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Investigating and quantifying the uncertainty beyond the stability analysis of high unstable fractured rock cliff by Remote Piloted Aerial System (RPAS)-based Digital Photogrammetry: the example of the Gallivaggio landslide

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The recent advantages in Remote Piloted Aerial System (RPAS) and 3D Digital/Virtual Outcrop Model (DOM/VOM) development from RGB images (e.g. Structure from Motion, SfM; Multi Stereo View, MSV; Simultaneous Localization And Mapping, SLAM) have increased the application of these technology in stability analysis of unstable rock cliffs affected by rock fall due to possibility to perform analysis with higher resolution, accuracy, safety and time-saving to respect the traditional manual techniques, and with higher applicability and affordability to respect the Laser Scanner technology. The principal aims of a geoengineering inspection of an unstable rock slope are to identify the possible Mode of Failure (MoF) of the rock mass (e.g. planar sliding, wedge sliding, toppling) and to estimate the rock volume that could be involved in a possible failure event. Then these results can be used for further numerical models and applications, as the rock fall simulations, here the uncertainty of the input parameters deeply influence the output results and, therefore, the reliability of the simulation. Due to the novelty of the RPAS-based DOMs, the uncertainty of the stability analysis is not always correctly identified (e.g. uncertainty equal to the DOM accuracy) and, therefore, sometimes the results and conclusion of the analysis could be partially wrong. Identifying and quantifying correctly the uncertainty is really important especially during emergency condition, when crucial decision must be made quickly.

In this study, the uncertainty of the stability analysis of the unstable rock cliff of Gallivaggio (Western Alps, Italy) is deeply investigated due to the possibility to compare the Mode of Failure and the unstable rock volume estimated before the failure event of the 29th May 2018 onto a DOM developed using the RPAS, with those identified and calculated after the failure. In particular, it is shown as uncertainty component of the instrumental error could be almost totally negligible to respect the components of the manual interpretation and analysis, also when no Ground Control Points (GCPs) are used to develop the DOM.