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SFM photogrammetry for rockfall hazard evaluation in a zero data site (case study of a touristic area of northern Tunisia)

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The study area is located in the north-west of Cap Bon, northern Tunisia, where the issues of landslides hazards have recently emerged. Despite the multitude, the complexity and the high degree of dangerousness of these instabilities, the region remains virgin without any previous numerical support or basic data for a risk study.

Djbel Korbous is an important relief dominating the southeastern edge of the Gulf of Tunis and presents a special site of tourism and therapy. The main road, which is the only access to it, is a coastal road passing along a damaged cliff and suffers of several instabilities and rockfall of different sizes reaching the sea and destroying the protection measures. Structure for motion photogrammetry, being a simple, practical and inexpensive monitoring tool, was an efficient choice to initiate the modeling of a very vulnerable and inaccessible cliff.

The present study aims at defining a multi-risk assessment methodology that fits to the characteristics of a touristic area where there were no pre-existing digital field data.

The first part aims at the development of a high quality digital terrain model for the entire site, about 12km2, which required photogrammetric acquisitions from the sea and GPS surveys to realize the georeferencing. Thus the mapping of phenomena and the characterization of potential and fallen volumes allow the consitution of the first instabilities inventory for the zone. In addition, many terrestrial LiDAR scans were realized to complete the first model as well as several local photogrammetric acquisitions were done to capture the spatiotemporal instabilities' evolution and to understand the mechanism of rupture and the cliff degradation.
The second part of the study is to constitute a quantitative and qualitative rockfall hazard zoning based on 2D and 3D trajectory modelling (RocFall, RockyFor 3D and Trajecto 3D).

As a result, SFM photogrammetry enabled the reconstruction of a high spatial resolution data support, providing a reliable and detailed 3D model for a site where there was no numerical data. Subsequently we define the main structurally controlled failure types and we could detect and map all potential instability sources from steep slopes. Combining different rockfall numerical models all together allowed a complete and comparative analysis methodology to predict the rockfall runout distance and the propagation areas and to estimate velocities and energies of fallen blocks.