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From hydro-geomorphological mapping to sediment transfer evaluation in the Upper Guil Catchment (Queyras, French Alps)

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The Guil River catchment (Queyras, Southern French Alps) is prone to hydro-geomorphic hazards related to catastrophic floods, with an amplification of their impacts due to strong hillslope-channel connectivity such as in 1957 (> R.I. 100 yr), and more recently in 2000 (R.I. 30 yr). In both cases, the rainfall intensity, aggravated by pre-existing saturated soils, explained the immediate response of the fluvial system and the subsequent destabilisation of slopes. This resulted in serious damages to infrastructure and buildings in the valley bottom, mostly along some specific reaches and confluences with debris flow prone tributaries. After each event, new protective structures are built. One of the purposes of this study, undertaken in the frame of the SAMCO (ANR) project, was to understand the hydro-geomorphological functioning of this upper Alpine catchment in a context of hazards mitigation and sustainable management of sediment yield, transfer and deposition.

To determine the main sediment storages that could be mobilised during the next major hydro-meteorological events, the first step of our study consists in the identification and characterisation of areas that play a role into the sediment transfer processing. From environmental characteristics (channel geometric, vegetation cover...) and anthropogenic factors (hydraulic infrastructures, urban development...), a semi-automatic method provides a typology of contribution areas with sediment storages sensitive to erosion, or areas that will be prone to deposition of sediments during the next flooding event.

The second step of the study is focused on the sediment storages with their characterisation and connectivity to the trunk channel. Taking into account the entire catchment and including the torrential system, this phase analyses the sedimentary transfers from the identification and classification of sediment storages to the evaluation of the degree of connectivity with the main or secondary channels. The proposed methodology is based on data directly derived from GIS analysis using interpretation of aerial photographs, regional scale Digital Elevation Model (DEM), high-resolution DEM derived from airborne-based LiDAR, and field survey. The data thus obtained can be used in the final geomorphological map. Future investigations will quantify the contribution of each sub-catchment in the global sediment budget of the Guil catchment. For a better assessment of sediment fluxes and sediment delivery into the main channel network, tracers (pit-tags) and diachronic Terrestrial Laser Scanning will be performed in selected sub-catchments in order to measure erosion rates and contribution to the sediment yield in the valley bottoms during the floods, avalanches and rainfall seasonal events.