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Estimates of ground motions in the Phlegraean Fields produced by potential seismogenic sources of major interest for the city of Naples, Italy

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This study is aimed at predicting the strong ground shaking in the Phlegraean Fields area, in the western part of the city of Naples, by the use of synthetic simulations of the seismic radiation possibly produced by earthquakes occurring on active faults of the southern Apennines range. Given their distance, geometry and expected mechanism these faults have been selected as the potentially most dangerous ones for the city of Naples.

We selected the seismogenic sources associated with earthquakes having caused intensity equal or above VII in the city of Naples and having occurred in the past 700 years (the most reliable time window for the historical earthquake catalogue). All seismogenic sources were taken from INGV's DISS database. These faults are long and relatively shallow structures (length greater than 25 km and maximum depth within 13 km) having seismic moment and focal mechanism comparable to the 1980, M 6.9 Irpinia earthquake. According to the literature, the latter is included in our simulation study by considering the occurrence of three separate rupture processes along three distinct fault segments.

A suite of synthetic seismograms at the basement rock in Naples for each considered fault has been generated by using the discrete wavenumber method proposed by Bouchon (1981) numerically implemented for the computation of complete wave field Green's function in a flat-layered medium. We adopted a simplified source model (line source Haskell model) to simulate the kinematic rupture process along an extended source, allowing for rupture nucleation in the middle (bi-lateral) and at the edge (uni-

lateral) of the Haskell line. This approach has been preliminary tested and validated with the comparison between synthetic and observed 10-Hz low-pass filtered 1980 Irpinia earthquake records.

The investigated site is located in the eastern part of the Phlegraean caldera, a plain area filled with recent ($<$ 12,000 yr) pyroclastic soils. Several specific experiments were performed to evaluate the effect of surface geology on ground shaking. The experimental data used in this study come from a 2D active refraction seismic survey, from the spectral analysis of the shot-induced multichannel surface-waves (MASW), and from a 2D small-aperture array that recorded both natural earthquakes and ambient noise. Simultaneously, a firm-site reference station was also operating on an outcrop of yellow Neapolitan tuff (lithoid facies), about 1 km away from the array. These data, integrated with stratigraphy available from boreholes drilled in the plain, allowed us to reconstruct a 1D vertical profile of shear-wave velocities at the site of interest. This velocity model was mostly based on the inversion of the dispersion curves obtained from ambient noise measured at the array combined with MASW results from the refraction survey. The fundamental resonance frequency of the site was assessed around 1 Hz. At this frequency, the soft-to-firm spectral ratios computed from the recorded earthquakes are consistent with the theoretical transfer function of the model in terms of both predominant frequency and amplitude. The rock-site synthetic seismograms were then convolved by the site theoretical transfer function in a linear-equivalent approach, where shear-modulus and damping curves for the soft materials of the uppermost layers are taken from the literature. Acceleration and displacement response spectra were computed from the convolved synthetics. A comparison of the retrieved response spectra with those required by the Italian seismic code (Italian government ordinance PCM 3274 of 20 March 2003) suggests that our results are consistent with expectations at short-periods ($T < 2$ s) but some discrepancies arise at longer periods, where our predictions exceed the spectral ordinates of the seismic codes. This finding stresses the need for more thorough investigations of intermediate-period surface waves