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Interactive comment

Interactive comment on "Erosional response of granular material in landscape models" *by* Riccardo Reitano et al.

Michele Cooke (Referee)

cooke@geo.umass.edu

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The paper presents a nice parametric study for a range of potential analog materials that could be used in coupled deformation and erosion models. The careful study very nicely contributes to our knowledge of these materials and will be a very valuable resource for future studies. Delineating a material recipe that can effectively simulate both deformational and erosional processes within the same experiment will enable many future investigations into the fascinating coupled feedbacks between these processes. I have a few suggestions that may strengthen the paper. These suggestions primarily relate to the framing and presentation of the findings rather than the results themselves, which are nicely gathered.

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Discussion paper

The need for analog models of erosion presented within the introduction can be strengthened. A reader unfamiliar with analog approaches might not be convinced that these approaches are needed from reading the somewhat vague statement in the manuscript that computation capacities are limited (line 40). Can you provide some examples of the limits of computational models? One approach may be to follow the reasoning presented in Reber et al (2020) for the benefit of analog models over numerical approaches. But the authors may have other even more compelling reasons to offer the reader.

The study can benefit from stronger support for the performance assessment. The manuscript frames its primary goal as "finding an analogue material that best mimics the erosional behavior of the natural prototype." The part that is missing is how specifically is good behavior assessed. How 'should' a slope of 15 degrees respond to the simulated precipitation rate? How do we know what experimental response is correct or wrong? The text states that a proper concave upward river profile is desirable (line 309) but are there some plausible conditions that would yield more or less concavity to the profile? My, albeit very basic, understanding of fluvial mechanics is that the concavity of river profiles relates to the different strength of channel bed materials along the profile. If the material is uniform along the river profile, what degree of concavity is expected? This information is very important for helping us assess the performance of the material. Can you add to the figure 7 the range of expected profile shapes? Could you use numerical solutions for similar slope and precipitation but at crustal scale and with a range of soil/rock properties to validate the performance of the analog materials? The comparison of the laboratory observations to numerical models may be more straight-forward than comparison to natural systems because the numerical models can have uniform properties and starting slope.

Presumably, each of the tested combinations of analog materials may be suitable for different conditions of geologic substrate or precipitation rate. Perhaps one recipe is best suited for 'typical' settings but others could be used if you want to look at some atypical geomorphic settings. Providing some guidelines for the conditions under which each recipe could be suitable (or not) would be helpful.

The comparison in section 4.5 of geomorphic parameters to measurements from crustal geomorphic systems and the limits for various processes is very interesting. Can you please add the values of K and theta for detachment limited and transport limited systems to figure 12? This will aid in the comparison. The last sentence of this paragraph asserts the match of the parameters with nature. Please add the ranges for geomorphic estimates of K and theta to figure 12.

Just a small note on porosity. If I understand correctly, the porosity is measured my comparing the volume prior to and after shaking. Doesn't this presume that they packing has no voids after shaking? If so, this doesn't seem realistic within granular materials which cannot pack with zero porosity. Maybe I'm missing something about this particular method of porosity measurement.

Specific notes: Some awkward grammar at the following lines: 19; 24-25 (rewrite 'wipe it out' as this is a bit colloquial for what you are describing); 60 (replace this argument with what you refer to); 83 (where active tectonic is present); 138-139; 145; 183-184 (inner part?); 202; 262; (divergences?); 336; 398-399; 442. Line 82: What does bivalent mean? Line 93: Like -> such as Line 247: ration -> ratio Line 264: but -> except for Line 320: comma after CM2, Line 334: Wipes out is a bit overly colloquial. 'Erodes' may be better. 350-351: This information may be more effectively conveyed within a table. 384-386: To improve clarity please expand what specifically you mean by the 'opposite behavior'? Also please explain what you mean by 'internal deformation style in convergent settings'. Do you mean the development of thrust faults? Line 410: Explain what the unrealistic brittle structures are. Line 469: Please explain that this length scaling is constrained by the strength of the granular material. Line 505: Provide specific for the poorness of behavior can be helpful.

-Michele Cooke Amherst, MA USA

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