Earthquake Hazard Mapping and Analysis by Integrating GIS, AHP and TOPSIS for Küçükçekmece Region in Turkey

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Key words: Risk management; Spatial planning; earthquake hazard analysis, GIS, multi-criteria decision making, AHP, TOPSIS, disaster and emergency management

SUMMARY

Earthquakes and related disasters have persistently caused severe negative impacts on human livelihoods resulting in widespread socio-economic and environmental damage, worldwide. The severity of these disasters have prompted recognition of the need for comprehensive and effective disaster and emergency management (DEM) efforts, which are required to plan, respond to and develop risk mitigation strategies. In this regard, recently developed methods, known as Multi-Criteria Decision Analysis (MCDA), have been widely used in DEM domains by emergency managers to greatly improve the quality of the decision-making process, making it more participatory, explicit, rational and efficient. In the present study, MCDA techniques of the Analytical Hierarchical Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), integrated with GIS, were applied to produce earthquake hazard maps (EHM) for earthquake disaster analysis for a case study region of Küçükçekmece in Istanbul, Turkey. The five main criteria that have the strongest influence on the impact of earthquakes on the study region were determined as: topography, distance to epicentre, soil classification, liquefaction, and fault/focal mechanism. AHP was used to determine the weights of these parameters, which were thereafter used as input into the TOPSIS method and GIS (ESRI ArcGIS) for simulating these outputs to produce earthquake hazard maps. The resulting earthquake hazard maps created by both the AHP and TOPSIS models were compared, showing high correlation and compatibility. To estimate the elements at risk, population and building data was used with the AHP and TOPSIS hazard maps for potential loss assessment, thus, we demonstrated the potential of integrating GIS with AHP and TOPSIS in generating hazard maps for effective earthquake disaster and risk management.

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FIG Congress 2018
Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
Istanbul, Turkey, May 6–11, 2018