Drought risk on a pan European scale: integrating the missing piece

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INTRODUCTION

The risk of natural disasters in a very general sense is a combination of hazard and vulnerability. Commonly, the drought hazard is described by one or a set of drought indicators, mostly based on hydro-meteorological information. Recently, Blauhut et al. (2015) developed a novel approach using past impact data from the European Drought Impact report (EDIR) as an indicator for vulnerability to drought, assuming that a system has been vulnerable if it has been impacted by the previous approach. Based on statistical modelling of the likelihood of impact occurrence in the past by the drought hazard indicator (SPI), a first generation of sector-specific drought risk maps for selected hazard levels at the scale of European macro regions has been presented.

VULNERABILITY FACTORS

In contrary to that, vulnerability to drought is typically estimated by a combination of relevant vulnerability factors aggregated to indices of Exposure, Sensitivity(S) and Adaptive Capacity(AC), the 'factor approach'. Those non-sector specific, episodic approaches require explicit information on physical, ecological, institutional and socioeconomic parameters (bottom). Nevertheless, both approaches are limited due to the nature of their construction. This work adds the missing piece to risk analyses: a direct integration of vulnerability factors, drought indices and past drought impacts for the next generation of drought risk maps on a pan-European scale.

METHOD

A statistical model is fitted to estimate the likelihood of drought impact occurrence (LID) drought risk) in each macro region using multivariable logistic regression models (MLRM) as:

\[ \log \left( \frac{P}{1-P} \right) = \alpha + \sum_j \beta_j X_j + \gamma \text{SPI} + \delta \text{AC} \]

where the left-hand side of the equation is known as the logit transformation. The model parameters \( \alpha \) and \( \beta \) are estimated using standard regression techniques. This approach considers more than one drought hazard index (i.e., SPI) at different aggregation times (SPI), in addition to the vulnerability components of S and AC to predict drought impact occurrence by a logistic regression model. The significant predictors are marked by asterisks (*) model performance was assessed by the area under the ROC curve (with AUC > 0.5; 0.5 < AUC < 1).

RESULTS

The presented drought risk maps exemplary considered four impact categories for increasing hazard intensities (SPI = -1 to SPI = -3) on a NUTS-combo scale. Morelly Maritime Europe has enough data to identify a multi-variable model for each impact category and guarantee good model performance. The drought risk maps show impact sector and region specific sensitivities to drought impacts.

To select the specific drought hazard indicators (SPI) for each region their significance as predictors was first tested in a simple binary logistic regression. As predictors in MLRM should be independent, only combinations of SPI indicators were chosen that had a correlation coefficient below 0.5. The table on the right gives an overview of the selected predictors used for modeling.