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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Estimation of the return period of rockfalls according to the block size" *by* Valerio De Biagi et al.

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The paper deals with the relation between the volume of blocks reaching elements at risk and their temporal frequency (or the return period). This relation is necessary for quantitative rockfall risk assessment and for the design of protection devices. The temporal frequency can be obtained from a catalogue of fallen blocks which have been measured and dated. The distribution of the volumes can be fitted with a probability law. Up to now a power law has been used to describe the distribution of the block volumes. In this paper, a Generalized Pareto Distribution (GPD) is proposed. A common problem for determining the temporal frequency from the observation of fallen blocks is that the fall date of the blocks is unknown (except for the more recent ones). The approach used in this paper consists in considering two catalogues of fallen blocks: recent blocks which have been dated (catalogue C, used for determining the temporal frequency) and the whole of the observed blocks (catalogue F, used for fitting the Generalized Pareto Distribution).

Comments

Title: The title is not adapted because the paper deals with the return period of blocks and not of rockfalls. I suggest to replace "rockfalls" by "fallen blocks".

1. The section 2 (Power laws in rockfall analysis) is not well adapted because it focuses on studies of rockfall volume distribution (which is not the subject of the paper) instead of block volume distribution (subject of the paper). I suggest references on block volume distribution: Corominas et al., 2005 (already cited); Nocilla et al., 2008 (Rock Mech Rock Eng); Ruiz-Carulla et al., 2015 (already cited), 2016 (Int. Symp. on Landslides); Hantz et al., 2016 (Int. Symp. on Landslides). When reading the paper, it takes a long time before understanding if the analysis concerns rockfall volumes or block volumes. I suggest some corrections in the pdf to clarify this point. The assertion "small rock blocks . . . have been rarely reported in the archives" (page 4, line 1) is true but it must be mentioned here that terrestrial laser scanning allows to build catalogues including very small rockfalls. Examples -Rosser N.J., Petley D.N., Lim M., Dunning S.A., and Allison, R.J.: Terrestrial laser scanning for monitoring the process of hard rock coastal cliff erosion, Q. J. Eng. Geol. Hydrogeol., 38, 363-375, 2005 -Abellan, A., Calvet, J., Vilaplana, J.M., Blanchard, J.: Detection and spatial prediction of rockfalls by means of terrestrial laser scanner monitoring, Geomorphology, 119, 162-171, 2010. - Dewez, T.J.B., Rohmer, J., Regard, V., Cnudde, C. : Probabilistic coastal cliff collapse hazard from repeated terrestrial laser surveys : case study from Mesnil Val (Normandy, northern France), Journal of Coastal Research, 65, 702-707, 2013. The paragraph discussing the values of the exponent b must be rewritten according to the works dealing with the block volume distribution (Ruiz-Carulli et al., 2015, 2016; Hantz et al., 2016; . . .). The values for the rockfall volume distribution are useless in this paper. Particularly, the sentence "the only reliable studies in this range (less than 10 m3) have been performed by Gardner (1970) and Hungr et al. (1999)" must be removed because a lot

of reliable studies have analyzed the volume distribution of smaller rockfalls, down to as 10-3 m3 (for example, Dewez et al. 2013, Journal of Coastal Research).

2. As the hazard (and the risk) is defined for a given point, the Catalogue C should be associated to an element at risk or to a line: Only the blocks which have stopped beyond a defined line should be considered in the analysis. So the notion of "representative area" (page 5, line 2) should be developped.

3. The explanation of Equation (5) is not evident. So I suggest to explain it as follow: Knowing the annual mean number of blocks bigger than Vt (λ) and the cumulative distribution function of the block volume (FV(v)), the temporal frequency (the inverse of the return period T) of blocks bigger than v is: λ (1- FV(v)) = 1/T Inversely, the volume with return period T (vT) is: vT = FV-1(1-1/λT) Moreover I suggest to remove the sentence "The combination of the two proposed statistical laws allows to determine the return period . . ." (page 6, line 1), because the Poisson's law is not used (the annual mean number of blocks can be estimated without it).

4. Equation (6) is not evident and should be explained.

5. Section 4 (Examples) As the annual mean number of blocks (λ) depends of the extent of the considered deposit area, more information should be given (at least the horizontal width and the inclined length of the area). As stated in section 2, the exponent of the power law (and λ) probably depends on the properties of the rock mass. So the geological and structural context of the Buisson site should be described (rock type and rock mass structure). The orientation of the foliation plane is useless if the orientation of the rock wall is not given (page 11, line 2).

6. As the power law (Equation 2) is commonly used to describe the distribution of the block volume, it should be of interest to compare the volume-annual frequency relations for both Generalized Pareto Distribution (Equation 13) and power law (1/T = λ (v/Vt)ˆ-b).

7. Minor corrections are in the pdf.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-234/nhess-2016-234-RC2-supplement.pdf

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Discussion paper