NEAR-FAULT AND SITE EFFECT PHYSICS-BASED GROUND MOTION MODELLING FOR BETTER UNDERSTANDING OF HISTORICAL EARTHQUAKES: THE CASE OF MUGELLO BASIN

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The Mugello basin, located in the north of Florence, Italy, is a sedimentary basin with a thickness of several hundred meters, bordered by two fault systems. The region has witnessed significant seismic events in the past, notably in 1542 (M 6) and 1919 (M 6.3), leading to extensive damage throughout the area. Particularly, these events caused disorders, repairs, and restorations to bell towers located in the region. These historical buildings serve as important indicators of past seismic events and can be used as ”stone seismometers” to analyze the ground motions that caused damage or repairs to the structures. It is important to note that there is an ongoing debate regarding the specific fault system accountable for the 1542 and the 1919 earthquakes.

The primary objective of the project is to reconstruct the seismic ground motion associated with these earthquakes. To achieve this goal, numerical modeling of the seismic ground motion is conducted, considering the complexity of source rupture and wave propagation in a 3D sedimentary basin. Many rupture scenarios are created by investigating the physical parameters of the fault model, primarily focusing on fault geometry, the fault position, and the fault kinematic parameters such as the slip distribution, the rupture velocity, and the hypocenter position with respect to the fault asperities which controls directivity effects. Ground motions produced by the selected rupture scenarios and propagating within the area including the basin are computed, with a particular focus on the studied bell towers. The site effects, essential to consider for earthquake damage assessment, are found to be highly dependent on the rupture scenario.