Consequence assessment of linear infrastructure exposed to hazardous weather-related events

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Linear critical infrastructures are fundamental for functioning of the society and for generating everyday economic activities. Maintenance of these infrastructures, as well as quick restoration of the services after service disruption are important and challenging tasks. Extreme weather events and related hazards (e.g. floods, erosion, landslides, and forest fires) may lead to a malfunctioning of these infrastructures, resulting in social and economic consequences.

A wide variety of methods are applicable for consequence assessment of linear infrastructure. A review and summary of existing methodologies has been made and recommendations for their use are provided. The review encompasses semi-quantitative approaches (e.g. multi-criteria analysis and indicator-based scoring approaches) and quantitative approaches, using damage assessment and economic impact tools. The approaches might be hazard specific, addressing the interaction between the hazard and the infrastructure assets or focus on the societal consequences of the malfunctioning infrastructure. In this work, special attention is paid to the assessment of the infrastructure service disruption as well as of physical damage to the linear infrastructures.

A framework for risk assessments of adverse weather-related events affecting terrestrial transportation lines has been established. The framework can be also applied to other linear infrastructure, such as water and electric power supply. The framework encompasses risk identification and assessment of hazard, exposure, vulnerability and consequences. In the risk identification, modes of malfunctioning of the infrastructure service are identified, as well as natural triggering events initiating the malfunctioning. Hazard encompasses frequency and intensity of the triggering events and is assessed at the location of the exposed infrastructure assets. The event intensity, is a parameter (single or composite) characterizing the damaging potential of a natural event, e.g. the water depth or velocity for flood. Vulnerability models represent the functional loss, the damage degree or the exceedance probability of damage levels pertinent to an infrastructure asset, expressed in terms of event intensity. For further consequence assessment, the criticality of assets need to be assessed, e.g. by using an event tree approach to analyse the relation between asset damage and service disruption. The indirect consequences depend on redundancy (multiple paths of supply) and robustness, but also on the capacity to restore functionality in a timely way (rapidity) as well as on the resources available to restore functionality (resourcefulness). Economic consequences (direct and indirect losses) due to
weather-related events have been evaluated for transportation infrastructures, considering material damage caused by flooding as well as consequences for the users stemming from the interruption of the transportation service.

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