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Topographic effects in the local seismic response at a test site in Catania (Italy)

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The evaluation of local seismic response in urban areas is one of the main tasks for city planning aimed at mitigating the potentially high seismic risk. The features of surface geology, as well as the geomorphologic and topographic setting play a key role in the evaluation of the ground motion at the surface. The characteristics of local topography imply the existence of diffraction phenomena, as well as reflections and conversion of the incident seismic waves leading to peculiar modification of the ground shaking. In recent years, many authors (Spudich et al., 1996; Del Gaudio et al., 2008) have reported cases of significant directional variations of the seismic site response linked to different geological and topographic conditions. In present study, we used the most commonly adopted methods to evaluate site response properties (SSR, HVSR and Nakamura technique) together with directional evaluation methodologies. Measures were carried out in a small hill named S. Sofia, located in the northern part of Catania, where the university campus is erected. Two seismic stations, equipped with broadband seismometers, were located on the top (CITT) and along the slope of the hill (POLI), respectively. They operated for about two years (1999-2001) and a set of 64 local and regional seismic events was used for further data analyses. Moreover, time series of ambient noise were recorded in fifteen sites for 30 minutes, using a sampling rate of 128 Hz. Data were processed evaluating both directional resonance and ground motion polarization. Spectral ratios from noise data through Nakamura technique show evident directional effects between 80° and 135°, in the frequency range 1.5-3.0 Hz, mainly along the slopes. SSR and HVSR from earthquakes data show greater amplifications at station POLI rather than at CITT. Results of polarization analysis of earthquakes point out the lack of a predominant directions at CITT, whereas evident directional effects appear at POLI. Such findings can be interpreted as the combined effect of source azimuth, wavefront path and slope of the hill. It is indeed observed that at the station POLI, amplification peaks are more pronounced than at CITT. This effect could be related to the location of the earthquakes source that, being local (etnean), have a low incidence angle and a wavefront azimuth of about 0°N. In such conditions, the maximum amplification has a tendency to shift from the top of the hill to the side that is opposite to the direction of the approaching wavefront (Geli et al.,1988; Bard and Riepl-Thomas, 1999). Directional effects, from both earthquake and noise data, are more evident at the stations located along the slope of the hill rather than at the topmost stations, showing angles that tend to follow the main grade lines.

References

Bard P.-Y., Riepl-Thomas J. (1999).Wave propagation in complex geological structures and their effects on strong ground motion. In Wave motion in Earthquake Engineering, Kausel and Manolis eds., WITPress, chapter 2: 37-95.

Del Gaudio V., Coccia S., Wasowski J., Gallipoli M.R., and Mucciarelli M.; 2008: Detection of directivity in seismic site response from microtremor spectral analysis., Nat. Hazards Earth Syst. Sci., 8, 751–762.

Geli L., Bard P.-Y., Jullien B. (1988). The effect of topography on earthquake ground motion: a review and new results. Bull. of the Seism. Soc. ofAm., 78: 42-63.

Spudich P., Hellweg M., and Lee W. H. K.; 1996: Directional topographic site response at Tarzana observed in aftershocks of the 1994 Northridge, California, earthquake: implications for mainshock motions. Bull. Seism. Soc. Am., 86(1B), S193–S208.