

Abstract

A comprehensive study of the soil shaking under the seismic wave-field excitation is presented. It includes theoretical, geological, geotechnical, data analysis and numerical simulations aspects. The aim is to quantify the main parameters allowing the estimate of the soil shaking in urban areas for better mitigating seismic risk due to future earthquakes. The city of Rome has been chosen as a case study because of its high density of population and large concentration of historical monuments with high earthquake vulnerability. This study improves significantly the knowledge concerning the detailed near-surface geology of the chosen study area of Rome, fulfills the absence both of knowledge concerning its geotechnical properties and earthquake data recordings in the city. Among others, it allows for a better explanation of the spatial damage pattern observed in the city due to earthquakes in the past. The main innovations include the construction and long-term operation a seismic array in the city, analysis of the natural seismic noise, and instrumental recordings of the 2009 L'Aquila earthquake sequence. The 3D array (including a borehole sensor at 70-m depth) is the first one in Italy planned, realized and operated within an urban area, and the first one that recorded a significant earthquake in the city. Finally, the recorded data are compared with hybrid numerical simulations of the ground motion in the Tiber valley, using new parallelized codes, based on the discrete-wave-number and 3D finite-difference methods.