TI: Investigations of Sediment Pulse Morphodynamics in a Flume with Fixed Bars

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AB: Evaluation of the impacts of anthropogenically introduced sediment to a river system (i.e., through dam removal or gravel augmentation) requires a detailed understanding of sediment pulse morphodynamics in river channels. In order to investigate the response of rivers to fine and coarse sediment pulses, experiments were conducted in a 28.0 m long
and 0.86 m wide flume with fixed alternate bars. The initial channel prior to sediment pulse introduction was designed to replicate conditions typical of those downstream of dams where upstream sediment supply has been eliminated. An equilibrium channel was first created by feeding a unimodal coarse sand and gravel mix (ranging from 0.8 to 11 mm) at a constant rate (40 kg/hr) under a constant water discharge (18.5 l/s). Under the same flow condition, the feed was then eliminated, allowing the channel to degrade and armor for 70 hours until the sediment flux exiting the flume approached zero. Sediment pulses were then introduced to the channel at the same, constant discharge. The four primary experimental pulses were: small fine and coarse pulses designed to model a gravel augmentation and large fine and coarse pulses designed to model sediment release from a dam removal. The volume of the small pulses was approximately the amount required to cover the flume bed one D50 thick of the original bed material, and was fed at four times the equilibrium feed rate prior to bed armoring. Relative to the small pulses, the larger pulses constituted four times the volume and were introduced at twice the feed rate. Both fine pulses were composed of coarse sand (ranging from 0.8 to 2.4 mm), which constituted about 10% of the original bed material. Both coarse pulses had grain size distributions equivalent to the original bed material prior to armoring the channel. Both small and large fine pulses moved rapidly through system at similar celerities via a combination of translation and dispersion, induced mobilization of the previously armored gravel bed, and left minimal topographic signatures by experiment termination. Coarse pulses dispersed slowly through the system, inducing sustained perturbations in flume length slope, deposited in lobes at pool tails and bars that forced localized scour, and left remnant deposits along bar margins at experiment completion. On a morphologic unit scale, pools had the highest magnitude and variance in bed elevation change, riffles and bars tended to have similar magnitudes in bed elevation change but riffles had the least variance. After the initial responses the differences in bed elevation between morphologic units was minimal and 1D reach averaged bed elevation changes adequately characterized the 2D response. A 1D numerical sediment transport model is used to reproduce experimental runs and the results are in good agreement with the 2D experiments on a reach–average basis.

DE: 1808 Dams
DE: 1825 Geomorphology: fluvial (1625)
DE: 1847 Modeling
DE: 1856 River channels (0483, 0744)
DE: 1862 Sediment transport (4558)
SC: Hydrology [H]
MN: 2006 Fall Meeting