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Earth Surface Dynamics Discussions

Interactive comment on "Bedrock incision by bedload: insights from direct numerical simulations" *by* Guilhem Aubert et al.

Anonymous Referee #1

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General comments: The paper reports on numerical simulations of bedload transport and its interaction with the underlying static sediment layer. The model used is based on the discrete element method, which allow for the explicit description of the "sediments" dynamics and trajectories. The interaction with the driving stream is taken into account through effective drag and entrainment. This numerical setting thus gives access to quantitative direct measurements of the corelation between beadload and erosive power. The paper is well written and well organised. The results are original and suggest interesting perspectives using similar approaches. I have however few comments that I raise in the following, and leave it to the authors to decide whether or not they want to add a line on these in their manuscript.

Specific comments:

p4: I understand why using spherical grains makes the computation much easier. However it is clear that the effect of the shape is non trivial and non negligeable. Hence my question: is there a typical shape of grains at the surface of river bed? Could it be that beyond dynamical consideration, saltating grains and covering grains belong to a different class in terms of shape/ aspect ratio etc. . . ? do we have any insight in these, including experimental data on the efficiency of tranport (namely lift and drag) for different class of grains?

p5, line 119: it seems very unlikely that comminution would affect the pebble over such short time scale as you consider indeed, the comment seems unnecessary (or maybe prompted by earlier referee?)

p7, line 190-195. Why the value phi_B=0.5 specifically? Why this simplification of the velocity profile, since this aspect does not seem to be CPU expensive (unless I am mistaken on this last point?)

p8, line 215-220. It seems that the general behaviour is dominated by binary collision. Can we imagine that trajectories between two collisions may be predicted analytically and hence the time step be adaptative, as in event-driven methods? That could permit to greatly increase the duration of the experiment at little cost.

Very general question: I have the idea (could be partly wrong) that mechanical incision occurs during rare catastrophic events during which larger than usual pebbles will be transported by a highly energetic flow, and just plough the river bed. That is, mechanical incision may no be the result of a regular process as you describe. How much the regime you simulate is "catastrophic" compared to normal flow condition?

- References: I am a bit surprised to find no Métivier et al on experimental beadload and no Ancey et al (particularly with T. Bohm or J. Heyman) who has addressed similar issues in recent years. This should certainly be added (= the minor revision of the recommendation).