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Fluvial obstacle marks as complex geomorphic systems: a comparison between physically modelled and natural forms

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Fluvial obstacle marks are bedforms that develop if flow is separated by an immobile obstacle at the stream bed. Due to local acceleration and deceleration of the flow, areas of potential erosion and deposition arise in the obstacle surrounding. This results in forms that commonly consist of a scour hole reaching from the upstream part to the sides of an obstacle and an adjacent depositional ridge.
Natural fluvial obstacle marks develop around pebbles, boulders, woody debris and plants. Individual forms of obstacle marks result from specific current patterns in the obstacle surrounding, which in turn are dependent on a variety of independent parameters like obstacle shape, -inclination, -alignment, -geometry, -porosity, -surface roughness and -flexibility as well as on sediment grading, bed-resistance, flow velocity, flow depth and steadiness of flow. Reciprocal interactions of these parameters make natural obstacle marks noteworthy examples of complex geomorphic systems.
In contrast, experimentally simulated obstacle marks in laboratory flumes can be regarded as complexity-reduced geomorphic systems and are characterised by diverging morphological features compared to natural obstacle marks. In spite of these emergent divergences flume experiments are still inevitable to identify principle formative processes. Also experimental simulations are necessary to develop physically-based explanatory approaches that can predict significant morphometric features (like maximum depth of scour, eroded/deposited material) of fluvial obstacle marks.
Within the scope of this work examples of natural fluvial obstacle marks are compared with obstacle marks simulated experimentally in a laboratory flume. In spite of morphological differences it can be deduced that a horseshoe-vortex system is the main agent that drives formative processes in the obstacle surrounding. The input of kinetic energy into this vortex system can be well described by determining the obstacle Reynolds number.