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Channel disturbances and morpho-dynamics: linking hydraulics, topographic changes and human impacts in a highly dynamic wandering river at multiple temporal scales

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Episodic erosion, transport and deposition of sediments produce changes in river's channel morphology. These changes, although are directly related to flow hydraulics and bed material availability, supply and transport, could also be highly influenced by structural and local human impacts. Dams cut the continuity of sediment transfer and alter flood magnitude and frequency. In-channel gravel mining, however, disturbs channel beds locally, with a direct influence in upstream and downstream reaches.

In this paper we present some of the preliminary results obtained in the background of MorphSed (www.morphsed.es). Morphsed is analysing the morpho-sedimentary dynamics of a mountain fluvial system located in the foothills of the Pyrenees, Iberian Peninsula. The study system is suffering major local alterations due to gravel mining.

Changes on bed topography along a 12-km river reach have been analysed at two temporal scales: (i) decadal or historical and (ii) flood-based or contemporary. The study reach has suffered natural and human channel disturbances (i.e. major flood events, and gravel extractions and channel embankments, respectively). Preliminary results show how gravel mining occurred after the large flood event registered in October 1982 created a sedimentary disequilibrium in the reach. Additionally, the channel was heavily constrained associated to channel narrowing by embankments. The river has reached a new dynamic equilibrium by means of bed coarsening and channel incision, and changing from a braided to a wandering pattern. Contemporary competent flood events, however, cause severe damages in some of the embankments (i.e. lateral erosion). Gravel extractions in these sites are performed to protect these infrastructures and, in turn, are influencing local channel morpho-dynamics, increasing the sedimentary disequilibrium, exacerbating local channel incision processes, and modifying channel roughness and sediment transport dynamics. 2d hydraulic models show as these contemporary extractions influence on the magnitude and variability of hydraulic forces and, in turn, modify the conveyance of water and sediments through the study reach. All these changes have a direct influence on the ecological status of the river at different temporal and spatial scales. These links will be a key goal for progress towards the understanding of the interactions between river bed disturbance and ecological responses at multiple scales, and provide the basis for an integrated methodology that can be used to aid prediction, management and restoration of human stressed fluvial systems.