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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 #2

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This paper investigates the theoretical bedrock incision model of Sklar and Dietrich (2001) using discrete element modeling to determine the functional dependence the Shield's number has on incision rates, as well as the dependence of sediment supply on the "cover-effect". The results of this research show similar bedrock incision trends to those expected from theory and recorded by experiments and also "predict[s] that the cover term should decay linearly at low sediment supply and exponentially at high". This work provides new insight into the mechanics of bedload transport and bedrock incision and is therefore worthy of publication. The introduction and methods are both well written, however, the results and discussion have parts that are a bit difficult to follow. Although I do not have any major reservations about the paper, I have a few suggestions and comments that I will list below in order as they appear in the manuscript.

15-84: The introduction is well written and provides a good background on the mechanics of berock erosion.

87-91: I would like to see more discussion of the use of spherical particles, since angularity has been shown to change the transport. If it would be easy to do, it would be interesting to see how the results would change for angular grains or simply cite the work on transport of angular grains and speculate how this simplification of spherical grains can effect to outcomes.

118: You use a single grain size population for the simulations, however grain hiding and protrusion due to relative grain size differences with neighboring pebbles has been shown to effect bedload transport and could therefore have an effect on incision rates.

153-155: How do these values for collision duration and coefficient of restitution compare with real values for bedload impacts? Schmeeckle et al (2001) provides good experimental results indicating coefficient of restitution of 0.65 for collision stokes numbers over 105.

240-363: The results provide a lot of information to the reader and can be a little overwhelming especially with the many figures presented, where some results are only presented for certain values of supply (line 261). It might be clearer to the reader if you present a table of all simulations with corresponding input parameters, then you could refer to those simulations when referring to which data is used for certain plots.

255: You compare your results to other "experimental observations" so a citation is needed.

257: Reference "most observations of the transport threshold" so citation is needed.

276: guarantee spelled wrong.

305: "This finding is once again consistent with most transport models" needs citation.

365-542: The discussion has organized well but just had a few areas that need clarifi-

cation.

367: “appears to be consistent with experimental observations” needs citation.

379-381: Sentence starting “Let us note. . .” is worded weirdly and should be rewritten for clarity.

385: Sentence starting with “Once rescaled with the value of threshold. . .”, please note which value you used.

386: “consistent with common measurements” needs citation.

422-432: Does the model take into account abrasion that can occur due to frictional sliding between bedload and bedrock? Gabor and Domokos (2012) and Litwin Miller et al. (2014) show that frictional abrasion, in addition to collisional abrasion played a role in overall pebble abrasion. This consideration could account for why you do not see any incision while the pebbles are only rolling while the experiments of Sklar and Deitrich (2001) did.

539: How do your simulation input parameters, as well as rock material properties (tensile strength, etc.) compare with the site in Taiwan?

539-542: If it is possible, I think that running a simulation to determine the long-term average incision rates would make the conclusions of this research much stronger.

576: “Though our results are qualitatively consistent with experimental observations and another type of models. . .” needs citation.

Figure 4: Label axis as “average flux” to differentiate from flux in figure 3.

Figure 7: Label y-axes for b) and c).

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