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Drought impact functions as intermediate step towards drought damage assessment

Sophie Bachmair (1), Cecilia Svensson (2), Ilaria Prosdocimi (2), Jamie Hannaford (2), Kelly Helm Smith (3), Mark Svoboda (3), and Kerstin Stahl (1)

(1) Hydrology, University of Freiburg, Freiburg, Germany , (2) Centre for Ecology and Hydrology, Wallingford, United Kingdom, (3) National Drought Mitigation Center, University of Nebraska-Lincoln, USA

While damage or vulnerability functions for floods and seismic hazards have gained considerable attention, there is comparably little knowledge on drought damage or loss. On the one hand this is due to the complexity of the drought hazard affecting different domains of the hydrological cycle and different sectors of human activity. Hence, a single hazard indicator is likely not able to fully capture this multifaceted hazard. On the other hand, drought impacts are often non-structural and hard to quantify or monetize. Examples are impaired navigability of streams, restrictions on domestic water use, reduced hydropower production, reduced tree growth, and irreversible deterioration/loss of wetlands. Apart from reduced crop yield, data about drought damage or loss with adequate spatial and temporal resolution is scarce, making the development of drought damage functions difficult. As an intermediate step towards drought damage functions we exploit text-based reports on drought impacts from the European Drought Impact report Inventory and the US Drought Impact Reporter to derive surrogate information for drought damage or loss. First, text-based information on drought impacts is converted into timeseries of absence versus presence of impacts, or number of impact occurrences. Second, meaningful hydro-meteorological indicators characterizing drought intensity are identified. Third, different statistical models are tested as link functions relating drought hazard indicators with drought impacts: 1) logistic regression for drought impacts coded as binary response variable; and 2) mixture/hurdle models (zero-inflated/zero-altered negative binomial regression) and an ensemble regression tree approach for modeling the number of drought impact occurrences. Testing the predictability of (number of) drought impact occurrences based on cross-validation revealed a good agreement between observed and modeled (number of) impacts for regions at the scale of federal states or provinces with good data availability. Impact functions representing localized drought impacts are more challenging to construct given that less data is available, yet may provide information that more directly addresses stakeholders' needs. Overall, our study contributes insights into how drought intensity translates into ecological and socioeconomic impacts, and how such information may be used for enhancing drought monitoring and early warning.