Spatio-temporal evolution of alluvial sand beds under unsteady flow

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The initiation and evolution of sandy bedforms during unsteady flows, such as the passage of a flood wave, are complex and highly variable in space and time. During such unsteady flows the evolution of dune dimensions can exhibit significant hysteresis due, in part, to the adjustment time required to re-shape the bedforms to the imposed changes to boundary conditions.

Results are presented from a series of experiments designed to quantify the impact of a changing hydrograph shape on the spatio-temporal evolution of alluvial dunes. Mobile sand bed (D_{50} of 450μm) experiments were undertaken in a recirculating, 16m long, 1.6m wide flume. Beds were water worked under steady unidirectional flow until equilibrium conditions were achieved, after which two distinct hydrographs were applied. At the end of each hydrograph, a period of steady flow was again run until equilibrium conditions were attained. Hydrograph 1 consisted of steeply rising (80 minutes) and falling (65 minutes) limbs. Hydrograph 2 had longer rising (170 minutes) and falling (230 minutes) limbs. Discharge ranged between 0.24 and 0.72m^3/s^{-1}. 3D bed morphology profiles were measured at 150 second intervals along a 5m by 0.6m, centreline swathe using twelve ultrasonic sensors.

Discrete analysis of bedform morphology indicates that the rate of hydrograph change affects equilibrium bed morphology as well as causing differing degrees of hysteresis in bedform parameters. *Continuous analysis* of bedform morphology data using 1D and 2D semi-variograms reveals that for beds of comparative aspatial properties there are significant differences in the spatial complexity of the bed morphology as a whole. The implications of these results for channel pattern and morphodynamics of change will be discussed.