EEFIT

Earthquake Engineering Field Investigation Team

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Project title: Monitoring recovery after earthquakes through the integration of remote sensing, GIS and ground observations: The case of L'Aquila, Italy.

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Description of research question and proposed project:

The usefulness of remote sensing imagery to develop indication maps of damages after earthquakes in urban areas has already been proven in the cases of Carrefour in Haiti, and ConcepciOn in Chile. Now the research question is: if and how Remote Sensing (RS), as well as Geographical Information Systems (GIS) integrated with ground observations can serve to efficiently monitor the recovery process, not only during the emergency, but also in its subsequent phases: early recovery, recovery and development phase.

Monitoring the progress of the recovery is a holistic process. It implies knowledge about the existing vulnerability before the earthquake, and the extraction of indicators in the physical, social, economic, institutional, cultural and ecological dimensions, in order to avoid impending vulnerability and assessing resilience.

The purpose of the project is to develop an index of recovery that is based on spatial indicators obtained through RS, GIS, and ground observations (such as field surveys and local knowledge), using L Aquila (Italy) as a case study area. The integration of these methods and techniques will allow us to obtain indicators in the physical dimension, from which it is possible to derive proxy indicators in the social, economic and ecological dimensions.

The first step of this project is to establish spatial variables of recovery after earthquakes that can be integrated to indicators, as well as defining an index of progress for every recovery phase in the physical, social, economic, institutional, cultural and ecological dimensions. After identifying the variables and indicators for each recovery phase, it will be necessary to design a methodology based on geospatial tools and techniques (RS, GIS and ground observations), in order to use these variables and indicators, combining them to a recovery index to measure the progress of an affected urban area in this aspect.

Between 2009 and 2013 we have been combining ground observations (fieldwork), GIS and RS, in a lesser proportion, in order to complete the map indicating the

degree of damage, and to monitor the changes in the land use in L'Aquila (Italy), after the earthquake. This time, the main reason for formulating this project is the possibility of exploiting the capabilities of geospatial tools and techniques, in order to efficiently monitor recovery, regarding time and cost.

Impact of research:

Several indices have been developed to measure vulnerability, but only few studies yielded a recovery index, which is the least studied phase in the cycle of disaster management. The recovery of Kobe (Japan) is the most well documented and successful recovery process in history, which reached the development phase in less than 10 years.

To monitor the recovery of a city after a disaster, it is necessary to collect fine scale data, in order to map the composition of the urban area under study, and for assessing not only the changes in the urban morphology, but also the patterns of the urban landscape, in which buildings were built and people are living.

In the past, the approach for urban analysis using remote sensing imagery was mainly a pixel-based approach. This approach has several limitations regarding the accuracy of the data obtained, and it does not offer the complete context that is necessary for extracting proxy indicators in the social and economic dimension. In our project, we propose a method which integrates RS, GIS and ground observations to measure the progress of the recovery of an urban area after an earthquake using the object based approach, known as OBIA. This object-oriented analysis technique is useful for deriving physical and proxy socio-economic indicators in the spatial context at the local level and with a higher accuracy (Blaschke, T., 2010; Kerle, 2010; Mills et al., 2010; and Gamba et al., 2005). OBIA is also compatible with GIS, allowing the aggregation of information, as well as multi-scale representation, offering the possibility of a more holistic assessment of the recovery progress in each phase. Ground observations account for fine scale data, used to validate the information derived from RS and integrated through GIS.

Currently, remote sensing tools (Satellite imagery and/or aerial photography) allow a quick identification of the most affected areas in a city after an earthquake. During the emergency, ground observation methods such as field surveys are carried out, in order to determine the degree of safety of the buildings in the city, and to develop a map of the degree of damage. However, this exercise cannot be carried out again three, five or ten years later, in order to keep a record of the post-disaster phases and monitor the achievements in the recovery process, mainly due to its costs. The result of our research will provide a method based on spatial indicators, derived from geospatial techniques, to monitor the different phases of a city's recovery, a task which would otherwise be time consuming, expensive, and the observations difficult to be documented.

Monitoring the recovery will allow us to keep the emergent causal factors of vulnerability under control, in order to avoid reproducing the pre-existing conditions that caused the disaster in the city. It will provide data to assess the resilience of a community, and encourage the formulation of pre-impact recovery plans and the improvement of recovery plans going on around the world.