June 27, 2012

Southwest Climate Outlook

Vol. 11 Issue 6

Wildfires of the Whitewater-Baldy complex burned through the Mogollon Mountains in the Gila Wilderness near Glenwood, NM on June 6. By June 25, more than 290,000 acres had been burned. Image copyright 2012 Daniel Griffin, University of Arizona Laboratory of Tree-Ring Research

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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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June Climate Summary

Drought: Dry conditions that began in late December have continued, and drought has intensified in Arizona and New Mexico in the last 30 days.

Temperature: Eastern New Mexico was more than 3 degrees F warmer than average in the last 30 days, while temperatures across most of Arizona were at least 1 degree F above average.

Precipitation: Most of Arizona and the western half of New Mexico received less than 5 percent of average rain in the last 30 days.

ENSO: Although ENSO-neutral conditions are in full swing, the Climate Prediction Center has issued an El Niño Watch, which means an El Niño may form in the next several months.

Climate Forecasts: There are slightly increased chances for above-average rain for the July–September period in southern Arizona and New Mexico, while temperature forecasts call for increased chances for warmer-than-average conditions throughout the summer.

The Bottom Line: Drought conditions expanded and intensified in May in both Arizona and New Mexico, continuing a trend that began in January. Warmer-than-average temperatures and below-average precipitation in recent months have primed the landscape for wildland fires. As of June 26, six fires were burning in the region, including the Whitewater-Baldy Complex in western New Mexico, where more than 290,000 acres have burned. This fire has become New Mexico's largest on record. Long-term drought conditions are evident in the low reservoir water storage in both states. All but one reservoir in New Mexico, for example, has below-average storage. Storage in Elephant Butte Reservoir is only 17 percent of capacity and farmers in its irrigation district are receiving substantially less water this year. The scant 2011–12 snow in the Upper Colorado River Basin will also decrease reservoir storage in coming months. The best estimate of inflow into Lake Powell for the 2012 water year is only 46 percent of average, which would be the third lowest water year streamflow since 1963. This will help lower water levels in Lake Powell by about 17 feet through the spring of next year. Improvements in drought conditions and fire risk will not come until the monsoon arrives in earnest. Precipitation forecasts from several sources, including the Climate Prediction Center, are currently optimistic. Experts forecast an early monsoon arrival with above-average rainfall totals in July. Although there is uncertainty in monsoon activity in August and September, the emergence of El Niño could increase chances for above-average rainfall in September. An El Niño would also increase chances for a wet winter —good news for a region that has been caught in the throes of short-term severe drought for more than 18 months.

Recent warming in AZ and NM outpace most states

The continental U.S. has warmed by about 1.3 degrees Fahrenheit during the past 100 years, with temperatures in some regions soaring more than others. The Southwest has been the hottest spot, particularly in recent decades, according to a new report "The Heat is On: U.S. Temperature Trends" published by the non-profit organization Climate Central based in Princeton, New Jersey. Since 1970, average temperatures in Arizona have outpaced all other 47 states in the analysis, rising, on average, about 0.64 degrees F per decade. Warming in New Mexico has been only slightly lower, at about 0.6 degrees F per decade, which ranks as the sixth fastest warming state average. The southeastern U.S. has experienced the lowest temperature increase of all other regions in the last 100 years. Natural variability and air pollution that shields incoming solar rays explain some of the regional differences in warming. However, the pace of warming in all regions accelerated dramatically starting in the 1970s, about the time when the effect of greenhouse gases began to overwhelm the other natural and human influences, the report states.

Read the report at: http://www.climatecentral.org/wgts/heat-is-on/HeatIsOnReport.pdf

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This work is published by the Climate Assessment for the Southwest (CLIMAS) project, the University of Arizona Cooperative Extension, and the Arizona State Climate Office.

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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The 2012 Monsoon Forecast, continued

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.

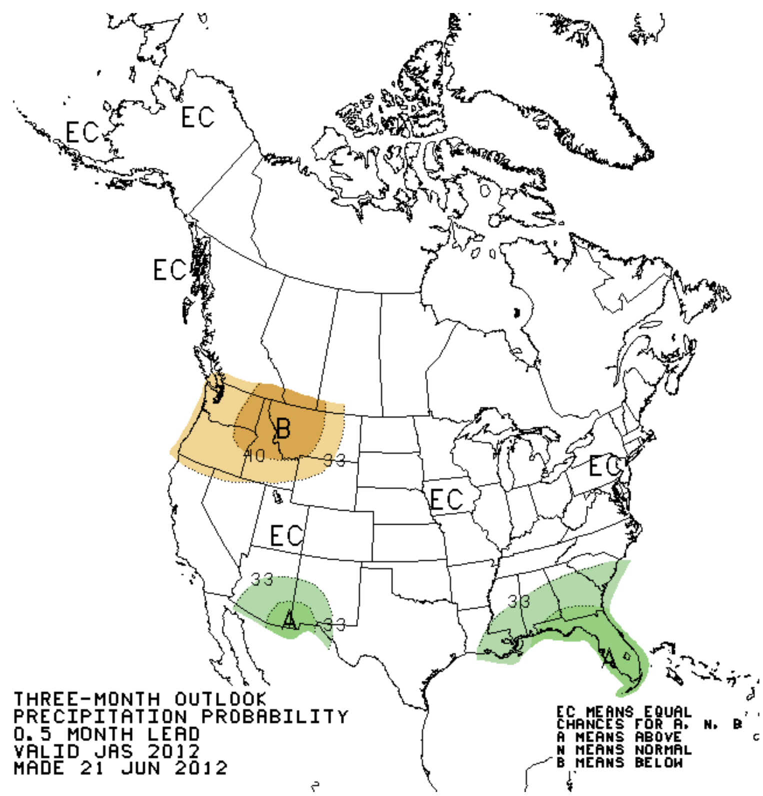


Figure 2. The July–September forecast issued by the CPC on June 21. Green hues represent regions in which rainfall is expected to be similar to the wettest 10 years in the 1981–2010 record. The numbered contours represent the probabilities for conditions to be similar to the wettest, driest, or middle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

continued on page 5

The 2012 Monsoon Forecast, continued

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.

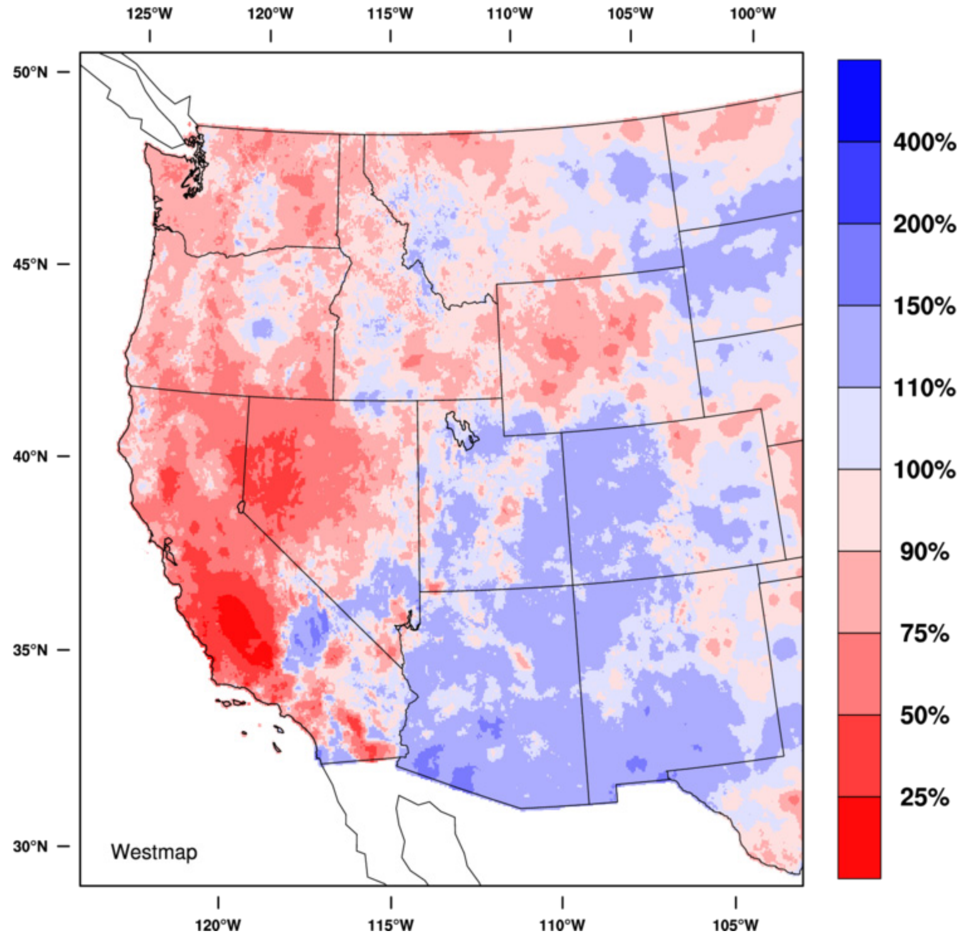


Figure 3. In the historical record, five summers most resemble current conditions defined by 12 climate variables. Comparing the total June–September precipitation for these years—1984, 1986, 2001, 2006, and 2008—suggests that most of the Southwest may receive rainfall totals exceeding 110 percent of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

Temperature (through 6/20/12)

Data Source: High Plains Regional Climate Center

Arizona's temperatures since the water year began on October 1 are well matched to the terrain, with the hottest conditions in the southwest deserts, the cooler conditions on the Colorado Plateau, and coldest at the highest elevations (*Figure 1a*). New Mexico temperatures also tend to follow the terrain, but are significantly cooler than those in Arizona. More of the storms have tracked across New Mexico than Arizona, although many clipped the northern half of the state. Few of the storms ferried cold temperatures, and therefore most of the region has experienced above-average temperatures (*Figure 1b*). In Arizona, temperature anomalies in Gila County were the largest in the region, registering between 2 and 4 degrees Fahrenheit above average. In New Mexico, the eastern counties experienced the warmest temperature anomalies, due in part to storms skipping these regions.

In the past 30 days, both states experienced unseasonably warm conditions (*Figures 1c–d*). High pressure in the eastern Pacific Ocean led to clear skies, dry westerly winds, and elevated air temperatures in the Southwest. Eastern New Mexico was the hottest area, with temperatures ranging from 3 to 6 degrees F warmer than average. The combination of warm conditions and the dry winter and spring helped the Whitewater-Baldy fire, located in the Gila National Forest, become New Mexico's largest wildfire on record.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2011, we are in the 2012 Water 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

Figure 1a. Water year 2011 (October 1 through June 20) average temperature.

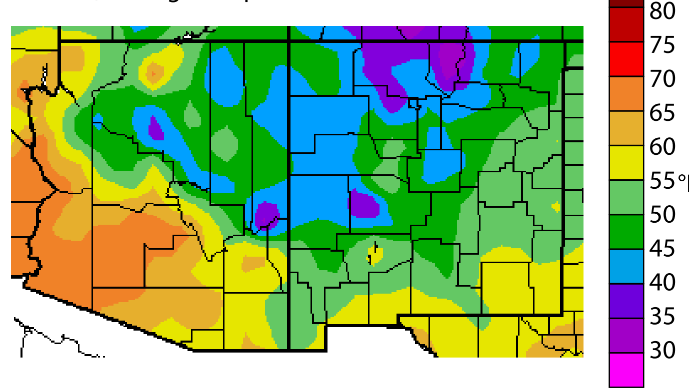


Figure 1b. Water year 2011 (October 1 through June 20) departure from average temperature.

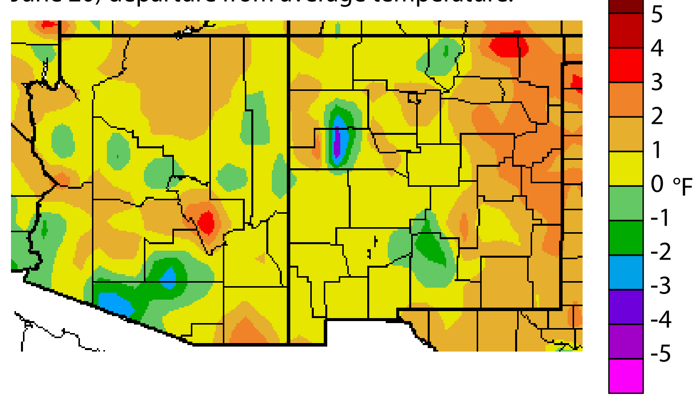


Figure 1c. Previous 30 days (May 22–June 20) departure from average temperature (interpolated).

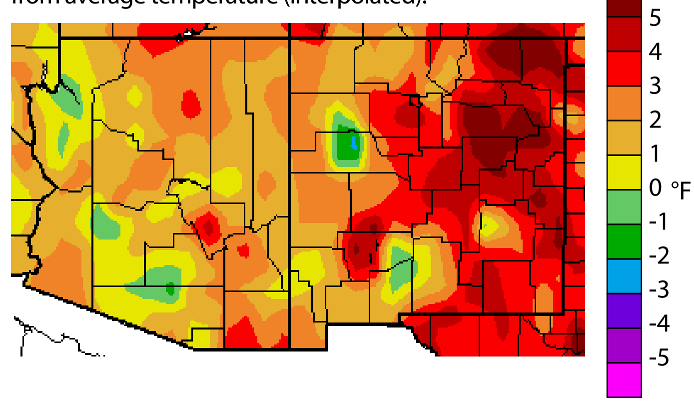
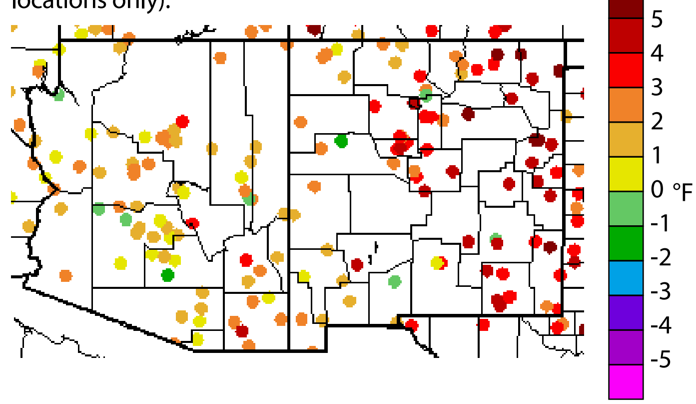


Figure 1d. Previous 30 days (May 22–June 20) departure from average temperature (data collection locations only).



Precipitation (through 6/20/12)

Data Source: High Plains Regional Climate Center

Precipitation since the water year began on October 1 has been less than 70 percent of average over most of Arizona and less than 90 percent over most of New Mexico (*Figures 2a–b*). While these percentages do not suggest conditions have been extremely dry, almost all the precipitation fell between October and December 2011. Since January 1 precipitation in Arizona and New Mexico has totaled less than 50 percent of average for most of both states, with numerous regions receiving less than 25 percent of average. The dry weather since January is a result of low moisture content in the winter storms that crossed northern Arizona and northwestern New Mexico. The lone region of above-average precipitation occurred in the Sangria Mountains in New Mexico, where topography repeatedly lifted air high enough to wring significant moisture out of the clouds. Elsewhere, a few isolated areas in southwestern and northwestern Arizona and Lincoln and Torrance counties in New Mexico have had nearly average precipitation this year.

In the past 30 days, Arizona was largely bone dry (*Figures 2c–d*). The one exception was in southeastern Arizona, where monsoon-flavored storms flared up on June 16. New Mexico also was parched, with only Harding, Quay, and San Miguel counties receiving some relief from the drought. Although the La Niña event, which helped deliver dry conditions this winter, is officially gone, it left its mark. The spring was one of the hottest and driest on record and followed a dry winter. Relief will only come when the monsoon thunderstorm activity begins in earnest, which historically has occured in late June and early July.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2011, we are in the 2012 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 state of the climate reports, visit http://www.ncdc.noaa.gov/sotc/

Figure 2a. Water year 2011 (October 1 through June 20) percent of average precipitation (interpolated).

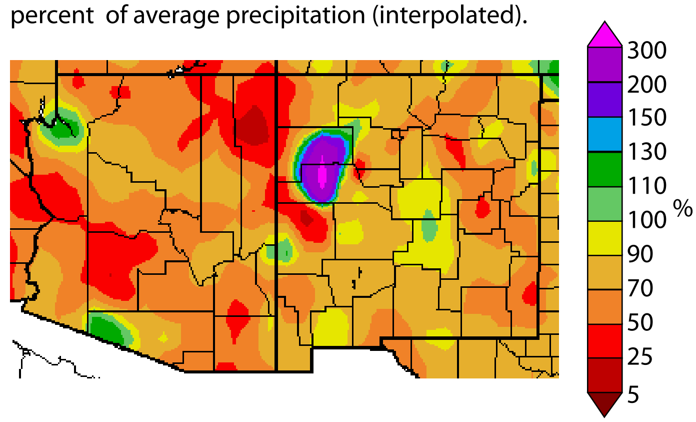


Figure 2b. Water year 2011 (October 1 through June 20) percent of average precipitation (data collection locations only).

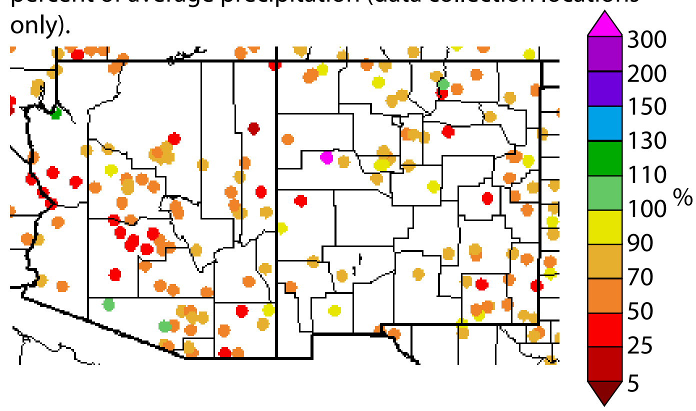


Figure 2c. Previous 30 days (May 22–June 20) percent of average precipitation (interpolated).

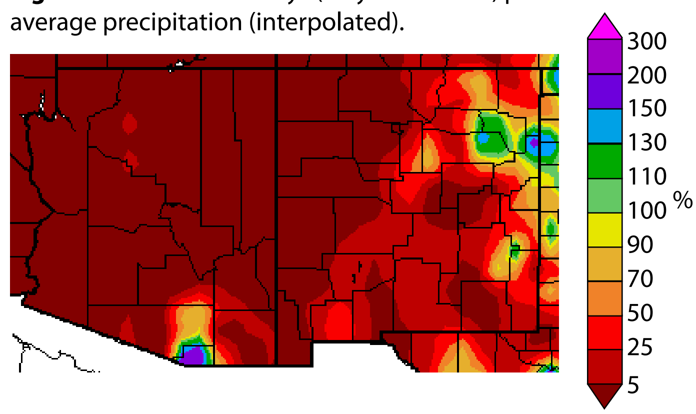
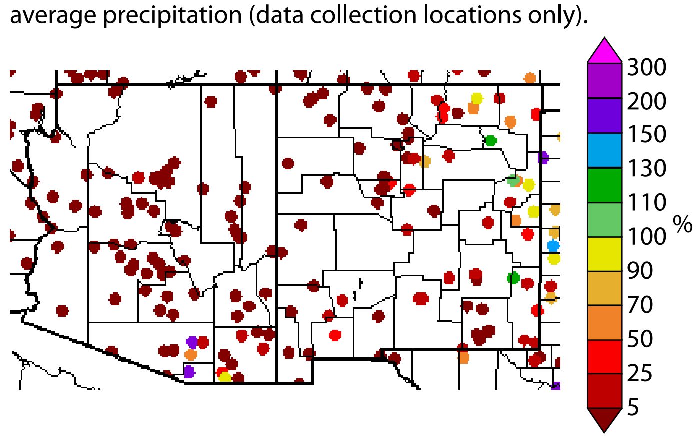


Figure 2d. Previous 30 days (May 22–June 20) percent of average precipitation (data collection locations only).



U.S. Drought Monitor (data through 6/19/12)

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

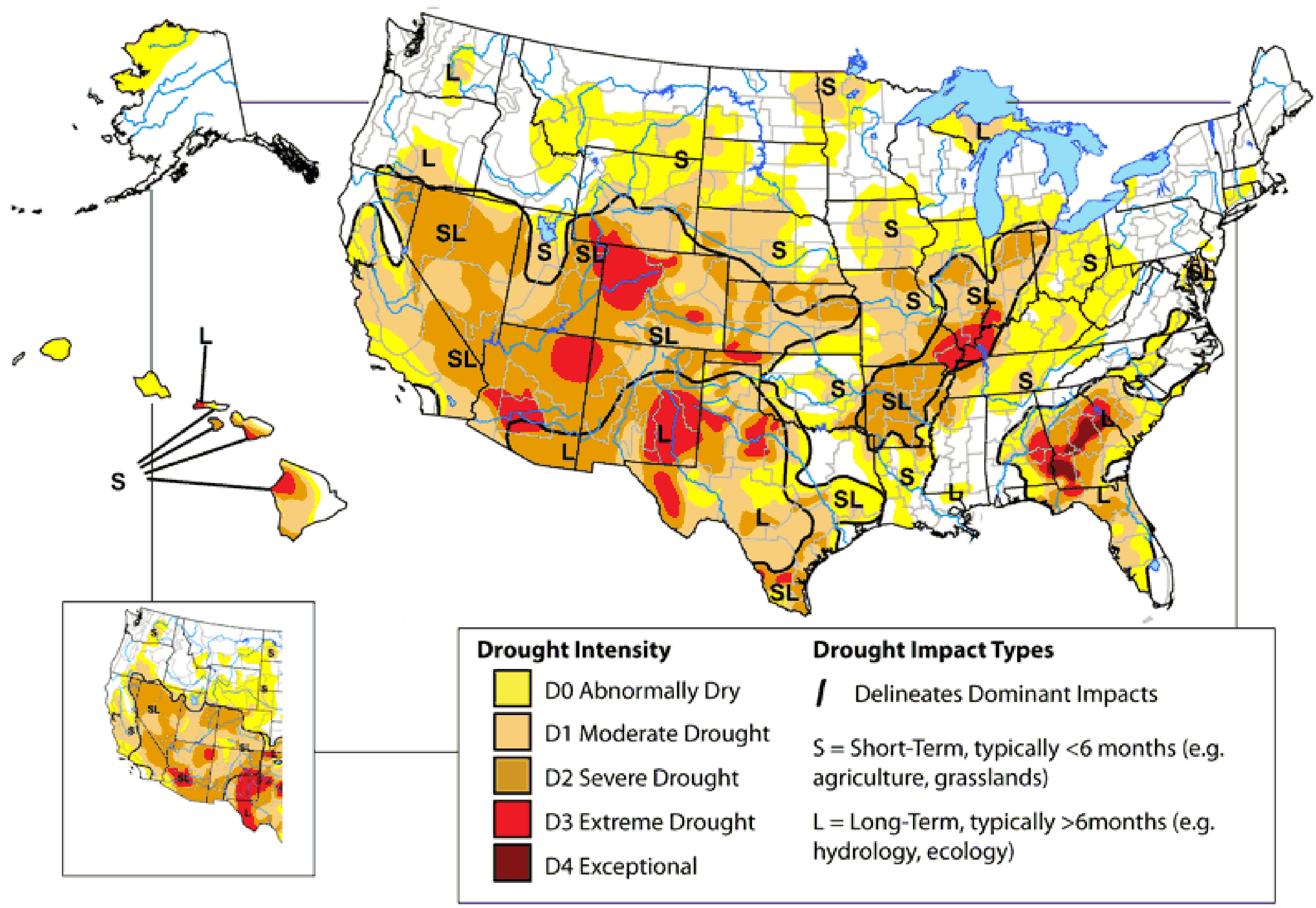
Abnormally dry conditions or a more severe drought category cover nearly 69 percent of the continental U.S. The West is the hardest hit region. Severe drought or a more severe category now covers approximately 37 percent of the western U.S., an increase of 10 percent from one month ago (*Figure 3*). The percentage of area designated with extreme drought also doubled from about 4 to almost 8 percent.

While much of the Northwest and northern Rockies remain drought free, conditions have continued to deteriorate across the Southwest during the past 30 days as a result of very low precipitation and hot summer temperatures. Arizona, New Mexico, Colorado, and Utah have experienced the greatest intensification in drought in the last month. Severe and/or extreme drought conditions expanded in each state, with the northwest quarter of Colorado experiencing the greatest shift—extreme drought now covers nearly 27 percent of the state.

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.

Figure 3. Drought Monitor data through June 19, 2012 (full size), and May 15, 2012 (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

Arizona Drought Status

(data through 6/19/12)

Data Source: U.S. Drought Monitor

Drought conditions worsened across Arizona during the past 30 days as a result of high summer temperatures and the unusually dry conditions that have persisted since late December. All of Arizona is classified with moderate drought or more severe conditions, according to the June 19 update of the U.S. Drought Monitor (*Figures 4a–b*). Severe or worse drought covers more than 90 percent of the state, representing a 24 percent increase in area classified with these categories from one month ago. The most extreme drought conditions continue to be in the northeast and central part of the state, where long-term precipitation deficits approach 6 to 8 inches for the past six months. Extreme drought in the northeast corner ballooned, occupying about 16 percent of the state on May 15 compared with nearly 25 percent on June 19.

Ongoing drought conditions are impacting native vegetation across the Sonoran Desert in southern Arizona (Associated Press, June 17). Many desert-adapted plant species are suffering under the current drought, as are prickly pear, saguaro cacti, and other succulent plants.

Figure 4a. Arizona drought map based on data through June 19.

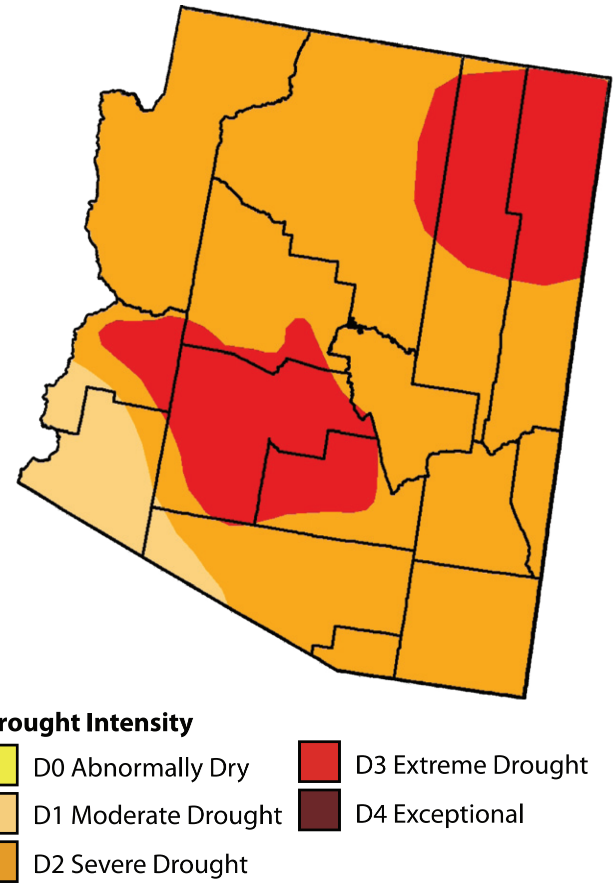


Figure 4b. Percent of Arizona designated with drought conditions based on data through June 19.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	93.72	24.60	0.00
Last Week (06/12/2012 map)	0.00	100.00	96.08	83.21	16.29	0.00
3 Months Ago (03/20/2012 map)	0.47	99.53	93.25	60.47	8.54	0.00
Start of Calendar Year (12/27/2011 map)	16.70	83.30	60.34	36.56	2.78	0.00
Start of Water Year (09/27/2011 map)	0.02	99.98	69.76	42.81	15.34	1.67
One Year Ago (06/14/2011 map)	22.51	77.49	56.26	28.69	18.27	5.62

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://droughtmonitor.unl.edu/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/default.htm

New Mexico Drought Status
(data through 6/19/12)

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

Drought conditions have intensified across parts of New Mexico due to below-average precipitation and above-average temperatures during the past 30 days. Nearly all of New Mexico continues to experience some level of drought; less than 1 percent is classified with abnormally dry conditions. Also, severe or worse conditions extend over more than 80 percent of the state, according to the June 19 update of the U.S. Drought Monitor (*Figures 5a–b*). This represents a substantial increase from one month ago, when such conditions blanketed slightly more than 60 percent of the state. The most pronounced drought classification changes occurred in the western half of New Mexico, where drought in some areas moved from abnormally dry to severe. On June 17, 85 percent of New Mexico rangelands rated as poor or very poor. Only 3 percent was rated as being in good or excellent condition, representing the lowest statewide percent in the country.

New Mexico experienced some drought improvement, albeit small. On May 15, a sliver of exceptional drought covered areas of Roosevelt and Curry countries in the east-central part of the state. In the last month, drought in these areas slightly improved to extreme conditions.

In drought-related news, extreme fire hazards brought on by drought caused New Mexico Gov. Susana Martinez to recommend that cities and counties move quickly to enact local firework bans prior to the July 4 (*The Las Cruces Sun-News*, June 12).

Figure 5a. New Mexico drought map based on data through June 19.

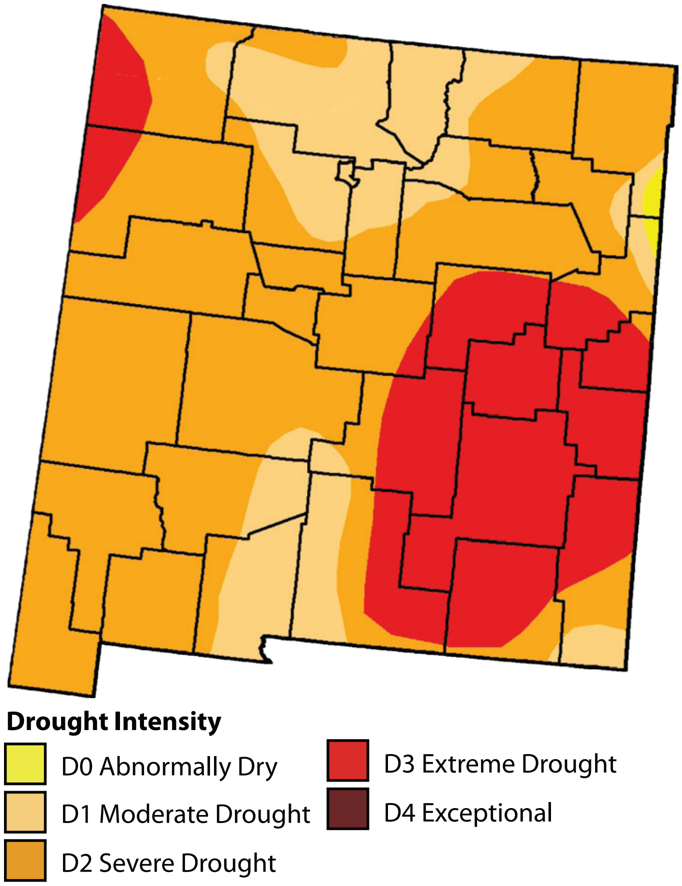


Figure 5b. Percent of New Mexico designated with drought conditions based on data through June 19.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	99.64	81.29	25.17	0.00
Last Week (06/12/2012 map)	0.00	100.00	99.64	73.03	23.46	0.00
3 Months Ago (03/20/2012 map)	11.31	88.69	81.79	60.84	24.94	9.13
Start of Calendar Year (12/27/2011 map)	8.63	91.37	87.60	72.15	23.37	7.57
Start of Water Year (09/27/2011 map)	0.00	100.00	96.40	88.99	69.61	35.13
One Year Ago (06/14/2011 map)	0.75	99.25	93.98	87.35	67.86	44.90

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://droughtmonitor.unl.edu/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 5/31/12)

Data Source: National Water and Climate Center

Combined storage in Lakes Mead and Powell decreased by 320,000 acre-feet in May but is still about 8 percent greater than it was one year ago due to copious winter snow in 2010–2011. Currently, total reservoir storage in the Colorado River Basin is 61.4 percent of capacity. For Lake Powell, the water level elevation on May 31 was 3,637 feet; storage stood at 64 percent of capacity (*Figure 6*). The April–July forecast issued in June for Lake Powell calls for inflow into the lake to be about 2 million acre-feet (MAF), or 28 percent of average. This is the third driest June forecast for Lake Powell since these forecasts first were issued in 1963. The most probable (i.e., 50 percent likely to be exceeded) unregulated inflow into Lake Powell for the 2012 water year (October–September) is projected to be 5 MAF, or 46 percent of average. If this projection holds true, 2012 would rank as the third driest year since the closure of Glen Canyon Dam in 1963. The driest unregulated inflow volume into Lake Powell was in 2002, when only 2.64 MAF, or 24 percent of average, flowed into the reservoir.

Elsewhere in Arizona, storage in Lyman Reservoir is almost 20 percent lower than it was last year. Storage in the San Carlos Reservoir is at about 1 percent of capacity, reflecting low precipitation in southeastern Arizona during two consecutive La Niña winters.

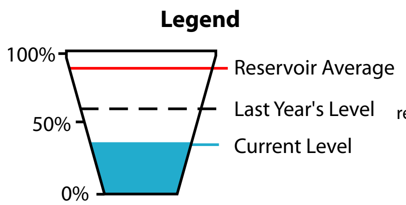
Notes:

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 Resources Conservation Service (NRCS).

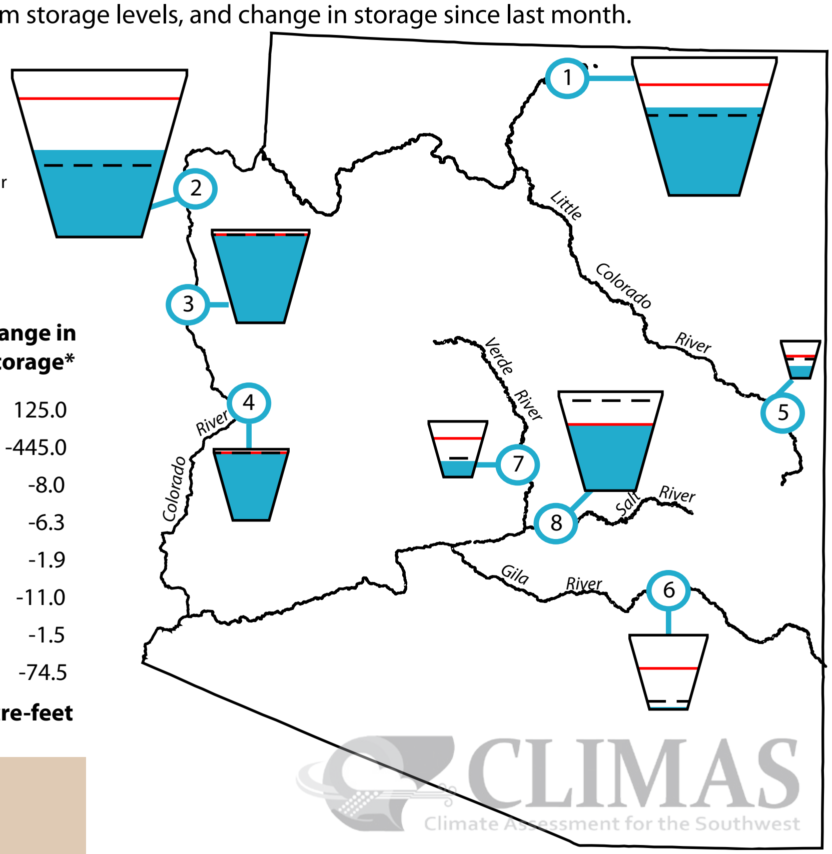
Figure 6. Arizona reservoir levels for May as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



size of cups is representational of reservoir size, but not to scale

Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Lake Powell	64%	15,632.0	24,322.0	125.0
2. Lake Mead	52%	13,541.0	26,159.0	-445.0
3. Lake Mohave	94%	1,700.3	1,810.0	-8.0
4. Lake Havasu	96%	595.7	619.0	-6.3
5. Lyman Reservoir	33%	9.9	30.0	-1.9
6. San Carlos	1%	5.5	875.0	-11.0
7. Verde River System	29%	83.3	287.4	-1.5
8. Salt River System	67%	1,354.9	2,025.8	-74.5

*** thousands of acre-feet**



CLIMAS
Climate Assessment for the Southwest

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 5/31/12)

Data Source: National Water and Climate Center

Storage in New Mexico's reservoirs reported here declined by 61,800 acre-feet in May (*Figure 7*). All but two of the reservoirs lost storage during the last month and most are at lower levels than they were one year ago. Elephant Butte, located on the Rio Grande in central New Mexico, remains only 17 percent full. Levels are particularly low in Pecos River reservoirs, due to the extended and severe La Niña episode, which deprived eastern and southern New Mexico of much precipitation in the last two years.

In water-related news, low water levels in Burn Lake, a man-made lake on the west side of Las Cruces, has reduced migratory bird populations and stranded domesticated waterfowl (*Las Cruces Sun News*, June 4). Low flows in the Rio Grande caused by scant precipitation for the last two years have lessened inflow into the lake. However, the lake could rapidly refill if the monsoon delivers substantial rain.

Also, southern New Mexico's Mesilla Valley farmers received irrigation water earlier than previously announced, according to Elephant Butte Irrigation District officials (*Las Cruces Sun News*, May 31). Water for these farmers and farmers in the El Paso region was released together to reduce losses from evaporation and seepage.

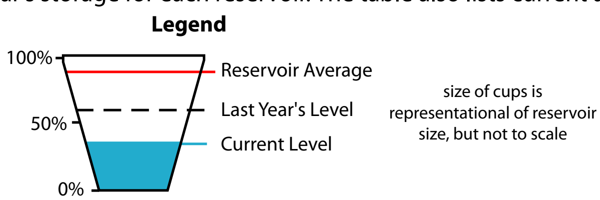
Notes:

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.

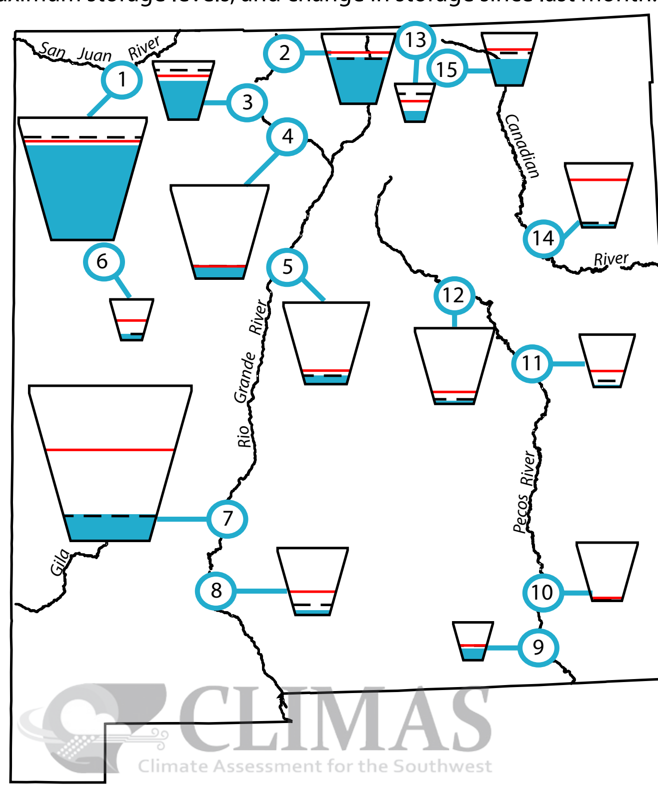
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Figure 7. New Mexico reservoir levels for May 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. Navajo	77%	1302.7	1,696.0	-44.1
2. Heron	66%	262.8	400.0	13.5
3. El Vado	66%	125.9	190.3	-8.8
4. Abiquiu	11%	170.5	1,192.8	-5.1
5. Cochiti	10%	49.8	491.0	-1.8
6. Bluewater	15%	5.6	38.5	-0.2
7. Elephant Butte	17%	366.1	2,195.0	-6.1
8. Caballo	7%	24.0	332.0	0.9
9. Lake Avalon	30%	1.2	4.0	-0.3
10. Brantley	1%	14.6	1008.2	-3.2
11. Sumner	3%	3.2	102.0	0.6
12. Santa Rosa	3%	11.0	438.3	-4.5
13. Costilla	28%	4.4	16.0	-0.5
14. Conchas	4%	10.5	254.2	-0.4
15. Eagle Nest	50%	39.4	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

Southwest Fire Summary
(updated 6/21/12)

Source: Southwest Coordination Center

The Southwest has experienced a substantial increase in the number and size of wildfires in the last month. On May 15, fires had scorched approximately 25,000 and 9,000 acres in Arizona and New Mexico, respectively. On June 20, those numbers jumped to about 74,500 and 367,500 acres (*Figure 8a*). This is no surprise, as wildland fire activity usually peaks in June before monsoon precipitation soaks the landscape. Fires this summer have also been aided by widespread moderate to extreme drought conditions (see page 10).

Currently, eight fires are burning in Arizona and New Mexico (*Figures 8b–c*). The Whitewater-Baldy Complex, located in the Gila National Forest near Glenwood, New Mexico, is the largest fire this year in the U.S. (*Figure 8c*). It also has become New Mexico's largest fire on record, surpassing the Las Conchas fire that charred more than 150,000 acres last year. The Whitewater-Baldy blaze started on May 17 from lightning strikes. As of June 20, it had scorched 297,000 acres and was 87 percent contained. Smoke from the fire caused the state's Environment and Health Department to issue an air quality advisory on May 24.

The Little Bear fire, also in New Mexico, is the second largest active fire in the Southwest. Sparked by lightning, it ignited on June 4 in the Lincoln National Forest, northwest of Ruidoso. As of June 21, approximately 43,000 acres had burned and the fire was only 60 percent contained.

In Arizona, monsoon-like storms brought much-needed moisture to the southeastern part of the state on June 16. Parts of Tucson, for example, received 0.5 inches of rain. These storms, however, did not deliver rain to the Coronado National Forest near Cascabel, where dry lightning strikes set the parched landscape aflame. As of June 21, the Fox fire had burned 7,500 acres there and was 60 percent contained.

Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2012. The figures include information both for current fires and for fires that have been suppressed. The top figure shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. The bottom two figures indicate the approximate locations of past and present "large" wildland fires in Arizona and in New Mexico. A "large" fire is defined as a blaze covering 100 acres or more in timber or 300 acres or more in grass or brush. The name of each fire is provided next to the symbol.

On the Web:

These data are obtained from the Southwest Coordination Center:
http://gacc.nifc.gov/swcc/predictive/intelligence/ytd_historical/ytd/wf/swa_fire_combined.htm

http://gacc.nifc.gov/swcc/predictive/intelligence/ytd_historical/ytd/large_fires/swa_ytd_combined.htm

http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_all_wf_by_state.pdf

Figure 8a. Year-to-date wildland fire information for Arizona and New Mexico as of June 20, 2012.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	648	64,077	39	10,528	687	74,460
NM	312	7,109	91	360,473	403	367,582
Total	960	71,186	130	371,001	1090	442,042

Figure 8b. Arizona large fire incidents as of June 21, 2012.

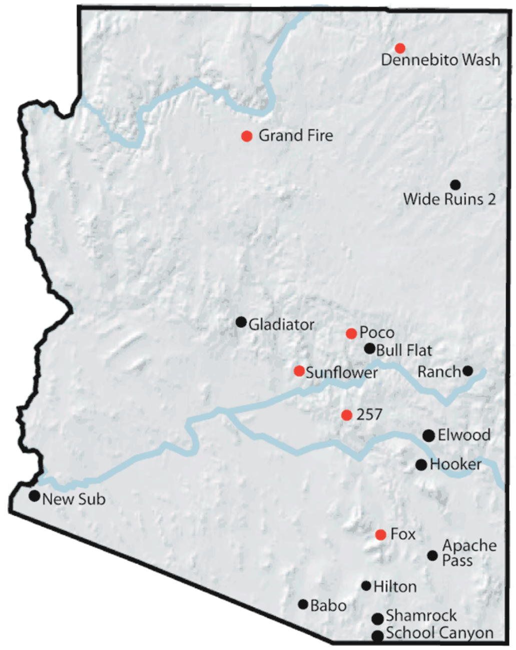
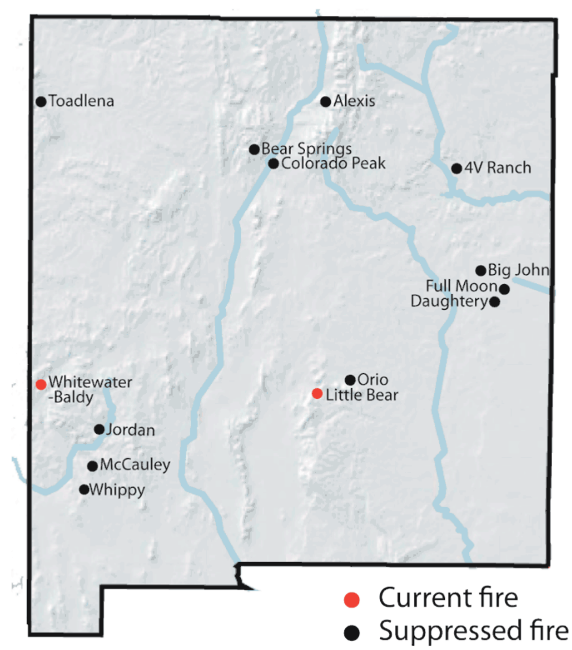


Figure 8c. New Mexico large fire incidents as of June 21, 2012.



Monsoon Summary
(through 6/20/2012)

Data Source: Western Regional Climate Center

A short-lived burst of monsoon activity began in southeast Arizona and southwest New Mexico on June 16. Several storms produced close to 0.4 inches of rain in parts of these regions (*Figures 9a–c*). Another series of monsoon storms produced some rain during the June 23 weekend (which is not reflected in the figures). The recent rain suggests the monsoon has begun earlier than average—historically, the monsoon begins in the southern parts of Arizona and New Mexico around July 1. The dew points, however, remain below temperatures historically used to define the onset of the monsoon. In 2008, the National Weather Service changed the definition of the onset of the monsoon to June 15 to facilitate clear communication of monsoon risks.

In most years, the monsoon forecast calls for equal chances that July–September rainfall will be above, below, or near average. This forecast is no better than flipping a coin. This year, however, signs are strong enough that the Climate Prediction Center (CPC), which issues the official forecasts, is calling for slightly increased chances for above-average monsoon rainfall totals (see pages 3–5). Confidence that the monsoon will begin early and be vigorous in July is driving this outlook. The CPC has more uncertainty in precipitation during August and September, in part because ENSO-neutral conditions may continue or evolve into an El Niño event (see page 19). If an El Niño forms, there is an increased chance that September could be wetter than average, in part because the frequency of tropical storms in the Pacific Ocean increases. The CPC forecast is also supported by methods that analyze past summers that most resemble current and expected conditions. Based on this analog forecast, wet conditions are also favored for July; it also suggests August will be near average and September will be wetter than average. Caution should be exercised when using monsoon forecasts, because predicting the monsoon is difficult; many climate and weather phenomena influence the convective storms.

Figure 9a. Total precipitation in inches (June 14–June 20, 2012).

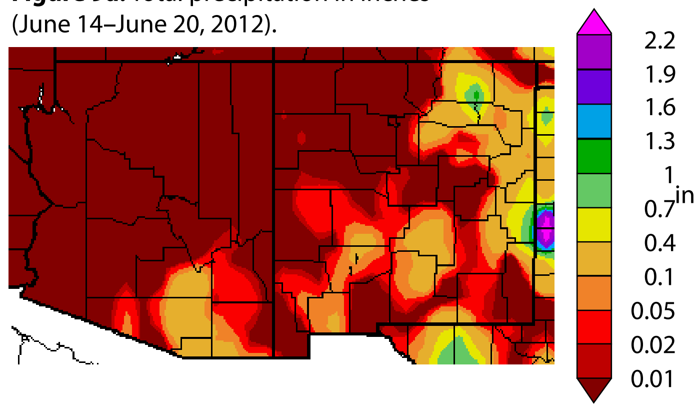


Figure 9b. Departure from average precipitation in inches (June 14–June 20, 2012).

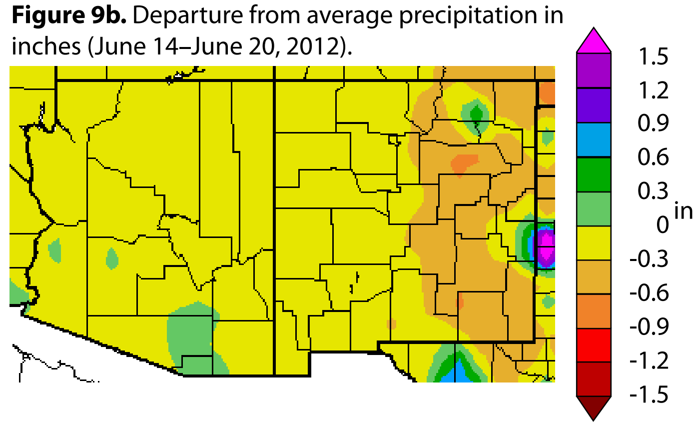
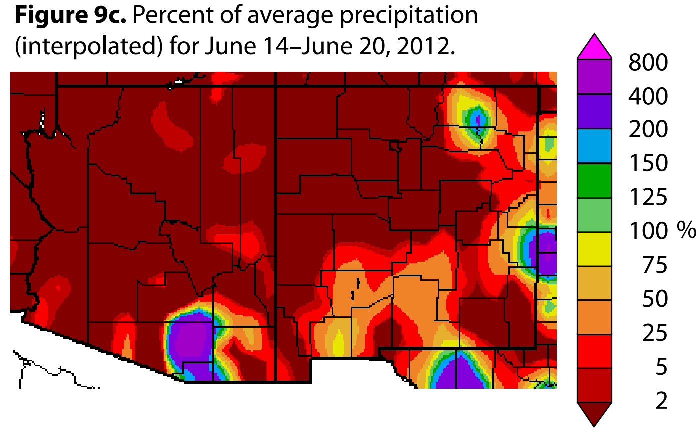


Figure 9c. Percent of average precipitation (interpolated) for June 14–June 20, 2012.



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
(July–December 2012)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA-Climate Prediction Center (CPC) in June call for increased odds that temperatures for the three-month seasons through December will be similar to the warmest 10 years in the 1981–2010 period (*Figures 10a–d*). Recent warming trends are principally influencing this forecast. The possibility that El Niño will develop later in the summer is not a driving influence, but may become more important during the winter; El Niño events tend to bring cooler-than-average conditions to the Southwest.

For the July–September period corresponding to the monsoon, there is a 40–50 percent chance that temperatures will be similar to the warmest 10 years in the 1981-2000 record, and a 60–70 percent chance that they will above average (not shown). The highest probabilities are in northwest Arizona. The monsoon has a notable influence on temperatures because vigorous and continuous rain cools the atmosphere. While it is expected that the monsoon will be early and deliver above-above average rain in July, August and September remain a black box.

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 1981–2010 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 10a. Long-lead national temperature forecast for July–September 2012.

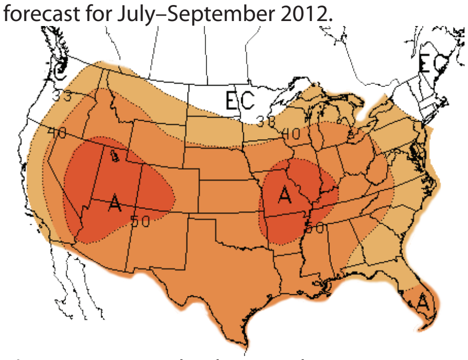


Figure 10b. Long-lead national temperature forecast for August–October 2012.

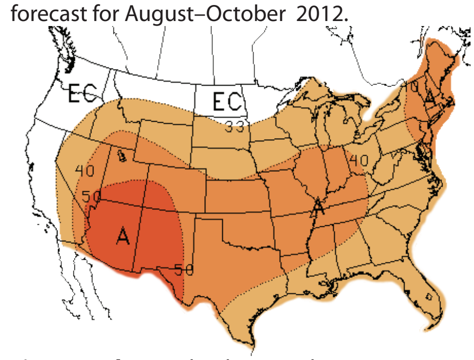


Figure 10c. Long-lead national temperature forecast for September–November 2012.

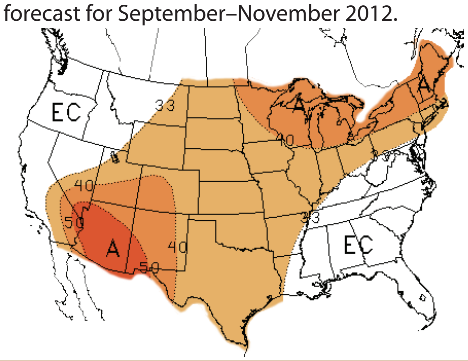
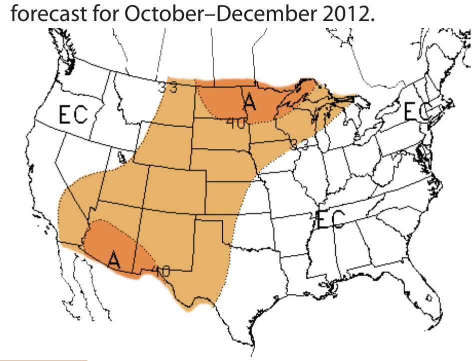


Figure 10d. Long-lead national temperature forecast for October–December 2012.



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

B=Below: 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

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
(July–December 2012)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (CPC) in June call for slightly increased chances that precipitation during the monsoon will be similar to the wettest 10 years in the 1981–2010 record for parts of southern Arizona and New Mexico (*Figures 11a*). These areas correspond to the region most heavily influenced by the monsoon. This forecast is based on the expectation that the monsoon will arrive early and deliver above-average rainfall totals in July, even though there is no indication of the monsoon's strength in August or September. Forecasters at the CPC caution that the chances for a wetter-than-average summer are only slightly better than average or below-average odds.

For the seasonal outlooks spanning August–November, the CPC forecasts equal chances that precipitation will be above, below, or near average (*Figures 11b–c*). The expectation that El Niño will develop in late summer or fall is causing the October–December outlook to favor wetter-than-average conditions because El Niño events historically deliver copious rains to the Southwest during the winter (*Figure 11d*).

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 1981–2010 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 11a. Long-lead national precipitation forecast for July–September 2012.

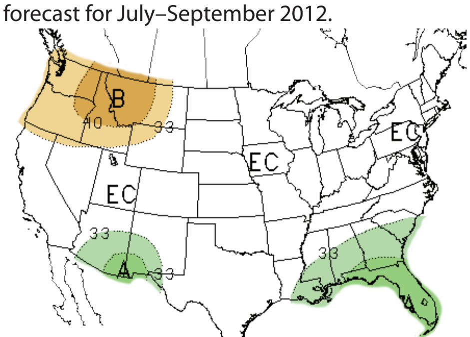


Figure 11b. Long-lead national precipitation forecast for August–October 2012.

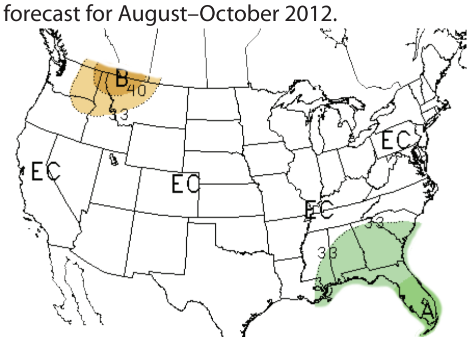


Figure 11c. Long-lead national precipitation forecast for September–November 2012.

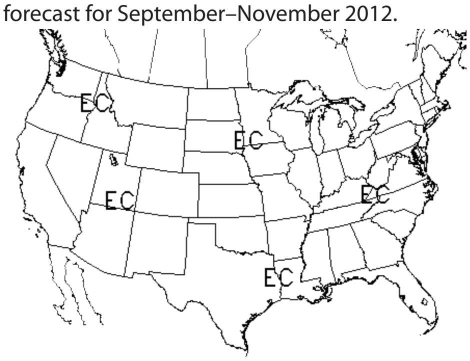
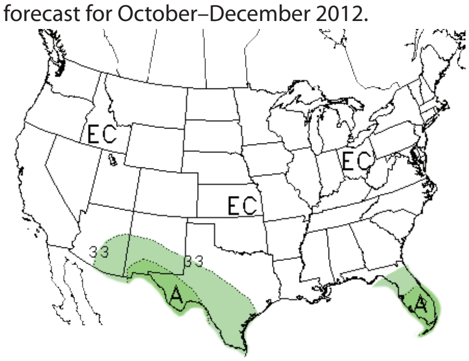
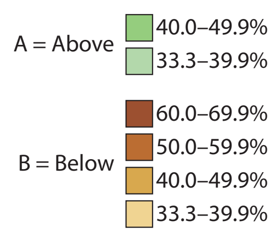


Figure 11d. Long-lead national precipitation forecast for October–December 2012.





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 March load slowly on your computer)

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

Seasonal Drought Outlook
(through September)
Data Source: NOAA–Climate Prediction Center (CPC)

This summary is partially excerpted and edited from the June 21 Seasonal Drought Outlook technical discussion produced by the NOAA-Climate Prediction Center (CPC) and written by forecaster A. Artusa.

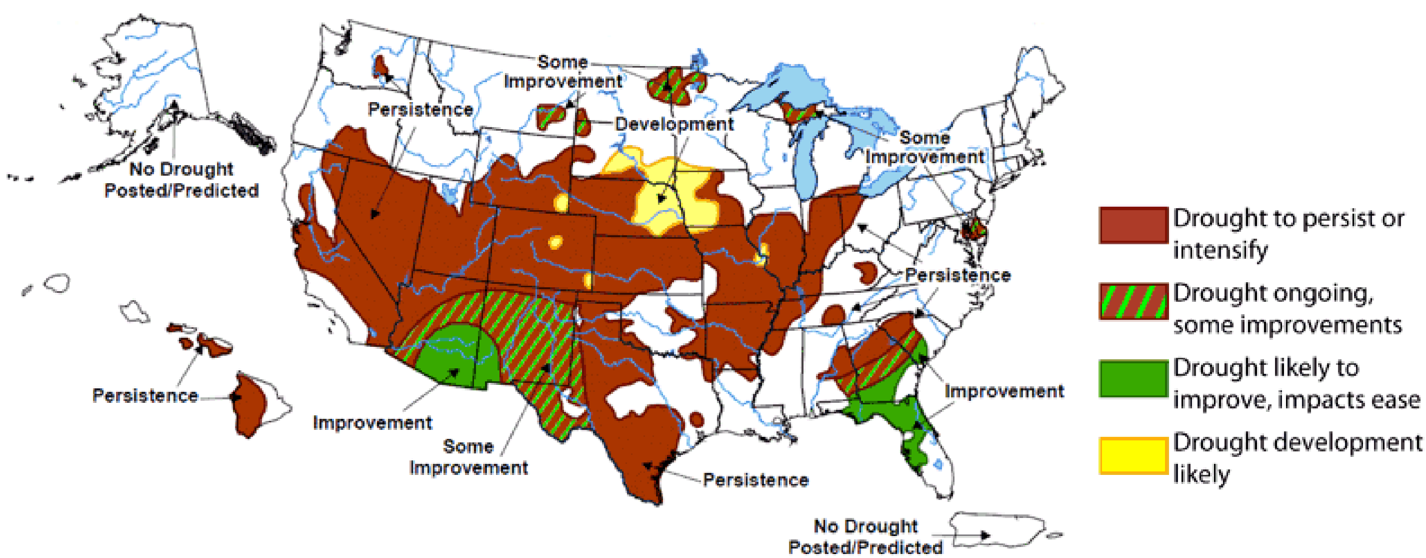
Drought conditions are expected to improve in southern parts of Arizona and New Mexico that historically are most heavily impacted by the monsoon; drought is expected to persist or intensify in other regions (*Figure 12*). Dry conditions across much of the Four Corners states in the last 30 days has caused precipitation deficits of 1 to 2 inches, most notably in central and southeastern New Mexico, Colorado, and central Utah. In the past month, rainfall surpluses of 1 to 3 inches accumulated over northeast parts of New Mexico. The typical onset for the monsoon in the U.S. Southwest is early July, with peak rainfall often occurring during August. Once the monsoon becomes established, thunderstorms have the potential to bring local drought relief, but as is often the case, there is considerable uncertainty in the monsoon's intensity and extent. The CPC has a low confidence for the drought forecast.

Elsewhere in the West, drought is likely to intensify or persist in most of California and Nevada. While the monsoon can bring moisture throughout the Four Corners states, the summer is climatologically dry across the Great Basin, California, and the Northwest. The NOAA-Climate Prediction Center's (CPC) monthly and seasonal climate outlooks favor increased chances for below-median precipitation over the Northwest. In a large majority of the West, precipitation forecast accuracy has been minimal, and therefore seasonal climate outlooks do not indicate if precipitation will be above or below average. The temperature forecasts, however, do favor hotter-than-average conditions in nearly the entire West, which can increase atmospheric demand for moisture and, where moisture is not present, intensify dry conditions. The CPC has high confidence in this forecast.

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 12. Seasonal drought outlook through September (released June 21).



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

Wildland Fire Outlook

(July–September 2012)

Sources: National Interagency Coordination Center, Southwest Coordination Center

Above-normal significant fire potential is expected to continue across most of Arizona and western New Mexico until mid-July (*Figure 13*). Significant fire potential refers to the likelihood that a wildland fire will require additional resources from outside the area in which the fire originated.

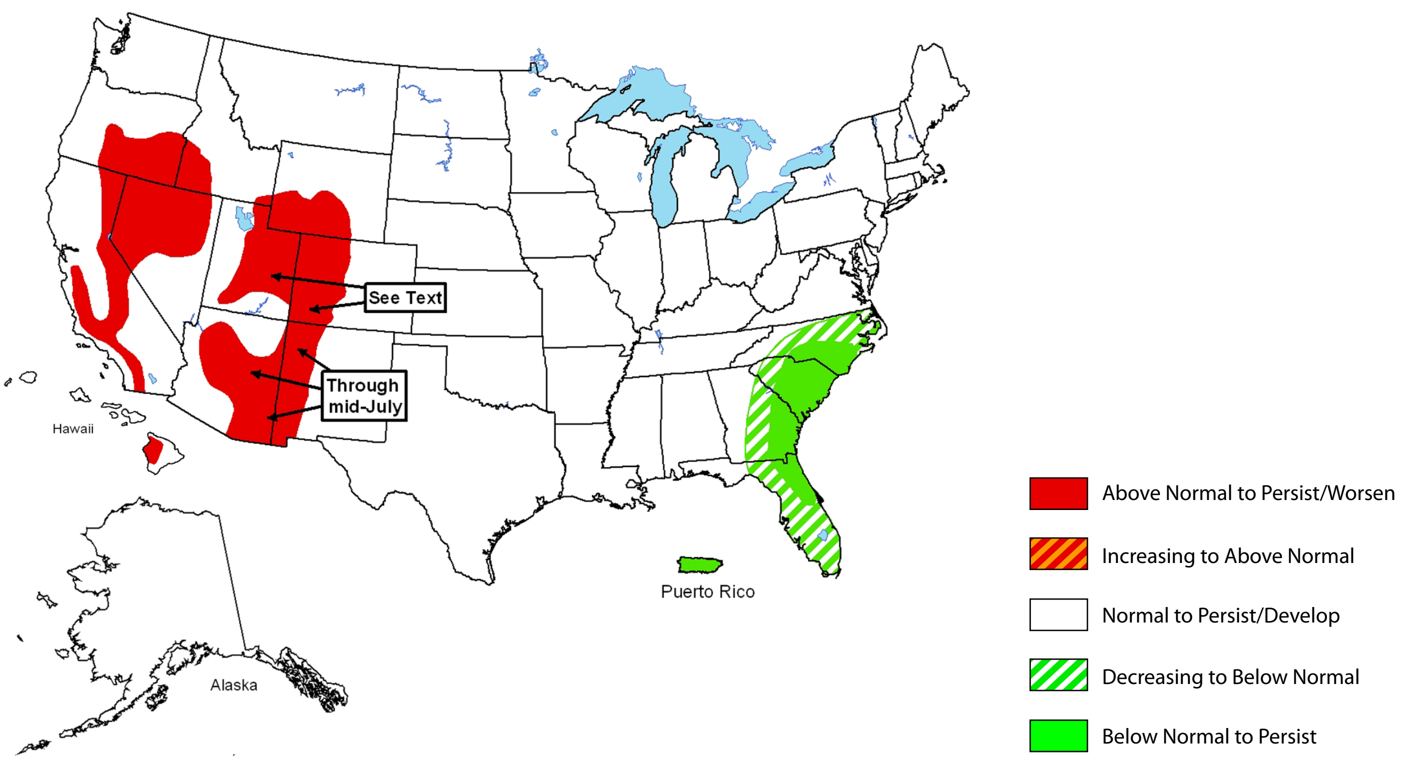
In the Southwest, fuel and soil moisture conditions remain extremely dry due to above-average temperatures and below-average precipitation—these conditions are reflected in the moderate to extreme drought that covers most of the Southwest (see pages 9–10). The monsoon, which historically begins in late June or early July in southern Arizona and New Mexico, will deliver much needed moisture and help squelch existing wildfires. The summer rains will also help limit the number of new blazes by increasing moisture in fuels such as brushes and trees. Until the monsoon begins, however, increasing dry lightning strikes will elevate the chances for new wildfires.

After mid-July the entire region is expected to move into normal significant fire potential due to increased monsoon moisture. However, there is uncertainty in this outlook as a result of unknowns in monsoon precipitation as well as the state of the El Niño-Southern Oscillation (ENSO). While the precipitation forecast calls for increased chances of above-average rainfall in July, forecasters are less confident in August and September precipitation. Also, if ENSO remains in neutral conditions, the northwestern portion of the region likely will experience drier conditions and would be at higher risk for wildfires. On the other hand, the development of an El Niño event favors drier conditions in the southeastern portion of the region, favoring higher fire risk there. ENSO forecasts favor a transition to El Niño in late summer.

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. The forecast (Figure 13) consider observed climate conditions, climate and weather forecasts, vegetation health, and surface-fuels conditions in order to assess fire potential for fires greater than 100 acres. They are subjective assessments, that synthesize information provided by fire and climate experts throughout the United States.

Figure 13. National wildland fire potential for fires greater than 100 acres (valid July–September 2012).



On the Web:

National Wildland Fire Outlook web page
http://www.nifc.gov/news/nicc.html

Southwest Coordination Center web page
http://gacc.nifc.gov/swcc/predictive/outlooks/outlooks.htm

El Niño Status and Forecast

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

ENSO-neutral conditions prevail in the tropical Pacific Ocean, but forecast models continue to favor the development of an El Niño later this year. Sea surface temperatures (SSTs), which had been warming in recent months, leveled during the last 30 days but remain near average across most of the eastern equatorial Pacific Ocean. This indicates that ENSO-neutral conditions currently dominate the Pacific Ocean basin, closing the door on the La Niña event of this past winter. This shift back towards average conditions is reflected in the May value of the Southern Oscillation Index (SOI), which returned to near zero (*Figure 14a*).

Last month, a large pool of warmer-than-average water flowed just below the surface across much of the eastern equatorial Pacific Ocean. Forecasters and forecast models expected this warm water to make its way to the surface sometime within a few months, bringing on weak El Niño conditions as early as this fall. While forecast models continued to favor the development of an El Niño event this month, they now depict the possibility of a slower onset of El Niño. Official forecasts issued jointly by the NOAA-Climate Prediction Center (CPC) and International Research Institute for Climate and Society (IRI) show a near 50–50 split between neutral conditions and El Niño conditions for the July–September period, with chances for the development of El Niño rising thereafter (*Figure 14b*). If and when El Niño develops, the current expectations are that it will be weak and may not heavily influence weather conditions in fall and winter. This forecast, however, will continue to evolve as the summer progresses.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through May 2012. 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, 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 14a. The standardized values of the Southern Oscillation Index from January 1980–May 2012. 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).

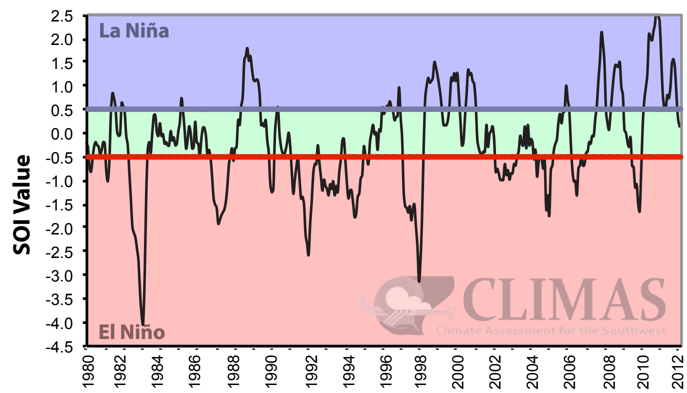


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released June 22). Colored lines represent average historical probability of El Niño, La Niña, and neutral conditions.