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Earth Surface Dynamics Discussions

Interactive comment on "Temperature effects on heavy rainfall modify catchment hydro-morphological response" *by* Nadav Peleg et al.

Anonymous Referee #2

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I have been invited to review "Temperature effects on heavy rainfall modify catchment hydro- morphological response". My expertise is in statistics, landscape evolution modeling and sediment transport models. Therefore I feel well qualified to evaluate the relevance, novelty, and quality of this work, with caveat that I have little expertise in sophisticated stochastic rainfall generators, and cannot evaluate those sections of this work.

The authors explore the effects of increasing rainfall intensity on sediment transport processes in a small alpine catchment through use of several coupled simulations. They correctly point out that most existing landscape evolution models (LEMs - which

model sediment transport) implement rainfall forcing in only the most basic way, and in order to address the question they have posed, it is necessary to have a landscape evolution that incorporates spatially distributed rainfall and hydrology, no easy feat. A large part of the novelty in this work stems from their use of cutting edge LEMs that are capable of simulating the geomorphic response to spatial and temporal changes in the rainfall forcing in a realistic way. Their integration of a sophisticated 2-D stochastic rainfall generator is also novel, and allows them to tackle the question of increasing rainfall intensity in a credible way. Though the timescales in question are small, much less than the timescales that geomorphologists usually think about, the relevance of their study is high due to the robust predictions of increasing rainfall intensity with increasing atmospheric temperatures, and concerns about how that might impact sediment transport processes with implications for geohazards.

In addition to the work being novel and relevant, I find the methodological choices to be reasonable, and I find no noteworthy faults with the approaches taken here (except for the details of the rainfall generator, which I do not have the expertise to evaluate). The work is timely and very well referenced, the authors are clearly aware of the state of the art in the relevant fields. The one significant criticism I have is that I think the authors could be a bit more clear in the abstract and conclusions about the result that peak rainfall intensity has little effect on the geomorphic response, especially in comparison to changes in the mean areal rainfall rates. I have highlighted those sections below along with some other minor suggestions. I think these suggestions would improve the manuscript, however I don't think that any are absolutely required, and it could be published as is.

Details: Abstract - Lines 16-18: " The results highlight that the response of the streamflow and sediment yields are highly sensitive to changes in the rainfall structure at the small-scale, in particular to changes in the areal rainfall intensity and in the area of heavy rainfall, which alter the total rainfall volume, and to a lesser extent to changes in the peak rainfall intensity." - This claim feels a little misleading to me. The use of

"rainfall structure" in the first sentence implies that something complicated is going on, when really it is just changes in areal intensity - can that count as rainfall structure? Similarly, "to a lesser extent" is not clear about the fact that the areal rainfall intensity is by far the dominant variable compared to peak intensity. You later make the point that simpler models that just increase the rainfall pattern as is without taking into account the seperate effects of mean areal intensity and peak intensity related through storm structure will over predict erosion. It seems that you're showing the large scale volumes are the first order effect, so actually simple models would get it right, as long as they don't confuse peak intensity with areal mean intensity. It seems to me it would be more useful to point out the importance of changing rainfall intensity at the correct scale. Abstract - Lines 18-19: "The hydro-morphological response is enhanced (reduced) when the local peak rainfall intensified and the area of heavy rainfall increased (decreased)" - It seems something is missing. Writing out the two versions of the sentence: The hydro-morphological response is enhanced when the local peak rainfall intensified and the area of heavy rainfall increased. The hydro-morphological response is (reduced) when the local peak rainfall intensified and the area of heavy rainfall (decreased). Local peak rainfall is missing it's paranthetical partner. Abstract - Line 9: "and how those impactS" - change to something like "and subsequent impacts on" Page 9 - Line 8: "moving sediments that are stored" -> "moving sediment that is stored" Page 9 - Line 24: "variables than rainfall" -> "variables besides rainfall" Page 11 - line 20: Drop parantheses on citation Page 16 - line 13: I was hoping you would share the exponent - could you add it - the convective rainfall one too? Page 18 - line 2: "The hydro-morphological response originated" -> "The hydro-morphological response driven/caused" Page 18 - lines 18-22: As I read it, these lines explain that convective rainfall drives a more pronounced enhancement of the total sediment yield, yet at the same time, the sensitivity of change in sediment yield to change in flow is weaker. This is a bit confusing. On the surface these seem like opposing statements. Is this because, while the exponent is smaller, the change in streamflow is so much greater than for stratiform rainfall that the overall increase in sediment yield is still greater? Is it possible to give a bit more expla-

nation here? Page 21 - lines 7 - 9: "Likely, the sensitivity of the hydro-morphological response in reality is larger than presented here, as the changes in rainfall structure are likely to be more complex than schematized in this work" - this is a confusing sentence because you argued in the abstract, and again directly after this statement that the real danger in simple models is in overprediction. But now you say that a limitation of the sophisticated model is that it underpredicts by an unquantified amount... Page 21 - line 32: "A viable alternative presented here" -> "A viable alternative is presented here" Page 22 - lines 23-24: "catchments of with a different topography" -> "catchments with a different topography" Page 22 - line 27: "are subject of future work." -> "are the/will be the subject of future work." Page 23 - line 4: "sediment related" -> "sediment transport/geomorphological/morphological related" Page 23 - line 5: "morphological" match to previous use of word in same sentence (previous suggestion) for clarity Page 23 - line 6: "erosion" - it would be better to use a more specific term, erosion happens by many processes and also in rivers. Perhaps sheet-flow driven erosion, or mass movements or runoff driven erosion

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