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Drought analysis in Switzerland: spatial and temporal features

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Drought as a natural hazard may have negative impacts even in regions characterized by a general abundance of water resources. The Swiss Alpine region has experienced several extreme meteorological events (heat waves, droughts) during the last fifty years that have caused human and economic losses. Though Swiss climate is far from arid or semi-arid, natural climatic variability, exacerbated by climate change, could lead to more severe impacts from naturally occurring meteorological droughts (i.e. lack or significant reduction of precipitation) in the future.

In this work, spatial and temporal features of meteorological droughts in Switzerland have been explored by the identification and probabilistic characterization of historic drought events on gridded precipitation data during the period 1961-2012. The run method has been applied to both monthly and annual precipitation time series to probabilistically characterize drought occurrences as well as to analyze their spatial variability. Spatial features have also been investigated by means of Principal Components Analysis (PCA) applied to Standardized Precipitation Index (SPI) series at 3, 6, and 12-month aggregated time scale, in order to detect areas with distinct precipitation patterns, accounting for seasonality throughout year and including both wet and dry conditions. Furthermore, a probabilistic analysis of drought areal extent has been carried out by applying an SPI-based procedure to derive Severity-Area-Frequency (SAF) curves.

The application of run method reveals that Ticino and Valais are the most potentially drought-prone Swiss regions, since accumulated deficit precipitation is significantly higher (up to two times) than in the rest of the country. Inspection of SPI series reveals many events in which precipitation has shown significant anomalies from the average in the period 1961-2012 at the investigated time scales. Anomalies in rainfall seem to exhibit high spatial correlation, showing uniform sub-regions that have climatic similarities. Such results are also confirmed by PCA. The SAF analysis shows that several droughts in the investigated period have encompassed almost the entire area of Switzerland, beyond the drought-prone regions.

The main results highlight the need for investigating the drought phenomenon in the Alpine region, where a lack of awareness of this natural hazard and unpreparedness to address its consequences could worsen its impacts on the possibly affected socio-economic systems in the future.