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Self-organisation of morphology and sediment transport in alluvial rivers

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The coupling of sediment transport with the flow that drives it shapes the bed of alluvial rivers: the channel steers the flow, which in turns deforms the bed through erosion and sedimentation. To investigate this process, we track bedload particles entrained by a laminar flow in a laboratory flume. We find that the bed spontaneously develops a convex shape which gathers the traveling grains around its center. As they travel downstream, the transported grains wander randomly across the bed's surface. This random walk induces a diffusive flux which transports grains towards the channel banks (Seizilles *et al., 2014*). Gravity, however, opposes this flux by returning particles towards the channel center. At equilibrium, diffusion and gravity balance each other. As a result, the bed shape and the sediment flux self-organize according to a Maxwell-Boltzman distribution, in which the bed's roughness plays the role of thermal fluctuations, while its surface forms the potential well that confines the sediment flux (Abramian *et al.*, under review). The same mechanism allows laboratory rivers to adjust their cross-section and their width to the sediment discharge: they widen and shallow to accommodate a larger input.

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