August 22, 2012

Southwest Climate Outlook

Vol. 11 Issue 8

Monsoon storms like this one on July 14 have drenched the Tucson metropolitan area this summer. Between June 15 and August 21, rain has totaled 5.21 inches at the Tucson International Airport, which is 1.11 inches above average. Photo credit: Zack Guido, CLIMAS.

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: zguido@email.arizona.edu

In this issue...

August Climate Summary

Drought: While monsoon precipitation has brought some short-term relief to parts of the Southwest, long-term drought conditions continue to plague all of Arizona and New Mexico.

Temperature: Temperatures have been near average in most of Arizona, while eastern New Mexico has continued to bake.

Precipitation: The monsoon has continued to track across the western border of Arizona, delivering substantial rains but leaving much of New Mexico extremely dry.

ENSO: Neutral conditions continue across the eastern Pacific Ocean, but a weak to moderate El Niño is expected to develop in the next few months.

Climate Forecasts: A materializing El Niño event is expected to bring wetter-than-average conditions to southern Arizona and New Mexico this fall and winter. Cool temperatures, also associated with an El Niño, will likely counter recent warming trends, and forecasts are unclear which will win out.

The Bottom Line: Precipitation deficits that have accumulated over the past two years continue to paint the region with long-term drought. About 94 percent of Arizona and 85 percent of New Mexico are classified with severe drought or a more extreme drought category. One reason for these classifications is that many of the region's important reservoirs are low. The most probable inflow volume into Lake Powell for the 2012 water year is projected to be 5.15 million acre-feet, or 48 percent of average. If this comes to pass, Colorado River streamflows will go down as the third lowest on record. A similar scene is playing out in New Mexico. Irrigation allotments from Elephant Butte Reservoir, which provides water to New Mexico's most productive agricultural region, were only 10 inches; 36 inches is considered a full allotment. While an active second half of the monsoon will help ease short-term drought conditions, it will not erase them or cause substantial rebounds in reservoir storage. A protracted stretch of average to above-average precipitation will be necessary to bring conditions back to normal. The good news is that an impending El Niño event could bring much-needed moisture. Experts expect El Niño conditions to develop during the August–October period and persist through the winter. Although El Niño events historically deliver above-average precipitation to the region, the odds of copious rain and snow are not a sure bet. The Southwest has experienced dry conditions during past El Niño events.

Warming in Arizona from urbanization alone could approach 4 degrees C

Population growth and its attendant urban expansion play an important role in local temperature change. This is particularly true in the Southwest, home to the most rapidly expanding megapolitan region in the country—Arizona's Sun Corridor. A recent peer-reviewed article showed that future warming is caused by local urban development, which can be substantial, and greenhouse gas-induced global climate change. It also showed that building practices can mitigate some magnifying effects of built environments.

In the *Nature Climate Change* study published in August, the authors used a climate model to analyze the impacts of high and low urban growth scenarios developed by the Maricopa Association of Governments. Based on the high growth scenario, results showed that urban expansion could increase average June–August temperatures by as much as 4 degrees Celsius (about 7 Fahrenheit) by 2050. The magnitude of this warming outpaces that of some projections of global warming caused by increased levels of greenhouse gases. The research also included a high growth scenario in which all roofs reflected 88 percent of solar rays, which would meet Environmental Protection Agency Energy Star rating requirements. The research found that reflective coating could reduce development-related warming substantially.

Read more at: https://geoplan.asu.edu/georgescu-megapolitan

Table of Contents:

SWCO Staff:

Mike Crimmins
UA Extension Specialist

Stephanie Doster
Institute of the Environment Editor

Dan Ferguson
CLIMAS Program Director

Gregg Garfin
Founding Editor and Deputy Director of Outreach, Institute of the Environment

Zack Guido
CLIMAS Associate Staff Scientist

Gigi Owen
CLIMAS Assistant Staff Scientist

Nancy J. Selover
Arizona State Climatologist

Jessica Swetish
CLIMAS Publications Assistant

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.

Coping with Drought on the Rio Grande

By Zack Guido

This article is part one in a series exploring the impacts of the current drought on water management and agriculture in New Mexico's Lower Rio Grande Valley.

Ditch runners—men patrolling irrigation channels—twist open steel gates cut into concrete waterways in New Mexico's Lower Rio Grande River Valley, bathing pecan orchards in water and nurturing vibrant chili plants.

At first sight, all seems a healthy, hydrated green. The upstream reservoirs, however, paint a darker, drier picture—one that water managers believe may be the new normal and will force agriculture to adapt to a diminished water supply.

Water storage in Elephant Butte and Caballo reservoirs, which supply water to about 90,000 acres of farmland in New Mexico and half the population of El Paso, Texas, has plummeted amid a decade-long drought. Stores in both reservoirs stand at less than 10 percent of capacity, and water destined for those pecan trees and chili crops is all but exhausted. Until a string of wet years restocks the reservoirs, agriculture and urban needs will be forced to make up shortfalls using groundwater and other practices.

On the Rio Grande—historically the wellspring for more than five million people in Colorado, New Mexico, Texas, and Mexico—coping with scarcity has become a reality, and water management and use in the region may be a leading example of how to adapt to drier times.

Water Use

The Rio Grande flows about 1,800 miles from the peaks of southern Colorado to the Gulf of Mexico, forming the international border between the U.S. and Mexico. The primary use of water changes with geography. In northern New Mexico, Rio Grande water supplies a substantial portion of urban water needs for Albuquerque, while irrigation draws the most water in the southern part of the state.

Elephant Butte is New Mexico's largest reservoir on the Rio Grande, storing about 2.2 million acre-feet of water. An acre-foot covers one acre of land in one foot of water and satisfies, on average, the annual water needs of about eight Albuquerque residents. The U.S. Bureau of Reclamation jointly manages Elephant Butte with Caballo Reservoir, a smaller structure about 25 miles down river that impounds an additional 350,000 acre-feet. In a good year, these reservoirs release about 790,000 acre-feet; 416,000 is allocated to the Elephant Butte Irrigation district (EBID) in southern New Mexico, and 314,000 and 60,000 acre-feet are passed to Texas and Mexico, respectively. When flows in the river and storage in Elephant Butte and Caballo reservoirs are sufficient, EBID doles out 36 inches of water per acre of land, which is considered a full irrigation allotment. In some years, EBID has allocated more; recently, the allocation has been less.

"In about 1978, we began a 23-year full-supply of surface water," said Gary Esslinger, director of the Elephant Butte Irrigation District (EBID). "We had plenty of snowpack runoff. The lakes were full. We were just over our heads in surface water."

In 2003, drought set in. It was a wake-up call, Esslinger said.

Dry Times

Low streamflows in the Rio Grande have been, on average, the rule in the past decade. The headwaters above Del Norte, Colorado, where most of the flow in the Rio Grande originates, have been about 83 percent of the historical average since 2002, marking the driest decade since the 1950s and early 1960s. Precipitation in the headwaters has been below average eight of the last 10 years. The low flows have caused storage in Elephant Butte to tank, leaving little water for farmers (*Figure 1*).

"In terms of releasable water, we will be down to zero [by the end of the irrigation

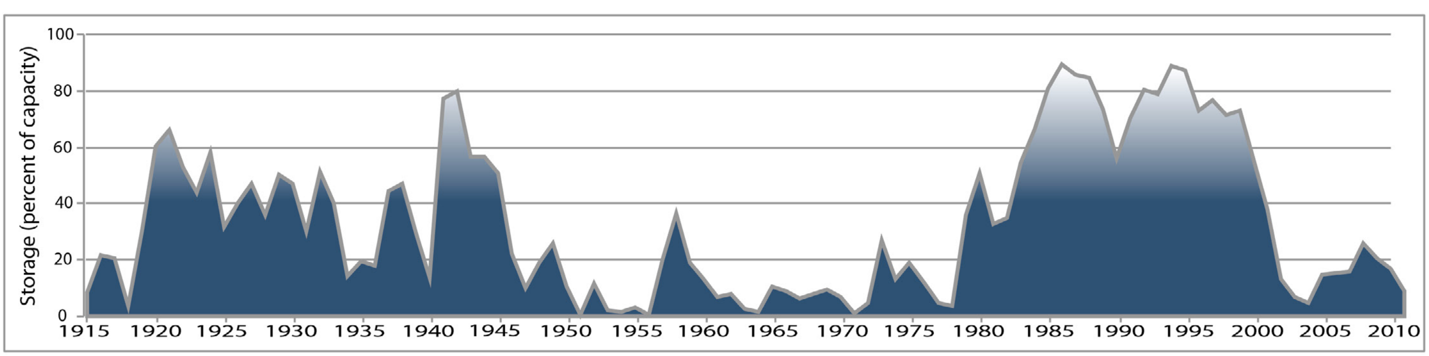


Figure 1. Water stored in Elephant Butte Reservoir (as a percent of its full capacity of 2.195 million acre-feet) at the beginning of the water year on October 1. Source: U.S. Bureau of Reclamation.

continued on page 4

Coping with Drought continued

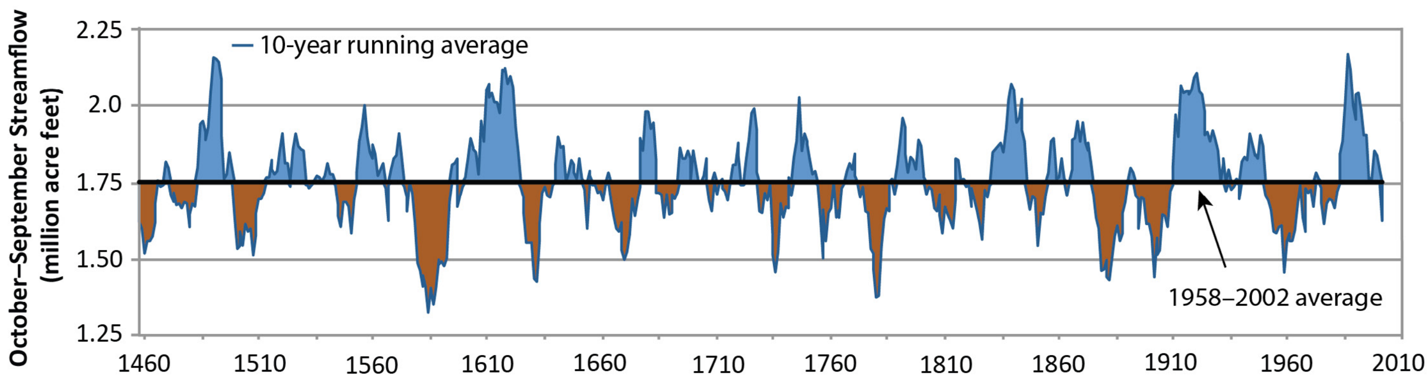


Figure 2. Reconstructed streamflow of the Rio Grande at Otowi Bridge north of Albuquerque. The record was developed using tree rings and published in a peer reviewed article that appeared in *Climate Research* in 2012. Source: www.treeflow.info.

season]," said Phil King, professor of civil engineering at New Mexico State University and an EBID consultant.

The low flows have forced EBID to allocate only 10 inches per acre to irrigators this year; last year it was only 4 inches. Since 2003, EBID has doled out a full allotment only once, in 2008.

The recent dry spell is not unusual. Researchers at the University of Arizona used tree rings to recreate streamflows at Otowi Bridge, about 60 miles north of Albuquerque, for the years 1450–2002. This 552-year record shows five 10-year periods in which flows were less than the lowest values measured by stream gauges (*Figure 2*). The most persistent drought occurred in the late 1800s, when flows measured 73 percent of average during an 11-year period.

The 20th century is not representative of streamflow variability in the Rio Grande, said Connie Woodhouse, professor at the University of Arizona's School of Geography and Development and co-author of the tree-ring reconstruction of Rio Grande streamflows. "We have longer droughts and more severe [lower] flows reconstructed," she said.

The record is a warning: the severity, frequency, and duration of droughts in the future may exceed those of recent years, which will create additional challenges for water management and use.

"The greatest uncertainty is the changes that are coming with climate change," said Filiberto Cortez, manager of the Bureau of Reclamation's El Paso Field Division. Historical practices are changing, he added.

Adapting to Drought

While best estimates from climate models suggest the future will be drier, recent trends suggest that drier climes already have set in.

"Average [Rio Grande streamflows] seem to be on a long-term decline," King said, adding that future droughts likely will become more severe.

In many places in the Lower Rio Grande, groundwater has been the saving grace during the last dry 10 years. Farmers and urban water managers have supplemented meager surface water allotments by ramping up pumping, lowering water levels in some areas.

"The groundwater is hydrologically connected to the river. It's not magically making water; it's really borrowing it from future water supplies," King said.

Pumping groundwater is also more costly than river water and saltier, which over time can lower crop yields. For smaller farms or those on tight budgets, pumping groundwater likely is only a short-term coping strategy and not a sustainable policy. This has led EBID to explore new strategies to boost supply, including capturing monsoon torrents by building earthen structures that funnel water spilling from drainages into irrigation canals.

"We've been really intense in developing a stormwater management plan to capture the water and use it to recharge our aquifer," Esslinger said.

Capturing monsoon precipitation, however, cannot completely compensate for reductions in streamflow experienced in the recent decade, King said. Other changes also likely will be needed.

"Farming will adapt," King said. "I think what you will see is a change in the crop types. Probably, [farmers will] concentrate what little water there is on smaller acreage and grow higher value crops."

While it easy to see gloom in a drier future, farmers and other water users will respond, perhaps in unexpected ways.

"Farmers here are very progressive, very innovative," Esslinger said. "Garlic and things that we've never thought of may be grown here and may be a new source of agriculture."

Part Two in this series will be issued in September and will explore how farmers are coping with the current drought.

Temperature (through 8/15/12)

Data Source: High Plains Regional Climate Center

Temperatures during the water year, which began Oct. 1, continue to depend on elevation. The coldest conditions have been at the highest elevations in both Arizona and New Mexico. The southwest deserts of Arizona, the lower Colorado River valley, and the southern border of New Mexico have been the warmest (*Figure 1a*). The winter storms that have tracked through the Southwest generally have passed over the northern portions of both states, and many storms have missed Arizona and New Mexico altogether. With few exceptions, Arizona was within 1 degree Fahrenheit of average statewide (*Figure 1b*). On the other hand, the highest departures from average temperatures have been in eastern New Mexico and only isolated locations have been colder-than-average (*Figure 1b*). Virtually no storms, dry or wet, crossed eastern New Mexico, which contributed to above-average temperatures in this region. The warmer-than-average water year thus far is the result of the La Niña circulation pattern that forced winter storms to pass north of Arizona and New Mexico.

In the past 30 days, the temperature pattern was controlled by the location of the subtropical high over the Southwest. The high pressure over eastern New Mexico pushed moisture and monsoon activity northward through eastern Arizona, leaving eastern New Mexico dry and therefore warmer than average. Northern Arizona was within 2 degrees F of average over the past month, the result of relatively constant thunderstorm activity. The southwest part of the state had a few days of activity in late July, but has been dry during most of August (*Figures 1c–d*).

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 2012 (October 1 through August 15) average temperature.

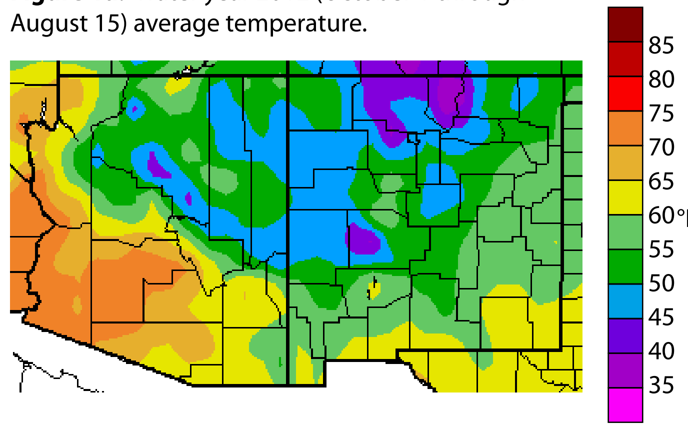


Figure 1b. Water year 2012 (October 1 through August 15) departure from average temperature.

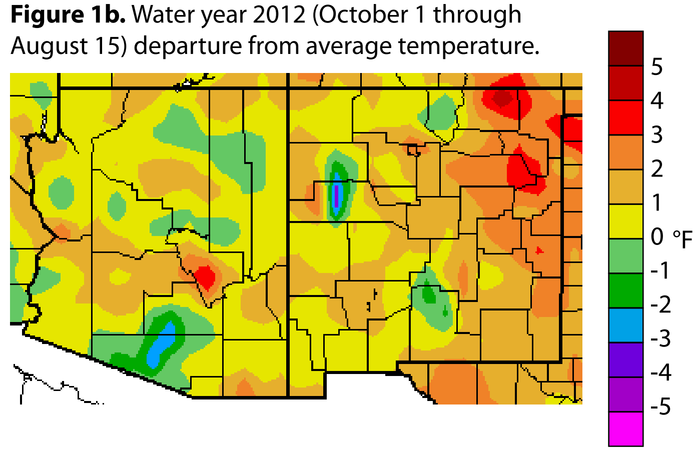


Figure 1c. Previous 30 days (July 17–August 15) departure from average temperature (interpolated).

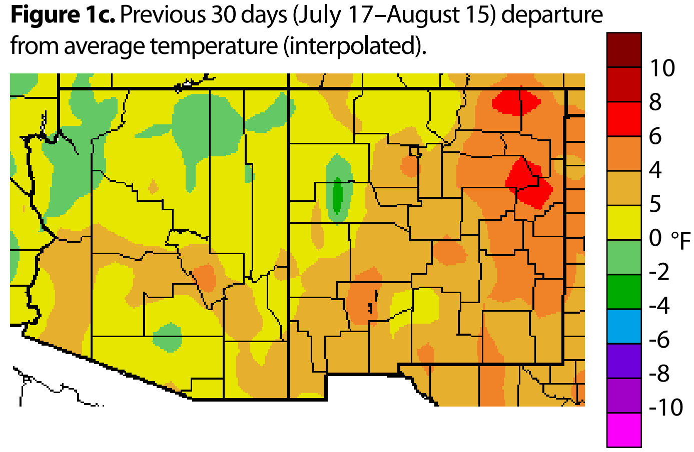
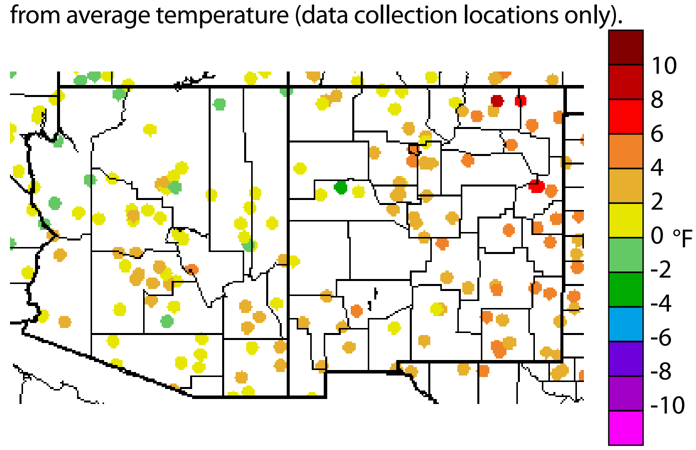


Figure 1d. Previous 30 days (July 17–August 15) departure from average temperature (data collection locations only).



Precipitation (through 8/15/12)

Data Source: High Plains Regional Climate Center

Most of the Southwest has been drier than average since the water year began Oct. 1 (*Figures 2a–b*). The pockets of wetter-than-average conditions illustrate how localized the winter precipitation was this past year. Very few storms moved through the region, and those that did produced significant precipitation over relatively small areas. Both the paucity of storms and the high variability in the precipitation are characteristic of La Niña patterns in the Southwest. Northwestern New Mexico, western Pima County, and central Mohave County in Arizona benefitted from a few of those wet storms, while the rest of the Southwest remained warm and dry. So far, the 2012 monsoon activity has not compensated for the dry winter.

In the past 30 days, the monsoon continued to track across the western border of Arizona, leaving much of New Mexico extremely dry, with less than 25 percent of average precipitation (*Figures 2c–d*). Activity along the Mogollon Rim and other higher elevation locations has been slightly wetter than average, while northwestern New Mexico and the southwest deserts of Arizona have been hot and dry. It remains to be seen if the monsoon will kick in in those parched regions before the summer rainy season ends at the end of September, or if it will continue to fail to deliver adequate rain for large areas of the Southwest.

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 2012 (October 1 through August 15) percent of average precipitation (interpolated).

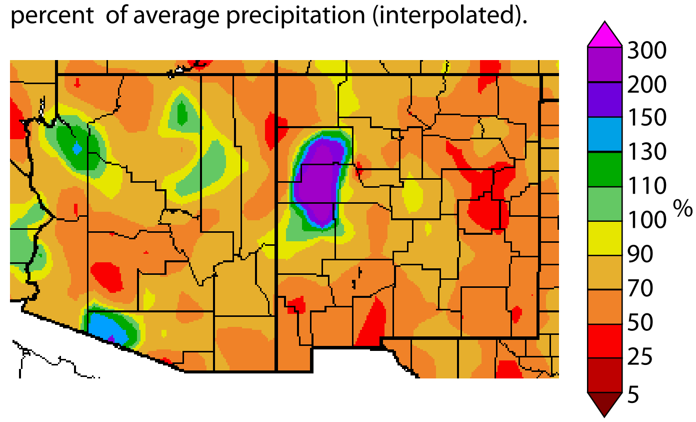


Figure 2b. Water year 2012 (October 1 through August 15) percent of average precipitation (data collection locations only).

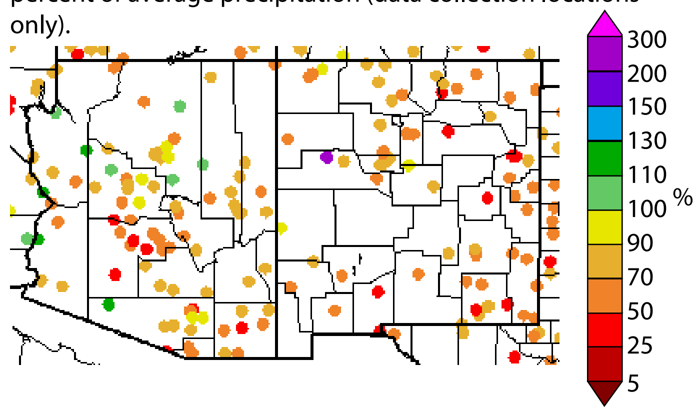


Figure 2c. Previous 30 days (July 17–August 15) percent of average precipitation (interpolated).

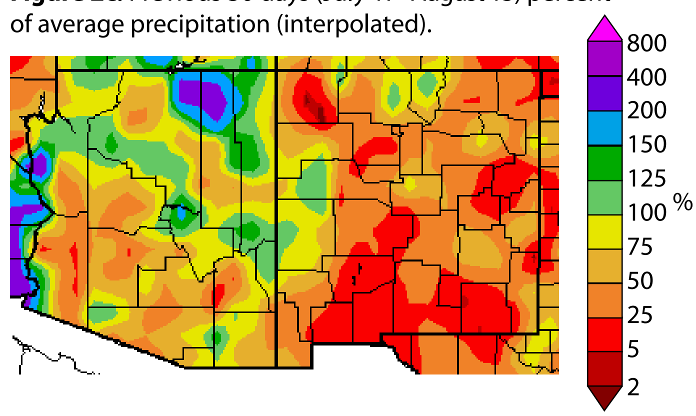
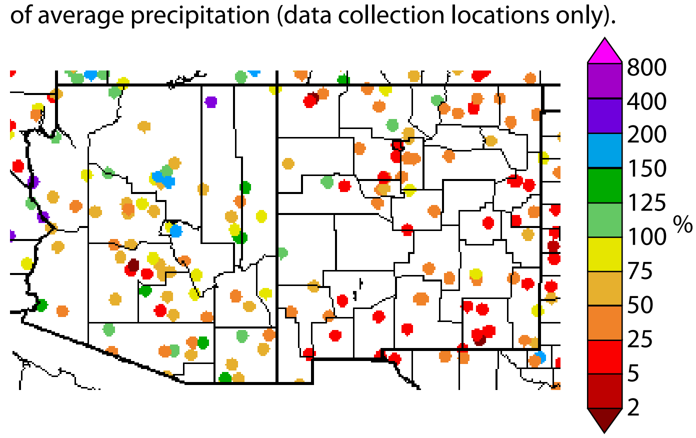


Figure 2d. Previous 30 days (July 17–August 15) percent of average precipitation (data collection locations only).



U.S. Drought Monitor (data through 8/14/12)

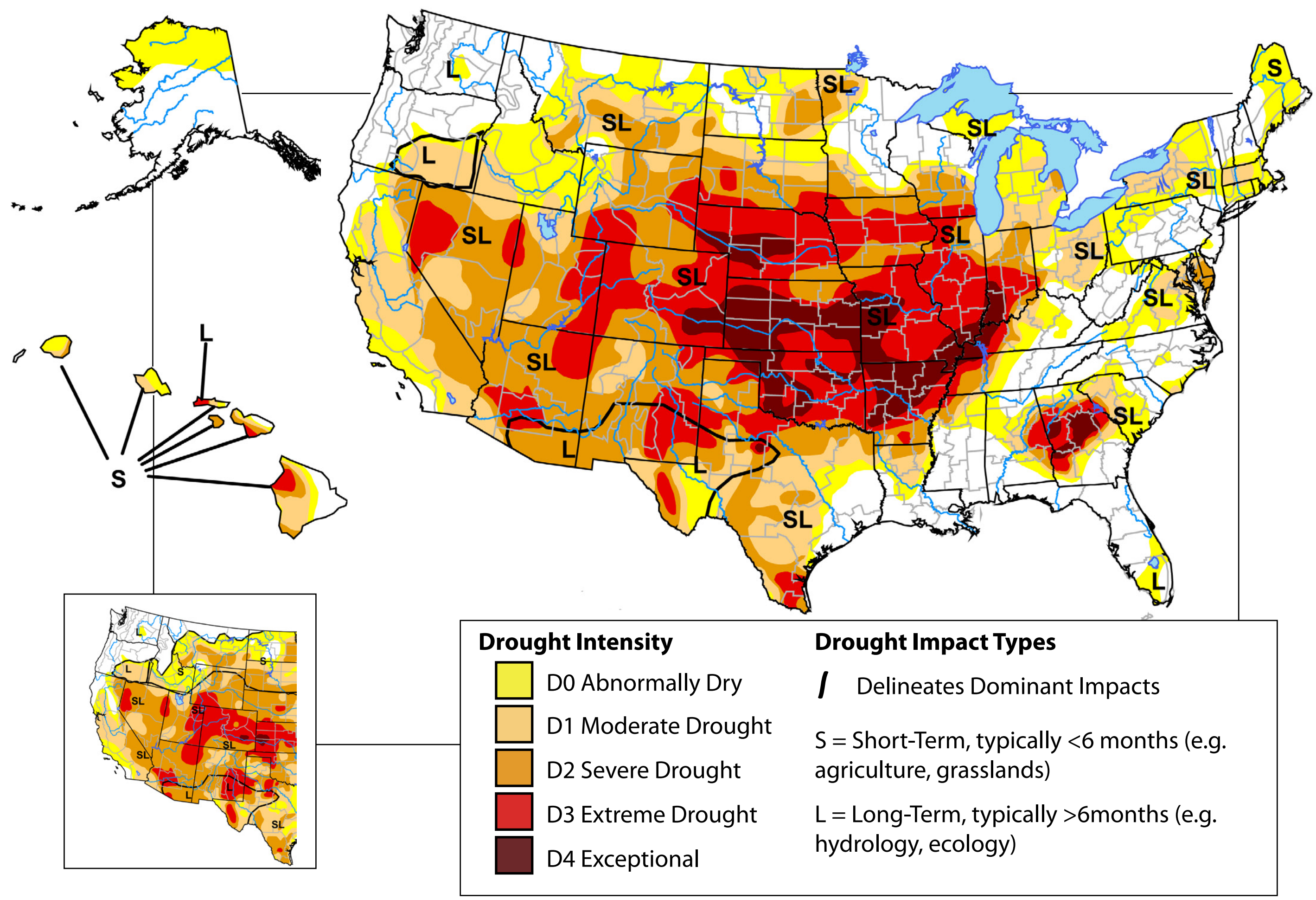
Data Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

Drought conditions persisted across much of the western U.S. and expanded to the north in the past 30 days during a record hot and dry summer (*Figure 3*). The area of the western U.S. covered by drought was up slightly from 79 percent in mid-July to 83 percent in mid-August. Nearly 17 percent of the western U.S. is classified with extreme drought, which is defined as a drought that occurs, on average, once in every 20 years. Colorado is experiencing the only exceptional drought in the West. The northern Rockies saw the greatest changes in drought in the last month, with abnormally dry to moderate drought conditions expanding across almost all of Montana. Most other areas observed static drought conditions, except for Colorado, which saw some areas of the state improve while other parts worsened.

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 August 14, 2012 (full size), and July 17, 2012 (inset, lower left).



On the Web:

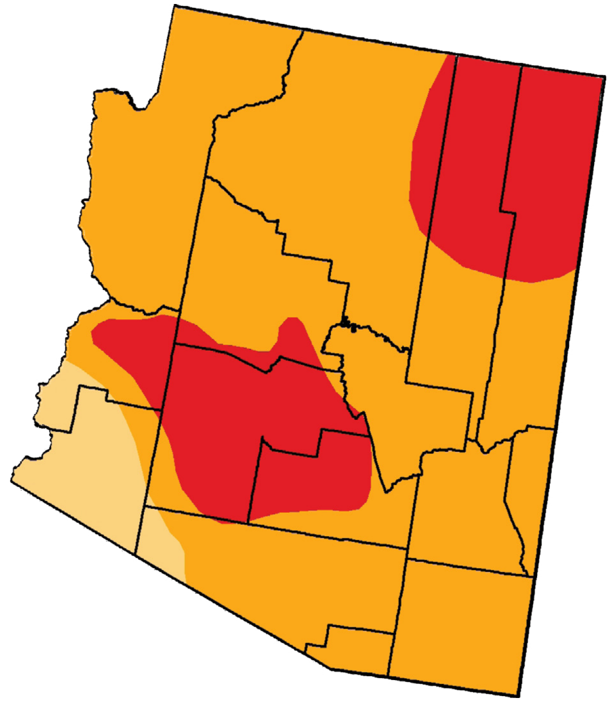
The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website http://www.drought.gov

Arizona Drought Status
(data through 8/14/12)
Data Source: U.S. Drought Monitor

Drought conditions changed very little over the past 30 days, with all of Arizona experiencing moderate to extreme drought (*Figures 4a–b*). Monsoon precipitation provided short-term drought relief in some areas, including parts of northern and central Arizona, but overall was spotty over the past month. Current drought conditions across the state stem from long-term precipitation deficits, particularly those that have accumulated over the past two years. Along stretch of average to above-average precipitation will be necessary to bring conditions back to normal. Monsoon precipitation through the rest of the summer season will help ease short-term drought conditions but will not erase them.

In drought-related news, ongoing dry conditions have reduced the water supply for Safford in eastern Arizona, forcing the mayor and city council to declare a state of emergency and set in place mandatory water use restrictions (*Eastern Arizona Courier,* August 15). Also, streamflow in Bonita Creek, the main surface water supply for the city, was down 18 percent at the end of July, making it difficult for the city to meet water use demand. The Stage One water restrictions call for residents to reduce nonessential water use and limit watering landscapes during daytime hours.

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

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	93.97	24.95	0.00
Last Week (08/07/2012 map)	0.00	100.00	100.00	93.97	24.91	0.00
3 Months Ago (05/15/2012 map)	0.00	100.00	96.08	69.31	16.29	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 (08/09/2011 map)	11.15	88.85	60.35	37.15	14.02	4.83

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 8/14/12)

Data Source: U.S. Drought Monitor

Limited monsoon activity across New Mexico has provided little relief to ongoing drought conditions across the state and the entire state remains in moderate to extreme drought (*Figure 5a*). The numbers have changed little since last month, but the area classified with severe or more elevated drought has grown slightly, from 79 percent in mid-July to 85 percent in mid-August (*Figure 5b*). This shift towards worsening conditions occurred in the southwestern corner of the state, where meager monsoon precipitation has led to worsening short-term drought conditions.

The USDA will continue to open up disaster assistance and aid programs to support farmers and ranchers impacted by drought across New Mexico (*New Mexico Business Weekly*, August 9). More than $600,000 will be available to farmers and ranchers in New Mexico through the USDA Natural Resources Conservation Service to support the development and improvement of livestock watering facilities and water conservation practices.

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

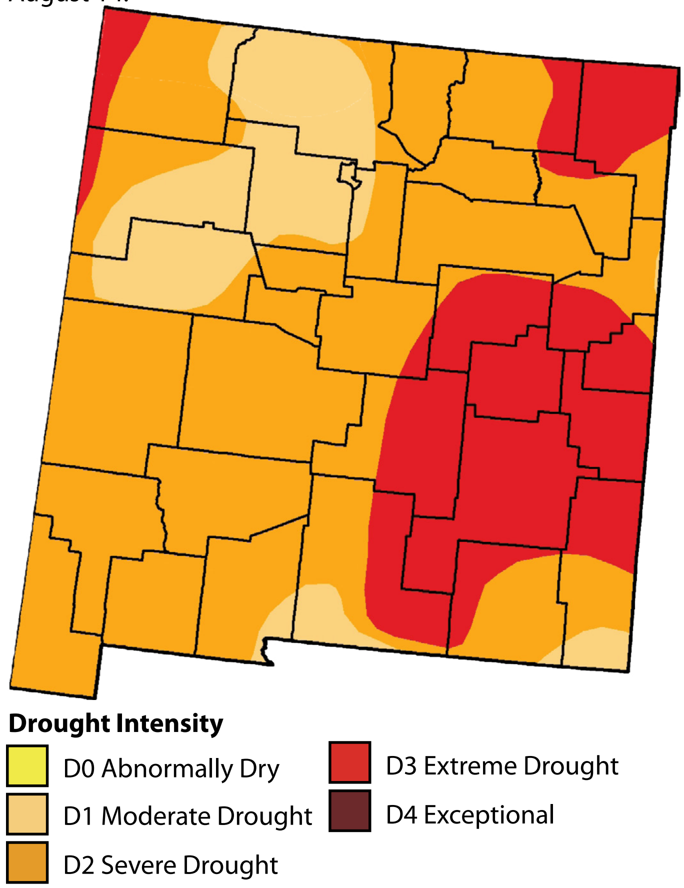


Figure 5b. Percent of New Mexico designated with drought conditions based on data through August 14.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	85.11	25.88	0.00
Last Week (08/07/2012 map)	0.00	100.00	99.93	80.24	25.74	0.00
3 Months Ago (05/15/2012 map)	0.00	100.00	96.20	62.63	23.99	0.67
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 (08/09/2011 map)	0.00	100.00	100.00	93.16	77.31	47.30

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 7/31/12)

Data Source: National Water and Climate Center

Combined storage in Lakes Mead and Powell stands at 55 percent of capacity, a decrease of 607,000 acre-feet during the last month (*Figure 6*). Total reservoir storage in the Colorado River Basin is at 59 percent of capacity. San Carlos Reservoir storage continued to decline in July, and only contains about 1,600 acre-feet. Also, combined storage in the Salt and Verde river basin systems is at 56 percent of capacity, which is about 19 percent less than it was one year ago.

In water news, a federal appeals court rejected a bid by the Grand Canyon Trust to annually assess how the operation of the Glen Canyon Dam affects the humpback chub, an endangered Colorado River fish (Capitol Media Services, August 14). The three-judge panel found no legal requirement for such an annual review. At issue for the trust is the current policy of operating Glen Canyon Dam releases based on demand for electricity. The trust prefers water releases that mimic the natural flow of the river, saying that would benefit endangered species downstream.

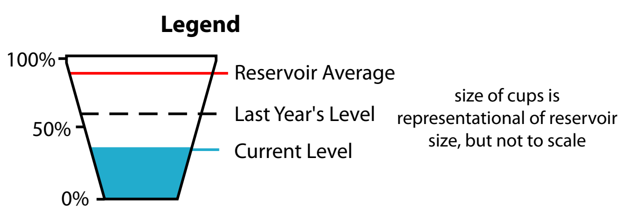
Notes:

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 four 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.

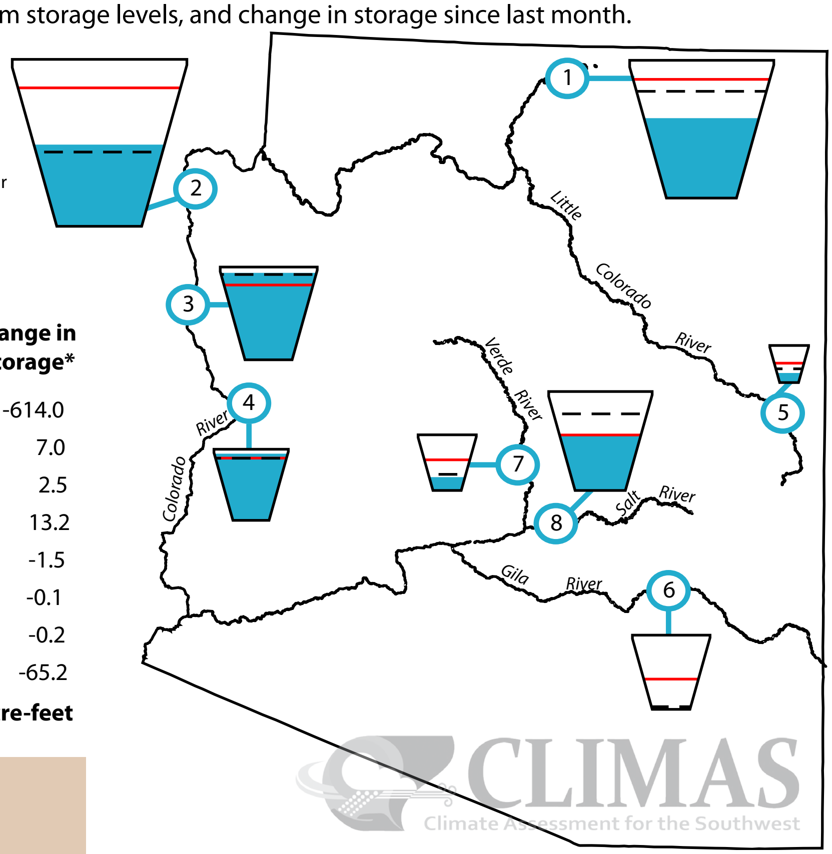
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Figure 6. Arizona reservoir levels for July 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	60%	14,680.0	24,322.0	-614.0
2. Lake Mead	50%	13,207.0	26,159.0	7.0
3. Lake Mohave	94%	1,695.7	1,810.0	2.5
4. Lake Havasu	97%	597.7	619.0	13.2
5. Lyman Reservoir	21%	6.4	30.0	-1.5
6. San Carlos	0%	1.6	875.0	-0.1
7. Verde River System	27%	79.0	287.4	-0.2
8. Salt River System	60%	1,212.2	2,025.8	-65.2

*** 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 7/31/12)

Data Source: National Water and Climate Center

New Mexico reservoirs lost 211,900 acre-feet of water in July (*Figure 7*). Cochiti Lake was the only New Mexico reservoir monitored by CLIMAS that increased storage during July. Elephant Butte Reservoir, located on the Rio Grande in central New Mexico, lost 89,000 acre-feet and is only 8 percent full. Lake Avalon is the only New Mexico reservoir with above-average storage. Low precipitation brought on this winter by the La Niña episode reduced runoff to streams feeding the reservoirs.

Low lake levels at the El Vado Reservoir, now at 19 percent of capacity, caused the closure of some boat ramps and campgrounds (Associated Press, August 9). In other water news, storm runoff following this year's Little Bear fire in New Mexico's Lincoln National Forest has left surface water near Ruidoso thick with sediment and ash (*Las Cruces Sun-News*, August 8). The village of Ruidoso has been forced to use only groundwater wells for its potable water supply and cut back residential outdoor water use.

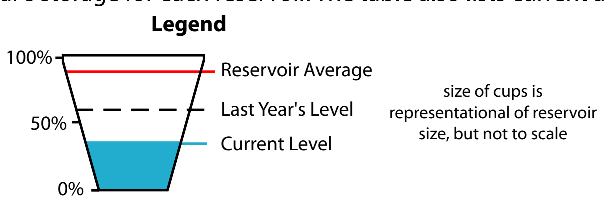
Notes:

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 four 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.

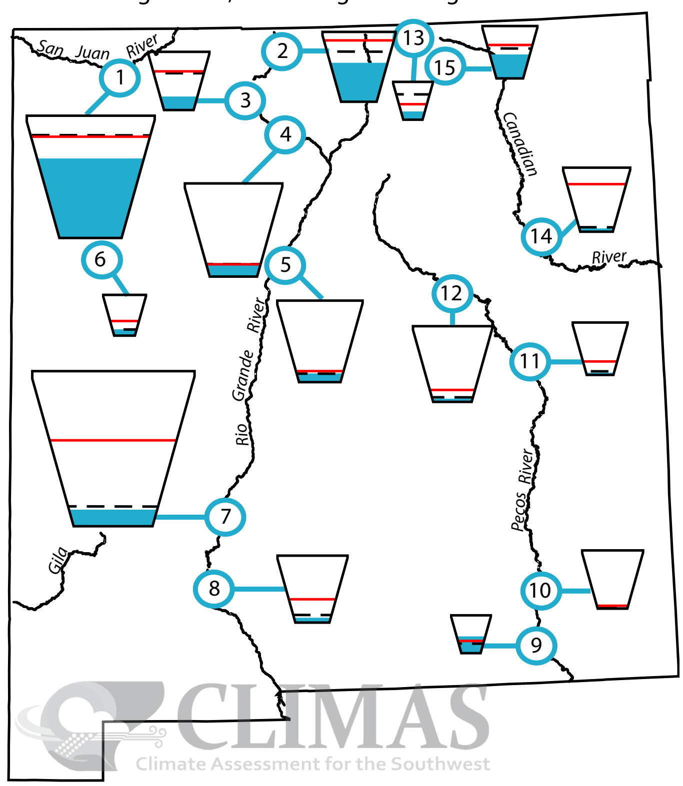
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Figure 7. New Mexico reservoir levels for July 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	69%	1,175.9	1,696.0	-66.9
2. Heron	64%	257.5	400.0	-7.0
3. El Vado	19%	37.1	190.3	-31.2
4. Abiquiu	12%	147.2	1,192.8	-10.3
5. Cochiti	10%	51.2	491.0	2.1
6. Bluewater	12%	4.8	38.5	-0.4
7. Elephant Butte	8%	177.4	2,195.0	-89.0
8. Caballo	6%	20.7	332.0	-0.1
9. Lake Avalon	35%	1.4	4.0	-0.2
10. Brantley	1%	5.9	1008.2	-1.1
11. Sumner	2%	2.2	102.0	-1.9
12. Santa Rosa	1%	6.4	438.3	-0.2
13. Costilla	12%	1.9	16.0	-1.0
14. Conchas	3%	7.2	254.2	-2.6
15. Eagle Nest	43%	34.1	79.0	-2.1

*** 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 8/16/12)

Source: Southwest Coordination Center

Numerous wildfires have erupted across both New Mexico and Arizona since the last update on July 19, but most of them have burned fewer than 100 acres. Monsoon moisture has helped firefighters squelch many of these fires relatively quickly. Between January 1 and August 8, more than 1,350 fires burned nearly 150,000 acres in Arizona and more than 800 fires charred roughly 370,000 acres in New Mexico (*Figure 8a*). Ten wildfires larger than 100 acres ignited between July 19 and August 14; eight of them were still active as of August 16 (*Figures 8b and 8c*).

Two of the largest wildfires burning in the region as of August 16 are located in the Tonto National Forest in Arizona. The Mistake Peak fire began on August 8 approximately 12 miles east of Tonto Basin. As of August 17, the fire had burned 4,800 acres and was 25 percent contained. Steep terrain made the fire moderately difficult to contain. The cause of the fire is under investigation. The other blaze, the Charley fire, was sparked by lightning near Sunflower, AZ, on August 12. Five days later, the fire had burned 2,300 acres, but was 80 percent contained. Three wildfires were active in New Mexico as of August 16 but none had burned more than 425 acres. High humidity, cooler temperatures, and rainfall have helped reduce fire growth and activity in the region.

Significant wildfire activity is keeping crews busy in other areas in the West, especially Nevada, California, and Idaho. The Holloway fire in northern Nevada, the result of an August 5 lightning strike, has burned more than 462,000 acres as of August 16—approximately 150,000 more acres than the Whitewater Baldy Complex fire, the largest wildfire in New Mexico's history.

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 current 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/daily/ytd_all_wf_by_state.pdf

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

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	813	91,144	556	57,925	1,369	148,924
NM	427	7,676	396	362,088	823	369,764
Total	1,240	98,820	952	420,013	2,192	518,688

Figure 8b. Arizona large fire incidents as of August 16, 2012.

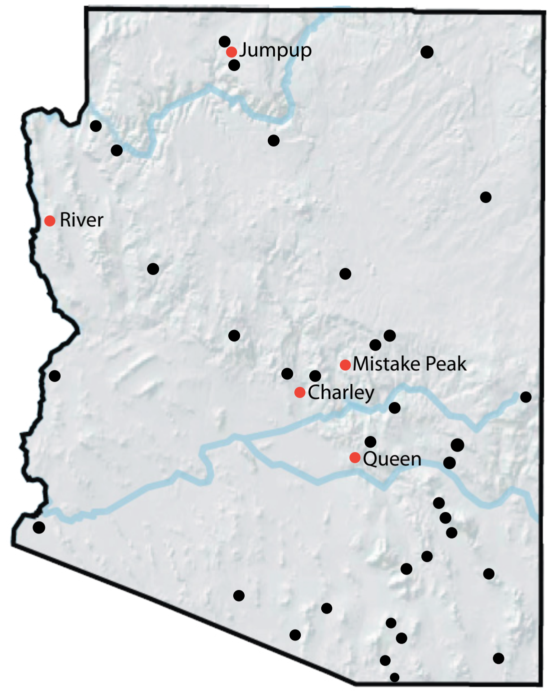
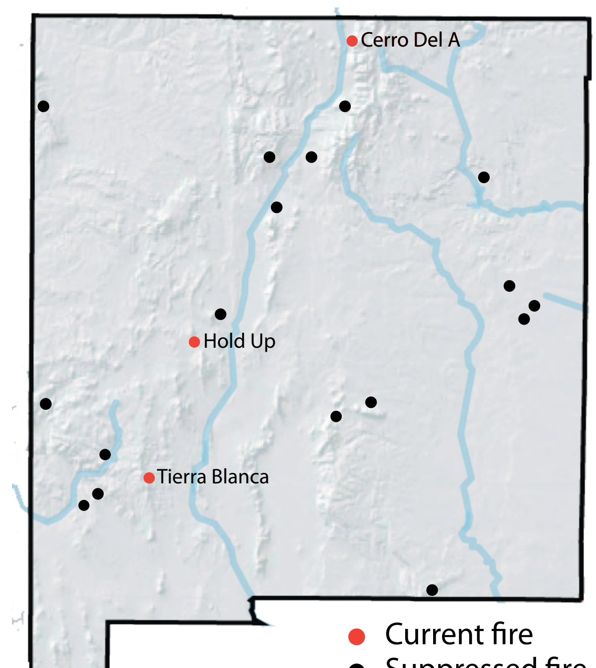


Figure 8c. New Mexico large fire incidents as of August 16, 2012.



Monsoon Summary
(through 8/13/2012)

Data Source: Western Regional Climate Center

Monsoon storm activity slowed down a bit this past month as the heat dome of high pressure that has been scorching the Great Plains shifted back west towards Arizona and New Mexico. With high pressure nearly overhead, high temperatures soared to record and near-record temperatures across the Southwest in early August and limited the development of widespread thunderstorm activity.

Areas receiving the most monsoon precipitation so far this season (June 15 to August 13) include higher elevation areas along the Mogollon Rim in Arizona, southeast Arizona, and the southern Rockies in western New Mexico (*Figures 9a–c*). Extreme southern Arizona in Santa Cruz County has received rainfall totals of more than 8 inches, which is close to 150 percent of average for this period.

Across southern Arizona, Nogales is the big winner, receiving almost 9 inches of monsoon rain so far this year, which is almost 2 inches above average. Totals in Tucson and Sierra Vista through August 17 are also above average. Tucson has received 4.64 inches–0.87 inches more than average—while Sierra Vista has received 6.04 inches, about 0.34 inches above average. Organ Pipe National Monument in far southwestern Arizona and Douglas in the far southeastern part of the state have fallen behind in 2012 monsoon precipitation totals. Douglas, in particular, has received only half of the 5 inches of rain that should have fallen so far this season. For more rainfall statistics in Arizona, visit: http://www.wrh.noaa.gov/twc/monsoon/rainfall.php.

Figure 9a. Total precipitation in inches (June 15–August 13, 2012).

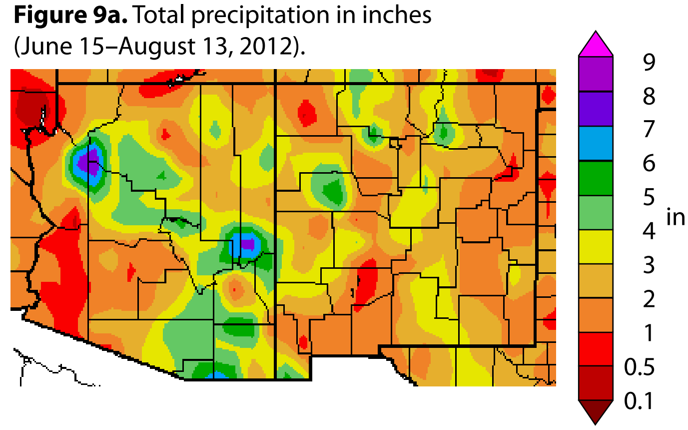


Figure 9b. Departure from average precipitation in inches (June 15–August 13, 2012).

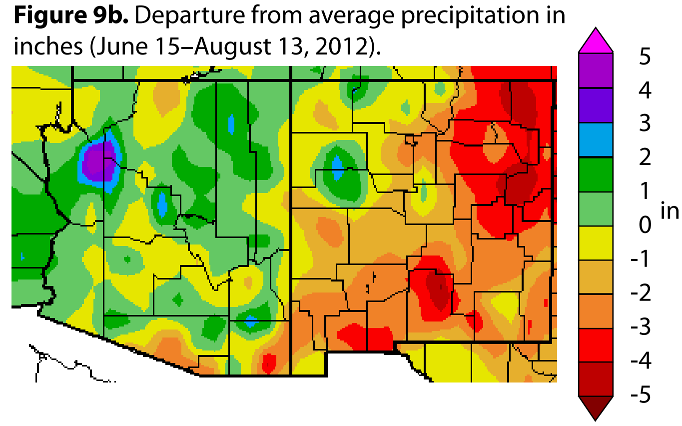
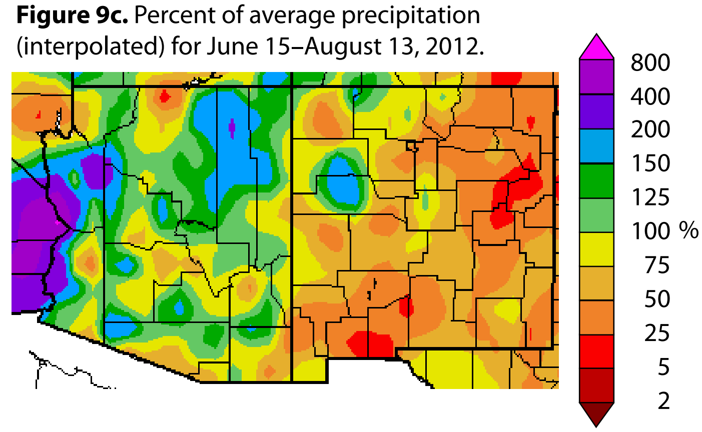


Figure 9c. Percent of average precipitation (interpolated) for June 15–August 13, 2012.



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
(September 2012–February 2013)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlook issued by the NOAA-Climate Prediction Center (NOAA-CPC) in August for the September–November period calls for slightly increased chances that temperatures will be similar to the warmest 10 years in the 1981–2010 period for eastern Arizona and all of New Mexico (*Figure 10a*). Recent warming trends during this period influence this forecast. In the three-month seasons that follow, forecasts call for mostly equal chances for above-, below-, or near-average conditions in Arizona and New Mexico, most notably in southern regions of both states (*Figures 10b–d*). The countervailing effects of El Niño and recent warming trends influenced the forecasts for these seasons. For example, El Niño brings increased chances of below-average temperatures in the Southwest. El Niño events also favor increased precipitation, which contributes to cooler temperatures. On the other hand, recent trends favor warming during these periods. Currently, it is unclear which influence will outweigh the other, leading to an equal chances forecast.

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 September–November 2012.

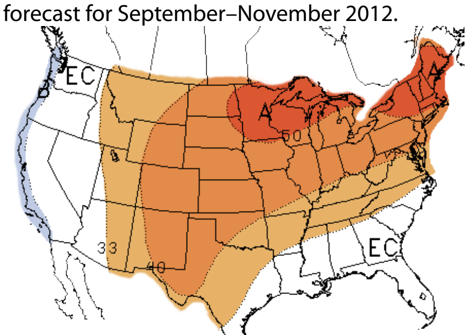
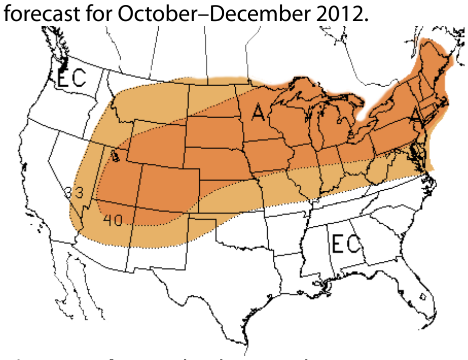


Figure 10b. Long-lead national temperature forecast for October–December 2012.



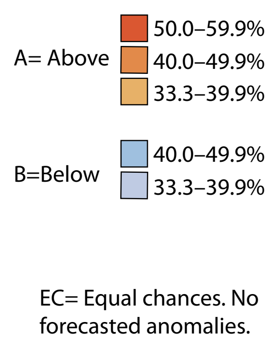


Figure 10c. Long-lead national temperature forecast for November 2012–Jaunary 2013.

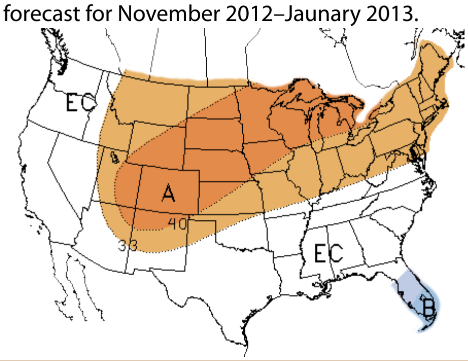
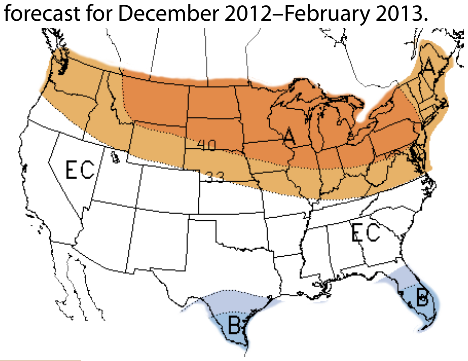


Figure 10d. Long-lead national temperature forecast for December 2012–February 2013.



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
(September 2012–February 2013)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (NOAA-CPC) in August call for slightly increased chances that precipitation during September–November will be similar to the wettest 10 years in the 1981–2010 record for the regions of southern Arizona and New Mexico most heavily influenced by the monsoon (*Figure11a*). This forecast is influenced by the expectation that monsoon activity will be enhanced through September. In subsequent three-month seasons, an El Niño event, which will likely materialize in the August–October period, could bring wetter-than-average conditions to parts of the Southwest (*Figures 11b–d*). This is most notable in the December–February period, when El Niño-Southern Oscillation (ENSO) events are strongest. Increased precipitation in the Southwest during El Niño events is caused by an enhancement of the subtropical jet, which helps deliver more moisture to the region.

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 September–November 2012.

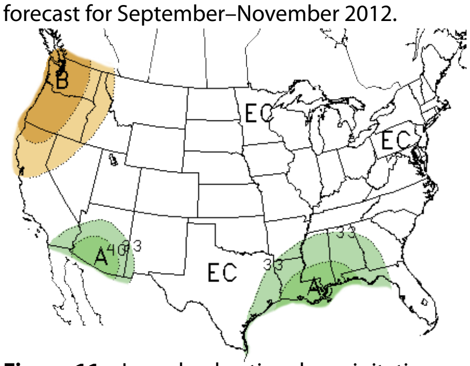


Figure 11b. Long-lead national precipitation forecast for October–December 2012.

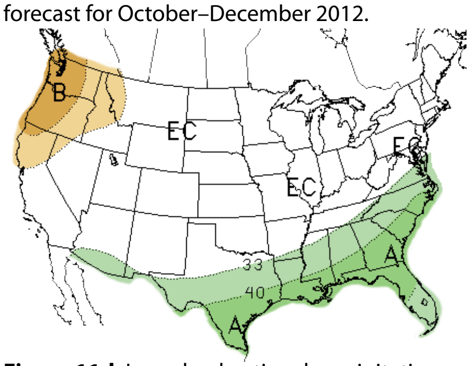


Figure 11c. Long-lead national precipitation forecast for November 2012–Jaunary 2013.

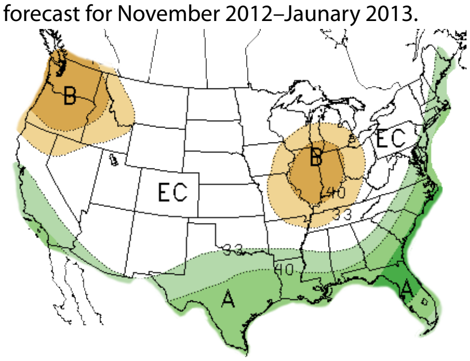
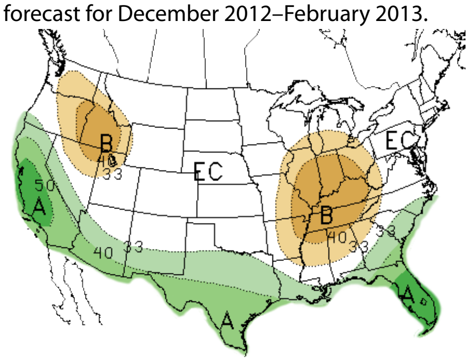


Figure 11d. Long-lead national precipitation forecast for December 2012–February 2013.



A = Above: 40.0–49.9%; 33.3–39.9%

B = Below: 60.0–69.9%; 50.0–59.9%; 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 March load slowly on your computer)

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

Seasonal Drought Outlook
(through November)

Data Source: NOAA-Climate Prediction Center (CPC)

This summary is partially excerpted and edited from the August 16 Seasonal Drought Outlook technical discussion produced by the NOAA-Climate Prediction Center (CPC) and written by forecaster R. Tinker.

Improvement in drought conditions is forecasted for much of Arizona and adjacent portions of Southern California, southeastern Utah, southwestern Colorado, and western New Mexico through November (*Figure 12*). A fairly narrow area of some improvement also surrounds this area. However, drought is expected to persist farther north and west, as well as in central New Mexico. Contributing to this forecast is the expectation for elevated chances of above-average precipitation in the Southwest and historically wet upcoming months in southwestern Colorado and nearby areas.

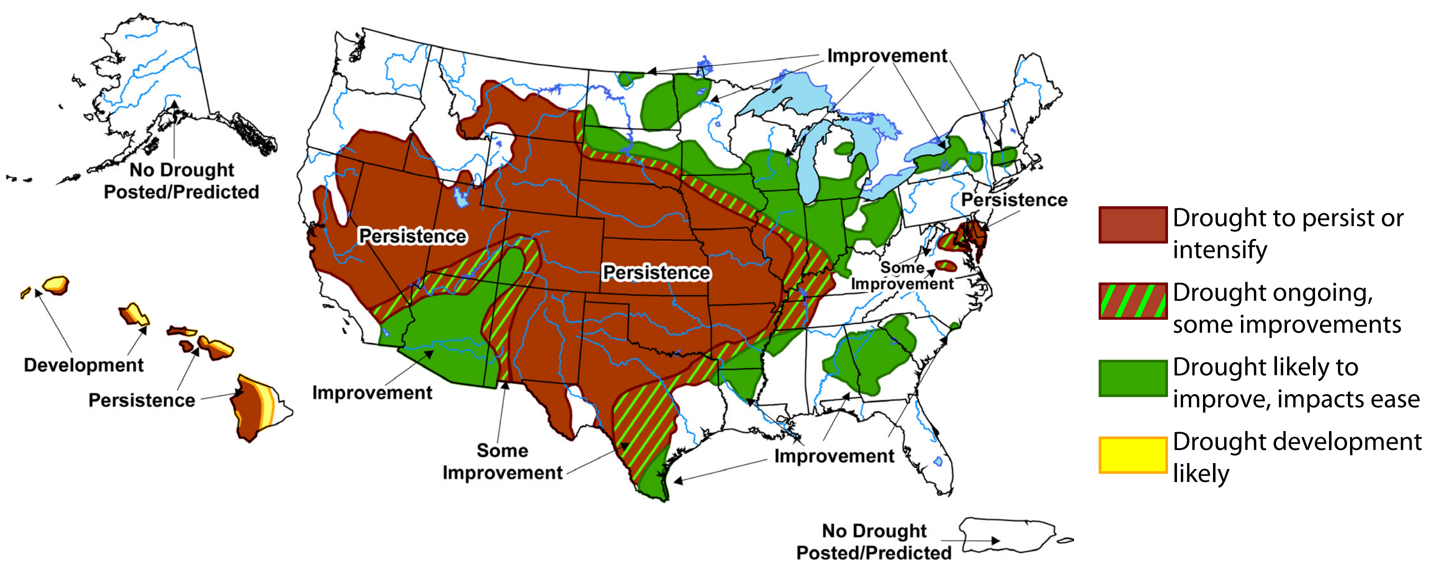
Elsewhere in the West, the remainder of August is forecasted to be dry. The three-month outlook favors below-average precipitation in central California, northwestern Nevada, Oregon, and Idaho. In addition, the water contained in mountain snowpack is a critical indicator of drought. Since precipitation during the September–November period has little impact on snow water content, drought does not tend to change during this time of year.

The NOAA-Climate Prediction Center (NOAA-CPC) assigns a moderate confidence in the forecast for drought improvement across southwestern Colorado and adjacent areas in Utah, New Mexico, and Arizona. The CPC assigns a high confidence in the drought forecast for areas outside this region.

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 November (released August 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

Wildland Fire Outlook

(September–November 2012)

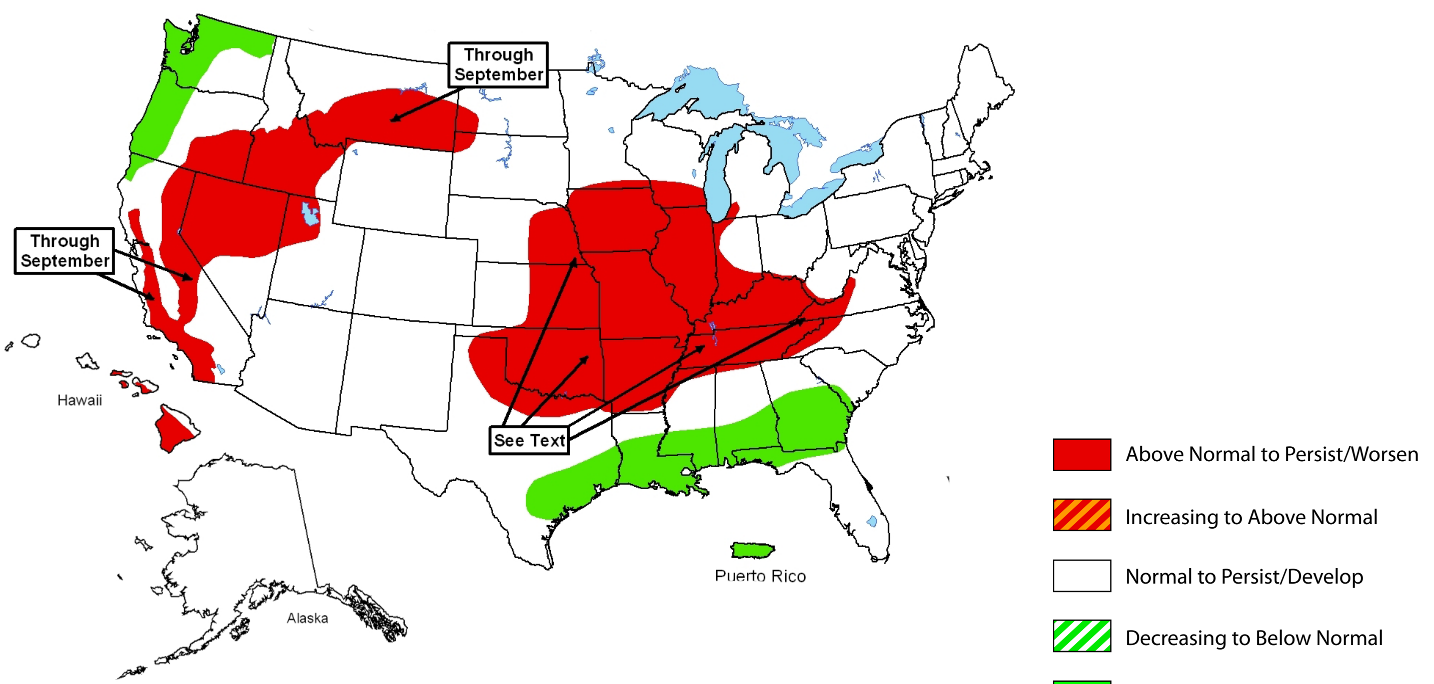
Sources: National Interagency Coordination Center, Southwest Coordination Center

Normal significant fire potential is expected for all of Arizona and New Mexico for September through November, according to the National Interagency Fire Center (*Figure 13*). While fires are expected to occur due to dry periods, above-average temperatures, and lightning strikes, the probability for large, persistent fires is low because of monsoon moisture. Summer precipitation, which has been above average in parts of the Southwest, particularly the Mogollon Rim area, has helped improve fuel and soil moisture. In addition, forecasts from the NOAA-Climate Prediction Center (CPC) for September through November show increased chances for above-average precipitation in the central and southern portions of Arizona and the southwestern tip of New Mexico (see page 15). The status of the El Niño-Southern Oscillation (ENSO) also will likely influence moisture levels in the Southwest. If sea surface temperatures continue to warm as expected, causing an El Niño event to develop in coming months, the region will likely experience above-average precipitation and below-average temperatures in the fall and winter. Copious winter rains could help reduce fire risk this year and next.

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. They are subjective assessments that synthesize information provided by fire and climate experts throughout the United States. The forecast (Figure 13) considers 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.

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

An El Niño Watch issued by the NOAA-Climate Prediction Center (NOAA-CPC) remains in effect this month, as warmer-than-average sea surface temperatures (SSTs) were present again this month across the eastern Pacific Ocean, slightly increasing in extent and intensity over the past 30 days. However, atmospheric circulation patterns, including winds along the equator and areas of tropical thunderstorm activity, so far have responded weakly to the shift towards warmer SSTs, slowing the progression of the El Niño event. The Southern Oscillation Index (SOI) increased slightly in the last month and still remains reflective of ENSO-neutral conditions (*Figure 14a*). NOAA-CPC notes that statistical and dynamical models continue to show an eventual progression towards El Niño conditions in the next month or two. As a result, NOAA-CPC may issue an El Niño Advisory in the next month or two as El Niño conditions strengthen.

Official forecasts issued jointly by NOAA-CPC and the International Research Institute for Climate and Society (IRI) depict a strong chance of El Niño conditions forming in the next several months and likely continuing through the spring season of 2013 (*Figure 14b*). Most models forecast that the event will be weak to moderate in intensity, with only a couple of dynamical models betting on a strong event forming. Chances are greater than 75 percent that an El Niño will develop in the August–October period and they remain above 70 percent through the December–February period. Seasonal climate forecasts for the upcoming fall and winter seasons pick up on the expectation of an El Niño event and forecast increased chances of above-average precipitation across parts of southern Arizona and New Mexico. However, a wet winter for the Southwest is not a slam dunk. While El Niño events typically favor above-average precipitation, in the past weak to moderate El Niño events have delivered below-average winter precipitation for Arizona and New Mexico. Despite this, seasonal forecasts call for a slightly increased chance of above-average precipitation, especially in the January–March period.

Notes:

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

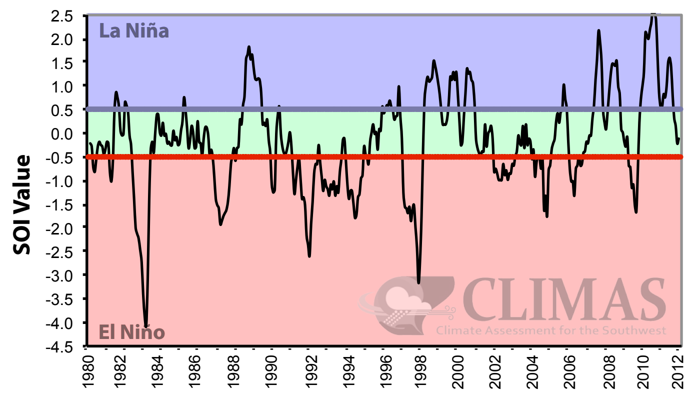


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released August 16). Colored lines represent average historical probability of El Niño, La Niña, and neutral conditions.