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Tracing the contribution of debris flow-dominated channels to gravel-bed torrential river channel: implementing pit-tags in the upper Guil River (French Alps)

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In the upper, wider reaches of Alpine valleys, shaping of active channels is usually subject to rapid change. It mostly depends upon hydro-climatic variability, runoff concentration and sediment supply, and may result in alternating sequences of fluvial and debris-flow pulses, as recorded in alluvial fans and terraces. Our study, carried in the frame of SAMCO (ANR) project, focuses on the upper Guil River Valley (Queyras, Southern French Alps) cut into the slaty shale "schistes lustrés". Steep, lower order drains carry a contrasted solid discharge, including predominantly sandy-loam particles mixed with gravels and boulders (sandstone schists, ophiolites). Abundant sediment supply by frost shattering, snow avalanche and landslides is then reworked during snowmelt or summer storm runoff events, and may result in catastrophic, very destructive floods along the main channel, as shown by historical records. Following the RI-30 year 2000 flood, our investigations included sediment budgets, i.e. balance of erosion and deposition, and the mapping of the source, transport and storage of various sediments (talus, colluvium, torrential fans, terraces).

To better assess sediment fluxes and sediment delivery into the main channel network, we implemented tracers (pit-tags) in selected sub-catchments, significantly contributing to the sediment yield of the valley bottoms during the floods and/or avalanches: Maloqueste, Combe Morel, Bouchouse and Peyronnelle catchments. The first three are direct tributaries of the Guil River whereas the Peyronnelle is a left bank tributary of the Peynin River, which joins the Guil River via an alluvial cone with high human and material stakes. The Maloqueste and the Combe Morel are two tributaries facing each other in the Guil valley, representing a double lateral constraint for the road during flood events of the Guil River. After pit-tag initialisation in laboratory, we set them up along the four tributaries: Maloqueste (20 pit-tags), Combe Morel (20 pit-tags), Bouchouse (40 pit-tags), Peyronnelle (100 pit-tags). All pit-tags were installed high upstream enough in each catchment to avoid their loss and/or burying, and permit their monitoring over several years. The grain size ($D50$ = 30-220 cm) of the selected blocks reflects the average size of the bed load. Smaller blocks were discarded to avoid losing their track from the first event. The blocks were positioned according to two logics: (i) Longitudinally, we implemented every 20-30 m a series of nested blocks into the channel; (ii) Transversally, we selected blocks placed in low and high position to quantify the transport dynamics during events of low (torrential) and high (debris flow) magnitude. The sites were mapped at high resolution, and blocks were spotted thanks to fluorescent painting, GPS surveys and detailed photographs. We emplaced the pit-tags in September 2013, before expected avalanches and debris flows during winter and spring 2014. Pit-tags detection, Lidar and photogrammetric surveys are planned for early summer 2014, during which we expect quantifying movement, distance and sorting of blocks along the thalwegs during "ordinary" snowmelt runoff. We intend to continue this monitoring long enough to put observed current and future dynamics in relation to short-term climatic changes.