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On the development of usable multi-variate damage models for residential buildings

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Flood damage models proposed in the literature can depend on a very limited number of input parameters (like uni-variate and bi-variate models) as well as on many damage explicative variables both related to the hazard and to the vulnerability of affected items (i.e. multi variate models). The first are simple to use, but their results are affected by high uncertainty. The second are more accurate, but often more complex and not easy to use. Indeed, parameters on which the model depends on could be not available or known, or it could be necessary to have specific knowledges, e.g. programming language or statistics concepts, to implement correctly the model.
Starting from a complex, multi-variate damage model, this study proposes a method to obtain a new model which maintains the accuracy and the conceptual structure of the original one but it is more "usable" by local authorities and land planners, meaning which has a simple mathematical formulation, and which depends on less, available input parameters. The method consists in four steps. First, input variables are chosen among the original ones, on the bases of their variability in the context under investigation, their availability, their independency, and of a local sensitivity analysis. Then, the model behaviour is analysed, by varying the input parameters one by one, in order to identify simple functions suitable for representing the role of each parameter on the final damage figure. Third, the single functions are calibrated by comparing damage estimated by the original model with damage estimated by the simplified one. Finally, functions are combined into the new model. The method is exemplified using as reference model INSYDE (IN-depth SYnthetic Model for Flood Damage Estimation, Dottori et al., Nat Hazards Earth Syst Sci, 2016), an Italian expert-based damage model for residential sector, by limiting its application to riverine type flood events. The new model is finally tested in Northern Italy.