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Interactive comment on "Numerical modelling landscape and sediment flux response to precipitation rate change" *by* John J. Armitage

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This paper deals with the response of a landscape to a change in precipitation rate in terms of sediment flux and response time. The authors use numerical modelling to explore the behavior of a landscape considering two end-member for the transport law : the stream power law and the sediment transport law. The first one has been widely used and has showed some limitations. It is therefore of high interest to compare this law to another one. The authors propose several simulations that can be compared with each other and show that the two transport laws lead to a similar first-order behavior but with different response time, that can thus be used to discriminate the on-going processus (instantaneous vs diffusive transport). The authors test their models on the Claret Conglomerate, associated to the PETM (a rapid climatic change) and suggest

that this formation is best explained by a diffusive model.

The purpose of this work is of interest for many fields of research. The methodology is consistent and the results are nicely supported by several numerical experiments. However, this work would benefit from some rewriting and reorganization to make the purpose of the authors more clear and easier to follow: some paragraphs could be reorganized and/or developed in particular to better highlight the state of the art in the domain (Introduction) or to develop some important aspects of the work (Method). Please find below my specific review.

INTRODUCTION

p2 l5 responds to tectono-environmental change : The main results of these models should be mentioned here.

p2 l9 to evaluate how the response time varies as a function of the model forcing: a few words about why this is important and how this will support your initial question would be welcome.

p2 after l16 in order to highlight the importance of your work, and to better present the general context, the equations of section 2.1 could be presented and discussed here

p3 l2 could you comment briefly the limitations that are suggested by: in principle ?

METHODS

p5 l3-4 Some logical transitions between sentences are necessary here.

p5 l13 the value of the exponent m is usually related to the value of n and is therefore not always close to 0.5.You should rather give a range of m value observed in nature and in experimental landscapes (see for example Kirby and Whipple 200, Lague et al 2003, Wobus et al 2006)

p5 l17 the last sentences could be supported by more references. In addition, the differences between the linear and non-linear cases should be discussed here.

p5 l24-29 not clear, please consider rewriting

p7 (and Appendix B) please specify which model/soft you used to solve Equation 11

p7 In Table 1, you mention two model sizes but there is only one in page 7. Please correct.

p7 l16-19 you use different grids (square vs triangular) and resolutions (number of nodes) for the two models. Can you please comment on these specific choices and the possible implications (or consider adding a paragraph on this topic in the Discussion) ?

p7 l20-24 (and in Appendix A and B) this paragraph needs to be developed and more precise: why do you consider two different times (5 and 10 Myrs)? by how much is increased or decrease the precipitation rate ? how do you define the values of the different coefficients ? These values are of main importance for your numerical models and should therefore be discussed more extensively (typical values in natural settings, in experiments, implications, etc).

p8 the last paragraph could be moved to line 20. Also consider a few words about the choice of the output you follow.

RESULTS

The particular value of m/n = 0.5 has been recently tackled by Kwang and Parker (ESurf 2017). They suggest that m/n = 0.5 leads to unrealistic scale invariance. Can you comment on this ?

p9 l1 and l 11 the choice of these values must be explained or supported by some references.

p10 Please specify wether you extract only one profile for each model or use several profiles

p14 l15-20 these sentences are about the amplitude of the response but it is in a section dedicated to the response time. Please consider moving this paragraph to a

more appropriate section.

DISCUSSION

Based on Figure 6, you propose that the response time is shorter for an increase in precipitations than for a decrease and you also show that the response time is related at first order to the precipitation rate (Figure 7). In your examples (Fig. 6), you start from the same initial precipitation rate (1 m/y) and you end with different values. Therefore, the shorter/longer response time be related to this difference in precipitation rates rather than to increase vs decrease. Can you comment on this ? Some simulations with different initial rates but similar final rates would be very interesting. If, even with similar final rates, the response times are still different according to the scenario, it would be very interesting to discuss why.

In the second part, the authors present the example of the PETM as a rapid change in precipitations and they discuss the timing of the contemporaneous sediment deposits.

1) Rohl et al propose a duration of 170 kyrs for the PETM. Please add some references for the lower value of 90 kyrs.

2) You assume a constant rate of deposition for these two formations to estimate a duration of deposition. However, average rate of sedimentation are very difficult to estimate and it is a very strong assumption to consider that a conglomerate is deposited at the rate of a paleosol. Therefore, it seems very difficult to consider that the conglomerate account for 1/3 of the total duration or that it is deposited at a rate or 5 10-4 m/y. In addition, based on your simulations, we expect a change in flux while the system is responding to the change in precipitations. One simple and more robust option is to refer to the value proposed in Schmitz and Pujalte, 2007.

3) Your work is focused on response time and sediment flux but in this natural example, you document a change in the nature of the deposits. Is there any argument to support a change in Qs ?

FIGURES

Figure 7 this figure is given for the specific value of 0.5. However, you ran some other simulations with different values of m. Do you observe the same behavior for different m values ?

MINOR COMMENTS

p2 l25 should be part of the previous paragraph

p3 l7 dirven -> driven

p3 l 25 bedrock, thickness -> with thickness

p5 l20 typical value of k ?

p5 eq7 alpha is not defined

p5 eq8 kp is already used in eq 5, with a different meaning

p6 l7 kappa is not defined + typical value ?

p9 table 1 please correct units for the precipitation rate

p9 consequently: the logical connexion between these two sentences is not clear

p10 l4 responce -> response

p11 l 6 missing ,

p13 l 1 knock-point -> knick-point

p14 l29 suggestion: due to a change in precipitation rate, for an uplift rate

p17 l 3 the the

p19 l 13 of -> how (?)

p22 l2 you could add some more references here, coming from natural, numerical or

experimental studies.

p25 (Figure 14)a -> (Figure 14a), id. b

p25 of 100 steady state the sediment flux -> of 100 the sediment flux (?)

p25 withn -> within

Same font and size for all figures (including the appendix).

Figures of Appendix should be labelled as such.

The second figure of Appendix B (Figure 13) is used any other figures of the appendices.

Figure 7 -0.5 = m could be in red

Figure 8b missing inbox legend

The sub-labelling of the figures (a and b) is not really used in the text, it could help the reader to compare the different models.

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