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Typology of potential high contribution areas in the sediment budget in the Upper Guil Catchment (Queyras, French Alps)

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In mountainous areas, especially in large river catchments with torrential tributaries, the production and sediment transport significantly increase flood impacts in the valley bottoms. For a better understanding of Alpine river catchments considered as complex systems, we focused our research on the Guil River catchment (Queyras, Southern French Alps - 317km^2). This catchment is prone to catastrophic summer floods (June 1957 (> R.I. 100 yr), June 2000 (R.I. 30 yr)...) characterized by considerable sediment transport from tributaries to downvalley, very much facilitated by strong hillslope-channel connectivity (≈12,000 m3 volume of sediment aggraded during the June 2000 flood event). During the last flood events, several infrastructures and buildings were seriously damaged. Most of them were located at confluences and, at specific reaches such as canyon reaches constrained by infrastructures. For risk mitigation some protection equipments were built after the 1957 event, but most of them are now poorly maintained and might be less effective in case of flood event.
In the frame of SAMCO (ANR 12 SENV-0004) project designed for mountain hazard mitigation in a context of Climate Change, one objective is to understand the hydro-geomorphological functioning of Alpine catchments for a sustainable management of sediment yield, transfer and deposition. Part of our study is aimed at a better assessment of sediment transfers, especially on adjacent sediment supply (i.e. from hillslope to channel, and from tributaries to the trunk river) for a better management of sediment fluxes in the frame of the local “River Scheme". For this reason, we decided to establish a sediment budget of the Guil River catchment, with a quantitative assessment and a spatial analysis of erosion, transport, and deposition processes. The initial phase of our study consists in identifying contributive, erosion and deposition areas with a twofold approach: (i) assessment of longitudinal sedimentary transfers in the floodplain, (ii) assessment of slopes contribution to sediment supply with a main focus on lower slopes where lateral cutting and landslides provide huge quantities of material to the valley bottom. The semi-automatic methodology proposed here is based on data directly derived from remote sensing, GIS analysis (e.g. interpretation of aerial photographs, measurement from regional scale Digital Elevation Model (DEM), high-resolution DEM derived from airborne-based LiDAR) and field surveys.
This study highlights spatial differences in sediment storage and redistribution areas grounded on quantitative and qualitative environmental parameters and index defined for 250 homogeneous sections (i.e. definition of morphological index, geometric measurement, rates and type of vegetation cover, hydraulic infrastructures location, urban development rates…). It also provides a useful classification of six distinct reach types and areas that will be susceptible to erosion, transport and deposition during the next flooding event (i.e. sediment production areas, temporary and permanent sediment storage areas, areas sensitive to erosion...).