SUPPLEMENTARY METHODS

The experiments were conduct at the Géosciences Environnement Toulouse (GET) laboratory using a setup specifically designed for studying landscapes and erosion dynamics at the drainage basin scale (Fig. S1). The facility is a box with horizontal dimensions of 100 x 55 cm and 50 cm deep. At its front side, a 41 cm wide sliding gate drops down at constant rate, acting as the base-level for erosion. The box is filled with silica grains (D_{50} ~20 µm) that are mixed with water and homogenized to saturate the silica paste porosity, reducing infiltration and allowing surface runoff. During an experimental run the sliding gate drops down at a constant rate and artificial rainfall is applied using 4 industrial sprinklers that generated small water droplets (Ø < 50 µm) to avoid splash effect at the surface of the model. Precipitation was preliminary calibrated by collecting droplets in 50 pans regularly disposed at the model location. The mean spatial precipitation rate of each experiment is of 95 $mm.h^{-1}$ with a spatial coefficient of variation (Standard deviation/mean) of 35%. Base level fall and precipitation rates are computer-controlled and remain constant during an experiment. During a run, the experiment is stopped every 5 minutes in order to digitize its topography using a laser-sheet device and to produce DEMs with a spatial resolution of 1 mm from point cloud data.

We report here results from 3 experiments, MBV06, MBV07 and MBV09, performed with different rate of base-level fall, of respectively 15, 10 and 5 $mm.h^{-1}$ and their duration time exceed 1000 minutes of erosion (Tab. 1).

Fig S1 Overviews of the experimental setup.

Hydraulic parameters from Floodos hydrologic model (Davy et al., 2017)

Hydraulic information such as water depth or shear stress is derived from DEMs using the Floodos Hydrodynamic model (see Davy et al., 2017 for a full description of the model). Floodos is a precipiton-based model that calculates the 2D shallow water equations (SWE) without inertia terms from the routing of elementary water volumes on top of topography. The output of floodos are maps of water depth, velocity and shear stresses. We ran Floodos on successive

DEMs of experiments by considering spatial distribution of precipitation, then generating several output raster products at the pixel size, including water depth, unit discharge and bed shear stress that were then used for computation of hydrologic parameters studied here (river width, specific discharge and shear stress; see also Baynes et al. (2018; 2020) for previous use of Floodos for extracting hydraulic parameters from DEMs of experiments).
The solution of the SWE depends on the friction coefficient (C) that depends on water viscosity only for laminar flow; its theoretical value is ~2.5×10^6 $m^{-1}.s^{-1}$ at 10°C (Baynes et al., 2018). To ensure that Floodos outputs (e.g. water depth raster maps) calculated using this value are consistent with actual experiment hydraulic conditions, we injected dye in the rainfall water during a run to catch the actual extent of water flow and make rivers visible. A visual comparison with Floodos results shows a good match between model outputs and experimental results, which validates the numerical method and the expected theoretical friction coefficient C (2.5×10^6 $m^{-1}.s^{-1}$; see Fig. S2).

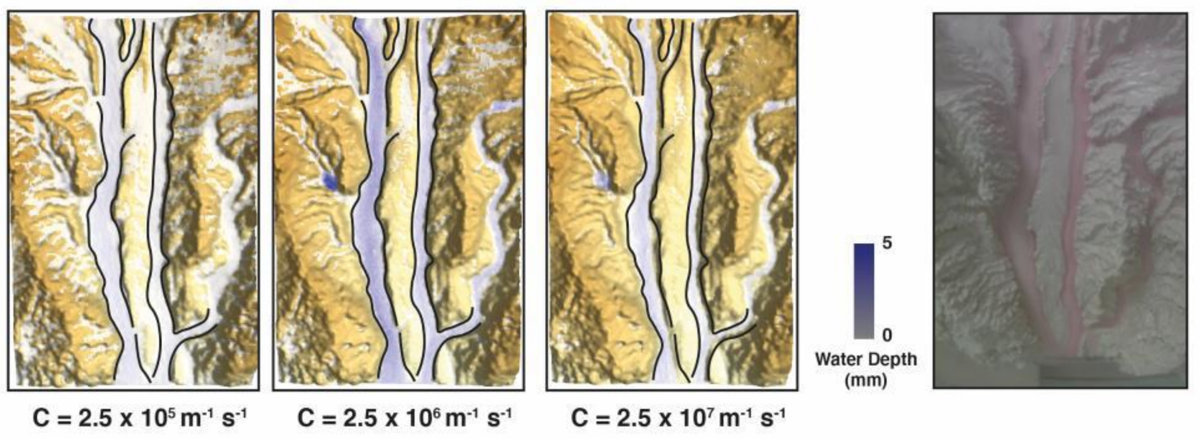

Figure S2. Floodos hydrodynamic model water depth output for three different friction coefficients C applied on the same DEM of an experiment. Black lines indicate the actual channel boundaries observed during the corresponding experimental run by injected red dye in the water used to produce the artificial rainfall (right). Channels visible on water depth maps tend to have a good match with actual observed channels when using the theoretical value of the fiction coefficient (2.5×10^6 m^{-1} s^{-1}).

SUPPLEMENTAL REFERENCES

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