Spatial distribution of geomorphic changes after an extreme flash-flood compared with hydrological and sediment connectivity

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An extraordinary flash-flood event occurred the 9th October 2018 in the north-eastern part of Mallorca Island. The spatial distribution of main geomorphic changes were accurately mapped through field and aerial UAV campaigns in two contrasted small headwater catchments (i.e., < 2 km²) of the Begura de Saumà River. The first one was massively covered by step terraces over Lias limestone, whilst the second one was only covered by check-dam terraces over Miocene marls.

Two weeks after the event, a UAV was used to record aerial photographs and build high-resolution digital elevation models (HR-DEM; i.e., 5 cm). Geomorphic changes were assessed comparing this HR-DEM with LiDAR-derived DEM (i.e., 25 cm resolution) obtained in 2014. The Borselli index of connectivity (IC; version of Cavalli et al., 2013) was calculated from the LiDAR-derived DEM to compare the geomorphic changes triggered by the flash-flood with the structural sediment connectivity distribution.

At hillslope scale, the HR-DEM allowed the identification of geomorphic changes, such as the initiation of rills and the wall collapse of old agricultural terraces in the terraced limestone catchment. In the main headwater valley axis of the marls catchment, where natural streams had been historically reduced and deviated with the construction of check-dam terraces, huge geomorphic changes enabled the recovering of natural streams.

The spatial distribution of the observed geomorphic changes on hillslopes was compared with the spatial patterns of sediment connectivity. Geomorphic changes elucidated a good concordance with structural connectivity, both in the location and magnitude. The analysis of these
concordances and some discordances allows the identification of hydrogeomorphological factors triggering the erosional response of hillslopes.

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