Geophysical Research Abstracts
Vol. 21, EGU2019-16733, 2019
EGU General Assembly 2019

What is moving where? Mapping bedload transport and surface texture in flumes

Marco Redolfi, Matilde Welber, and Walter Bertoldi

Department of Civil, Environmental and Mechanical Engineering, University of Trento, Italy (marco.redolfi@unitn.it)

Sediment transport in a river reach or model flume is most commonly characterized through local measurements of input and output fluxes. In contrast, obtaining quantitative information on the spatial variability of bed load is challenging even under controlled laboratory conditions. Therefore, the relationship between active area - defined as the region of the bed where sediment transport occurs – and other channel properties is still poorly understood. In this work, a range of established and innovative monitoring techniques were applied to a large laboratory model of a gravel bed river in order to investigate links between the spatial patterns of active area, surface texture and morphological evolution.

The physical model consists of a 24 m long straight channel with fixed banks filled with poorly-sorted sand. Discharge values, slope and channel width were selected in order to produce a range of morphological configurations typical of alpine and piedmont rivers, including nearly-plane bed, alternate bars and wandering patterns. The model was run under steady and unsteady flow conditions, with cyclic discharge fluctuations simulated as sequences of triangular hydrographs.

During model runs, software-controlled cameras were used to monitor changes in bed surface colour caused by grain displacement. Time-lapse imagery was analysed using an automated image processing technique calibrated on ground truth maps, producing maps of the active portions of the bed. Runs were stopped at regular intervals corresponding to different flow stages (minimum and maximum discharge and halfway through the rising and falling limb) to acquire high resolution photos of the drained surface, which were used to reconstruct bed topography through Structure-from-Motion. The same images were used to map surface texture at patch scale (100-1000 grains), by calibrating a functional relationship between the spatial autocorrelation of colour and median grain size.

The resulting dataset shows clear links between bed elevation/local slope, local grain size distribution and bed load transport especially in the presence of well-developed bedforms like alternate bars. Image-based monitoring techniques provide spatially dense and temporally continuous data that open new opportunities to investigate morphodynamic processes under steady and unsteady flows.