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Earth Surface Dynamics
Discussions

Interactive comment on "A probabilistic framework for the cover effect in bedrock erosion" *by* Jens M. Turowski and Rebecca Hodge

Anonymous Referee #2

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In this manuscript, the authors presented a probabilistic framework for predicting partial cover in mixed bedrock-alluvial channels, which they used to explore how probability of sediment deposition, relative sediment supply, and particle speed interact. It represents a next step in the progress that has been made over the past several years in modeling areal fraction of sediment cover. Overall, I found this to be a good paper, with sound methods and interesting results.

1. My main concern with the manuscript is the equations for entrainment rate and deposition rate. Although the authors explain that eq. 20 approaches Emax* as Ms* goes to infinity, does the same apply to eq. 21? I think Mm* cannot be infinity because it is limited by the capacity value M0*. If so, when Ms* is very large, it is impossible to balance D with E.

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2. The authors assume that increasing sediment deposition decreases local shear stress and increases the critical entrainment shear stress for grains (Line 186-192 and 242-245). I think this assumption is limited to the case of smooth bedrock. Sediment deposition does not necessarily decrease the flow velocity. In rough bedrock, increasing sediment deposition increases local shear stress and decreases the critical shear stress for grains.

3. In section 4.2, although the authors explain the differences from the model presented by Nelson and Seminara (2011, 2012); the model presented in this paper has more similarities to the model presented by Inoue et al. (2014). In the mentioned paper, they have distinguished between mobile and stationary sediment, and have not assumed a direct correspondence between sediment concentration and degree of cover, which is different from Nelson and Seminara (2011, 2012). I think the main difference is in the sediment continuity equation including entrainment rate and deposition rate. This equation seems very useful. I encourage the authors to explain the differences from Inoue et al. (2014) and the advantages of this sediment continuity equation.

Additional comments by line number below:

Line 140: There are situations when sediment does not accumulate even if the exposed part is zero. For example, runaway alluviation in Chatanantavet and Paker (2008).

Line 242-245: It is good to describe a physical reason for smoothing.

Line 345: Can (1-eˆ-Ms)qt* be converted to (1-A)qt*? If so, the entrainment rate is proportional to the areal fraction of sediment cover.

Figure 4 and Figure 5: Q* = Qs*?

Figure 7: What is arbitrary unit? Is the sediment supply rate specified?

Figure 8: Please explain the distance from upstream end to downstream end, transport capacity, bed slope and grain size.

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Figure10: Which equations are used to calculate 99% response time?

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