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# Cascading effects of floods on interdependent infrastructure systems

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Flood is among the most frequent and damaging natural hazards worldwide. Assessment of direct losses due to flooding is well-advanced, and include multiple models for the built environment (infrastructure, buildings). On the contrary, the knowledge and the literature on the assessment of indirect losses and cascading effects is less developed. Impacts on infrastructure are not necessarily due to the physical contact with floodwater but also result from a reduced performance of the service/functionality, which usually propagate outside the flooded area and beyond the impacted infrastructure (e.g. power disruptions resulting in communications failures). This work presents the risk analysis of two linear infrastructure systems, i.e. the water distribution system (WSS) and the road network system, for flooding. The evaluation of indirect flood impacts on the two networks is carried out for four probabilistic flood scenarios, obtained by a coupled 1D-quasi 2D hydraulic model. The impacts on the water distribution system and on the road network are simulated with a Pressure-Driven Demand model and a transport network disruption model respectively. Common impact metrics, similarities and differences of the methodological aspects for the two networks and risks are identified. The method is applied to the metropolitan area of Florence (Italy). The risk assessment is first carried out considering the two systems as separately affected; in a second analysis, the risk assessment includes the cascading effect and systemic interdependency, i.e. it evaluates the consequences on WSS due to the lack of accessibility, which prevents timely repairs and replacement at the WSS lifting stations. The results show that the risk to the WSS in terms of Population Equivalent not served (PE/year) can be reduced by the 71.5% and the 41.8% respectively, if timely repairs to the WSS stations are accomplished by 60 and 120 minutes. The study highlighted that systemic risk-informed planning can support timely interventions and enhance infrastructure resilience; however, it is recommended to conduct further studies which focuses on the complex dynamics of water runoff, water supply and traffic flows to support practical action planning.