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Geographical Information Systems in Assessing Natural Hazards

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Abstracts

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SESSION 6 GIS DEVELOPMENTS TO FULFILL THE REQUIREMENTS FOR COPING WITH NATURAL CATASTROPHES

PREFACE

Natural catastrophes, such as flash floods, volcanic eruptions, earthquakes tsunamis and landsliding, have always constituted a major problem both in developed and developing countries. In the recent years, the growth of population and the diffusion of settlements and life-lines over hazardous areas have sharpened the impact of natural disasters.

The International Decade for Natural Disasters Reduction provides a unique opportunity for institutions and individuals working in the realm of natural catastrophes to:

-a) critically evaluate current methods for assessing and predicting natural catastrophes and mitigating their impact;
-b) investigate the potential of the new technological advancements for improving hazard evaluation and risk reduction.

Among these new technologies, Geographical Information Systems may play an important role in order to:

-a) collect, store, manipulate, analyse and display large sets of geographically referenced data, in an efficient and cost-effective way;
-b) facilitate attempts to develop or define new and more reliable models which better reflect the *real world*, that is, incorporate the actual processes and factors leading to the occurrence in space and time of the different catastrophic events.

However, although the first *relevant* achievements in the domain of geographical data electronic processing date back to the early 1970s, there is no general agreement on the procedures, requirements and even scope associated with automating these operations.

Owing to the explosive growth of computer technology, today, platforms running under UNIX operative systems and the most recent microcomputers provide fast CPU and large drive storage units, at reasonable costs. Hence, somebody argues that in geographical data electronic processing hardware is not anymore a problem. However, in a short future this belief may turn out to be too optimistic. Indeed, in many applications data sets will grow in volume faster than the increase in storage capacity provided by the current technological advancement.

In the recent years, many conferences, symposia and workshops on GIS technology and applications have been held world-wide. All of this has led to an increase in awareness of this technique and in a better exploitation of its potential, particularly in the domain of resources inventory. However, from an examination of the scientific and technical literature on the topic, it appears that GISes are *too frequently* employed more as tool for displaying data in a *fashionable* way than as a new technique for *thoroughly* manipulate relevant information.

In the recent years, in the domain of GIS-supported hazard studies, several sound investigations were carried out; some of them may constitute a reliable starting point for future projects aimed at evaluating hazard and mitigating risk within nation-wide projects.

However, events, such as severe earthquakes, major volcanic eruptions, large flash floods and huge landslides, are intrinsically complex phenomena caused by a large sets of factors, many of which ill-known or unmappable. The prediction in space and time of these (fortunately) rare events is a very difficult task, requiring many geo-referenced data, long records of the past occurrence of natural disasters over the region to be investigated and sophisticated models of the physical processes involved.

GISes may well have a great potential in such a type of investigations, but at present various obstacles hamper a wider and more effective use of this technology, namely:

-a) the acquisition of relevant data is difficult and costly;

-b) digitisation constitutes an overhead cost, sometime unaffordable;
-c) Modelling and simulation within a GIS environment are still experimental;
-d) Many experts in natural catastrophes do not make a proper use of GISes.

This unhealthy state, which appears primarily dependent on the fact that geographical data processing is still a pioneering field, needs significant developments both in technology and in methodology.

Today, a great variety of GIS software modules exits. They range from relatively small packages developed by academic or governmental institutions and distributed at almost nominal price to complex and costly systems marketed by private firms. In spite of this wide choice, potential GIS users may find difficult to select a system that meets their actual needs. Nowadays, an efficient approach to geographical data processing requires both the use of raster and vector structures and the ability of switch from one to the other efficiently and accurately. Few or none systems fulfil these requirements. Most systems lack a true friendly user-interface and, equally importantly, do not facilitate data exchange between different systems. Poor documentation, excessive delay in system installation or upgrade, and slow or inadequate customer support, are other drawbacks which create dissatisfaction among users.

Awareness of GIS potentials and current drawbacks, and the belief the hazard needs a multidisciplinary approach and international co-operation, led to the organisation of this Workshop, which will focus on the following three main issues:

1) Present state-of-the-art of GIS technology (hardware/software) with emphasis on short-term and long-term developments in hardware performance, spatial data-structures, effectiveness of spatial modules, and system-user interfaces.

2) Potentials and limitations of GIS-based methods for the identification, mapping, prediction and reduction of hazards and risks related to the following types of catastrophes:

   a) *floods;*
   b) *landslides;*
   c) *volcanoes and earthquakes;*
   d) *ground water pollution.*

The above list, which does not cover all types of natural catastrophes, resulted from an estimate, surely bias, of the types of hazards most frequently investigated using GIS methods. The inclusion of ground water pollution, that is essentially man-induced, stems from its current importance in many industrialised societies. If extreme natural phenomena have always caused damage and losses to man and its society. Today, the explosive growth of industrialisation and urbanisation are exerting a tremendous impact on the environment which will lead to man-induced changes even more catastrophic than the natural ones (such as land, water and atmospheric pollution, desertification, and eventually a global climatic change).

During the Workshop, emphasis will be placed on the advantages derived from collecting, storing, analysing, modelling and simulating geographical data with the aid of modern GIS-based techniques. Drawbacks of current systems will be highlighted with reference to the data and information required for effectively predicting and monitoring natural disasters. The usefulness of integrating GIS information with remotely sensed data will be also evaluated.

3) Demonstration and review of selected case studies where GIS techniques are applied for predicting and mapping natural hazards.

To cover the first two issues, the workshop organising committee has brought together almost 40 scientists, from 11 countries of Europe, North America and Far East, with a disciplinary background ranging from computer sciences to hydraulic engineering, civil engineering, geology, geography and geophysics. The third issue will be covered with the joint co-operation of the workshop organisers and a few world-wide leading Companies and Institutions that operate in GIS modules production and distribution.
In order to facilitate the exchange of ideas and experiences, an open poster-section has been organised.

The workshop will be structured into six sessions, namely:

a) Present GIS technology and future trends;
b) GIS applications in flood hazard prediction and prevention;
c) GIS applications in landslide hazard prediction and prevention;
d) GIS applications in volcanic and seismic hazard prediction and prevention;
e) GIS applications in ground water pollution hazard prediction and prevention;
f) GIS developments to fulfil the requirements for coping with natural catastrophes.

The above topics will be also discussed during a panel section which will be organised at the end of the last Session. Also, the needs for nation-wide projects aimed at monitoring and predicting natural hazards will be examined in the light of present and future GIS-supported techniques.

The long-abstracts of the participants contributions, assembled in the present *pre-proceedings* volume, provide an outline of the subjects and ideas which will be discussed during the different sessions.

Hopefully, the comunications of the speakers and the follwing discussions, will help both in outlining the actual effectiveness of GISes for coping with natural disasters, and in setting forth a strategy for future activites aimed at improving methods and techniques in hazard assessment and mitigation, nationally and internationally.

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