

# SMALL SATELLITE UTILIZATION FOR DISASTER MANAGEMENT INFORMATION SYSTEMS

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## ABSTRACT

Effective disaster management is a complex problem, because it involves many parameters, which are usually not easy to measure and even identify: Analysis of current situation, planning, optimum resource management, coordination, controlling and monitoring current activities and making quick and correct decisions are only some of these parameters, whose complete list is very long. Disaster Management Information Systems (DMIS) assist disaster managers to analyze the situation better, make decisions and suggest further actions following the existing emergency plans. This requires not only fast and thorough processing and optimization abilities, but also real-time data provided to the DMIS.

The need of DMIS for disaster's real-time data can be satisfied by Small Satellites data utilization. Small Satellites can provide up-to-date data, plus a better media to transfer data.

This paper suggests a rationale and a framework for utilization of Small Satellite data by DMIS. DMIS should be used "before", "during" and "after" the disasters. Data provided by the Small Satellites are almost crucial in any period of the disasters, because early warning can save lives, and Satellite data may help to identify disasters before they occur. The paper also presents "when", "where" and "how" Small Satellite data should be used by DMIS.

## 1. INTRODUCTION

Most of the disasters are unavoidable, yet regardless of the reasons of the disasters, the unwanted results, (harm and loss), of the disasters can be avoided when necessary actions are performed [1] [2] [3] [4] [5]. Effective disaster management activities follow a cycle of four phases: *Preparedness*, *mitigation*, *response*, and *recovery*. For each and every phase of the effective disaster management, Disaster Management Information Systems (DMIS) can be utilized for better managing the very complex catastrophic conditions, which are complex problems for the disaster managers.

After providing brief information regarding DMIS, the paper provides utilization opportunities of small satellites for disaster management. In addition, a framework to show "when", "where" and "how" to use the space technology for disaster management purposes is also provided.

## 2. DISASTER MANAGEMENT INFORMATION SYSTEMS

In its simplest and broadest definition, a DMIS is an information system developed and used for disaster management purposes. To support various types of DMIS users (ranging from the operators to the incident command manager), the DMIS that is referred to by this paper possesses the above definition specifications, furthermore it keeps track of data and information regarding the following functional areas

- Disasters of all types (parameters and models to support disaster simulations),
- Resources inventory,
- Vulnerables (of all forms, assets, values and functions),
- Treaths and weaknesses, their indicators, and interpreters,
- Geographical Information System data for the disaster area,
- Emergency response, mitigation and recovery plans,
- Crisis management and monitoring,
- Task assignment at all phases of disaster management.

The technical specifications that should be satisfied by means of DMIS can be grouped as follows:

- Mobility (DMIS should be used as place independent),
- Flexibility (DMIS should be flexible and generic enough to support all types of possible disasters),
- High Performance (Time is very crucial in disaster management, DMIS should be fast),
- Continuity (DMIS should work continuously without failure),
- Open (DMIS may need to communicate with other systems thus it should provide open standards communication),
- Scalability (DMIS should respond effectively to requests of all scales).

Having clarified what is meant by DMIS in this study, following section presents use of satellites by DMIS.

## 3. SMALL SATELLITES UTILIZATION BY DMIS

There are many application areas for satellite utilization [6] [7]. Being one of these areas, disaster management utilizes satellite technology for various purposes, ranging from planning to monitoring, mitigation and post-disaster evaluation.

Utilization of satellite technology for disaster management is not a new topic [8] [9] [10] [11]. However, it is still a hot topic due to recent improvements in the technology and presented advantages of satellites usage for disaster management [12] [13] [14] [15] [16] [17] [18] [19] [28]. Some of these studies focuses on one respect of satellite utilization in disaster management: Satellite communication [20] [21]. There are also studies regarding small satellites usage in disaster management [22] [23] [24] [25].

In order to present a framework for small satellites utilization for DMIS, following dimensions of disaster management will be defined:

- Disaster type (Natural and technological types of disasters origins, e. g. Earthquake, flood, fire, NBC, terrorist activities, etc.),
- Time (before, during and after disaster situation),
- Functionality (Preparedness, mitigation, response, and recovery),
- Scale (level of disaster management for different scales, e. g. enterprise, provincial, regional, national, international, global).

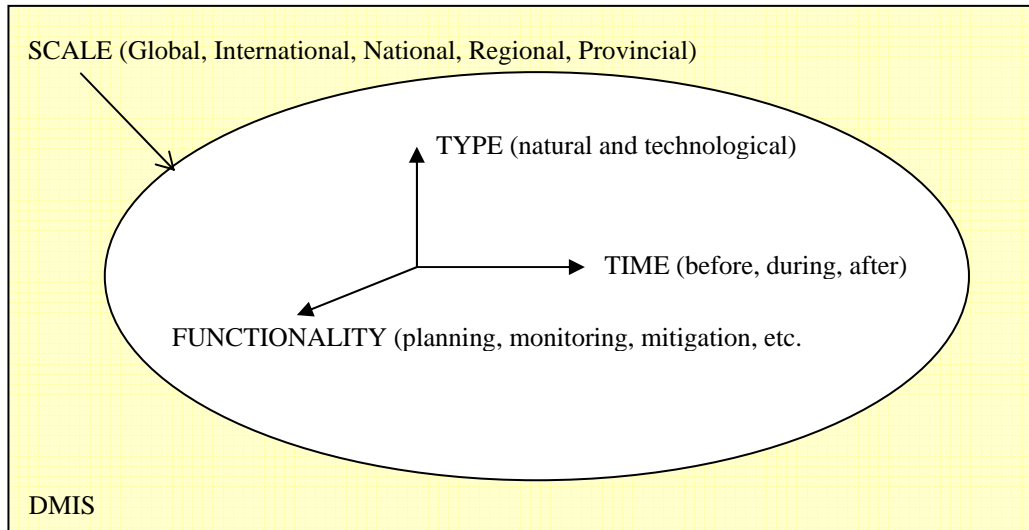


Figure 1. Utilization of Small Satellites at Four Dimensions of Disaster Management

Figure 1 aims to present the utilization areas of small satellites for DMIS, regarding the four dimensions in disaster management type, time, functionality and scale as defined above. The figure suggests that small satellites can be utilized for all types of disaster, for every time period of the disaster, and for every functionality of disaster management. As for the scale dimension, it is not very effective to suggest use of satellites for homeland security, or enterprise level disaster management. Better results can be obtained if small satellites are used for larger scale disasters, like international and global.

Integrated use of small satellite system may support international even global disaster management, and thus may reduce unwanted effects of disasters, saving many lives and resources. Recent trends are in parallel to the above suggestion. Global Earth Observation System of Systems (GEOSS) is a program aiming to pool all national and regional observation data within the next ten years. Once in place, information would be available instantaneously to all countries. It is stated that if such a network had already been in place, tens of thousands of lives lost during the Indian Ocean tsunami strikes on December 26 might have been saved [27].

#### 4. CONCLUSION

This extended abstract briefly explains DMIS and satellite utilization for disaster management. It suggests a framework for utilization areas of small satellites in disaster management. According to the dimensions depicted for disaster management, small satellites can be used:

- Time: All time periods of disasters (i.e. before, during and after disasters)
- Type: All possible types of disasters originated from natural and technological or human factors
- Functionality: Almost every function of disaster management can be served via small satellites
- Space: Serving large scale disaster management is more preferred to serving small scale levels.

Full-size study deals with more details of the above statements, identifying specific areas of use with supporting samples, and presenting areas of future studies.

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