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Validation of a multi-variable flood damage model using empirical records from Northern Italy

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Flood risk management commonly relies on assessments performed using uni-variate models in which the hazard characterization is demanded exclusively to water depth data (stage-damage curves). Such simplified flood loss models carry important uncertainty, especially if they are not calibrated and validated specifically for the areas where they are employed. Multi-variable models, on the other hand, take into account more factors that can influence flood losses and can improve damage estimation when extensive datasets are available to characterize hazardous conditions (e.g., flow velocity, duration, presence of pollutants, etc.), as well as exposure and vulnerability. In this paper we collected a comprehensive dataset related to three recent major flood events in Northern Italy (Lodi 2002, Vicenza 2010 and Modena 2014), including floods depth, velocity and duration, buildings characteristics and their economic values. For those events, all declared damage records were also available. First, we used a tree-based regression approach to assess the relative importance of each explanatory variable on the damage output. Then, we performed a validation test of an existing multi-variable synthetic flood damage model developed for Italy (INSYDE) to evaluate its reliability within the Po river basin and we compared its performance in loss estimation with the one of stage-damage curves, empirically derived for similar case studies. Our results provide important considerations about the transferability of the models and confirm that multi-variable models outperform those that are only based on uni-variate stage-damage curves.