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Geomorphological mapping and mass-wasting analysis in complex landslides using Terrestrial and Airborne LiDAR

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High-Resolution Digital Elevation Models (HR DEMs) obtained with Light Detection and Ranging technology, (LiDAR) have proved to be useful in the analysis of landslide processes in mountainous terrains, for different purposes and at different spatial scales, including improvement of landslide inventories, susceptibility assessment and appraisal of landslide geomorphic features. The application of laser scanning techniques results in data sets with enormous data size, extremely high accuracy (up to cm-scale) and very high spatial resolution. The exploitation of HR DEMs in landslide analysis can be manifold, comprising automated spatial data processing as well as expert knowledge - supervised procedures.

First goal of this paper is to stress the advantages given by the usage of Shaded Relief datasets obtained from HR DEMs in geomorphological mapping of complex landslides. Through the use of such datasets, surveyors gain an enhanced capacity to identify slope-scale geomorpho-dynamic units, the possibility to increase the precision of scarps and detachment areas zonation, the capacity to identify and map compressive and extensional features all across the landslide body, and the possibility to retrieve other relevant geomorphological indicators of movement. These advantages are exemplified by presenting maps of large-scale earth slide – earth flows and deep seated rock slides located in the Alps and in the Apennines, that have been obtained by making use of shaded relief maps calculated from regional and local datasets using different scene illumination parameters.

Second goal of this paper is to exemplify the usage of Differential HR DEMs is mass-wasting analysis applied to active earth slides - earth flows located in the northern Apennines. This simple DEM subtraction procedure can be carried out using multi-temporal airborne or terrestrial surveys, or by fusing airborne and terrestrial data. Examples are presented of landslides for which mass wasting at the slope scale and total volumetric magnitude of the events have been assessed using both single-type and fused-type data sources. Disregard possible uncertainties, these pieces of information helped in depicting possible future scenarios. Moreover, considering that earth slides – earth flows moving at a rate up to 10 m/day are difficult to be monitored with classical in situ instrumentation, the results suggest that LiDAR systems could also be used, under certain organizational conditions (temporal resolution of the surveys, costs, post-processing efforts etc.), as a near-real time monitoring system during and after reactivation events.