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A multidisciplinary approach to landslide structure characterization: integration of seismic tomography survey and high resolution LiDar data with the Sloping Local Base Level method.

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A challenge to progress in the understanding of landslides is to precisely define their 3D geometry and structure as an input for volume estimation and further hydro-mechanical modelling.
The objective of this work is to present a multidisciplinary approach to the geometrical modelling of the La Valette landslide by integrating seismic tomography survey (P and S wave) and high resolution LiDar data with the Sloping Local Base Level (SLBL) method.
The La Valette landslide, triggered in March 1982, is one of the most important slope instability in the South French Alps. Its dimensions are 1380 m length and 290 m width, and the total volume is estimated at 3.5 106 m3. Since 2002, an important activity of the upper part of the landslide is observed, and consisted mainly in the retrogression of the crown through the opening of an important fracture over several meters and rotational slumps. The failed mass is currently loading the upper part of the mudslide and is a potential threat for the 170 residential communities.
A seismic tomography survey combined to airborne and terrestrial LiDar data analysis have been carried out to identify the geological structures and discontinuities and characterize the stability of the failing mass. Seismic tomography allows direct and non-intrusive measurements of P and S waves velocities which are key parameters for the analysis of the mechanical properties of reworked and highly fissured masses. 4 seismic lines have been performed (3 of them in the direction of the slope and the other perpendicular). The 2 longest devices are composed of 24 geophones spaced by 5 meters and have a sufficient investigation depth for a large scale characterization of the landslide's structure with depth. The 2 shortest devices, composed of 24 geophones spaced by 2 meters bring information about the fracturing degree between the moving material of the landslide and the competent rock. 100gr of pentrite for each shot were used as seismic sources. The processing of the first arrival travel time P wave was carried out with the Rayfract seismic tomography software based on the wavepath Eikonal traveltime inversion algorithm. Shear waves velocity sections were obtained using SASW method based (surf96-CPS program) which allows to analyse the dispersive character of surface waves and to obtain a S-wave vertical velocity profile by 1D inversion of dispersion curves. The seismic interpretation is then combined to geomorphological information obtained from high resolution digital elevations models, analysis of photographs and maps and geological field surveys. The Sloping Local Base Level (SLBL) method is applied to identify possible rotational failure surfaces and estimate the volume of the unstable mass. A conceptual model describing the development of the failure mechanism through time is proposed.