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Sediment transport during flash flood events on an intermittent river: an experimental laboratory study.

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Flash floods have a number of impacts on the water quality of river systems because the later is the resultant of pollutant input into the river and its transformation along its course. In the case of intermittent rivers this impact is increased by the long drought periods that usually precede such floods. Indeed, the pollutants are known to accumulate in the dry river sediments during the drought period and are flushed away by the first floods.

The Vène, a small experimental catchment (67 km^2) located in southern France is a perfect example of this type of behavior. The field data collected on the catchment since 1994 through routine and flood monitoring clearly show an increase in suspended solids and nutrient concentrations during flash floods. However, the hydraulic conditions which lead to the triggering of sediment movement and re-suspension are not known.

The aim of this study is to investigate sediment re-suspension mechanisms by reproducing the dynamics of sediment movement during flash floods at the reach scale in controlled laboratory conditions. A rectangular flume (6m*0.29m*0.18m) is used as a scale model of a 1 km reach. Variable flow conditions can be set in the flume through a quarter turn valve. Discharge values are monitored using an electromagnetic flow meter and water velocity measurements are carried out in the flume using a Pitot probe coupled to a digital manometer.

Dynamic similarity is imposed between the reach and the flume i.e. the reach's Froude number is set equal to that of the flume. The reach's rating curve is used to determine a set of experimental height and flow values for the flume. For each test, the slope of the flume is modified in order to respect the rating curve. The flume's bed is reconstructed by respecting the similarity ratios determined previously using glass micro beads to represent its sediments.

Various tests are carried out in steady-state conditions for different discharge values. In transient conditions, the observed hydrograph's rising times are used to calculate corresponding flow durations in the flume. The entire water column is sampled for sediment mass at the outlet of the flume using very fine time steps. The measured velocity gradients are used to calculate the corresponding shear stress values at the bottom of the water column. Relationships between discharge, rising time, shear stress, and sediment mass dynamics are analyzed.

The preliminary results highlight the role of turbulent processes on sediment movement and re-suspension. However, the results are extremely sensitive to the sediment arrangement pattern i.e. to bed morphology. Although the Pitot probe has clear advantages in terms of ease of use and price, the corresponding measurements do not allow an accurate determination of shear stress values. The experimental protocol is currently being enhanced to solve this problem by seeking alternate measurement devices.