

Holistic and Multidimensional Approaches to Assessing Systemic Vulnerability in Urban Settlements

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Abstract Urban and metropolitan areas in Italy are increasingly exposed to multiple and interacting hazards, including natural disasters and climate change-induced events such as heatwaves, flooding, and storms. These challenges are intensified by structural and interlinked dynamics, such as rapid urbanization, socioeconomic inequalities, and fragmented governance systems that stress urban resilience and require systemic thinking. In this context, there is growing consensus in the scientific literature on the need for a comprehensive and integrated conceptualization of vulnerability in multi-risk scenarios that is based on a holistic understanding of how different hazards interact and how urban populations, infrastructures, and governance systems respond to these complex risks. Systemic vulnerability of urban settlements in multi-risk scenarios, focusing - unlike traditional notions of vulnerability - on the interdependent nature of urban systems and their propensity to cascade functional failures across domains, is increasingly recognized as a critical yet underexplored factor of urban resilience. The contribution presents a multidimensional framework for assessing systemic vulnerability to multiple hazards in urban settlements, advancing theoretical discourse and practical applications in environmental design and building technology for urban resilience. The study presents intermediate results from research conducted within Task 5.3.3 of the extended partnership “RETURN: Multi-risk Science for Resilient Communities under a Changing Climate”, focusing specifically on systemic vulnerability. Based on a comprehensive literature review and rooted in social-ecological-technological systems (SETs) theory, resilience thinking, and risk governance, the proposed approach conceptualizes systemic vulnerability as dynamic, context-dependent, and multi-scalar. The results identify key vulnerability dimensions, such as socio-spatial inequalities, urban form, and environmental characteristics, along with their necessary criteria and indicators for risk assessment and to orient transformative responses. The methodology emphasizes multidimensionality and interconnection: rather than isolating vulnerability into separate silos, it considers the interactions between social fragility, ecological features of the urban environment, and spatial configurations. The framework is tested through an indicator-based assessment of climate vulnerability at the district scale in Naples, Italy. Preliminary results demonstrate its potential to capture systemic interactions and inform policy-relevant strategies for risk reduction, resilient planning, and design. Ultimately, this work contributes to advancing holistic approaches and integrated tools for vulnerability assessment, supporting the development of adaptive and anticipatory governance mechanisms in the face of complex multi-risk scenarios.