International Charter and UNOSAT in Managing Disasters and Emergency Responses - An Initial Evaluation

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ABSTRACT: Natural and man-made disasters cause a huge loss of lives and properties, social and economic disruptions, environmental degradation, etc. To mitigate the losses, effective disaster management using modern technology plays an important role. Over the past years, Remote Sensing and Geographic Information System (GIS) have been increasingly used for disaster management and emergency responses all over the world. During and immediately after a disaster, timely and cost effective ways are needed to make the appropriate satellite imagery and rapid mapping services available to the emergency managers to facilitate the emergency responses, rescue and relief operations. In this regard, the International Charter 'Space and Major Disasters' and UNOSAT were established to provide necessary satellite imagery for managing emergency situations and help mitigate the damages. Over the past years, they have provided various satellite imagery and mapping services to the affected communities in different countries. In some cases, the end-users and concerned authorities faced some difficulties in terms of Charter data quality, management and other aspects. In this paper, the authors review and evaluate their past activities, past performances and provide some recommendations for their more effective contributions in disaster management and emergency response for a better acceptance within disaster management communities.

Keywords: Disaster, International Charter, UNOSAT, Satellite Imagery, Emergency Response

1. INTRODUCTION

Natural and man-made disasters cause a huge loss of lives and properties, social and economic disruptions, environmental degradation, etc in the affected areas. Effective disaster management is essential for disaster risk reduction. Over the past years, Remote Sensing and Geographic Information System (GIS) technologies have been increasingly used for disaster management and emergency responses all over the world (Tran et al., 2008; Cutter, 2003; Islam and Sadu, 2001). During and immediately after a disaster, timely and cost effective ways are required to make appropriate satellite imagery and rapid mapping services available to the emergency managers in order to facilitate the emergency responses, rescue and relief operations.

In recent years, a number of global initiatives have been undertaken for disaster reduction. The World Conference on Disaster Reduction (WCDR), which took place in Kobe, Hyogo, Japan in 2005, resulted in the Hyogo Declaration and Framework for Action 2005-2015. The Hyogo Declaration and Framework provides the context for international coordination and cooperation on international disaster reduction. The UN International Strategy for Disaster Reduction (UN-ISDR) is the focal point in the UN System for implementation of the Hyogo Framework. Among several priorities, the Hyogo Framework calls for promoting "the use, application and affordability of recent information, communication and space-based technologies and related services, as well as Earth observations, to support disaster risk reduction" (UN-ISDR, 2005).

In this regard, the International Charter 'Space and Major Disasters' was initiated by the European and the French Space Agencies in 1999 to provide necessary satellite imagery and help mitigate the damages and losses from the natural and man-made disasters (Retiere, 2005). In addition, UNOSAT, a United Nations Programme, have been established to provide satellite solutions and other mapping services to the disaster managers in disaster and emergency situations. Over the past years, International Charter has been activated several times during severe disastrous occasions around the world providing the required satellite imagery and other relevant services. UNOSAT has also provided satellite and other mapping services in managing the disasters. Sometimes the end-users and concerned authorities experienced some problems and difficulties in terms of Charter data quality, management aspects, etc during the past disaster and emergency situations (Charter 7th Annual Report, 2008). Based on the end-user evaluation of the Charter annual report and other sources, the authors critically review these activities, performances and suggest some ways for an even better acceptance within the disaster community including further improvement and practicalness of these services.

2. INTERNATIONAL CHARTER 'SPACE AND MAJOR DISASTERS'

International Charter 'Space and Major Disasters' was initiated by the European and the French space agencies (ESA and CNES) following the UNISPACE III conference held in Vienna, Austria in July 1999 aiming at providing a unified system of space data acquisition and a non-bureaucratic delivery to those affected by natural or man-made disasters. Afterwards, Canadian Space Agency (CSA) signed the Charter on 20 October 2000. Other members, who joined the Charter later on are the Indian Space Research Organization (ISRO) and the US National Oceanic and Atmospheric Administration (NOAA) in 2001, the Argentine Space Agency (CONAE) in 2003, Japanese Aerospace and Exploration Agency (JAXA) and the U.S.

Geological Survey (USGS), as well as the Disaster Monitoring Constellation (DMC) via the British National Space Center (BNSC) in 2005 and the China National Space Administration (CNSA) in 2007.

As shown in Figure 1, the On-Duty Operators (ODO) and Emergency On-Call Offcers (ECO) receive the requests from Authorized Users (AU) and process for relevant satellite data on a 24/7 basis. Authorized users are civil protection, relief organizations or national authorities with a mandate related to disaster management from within the country of a Charter member. They request the mobilization of the space and associated ground resources (RADARSAT, ERS, ENVISAT, SPOT, IRS, SAC-C, NOAA satellites, LANDSAT, ALOS, DMC satellites and others) of the member agencies to obtain data on a disaster occurrence. Project managers quickly assess the severity of particular disasters and the relevancy of satellite data holdings and capabilities. Satellite image capturing plans and feasibility are determined and the appropriate space agencies are contacted to conduct satellite-imaging operations.

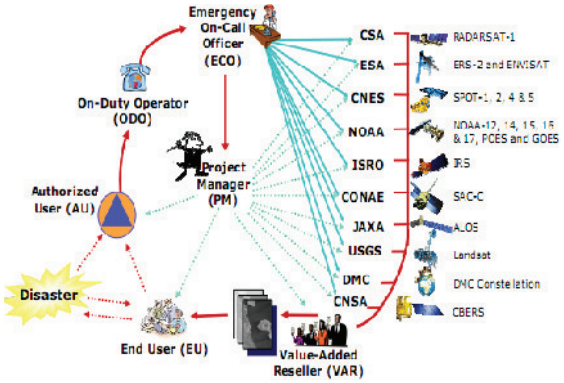

Fig. 1: International Charter Operation Loop

The Charter has been activated more than 200 times in response to floods, earthquakes, landslides, volcanic eruptions, and emergencies such as oil spills and hazardous materials outbreaks (Stryker and Jones, 2009). A major test of the Charter's capabilities occurred in 2004 when a tsunami caused massive destruction throughout the Southeast and South Asia. Both government and privately owned satellite systems provided data to identify and analyze areas impacted by the tsunami. Relief teams were able to use these data and derived information products to rush medical supplies, food and clothing to coastal communities devastated by the enormous waves. Many other countries have also benefited from the Charter partnerships. When Hurricanes Katrina and Rita hit the USA, the Charter members rapidly provided invaluable perspectives from satellites.

3. UNOSAT

United Nations Operational Satellite Application (UNOSAT) is a programme of UN Institute for Training and Research (UNITAR) and implemented in co-operation with the European Organization for Nuclear Research (CERN). UNOSAT is a people-centred programme delivering satellite solutions to relief and development organisations within and outside the UN system to help make a difference in the life of communities exposed to poverty, hazards and risk, or affected by humanitarian and other crises (UNOSAT, 2008a).

UNOSAT is authorized to request data from the Charter members in response to an emergency. It has provided value added processing services for many Charter activations over the years. One important achievement is its dedicated support to the planning and coordination of humanitarian relief operations. UNOSAT operates humanitarian rapid mapping service 24 hours a day all year-round, ensuring that experts are available whenever needed for rapid acquisition and processing of satellite imagery and data for the creation of map and GIS layers in support of emergency response and humanitarian relief coordination.

4. END-USER EVALUATION OF THE PAST CHARTER ACTIVATIONS

End-user evaluation of the past Charter activations is necessary for identification of the existing drawbacks and improvement of their service. During the International Charter activations in different disastrous events in 2007, the end-users and emergency managers experienced different difficulties and problems in terms of quality of the data, management or some other aspects (Charter 7th Annual Report, 2008). The problems faced in some specific disaster events in 2007 and suggestions made by the project managers are shown in Table 1.

Table 1: Problems faced regarding Charter data and respective suggestions made by the end-users

Disaster event	Problems faced	Suggestions
Flood, Argentina (Pilcomayo River), January 2007	It was not easy to download the IRS satellite data due to large size (more than 500 MB each band).	If it is possible, the data can be resized to approximately the area of interest (AOI). Data compression may be considered. Communication between PM (Project Managers) and EU (End-Users) needs to be improved.
Cyclone Sidr, Bangladesh, November 2007	Lack of Radar satellite imagery to assess the affected areas in a very narrow time frame.	When the use of very high-resolution imagery is necessary and the AOI is huge, a fast and effective communication with the user is crucial in order to get information on more specific points of interest.

Flood, North West of Argentina, 2007	The activation was requested rather late, seven days after the start of the flooding. There were serious difficulties in the usefulness of the products from optical sensors to provide good data to the end users because the area was cloudy and the radar data was not so good because the weather was windy too.	With these limitations the most useful value added products that could be produced vary fast were reference maps and details of the situation in reduced areas. These products were very much appreciated by the users. More elaborated products were produced with lower priority.
Earthquake, Afghanistan, April 2007	This earthquake struck in a very rugged and remote part of the country. There was no communication infrastructure in that area so the government had no idea if the damage was minimal or if entire villages had been killed.	It needs to make some improvements in data delivery so that it is easily accessible from areas with poor connectivity. Very high resolution, such as from an aerial survey would be necessary to detect damage from this type of earthquake.
Flood, Slovenia, September 2007	Coordination of the data acquisitions got complicated due to additional area of interest that has to be included after ECO orders.	The PM nomination should be communicated to all data providers to avoid misunderstandings and to guarantee approval of PM data orders or order changes.
Ice hazard, Canada, April 2007	Sea ice hazards are extremely dynamic processes that require Near Real Time data delivery of data. The main criticism was addressed to the timeliness of the data delivery. Charter data was delivered within very reasonable delays.	The variety of data and formats type created some delays in interpretation. In addition to proprietary formats (CEOS, HDF, etc.), all datasets should be provided in at least one standard format (like for example GeoTiff) so that data can be ingested and processes rapidly upon transmission to the EU or VAR.
Flood, North Korea, August 2007	Like in other UN Charter activations, if User Request Form could be sent directly to the Charter, valuable time would be saved, which could be used to improve timeliness of acquisition, processing and delivery of products.	When large areas with relatively strong and varied topography, identification of flooded areas is particularly challenging and requires data to be acquired at the right time, which is often difficult under current Charter procedures.
Flood, United Kingdom, July 2007	Initially there was misunderstanding about activation of the Charter by UK Civil Contingencies Secretariat (UKCCS), Cabinet Office. Though UKCCS activate the Charter in the UK, the decision to activate the Charter is taken by Government Agencies such as the Environment Agency. Environment Agency (EA) staff had decided to activate the Charter, but personnel within UKCCS thought that the Charter activation was not required. This meant that the Charter activation was a day later than planned. ESA had issues with the role of the PM in this activation and that ESA had 'observed serious anomalies' in the Charter process. This appeared to stem from the requirement for programming of data acquisition for the Charter, which according to ESA was not carried out properly. The PM assumed that the ECO had defined the programming and was not aware of the requirement to redefine the programming. The PM have not had training for the Charter, but the Charter ordering system seems unnecessarily complicated, with a patchwork system of ordering data.	The Charter has the potential to provide useful information about the extent of flooding in the UK if certain issues are addressed. The issues that require resolving include: a) The spatial resolution of the data used for flood extent mapping must be fine enough. In the UK, data with a spatial resolution of a few metres are suitable for mapping flood extent. Data with a spatial resolution of 10s of metres are much less useful, as UK flooding tends to occur over relatively small areas compared to, for example, the September 2007 flooding in West Africa. b) The data from the SAR satellites available under the Charter are unsuitable for mapping flood extent in urban areas on their own. c) The repeat times of the current SAR satellites available under the Charter do not provide the frequency of coverage required for UK flooding. The availability of TerraSAR-X acquisitions has improved the temporal sampling of the virtual constellation of Charter satellites, allowing a better analysis of the flood.

Based on Charter 7th Annual Report (2008), summarized.

5. ANALYSIS AND RECOMMENDATIONS

To this end, the International Charter program has been able to provide necessary satellite data and other mapping services over the past years around the world. From the end-user evaluations listed in Table 1, the authors have identified some specific problems and provide herein respective suggestions or recommendations for future Charter activations. From other sources like UNOSAT (2008b), it has been suggested to improve its data quality and provide necessary trainings to the project managers for effective future activations of the Charter.

After initial evaluation, the following recommendations are made for improving the Charter services for maximum benefit of the end-users:

a) The International Charter should provide required satellite imagery and data within the shortest time period considering the type of disaster, location, area characteristics and other factors. In this regard, the existing activation procedures may be revised to ensure timely supply of data and mapping services.

b) Necessary initiatives need to be undertaken to improve the data quality of the Charter. Satellite data in appropriate format with appropriate resolution should be processed and supplied for necessary emergency response activities.

c) The coordination and communication among the authorities and users involved in the Charter should be made in a way so that its effectiveness and efficiency can be strengthened.

d) Presently the satellite imagery and data provided by the Charter are processed by some specialized institutions and then necessary mapping and information services are delivered to the disaster-affected communities specially the developing countries lacking required geospatial technologies. In this regard, the local capacity and local infrastructure can be built and strengthened to use the International Charter and UNOSAT provided data and services.

e) The Project Managers of the International Charter should be trained in a way so that they can play their due role in an efficient way for effective disaster management and emergency responses. This will foster collaboration among the various Space Charter members and their implementing partners.

f) Along with supporting emergency response activities, the Charter data and mapping services can also be made available in other disaster management phases like mitigation and preparedness activities to support full disaster management cycle.

6. CONCLUSION

It is evident that the International Charter and UNOSAT have been able to provide invaluable satellite imagery and other mapping services in managing disaster and emergency situations over the past years around the world. The provided recommendations may be proved useful for future activations of the Charter. The end-user evaluation should be continued on a regular basis for identifying further problems and getting feedback from them to improve the service. The existing mechanisms can be updated in a way so that International Charter 'Space and Major Disasters' and UNOSAT can play more effective role in coming years in disaster management and emergency response reducing loss of lives and properties. At a result, they would be able to contribute significantly towards achieving the goals of the Hyogo Framework for Action and other disaster reduction initiatives.

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