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Modeling drought impact occurrence based on climatological drought indices for four European countries

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The relationship between atmospheric conditions and the likelihood of a significant drought impact has, in the past, been difficult to quantify, particularly in Europe where political boundaries and language have made acquiring comprehensive drought impact information difficult. As such, the majority of studies linking meteorological drought with the occurrence or severity of drought impacts have previously focused on specific regions, very detailed impact types, or both. This study describes a new methodology to link the likelihood of drought impact occurrence with climatological drought indices across different European climatic regions and impact sectors using the newly developed European Drought Impact report Inventory (EDII), a collaborative database of drought impact information (www.geo.uio.no/edc/droughtdb/). The Standardized Precipitation Index (SPI) and Standardized Precipitation-Evapotranspiration Index (SPEI) are used as predictor variables to quantify meteorological drought severity over prior time periods (here 1, 2, 3, 6, 9, 12, and 24 months are used). The indices are derived using the gridded WATCH Forcing Datasets, covering the period 1958-2012. Analysis was performed using logistic regression to identify the climatological drought index and accumulation period, or linear combination of drought indices, that best predicts the likelihood of a documented drought impact, defined by monthly presence/absence. The analysis was carried out for a subset of four European countries (Germany, UK, Norway, Slovenia) and four of the best documented impact sectors: Public Water Supply, Agriculture and Livestock Farming, Energy and Industry, and Environmental Quality. Preliminary results show that drought impacts in these countries occur most frequently due to a combination of short-term (2-6 month) precipitation deficits and long-term (12-24 month) potential evapotranspiration anomaly, likely associated with increased temperatures. Agricultural drought impacts were explained best by shorter, seasonal indices (2-6 months), while impacts to the Energy sector were best explained by long-duration (12-24 month) anomalies, related to hydropower reservoir storage. Notably, drought impacts in the UK were not affected by short (< 6 month) anomalies, which may point to successful management strategies or underlying geoclimatic differences. By identifying the climatological drought indices most strongly linked to drought impact occurrence and generating regression equations that can predict the likelihood of a drought event, this research is a valuable step towards measuring and predicting drought risk. This work provides a methodological example using only a subset of European countries and impact types, but the accuracy and scope of these results will improve as the EDII grows with further contributions and collaboration.