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A simplified methodological framework for the assessment and management of flood hazard associated with extended linear infrastructures (railways)

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In case of flood events the damage and/or service disruption of linear infrastructures (e.g. railways, highways, etc.) is responsible for a considerable part of the total direct and indirect loss, especially in developed countries. Moving from this consideration, this study focuses on large networks of linear infrastructures (in particular, railways) and proposes a simplified methodological framework for (1) identifying segments and elements of the infrastructure network that are exposed to fluvial flooding and (2) grouping the identified elements into different classes depending on the mechanism and severity of the expected flooding scenario (i.e. damage due to overtopping, embankment instability due to erosion or washout, train or vehicles collision against fluvial deposits or debris, etc.). The identification of these network elements, as well as the estimation of flood hazard indexes influencing the damage process (e.g., water depth, flow velocity, flood duration, etc.) can rely on the results of hydrodynamic simulations, when available, or on the application of fast-processing DEM-based (Digital Elevation Model) algorithms and indices, such as, in our case, the Geomorphic Flood Index, or GFI. This latter approach delineates flood-prone areas with high accuracy and reliability starting from the geomorphologic characterization of the river basin. The proposed methodological framework is suitable for large scale studies since it is mainly based on simple DEM analyses and it only requires flood maps delineated for real events or hydraulic simulations for calibrating purpose. Similarly to the GFI, a different geomorphic approach is also used to identify potential debris flow sources which path can hit the infrastructure. The procedure is tested in few real case studies in Italy and the results are compared with observed data collected in the last decades along sections that suffered a slow down or interruption of the traffic due to flood events. Results show the great potentials of the methodology, which can be easily adapted to different case studies and specific requirements. The proposed procedure represents a robust tool that can be applied at national scale to support planning measures for managing and mitigating of flood risk associated with large networks of linear infrastructures.