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How far can we estimate pluvial flood damage risk by statistical learning?

Gregor Laaha and Clemens Nocker
University of Natural Resources and Life Sciences, BOKU Vienna, Institute of Statistics, Vienna, Austria
(gregor.laaha@boku.ac.at)

Pluvial flooding is getting increasing attention around the world, but there are very limited studies on how to estimate pluvial flood damage risk at a regional scale. In this paper, we evaluate the value of statistical methods for pluvial flood risk estimation. One objective is to assess if statistical methods can deliver significant relationships between precipitation indices, soil and landscape characteristics, and pluvial flood damage risk in agricultural areas. Additionally, we want to explore if the statistical methods could be a cost-efficient alternative to deterministic surface run-off models. The analyses are performed for agricultural landscapes in Upper Austria where flood damage location reports of the Austrian hail insurance are available for the 2007 to 2013 period. We assess the relative performances of a generalized linear model (GLM) and a random forest (RF) model to estimate pluvial flood occurrence based on presence/absence raster data set, where the imbalance of the binary target variable and multicollinearity of predictors pose specific challenges. The analysis reveal that within the study area the most severe agricultural damages were triggered by intense rain events, but in one case the damage was caused by longer lasting low intense rain. By means of log-linear models and random forests the relationships between the location characteristics and damage events are investigated. A specific focus is laid on comparing the skills of continuous versus classified parameters, and on methods for dealing with collinearity. We compare the performances of both models based on cross-validation statistics and the process-realism of results. We finally discuss how far the statistical methods appear appropriate for quantifying pluvial flood damage risk at a regional scale.