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Diversity of precipitation characteristics in contiguous United States: climatology, interannual variation, and change in the warming climate

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Individual precipitation events induce different levels of hydrological impacts given their diverse characteristics, not only in precipitation amount but also in precipitation rate, duration, and size. It thus calls for an understanding of the diversity in precipitation characteristics and its influence on the total precipitation in contiguous United States.

The framework we use to look into the precipitation diversity includes three steps: 1. we analyze the precipitation in observations (StageIV, 4kmx4km, 1h) and regional climate models (CCSM4-WRF downscaling,12kmx12km, 3h), in which the high spatio-temporal resolution enables us to "see" individual precipitation events. 2. switching from the Eulerian to Lagrangian perspective, we track individual rainstorms using Chang et al. (2016), in which algorithm both small and big events are identified to ensure the full spectrum diversity. 3. we use a set of metrics to characterize varying aspects of diversity and decompose their contributions to the total precipitation in CONUS. We also measure the variation and change in event frequency.

The overall understandings are the following: 1. as to the climatology, though certain rainstorms with longer duration or larger size have better abilities to produce precipitation, the scarcity limits their overall contributions to the seasonal precipitation in CONUS. 2. as to the interannual variation, for a wetter year when the total precipitation is larger than normal and events are more frequent, the averaged rainstorm size is larger though the intensified precipitation rate shortens the rainstorm duration. 3. as to the change in a warming climate (as in Chang et al. 2016), CCSM4-WRF projection under RCP8.5 scenario suggests that, along with the increasing precipitation amount and intensity, the averaged rainstorm duration become longer but the size becomes overall smaller. The total number of events does not change much. 4. different relations governing the interannual variation and mean state change suggest that the physics across varying time scales could be orthogonal and thus require individual investigation and comparison to reach an overall understanding.