Geophysical Research Abstracts
Vol. 20, EGU2018-14354, 2018
EGU General Assembly 2018

Bayesian Network based meso-scale flood loss modeling with BN-FLEMO in the upper Danube basin

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The frequent occurrence of large river floods and the resulting economic loss emphasize the need for risk-oriented flood management approaches. Flood loss estimation on the meso-scale is an integral component for the implementation of the EU Floods Directive and an indispensable tool for the insurance and reinsurance industry to calculate premiums and define solvency requirements.
Despite this important role, flood loss models often rely on simple water-depth to damage relations and usually neglect other flood intensity metrics and other relevant factors describing the resistance characteristic. Further, flood loss predictions are associated with large uncertainty. We approach this problem by proposing the multi-variable probabilistic loss model BN-FLEMO that allows for the consideration of multiple predictor variables and the quantification of uncertainties in model outputs. BN-FLEMO estimates the relative loss to residential buildings in dependence on flood experience of the population, precautionary measures, building area, return period, duration and water depth. The model is based on empirical data and has been validated in a number of case studies throughout Europe. The focus of this contribution is on the application of the model within a continuous long-term simulation, over a period of 10.000 years, of the German part of the Danube for current climate conditions. This simulation builds on the outputs of a model chain consisting of a stochastic weather generator, a hydrological model and a hydrodynamic model. Within this set-up, large-scale risk assessment is investigated under consideration of uncertainties regarding the flood hazard, described via a stochastic event set and uncertainty of flood loss estimates, which is represented by the conditional probability distribution of relative flood loss within the Bayesian Network.