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Influence of horizontal model resolution on the horizontal scale of extreme precipitation events

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A fundamental characteristic of extreme precipitation events (EPEs) is the horizontal scale of the associated vertical motions, called “extreme ascent.” This horizontal scale can influence the intensity of an EPE through its effect on the temporal and spatial scales of an EPE as well as its effect on the strength of convective feedbacks. Thus, to have confidence in future projections of extreme precipitation, the horizontal scale of extreme ascent and EPEs in GCMs should be evaluated. Analyzing daily output from 27 models participating in the Coupled Model Intercomparison Project phase 6 (CMIP6), including 13 models participating in the High Resolution MIP (HighResMIP), we computed the horizontal scales of EPEs and extreme ascent for annual maximum EPEs during 1981-2000. We found that the horizontal scale of both EPEs and extreme ascent are resolution dependent, and the horizontal scales decrease as the horizontal model resolution increases. Further analysis reveals that this resolution-dependence is due to the fact that the precipitation during the EPEs is almost entirely resolved (rather than parameterized) precipitation. However, the EPEs are not simply grid-box storms and analysis of the horizontal scales of geopotential anomalies suggests that the large-scale dynamics in GCMs is not resolution dependent. Thus, the dominance of resolved precipitation during EPEs is more likely due to convection on the model grid or formation of strong fronts, and additional work is needed to explore these possibilities further and find a solution for the resolution dependence. This work is currently undergoing revision for consideration by Journal of Geophysical Research-Atmospheres.