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Predicting hydrologic extremes in a changing climate

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On the basis of first principles, precipitation – the primary driver of land surface hydrology – is expected to increase in a warming climate due to increased water vapor holding capacity of the atmosphere. While this effect is spatially variable due to other factors such as changes in atmospheric circulation, over much of the globe most climate models predict increased extreme precipitation (regardless of predicted changes in the long-term mean). Changes in flooding often have been interpreted by the climate community in the context of changing precipitation extremes (hence many climate reports project increased flooding), but this is not substantiated by streamflow observations. I explore some of the reasons for this discrepancy, including recent work on the role of changes in antecedent soil moisture (mostly drying due to increased evaporative demand) and changes in storm extent. I also present recent work examining changes in rain-on-snow (ROS) flooding in those parts of the conterminous U.S. where ROS contributes substantially to the annual maximum series, and where cold season warming has affected patterns in ROS events. Droughts, like floods, are widely expected to increase in a warmer climate. However, also in common with flooding, evidence for ongoing changes is less clear. I show results from recent work over the conterminous U.S. (CONUS) documenting that most of the 16 “great droughts” (those covering over half of the CONUS at their maximum extent) occurred in the first half of the ∼100-year record, and only two have occurred in the last 30 years. I discuss reasons for the apparently diminishing number of great droughts.