

Investigation of sediment transport effect on pool-riffle self-maintenance mechanism

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For decades pool-riffle morphodynamics has been described based on the cross-sectional averaged flow characteristics, using episodic shifts in higher shear stress or velocities from the riffles to the pools (i.e. reversal conditions) as an indication of the long term self-maintenance of the structures. However, less attention has been paid to the interactions of flow unsteadiness, sediment supply and sedimentological contrasts as the significant drivers for maintaining pool and riffle sequences. In this study, we investigate the effects of sediment size distributions in different flow episodes together with sediment supply on self-maintenance mechanisms due to erosion and aggradation in pools and riffles. In order to do that, we conduct laboratory experiments on a scaled-down pool-riffle sequence of an existing gravel bed river within a 13-meter long and two-meter wide experimental flume. Froude similitude and equality of Shields' number are applied to scale down one to four year recurrence flood events and sediment size distributions, respectively. Sediment with a given size distribution was introduced at the upstream end of the flume representing the sediment supply of the river. For each hydrograph and sediment size distributions in pool centre, pool head, pool tail and riffle, we measure spatial and temporal variations of the velocity profile (using an Ultrasonic Velocity Profiler) and bed level (using a bed profiler). In addition, we analyse images of the painted bed sediments using an automatic digital technique to determine longitudinal sorting during the hydrograph. Combining these data gives us a unique opportunity to analyse the effects of a) upstream sediment feeding b) unsteadiness in terms of acceleration-deceleration flow and bed shear stress, and c) longitudinal sorting on the stability of pool and riffle sequences. The results show that for smaller floods with the 1-year recurrence interval the effect of sediment supply and sedimentological contrasts between pool and riffle is more influential than unsteadiness on size-selective sediment transport and consequently on pool-riffle aggradation-degradation processes.

Keywords: Fractional sediment transport, Longitudinal sorting, Sediment supply, Unsteadiness, Morphodynamics