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A systematic bias in future heatwave diagnostics throughout the seasonal cycle

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Human-induced climate change is leading to a warming Earth, resulting in more frequent and intense temperature extremes. Daily temperature extremes can be defined following various approaches, with relative percentile-based thresholds being a common method. Here we explore spatio-temporal heatwaves across the seasonal cycle derived from daily temperature extremes, emphasizing the critical role of the extreme threshold chosen in their definition.

To investigate the sensitivity of heatwave characteristics to the extreme threshold definition, we focus on the approach utilizing a so-called moving threshold. This method involves a 31-day running window to increase the sample size for percentile calculations as well as an additional 31-year running window to account for the impact of global warming. We recognize that introducing a seasonal running window may introduce biases in threshold exceedances. To address this issue, *Brunner and Voigt (2023)* proposed a simple bias correction method, involving the removal of the mean seasonal cycle before percentile threshold calculation, which we also use here to explore effects on downstream impact metrics.

We focus on the 99th percentile as threshold and show the potential for a significant bias in the extreme frequency, exceeding 50% in certain regions according to 5 selected CMIP6 models. Our findings further reveal that without bias correction this also leads to a substantial underestimation of derived heatwave properties, in particular area, duration, and magnitude. For the ACCESS-CM2 model, the difference in heatwave area can reach up to 40%, when comparing bias-corrected and not bias-corrected results for the 100 biggest events in the period 1960-1990.

Our results contribute to a better understanding of the implications of using a seasonally running window on heatwave characteristics, providing valuable insights for future climate projections. We emphasize the importance of adopting appropriate methods and bias correction techniques to enhance the accuracy of temperature extreme assessments in the context of ongoing climate change.

References:

Brunner and Voigt (2023): Revealing a systematic bias in percentile-based temperature extremes. *EGU General Assembly 2024*. EGU24-1722