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Interactive comment on "Short Communication: Monitoring rock falls with the Raspberry Shakes" *by* Andrea Manconi et al.

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GENERAL COMMENTS

This paper presents preliminary results of a field study using low-cost seismic sensors applied on case of a major high-alpine landslide currently developing in the Swiss Alps (Moosfluh, Valais, CH). On a secondary aspect the paper also tries to evaluate the performance of such sensors and give hints for the future use of such sensors to better quantify rock fall phenomena. I think it would be better if the authors decide on focussing on one goal for this paper, not two.

Such "cheap" seismic sensors have recently become a major attraction, not only in research but also beyond, mainly due to their accessibility (low procurement price, one-

stop-shop, simple operation) but also in the light of deploying denser seismic networks as is typically achievable with "expensive" state-of-the-art seismic sensors. Therefore a detailed and comprehensive study comparing such sensors is highly desirable and would most likely be highly cited. However the present paper does not show any comparison (to other seismic sensors) and hence cannot be seen as a "performance evaluation" as hinted in the first sentence of the abstract. Apart from the discussion of references the paper does not show any "ground truth" or "baseline" w.r.t. seismic sensors. Also, important technical details (quality of the time synchronisation, coupling of the sensors to ground, shielding from environmental influences, quantification of environmental/antropogenic influence factors) are not discussed (in great detail). Rather the paper is a preliminary experience report supported by a short presentation and qualitative alysis of data captured using three raspberry shake sensors, mainly w.r.t. earthquakes and rock fall.

The paper suggests to provide "hints" for the use of such low-cost sensors but apart from the feasibility of using such sensors on a (remote) landslide site (which in itself is not really surprising and/or novel) few hints are actually presented. A webcam for validation is frequently used in many field study - it can almost be regarded as "necessary" for current field studies. What would be really interesting to hear is how and why sensors are selected (1D vs. 3D geophone sensors, sensor characteristics), how dense a seismic network should be (given that these sensors are cheap and you suggest we can/should have more of them on a given site). How dense is dense? And what density do we need for what purpose. Also where do we need permanent networks and where can we work in campaign mode using temporary installations? Also more detailed insight into the packaging necessary, mounting on the ground and shielding from external influences would be most insightful. In high alpine settings we typically cannot burry geophone sensors under a 1m soil column or place them in a highly shelterd environment. How do you go about filtering out unwanted signals and how much of the signals aqcuired is noise? I would rather read about such aspects specific to geophones here rather than a lengthy general discussion of other monitoring methods that could be used (top half of the second page).

Even if not feasible for you to co-locate another seismic instrument in order to compare data accross different sensor types or mounting/shielding scenarios it would be highly desirable that you discuss the difference of your system/performance vs. that of other geophone systems deployed in the aletsch moosfluh field site:

https://www.srf.ch/news/regional/bern-freiburg-wallis/die-moosfluh-kommt-nicht-zur-ruhe

https://www.tagesanzeiger.ch/panorama/vermischtes/im-wallis-droht-ein-gigantischer-bergsturz/story/26669694

Or the long-term infrastructure seismic sensors of the swiss seismological service (SED, e.g. station FIESA

http://seismo.ethz.ch/en/research-and-teaching/products-software/fdsn-web-services/

If your data is available publicly, or you have plans in providing the data set with your publication please mention and explain this.

SPECIFIC COMMENTS

Section 2 and the text in the supplementary material are identical (apart from 1-2 sentences). remove one or the other.

It is very interesting to read more details about the signal processing internals of the raspberry shake. Is this information due to personal communication or can you possibly give references for this (period extension, downsampling etc). the manuals of the raspberryshake product are rather thin here!

Supplementary material, last sentence: (Site the SEED manual). i gues you still want to include a reference here?

Figure S1 and S2 are taken (copied) from the raspberry shake product documentation:

https://manual.raspberryshake.org/specifications.html

Please cite correctly, but really what do these figures help in replication here? you can simply reference them and we look them up in the OSOP documentation.

Figure S3: You mention the period (july-october) in the text but not in the figure caption. Please also add comment/figure to the number of rockfalls observed in the other periods of your observation year. Also, is there any correlation observed to hydrological observations (rain, snowmelt)? Is the variation of rockfall events vs. hour of the day observed a real observation, or is it possibly influenced by characteristics of the instrument and changes in the environment (ie. temperature changes?)

Figure S4: It is a nice story that you detect the cengalo rockfall but without quantitative analysis it really only is a story and nothing we can really learn from here. Did you "find" this event like you described by analysis of the seismic waveform and subsequent checks with webcam images or did you specifically go and look at the time period of concern using expert/external knowledge?

Earthquake analysis results: You mention that you are able to match 47 out of 65 earthquakes in a 1Y period. Is that a good or a bad result? what is the state-of-the art? And what are the error sources? where do you see room for improvements?

Rockfall analysis results: Are you sure that your timing accuracy on the raspberry sensors over 3G radio links is good enough to perform comparisons/corellations from different sensors? I have my doubts about this knowing quite well how NTP performs over cellular links. Of course i acknowledge that in you preliminary study your analysis is mainly qualitative. But figure 4 talks about phase differences and if your network timping is only off by a few milliseconds this data will look very different!

Why do you choose a 1D rasperry shake and not the 3D or 4D (1-axis geophone, 3-axis accelerometers) models?

this may be a recent and interesting piece to look at:

https://www.earth-surf-dynam-discuss.net/esurf-2018-60

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