Observed and projected hydroclimatic variability and change in the southwestern United States

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We present a summary of recent research on regional climate change in the southwestern U.S., emphasizing precipitation and other hydroclimatic variables. Paleoclimatic reconstructions of precipitation and streamflow illustrate that there have been very pronounced decadal-scale climatic variations in the Southwest throughout the past millennium. A growing body of empirical and model-based evidence points to tropical ocean fluctuations as a likely primary cause of interannual/decadal anomalies, via the effects of tropical SST anomalies on shifts in the cold season storm track across western North America. The extreme drought during the first half of 2011, in concert with a strong La Niña event, is certainly consistent with this concept.

Future model-based projections of climate change associated with increasing greenhouse gases suggest a modest downward century-scale trend in regional cold season precipitation and no clear trend at all in summer precipitation. Pronounced interannual/decadal variability provides considerable "noise" in the precipitation record, compared to which existing projections of forced long-term trends in 21st Century precipitation are relatively small.

Nevertheless other hydroclimatic variables that are more directly associated with surface temperature -- including snowpack, soil moisture and streamflow -- are projected to change very considerably during this century. Projected temperature increases, if realized, would generate very significant decreases in hydroclimatic variables even in the absence of regional precipitation decreases. Preliminary analyses of recent decadal variability suggests that these hydroclimatic changes are underway, despite no clear trends, but lots of variability, in observed precipitation.