We analyze the ability of global (GCMs) and regional climate models (RCMs) to simulate very heavy daily precipitation and supporting processes. GCM output comes from the Coupled Model Intercomparison Project – Phase 5 (CMIP5); RCM output comes from the North American Regional Climate Change Assessment Program (NARCCAP). The NARCCAP results also include output from a time-slice, high-resolution global simulation. All NARCCAP output is at half degree resolution, while CMIP5 resolutions vary. The combined analysis allows us to assess added value of finer resolution in simulating very heavy precipitation. Analysis focuses on the upper Mississippi basin for winter (DJF) and summer (JJA). 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 dataset. Reanalysis fields come from the North American Regional Reanalysis.

In both seasons, the high resolution models generally reproduce well the precipitation-vs.-intensity spectrum seen in observations, while producing overly strong precipitation at high intensity thresholds. CMIP5 GCMs do not produce precipitation at high thresholds, 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". For widespread events, analysis focuses on 500-hPa and near-surface circulation, among others, to compare atmospheric states and processes leading to such events in the models and observations. The finer resolution models generally reproduce the physical behavior of very heavy events, with the coarser model showing a smoother rendition.