



Ground Motion Prediction Equations for the Campi Flegrei volcanic area

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Ground Motion Prediction Equations (GMPEs) are semi-empirical relationships commonly used to model ground motion intensity measures, such as peak ground accelerations (PGA) and velocity (PGV) and pseudo-spectral amplitudes (SA) at a specific site, conditional to earthquake parameters such as magnitude, source-site distance, and local site amplification effects. They are used for several seismological and earthquake engineering applications, such as probabilistic seismic hazard and rapid response (ShakeMap) analyses.

In the last decade, the very densely populated volcanic area of Campi Flegrei in Southern Italy, has experienced an intense seismic activity, related to the inner-caldera resurgency and ground uplift, with more than eight-thousand recorded events. During the last two years, both the uplift rate and the seismic activity accelerated, leading to the occurrence of about forty events with duration magnitude between 2.5 and 4.2 whose shaking has been well perceived by the population. Some of these earthquakes showed ground motion intensity (i.e., spectral pseudo-acceleration, SA), leading to non-negligible seismic actions on structures at specific natural vibration periods. Nevertheless, even structures located at less than few km from the source did not sustain significant damage.

Due to the strong discrepancy between observed and predicted data using literature GMPEs for Campi Flegrei, in this work, ad-hoc GMPEs were calibrated for PGA, PGV and 21 SA at periods T in the range [0.01s 10s]. Data come from the largest magnitude events (38) occurred in the last two years, and recorded at thirty-four accelerometric and/or velocimetric stations located at epicentral distance $R_{epi} < 40$ km. The events were re-located with a probabilistic, non-linear approach and the moment magnitude was computed from displacement spectrum amplitudes. Results indicate that the re-calibrated GMPEs expect larger PGA and PGV very close to the source ($R_{epi} < 5$ km) and a higher attenuation at larger distances with respect to the existing attenuation relations for Italian volcanic areas.

The retrieved GMPEs for the Campi Flegrei caldera have been used to map the minimum magnitude of close-by earthquakes expected to exceed code-mandated design (elastic) seismic actions on structures; so-called strong earthquakes. This minimum magnitude is found in the range 4.1-5.1, depending on the ground motion intensity measure, for sites located within or in proximity of the caldera and earthquakes occurring at epicentral distances smaller than 1 km.