

Observed and Model Simulated Atmospheric Circulation Patterns Associated with Extreme Temperature Days over North America

With a goal of understanding the physical mechanisms involved in extreme daily temperature events, we developed composite atmospheric circulation patterns associated with extreme daily temperatures over North America using a gridded daily temperature product and atmospheric reanalysis data. At most locations, warm extremes are associated with positive 500-hPa geopotential height and sea level pressure anomalies just downstream and negative anomalies farther upstream. The characteristics of these circulation patterns vary based on latitude, season, and the presence of nearby mountains and coastlines, with circulation patterns aloft more coherent in space than those at the surface. The anomaly patterns associated with cold events tend to be similar to, but opposite in sign of, those associated with warm events, particularly within the westerlies. The observed circulation patterns are compared with those simulated by a suite of seventeen climate models fully coupled, state of the art, general circulation models obtained from the fifth phase of the Coupled Model Intercomparison Project. In general, the multi-model ensemble mean represents the observed patterns well, especially in areas removed from complex geographic features (e.g. mountains and coastlines). Results from individual models vary; however the majority of models capture the major features observed. The multi-model ensemble captures several key features including regional variations in the strength and orientation of atmospheric circulation patterns associated with extreme temperature, both near the surface and aloft, as well as seasonal and latitudinal variations. Our results suggest that these models can be used to comprehensively examine the role that changes in atmospheric circulation will play in projected changes in temperature extremes due to anthropogenic climate change.