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Persistence and frequency of drought-relevant circulation types during temperature extremes in southern Central Europe

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The German weather service reports a new record mean June temperature for Germany and intensive heat waves during 2018 and 2019. Between January 2018 and June 2019, three new monthly top extremes were recorded (April 2018, May 2018 and June 2019).

In this study the relationships between the persistence and frequency of atmospheric circulation patterns related to drought and surface air temperature anomalies are investigated. The study area is in southern Central Europe, including parts of Germany and Switzerland as well as Austria and Czech Republic.

Large-scale atmospheric circulation types (relevant to drought) have been derived by using the COST733 classification software. Atmospheric variables from gridded daily JRA55 reanalysis data (Japanese Meteorological Agency 2018) and gridded precipitation data for the study area (6x6km, based on timeseries of 1756 weather stations from Zentralanstalt für Meteorologie und Geodynamik 2018) were used for the classification. All input variables were specifically weighted in the classification process. Daily maximum temperature data from ECA&D (2019) for different stations within the study area are used to evaluate the relationship between a circulation type and heat (cold) waves.

The drought-relevant circulation types are determined according to relative frequencies of circulation type days under a particular percentile of precipitation: If at least 20 percent of the circulation type days are below the 20th percentile of precipitation, the circulation type is defined as drought relevant.

For the derived drought-relevant circulation types, the mean seasonal frequencies [in %] (April-September, October-March) and the mean persistence [in days] (1961-2017) are calculated. To evaluate the relationship between a circulation type and heat (cold) waves, an efficiency coefficient is calculated. The efficiency coefficient is defined as ratio between the frequency of the circulation type in heat (cold) waves and its mean seasonal frequency.

For the study area, those circulation types relevant to drought with a high proportion of seasonal temperature anomalies could be identified. The circulation type with a dominant Azores high with ridges of high-pressure towards Central/Eastern Europe has the highest proportion of positive

temperature anomalies in summer.