Introduction

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Natural and anthropogenesis disasters cause widespread loss of life and property and therefore it is critical to work on preventing hazards to become disasters. This can be achieved by improved monitoring of hazards through development of observation systems, integration of muti-source data and efficient dissemination of knowledge to concerned people. Geo-information technologies have proven to offer a variety of opportunities to aid management and recovery in the aftermath. Intelligent context-aware technologies can provide access to needed information, facilitate the interoperability of emergency services, and provide high-quality care to the public.

Disaster management poses significant challenges for real-time data collection, monitoring, processing, management, discovery, translation, integration, visualisation and communication of information. Challenges to geo-information technologies are rather extreme due to the heterogeneous information sources with numerous variations: scale/resolution, dimension (2D or 3D), type of representation (vector or raster), classification and attributes schemes, temporal aspects (timely delivery, history, predictions of the future), spatial reference system used, etc.

There is a need to continuously discuss the state of the observing systems and integration of effective monitoring of disasters, development of predictions systems, integration and analysis of geo-information. Recognising the importance of use of geo-information in disaster management, several universities (Delft University of Technology, VU University Amsterdam, The Netherlands; University of Waterloo, Canada), international organisations (ISPRS, UNOOSA, EU, ICA, FIG, OGC) and vendors (Bentley, Intergraph, Oracle, PCI) have taken the initiative to organise an annual symposium, which aims at uniting the efforts of researchers, developers, data providers and users from different countries and continents. The symposium was organised first in Delft, The Netherlands (March, 2005). Three more symposia were organised under the coordination of the ISPRS WGIV/8: Goa, India (September 2006), Toronto, Canada (2007) and Harbin, China (August, 2008).

The second symposium concentrated on natural disasters as the general theme was 'Remote Sensing and GIS Techniques for Monitoring and Prediction of Disasters'. It was organised by the Indian Society of Remote Sensing, ISPRS, ISRO, UNOOSA, FIG, EC, AGILE, ICA and Delft University of Technology on 25-26th of September 2006, Goa, India. The two-day symposium has accommodated 60 participants from 12 countries. From the originally 96 submitted abstracts (from 28 countries), 46 full papers were received. The papers were presented in 6 oral sessions and one poster session in the first day. The symposium was closed with a panel session devoted to providing timely geo-information, quality of data, use of technical expertise after a disaster and involvement of geo-specialist in efforts to predict and mitigate disasters.

There are practically no doubts about current status of technology in providing spatial data to end users. Global navigation satellites and Earth observation satellites have largely demonstrated their flexibility in providing data for a broad range of applications: weather forecasting, vehicle tracking, disaster alerting, forest fire and flood monitoring, oil spills detection, desertification spread monitoring, crop and forestry damage assessment. Monitoring and management of recent natural disasters have also benefited from satellite imagery, such as the Indian Ocean tsunami in 2004, floods (Austria, Romania, Switzerland, and Germany in 2005), hurricanes (USA in 2005), forest fires (Portugal, France in 2005), earthquakes (Pakistan in 2005, Indonesia in 2006), etc.

However, it is recognised that effective utilisation of satellite positioning and remote sensing in disaster monitoring and management requires research and development in numerous areas: data collection, access and delivery, information extraction and analysis, management and their integration with other data sources (airborne and terrestrial imagery, GIS data, etc.) and data standardization. Establishment of Spatial Data Infrastructure at national and international level would greatly help in supplying these data when necessary. In this respect legal and organisation agreements could contribute greatly to the sharing and harmonisation of data.

Quality of data in case of disaster is still a tricky issue. Data with less quality but supplied in the first hour might be of higher importance in saving lives and reducing damages compared to trusted, high quality data but after two days. Apparently a balance should be found in searching and providing data as the general intention should to make increased use of accurate, trusted data.

Charters and international organizations have already launched various initiatives on the extended utilization of satellite positioning and remote sensing technologies in disaster monitoring and management. For example, the International Charter is often given as a good example of availability of data and expertise after a disaster, but still the coordination between the different initiatives at local and international level is considered insufficient. This observation is especially strong for developing countries, although some authorities in developed countries (e.g. USA in the case of Hurricane Katrina) also fail to react appropriately. Capacity building needs to be further strengthened and the governments must be the major driving factor in this process. Related to this is the role of the geo-specialist in disaster management. Geo-specialist are not directly involved in emergency response, e.g. training together with first responders or preparing monitoring and mitigation programs, but there is high understating of closer work with users.

The Second Symposium has clearly revealed regional specifics in disaster management. While the symposium in Europe addressed Spatial Data Infratsructures and cooperation between different rescue units as major challenges, the symposium India discussed mostly availability and processing of data and put emphasis on early warning systems, realizing that the national SDI for disaster management either do not exist or are at a very early stage.

The chapters of this book reflect some of the topics mentioned above. The efforts of many researchers over the past four years to continue research and development in the area of spatial data integration for effective emergency services and disaster management have also provided guidance and inspiration for the preparation of this book.

This book consists of 14 chapters organised in three parts. The readings in this book outline major bottlenecks, demonstrate use of remote sensing technology, and suggest approaches for sharing and access of information in various stages of disaster management process.

Part 1: Use of geo-information technology in large disasters.

The first chapter of Kerle and Widarontono elaborate on use of geo-information during the earthquake on 27 May 2006 in the Yogyakarta area, Indonesia. The authors provide numerous chronological details on the work of the different local and national organisations involved and the use of remote sensing data. This particular disasters is an excellent illustration of the works completed after the activation of the International Charter 'Space and Major Disasters'. Thanks to the almost immediate activation of the Charter, much satellite information could be quickly provided in the first two days. The authors also address some issues that need further improvement such as prices, availability of high resolution data, etc.

The second chapter is devoted to the lessons learned from the Katrina hurricane. The author Henrike Brecht has participated in the emergency response activities immediately after the water flooded the city of New Orleans. The personal observations of the author are organised in five groups of lessons namely management, technology and infrastructure, data, operational (and workflow) and map products. Clearly, many improvements have been observed in providing and use of geo-information comparing to any other disaster in USA, but problems still exist. The chapter provides a very good overview on bottlenecks and failures largely contributing to the 'what went wrong' issue. Interestingly, the lessons learned are very similar to the 9/11 experiences.

The third chapter addresses the damages on the fauna and flora on the Indian cost after the Tsunami, December 2004. Shailesh Nayak and Anjali Bahuguna present their elaborated study on the impact on major ecosystems applying high-resolution satellite imagery. As illustrated in the chapter, the applied methodology has helped to estimate the loss and help in the rehabilitation process. The damage to ecosystem (especially the coral reef and the mangroves) is critical as it directly affects fishery recourses of coastal communities.

After the first three chapters on use of remote sensing information for monitoring and damage assessment, Chapter 4 elaborates on a new initiative for developing countries that have to further ease access and sharing of satellite data. David Stevens elaborated on the tasks and activities of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), established in December 2006 as a program of the United Nations Office for Outer Space Affairs. Through presenting recent major meetings, conferences and assemblies, and summarizing the most important activities of various organisations, the author motivates the work of the new program.

Part 2: Remote sensing technology for disaster monitoring

The second part of this book consists of five chapters all presenting remote-sensing technologies (satellite imagery, radar technology, Global Positions Systems) applied for various hazards or phases of disaster management process.

Chapter 5 is a collaborative work of eight universities and organisations and present a broad overview on need of different technology for monitoring of hazards, response to disaster, recovery and mitigation. The authors discuss availability of remote sensing data (illustrated with useful web links), provide practical examples from case studies and report software developments within the participating organisations. Special attention is given to dynamic integration of data for geo-visualisation in virtual environments and on hand-held. The chapter concludes with thoughts about a well-recognised need for an appropriate geo-education for disaster managers.

Hedge, Shalini, Nayak and Rajawat present a satellite-image based methodology for monitoring of pollution in the shore water. According to the authors, the pollution dispersion in the near shore water is highly complex and dependent on a number of factors. Ocean Colour Monitor patterns as well as other satellite data products have helped to successfully trace sediments dispersion and understand sediment dynamics through the different seasons.

In the following chapter, Surendranath, Saibal Ghosh, Ghosal and Rajendran address mapping of landslides in the Darjeeling Himalayas in East India. Again, this chapter is an excellent illustration of use of remote sensing data for monitoring of hazards. The authors are confident that some conventional methods based on aerial photogrammetry and manual inspection can successfully be replaced by high-resolution satellite images. The chapter present details on the methodology for the derivation of accurate DEM from topographic maps, IRS pan stereoscopic satellite imagery and freely available Shuttle Radar Topography Mission elevation data. Their method is especially suitable for highly rugged hilly areas, which are constantly under the highly dynamic and active erosion processes.

Chapter 8 discusses the potential of Persistent Scattered Interferometry for detection and monitoring of land subsidence. This technology reveals high cost effectiveness compare to conventional geodetic techniques. Besides the applicability of radar technology for monitoring of deformations, this research stresses the need of incorporating supplementary geo- information sources for an improved interpretation. Swati Gehlot and Ramon Hanssen report very promising results of applying this technology in the city areas in the Netherlands.

The last chapter in this Part 2 presents an extended procedure for GPS data collection. The improved procedure makes use of special waypoint protocol. Robert Mikol discusses the waypoint naming in detail (and the consequent organisation in a database) and illustrates its applicability for rapid data collection in case of oil spill. Though the DBMS has been never used during oil spill and subsequent cleanup, the idea was accepted as successful for data collection under limited financial resources.

Part 3: System architectures for access of geo-information

This part presents different approaches for management, access and sharing of geo-information for disaster management. Though not specifically concentrated on remote sensing data, the presented systems can easily be used if remote sensing imagery is available.

Jan Herrman addresses the very important issue of access and sharing of data through web services. Access control and security (protection of information) are especially important to enforce restricted access to protected spatial data or to declare views on the relevant data for certain users/roles. The author provides a overview on existing technology and elaborates on the advantages of Geo OASIS's eXtensible Access Control Markup Language (GeoXACML).

Chapter 11 elaborates further on a Spatial Data Infrastructure for disaster management in the Netherlands. The presented system architecture is a typical example of thin client client-server architecture, which should be able to serve any type of user on the field or in the commando center. The implemented services are context-oriented and follow recent standardization developments toward chaining of generic services. A spatio-temporal model for management of operational data is one of the few attempts worldwide to manage emergency operational data in DBMS.

Charles Siegel, Donald Fortin and Yves Gauthier their system for cooperation and collaboration during emergencies. As discussed in the chapter, real-time contact and making available all the data to all the participants in an emergency is considered a key component in every command and control system. The developed system allows live Internet geo-collaboration and is in use in civil security operating in the Québec Ministry of Public Security. The presented case studies come from real emergency management situations.

Chapter 13 presents yet another approach to access and visualize data over Internet, this time for flood management. The authors extensively discuss the decisions taken in development of the client-server architecture, data model for management of flood information, street/road networks and other spatial information. This approach convincingly illustrates the advantage of storing and managing information in DBMS: integrated spatial analysis can readily be performed at the server. A light web-application allows for visualization and inspection of performed analysis.

The last chapter presents a usability study about new type of hardware, i.e. Multi Tangible Tabletop User Interface, for its applicability in disaster management. The tangible table does not require use of mouse and keyboard; instead, the user can touch the surface with fingers. As the name suggests, multiple many users can work simultaneously as the table 'remembers' who 'possesses which objects. The authors suggest that this technology could be very appropriate at a tactical level in commando centers, where disaster managers have to discuss steps in managing emergency situations.

The chapters in this book are aimed at researchers, practitioners, and students who apply remote sensing technology in monitoring of hazards and managing of disasters. The book itself is the result of a collaborative effort involving 37 researchers located in 8 countries.

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Previous book volumes in the series of Gi4DM

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