A Spatially Transferable Drought Hazard and Drought Risk Modeling Approach Based on Remote Sensing Data

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This study presents a new methodology for spatially explicit and globally applicable drought hazard, vulnerability and risk modelling. We focused on agricultural droughts since this sector affects the food security and livelihood situation of the often most vulnerable communities especially in developing countries. Despite recent advances in drought modeling, coherent and spatially explicit information on drought hazard, vulnerability is still lacking over wider areas. In this study a spatially explicit inter-operational drought hazard, vulnerability and risk modeling framework was investigated for agricultural land, grassland and shrubland areas. The developed drought hazard model operates on a higher spatial resolution than most available global drought models while also being scalable to other regions. Initially, a logistic regression model was developed to predict drought hazard for rangelands and cropland in the USA. The model results showed a good spatiotemporal agreement within the cross-verification with the United States Drought Monitor (USDM), using visual interpretation. Subsequently, the explicit and accurate drought hazard model was transferred and calibrated for South Africa and Zimbabwe, where a simplified drought risk indicator was calculated by the combination of drought hazard and drought vulnerability. The drought hazard model used time series crop yields data from the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) and biophysical predictors from satellite remote sensing (SPI, NDII, NDVI, LST, albedo). The McFadden's Pseudo $R^2$ value of 0.17 indicated a good model fit for drought hazard in South Africa. Additionally, the plausibility of the model results in Southern Africa was evaluated by using regional climate patterns, published drought reports and through visual comparison to a global drought risk model and food security classification data. Drought risk and vulnerability were also assessed for Southern Africa and could be mapped in a spatially explicit manner, showing, for example, lower drought risk and vulnerability over irrigated areas. This developed modeling framework can be applied globally, since it uses globally available datasets and therefore can be easily modified to account for country-specific conditions. Additionally, it can also capture regional drought patterns on a higher spatial resolution than other existing global drought models. This model addressed the gap between global drought models, that cannot accurately capture regional droughts, and sub-regional models that may be spatially explicit but not spatially coherent. The approach of this study can potentially be used to identify risk and priority areas and possibly in an early warning.
capacity while enhancing existing drought monitoring routines, drought intervention strategies and the implementation of preparedness measures.