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# Effects of successive floods on bed load transport in a steep flume

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Rivers in mountainous areas are subject to cyclic perturbations due for instance to summer storms or daily variations in snowmelt. Such phenomena cause successive floods occurring under very similar forcing conditions. However, as shown by several field studies, measured bed load transport may vary significantly from one event to another. These fluctuations are still only partially understood and further research is necessary given the natural hazards and sediment stock issues at stake.

This work aims to investigate bed load transport over steep slopes during repeated floods. Experiments are carried out in a 17 m long 60 cm wide flume inclined with an angle of 1.7°. The bed is initially flat and made of homogenous natural gravel with a mean diameter of 6 mm. 200 identical floods are performed with no resetting of the bed between two simulations.

Each flood lasts 1 hour and the input hydrograph is triangular with a minimum discharge of 5 l/s and a peak discharge of 21 l/s. The sediment input discharge is also triangular and ranges from 0 g/s to 20 g/s. At low flow, no sediment transport is observed. The bed topography is measured after each flood by ultrasound sensors and bed load is monitored continuously at the output via geophones.

The bed slope derived from the bed topography presents an oscillatory behaviour characterized by a period of approximately 20 floods and relatively constant amplitudes. However, the general trend shows two phases: the average slope primarily decreases during the first 100 runs and then remains constant. This suggests that after a relaxation time, a quasi-equilibrium state is reached.

Measured bed load also oscillates with a period of 20 floods in the first phase. However, the amplitudes are less regular and strong peaks are observed. The intensity of the latter decreases as the system develops toward the quasi-equilibrium state. When the second phase is reached, the solid flux fluctuations lose their periodic nature. Peaks are still observed.

Bar formation is closely related to bed load transport in the first phase. Indeed, bar formation occurs when a strong solid flux is measured. During an aggradation period, when the bed load is low, the bars are filled. Bar creation and destruction therefore show the same periodic characteristics as explained above. In the second phase, bars are larger but their evolution seems much slower.

These observations suggest that a river system responds to cyclic floods in a succession of aggradation and degradation phases until a quasi-equilibrium state is reached after a sufficient amount of time. During this adjustment period, bed features vary with a relatively regular oscillatory behaviour. Once at the quasi-equilibrium state, large fluctuations in solid flux still occur.