Integrating textual impact reports and vulnerability information to drought risk analysis

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Introduction

Drought risk in general describes the probability of socioeconomic and environmental systems to suffer negative consequences. In the framework of risk assessment, drought risk can be estimated from the risk analysis or vulnerability assessment perspective, combining hazard information with impact information and quantification of impacts (damage) as a proxy for vulnerability; the impact approach, or with (II) a combination of vulnerability factors: the factor approach. Impact approaches mainly focus on specific sectors, whereas the majority of factor approaches estimates risk for entire systems. For both approaches, criteria for indices and factor selection applied are rather based on expert knowledge than empirical context. This work introduces a novel hybrid approach combining hazard information and vulnerability factors to predict the likelihood of impact occurrence in an empirical model framework (Blauhut et al. 2016).

Methodology

Steps to pan-European drought risk maps

Step 1: Aggregation of all input data to NUTS-combo level (climateologically comparable region across Europe, Blauhut et al. 2015).

Step 2: Analysis of the best combination of one or two hazard indices and up to three vulnerability factors by impact category and macro region based on stepwise multivariable logistic regression models (MLRM). Starting with hazard indices, the best performing hazard index was selected by predictor significance (p-values) and model performance (AROC). Subsequently, not correlated predictors were selected by model improvement, measured by AROC and the Bayesian Information Criterion (BIC). Accordingly, further predictors were only chosen for the final MLRM if AROC increases or remains constant and BIC decreases.

Step 3: Application of MLRMs to construct drought risk maps for fifteen impact categories and for three hazard levels. For countries with a lack of sufficient vulnerability data, LIO was estimated using the best hazard-only model.

Data

Impact information: The EDII compiles reported information on the negative impacts of past drought events from a variety of information sources. All reports are spatially referenced, time-stamped to at least the year of occurrence, assigned to one of fifteen impact categories and a number of impact types.

Vulnerability information: The collection of vulnerability data builds on the experience gained by De Stefano et al. (2016) and was complemented by additional data (e.g. landcover). Furthermore, combined vulnerability factors are analyzed (e.g. adaptive capacity). In summary, 69 vulnerability factors were compiled.

Results & Discussion

The results indicate sector- and macro region specific sensitivities of drought indices and vulnerability factors, with the SPEI for a twelve month accumulation period as the overall best hazard predictor. The application of the "hybrid approach" revealed strong regional and sector specific differences in drought risk across Europe (bottom). The majority of best predictor combinations rely on a combination of SPEI for shorter and longer aggregation periods, and a combination of information on landuse and water resources.

Take home messages:

This study suggested objective criteria for drought indices selection and use in risk assessment. Drought indices and vulnerability factor selection was impact sector specific. Temporally accumulated indices and vulnerability factor selection was region specific. The application of vulnerability factors generally improved impact prediction and added plausible spatial detail to the pattern of mapped drought risk. Current applications of drought indices may benefit from revision with regard to their impact-specific power.