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Mechanisms of Temperature Extreme Events in Climate Models over Europe

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Changes in intensity, frequency, and location of temperature extreme events have been in the focus of research for the last years. Currently, many studies rely on simulations from climate models to assess these changes. Even though climate models simulate temperature extreme events, it has not been evaluated yet if such extreme events are simulated for the right reasons by models. Given the trust put in climate models, it seems necessary to assess the capability of climate models to properly simulate the mechanisms associated with temperature extreme events.

In this study, known mechanisms and relevant meteorological variables are exploited and considered in a composite analysis to identify a climatology of synoptic weather patterns related to hot and cold temperature extreme events over Europe using seasonal extremes. Weather patterns, here within a selection of CMIP5 models, are compared with patterns derived from ERA Interim. The ability to simulate mechanisms related to extreme events is not only assessed by comparing patterns with each other, but also by projecting the patterns onto the time steps of meteorological variables occurring simultaneously. Mechanisms thereby can be quantified through a linear regression and compared throughout the range of models.

The results indicate that climate models simulate mechanisms associated with temperature extreme events reasonably well, in particular circulation-based mechanisms. Further, the amplitude and length of events is assessed, where in some cases significant deviations from ERA Interim are found.