

# Spatial vulnerability indicators applied to recovery and disaster risk reduction after earthquakes: The case of L'Aquila - Italy

Contreras, D., Kienberger, S. and Zeil, P.  
 Z\_GIS – Centre for Geoinformatics, Salzburg University ;  
 Schillerstrasse 30, 5020 Salzburg  
 dianamaria.contreras-mojica@sbg.ac.at

## Project Context 1

Vulnerability assessment is a key step to formulate recovery and development policies in the risk management process. "More vulnerable zones have longer recovery phases" (Wisner et al., 2004). The *post-disaster phases* present an opportunity to *address the pre-existent vulnerability conditions* in order to reduce the risk, and create more resilient societies.

This research is a part of MOVE, a project with multidisciplinary approach to create knowledge, framework and methods to assess the vulnerability to natural hazards in Europe. The project also will take into account the outcomes from the "Recovery plan" formulated in Bogotá D.C. (Colombia), which is a pre-impact recovery plan based on an intervention model.



Source: <http://www.move-fp7.eu/>

## Case study area 3

The case study area is *L'Aquila (Italy)*, which was shaken by the 6<sup>th</sup> of April 2009 earthquake. The historical center was devastated, *1.500 people were injured* (202 serious injured and 898 light injured), *308 lost their life*, *44.000 became homeless* and between *3.000 and 10.000 buildings were damaged*. The cost of the damage is estimated to be about *16 billions of Euros*.



Source: Google Earth



Perspective of L'Aquila city (Italy).  
 Source: [http://newsitemstoday.today.com/files/2009/04/laquila\\_italy\\_earthquake\\_2009.jpg](http://newsitemstoday.today.com/files/2009/04/laquila_italy_earthquake_2009.jpg)

## Objective 2

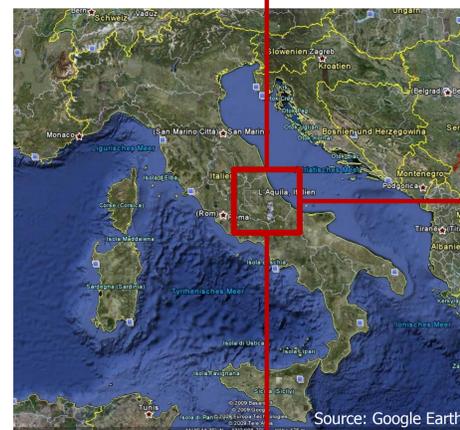
The main objective of this research is to *develop a methodology for monitoring and evaluating the recovery process after earthquakes, based on a framework of spatial vulnerability indicators other than the usual which mostly evaluate the physical aspect*. This research is an attempt to find the correlation between vulnerability conditions and the dynamics of relief, recovery and development processes and to know which and how other factors influence the interventions during post-disaster phases.

## Methodology 4

The methodological approach relies on *spatial variables* to develop an *index of geospatial indicators*, which is not only based on physical patterns but also on the social, economical, institutional, cultural and environmental dimensions.



Destroyed houses in the village of Onna (Italy).  
 Photographed by Max Rossi/REUTERS



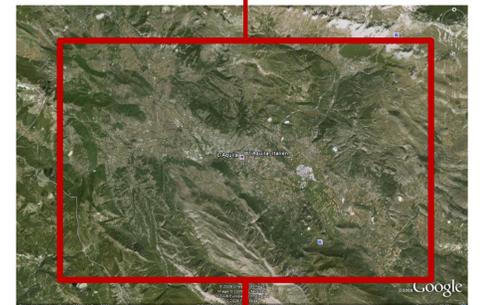
Source: Google Earth



L'Aquila province in Abruzzo region (Italy).  
 Source: <http://www.luventicus.org/mapas/italia/abruzzo.html>



Shelter in a gymnasium in L'Aquila (Italy).  
 Photographed by Mario Laporta

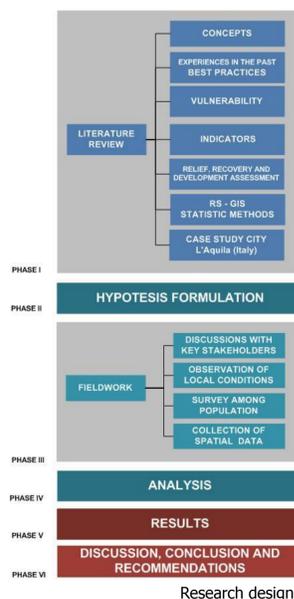


## Conceptual framework 5

The OECD model identifies three groups of indicators: *pressure, state* and *response* indicators. *State indicators* are based on the vulnerability conditions, *pressure indicators* rely on the level of damage and *response indicators* show the effectiveness of the relief and recovery activities. From these results, it should be possible to know if the stage of development in the recovery process (window time about 5 years) is reached.

The indicators extracted from the relief, early recovery and recovery variables, can be considered as *monitoring* indicators; however, the indicators extracted from the recovery variables are also useful to determine if the stage of development is reached. Therefore, these are also denominated as *performance* or *evaluation* indicators.

Individually, the indicators will be based on spatial variables, and they will part of an index or composite indicator to measure the effectiveness of the relief, early recovery, and recovery activities to determine if the development stage has been reached. The added value with spatial indicators is that *not only the physical dimension will be measured, but also the social, economical, institutional, cultural and environmental*.



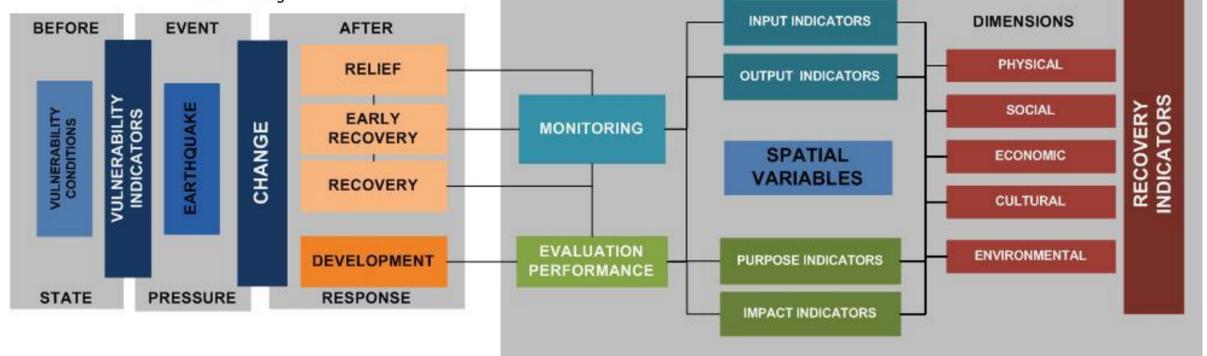
Research design.



Reconstruction activities in L'Aquila (Italy).  
 Source: European pressphoto agency



L'Aquila (Italy) location and fault line.  
 Source: Googlemaps



Conceptual framework.