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New improvement of the Slope Angle Distribution approach in order to assess hazard and risk along roads exposed to rockfalls: example of the Bagnes valley, Swiss Alps.

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Fine analysis of recent High Resolution Digital Elevation Models (HRDEM) with the Slope Angle Distribution (SAD) approach (Loye et al., 2009) allows to detect potential rockfall source areas at regional scale. Applying this procedure, only Boolean information can be given, i.e. if this is a potential rockfall source area or not, but it does not provide any information on the probability of block release from the identified area. In order to fill the gap between susceptibility and hazard, we introduce a normal cumulative distribution function linking the local slope angle to a probability of block release (Michoud et al., submitted). Then, the numerical model of propagation Flow-R (Horton et al., 2008) is used to assess the rockfall runout areas, taking into consideration both the probability of block release and the probability of propagation. This approach is used to draw hazard maps, hazard being usually the most difficult parameter to assess during a Quantitative Risk Assessment (QRA).

To illustrate the process, a quantitative hazard and risk assessment is performed along the main roads of the Bagnes valley (Swiss Alps). This municipality, which lies between 600 and 4200 m a.s.l., is subject to a rapid development resulting of the fast growth of the ski resort of Verbier. As results, we show that the risk varies a lot inside Bagnes. In the lower portion of the valley, where the traffic is high (up to 5800 cars per day), the risk is low because there are only few blocks that can reach the road. On the opposite, in the upper portion of the valley, even if the traffic is low (about 600 cars per day), the risk is great because are a huge number of blocks that can reach the road. Finally, it appears that in the whole valley, approximately 1 car is hit every 10 years. This risk seems a little bit high, because it does not take into account the potential non-correlation between the repartition of rockfall events and traffic all day long and remediation measures already achieved.

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