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Transfer equations for modeling interrill erosion

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Numerous models are available for matter transfer along an hillslope. They are usually process-specific, requiring to use several models to simulate transfers along an hillslope. To overcome this issue, we develop a new model valid for chemical (nutrients, pollutants, dissolved carbon) and particle transfers by water. It is able to simulate both interrill and rill erosion. This new equation encompasses the previous models of Gao et al. (2004), Hairsine and Rose (1992, 1991) and Lajeunesse et al. (2013) in a single and unified form. We show that it can account for multi-class particle transport able to simulate both linear and non-linear behaviors. Surface conditions (crusts) is accounted for, making possible for space and time changes of soil properties.

For the calibration of the model, specific laboratory experiments have been carried out to validate the effect of rainfall on travel distance of particles. These experiments allow to separate detachment by raindrops from the agitation of the flow by the drops. Different particle sizes and rainfall kinetic energies are investigated. The results assess the exact role of rainfall on sediment transport. Our new model is able to represent adequately these experimental results.