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Diffusive evolution of experimental river channel networks

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Braided rivers are complex systems in which a network of ephemeral, interacting channels continually migrate to create a rapidly changing landscape. We present results of a set of $\sim$ 1m-scale experiments of braided rivers forming over a bed of monodisperse glass beads. The experiments evolve from an initial flat bed, allowing us to study the approach to a steady state, with data in the form of repeat high-resolution topography scans. We find that, although channels migrate rapidly, they have stable, self-similar geometries organized to a critical Shields stress criterion. Above the individual channel scale, we find that we can directly describe many aspects of the system with a diffusional framework. The timescale to equilibrium slope, the timescale of decorrelation of the channel network, the rate at which downstream correlation lengthscales increase, and the dependence of the equilibrium slope on sediment flux can all be described with diffusivities that are consistent with a theoretical prediction. The emergent picture of our braided river system is one in which sediment transport drives the interaction of dynamic but equilibrium channels, which in turn act as elements of randomness that create diffusive behavior at the system scale.

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