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Seismic response of L'Aquila (Central Appennines, Italy) from 2D numerical simulation

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Experimental and modeling approaches fulfill complementary needs in the assessment of the seismic soil response. Here we present some results from 2D simulation performed for the L'Aquila basin (Central Appennines, Italy).
The city of L'Aquila on April 6th, 2009 at 01:32 UTC was struck by a magnitude Mw=6.3 earthquake localized about 2 kilometers west of the city centre at hypocentral depth $\sim$ 9 km. The city of L'Aquila suffered wide spread destructive damage in its historical centre where housing is mainly 2 to 3 storey medieval masonry. Several reinforced concrete buildings built in the late 70s collapsed in the south-west section of the city and also monumental, historical churches were severely damaged. Because of its location, the ground motion recorded in the city is strongly influenced by the source rupture mechanism, nonetheless, local amplification are expected to have influenced the ground shacking. L'Aquila is indeed built over a Quaternary terraced alluvial-lacustrine basin with a rather complex lithology as well as surface topography.
The 2D seismic modeling of L'Aquila terrace was already performed by several authors along transversally oriented (NE-SW) geological sections. In this study we present some new results obtained by the use of longitudinal cross sections (NW-SE) in order to better understand the role of lateral geological heterogeneities as derived by recent geological and geophysical data. The simulations have been performed using the impedance-operator-based numerical code.
The models of L'Aquila terrace are based on geological and geophysical investigations performed in the framework of the micro-zoning activities of the city following the disastrous April 6th 2009 Mw=6.3 earthquake and in subsequent studies. The depth to the bedrock of the basin is constrained by gravimetric and deep borehole data with an estimated maximum depth of about 300 m. The basin is filled by silt and silty-clay of lacustrine origin topped by a breccia layer (BrA) of gravitational-fluvial origin. BrA does not extend continuously over the terrace and in particular in the southern area of the city it is locally replaced by silt and silty-clay of lacustrine origin with lens of BrA and gravel with silt. Locally, on the top of the terrace lens of less competent red silt were found by the recent deep borehole surveys performed in the micro-zoning activities.
We have further constrained our 2D models using the resonance frequencies from noise and earthquake spectral ratios for selected sites. The wave velocities have been inferred by MASW and cross-hole analyses.
We have compared the spectral ratios obtained from SH, P-SV and Rayleigh incident waves field in the range 0°-90° to the observed spectral ratios computed using the earthquake aftershocks recorded by the micro-zoning portable network. The modeling results are able to match the resonance frequency obtained by seismological data and to verify the role of the reversal in the velocity-depth profile and the lateral continuity of the top fast layer (BrA).