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Response of precipitation extremes to global warming in an aqua-planet climate model: Towards robust projection from regional to global scales

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Reliable projection of precipitation extremes is essential for human society to prepare for future climate change. To understand the inconsistencies of the projections across the climate models, a series of idealized "aquaplanet" AGCM runs have been performed with the Community Atmosphere Model (CAM) to investigate the effects of horizontal resolution on precipitation extreme projections under two simple global warming scenarios. The use of idealized orography helps isolate and diagnose the response of the physics responsible for extreme rainfall to change with resolution. Results show that a uniform increase of sea surface temperature (SST) and an increase of low-to-high latitude SST gradient both lead to increase of precipitation and precipitation extremes for most latitudes. The perturbed SSTs generally have much stronger impacts on precipitation extremes compared with mean precipitation. The horizontal and temporal resolution of the model strongly affects the global warming signals in the extreme precipitation in the low to mid latitudes, but not in high latitude regions. This study shows that resolution-invariant treatments of atmospheric processes in AGCMs could lead to more robust projections of extremes at local and regional scales.