
Experimental investigation of a sediment transport instability

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Résumé

Alluvial rivers shape their channels by exchanging sediment with their bed. An increase in sediment discharge typically leads to a wider channel (Popovic2021). However, beyond a critical threshold, laboratory rivers destabilise into several intertwined channels – the experimental analogue of a braided river. This transition could be related to the instability proposed by Abramian *et al.* (Abramian2019). According to this theory, erratic grain movements across the bed induce diffusion from high- to low-transport areas. By bringing grains from troughs to crests, this positive feedback causes perturbations to grow. Here, we investigate this mechanism in a radial experimental setup, made of a vertical cylinder filled with grains. The injection of a mixture of water, glycerol and grains at the centre of the cylinder forms a thin laminar film. As this film spreads towards the edges of the setup, it exchanges grains with the underlying granular bed. The flow, however, rapidly destabilises, and we observe the emergence of radial deeper streaks where sediment transport concentrates, separated by shallower, less active areas. After a few minutes, these streaks evolve into distinct channels, which sometimes merge, split or migrate. We believe that the initial instability and long-term non-linear behaviour of this ideal system share similarities with those underlying the formation of braided rivers.

References:

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Mots-Clés: river dynamics, instability, sediment transport, granular media

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