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Bedload transport powered by daily floods: unsteadiness and stochasticity.

Joris Heyman (1), Eric Bardoux (2), and Christophe Ancey (1)
(1) EPFL, ENAC, LHE, Switzerland (joris.heyman@epfl.ch), (2) CREALP, Switzerland

The use of geo-sensors in mountain rivers becomes more and more frequent. It provides valuable continuous time series of bedload transport discharge at high temporal resolution that are essential to evaluate, compare and fit theoretical model.

This increasing amount of in-situ data has to be interpreted and analyzed carefully at least for two reasons: (a) the flow conditions are unsteady and (b) the bedload transport process is stochastic. We show in this talk that the combination of both of those characteristics can be the source of a mislead.

In mountain rivers, during the hot season, glacier ice melting causes daily floods. They induce a periodic forcing on the gravel bed that erode in response. Thus, the sediment transport process itself has to be regarded as unsteady.

Most of the traditional bedload formula assume steadiness in flow and sediment transport, which result in a direct relation between flow strength and bedload transport rates. The quasi-steady approximation relaxes the steady flow forcing in assuming that bedload instantaneously responds to slow flow changes, so that steady theory can still be used.

However, there are evidences that auto-correlation of bedload time series might be still positive after a long time. Bedforms and bar migration, segregation, collective entrainment are all possible phenomena responsible for this non-vanishing correlation. In that case, the quasi-steady approximation is not justified anymore. Indeed, we show that some of the observed randomness of bedload discharge can emerge from a deterministic “relaxation” artifact, caused by the unsteady conditions. We show how to overcome this artifact.