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Integration of geophysical methods for landslide characterisation: application to Romanian Carpathians

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The south-eastern part of the Carpathian Mountains (region of Vrancea, Romania) is prone to high magnitude earthquakes (M>7) with deep hypocenters (60-200 km). It is known that the 1940 (M7.7) and 1977 (M7.2) Vrancea earthquakes induced several landslides. This region also presents numerous large slopes with morphologies which might be due to seismically induced failures of rather ancient origin. However, as already historical seismically induced landslides are poorly documented, proving the seismic origin of those older mass movement is even more complicated. The investigation and the characterisation of Romanian landslides may therefore lead to a better understanding of their origin, and could therefore make an important contribution to (supra-)regional seismic risk assessment.

We focus our analysis on two sites in the Buzau region: the Eagle's Lake (Lacul Vulturilor) landslide and the Balta rock slide. In October 2018, we performed a geophysical survey on both sites. This included seismological array measurements to retrieve S-waves velocity profiles from surface waves dispersion properties. We identified the bottom of the landslide body from the estimation of the resonance frequency derived through horizontal-to-vertical noise ratio measurements. Active seismic measurements, i.e. seismic refraction tomography and multichannel analysis of surface waves, were carried out to obtain, respectively, P-wave velocity profiles identifying lateral contrasts in soil properties, and shear-wave velocities in the subsurface. In addition, drone flights were used to establish a 3D model of the investigated sites. These combined measurements form a rich dataset and are used to retrieve the geometry of the landslides as well as to provide an estimation of the volumes of the failed material.

This work, perspectively, aims at reconstructing the conditions and the energy needed for triggering these landslides, in order to understand the seismic component, if applicable, in the failure process.