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A combined flood-seismic resilience-based planning framework to improve the recoverability of urban settlements

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According to UNDRR terminology, resilience is the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. Damages to urban physical structures caused by consequent and/or interacting natural hazards create a complex and challenging post-disaster environment. Many functions provided by the affected structures are disrupted and consequently, systemic processes, including recovery, are impaired and delayed. Despite its criticality, recovery is the less explored phase in the disaster management framework, specifically from a pre-disaster perspective, in terms of planning and actions for better recovery before disasters occur.

This work presents a modeling framework to determine which infrastructures and with what level of functionality in an urban system, after a disaster, can ensure that the system can efficiently go through the path of the recovery process. The final goal is to increase the overall resilience of the urban settlements from multiple hazards. This research question is addressed considering (i) multiple functionalities (e.g. economic, social, health, etc.) of the territorial elements; (ii) the potential interactions and interdependencies among them as well as the overall functionality of the system; (iii) a multi-hazard risk perspective, considering both flood and seismic hazard scenarios; (iv) pathway and goal of the recovery process able to ensure not only the prioritization of recovery interventions but also the improvement of system resilience according to a 'build back better' perspective.

First, the main results of a critical review of existing literature and guidelines on disaster recovery are provided with the twofold aim of identifying current gaps and providing the layout to develop a multi-hazard framework for decision-making and investments optimization in pre-disaster recovery planning. As a first step of the framework definition, the essential urban structures that contribute to economic, social, cultural, demographic, environmental, governmental, and community functions, and their interdependencies are identified. Then, the contribution of each structure to the overall functionality of the urban system is determined using quantitative data and qualitative data. Stakeholders' priorities and needs for going through a good recovery are also integrated into the approach thanks to structured stakeholder-engagement activities based on a participatory approach. The influence of the hazards on the system is evaluated by imposing multi-hazard risk scenarios of floods and earthquakes, considering various levels of interaction between them (hazard, exposure, vulnerability, risk, DRR measures).

The developed modeling framework represents the basis for the implementation of a quantitative tool for decision-makers to find and plan the optimal investment alternatives to increase the

system’s resilience under a limited budget.