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RPAS application for estimating road exposition to rockfall

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The use of Remotely Piloted Aircraft Systems (RPASs) for landslide analysis and characterization is often aimed at the acquisition of DSMs and orthpohotos. One of the most interesting utilizations of RPASs to landslide studies consists in the production of data for rockfall risk assessment. A typical approach to study rockfalls consists in the application of numerical or stochastic models for the definition of possible trajectories of rock blocks to accurate DTMs of the source and runout areas. In this work, the case study of the rockfall of Vinnanova di Accumoli (Marche Region, central Italy) is presented and discussed. In this area, the earthquakes of the seismic sequence started on 24 August 2016 that struck central Italy caused several rockfalls that, in some cases damaged roads, and represented a threat to the population. In particular, the provincial road SP18 near Villanova di Accumoli was closed due to a 1 m3 rock block that fell down from the slope and crossed the SP20, partially damaging it. During the emergency, it was decided to apply a numerical model to estimate the trajectories of the remaining instable rock masses and to define the possible places where to set up protection measures to safely re-open the road. Therefore, a survey with a multicopter was carried out to obtain (i) an accurate DSM of the source area and the slope (ii) the identification and characterization of other instable blocks possibly not visible in the field. The 6,500 m2 area was covered by a total 161 photograms by a 34 Mpixel camera, obtaining a 1.5 cm/pixel Ground Sampling Distance (GSD). The final orthophoto has a resolution of 2.5 cm, whereas the DSM has a resolution of 20 cm. The DSM was then filtered by a three-step procedure including manual removal of sparse vegetation cover. In area covered by dense vegetation (the lower part of the slope) the DSM could not be manually filtered, which hampered to run the numerical model. This problem was addressed by a GPS RTK survey of the most vegetated area. A total of 73 points with less than 1m error were acquired and integrated in the DTM. The resulting integrated DTM has a resolution of 25 cm. The numerical model STONE was then applied to the source areas mapped in the field and by photo-interpretation of the RPAS orthophoto to get a 1m raster showing the potential trajectories of the mapped instable rock masses. Results showed that only the part of the road hit by the rockfall was actually exposed to rockfall trajectories. Therefore only limited protection measures were suggested to reduce the exposition of the road.