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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Influence of meteorological factors on rockfall occurrence in a middle mountain limestone cliff" *by* J. D'Amato et al.

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The authors thank the reviewer for his useful comments.

Response to issue a

The effect of the size of the detachable mass on the influence of freeze-thaw has been analyzed by doing a new analysis of DB1, keeping only the rockfalls bigger than 0.1 m3. The influence factors become 5.8 (instead of 7) for freeze-thaw and 6.5 (instead of 4.5) for rainfall. Again the hypothesis of no rainfall influence can't be rejected. According to the uncertainties, no significant conclusion can be drawn. These results

have been incorporated in the manuscript (new paragraph at the end of Section 4.1): "A similar analysis has been carried out keeping only the rockfalls bigger than 0.1 m3. The influence factors become 5.8 (instead of 7) for freeze-thaw and 6.5 (instead of 4.5) for rainfall. Again the hypothesis of no rainfall influence can't be rejected. According to the uncertainties, no significant conclusion can be drawn."

Response to issue b

The authors agree that the term hazard is not appropriate because the volume is not considered in the proposed scale. Consequently, it has been replaced by frequency in the section 5.6, in the abstract and in the conclusion.

Response to issue c

The authors agree that the regression parameters must not be considered as exact values. Consequently, the uncertainty affecting the base rockfall frequency has been considered according to Table 4 (section 4.1), and the proposed frequency scale has been simplified (section 5.6), taking into account this uncertainty.

Sections 4.1 and 5.6 have been modified as below:

Section 4.1

"The test of the multiple regression, using a Fischer Test, is significant: F(duration) = 9.45 and F(amount) = 9.71, in comparison with F(0.05;2;20)=3.49 at the 0.05 significance level, 2 degrees of freedom, and around 20 observations (here 24). We can then consider that the determination coefficient for the multiple regression R^2, close to 0.5, is also significant. It means that around 50% of the variability of rockfall frequency can be explained by the variability of rainfall and freeze-thaw duration or amount. It means that about 50% of the rockfalls are not triggered by rainfall or freeze-thaw and may occur at any time. The number of these rockfalls is then (from Tables 3 and 4) about 406 for an observation period of 887 days, and their frequency ("base" frequency) is about 0.019 rockfall per hour." . . .

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"It can be noted that for all the multiple regressions, the constant of the regression represents the rockfall frequency for periods without either rainfall or freeze-thaw (base frequency), which can't be estimated directly because there is no period without freeze-thaw or rainfall. Its value is around 0.021 [0.011-0.031] hour-1 (Table 4). Note that the confidence interval includes the previously estimated value of 0.020. From this value, one can estimate for the observation periods including freeze-thaw episodes, the number of rockfalls which occur when there is no freeze-thaw, and then the number of those which occurs during freeze-thaw (neglecting the rockfalls due to rain, because they are much less frequent and precipitation is snow during freezing periods). An estimate of the rockfall frequency during freeze-thaw episodes can then be obtained by dividing the number of rockfalls during freeze-thaw by the effective duration of freeze-thaw. A value of 0.147 [0.127-0.167] rockfalls/h is obtained, which is 7 [4-15] times higher than without freeze-thaw or rainfall."

Section 5.6

"Our results make it possible to propose a more precise temporal frequency prediction based on meteorological parameters. We suggest the following frequency levels, which correspond to different values of the influence factor (with respect to the frequency without rainfall or freeze-thaw): - Low frequency: No rainfall or freeze-thaw episode in progress for at least 24 h. - Medium frequency (influence factor > 4): during negative warming, thawing (defined using the freezing potential) or if the cumulative rainfall since the beginning of the rainfall episode is higher than 20 mm. - High frequency (influence factor > 16): rainfall intensity since the beginning of the rainfall episode higher than 5 mm/h."

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/3/C3201/2016/nhessd-3-C3201-2016-supplement.pdf

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