July 25, 2012

Southwest Climate Outlook

Vol. 11 Issue 7

Monsoon storms pummeled the Tucson metro area on July 15, drenching parts of the city with more than 1.5 inches of rain. Photo credit: Zack Guido

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...

June Climate Summary

Drought: Drought conditions did not change much during the past 30 days. About 94 and 80 percent of Arizona and New Mexico, respectively, are classified with at least severe drought.

Temperature: Early and continuous monsoon activity has broken the heat over western and southern Arizona, while eastern New Mexico continues to bake.

Precipitation: Vigorous monsoon activity has helped deliver above-average precipitation to some parts of Arizona. However, the monsoon has yet to kick in with full force in southern New Mexico.

ENSO: An El Niño Watch remains in effect this month as sea surface temperatures continue to warm and spread across the eastern equatorial Pacific Ocean. Weak to moderate El Niño conditions are expected to develop in the fall.

Climate Forecasts: Forecast models favor above-average precipitation and temperatures in many parts of the Southwest through the monsoon.

The Bottom Line: Summer precipitation arrived in southern Arizona earlier than average and has delivered copious rain to many areas. Vigorous monsoon activity has helped suppress wildland fires and reduce the risk of new blazes. However, like always, the monsoon has soaked some places while leaving others dry. Southwestern New Mexico, for example, has not yet received a hefty summer dousing, as the position of the monsoon high has impeded a continuous stream of moisture into the region. Also, while the first month of the monsoon generally has been good across the region, it is still early and forecasters are reticent to declare improved drought conditions until additional moisture falls. As a result, Arizona and New Mexico have about the same drought classifications as they did one month ago. Severe drought or a more extreme drought category currently covers about 94 percent of Arizona, while about 80 percent of New Mexico is labeled with these conditions. Short-term drought relief, however, may be on the horizon. The NOAA-Climate Prediction Center calls for slightly increased chances for above-average rain in coming months. Copious rains will need to persist into the winter and possibly longer to improve drought impacts related to water supply, like reservoir storage. After a dry winter, for example, total streamflow in the Colorado River during this water year is expected to be about 46 percent of average, which will be its third lowest water year on record. Also, streamflows on the Rio Grande will be well below average. The winter precipitation outlook favors some improvement in drought. Forecasts call for an El Niño event to materialize in coming months, which will increase chances for a wet winter.

Are Recent Extremes and Global Warming Related?

It has been a hot 2012. The year has experienced the warmest January–June period on record in the U.S., and more than 25,000 maximum daily temperatures were eclipsed between January 1 and July 18. These extreme conditions are a continuation from last year—2011 earned the moniker "the year of billion-dollar disasters," which included devastating drought in the Southwest. The recent extreme conditions across the country have many pe ople inquiring if these events relate to global warming. Until recently, scientists said it is not possible to attribute a single event to climate change. Now, however, it is widely accepted that linking individual events to climate change is tenable.

While not every event is linked to climate change, long-term warming has played a part in some instances. A compilation of analyses, the first edition of what is to be an annual report, helps answer if human actions contributed to select extreme events. The report, "Explaining Extreme Events of 2011 from a Climate Perspective," analyzed six events, including the drought that besieged the southern tier of the U.S. in 2011. According to the report, conditions that led to the Texas portion of this drought are now distinctly more probable than they were 40–50 years ago because of recent global warming. As for the extreme heat this year, we'll have to wait until next July's report for an answer.

Read the report at: http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-12-00021.1

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.

Droughts, Megadroughts, and More: A Conversation with Jonathan Overpeck

By Zack Guido

Soaring temperatures and scant rain have besieged the country in recent months, prompting 26 U.S. states to declare a drought emergency, including New Mexico and Arizona. In the Midwest, the lethal combination of high temperatures and dry conditions has wreaked havoc on a once promising corn harvest. For New Mexico, two consecutive years of scarce winter snows in the Rio Grande headwaters have caused paltry irrigation allotments from Elephant Butte Reservoir, which supports more than 90,000 acres of farmland. This year, the allocation is only 10 inches per acre, down from 36 inches when lake levels are higher. Many farmers in New Mexico also face reduced crop yields and increased production costs.

While periodic dry conditions are common in the Southwest—records pieced together from tree rings reveal a past peppered with intense and protracted dry spells—the current dry conditions stand out from the historical record, according to Jonathan Overpeck, professor of geosciences at the University of Arizona, co-director of the UA's Institute of the Environment, and an expert on past climate variability and causes. Temperatures are warmer than they were during past droughts, with the added heat amplifying the dry conditions, Overpeck explained during a June 15 interview. As bad as the current drought seems, future dry spells may be even worse. But it is not all bad news; climate change will also bring economic opportunity to the Southwest, Overpeck says.

The following transcription was adapted from a filmed interview, which you can view at: www.climas.arizona.edu/media

Jonathan Overpeck, professor of geosciences at the University of Arizona, co-director of the UA's Institute of the Environment, and an expert on past climate variability and causes, discusses drought and other topics in a recent filmed interview.

Question: Why and how is the Southwest a hotspot for climate change?

Jonathon Overpeck: The Southwest is a hotspot for climate change because the warming in the Southwest is larger than just about anywhere in the United States outside of Alaska. It's more than the global average. So the whole Southwest is heating up. Heating up is causing snowpack to melt earlier and that also is affecting water resources. We are, for example, getting a dryer Colorado River. All of these things have been linked to climate change.

Q: What is unique about the recent drought in comparison to those of the past?

Overpeck: This drought isn't unusually long compared to the droughts that have occurred, say in the tree-ring or paleoclimate record. But it looks like it's anomalously hot and that's what makes this a global-change style drought or a global-warming style drought. And [the drought] has much bigger impacts because it's such a hot drought.

Q: What can past droughts tell us about the future?

Overpeck: The scary thing about the current drought is that as bad as it is, we can go back in the paleoclimatic record, for example from tree rings, but also from caves and lake sediments and other sources, and find clear evidence of droughts that were longer, some cases as long as 50 years, with only one year of normal precipitation. But we can also find evidence that shows some of the paleo droughts or megadroughts—the really bad ones—were much more severe, so they were drier, but not necessarily hotter. There is no evidence that they were hotter than the

continued on page 4

Droughts, Megadroughts, and More continued

drought today. So what we really worry about, what I worry about, is that we could get one of these really long, severe precipitation deficit droughts coupled with the warming temperatures of the Southwest. And that would really be a very devastating climate emergency.

Q: How would a megadrought impact the Southwest?

Overpeck: If we got one of these really hot megadroughts, and I think our recent research suggests that there's certainly better than one chance in 10 we will before 2100, maybe as high as one chance in three, it will affect water resources dramatically. We will probably have major shortages on the Colorado River, the Rio Grande, and other rivers upon which we depend for water supply. But we will also see devastating impacts in our landscape. We've already seen with this current drought—one that's not that long, not that hot [in relation to what could occur in the future]—widespread tree mortality, meaning trees are dying; desert plants are drying. We are also seeing all this unprecedented wildfire. All that's related to drought, but it's all related to a drought that's just not that bad compared to what we could get.

Q: Is there a silver lining to climate change?

Overpeck: The silver lining in all of this is that we understand that it's happening. We understand in many cases why it's happening. We certainly understand that temperature increases are making the situation a lot worse and will make it even worse in the future. And because we know the cause in advance of it getting really bad, we are in a position to do two things. One is to discuss possible ways to reduce anthropogenic climate change, to reduce the potential disaster risk here in the Southwest. And the second thing we can start doing is figuring out how to adapt to these hotter, drier conditions. And everyone knows that we are not going to reduce greenhouse gas emissions to zero overnight. That means we have quite a bit of climate change no matter what. So I think we really have to take time to debate how to adapt to these changes, put into place adaptation plans, and at the same time debate whether and how to reduce the greenhouse gases.

A positive side of [climate change] is that we're blessed with a lot of sunlight and windy conditions up in the mountains around here in the Southwest. And that means that the solutions to reducing greenhouse gases would be a big economic win for our region because we would be the ones who would be exporting solar and wind energy to the rest of the United States and Mexico. So we could go from a position where we're a net importer of energy—coal for example—to one where we're a net exporter of energy. So, solving the problem could end up in the end, ironically, producing a much more viable, economic engine for the Southwest.

Bathtub rings on Elephant Butte are visual reminders that replenishing snowpacks in the headwaters of the Rio Grande have been absent in recent years. As of June 30, Elephant Butte and Caballo reservoirs were only 12 and 6 percent of full capacity, respectively. Image credit: Zack Guido

Temperature (through 7/18/12)

Data Source: High Plains Regional Climate Center

The temperature pattern in the Southwest since the water year began on October 1 has been tied to elevation. The coldest conditions are found at the highest elevations in both states, while the southwest deserts and the Lower Colorado River Basin have had the warmest temperatures (*Figure 1a*). The winter storms that tracked through the Southwest generally passed over the northern portions of both states, and many of them missed Arizona and New Mexico altogether. Those that did strike the region generally ferried warm conditions. The combination of dry winter conditions and relatively warm storms resulted in warmer-than-average temperatures in the region. Eastern New Mexico had the highest temperature departures from average, and only isolated locations were colder than average. The unusually cold temperatures in south-central Arizona were the result of a single storm that tracked across northern Mexico (*Figure 1b*). The lack of winter storms through central Arizona caused Gila County to be the warmest location in Arizona, while Colfax County in northeastern New Mexico was that state's hot spot.

In the past 30 days, the temperature pattern was largely dictated by monsoon moisture. The western half of Arizona had near-average temperatures due to numerous surges of moisture from the Gulf of California, primarily in the past two weeks (*Figures 1c–d*). High pressure over eastern Texas brought clear skies and above-average temperatures to eastern Arizona and most of New Mexico and Colorado.

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 July 18) average temperature.

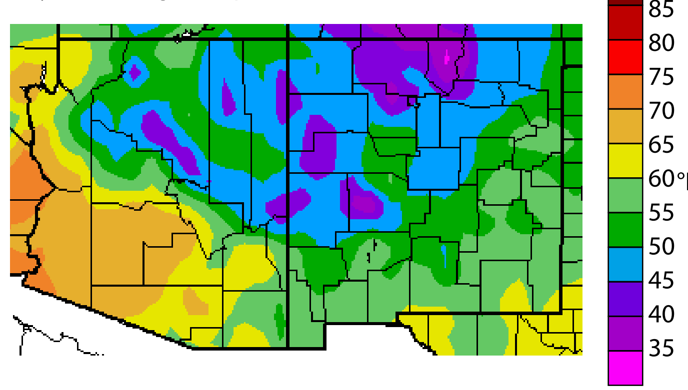


Figure 1b. Water year 2011 (October 1 through July 18) departure from average temperature.

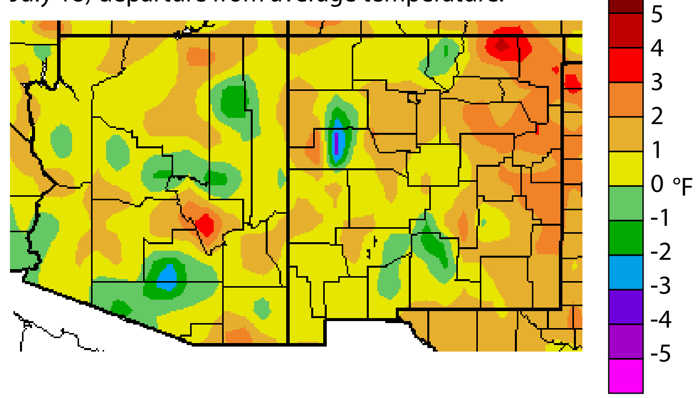


Figure 1c. Previous 30 days (June 19–July18) departure from average temperature (interpolated).

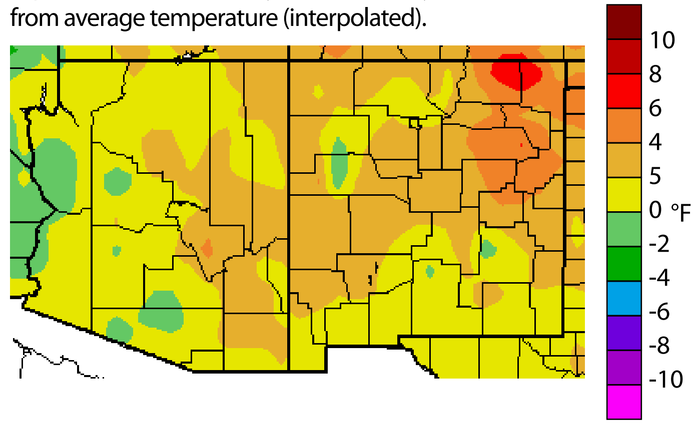
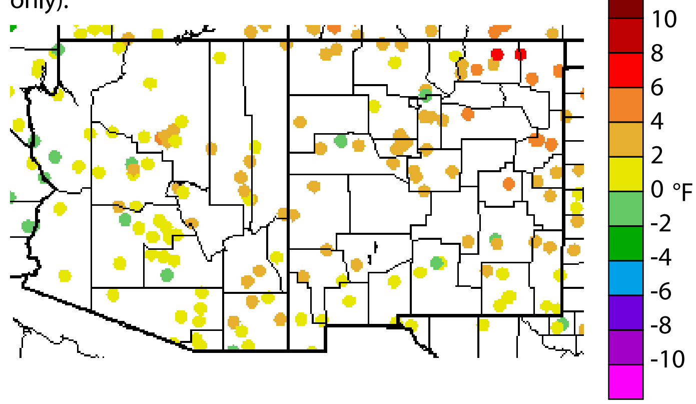


Figure 1d. Previous 30 days (June 19–July 18) departure from average temperature (data collection locations only).



Precipitation (through 7/18/12)

Data Source: High Plains Regional Climate Center

Dry conditions since January 1 have finally dominated the water year signal, canceling out the wet weather of November and December. Across most of Arizona and New Mexico, precipitation has been below average since the water year began on October 1 (*Figures 2a–b*). Only a few isolated areas have above-average precipitation totals; a single winter storm and early monsoon activity delivered 130–200 percent of average precipitation to western Pima County and copious precipitation to northwest New Mexico. The Colorado Plateau has seen considerable variability in precipitation. Infrequent storms left part of the Navajo Nation dry while pelting adjacent areas with more rain and snow. Central Mohave County in northwest Arizona also benefitted from several winter storms.

In the past 30 days, monsoon activity created wetter-than-average conditions along the lower Colorado River valley between Arizona and California and extremely wet conditions in most of southern Arizona (*Figures 2c–d*). Eastern New Mexico remains in a monsoon void, as the high-pressure ridge often has remained too far to the west to pull moisture from Mexico into that region. Southwestern New Mexico also has missed out on the monsoon, which normally tracks through the southern border of the two states.

Figure 2a. Water year 2011 (October 1 through July 18) percent of average precipitation (interpolated).

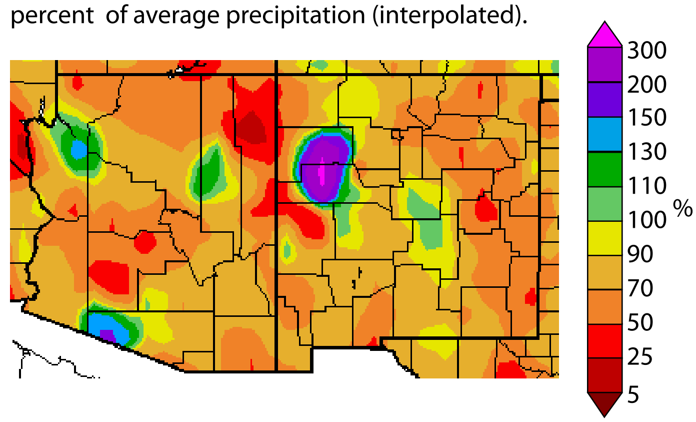


Figure 2b. Water year 2011 (October 1 through July 18) percent of average precipitation (data collection locations only).

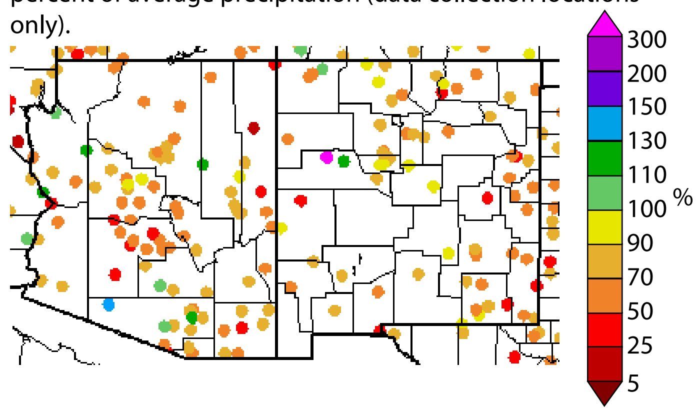


Figure 2c. Previous 30 days (June 19–July 18) percent of average precipitation (interpolated).

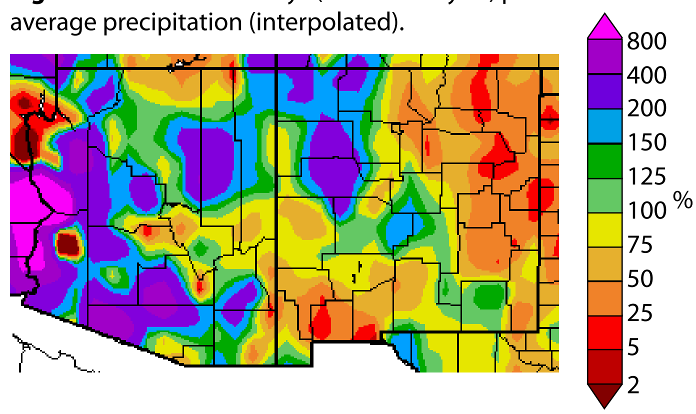
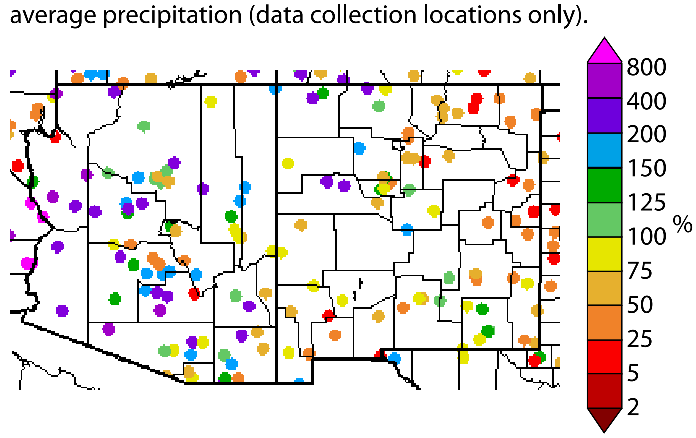


Figure 2d. Previous 30 days (June 19–July 18) percent of average precipitation (data collection locations only).



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/

U.S. Drought Monitor (data through 7/17/12)

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

Drought conditions made a push north across much of the western U.S. during the past 30 days, due to unusually dry and warm conditions. Almost 68 percent of the 11 western states (excluding Alaska and Hawaii) are experiencing moderate drought or a more severe category, according to the July 17 update of the U.S. Drought Monitor (*Figure 3*). This is an increase of about 8 percent reported in mid-June. Nearly 16 percent of the contiguous western U.S. is classified with extreme drought, with largest of those areas located in Arizona, New Mexico, Nevada, and Colorado. In the last month, Colorado experienced the most change in drought conditions. Currently, about 70 percent of the state is labeled with extreme drought, an increase from about 26 percent one month ago. Also, moderate drought expanded across southern Oregon, while moderate to severe drought pushed far north from northern Colorado into central Montana.

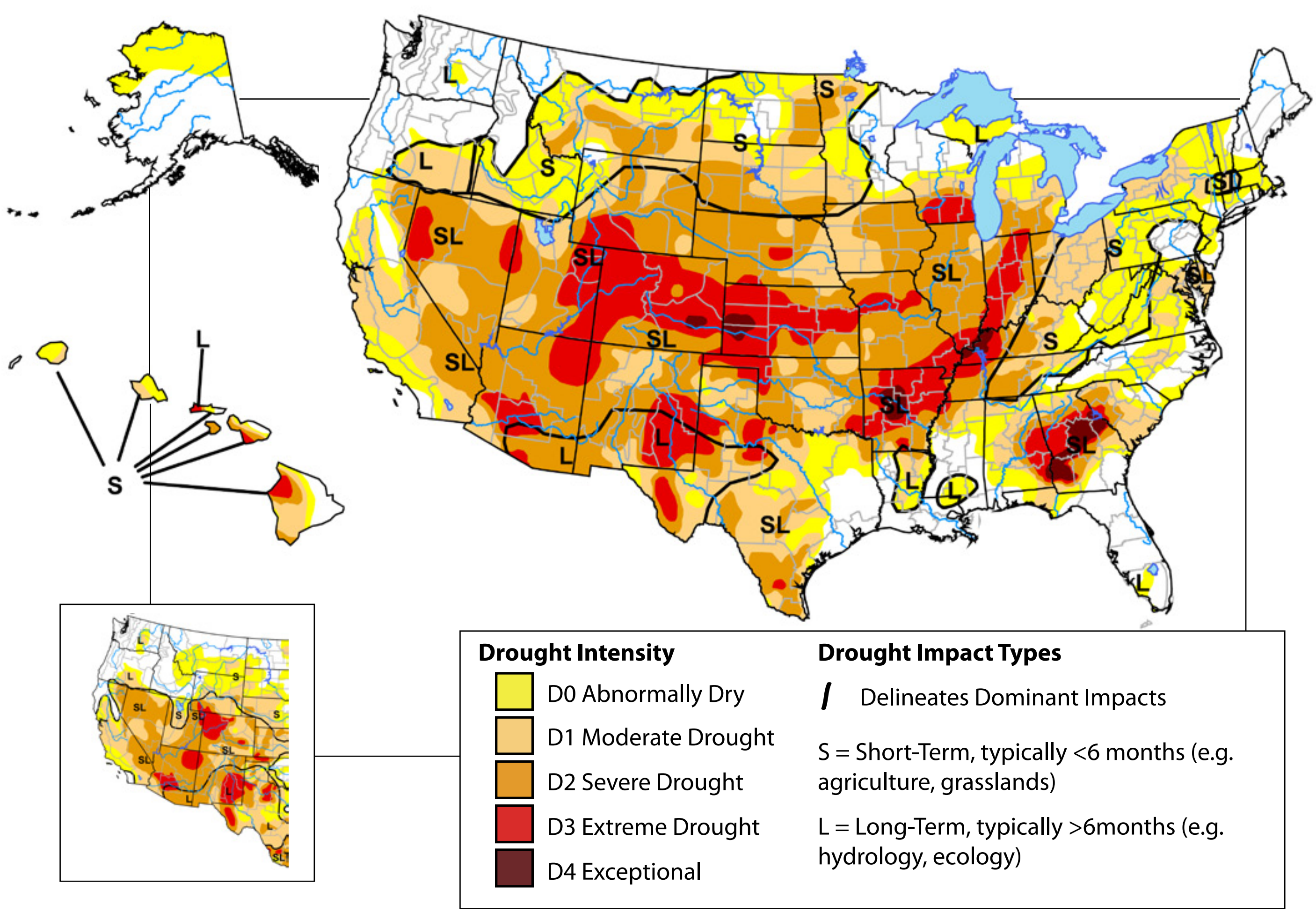
Drought is not confined to the western U.S. Nearly 60 percent of the U.S. is classified with at least moderate drought. Some of the hardest hit regions have been in the Midwest Corn Belt. As a result, crop forecasts are projecting around a 12 percent decline in yields due to the persistently dry and hot weather, according to the U.S. Department of Agriculture.

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 July 17, 2012 (full size), and June 19, 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 7/17/12)

Data Source: U.S. Drought Monitor

Drought conditions have changed little over the past 30 days, but early monsoon precipitation likely will provide some short-term relief in some parts of the state (*Figure 4a*). Any changes likely will be reflected in subsequent U.S. Drought Monitor updates. Early season monsoon precipitation has been heaviest across far southern Pima and Santa Cruz counties and parts of Yavapai and southern Mohave counties; much of the state has received some monsoon moisture. Nevertheless, all of Arizona is experiencing some level of drought, with more than 94 percent of the state classified with at least severe drought (*Figure 4b*). The only change in drought status in the last month was the development of a small area of extreme drought in far southern Pima County.

In drought-related news, all of Arizona is recognized as a federally declared drought disaster area for the 10th year in the last 13 (*Arizona Daily Star*, July 14). This declaration, issued by the U.S. Department of Agriculture, makes available low interest loans for farmers and ranchers to mitigate crop damage and losses and aid the purchase of emergency feed for livestock. Last year, which also was declared a federal drought disaster, 4,200 ranchers used $8.7 million in livestock forage assistance.

Figure 4a. Arizona drought map based on data through July 17.

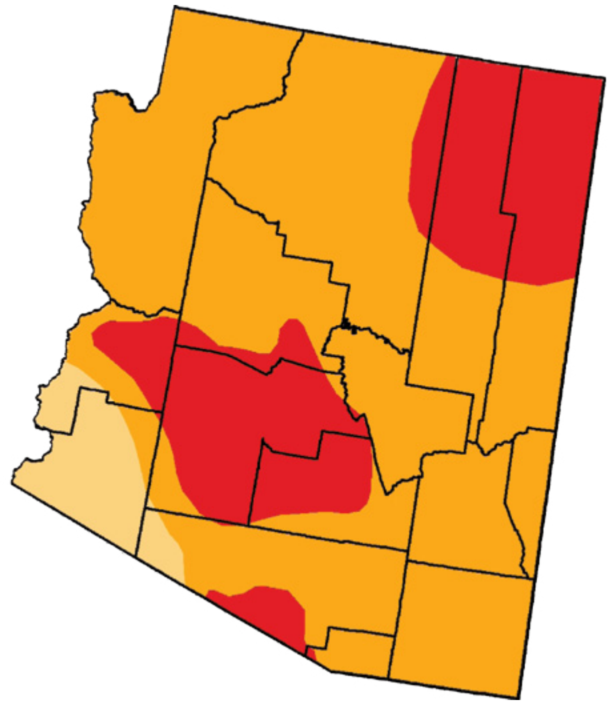


Figure 4b. Percent of Arizona designated with drought conditions based on data through July 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	94.07	26.33	0.00
Last Week (07/10/2012 map)	0.00	100.00	100.00	94.07	26.33	0.00
3 Months Ago (04/17/2012 map)	0.00	100.00	95.88	64.96	12.61	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 (07/12/2011 map)	12.78	87.22	60.35	38.20	15.02	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

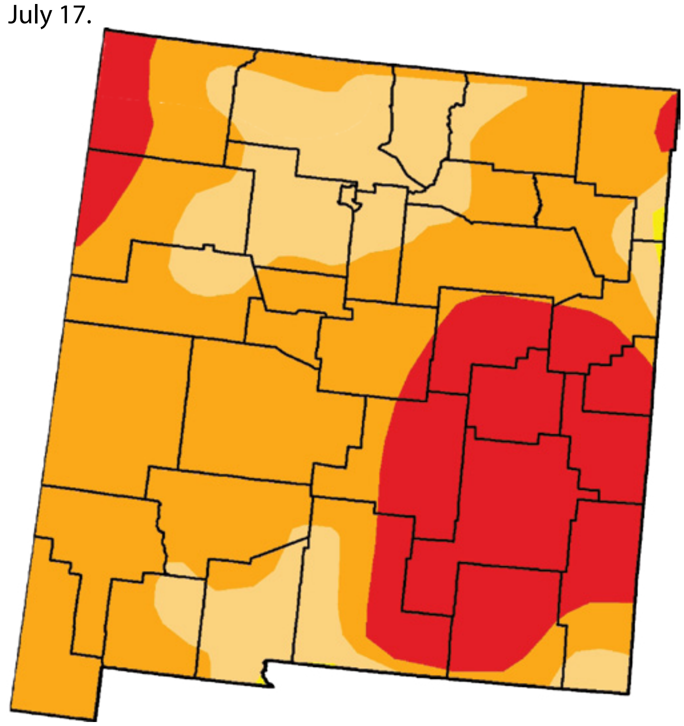
New Mexico Drought Status
(data through 7/17/12)

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

Drought conditions changed very little across New Mexico over the past 30 days. Nearly all of New Mexico continues to experience some level of drought. about 80 percent of the state is classified with at least severe drought, according to the July 17 update of the U.S. Drought Monitor (*Figures 5a–b*). So far, the monsoon has not provided drought relief. The majority of the eastern and southern regions have received less than 25 percent of average precipitation over the past month. These areas are also where drought conditions are the worst, which is helping to perpetuate extreme drought.

In drought-related news, Cibola County has been added to the U.S. Department of Agriculture's recent counties that have been declared drought disaster areas (*Alamogordo Daily News*, July 19). The county, in the northwestern corner of the state, has joined the growing list of counties eligible for supplemental funds to mitigate losses incurred by the dry conditions; more than 39 counties filed the declaration in recent weeks. The Southwest is only one of many regions experiencing devastating droughts. More than 60 percent of the U.S. is classified with at least moderate drought, and the total number of counties with drought disaster declarations exceeds 1,300 so far this year.

Figure 5a. New Mexico drought map based on data through July 17.



Drought Intensity

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

Figure 5b. Percent of New Mexico designated with drought conditions based on data through July 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	99.78	79.57	25.98	0.00
Last Week (07/10/2012 map)	0.00	100.00	99.79	79.76	25.98	0.00
3 Months Ago (04/17/2012 map)	0.00	100.00	86.48	58.54	24.94	8.86
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 (07/12/2011 map)	0.00	100.00	100.00	93.96	79.01	48.21

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 6/30/12)

Data Source: National Water and Climate Center

Storage in each of the Arizona reservoirs listed in Figure 6 declined during the last month. Combined storage in Lakes Mead and Powell decreased by 679,000 acre-feet in June. Total reservoir storage in the Colorado River Basin is 60 percent of capacity (rounded to 0 percent in Figure 6, around 5 percent lower than it was at the beginning of the water year. Storage in the San Carlos Reservoir, which completely dried in 1976 and 1977, is at about 0.2 percent of capacity, an extremely low level that reflects scant precipitation in southeastern Arizona for two consecutive La Niña winters. The reservoir is also nearing its lowest capacity in 20 years. Combined storage in the Salt and Verde river basin systems is 59 percent of capacity, which is about 20 percent less than it was one year ago.

In water-related news, hot and dry conditions have left the Blue Ridge Reservoir, a key to the water security of Rim Country, near Payson, vulnerable to wildfires. Fires, if ignited, would elevate post-wildfire erosion that could greatly reduce storage capacity (*Payson Roundup*, July 13). Future growth in the region would subsequently be impacted, as it is in part tied to the 14,000 acre-foot capacity reservoir.

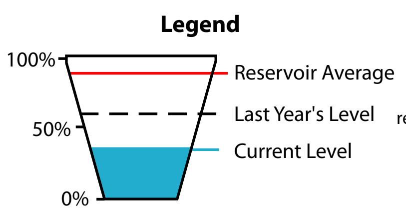
Notes:

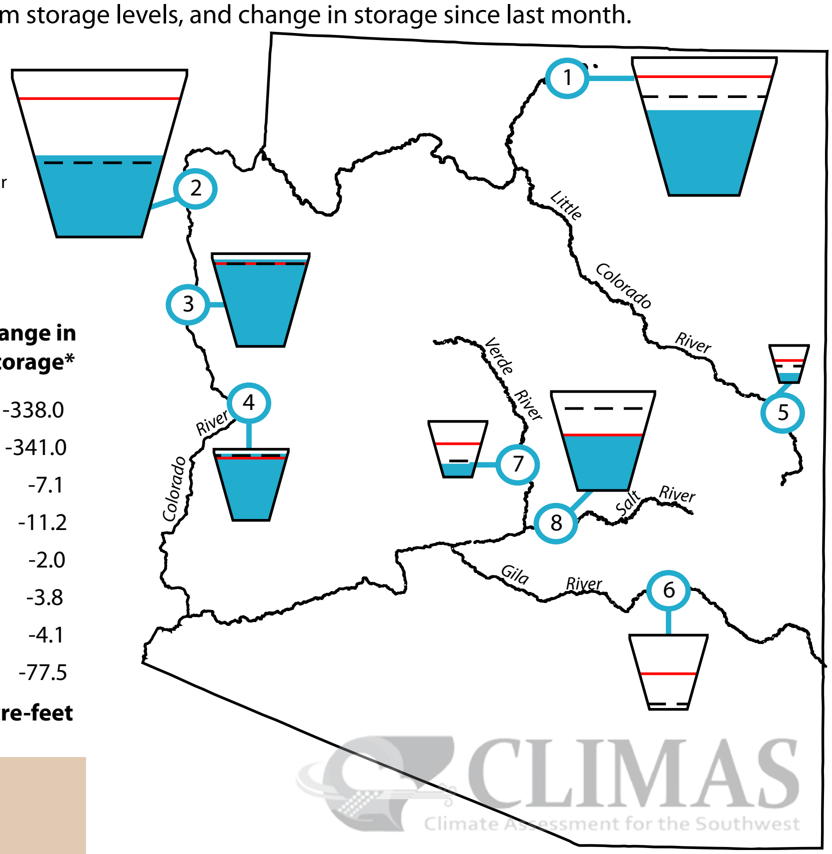
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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 June as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.





Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Lake Powell	63%	15,294.0	24,322.0	-338.0
2. Lake Mead	50%	13,200.0	26,159.0	-341.0
3. Lake Mohave	94%	1,693.2	1,810.0	-7.1
4. Lake Havasu	94%	584.5	619.0	-11.2
5. Lyman Reservoir	26%	7.9	30.0	-2.0
6. San Carlos	0%	1.7	875.0	-3.8
7. Verde River System	28%	79.2	287.4	-4.1
8. Salt River System	63%	1,277.4	2,025.8	-77.5

*** 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 6/30/12)

Data Source: National Water and Climate Center

New Mexico reservoirs decreased by 248,900 acre-feet in June (*Figure 7*), due to increased water demand, early snowmelt runoff, and a lack of spring precipitation. Most New Mexico reservoirs are at lower levels than they were one year ago. Elephant Butte Reservoir, located on the Rio Grande in central New Mexico, is 12 percent full. Reservoir levels continue to be particularly low in the Pecos and Canadian river basins. Low precipitation, due to two consecutive La Niña episodes, reduced runoff to streams feeding the reservoirs.

In water-related news, New Mexico Senators Jeff Bingaman and Tom Udall are co-sponsoring a bill that would help rural and tribal communities in New Mexico and other states meet their future water needs. If the bill is passed, it would allow the U.S. Bureau of Reclamation to send $80 million each year toward congressionally approved rural water projects (Associated Press, July 18). Many approved rural water projects in New Mexico lack funds for construction. Also, Bonito Lake, a fishing retreat and source of drinking water for Alamogordo, has experienced large influxes of silt and ash from this year's Little Bear fire (*Alamogordo Daily News*, July 10).

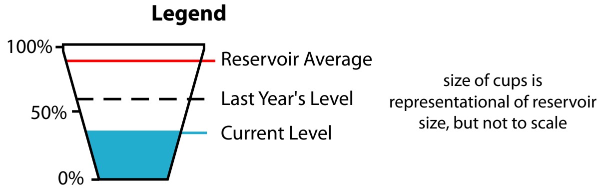
Notes:

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.

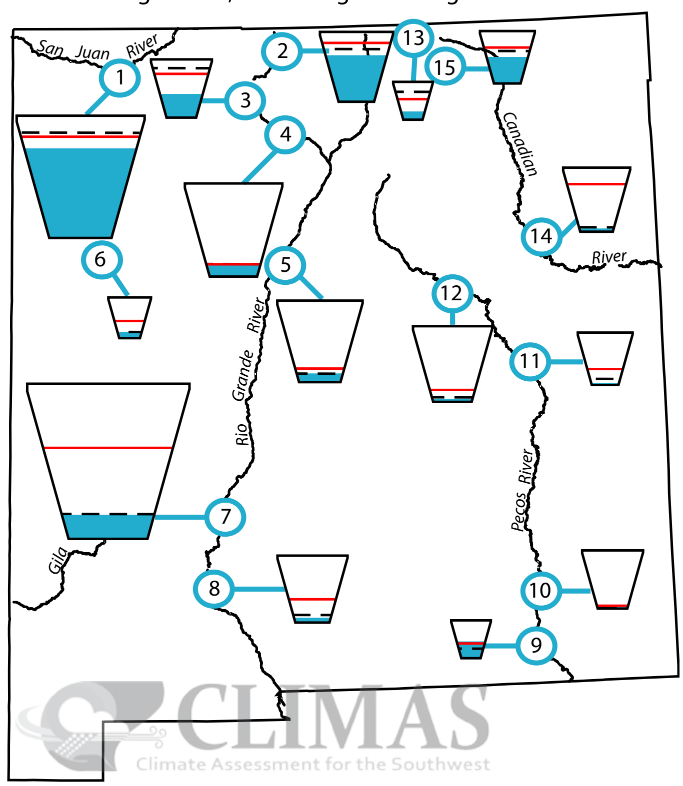
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Figure 7. New Mexico reservoir levels for June 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	73%	1242.8	1,696.0	-59.9
2. Heron	66%	264.5	400.0	1.7
3. El Vado	36%	68.3	190.3	-57.6
4. Abiquiu	13%	157.5	1,192.8	-13.0
5. Cochiti	10%	49.1	491.0	-0.7
6. Bluewater	14%	5.2	38.5	-0.4
7. Elephant Butte	12%	266.4	2,195.0	-99.7
8. Caballo	6%	20.8	332.0	-3.2
9. Lake Avalon	40%	1.6	4.0	0.4
10. Brantley	1%	7.0	1008.2	-7.6
11. Sumner	4%	4.1	102.0	0.9
12. Santa Rosa	2%	6.6	438.3	-4.4
13. Costilla	18%	2.9	16.0	-1.5
14. Conchas	4%	9.8	254.2	-0.7
15. Eagle Nest	46%	36.2	79.0	-3.2

*** 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

Southwest Fire Summary
(updated 7/19/12)

Source: Southwest Coordination Center

Monsoon precipitation helped dampen fire activity across most of Arizona and New Mexico during the last month, as expected. In Arizona, about 139,000 acres burned between January 1 and July 14 (*Figure 8a*). Between June 20 and July 19, 14 wildland fires started; eight remained active as of July 19 (*Figure 8b*). These fires nearly doubled the total acres burned since January 1. Lightning strikes caused several of these fires, including the Grapevine fire, which torched about 19,000 acres in the Coronado National Forest near Safford. Lightning also set off the Trap Peak fire, the Pinnacle fire, and the Cottonwood fire, all of which had burned less than 2,000 acres as of July 14.

In New Mexico, only four fires have ignited since June 21. All of these have been completely contained and were relatively small, burning a combined total of approximately 7,800 acres. Between January 1 and July 14, more than 367,000 acres have burned in the state, with the vast majority—approximately 298,000 acres—consumed in the Whitewater-Baldy Complex fire in the Gila National Forest near Glenwood. As of July 19 it was the only active fire (*Figure 8c*).

Other parts of the western U.S. have not experienced the fire-quelling benefits of monsoon moisture. In Colorado, severe drought and high temperatures continue to contribute to high fire risk and activity. Several Colorado fires made national news, including the Waldo Canyon fire, which began on June 23 and burned more than 18,000 acres in Pike National Forest near Colorado Springs. That fire killed two people, destroyed almost 350 houses, and sparked the evacuation of more than 32,000 residents. The High Park fire, which began June 9 near Fort Collins, was also devastating, charring more than 87,200 acres and 260 homes.

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 July 14, 2012.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	775	91,047	256	47,879	1,031	138,781
NM	397	7,488	282	359,858	679	367,346
Total	1,172	98,535	538	407,737	1,710	504,127

Figure 8b. Arizona large fire incidents as of July 19, 2012.

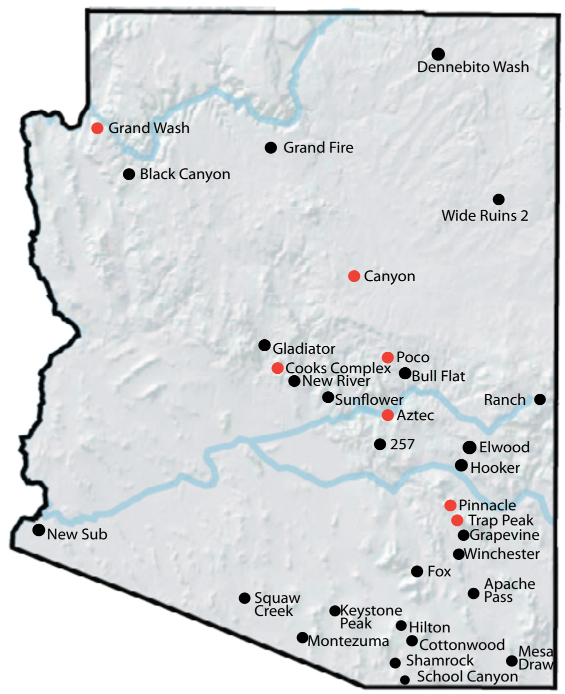
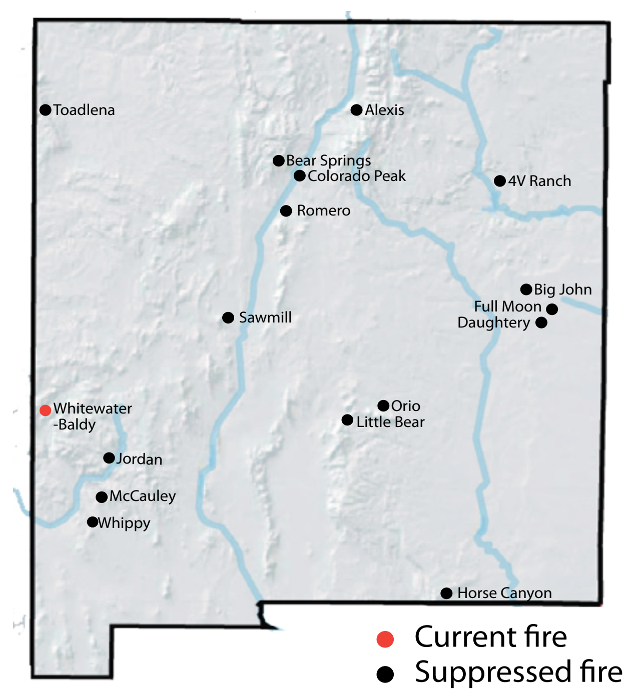


Figure 8c. New Mexico large fire incidents as of July 19, 2012.



Monsoon Summary
(through 7/14/2012)

Data Source: Western Regional Climate Center

The monsoon is off to a strong start, delivering substantial precipitation in many locations in southern Arizona. While the early and frequent rainfall in parts of the Southwest bodes well for above-average total monsoon rainfall, the season is only a month old. With two months remaining, a promising start can fade. In other words, it is too early to tell if this monsoon will be a boom or a bust.

Between June 15 and July 14, most of southern Arizona and northwest New Mexico received above-average rainfall (*Figures 9a–c*). The highest rainfall totals for this period reported from official weather stations occurred on the border between central Pima and Pinal counties in Arizona. In Tucson, several storms have produced very high, localized precipitation, with amounts exceeding 3 inches—values that have been reported on www.rainlog.org, a citizen science effort to record daily precipitation across the Southwest. Other weather stations across southeast Arizona reported above-average rainfall between June 15 and July 18. These include 3.85 inches at Tucson International Airport (1.22 inches is average); 4.19 inches at Nogales International Airport (2.71 inches is average); 3.81 in Wilcox (1.54 inches is average); and 1.33 at Picacho Peak (0.43 inches is average). For more rainfall statistics in Arizona, see: http://www.wrh.noaa.gov/twc/monsoon/rainfall.php.

The southwestern part of Arizona has benefited from Gulf of California surges that have ferried moist near-surface air into the region. However, the corner of southeast Arizona has not fared as well, in part because it imports moisture from southwest New Mexico, which has been dry so far.

The better-than-average start to the monsoon conforms to the NOAA-Climate Prediction Center (CPC) forecast issued in mid-June, which called for elevated chances for above-average rainfall in July. Looking ahead, the CPC forecast for August again calls for elevated chances for above-average rain. However, other forecasts noted that August rain might not be as vigorous as it was in July (see http://www.climas.arizona.edu/feature-articles/jun-2012).

Figure 9a. Total precipitation in inches (June 15–July 14, 2012).

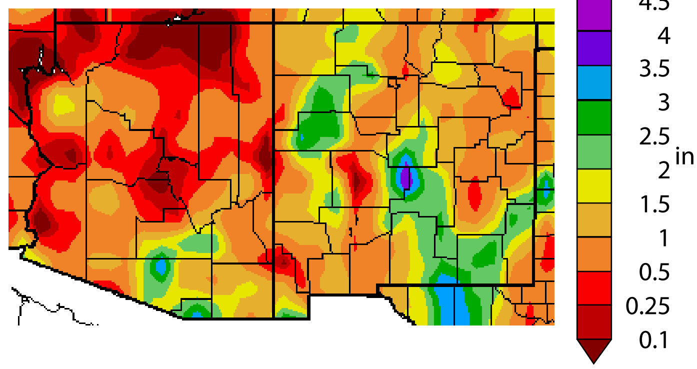


Figure 9b. Departure from average precipitation in inches (June 15–July 14, 2012).

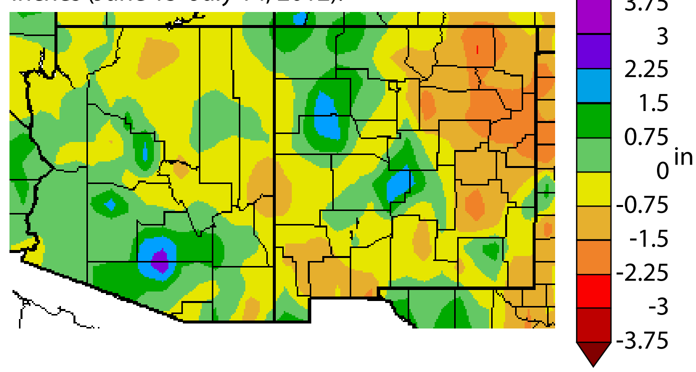
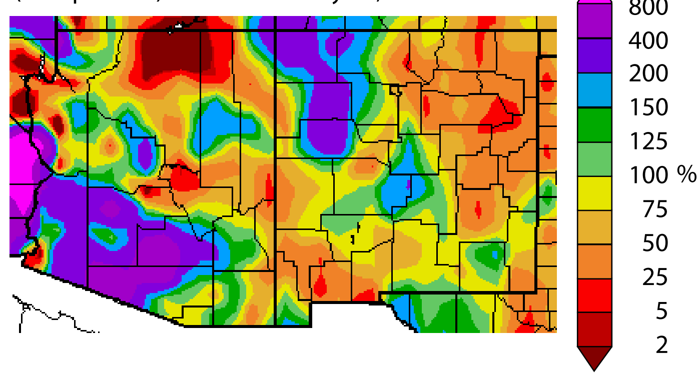


Figure 9c. Percent of average precipitation (interpolated) for June 15–July 14, 2012.



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

(August 2012–January 2013)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlook issued by the NOAA-Climate Prediction Center (CPC) in July for the August–October period calls for increased chances that temperatures will be similar to the warmest 10 years in the 1981–2010 period in much of the Southwest (*Figure 10a*). Recent warming trends during this period influence this forecast. Odds diminish in the three-month seasons that follow, and forecasts call for mostly equal chances for above-, below-, or near-average conditions in Arizona or only slightly increased chances for above-average temperatures in New Mexico (*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 in many regions.

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 August–October 2012.

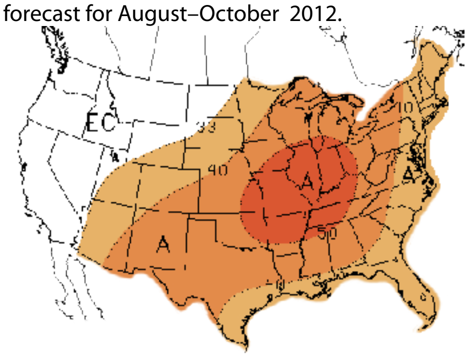


Figure 10b. Long-lead national temperature forecast for September–November 2012.

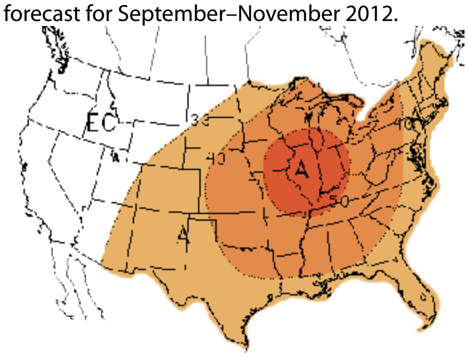


Figure 10c. Long-lead national temperature forecast for October–December 2012.

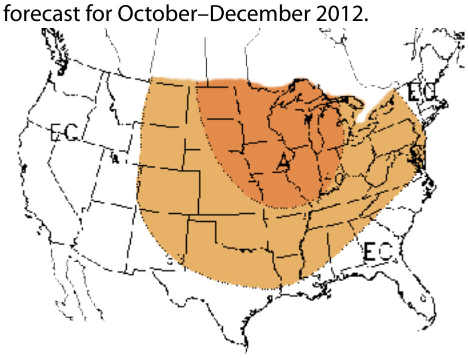
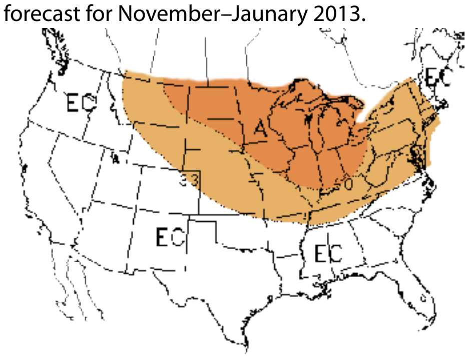


Figure 10d. Long-lead national temperature forecast for November–Jaunary 2013.



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
(August 2012–Janaury 2013)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (CPC) in July call for slightly increased chances that precipitation during the August–October and September–November periods will be similar to the wettest 10 years in the 1981–2010 record for parts of southern Arizona and New Mexico (*Figures 11a–b*). These areas correspond to the region most heavily influenced by the monsoon. This forecast is influenced by the expectation that El Niño will continue to develop in coming months. Based on past El Niño events during these periods, there are increased chances for above-median precipitation from Southern California to New Mexico and as far north as Utah and Colorado because convection in the eastern Pacific Ocean instigates moisture surges into these regions. There are also increased odds that precipitation will be above average during the October–December and November–January periods (*Figures 11c–d*). This, too, relates to El Niño, which often alters atmospheric circulation patterns so that more storms soak the Southwest.

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 August–October 2012.

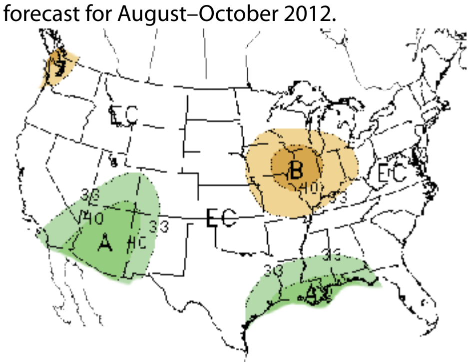
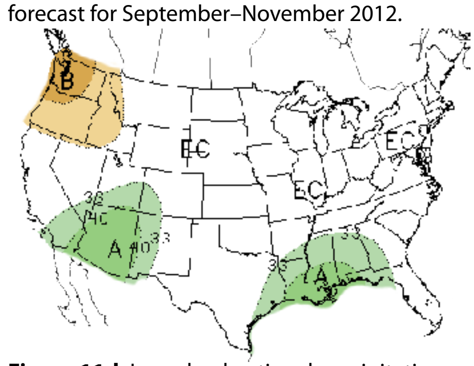


Figure 11b. Long-lead national precipitation forecast for September–November 2012.



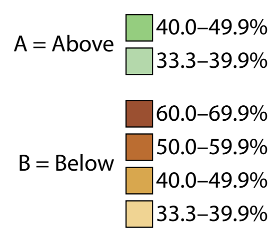


Figure 11c. Long-lead national precipitation forecast for October–December 2012.

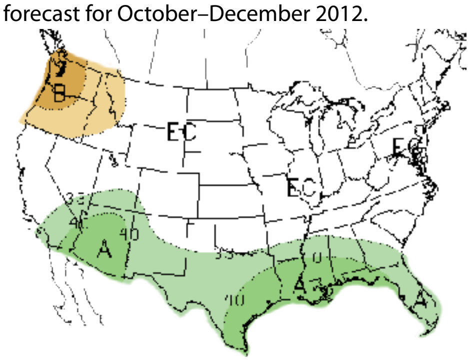
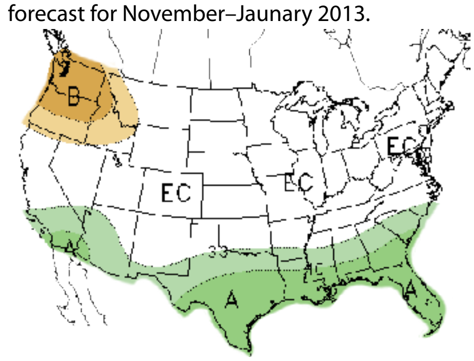


Figure 11d. Long-lead national precipitation forecast for November–Janaury 2013.



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 October)

Data Source: NOAA–Climate Prediction Center (CPC)

This summary is partially excerpted and edited from the July 19 Seasonal Drought Outlook technical discussion produced by the NOAA-Climate Prediction Center (CPC) and written by forecaster D. Miskus.

The monsoon brings a large portion of the annual precipitation in parts of Arizona, New Mexico, western Texas, and eastern Colorado during the June–September period. Since July 1, the monsoon has produced substantial rain across much of the Southwest. Many areas also have reported above-average rainfall since June 19, and most of Arizona and southeast California also have received above-average rainfall in the last 60 and 90 days, respectively.

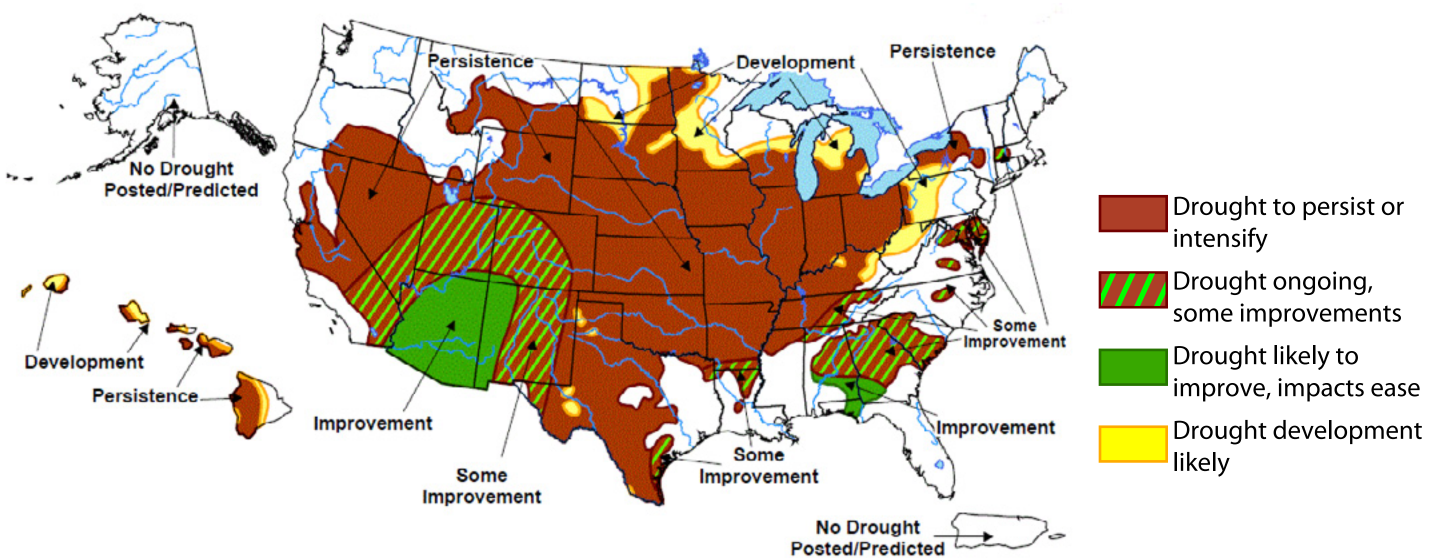
The monthly and seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (CPC) all favor near- to above-median rainfall across this region. With these and other forecast tools in agreement, drought improvement is forecast for nearly all of Arizona and western New Mexico, with some improvement for the remainder of the Southwest (*Figure 12*). The CPC assigns a moderate to high confidence in this forecast.

In other parts of the West, widespread moderate and severe drought covers many regions and there is little chance for improvement because the summer is historically dry. The CPC precipitation forecasts also favor slightly enhanced chances for below-median precipitation over the Northwest and equal chances that precipitation will be above, below, or near average in the Great Basin and northern Rockies. As a result, the seasonal drought forecast calls for the existing drought to continue without any areas of improvement or new development. The CPC assigns a 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 October (released July 19).



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

(August–October 2012)

Sources: National Interagency Coordination Center, Southwest Coordination Center

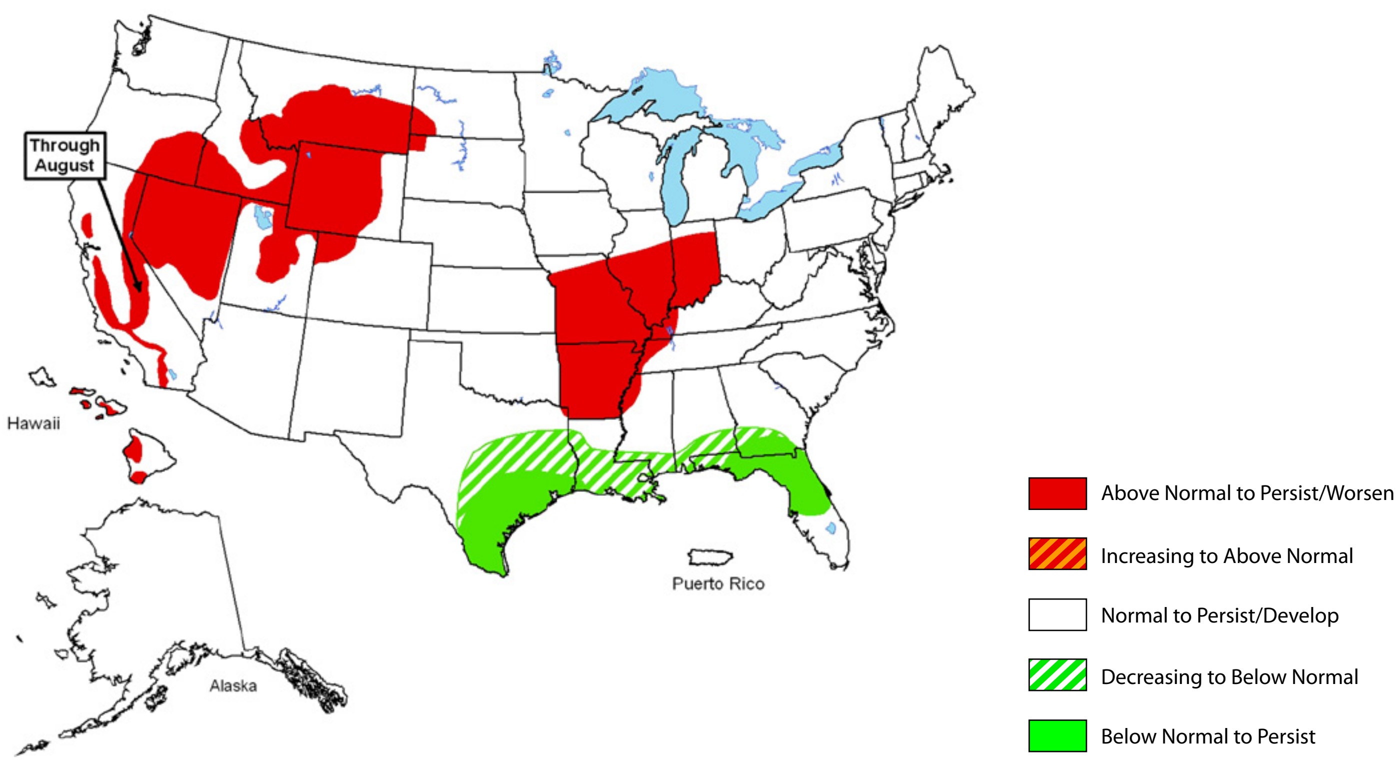
Normal significant fire potential is expected across Arizona and New Mexico for August through October (*Figure 13*). Significant fire potential refers to the likelihood that a wildland fire will require additional resources from outside the area in which the fire originated.

Moisture from the monsoon has helped reduce the number and size of wildfires in Arizona and New Mexico, particularly in southern areas. While some parts of the region remain in severe drought, soil and fuel moisture levels have generally increased over the last month, and these trends are expected to continue. Forecasts from the NOAA-Climate Prediction Center (CPC) show increased chances for above-average precipitation (see page 15), especially across Arizona and western New Mexico. This means that the drought and related impacts are likely to improve through October (see page 16). Wildfire risk and activity should therefore continue to decrease across parts of the Southwest. However, there is uncertainty in the precipitation forecast because the monsoon is always variable. Although it is off to an early and vigorous start, it is common to have protracted breaks in monsoon rainfall, which would increase risks of fire, especially in places that have received fewer summer storms. So far, the state of the El Niño-Southern Oscillation (ENSO) may also influence precipitation in coming months. The expectation is that sea surface temperatures will continue to warm, causing an El Niño event in coming months. In the past, El Niño events have caused a slight decrease in precipitation in parts of southern, central, and northwestern Arizona during the July–September period. El Niño events, however, increase chances for above-average precipitation in many parts of Arizona and New Mexico during the winter.

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 August–October 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 (CPC) remains in effect this month as sea surface temperatures (SSTs) continue to warm and spread across the eastern Pacific Ocean. SSTs have risen to between 0.5 to 1.5 degrees Fahrenheit across the eastern Pacific as easterly winds along the equator have weakened—the Southern Oscillation Index (SOI) continues to decline (*Figure 14a*)—both indicative of a shift towards El Niño conditions. An El Niño Watch means that conditions are favorable for an event to form within the next six months.

The CPC notes, however, that dynamical and statistical forecast models differ on whether an El Niño event will form in the next several months or if neutral conditions will persist. Dynamical models—which explicitly model physical prcesses—favor the development of an El Niño by early fall, but statistical models—which rely on ENSO tendencies derived from past events—are less certain that warm conditions will build long enough to sustain an El Niño through the winter season and suggest neutral conditions will persist through next spring. Forecasters, however, favor dynamical models and the expectation is that at least a weak, and possibly a moderate, El Niño will develop by late fall. Official forecasts issued by CPC and the International Research Institute for Climate and Society (IRI) reflect this, indicating that chances for El Niño developing by the September–November period are about 78 percent, with about a 22 percent chance of neutral conditions persisting (*Figure 14b*). The CPC notes that there is still much uncertainty surrounding the eventual strength and magnitude of the developing event and how much El Niño would impact different geographical regions in the fall and winter. If El Niño does materialize, it will bring increased chances for above-average winter precipitation in the Southwest.

Notes:

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

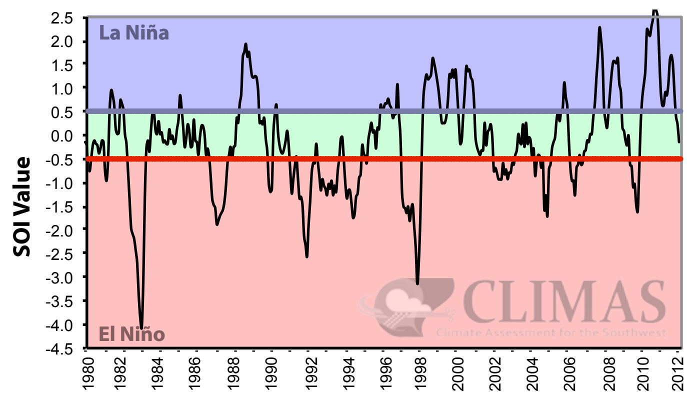


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released July 23). Colored lines represent average historical probability of El Niño, La Niña, and neutral conditions.