Smartphones for post-event analysis: a low-cost and easily accessible approach for mapping natural hazards

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A real opportunity and challenge for the hazard mapping is offered by the use of smartphones and low-cost and flexible photogrammetric technique (i.e. 'Structure-from-Motion'-SfM-). Differently from the other traditional photogrammetric methods, the SfM allows to reconstitute three-dimensional geometries (Digital Surface Models, DSMs) from randomly acquired images. The images can be acquired by standalone digital cameras (compact or reflex), or even by smartphones built-in cameras. This represents a "revolutionary" advance compared with more expensive technologies and applications (e.g. Terrestrial Laser Scanner TLS, airborne lidar) (Tarolli, 2014). Through fast, simple and consecutive field surveys, anyone with a smartphone can take a lot of pictures of the same study area. This way, high-resolution and multi-temporal DSMs may be obtained and used to better monitor and understand erosion and deposition processes. Furthermore, these topographic data can also facilitate to quantify volumes of eroded materials due to landslides and recognize the major critical issues that usually occur during a natural hazard (e.g. river bank erosion and/or collapse due to floods). In this work we considered different case studies located in different environmental contexts of Italy, where extensive photosets were obtained using smartphones. TLS data were also considered in the analysis as benchmark to compare with SfM data. Digital Surface Models (DSMs) derived from SfM at centimeter grid-cell resolution revealed to be effective to automatically recognize areas subject to surface instabilities, and estimate quantitatively erosion and deposition volumes, for example. Morphometric indexes such as landform curvature and surface roughness, and statistical thresholds (e.g. standard deviation) of these indices, served as the basis for the proposed analyses. The results indicate that SfM technique through smartphones really offers a fast, simple and affordable alternative to lidar technology. Anyone (included farmers, technicians or who work at Civil Protection) who has a good smartphone can take photographs and, from these photographs, they can easily obtain high-resolution DSMs. Therefore, SfM technique accomplished with smartphones can be a very strategic tool for post-event field surveys, to increase the existing knowledge on such events, and to provide fast technical solutions for risk mitigation (e.g. landslide and flood risk management). The future challenge consists of using only a smartphone for local scale post-event analyses. This can be even enhanced by the development of specific apps that are able to build quickly a 3D view of the case study and arrange a preliminary quantitative analysis of the process involved, ready to be sent to Civil Protection for further elaborations.

Tarolli, P. (2014). High-resolution topography for understanding Earth surface processes: opportunities and challenges. Geomorphology, 216, 295–312, doi:10.1016/j.geomorph.2014.03.008.