Geophysical Research Abstracts
Vol. 20, EGU2018-16675, 2018
EGU General Assembly 2018

The use of RPAS for rock mass characterization: comparison of techniques along the Scascoli Gorges, Bologna, Northern Appennines, Italy

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Geomechanical characterization of rock masses is usually performed by means of standard methods based on visual inspection and direct measurements. Sometimes this can be difficult, if not impossible, due to hard site accessibility, rockfall danger, or simply because of the considerable extension of the outcrop (Coggan et al., 2007). Remote sensing techniques, including TLS (Terrestrial Laser Scanning) and CRP (Close Range Photogrammetry), combined with the application of algorithms deriving from Computer Vision, now represent a valuable alternative for the characterization of the rock masses in these difficult cases. The products that can be obtained, (point cloud, orthophoto, DTM, mesh, discontinuities network, rock block volumes), constitute a considerable improvement compared to traditional detection techniques in terms of quality and quantity of data, as well as regarding the execution time and safety of the operators.
In this work we investigated a rock cliff with two types of RAPS (Remotely Piloted Aircraft System): a professional prototype and a commercial UAV (Unmanned Aerial Vehicles). The test site is located about 20 km to the south Bologna (Scascoli Gorge, Bologna; Northern Apennines of Italy). The cliff is about 70 m height, 130 m long and it is made up of a weak sandstone with thin layers of mudstone. The cliff was affected by a large rockfall in 2005 (volume of about 35,000 cubic meters), then it was re-profiled by blasting. Here we compared the data acquired by the two systems (surveys performed in March 2016) and the results in terms of slope geometry, micro-morphology, geomechanical characteristics of the rock mass, and rock block volumes. In particular, the geomorphological analyses were conducted on the raster DTMs, investigating the slope map and the roughness index. As regard geometry, we focused on the distance between point clouds and on the detection of potentially unstable rock masses. The results were compared with those obtained by traditional method in terms of: i) discontinuity sets; ii) possible failure mechanisms; iii) effect on rockfall trajectories computed by two-dimensional and three-dimensional modelling. The comparison also included a TLS survey of 10 years before, in order to investigate the recent morphological evolution of the cliff and to compare different methods of survey and data analysis. The overall results show no significant differences between the two techniques, and highlight the robustness and geometric repeatability of the photogrammetric method for the geomechanical survey of rocky slopes.