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Particle tracking velocimetry to study two-size bedload transport on steep slopes

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Bedload, the part of sediment transport remaining in contact with the bed has been mainly investigated from a fluid perspective. Bedload should also be considered from a granular point of view, and take into account the grain-grain interactions. This paper focuses on particle tracking velocimetry algorithms to better understand bedload transport at the particle scale. Two-size mixtures of spherical glass beads entrained by a shallow turbulent and supercritical water flow were analysed in a quasi-two-dimensional 10 % steep channel with a mobile bed. The coarse particle diameters were 6 or 5 mm and the finer diameters ranged from about 0.7 to 4 mm. Water flow and sediment rates were kept constant at the inlet. After obtaining bed load equilibrium for the coarser particles only, that is, neither bed degradation nor aggradation over sufficiently long time intervals, and a bed slope parallel to the flume slope, finer sediment was introduced. The evolution towards a new equilibrium state was recorded through video acquisition from the side by a high-speed camera. Particle tracking algorithms made it possible to determine the position, velocity and trajectory of a very large number of both coarse and sometimes fine particles over the depth of the bedload layer. This paper will present in detail the algorithms used for detecting and tracking the glass beads, before analysing results on particle velocity distributions and depth profiles as well as results on concentrations and sediment rates.