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Evaluating CMIP6 Model Fidelity at Simulating Non-Gaussian Temperature Distribution Tails

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Under global warming, changes in extreme temperatures will manifest in more complex ways in locations where temperature distribution tails deviate from Gaussian. For example, uniform warming applied to a temperature distribution with a shorter-than-Gaussian warm tail would lead to greater exceedances in warm-side temperature extremes compared with a Gaussian distribution. Confidence in projections of future temperature extremes and associated impacts under global warming therefore relies on the ability of global climate models (GCMs) to realistically simulate observed temperature distribution tail behavior. This presentation examines the ability of the latest state-of-the-art ensemble of GCMs from the Coupled Model Intercomparison Project phase six (CMIP6) to capture historical global surface temperature distribution tail shape in hemispheric winter and summer seasons. Comparisons between the multi-model ensemble mean and a reanalysis product reveal strong agreement on coherent spatial patterns of longer- and shorter-than-Gaussian tails for the cold and warm sides of the temperature distribution, suggesting that CMIP6 is broadly capturing tail behavior for plausible physical and dynamical reasons. Most individual GCMs are also reasonably skilled at capturing historical tail shape on a global scale, but a division of the domain into sub-regions reveals considerable model and spatial variability. To explore potential mechanisms driving these differences, a back trajectory analysis examining patterns in the origin of air masses on days experiencing extreme temperatures is also discussed.