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3D shallow velocity model in the area of Pozzo Pitarrone, NE flank of Mt. Etna Volcano, by using SPAC array method.

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In volcanic environment the propagation of seismic signals through the shallowest layers is strongly affected by lateral heterogeneity, attenuation, scattering, and interaction with the free surface. Therefore tracing a seismic ray from the recording site back to the source is a complex matter, with obvious implications for the source location. For this reason the knowledge of the shallow velocity structure may improve the location of shallow volcano-tectonic earthquakes and volcanic tremor, thus contributing to improve the monitoring of volcanic activity. This work focuses on the analysis of seismic noise and volcanic tremor recorded in 2014 by a temporary array installed around Pozzo Pitarrone, NE flank of Mt. Etna. Several methods permit a reliable estimation of the shear wave velocity in the shallowest layers through the analysis of stationary random wavefield like the seismic noise. We have applied the single station HVSR method and SPAC array method to seismic noise to investigate the local shallow structure. The inversion of dispersion curves produced a shear wave velocity model of the area reliable down to depth of about 130 m. We also applied the Beam Forming array method in the 0.5 Hz – 4 Hz frequency range to both seismic noise and volcanic tremor. The apparent velocity of coherent tremor signals fits quite well the dispersion curve estimated from the analysis of seismic noise, thus giving a further constrain on the estimated velocity model. Moreover, taking advantage of a borehole station installed at 130 m depth in the same area of the array, we obtained a direct estimate of the P-wave velocity by comparing the borehole recordings of local earthquakes with the same event recorded at surface. Further insight on the P-wave velocity in the upper 130 m layer comes from the surface reflected wave visible in some cases at the borehole station. From this analysis we obtained an average P-wave velocity of about 1.2 km/s, in good agreement with the shear wave velocity found from the analysis of seismic noise.
To better constrain the inversion we used the HVSR computed at each array station, which also give a lateral extension to the final 3D velocity model. The obtained results indicate that site effects in the investigate area are quite homogeneous among the array stations.