RE: NHESS 2016 321 Walter et al. Rapid Detection location of debris flow at Illgraben, Switzerland

Overview

This paper presents an application of seismic signal analysis for detecting the debris flow initiation in not accessible sites. Therefore, it is well suited to NHESS. However, the submitted manuscript is not yet ready for publication. The writer in the two points below, shows two main deficiencies that have to be worked out.

1) As not all the readers are expert on seismic signal analysis, the writer recommends a better and wider explanation of the method for determining debris flow location through the analysis of seismic data.
2) An analysis of the influence of distance of seismometers from the initiation site on their efficiency in detecting the debris flow triggering is needed.

Specific comments

Title

The proposed methodology for debris flow detection has been verified in an unique case, so that about title I propose the following:

A case of Rapid Detection location of debris flow at Illgraben, Switzerland

Abstract

The sentence at line 25 is understandable only after reading the entire paper. Please provide more understandable explanations.

Introduction

Moreover, what could it happen in the case of occurrence of other debris flows in the neighbouring areas? The proposed methodology could be able to identify the exact location of debris flow?

The authors should also consider this eventuality in the introduction and conclusions: just write some sentences that clarify this aspect.

2 Illgraben debris flows

page 4: debris flow initiation

The writer believes that abundant runoff production mobilizes the sediments laying in the main channel triggering the debris flows (runoff generated debris flows). This is the main triggering mechanism and it is very common in Alps (Berti and Simoni, 2005; Gregoretti and Dalla Fontana, 2008; Theule et al., 2012) as elsewhere (Cannon et al., 2008; Coe et al., 2008; Hurlimann et al., 2014). Recent studies (Kean et al., 2012; Rengers et al., 2016; Gregoretti et al., 2016) have shown that the hydrological response of steep slopes is very fast and provides large peaks flows that are able to mobilize large quantities of sediments triggering debris flow phenomena. Main source of sediments are the steep lateral slopes. Sediments delivered to the main channel could also obstructing it, forming a dam (Costa and Shuster, 1988; Clague and Evans, 1994). In this last case, the failure/erosion of the formed dam due to runoff after thunderstorm cause a large solid-liquid wave. This is a particular case of the runoff generated debris flow and could also be seen in the video of the debris flow occurred at Acquabona the 12th of June 1997 (see web page of Matteo Berti, University of Bologna) where runoff impact a debris deposit, originated by banks failure that obstructs the channel.
I suggest the authors to adapt the description above in the explanation of debris flow occurrence at Illgraben.

3 Seismic data

I suggest to eliminate IGB8 and renumbering the following seismometers.

Panel A of Figure 5 shows that the amplitude of signal corresponding to the green bar is very large for IGB07 while this does not appear in panel C. What about the difference between normalized ground velocity and scaled ground velocity? Some explanations in the text is due.

4 Detection and Location Scheme

Points, 2, 3 and 4 at pages 6 and 7 look like statements rather than demands. They, together the explanations points to points below, could be presented at the beginning justifying the proposed approach.

The writer does not understand the computation of debris flow location through decay fitting. The analysis of the measured signal amplitude shows the exact moment of debris flow occurrence due to the high increase of the measured signal amplitude. About equation (1) A_i is a data and r is the unknown quantity. How A_O can be determined? Moreover, some more explanations on the matching between RMS distribution and eq. (1) predictions could help the reader.

Equation (3): What is it fit? The RMS? This should explained because most of readers are not expert on the analysis and use of seismic data.

5 Results: Seismic Noise....

Figures 6 and 7. The upper green triangle seems IGB10 rather than IGB9. Moreover, I suggest to label the black triangles corresponding to IGB01, IGB02 and IGB03.

Figure 6 caption. What about black cross? I do not see them.

Line 31 of page 9. The writer does not understand the distance from variance reduction maximum: in the caption of Figure 9 there is no information about distance from variance reduction maximum as the ordinate of the panel B. Moreover, add the label 1000 and 3000 in the vertical axis.

6 Discussion: detectability and background noise and Conclusions

Please add some comment about the influence of the distance of the seismometer station from the debris flow occurrence location. Panel C of Figure 5 shows that only signal from IGB01, IGB02 and IGB03 are marked. Were also the other signal from IGB04-IGB10 used for computing decay fitting? In the case that station IGB01, IGB02 and IGB03 are missing the results from seismic data are the same? Please add some comment explanation.

Technical corrections

CD9 is missing in Figure 1

line 9 of page 8: demands instead of demand?

Berti, M., and A. Simoni (2005), Experimental evidences and numerical modelling of debris flow initiated by channel runoff, *Landslide*, 2, 171--182.

Cannon, S., Gartner J.E., Wilson, R.C., Bowers, J.C., Laber, J.L. 2008. Storm rainfall conditions for floods and debris flows from recently burned areas in Southwestern Colorado and Southern California. *Geomorphology*, 96, 250-269.

Coe, J.A., Kinner D.A., Godt, J.W., 2008. Initiation conditions for debris flows generated by runoff at Chalk Cliffs, central Colorado. *Geomorphology*, 96, 270-297.

Clague, J. and Evans, G. (1994). Formation and failure of natural dams in the Canadian Cordillera,*Geological Survey of Canada Bulletin* 464

Costa, J.E., and Shuster R.L. (1988) The formation and failure of natural dams.,*Geological Society of America Bulletin*, v 100, 1054-1068.

Gregoretti, C., Dalla Fontana G., 2008. The triggering of debris flow due to channel-bed failure debris flow in some alpine headwater basins of the Dolomites: analyses of critical runoff. *Hydrological Processes*. 22, 2248-2263.

Gregoretti C., Degetto M., Bernard M., Crucil, G., Pimazzoni A., De Vido G., Berti M., Simoni A. Lanzoni S. Runoff of small rocky headwater catchments: Field observations and hydrological modeling. *Water Resources Research*. 52(8) doi: 10.1002/2016WR018675

Hurlimann M., Abanco C., Moya, J., Vilajosana I. (2014). Results and experiences gathered at the Rebaixader debris-flow monitoring site, Central Pyrenees, Spain. *Landslides*. doi:10.1007/s10346-013-0452-y 161-175

Kean J.W., Staley D.M., Leeper R.J., Schmidt K.M., Gartner J.E. (2012). A low-cost method to measure the timing of postfire flash floods and debris flows relative to rainfall. *Water Resources Research*, 48, W05516, doi:10.1029/2011WR011460

Rengers, F.K., L.A. McGuire, J.W. Kean and D.E. Hobley (2016), Model simnulations of flood and debris flow timing in steep cachments after wildfire, *Water Resources Research*, 52, doi:10.1029/2015WR018176.

Theule, J.I., Liebault, F., Loye, A., Laigle, D., and Jaboyedoff, M., 2012. Sediment budget monitoring of debris flow and bedload transport in the Manival Torrent, SE France. *Natural Hazard Earth Sciences*, 12, 731-749.