Geophysical Research Abstracts
Vol. 13, EGU2011-6816, 2011
EGU General Assembly 2011

Local seismic hazard map (microzonation) of Bucharest by using probabilistic and deterministic approaches, linear and nonlinear methods

Gheorghe Marmureanu (1), Carmen Ortanza Cioflan (2), and Alexandru Marmureanu (2)

(1) University of Bucurest, Faculty of Physics, Bucurest, Romania (marmur@infp.ro), (2) National Institute for Earth Physics,Bucharest, Romania

Bucharest is one of the cities most affected by earthquakes in Europe. From the geological point of view, the city is located in the central part of the Moesian Platform, at an epicentral distance of almost 140 – 160 km from Vrancea region. Very high vulnerability of existing buildings from Bucharest has been observed during the last catastrophic earthquakes (Nov. 10, 1940, MW =7.7 and h=140 km; March 4,1977, MW = 7.4 and h=95 km. The sedimentary cover has a thickness of almost 6 km, of which the first 650 m in the southern part of the city, respectively the first 1450 m in the northern part of the city, belong to the Tertiary and Cuaternary. The total thickness of these deposits varies from 160-200 m in the southern part of the city to 350-450 m in the northern part.The fundamental periods of the surface deposits over the city of Bucharest computed or recorded during of last strong earthquqkes outlines the domain of interest for Bucharest between 1.45s in the southern part of Bucharest and 1.70 s in the northern one. All variations of the fundamental periods are function of local geological structures and strong Vrancea earthquake magnitude.In the hazard and microzonation studies, the nonlinear viscoleastic behavior of the superficial and deep soils deposits for such large defomations generated by strong Vrancea earthquakes has an important influence on the propagation of the seismic waves from Vrancea to and in Bucharest metropolitan area. Aki, in 1993, wrote:„Nonlinear amplification at sediments sites appears to be more pervasive than seismologists used to think... Any attempt at seismic zonation must take into account the local site condition and this nonlinear amplification". In last 7 years,to construct the microzonation maps, the authors used:(i)- Very Hard Rock(VHR) and Joint Source Site Determination(JSSD) methods to find site amplifications;(ii)-spectral amplification factors(SAF)-authors' method to find the quantitative evidence of the nonlinear effects, essential parameters to construct the design spectrum; (iii)-down-hole seismic measurements performed last time in Bucharest metropolitan area;(iv)-the amplifications of PGA during of Vrancea earthquake on Oct. 27, 2004 (MW =6.00) in other 6 boreholes made in Bucharest City with deep sensors at -153m,-78m,-70m,-68m,-66m,- 52m and shallow sensors, respectively at -24m,-28m,-30m,-28m,-28m and -28 m;(v)- attenuation laws to Bucharest by using different models (Joyner-Boore, Crouse etc.);(vi)-attenuation laws and intensity map by using the azimuths of Bucharest and all cities from extra-Carpathian area to get so-called "banana" shape;(vii)-developed the concept of "etalon(reference)" earthquake; (viii)-probabilistic and deterministic/(neo)deterministic analyses for strongest deep Vrancea earthquake with magnitude of MW =7.7;(ix)-using "Fuzzy Set Theory" concept in interpretation of seismic hazard maps in probabilistic analysis. The scenario-based methodology developed at this point is strictly based on observable facts and data from 74 seismic stations on metropolitan area and complemented by physical modeling techniques, probabilistic and deterministic approaches, linear and nonlinear methods, which can be submitted to a formalized validation process. Finally, there are constructed 3 local seismic hazard maps (microzonation) of Bucharest metropolitan area to maximum Vrancea earthquake of 7.7 on seismic moment scale for PGA(cm/s2), fundamental periods and MMI scale. The novelty and complexity degree comes from the fact that for the first time, local seismic hazard maps for Bucharest metropolitan area were built to maximum possible Vrancea earthquake (MW=7.5) by using probabilistic (inclusively "Fuzzy Set Theory" concept) and deterministic/(neo)deterministic approaches, linear and nonlinear methods, including a development of the nonlinear seismology concept, necessary to the (neo)deterministic analysis.