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A scenario-based assessment of debris-avalanche risk for the designing of countermeasures

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Simulation of rock- and debris-avalanche down-valley propagation is mandatory to assess the risk on resident population, the existing structures and activities, and the efficiency of planned mitigation works. In this contribution, we apply a quasi-three-dimensional finite element model (Chen and Lee, 2000; Crosta et al., 2006) to simulate different debris-avalanche scenarios for the Bindo-Cortenova study area, where a large portion of the slope is still potentially unstable after the occurrence of a large debris avalanche (1.2 Mm3) on December 2002 and a successive smaller event on May 2004 that involved about 200,000 m3. The potential instability has a volume between 1 to 1.5 Mm3, and threatens the village at the toe of the slope and several infrastructures. For this reason, the Authorities financed the deployment of a monitoring network and the building of a large defensive countermeasure at the toe of the slope. During the planning stage, three alternatives of the passive countermeasures have been designed, with different costs and technical specifications. For a complete cost-benefit analysis of the efficiency of the countermeasure in controlling the possible debris avalanche, it is necessary to assess the spreading of the landslide, and the energy of impact with the defensive structure. In this contribution, we back-calibrate the runout model by simulating the 2002 debris avalanche and the 2004 smaller event. Then, we apply the calibrated model to simulate different future debris-avalanche scenarios, in order to verify the technical efficiency of each alternative. Finally, by considering the costs of the mitigation countermeasure, the expected losses following the occurrence of the landslide, and the benefit resulting from the adoption of the mitigation strategy, we evaluate the risk acceptability and the cost efficiency of each alternatives by means

of a cost-benefit analysis. This allows us to evaluate the risk level and to identify the optimal alternative considering both technical and economical aspects.

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