Evaluation of Reanalysis Simulations of U.S. Precipitation Extremes

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Extreme precipitation events are the proximate cause of flooding, which is one of the most costly natural hazards. Both observations and climate model simulations suggest increases in precipitation intensity and frequency in a warming climate. Urban flooding is especially sensitive to changes in the statistics of short duration precipitation extremes, whereas floods in large river basins are more sensitive to accumulated precipitation over multiple day and longer periods. We evaluate reanalysis products for sub-daily to multi-day extreme precipitation in comparison with observations across the continental U.S. We processed hourly precipitation data from 1800 stations that have relatively complete records for the period 1979-2009. Hourly precipitation observations were used to estimate annual/seasonal maximum precipitation at 6, 12, 18, 24, 48, 120, and 240 hour durations. These observations from station data were then gridded at 0.5 degree resolution to generate gridded observations of precipitation extremes for the United States. We interpolated precipitation extremes (6-hour) from the reanalysis products (NASA-MERRA, CFSR, ERA-Interim, NCEP-DOE (R2), 20th Century Reanalysis (v2), and NARR) at the same 0.5 degree grid using appropriate areal reduction factors. For each of the precipitation durations, annual/seasonal maximum precipitation and precipitation maxima at return periods from 5 to 100 years estimated from probability distributions fit to the reanalysis products were compared with distributions fit to the gridded observations. We assess spatial variations in biases in the reanalysis produces relative to observations as a function of precipitation duration and return period.

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