

A Gradient Boosting Framework to Quantify the Effect of Behavior, Experience and Socio-economic Factors on Flood Resilience for the Continental US

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Day 2 – Advances in Modeling Socio-Economic Impacts

Abstract

We developed a data-driven model to understand the effects of socio-economic and behavioral factors of flood risk. The US Federal Emergency Management Agency has recently released country-wide household-scale data on flood insurance policies in-force since 2009. Flood insurance purchase is considered as a proxy of flood resilience which influences future flood vulnerability. We investigate relationships between people’s socio-economic profiles and their probability of purchasing a flood insurance and develop a gradient boosting framework with tree-based learning algorithms to model insurance coverage, on a census tract level. As predictors, 390 socio-economic variables from the American Community Survey (e.g., household income, level of education, housing costs), variables on previous flood experience based on flood insurance claims data and ownership information are used. SHAP (SHapley Additive exPlanations) values are analyzed to find the marginal contribution of each input and narrow down the vast range of features. Model predictions show R^2 values up to 0.8 during testing. Using this approach we quantified and ranked the effect of ownership, flood experience and social background. We found that the experience of one severe event predominantly shapes resilience. Ownership as well as income show a strong effect compared to the other socio-economic and behavioral variables. Understanding the factors driving people’s choices regarding flood insurance purchase is the first step to improve the National Flood Insurance Program’s strategies and address societal inequalities in disaster risk management.