Geophysical Research Abstracts
Vol. 19, EGU2017-692, 2017
EGU General Assembly 2017

Study of geomorphological changes by high quality DEMs, obtained from UAVs-Structure from Motion in highest continental cliffs of Europe: A Capelada (Galicia, Spain)

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This study analyses the geomorphological evolution of a highly dynamic coastal environment, one of the higher cliffs in Continental Europe (A Capelada, NW Spain), using Structure from Motion-Multi View Stereoscan techniques (hereafter referred to as SfM-MVS). Comparing orthoimages from the last 10 years we observed several topographical changes in one specific valley (Teixidelo). Interestingly, these changes were caused by 2 different processes: (i) heavy coastal erosion and (ii) slow complex landslides, working in opposite directions. The main challenge was obtaining high quality topographical data for quantifying the changes during the last few years using low cost-high quality techniques in remote areas. Unmanned Aerial Vehicle platforms (drones, hereafter referred to as UAVs) and SFM-MVS offer ultrahigh-density topographical data. Furthermore, the use of drones and SfM-MVS close range images requires new applications in geomorphology for understanding the workflow and limitations.

In this paper we present the 2 main results: (i) a centimeter spatial resolution DEM from august 2016 was obtained using a @DJI Phantom 3 advanced model drone. The pictures were processed in Agisoft PhotoScan Pro 1.2.6 version by SfM-MVS techniques, generating a high-density point cloud (i.e. $\sim$2000 points/m^2) with 3mm of RMSE (i.e. the point cloud was georeferenced in a geographical coordinates system using $\sim$40 Ground Control Points obtained from differential RTK-GPS and a Total Station network) and (ii) a DEM of Differences, which compares official freely available 2010 LiDAR data (i.e. $\sim$2 points/m^2) with a 2016 DEM derived by UAVs-SfM, where we have observed meter-scale elevation changes (i.e. sediment and erosion processes). During this time, 75% of the sediment has been mobilized. The novel UAVs and SfM-MVS techniques prove to be great for advancing the study of geomorphological processes in remote areas.