Geophysical Research Abstracts
Vol. 19, EGU2017-9008, 2017
EGU General Assembly 2017

Flood damage estimation of companies: A comparison of Stage-Damage-Functions and Random Forests

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The development of appropriate flood damage models plays an important role not only for the damage assessment after an event but also to develop adaptation and risk mitigation strategies.
So called Stage-Damage-Functions (SDFs) are often applied as a standard approach to estimate flood damage. These functions assign a certain damage to the water depth depending on the use or other characteristics of the exposed objects.
Recent studies apply machine learning algorithms like Random Forests (RFs) to model flood damage. These algorithms usually consider more influencing variables and promise to depict a more detailed insight into the damage processes. In addition they provide an inherent validation scheme.
Our study focuses on direct, tangible damage of single companies. The objective is to model and validate the flood damage suffered by single companies with SDFs and RFs. The data sets used are taken from two surveys conducted after the floods in the Elbe and Danube catchments in the years 2002 and 2013 in Germany. Damage to buildings (n = 430), equipment (n = 651) as well as goods and stock (n = 530) are taken into account. The model outputs are validated via a comparison with the actual flood damage acquired by the surveys and subsequently compared with each other.
This study investigates the gain in model performance with the use of additional data and the advantages and disadvantages of the RFs compared to SDFs. RFs show an increase in model performance with an increasing amount of data records over a comparatively large range, while the model performance of the SDFs is already saturated for a small set of records. In addition, the RFs are able to identify damage influencing variables, which improves the understanding of damage processes. Hence, RFs can slightly improve flood damage predictions and provide additional insight into the underlying mechanisms compared to SDFs.