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The Effects of Hydrodynamic and Grain to Grain Interactions on Bed Load Flux Intermittency: Application to Mountain Streams

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Bed load transport – the movement of sediment in frequent contact with the river bottom – remains notoriously unpredictable, despite almost a century of quantitative research. The problem is particularly acute in steep mountain streams, where transport occurs close to the threshold of entrainment and flux is highly intermittent; the resulting large-magnitude bed load pulses contribute to the break down of bed load transport equations. There are two unique aspects of mountain streams that warrant special attention, and that we examine the consequences of here: (1) the presence of large, rarely-mobile boulders of comparable size to flow depth; and (2) highly energetic grain-grain collisions due to steep slopes and large grain sizes. This work will delineate the length and time scales of hydrodynamic and granular processes, and relate them to stochastic fluctuations of bed load transport – helping to formalize the averaging procedure for applying bed load transport formulas in challenging environments. Results will also improve parameterizations of bed load transport equations, because: (1) a new form drag correction will be developed for low relative submergence boulder arrays, a common configuration in steep mountain streams; (2) we will quantify the effects that resistant, stationary granular structures have on the entrainment threshold; and (3) momentum transfer