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# LOCAL SEISMIC RESPONSE EVALUATION: THE STUDY CASE OF LAMPEDUSA ISLAND (ITALY)

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The Lampedusa Island is located in the Sicily channel within the central Mediterranean sea. It belong to the African-Pelagian foreland that consists of a Meso-Cenozoic shallow-water to basinal carbonate succession, 6–7 km thick (Civile et al. 2008; 2013). From the geological point of view the island is formed by a horst structure formed by Upper Miocene shallow see limestone deposits Grasso & Pedley, 1988) .The area is characterized by moderate seismic activity with shallow events ($h \leq 25$ km) located in the Sicily channel.

The present study aims to evaluate the local seismic response using as seismic input ambient noise recordings and processing data through spectral ratio techniques. Eighty measurement sites (yellow pins in Fig. 1) were almost homogeneously spaced along a grid having size of about 600 m whereas, six transects (four recording each; red pins in Fig. 1), where fulfilled along the fault lines and morphologic scarp mostly located in the eastern part of the island. Moreover, ambient noise was also recorded in five buildings (green pins in Fig. 1), built in either reinforced concrete or masonry, in order to evaluate their fundamental period. Ambient noise was recorded using Tromino, a 3-component velocimeter. Time series of 40 minutes length were recorded using a sampling rate of 128 Hz and processed through the spectral ratio technique (HVNR). Time windows of 50 s were considered and the most stationary part of the signal was selected excluding transients associated to very close sources. In this way the Fourier spectra were calculated in the frequency range 0.2-30.0 Hz and smoothed using a proportional 20% triangular window. Following the criteria suggested by SESAME project (2004), only the spectral ratio peaks having amplitude greater than two units were considered significant.

Experimental spectral ratios, obtained in the measurement sites located along the transects, were also calculated after rotating the horizontal components of motion by steps of 10 degrees starting from 0° (north) to 180° (south) in order to investigate about the possible presence of directional effects. A direct estimate of the polarization angle was also achieved through the time-frequency polarization (TFP) analysis (Burjánek *et al.* 2012).

The results set into evidence that in all HVNR an increase of amplitude in the frequency range 2,0 a 4,5 Hz is observed. These spectral ratio peaks often do not reach two units amplitude, both in the South-eastern part of the island, where the most ancient terrains outcrop, and in the central and western portion, where more recent deposits are located. This is in good agreement with the stiffness of the limestone formations extensively outcropping in the highland. More pronounced spectral ratio peaks are detected in the measurement sites located along the transects crossing the tectonic structures existing in the eastern boundary of the island (e.g. #61, #64, #58, #59) as well as in those transects performed perpendicularly to the strike of the morphologic escarpments existing in the north eastern side of the island (e.g. #65, #66). The polarization of the horizontal components of motion, evaluated

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in the measurement sites located nearby the fault lines, show that the largest amplifications occur at high angle from the fault strike. On the other hand, measurements performed at increasing distance from the fault zone do not show a similar behavior and this suggests that the observed directional effects can be ascribed to the fault fabric (Panzera et al., 2014).

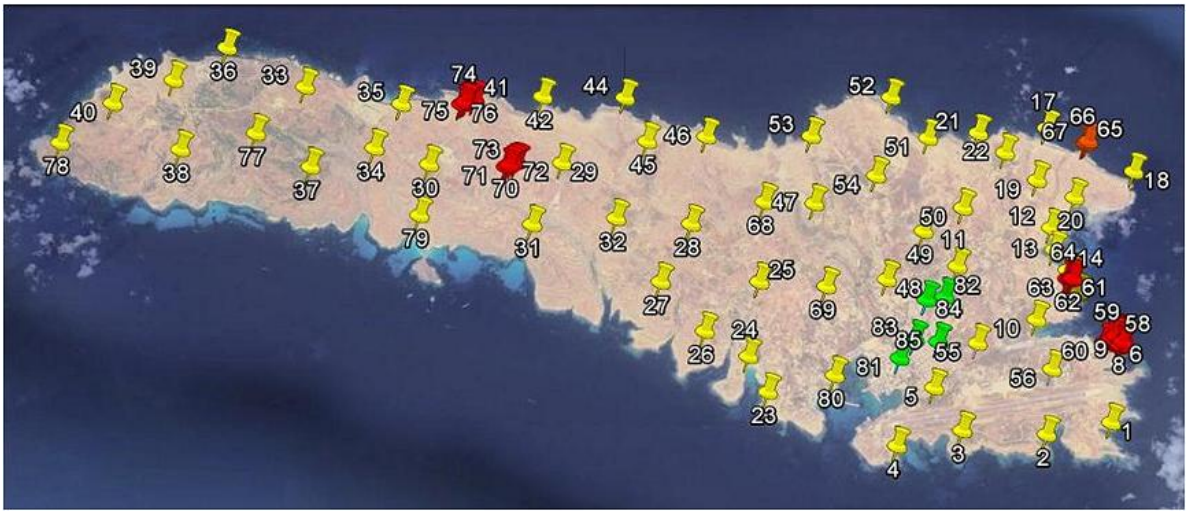

Figure 1. Location of the noise recording sites (see text for details)

The measurement performed on buildings allowed us to infer the fundamental period of the investigated buildings, showing that there was no particular soil-to-structure effects. More pronounced and dominant spectral ratio peaks were observed in tall and isolated buildings whereas, secondary spectral ratio peaks were observed in case of adjacent buildings, independently from their typology of construction. It is interesting to mention that the fundamental periods experimentally evaluated appear smaller than those obtained through the use of the relationships proposed by the official norms.

We can finally affirm that the use of ambient noise records showed to be a reliable and not expensive technique for a quick characterization of the local seismic response and the experimental evaluation of building fundamental periods, as well as investigations about possible soil-to-structure interactions. This kind of studies appear to be particularly useful to governmental agencies tasked with emergency response and rescue.

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