The one-dimensional Hairsine-Rose erosion model describes time-varying suspended sediment concentrations of multiple particle sizes. The H-R model, in contrast to other process-based erosion models, considers erosion and deposition processes separately by taking account of the contributions of the individual size classes to the total sediment concentration. The H-R model has been evaluated under different experimental conditions, and has been shown to explain reliably experimental data in a consistent manner [4-5]. However, the H-R model has not been validated under conditions of significant raindrop splash even though for interrill erosion it is known that raindrop splash is an important mechanism of sediment detachment and therefore of sediment delivery [6]. The aim of this study is to test experimentally and numerically the consistency of the H-R model parameters in the presence of raindrop splash. The effect of splash is differentiated by carrying out experiments that are the same in all aspects except that different transversal widths are used within the 2 m • 6 m EPFL erosion flume.

According to manual observations taken during and after the experiment, as well as the finely resolved DTM data shown have that:

- The sediment transport process alternates between 1D and 2D. In flume 1 (1 m width), it is clear that the 2D behavior was dominant during the erosion event. In the flume 2 (0.5 m width) the sediment transport behavior was more 2D than 1D but less significant than in flume 1. In flumes 3 and 4 (0.25 m width) the soil erosion effect was homogenous and concentrated in the mid-line of the flumes.
- The post-experiment highlighted the presence of the 4 transversal-parallel lines of deposition at distances 0.5, 2, 3.5, and 5 m from the top of the flume due to the overlap of the sprinklers.
- In the smaller flumes the sediment was stuck to the barriers (10 cm) due to the deposition of material to a distance of about 0.3 m from the drainage surface. The lines of depression at distances 0.5, 2, 3.5, and 5 m from the top of the flume were generated using a 2D H-R model coupled with the shallow water equations, which have developed by [4], is:

\[
\begin{align*}
\frac{\partial \eta}{\partial t} + \frac{\partial (\eta h \alpha_{i} \gamma_{i})}{\partial x} = & \frac{\partial}{\partial x} \left( \frac{h^2 \alpha_{i} \gamma_{i}}{s \alpha_{i} \gamma_{i}} \right) + \frac{\partial}{\partial x} \left( \frac{h \alpha_{i} \gamma_{i}}{s \alpha_{i} \gamma_{i}} \right) \\
- \left( \frac{h}{s} \right) \frac{\partial h}{\partial x} = & - \frac{\partial}{\partial x} \left( \frac{h \alpha_{i} \gamma_{i}}{s \alpha_{i} \gamma_{i}} \right) \frac{\partial h}{\partial x} \\
\end{align*}
\]

As a function of time the protective layer of Deposited sediment develops according to

\[
\eta = \left[ \frac{h \alpha_{i} \gamma_{i} \partial h}{s \alpha_{i} \gamma_{i}} \right] \frac{\partial h}{\partial x}
\]

The effective settling velocity for each size class, which takes into consideration the effect of the raindrop splash on the deposition force of the particles, is:

\[
V_{\text{settl.}} = \frac{1}{\gamma_{i}} \left( \frac{1}{\alpha_{i} \gamma_{i}} \right) \left( \frac{\partial h}{\partial x} \right) \eta
\]

where:

- \eta: the proportion of raindrops that generate the splash process (1/10)
- D_{s}: the average splash length ranging from 4 to 23 cm, here taken as 10 cm;
- \gamma_{i}: the settling velocity of each size class (m/s);
- \eta: the overland flow per unit width (m/s).

The effective settling velocity is given by

\[
\eta = \left( \frac{1}{\alpha_{i} \gamma_{i}} \right) \left( \frac{\partial h}{\partial x} \right) \frac{1}{\gamma_{i}} \left( \frac{1}{\alpha_{i} \gamma_{i}} \right) \left( \frac{\partial h}{\partial x} \right)
\]

The boundary condition for each flume. A comparison between the experimental results and the numerical ones showed that:

- The estimated parameters are consistent between the flumes 1 and 2. However, for flume 3, \( \eta_{3} \) and \( \eta_{4} \) are different to the values obtained in flumes 1 and 2. On the other hand, the parameters of flume 4 are completely different to the other flumes. This could be explained by the drainage collector’s location for this flume.

The one-dimensional Hairsine-Rose Erosion Model: Parameter Consistency in the Presence of Rainfall Splash

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4. Model

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