We thank Mikaël Attal for his review and comments. We give detailed replies and outline the changes made to the manuscript.

My main criticism relates to the fact that part of the analysis could be developed further, in particular the discussion about channel dynamics which may be too speculative in places (both amplitude and "length" of sediment pulses are likely to change during transport; and I suspect that different debris flow processes may produce different spectral signatures – it is not just about discriminating between fluvial flow and debris flow).

We agree that debris-flow characteristics influence the sediment transport, like the organisation of particles in the flow, their saltation length, or the impact frequency, velocity and energy. This will directly influence the seismic energy that is delivered to the channel bed and recorded at nearby stations, but also the frequency content, which is related to the bedload characteristics (e.g., Huang et al., 2007). These features are discussed in our interpretations of the variations in the seismic signals between flow pulses. In contrast to flows 1 and 2 that had similar flow depths, flow pulse 3 had half the height of the previous flows. In addition, flows 2 and 3 were characterized by significant transport of coarse particles (impact rate data shown in Fig. 9), whereas little coarse transport was detected during flow 1. For pulse 2 to 3, the main difference was in the flow depth, which may have affected the flow dynamics. From the seismic data, we observed a different spectral pattern with a larger proportion of low frequency content for the third flow pulse. For pulse 1 to 2, the main difference was in the sediment transport and we observed a lack of low frequency content for the first flow. Therefore, the spectral pattern of the recorded seismic signals fluctuates with variations in sediment transport and flow dynamics, as they are also both linked. These points were already covered in the original submission, but we have amplified them in the revised manuscript. We think that further interpretation or discussion is difficult without more independent constrains (fluid density, flow structure...) that are not available for the event. It is important to note that flow density data are commonly recorded at CD29, but that the relevant data were compromised for the flow events in question. From a perspective point of view, our observations may be useful to link the spectral pattern to the erosive power of a debris-flow, because this is what connects the flow dynamics and the sediment transport (power and tools). In summary, we believe that we have advanced this analysis as far as the data permit, and that further independent constraints on flow properties may be profitably combined with seismic observations.

In response to the referee's request for attention to the duration of pulses, we have estimated the duration, separation and intensity of individual flow events along the trunk channel of the Illgraben. The results of this analysis add little to the estimates of flow energy and velocity summarized in Figure S3 (new supplementary material, see also Figure R1 of this document) and in the text (3rd paragraph of Section 5.3 "Comparison with *in situ* monitoring").

Also, how representative a mountain catchment is the studied catchment? A 10 kmˆ2 catchment supplying 5-15 % of the sediment load of a major river system (Rhone) seems like an anomaly rather than the norm to me. So, how indicative of typical mountain catchment processes are the processes documented here?

We have selected the Illgraben for our study because of its size, simplicity, accessibility, rate of geomorphic activity and availability of independent streamside and in-channel observations. Indeed, the Illgraben catchment can be considered a "special" location, in the sense that it yields sediments at a rate much higher than the surrounding mountain terrain. However, the erosion processes in the Illgraben, rockfall, avalanching, debris flow and bedload transport, are universal, as is the geometry of the catchment, with a trunk stream flanked by steep bedrock slopes and a fan with a single channel below a steep source area.

These attributes permit extrapolation of our findings to other mountain settings, where the rate of erosion may be different, but the mode of erosion essentially the same. However, we do acknowledge that the link between geomorphic process domains may be more efficient and direct in the Illgraben than in many other mountain catchments where colluvial and alluvial buffer zones may delay sediment transfer. We have amended the manuscript to address this point (2nd paragraph of Section 2.1 "Study area").
Further, the use of a seismic monitoring approach is not restricted to extreme geomorphic activity. It is our aim to develop this seismic tool for use in "normal" catchments, irrespective of the rate of geomorphic activity. The deployment of seismic sensors in the Illgraben was motivated by the high frequency of geomorphic events. Since we were working with seismometers borrowed from national equipment pools for a limited time period (~ 4 months), we had to maximize the acquisition of relevant seismic data for our purpose. An equivalent experiment could have been made in another location but similar observations might have required 2 to 3 years of monitoring, whereas we had a single summer was necessary in this catchment.

- 4. 20-24: this seems doable for small basins. Do you think it could be applied to larger ones (i.e., > 100 km^2)?
The seismic monitoring of geomorphic processes using a 2-D geometry array was tested in a Taiwanese catchment (Burtin et al., 2013), where 14 seismic stations were deployed in an intermediate size watershed of 370 km² to map the geomorphic activity. For a given number of instruments, there is a trade-off between areal coverage and spatial resolution as well as the minimum size of detectable events.

- 10. this paragraph could be better organised. It starts with saying that the whole analysis is made using a given approach, then shortly after it says that two approaches have been developed and compared. You should probably start saying that the two approaches have been tested and compared, that one gives much better results than the other (waveform rather than envelope) and that for this reason the waveform analysis approach has been used in the following.
We re-organised the paragraph in the revised manuscript as suggested by M. Attal.

- 11. Section 4 is very long, maybe it could be fragmented / synthesised?
Section 4: We have fragmented this section in two points, (1) Seismic signals and sources in the Illgraben, and (2) Seismic anatomy of a debris flow sequence.

- 13. 1: what happens between rock fall and sediment pulse? Is it just that rock falls are more energetic than sediment in channel flow, so the rock falls can be detected at some distance whereas sediment in channel is detected only when it passes in the vicinity of a station?
For rockfalls to be detected and located, we required that they registered at a minimum of five stations. Thus, only larger rockfalls were considered in this study. In contrast, channel flow events registered primarily at streamside stations and we have used records from individual stations to characterize and track these events. At a station, the flow signal waxes and then wanes as the flow approaches and the moves away from a station. If a channel sediment transport event is preceded by a rockfall, then there is an interval after the rockfall, during which the flow constitutes and then approaches the first station downstream of the location where the rockfall reached the channel.

- 13. 24: has Rock 0 been detected at IGB01? It should have been, it is closer than Rock 1. If yes, please highlight it as you did with the other Rock events on IGB01's spectrogram.

Rock 0 was detected at IGB01 and all other stations in the network. This event is not visible on Figure 4 because it occurred before the beginning of the displayed window. Rock 0 can be observed in Figure 3 at an approximate time of 18 min after the beginning of the time window (14.45 UT).

- 13. 26-27: what about the spike at 4 minutes at IGB01 and 07? How close to a rockfall do you have to be to detect it?
The event observed at ~ 4 min in Figure 3 at IGB07 and IGB01 is not detected at enough stations to provide a location. The signal to noise ratio is too low for cross-correlating the seismic signal. The event detection distance is linked to its size, where smaller events have a smaller detection distance than larger events.

- Sections 5.1-5.2: would it possible to get more information about changes in the "shape" of the pulse from the signal recorded? I imagine pulses can stretch, form smaller pulses within a pulse and/or amalgamate (see for example recent work by Kean et al., DOI: 10.1002/jgrf.20148). So it is not just about amplitude, it is also about the duration of the pulse. If a pulse is stretched, it can decrease its maximum amplitude while not losing any energy (so in a way integrating the signal over the duration of the pulse may be more informative than looking at the peak amplitude). This could affect the interpretation page 16 (last paragraph).
The shape of a debris-flow can be seismically tracked from a station to another. We determined the total duration for this debris-flow sequence from the time the seismic signal exceeds the background level to the time it returns to this prior value (Fig. S3). The total duration is quite constant, increasing slightly inside the catchment (from 48 min at IGB01 to 57 min at IGB02) and stabilizing on the debris fan (54 min at IGB09). For the duration of seismic pulses, one key issue is to define the onset and the end of a pulse when they can overlap (e.g., 2 first pulses at IGB01) or because of their complexity (pulse 1 and 3 at IGB02). When picked manually (Fig. R1), the durations of the studied pulses were relatively similar with standard deviations of 5, 16 and 14% of the pulse duration for pulses 1, 2 and 3, respectively. For this debris-flow sequence, the impact of stretching was limited, but we shall consider these aspects in future characterizations. Details are added to the text (3rd paragraph of Section 5.3 "Comparison with *in situ* monitoring").

- 15. 12: this is intuitive but you may want to develop further. Do you have any information / data about roughness and slope?
There is no detailed survey of channel bed roughness along the Illgraben stream, except for a few reaches on the debris fan. Therefore we cannot make quantitative statements. Field inspections indicate that the channel inside the catchment contains many large sediment particles (up to metric size), presumably where rock avalanches occurred. In the debris fan, the channel is smoother.

- 17. 5: Can you get information about the pulse velocity between check dam 29 and IGB09?
Station IGB09 is roughly halfway in between Check Dam 28 and Check Dam 29, but there is no independent velocity estimate for that reach.

- 18. 16-20: maybe they are different types of debris flows? You probably don't want to turn this part into an in-depth discussion about "can we discriminate between different types of debris flows" but you need to acknowledge the potential complexities associated with these types of processes (some debris flows have the coarser material "rafted" on top and on the side of the flow). Do you have videos of the pulses passing through the check dams?
There is no camera that tracks the flow propagation at the check dams. We have amended the

manuscript to address the potential complexities of debris flows (last paragraph of Section 5.3 “Comparison with *in situ* monitoring”).

- 19. Conclusions are long and read more like an extended summary. Focus on the outcomes of the study and go to the point.

- 20. 10: this is a pretty small basin. Do you think the technique can be applied over much larger areas?

See Burtin et al., 2013.

Figures

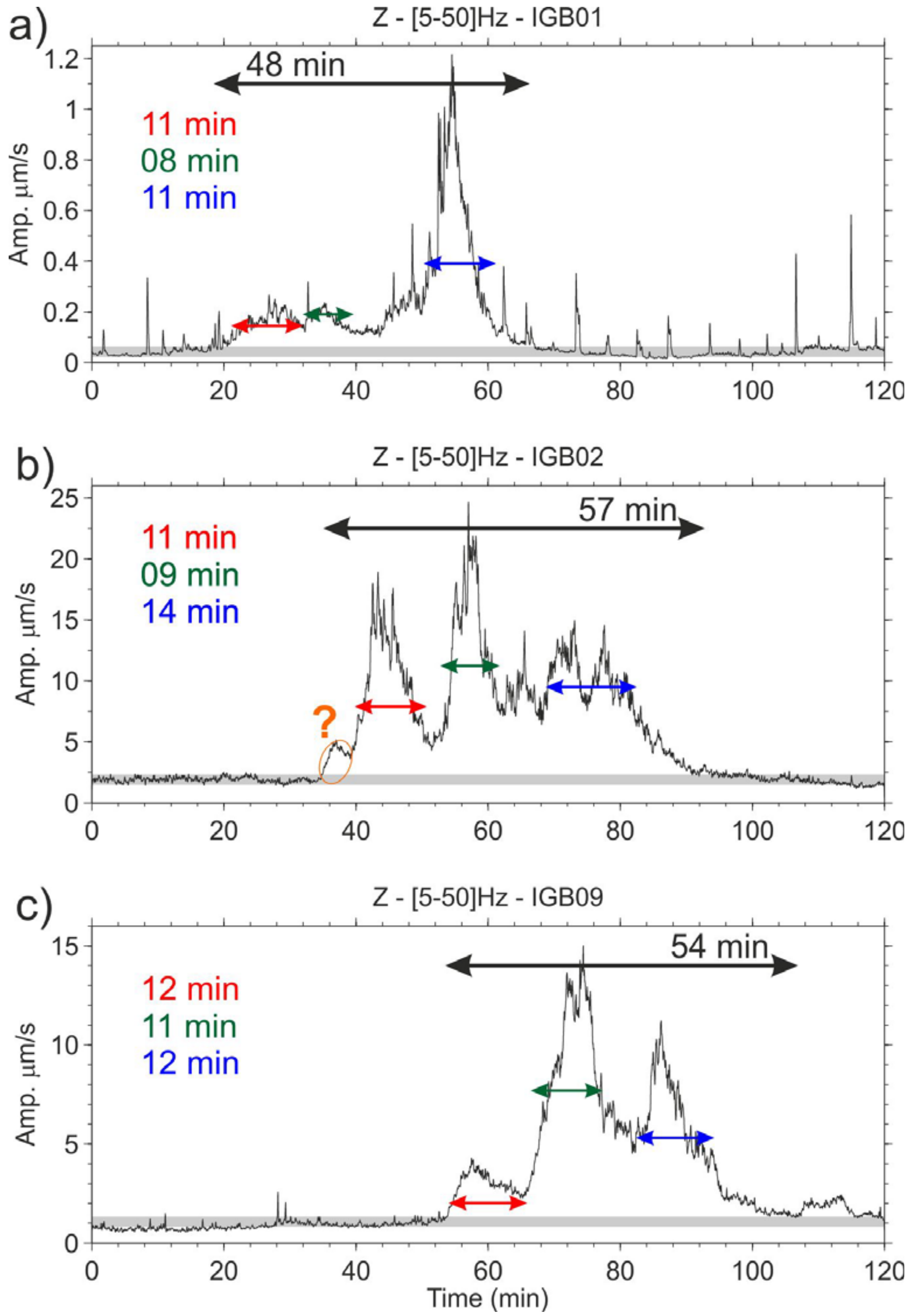

Figure R1: Vertical seismic envelops for [5-50] Hz frequency band at IGB01 (a), IGB02 (b), and IGB09 (c). The total duration of the debris-flow sequence is highlighted with a black arrow. The pulses duration are represented with a red (flow 1), green (flow 2) and blue (flow 3) arrow. The grey line represents the background seismic noise level used to determine the duration of the total flow sequence.