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Geomorphological mapping of shallow landslides using UAVs

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The mapping of event shallow landslides is a critical activity, due to the large number of phenomena, mostly with small dimension, affecting extensive areas. This is commonly done through aerial photo-interpretation or through field surveys. Nowadays, landslide maps can be realized exploiting other methods/technologies: (i) airborne LiDARs, (ii) stereoscopic satellite images, and (iii) unmanned aerial vehicles (UAVs). In addition to the landslide maps, these methods/technologies allow the generation of updated Digital Terrain Models (DTM). In December 2013, in the Collazzone area (Umbria, Central Italy), an intense rainfall event triggered a large number of shallow landslides. To map the landslides occurred in the area, we exploited data and images obtained through (A) an airborne LiDAR survey, (B) a remote controlled optocopter (equipped with a Canon EOS M) survey, and (C) a stereoscopic satellite WorldView II MS. To evaluate the mapping accuracy of these methods, we select two landslides and we mapped them using a GPS RTK instrumentation. We consider the GPS survey as the benchmark being the most accurate system. The results of the comparison allow to highlight pros and cons of the methods/technologies used. LiDAR can be considered the most accurate system and in addition it allows the extraction and the classification of the digital surface models from the surveyed point cloud. Conversely, LiDAR requires additional time for the flight planning, and specific data analysis user capabilities. The analysis of the satellite WorldView II MS images facilitates the landslide mapping over large areas, but at the expenses of a minor resolution to detect the smaller landslides and their boundaries. UAVs can be considered the cheapest and fastest solution for the acquisition of high resolution ortho-photographs on limited areas, and the best solution for a multi-temporal analysis of specific landslide phenomena. Limitations are due to (i) the needs of optimal climatic conditions during the acquisition, (ii) the needs of ground control points to be acquired simultaneously with the UAV surveys, and (iii) the restrictive laws existing in different countries that could limit the use of these systems.