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# *Interactive comment on* "Modelling sediment clasts transport during landscape evolution" *by* S. Carretier et al.

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We thank referee 2 for its constructive remarks and we apology for the delay in responding.

Concerning the shortness of the introduction, we agree that explaining why flux-clast modelling is challenging deserves more explanations. We will do it in the revised version of the manuscript.

The lack of informations concerning how clasts are moved was also pointed out by reviewer 1. We gave more details in our response to this referee. For the sake of conciseness we do not repeat it here, but we will add this information in the revised version.



Concerning the dependence of variance on dx, this is a direct consequence of the simplified method adopted here. You can imagine an extreme case where we impose that all clasts initially seeded at one pixel of an inclined plane, descent at the same rate. This means that the probability to move downstream is identical for all the clasts. They will step all from line to line, but they will increasingly spread along each line because they can choose one of the three downstream direction. In that case, the mean transport rate does not depend on dx, but the variance necessarily does. Note that the probability to go to these downstream directions is calculated by the multiple flux algorithm. One may think that this algorithm should be adapted for large pixels. The comparison of observed and modelled clast movements in specific cases may actually help to improve the multiple flux algorithm. One simple way to do this could be to reproduce the downstream spreading of gravels of a particular color sourced from a localised rocks (dyke, hydrothermally altered rock, etc...) for different pixel sizes. Such cases exist for example in the Andes. Note that the variance decreases always with dx. Figures 3,4,5 B may be ambiguous because the sqrt(t) trend fitted to the reference model is not the predicted variance. It indicates that the scaling is respected, although the expansion factor is overestimated. This is briefly mentioned in the captions but we will state this more clearly in the main text.

Concerning the clue that the model predicts the classical topographic statistic in Figure 6, we provide here several Figures which may be added as an Electronic Supplement. In the experiment of Figure 6 we isolate the mountain block and imposed an uplift during 20 Myrs until reaching a dynamic equilibrium. FigureES1-A shows that the Slope Area relationship (S-A) is scattered. The scattering corresponds to pixels located in the wide main valleys. Restricting the logS-logA plot to the upper catchments (FigureES1-B) shows a linear fit for areas dominated by diffusion below areas of 10 pixels. For larger areas, the influence of fluvial processes is larger. The logS-logA plot is also linear in this fluvial domain. Without lateral erosion, FigureES2 shows an almost perfect linear fit in the whole fluvial domain. The observed steepness index ks=0.4-0.42 and concavity theta=0.49-0.5 agree with predictions. Indeed, the dynamic equilibrium could be stated as (Davy and Lague JGR, 2009):

U = D – E.

For fluvial processes (Equations 2 and 7 of the manuscript) this equality leads after development to

S = U/K (1/dxˆ0.5) (1+1/L) Nˆ(-m)

where N is the drainage area in number of pixels as displayed in FigureES2. With the model parameters of Figure 6 (excluding lateral erosion), ks = U/K (1/dxˆ0.5) (1+1/L) = 0.416 and theta = m = 0.5. In addition, FigureES2 indicates that the method used to calculate the drainage area (steepest descent or multiple flow algorithm) strongly impacts the scattering of the diffusion-dominated S-A scaling.

FigureES3 shows the scaling between valley width and total discharge calculated for several transverse profiles indicated in the inset topography. For each profile, the width of several valleys crossed by the line and their total discharge were determined. The model is too coarse to reach a good statistic with a large range of width values. Many total discharges correspond to the same valley width because the width tends to increase by synchronous steps for both sides of the valley. Nevertheless, even this coarse model may be consistent with observed hydraulic geometries worldwide. Those results are preliminary and we leave this for future works on the influence of the chosen lateral erosion law on predicted topography.

In Figure 6, clasts stop moving because they are buried under sediment.

Particular comments:

pg.3 ln 26. Thanks, we will add this in the revised manuscript.

Pg9 ln 19. Thanks.

pg10 equation 9. You are right, we should have explained this. The bank can erode if the flow width is fixed at dx or evolving as Qˆ0.5. FigureES3 suggests that the lateral



erosion law is able to reproduce the Qˆ0.5 scaling but requires more in-depth analyses. As stated in the manuscript, and although this is a very interesting question with many implications, the particular prediction of the chosen lateral erosion law is beyond the scope of this paper.

Pg eq 10. Thanks.

pg12 ln 8. Thanks.

Figure 2A & B. OK We will try to enhance the black dots.

Figure 5A. Thanks.

Figure 5B. Thanks.

Figure 6. Thanks, we will mention this.

Pg 18 ln 18. Thanks, we will add these references.

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Interactive comment on Earth Surf. Dynam. Discuss., 3, 1221, 2015.

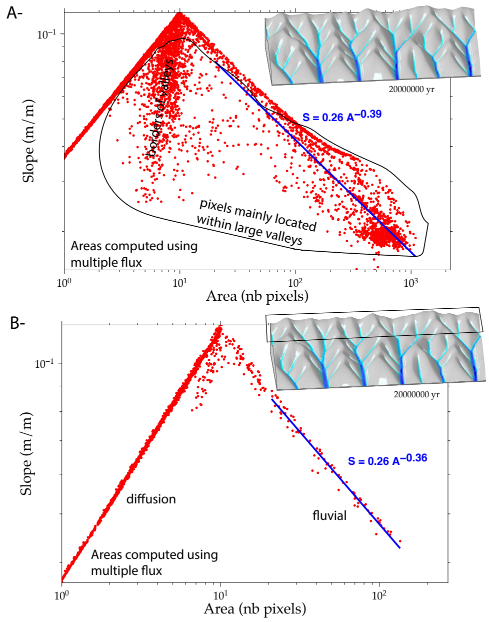


**Fig. 1.** FigureES1



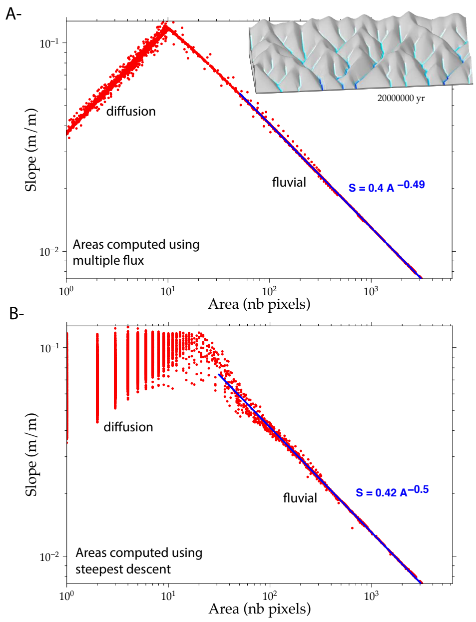


**Fig. 2.** FigureES2

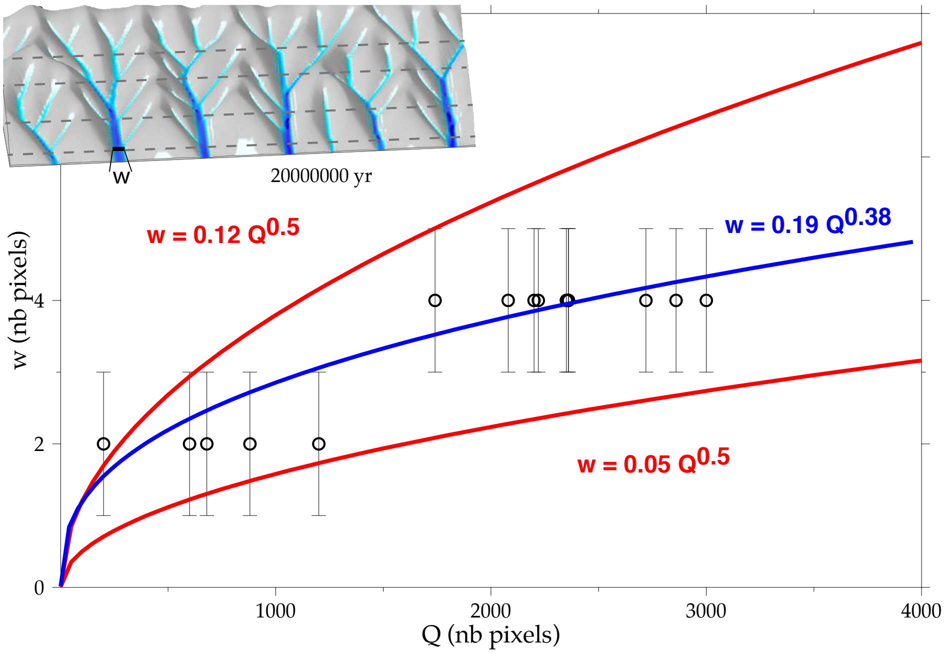


**Fig. 3.** FigureES3