



Development of vulnerability curves to typhoon hazards based on insurance policy and claim dataset

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Vulnerability refers to the characteristics and circumstances of an exposure that make it vulnerable to the effects of some certain hazards. It can be divided into physical vulnerability, social vulnerability, economic vulnerabilities and environmental vulnerability. Physical vulnerability indicates the potential physical damage of exposure caused by natural hazards. Vulnerability curves, quantifying the loss ratio against hazard intensity with a horizontal axis for the intensity and a vertical axis for the Mean Damage Ratio (MDR), is essential to the vulnerability assessment and quantitative evaluation of disasters. Fragility refers to the probability of diverse damage states under different hazard intensity, revealing a kind of characteristic of the exposure. Fragility curves are often used to quantify the probability of a given set of exposure at or exceeding a certain damage state. The development of quantitative fragility and vulnerability curves is the basis of catastrophe modeling. Generally, methods for quantitative fragility and vulnerability assessment can be categorized into empirical, analytical and expert opinion or judgment-based ones. Empirical method is one of the most popular methods and it relies heavily on the availability and quality of historical hazard and loss dataset, which has always been a great challenge. Analytical method is usually based on the engineering experiments and it is time-consuming and lacks built-in validation, so its credibility is also sometimes criticized widely. Expert opinion or judgment-based method is quite effective in the absence of data but the results could be too subjective so that the uncertainty is likely to be underestimated.

In this study, we will present the fragility and vulnerability curves developed with empirical method based on simulated historical typhoon wind, rainfall and induced flood, and insurance policy and claim datasets of more than 100 historical typhoon events. Firstly, an insurance exposure classification system is built according to structure type, occupation type and insurance coverage. Then MDR estimation method based on considering insurance policy structure and claim information is proposed and validated. Following that, fragility and vulnerability curves of the major exposure types for construction, homeowner insurance and enterprise property insurance are fitted with empirical function based on the historical dataset. The results of this study can not only help understand catastrophe risk and manage insured disaster risks, but can also be applied in other disaster risk reduction efforts.