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# A framework for the selection and ensemble development of flood vulnerability models

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Effective understanding and management of flood risk requires comprehensive risk assessment studies that consider not only the hazard component, but also the impacts that the phenomena may have on the built environment, economy and society. This integrated approach has gained importance over recent decades, and with it so has the scientific attention given to flood vulnerability models describing the relationships between flood intensity metrics and damage to physical assets, also known as flood loss models.

Despite considerable progress in this field, many challenges persist. Flood damage mechanisms are complex and depend on multiple variables, which can have different degrees of importance depending on the application setting. In addition, data required for the development and validation of such models tend to be scarce, particularly in data poor regions. These issues are reflected in the large amount of flood vulnerability models that are available in the literature today, as well as in their high heterogeneity: they are built with different modelling approaches, in different geographic contexts, utilizing different explanatory variables, and with varying levels of complexity. Notwithstanding recent developments in this area, uncertainty remains high, and large disparities exist among models.

For these reasons, identifying which model or models, given their properties, are appropriate for a given context is not straightforward. In the present study, we propose a framework that guides the structured selection of flood vulnerability models and enables ranking them according to their suitability for a certain application, based on expert judgement. The approach takes advantage of current state of the art and most up-to-date knowledge on flood vulnerability processes. Given the heterogeneity and uncertainty currently present in flood vulnerability models, we propose the use of a model ensemble. With this in mind, the proposed approach is based on a weighting scheme within a logic-tree framework that enables the generation of such ensembles in a logically consistent manner. We test and discuss the results by applying the framework to the case study of the 2002 floods along the Mulde River in Germany. Applications of individual models and model ensembles are compared and discussed.