Changes in braided river morphology driven by flood sequencing

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Sequential observations of channel adjustments in relation to short-term flow variability are required to evaluate the effects of temporal ordering of hydrologic events on channel form. With the increasing hydroclimate variability due to global climate change, fluvial morphology might also exhibit adjustments toward changing equilibria. By combining flume and numerical modelling we examine the mechanism of bed morphology changes of braided rivers to a sequence of low to moderate magnitude flood events. Over 60 runs were performed in a mobile bed flume (10 m x 2.5 m), with constant longitudinal slope (0.015) and mean grain size (0.45 mm) in the Total Environment Simulator at the University of Hull, UK. The outcomes of each run were characterized by a detailed digital elevation model, digital imagery and continuous monitoring of the sediment transported through the flume outlet. Sediment conditions included floods with equilibrium and deficit loads. Rivers were allowed to evolve from an initially flat-bed to a self-organized, steady state. The rate of change and rate of bed load movement against time were indicative of the gradual approach to equilibrium. The Delft3D code in depth-averaged (2-D) mode was used to reproduce different aspects of the braiding process over an up-scaling of the laboratory river. Data analysis allowed us to assess the effect of discharge variation on the braiding dynamics and on the width-to-depth ratio of channels, which although variable in time, fluctuated among defined values. Once in equilibrium, net changes in reach-averaged width and depth values were relatively minor. The adjustment of the river morphology through time was well fitted by an exponential decay expression, and we tested diffusive relationships held within our braided river system for both constant and varying discharge conditions. In long term process-response systems, climatic changes introduce sequences of disruption of equilibria such as those analysed in this study. The results might provide then a useful basis for analysing the similar but more complex long-term dynamics found in natural rivers.