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Earth Surface Dynamics Discussions

Interactive comment on "Rarefied particle motions on hillslopes: 2. Analysis" *by* David Jon Furbish et al.

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In part 2 of the Rarefied paper series, Furbish et al. analyze a combination of previously published field and experimental data, as well as new experimental data, to compare with predictions from the rarefied hillslope sediment transport theory independently developed in the first paper. They first summarize the key theoretical components and predictions from the first paper. I found this section very helpful, as it crystallizes key aspects of the first paper. Next, they step through a series of experimental and field studies to examine different aspects of the theory, and find that all data support their general predictions: particle travel distances can be characterized by a general Pareto distribution, where the specific form of the distribution is controlled by the kinetic energy balance of the particles. They include a useful discussion of limitations of their work,

along with suggestions for future studies that can untangle some of the unknown details of particle behavior. The videos from the Vanderbilt experiments are delightful, and really help to visualize a lot of the concepts presented in the paper. I found their careful analysis convincing and mostly well-presented, and I imagine this paper will become canonical among those studying sediment transport not only on steep hillslopes, but in a variety of settings.

I have only minor comments for this paper. While much of the paper is clear and well-organized, a couple elements remain unclear: 1) the role of grain size/angularity and how it relates to theory 2) the difference between presented experiments and field studies, and why they test different aspects of the theory. To be clear, these points are both discussed extensively in the paper, but without organized explanations both toward the beginning of the paper and at the beginning of each new section, they are a bit hard to follow. One unclear point relates to the subtle difference between spherical particles traveling over a rough surface, and angular particles traveling over a smooth surface, with seemingly similar effects. I think this is one of the more interesting points of the paper, but it is currently lost without being set up properly in the introduction.

Line by line comments:

Page 2, Lines 4-5: can you give an example of another system where this work might be relevant?

Page 2, Lines 10-21: This is an excellent summary of the theory presented in the first paper.

Page 2, Lines 24-25: are you not mainly summarizing theory from the first paper?

Page 2, Line 28: change to "new laboratory experiments" to show that they are being reported for the first time in this study

Page 11, Line 23: "Section 3, Laboratory Measurements": Add a little intro here to remind us where we are. "Now we're going to summarize experimental studies and

compare their results to our theory. . .” Also consider adding a very brief summary of the results for both experimental and field comparisons, as it will help guide the reader through the various points of comparison in the coming sections. . .

Figure 3 and 4: What do the different symbols in the figure correspond to?

Page 14 line 8: “bumpety bump” I sincerely hope this technical wording remains in the final verison of the paper.

Page 15 line 17: can you more explicitly state how these experiments differ from those of gabet? What aspects of the theory will you be comparing for this set of experiments?

Page 17: “Experiments” Summarize briefly (1 sentence) what aspects of theory you will be comparing. Did you also measure travel distances to be able to make a plot similar to figures 3 and 4? Oh, I see. Why are figures after figure 10 placed at the end of the manuscript? I’m sure this will be fixed in editing but it currently hides some of the most exciting results of the paper.

Vanderbilt Experiments: Though you test different grain sizes, it is unclear what effect this has in your experiments. Is there a plot you can show highlighting the effect? Or a short amount of discussion?

Page 24, section 4.1: Typo. “DiBiase”

Page 26, line 27: did this experiment endanger helpless banana slugs? I sure hope not.

Page 26, line 31: Phew.

Page 30, lines 8-9: Why not plot the data like this to show us?

Page 33, line 39: It’s unclear what this means- can you expand on it a little?

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