Engineering research at Campi Flegrei during bradyseism

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Campi Flegrei, a densely populated volcanic area bordering the city of Naples (southern Italy), is currently experiencing volcanic unrest, with the inner caldera undergoing bradyseism and seismic activity. There is public attention on seismic risk in the area for reasons that can be summarized in three points. First, half of the about nine-thousand events occurred in the last decade, with duration magnitude (M_d) in the $[-1.1,4.4]$ interval, had been recorded in 2023 and 2024. Second, several of these events were widely felt by the population, with some earthquakes causing, at less than 1 km epicentral distance, seismic structural actions that can be considered relevant from the engineering perspective. Third, many buildings in the area lack modern seismic standards or any seismic design at all. This contribution summarizes some of the results of the earthquake engineering research on Campi Flegrei. First, it presents a database collecting more than one thousands three-component accelerometric waveforms from thirty-two events with $M_d \geq 2.5$ that were recorded between Aug. 2023 and Dec. 2024, publicly available at http://wpage.unina.it/iuniervo/CampiFlegrei_EQ_Records/. Using this database, whose details are given in Cito et al. (2024), the features of ground shaking are analysed, also using ShakeMap-like estimates obtained using a ground model calibrated ad-hoc for Campi Flegrei (Scala et al., 2024), and it is shown that attenuation is such that the largest intensity from all $M_d \geq 2.6$ events, is reduced by more than sixty percent already at less than 4 km from epicenters. Then, it is shown that the minimum magnitudes expected to cause exceedance of ground motion for new design/retrofitting interventions, are larger than the lower bound of the reference moment magnitudes for the area, being them in the 4.4-5.1 range according to fault mapping and geomorphological inference, combined with high-precision earthquake relocation and stress-drop analysis (Iervolino et al., 2024). Fatality risk analysis shows that upgrading existing residential buildings, designed in different epochs, to contemporary code-conforming safety standards, would result in a fatality risk reduction of more than seventy percent.

References

Cito, P., Baraschino, R., Iervolino, I. Ground motion, estimated shaking, and structural response at Campi Flegrei during bradyseism. Under review.

Iervolino, I., Cito, P., De Falco, M., Festa, G., Herrmann, M., Lomax, A., ... & Zollo, A. (2024). Seismic risk mitigation at Campi Flegrei in volcanic unrest. *Nature Communications*, *15*(1), 1-14.

Scala, A., Strumia, C., Cito, P., Scotto di Uccio, F., Festa, G., Iervolino, I., Zollo, A., Bobbio, A., Convertito, V., Elia, L., Emolo, A., Iaccarino, A. G. Ground Motion Prediction Equations for Campi Flegrei (Italy). Under review.

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