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Application and validation of different geomatic techniques for the quantification of mass-wasting processes in a torrential catchment in the Axial Pyrenees.

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Torrential processes like debris flows and debris floods significantly change the morphology of high-mountain catchments. In addition, other types of mass movements and superficial erosion affect the landscape.
In the present study, the mass-wasting in the Rebaixader catchment located in the Axial Pyrenees was quantified for a time span of more than 50 years by four different geomatic techniques: 1) Terrestrial Laser Scanning (TLS), 2) Airborne Laser Scanning (ALS), 3) Digital Photogrammetry from Historic Aerial Photographs (DP-HAP), and 4) Digital Photogrammetry from Unmanned Aerial Vehicle (DP-UAV). The Rebaixader catchment is characterized by a large open scarp with a very heterogeneous and irregular morphology. This scarp is situated in a side moraine and affected by many types of mass-wasting processes. The results of the geomatic techniques were compared and validated with the data gathered at the monitoring system, which was installed in 2009 in the channel reach below the scarp. In addition, a detailed dendrogeomorphological study on the fan's depositional units spanning more than 70 years of activity, was used to compare the results.
The results obtained by the different geomatic techniques show that the rate of mass wasting in the catchment is about 15000 m3 per year. This value is supported by the monitoring data gathered by the sensors installed. The comparison with the dendrogeomorphological study leads to less coherency due to the limitations of the dendrogeomorphological method. Other outcomes of our investigation refer to the applicability and precision of the different geomatic techniques. The study shows that TLS technique is rather difficult to apply to the scarp, where the morphology is very irregular, the surface is partly humid, the scan distances are large and the vegetation may avoid a good visibility. In contrast, DP-HAP of aerial photographs of 1975 (and with less significance of 1956) provided a rather precise digital elevation model. Finally, first results applying DP-HAP are promising and reveal the large potential of this technique.