EGU2020-7780
https://doi.org/10.5194/egusphere-egu2020-7780
EGU General Assembly 2020

Using RPAS derived images and LiDAR DEM's for the assessment of geomorphic changes in a cultural heritage site affected by recent landslides

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The recent advances in the acquisition of aerial images using Remotely Piloted Aircraft Systems (RPAS) offer an efficient and low-cost solution for the assessment of geomorphologic changes in areas affected by landslides, gullies and rill erosion, river channel migration, through the creation of accurate Digital Elevation Models (DEM's). Despite many advantages of DEM's obtained through Structure from Motion (SfM) method (resources, availability, high resolution - spatial and temporal), they are suitable for reduced study areas, usually under 100-200 ha, where there is a significant intensity of geomorphic processes and where their effects threaten human assets or heritage.
This study focus on the area of Poiana Mănăstirii Thraco-Getic fortress (2550-2050 yr BP), located in the central part of Moldavian Plateau, Romania. Covering a surface of 12 ha, the fortress is surrounded by a 2-3 m high wall, with a 10 m wide base, and a 1 m deep and 4-6 m wide trench. In its southern part, the landslides destroyed these remnants, and due to the deforestation of the slope in the last 30 years, these processes recorded almost yearly reactivations. The main landslide scarp is affected by a gully system that contributes to the archaeological site degradation.
A DJI Phantom 4 Pro UAV was flown over the study area in October 2019 and acquired images with 80 % side and forward overlap at 20 MP resolution. Visual SFM open source software was used to obtain the point cloud and for georeferencing, a Ground Control Point network was measured with a Trimble GeoExplorer 6000 GPS. In order to detect and to map geomorphic changes, LiDAR point clouds (2012) were used as a reference dataset (with a spatial resolution of 0.25 m, and a vertical accuracy of 0.13 m).
A detailed map showing the changes in topography between 2012 and 2019 has been carried out, supplementing a geomorphological mapping. The most dynamic portions of the landslide are accompanied by dense micro-topographic features like secondary scarps, longitudinal and transversal cracks, which have been mapped using the ortophotoimage. The most dynamic parts of the hillslope are an earthflow, shallow and slumps along with the eastern gully system, piping sinkholes, and the main scarp gullies. The evolution of the landslides and gullies indicate that the

southern part of the fortress will be affected in the near future. Alongside the identification of the most active parts of the landslide, we conclude that the entire recently deforested area must return as quick as possible to the initial land use (forest).

How to cite: Margarint, M. C., Niculita, M., Ciotina, M. C., Vaculisteanu, G., Linu-Stoilov, V., and Tarolli, P.: Using RPAS derived images and LiDAR DEM's for the assessment of geomorphic changes in a cultural heritage site affected by recent landslides, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7780, https://doi.org/10.5194/egusphere-egu2020-7780, 2020