Geophysical Research Abstracts
Vol. 20, EGU2018-13130, 2018
EGU General Assembly 2018

Probabilistic multi-variate loss estimation for pluvial floods

Viktor Rözer (1), Kreibich Heidi (1), Kai Schröter (1), James Doss-Gollin (2), Upmanu Lall (2), and Bruno Merz (1)

(1) Section 5.4 Hydrology, GFZ German Research Centre for Geosciences, Potsdam, Germany (vroezer@gfz-potsdam.de), (2) Department of Earth and Environmental Engineering, Columbia University, New York, NY, United States

Pluvial flood events of different magnitudes including smaller events in Amsterdam 2014 or Berlin 2017 and large events such as in Copenhagen 2011, Beijing 2012 or Houston, TX 2017 have caused overall economic losses in the range of tens of billion Euros over the last decade. Unlike riverine flooding, these floods are directly caused by storm events with high rainfall rates well above the design levels of urban drainage systems, which lead to inundation of streets and buildings before the storm water reaches a watercourse. A projected increase in frequency and intensity of heavy rainfall events in many areas around the globe and an ongoing urbanization may further increase pluvial flood losses in the future. For an efficient risk assessment and adaptation to pluvial floods, a quantification of the pluvial flood risk is needed. So far, most studies have been focusing on the hazard component, while only few models have been developed to analyze the vulnerabilities associated with pluvial floods. These models usually use simple water level- or rainfall-loss functions and come with very high uncertainties. To quantify these uncertainties and improve the loss estimation, we present a probabilistic multi-variate loss estimation model for pluvial floods based on empirical data. The model was developed in a two-step process using a machine learning approach and a comprehensive database comprising 783 records of direct damage to private households. The data was gathered through telephone surveys with affected households after four different pluvial flood events in Germany between 2005 and 2014. In a first step, linear and non-linear machine learning algorithms, such as tree-based and penalized regression models were used to identify the most important loss influencing factors among a set of 56 candidate variables. The variables cover hydrological and hydraulic aspects, early warning, precaution, building characteristics and the socio-economic status of the affected households. In a second step, the most important loss influencing variables were used to develop a probabilistic multi-variate pluvial flood loss estimation model using a Bayesian beta regression model. To account for cases, where high individual coping capacities and low water levels did not lead to any direct building damage, a zero-inflation component was added to the beta regression model. Probabilistic loss estimates are made through Bayesian inference using Markov Chain Monte Carlo (MCMC) sampling. In comparison with deterministic and ensemble loss estimation models using the same data, it is shown that Bayesian loss models can considerably improve the accuracy and reliability of loss estimates. With the ability to cope with incomplete information, implementation of expert knowledge through priors, as well as inherently providing quantitative uncertainty information, multi-variate Bayesian loss models offer a promising new framework for risk assessment of pluvial floods.