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Major historical droughts in Europe as simulated by an ensemble of large-scale hydrological models

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As drought is regional by nature it should preferably be studied at the large scale to consistently address the spatial and temporal characteristics of drought and related drought causing processes. Nevertheless, there is a high spatial variability within a drought affected region caused by a combination of small-scale climate variability and catchment properties, which influences our ability to identify a particular event in a consistent way. Several studies have addressed the occurrence of major drought events in Europe in the last century, still no thorough analysis exists that compares across the different methods, variables and time periods employed. Thus, there is a need for a comprehensive pan-European study of historical events, including their definition, cause, characteristics and major impacts. Important to consider in this respect are the type of data to be analysed and the choice of methodology for drought identification and drought indices best suited for the task.

In this study focus is on hydrological drought, i.e. streamflow drought, and the main aim is to analyse key characteristics of major historical droughts in Europe over the period 1963-2000, including affected area, severity and persistence. The variable analysed is simulated daily total runoff for each grid cell in Europe (4425 land grids) derived from the WATCH multi-model ensemble of nine large-scale hydrological models. A grid cell is defined to be in drought if the runoff is below the q20 (20% non-exceedance frequency of the empirical runoff distribution on the respective day). Spatial continuity is accounted for by the introduction of a drought cluster, defined as a minimum of 10 spatially contiguous grid cells in drought on a given day. The results revealed two major dry periods in terms of the mean annual drought area, namely 1975-76 and 1989-90, when also a high consistency was found among models. On the other hand, daily time series during these events depicted a high model variability. Overall, models agreed better at the time of maximum daily drought extent, when nearly 50% of the model domain was in drought at the time of maximum extent for both events. Based on the ensemble mean, the poster will present further details of the spatial extent and location of selected events in this comprehensive catalogue of major European droughts.