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Interactions of hydraulics, bedform and particle mobility in a steep and large meandering system (Durance River, South-Eastern France)

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The Durance River (South-Eastern France) is a large (mean width: 240m) and steep (mean slope: 0.28%) gravel-bed river, deeply impacted by gravel mining and flow diversion in its whole catchment area (drainage basin of 14,000km^2). In its median part the Durance River has a positive sediment budget because of the yields of active tributaries. However in its upper and downstream parts, it is characterized by a sediment deficit, that led to a reduction of the bankfull channel width (from 50 to 80% for the 1960-2000 period), a river bed degradation and, above all, a vegetation encroachment associated to an important overbank sedimentation. The fluvial style shifted consequently from historical braiding into meandering in the major part of the studied reach. These lateral and vertical dynamics lead to important issues in terms of landscape management, because of (i) maintaining the bed hydraulic capacity to evacuate flood discharges and (ii) planform evolution of the river that conflicts with landscape use. The aim of the global study is to better understand the particle mobility processes, at different spatial scales: at segment (10^2km), reach (10^1km) and bedform (10^0km) scales, in order to give clues of management to river stakeholders. Here we focus on the study of the modalities of sediment transport at bedform scale, i.e. in a riffle-pool system located in the downstream part of the river. First, we quantified and linked the vertical mobility of the bar and the lateral mobility of the bank by an event based topographic and scour chains field survey (including for a Q_4 flood -1,200m^3/s- that occurred in June 2010). To relate modalities of transport with particle and bedform's geometry changes, we made a tracer experiment with painted particles and PIT tags in order to determine particle motion thresholds (Q_c=180m^3/s), distance of transport (mean and maximum distances were respectively 90m and 667m) and influence of initial position on the bedform. We then coupled the results' analysis of bedform evolution with a 3D hydraulic model of the riffle-pool system in order to link theoretical shear stresses with observed bedforms' dynamics.