



Physical Behavior of Precipitation Extremes in CMIP5 GCMs and Observations

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Extreme precipitation events can cause costly and sometimes catastrophic floods in regions that may not be adequately prepared to combat such events. Therefore, adequate simulations by models are vital, a need which has prompted substantial interest in the science community. In order to gain confidence in climate models' ability to simulate the environment when these extreme precipitation events are occurring, simulations need to be compared to observational data. By using projections, based on validated models, decisions and analysis with regard to future climate change can be made with much higher confidence.

One source of model analysis lies in analyzing global climate models (GCM). We analyze the ability of sixteen CMIP5 GCMs to simulate extreme daily precipitation and supporting processes for regions of North America. The combined analysis allows us to assess added value of finer resolution in simulating extreme precipitation. Analysis focuses on selected regions of North America for winter (DJF) and summer (JJA), building on several previous analyses focused on this area. In addition to comparing results from the different models, we also compare simulated precipitation and supporting processes with those obtained from observed precipitation and reanalysis atmospheric states. Precipitation observations are from the University of Washington gridded data set. Reanalysis fields come from the North American Regional Reanalysis.

In both seasons, higher resolution models generally reproduce well the precipitation-vs.-intensity spectrum seen in observations, with a tendency toward producing overly strong precipitation at high intensity thresholds, such as the 95, 99 and 99.5 percentiles. Coarse-resolution global model output shows threshold values that are roughly one half the magnitudes of those in the higher resolution models and observations, most likely because of the coarser resolution. Further analysis focuses on precipitation events exceeding the 99.5 percentile that occur simultaneously at several points in the region, yielding so-called "widespread events". Collectively, the models tend to produce widespread events with larger spatial scale than observations, with coarser GCMs tending to produce extremes with the largest scales.

Analysis of 500 hPa heights, near-surface circulation and temperature and humidity fields are also analyzed. They reveal processes leading to extreme events in the models and observations. The higher resolution models generally reproduce the physical behavior leading to extreme events, especially in DJF, with the coarser models showing smoother fields, especially in summer. Further analysis will consider future extremes and their consistency with present extremes.