Diagnosis of Changing Cool Season Precipitation Statistics in the Western U.S. from 1916-2003

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ABSTRACT:
Since about 1977, cool season (Oct-March) precipitation in the Western U.S. has increased in variance, autocorrelation, and regional covariance. These changes have manifested themselves in increasing flood risk, increasing confidence of regional hydropower resources, and increasing drought and fire impacts in the west. We explore these changes in precipitation variability using two approaches: statistical analysis of regionally averaged cool season precipitation (mean, variance, autocorrelation, and regional covariance) and an EOF analysis of 1/8th degree gridded cool season precipitation anomalies over the western U.S. The changes in cool season precipitation are characterized by statistically significant changes in the variance (p=0.05). Increases in autocorrelation and regional covariance, although substantial on an absolute scale, are not statistically significant (p=0.85). The EOF analysis shows increased amplitude of the PC associated regional covariance (EOF1) starting around 1977, and the PC associated with the N/NW dipole (ENSO/PDO) (EOF2) also shows evidence of expanding variance at about the same time. Although the paleological record supports the argument that natural variability is sufficient to explain the late 20th century patterns in the CORB and SSJ, it remains unclear whether global climate change is contributing to the effects or not. GCMs do not reliably simulate the changes in precipitation variability seen in the observed record (thus conventional detection and attribution studies typically fail in the initial step), however this could also be related to other factors such as GCM deficiencies in simulating cool season precipitation variability at the regional scale. That said, there is currently little evidence to support the hypothesis that recent changes in cool season precipitation variability are an expression of global greenhouse forcing.

RESULTS:
The EOF analysis shows increased amplitude of the PC associated regional covariance (EOF1) around 1977. The PC associated with the N/NW dipole (EOF2), which is well correlated (r=0.5) with ENSO/PDO also shows evidence of expanding variance at about the same time. Although the mean of the PC1 is not significantly different after 1977, the change in variance is strongly statistically significant (p=0.05).

DISCUSSION:
The expansion of variance in EOF1 explains both increased variance and increased regional coherence in the regional average time series. EOF1 shows more red noise characteristics post 1975 indicating increasing persistence and amplitude of coherence throughout the west. EOF2 seems to be functioning more on interannual time scales and exhibits less long-term persistence. The ENSO/PDO pattern associated with EOF1 seems to be getting stronger in the extremes, but expresses itself only in isolated years and therefore does not greatly interfere with the large coherent signals associated with the expansion of variance in EOF1.

REFERENCES:

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