Earth Surf. Dynam. Discuss.,
doi:10.5194/esurf-2017-12-RC3, 2017

Earth Surface Dynamics Discussions

Interactive comment on "Validity, precision and limitations of seismic rockfall monitoring" *by* Michael Dietze et al.

Anonymous Referee #3

Received and published: 13 May 2017

General comments

This manuscript presents a new approach for detecting and locating rockfalls using seismic signals, applied to a case study in the Swiss Alps. I find the manuscript well written, well organized and the results interesting. Validity and precision of the method have been carefully discussed, while I found the discussion about possible limitations a bit dry. I suggest to improve this part, especially given the fact that several manual adjustments and optimizations are needed in post-processing. Below are some minor comments about the main text and the supplementary materials.

Specific comments on the main text.

Title: I find the title too vague. The title should reflect that the manuscript is about one possible method for seismic rockfall monitoring, applied to a specific case study.

P. 3, Lines 19-20: this would be true if seismic waves were travelling in a homogeneous medium. When looking at high frequencies, like in this study, seismic waves are mostly sensitive to the crust and therefore their travel time is strongly affected by crustal heterogeneities and shallow slow velocity layers. Seismic tomographies of the Alps have shown crustal heterogeneities as large as 20

Figure 1: a large-scale map, showing the Lauterbrunner Vally on a larger context, would be informative.

Figure 2 and 4: the power spectral density is usually normalized to the frequency bin width and therefore the unit is $(m/s)^2/Hz. Why this is not the case here?$

P. 6, Line 23: how the length of the STA and LTA windows affects your results? How these two values have been chosen?

P.6, Line 28: the authors set the minimum cut-off frequency of the filter to 10 Hz, but in Table 1 they also showed that, after adjusting by hand the frequency range for location, 5 rockfalls over 10 are detected at minimum frequencies lower than 10 Hz. Please discuss this point.

P.7, Lines 13-14: criterion (iv) is basically the geometrical spreading, which is also characteristic of seismic waves generated by earthquakes.

P.7, Line 19: "windows of 1.4 and 1.1 s" are referred to what?

P.8, Line 4: "700 to 4000 m/s" is referred to which seismic phase?

P.10, Lines 2-3: how do you choose the STA/LTA threshold?

Table 2: the default frequency range varies from rockfall to rockfall. How it has been chosen?

P.14, Line 4: The signal-to-noise ratio is strongly related to the amplitude of ambient seismic noise, which may vary in time and space. I think it's difficult to find a correlation with the duration of the event (and in fact, the correlation coefficient r is pretty small).

Please discuss this point.

P. 14, Line 9: is 2700 m/s the velocity of S waves? Please, specify the seismic phase associated with the velocity here and everywhere in the paper.

P. 16, Line 9 and P.17, Line 28: please, define the threshold value using 3 digits or use the exponential notation.

P.17, Lines 14-16: it seems that, although the algorithm should work automatically, a lot of small manual adjustments are needed in order to get a precise location of the rockfalls. I encourage the authors to discuss more in detail this point, and not just in three lines. Manual adjustments imply a certain level of subjectivity and, in order to ensure reproducibility of the results, this limitation should be discussed carefully.

P. 18-19, section 6.3: a recent paper (Gualtieri and Ekstrom, 2017) discussed a similar rockfall behavior. Please discuss your findings in relation with this reference. In particular, they describe the first stage of a rockfall as related to the elastic rebound of the Earth following the mass detachment rather than to the opening and propagating of fracturing. Figure 2 also shows a strong signal at 9:03:48, potentially related to a fourth stage.

P.20, Line 17: sensu strictu should be sensu stricto.

Specific comments on the supplementary materials.

I have tested the code and I have two main remarks:

1) the .pdf with the detailed explanation of the code is very useful, but it would be also good to have the actual code (a file .R) in the folder.

2) The code worked as promised, except for the installation of the package “eseis”. I had to download and install the package manually. I am working on a Mac OS v. 10.12.4 and I am using Rstudio v. 1.0.136.

Suggested references.

Diehl, T., Husen, S., Kissling, E., Deichmann, N. (2009). High-resolution 3-D P-wave model of the Alpine crust.ÂăGeophysical Journal International,Âă179(2), 1133-1147.

Gualtieri, L., and Ekström, G. (2017). Seismic Reconstruction of the 2012 Palisades Rockfall Using the Analytical Solution to Lamb’s Problem.ÂăBulletin of the Seismological Society of America,Âă107(1), 63-71.

Interactive comment on Earth Surf. Dynam. Discuss., doi:10.5194/esurf-2017-12, 2017.