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SHAKE modelling of seismic site effects based on data recorded in Bucharest City, Romania

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Within the NATO-funded Science for Peace Project 981882 “Site-effect analyses for the earthquake-endangered metropolis Bucharest, Romania” was obtained a complete and homogeneous dataset of soil-mechanic and elasto-dynamic parameters. Ten 50 m deep boreholes were drilled in the metropolitan area of Bucharest in order to obtain the necessary data (dynamic tests at cores and vertical seismic profiles) for a new and modern map with site effects related to earthquake wave amplification in the shallow sedimentary layers.

Thick unconsolidated sedimentary layers in the area of Bucharest amplify the arriving seismic shear-waves causing severe destruction. Moreover the seismic site effects are not equally spreaded over the city area: during the earthquake of 27.10.2004 (Mw = 6), the PGA map of the horizontal component EW shows variations from 16 to 64 cm/s2 in the Bucharest area – roughly a circle of 20 km diameter.

The 10 drillings and the Vp and Vs (seismic longitudinal and shear-wave velocities) measurements in the boreholes were done in the years 2006-2007 (Bala et al., 2007). Rock samples were taken from each borehole at different depths for laboratory tests to determine the geotechnical parameters of each sedimentary rock type at the sites. Thus a valuable data base is assembled which contains: Vp and Vs values for each sedimentary layer, density and geologic characteristics of each layer, which are the basic data for equivalent linear modelling of the site; other geotechnical parameters measured in the laboratory on the rock samples will permit further the nonlinear modelling of each site.

Using the program SHAKE2000 we compute spectral acceleration functions at specific depths and transfer functions for the 1D models obtained from the in situ measurements. The acceleration response spectra correspond to the wave amplifications due to the package of sedimentary layers from 50 m depth (maximum depth) up to the surface, that are expected for a moderate real earthquake motion incident at the bottom of each 1D model. Because of the lack of outcropping bedrock in the Bucharest area, a seismic signal recorded in a borehole (PRI station, 52 m depth) at a moderate earthquake (Mw= 6), is used as input for the entire study area. Based on 1D models, a map with variation of the spectral acceleration was constructed for the central area of the city, where great variation in the PGA values were recorded at the last moderate Vrancea earthquake from 27.10.2004.