

Integration of social vulnerability into emergency management plans: designing of evacuation routes against flood disasters

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Flash floods are highly spatio-temporal localized flood events characterized by reaching a high peak flow in a very short period of time, i.e. generally with times of concentration lower than six hours. Its short duration, which limits or even voids any warning time, means that flash floods are considered to be one of the most destructive natural hazards with the greatest capacity to generate risk, either in terms of the number of people affected globally or the proportion of individual fatalities. The above highlights the importance of a realistic and appropriate design of evacuation strategies in order to reduce flood-related losses, being evacuation planning considered of critical importance for disaster management. Traditionally, evacuation maps have been based on flood-prone areas, shelters or emergency residences location and evacuation routes information. However, evacuation plans rarely consider the spatial distribution of vulnerable population (i.e. people with special needs, mobility constraints or economic difficulties), which usually require assistance from emergency responders.

The goal of this research is to elaborate an evacuation map against the occurrence of flash floods by combining geographic information (e.g. roads, health facilities location, sanitary helicopters) and social vulnerability patterns, which are previously obtained from socioeconomic variables (e.g. population, unemployment, dwelling characteristics). To do this, ArcGis Network Analyst tool is used, which allows to calculate the optimal evacuation routes.

The methodology proposed here is implemented in the region of Castilla y León (94,230 km²). Urban areas prone to flash flooding are identified taking into account the following requirements: i) city centers are crossed by rivers or streams with a longitudinal slope higher than 0.01 m m⁻¹; ii) city centers are potentially affected by flash floods; and iii) city centers are affected by an area with low or exceptional probability of flooding (i.e. 500-year flood).

A total of 3 evacuation routes were designed and automatically traced for each of the 39 urban areas identified as interest, considering the nearest: i) health facility, ii) hospital; and iii) evacuation area (i.e. sports halls or any other).

The suitable elaboration of evacuation plans is really important in small mountainous areas prone to flash flooding as they are managed by local organisms where available economic resources are often limited. Furthermore, the short response time obliges emergency responders to act efficiently, which requires the design of evacuation plans taking into account certain social characteristics for evacuation routes designing.