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Reviewed empirical ground motion attenuation relations for northern Italy using weak and strong motions data

M. Massa (1), P. Morasca (2), L. Moratto (3), S. Marzorati (1), P. Augliera (1), D. Spallarossa (2) and G. Costa (3)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Milano (INGV-MI), via Bassini, 15, 20133 Milano, Italy, (2) Dipartimento per lo Studio del Territorio e delle sue Risorse, Università di Genova, Viale Benedetto XV, 5, 16132 Genova, Italy, (3) Dipartimento di Scienze della Terra, Università di Trieste, via E. Weiss, 1, 34127 Trieste, Italy (massa@mi.ingv.it)

The aim of this work is to develop attenuation models for Northern Italy using high-quality data obtained by collecting and merging information from three neighbouring regional seismic networks operating in Genoa, Milan and Trieste: the Regional Seismic network of Northwestern Italy (RSNI), the velocimetric and strong-motion stations in Lombardia and Veneto (INGV-MI) and the Friuli-Venezia Giulia strong-motion network (RAF). In the last two years three different ground motion models have been developed for the area under study in order to investigate in detail the attenuation patterns related to the Western Alps and the Northern Apennines (Frisenda et al., 2005), the Central Alps and the Po Plain (Massa et al., 2006) and the Eastern Alps (Bragato and Sleiko, 2005). These attenuation relations have been derived starting from datasets characterized both by different local magnitude ranges and by different hypocentral or epicentral distances. The assembled dataset used in this work is characterized by a total of about 20.000 waveforms (both velocimetric and accelerometric records) recorded in the last 30 years and included events with local magnitude up to 6.3 (29 events with Ml $\geq$4.5). The great amount of data allow us to select for the regressions only high-quality waveforms (on the basis of the signal-to-noise ratio) and to consider only records characterized by distances less than 100 km. The regression analysis has been performed for the peak ground motion parameters and provides attenuation relationships for the maximum horizontal components. The ground motion models have been derived for peak ground velocity (PGV), peak ground acceleration

(PGA) and spectral accelerations (SA), for 5% critical damping, at 12 frequencies between 0.5 and 25 Hz. For the attenuation function both epicentral and hypocentral distances have been considered. Finally, a soil classification has been introduced in the models: the site coefficients have been estimated starting both from H/V analysis computed at the site in which the station are installed and following the EC8 code site classification. All coefficients have been determined applying the random effects model (Abrahamson and Youngs, 1992), that allows the determination of the inter-event, inter-station and record-to-record components of variance. The results of this study will be useful in future revisions of the Italian National Seismic Hazard maps.