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Earth Surface Dynamics Discussions

Interactive comment on "The sensitivity of landscape evolution models to spatial and temporal rainfall resolution" *by* T. J. Coulthard and C. J. Skinner

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The authors present an interesting and detailed investigation into the sensitivity of landscape evolution models to the spatio-temporal resolution of rainfall data input. I don't wish to preempt the responses of the other reviewer(s), but I offer a few comments on the paper that the authors may wish to remark on or consider in their final manuscript.

Data Source

The authors have chosen to use rainfall radar data from the Met Office NIMROD system (Section 2.3, page 7, l.7), an appropriate choice for a study of this nature. A minor point, but several different variations of this data prod-

uct are available, and it may help readers and future investigators to clarify precisely which data source was used – either the UK composite product, or the single site-specific radar data source from the nearest radar station to the Swale basin? (Both are available at 5km resolution). There are small processing differences between the two products (see http://browse.ceda.ac.uk/browse/badc/ukmo-nimrod/doc/radar_products_description.pdf). The citation could then be clarified appropriately, e.g.:

Met Office (2003): 5 km Resolution UK Composite Rainfall Data from the Met Office Nimrod System. NCAS British Atmospheric Data Centre.

As apposed to the current citation given which is a generic one for all the NIMROD rainfall radar datasets.

Orography vs Spatial Resolution

In section 4.1 (page 10, first paragraph) the authors discuss whether the increased erosion rates are due to the cumulative effects of orographic enhancement of rainfall, or purely due to the spatial resolution increase. They describe 'jumbling' the 5km rainfall data cells to produce a shuffled re-distribution of rainfall. However, is it possible that the jumbling of grid cells could have produced an pseudo-orographic effect in some of these jumbled simulations? In other words, a truly random shuffling of rainfall grid cells should be just as likely to produce some loose form of structure in the rainfall data as it is to produce a rainfall data set with a high degree of variability between neighbouring rainfall grid cells. Did the authors inspect the shuffled data to see if this had occurred? If so, this could be clarified, perhaps at an appropriate point the Methods section. Otherwise, I'm not sure that Figure 7 in particular supports the assertion that rainfall *spatial* resolution alone is responsible for increased sediment yields (and not due to any unintended rainfall pattern within the 'jumbled' data).

As a general comment regarding orographic rainfall effects (and perhaps as a corollary to the above comment), it is questionable whether this rainfall data, even at 5km

resolution, could sufficiently resolve smaller-scale orographic detail in rainfall in such a relatively small basin (Golding, 2000; Smith et al., 2015). Referring to Figure 1, only three rainfall grid cells (the highest rainfall resolution) cover the catchment in a North-South direction. In the East-West direction (c.30km), a general orographic gradient may well be resolved, however, due to sufficient grid cells in this dimension. Using a higher resolution rainfall radar product (Met Office, 2003) might be illuminating when investigating smaller basins (e.g. Valters et al., 2015).

Unlimited Sediment Supply

The authors use a model set-up with no bedrock layer (Section 2.3, page 7, l.31). I assume this means that there is effectively an unlimited supply of sediment during the model simulation. While it might be beyond the scope of this study to start considering transport-limited vs. detachment-limited scenarios, it could be useful to readers for the authors to discuss whether this could have an effect on their results. I.e. is it appropriate for the type of landscape in the Swale basin, particularly in its upland reaches (Howard, 1994), and would having limited sediment depth potentially have a limiting effect on sediment yields at higher rainfall resolutions? A brief comment on these aspects perhaps under 'Discussion' or 'Limitations' could clarify.

Thanks again to the authors for presenting an engaging study into the effects of rainfall resolution on landscape evolution models. I look forward to reading the final version of the manuscript in print.

References

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