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Seismic amplification measured on landslides compared with requirements from simple activation models

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In the last years, the behavior of landslides exposed to the seismic action has been the subject of different view as far as the role of seismic amplification is concerned. On one side, some authors provided simplified models based on 1D or 2D geometry of the sliding surface as the main factor controlling the frequency and amplification. On the other hand, seismic codes (such as the Italian Normative NTC 2008) do not provide specific information on the role of seismic amplification in the activation analyses of landslides, suggesting simplified models based on Vs30. In this work we studied five landslides, situated in Southern Italy, with different geological and mechanical characteristics. In each site ambient noise measurements were recorded on dense array whose principal directions were maximum slope and transversal profile. These data allowed to assess the presence of a frequency indicating possible amplification. The results achieved have been compared with the horizontal to vertical spectral ratio obtained by accelerometric recording of local earthquakes at selected sites. The comparison showed that noise and earthquakes provided the same frequency. Moreover, to check the possible presence of an impedance contrast, other geophysical tests have been performed, specifically down hole or Extended Spatial AutoCorrelation (ESAC). It was then possible to compare the depth of the impedance contrast with the one of the sliding surface, known thanks to geotechnical information such as the soil stratigraphy and inclinometer data. These information were used to understand if the amplifications estimated by noise or accelerometer data were caused by the contrast of impedance between different soil, by the slip surface or by other more complex phenomena that will need future analyses. The results obtained were complex: not for all the landslides the sliding surface represents also an impedance contrast, and no amplification can be recorded associated with it. Even when a clear impedance contrast is present, simplified geotechnical 1D models fail to reproduce the observed resonance frequency. This suggest that appropriate local seismic response analysis should be performed before activation studies to take into account the possible amplification of the sliding mass.