Meko Uses Tree Rings to Solve Monsoon Mystery

• *By Melanie Lenart*

The North American monsoon usually arrives in the Southwest with fanfare, making lightning bolts fly, rivers flow, and trees grow. Like the clouds carrying the rains, though, evidence of the monsoon was quickly dissipated – until LTRR researcher Dave Meko figured out how to detect a long-lasting signal in tree rings.

Meko, a Principal Research Specialist at the Laboratory of Tree-Ring Research, managed this by dividing the annual growth of certain trees into pre-June (earlywood) and post-June (latewood) growth. Using a separation technique developed by Senior Research Specialist Chris Baisan, Meko worked out the statistical details so the annual rings can yield seasonal information.

"By separating out the summer with the latewood component you get a super signal," Dr. Meko explained. "It's been so dry in the spring before the rains start up that the trees are primed to respond to whatever happens."

The monsoon typically sweeps into the Southwest by early July. The hot, cloudless days of May and June inspire many southwestern trees to taper off their wood production, putting down darker wood that remains as a telltale sign of the seasonal slowdown. By recognizing these seasonal markers and separating the growth periods into "before" and "after" the dry spring, Meko has improved reconstructions of past precipitation for both summer and non-summer.

For example, using five Arizona sites in various mountain ranges stretching north between Tucson and Tombstone, Meko and colleagues were able to predict about 53% of the variability in regional summer rainfall and 64% of the variability in non-summer precipitation, using historical records as the basis for comparison. This compares to being able to predict about 45% of the variability in annual precipitation when both growth periods are lumped together into one annual ring.

One result of this pioneering research is that Meko can reconstruct monsoon strength beyond historical records, which extend only to 1868 at best.

"It turns out the quality of the latewood is good enough to use in a regression model and get accurate estimates back in time," Meko noted.

So far, the LTRR researcher has created a 242-year proxy record of summer rainfall that reflects monsoonal strength in southeastern Arizona and southwestern New Mexico. By "splicing together" information from wood samples stored in the LTRR archives, Meko hopes to extend the information on Southwest summer rainfall back to the 1500s or beyond.

The regression model relates the average size of the summer season tree ring to estimated inches of rainfall that season. Previously, Meko and Baisan used a non-linear model to reveal unusually dry summers of the past without trying to reconstruct rainfall totals.

Their initial analysis indicated the monsoons in the 20th Century were more reliable than those of the previous century, where a cluster of three dry summers in 1822 capped off 11 dry summers since 1791. A summer was considered dry in the historic part of the record if less than five inches of rain fell after June.

The expanded regression analysis also increases understanding of another feature of summer rainfall in the region. Historical records show little correlation between southwestern winter precipitation, which is generally related to large-scale circulation patterns like El Niño, and summer rainfall, which is usually linked to thunderstorms, tropical depressions, and the monsoon.

Meko's tree-ring reconstruction indicates winter and summer precipitation patterns are no more strongly related in the long term. So attempts to predict monsoon strength based on winter precipitation will generally fail in the region covered by his analysis.

Winter precipitation might not help predict the coming monsoon's strength, but Meko hopes the creation of a longer timeline of monsoonal rainfall will shed light on other cyclical patterns.

"This will give us an idea of the mechanism behind the monsoon," he noted. "And anything that helps us understand the mechanism of the monsoon can help us predict future occurrences."

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Dave Meko, shown here in the Rincon Mountains before the 2003 monsoon season, uses tree rings to estimate past summer rainfall.