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Attenuation Relations for Engineering Ground Motion Parameters and generalised Site Conditions in Romania based on Fourier Amplitude Spectra: intermediate-depth Vrancea Earthquakes

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We present regional attenuation relations for Peak Ground Acceleration (PGA), Response Spectra Amplitudes (RSA) and seismic intensity (MSK or MMI scale) for the Vrancea intermediate depth earthquakes (SE-Carpathians) and territory of Romania. The Vrancea focal zone is characterised by a high rate of occurrence of large earthquakes in a narrow focal volume (depth 70-170 km). The used earthquake ground motion database includes several hundred acceleration records from more than 120 small magnitude ($M < 6.0$) earthquakes, which occurred in 1996-2004, and several records obtained during four large (M 7.4, 7.2, 6.9, and 6.3) earthquakes. The attenuation relationships were obtained using a stochastic method, which is based on Fourier Amplitude Spectra (FAS). First, it has been found that seismic radiation (within the frequency range from 0.2-0.3 to 15-20 Hz) during the Vrancea earthquakes of various magnitudes may be described by the omega-square single-corner-frequency spectral model and a correspondent 3-layers Q-model for rock sites and simple geological conditions. The developed FAS model was used for the evaluation of generalised site amplification functions for rock and soft soil sites. Characteristics of site response were analysed by means of ratios between spectra of earthquake records (horizontal components) and the FAS, modelled for a hypothetical "very hard rock" (VHR) site. Second, the PGA and RSA attenuation relationships were calculated, using the stochastic technique, as the dependencies on magnitude and epicentral distance for earthquakes of various depths. The seismic intensity attenuation models were evaluated using the recently developed relationships between intensity and FAS. The results of the study

were compared with correspondent empirical attenuation models, obtained for the region by other authors. This study was carried out in the Collaborative Research Center (Sonderforschungsbereich) 461 ”Strong Earthquakes: a Challenge for Geosciences and Civil Engineering”.