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Alternative(s) to fractional-diffusion equations in bedload-transport models

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The idea of stochastic sediment transport models emerged in the 1930s, notably with the doctoral work of Hans A. Einstein (1936). Einstein's seminal work gave impulse to several stochastic models, which usually led to thin-tailed or bounded distributions for the particle-transport rate. Experimental observations together with field surveys suggest that particle-transport rate exhibits frequent and large fluctuations, in particular at low flow rates (i.e., when the bottom shear just exceeds the threshold of incipient motion), which cannot be described using classic distributions used so far for modelling bedload transport (e.g., Hamamori's distribution). The existence of these large and frequent fluctuations could offer a wide field of applications to fractional-derivative theory. Alternative approaches exist as well: in this talk, we explore the potentialities of a birth-death Markov model to model sediment transport within a fixed volume of control. Under steady-uniform-flow conditions, the model predicts that the number of moving particles inside the control volume follows a negative binomial distribution. Although this probability distribution does not enter the family of heavy-tailed distributions, it may give rise to large and frequent fluctuations. We investigate the consequences of these fluctuations on bed dynamics, more especially on the features (growth rate and probability distribution) of nascent bedforms that develop on initially planar beds as a result of intermittent bedload transport.