September 23, 2010

Southwest Climate Outlook

Vol. 9 Issue 9

Source: Zack Guido, CLIMAS.

Photo Description: Monsoon storms flooded some streets in the Southwest this summer, particularly during the heaviest and most continuous period between mid-July and mid-August. Photo was taken on August 29 in South Tucson.

Would you like to have your favorite photograph featured on the cover of the *Southwest Climate Outlook*? For consideration send a photo representing Southwest climate and a detailed caption to: macaulay@email.arizona.edu

In this issue...

CLIMAS Climate Assessment for the Southwest

ARIZONA COOPERATIVE EXTENSION THE UNIVERSITY OF ARIZONA • COLLEGE OF AGRICULTURE AND LIFE SCIENCES

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September Climate Summary

Drought– Much of southeastern Arizona and southern New Mexico remain drought-free where abundant monsoon rains were observed. Drought conditions continue to worsen across northwest Arizona, where overall monsoon season precipitation has been spotty and generally below average.

Temperature– Temperatures during the last 30 days generally have been 0–4 degrees F warmer than average. Since the water year began on October 1, conditions have remained cooler than average in the Southwest.

Precipitation– The monsoon season is winding down. Precipitation in the last 30 days has been drier than average except in a few locations, including southeastern Arizona.

ENSO– A La Niña Advisory remains in effect, meaning that La Niña conditions are present across the equatorial Pacific Ocean. These conditions are expected to persist and possibly strengthen through the upcoming fall and winter seasons.

Climate Forecasts– Drier-than-average and warmer-than-average conditions are forecasted for all of Arizona and New Mexico through the winter. The ongoing and strengthening La Niña event heavily influences these outlooks.

The Bottom Line– The monsoon season shaped up to be near average in most parts of the Southwest but was unique nevertheless. High humidity, warmer-than-average nighttime temperatures, and a brief wet period between mid-July and mid-August defined this summer. In the past 30 days, drier- and hotter-than-average conditions covered most of the Southwest. Drought conditions, however, remained similar to last month, but may expand soon. The current La Niña event is moderate to strong, which portends drier-than-average winter conditions and is reflected in the most recent seasonal climate forecasts. Temperatures are also expected to be warmer than average, reflecting both the La Niña event and the warming trend observed in recent decades.

Lake Mead water levels not the whole story

Lake Mead's water levels declined slightly last month, inching to within 13 feet of the 1,075 elevation line that will trigger water allocation declines in the Lower Colorado River Basin. But joint management of Lakes Powell and Mead is often overlooked when discussing water shortages, and temporary relief may be on the way from Lake Powell.

Water managers devised a set of rules for different scenarios outlined in the 2007 Environmental Impact Statement that provide guidelines for managing the basin under drought conditions. Under these rules, Lake Powell would release additional water to Lake Mead if water level forecasts in April suggest that Lake Mead levels will fall below 1,075 feet above sea level and Lake Powell water levels are within specific ranges on September 30. The recent September forecast issued by the Bureau of Reclamation (BOR) suggests a 58 percent probability Lake Powell will release 11.28 million acre-feet (MAF) after April 1, 2011, about 3 MAF more than average. This extra pulse would have the effect of increasing the water level in Lake Mead by about 30 feet and delaying water rationing. If drought conditions continue to lower the water levels in both reservoirs, this extra dollop could be a one-time deposit.

Read more about joint management of Lakes Mead and Powell under drought conditions on the Record of Decision for the Final Environmental Impact Statement posted on the BOR's website: http://www.usbr.gov/lc/region/programs/strategies.html

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A One-Month Wonder: spottiness and brevity characterize 2010 monsoon season

By Zack Guido

The 2010 monsoon season in the Southwest was lackluster at first glance. Clouds arrived late. Storms burst in fits and starts only briefly. And then the rains disappeared. By the middle of September, the seasonal precipitation total was a drab near average.

Describing this monsoon season as average, however, would be a slight. It had many peculiarities, according to climatologists and meteorologists at universities and National Weather Service offices around the Southwest.

"I can't think of another year I would characterize as similar," said Dave Gutzler, professor of earth and planetary sciences at the University of New Mexico and someone who has focused his attention on understanding the monsoon in the Southwest.

The rapid transition from El Niño to La Niña helped set the stage for the delayed arrival. Rain had higher variability from place to place than is typical. Humidity was high even in periods without rain. Storms were glued to the mountains. Nighttime temperatures soared. And most of the rain came in a four-week period, leaving many forecasters and climatologists calling this season a one-month wonder.

While it's too early to have crunched data and weave these pieces into a coherent story—two weeks remain to squeeze monsoon moisture from the atmosphere—exploring the characteristics and their causes will help place this season into a proper context.

The Sun Primes the Monsoon

Monsoon rains contribute more than 40 percent of the annual precipitation total for many places in Arizona and New Mexico, providing important moisture for urban water supply, farming, and agriculture. Forecasting the monsoon and understanding its behavior in future climes is therefore important to many people. While the complexities of the monsoon present challenges to detailed predictions, monsoon basics are well understood and provide a solid foundation for expectations.

The monsoon is driven by the sun heating up the land and the Pacific Ocean at different rates, with land surfaces warming more quickly than the ocean. As the spring transitions into summer, the warming land causes air to rise like a hot air balloon, creating low-pressure zones. Winds from the west and south rush in to fill the void created by the rising air and carry with them cooler, humid air from the Gulf of California. As the moist air wafts over the hot land, it warms, rises, and eventually coalesces to form towering anvil clouds that are precursors to intense thunderstorms.

The monsoon has a built-in amplifying system so that rain begets rain. When the precipitation starts—usually around the first week of July for Arizona and New Mexico—vegetation grows and releases moisture back to the atmosphere, adding humidity to the moist air continuously flowing in from the Gulf of California. This cycle usually continues until around the end of September, when the shrinking temperature difference between the land and water sufficiently reduces the flow of air into the Southwest.

How the 2010 Monsoon Evolved

The 2010 monsoon was like a poor Broadway performance. It arrived on stage late, dazzled the viewers while it lasted, but exited too early, leaving the audience wanting.

Percent of Normal Precipitation

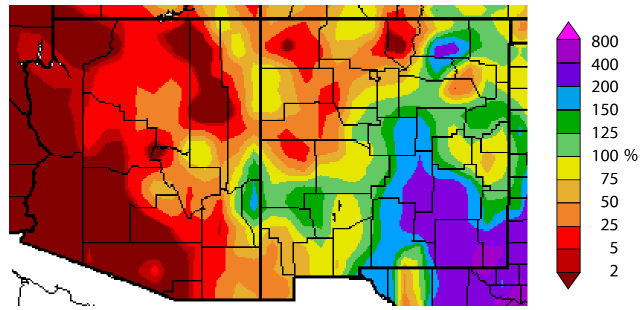

Figure 1a. June 15–July 14, 2010.

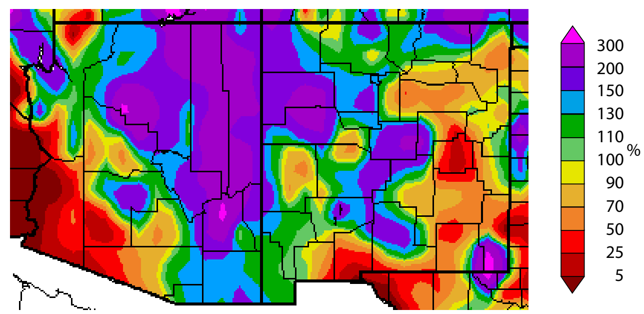

Figure 1b. July 15–August 13, 2010.

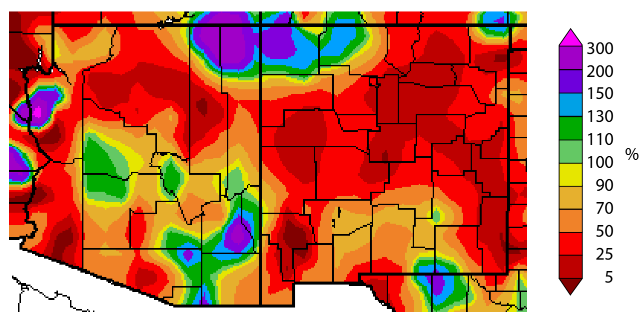

Figure 1c. August 17–September 15, 2010.

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monsoon season, continued

Forecasters had expected a later start to the rains and warmer temperatures, in part because the Pacific Ocean was experiencing a rapid shift from El Niño to La Niña conditions.

"We are going to have a hotter-than-usual summer and we're expecting the monsoon high to move north a little late, which is an expectation based on the climatological trend—the Southwest has been heating up over the past 20 years," Erik Pytlak, science and operations officer for the National Weather Service (NWS) in Tucson, said on June 11. "There are also equal chances for experiencing above- or below-average precipitation this summer, in part because in the past years where we've gone from a strong or moderate El Niño to a La Niña very rapidly we tend to have pretty average summer rainfall."

For the most part, this forecast was spot on. Between June 15—the official start date of the monsoon adopted by the NWS in 2008—and July 15, rainfall totals were below average in nearly all parts of Arizona and northwest New Mexico (Figure 1a). Rains did not begin until around July 15—roughly a few weeks later than the average start date—despite high humidity, a clear indication that moisture is available to form storms.

When the rains finally came, they were intense, spotty, and lasted only about four weeks in most of the Southwest except for southeast Arizona, where they continued longer (Figure 1c). Between about July 15 and August 15, monsoon storms doused the high country in the north and the lower deserts with more than 130 percent of average rainfall (Figure 1b).

In July, only the corners of southwest Arizona and southeast New Mexico were drier than average. All climate divisions in New Mexico and most of those in Arizona were well above average. The southeast corner of New Mexico experienced the highest percentage in the region, measuring about 190 percent of average.

The rains, however, lacked staying power, and drier-than-average conditions returned in August (Figure 2). September also has been dry. Rainfall totals in the first half of the month were less than 50 percent of average in both states. While September amounts are not yet final and moisture from the Gulf of California is still penetrating the area, the story is unlikely to change.

High humidity but scant, patchy rain

Humidity is a measure of the water vapor wafting in the air. The more humid the conditions, the higher the likelihood for rain, most of the time.

The dry-wet-dry summer is what Dave Novlan, meteorologist for the NWS in El Paso, Texas, calls a "low-investment monsoon."

"We've had high humidity but low rain, which just makes it more miserable for people," he said.

The Tucson area exceeded the dew point temperature—the temperature at which water vapor condenses to form rain—of 54 degrees Fahrenheit on July 9. Higher dew points mean higher humidity, and historically meteorologists declared the monsoon to have officially begun after three consecutive days exceeded the 54-degree dew point mark. The average onset date under those guidelines was July 9 in Tucson.

From July 11 to September 9 this year, dew points were mostly above the historical average, sometimes by as much as 10 degrees F. Phoenix also spent much of its summer with above-average dew points.

While moisture was present, it often did not rain in the lower elevations, particularly in southern Arizona. Storms often begin on the mountains and as they grow winds aloft push them over the desert valleys. This year, however, saw weak winds and the atmosphere was abnormally warm aloft. This reduced the temperature difference between the surface and mid-altitudes in the atmosphere, creating a more stable environment. The result was that storm clouds often were not blown off the mountains into the valleys; even when they were, the stable atmosphere prevented moisture from rising, condensing, and causing the thunderous storms for which the monsoon is famous.

"The summer had a more hostile environment for storms to form and persist than we would have expected given the high moisture availability and warm surface temperatures," said Gary Woodall, meteorologist-in-charge at the NWS in Phoenix.

The hostile conditions helped create rainfall patches that were more isolated than typical, according to Gutzler and meteorologists at NWS offices in Albuquerque, El Paso, Tucson, and Phoenix.

"What seemed to characterize the monsoon in the Southwest was spottiness," Gutzler said. "My perception is that in years that have been really wet, like in 2006, thunderstorms seemed to cover larger areas. This year, it appeared that the rains did not persist long enough to fill the gaps… . We would have bursts that filled gages here and there and then the rains fizzled."

Precipitation around Albuquerque exemplifies this. Four measuring stations within 25 miles of each other reported June–August rainfall totals that ranged from 60 to 120 percent of average. Rainfall also was extremely variable in southern New Mexico. Places within 10 miles of each other differed by as much as 4 inches of rain.

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monsoon season, continued

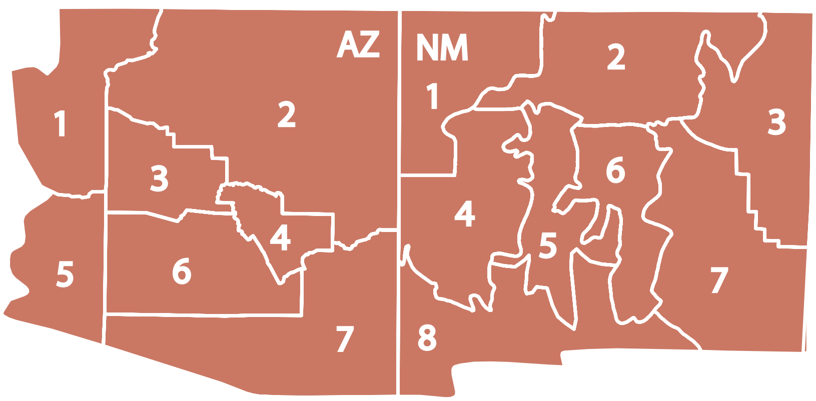
Warmer nighttime temperatures

The monsoon season has been about more than wishy-washy rain. It also has been hotter than average. Temperatures have been between 0 and 2 degrees F warmer than average, and the largest temperature anomaly has occured after the sun goes down.

At night, the daily minimum was about 3 degrees F warmer than average in Arizona and New Mexico for the June–August period. It was even greater in Phoenix. During July, low temperatures were about 4 degrees F warmer than average. What caused this "was probably a combination of a warming trend we have seen in the last 10 years and a lack of thunderstorm activity that would have broken the heat," Woodall said.

Although rains were inconsistent, warm temperatures and high humidity combined to fuel intense storms as long as other conditions were in place. When it rained it poured. Some areas in southern New Mexico and western Texas, for example, received 3 to 4 inches on one day, and 3 inches soaked parts of southeast Arizona in mid-July.

"We saw some monstrous events this summer," Novlan said. "This year we had strong thermal forcing. Occasionally that forcing was able to break through the dry downward air movement [that was helping to suppress the development of thunderstorms] and when it did, we had really big storms."



Climate Division	Jun (%)	Jul (%)	Aug (%)	Summer Total (%)	Summer Rank Driest	Summer Rank Wettest
AZ1–Northwest	53	69	72	65	24th	93
AZ2–Northeast	59	135	108	114	75th	42
AZ3–North Central	46	97	100	92	49	68
AZ4–East Central	40	148	82	105	69	48
AZ5–Southwest	79	51	61	55	25	92
AZ6–South Central	29	107	80	86	43	74
AZ7–Southeast	31	135	88	105	71	46
NM1–NW Plateau	38	150	118	119	86	31
NM2–Northern Mtns	42	140	65	85	35	82
NM3–NE Plains	69	130	92	97	73	44
NM4–SW Mtns	74	144	90	108	84	33
NM5–Central Valley	52	134	64	88	58	59
NM6–Central Highlands	57	171	77	108	87	30
NM7–SE Plains	109	189	70	118	100	17
NM8–Southern Desert	67	167	67	108	91	26

Figure 2. Average precipitation for the climate divisions in Arizona and New Mexico during June, July, and August show that the 2010 monsoon season had a dry-wet-dry pattern. Average summer precipitation for most climate divisions ranked in the middle of the 1895-2010 record. Information for this figure is derived from Parameter-elevation Regressions on Independent Slopes Model (PRISM) data.

The monsoon in a warmer world

What can we learn about future monsoons from 2010? The jury is still out. Basic science principles paint plausible yet contrasting pictures of a drier or wetter monsoon in a warming world.

On the one hand, warming air temperatures would require clouds to ascend to higher altitudes before the vapor condenses into rain. If the atmosphere warms up enough, the mountains—which push air upwards and help develop thunderous storms—would not play as prominent a role in organizing rainfall.

On the other hand, warmer air temperatures carry more moisture and may increase the temperature difference between the Southwest and eastern Pacific Ocean. The monsoon winds would then intensify and deliver more moisture to the region, theoretically increasing rainfall.

The devil is in the details. As the Southwest experienced this summer, high humidity does not always equal more rainfall. There are a host of other influences and complex interactions that need to align and make it extremely difficult to predict future monsoons.

"There is a lot about climate change we will need to analyze over long timescales, and this is particularly true for the monsoon," Gutzler said. "It's hard to say something definitive from one summer."

But the uniqueness of the 2010 monsoon begs important research questions, such as what caused the patchiness in rainfall, that will help move scientists toward a better understanding of current and future conditions.

Temperature (through 9/15/10)

Data Source: High Plains Regional Climate Center

Temperatures since the water year began on October 1 on the Colorado Plateau in northeastern Arizona and in the northern third of New Mexico remain between 40 and 55 degrees Fahrenheit (Figure 1a). Central and eastern New Mexico have had average temperatures ranging between 50 and 60 degrees F, while the southern border of New Mexico and Arizona have been between 60 and 65 degrees F. The lower elevation deserts in southwestern and western Arizona have been warmer, with average temperatures between 65 and 75 degrees F. For most areas in northern and central Arizona and most of New Mexico, temperatures have been 0–2 degrees cooler than average (Figure 1b). The cooler temperatures are due to the El Niño circulation during the winter. There have been a few regions with warmer-than-average temperatures, including southeastern Arizona and northeastern New Mexico.

During the past 30 days, temperatures across most of Arizona have been 0–2 degrees F warmer than average, with east-central and southeastern Arizona averaging 2–4 degrees F above average (Figure 1c–d). While western New Mexico has been 0–2 degrees F warmer than average, the higher elevations have been 0–2 degrees cooler than average. Eastern New Mexico has been 2–4 degrees warmer than average, while the far northeastern corner of New Mexico has been 4–8 degrees warmer than average. Less frequent monsoon storms likely contributed to the increased temperatures during the past 30 days.

Figure 1a. Water year '09–'10 (October 1 through September 15) average temperature.

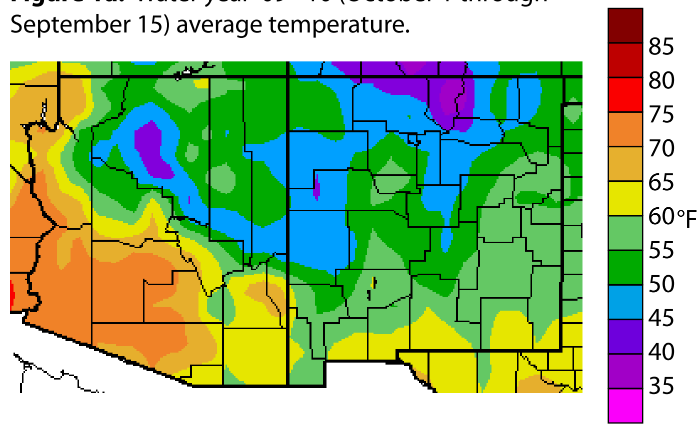


Figure 1b. Water year '09–'10 (October 1 through September 15) departure from average temperature.

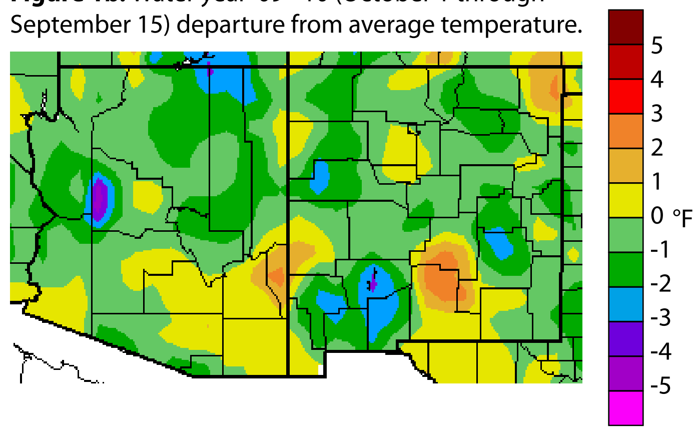


Figure 1c. Previous 30 days (August 17–September 15) departure from average temperature (interpolated).

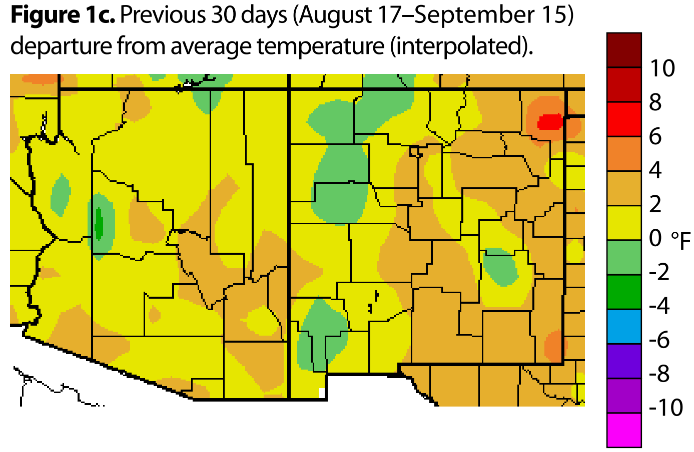
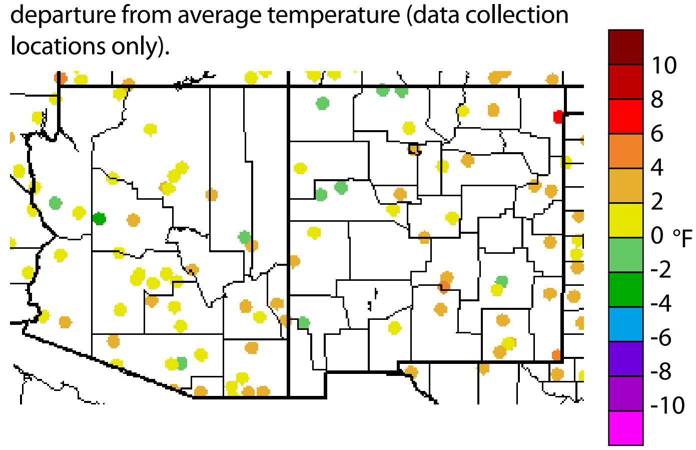


Figure 1d. Previous 30 days (August 17–September 15) departure from average temperature (data collection locations only).



Notes:

The water year begins on October 1 and ends on September 30 of the following year. Water year is more commonly used in association with precipitation; water year temperature can be used to measure the temperatures associated with the hydrological activity during the water year.

Average refers to the arithmetic mean of annual data from 1971–2000. Departure from average temperature is calculated by subtracting current data from the average. The result can be positive or negative.

The continuous color maps (Figures 1a, 1b, 1c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. The dots in Figure 1d show data values for individual stations. Interpolation procedures can cause aberrant values in data-sparse regions.

These are experimental products from the High Plains Regional Climate Center.

On the Web:

For these and other temperature maps, visit:
http://www.hprcc.unl.edu/maps/current/

For information on temperature and precipitation trends, visit:
http://www.cpc.ncep.noaa.gov/trndtext.shtml

Precipitation (through 9/15/10)

Data Source: High Plains Regional Climate Center

Precipitation since the water year began on October 1 has been well below normal on the Colorado Plateau, as well as in the southwestern quarter of both Arizona and New Mexico (Figures 2a–b). These areas, along with northeastern New Mexico, have received 50–90 percent of average precipitation. Central and southeastern Arizona and northwestern and east-central New Mexico have received 100–130 percent of average. A few isolated areas also have seen 130–200 percent of average precipitation, including northeastern Arizona, southeastern New Mexico, and the area near the Nevada-California-Arizona border. The spotty nature of the water year precipitation seems a bit unusual in an El Niño year, when winter precipitation tends to be more uniform. This year, however, the moisture source was inconsistent, and the winter storms tended to be localized.

A decrease in storm activity over the past 30 days left most of New Mexico with less than 50 percent of its average rainfall (Figure 2c). The southern half of Arizona has received 50–100 percent of average rainfall, with areas of southeastern Arizona receiving 110–300 percent of average. A large area covering northeast Arizona and northwest New Mexico has received 130–300 percent of average precipitation. For some areas the summer rainfall filled in gaps left by isolated winter storms, but in many cases the dry areas during the winter were also dry areas during the monsoon.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2009, we are in the 2010 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year.

Average refers to the arithmetic mean of annual data from 1971–2000. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100.

The continuous color maps (Figures 2a, 2c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

The dots in Figures 2b and 2d show data values for individual meteorological stations.

On the Web:

For these and other precipitation maps, visit:
http://www.hprcc.unl.edu/maps/current/

For National Climatic Data Center monthly precipitation and drought reports for Arizona, New Mexico, and the Southwest region, visit: http://lwf.ncdc.noaa.gov/oa/climate/research/2003/perspectives.html#monthly

Figure 2a. Water year '09–'10 (October 1 through September 15) percent of average precipitation (interpolated).

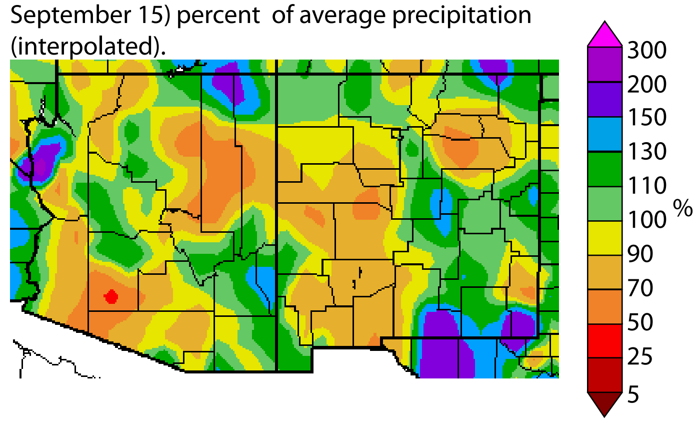


Figure 2b. Water year '09–'10 (October 1 through September 15) percent of average precipitation (data collection locations only).

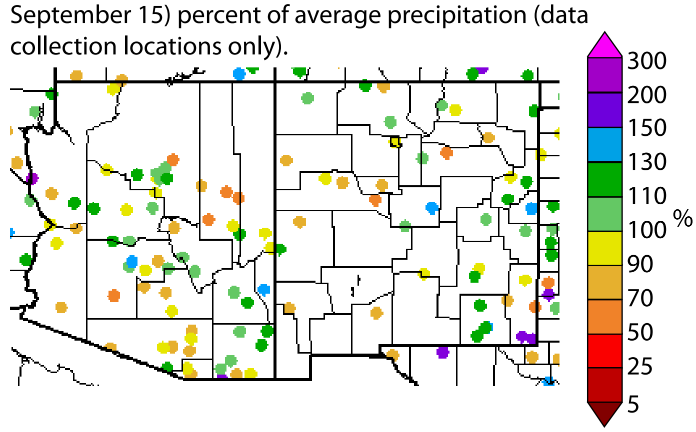


Figure 2c. Previous 30 days (August 17–September 15) percent of average precipitation (interpolated).

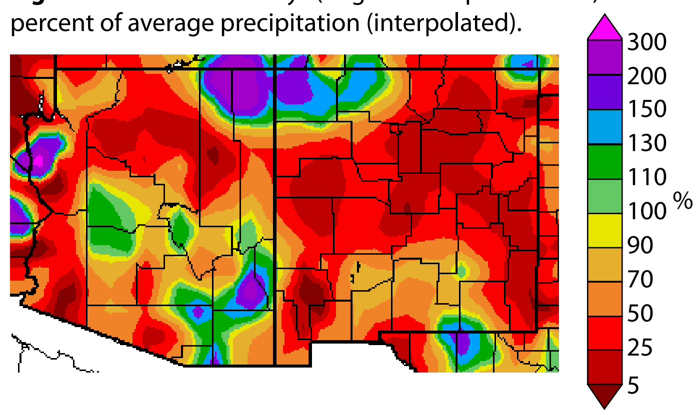
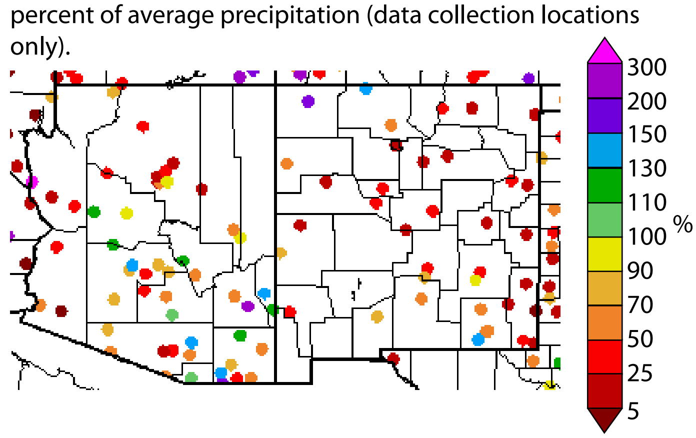


Figure 2d. Previous 30 days (August 17–September 15) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(data through 9/14/10)

Data Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

The extent of drought conditions across the western U.S. has not changed much in the past 30 days, according to the September 14 update of the U.S. Drought Monitor (Figure 3). Monsoon rains generally have been near average for the region, although there has been large spatial variability that has left some areas drier than others—a common occurrence during the monsoon. Northern and western Arizona are currently experiencing the brunt of the drought conditions in the region.

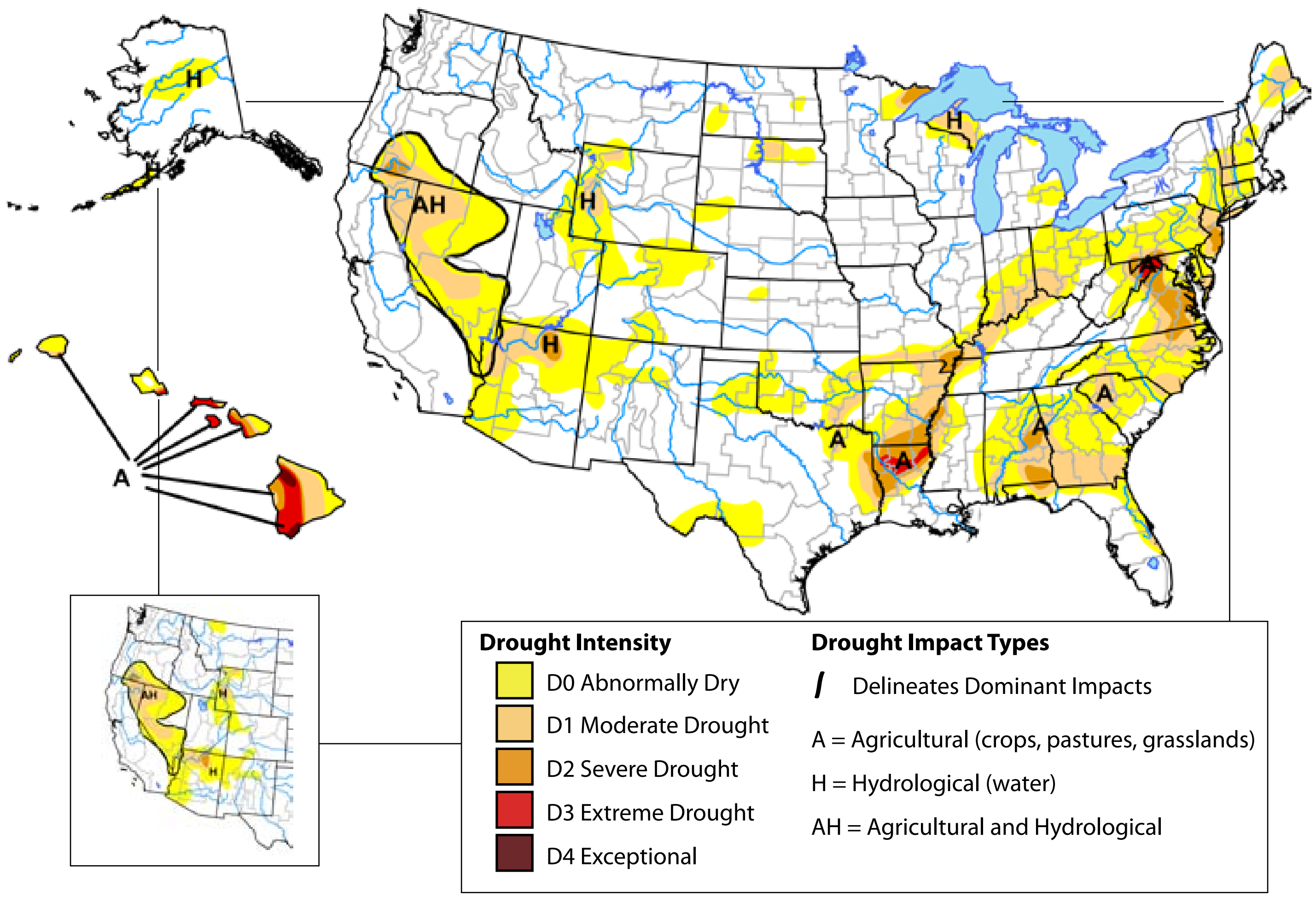
In other areas, dry conditions have plagued western Nevada and parts of northern California for most of the summer. Although these areas typically don't experience much summer precipitation, less than 0.5 inches have fallen in many parts of this large region in the past 90 days. In the central Rockies, a dry spell has promoted the expansion of abnormally dry conditions over northern Colorado. Overall, approximately 27 percent of the West is classified with abnormally dry conditions or worse, just a 2 percent increase from one month ago.

Notes:

The U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The inset (lower left) shows the western United States from the previous month's map.

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of several agencies; the author of this monitor is Matthew Rosencrans, NOAA/NWS/NCEP/CPC.

Figure 3. Drought Monitor data through September 14 (full size), and August 17 (inset, lower left).



On the Web:

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website: http://www.drought.gov/portal/server.pt/community/current_drought/208

Arizona Drought Status

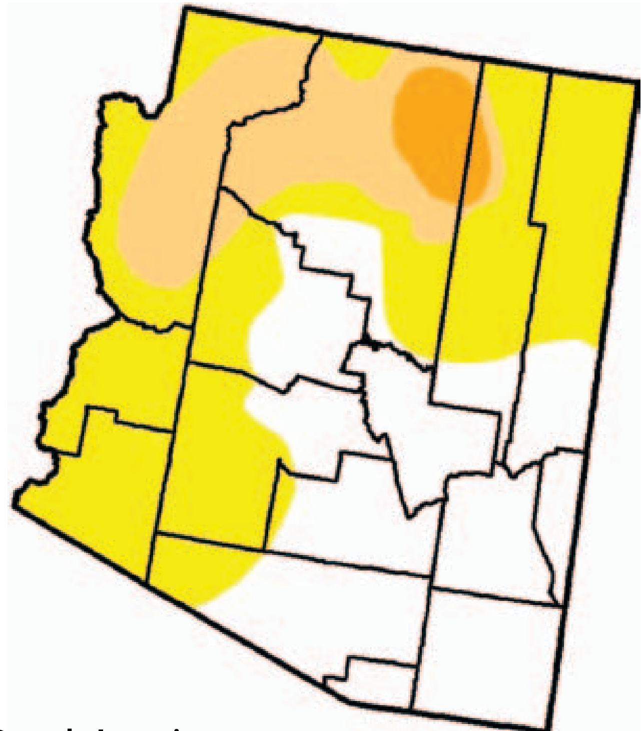
(data through 9/14/10)

Data Source: U.S. Drought Monitor

Spotty monsoon precipitation has continued to help keep short-term drought conditions at bay across much of southeast Arizona. In most parts of Arizona outside the southeast, however, precipitation in the last month has been below average (Figure 4a). This had led to persistence of the abnormally dry conditions in the northern and western parts of the state and the expansion of moderate drought conditions through most of Mohave County. The overall area experiencing some drought conditions is the same as last month. However, while abnormally dry conditions dropped 5 percent to 4 percent during the last 30 days, moderate drought conditions or worse have expanded by an equal amount (Figure 4b). The most recent seasonal precipitation forecast issued by the NOAA–Climate Prediction Center (CPC) calls for increased odds for a dry winter (see page 15). This forecast reflects a greater than 90 percent chance that the La Niña event will persist through March. La Niña events often bring below-average precipitation to the Southwest.

Drought impacts reported by Arizona DroughtWatch support the current depiction of drought status across Arizona. Reports indicate low range productivity, increasing forage toxicity, and the need for water hauling in some areas, among other impacts. More drought impact reports can be viewed on Arizona Droughtwatch's webpage at http://azdroughtwatch.org/.

Figure 4a. Arizona drought map based on data through September 14.



Drought Intensity

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional

Figure 4b. Percent of Arizona designated with drought conditions based on data through September 14.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	40.0	60.0	18.6	3.2	0.0	0.0
Last Week (09/07/2010 map)	40.0	60.0	12.5	3.2	0.0	0.0
3 Months Ago (06/22/2010 map)	59.8	40.3	14.6	2.7	0.0	0.0
Start of Calendar Year (01/05/2010 map)	0.0	100.0	97.2	71.1	5.1	0.0
Start of Water Year (10/06/2009 map)	1.4	98.6	80.3	10.7	0.0	0.0
One Year Ago (09/15/2009 map)	1.2	98.8	59.1	0.0	0.0	0.0

Notes:

The Arizona section of the U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of several agencies.

On the Web:

For the most current drought status map, visit:
http://www.drought.unl.edu/dm/DM_state.htm?AZ,W

For monthly short-term and quarterly long-term Arizona drought status maps, visit:
http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/DroughtStatus.htm

New Mexico Drought Status

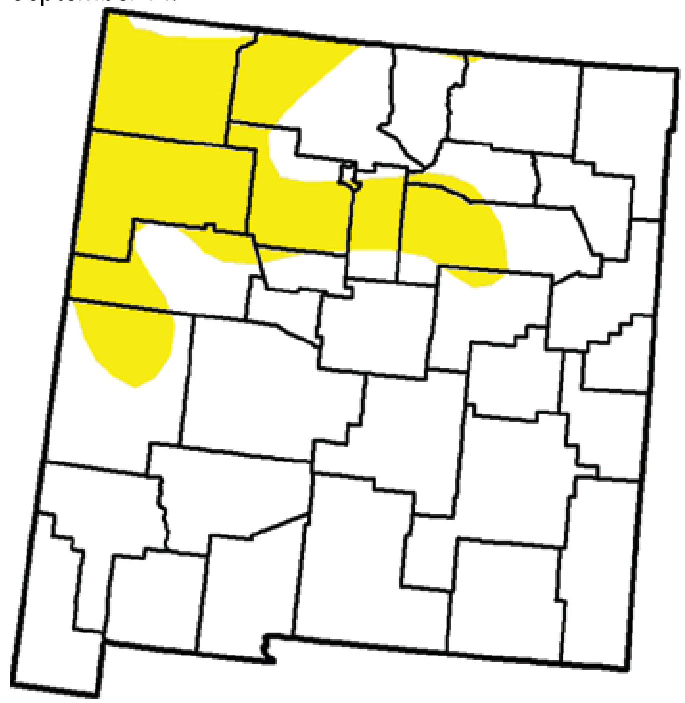
(data through 9/14/10)

Data Source: New Mexico State Drought Monitoring Committee , U.S. Drought Monitor

Drought conditions across New Mexico have remained unchanged from last month, according to the September 14 update of the U.S. Drought Monitor (Figures 5a–b). A small area of abnormally dry conditions continues over the northwest quarter of the state. Monsoon rains have been limited in this area and have not provided any relief to the dry conditions. Overall monsoon season precipitation has been fairly robust across the rest of New Mexico, with most areas observing at least average rainfall over the past 90 days. This has helped keep short-term drought conditions from creeping back into the southern and eastern parts of the state.

Eyes are now turning towards the upcoming fall and winter seasons with the concern that drought conditions may move in across the Southwest. There is a growing chance that strengthening La Niña conditions will shift winter storm tracks away from the Southwest, leaving New Mexico with below-average precipitation through next spring. The most recent seasonal precipitation forecast issued by the NOAA–Climate Prediction Center (CPC) calls for increased odds for a dry winter (see page 15). This forecast reflects a greater than 90 percent chance that the La Niña event will persist through March 2011. La Niña events often bring below-average precipitation to the Southwest.

Figure 5a. New Mexico drought map based on data through September 14.



Drought Intensity

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional

Figure 5b. Percent of New Mexico designated with drought conditions based on data through September 14.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	80.0	20.0	0.0	0.0	0.0	0.0
Last Week (09/07/2010 map)	80.0	20.0	0.0	0.0	0.0	0.0
3 Months Ago (06/22/2010 map)	49.2	50.8	17.3	0.0	0.0	0.0
Start of Calendar Year (01/05/2010 map)	56.9	43.1	10.1	2.3	0.0	0.0
Start of Water Year (10/06/2009 map)	72.2	27.8	3.4	0.0	0.0	0.0
One Year Ago (09/15/2009 map)	55.4	44.6	11.3	0.0	0.0	0.0

Notes:

The New Mexico section of the U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of several agencies.

This summary contains substantial contributions from the New Mexico Drought Working Group.

On the Web:

For the most current drought status map, visit:
http://www.drought.unl.edu/dm/DM_state.htm?NM,W

For the most current Drought Status Reports, visit:
http://www.nmdrought.state.nm.us/MonitoringWorkGroup/wk-monitoring.html

Arizona Reservoir Levels

(through 8/31/10)

Data Source: USDA-NRCS, National Water and Climate Ctr.

Overall storage in the Colorado River Basin as of September 1 was 56.7 percent of capacity. During the last month, storage in both Lakes Mead and Powell decreased to a combined storage of 51.0 percent of capacity (Figure 6), which is about 2 percent less than a year ago. Currently, the water elevation in Lake Mead is only 13 feet above 1,075 feet; when water levels dip below the 1,075-foot elevation, shortage sharing agreements go into effect. However, it's likely that more water than normal will be released from Lake Powell into Lake Mead during the upcoming water year to temporarily prevent water levels from decreasing below that threshold. Determination of whether this "equalization" strategy will occur depends on the reservoir conditions projected for the end of 2011 water year in the Bureau of Reclamation's April 2011 24-Month Study.

In other reservoirs within Arizona, storage in the Salt and Verde River basins is greater than average and greater than last year.

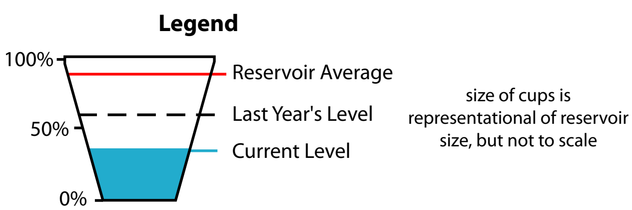
Notes:

The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (dotted line) and the 1971–2000 reservoir average (red line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

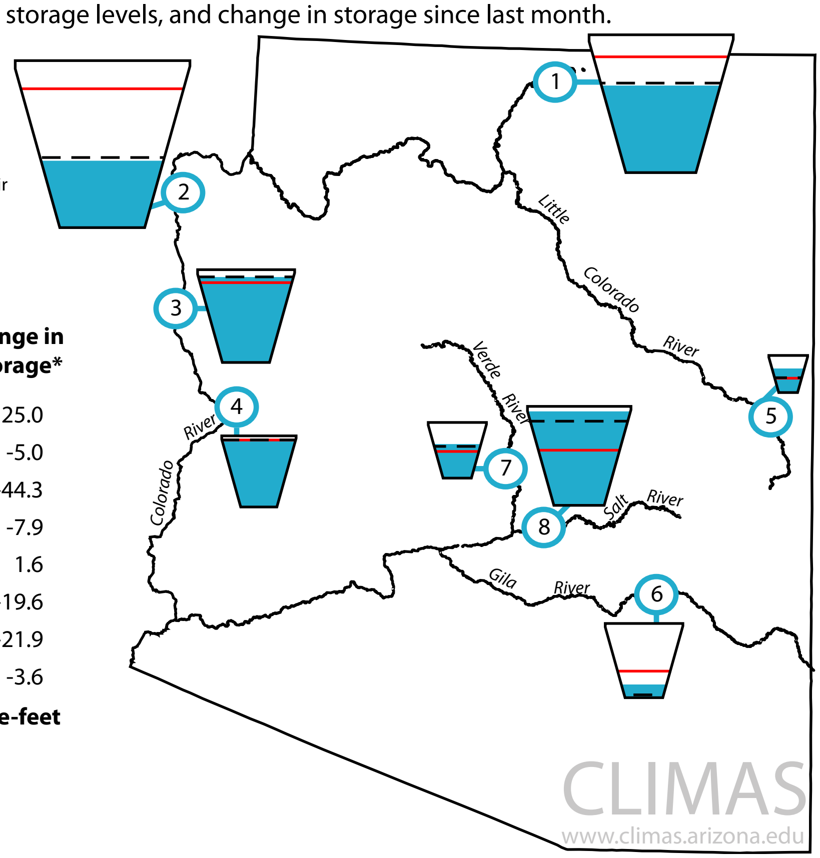
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for August as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Lake Powell	63%	15,371.0	24,322.0	-225.0
2. Lake Mead	40%	10,352.0	26,159.0	-5.0
3. Lake Mohave	92%	1,670.1	1,810.0	-44.3
4. Lake Havasu	94%	583.9	619.0	-7.9
5. Lyman Reservoir	65%	19.6	30.0	1.6
6. San Carlos	18%	160.6	875.0	-19.6
7. Verde River System	61%	174.9	287.4	-21.9
8. Salt River System	95%	1,919.1	2,025.8	-3.6

*** thousands of acre-feet**



On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

New Mexico Reservoir Levels

(through 8/31/10)

Data Source: USDA-NRCS, National Water and Climate Ctr.

Total reservoir storage in New Mexico decreased by about 143,000 acre-feet in August (Figure 7). However, reservoir declines are typical for this time of year. Storage in the two largest New Mexico reservoirs—Navajo and Elephant Butte—decreased by about 88,000 acre-feet. Compared to one year ago, combined storage in Pecos River reservoirs is up by about 29,000 acre-feet (reservoirs 9–12 on figure 7), and combined storage in Canadian River reservoirs is up by more than 16,000 acre-feet (reservoirs 13–15 on figure 7).

New Mexico has asked the state Water Quality Control Commission to designate 700 miles of 192 perennial rivers and streams, 29 lakes, and about 6,000 acres of wetlands in wilderness areas as outstanding national resource waters (*Santa Fe New Mexican*, September 13). The designation would require the U.S. Forest Service to add environmental protections for rivers, streams, lakes, and wetlands in designated wilderness areas.

Notes:

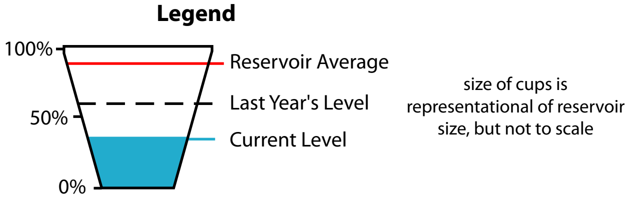
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (dotted line) and the 1971–2000 reservoir average (red line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Wayne Sleep, wayne.sleep@nm.usda.gov.

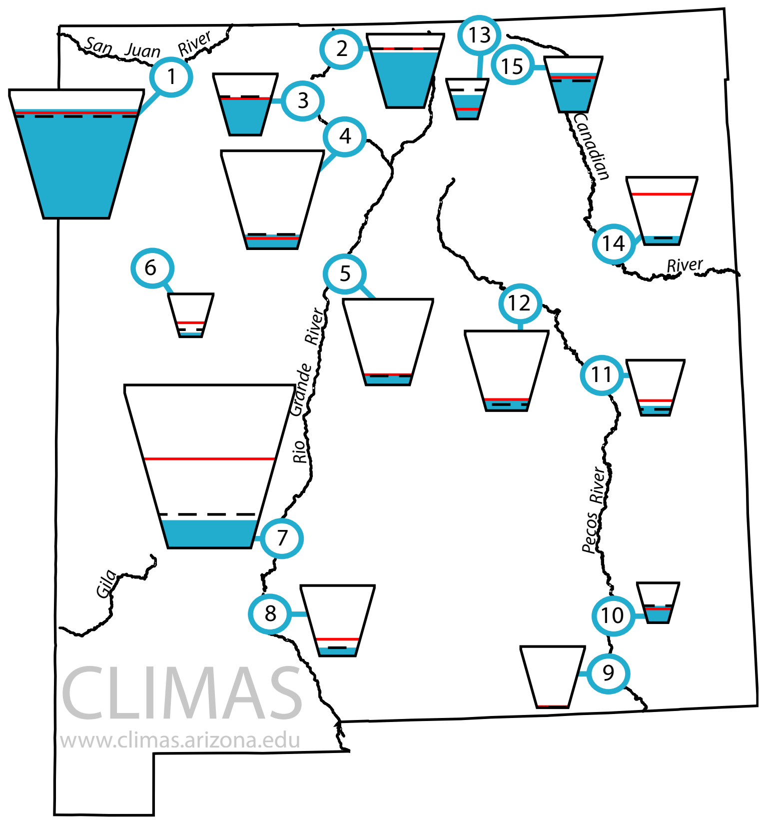
Figure 7. New Mexico reservoir levels for August as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	85%	1,446.0	1,696.0	-27.9
2. Heron	75%	301.9	400.0	-31.1
3. El Vado	62%	118.4	190.3	-11.8
4. Abiquiu	15%	174.8	1,192.8	26.8
5. Cochiti	11%	52.2	491.0	-0.1
6. Bluewater	10%	3.8	38.5	-6.6
7. Elephant Butte	17%	383.9	2,195.0	-60.4
8. Caballo	12%	40.6	332.0	-20.2
9. Brantley	2%	15.7	1,008.2	-9.9
10. Lake Avalon	43%	1.7	4.0	0.5
11. Sumner	17%	17.4	102.0	1.8
12. Santa Rosa	13%	56.4	438.3	-1.8
13. Costilla	60%	9.6	16.0	-1.9
14. Conchas	13%	33.7	254.2	0.8
15. Eagle Nest	71%	56.4	79.0	-1.8

*** thousands of acre-feet**



On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

Monsoon Summary
(through 9/13/2010)

Data Source: Western Regional Climate Center

The monsoon season is winding down and officially ends on September 30 in Arizona. During the last month, hotter and drier-than-average conditions characterized many regions in the Southwest (see this month's feature article). Most areas received less than 70 percent of average precipitation, with the exception of southeast Arizona, where copious rainfall around the mountains dropped between 150 and 200 percent of average. Reviewing the season's precipitation totals reveals that most activity occurred during a four-week window between mid-July and mid-August. Despite a late start and drier-than-average end to the season, the three-month totals between June 16 and September 13 reflect near-average monsoon rainfall conditions for many parts of Arizona and New Mexico (Figures 8a–c). Since September 13, moisture incursions from the Gulf of California have produced typical isolated thunderstorms, but have not generally increased precipitation totals . Between June 15 and September 16, rainfall totals in southeast Arizona have been near average, tallying 5.44 inches in Tucson, 8.15 inches in Nogales, 11.17 inches in Sierra Vista, and 7.00 inches in Wilcox.

The monsoon season was also characterized by warmer-than-average temperatures during the day and night. The daily low temperatures, which reflect night conditions, were on average 3 degrees F warmer than average in both states during June through August; Phoenix nighttime temperatures in July were around 4 degrees F warmer than average. Long gaps in monsoon storms and the general summer warming trend likely account for these conditions, according to the National Weather Service in Phoenix.

Figure 8a. Total precipitation in inches (June 16–September 13, 2010).

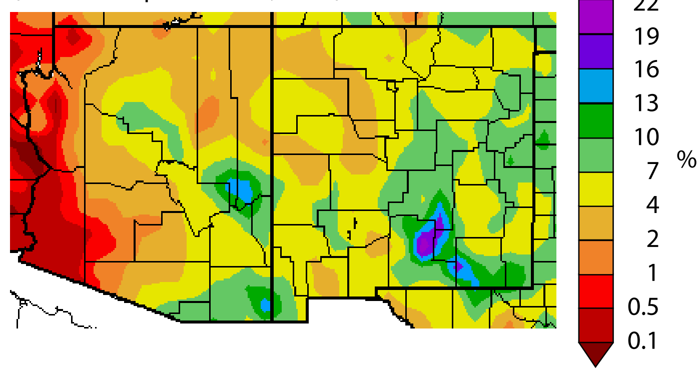


Figure 8b. Departure from average precipitation in inches (June 16–September 13, 2010).

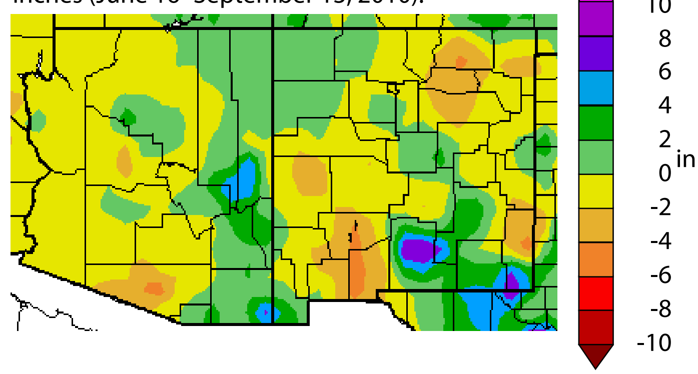
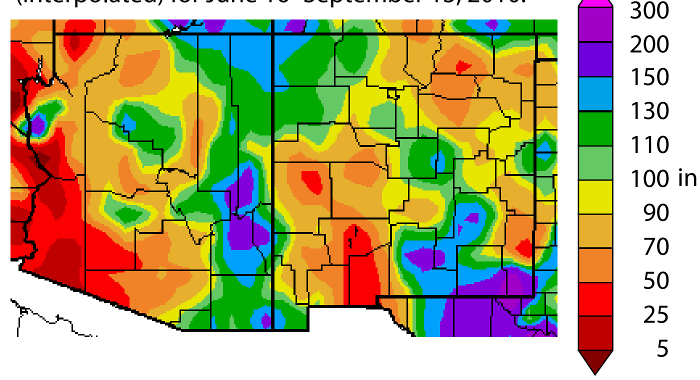


Figure 8c. Percent of average precipitation (interpolated) for June 16–September 13, 2010.



Notes:

The continuous color maps (figures above) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

Average refers to the arithmetic mean of annual data from 1971–2000. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100. Departure from average precipitation is calculated by subtracting the average from the current precipitation.

On the Web:

These data are obtained from the National Climatic Data Center:
http://www.hprcc.unl.edu/maps/current/

Temperature Outlook

(October 2010–March 2011)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA–Climate Prediction Center (CPC) in September call for increased chances for temperatures to be similar to the warmest 10 years during the 1971–2000 period (Figures 9a–d). For the October–December period, CPC outlooks call for greater than a 50 percent chance that temperatures will resemble the warmest years in the climatological record in New Mexico (Figure 9a). For the November–January outlook, temperatures in all of Arizona and New Mexico have greater than a 50 percent probability (Figure 9b). The probabilities for elevated temperatures decrease during the December–February and January–March periods but remain at greater than 40 percent in most of both states (Figures 9c–d). Both the expectation of La Niña conditions and decadal warming trends contribute to the enhanced probability of above-average temperatures in the West.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average temperature, but not the magnitude of such variation. The numbers on the maps do not refer to degrees of temperature.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC temperature outlook, areas with light brown shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average temperature. A shade darker brown indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average temperature, and so on.

Equal Chances (EC) indicates areas where no forecast skill has been demonstrated or there is no clear climate signal; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 9a. Long-lead national temperature forecast for October–December 2010.

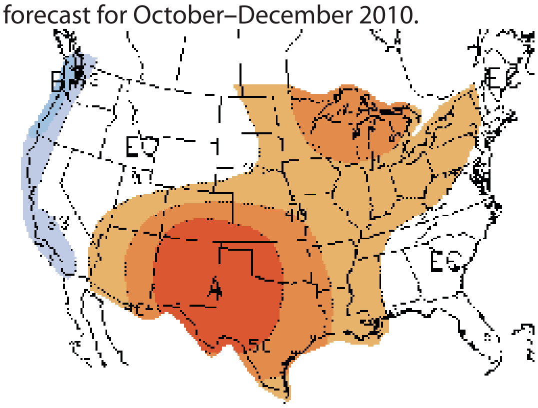
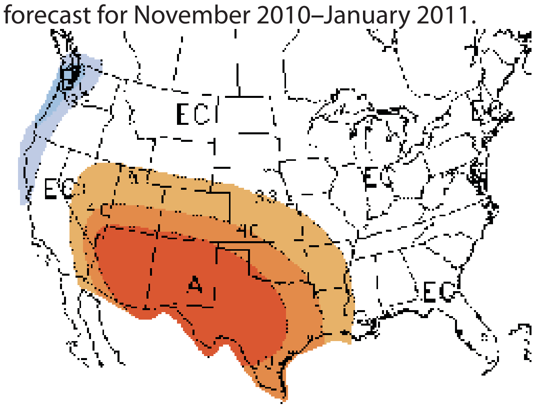


Figure 9b. Long-lead national temperature forecast for November 2010–January 2011.



A= Above
50.0–59.9%
40.0–49.9%
33.3–39.9%

B=Below
40.0–49.9%
33.3–39.9%

Figure 9c. Long-lead national temperature forecast for December 2010–February 2011.

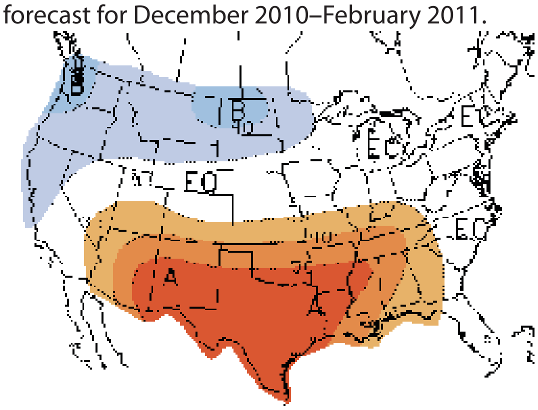
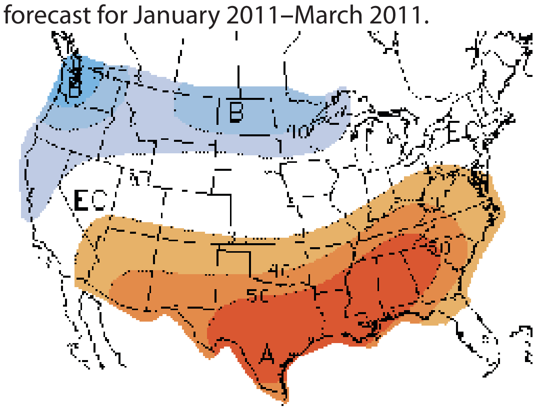


Figure 9d. Long-lead national temperature forecast for January 2011–March 2011.



EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions//multi_season/13_seasonal_outlooks/color/churchill.php

For seasonal temperature forecast downscaled to the local scale, visit: http://www.weather.gov/climate/l3mto.php

For IRI forecasts, visit: http://iri.columbia.edu/climate/forecast/net_asmt/

Precipitation Outlook

(October 2010–March 2011)

Data Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (CPC) precipitation outlooks suggest drier-than-average conditions for the remainder of the fall and early winter in all of Arizona and western New Mexico (Figures 10a–d). This outlook is influenced heavily by the current moderate to strong La Niña event. During La Niña events since 1950, winters in the southwestern U.S. and particularly Arizona have been dry between 60 and 80 percent of the time. The outlooks indicate that nearly all of New Mexico and southern Arizona have greater than a 40 percent chance for experiencing precipitation totals that are similar to the driest 10 years in the 1971–2000 period.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC precipitation outlook, areas with light green shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. A shade darker green indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average precipitation, and so on.

Equal Chances (EC) indicates areas where no forecast skill has been demonstrated or there is no clear climate signal; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 10a. Long-lead national precipitation forecast for October–December 2010.

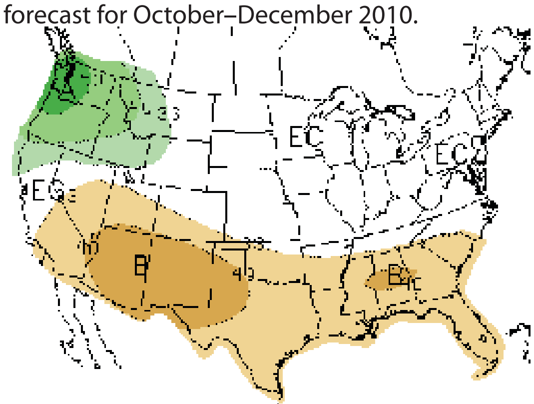


Figure 10b. Long-lead national precipitation forecast for November 2010–January 2011.

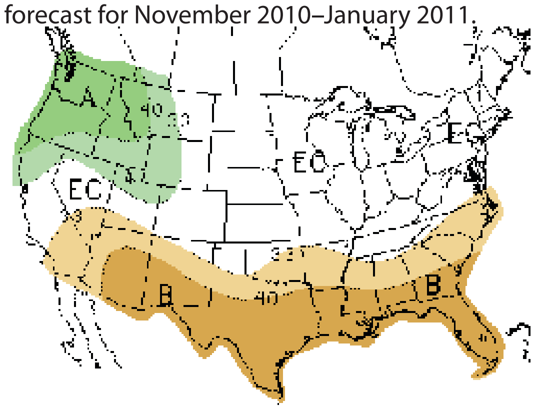


Figure 10c. Long-lead national precipitation forecast for December 2010–February 2011.

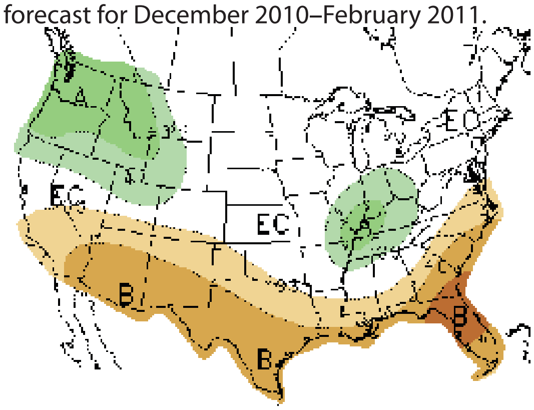
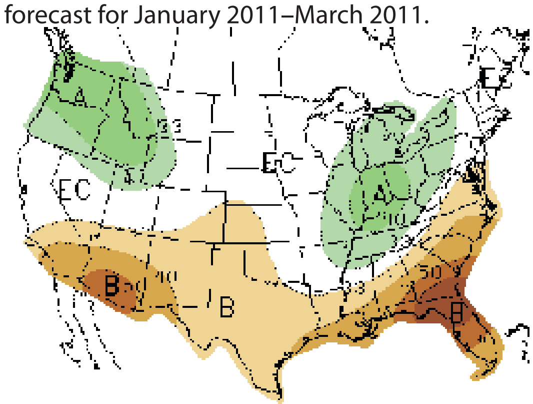


Figure 10d. Long-lead national precipitation forecast for January 2011–March 2011.



B= Below: 33.3–39.9%, 40.0–49.9%

A=Above: 40.0–49.9%, 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions//multi_season/13_seasonal_outlooks/color/churchill.php
(note that this website has many graphics and September load slowly on your computer)

For IRI forecasts, visit:
http://iri.columbia.edu/climate/forecast/net_asmt/

Seasonal Drought Outlook

(through December)

Data Source: NOAA-Climate Prediction Center (CPC)

This summary is excerpted and edited from the Aug 16 Seasonal Drought Outlook technical discussion produced by the NOAA–Climate Prediction Center and written by forecaster A. Allgood.

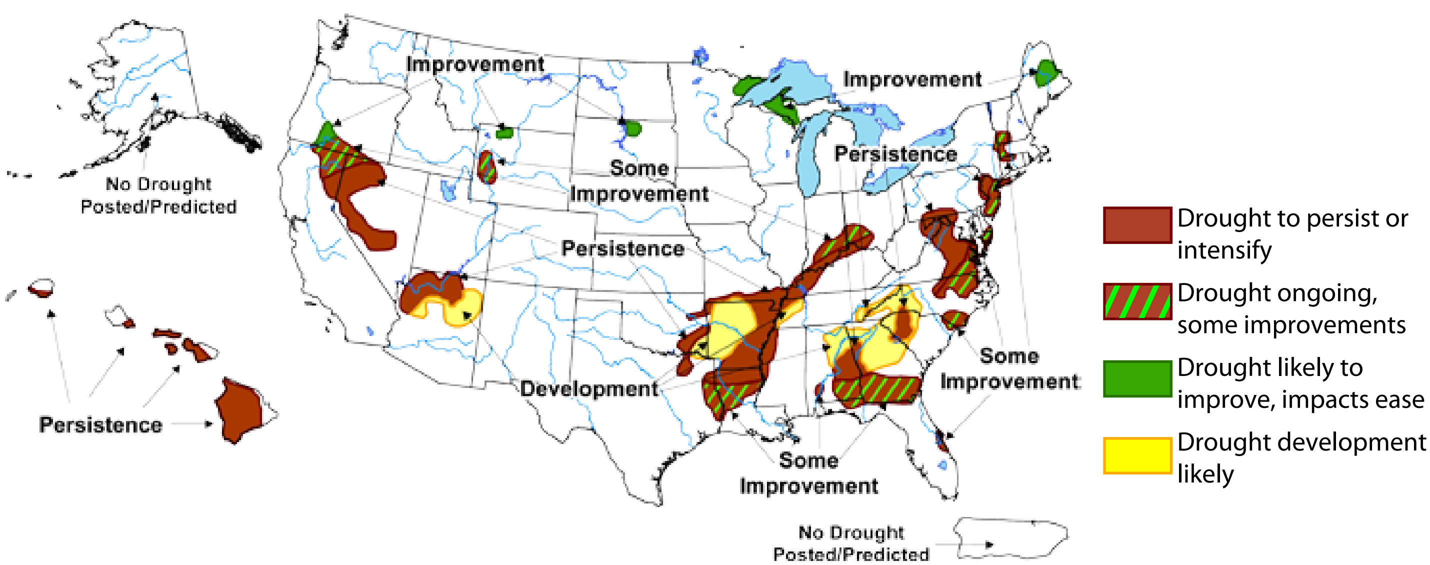
In the Southwest, drought persistence is forecast for northern Arizona, with drought development likely in areas already experiencing abnormal dryness. Many forecast models, including the 6-10 day and 8-14 day (Figure 11) forecasts, the October monthly forecast, and the October–December seasonal forecasts, all favor drier conditions across much of the Southwest, and confidence in this forecast is high. Below-average precipitation in the past two weeks and a mounting la Niña event play a large role in this forecast. La Niña events often bring dry weather to the Southwest. Since 1950, the southwestern U.S. and particularly Arizona have been drier than average between 60 and 80 percent of the time. Currently, the strength of the La Niña event is moderate to strong, and it is expected to persist into next year.

Elsewhere in the West, drought conditions have persisted across the Great Basin and parts of the northern Rockies region throughout the summer dry season. As winter approaches, the La Niña event will likely shift storm tracks into the Pacific Northwest, bringing increased precipitation to the region. The region of increased precipitation can extend as far south as northern California, but a sharp gradient exists between the enhanced precipitation in the Northwest and the typically drier Southwest during a La Niña event. Due to the high likelihood of elevated precipitation across the Pacific Northwest, drought improvement is forecast for southern Oregon, while some improvement is indicated for northern California and far northwestern Nevada. Persistence is forecast for the remainder of the Great Basin, as the La Niña climate anomalies are drier towards the south. Confidence is this forecast is high for the northern Great Basin.

Notes:

The delineated areas in the Seasonal Drought Outlook are defined subjectively and are based on expert assessment of numerous indicators, including the official precipitation outlooks, various medium- and short-range forecasts , models such as the 6-10 day and 8-14 day forecasts, soil moisture tools, and climatology.

Figure 11. Seasonal drought outlook through December (released September 16).



On the Web:

For more information, visit:
http://www.drought.gov/portal/server.pt

For medium- and short-range forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/forecasts/

For soil moisture tools, visit:
http://www.cpc.ncep.noaa.gov/soilmst/forecasts.shtml

El Niño Status and Forecast

Data Sources: NOAA-Climate Prediction Center (CPC), International Research Institute for Climate and Society (IRI)

A La Niña Advisory remains in effect this month as the current La Niña event continues to gain strength. The NOAA–Climate Prediction Center (CPC) issues La Niña Advisories when conditions are observed and expected to continue.

Sea surface temperatures (SSTs) in the central and eastern Pacific Ocean continue to cool. The most recent weekly measurements indicate that SSTs in the key Niño 3.4 region in the central Pacific Ocean are -1.5 degrees Celsius, indicating a moderate to strong La Niña event; this is somewhat colder than the -1.20 degrees C temperatures observed in August. The Southern Oscillation Index (SOI) remained high again this month, indicating a strong atmospheric response to the below-average SSTs (Figure 12a). Stronger-than-average easterly winds along the equator in the eastern Pacific are helping to elevate cooler-than-average water to the surface, further reinforcing the strong easterly winds wafting across the Pacific. This self-reinforcing cycle between the ocean and atmosphere is expected to help maintain and potentially strengthen the La Niña event through the upcoming fall and winter seasons.

Forecasts issued by the International Research Institute for Climate and Society (IRI) continue to show a high probability that La Niña conditions will persist through at least the winter season (Figure 12b). The chance of the current La Niña event continuing through the January–March period is 90 percent; in contrast, the return of an El Niño event is only 1 percent. The strong indication for a winter La Niña has implications for weather in the Southwest. Seasonal forecasts issued by the CPC indicate increased chances for drier-than-average conditions across all of Arizona and New Mexico through May.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through July 2010. The SOI measures the atmospheric response to SST changes across the Pacific Ocean Basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

The second figure shows the International Research Institute for Climate and Society (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, the coolest 25 percent of Niño 3.4 SSTs; and neutral conditions where SSTs fall within the remaining 50 percent of observations. The IRI probabilistic ENSO forecast is a subjective assessment of current model forecasts of Niño 3.4 SSTs that are made monthly. The forecast takes into account the indications of the individual forecast models (including expert knowledge of model skill), an average of the models, and other factors.

On the Web:

For a technical discussion of current El Niño conditions, visit:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

For more information about El Niño and to access graphics similar to the figures on this page, visit:
http://iri.columbia.edu/climate/ENSO/

Figure 12a. The standardized values of the Southern Oscillation Index from January 1980–July 2010. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).

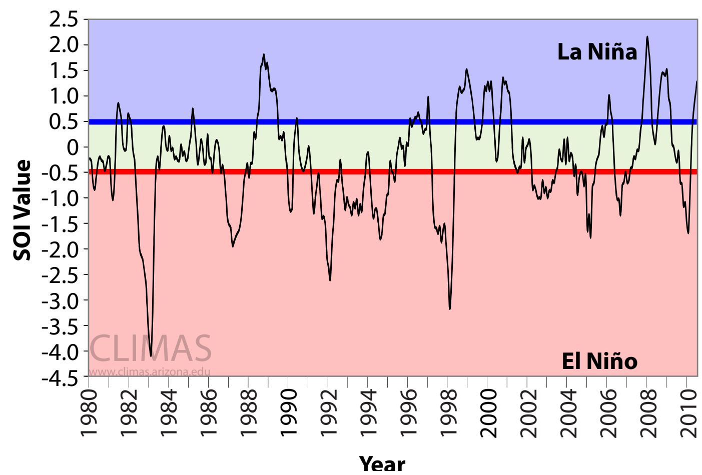
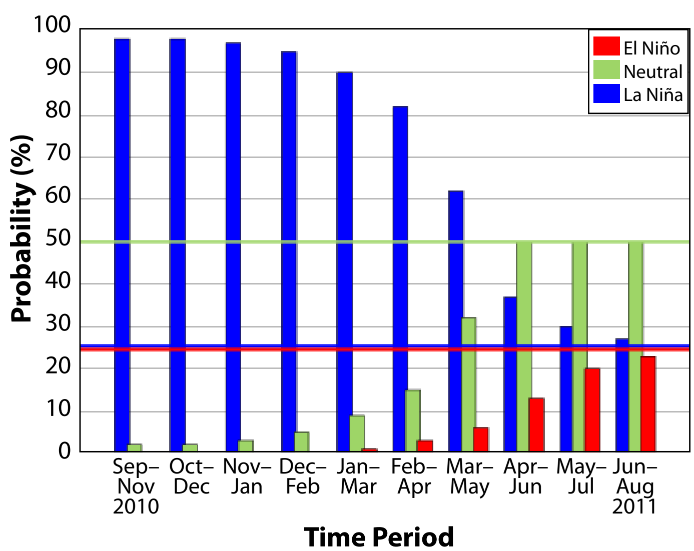


Figure 12b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released September 16). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(October 2010–March 2011)

Data Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed temperatures for October–December to forecasts issued in September for the same period suggest that forecasts in all but the southwest region of Arizona and northern New Mexico have been more accurate than an equal chances forecast; in these two regions forecasts have been similar to an equal chances forecast (Figure 15a). Forecast skill—a measure of the accuracy of the forecast—is highest in southeast Arizona and southwest New Mexico for the October–December and November–January periods (Figures 15a–b). Forecast skill for the three- month lead time diminishes and few regions have been more accurate than simply using an equal chances forecast (Figure 15c). Forecast skill for the January–March period have highest in southern Arizona and New Mexico (Figure 15d). While bluish hues denote more accurate forecasts, caution is advised to users of the seasonal forecasts for regions with reddish colors.

Notes:

These maps evaluate the historical performance of the one- to four-month long-lead forecasts made by NOAA's Climate Prediction Center (CPC). The maps convey the historical accuracy of the CPC forecasts in relation to the reference forecast, which assigns a 33 percent chance to the three CPC categories, "above," "below," and "neutral." These categories indicate whether conditions are predicted to be similar to the warmest, coolest, or normal temperatures for 1971 to 2000. The maps are generated from the Forecast Evaluation Tool, which was developed by The University of Arizona in partnership with NOAA, NASA, NSF, and the University of California-Irvine.

The maps display the Ranked Probability Skill Score (RPSS). The more the forecasts and actual weather match, the bluer the color. A bluish or reddish RPSS indicates the forecast is more accurate or less accurate, respectively, than assigning a 33 percent chance to each of the three CPC categories.

The RPSS is calculated by comparing all the forecasts made since December 1994 for particular seasons and specified lead times to the actual weather of the season.

Figure 13a. RPSS for October–December 2010.

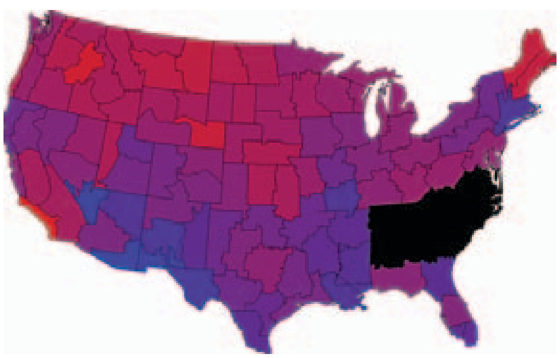


Figure 13b. RPSS for November 2010–January 2011.

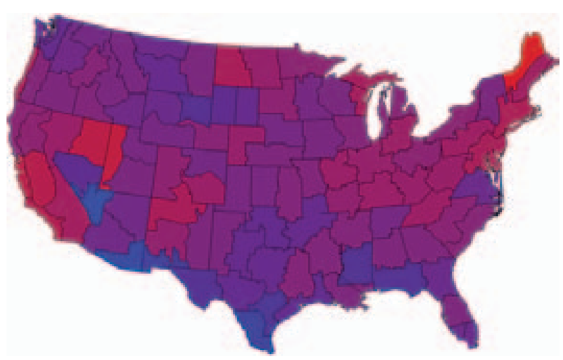


Figure 13c. RPSS for December 2010–February 2011.

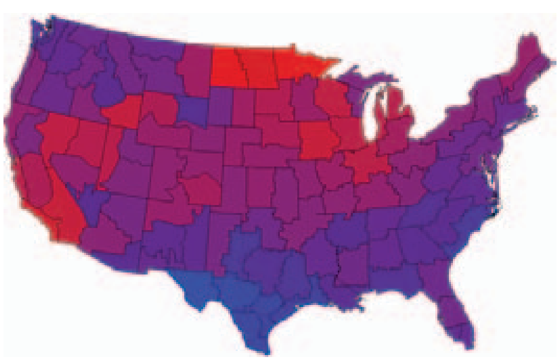
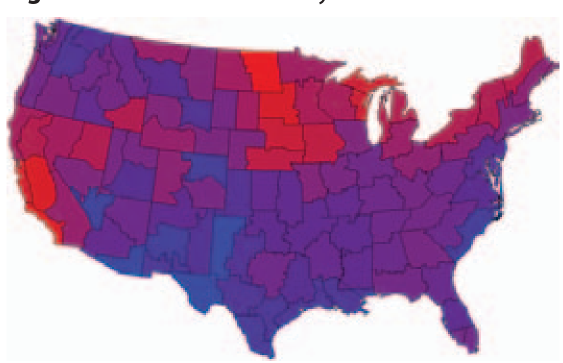
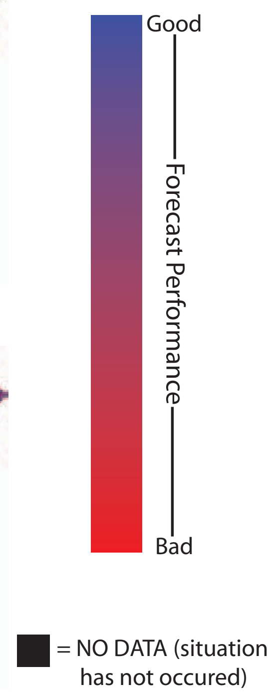


Figure 13d. RPSS for January–March 2011.





On the Web:

For more information on the Forecast Evaluation Tool, visit
http://fet.hwr.arizona.edu/ForecastEvaluationTool/

For a CLIMAS publication that explains how to use the Forecast Evaluation Tool, visit
http://www.climas.arizona.edu/feature-articles/november-2005

Precipitation Verification
(October 2010–March 2011)

Data Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed precipitation for October–December to forecasts issued in September for the same period suggest that forecasts have been slightly more accurate than forecasting equal chances (i.e., 33 percent chance that rain will be above-, below-, or near-average) only in southeast Arizona. This largely reflects the area of Arizona most influenced by the monsoon (Figure 14a). Outside of southeast Arizona, forecast skill—a measure of the accuracy of the forecast—is similar to an equal chances forecast. For the November–January period, forecasts have been better than equal chances in southeast and northwest Arizona and southwest New Mexico (Figure 14b). Historically, the three- and four-month lead forecasts issued in September have not been more accurate than equal chances in any areas of the Southwest (Figures 14c–d). While bluish hues suggest that CPC historical forecasts have been more accurate than equal chances, caution is advised to users of the seasonal forecasts for regions with reddish colors.

Notes:

These maps evaluate the historical performance of the one- to four-month long-lead forecasts made by NOAA's Climate Prediction Center (CPC). The maps convey the historical accuracy of the CPC forecasts in relation to the reference forecast, which assigns a 33 percent chance to the three CPC categories, "above," "below," and "neutral." These categories indicate whether conditions are predicted to be similar to the wettest, driest, or normal precipitation for 1971 to 2000. The maps are generated from the Forecast Evaluation Tool, which was developed by The University of Arizona in partnership with NOAA, NASA, NSF, and the University of California-Irvine.

The maps display the Ranked Probability Skill Score (RPSS). The more the forecasts and actual weather match, the bluer the color. A bluish or reddish RPSS indicates the forecast is more accurate or less accurate, respectively, than assigning a 33 percent chance to each of the three CPC categories.

The RPSS is calculated by comparing all the forecasts made since December 1994 for particular seasons and specified lead times to the actual weather of the season.

Figure 14a. RPSS for October–December 2010.

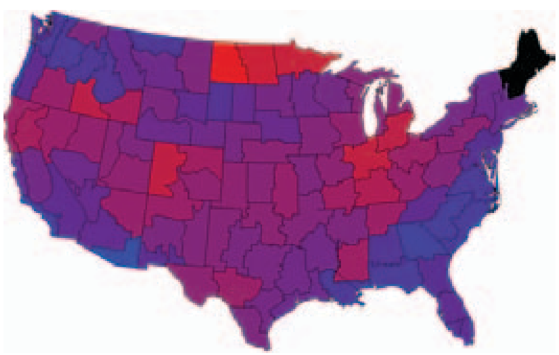


Figure 14b. RPSS for November 2010–January 2011.

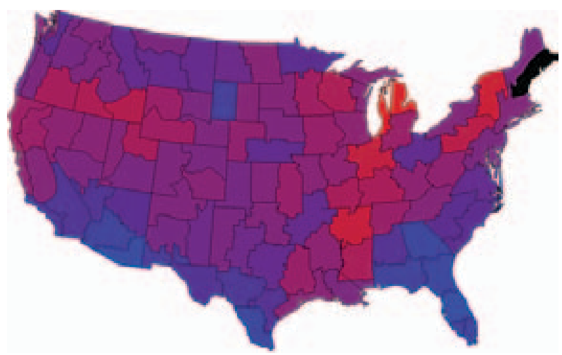


Figure 14c. RPSS for December 2010–Febuary 2011.

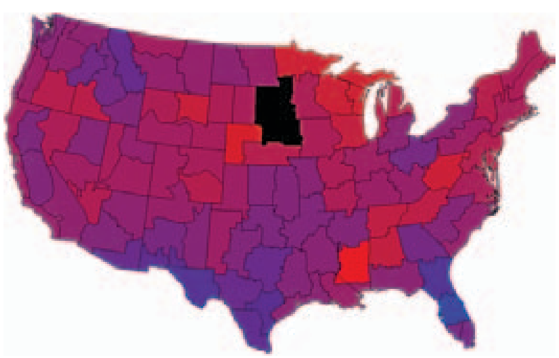
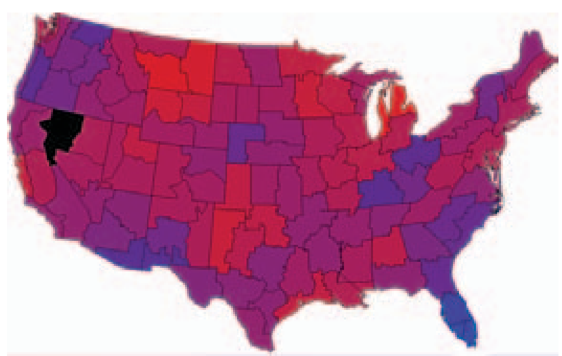
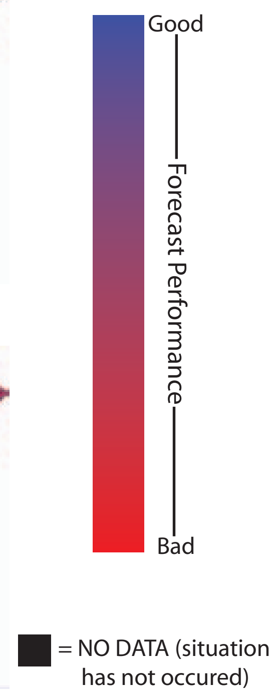


Figure 14d. RPSS for January–March 2011.





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