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Decadal variability in European wet and dry phases

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Climate varies over time and space, triggered by a large variety of processes. At continental and regional scales, numerous long-term changes in climate have been observed with profound direct and indirect influences on natural environments and the human society. This study focuses on the spatio-temporal characteristics and changes of long-lasting dry and wet spells in Europe for 1851–2010. Analysis is done for seven European sub-regions ranging from Northern Europa via Central Europe to the Mediterranean area.

The decile indicator is used for precipitation time series to define long-lasting dry and wet phases that may last several months to years. Its calculation is based on three-month precipitation totals. Different decile-based thresholds are used to determine the start and the end of the respective dry or wet phase. They are calculated separately for each of the twelve three-month periods to account for the seasonal precipitation cycle. Links of this precipitation-based indicator to flood events in European catchments are examined.

We noticed that during certain times, dry and wet phases, respectively, occur more frequent and last longer than during other times, where almost no event occurs. Considering all of Europe, dry phases were particularly frequent and long between 1880 and 1910, the mid-1940s to mid-1960s and in the mid 1970s, while wet phases showed a peak in occurrence from 1910 to the early 40s, from the mid-1960s to the early 1980s and from 1994 to 2010. The picture changes if individual sub-regions are considered.

Opposite sub-regional trends lead to almost negligible or indifferent trends over Europe. Spatial extent and duration of dry phases have decreased noticeably and most pronounced in the second half of the 20th Century, while wet phases show increases in spatial extent and duration from 1851 to the present. Those developments are particularly pronounced in Northern Europe. Opposite trends – particularly for the second half of the 20th century – were noticed for Central Europe and the Mediterranean area.

Besides those long-term trends exists a strong inter-decadal variability of the spatial coverage of dry and wet phases, respectively, within all sub-regions, indicating a relation of decile phase occurrence to long-term variations in atmospheric circulation. We explored the relationship between dry and wet phase occurrence and large-scale atmospheric circulation patterns, e.g., Hess-Brezowsky catalogue of circulation types (GWT), North Atlantic Oscillation (NAO) and Atlantic Multidecadal Oscillation (AMO) and found some links depending on the particular sub-region. Yet, the observed links cannot simply be reduced to simple cause-effect relationships.