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Probing parametric uncertainty in the rainfall response to mid-Holocene conditions for North Africa

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Climate models disagree on the pattern and in some cases, the sign of change of future rainfall. Much of this uncertainty is thought to be related to differences in the parameterisations of moist convection in the atmosphere, which occurs on a spatial scale that is at least an order of magnitude finer than is resolved in global models. One approach to improving this is to turn to climate states from the past which fall outside of the narrow envelope of observed variability. The mid-Holocene, 6000 years before present is among the best-placed past time-periods for this. A variety of evidence lines indicate that a known change in the orbit caused major monsoon enhancements that led to a 'greening' of the Sahara. However, climate model simulations fail to reproduce the rainfall increase inferred from pollen and other palaeo-data.

In this study, we analyse how changes in monsoon rainfall are dependent on parametric uncertainty within a well-used climate model, in this case HadAM3. We will show results from 150-member perturbed parameter ensembles of past (mid-Holocene), present and future (or 2x CO_2) conditions. We evaluate the sensitivity of both absolute rainfall and the change in rainfall, to convection scheme parameter values and compare approaches to using these outputs to learn about the real climate system. Using a statistical emulator, we use these ensembles to discern the main parameter interactions and discuss their relevance to the observed rainfall change. Ultimately, we aim to develop a statistically-based approach to quantify whether or not understanding palaeo-rainfall changes can reduce uncertainty in future projections.