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Urban Earthquake Shaking and Loss Assessment

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This study, conducted under the JRA-3 component of the EU NERIES Project, develops a methodology and software (ELER) for the rapid estimation of earthquake shaking and losses the Euro-Mediterranean region. This multi-level methodology developed together with researchers from Imperial College, NORSAR and ETH-Zurich is capable of incorporating regional variability and sources of uncertainty stemming from ground motion predictions, fault finiteness, site modifications, inventory of physical and social elements subjected to earthquake hazard and the associated vulnerability relationships. GRM Risk Management, Inc. of Istanbul serves as sub-contractor tor the coding of the ELER software.

The methodology encompasses the following general steps:
1. Finding of the most likely location of the source of the earthquake using regional seismotectonic data base and basic source parameters, and if and when possible, by the estimation of fault rupture parameters from rapid inversion of data from on-line stations.
2. Estimation of the spatial distribution of selected ground motion parameters through region specific ground motion attenuation relationships and using shear wave velocity distributions.(Shake Mapping)
4. Incorporation of strong ground motion and other empirical macroseismic data for the improvement of Shake Map
5. Estimation of the losses (damage, casualty and economic) at different levels of sophistication (0, 1 and 2) that commensurate with the availability of inventory of human built environment (Loss Mapping)

Level 2 analysis of the ELER Software (similar to HAZUS and SELENA) is essentially intended for earthquake risk assessment (building damage, consequential human casualties and macro economic loss quantifiers) in urban areas. The basic Shake Mapping is similar to the Level 0 and Level 1 analysis however, options are available for more sophisticated treatment of site response through externally entered data and improvement of the shake map through incorporation of accelerometric and other macroseismic data (similar to the USGS ShakeMap System). The building inventory data for the Level 2 analysis will consist of grid (geo-cell) based urban building and demographic inventories. For building grouping the European building typology developed within the EU-FP5 RISK-EU project is used. The building vulnerability/fragility relationships to be used can be user selected from a list of applicable relationships developed on the basis of a comprehensive study, Both empirical and analytical relationships (based on the Coefficient Method, Equivalent Linearization Method and the Reduction Factor Method of analysis) can be employed. Casualties in Level 2 analysis are estimated based on the number of buildings in different damaged states and the casualty rates for each building type and damage level. Modifications to the casualty rates can be used if necessary. ELER Level 2 analysis will include calculation of direct monetary losses as a result building damage that will allow for repair-cost estimations and specific investigations associated with earthquake insurance applications (PML and AAL estimations).

ELER Level 2 analysis loss results obtained for Istanbul for a scenario earthquake using different techniques will be presented with comparisons using different earthquake damage assessment software.

The urban earthquake shaking and loss information is intented for dissemination in a timely manner to related agencies for the planning and coordination of the post-earthquake emergency response. However the same software can also be used for scenario earthquake loss estimation, related Monte-Carlo type simulations and eathquake insurance applications.