Interactive comment on "How do modeling choices impact the representation of structural connectivity and the dynamics of suspended sediment fluxes in distributed soil erosion models?" by Uber et al.

Answer to editor G. Hancock

We wish to thank you for your comments that helped us to substantially improve the paper and we hope that the changes made accordingly will contribute to an easier understanding of the text. In the following, your comments appear in black italic and our answers are provided in blue. When there are quotations from the text of the article, they appear in quotation marks.

Review of 'How do modelling choices impact the representation of structural connectivity and the dynamics of suspended sediment fluxes in distributed soil erosion models' by Uber et al. This is a timely paper. Given the number of hydrology and sediment transport models available understanding the sensitivity of parameters is extremely important. Therefore, the topic is of high interest. The paper reports on an assessment of model sensitivity in two catchment in France. The field data and numerical experiment is nicely done. However, there a few comments that need to be addressed that can make the paper stronger.

Thank you very much for the review of our manuscript and for the recognition of our work.

The Abstract summarises the paper nicely. However, the Introduction needs some attention. At the end of the Introduction, I largely agree and understand all the you have described, but I am not sure where the paper is really going. I have read the Introduction several times and it is not clear what you are really going to do. This leads to a comment about Section 3.4 (and its logic) which is somewhat difficult to rationalise in terms of the various model runs and setup. The Introduction needs to be refocussed with a much stronger and defined aim particularly at the end of the section. The sentence on lines 72-74 seems to summarise the overall intent of the paper. While the sentences on lines 92-94 are quite vague.

Thank you for pointing out that the introduction was not clear and that the objectives were not easily understandable. This flaw also got evident from some of the comments of the anonymous referee #1 and to some misunderstandings of the referee despite considerable effort made and multiple readings of the paper.

Following your comment and the comments by referee #1 we reformulated the sentence in line 72-74 you refer to: "This paper contributes to improve our understanding of the hydrosedimentary processes in the catchment that lead to sediment flux variability at the outlet". We also slightly reformulated the objectives "Since model outputs are supposed to be highly sensitive to the choices made during model set-up, the first objective is to assess the impact of the choices made during model discretization and parameterization on modeled suspended sediment flux dynamics. A second objective is to assess how structural connectivity, particularly the location of the sediment sources, impacts modeled suspended sediment flux dynamics for both catchments."

Moreover, we propose to change the title to better reflect these two objectives: "How do modeling choices and erosion zone locations impact the representation of connectivity and the dynamics of suspended sediments in a multi-source soil erosion model?"

We further revised the column "Aim" in table 2 to better relate this table to the two objectives of the study.

Line 174- Soil erosion module I have no problem with using a single layer in an instance like this. However, the model used here only models erosion? No deposition? I realise that the inclusion of deposition adds complexity and would likely slow model run time but what is the effect of neglecting this on the findings? Landscape Evolution Models have demonstrated that including deposition has a significant influence on erosion particularly gullying. I say this as you mention gullies in the Badlands in Section 3.3.

It is true that we don't include deposition in our model and we agree that it could be considered as a strong simplification of reality. However, in both catchments, the slopes of the stream are high (>2.5%) and mainly incised into the bedrock. Contrary to what can happen downstream of the measuring stations where the slopes of the river decrease considerably, the temporary storage of fine sediments and their resuspension are not dominant processes compared to the fluxes of fine sediments coming from the primary sources of the catchments. For further studies we plan to include deposition and resuspension to assess to which extent these temporary storages are important processes to consider in such catchment configuration. Nonetheless, in this first step, we wished to keep the model as simple as possible and to focus on the processes that we believed were the most important ones in our catchments (i.e. rainfall detachment and transport via surface runoff). Both of our study sites are prone to heavy rainfalls and flash floods that lead to high sediment exports during these events. We focus on these events where we believe that the sources are highly connected to the river network.

A further issue is that you are only modelling suspended sediment? Is this the case? What about bedload? Is the quantity of bedload significant? Should you be examining total load? Line 420-424. Here you talk about total solids. Does this include bedload? Or is it suspended load?

You are right, we are only modeling suspended sediments. When we wrote "total solid discharge" we meant the sum of solid discharge from the different sources. It is true that this is ambiguous, so we changed it to "total suspended load" or to "total suspended solid discharge" in line 421 and elsewhere.

Conclusion. Can this be rewritten to summarise succinctly the interesting work here. A Conclusion should summarise and largely be standalone with data presented. I suggest that lines 489-492 have been discussed elsewhere. As presented it reads like an extension of the Discussion and does not do the paper justice.

As suggested we have reorganized and shortened the conclusion to highlight the main findings of this study. We therefore propose the following conclusion in the revised version of the article that will be submitted.

"This study aimed to improve our understanding of hydrosedimentary processes leading to temporal variability in the contribution of potential sources to suspended sediments at the outlet of two mesoscale catchments using a distributed, physically based numerical model. As a first objective, we analyzed to which extent the choices made during model discretization and parameterization impacted the representation of the structural connectivity in the model. The shape and the magnitude of the modeled hydrographs and sedigraphs were sensitive to the contributing drainage area threshold to define the river network and to Manning's roughness parameter *n* in the river network and on hillslopes. However, the model was less sensitive to all three values once the parameters varied only in a restricted, reasonable range. The pattern of modeled source contributions remained relatively similar when the CDA threshold was restricted to the range of 15 to 50 ha, *n* on the hillslopes to the range 0.4-0.8 and to 0.025-0.075 in the river.

Therefore, the second objective was to assess how the location of geological sources in the catchment impacted the modelled temporal dynamics of suspended sediments at the outlets. The classification of the geological sources in subgroups showed that the hydrosedimentary responses differed in the

two studied catchments due to the combined effects of the distance from the sources to the point of entry of sediments in the river network, the distance of the sources to the outlet as well as the slopes of hillslopes and rivers. Among the various structural connectivity indicators tested to describe the geological sources, the mean distance to the stream was found to be the most relevant proxy of the temporal characteristics of the modeled sedigraphs."

Other issues:

Line 128. What is 'molasses'?

It is a geological classification of sedimentary rocks. This was given in line 123 "The catchment is entirely located on sedimentary rocks comprising limestones (34%), marls and marly limestones (30%), gypsum (9%), molasses (9%) and Quaternary deposits (18%)."

I really liked the interactive figures

Thank you for the positive feedback on the interactive figures.