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# Testing of a "smart-pebble" for measuring particle transport statistics

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This paper presents preliminary results from novel experiments aiming to assess coarse sediment transport statistics for a range of transport conditions, via the use of an innovative "smart-pebble" device. This device is a waterproof sphere, which has 7 cm diameter and is equipped with a number of sensors that provide information about the velocity, acceleration and positioning of the "smart-pebble" within the flow field. A series of specifically designed experiments are carried out to monitor the entrainment of a "smart-pebble" for fully developed, uniform, turbulent flow conditions over a hydraulically rough bed. Specifically, the bed surface is configured to three sections, each of them consisting of well packed glass beads of slightly increasing size at the downstream direction. The first section has a streamwise length of L1=150 cm and beads size of D1=15 mm, the second section has a length of L2=85 cm and beads size of D2=22 mm, and the third bed section has a length of L3=55 cm and beads size of D3=25.4 mm. Two cameras monitor the area of interest to provide additional information regarding the "smart-pebble" movement. Three-dimensional flow measurements are obtained with the aid of an acoustic Doppler velocimeter along a measurement grid to assess the flow forcing field. A wide range of flow rates near and above the threshold of entrainment is tested, while using four distinct densities for the "smart-pebble", which can affect its transport speed and total momentum. The acquired data are analyzed to derive Lagrangian transport statistics and the implications of such an important experiment for the transport of particles by rolling are discussed. The flow conditions for the initiation of motion, particle accelerations and equilibrium particle velocities (translating into transport rates), statistics of particle impact and its motion, can be extracted from the acquired data, which can be further compared to develop meaningful insights for sediment transport mechanics from a Lagrangian perspective and at unprecedented temporal detail and accuracy.