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# Potential for constraining in the presence of large natural variability

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Projected changes in extreme events are very uncertain due to internal variability and model uncertainties. However, we show that there is a potential to reduce the uncertainties in projections of the hottest annual temperatures (TXx) by means of an observational constraint. Observational data is used to identify skillful models that are trustworthy on long term due to their ability to accurately capture complex feedbacks. We evaluate whether CMIP5 models can reproduce the observed change in warm extremes in response to warming summer temperatures.
We find that natural variability poses a great challenge for assessing model skill for the observed period. We establish a set of criteria that help us to identify regions where the observational constraint can be implemented despite large natural variability. Where observations are available and criteria are met (Australia, Central North America and the US), the constrained ensemble projects smaller increase in warm extremes than the full CMIP5 ensemble would suggest.
Nevertheless over a large portion of regions where in principle a constraint could substantially reduce projection uncertainties, the lack of long-term, reliable and homogeneous observations impedes the evaluation of models. Hence we use a perfect model approach to investigate the potential reduction in uncertainties if we had available observations. We show that uncertainties could be reduced by about a half in most regions considered. This would be of great benefit given the importance of having skillful projections as they are used to drive impact models.