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Some thoughts on the exchange of energy between sediment particles and turbulent flows

Manousos Valyrakis

University of Glasgow, Infrastructure and Environment Research Division, Civil and Environmental Engineering, Glasgow, United Kingdom (manousos.valyrakis@glasgow.ac.uk)

The contemporary research developments on the grain scale mechanics of sediment transport are discussed here. The recently introduced event based criteria (impulse and energy) according to which sufficiently energetic flow structures can mobilise particles resting on the bed surface, allow for a dynamic description of particle entrainment consistent to a Lagrangian framework to sediment transport. These are in turn is fundamentally distant to Eulerian-continuum traditional approaches, such as Shield's shear stress.

Even though all these approaches have a sound physical basis and are derived from fundamental laws of physics, there is lacking a consistent theoretical basis for upscaling the dynamical description of particle entrainment due to the action of turbulent flows and for a wider range of sediment transport rates.

These aspects are discussed, along the presentation of a generalized framework, which can describe the transfer of turbulent kinetic energy to the bed surface grains, towards its entrainment, as well as the loss of the particle's mechanical energy in the form of heat (e.g. due to inter-particle collisions) or back to the fluid. A potential route towards upscaling to useful macroscales of engineering interest is offered.