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Check dams effects on sediment transport in steep slope flume

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Depending on many influences (geology, relief, hydrology, land use, etc.) some mountainous watershed are prone to cause casualties and facilities damages. Large amounts of sediments episodically released by torrents are often the biggest problem in torrent related hazard mitigation. Series of transversal structures as check dams and ground sills are often used in the panel of risk mitigation technics.

A large literature exits on check dams and it mainly concerns engineering design, e.g. toe scouring, stability stress diagram, changes in upper and lower reaches equilibrium slopes. Check dams in steep slope rivers constitute fixed points in the bed profile and prevent general bed incision. However their influence on sediment transport once they are filled is not yet clear. Two flume test campaigns, synthetize in Table 1, were performed to investigate this question:

Table 1 : experiment plan

Run (duration)	Ref1 (50h)	CD1a (30h)	CD1b (30h)	Ref2 (92h)	CD2 (18h)
Solid feeding discharge ($g.s^{-1}$)	44	44	44	60	60
Number of check dams	none	1	3	none	2

A nearly 5-m-long, 10-cm-wide and 12%-steep flume was used. The water discharge was set to 0,55 l/s in all runs. A mixture of poorly sorted natural sediments with diameters between 0.8 and 40 mm was used. An open solid-discharge-feeding circuit kept the inlet sediment flux constant during all experiments.

As both feeding rates did not present variation, changes in outlet solid discharge were assumed to be due to bed variations in the bed storage. We observed strong fluctuations of solid flux and slope in each reaches of all runs between: (i) steep aggradating armoured bed and (ii) less steep and finer bed releasing bedload sheets during erosion events and inducing bedload pulses.

All experiments showed consistent results: **transported volume associated with erosion event decreased with the length between two subsequent check dams**. Solid transversal structures shorten the upstream erosion-propagation and avoid downstream change in the bed level. As long as they are not buried by too strong aggradation they allow a "bed level independence" between reaches.

On the long term, **as the total inlet flux is kept constant, a decrease in transported volumes induces an increase in the erosion event frequency**: sediment releases are more frequent but littler. As proposed by Poncet (1995), check dams participate efficiently in hazard mitigation because "*they release in retail what torrents would too abruptly delivered wholesale*".

Reference : Poncet, A. "Restauration et conservation des terrains en montagne." Office national des forêts, Paris (1995).