Issued: September 22, 2009

Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: Zack Guido, CLIMAS.

Photo Description: An anvil shaped cloud smothers the Tucson Mountains on September 7. These rain clouds have been a rare occurrence this monsoon season, which is shaping up to be among the driest this decade.

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

In this issue...

CLIMAS Climate Assessment for the Southwest

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

NM STATE UNIVERSITY

September Climate Summary

Drought– Last month was the fourth driest August in Arizona in the last 116 years. On September 15, 90 percent of the state was classified as abnormally or moderately dry. In New Mexico, 45 percent of the state was abnormally dry or worse.

Temperature– The dry monsoon has provided no relief to the extremely warm conditions across the Southwest.

Precipitation– Recent monsoon activity in western New Mexico and central and eastern Arizona brought flash floods but no drought relief.

ENSO– An ENSO Advisory declared by the NOAA-Climate Prediction Center remains in effect this month. Weak to moderate El Niño conditions are expected to persist through the fall and early winter.

Climate Forecasts– Temperature forecasts call for increased chances of above-average temperatures in the Southwest throughout the remainder of 2009; precipitation forecasts state equal chances for above-, below-, or average precipitation.

The Bottom Line– Although Hurricane Jimena pushed moisture-laden air into the Southwest in early September, it was too little, too late. With the monsoon season officially wrapping up on Sept. 30, rainfall in most of Arizona and New Mexico has been below average. Scant precipitation caused drought conditions to expand, and some fear that if fall and winter precipitation is not at least average, drought impacts may become severe. Fortunately, El Niño conditions—which are forecast for fall and winter—typically bring above-average precipitation to the region.

Timing Matters

With the relatively meager rainfall totals delivered to most of the Southwest this summer, many people, including ranchers, might not notice that the monsoon season is waning. But even if a tropical hurricane steered moisture to the region and drenched rangelands—a possibility over the next few months—it may be too little, too late. To have grass growth, the kind that fills the bellies of cows, the timing of rain is important.

Summer grass growth is tied to temperature and precipitation. Grasses falter if sufficient rains do not accompany warm summer temperatures. Growth also is stunted when the monsoon rains are interrupted with long dry periods. Both of these scenarios played out in many parts of Arizona and New Mexico this summer. As a result, about 80 percent of Arizona rangelands were classified in poor or very poor conditions as of August 30.

To make matters worse, the brown pastures have impacts beyond this year. In dry summers like this one, grasses don't produce seeds and next year's crop suffers, said Kim McReynolds, Cochise County Agricultural Extension Agent.

"Many ranchers are selling cows," McReynolds said.

Disclaimer - This packet contains official and non-official forecasts, as well as other information. While we make every effort to verify this information, please understand that we do not warrant the accuracy of any of these materials. The user assumes the entire risk related to the use of this data. CLIMAS, UA Cooperative Extension, and the State Climate Office at Arizona State University (ASU) disclaim any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose. In no event will CLIMAS, UA Cooperative, and the State Climate Office at ASU or The University of Arizona be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profit resulting from any use or misuse of this data

Table of Contents:

SWCO Staff:

Mike Crimmins, *UA Extension Specialist*
Stephanie Doster, *Institute of the Environment Associate Editor*
Dan Ferguson, *CLIMAS Program Manager*
Gregg Garfin, *Institute of the Environment Deputy Director of Outreach*
Zack Guido, *CLIMAS Associate Staff Scientist*
Rebecca Macaulay, *CLIMAS Graphic Artist*
Nancy J. Selover, *Arizona State Climatologist*

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, the Institute of the Environment, 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.

What do we do now? Important climate change issues vocalized by resource managers

By Zack Guido

For many people climate change is imperceptible, slow, and masked by swings in the weather. Cold fronts sweeping down from the north, sweltering summer heat waves, torrential rains from Pacific tropical storms, and late-winter dry spells make it difficult to see consistent changes. But to the trained eye and to agencies tasked with managing the landscape, climate change is an immediate and clear challenge best met head-on with strategic planning.

Dale Hall, former director of the U.S. Fish and Wildlife Service (FWS), made that challenge clear when he wrote in a 2007 message, "The warming of the earth could potentially have more far-reaching impacts on wildlife and wildlife habitat than any challenge that has come before us."

That is why the Southwest and California and Nevada Regions of the FWS, along with the US Geological Survey (USGS) launched an effort in 2008 to reduce the effects of a changing climate on the diverse ecosystems of California, Nevada, Arizona, and New Mexico.

This effort included a three-day workshop with top scientists from universities and more than 200 FWS and USGS employees and interest groups who met in Tucson, Ariz., in August 2008 to translate science on the environmental effects of climate change into real action.

Based on that workshop, the Climate Assessment for the Southwest (CLIMAS) project at The University of Arizona and FWS has released a new report that identifies the major challenges climatic changes will present to the conservation and protection of fish, wildlife, and habitats in the Southwest.

Figure 1. The Apache trout is one of two trout species native to Arizona. It is listed as a threatened under the Endangered Species Act. *Photo is courtesy of the U.S. Fish and Wildlife Service.*

"Climate change is likely to be the toughest environmental challenge we will address this century, and desert ecosystems will be especially hard hit," said Benjamin Tuggle, FWS's Southwest Regional Director.

"We will only be able to meet our conservation goals by collaborating on a landscape level with academic institutions, other natural resource managers, land users and the public at large," Tuggle said. "Our partnership with CLIMAS allows us to analyze and prioritize some of the best strategic thinking on ways to address a warming climate in our critical Southwest desert landscapes."

Putting Knowledge into Action

FWS has one sweeping charge: conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continued benefit of the American people. Its flagship conservation tool—the National Wildlife Refuge System (NWRS)—protects approximately 150 million acres that provide sanctuary to more than 700 species of birds, 220 species of mammals, and 200 species of fish. About 25 percent of all threatened and endangered species in the U.S. are found within refuges, which encompass a combined area about the size of New Mexico and Arizona.

While the NWRS has definite borders, plant and animal habitat does not. Therein lies one of the largest challenges: How does the FWS fulfill its mission if climate change forces plants and animals to seek new territory—habitat that may lie outside the protective boundaries of the NWRS?

This issue and many others were discussed by resource managers during the 2008 workshop and is the focus of the report, "Putting Knowledge into Action: Tapping the Institutional Knowledge of U.S. Fish and Wildlife Service Regions 2 and 8 to Address Climate Change," released by CLIMAS and FWS Sept. 15.

The workshop included small group discussions, led by CLIMAS, in which resource managers discussed the obstacles

continued on page 4

What do we do now, continued

and opportunities climate change presents. Their comments covered a range of topics, from the need to retool management strategies to improvements to public outreach.

Some meeting participants suggested conservation strategies should target an entire ecosystem instead of "charismatic" species such as the Gila monster that have widespread popular appeal; protecting one animal will not be effective if its food source becomes scarce. Other participants noted that climate change liaisons to the public will help increase awareness and engage interested citizens in management activities, such as empowering people to collect data on the timing of plant flowering.

Across the Southwest, the effects of climate change already are being observed, and little doubt exists within the scientific community that change will continue. The average annual temperature has risen 2.5 degrees F in Arizona and 1.8 degrees F in New Mexico since 1976, according to the report. Winter snow is melting earlier in the year compared with time periods before 1950. Rain is replacing some snow storms, and April snowpack—critical to the region's water supply—contains less water. In addition, yearly streamflows in the Colorado River basin have decreased slightly since 1950, and computer models generally project declines in the average annual runoff in the Southwest as the amount of snow decreases and evaporation increases (see side bar).

In turn, these changes influence the size and frequency of wildfires and many ecosystem processes, such as the timing of plant and animal life-cycle events and the distribution and extinction of species, according to the report. Climate change likely will alter habitat ranges for animals, pushing them outside current preservation areas.

continued on page 5

Climate Change Impacts

Climate change and variability shape wildlife and landscapes. Research in the Southwest has documented climate-change related impacts and suggests these changes will continue. Some of the impacts are summarized below. More details and corresponding citations can be found at the Southwest Climate Change Network Web site, www.southwestclimatechange.org.

Temperature

Temperatures in Arizona and New Mexico have been rising, particularly since the mid-1970s. Since 1976, the average annual temperature increased by 2.5 degrees F in Arizona and 1.8 degrees F in New Mexico. The Intergovernmental Panel on Climate Change (IPCC) projects the world's average annual temperature this century will likely increase between 3 and 7 degrees F. Projections for the Southwest show greater temperature increases than the global average, with summer temperatures rising even higher than winter ones.

Precipitation

Precipitation records for the Southwest contain a high degree of variability. The observational evidence shows some support for Global Climate Model (GCM) projections of a poleward shift in the jet stream, a pattern that could mean El Niño events might often fail to bring rain and snow to the Southwest. Annual precipitation is projected to drop by 5 percent by century's end for much of Arizona and New Mexico, based on results from GCMs.

Fire

In recent years, the number of acres burned and the frequency of fires have increased in the West. Temperature increases and possible reductions in winter precipitation will likely cause this trend to continue, although other factors also may influence future fires.

Snowpack

In comparison to time periods before 1950, winter snowpack is melting earlier in the year; rain is replacing some snow storms, especially at elevations of 5,000–8,000 feet; and the April snowpack contains less water. Higher projected future temperatures will likely continue these trends.

Streamflow

Annual streamflows in the Colorado River basin have decreased slightly since 1950. Models generally project substantial declines in the average annual runoff

continued on page 5

What do we do now?, continued

Insights from the Report

During the small group sessions, meeting participants prioritized the actions that will guide the FWS on climate change adaptation. The most important steps included more educational programs for the public; more regional-scale, holistic conservation planning; more scientific research to study climate and ecosystem connections', and improved communication and collaboration.

Several other key findings of the report included:

- Participants of the group discussions were most concerned about the impacts of climate change on water issues and on species and habitat.
- Participants stated effective climate change planning will require fortifying existing partnerships and developing new ones.
- Participants stated that although many people are wary of using climate and other models, they find it unavoidable and therefore urge cautious and well-informed use.
- Integrated assessments of species and habitat risks, including climate change and other threats, will improve resource management.

Group discussions also highlighted ways to improve the efficacy of resource management in the face of climate change. These included improving the ability to translate science to the public and decision makers; building new collaborations with existing partners; working with other organizations to, among other things, synthesize impact assessments, fact sheets, and other information; and enhancing the commitment to monitoring species and habitats.

Moving Forward

As the Southwest and other U.S. states grapple with climate change, one thing is certain: decision makers need useful and up-to-date climate data and information. The goal of the report was to synthesize the ideas of resource managers, providing a context for future planning and providing a window into the key issues resource managers face.

"The Fish and Wildlife Service recognizes that climate change poses a serious challenge to their conservation practices. This report highlights challenges and opportunities FWS employees identified as critical in the context of a changing climate, including the need to form new partnerships, to build climate concerns into management priorities, to develop a better understanding of potential climate-driven impacts, and to find new ways of interacting with the public," said Dan Ferguson, CLIMAS program manager and co-author of the report. "This workshop represents an important step forward."

Figure 1. The Gila monster's habitat is primarily in the desert Southwest, where urban sprawl and habitat destruction have caused its numbers to dwindle. Currently, Arizona and Nevada have state laws that help protect them. *Photo credit: Manny Rubio, Arizona-Sonora Desert Museum, Sonoran Desert Digital Library.*

Climate Change, continued

in the Southwest due in large part to declines in the amount of snow and higher evaporation.

Phenology

Studies document an advance in the date that flowers bloom in the West. Because the date and abundance of flower blooms are highly correlated with winter snowpack, projected declines in snowpack will decrease flower abundance and advance the date of flowering.

It also became a stepping stone for a second workshop on the challenges climate change presents to management that convened in Austin, Texas, several weeks ago. Resource managers and academics discussed issues related to Texas and Oklahoma, setting the stage for strategic planning for that region.

In announcing that workshop, Tuggle said, "This workshop, along with the Tucson meeting a year ago, sets the stage for the upcoming climate-related challenges in the Southwest Region that we are already beginning to face, but are only just beginning to identify."

To read the report, visit: http://www.climas.arizona.edu/pubs/pdfs/knowledge_into_action.pdf.

Temperature (through 9/16/09)

Source: High Plains Regional Climate Center

Average temperatures in the southwest deserts of Arizona since the water year began on Oct. 1 have been between 65 and 75 degrees Fahrenheit, with averages near 80 degrees Fahrenheit near Yuma (Figure 1a). The warmest average temperatures in southern New Mexico and southeastern Arizona have been in the low 60s while temperatures across the Colorado Plateau of northern Arizona and the northern two-thirds of New Mexico have been between 50 and 60 degrees F. The highest elevations in both states have averaged between 40 and 50 degrees F. Temperatures have been from 1 to 3 degrees F warmer than average for the water year (Figure 1b). Only a small area of west-central Arizona has had temperatures slightly cooler than average.

Over the past 30 days, temperatures in most of New Mexico and central Arizona have been 0–2 degrees F above average, while parts of southern and northern Arizona have been 2–4 degrees F above average (Figures 1c–d). This difference is partly attributed to a more active monsoon in western New Mexico than in Arizona—more rain provides relief from the heat. Southwestern New Mexico has had temperatures up to 2 degrees F cooler than average for this 30-day period due to the extensive storm activity. In various parts of the state, Arizona has had temperatures at or above 110 degrees F on 10 of the last 30 days.

Figure 1a. Water year '08–'09 (through September 16, 2009) average temperature.

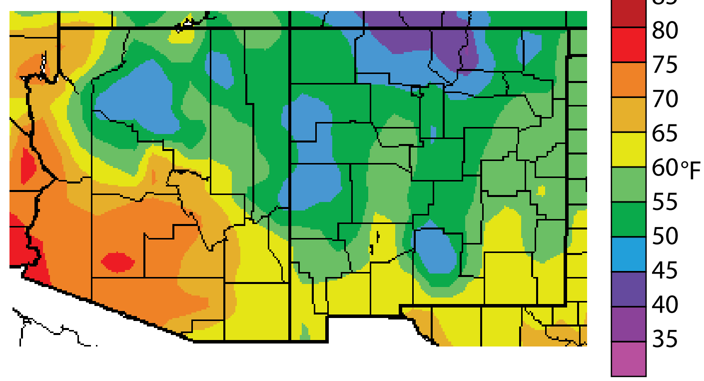


Figure 1b. Water year '08–'09 (through September 16, 2009) departure from average temperature.

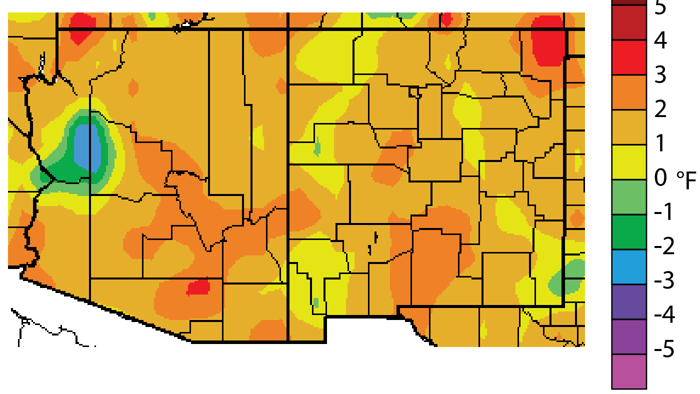


Figure 1c. Previous 30 days (August 18–September 16, 2009) departure from average temperature (interpolated).

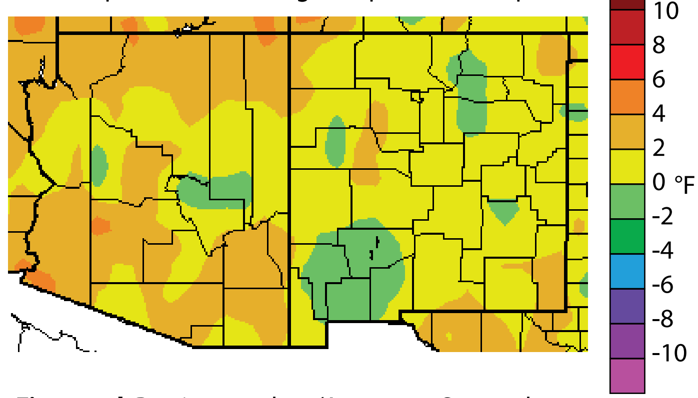
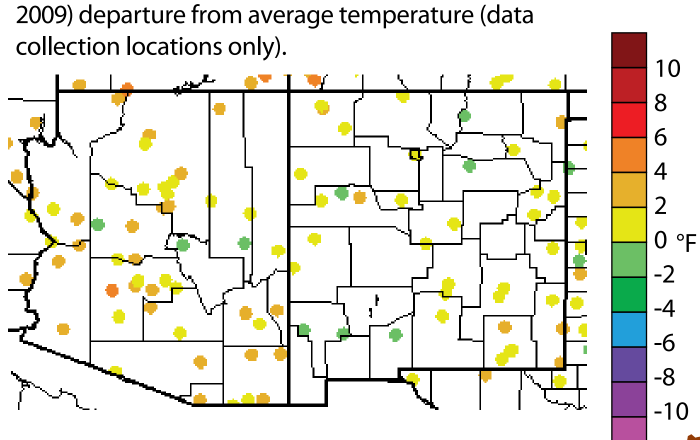


Figure 1d. Previous 30 days (August 18–September 16, 2009) departure from average temperature (data collection locations only).



Notes:

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

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

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

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

On the Web:

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

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

Precipitation (through 9/16/09)

Source: High Plains Regional Climate Center

The 2009 water year, which began Oct. 1, has been dry across the Southwest, seeing less than 80 percent of average precipitation in most areas of Arizona and across central New Mexico (Figures 2a–b). Central and southern Arizona have been extremely dry, with precipitation totaling less than 70 percent of average in many areas. The southern third of Arizona receives the majority of its annual precipitation in the summer, but this monsoon has been much drier than average. A few areas at higher elevations in northern New Mexico, across the Arizona and New Mexico border west of the Grand Canyon, and along the New Mexico and Texas border have received 100–130 percent above-average precipitation.

The past 30 days have brought very isolated pockets of rainfall near the Colorado River Valley of northwestern Arizona, western Maricopa County and Sedona in central Arizona, and the White Mountains of eastern Arizona (Figures 2c–d). Central Arizona received heavy rainfall that resulted in serious flash flooding through Sedona. Western New Mexico and the northern mountains of the state also have been very wet, receiving 110–300 percent of average for the past month. Raton in northern New Mexico was drenched with 1.95 inches of rain on Sept 12. Portales received 1.46 inches on Sept. 8 and Gallup was showered with 1.56 inches on Sept. 5. Even though monsoon storms in the past month have been fairly active in southeastern Arizona, the totals are still significantly below average.

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 September 16, 2009) percent of average precipitation (interpolated).

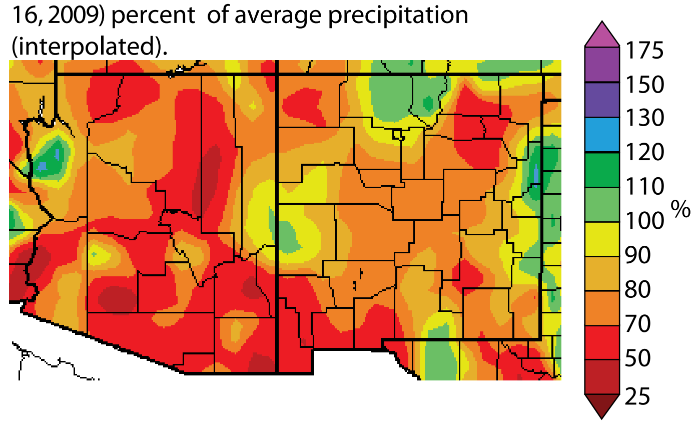


Figure 2b. Water year '08–'09 (through September 16, 2009) percent of average precipitation (data collection locations only).

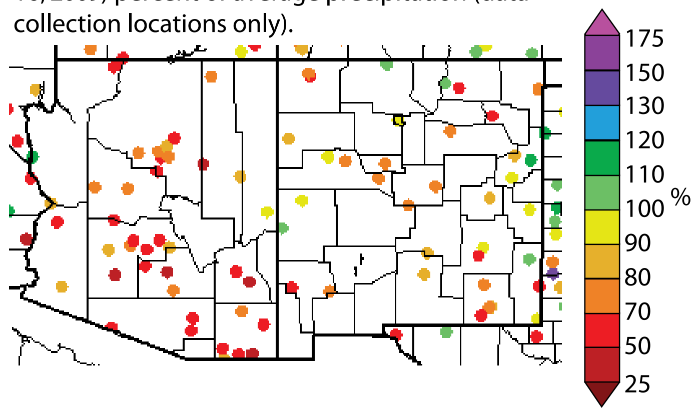


Figure 2c. Previous 30 days (August 18–September 16, 2009) percent of average precipitation (interpolated).

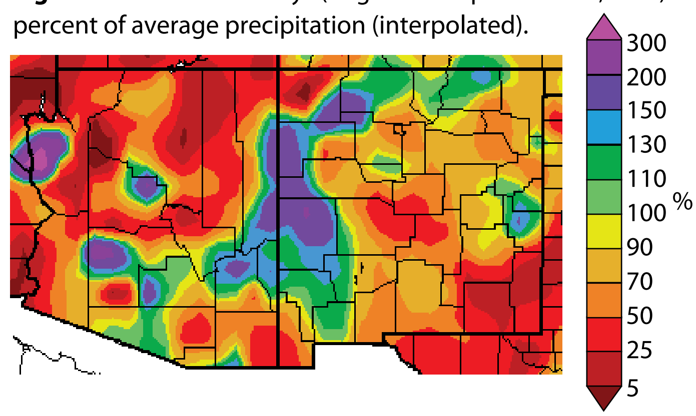
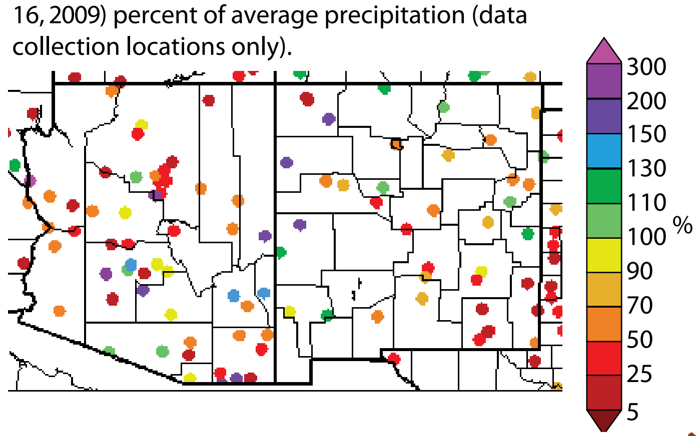


Figure 2d. Previous 30 days (August 18–September 16, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 9/17/09)

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

A dry August fueled the expansion of drought in the Southwest (Figure 3). This story also has played out in much of the West, particularly in California. The Sept. 15 U.S. Drought Monitor reported about 50 percent of the West—the 11 states west of the Rocky Mountains—has abnormally dry conditions or worse, an 8 percent increase from one month ago. At the beginning of September, rangeland conditions in California, Arizona, and New Mexico were worse than the long-term historical average for this time of year; Arizona and California led the nation in poor or very poor pasture conditions, with 44 and 33 percent more area suffering from dryness than average, respectively.

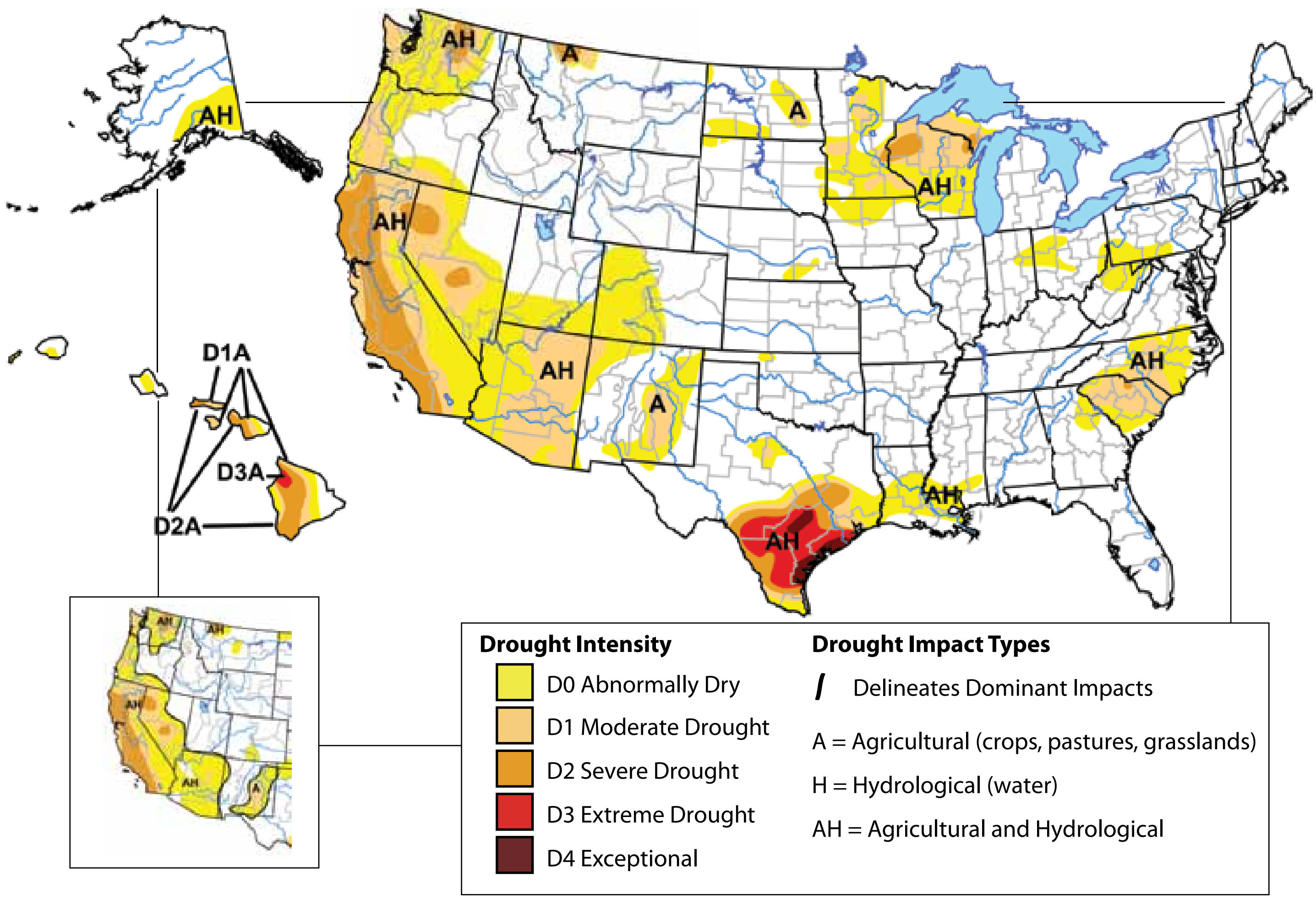
There are widespread drought impacts in the West. In New Mexico, for example, the U.S. Department of Agriculture declared seven counties disaster areas as a result of severe drought and high winds (*The Daily Times*, August 18). In California, a third consecutive year of drought has forced 64 water agencies to execute mandatory rationing and has interrupted farming, resulting in large numbers of job losses (*New York Times*, September 3).

Notes:

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

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

Figure 3. Drought Monitor released September 17, 2009 (full size), and August 20, 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 9/17/09)

Source: U.S. Drought Monitor

Warm and dry conditions during the past 30 days have caused nearly all of Arizona to be classified as abnormally or moderately dry. As of September 15, 59.1 percent of the state was deemed as having moderate drought, while 39.7 percent was characterized as abnormally dry (Figures 4a–b). Only 1.2 percent of the state, a small sliver near the border with New Mexico, is free of a short-term drought classification. One month ago, about 85 percent of the state was abnormally dry, but only 4.3 percent was moderately dry. The expansion of the area impacted by drought and the drought intensity reflects a weak monsoon season. The season officially ends in Arizona on Sept. 30. New Mexico has no official end date.

The current weak El Niño event in the Pacific Ocean helps explain why the 2009 summer monsoon thunderstorm season in Arizona has been a dud. The Tucson National Weather Service notes that the mid-latitude jet stream just north of Arizona has been stronger than average in response to the El Niño event in the Pacific. This has periodically pushed the monsoon high pressure system out of position, limiting the necessary flow of subtropical moisture up from Mexico into Arizona. Most of Arizona and New Mexico have experienced below-average rainfall in the past month, following a month of widespread dry conditions in the Southwest. As a result, rangelands that rely on summer precipitation have been especially hit hard during the quickly emerging short-term drought conditions. The US Department of Agriculture (USDA)-Natural Resources Conservation Service reported that about 80 percent of rangelands in Arizona were classified in poor to very poor condition as of August 30.

Figure 4a. Arizona drought map based on data through September 15, 2009.

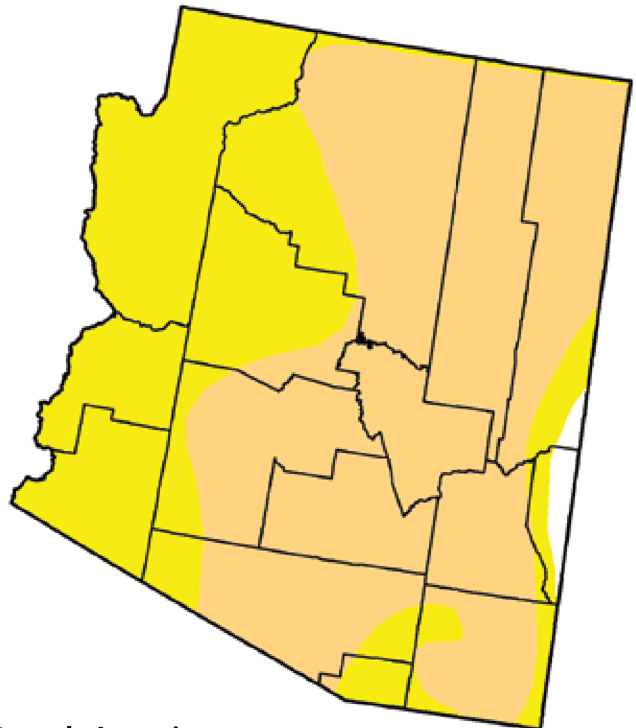


Figure 4b. Percent of Arizona designated with drought conditions based on data through September 15, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.2	98.8	59.1	0.0	0.0	0.0
Last Week (09/08/2009 map)	1.2	98.8	60.4	0.0	0.0	0.0
3 Months Ago (06/23/2009 map)	35.4	64.6	7.2	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 (09/16/2008 map)	83.1	16.9	3.2	0.0	0.0	0.0

Notes:

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

On the Web:

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

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

New Mexico Drought Status
(released 9/17/09)

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

Although short-term drought in New Mexico is not as widespread or severe as in Arizona, nearly 45 percent of the state is either abnormally or moderately dry (Figure 5a). In the past month, drought conditions expanded by approximately 8 percent of New Mexico's area, with moderate drought increasing by about 3 percent. The expansion in drought conditions was caused in part by the fifth driest August in the past 116 years, according to the National Climatic Data Center. The Four Corners region saw the greatest expansion of drought. In this area, precipitation in the past month was less than 25 percent of average. In comparison to last year, short-term drought conditions are worse (Figure 5b).

West-central New Mexico is one of a few regions in the state to see above-average precipitation. As a result, this area is void of a drought classification. In the southeast, however, precipitation has been scant. Fortunately, early monsoon season rains helped protect this area from short-term drought impacts. Nevertheless, the US Department of Agriculture (USDA) reported rain is needed for all parts of New Mexico to improve the agricultural growing conditions of the top five feet of the soil. Also, the USDA-Natural Resources Conservation Service reported on August 30 that about 39 percent of New Mexico rangelands are classified in poor to very poor condition.

Figure 5a. New Mexico drought map based on data through September 15, 2009.

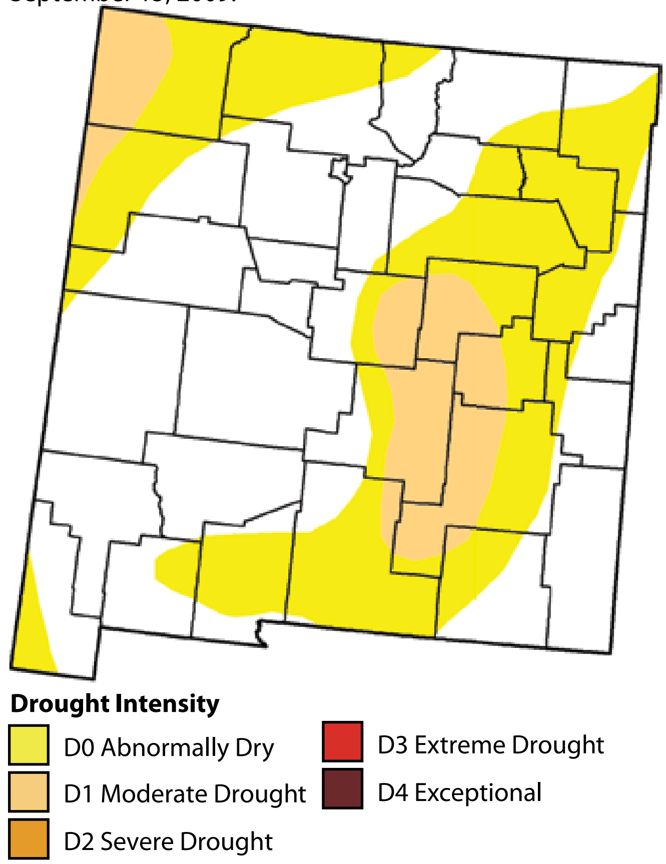


Figure 5b. Percent of New Mexico designated with drought conditions based on data through September 15, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	55.4	44.6	11.3	0.0	0.0	0.0
Last Week (09/08/2009 map)	55.4	44.6	11.3	0.0	0.0	0.0
3 Months Ago (06/23/2009 map)	38.2	61.8	36.7	9.2	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 (09/16/2008 map)	70.7	29.3	1.5	0.0	0.0	0.0

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

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

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

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

Arizona Reservoir Levels

(through 8/31/09)

Source: NRCS, National Water and Climate Center

Water storage in Lake Mead dropped 40,000 acre-feet in August, keeping the reservoir at around 42 percent of capacity, the same as it was last month (Figure 6). This is slightly more than half of the lake's historical August average capacity of 83 percent. Water levels in most other Arizona reservoirs also declined, including a 428,000 acre-foot drop in Lake Powell and a nearly 105,000 acre-foot drop in the Salt River basin. Storage in the Verde reservoir systems, however, declined by only about 5,000 acre-feet in August. Water levels in the San Carlos reservoir dropped nearly 50 percent during August, leaving it at only 4 percent of capacity.

In water-related news, a new governmental panel has been created to address the state's water challenges, including an insufficient water supply and inadequate water policies (*Nogales International*, September 8). The panel particularly will focus on water conservation and recycling; many current policies inhibit using gray water, which could increase Arizona's water supply.

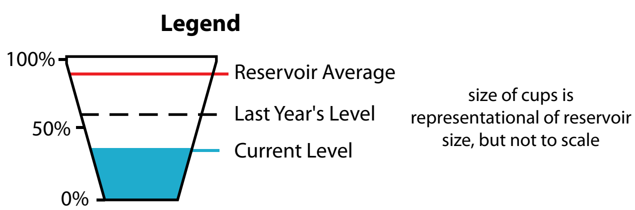
Notes:

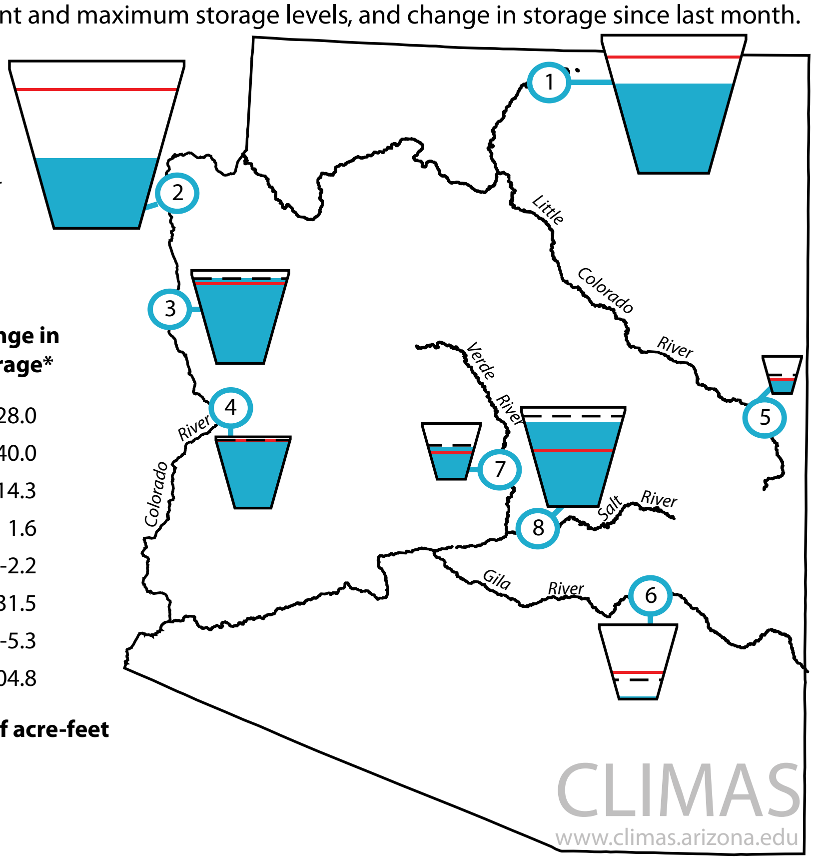
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total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

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

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

Figure 6. Arizona reservoir levels for August 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	65%	15,710.0	24,322.0	-428.0
2. Lake Mead	42%	10,938.0	26,159.0	-40.0
3. Lake Mohave	92%	1,668.7	1,810.0	14.3
4. Lake Havasu	94%	583.7	619.0	1.6
5. Lyman Reservoir	40%	11.9	30.0	-2.2
6. San Carlos	4%	36.6	875.0	-31.5
7. Verde River System	57%	164.5	287.4	-5.3
8. Salt River System	85%	1,718.2	2,025.8	-104.8

*** thousands of acre-feet**

On the Web:

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

New Mexico Reservoir Levels

(through 8/31/09)

Source: NRCS, National Water and Climate Center

The total reservoir storage in New Mexico declined by about 238,000 acre-feet in August, a decrease of 50,000 acre-feet more than last month. Elephant Butte Reservoir had the largest drop, with its water level falling 85,000 acre-feet. It is currently only at 21 percent of capacity, well below its historical August average of 55 percent (Figure 7). Navajo Reservoir also had a large decrease of nearly 75,000 acre-feet but is still at 79 percent of capacity, close to its long-term average of 82 percent for August. Of the 15 reservoirs included in Figure 7, only three—Abiquiu, Lake Avalon, and Conchas—reported slight increases in storage.

In water-related news, the New Mexico Environment Department (NMED) was awarded $650,000 by the Environmental Protection Agency to address groundwater contamination at the North Railroad Avenue Plume Superfund site in Espanola (EPA news release, September 1). NMED will use this money to continue long-term cleanup of groundwater polluted by chlorinated solvents.

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).

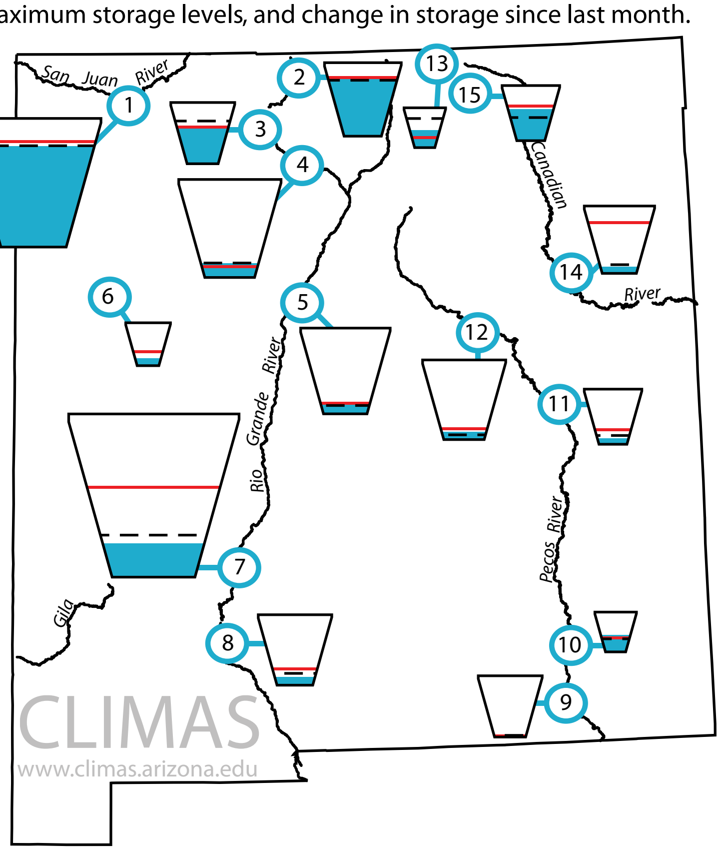
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 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 August 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	79%	1347.3	1,696.0	-74.8
2. Heron	80%	318.6	400.0	-20.9
3. El Vado	63%	120.2	190.3	-30.0
4. Abiquiu	15%	180.7	1192.8	3.2
5. Cochiti	11%	52.3	491.0	-0.7
6. Bluewater	17%	6.7	38.5	-0.5
7. Elephant Butte	21%	466.8	2,195.0	-85.4
8. Caballo	12%	40.4	332.0	-15.6
9. Brantley	1%	15.1	1008.2	-6.0
10. Lake Avalon	43%	1.7	4.0	0.1
11. Sumner	11%	11.1	102.0	-2.7
12. Santa Rosa	10%	45.3	438.3	-3.0
13. Costilla	44%	7.0	16.0	-4.5
14. Conchas	10%	26.3	254.2	6.3
15. Eagle Nest	57%	45.3	79.0	-3.0



On the Web:

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

Monsoon Summary
(through 9/12/2009)

Source: High Plains Regional Climate Center

With only a week before it officially ends on Sept. 30, this year's monsoon season may be the driest summer rainy season southeast Arizona has seen since 2002, according to the Tucson National Weather Service (NWS-Tucson). The monsoon similarly has been a dud for the rest of the Southwest except in southeast New Mexico (Figures 8a–c). As of September 10, precipitation at Tucson International Airport measured only 54 percent of average. Parched conditions also blanket Sierra Vista, Douglas, Nogales, and Oregon Pipe, where rainfall has tallied 56, 47, 70, and 51 percent of average, respectively. Rainfall has been particularly scant in the Four Corners region of Arizona and New Mexico, measuring less than 50 percent of average (Figure 8c). One reason for the dry conditions has been a shift southward of the monsoon high—a high pressure system aloft in the atmosphere that helps channel moisture into the Southwest. In mid-July, the high moved into Mexico—possibly the result of a strengthening El Niño—and impeded moisture flow to the north.

Long dry spells punctuated by significant monsoon storms characterize the 2009 monsoon season. Hurricane Jimena was the latest moisture burst, making landfall on Baja California, Mexico, on Sept. 2. More rain could be in store, as water temperatures off the Mexican west coast remain several degrees above average, and the elevated temperatures could stimulate hurricane activity.

Figure 8a. Total precipitation in inches (June 15–September 12, 2009).

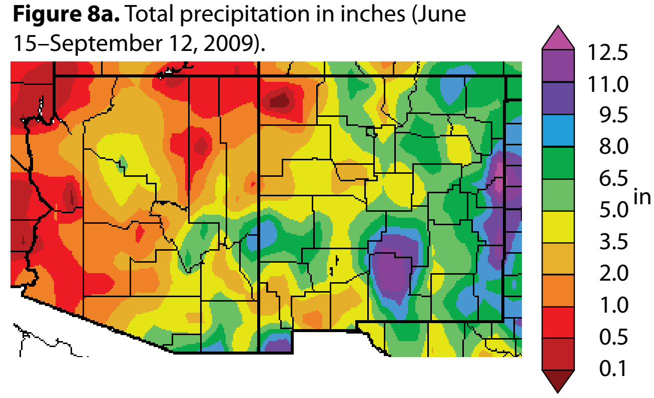


Figure 8b. Departure from average precipitation in inches (June 15–September 12, 2009).

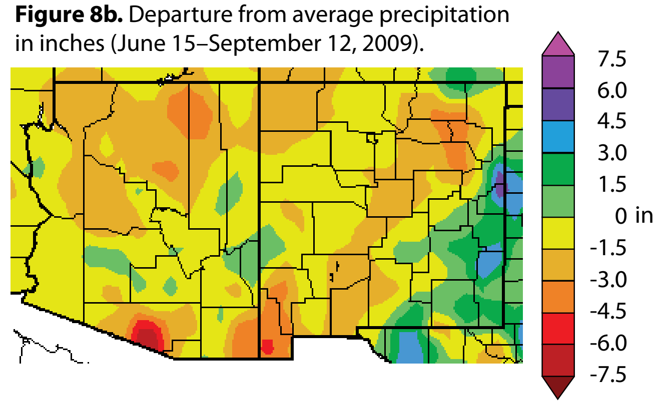
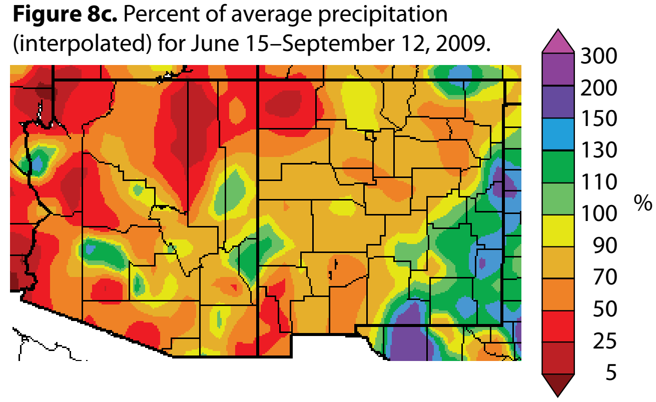


Figure 8c. Percent of average precipitation (interpolated) for June 15–September 12, 2009.



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.

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.

On the Web:

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

Temperature Outlook
(October 2009–March 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA–CPC) long-lead temperature forecasts for the continental US show an increased probability that much of the West will experience warmer-than-average autumn and early winter temperatures (Figures 9a–b). For Arizona, the forecast through December calls for an increased chance that temperatures will be similar to those of the warmest 10 years of the 1971–2000 observed record.

The temperature forecasts for the West are based primarily on the ongoing warming trend, although the developing El Niño-Southern Oscillation (ENSO) also influences the forecast, particularly into mid- to late-winter. El Niño is underway and likely will intensify somewhat through the fall and into winter. El Niño typically results in cooler fall and winter conditions through the southern tier of the US (Figures 9b–d).

Notes:

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

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

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

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

Figure 9a. Long-lead national temperature forecast for October–December 2009.

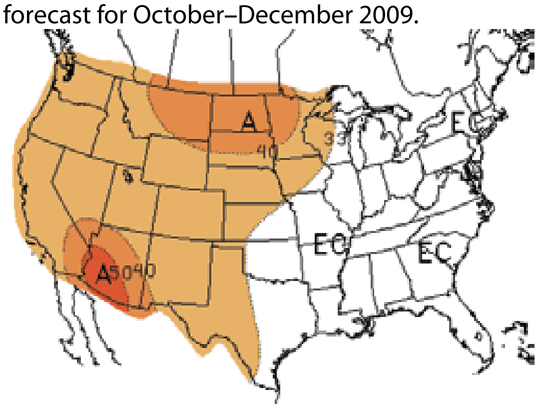


Figure 9b. Long-lead national temperature forecast for November 2009–January 2010.

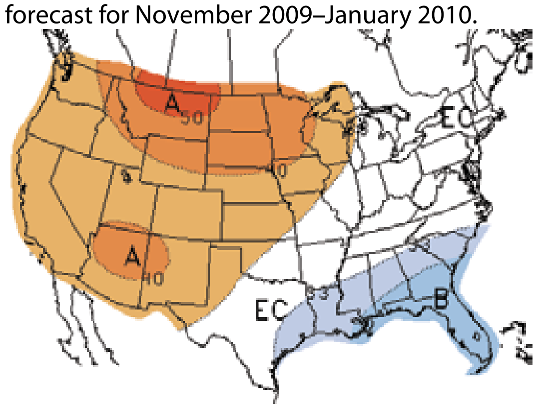


Figure 9c. Long-lead national temperature forecast for December 2009–February 2010.

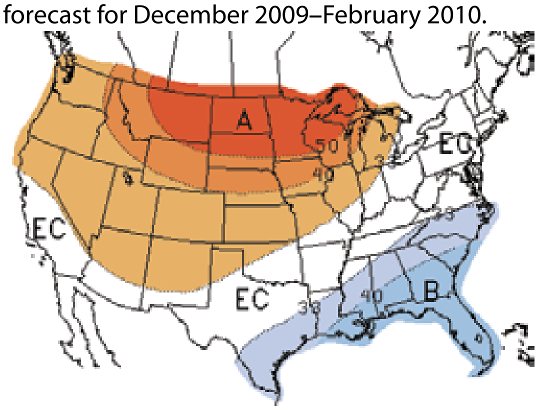
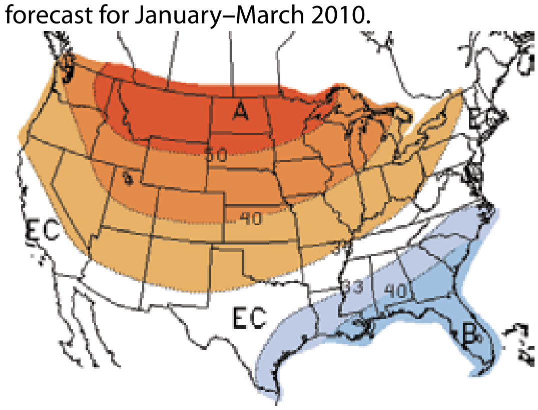


Figure 9d. Long-lead national temperature forecast for January–March 2010.



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
(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
(October 2009–March 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA–CPC) long-lead precipitation outlooks through the end of 2009 indicate equal chances of above-, below-, and near-average precipitation (Figures 10a–b). The outlook through March for the Southwest shows a slight tilt in the odds toward conditions that are similar to the wettest 10 years of the 1971–2000 observed record (Figures 10c–d). In other parts of the country, forecasts through March indicate increasing chances for above-average precipitation along the southern tier of the US and increasing chances of below-average precipitation throughout the Pacific Northwest and the Ohio and Mississippi river valleys (Figures 10a–d). These outlooks rely heavily on the expected impacts of a probable El Niño event, which typically brings wetter winter conditions to the southern part of the US and drier conditions to the northwestern regions of the country.

Notes:

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

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

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

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

Figure 10a. Long-lead national precipitation forecast for October–December 2009.

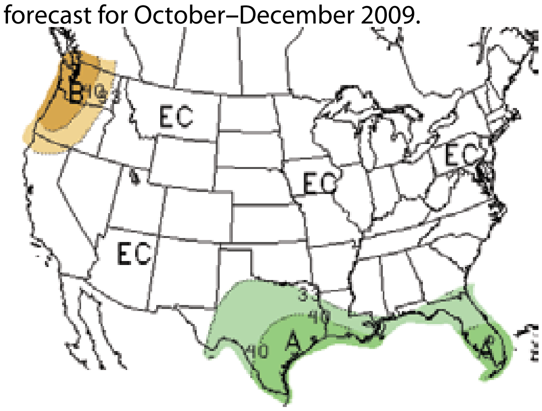


Figure 10b. Long-lead national precipitation forecast for November 2009–January 2010.

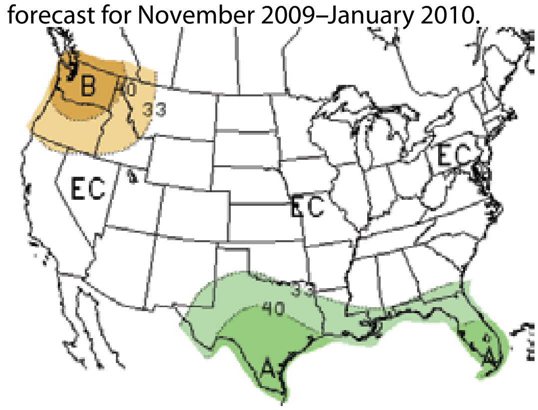


Figure 10c. Long-lead national precipitation forecast for December 2009–February 2010.

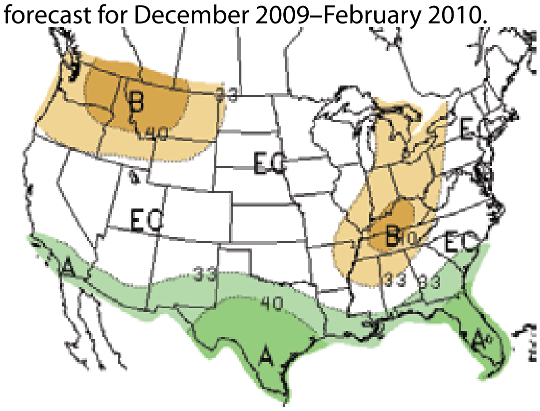
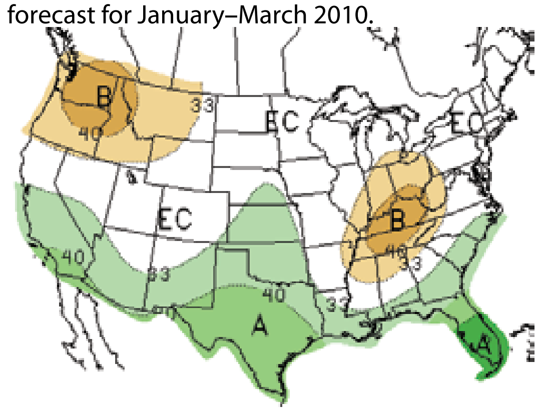


Figure 10d. Long-lead national precipitation forecast for January–March 2010.



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 December 2009)

Source: NOAA-Climate Prediction Center (CPC)

The following text is excerpted and edited from the Seasonal Drought Summary produced by the NOAA–CPC on September 17.

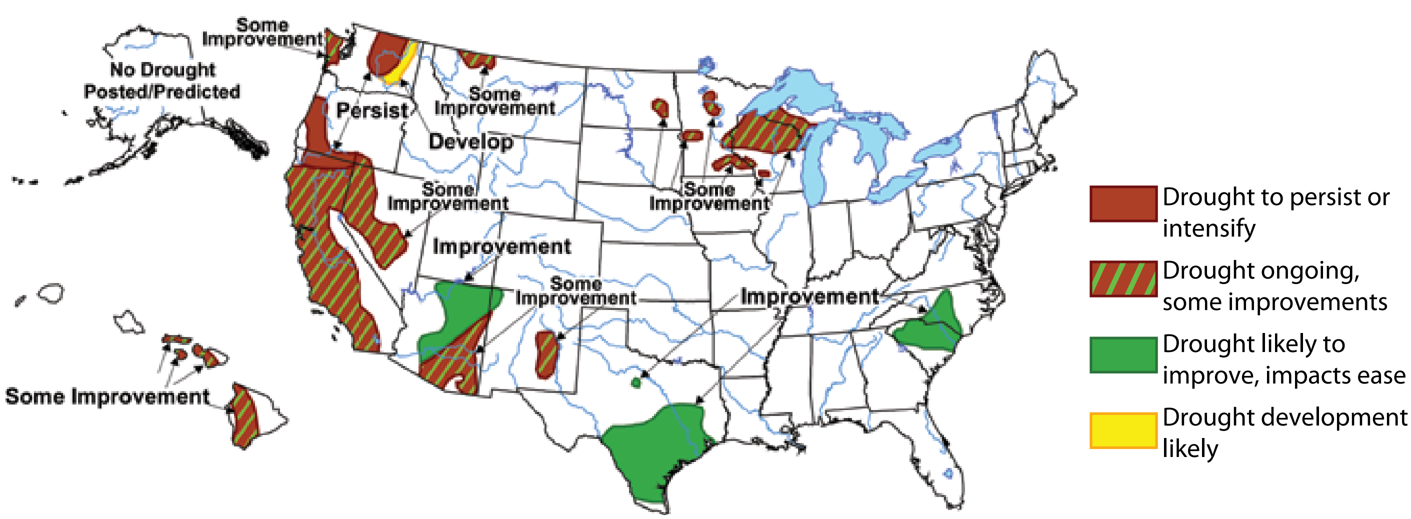
Heavy early-September rains brought significant and widespread improvements to the drought conditions affecting central and southern Texas for the first time in several months. NOAA's Climate Prediction Center (NOAA–CPC) Drought Outlook through December calls for additional improvements throughout this heavily drought-impacted region. Some improvement is also anticipated for the lingering drought in eastern New Mexico (Figure 11). Moderate to heavy precipitation is expected through the first five days of the period, with near- or below-average amounts favored later in September. Thereafter, forecasts favor neither above- nor below-average precipitation from October to December. Based on the precipitation expected in the near-term, seasonably-declining temperatures, and the potential for increased precipitation late in the period, related to the expected development of moderate El Niño conditions, at least limited improvement seems most likely, though confidence is not great. Forecast confidence for eastern New Mexico is low.

Despite near- or below-normal precipitation expected during the second half of September in the drought area covering central and eastern Arizona, improvement is forecast by the end of December in the northwestern half of the region, with more limited improvements expected farther southeast. Above-normal precipitation is anticipated across the northwestern half of the region in October, with equal chances forecast farther southeast. The October to December forecast calls for equal chances of above- and below-normal precipitation throughout the area, but precipitation could increase late in the period if moderate El Niño conditions develop as expected. In addition, as is true throughout the country this time of year, seasonably-declining temperatures allow any precipitation that does fall to be more beneficial for surface and sub-surface moisture conditions, and this is particularly true for snow that accumulates in the higher elevations. Forecast confidence for central and eastern Arizona is moderate.

Notes:

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

Figure 11. Seasonal drought outlook through December 2009 (released September 17, 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

El Niño Status and Forecast

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

An El Niño Advisory remains in effect again this month, as weak El Niño conditions have persisted across the equatorial Pacific Ocean. Sea surface temperatures (SSTs) warmed slightly in recent weeks in the eastern Pacific to 0.9 degrees Celsius above average, indicating a slight strengthening of the current event. Westerly winds along the equator over the past several weeks helped push some warmer water eastward, producing an increase in eastern Pacific SSTs. Even with this recent strengthening, the current El Niño is classified as a weak event by both the NOAA-Climate Prediction Center (NOAA–CPC) and Institute for Climate and Society (IRI). The Southern Oscillation Index (SOI) is slightly negative this month, indicating a weak atmospheric response to the current El Niño SST pattern (Figure 12a). IRI notes, however, that the pattern of warm SSTs is relatively unstructured and may have difficulty reinforcing warmer and stronger El Niño conditions through the upcoming winter and fall seasons. This fact is reflected in a majority of El Niño-Southern Oscillation (ENSO) forecasts that indicate the current El Niño will top out at a weak- to moderate-strength event.

Almost all forecast models indicate that at least weak El Niño conditions will persist through next spring. IRI's probabilistic forecast shows about an 80 percent chance of El Niño conditions persisting through the December–February season (Figure 12b). The forecast falls to 50 percent during the March–May period but is still more likely than either neutral conditions or a La Niña event. The chance of neutral or La Niña conditions returning over the next six months remains very small (up to 25 percent and 3 percent, respectively), but a return to neutral conditions rapidly becomes more probable after February. In the mean time, weak to moderate El Niño conditions will likely bring an increased chance of above-average precipitation during the late fall and early winter seasons across southern Arizona and New Mexico.

Figure 12a. The standardized values of the Southern Oscillation Index from January 1980–August 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).

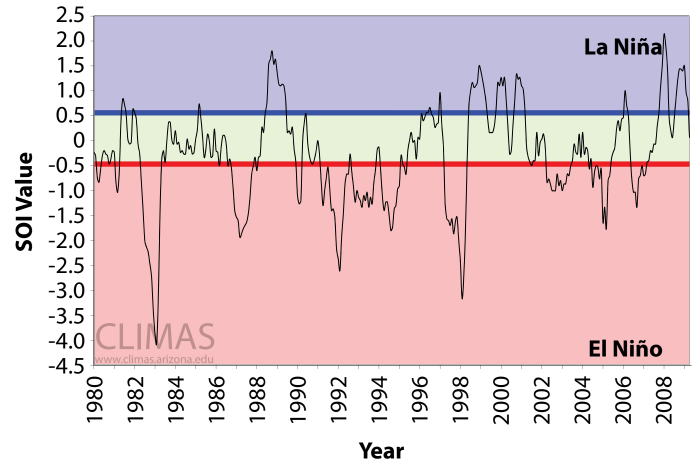
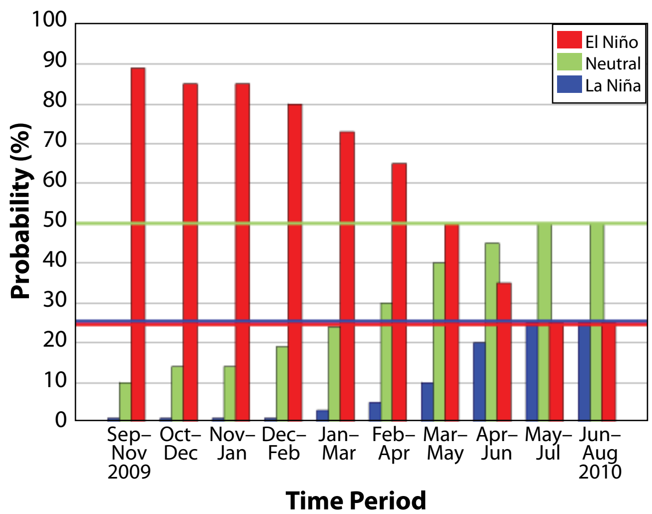


Figure 12b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released September 17, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Notes:

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

Temperature Verification
(October 2009–March 2010)

Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-622-8149.

Comparisons of observed temperatures for October–December to forecasts issued in September for the one-month lead time covering the same period suggest that forecasts are most reliable in northern Arizona and southwestern New Mexico (Figure 13a). Forecast skill—a measure of the accuracy of the forecast—for the southwestern parts of Arizona and northern New Mexico has not been much better than using equal chances as a forecast. Forecast skill for the two-month lead times (forecasts issued in September for November–January) suggest that outside southeastern and northwestern Arizona and southwestern New Mexico, forecasts have been less accurate than the climatology forecast (Figure 13b). In the Southwest, forecasts consistently have been more accurate in the southeast corner of Arizona and the southwest corner of New Mexico than in other regions. Caution is advised to users of the NOAA–CPC seasonal outlooks for regions where the verification maps display reddish hues.

(Note: the NOAA-Climate Predictions Center (NOAA–CPC) has not issued September–November forecasts in the past for map regions displayed in black).

Notes:

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

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

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

Figure 13a. RPSS for October–December 2009.

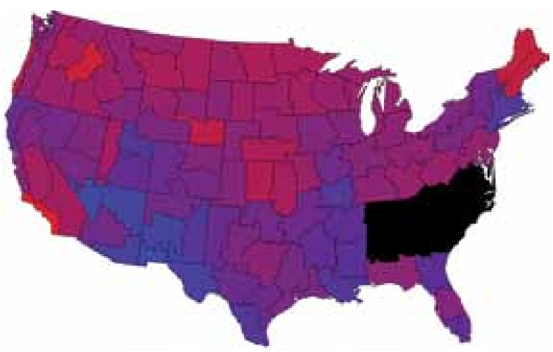
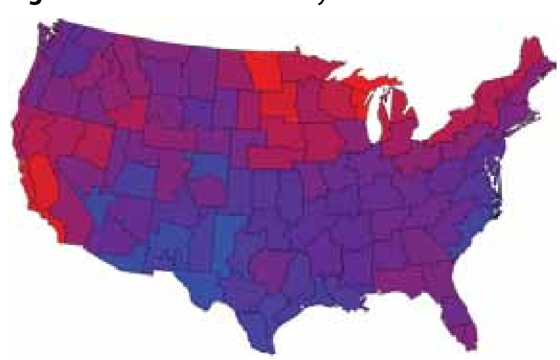
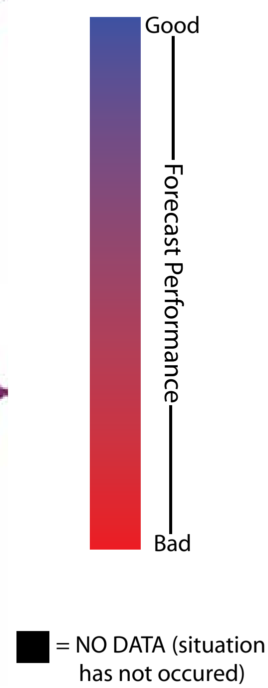


Figure 13b. RPSS for November 2009–January 2010.

Figure 13c. RPSS for December 2009–February 2010.

Figure 13d. RPSS for January–March 2010.





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
(October 2009–March 2010)

Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-622-8149.

Comparisons of observed precipitation for October–December to forecasts issued in September for the one-month lead time covering the same period suggest that forecast skill is good for southeastern Arizona, slightly better than equal chances for most of Arizona and New Mexico, and near-equal chances in northern Arizona and New Mexico (Figure 14a). (Note: the NOAA-Climate Predictions Center (NOAA–CPC) has not issued September–November forecasts in the past for map regions displayed in black). At all lead times, the part of the Southwest where seasonal forecasts issued in September have displayed the highest skill is in southeast Arizona. Forecast skill for the two-month lead time (forecasts issued in September for November–January) shows improvement in most of Arizona and New Mexico (Figures 14a–b). For this forecast, the southeast corner of Arizona again exhibits the highest skill. For the three- and four-month forecasts, historical forecasts issued for regions outside parts of both southern Arizona and New Mexico have not been much better than the climatological forecasts (Figures 14c–d). Caution is advised to users of the NOAA–CPC seasonal outlooks for regions where the verification maps display reddish hues.

Notes:

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

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

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

Figure 14a. RPSS for October–December 2009.

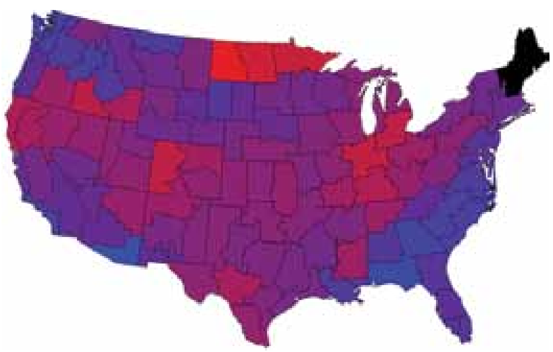


Figure 14b. RPSS for November 2009–January 2010.

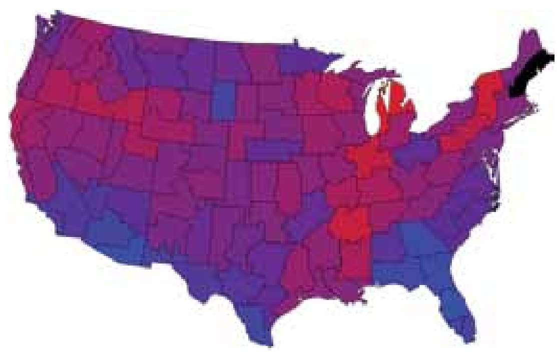
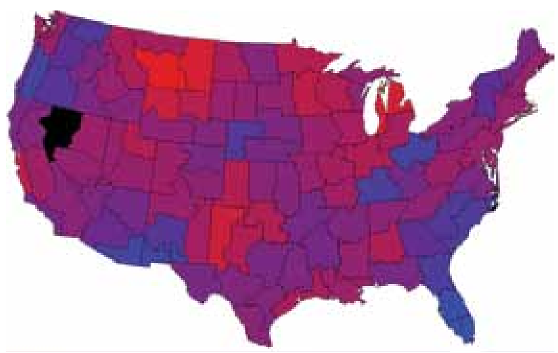
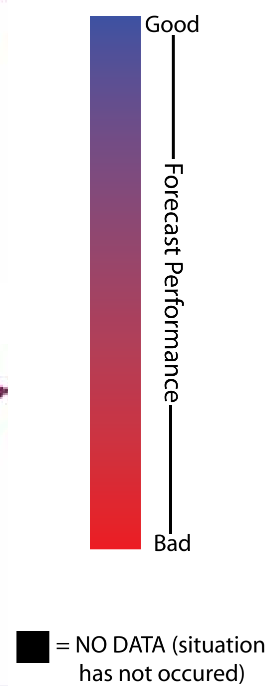


Figure 14c. RPSS for December 2009–February 2010.

Figure 14d. RPSS for January–March 2010.





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