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## Enhancing resilience through integrated modelling and scenario simulation

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## Enhancing resilience through integrated modelling and scenario simulation

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**Abstract:** Urban planners need to intervene in a complex environment that is evolving in space and over time. Decisions they make often have long-term implications and require vast resources. This requires a transdisciplinary approach capable of dealing with the uncertain nature of future socio-economic, environmental and technological developments.

Against this backdrop it is increasingly recognised that tools to support robust decision-making should provide capabilities to test multiple plausible futures or pathways, including scenarios involving extreme impact, but low probability, disruption events e.g. natural hazard (storm surge, earthquake, tsunami, volcanic) or human-induced (terrorism, cyber-attack) disruption events.

This paper describes Spatial-MERIT as developed within the New Zealand government-funded 'The Economics of Resilient Infrastructure' research programme. Spatial-MERIT is an integrated model developed in the Geonamica software environment capable of simulating the ex-ante impacts of planning options across space and through time. It is intended to support urban policy and decision-making by enhancing understanding of the integrated nature of the economic, land use, and transport sub-systems as well as the wider systemic impacts of disruptions, and importantly, the societal value of investing in resilience-building mitigations and adaptations.

Spatial-MERIT applies a 'systems of systems' approach to simulating future developments and the implications of infrastructure disruption. Theory-based generative modelling is at the heart of Spatial-MERIT, with demographic, economic, land use, transport and organisational behavioural change sub-systems dynamically coupled to understand the implications of prioritisation and bundling of resilience-building initiatives through time.

Our modelling is showcased using a hypothetical volcanic event in the Auckland isthmus.

**Keywords:** Infrastructure Resilience, Integrated Land Use Modelling, Long-term Scenarios