

Chapter 19

A GIS Implementation of a Model of Systemic Vulnerability Assessment in Urbanized Areas Exposed to Combined Risk of Landslide and Flood

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ABSTRACT

This chapter aims to analyze the systemic vulnerability of a complex urban area when a combined flood-landslide event occurs. The proposed approach of vulnerability evaluation differs from traditional methods as it provides an analysis of “systemic vulnerability” measuring the relationship between extreme event magnitude and the direct and indirect consequences of this event on the territorial system. GIS technology has been introduced for the proposed systemic vulnerability assessment because it allows the implementation of the spatially and thematically distributed models used. The software also allows the automated application of the method by creating a model that processes, analyzes, and displays data in the form of maps. The model proposed was shown to be able to support the territorial planning and the appropriate management of an emergency due to natural catastrophes such as floods and landslides. The priority intervention elements can be defined as those with higher values of integrity and functionality (the most efficient rescue units) and the elements which need intervention are most affected by systemic vulnerability (the most damaged nodes).

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INTRODUCTION

One of the main innovative working areas of “systemic vulnerability” models (Pascale et al., 2009 and 2010; Sdao et al., 2010a and 2010b; Sole et al., 2010) aims at integrating the different types of natural risks (seismic, hydrogeological, landslides, fires), and therefore, understanding the dynamic and the functional interrelation in the territorial system. This model starts from the study of a certain area (a survey which refers to the exposition of the current functional systems) and continues in the study of the main territorial features related to the vulnerability due to risks. In this case, the risks related to objects vulnerable for landslide and flooding, can be considered as “targets” for possible damage due to a presumed natural disaster.

Depending on the sorting out of the suitable scenarios the simulation and modeling procedures lead to the definition of possible risks. This process allows the identification of the territorial units on which we carry out a concrete and detailed survey to sort out the mitigation actions on one hand, and a priority programme of intervention on the other. Even if the scientific community is concerned about the causes of natural disasters, it is important to find methods for interpreting these phenomena, anticipating the risks and defining strategies for mitigating the effects from flooding. The landslide and flooding frequency has led the government and the scientific community to take more interest in this problem.

Landslides and floods can cause a suspension or a loss of functionality with damage to the elements in a certain area or the loss of lives. The urban risk has more serious consequences than flooding or a landslide in unurbanized areas crossed by a river or on unstable terrain. This is due to a high concentration of people and objects exposed to damage or to the loss of functionality. In fact, the urban areas are a complex system of houses with main roads and by-roads, professional and local health centers and factories incorporated in the

expanded urban areas. Overlooking the loss of life, the territorial vulnerability during a natural catastrophe depends not only on the features of its elements but also on the relations between their parts; in most cases such relations are critical points in a territory. Firstly, vulnerability depends on the damage to people or things in the case of impact, such as flooded houses and damaged factories with the consequence that work stops, a loss of money, the bursting of sewage network pipes and injured people.

Secondly, during the emergency, after the impact, the type of vulnerability affects the compensation for damages. This includes a delay in aid, difficult communication and the impossibility for different social and territorial systems to get in contact with each other, that is to say blackouts, a collapse in water and gas supplies, damage to infrastructures, work stops and no access for exchanging goods. In order to combine two of these consequences, a GIS implementation is shown here to be more useful. In the Information System, it is easy to facilitate and run a model to combine and analyze the data, compare different kinds of maps so as to understand the processes, pass the data over and visualize steps and results. Geographic information systems make this model rapid and clear to elaborate and analyze in the combining of data and maps. In addition, GIS makes the spatial processes easy to organize and integrate into a large system which models the real world. The model proposed is able to support the territorial planning and the appropriate management of an emergency due to natural catastrophes such as floods and landslides. The priority intervention elements can be defined as those with higher values of integrity and functionality (the most efficient rescue units) and the elements which need intervention are most affected by systemic vulnerability (the most damaged nodes).

The proposed model was applied to the municipal area of Potenza, in Basilicata, southern Italy. Potenza is characterized by its industrialization, excessive building, agricultural interventions and

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