The 2012 Monsoon Forecast: A Case for Optimism

By Zack Guido

The North American monsoon, the fickle phenomenon that is the summer rainy season in the Southwest, is forecast to be more vigorous than average, with a strong beginning and end.

During most years, the July–September rainy season forecast for Arizona and New Mexico is no better than a coin flip. But not this summer, when increasing confidence has caused forecasters to paint a more optimistic picture—good news for a region that has been caught in the throes of short-term severe drought for more than 18 months.

"The ecosystem is so tuned up to summer moisture that an early, consistent monsoon can stimulate a robust growing season and provide short-term drought relief," said Mike Crimmins, a climate extension specialist at the University of Arizona.

Figure 1. Monsoon rains are a welcome guest in the Southwest, helping to suppress scorching temperatures and delivering nearly half of the yearly rainfall for parts of southern Arizona and New Mexico. Photo Credit: Zack Guido

Forecasting challenges

Forecasting the monsoon is no easy task. Experts at the National Oceanic and Atmospheric Administration's Climate Prediction Center (CPC) mine 41 different analysis tools, from global climate models that incorporate atmospheric physics to historical relationships between rainfall and the state of El Niño–Southern Oscillation (ENSO), a natural force that influences climate and weather around the globe.

In May, conflicting evidence in many of these tools created doubt about the strength and onset of the 2012 summer rains, resulting in an "equal chances" forecast that the monsoon would be above, below, or near average.

"I tried hard to put something on the map because we know most people think [equal chances] is a non-forecast," said Jon Gottschalck, head of forecast operations at the CPC. "When I was making [the forecast in May] the signals were all over the place."

Uncertainty in the monsoon is the norm. The CPC has stamped an "EC" on the Southwest in 12 of the 17 years forecasts have been issued in May. Part of the forecasting challenge lies in geography: Arizona and New Mexico sit on the northern fringes of the core North American monsoon region, which is centered over the Sierra Madre Occidental in northwest Mexico. As a result, many climate factors come into play and cause high year-to-year and month-to-month variability.

"Sea surface temperatures in the Pacific and Atlantic oceans, snow cover in the Rocky Mountains, the state of El Niño–Southern Oscillation, dry conditions in the Midwest, and tropical storm activity have all been stated to influence the monsoon during different places and-times of the season," Crimmins said.

Optimistic Outlooks

In June, forecast models and other analysis tools became strong enough to slightly nudge the optimism of CPC forecasters.

"Our main climate model has been doing very well in recent years and has

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shown some accuracy in forecasting the monsoon during the first month," said David Unger, a CPC meteorologist. "There is some indication that July will be above average, and even if the final two months are average, there is still a good chance for a wet monsoon."

It is still a cautious forecast; the odds are only slightly better than equal chances that about half of Arizona and New Mexico will get a healthy dousing (*Figure 2*). Also, the CPC model has shown little accuracy forecasting August and September with more than a 30-day lead time, and so these months remain a black box to the CPC.

"Monsoon forecasting over the season is so difficult," Gottschalck said. "July through September is a long period, and a lot can happen. Anything early on could be completely outweighed by the final two months."

Despite CPC uncertainty in much of the monsoon, a strong start favors an above average season. Another forecast, based on past summers that most resemble current and expected conditions, also bolsters this outlook.

"The bottom line is that when we look at our analog forecast, it is for a wet July, a so-so August, and a wet September," said Art Douglass, professor and chair of the department of atmospheric sciences at Creighton University.

Douglass, who has been forecasting the monsoon since 1977, developed this outlook by analyzing 12 variables that span the Pacific and Atlantic oceans, including SSTs, sea level pressure, pressure levels in the atmosphere, and tropical convection. Five summers on record—1984, 1986, 2001, 2006, and 2008—had very similar conditions to those in June. When combined, most of Arizona and New Mexico received between 110 and 150 percent of average during these summers (*Figure 3*).

"When you composite these years, it's a pretty optimistic forecast for rain," Douglass said.

Monsoon by month

The strings guiding Douglass' forecast are tethered to conditions in the Midwest and Pacific Ocean. Research in the late 1980s, for example, found a strong correlation between dry conditions in the Midwest, centered over Iowa, and wet weather over the Southwest and northern Mexico during the initial weeks of the summer rainy season.

"If you're interested in what's going on in the southwestern U.S., you also better be interested in what's going on in the Midwest," Douglass said. "And if you start looking at lags, it's the Midwest that seems to be behaving first."

The Midwest has been dry for the past three months, with many parts of the region receiving less than 70 percent of average. The SSTs in the tropical Pacific Ocean have been recently warming and also favor an early and wet onset.

"This year sea surface temperatures look nearly identical to last year," said Christopher Castro, an assistant professor of atmospheric sciences at the University of Arizona. "This would suggest an early to average start with average to above-average precipitation from late June to early July."

El Niño also figures into the mix. SSTs are currently near average, but many ENSO forecasts project El Niño will develop by late summer.

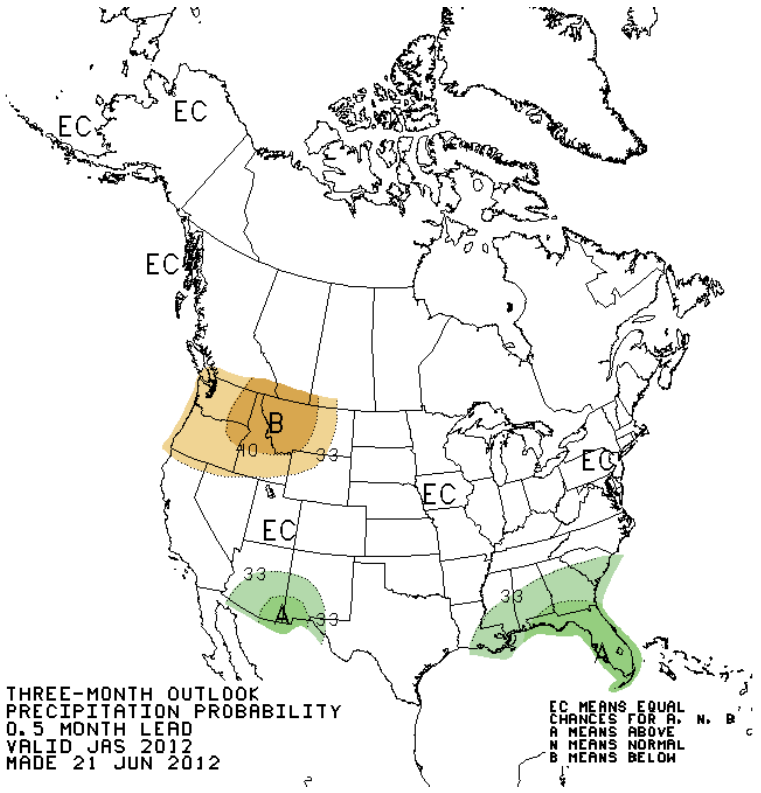

Figure 2. The July–September forecast issued by the CPC on June 21. Green hues represent regions in which rainfall is expected to be similar to the wettest 10 years in the 1981–2010 record. The numbered contours represent the probabilities for conditions to be similar to the wettest, driest, or middle third. Equal chances reflects a 33 percent chance that rainfall will be in one of the three categories. Image credit: NOAA-CPC

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During El Niño summers, conditions in August tend to be dry, Douglass said. Generally, this occurs because the subtropical jet intensifies as SSTs warm. This, in turn, pulls the monsoon high south, exposing southern Arizona and New Mexico to the dry northern side of this high.

As for September, El Niño conditions tend to increase the frequency of tropical Pacific Ocean storms, which can squeeze moist air from the Gulf of California into the Southwest. The intensifying subtropical jet and waning solar radiation also creates a conduit that helps steer storms into the region.

There are no guarantees that El Niño will evolve in this manner, however, Douglass said. It's a forecast based solely on historical data.

Nonetheless, after two consecutive dry winters that sandwiched a lackluster monsoon for many parts of the Southwest, optimism is a welcome guest. If the forecasts prove accurate, the monsoon will help squelch dry conditions that have been plaguing the region. The recent thunderstorms in southern Arizona on June 16 and again around June 24 had a monsoon flavor, suggesting an early and strong beginning. The storms could also be a false start, as they sometimes have been in the past, proving again that the monsoon is a fickle phenomenon.

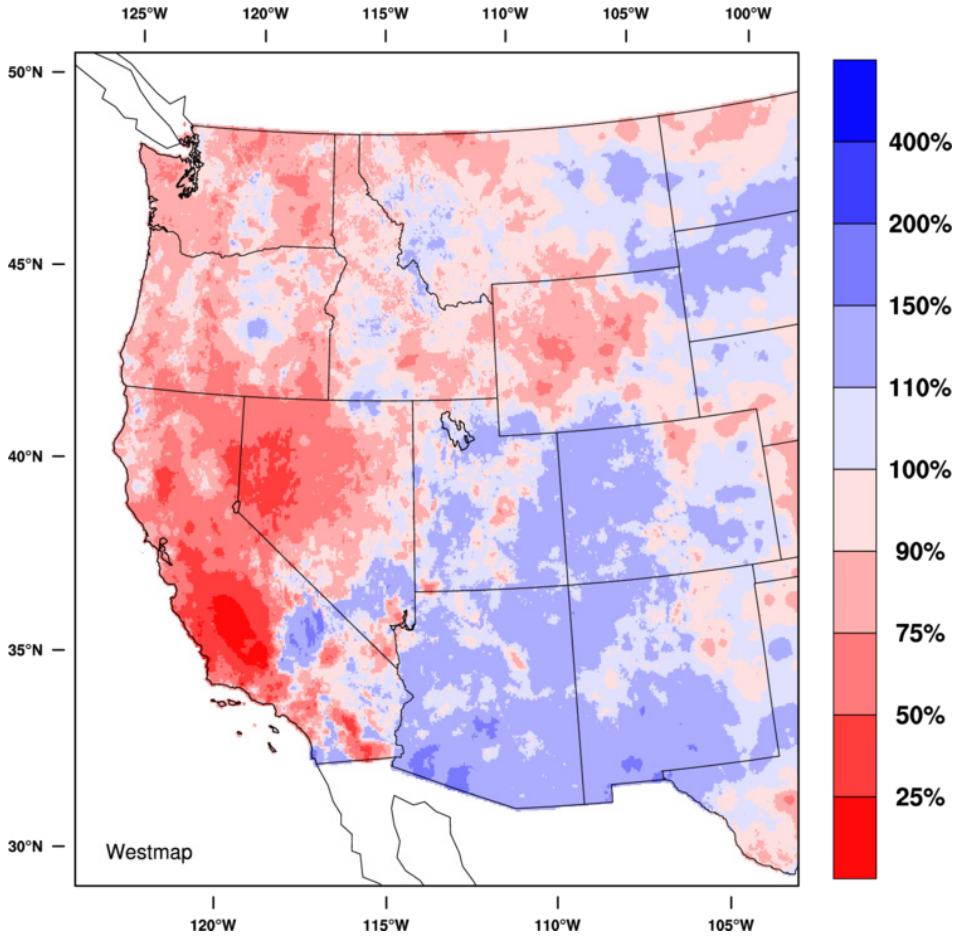

Figure 3. In the historical record, five summers most resemble current conditions defined by 12 climate variables. Comparing the total June–September precipitation for these years—1984, 1986, 2001, 2006, and 2008—suggests that most of the Southwest may receive rainfall totals exceeding 110 percent of the 1971–2000 average. Image credit: Westmap.