

Interactive comment on “Seismic constraints on dynamic links between geomorphic processes and routing of sediment in a steep mountain catchment” by A. Burtin et al.

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Dear Editor, dear Authors,

I was delighted to review this manuscript which presents novel work on the monitoring and characterisation of geomorphic processes. The work builds on techniques developed by the authors and published elsewhere but these techniques are used here for the first time to characterize geomorphic processes and sediment's fate during a single storm event from the source to the “sink” of a mountain catchment. In particular, the authors claim they have documented the generation of sediments on hillslopes and their subsequent transport as bedload along the river. The manuscript is well written

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and illustrated and the argument is generally convincing. A lot of detail is given about the techniques used, which means that the approach can be replicated by others, provided they have basic expertise in seismology and signal processing (I am personally not an expert). 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). Also, how representative a mountain catchment is the studied catchment? A 10 km² catchment supplying 5-15 % of the sediment load of a major river system (Rhône) seems like an anomaly rather than the norm to me. So, how indicative of typical mountain catchment processes are the processes documented here? I value the work presented in this manuscript but think it would be good to at least briefly discuss this point. I give below some more specific comments to the authors which I hope they will find useful. I think this work truly improves our understanding of mountain catchment processes and demonstrates the potential of seismic methods for documenting processes that would otherwise be extremely challenging to monitor. I am thus in favour of its publication.

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Comments to authors (numbers are page. line numbers):

- 3. 11: you may want to add Wobus et al., 2010 (impact of climate on landscape and river profile development)?
- 3. 17: I would add the work by Yanites et al. on the “progress of eroded material” in Taiwan.
- 4. 20-24: this seems doable for small basins. Do you think it could be applied to larger ones (i.e., > 100 km²)?

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- 5. 5: how “special” is this mountain catchment (see general comment)? I understand the need for a very geomorphically active catchment for this type of work but I think the specificity of the study area should be discussed.
- 6. 27: how regular? Yearly?
- 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.
- 10. 5: “small” rather than “limited”?
- 10. 7-8: hard to follow.
- 10. 11-14: this means the difference is 0.21 km, which is still pretty good.
- 11. Section 4 is very long, maybe it could be fragmented / synthesised?
- 11. 5: “consistent” or “associated” rather than “coherent”?
- 11. 27-28: highlight hillslope events on Fig. 3 or mention how to identify them in caption?
- 12. 12: “observation of debris flows”: when, where? Did you see them on videos? Did you record them at the monitoring stations? Are they fluvial or debris flow transport events? This reads like interpretation rather than fact at this point.
- 12. 27-28: problem with sentence structure.
- 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

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vicinity of a station? This is probably trivial but it may be worth mentioning it for the non-expert.

- 13. 8: “best-fit”.
- 13. 16-17: yes, I guess this is always going to be an issue. Do you at least have evidence for active/recent erosion in the area? It seems yes: you may want to mention it here so you don’t have to be so negative!
- 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.
- 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?
- 13. 28-29: I don’t understand the last sentence, do you really mean “neither”? In line 8-10 you explain how a pulse has triggered mass wasting during passage!
- 14. 11: change the beginning of the sentence into “This event may be a bank collapse that may have resulted. . .”
- 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).
- 15. 12: this is intuitive but you may want to develop further. Do you have any information / data about roughness and slope?

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- 15. 16: "evolved" rather than "developed"?
- 15. 17: refer to Fig. 8b at the end of sentence.
- 17. 5: should be "downstream". Can you get information about the pulse velocity between check dam 29 and IGB09?
- 18. 8: maybe true for fluvial transport but not necessarily for debris flows.
- 18. 15: "straightforward".
- 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?
- 19. Conclusions are long and read more like an extended summary. Focus on the outcomes of the study and go to the point.
- 19. 15: "without DETECTED significant precursor activity". No evidence does not mean there isn't precursor activity (I don't think you have demonstrated it).
- 19. 23-28: or different processes (in particular when there are debris flows involved).
- 19. 25-26: very speculative. I don't have problems with speculation as long as it is presented as such ("we interpret. .").
- 20. 10: this is a pretty small basin. Do you think the technique can be applied over much larger areas?
- Fig. 5 caption: "from top left to bottom right".
- Fig. 6: label Rock 0 on spectrogram of IGB01, like the other rock events? If it hasn't been detected, discuss why (Rock 0 is close to IGB01). Fig. b: "Rock 1" is not very

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visible.

- Fig. 7 caption: "likely".
- Fig. 9: highlight the pulses with numbers again as in Fig. 3? (c): "flow depth" on y-axis and "flow height" in caption.

Interactive comment on Earth Surf. Dynam. Discuss., 1, 783, 2013.

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