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Future changes in precipitation extremes for the Rhine catchment

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The 17-member ensemble ESSENCE data set (1950 - 2100) is used to investigate how the distribution and time sequence of extremes in daily to 20-day precipitation sums over the Rhine basin may change in a future climate. For example, if long dry periods followed by intense heavy rainfall are becoming more frequent, the single-day sum may change at a different rate to multiday sums. The extremes in 10-20 day sums in particular are relevant for discharges of large rivers and flooding events.

In winter, the upper quantiles of wet-day sums show an almost uniform increase (of the order of 10% for the 95th percentile for 1950-2100) with respect to summation length. With practically no change predicted for the wet-day frequency, the quantiles' increase is largely due to an increase in the intensity of precipitation events.

In summer, the upper-quantiles of wet-day sums are found to decrease exponentially with the summation length, in such a way that extreme one-day sums increase, while extremes of sums over 5 days or longer are reduced. The summertime change in intensity is small in comparison to the winter season and it is the decrease in wet-day frequency that causes the multiple-day sums to be reduced. The sequence of events however is key to reproducing the scaling behaviour, and we investigate the role played by changes in large-scale circulation.