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Space-time patterns of meteorological drought events in the European Greater Alpine Region.

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Drought is a natural hazard impacting tremendously on human systems as latest events, like the summer 2015 drought in Central and Eastern Europe, show. However, extreme events are rare and only a few of the most recent ones are analyzed in detail concerning their emergence in space and time. With the study presented here, we aim to investigate spatiotemporal drought characteristics on a much larger sample of events covering the past 200+ years. The area of interest is the European Greater Alpine Region located at the intersection of three major climate divisions in Europe: Mediterranean climate as well as temperate oceanic and continental climate.

We use gridded data of 3-month moving average precipitation sums which are transformed into percentile values for each grid point and each month individually to ensure comparability across regions and seasons. A threshold is applied to detect contiguous areas within the gridded fields below a given percentile threshold (20th percentile). Subsequently, all areas overlapping to a certain degree along time are treated as the same space-time object to form a meteorological drought event. Distinct attributes are derived for every event like duration, spatial extent, intensity, overall severity, season of peak intensity, temperature anomaly etc., which are analyzed in terms of their long-term temporal evolution, seasonality, spatial clustering and temperature characteristics.

Our results indicate on one hand only minor changes in drought frequency and duration over the last 200 years, but on the other hand large variations in drought intensity and overall severity on multidecadal time scales. The time period from 1850-1880 shows highest drought intensities and also highest severities followed by a second peak from around 1930-1950. Furthermore, the top 10% of events in terms of their severity reveal a general shift in seasonality from winter/spring events in the late 19th century towards autumn events during the last decades of the 20th century. Investigations on the temperature anomaly during droughts indicate a tendency towards below average temperatures during high intensity events in winter, with the opposite taking place in summer. However, the long term warming trend has no influence on drought intensity, duration or frequency. In addition we were able to show that temperature anomalies during droughts in summer are shifted towards positive anomalies, if the preceding spring was already dry – an indication of the soil moisture-temperature feedback taking effect in the warm season.