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Renewing confidence in the 3/2 power-law

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Numerous transport relationships have been devised throughout the years to predict bedload transport in rivers, particularly gravel bed rivers for which bedload exerts a strong control on river morphology. Transport relationships based on laboratory experiments are typically expressed in terms of bed shear stress and take the form of a power law regime with a 3/2 exponent above a critical value for the inception of motion. However, available studies from natural gravel bed streams show that the conditions for such an asymptotic regime to be observed rarely exist. Using an extensive survey carried out over three years in a mountain gravel bed stream in China, we show that, despite high variability in measurements made in-situ, it is possible to derive a clear power law relationship with an exponent 3/2 for the bulk transport over more than 2 orders of magnitude of the bed shear stress. This is done through the development of a new integral technique that averages out the variability of bedload measurements. The same conclusions apply for smaller samples at different sites along the river, as well as for previously published datasets that are based on individual point measurements instead of cross-section averaging. This result highlights problems in how field surveys have been performed over the last decades and demonstrates the need to make individual point measurements at different points along the same section. When considering the entire range of grain sizes and the entire dataset, our data show that the threshold for motion inception most probably corresponds to the threshold of the smallest grains caught by the sampler.