

## ***Interactive comment on “An approach for evaluating the role of protection measures in rock fall hazard zoning based on the Swiss experience” by Erika Prina Howald et al.***

### **Anonymous Referee #1**

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The paper presents a procedure for evaluating the actual performance of the risk mitigation measures and how it could affect the assigned hazard level of the protected areas. The methodology considers two steps that take into account various factors that may interfere on the performance of the measures. Penalty coefficients are applied in case the efficacy of the measures is adversely affected by the considered factors. The paper is well written and the topic certainly fits within the scope of NHESS. The approach is novel and addresses a gap in the rockfall hazard analysis which is the consideration of the protected areas. The authors must be acknowledged for this effort. In my opinion, the rationale of the methodology must be better supported and the paper needs further developments before it could be accepted.

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I found three main issues should be specifically addressed and require in depth consideration:

1) The authors state that the procedure is straightforward. However, it is unclear how the methodology is applied in real cases. In particular, how the resultant effective capacity is integrated in the calculation of the intensity-frequency value. A worked example should be presented to illustrate it. 2) I cannot see the reasons that justify the use of this procedure for Scenario 0 or the design of new mitigation measures. Engineering designs such as the rockfall stabilization and protection works usually follow to the specifications of the design codes prepared by professional societies and/or administrations. Generally, the chief designer must prove that the structure satisfies the specified performance requirements, such as the safety and serviceability with the appropriate levels of reliability and that he/she has followed the procedures defined in the codes for the design calculation. If environmental factors (p.6 lines 14 to 17) affecting the efficacy of the structure are identified, this must be considered in the engineering design as well. Even though some remedial works might not be safe enough in practice, the underlying concept in the methodology that their design is independent of the context of the site is not appropriate for a recommended procedure. 3) The last point is the concept that hazard can be reevaluated. The remedial measure is an acceptable option in case of an existing risk (presence of exposed elements in a threatened area). It is clear that the land beyond the protection structure is safer as the probability of occurrence of the damaging event has been significantly reduced. However, the decision of changing the hazard level is not evident. A low hazard and risk level due to the absence of the threat has a different meaning than the risk being reduced by the existence of a protection work. In the latter, the threat is still there and the hazard zonation proposed by the authors is closely linked to the expected performance of the protection work. If as mentioned in the abstract, the procedure aims to be extended elsewhere, the criteria for hazard reclassification must be well defined and in the paper it is not.

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Minor comments:

Page 2. Lines 4-6. Land use regulations aim at avoiding exposure to the hazard rather than reducing the consequences. The latter are usually the goal of the protection measures.

Page 3. Lines 10-14. Residual risk is usually interpreted as the one remaining after all efforts to mitigate risk have been made. You should add a sentence highlighting the difference with the concept of “residual hazard” used in Switzerland and in the paper.

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