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Characterising the dynamic physical vulnerability of Tomorrow's Cities to multiple natural hazards

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During their expansion, cities are increasingly exposed to various risks from different natural hazards. Moreover, different drivers of these risks may evolve over time due to several endogenous and exogenous factors. In the context of proactive risk-informed, people-centred, and pro-poor urban planning and design, capturing the above dynamic effects is crucial. This study focuses on modelling the time-dependent physical fragility and vulnerability (i.e., the likelihood of damage and losses as a function of a hazard intensity measure) of building stocks. Given a set of relevant hazards for a case-study region, this research combines existing methodologies and datasets to 1) match the relevant building classes (i.e., construction types) in the case-study database with existing fragility and/or vulnerability models; 2) use state-of-the-art numerical and/or empirical methods to develop fragility/vulnerability models not already available, supplementing existing models; 3) identify and account for the factors affecting the time dependency of the above fragility/vulnerability models (e.g. ageing of buildings, the interaction of different hazards); 4) create a Geographic Information System (GIS) vulnerability database for integration within a broader risk model. The proposed approach offers a reasonable trade-off between the refinement of the considered time-dependent vulnerability assessment and the expected computational complexity of a building portfolio multi-hazard risk model. The proposed approach is demonstrated for the realistic urban prototype "Tomorrowville", considering earthquakes, floods, and debris flows as case-study hazards.