



Obstacles and pitfalls in quantifying avalanche risks to roads

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Alpine roads have become economic lifelines for many mountainous regions in Europe, the Americas, and Asia. By enabling both, commuting and tourist traffic, these roads allow for the economic survival of remote valleys. The increased economic dependence on tourism in many Alpine regions underlines the importance of safeguarding traffic routes. Consequently, avalanche management on roads has become a crucial task for local road authorities and natural hazard departments.

Current avalanche management consists of a twofold assessment. In the technical risk analysis, avalanche risks and impacts of risk mitigation measures are quantified. Subsequently, the estimated risks are evaluated from a socio-economic perspective aiming at an optimum level of public safety. In order to allow meaningful evaluations, the accurate quantification of avalanche risk is a core requirement. Within the last decade some approaches to quantify avalanche risks on roads have been proposed. However, we feel that the proposed approaches fail to cover certain aspects of avalanche risk on roads. Namely, they (i) do not consider the statistical implications of exceedance probabilities and (ii) neglect that mortality risk is a function of the respective avalanche pressure.

In this contribution, we will first review current methods to quantify avalanche risks on roads and point out common obstacles and pitfalls (e.g., specifying discrete hazard scenarios, estimating run-out areas, deriving intensity maps). Second, we will present an extended risk model, which explicitly addresses the shortcomings described above. Third, we will outline the importance of improved risk quantification in order to reduce ambiguity of choice among alternatives of mitigation measures. In conclusion, our

contribution aims at fostering the understanding of avalanche risk quantification with regard to its role as decision device in cost-benefit analyses.