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Monitoring of Open-pit mining using geomorphometry and Unmanned Aerial Vehicles (UAVs)

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Mining activities have a significant impact on the Earth's surface, and open-pit mines are the most evident landscape signatures of the mining operations. Despite the importance of such human impacts, an open challenge for the Earth Science community is to explore a fast, accurate and low-cost method to monitor changes in open-pit mining. The main goal of this work is to develop such a methodology. In this study, we used an Unmanned Aerial Vehicle(UAV) to collect two series of photographs(August 2014 and October 2016). Through the structure from motion (SfM) photogrammetric techniques, the images were used to generate high-resolution Digital Surface Models (DSMs). DSMs were co-registered by seven ground control points, and the accuracy of the co-registration was checked and corrected by comparing non-change areas. Finally, two kinds of landscape metric were used to detect the changes: (1) the Slope Local Length of Auto-Correlation (SLLAC)(Sofia et al., 2014), which allows to estimate the surface covered by open-pit mining by using a simple empirical model; (2) the DSM of Difference (DoD) , which calculated the changes between two DSMs on a cells-by-cells basis, to accurately estimate the volumetric changes. The results underline the effectiveness of the UAV survey techniques and adopted landscape metrics. This study has demonstrated a robust and rapid workflow to dynamic monitor the open-pit mine and support sustainable environmental planning.