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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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Thank you for the review – we hope we can use the online discussion to clarify one of the main points made before submitting a more formal response when all of the reviews are in.

Our query focuses around the comment "My main concern is about the potential effect of changes in soil hydrological properties (spatially and temporally) as the spatiotemporal resolution of rainfall is changed. This is not at all considered by the authors their simulations while they recognise at the end of the discussion that it may change considerably the sensitivity of landscape evolution models to rainfall resolution. As hydrological properties might be scale-dependent, changing only the spatiotemporal

resolution of rainfall between runs without considering potential scale interactions between rainfall and soil behaviour may lead to erroneous conclusions on the sensitivity of landscape models. I know that adding runs in which the soil properties are randomly changed (m and K parameters) will need considerable additional computation time but the conclusions of the paper would be more supported and strengthened"

As a simple description, a normal lumped application of Topmodel contains a store of water, release from which is controlled by the m parameter – and whether or not this is treated as runoff by k. In a regular – catchment wide lumped application, there is one store, one m value and one k value for everywhere. M and k are kept constant throughout operations of Topmodel – unless you are representing, for example, a change in land cover.

In our application, each 5km climate or hydrological cell contains a separate version of Topmodel – with its own store and (if required) m or k value (though in this study we deliberately keep these the same). Therefore the soil hydrological properties (the soil water store in Topmodel) of each cell are independent – so there is a spatio-temporal change in soil moisture across the basin (albeit in 5km cells). There are no sideways movements of water between adjacent climate/hydrological cells. Changing m or k for each cell in our application - would be akin to altering the land use within each cell which is not the focus of this paper. You could randomly change the m and k parameters randomly in each climate/hydrological cell – and repeat several (10's or even 100's) of times with the same rainfall patterns – to see whether the effect of rainfall resolution persisted through random variable changes. But would this really tell us any more than running it with the same m and k across the basin? If you randomly vary the m and k spatially and repeat enough times, then the average values of m and k will become constant and thus average water/sediment values will have the same output. Is this what is requested in the review?

There is of course a need to look at the sensitivity of models to both spatial and temporal changes in precipitation AND land use – but in this paper we have focused on

just one. This is to (a) make the experimental design simpler and (b) because spatial changes in land cover is really a different research/science question that we have answered in an additional paper (accepted - in press in another journal).

We hope this addresses the issue raised by the reviewer – but if we have misunderstood the above point then we would be very grateful if the reviewer could give some clarification?

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