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High resolution global climate modelling from the UPSCALE simulation campaign

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A traceable hierarchy of global climate models (based on the Met Office Unified Model, GA3 formulation), with mesh sizes ranging from 130km to 25km, has been developed in order to study the impact of improved representation of small-scale processes on the mean climate, its variability and extremes. Five-member ensembles of atmosphere-only integrations were completed at these resolutions, each 27 years in length, using both present day forcing and a future climate scenario. These integrations, collectively known as the "UPSCALE campaign", were completed using time provided by the European PrACE project on supercomputer HERMIT (HLRS Stuttgart).

A wide variety of processes are being studied to assess these integrations, in particular with regards to the role of resolution. Tropical cyclone characteristics are shown to improve as resolution is increased (in terms of spatial extent, frequency, structure and variability), particularly in the Atlantic basin, where ensemble correlations with observed interannual variability approach 0.8. Mid-latitude Atlantic jet positioning improves in some seasons, although the spread between ensemble members has a similar magnitude to the spread between ensembles means at resolution. The simulation of decadal trends in Sahel rainfall also improve as resolution is increased, which is very likely linked to processes such as African Easterly Waves. The simulation of polar lows and other processes also become more realistic in the higher resolution simulations.

Some aspects of the relationship between the improved simulation of the current climate, and how this impacts on changes in the future climate, will also be discussed. In particular tropical cyclone frequency decreases robustly in the Southern Hemisphere, but changes in the Northern Hemisphere are more basin-dependent, with a decrease in the Atlantic but a shift in tracks in the Pacific.