Precipitation extremes over the continental United States in a transient, high-resolution, ensemble climate model experiment

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Understanding future changes in the frequency, intensity and duration of extreme events in response to increased greenhouse gas forcing is important for formulating adaptation and mitigation strategies that minimize damages to natural and human systems. We quantify transient changes in daily-scale seasonal extreme precipitation events over the U.S. using a 5-member ensemble of nested, high-resolution climate model simulations covering the 21st century in the IPCC SRES A1B scenario. We validate our simulations over the baseline period using the NOAA CPC Unified precipitation dataset. Our results imply fewer but heavier precipitation events in the future, leading to more frequent wet and dry extremes in most regions of the U.S, and increasing contribution of extremes to total seasonal precipitation. We find substantial increases in the frequency of extreme wet events over the northwestern U.S. in autumn, winter and spring, and the eastern U.S. in spring and summer. Increases in dry day frequency occur over most parts of the U.S., with the most intense and widespread changes in summer. These changes in precipitation extremes result from changes in atmospheric circulation, moisture convergence and daily-scale precipitation variability. Our simulations suggest that many of these changes are likely to become statistically significant by the mid-21st century. To test the statistical significance of these changes, we employ the binomial test and the non-parametric Mann-Whitney U test. Further, we compare the intra-ensemble spread in the projections of the extreme precipitation metrics with their inter-model spread evaluated from the NARCCAP ensemble to understand the contribution of the different sources of uncertainty.