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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 #1for his constructive review, pointing out several unclear points and offering us the possibility to be more accurate.

1- and 2- The initial set up of the 3D landscape model consists of the definition of an initial elevation grid, the choice of values for the erosion parameters (Equations 5 to 10), and the definition of several additional grids (the uplift-subsidence rates, a grid for the precipitation rates, and the boundary conditions).

Erosion parameters may depend on geology. The geological model includes the erodability of different materials at different locations and different depths. Values of the "erodability" parameters (Equations 5, 6 and 7) are attributed to these various materials. Sediment erodability (either resulting from deposition of physically detached material or in situ regolith production by bedrock weathering) can be set differently from that of bedrock. Nevertheless, in the experiments presented in this manuscript, there is only one bedrock type. This will be clarified in the revised version.

3- The initial number, size, location and depth of the clasts are set by the user. A list of initial clasts is used as input. There is no limitation except the one imposed by computational times. For instance, 1000 clasts can be spread randomly over the grid with depths varying between 0 and 100 m, and sizes between 1 mm and 5 cm. In the run described in Figures 3, 4 and 5, 1000 identical clasts are initially set at the surface of one cell. In the more general example of Figure 6, clasts are initially grouped in two populations at two different cells and depth ranges.

4- In the experiments presented in this manuscript, the clast size has been chosen so that the mean transport rates are within the range of 1 to 5 km / 50 kyr. Smaller clasts would go faster, larger clasts would go slower. The important point here is that their mean transport rates are consistent with the transport fluxes calculated from the deterministic rules of Cidre, which is illustrated by Figures 3B and 5B.

The erosion-deposition-transfer fluxes calculated from the deterministic rules of Cidre can be viewed as mean values for a distribution of clast sizes. The probability of clast movement uses these fluxes in a simple way as illustrated by Figure 1B, but it also takes into account the clast size and the time step (Equation 11). Consequently, a 20 cm boulder may travel slowly across a cell because it has a low movement probability (cf Equation 11 where the probability to leave the cell is proportional to 1/2R with R clast radius) while the sedimentary layer of 5 cm above the bedrock is removed during a time step. This case can occur because the transport flux calculated by Cidre represents a time-average over an implicit distribution of grain size (this is a volume of transported sediment without specifying its size), whereas the clasts are individuals which move stochastically. This distinction is consistent with the field observations. For example, we can imagine a case where boulders go down an eroding bare bedrock hillslope. A mean long-term denudation rate of the hillslope can be determined, consistent with the diffusion model for example, while the boulders go down stochastically.

We describe here the procedure used to determine if a clast is detached and then leave a given cell during a time step. If the removed layer E.dt incorporates the base of the clast, it is detached and can potentially leave the cell. Then a “leave cell” number (between 0 and 1) is calculated using Equation 11. It is compared to a random value between 0 and 1. If the “leave cell” number is larger or equal than this random value, the clast leaves the cell. If not, it stays at the cell surface. This procedure makes the mean clast transport rate independent on the time step and cell size, as illustrated by Figures 3B, 4B, 5B.

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