Forecasting the Monsoon: What to Expect (or not) this Summer

By Zack Guido

As fires rage and drought intensifies and spreads in Arizona and New Mexico, questions about the monsoon are on everyone's mind. Will the monsoon deliver copious rains like it did in 2006, or will it fizzle like it did in 2008? And when will it arrive this year?

The answer to all of the above? We'll have to wait and see, because the monsoon forecast isn't the crystal ball we'd like it to be.

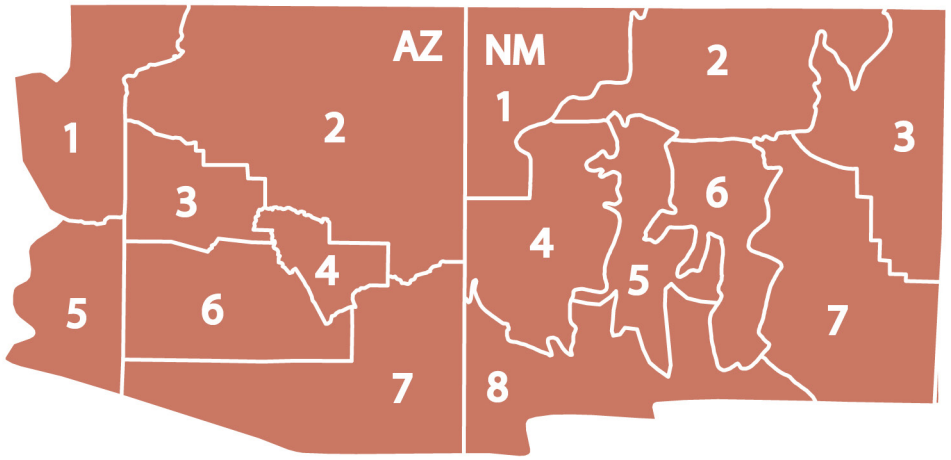
Forecasting when the raucous rain will come—let alone how much rainfall will occur over the season—is hard, plain and simple. In recent years, however, forecast models have shown some accuracy in projecting the onset, especially when strong climate signals, such as very warm or cold sea surface temperatures (SSTs), occur in the tropical Pacific Ocean, Gulf of California, and Atlantic Ocean. When these signals are weak, it's a three-way tie for early, late or on time.

On average, the monsoon season starts in early July for southern parts of Arizona and New Mexico, and later in areas to the north. Recently, the National Weather Service adopted a static start and end date to the monsoon season–June 15 and September 30—to simplify communicating the onset of monsoon hazards, such as floods.

Forecasts for the total seasonal precipitation of the Southwest monsoon, however, generally have not been accurate.

Predicting summer rain is hard, said Dave Gochis, scientist at the University Center for Atmospheric Research in Boulder, CO, and the North American Monsoon Experiment (NAME). NAME is an international scientific effort established in 2004 to observe and understand the key components of the North American monsoon system to improve forecasting. Predicting the monsoon is difficult in

Monsoon Rainfall Statistics, July–September 1895–2010



Climate Division	Monsoon Average (inches)	Monsoon Percent of Annual Total	Minimum (inches)	Maximum (inches)
AZ1–Northwest	3.12	32	0.59	9.80
AZ2–Northeast	4.83	38	1.99	8.60
AZ3–North Central	5.70	37	2.47	11.58
AZ4–East Central	6.90	35	3.25	11.94
AZ5–Southwest	1.82	36	0.45	6.54
AZ6–South Central	3.66	36	1.03	7.70
AZ7–Southeast	6.99	51	3.55	10.80
NM1–NW Plateau	4.45	41	1.73	9.09
NM2–Northern Mtns	7.19	41	3.95	11.76
NM3–NE Plains	6.94	45	2.77	14.09
NM4–SW Mtns	7.28	50	3.54	11.70
NM5–Central Valley	5.28	50	2.30	10.36
NM6–Central Highlands	7.76	49	3.97	14.23
NM7–SE Plains	6.36	47	2.17	13.44
NM8–Southern Desert	5.72	52	2.53	11.66

Figure 1. Monsoon rainfall in Arizona during July-September is, on average, highest in the southeast part of the region and diminishes to the north. In New Mexico, monsoon rainfall is less variable spatially, and the southern half of the state receives about 50 percent of its yearly precipitation during these three months. The data source is PRISM and accessed through the online web tool WestMap.

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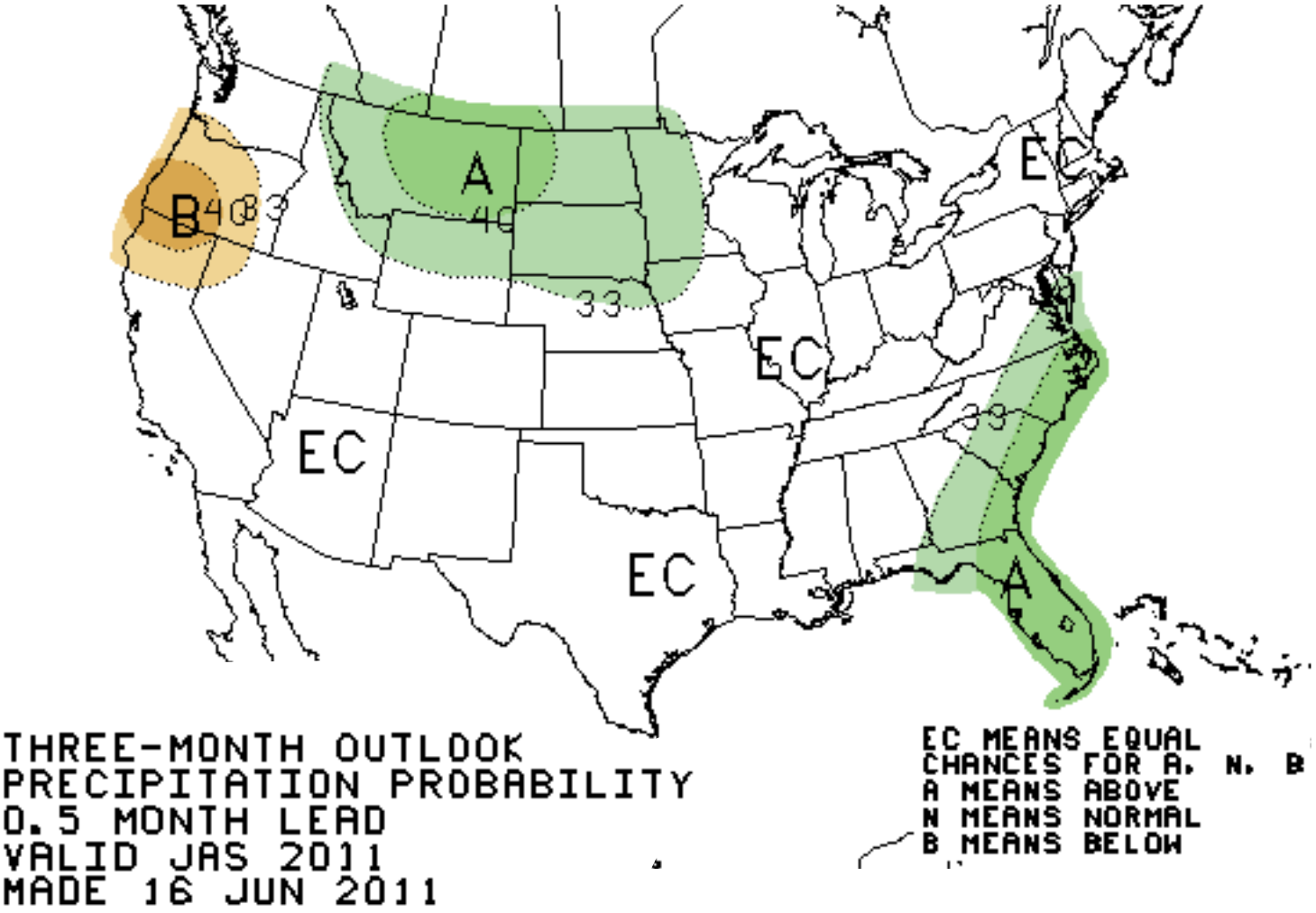

Figure 2. The NOAA-Climate Prediction Center forecasted on May 19 an equal chance that July-September rainfall will be above, below, or near average.

part because Arizona and New Mexico lie on the northern fringes of the monsoon region and are therefore influenced by many climate and weather processes: the position of the monsoon ridge, the rate at which the landscape heats up in the spring and summer, the amount of snowfall in the preceding winter, and SSTs in the tropical and north Pacific Ocean. All these factors add uncertainty to the forecasts.

"Being on the northern periphery of the monsoon region causes the monsoon to be unique every year," said Mike Crimmins, climate science extension specialist at the University of Arizona. "If you were in central Mexico, the heart of the monsoon region, you would expect it to deliver each year. But here [in the U.S. Southwest], there are additional variables that either enhance or suppress the monsoon, which causes high variability in our region."

Generally, southeast Arizona and southern New Mexico receive the most rainfall, with average summer precipitation declining to the north (*Figure 1*).

Additional questions arise related to a nascent scientific understanding of convection dynamics and the role of vegetation in recycling water back to the atmosphere through evapotranspiration. Both are important components of the monsoon but cannot be fully represented in most computer models due to the models' large spatial resolution (typically a 50-km by 50-km grid). That size effectively flattens the high elevations of relatively small mountain ranges that play a key role in initiating monsoon storms, rendering the results of computer simulations likely less reliable than if models incorporated realistic topography.

The general onset data and total precipitation of this monsoon season is proving particularly difficult to forecast. "Predictability [of the onset this year] is not what it has been in recent years because of mixed signals," Gochis said.

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To issue forecasts, 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 statistical trends. The monsoon outlook, then, is a blend of science and expert judgment.

This summer, some tools point to wetter conditions and others to drier. As a result, the official U.S. seasonal climate outlooks issued by the CPC call for equal chances of above-, below-, or near-average rainfall for the monsoon season (*Figure 2*).

The primary basis for this forecast is that the moderate to strong La Niña event that delivered dry conditions this winter waned rapidly this spring and SSTs in the tropical Pacific are now near average. Meanwhile, SSTs in the Atlantic Ocean and Gulf of California are above average, but only slightly so. As a result, no strong climate signals have emerged to nudge the model one way or the other.

In addition, a heavy snowpack has blanketed the Rocky Mountains, which tends to help delay the onset of the monsoon, while a drought has gripped Texas and the Southwest, favoring an earlier onset.

The ambiguous signals make it difficult to forecast wet or dry, said David Unger, meteorologist at the CPC. Seasonal forecasts are also conservative because climatologists want to avoid false predictions.

Several other forecasts warrant mentioning. The experimental forecasts produced by NAME suggest a late onset and below-average rainfall. (Again, note that forecasts for total precipitation during the monsoon season have not been accurate).

"We haven't seen a forecast in four years since we started [these experimental forecasts] that has been this dismal," Gochis said.

Conversely, a forecast issued by Art Douglass, professor and chair of the department of atmospheric sciences at Creighton University in Nebraska, suggests that the monsoon will be above average for June through August. Douglass's approach does not rely on forecast models. Rather, he analyzes 15 different phenomena that influence the monsoon in the Southwest and selects past years that have similar climate conditions as this year. This analog year approach uses the past as a guide for the current season.

While it's unclear when the monsoon will arrive and whether it will deliver on rainfall totals, one thing is completely clear. The region is hanging its hopes on the rains to douse the wildfire flames and quench a thirsty landscape.