

How urban system vulnerabilities to flooding could be assessed to improve resilience and adaptation in spatial planning

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Natural hazards damage assets and infrastructure inducing disruptions to urban functions and key daily services. These disruptions may be short or long with a variable spatial scale of impact. From an urban planning perspective, measuring these disruptions and their consequences at an urban scale is fundamental in order to develop more resilient cities. Whereas the assessment of physical vulnerabilities and direct damages is commonly addressed, new methodologies for assessing the systemic vulnerability at the urban scale are required to reveal these disruptions and their consequences. Physical and systemic vulnerability should be measured in order to reflect the multifaceted fragility of cities in the face of external stress, both in terms of the natural/built environment and socio-economic sphere. Additionally, a systemic approach allows the consideration of vulnerability across different spatial scales, as impacts may vary and be transmitted across local, regional or national levels. Urban systems are spatially distributed and the nature of this can have significant effects on flood impacts.

The proposed approach identifies the vulnerabilities of flooding within urban contexts, including both in terms of single elementary units (buildings, infrastructures, people, etc.) and systemic functioning (urban functions and daily life networks). Direct losses are appraised initially using conventional methodologies (e.g. depth-damage functions). This aims to both understand the spatial distribution of physical vulnerability and associated losses and, secondly, to identify the most vulnerable building types and ways to improve the physical adaptation of our cities, proposing changes to building codes, design principles and other municipal regulation tools.

The subsequent systemic approach recognises the city as a collection of sub-systems or functional units (such as neighbourhoods and suburbs) providing key daily services for inhabitants (e.g. healthcare facilities, schools, administration offices, food shops, leisure and cultural services etc.) and which are interconnected through transport networks. Moreover, each city is part of broader systems - which may or may not follow administrative boundaries – and, as such, need to be connected to its wider surroundings, in a multi-scalar perspective. The systemic analysis, herein limited to residential households, evaluates the presence, the distribution among functional units and the redundancy of key daily services. As such, systemic interdependences between neighbourhoods/suburbs and municipalities emerge, highlighting how systemic vulnerability spreads beyond the flooded areas. This aims to understand which planning patterns and existing mixed-use developments are more flood resilient (thereby informing future urban development/regeneration) and which infrastructure and assets have a key role within the urban system (and have therefore to be prioritised for protection).

The methodology is currently developed through an extensive use of Geographic Information Systems (GIS) and applied to an Italian case study (Noale municipality, Venice). Current developments and on-going issues in its application and in the data collection (including the use of aerial survey data) will be discussed in the presentation.