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Indirect consequences of flooding – assessment of service disruption of road transport

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Efficient and secure transport networks ensure transportation of goods and people as well as access to essential services such as education, health care and emergency services. Natural hazardous events such as e.g., storms, floods, erosion, landslides, and forest fires might lead to disturbances in road and rail transport lines. The infrastructure users are then left with the choices of postponing or cancelling the trip, taking a detour, changing the mode of transport, or changing the travel destination.

The work described in this abstract proposes strategies for assessment of indirect consequences of extreme events affecting road transport. Functional vulnerability functions, expressing the probability of service disruption as a function of event intensity, are useful in the consequence assessment. The main portion of indirect consequences of a road service disruption stem from additional travel time for the users. The indirect economic consequences depend on the duration and the severity (e.g., full/partial closure) of the service disruption, the quality and capacity of the alternative transportation routes or alternative modes of transportation as well as the traffic volume, traffic composition and the time values related to the users in the affected network.

A case study is provided for simplified assessment of the indirect consequences of flooding on roads in Portugal. The analysis is conducted at a regional scale and is performed within a GIS environment. The road network was subdivided into links, defined as continuous road segments without opportunities for detours. Flooding of one link would lead to a service disruption within the road network. The flood risk for the exposed links was analyzed as a function of the return period of the flooding, the flood intensities, and the expected duration of the service disruption. Flood hazard maps for different return periods (10-year, 100-year, and 500-year) were combined with a functional vulnerability model relating the flood intensity (flood depth and flood velocity) to a service disruption duration. The case study categorizes the risk into 3 classes: low, medium and high. For a quantitative risk assessment, the risk classes need to be expressed using a quantitative parameter. Each risk class was quantified as the product of the probability of the flooding, the duration of the service disruption and unit costs of a service disruption. This allows the presentation of risk in terms of expected annual indirect costs associated with flooding.

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