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The relationship between precipitation and surface temperature in the European domain

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In several recent studies, it has been argued that heavy precipitation intensities would increase exponentially with a temperature induced increase in atmospheric moisture holding capacity, according to the Clausius-Clapeyron equation. We investigate to which extent this scaling with temperature can be observed in present day climate over the seasonal cycle. To this purpose we use an observational data set of surface temperature and precipitation over the European domain. As the domain is forced by different synoptic patterns over the year, we divide the data into monthly sub-periods, which results in rather different relationships between the two variables over the year. In general, we find that there is an exponential increase in the extreme precipitation with increasing temperatures in winter, similar to what can be estimated from the Clausius-Clapeyron equation given the temperature increase. However, in summer we observe a decrease of a similar magnitude, which can be explained by large scale synoptic events advecting moisture into the region studied. Using a set of regional climate models, we compare model output to the observations, and explore the differences in the temperature relation for the large scale and convective precipitation types. We find that the large scale precipitation generally dominates over the convective, except for the warmer temperatures in summer, where the convective precipitation grows more intense.