Issued: June 23, 2009

Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: Zack Guido, CLIMAS

Photo Description: The monsoon began officially in Arizona on June 15. National Weather Service and University of Arizona scientists have indicated that monsoon storms, like this one that produced heavy, isolated thunderstorms on the Colorado Plateau in July 2008, will likely bring above-average rain during June and July this year.

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

In this issue...

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June Climate Summary

Drought– Drought conditions in Arizona and New Mexico improved slightly, as late May and early June rains soaked many parts of the states.

Temperature– After a record-breaking streak of warmer-than-average temperatures in early May, late May and early June have been generally cooler than average across the Southwest.

Precipitation– A persistent low pressure trough has brought unusual late spring-early summer precipitation to the Southwest in the past 30 days. Most of Arizona and western New Mexico have received 150 to more than 800 percent of average precipitation.

ENSO– Conditions in the equatorial Pacific Ocean appear favorable for a transition into El Niño conditions in June–August; the expectation is for a weak El Niño into next year.

Monsoon– The start of the monsoon season officially began on June 15 in Arizona, and the expectation for a soggy first-half of the monsoon season continues.

Climate Forecasts– Temperature forecasts through summer show a tilt in the odds toward warmer temperatures, while precipitation forecasts suggest a good chance of wetter-than-average conditions through the monsoon season.

The Bottom Line– It rained somewhere in Arizona every day from May 18 to the end of May, contributing to above-average precipitation in most of the state. Western New Mexico saw similar rain events, and both states experienced improvements in drought conditions. With the expectation that the early monsoon season will be soggy, forecasts suggest additional drought improvement.

New Report on Climate Change Impacts

Recent warming in the Southwest has been among the most rapid in the nation, driving declines in snowpack and Colorado River flow, according to the new report, *Global Climate Change Impacts in the United States*, issued by the U.S. Global Change Research Program. John Holdren, science and technology advisory to President Obama, touted the report as the most up-to-date, comprehensive, and authoritative assessment of present and future climate change impacts in the U.S.

Some of the important findings of the report mimic the conclusions of the International Panel on Climate Change (IPCC): global warming is unequivocal and human actions are primarily the cause for the warming. The report, however, draws on more up-to-date information than the IPCC and focuses on the U.S., including the Southwest.

Climate change impacts in the Southwest cited in the report will lead to increasingly scarce water supplies, necessitating tradeoffs among competing uses and potentially leading to conflict. The report also emphasizes, among other key findings, that increasing temperature, drought, wildfire, and invasive species will accelerate changes to the southwestern landscape. Jonathan Overpeck, lead investigator of CLIMAS, is among the lead authors of the report. To read the report, visit http://www.globalchange.gov/.

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This work is published by the Climate Assessment for the Southwest (CLIMAS) project and the University of Arizona Cooperative Extension; and is funded by CLIMAS, Institute for the Study of Planet Earth, and the Technology and Research Initiative Fund of the University of Arizona Water Sustainability Program through the SAHRA NSF Science and Technology Center at the University of Arizona.

Southwest faces diminished stream flows, new water policies

By Melissa Lamberton

Figure 1. This image captures the water level in Lake Mead. In the last 100 years, the Colorado River flow has averaged 15.1 million acre-feet per year. Climate change threatens to reduce this amount. Photograph is courtesy of Bureau of Reclamation.

Growing populations, energy production, and agriculture all tap water from Southwest rivers. Now, climate change is staking its own claim, challenging western states and water managers to reconsider long-standing policies on how water is allocated and used.

University of Arizona law professor Robert Glennon says this marks an "era of reallocation." In his book *Unquenchable: America's Water Crisis and What to Do About It*, released in April, Glennon calls for new ways of valuing water that recognize the resource as limited.

"There is no new oasis out there where we can magically come up with new water," Glennon said in an April interview. "We in the West traditionally allowed anyone to put another straw in the glass. It's a recipe for disaster."

In an effort to avert disaster, Glennon and other water experts are increasingly looking toward innovative solutions for the future, including incorporating new legal measures to ensure states share a certain volume of river water, pricing water appropriately, and reallocating existing water rights.

Higher temperatures diminish flows

Climate change will not affect all rivers alike. Kevin Trenberth, a scientist at the National Center for Atmospheric Research in Boulder, Colo., co-authored a study that examines changes in the amount of water that reaches the sea from rivers around the world. The study appeared in the *American Meteorological Society's Journal of Climate* in May.

About 10 percent of the world's largest 200 rivers showed an upward trend in 1948–2004 data, typically in northern latitudes where snowmelt and precipitation have increased. Forty-five of the 200 rivers—about 23 percent—had diminishing trends, particularly in subtropical and tropical regions. One of those regions is the Southwest, which falls into the subtropical range, roughly 20 to 35 degrees latitude.

Trenberth's study shows lessening flows in the Colorado River, which serves a growing population in seven U.S. states and Mexico. "Dams and human withdrawals complicate the picture everywhere and are certainly an important factor for the Colorado," Trenberth said. "But the study suggests climate change is also a significant driver."

The Colorado River primarily is fed by snowmelt, which seeps from high elevations to add a swell of cold water in spring. A 2007 National Research Council study explained how a warming climate decreases snowpack in the mountains and leads to earlier snowmelt. Higher temperatures also cause more evaporation. The result, the NRC study concluded, is likely altered hydrologic cycles and reduced flows in western rivers.

The effect of warming temperatures on precipitation in the Southwest is harder to predict. Some scientists, including Trenberth, suggest climate change will bring fiercer summer thunderstorms with fewer soaking winter rains. Other models predict different precipitation changes. Most scientists agree that higher temperatures alone will reduce runoff in western rivers, with precipitation changes likely to exacerbate the problem.

Various models calculate reductions in the Colorado's flows, with several of the most well-regarded models projecting declines of 10 to 30 percent by mid-century. The Colorado River is particularly vulnerable to climate change because its flows have already been over-allocated for human use, Trenberth noted.

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Stream flows, continued

Interstate compacts

Even small reductions in a river's flow can have a serious impact on interstate policies. Rivers that flow over state borders, like the Colorado, Rio Grande, Klamath, and Pecos, are divided among users through complex agreements called compacts. Some of these compacts are flexible and capable of resolving conflicts, while others may be ill-equipped to deal with climate change, said Edella Schlager, a University of Arizona associate professor of public administration and policy.

Schlager heads up a National Science Foundation study that examines 14 western interstate compacts. How these compacts will respond to climate change will vary from state to state, Schlager said. The Costilla Creek Compact, for example, allocates water between Colorado and New Mexico by percentages. If river flows are reduced, the shortage will be spread among the two states. In the South Platte Compact, however, Colorado guarantees a minimum flow to the downstream state, Nebraska.

"The burden of climate change, in a water allocation rule like that, rests on the upstream state," Schlager said.

The Colorado River, not included in Schlager's study, is governed by a complex series of allocation rules collectively known as the Law of the River. The law's cornerstone is the 1922 Colorado River Compact, which divided 16.5 million acre-feet of water among the users, not including evaporation loss. One acre-foot is about 326,000 gallons, enough water to satisfy the needs of about four people for one year.

The compact allows the states in the Colorado River's upper basin—Colorado, Utah, New Mexico, and Wyoming—to consume 7.5 million acre feet per year. The rules also require the upper basin to deliver 7.5 million acre-feet to the river's lower basin—Arizona, New Mexico, Nevada, and California—plus another 1.5 million acre-feet to Mexico. Although there is some flexibility in the law—the required amount can be delivered yearly or averaged over a decade—the upper basin is obliged to cut back its water use, if needed, to make the delivery.

Tree-ring data spanning more than 1,200 years have since estimated the river's annual flow to average 14.65 million acre-feet. In a 2007 amendment to the Law of the River, the U.S. Bureau of Reclamation

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Figure 2. Periodic drought plays a major role in water management in the Southwest U.S. For example, in 2002 the Colorado River flow was 5.4 million acre-feet, slightly more than one-third of the 1906–2005 average. Image courtesy of University Corporation for Atmospheric Research.

Stream flows, continued

developed an environmental impact statement that considers how climate change might influence management of the Colorado. Kathy Jacobs, director of the Arizona Water Institute and a major contributor to the project, said the new guidelines allow for joint operation of two reservoirs—the upper basin's Lake Powell and the lower basin's Lake Mead—to improve flexibility during shortages.

Climate change is also likely to burden river ecosystems because rivers themselves are last in line for water. All of the compacts were developed prior to the 1970s, and "none of them consider environmental values," Schlager said.

The compacts are based on the prior allocation rule, which states that the first person to divert water for a "beneficial use" has a priority right. Historically, leaving water in a riverbed was not considered a beneficial use, nor did it fulfill the requirement to physically divert water from the stream. The system was developed in western mining camps, where miners needed to divert large quantities of water to wash gold and silver from the hillsides. The rule later was adopted for irrigation and domestic water use.

The benefits of preserving in-stream flows have only recently gained recognition. "Healthy rivers are critical to us as a people," Glennon said. "It's the legacy of the area. It's what people originally settled here for."

Solutions for adapting

States are generally unwilling to reopen hard-won water compacts for renegotiation. If climate change reduces river flows, states will likely try to adapt within the existing framework.

"It's really hard to overstate the value of water and how states treasure their water resources," Schlager said. "They're reluctant to do anything to place their water resources at risk."

Most western compacts, she said, currently lack compliance mechanisms to ensure upstream states deliver the promised water when flows are low. She suggests states should incorporate compliance measures into their compacts, such as third parties to oversee river management or a pool of water in an upstream reservoir controlled by the downstream state.

Schlager also advocates for investments in sophisticated hydrological models to track river changes. Hydrologic monitoring is critical, she said, because many of the compacts have complicated allocation rules that rely on knowing exactly how much water is in the river. Climate change is likely to alter the rhythm of rivers' flows, making it more difficult for upstream states to meet their delivery requirements. States need to implement an information system that all the users agree on, so that when disagreements arise they will be able to pinpoint how much climate change is to blame for diminished flows, or whether the upstream state also bears responsibility, Schlager said.

"There might be opportunities for states to cooperate, given that they're facing a new hydrologic regime," she said. "The only way to really survive is to work together to provide a common response."

Glennon also sees a need for extensive monitoring systems, but he envisions this coming mostly from the federal level. He calls for fundamental changes in the way water is viewed in the West, outlining new mechanisms for controlling water use that would supersede existing policies. For example, farmers currently receive about 80 percent of the water resources in western states, Glennon said. He suggests reallocating water from low-value uses, like alfalfa and cotton, to high-value uses, like the Intel Corporation, which requires large quantities of ultra-pure water to manufacture microprocessors. Glennon writes that an acre-foot of water used to grow alfalfa generates about $264, while an acre-foot used to manufacture Intel chips generates $13 million.

Glennon also suggests using market forces to discourage wasting water. In the U.S., he said, one-third of all water companies have decreasing block rates, so the more you use, the less it costs per gallon. Other companies simply offer a flat rate. He envisions policies that recognize a human right to water for basic necessities, coupled with increasing block rates so that the larger water consumers pay more.

"We think of water like air—something that's inexhaustible and limitless," Glennon said. "We have so undervalued the resource that most of us pay more for cell phone service and cable television."

In addition, developers should have to purchase and retire an existing water right in exchange for permission to build, rather than simply adding a new straw to the glass, Glennon said. The usual engineering solutions—more dams, diversions, or pipelines—are not going to work anymore, he said. Instead of searching for new sources, he advocates for ways to conserve the existing supply.

In his book, Glennon also writes of a growing movement in western states to develop "water trusts," organizations that protect in-stream flows by purchasing water rights. Water trusts provide incentives to farmers to conserve water for environmental uses and ensure that if a farmer chooses to leave water in the stream—perhaps to improve fishing or protect an endangered species—another farmer cannot claim the water by diverting it.

"This is a crisis, but not a catastrophe," Glennon said. "It's a time when we still have options. Now we need the courage and political will to act."

For questions or comments, please contact Melissa Lamberton, at mllamb@email.arizona.edu

Temperature (through 6/17/09)

Source: High Plains Regional Climate Center

Temperatures in the Southwest since the water year began October 1 continue to reflect elevation differences, generally averaging 60 to 70 degrees Fahrenheit in the lowland deserts, between 55 and 60 degrees F in southern New Mexico, 45 to 55 degrees F in central New Mexico, and between 35 and 50 degrees F in the Colorado Plateau and the mountains of northern New Mexico (Figure 1a). These temperatures are 1 to 3 degrees F above average across most of both states (Figure 1b). A few isolated locations have been up to 4 degrees F above average. The cool area near Bagdad, Ariz., is due to a station relocation rather than a drop in temperatures. The warmer-than-average temperatures were associated with La Niña conditions that brought fewer-than-average cold fronts and winter storms into the Southwest.

After a record breaking streak of warmer-than-average temperatures in early May, late May and early June have been generally cooler than average across the Southwest. Only the lower Colorado River region and several other small areas have experienced temperatures warmer than average for this time of year (Figures 1c–d). Southern Arizona and southeastern New Mexico have been about 1 degree F cooler than average, while the Colorado Plateau and higher elevations in New Mexico have been 2 to 5 degrees cooler than average. The cooler temperatures are associated with sub-tropical moisture and cloudiness that has been drawn into the Southwest by a persistent low pressure system off the Southern California coast.

Notes:

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

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

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

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

On the Web:

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

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

Figure 1a. Water year '08–'09 (through June 17, 2009) average temperature.

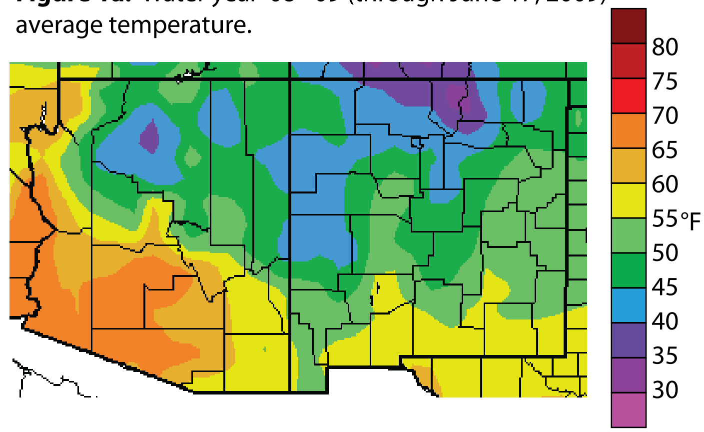


Figure 1b. Water year '08–'09 (through June 17, 2009) departure from average temperature.

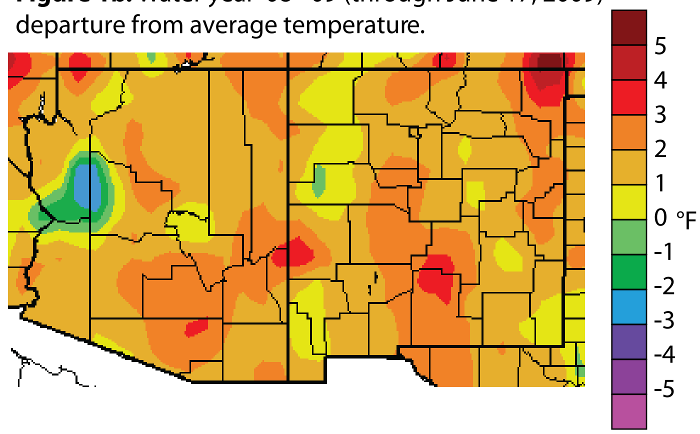


Figure 1c. Previous 30 days (May 19–June 17, 2009) departure from average temperature (interpolated).

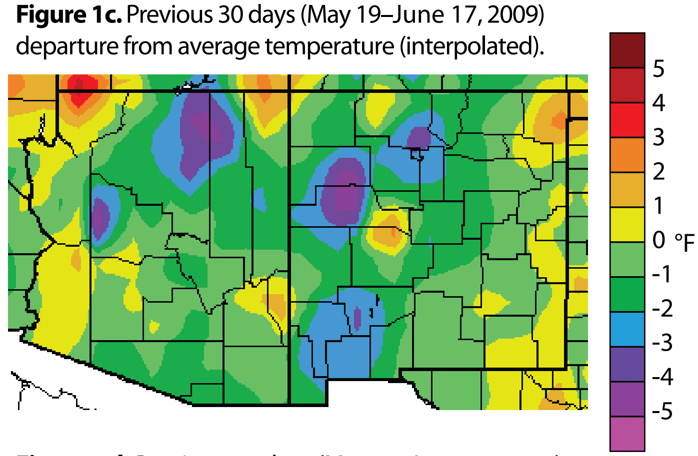
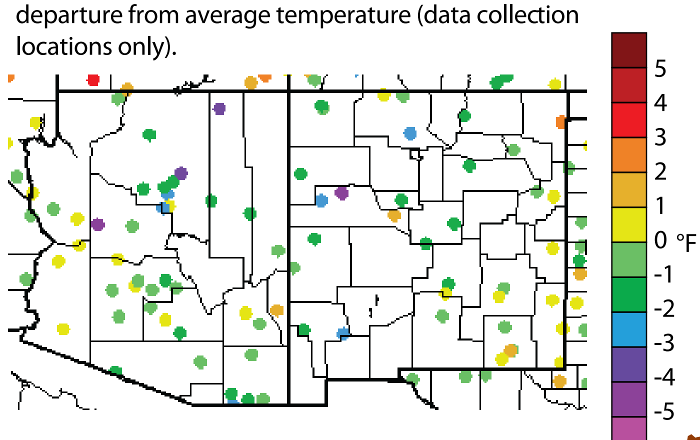


Figure 1d. Previous 30 days (May 19–June 17, 2009) departure from average temperature (data collection locations only).



Precipitation (through 6/17/09)

Source: High Plains Regional Climate Center

Precipitation since the water year began October 1 remains below average across most of Arizona and New Mexico, with only a few isolated high elevation locations recording above-average precipitation (Figure 2a). Southern Arizona and southern and east-central New Mexico have received less than 70 percent of their average precipitation since October 1 (Figure 2b). Northwestern New Mexico recorded 70 to 100 percent of average, while the Sangre de Cristo Mountains in north-central New Mexico received 110 to 120 percent of average precipitation. The northwestern corner of Arizona and the Navajo Nation, south of Monument Valley, have also received 110 to 120 percent of average.

There has been unusually heavy and widespread rainfall in the past 30 days (Figures 2c–d). With a few isolated exceptions, Arizona and western New Mexico have received 150 to more than 800 percent of average precipitation. This swath of heavy precipitation corresponds to the path of the moisture flow from the southwest to northeast, with the heaviest rainfall amounts in southern Arizona near the Mexican border. However, eastern New Mexico is much drier, with a steep gradient from west to east, and has received between 5 and 75 percent of average precipitation. The Lower Colorado River and Southern California are also relatively dry, with 2 to 75 percent of average rainfall.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2008, we are in the 2009 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year.

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

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

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

On the Web:

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

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

Figure 2a. Water year '08–'09 (through June 17, 2009) percent of average precipitation (interpolated).

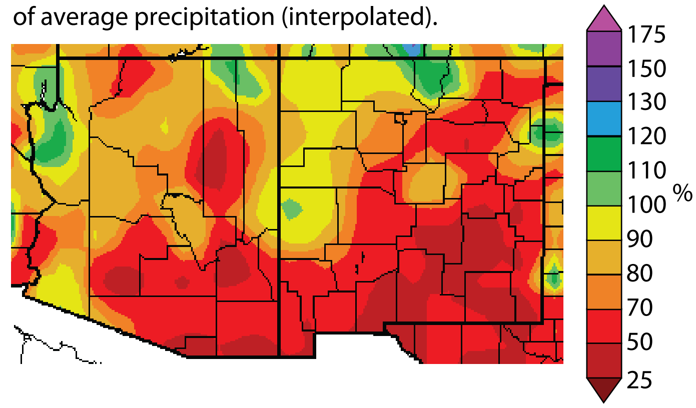


Figure 2b. Water year '08–'09 (through June 17, 2009) percent of average precipitation (data collection locations only).

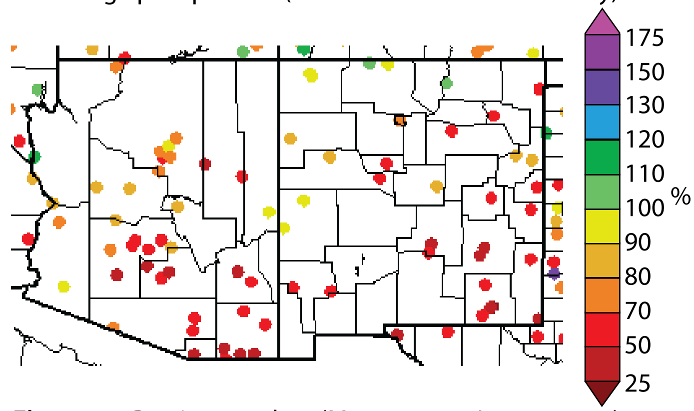


Figure 2c. Previous 30 days (May 19, 2009–June 17, 2009) percent of average precipitation (interpolated).

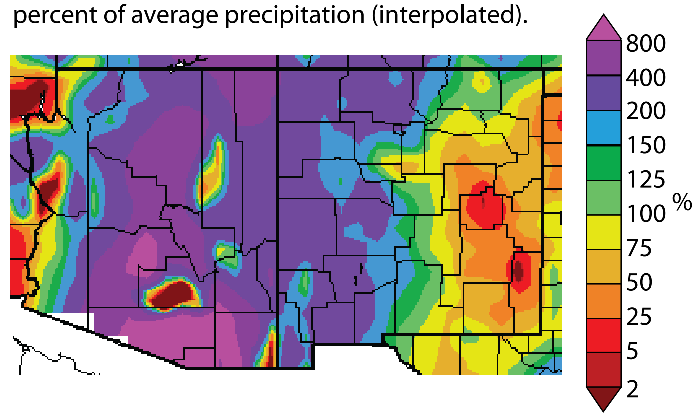
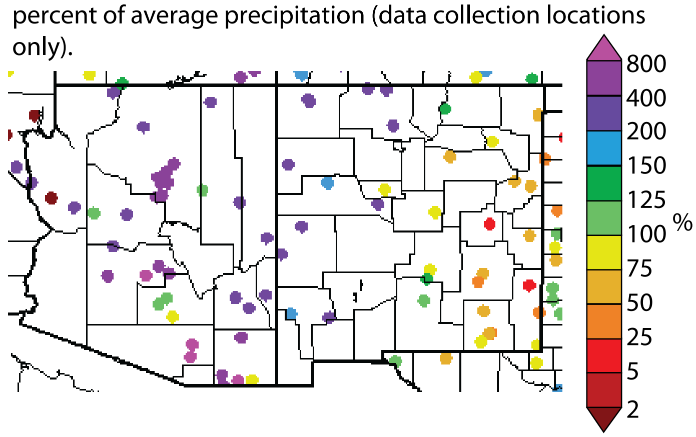


Figure 2d. Previous 30 days (May 19, 2009–June 17, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor
(released 6/18/09)

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

The U.S. Drought Monitor reports ameliorating drought conditions for much of Arizona and New Mexico (Figure 3). These conditions have been influenced by unusually wet weather in the past 30 days. Drought severity has improved across much of the Four Corners region, but increased in Southern California.

The Southern Nevada Water Authority (SNWA) has established a link between a proposed pipeline project and the level of Lake Mead (Las Vegas Review-Journal, June 1). The pipeline would pump groundwater from Lincoln County to Las Vegas. The SNWA will ask the water authority board to allow pipeline construction if Lake Mead water levels fall below 1,075-foot elevation—a 23-foot drop from Mead's present elevation.

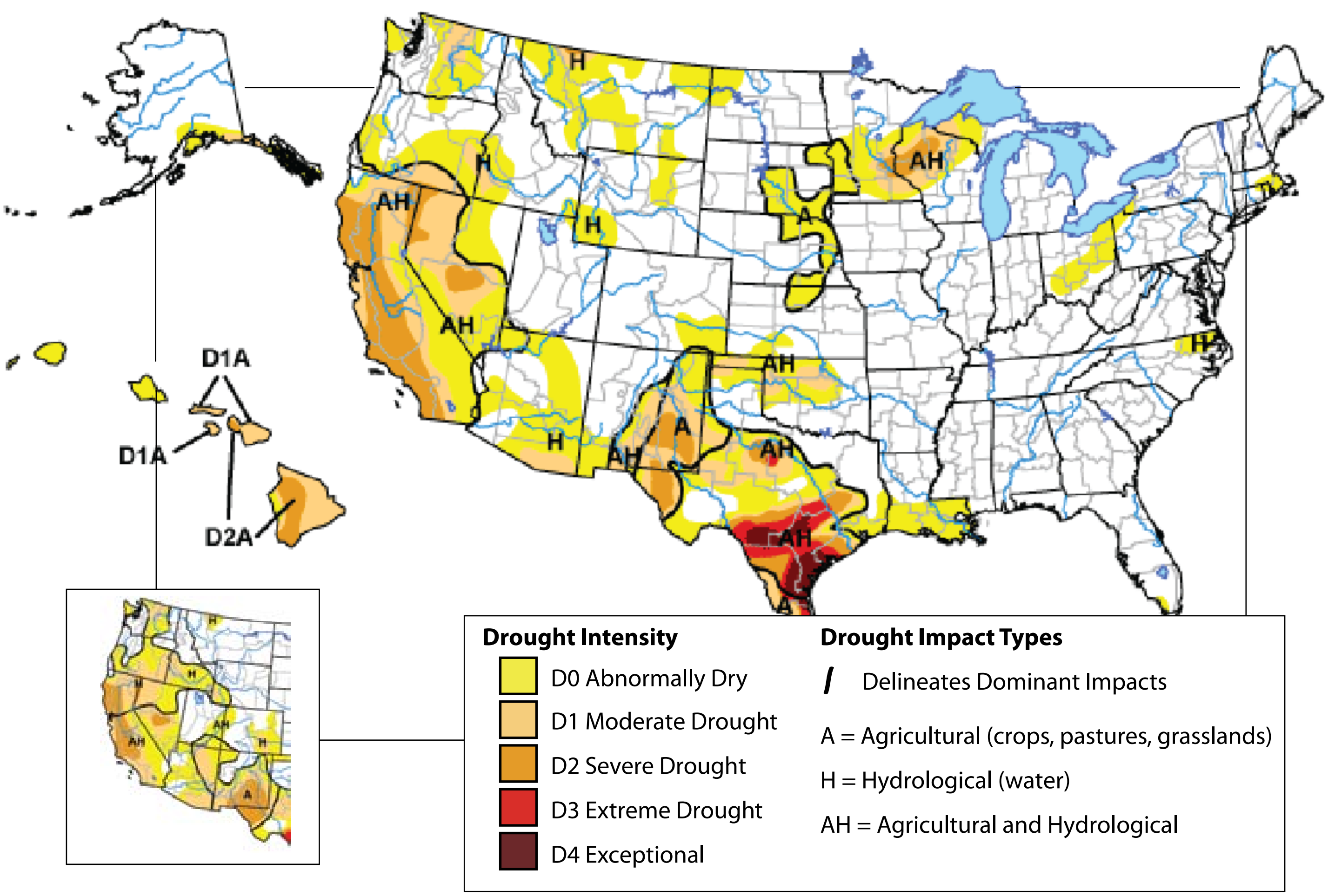
Declining Lake Mead levels are also affecting marina operators and recreational activities, such as fishing (lasvegasnow.com, June 10). Tourism and recreation are important to the local economies of communities near the lake, and the costs of moving boat ramps to accommodate declining lake levels can run into the millions of dollars.

Notes:

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

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of several agencies; the authors of this monitor are M. Brewer and L. Love-Brotak, NOAA/NESDIS/NCDC.

Figure 3. Drought Monitor released June 18, 2009 (full size), and May 19, 2009 (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.unl.edu/dm/monitor.html

Arizona Drought Status
(released 6/18/09)

Source: U.S. Drought Monitor

Beginning with this issue, the Southwest Climate Outlook will highlight Arizona drought conditions issued by U.S. Drought Monitor instead of the Arizona Department of Water Resources (ADWR). This switch has the advantage of providing the most current drought summary, as the ADWR report had a one-month lag. The outlook will link to the ADWR Web page, where monthly short-term and quarterly long-term drought status reports can be read.

During the past month, drought conditions have improved across most of Arizona due to late-May storms and near-average streamflow across most of the state. On June 16, the U.S. Drought Monitor reported about 35 percent of Arizona had no drought status, while about 65 percent was deemed abnormally dry or worse (Figures 4a–b). Compared to last month, drought severity has decreased throughout many eastern counties, including Cochise, Greenlee, and Navajo.

In Arizona water news, ADWR is considering deeming the Big Chino sub-basin of the Verde River groundwater basin an Active Management Area, or AMA (verdenews.com, June 14). The AMA designation reflects concern over the sustainable use of the groundwater aquifer, given the pressures of population growth and water demand in the area. Hydrologists believe that future pumping in the sub-basin may affect flows in the headwaters of the Verde River.

Figure 4a. Arizona drought map based on data through June 16, 2009.

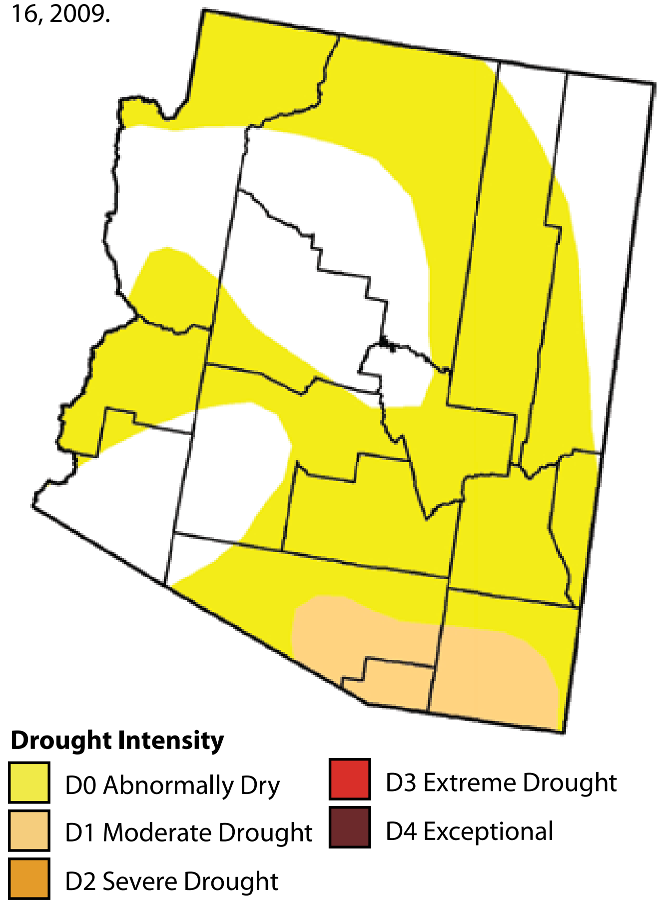


Figure 4b. Percent of Arizona designated with drought conditions based on data through June 16, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	35.4	64.7	7.2	0.0	0.0	0.0
Last Week (06/09/2009 map)	35.2	64.8	7.2	0.0	0.0	0.0
3 Months Ago (03/24/2009 map)	59.7	40.3	1.7	0.0	0.0	0.0
Start of Calendar Year (01/06/2009 map)	62.3	37.7	1.0	0.0	0.0	0.0
Start of Water Year (10/07/2008 map)	83.1	16.9	0.8	0.0	0.0	0.0
One Year Ago (06/17/2008 map)	43.1	56.9	23.8	1.9	0.0	0.0

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

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

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

New Mexico Drought Status

(released 6/18/09)

Source: New Mexico State Drought Monitoring Committee

Drought status decreased in northwestern New Mexico during the last month, due to late May and early-June precipitation (Figures 5a–b) the USDA-Natural Resources Conservation Service reports above-average mountain precipitation in the Zuni-Bluewater basin, but average to below-average mountain precipitation throughout the rest of the state. Currently, about 38 percent of New Mexico is drought free, compared to 30 percent one month ago. Drought conditions deemed moderate or worse also decreased, from about 50 percent to approximately 37 percent. The most severe drought status is centered on Chaves County, where the U.S. Drought Monitor designated severe drought. Compared with one year ago (not shown), drought status is less severe across much of southwestern and northeastern New Mexico.

Topsoil moisture is deficient in most of the state and wind damaged some New Mexico crops, in particular 14 percent of the winter wheat crop (*USDA Weekly Weather and Crop Bulletin*, June 16). The bulletin also reports 100 percent of the chili crop has been planted, and 60 percent of the crop is in good or excellent condition. Fifty-seven percent of the state is reporting poor or very poor pasture and rangeland conditions.

The eastern New Mexico city of Portales is encouraging all residents to practice voluntary water conservation, beginning in June (*pntonline.com*, June 2).

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

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

On the Web:

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

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

Figure 5a. New Mexico drought map based on data through June 16, 2009.

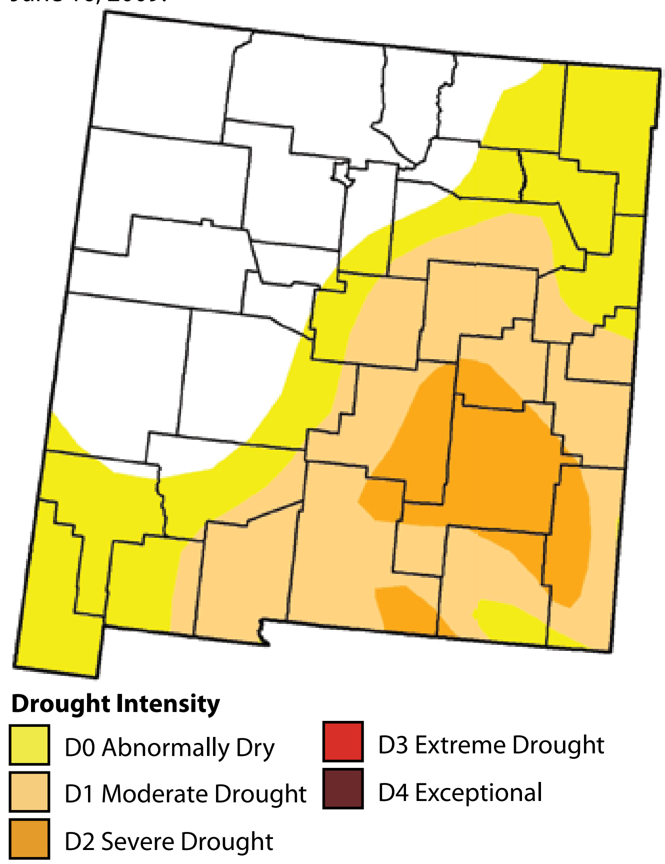


Figure 5b. Percent of New Mexico designated with drought conditions based on data through June 16, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	38.1	61.9	37.1	10.0	0.0	0.0
Last Week (06/09/2009 map)	38.3	61.7	37.1	10.0	0.0	0.0
3 Months Ago (03/24/2009 map)	44.4	55.6	37.3	0.0	0.0	0.0
Start of Calendar Year (01/06/2009 map)	76.6	23.4	1.5	0.0	0.0	0.0
Start of Water Year (10/07/2008 map)	70.7	29.3	1.5	0.0	0.0	0.0
One Year Ago (06/17/2008 map)	16.8	83.2	69.1	39.8	15.3	1.1

Arizona Reservoir Levels

(through 5/31/09)

Source: NRCS, National Water and Climate Center

Water levels in almost all of Arizona's large reservoirs, with the exception of Lake Powell, dropped during May. Lake Mead observed the largest change between April and May, losing more than 300,000 acre feet of water (Figure 6). The Verde River basin system lost 38,200 acre feet. Lake Powell and Lake Mohave observed higher water levels in May, rising 1.9 million and 27,900 acre-feet respectively. Even with the rise in water level, Lake Powell is at 61 percent of full capacity, well below the long-term average of 81 percent. Lake Mead is at 43 percent of capacity, which reflects the effects of long-term drought conditions across the Upper Colorado River Basin.

The U.S. Bureau of Reclamation (USBR) reports that Lake Powell reached its peak water level on May 28. USBR notes that above-average spring temperatures caused snow to melt earlier than usual and almost all of the snowpack in the upper basin has melted. USBR expects inflows into Lake Powell to continue to decrease throughout the remainder of the summer.

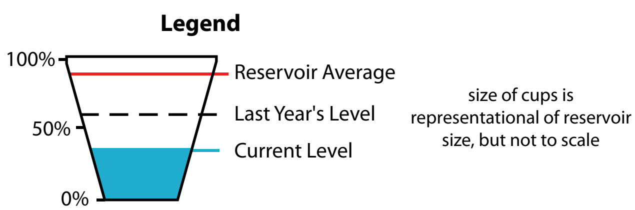
Notes:

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

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

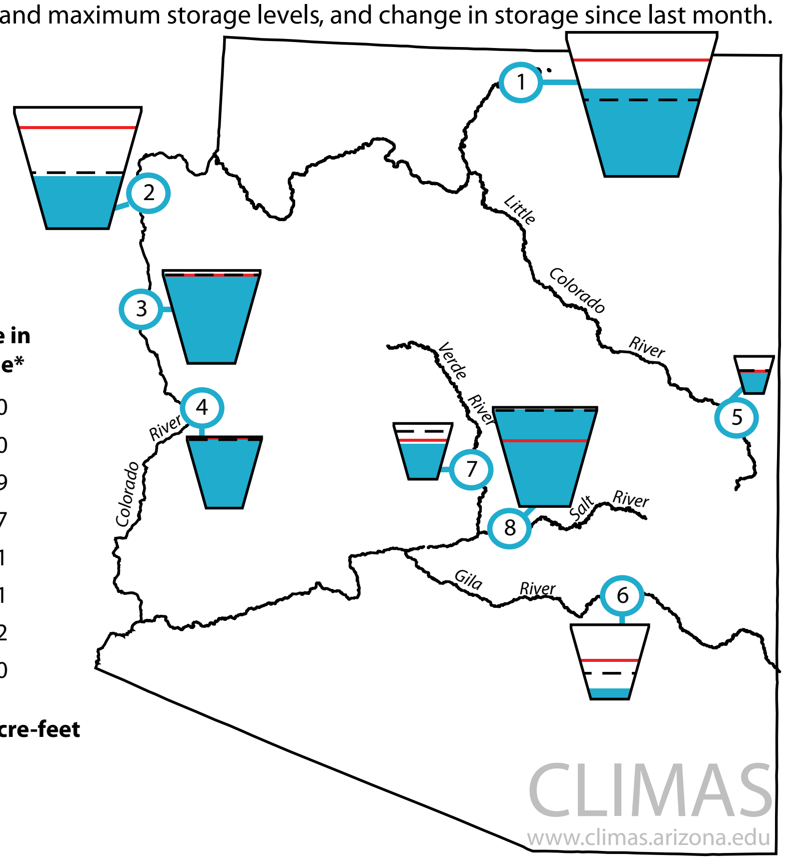
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for May 2009 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	61%	14,751.0	24,322.0	1893.0
2. Lake Mead	43%	11,217.0	26,159.0	-361.0
3. Lake Mohave	96%	1,736.2	1,810.0	27.9
4. Lake Havasu	96%	593.8	619.0	-0.7
5. Lyman Reservoir	58%	17.5	30.0	-1.1
6. San Carlos	15%	128.9	875.0	-25.1
7. Verde River System	63%	182.4	287.4	-38.2
8. Salt River System	98%	1,987.5	2,025.8	-12.0

*** 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 5/31/09)

Source: NRCS, National Water and Climate Center

Above-average spring temperatures in April and May caused snow to melt early in much of New Mexico, reservoir levels increase ahead of schedule (Figure 7). Most reservoirs in New Mexico have experienced increasing water levels through the month of May. Navajo Reservoir on the San Juan River and Elephant Butte Reservoir on the Rio Grande observed the largest increases in storage—187,000 and 74,000 acre-feet respectively. The largest drop in water levels was at the Brantley Reservoir on the Pecos River, which lost 5,800 acre-feet in the past month.

Notes:

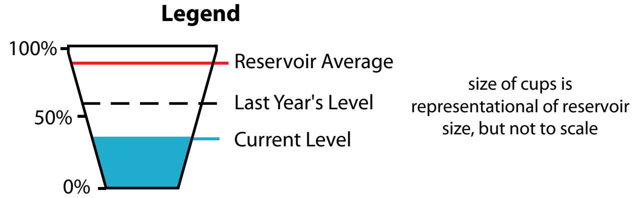
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total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

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

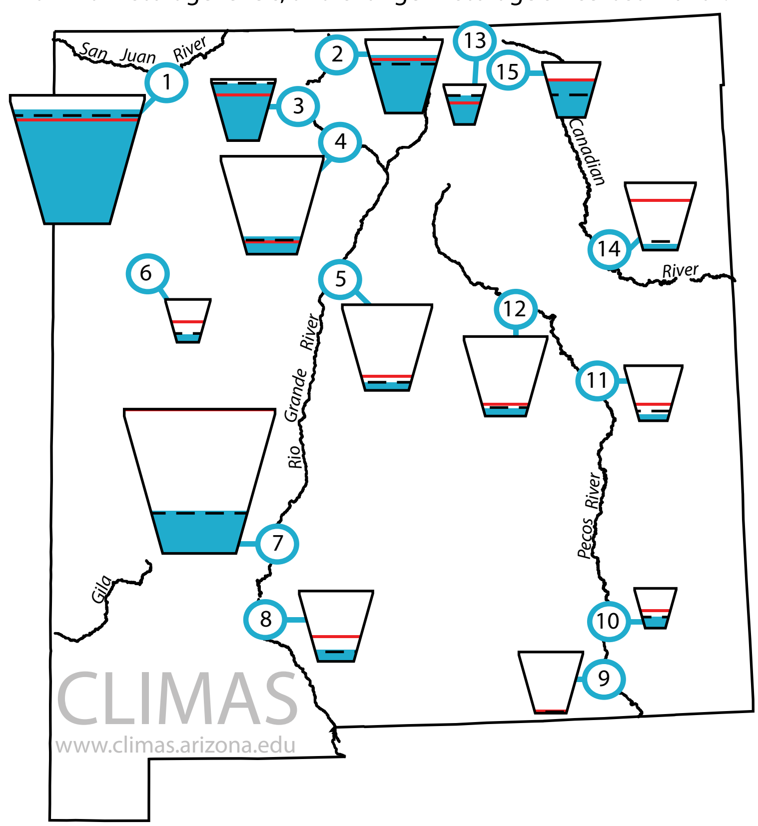
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Richard Armijo, Richard.Armijo@nm.usda.gov.

Figure 7. New Mexico reservoir levels for May 2009 as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	89%	1515.1	1,696.0	187.0
2. Heron	79%	316.7	400.0	50.5
3. El Vado	94%	179.2	190.3	8.6
4. Abiquiu	18%	211.3	1192.8	31.8
5. Cochiti	10%	49.8	491.0	0.2
6. Bluewater	19%	7.4	38.5	2.5
7. Elephant Butte	30%	654.4	2,195.0	74.0
8. Caballo	17%	56.9	332.0	4.7
9. Brantley	2%	17.9	1008.2	-5.8
10. Lake Avalon	28%	1.1	4.0	-0.1
11. Sumner	12%	12.1	102.0	-2.9
12. Santa Rosa	10%	45.6	438.3	18.5
13. Costilla	73%	11.6	16.0	0.1
14. Conchas	9%	22.7	254.2	-1.5
15. Eagle Nest	66%	52.2	79.0	1.7



On the Web:

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

Southwest Fire Summary
(updated 6/18/09)

Source: Southwest Coordination Center

Continued dry conditions have influenced recent high fire activity across both New Mexico and Arizona. The pre-monsoon season is particularly susceptible to fires because monsoon storms generate thousands of ground strikes; the monsoon is accompanied by a large fraction of the 673,000 lightning bolts that touch down in Arizona each year on average. Lightning caused most of the current fires. Recent fires in Arizona include three in the southeastern part of the state—two of which are human-induced, while the third is of unknown origin—that are burning almost 4,000 acres (Figure 8a). Five fires in central Arizona have burned about 3,900 acres, and one in northern Arizona has burned around 3,800 acres in and around Grand Canyon National Park (Figure 8b). Recent fires in New Mexico include the Stoner fire, which is the only recent human-caused fire in the state and has burned 1,795 acres (Figure 8c). The Pasco fire, also in New Mexico, is nearly 100 percent contained but has burned more than 93,000 acres at a cost of $414,000. The Meason fire also has been costly, totaling nearly $1.5 million.

Figure 8a. Year-to-date wildland fire information for Arizona and New Mexico as of June 17, 2009.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	697	69,638	97	8,203	794	77,841
NM	390	84,690	170	207,937	560	292,627
Total	1087	154,328	267	216,140	1354	370,468

Figure 8b. Arizona large fire incidents as of June 18, 2009.

Figure 8c. New Mexico large fire incidents as of June 18, 2009.

Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2008. 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 and prescribed burns 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 website:
http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_wf_daily_state.pdf

http://gacc.nifc.gov/swcc/predictive/intelligence/maps/wf/swa_fire_combined.htm

Monsoon Summary
(through 6/22/2009)

Source: Western Regional Climate Center

The start of the monsoon season officially began in Arizona on June 15, the date the National Weather Service (NWS) adopted last year to reduce public confusion about when the monsoon season begins. New Mexico, however, does not have official dates for the summer rainy season.

Rain drenched many parts of the Southwest around May 20 and contributed to above-average precipitation during the past 30 days in many parts of Arizona and New Mexico (Figures 9a–c). This regional event, which occurred prior to the official onset of the monsoon, is not counted as monsoon precipitation. The monsoon in central Mexico, however, began about two weeks ago, according to the National Weather Service Office in Tucson. For the U.S. Southwest, the expectation continues that the first-half of the monsoon season will be soggy. Scientists at The University of Arizona and NWS last month forecasted above-average rainfall for the first half of the monsoon season but were less certain about the rains later in the summer.

Prior to having a constant monsoon start date (June 15), the date changed each year depending on certain criteria, such as dew point temperatures. Using these criteria as indicators, during the period 1958–2007, the earliest monsoon onset in Tucson and Phoenix occurred on June 17, 2000, while the latest occurred on July 25, 1987. Since 2000, the average start date in both cities has been July 7.

Figure 9a. Total precipitation in inches (June 16–June 22, 2009).

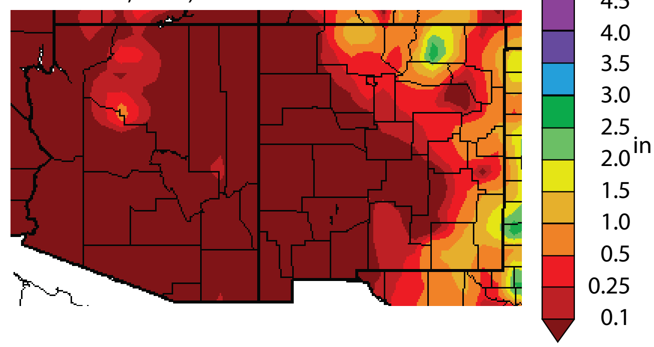


Figure 9b. Departure from average precipitation in inches (June 16–June 22, 2009).

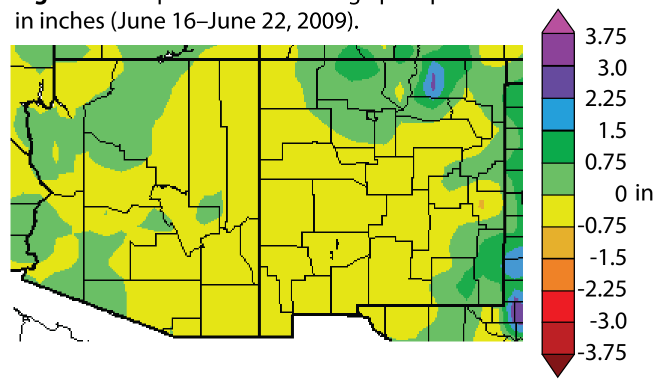
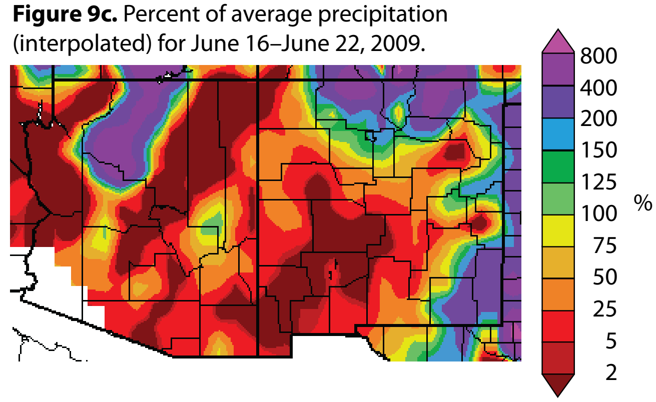


Figure 9c. Percent of average precipitation (interpolated) for June 16–June 22, 2009.



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.

On the Web:

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

Temperature Outlook

(July–December 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) long-lead temperature forecasts for the continental U.S. show a tilt in the odds toward a warm summer and early fall for much of the West. The temperature forecast for July through September shows elevated chances for temperatures to be similar to the warmest 10 years of the 1971–2000 observed record for most of the region west of the Rocky Mountains (Figure 10a). As the forecast moves into fall, the chances of warmer conditions increase for much of southern Arizona and southwest New Mexico (Figures 10b–d). Nearly all of the forecast tools, which include long-term trends, El-Niño Southern Oscillation (ENSO) conditions, and various models, call for an increased likelihood for extra warmth across the Southwest. These temperature forecasts, at least through early fall, are largely based on ongoing warming temperature trends.

Notes:

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

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

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

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

Figure 10a. Long-lead national temperature forecast for July–September 2009.

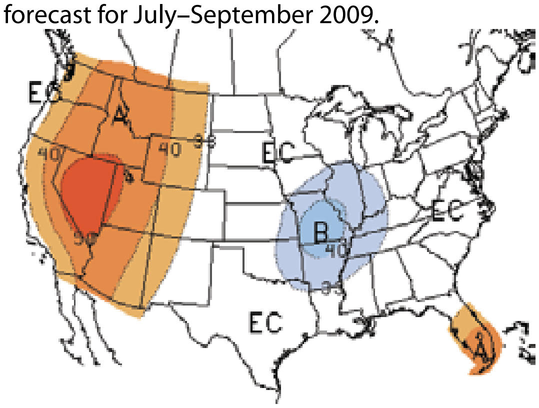
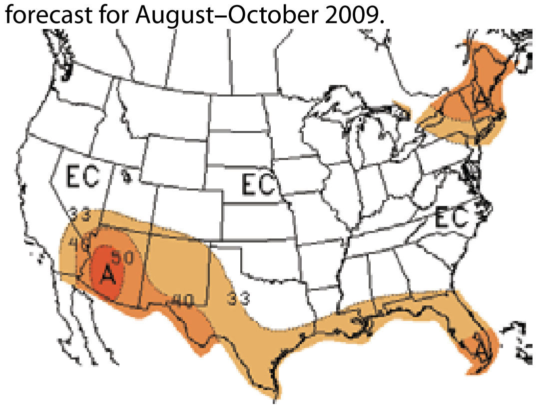


Figure 10b. Long-lead national temperature forecast for August–October 2009.



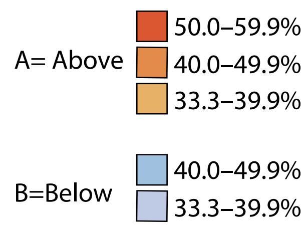


Figure 10c. Long-lead national temperature forecast for September–November 2009.

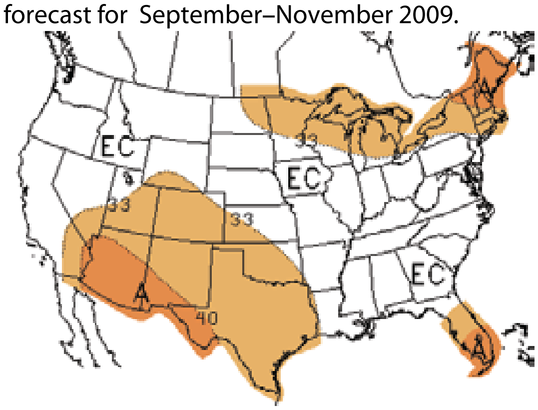
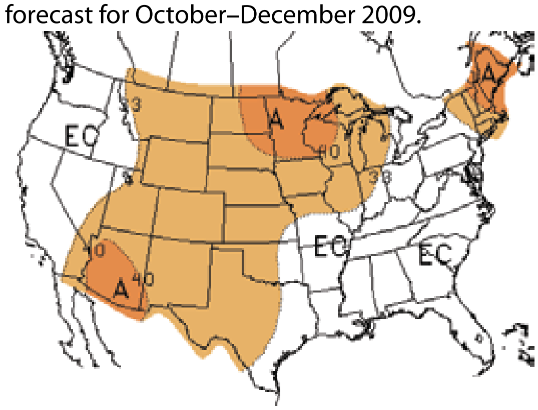


Figure 10d. Long-lead national temperature forecast for October–December 2009.



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 may load slowly on your computer)

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

Precipitation Outlook
(July–December 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) long-lead precipitation forecast through September for much of Arizona and New Mexico shows increased chances of precipitation to be similar to the 10 wettest years in the 1971–2000 observed record (Figure 11a). As we move out of the monsoon season, the climate forecasts for Arizona begin to shift toward mostly equal chances of below-, above-, or near-average conditions (Figures 11b–d). An equal chances forecast indicates that no forecast skill has been demonstrated for this period or there is no clear climate signal. These long-lead forecasts also indicate that much of the Pacific Northwest will experience precipitation conditions like those of the driest 10 years of the 1971–2000 observed record.

Notes:

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

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

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

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

Figure 11a. Long-lead national precipitation forecast for July–September 2009.

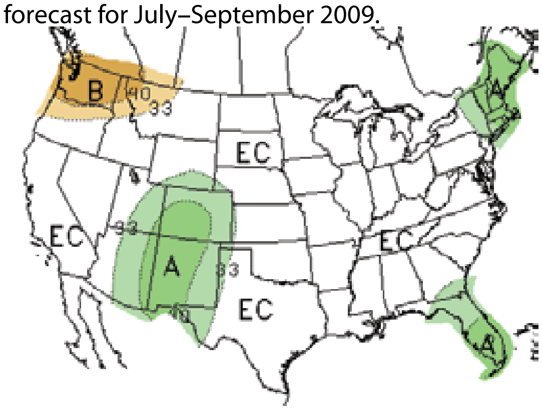


Figure 11b. Long-lead national precipitation forecast for August–October 2009.

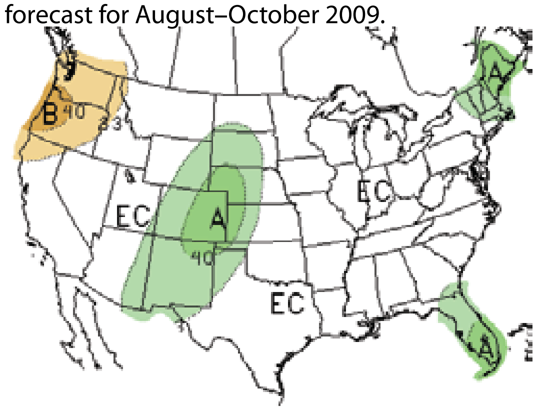


Figure 11c. Long-lead national precipitation forecast for September–November 2009.

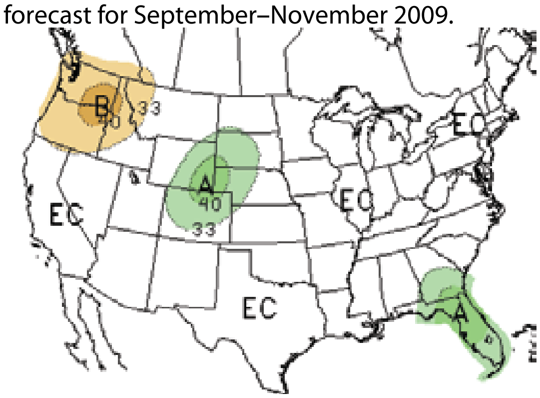
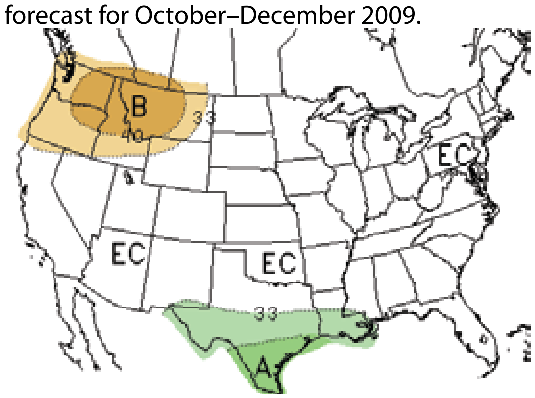


Figure 11d. Long-lead national precipitation forecast for October–December 2009.



B= Below: 33.3–39.9% | 40.0–49.9%

A=Above: 40.0–49.9% | 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

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

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

Seasonal Drought Outlook
(through September 2009)
Source: NOAA Climate Prediction Center (CPC)

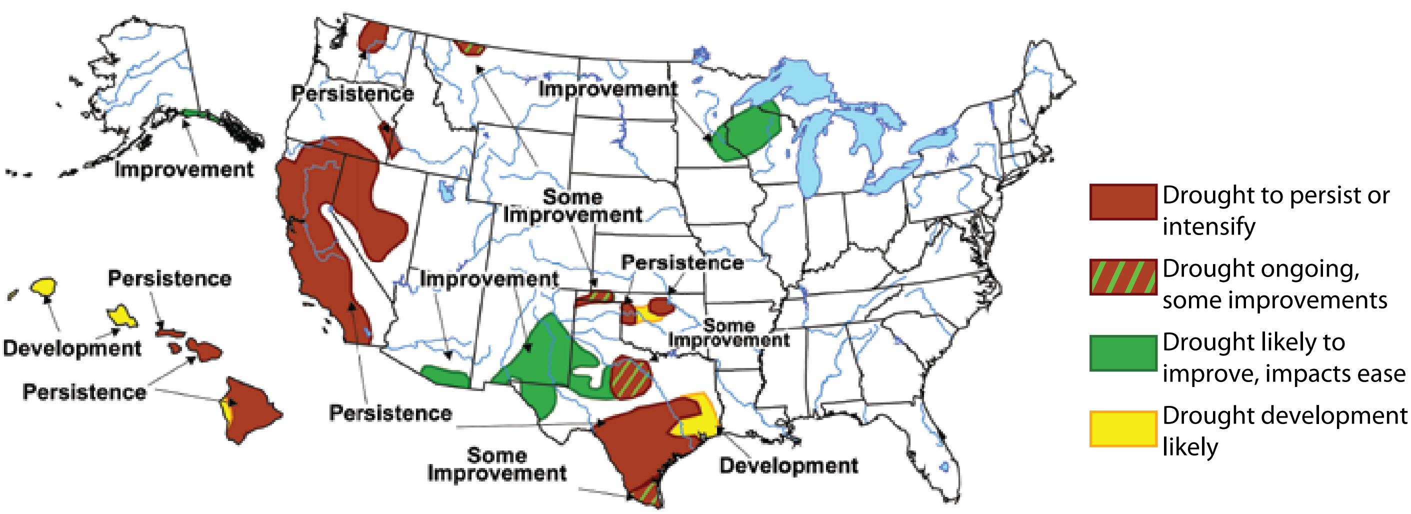
According to NOAA's Climate Prediction Center (CPC), the drought outlook for the Southwest continues to show improvement. Eastern New Mexico and parts of West Texas have fairly high chances of improvement, as a surge of moisture out of Mexico was evident on satellite imagery at the time the current CPC outlook was prepared. This rainfall, in addition to the typical improvement from summer thunderstorm activity, should provide a good chance for improved drought conditions. The CPC's long-lead precipitation forecast (see Figures 11a–d) shows the odds tilting toward above-average rainfall across much of the Southwest, further adding to confidence in the drought outlook. Forecast confidence for the Southwest is high.

For the rest of the country, drought likely will expand across eastern Texas during the second half of June with the continuation of hot and dry conditions, according to the CPC Seasonal Drought Outlook discussion summary. Some rainfall may help south Texas, but south-central Texas, classified in severe drought, likely will see no significant relief. A favorable precipitation outlook is forecast to help bring some improvement to the Oklahoma Panhandle, while small areas of drought in central Oklahoma are forecast to expand.

In the West, above-average precipitation during the first half of June brought some relief, especially for Oregon and Idaho according to the CPC discussion summary. Above-average rainfall is forecast for the second half of June over the Northwest, but precipitation is expected to be less than observed earlier in the month, and the region typically doesn't see drought relief during the July–September period. Thus, drought is expected to persist from California and Nevada into southern Oregon.

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

Figure 12. Seasonal drought outlook through September 2009 (released June 18, 2009).



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

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

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

Wildland Fire Outlook

(July–September 2009)

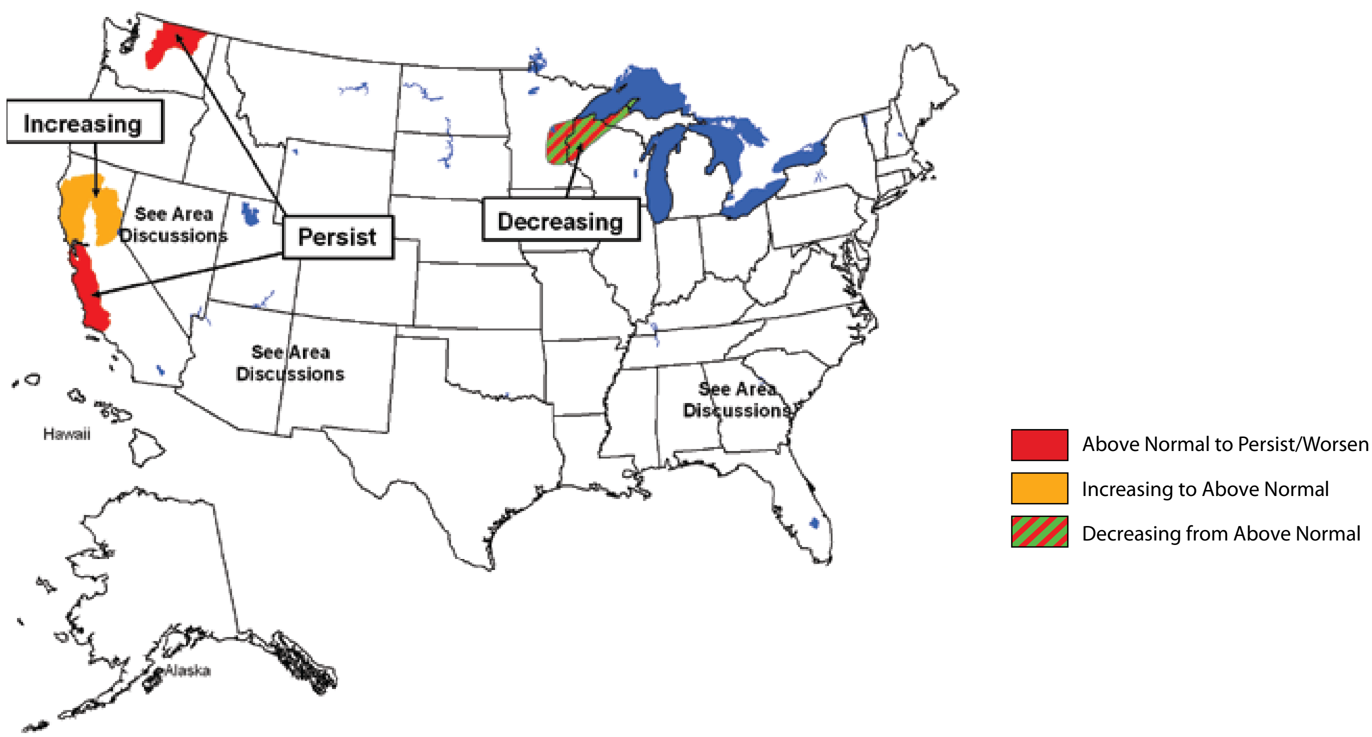
Sources: National Interagency Coordination Center, Southwest Coordination Center

The Southwest Coordination Center (SWCC) predicts average fire potential for most of the Southwest, with below-average fire potential for most of New Mexico in June (Figure 13). The above-average wet conditions during the second half of May has helped dampen recent fire activity and lower near-future fire risk. On the other hand, fire risk is elevated by the warmer-than-average temperatures expected for June and the forecast for periods of increased wind, which may result from a persistent eastern Pacific and West Coast mid- to upper-level trough. Contributing to this fire outlook is the projection for an early and strong monsoon season, which will help improve drought conditions. In fact, the Seasonal Drought Outlook indicates that moderate drought conditions in Arizona and an area of moderate to severe drought conditions in eastern New Mexico are expected to improve into August (see Figure 12).

Notes:

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

Figure 13. National wildland fire potential for fires greater than 100 acres (valid July–September 2009).



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

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

The NOAA Climate Prediction Center (CPC) states that conditions favor a transition into an El Niño episode between June and August. CPC notes that although ENSO-neutral conditions persisted across the equatorial Pacific Ocean during May, sea surface temperature (SST) anomalies increased for the fifth consecutive month. The Southern Oscillation Index (SOI), a measure of the air pressure fluctuations in the equatorial Pacific Ocean, decreased slightly from 0.7 to -0.4 (Figure 14a). In general, prolonged periods of negative SOI values coincide with abnormally warm ocean waters across the eastern tropical Pacific typical of El Niño episodes.

The International Research Institute for Climate and Society (IRI) states that there is less than a 5 percent chance that conditions will evolve into another La Niña during the remainder of 2009 (Figure 14b). Whether El Niño develops or ENSO-neutral conditions continue to persist is less certain. According to CPC, considerable spread in the model forecasts continues. However, current observations, recent trends, and the dynamical model forecasts indicate that conditions are favorable for a transition from ENSO-neutral to El Niño conditions during June through August. The IRI states that the probability of such a transition is about 55 percent.

As a result, the CPC has issued an El Niño Watch as part of its new ENSO Alert System. The new system was devised to provide a succinct and standardized way of communicating ENSO conditions to the general public. An El Niño Watch is issued when an El Niño event may develop during the next three months based on current observations and forecasts. An El Niño event could bring an increased chance of precipitation to the Southwest later this fall and through the upcoming winter. Stay tuned to the Southwest Climate Outlook and the NOAA Climate Prediction Center for updates.

Notes:

Figure 14a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through March 2009. 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.

Figure 14b shows the International Research Institute for Climate and Society (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, the coolest 25 percent of Niño 3.4 SSTs; and neutral conditions where SSTs fall within the remaining 50 percent of observations. The IRI probabilistic ENSO forecast is a subjective assessment of current model forecasts of Niño 3.4 SSTs that are made monthly. The forecast takes into account the indications of the individual forecast models (including expert knowledge of model skill), an average of the models, and other factors.

On the Web:

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

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

Figure 14a. The standardized values of the Southern Oscillation Index from January 1980–May 2009. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).

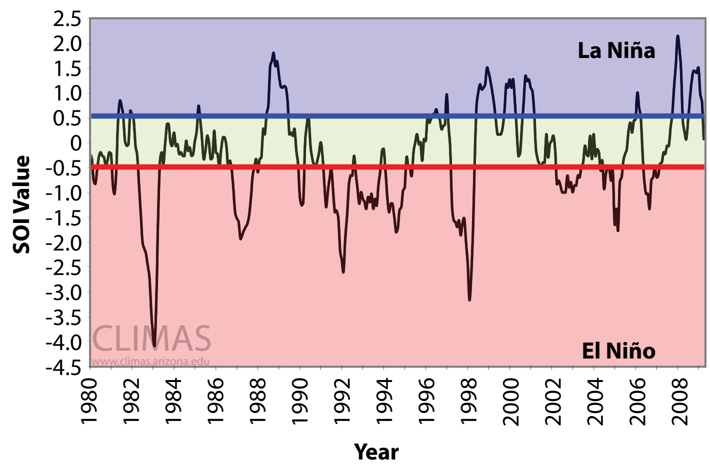
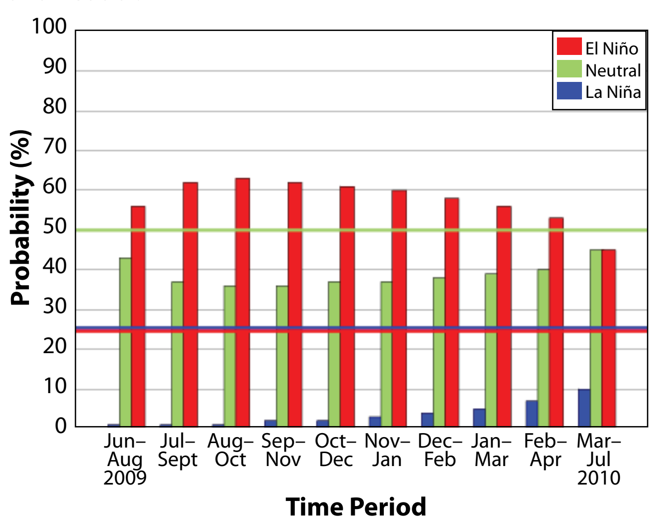


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released June 18, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(July–December 2009)

Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-882-0870.

The NOAA-Climate Prediction Center (CPC) forecasts show increased chances for temperatures in the Southwest to be similar to the warmest 10 years of the 1971–2000 climatological record. Comparisons of all the forecasts issued in June for the one-, two-, three-, and four-month lead times and the actual weather give reason to believe these forecasts for Arizona, particularly in the southern portion of the state. All regions in the state show a bluish color for each lead time, indicating that the NOAA–CPC forecasts historically have been more accurate than a climatological forecast (Figures 15a–d). In New Mexico, the one- and two-month forecasts have been less accurate then the climatological forecast, while the three- and four-month forecasts have been slightly more accurate. Stakeholders should be leery of basing decisions on forecasts with reddish colors.

Notes:

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

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

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

Figure 15a. RPSS for July–September 2009

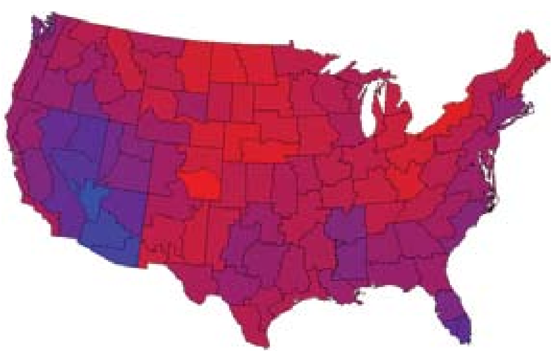


Figure 15b. RPSS for August–October 2009

Figure 15c. RPSS for September–November 2009

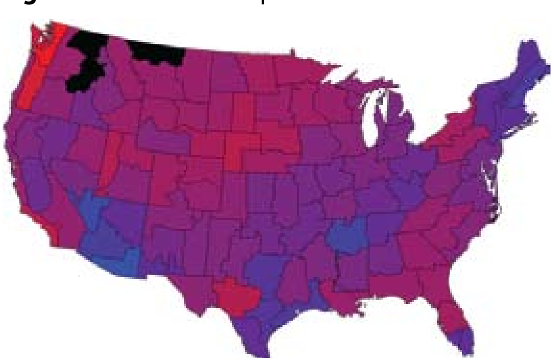
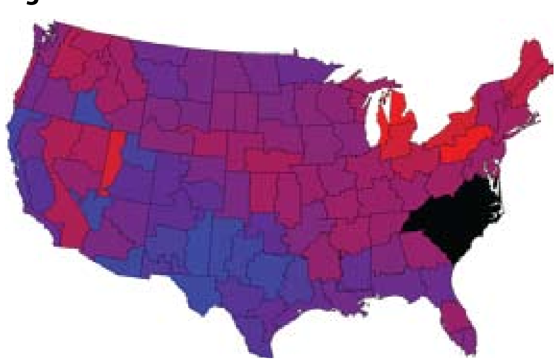
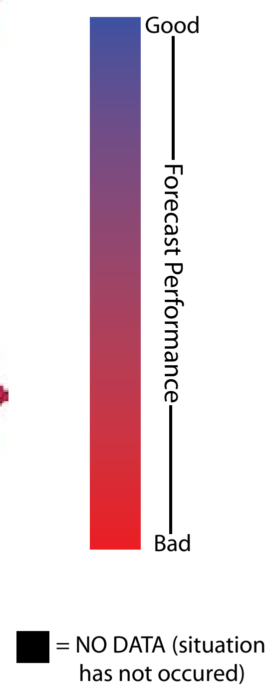


Figure 15d. RPSS for October–December 2009





On the Web:

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

For a CLIMAS publication that explains how to use the Forecast Evaluation Tool, visit
http://www.climas.arizona.edu/forecasts/articles/FET_Nov2005.pdf

Precipitation Verification
(July–December 2009)
Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-882-0870.

The one- and two- month lead forecasts by the NOAA-Climate Prediction Center (CPC) show slightly increased chances for precipitation to be similar to the wettest conditions of the 1971–2000 record for parts of the Southwest. However, comparisons of the actual weather to all the forecasts issued in June for the one-month lead time suggest that in many parts of both states these forecasts have been less accurate than the climatological forecast, particularly in southeast Arizona (Figure 16a). Similarly, the two-month lead time forecast for August–October has been inaccurate in the northern parts of both states (Figure 16b). CPC also issued an equal chances forecast for the three- and four-month lead times—equal chances indicate the same chances for above-average, average, and below-average conditions. Stakeholders should be leery of basing decisions on forecasts with reddish colors.

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

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

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

Figure 16a. RPSS for July–September 2009

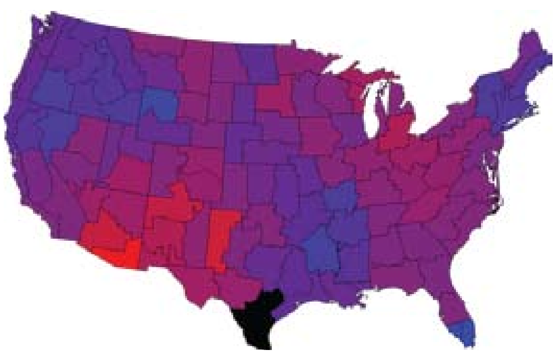


Figure 16b. RPSS for August–October 2009

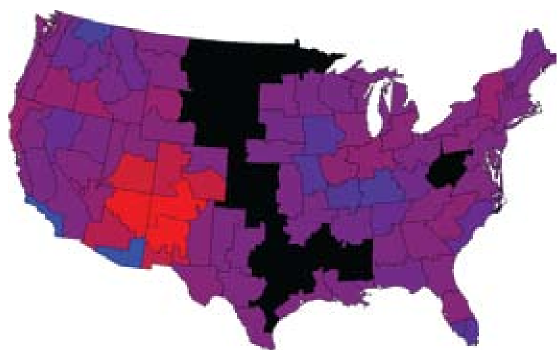


Figure 16c. RPSS for September–November 2009

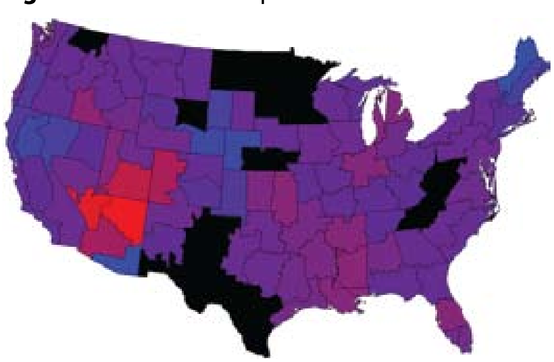
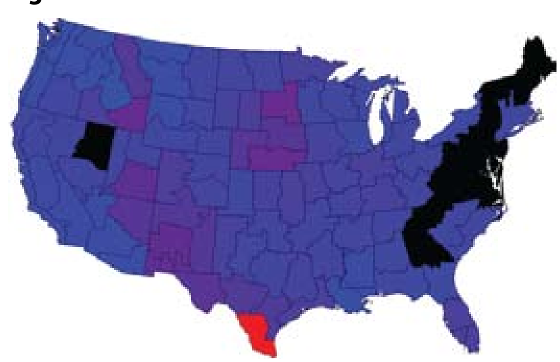
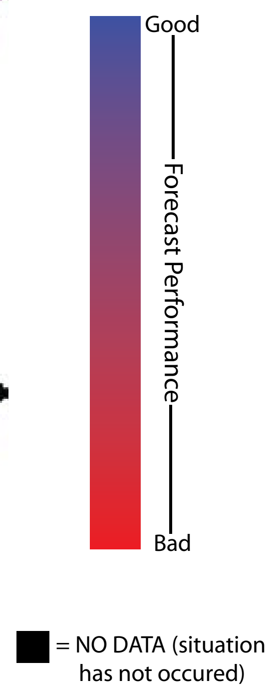


Figure 16d. RPSS for October–December 2009





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