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Methodology for spatial and temporal analysis of drought using large-scale gridded data

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In recent years, there is an increased understanding of the importance of drought, in particular due to global change. For a good understanding of historic droughts, and to evaluate the impact of future global change scenarios, more advanced techniques to account for spatio-temporal variability are required. So far, methodologies to characterize spatio-temporal patterns of large-scale drought (e.g. global scale) are still limited. This explorative work presents methodological processes developed to analyze a gridded dataset with forcing data that has been compiled through the EU-FP6 WATCH project (0.5o, daily, 1958-2001). Two new methodologies are proposed: the Standardized Clustered Precipitation Index (SCPI), which quantifies monthly precipitation changes, and the Cluster Precipitation Distributions (CPDs) which consider the spatial reduction of continuous period without daily rain. Both methods are used to characterize meteorological drought. The SCPI methodology is an extension of the Standardized Precipitation Index (SPI) that incorporates a multivariate clustering analysis to determine the spatial changes of the index and the rate of change. The SPIs are calculated based on a monthly moving average of a specified length (e.g. 30 days), and their variability is calculated in k years to identify a change in the SPI levels. To determine this k-years change, a monthly spatial pattern of severity is calculated in the time frame defined in the calculation of the SPI. A second method is presented (i.e. CPD) to prepare for analysis of hydrological drought in a next phase of this research. CPD identifies spatial regions where probabilities of longer periods of non-precipitation events are present. These probability distributions, however, do not consider geographical positioning which may affect drought analysis of a particular region. Therefore, the probabilities of non-precipitation events are grouped using a clustering technique that allows for geo-referenced information. The two methodologies provide important information for principles that can be used to develop methods to evaluate meteorological and subsequently hydrological drought from different types of large-scale grid-based models (e.g. RCMs, LSHMs, GHMs).