disasters tend to cause economic and social disruptions on a gargantuan scale on a very short notice. In such situations, the administrative and economic structures of the country require a considerable amount of time to restore normalcy to the lives of the affected population. Although no region of the world is completely spared from the wrath of nature, manifested in natural disasters, the poorest countries are hit the most, on account of the inability of the administrative and economic structures of such countries to quickly adapt to and make provision for the emergent situations in the aftermath of any natural disasters.

The fourth assessment report of the Inter-Governmental Panel on Climate Change (IPCC), published in 2007, highlighted climate change would bring some challenges to South Asia, such as:

a) Melting of glaciers in the Himalayas would increase flooding and this in turn would affect long-term water resources and availability in South Asia.
b) Compound pressure on natural resources and environment owing to rapid urbanization, industrialization and economic development.
c) Crop yields would likely decrease up to 30% by the middle of the 21st century.
d) Periodic floods and droughts would impact upon the health of the population.
e) Rising sea level would exacerbate inundation, storm surge, soil erosion and other coastal hazards.

The fifth Assessment Report of the IPCC has highlighted the risk of increase in intensity and frequency of climate related hazards. It indicates the greater variability in monsoons and the emergence of new hazards turning into major disasters that will be manifested in the form of sea level rise and new vulnerabilities. Due to geographic layout of the region, with the Hindu Kush Himalayan mountain range in the north, the Indian Ocean in the south, the Bay of Bengal in the east and the Arabian Sea in the west, high population density, large population under the poverty line and poor infrastructure, the SAARC countries have been historically vulnerable to natural and man-made disasters.

Now climate change has added a new dimension to the region's existing socio-economic and environmental vulnerability.
Human life as well as property will continue to be lost in prodigious amounts and increasingly so unless we shift towards proactive solutions instead of re-active ones.

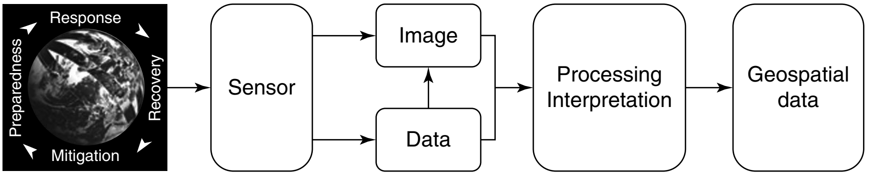
II. Space Technology for Detection and Management of Disasters

The issue of detection and management of disasters; whether natural or man-made, raise certain requirements which have to considered and provided for in any effective system or solution for the detection and management of disasters. Some of those requirements are enumerated below:

a. Any effective system has to be able to carry out surveillance of an extremely large area in a very short time.
b. It must not be dependent upon any ground based infrastructure within the area under surveillance.
c. The surveillance system must be in operation round the clock.
d. The surveillance system must be able to interface and communicate with a multitude of information gathering and communication systems.

Satellite remote sensing refers to technology used for observing various earth phenomena with instruments that are typically onboard a spacecraft. These observations consist of measuring the electromagnetic energy of phenomena that occur without initiating physical contact with the object of interest. Many types of disasters will have certain precursors that satellites can detect. Satellite remote sensing enables information to be provided throughout the different phases of disaster management including assessment, preparedness and mitigation planning, early warning, impact assessment, and emergency communications. This diagram illustrates the remote sensing process as applied to disaster management.

Figure 1 The remote sensing process applied to disaster management. (Source: Enrique Urquijo, 2013)



Satellite remote sensing systems from their vantage point have thus unambiguously demonstrated their capability in providing vital information and services for disaster management. The Earth observation satellites provide comprehensive and multi temporal coverage of large areas in real time and at frequent intervals. Thus they have become invaluable for continuous monitoring of atmospheric as well as surface parameters related to disasters. Polar orbiting satellites have the advantage of providing much higher resolution images, even at low temporal frequency, which could be used for detailed monitoring, damage assessment and long-term relief management. Geo-stationary satellites provide continuous and synoptic observation over large areas with respect to weather patterns including cyclone monitoring. The vast capabilities of communication satellites are available for timely dissemination of early warning and real-time coordination of relief operations. The advent of Very Small Aperture Terminals (VSAT) and Ultra Small Aperture Terminals (USAT) have enhanced the capability further by offering low cost, viable technological solutions towards management and mitigation of disasters.
Satellite communication capabilities – fixed and mobile is vital for effective communication, especially in data collection, distress alerting, position location and coordinating relief operations in the field. The use of remote sensing has become an integrated, well developed and successful tool in disaster management, and the requirement for hazard mitigation and monitoring rank high in the planning of new satellites. The deliverables that can be expected from space data sets at the present scenario include high temporal revisit, high spatial resolution, stereo mapping capability, interferometric SAR and onboard processing. Since each individual satellite covers a relatively small portion of the Earth's surface, a rapid response using high-resolution satellites can only be achieved with several satellites operating simultaneously. Hence, a separate constellation of satellites for disaster management is the need of the hour. The end product obtained from remote sensing that is particularly useful for disaster management is geospatial data.

III. Application of Space Technologies for Disaster Management

The availability of remote sensing technologies data interpretation skills for disaster management is limited in the case of many member nations. Some major differences existing between the member nations with significant economic capacity and those with developing or underdeveloped economic capacities are mentioned below.
Major economies: The majority of the member nations with significant economic capacities have developed complex mathematical models based on meteorological stations placed on a grid over a certain region to provide real time data. These models have evolved to incorporate remote sensing data.

Developing economies: The hydrological models, telemetric models and radar data are scarce.[5] Hence, access to this tool is still limited due to several factors.
Some of the international organizations that use satellite technology for humanitarian activities are the United Nations Institute for Training and Research (UNITAR)[6] through its Operational Satellite Applications Programme (UNOSAT), and the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER).[7] The core missions of these UN agencies involve improving and increasing the use, access, and know-how capabilities of satellite technology, especially in developing States. However, the existing lack of training, knowledge, and infrastructure of end users in these developing countries impacts the State's decision-making abilities and complicates the tasks of UN agencies.
For example, in October 2011, Thailand, Cambodia, Laos, and Vietnam, faced floods that affected over 6.5 million people and claimed at least 500 lives. This particular region has been identified as one of the most impacted by natural disasters. As a result, UNITAR is leading efforts in Thailand to develop satellite based maps and GIS analysis to aid with assessing floods as well as to assist national, regional, and local agencies with planning an efficient disaster management response.
UNOSAT and the Asia Disaster Preparedness Centre (ADPC) both have acknowledged that countries in South Asia are increasing their knowledge base, expertise, and utilisation of satellite data for this purpose.[8] Consequently, these nations are able to respond to and minimise the impact of disasters to a larger degree as compared to the past. Optimizing the institutional knowledge of this technology on a decision-making level and providing for prompt and effective communication and application of this satellite-derived information requires a lot of further effort.
The situation is such that merely attempts to facilitate the transfer of satellite data and images through international platforms is not a complete solution. The frequency of natural disasters in various areas of the globe necessitates not only a prompt response to such disasters, but also requires that attention be paid to the other phases of disaster management. The paucity of distributors of

5 See e.g. Lettenmaier, De Roo and Lawford, Towards a capability for Global Flood Forecasting, World Meteorological Organisation Bulletin 55 (3), July 2006.
6 UNITAR (The United Nations Institute for Training and Research), The mission, United Nations Institute for Training and Research www.unitar.org/the-institute.
7 UNITAR delivers satellite imagery analysis and knowledge transfer to develop capacities of beneficiaries and NGO's in the field of disaster management and assist other UN agencies with their humanitarian activities for free. UN-SPIDER ensures and provides capacity building to States for better disaster management using UNITAR's satellite expertise per region.
8 See e.g. IRIN, ASIA: How space technology aids a flood response, available at www.irinnews.org/report/93933/asia-how-space-technology-aids-a-flood-response (last accessed Sept. 2 2013).

high quality satellite imagery raises the financial and time cost for the humanitarian and disaster management agencies to obtain the requisite satellite data and images to aid their efforts.

Though the Disaster Charter is an example of a free and useful repository for the sharing of satellite imagery for any disaster, its mandate restricts its use of resources only to disaster response, limiting the time and opportunities for data utilization. This excludes the other phases of the disaster management process.[9] According to Article I, the Charter can be activated during a "crisis," this is defined as "the period immediately before, during or immediately after a natural or technological disaster, in the course of which warning, emergency or rescue operations take place." Moreover, the imagery available under the Charter has a limited authorized duration of only 15 days, immediately following Charter activation.

The financial cost of obtaining satellite data and imagery remains one of the major factors, as private companies continue to be the sole providers for specific satellite imagery. But economics is not the only factor to be considered. The political aspects of usage of satellite data and imagery continue to loom large in any discussion in relation to the sharing of satellite data and imagery. Consequently, it is up to the disaster prone member nations to start establishing appropriate political guidelines to overcome economic costs, facilitate the transfer, sharing and use of data and build up satellite network capabilities with tailored technologies able to continuously monitor for natural disasters and provide warning for the same in sufficient time. The table below illustrates the need for sharing satellite technology. As the chart indicates, these are all developing countries without satellite remote sensing resources, except for the United States. The list includes the top 10 countries that have used the Charter resources in the past five years, from 2008 to 2012.

Table 1 The top 10 countries that have accessed Charter resources in the past five years (2008-2012) (based on the Charter activations archive, 2013)

Country	Total
USA	18
Chile	10
Vietnam	6
Pakistan	6
China	6
Philippines	6
Colombia	5
Canada	5
Nigeria	5
Algeria	4

9 The Disaster Charter does not authorize the release of images for the other phases of the disaster management cycle, such as mitigation, preparedness, risk and reduction.

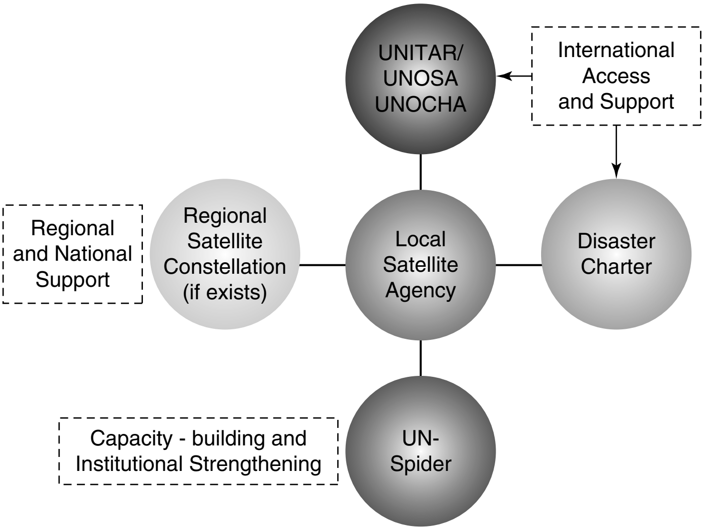
Given the need to enhance or establish national guidelines and policies on disaster management, some member nations inevitably require more attention than others in elaborating national frameworks.
It is generally agreed, that governments should endeavour to put in place national disaster risk reduction guidelines established under strong institutional frameworks to ensure the safety of the lives and property of their citizens. Some countries, however, have at most a superficial institutional framework or have no such framework at all. Moreover, availability of personnel knowledgeable and trained in the effective utilisation of satellite data and imagery may be deficient as well. When the State (end user), has only partial access to knowledge and expertise of GIS and related applications this often results in a slow or difficult coordination of satellite imagery resources, as well as hinders third party assistance in data interpretation and distribution. To overcome this situation, States should adopt UN recommended practices to promote national efforts in establishing efficient disaster management phases. In 2012, UN-SPIDER prepared a set of activities, to promote the use of space-based information to reduce the impacts of natural disasters under these topic frameworks, with a special emphasis on developing countries, in regard to their application of the aforesaid activities:[10]

- Satellite imagery inventories;
- Geo-spatial information management;
- Imagery processing;
- Changes in natural hazards associated with land-use changes;
- Strategies to promote the use of information generated using recommended practices.

The orgranigram below illustrates efficient management of domestic space resources, with contributions from international aid agencies. The core of this system is based on the objective of national governments improving their domestic knowledge and management of technology by cooperating with key international actors and domestic space agencies.

10 UNOOSA, 2012, Technical Cooperation Concept Note, available at www.unoosa.org/pdf/donors/FRT_2012_spider.pdf (last accessed Aug. 4 2013).

Figure 2 An efficient domestic Disaster Risk Management and Cooperation Framework would suggest a disaster management organization scheme like Thailand's disaster management structure using satellite resources.[11]



Besides establishing a solid political framework, a legal framework is necessary on both the international and national levels to manage the acquired satellite data. The following section describes the legal challenges the international community faces in obtaining and making use of satellite data for natural disasters.

IV. Legal Challenges to Application of Space Technologies for Disaster Management

To start with, it is pertinent to note that a single overarching legal framework governing satellite data for disaster management does not yet exist.[12] Consequently, various instruments and legal regimes are applicable, depending on the case and any enacted inter-party legal instruments between the parties involved in the situation. Broadly speaking, five types of legal issues have been identified which are significant in regard to space based applications for disaster relief and management. The implications of these issues affect the

11 See e.g. Srivastava, Sanjay K, Satellite Imagery for Disaster Risk Management: Policy Issues for South East Asia, UNESCAP, p7, available at www.unescap.org/idd/events/2012-Workshop-on-flood-risk-reduction-through-space-applications-in-south-east-asia/Satellite-imagery-for-disaster-risk-management-Sanjay.pdf (last accessed Sept. 2 2013).

12 Ito, Atsuyo, "Legal Aspects of Satellite Remote Sensing" at 162 (2011).

acquisition, sharing, and use of remote sensing data, which can result in conflicts of law and interests between the parties providing and consuming the aforementioned technological products and services. An evaluation of the applicable law is therefore required on a case-by-case basis, even where the provision of any such satellite data and imagery is strictly for humanitarian purposes. This illustrates the evolving nature and challenges that (space) technologies pose for the legal community and governments while simultaneously seeking to maintain the certainty and sovereignty of national laws and frameworks:[13]

1. National Security and Privacy

The very nature of satellite networks and remote sensing technologies makes any data and images obtained from such networks, very sensitive from a military and intelligence point of view. The geo-political situation in south-east Asia, particularly the relations between China, India and Pakistan, the three major powers in the south-east Asian region; render any attempts to establish an institutional framework for the sharing of satellite data and imagery between the agencies of these countries fruitless. The domestic political situation in India and Pakistan, especially in light of their past history, will prove to be a major obstacle in any attempt to facilitate sharing of satellite data and images between these countries. The differing legal and administrative frameworks of each member nation, which are intended to protect the national safety interests of the respective member nations, place restrictions on the private providers of satellite data and images in the form of resolution restrictions or limits on the transfer and sharing of satellite data and images with entities belonging to other nations.[14] These administrative and legal frameworks and the existing geopolitical climate pose significant challenge to the formulation of a supranational policy and institutional and legal framework based thereupon, for the seamless sharing of satellite data and images among the disaster relief and management agencies of the respective member nations.

The rapid development in data collection and data processing technologies of satellites have led to the rise of serious concerns in regard to the privacy of individuals. This assumes importance particularly in the present scenario where sweeping and pervasive surveillance of private individuals over electronic communication networks, by both public and private organisations is proving to be the norm rather than the exception. The data of the individu-

13 See e.g. Annelie Schoenmaker, "Community Remote Sensing Legal Issues" p2, available at http://swfound.org/media/62081/Schoenmaker_Paper_C ommunity_Remote_Sensing_Legal_issues_Final.pdf (last accessed Aug. 3 2013).

14 The Land Remote Sensing Laws and Policies of National Governments: A Global Survey", National Center for Remote Sensing, Air, and Space Law, University of Mississippi (2007).

als, which often consists of private communications and personal details, thus collected is used for a plethora of purposes, which are not stated in the public domain. The lack of adequate and transparent legal framework which regulates the privacy interests of individuals in the south-east Asian region[15] creates an uncertain administrative and regulatory environment. On account of these conditions, acquisition of satellite data and images of adequate quality can prove to be difficult for disaster relief and management efforts.

2. Intellectual Property

It is generally held that the ownership of any intellectual property or creative work is vested in the creator of the work. Different legal instruments, both national and supranational, are applicable to different forms of intellectual property such as images, music, literature, scientific formulae, technological products and services, collections or databases of any form of intellectual property. However, the underlying principles of ownership and control of such intellectual property are based on the traditional definitions and concepts of creation and ownership of property. The nature of scientific and technological development in the twenty first century is different from the preceding periods, wherein scientific and technological development was usually undertaken by an individual or a singular organisation. In the twenty first century, scientific and technological development is more often than not, a collaborative effort involving the endeavours of many individuals and organisations. This is particularly true in the case of any intellectual property related to space, as it involves the use of technological products and services sourced from or owned by different parties. Thus determining the ownership of intellectual property on the basis of traditional concepts of creation and ownership becomes difficult. In the absence of a concrete legal framework for identifying the ownership of space based data and information, the generation and consequent sharing of such data and information is adversely affected.

3. Liability

The importance of high quality satellite data and images cannot be over emphasised in disaster relief and management efforts. Satellite data and images are a vital component in all phases of disaster management from disaster warning to search and rescue operations and disaster mitigation efforts. It goes without saying that thousands of human lives and millions of dollars' worth of property are at stake during such operations. The success of these operations depends, to a large extent, on the quality of the satellite data and images made available to the agencies conducting the disaster management efforts. The satellite data and images, in order to be effective, must be accurate with highly detailed resolution and must be as proximate to the current situation on ground zero as possible with continuous updates. In those situations,

15 DLA Piper's Data Protection Laws of the World Handbook, 2012; pg. 160, 283.

where the satellite data and images available with the providers of such information is only partially accurate or not up to date, the providers of satellite data and images may find themselves vulnerable to legal liabilities for any losses which may arise on account of the usage of such data. In such cases, in order to pre-empt any possibility of situations involving litigation or claims for damages or compensation, providers of satellite data and images may abstain from the transfer or sharing of any partially accurate satellite data and images even though they may have the potential to save lives.

4. Licensing

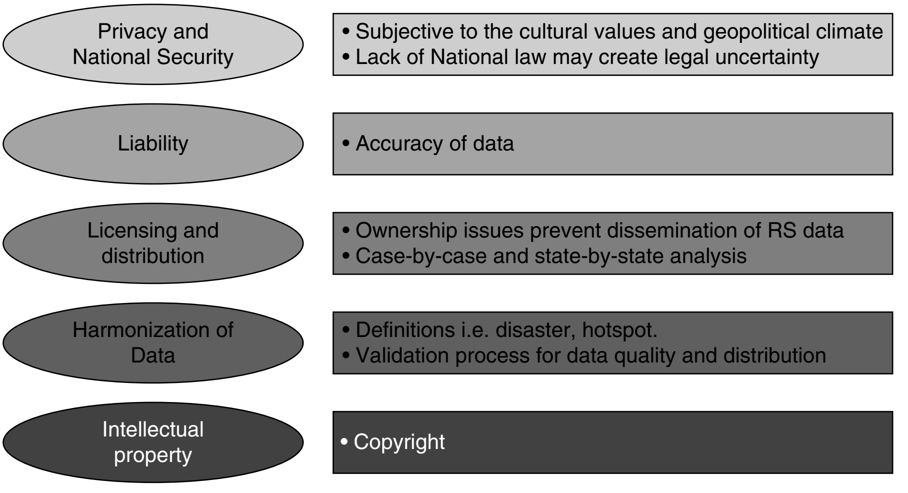
Utilisation of satellite data and images provided by private and commercial satellite providers to other parties is governed by licensing contracts between the satellite providers and the other parties. These contracts place limitations on the transfer of satellite data from the purchasing parties to third parties. The rapid technological development in satellite data collection and data processing; made it possible for a plethora of applications, both public and commercial, to integrate the use of satellite data on a large scale in various technological products and services. However, the existing legal framework governing ownership and use of intellectual property and satellite data has not kept pace with the aforementioned technological developments. Consequently, the data generated by these products and services occupy a legal grey area which deters the substantial dissemination and use of remote sensing data by the agencies involved in disaster relief and management.

5. Harmonisation of Data

In order for the national authorities, disaster management bodies, and emergency agencies of member nations to use the satellite data and images for disaster management, the data is required to be organized into user-friendly categories. Such categories include: searchability, findability, usability, and shareability (as free of charge as possible). The Open Geospatial Consortium (OGC) and UN-SPIDER are two relevant organizations working towards the standardization of geospatial data. The goal is to establish uniform and compatible standards at both the domestic and international levels. These standards include, for instance, how the data is sourced, organized etc.

For the purposes of this article, the most significant legal issues faced by international organizations and governments in utilizing satellite technology for disaster management and relief are illustrated below:

Figure 3 Summary of Legal Challenges. Source: Sandra Cabrera Alvarado (based on 2013 interview with Mr. Luc St-Pierre from UNOOSA)



V. Recommendations for the Use of Space Technologies for Disaster Management in the SAARC Region

1. *Devise mechanism for integration of policy, planning and programmes*
   The SAARC member states have separate set of policies, planning and programmes with respect to the development, regulation and integration of satellite information and communication technologies within the sphere of various activities and purposes. Though, these are often in consonance with each other, there is a need for convergence of processes for integrating satellite technologies with Disaster Management (DM) and Disaster Risk Reduction processes through policies, plans and programmes. A mechanism is therefore required to be put in place within individual countries as well as the region as a whole for ensuring complete integration of legal and administrative policies and structures, plans and programmes undertaken for the improvement of DM and DRR through satellite technology. The transboundary impact of disasters underlines the need for integrated policies and programmes.
2. *Set up platform for knowledge management*
   A number of regional and national institutions are working on various measures to advance DM and DRR through satellite technologies such as database of geological and weather fluctuations, etc. A platform is required for facilitating sharing of such knowledge or information in the form of images, databases, mathematical climate models, etc., conducting regional research studies and pilots and replication of good practices on both these issues among the member states. Therefore, it may be appropriate to

consider setting up a SAARC Knowledge Management Centre on the lines of the SAARC Disaster Management Centre (SDMC). Alternatively, a Knowledge Management Division may be opened in the SDMC itself for better integration of technology at a regional level.

3. *Set up regional coordination mechanism*
   SDMC could help member states in establishing a regional mechanism for coordination between sector agencies in the member states on managing regional common resources and also to facilitate seamless integration of technology capabilities of the member states in times of natural Disasters.
4. *Establish mechanism for monitoring, evaluation and quality control*
   In addition to the governmental agencies, a number of organisations/agencies, regional intergovernmental, regional alliances and networks, etc. are involved in activities pertaining to collection and processing of weather and geological information. The activities related to collection of weather and geological information and data across sectors and disciplines by various agencies result in data which tends to be relied upon in the event of a disaster. Thus, there is a need for developing a mechanism for monitoring and evaluating the information, whether in the public or private domain, which is gathered by various agencies so as to ensure compliance to a certain standard of quality. Guidance notes on compliance, quality control and evaluation criteria with different scales may be developed to guide both policy makers and organisations. A set of quality criteria with respective indicators to monitor and evaluate the data may also be developed for various levels on the basis of which member states or organisations involved in DM and DRR can depend on with respect to the reliability of the information received by them.
5. *Develop strategy for integration of tools and techniques*
   The tools and techniques used in information and communication techniques such as cloud computing, data analytics, mobile data networks, etc. should be integrated in DM and DRR policies and programmes. It may be beneficial to consider a common strategy for SAARC member states to integrate such tools and techniques in DM and DRR policies and programmes.
6. *Create and maintain roster of experts*
   The SAARC member states have developed considerable scientific and administrative expertise on integration of information and communication technologies in various aspects of DM and DRR which should be utilised for the common good in the region. The SAARC Secretariat should create and maintain a pool of experts and institutions from the member states that may be utilised as when required by any member state. This list should also draw upon the expertise available with civil society organisation, including the corporate sector.

7. *Provide financial support*
   integration of satellite detection and communication technologies in DM and DRR would be a long term process requiring sustained efforts on the part of various national and regional institutions. Promotion of satellite technologies in DM and DRR would thus necessitate long-term financial support. The SAARC Secretariat may consider making dedicated non-lapsable funding support for the purpose on a long-term basis. The SDMC could anchor such a facility.
8. *Provide for corporate engagement*
   As the developing of the SAARC region is attracting many foreign corporate entities in the information and communication technology sector to set up their businesses in the region, SDMC should explore the idea of providing a platform to them for their engagement and the pooling of corporate/foundation resources to augment government resources earmarked for leveraging satellite and other communication technologies for undertaking DM and DRR. SDMC should also provide a platform for continuous engagement with the corporate to support risk sensitive development.

VI. Conclusions

No country can effectively monitor the entire planet. International cooperation is the only way to get the most up to date satellite imagery for disaster relief and humanitarian efforts. Indian satellites already have the South Asia neighbourhood and parts of Indian Ocean well covered. If governments can agree on modalities for sharing the massive stream of data coming from the skies, countries can focus on building or expanding systems that apply it for national needs. For this to succeed, India must engender greater trust among its neighbours. One measure is to place technical and humanitarian cooperation above the interests of commerce and politics. To effectuate this objective, an open data access policy is key, allowing for the free and timely sharing of data. International organizations, along with several nations, have already acknowledged this necessity instigating a trend of open data policies and guidelines. Challenges to achieve this purpose still remain, mainly in the political and legal sectors. Consequently, the political will and authority to make these changes lies with States. The urgency and humanitarian nature of this framework, however, should serve to spur Nations into acting. Even laws may be modified for this purpose. The particular and effective use of existing and available satellite technologies for improving disaster risk management strategies is too significant to be waylaid by regional politics.