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Assessing risk based on uncertain avalanche activity patterns

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Avalanches may affect critical infrastructure and may cause great economic losses. The planning horizon of infrastructures, e.g. hydropower generation facilities, reaches well into the future. Based on the results of previous studies on the effect of changing meteorological parameters (precipitation, temperature) and the effect on avalanche activity we assume that there will be a change of the risk pattern in future. The decision makers need to understand what the future might bring to best formulate their mitigation strategies. Therefore, we explore a commercial risk software to calculate risk for the coming years that might help in decision processes.
The software @risk, is known to many larger companies, and therefore we explore its capabilities to include avalanche risk simulations in order to guarantee a comparability of different risks. In a first step, we develop a model for a hydropower generation facility that reflects the problem of changing avalanche activity patterns in future by selecting relevant input parameters and assigning likely probability distributions. The uncertain input variables include the probability of avalanches affecting an object, the vulnerability of an object, the expected costs for repairing the object and the expected cost due to interruption. The crux is to find the distribution that best represents the input variables under changing meteorological conditions. Our focus is on including the uncertain probability of avalanches based on the analysis of past avalanche data and expert knowledge. In order to explore different likely outcomes we base the analysis on three different climate scenarios (likely, worst case, baseline). For some variables, it is possible to fit a distribution to historical data, whereas in cases where the past dataset is insufficient or not available the software allows to select from over 30 different distribution types.
The Monte Carlo simulation uses the probability distribution of uncertain variables using all valid combinations of the values of input variables to simulate all possible outcomes. In our case the output is the expected risk (Euro/year) for each object (e.g. water intake) considered and the entire hydropower generation system. The output is again a distribution that is interpreted by the decision makers as the final strategy depends on the needs and requirements of the end-user, which may be driven by personal preferences.
In this presentation, we will show a way on how we used the uncertain information on avalanche activity in future to subsequently use it in a commercial risk software and therefore bringing the knowledge of natural hazard experts to decision makers.