S1 Introduction

The method used for the normalization of the seismic power and its result are presented in $Sect.S2$. The reference experiment carried out without the storage area is discussed in $Sect.S3$. Finally, in $Sect.S4$ we show the experiment with which we test the spatial variability of seismic noise along the flume.

S2 Normalization of the seismic power

In addition to sediment transport, several sources contribute to the seismic signal detected in the channel, such as the water pump, water flow and storage area's processes. In order to focus on the sediment transport-induced seismic noise and also remove flume resonance effects, we normalize the seismic power by subtracting (in the dB space) the mean seismic power corresponding to a $200\ s$ long time window selected at the beginning of the experiment from the raw signal. Fig. S1 shows the comparison between the raw and normalized seismic power. We can observe how the mentioned sources produce low frequency seismic noise and that flume resonance, materialized by horizontal bands in Fig. S1a, is not as much visible in Fig. S1b.

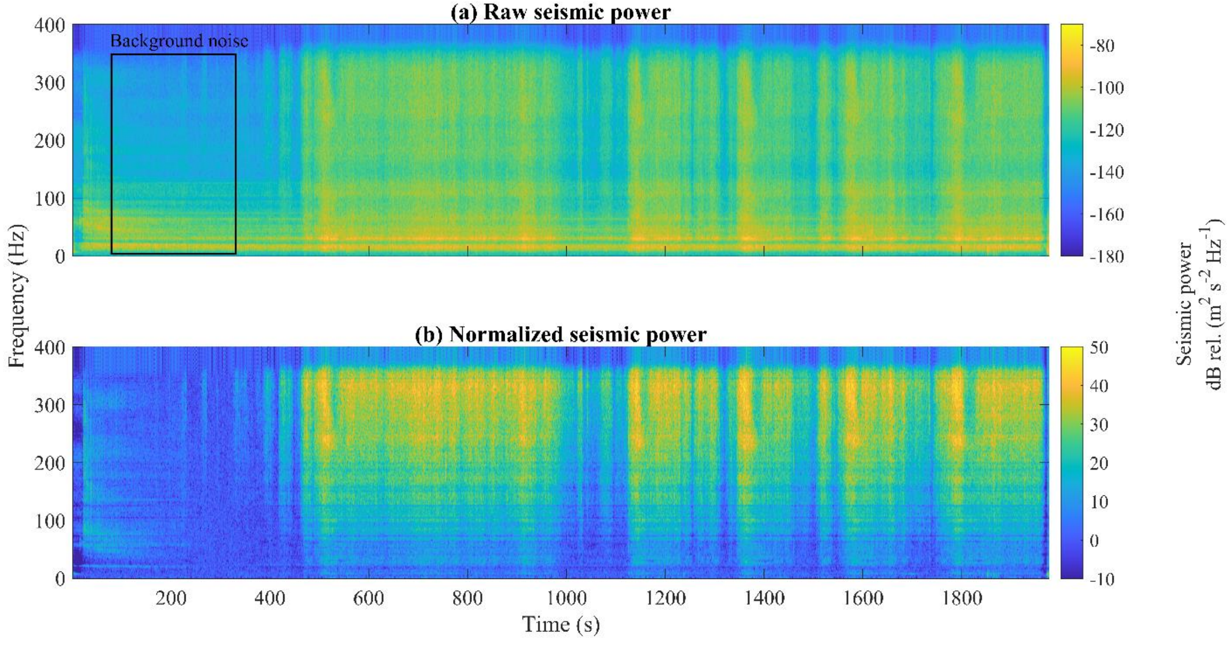


Figure S1: Comparison between the raw spectrogram (panel (a)) and the normalized one (panel (b)). The seismic power is shown as a function of time and frequency, where different colours refer to different level of power.

S3 Supplementary experiment without the storage area

In order to test in-channel sediment storage potential and discriminate the processes controlled by upstream sediment accumulation zone, we carry out a supplementary experiment that consists in feeding the $18\ \%$ steep channel directly. We investigate the channel response in terms of flow stage, seismic noise and outlet solid discharge (respectively, panels a, b and c in Fig. S2). We observe minor fluctuations in the flow stage and its instantaneous variation is likely due to the detection of moving particles (Fig. S2a). Indeed, by means of the camera installed above the upper part of the channel (see video 5 in Supplement) we observe that the material is transported downstream with no bed aggradation. However, the coarsest fraction of the sediment mixture occasionally gets stuck close to the rough sidewalls. These particles act as local obstructions dissipating the energy otherwise available for sediment transport, leading to the formation of small lateral clusters. Nevertheless, these bedforms are transient since sudden impacts of grains can destroy their structure. Therefore, their influence is marginal and does not affect the flow. This is confirmed by the outlet solid discharge shown in Fig. S2c: during the run, the transport rate exhibits only small fluctuations since more than $80\ \%$ of the samples have a variation lower than $\pm 20\ \%$ around a mean value equal to the inlet solid discharge ($Qs = 80\ g\ s^{-1}$). We expect that the few peaks around $100\ g\ s^{-1}$ are the result of the destabilisation of the ephemeral bedforms that develop along the channel. Observations remain identical even at higher sampling frequency (see the fourth and seventh groups of bars in panel c). The samples are characterized by a similar grain size distribution, with minor variations that likely depend on the input solid discharge being characterized by a varying grain size distribution. However, coarser grain size distribution could result from clusters' destabilizations.

No significant changes over time are highlighted in the seismic power measurements (Fig. S2b), confirming that the sediment flux remains almost constant during the experiment. Moreover, the impact of sediment clusters' mobilization is supposed to be very low compared to the magnitude of the continuous bedload transport experienced by the channel.

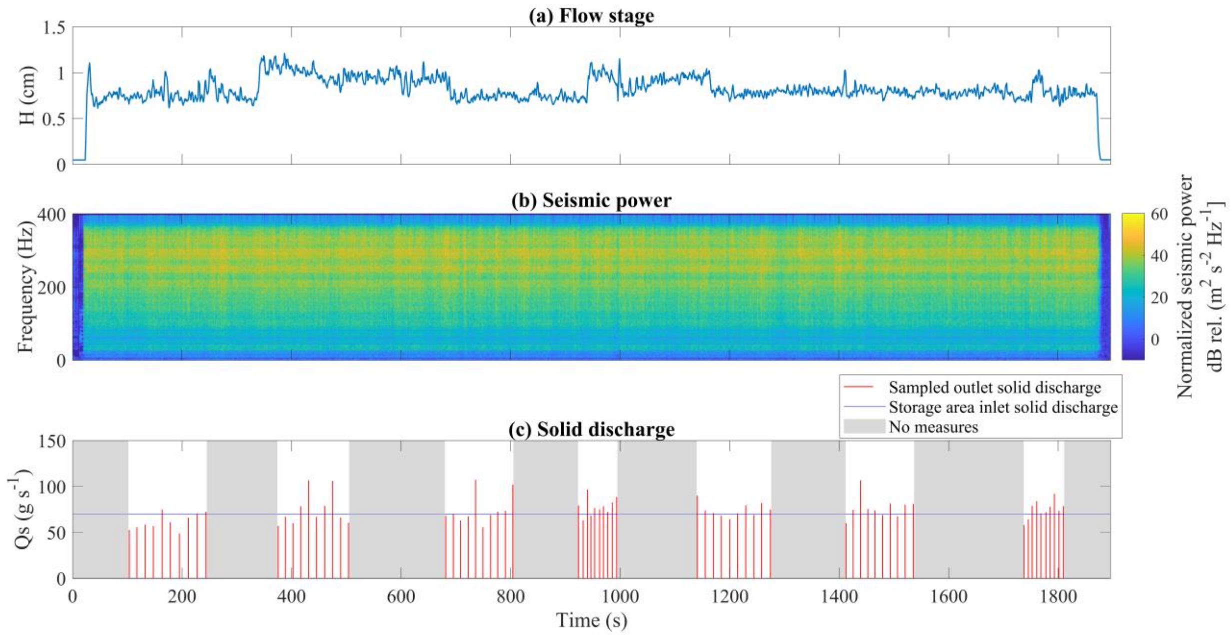
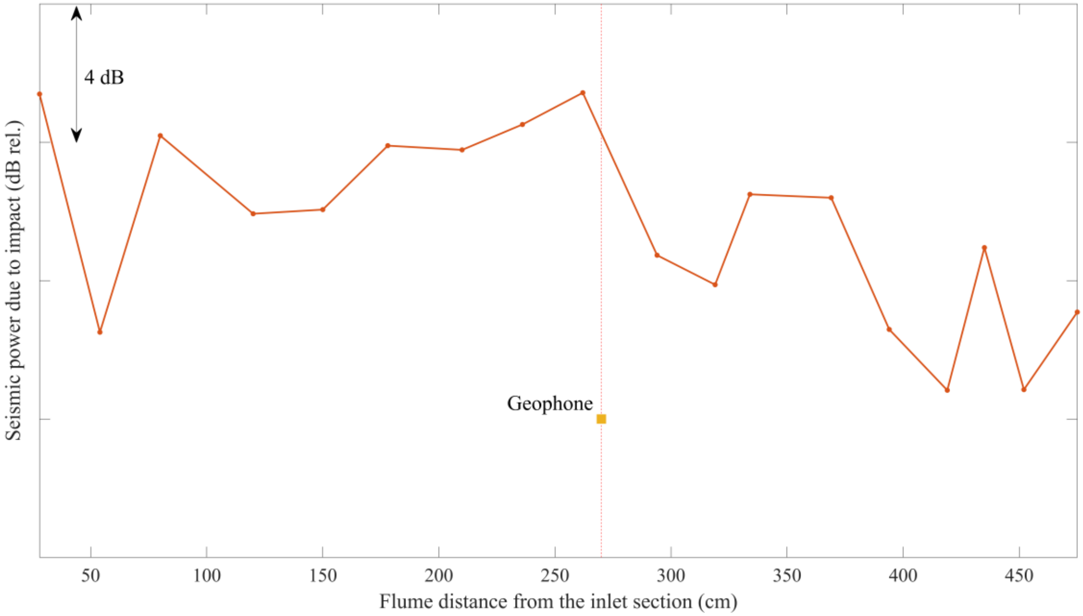


Figure S2: Comparison between measures. Panel (a) shows the flow stage detected by the ultrasonic sensor placed in the middle section of the flume; panel (b) shows the seismic power detected in the middle section of the flume. The seismic power is shown in decibel and computed as a function of time and frequency, where different colours refer to different level of power; panel (c) compares the inlet solid discharge (blue line) with the sampled outlet solid discharge (red bars).

S4 Testing the spatial variability of the seismic noise

We carry out a specific test in order to investigate the potential spatial changes in the seismic response of the flume to a given force solicitation. We record the seismic noise generated by identical impacts of a pebble of known mass $(m = 66\ g)$ dropped from a known height $(z = 10\ cm)$ in 18 different points along the channel. We observe that in the $200 - 350\ Hz$ frequency range of interest for sediment transport the seismic power varies within $10\ dB$, with the highest amplification effects being placed right near and upstream of the geophone used in our analysis (Fig. S3). We can therefore consider the seismic noise recorded in the middle section as induced by in-channel processes occurring all over the flume with preferential sensitivity to a $1\ m$ long segment centered on the geophone's location.



55 **Figure S3: Measured variations of seismic power along the flume. Each point results from the mean of the seismic power (in the 200-350 Hz frequency range) due to three identical impact in prescribed locations. The yellow square represents the position of the geophone used in the analysis.**