

Estimating network related risks: A methodology and an application in the transport sector

Jürgen Hackl¹, Juan Carlos Lam¹, Magnus Heitzler², Bryan T. Adey¹, and Lorenz Hurni²

¹Institute of Construction and Infrastructure Management, ETH Zurich, 8092 Zurich, Switzerland

²Institute of Cartography and Geoinformation, ETH Zurich, 8092 Zurich, Switzerland

Correspondence to: Jürgen Hackl (hackl@ibi.baug.ethz.ch)

Abstract. Networks, such as transportation, water and power, are critical lifelines to society. Managers plan and execute interventions to guarantee the operational state of their networks under various circumstances, including after the occurrence of (natural) hazard events. Creating an intervention program demands knowing the probable direct and indirect consequences (i.e., risk) of the various hazard events that could occur to be able to mitigate their effects. This paper introduces a methodology to support network managers in the quantification of the risk related to their networks. The methodology is centered on the integration of the spatial and temporal attributes of the events that need to be modeled to estimate the risk. Furthermore, the methodology supports the inclusion of the uncertainty of these events and the propagation of these uncertainties throughout the risk modeling. The methodology is implemented through a modular simulation engine that supports the updating and swapping of models according to the needs of network managers. This work demonstrates the usefulness of the methodology and simulation engine through an application to estimate the potential impact of floods and mudflows on a road network located in Switzerland. The application includes the modeling of (i) multiple time-varying hazard events, (ii) their physical and functional effects on network objects (i.e., bridges and road sections), (iii) the functional interrelationships of the affected objects, (iv) the resulting probable consequences in terms of expected costs of restoration, cost of traffic changes, and duration of network disruption, and (v) the restoration of the network.