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Observed trends in hot and cold extremes in Europe from 1950 to 2016

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An increase in mean and extreme temperatures, as well as in the frequency of occurrence of extreme temperature events has been observed in most regions of Europe. Many climate models project cold extremes to warm faster than the mean temperatures in Northern Europe and warm extremes to increase more than the mean temperature in Southern and Central Europe with global warming. However, there is not robust observational evidence for this warming amplification. Here, we analyze extreme temperature trends for Europe using the E-OBS gridded dataset for Central Europe, Mediterranean and Northern Europe from 1950 to 2016.

On average, cold and warm extremes expressed as yearly maximum of daily maximum temperature (TXx) and minimum of daily minimum temperature (TNn) increased by 1.7°C and 2.8°C, respectively, over the period 1950–2016. The area average trends are statistically significant both for cold and hot extremes. Over large areas of Europe, TXx and TNn also appear to have increased more than the summer and winter means, respectively. While these differences are not statistically significant, they follow clear geographical patterns: TXx increased more than the mean temperature in a large area covering most of Central Europe and the British Isles, while the opposite trend occurred in most of Northern Europe. TNn increased more than the mean winter temperature in Northern Europe, while TNn shows little difference and a less clear distribution in Central and Mediterranean Europe to winter mean temperatures. This pattern is broadly consistent with results of ENSEMBLES and EURO-CORDEX RCM projections.

In addition to intensity changes, we also observe increasing frequencies of the hottest days per year, expressed as the 1% hottest days. Temperatures that occurred on average on about 2 days per year from 1957 to 1977, occurred on about 6 days per year for the period 1997 to 2016.

In summary, we provide an update on observed hot and cold extremes over Europe taking into account the potential limitation of the gridded E-OBS data set and the role of internal variability. Temperature during hot as well as cold extremes have been increasing over most of Europe at a rate exceeding the average minimum and maximum daily temperatures.