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SEISMIC CHARACTERIZATION OF SOILS IN THE CITY OF LORCA (SE OF SPAIN) FROM AMBIENT VIBRATION MEASUREMENTS

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A Mw5.2 earthquake shook the city of Lorca, in Murcia region (SE-Spain) on 11 May 2011 at 18:47 local time. The main shock was preceded by a large Mw4.5 foreshock, about two hours before. The strongest aftershock, around four hours later, reached Mw3.9. The event caused 9 fatalities and more than 300 people were injured in a town with a population of around 60000 in an area of 7 km^2. Around 1000 buildings, including residential, cultural heritage, schools, government buildings, healthcare, security facilities, etc., were damaged with different degree. Damage was concentrated in several areas of the town where around 40% of buildings were affected. In the historical centre 16% of buildings were damaged. Historical heritage was severely affected including old churches and medieval wall towers. Nearby towns and provinces were not seriously affected.

Earthquakes are not infrequent in Murcia region, where Lorca city is located. Several events in the historical record reached maximum EMS-98 intensity VIII (*e.g.*, one in 1674 and two in a 1911 sequence), while in the last 10 years a number of events have occurred in the same region in 1999, 2002, and 2005 of magnitudes 4.8, 5.0 and 4.7, respectively. These three events reached intensities EMS98 VI-VII, causing damage and economic losses in several towns in the region.

Within the two years following the 2011 earthquakes in Lorca, several ambient vibration measurement campaigns, both single-station and multi-station array configurations, were performed in order to constrain seismic properties of the subsoil in the city and its surroundings. Single-station ambient-vibration records were obtained at 79 sites in Lorca, mainly in its urban area. Additionally, at 13 sites, 9 three-directional digital tromographs were deployed in 2-D array configurations, characterized by dimensions of the order of 100 m. Measurements in the vertical component were used to retrieve the relevant effective dispersion curve of Rayleigh waves by considering ESAC and f-k approaches. Furthermore, at each measurement point within the array, horizontal-to-vertical average spectral ratios (HVSR) were also computed. Moreover, polarization analysis was carried out, which allowed detecting possible anisotropies in the ambient vibration wave field.

The dispersion and HVSR curves obtained at each site were jointly inverted by considering a genetic algorithm (GA) approach, assuming that the monitored ambient vibration wave field is dominated by surface waves including both Love and Rayleigh waves with relevant higher modes. By this procedure, S-wave velocity profiles, along with the relevant uncertainties, were estimated at each site up to depths of the order of hundreds of meters. Preliminary results reveal that possible ground-motion amplification by local soils is not significant in most of the Lorca urban area and they also

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suggest the presence of significant lateral heterogeneities in the subsoil structure, resulting from past tectonic activity of major faults present in the region.