



## A new methodology for modeling of direct landslide costs for transportation infrastructures

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The world's transportation infrastructure is at risk of landslides in many areas across the globe. A safe and affordable operation of traffic routes are the two main criteria for transportation planning in landslide-prone areas. The right balancing of these often conflicting priorities requires, amongst others, profound knowledge of the direct costs of landslide damage. These costs include capital investments for landslide repair and mitigation as well as operational expenditures for first response and maintenance works.

This contribution presents a new methodology for ex post assessment of direct landslide costs for transportation infrastructures. The methodology includes tools to compile, model, and extrapolate landslide losses on different spatial scales over time. A landslide susceptibility model enables regional cost extrapolation by means of a cost figure obtained from local cost compilation for representative case study areas. On local level, cost survey is closely linked with cost modeling, a toolset for cost estimation based on landslide databases. Cost modeling uses Landslide Disaster Management Process Models (LDMMs) and cost modules to simulate and monetize cost factors for certain types of landslide damage. The landslide susceptibility model provides a regional exposure index and updates the cost figure to a cost index which describes the costs per km of traffic route at risk of landslides. Both indexes enable the regionalization of local landslide losses.

The methodology is applied and tested in a cost assessment for highways in the Lower Saxon Uplands, NW Germany, in the period 1980 to 2010. The basis of this research is a regional subset of a landslide database for the Federal Republic of Germany. In the 7,000 km<sup>2</sup> large Lower Saxon Uplands, 77 km of highway are located in potential landslide hazard area. Annual average costs of \$52k per km of highway at risk of landslides are identified as cost index for a local case study area in this region. The cost extrapolation for the Lower Saxon Uplands results in annual average costs for highways of \$4.02mn. This test application as well as a validation of selected modeling tools verifies the functionality of this methodology.