

# Precipitation and Drought in the Rio Yaqui Watershed

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31 January 2006

## ABSTRACT

Characterized by a semi-arid climate, the Rio Yaqui watershed is one of the major river systems of northwest Mexico. A diverse agricultural economy, centered in the lower Yaqui Valley and anchored by highly-productive wheat and soy croplands, is dependent upon the availability of irrigation water from reservoirs in the Yaqui basin. Such an arrangement is vulnerable to disruption, as demonstrated by a recent drought. In this study, we use a statistical approach to explore the variability of precipitation and drought on seasonal to decadal timescales, and identify sources of predictability.

We have developed a monthly 1900-2003 precipitation index for the Yaqui basin by merging two gridded land-surface precipitation products derived from local station data. Average annual rainfall is  $553 \pm 104$  mm, arriving via two distinct seasonal mechanisms. “Summertime” (JJAS) rainfall dominates the annual total (71%) and is associated with the North American Monsoon System, but we have been unable to identify any large-scale climatic processes associated with summertime anomalies. Significantly less rain (22%) falls during “winter” (NDJFMA) although the absolute variance in the seasonal total is actually larger. Monthly anomalies tend to be well-correlated with one another during the winter months and the seasonal anomalies are well-correlated ( $r = 0.5$ ) with indices of ENSO, which is known to deflect the storm track during El Niño years. Using this relationship, we develop two types of simple models for forecasting wintertime total precipitation: a “deterministic” linear-regression model and a “probabilistic” tercile model. If we employ recently-developed ENSO models rather than simply relying on persistence of current ENSO conditions, reasonably skillful forecasts of wintertime rainfall can be made up to six months out.

Through analysis of our precipitation index and a 350-year proxy for wintertime rainfall based on Douglas Fir ringwidth chronologies, we find that serious droughts recur on multidecadal timescales and can be caused by persistent deficits in either season. The greatest wintertime deficits of the entire 350-year record were found to occur during the most recent drought.