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Local Seismic site effects estimated by detailed seismic surveys: the case of Castelnuovo village (L'Aquila Basin, central Italy)

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Assessing seismic site effects is essential in earthquake hazard studies. Local seismic amplification is strongly related to the site stratigraphy and topography, the dynamic properties of the subsoil deposits, and the earthquake features. The evaluation of these factors is mandatory to achieve a consistent model of the seismic hazard at small scale. Here we discuss the case of Castelnuovo village (L'Aquila, central Italy). Located on a small ridge, approximately 60 m higher than the valley floor, the village was heavily struck by April 6, 2009, M_w 6.3 L'Aquila earthquake, with catastrophic collapse of several buildings. Previous studies ascribed the observed damage to the presence of shallow caves beneath the buildings or to the topographic amplification.

In this work, an updated and detailed subsoil model for Castelnuovo site has been provided, based updated geological surveys, such as borehole logs and geophysical data consisting in microtremor measurements and down-hole.

These measurements identified resonant frequencies occurring in the range of 0.7-3.0 Hz. These frequency peaks are related to the presence of a velocity contrast at depth between the San Nicandro silts and the Madonna della Neve breccias, as indicated by the performed deep boreholes. Thanks to analytical, numerical, and geostatistical techniques, we identified the main impedance contrast at approximately 210 m depth from the top of the hill, much deeper than previous studies. These new findings allowed to create an accurate and consistent subsoil model summarized by two geological cross-sections of the Castelnuovo ridge, showing that the seismic site effects at the Castelnuovo village are mainly related to stratigraphic amplification.