IMPLEMENTATION OF THE UNISPACE III RECOMMENDATIONS FOR A GLOBAL DISASTER MANAGEMENT SYSTEM (ACTION TEAM 7)

A. Mahmood [a, *], S. Parashar [a], M. Larocque [a], M.E. McGuire [a],
Li Chuanrong[b], Tang Lingli[b], J-L. Bessis[c], J. Breton [c], T. Chiku[d], S. Camacho[d]

[a] Canadian Space Agency, 6767 route de l'aéroport, Saint-Hubert, Québec, Canada, J3Y 8Y9 – (Ahmed.Mahmood, Surendra.Parashar, Manon.Larocque, Mary Ellen.McGuire)@space.gc.ca
[b] China Remote Sensing Satellite Ground Station, 45 Bei San Huanxi Road, Beijing, P.R. China 100086 – (crli, lltang) @ne.rsgs.ac.cn
[c] Centre National d'Études Spatiales, 18, avenue Edouard Belin, 31401 Toulouse Cedex 4, France – (jean-luc.Bessis, Jacques.Breton)@cnes.fr
[d] United Nations Office of the Outer Space Affairs (OOSA), Wagrametstrasse 5, A1220 Vienna, Austria – (Takemi.Chiku, Sergio.Camacho)@unvienna.org

KEY WORDS: Earthquakes, Floods, Forest Fire, Hazards, Monitoring, Disaster, International

ABSTRACT:

Several action teams were constituted to pursue the recommendations of the 3rd United Nations conference on the exploration and peaceful uses of outer space (UNISPACE III) held in 1999. One of these teams was assigned the task to propose the implementation of a global disaster management system, especially through the use of existing space resources and related services. After an elaborate process of consultations, surveys, gap and need analysis, Action Team 7 has recently submitted its findings and recommendations that are reported here. Natural and man-made disasters strike indiscriminately all parts of the world and require coordinated international efforts to manage their effects and supplement the ongoing global approaches. Currently, there is some emphasis on disaster response, but too little on prevention and mitigation. A large number of countries have little or no exposure to the benefits of space systems, and there is a lack of single point of contact for assimilating the space-based information. The Team is therefore recommending the implementation and funding options for an international space coordination body for disaster management, nominally identified as the 'Disaster Management International Space Coordination Organization (DMISCO)'. Such a body would have the mandate to provide the necessary means to optimise the efficiency of current and future services for disaster management. The concept would be based on a ' Disaster Management Space Support System (DMS3)' universally accessible to all stakeholders: Users, emergency response and civil protection agencies, local and national authorities, lending institutions, value-added service and product resellers, and space operators.

1. BACKGROUND

1.1 Establishment of the Action Team

The U.N. Action Team on disaster management is one among several that were formed based on the decision of the Committee on the Peaceful Uses of Outer Space Affairs (COPUOS) at its 44th session to follow up on the recommendations of UNISPACE III. Its membership was derived from countries possessing advanced scientific and technological capability and from those for which disaster management was of special concern. Later, several other Member States, and entities of the United Nations system and organizations that had observer status with COPUOS also joined the Action Team and contributed to its work. The Action Team was co-chaired by Canada, China and France, called CCF, following their election by the participating states and approval by the Scientific and Technical Subcommittee (STSC). The mandate of the Action Team relates to the implementation of an integrated global system, especially through the international cooperation and the use of existing space and associated ground resources of Earth Observation and other satellites. The Action Team was tasked to analyse the current situation and to provide views and proposals on the initiatives to be taken in order to bring the benefits of space-based information to all countries suffering from disasters.

The activities, findings and recommendations of the Action Team presented in this article are covered in a detailed report (A/AC.105/C.1/L.273) being submitted to the U.N. General Assembly for approval.

1.2 Space and Disaster Management

The management of natural disasters is often beyond the scope of ground and airborne capabilities and investing space technologies in disaster relief and mitigation is therefore well justified. Given the inevitable occurrence of natural phenomena, exacerbated by global environmental change, aggravated ecological imbalances, the growing world population, inappropriate human practices in terms of land use and land development and increasing pressures on natural resources, disasters are occurring at a growing frequency and their consequential damage is on the rise. Reports show that, while the actual number of human losses is being contained slowly by some preventive measures, the size of populations being affected by disasters is increasing (Walter, 2003). Human loss and hardships are higher in countries already suffering from low development and income levels. The effects of disasters on

* Corresponding author

such countries are more severe and longer-lasting, compared to countries that are economically better off, where greater investment is made in preparedness and losses are predominantly financial, especially for settlement of insurance claims, and related to property and infrastructure damage.

During the past decades, significant progress has been made in the scientific understanding of the various planetary phenomena, in the atmosphere, on the land and in the oceans. Space systems and technologies are making important contributions to this understanding. Many events that were previously perceived as erratic and inevitably fatal, such as volcanic eruptions, earthquakes, tsunamis and ocean storms, among others, are now much better known for their causes and effects, and their manifestation is becoming more and more predictable.

Space systems provide a global perspective. They are excellent tools to observe and monitor natural disasters and to help model their evolution. They also have the unique capability of allowing multi-scale observation of an area hit by disaster, from synoptic viewing to localised assessment, thus facilitating the activities of the authorities involved in disaster relief and recovery. The benefits that space systems can provide should consequently be extended to the humanity as a whole, and should not remain limited to a privileged few in the technology affording nations. A clear advantage was therefore seen in the initiative that followed UNISPACE III in the field of disaster management, for both the advanced countries that offer space-based tools and technologies as well as for the less developed states that are least prepared to cope with disasters on their own.

2. ACTIVITIES

2.1 Introduction

The CCF co-chairs of the Action Team followed a three-year workplan in a phased approach to fulfill the Action Team mandate of carrying out studies and analysis and proposing a scheme for a global disaster mitigation and management system or systems that would fully utilize existing resources. The Action Team conducted its business through regular plenary sessions and task-oriented working groups. In addition, the CCF co-chairs held frequent discussions by means of conference calls and meetings and with the complete support of the Office of Outer Space Affairs (OOSA). The following is an account of the activities undertaken to gather the necessary material and information on which to base the Action Team's findings and recommendations.

2.2 Survey of Needs, Capacities and Systems

The main challenge for the U.N. Action Team was to relate information on available space technologies to the needs of the user communities, which had a varying degree of experience in, and knowledge of, these technologies. A broad-based consultative process was launched in order to collect information on the needs of the countries for managing disasters and on the resources available to meet the needs. The Action Team conducted a global survey on user needs and national capacities, using customized forms. The Action Team also compiled an inventory of existing space systems that had capabilities believed to be relevant to disaster management. Based on the responses to the surveys received, the usefulness or adequacy of the available space technologies for disaster management could be assessed. The results of the surveys and the subsequent analysis are described below.

2.2.1 User Needs: The replies to the survey covered a wide variety of disasters, from floods and ocean storms to forest fires and droughts. The user needs in terms of spatial and temporal information and the responsibility centre varies from disaster to disaster. For example, in the case of floods and fires, the main spatial information need is about the extent of the affected area, whereas in regard to earthquakes, the priority spatial information need for planning is basically associated with the assessment of land use and urbanization. For a technological disaster like oil spills, the most important information by far is the location and extent of the oil slick and the rate of its displacement. The ground resolution requirement would vary depending on the observation target, whether it is the submerged infrastructure (10m) or the flood map (20-30m). For forest fires likewise, the critical ground resolution needs range from 10 m or less for infrastructure and buildings and 100-300 m for burnt or forested area. The spatial resolution in the case of ice hazard is 100 m for detection and 50 m for characterization of sea and lake ice; a resolution of 30 m is required for tracking a beset vessel. The detection of drought conditions could be made on the scale of 30 m in the case of farmland and up to 500 m for a landcover map. The temporal resolution for this disaster ranges from days and months to years, more in line with forecasting and prevention, than for disasters like forest fires and floods, when the information turnaround should be within hours. A field office is the most important responsibility centre for fast evolving disasters like floods and forest fires. The responsibility for action in the event of an earthquake lies with decision makers, rescue workers and insurance sector at the local level.

2.2.2 National Capacity: Only a few respondents could identify a designated disaster management authority in their country. In most cases, the authority is ill-defined or spread over administrative and vocational boundaries. One of the main obstacles to the use of space-derived information is the delay in information dissemination. Many countries do not have access to fast transmission devices, nor do they have the space data processing and fusion capabilities. Geographical information and cartographic databases necessary for reporting the space-based data is also at a variable state of development in the surveyed countries. The need for a comprehensive international training program, both at the level of experts and the level of field officers, was widely recognized in the survey. The results of the survey indicated that the number of people to be trained would be in the order of 500 at the expert level and no less than 5,000 at the filed officer level. In summary, countries can be grouped into three categories in terms of the national capacity for using space information: The more developed nations increasingly concerned with national security issues; countries having some capacity but where the progress is slow because of funding problems; and a vast majority of the remaining countries for which space applications are still to find use.

2.2.3 Space Systems: The Action Team prepared a document containing a detailed inventory of space systems and the related data products and policies (Mahmood, 2002). The information compiled in the document assisted the Action Team in evaluating the effectiveness of space technologies to meet the needs of the users and the ability of their respective countries to integrate space technologies into their disaster management structures. The potential benefits of space information in disaster management can be grouped into two primary phases: A 'hot phase" covering the emergency response, and a "cold phase" or the period preceding or following the crisis. Space systems are a unique tool in managing the "hot phase" and a valuable asset when combined with other technologies in planning disaster reduction and prevention. The said document describes the various sensors and missions, product types and applicable data policies.

3. MAIN FINDINGS

Based on the information collected, working groups from the member countries were formed to study possible features of an integrated global disaster management system from various aspects. These working groups focused on identifying the key technical, operational, organizational, financial and educational issues and their implication for each type of disaster.

3.1 Practical Issues for Specific Types of Disasters

3.1.1 Floods: Two points were underlined by the concerned working group. Firstly, the most important piece of information needed following this disaster occurrence is a wide-area map, with proper markers for localization. The same map can be generated at a regular frequency to monitor the flood condition. Secondly, floods are treated as crisis despite their recurrence; therefore, more attention needs to be given to the prevention phase. In order to derive flood maps, space data are merged with geospatial data, such as terrain elevation models, geological and land use maps, demographic statistics, etc., which, if at all available, are not of required accuracy in many countries. Funding and data policies are a problem in acquiring the space and other maps.

3.1.2 Forest Fires: Both the temporal frequency and the spectral coverage should be improved. Data policies, formats and communication capabilities are the limiting factors in making optimal use of space data and the funding sources are not reliable. Although only a few in number, there are specialized institutions that can be involved for generating value-added operational products and for training of personnel.

3.1.3 Drought is an evolving disaster and, as such, does not have an emergency response phase, like the other disasters. It does not have special spatial and temporal resolution requirements, although spectral resolution for soil and landcover moisture determination is important for this disaster. Space technologies need to help in refining drought prediction models.

3.1.4 Earthquakes: The management of this disaster is still in large part in the realm of research and development. Very high- resolution optical sensors are most effective in assessing damage to infrastructure. Seismic zone hazard mapping and prediction modelling can be helped by the emerging radar interferometric techniques based on the selection of scattering references.

3.1.5 Oil Spills: A single sensor is not always capable of detecting an oil spill in a reliable manner. Data from various types of space-borne sensors (synthetic aperture radar, panchromatic, multispectral and hyperspectral imagres) are needed to be combined with ground data (airborne and meteorological) and geographic information systems, including bathymetry. In view of the shifting wind conditions, a daily coverage is necessary for monitoring purposes. The value-added products should provide measurements on the thickness of the oil spill.

3.1.6 Ice Hazard: The purpose of managing ice hazard is to allow ships transiting icy waters safely and to support maritime rescue operations. Synthetic aperture radar sensors are the most widely used for this purpose. The primary issue here is the near real-time delivery of ice products, and in this regard the current operational arrangements between the Canadian and the U.S. ice services for using RADARSAT-1 data can be considered as a model. The data-sharing arrangements and the associated funding support are however not considered sustainable in the future.

3.2 Implications for an Integrated System

Technically and operationally, satellite coverage and data turnaround stand out as the main issue. There are not many countries with ground stations that are able to receive and process satellite data. An important achievement of the proposed global system should be to improve significantly the data turnaround time to say within 24 hours. A coordinated response to a disaster by means of a single point of access to global assets is required.

From an organizational viewpoint, local capacity building and information sharing are the key issues. These can be met by assigning a designated governmental authority that would be responsible for disaster relief and mitigation and that would interface with the space data and service providers. These national authorities should themselves be equipped with the front-end architecture, such as cartographic, hydrological, meteorological and demographic databases critical for an effective use of Earth observation satellite data in the disaster management cycle. Disasters require timely and up-to-date situational analyses through the full cycle of disaster management, namely mitigation, preparedness, recovery and response linked to geosocial databases or thematic maps.

The main financial issue concerns data pricing policies of space data providers and the funding for defraying the cost of data, operating a global system and developing value-added products and services. Even though the data policies of individual space operators are not always driven by commercial considerations, there has so far been no attempt to devise a single international Earth observation data policy. Nearly every country has put in place some sort of a disaster management structure, either at the national or regional level, however, the operation of a global system demands global funding sources, and in this regard the international funding institutions (banks, aid organizations.) and stakeholder contributions (insurance sector, development programs) can be targeted.

3.3 Required Characteristics of an Integrated System

The concept of a global integrated disaster management system that employs space resources should take into account the current imbalance between disaster response and recovery and longer term planning and prevention. For example, early warning systems for floods, droughts and landslides should be as much the focus of space data applications as recovery from a disaster happening.

A better understanding between technology and data providers and the users needs to be established. Simply facilitating access to data holdings will not necessarily maximize data use. In fact a more flexible means of establishing information-service pathways will have to be evolved to meet the various needs of the users if the use of Earth observation data is to be advanced and sustained.

Disaster management in most countries is spread over several responsibility centres, which is not helpful for the integration of space technologies. A single point of contact should be designated to interface with space data providers and should be part of the global space-supported disaster management system. An international centre, virtual or physical, for disaster management connected to local and regional structures is one way of implementing the system. One of the main roles of such an international entity would be that of a study centre, which would provide quick and effective consultancy and decision-making alternatives to its customers and associates.

Another important element of the global system is that the space-based disaster management support should be a common endeavour among all stakeholders, public and private, requiring participation of technology suppliers and operators, data users, insurance and communications industries and government sponsorship to share costs and responsibilities of the system operation.

There are some notable international efforts, which need to be strengthened and complemented by the creation of a global disaster management system.

4. RECOMMENDATIONS

4.1 Concept

Figure 1 is a schematic representation of the concept derived from the characteristics described above. The concept is based on a 'Disaster Management Space Support System ' or 'DMS3' (Mahmood, 2002) that provides essentially stakeholder linkages and pathways in a global system that covers all the four phases of the disaster management cycle and offers universal access. Some of the current international disaster management initiatives, like the International Charter 'Space and Major Disasters' (Bessis et al, 2003), which looks after the response and recovery phase of a disaster, become natural associates of the system. The Figure illustrates the coordination that the system will allow among the various stakeholder groups, such as the civil protection and environmental security agencies, lending institutions or banks, emergency response centres. These are collectively called 'Authorized Users' of space-derived and value-added data and information, which are obtained from partner space agencies and expert affiliated centres.

4.2 Implementation

In order to implement the concept and characteristics suggested for a global integrated disaster management system, the Action Team has made the following three recommendations.

4.2.1 Recommendation 1: An international space coordination body for disaster management nominally identified as the 'Disaster Management International Space Coordination Organization (DMISCO)' should be established. Such a body would have the mandate to provide the necessary means to optimise the efficiency of services for disaster management. It would ensure affordable, comprehensive and universal space-based delivery by fully utilizing existing and planned space and ground assets and infrastructures, and with the full participation of organizations and mechanisms currently in place. The proposed organization would act as the focal point for the global space efforts in support of disaster management.

4.2.2 Recommendation 2: A fund should be established as a sustainable resource used for applying space technologies in support of disaster management and for capacity building. The primary contributors to the funding resource should be development and relief organizations and those who would be the main beneficiaries of disaster reduction.

4.2.3 Recommendation 3: Member States should be encouraged to allocate a portion of their disaster management resource/funds to using space technologies and to identify single points of contact for their respective countries in order to focus their internal disaster management activities and to liaise with external efforts.

References

Bessis, J-L., Béquignon, J. and Mahmood, A., 2003. The International Charter "Space and Major Disasters" initiative. *Acta Astronautica*, 54 (2003), pp. 183-190.

Mahmood, A., 2002. Report on Space Program, Systems and Policies for Disaster Management, Houston, Texas, U.S.A. http://www.oosa.unvienna.org/unisp-3/followup/action_team_07

Walter, J., ed., 2003. International Federation of Red Cross and Red Crescent Societies, World Disasters Report 2003: Focus on Ethics in Aid. Bloomfield, Connecticut, U.S.A., Kumarian Press, p. 239.

Acknowledgements

The authors thank the country delegates of the Action Team for their contribution to this work. Special thanks are due to Dr. Ian Downey of the British National Space Centre for helping with the Action Team report and recommendations.

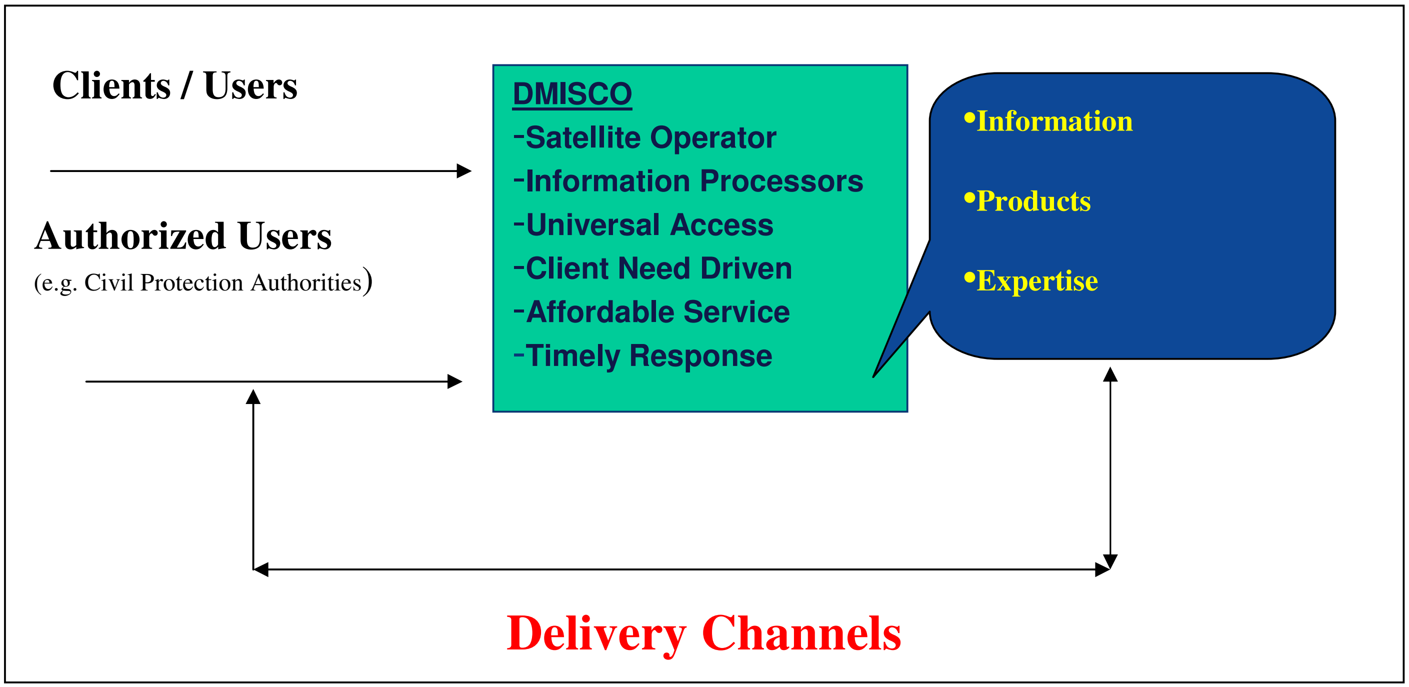

Figure 1. Concept for a proposed integrated global disaster management system