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Interactive comment on "A reduced-complexity model for sediment transport and step-pool morphology" *by* M. Saletti et al.

Anonymous Referee #1

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This manuscript presents a new model for sediment transport in steep streams using a stochastic cellular automaton model. It specifically addresses the formation of step-pools incorporating into the model a so-called jamming process. The paper is well-written and gives a nice overview of an intensive field of research at the interface between geomorphology and the physics of sediment transport. However, there are a few major issues that need to be addressed and I consider that this manuscript needs to be significantly modified to be useful for a large number of researchers in these communities. I hope that the following comments will help.

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Discussion paper

Major issues

- A roughness is a measure of amplitude. It seems very awkward to call *roughness* a variable that can be negative. What is called the *roughness* in this manuscript is basically a local downstream slope.
- This is not because you develop a "*Reduced Complexity Model*" (RCM) that it is not necessary to check some basic relations, such as the relation between sediment transport and slope. But, taking into account the previous comment, this is basically what you do when you investigate the mean roughness with respect to E and i_{R}. This relation should be used to set-up the model and not presented as a result.
- There is no deposition length in the model and you never discuss the characteristic length scale of the exponential decays for particle hop distance. You need to test the dependency of this characteristic length scale to the system length and to describe how it varies with respect to the model parameter values.
- You propose a two-dimensional RCM with only 3×10^3 cells. This is two orders of magnitude smaller than the actual number of particles in continuous numerical models that solve turbulent flow and particle collisions. I do understand that size does not matter but you should explain and justify why such a small section of the bed is enough in your model.
- Please clarify your initial condition. This is particularly important because I have the feeling that you can have stationary states for which there is no erosion or deposition. Furthermore, the steady-state is not very convincing from the fluctuations observed in Fig. 3a.
  You should also be more careful about your downstream boundary conditions and explain how the 10 sections that are removed affect the results.

- Is there an increase of the sediment flux downstream leading to saturation and then to jamming? If it happens to be the case, how does this mechanism relate to the saturation flux and the saturation length in classical transport model?
- In relation with the previous point, is there a characteristic wavelength for the formation of step-pools? It could be informative to characterize the height distribution of these step-pools.
- Before exploring the role of variable flow strength, it is necessary to understand the dynamics of step-pool formation. I have the feeling that the huge amount of deposition create a barrier, which is subsequently responsible for net deposition upstream. Is it the case in the model and in nature?
- I suggest to plot a space-time diagram for the formation (and the disappearance) of step-pools.

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