EGU2020-22483
https://doi.org/10.5194/egusphere-egu2020-22483
EGU General Assembly 2020

Modelling the three-dimensional site response in the village of Amatrice, Central Italy

Roberto Razzano[1], Iolanda Gaudiosi[1], Massimiliano Moscatelli[1], Callisto Luigi[2], Giuseppe Lanzo[2], Guido Martini[3], and Salomon Hailemikael[3]

[1]Consiglio Nazionale delle Ricerche, Istituto di Geologia Ambientale e Geoingegneria (CNR-IGAG), Rome, Italy

[2]Sapienza University of Rome, Italy

[3]ENEA, Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile, Rome, Italy

We analyzed the seismic site response of the Amatrice village, that experienced extensive and very high level of damage after the 24th of August 2016 earthquake, further aggravated by the following shocks of October 2016. In particular, site response was investigated by simulating seismic wave propagation through an advanced 3D subsurface model of the site. Availability of experimental site transfer functions allowed validating simulation results and evaluating advantages and drawbacks of this approach.

The 3D subsoil model was developed based on the available dataset of borehole stratigraphic logs, shear wave velocity profiles obtained from Down-Hole tests and 2D ARRAY measurements as well physical and mechanical properties measured by means of laboratory tests (EmerTer Project, 2018; CNR IGAG Report, 2018).

The model was forced by 3-component (3C) input constituted of acceleration time histories that were selected from the European Strong-Motion database (www.esm.mi.ingv.it ; Luzi et al., 2016) by considering a return period = 975y.

The explicit finite-difference code FLAC3D (ITASCA Consulting group Inc., 2017) was used for numerical simulations; this code operates in the time domain, incorporates a compliant base, free-field lateral boundaries and uses a fully nonlinear approach to model the dynamic soil properties. The identification of the seismic bedrock depth was carried out by an iterative procedure that minimizes the difference between recorded motions after deconvolution at depth. A hysteretic-damping model and Rayleigh damping formulation were used to account for viscous damping in dynamic condition. Rule by Kuhlemeyer and Lysmer (1973) was adopted for element size definition to achieve a satisfactory level of accuracy up to 10 Hz. The finite difference mesh consists of about 1.1 million tetrahedral-shaped elements.

Three control points in correspondence with three temporary seismic stations, i.e., MZ12, MZ28 and MZ31, were considered in order to compare the simulated 3D transfer functions with the experimental ones. In particular, MZ12 was located in the historical center of Amatrice village, MZ28 in the southeastern part of the village, while MZ31 in the western sector. Available Standard

Spectral Ratios (Borcherdt, 1970, Milana et al., 2019) were used to determine the experimental frequencies and amplifications. The results showed that the average amplification is about 4 for MZ12 in the frequency range 5-7Hz and about 2 for MZ28 station at 3Hz, while amplification function is essentially flat at MZ31. In the historical part of the village, only Horizontal-to-Vertical Spectral Ratio (Nakamura, 1989) measurements were available. Reasonable agreements were found in the considered frequency range 1-10Hz.

This approach, which simulated the 3C ground motion field, demonstrated to be useful to evaluate the most important 3D model features relevant for site amplification.

The present work was performed in the frame of the SISMI Project, funded by Regione Lazio and devoted to developing new technologies for improving the security and the reconstruction process of the historical centers in central Italy. All the activities were carried out under in the framework of the “DTC Lazio” (https://dtclazio.it/).