Geophysical Research Abstracts
Vol. 17, EGU2015-10925, 2015
EGU General Assembly 2015

Conceptual issues with risk analysis in Switzerland

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Risk analysis is a tricky procedure, where one can easily make mistakes. Indeed, although risk equations are rather general, transferring a methodology to another context or hazard type can often lead to inaccuracies or even significant errors. To illustrate this, common mistakes made with the Swiss methodology are presented, together with possible solutions. This includes the following:

- Risk analysis for moving objects only takes the process dimension into account (e.g. the length of a road section potentially affected by a landslide), but not the object dimension (e.g. the cars length). This is a fair simplification as long as the object dimension is considerably smaller than the process dimension. However, when the object is large compared to the process (e.g. rockfalls on a train), the results will be wrong. This problem can be illustrated by considering two blocs. According to this methodology a 1 m diameter bloc will be twice more susceptible to reach a train than a 50 cm bloc. This is obviously not correct. When it comes to rockfalls risk analysis on roads or railway found in the literature, the bloc dimension is usually neglected, in favour of the object dimension, which is a fair assumption in this context. However, it is possible to include both dimensions by using the sum of the lengths instead of one of them.
- Risk analysis is usually performed using 3 different scenarios, for 3 different ranges of return periods, namely 1-30, 30-100 and 100-300 years. In order to be conservative, the operator commonly considers the magnitude of the worst event that happens with a return period included between the class bounds, which means that the operator evaluates the magnitude reached or overpassed with a return period of 30, 100 and 300 years respectively. Then, since the magnitude corresponds to the upper bounds of the classes, risk is calculated using the frequency corresponding to these return periods and not to the middle of the class (and also subtracting the frequency corresponding the next return period, to consider each magnitude only once). The consequence of this is that the risk is underestimated in-between the classes bounds, since the 30 years return periods applies from 30 to 100 years and so on.

These examples show that conceptual errors are easily made in risk analysis and affect the results. In addition, even when accounting for the uncertainty on the input variables (e.g. using a Monte-Carlo approach) it is not sure that the fluctuation range assigned to the inputs will be large enough to include the “correct” output. Furthermore, since calibration data are often not available, and since input variables suffers from deep uncertainties, it is generally difficult to assess the result quality and a conceptual mistake can go unnoticed. As a conclusion, the uncertainty assessment needs not only to consider the uncertainty on the inputs, but needs to carefully review the model structure to ensure a good match with the context.