

Decadal Hydroclimatic Variability over Western North America

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Abstract

Variability of precipitation over North America on ENSO and decadal time scales is examined from several decades of precipitation and snow course records. Band pass (periods of 3-7 years) and decadal (periods of 7 years and greater) filtering was performed on gridded precipitation data (obtained from Eischeid and Diaz, NOAA) to isolate ENSO and decadal period fluctuations. For both time scales, three prominent patterns that emerge, via a rotated principal components (RPC) analysis, have anomaly centers over (1) the Pacific Northwest and (2) the Southwest, and (3) California-Nevada. Components of these same patterns are also present in the high elevation springtime snow accumulation fields as measured at a set of snow courses over the western United States. In the time domain, similar decadal filtered historical time series of snow accumulation and streamflow confirm the decadal RPC fluctuations – there is a close comparison between the RPC time-varying amplitudes, regional snow course records, and a representative stream gage record in the three respective regions.

To begin to understand the causes of these low-frequency variations in precipitation, the RPC series were correlated with gridded historical sea level pressure (SLP) and sea surface temperature (SST), which were also filtered at the ENSO or decadal bands.

The fields of correlation that emerged indicate that anomalous precipitation is driven by low-frequency changes in the atmospheric circulation. In general, anomalously low pressure over a particular region or just upstream to the northwest is associated with heavier-than-normal precipitation. There are also associated anomalous regional and larger scale patterns in SST, but the question remains whether SST is a *causal factor* or just another *symptom* of altered circulation?

There is some evidence that western North America precipitation modes associate with *global* SLP and SST anomalies. In these cases, the SLP anomalies cross the hemisphere and cross the equator, while SST patterns show significant correlation over the global ocean basins. The Southwest decadal precipitation pattern (mode 1) relates to an El Niño-like SST anomaly pattern and an inter-hemispheric pressure mode. This mode, which has seen increased precipitation and snowpack since the 1970s, projects quite strongly upon a global decadal precipitation pattern with primary center in the Sahel. Thus, there is some evidence of a global component in western North America precipitation.