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Experimental investigation of the influence of the sediment size distribution on bedload transport

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We report the results of an experimental investigation of bedload transport of a bimodal sediment bed. The experiments are carried out in a tilted rectangular flume, partially filled with an erodible bed composed of a mixture of 2 populations of quartz grains of sizes $D_1 = 0.7mm$ and $D_2 = 2.2mm$, respectively. The sediment bed is sheared by a steady and spatially uniform turbulent flow. Using a high-speed video imaging system, we measure the average velocity and the surface density of the moving particles of each size fraction. We show that they follow laws similar to those reported by Lajeunesse et al. [2010a] for an homogenous sediment bed. Indeed, noting τ_i^* and $\tau_{\mathrm{c,i}}^*$, the Shields and threshold Shields number calculated for the grain size D_i, we find that (1) the surface density of moving particles increases linearly with $\tau_i^* - \tau_{\mathrm{c,i}}^*$; (2) the average particle velocity increases linearly with $\tau_i^{*1/2} - \tau_{\mathrm{c,i}}^{*1/2}$, with a finite nonzero value at threshold. The influence of the sediment bed size distribution appears to be encoded in the value of the threshold Shields number which is found to vary with the proportion of small grains.