Numerical experiments on the effects of channel width, unsteady flow, and sediment supply on gravel-bed river morphodynamics

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Abstract. River channels are often characterized by downstream variations in channel width. The effect of width variation on bed topography and sorting patterns, however, remains poorly understood, especially under conditions of unsteady flow or changing sediment supply. In this presentation, we use one- and two-dimensional morphodynamic models to explore how different channel width variations, hydrograph shapes, and changes in sediment supply influence channel morphology. We first present a one-dimensional numerical model used to simulate conditions from a flume experiment in which a straight channel with sinusoidal width variations developed equilibrium morphology under steady flow and sediment supply, and was then given a large pulse of sediment. Both physical and numerical results indicate that width is a primary control on bed topography under both steady and pulsed sediment supplies with steady discharge. We then use a two-dimensional model (Nays2D) to systematically explore how the amplitude and wavelength of sinusoidal width variations affect the shape and location of bars, and sorting patterns between riffles and pools. 2D simulations were conducted under both steady discharge and repeated hydrographs. The topographic relief of the equilibrium morphology formed under steady discharge is similar to that developed under repeated hydrographs. Preliminary results suggest that bed material sorting is more pronounced under unsteady flow conditions.