

## **Dynamic rockfall risk assessment along the SS113 coastal road (Northern Sicily)**

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Rockfalls are natural hazards that usually affect only small areas. However, due to the big amount of material that can be moved and the associated kinetic energy they can cost serious damages to infrastructures and people. Even fairly small rockfall fragments are a significant hazard if deposited on a highway or along a rail-road track since they are not easily detected and can cause accidents or derailments. Rockfalls can also cause the closure of streets resulting in long term indirect economic losses due to transportation delays as well as to the impact on the commercial and tourist activities.

In literature there are numerous examples of rockfall risk assessments along transportation corridors, most of them are based on the use of standard risk estimation methods. The latter are static approaches founded on a macroscopic view of road traffic, assumed as uniform in space and time, thus characterized by average values of parameters. Lately, a new dynamic approach has been developed within the 'risk analysis group' at the University of Lausanne (Voumard, 2013). It consists of a kinematic interpretation of road traffic where vehicles are parametrized as single entities with different characteristics, speed, dimensions and behaviour. We apply this new approach to estimate the dynamic risk due to rockfall occurrence on the SS113 national road running along the northern coast of Sicily. In this work we focus our attention on a  $\approx 10$  km section along which the SS113 road and a railway connect all the coastal villages going through very steep cliffs and very close to the sea with evident problems of erosion and maintenance. The area is a tourist destination and many hotels and facilities are found along the road. Moreover the area was already hit in the past by numerous rockfalls resulting in the closure of the road for periods running from a few days up to a few years with big direct and indirect damages to the local socio-economic activities. In order to achieve a rockfall risk assessment we apply a two steps approach. First, we realize a hazard estimation along the SS113 road applying a classical approach to evaluate the propagation area, so the probability of impact and storage of boulders on the road lanes. Then, we use this result as input to realize a dynamic estimation of risk for vehicles traveling on the road. Using the TSiNaHa numerical simulator we estimate the risk relative to different combinations of rockfall scenarios and traffic variables. The aim of the work is to get informations that could be used by local politicians and decision makers to take decisions both, about permanent mitigation measures and emergency actions to be taken during the alert phase or after the occurrence of a rockfall.