Bedload sheet characteristics under steady versus unsteady flow

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Abstract. Heterogeneous, coarse-grained channel surfaces often self-organize into migrating patches of similar grain size and sorting known as bedload sheets. Under steady-state equilibrium conditions, bedload sheets partly account for the sometimes extreme variations in bedload measurements around a mean value. These "free patches" of sorted bed material that move freely down the channel have been studied under conditions of variable sediment supply. However, the response of the wavelength, amplitude, and celerity of these bedforms to changes in discharge or variations in channel geometry remains largely unexplored. Here we present the results from an ongoing laboratory study in a 0.86 m-wide, 18-m long straight flume subjected to both steady discharge as well as repeat hydrographs. In all experiments, the bed was composed of a sediment mixture ranging in size from 1 to 8 mm, with a median value of 4.2 mm, and sediment was fed into the channel at the upstream end at a constant rate to maintain equilibrium conditions. The steady flow runs, conducted at a discharge of 0.066 m^3/s with a mean flow depth of 9 cm, show consistent bedload sheet development and dimensions with mean wavelengths of approximately 1.5 m, amplitudes of 1.5 cm, and celerities of 30 cm/min. Because bedload sheets in gravel-bedded channels are analogous to dunes in sand-bended channels, we hypothesize that bedload sheets will react to unsteady flow in a similar fashion to sand dunes, where both bedform height and wavelength increase with discharge and flow depth. Ongoing flume studies also aim to explore how variations in downstream channel width affect bedload sheet characteristics.