

Interactive comment on “Landscape evolution models using the stream power incision model show unrealistic behavior when m/n equals 0.5” **by Jeffrey S. Kwang and Gary Parker**

Anonymous Referee #2

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This paper presents a call to arms, urging landscape evolution modelers who use the stream power incision model (SPIM) to “move on to more sophisticated models”, which better represent the physical mechanisms responsible for river erosion of bedrock, such as abrasion by sediment. The argument rests primarily on the finding of scale invariant solutions when the SPIM exponent ratio $m/n = 0.5$, for the case where the commonly-used hillslope “diffusion” term is omitted. Overall, the paper is well written, and the analysis is clearly presented.

While I am sympathetic to the stated goals of this work, I worry that, ironically, this paper may have the opposite impact by focusing so narrowly on a rather anecdotal result. The model behavior described here will rarely occur in model studies because

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modelers typically use other m/n ratios, or hillslope diffusion terms, minimum hillslope lengths or other model components that avoid this result. Will this finding convince anyone to abandon what has become the standard model for the advective component of landscape evolution modeling? I doubt it. More likely, this result will be cited perfunctorily in statements that acknowledge the limitations of the SPIM to assuage the concerns of reviewers who might prefer the use of “more sophisticated models”.

I agree with the suggestions of the first reviewer for how this work could be extended in constructive ways. For example, can scale analysis be used to identify when the SPIM may lead to incorrect interpretations, or test the validity of divergent model outcomes, such as the findings of Egholm et al. (2013) who directly compared the SPIM with a bedload abrasion incision model? Alternatively, this paper might stand on its own as a technical note, if motivated more narrowly by a problem this result helps to solve.

Egholm, David L., Mads F. Knudsen, and Mike Sandiford. "Lifespan of mountain ranges scaled by feedbacks between landsliding and erosion by rivers." *Nature* 498.7455 (2013): 475-478.

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