



G.I.S. applications for evaluation and management of evacuation plans in Tsunami risk areas

M. Laghi (1), P. Polo (2), A. Cavalletti (3) and M. Gonella (1,2)

(1) C.I.R.S.A., University of Bologna, Ravenna, Italy, (2) Med Ingegneria s.r.l., Italy, (3) Italian Ministry of Environment, Land and Sea, Italy. (mario.laghi2@studio.unibo.it)

The problem of pedestrian evacuation in case of tsunami has been studied through the application of G.I.S. Spatial Analysis techniques.

The work is part of the C.R.A.T.E.R. project which represents the Italian Ministry of Environment and Territory technical contribution to the areas affected by the December 2004 event in Thailand.

Aim of the project as a whole, is the creation of tools suitable for risk assessment and evaluation processes, together with the proposal of efficient mitigation measures.

In this contest the attention was focused on the elaboration of a technique aimed at optimizing evacuation plans and identifying the best choice for implementation through GIS tools.

Evacuation plans are widely considered as a fundamental instrument for risk mitigation at the local scale; however those are commonly created by choosing main roads as suggested evacuations routes and, while this method can be effective for large scale evacuation, it might not be reliable for pedestrian evacuation; especially for tourist areas as the two shown in this study, Kamala Beach (Phuket Province - Thailand) and Laem Pakarang (Phang Nga Province - Thailand).

To define the best evacuation route from a given point it must be considered that the fastest path is not always the shortest. This path, in fact, could intersect natural barriers, buildings, rivers, lakes, sandy areas, or even present a very steep slope. For this reason when we compute the distance between two points (i.e between starting and assembly point) we have to consider not only the geometric distance but also the cost (in term of time, energy etc.) needed to move along the given path.

The concepts of path and distance are here replaced with the new concepts of *minor cost path* and *Cost Weighted Distance* (CWD) allowing in this way the calculation of the shortest (not simply in terms of physical distance) and safer evacuation route.

Tools used to identify the shortest way option include:

- spatial analysis
- hydrological models and
- tri-dimensional analysis

These tools are applied using a *raster technique*.

With this innovative solution a series of ArcGIS[®] tools have been built, defining evacuation routes by means of geographic information system spatial analysis techniques.

The tools are assembled into an “EVACUATION ROUTES TOOLS ArcGIS[®] toolbox” that will allow local authorities and various end users to directly apply the methodology and calculate themselves the best evacuation route for their area of interest.

These innovative methodology and tools will be presented.