Discrete element methods and continuum models in bedload transport

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An ongoing research effort is reported on sediment transport multi-scale modeling in the framework of the ANR project SegSed ‘Size SEGregation in SEDiment transport’. Using a coupled fluid-discrete element model, a variety of numerical experiments were carried out in 2D and 3D bedload configurations studying the dynamics of the depth structure of mono- and bidisperse mixtures. Such models allow access to internal processes in the case of grain sorting and to variables very difficult to measure in the laboratory such as particle shear stress and rate. These variables are the key ingredients to derive constitutive relationships. Such a relationship inspired by one used in dry granular flows was successfully implemented in a Eulerian-Eulerian two-phase flow model. Progress is being made with a multi-class model where the momentum balance for each grain size class should be inferred by discrete element modelling. Ultimately, such studies could be useful to improve Exner-shallow water-type models in particular when grain sorting is considered.