Issued: October 20, 2009

Southwest Climate Outlook

Source: *Phil Pasteris, Global Water Resources. April 16, 2009.*

Photo Description: Lake Mead ended the water year with water levels around 1,094 feet above sea level and stands only 18 feet above the level that triggers the first phase of water allocation reductions. This photo was taken on April 16, 2009 when the water level was about 1,105 feet above sea level.

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
ARIZONA
NM STATE UNIVERSITY

October Climate Summary

Drought– A weak monsoon season has caused drought to expand and worsen in Arizona; the entire state is now blanketed in drought conditions. Much of New Mexico, however, remains drought free due to near-average precipitation over the past 30 days.

Temperature– The water year is off to a significantly cooler-than-average start in Arizona and northern New Mexico.

Precipitation– The summer dryness continued through the start of the water year.

ENSO– Weak to possibly moderate El Niño conditions are expected to persist through the fall and early winter seasons, bringing increased chances for above-average precipitation across southern Arizona and New Mexico.

Climate Forecasts– Forecasts call for slightly increased chances of above-average temperatures in most of the Southwest throughout the fall and into winter. Precipitation forecasts indicate slightly increased chances of wetter conditions throughout the southern portion of the region into spring.

The Bottom Line– The hot and dry summer monsoon has been nicknamed the "non-soon" in reference to the scant rains it delivered. As a result, drought conditions have spread to every corner of Arizona, causing poor ranchland conditions and forcing many ranchers to sell livestock, among other impacts. While El Niño is partly to blame for the lack of summer rains, it may also bring wetter-than-average conditions to parts of the Southwest, particularly the southern portions.

Drought Planning May Face Funding Challenges

The Arizona Department of Water Resources (ADWR) faces a 15 percent reduction in its 2010 fiscal year budget. To meet this $4.1 million shortfall, the ADWR recently proposed slashing or eliminating many programs and projects. Although definitive decisions have yet to be made on how to best balance the budget, the current proposal limits funding for activities that include drought planning. The proposal cuts the Statewide Planning Division and the Statewide Drought and Conservation Program. The Statewide Planning Division has been instrumental in water planning, while the Statewide Drought and Conservation Program has established a drought reporting structure as well as an "on the ground" capability with local drought impact groups. Other cuts include reductions in grants available for water conservation, closing the Santa Cruz Active Management Office in Nogales, Ariz., and focusing monitoring efforts only on streamflow gauges important for flood monitoring. The proposal also adds that the Bureau of Reclamation and other federal agencies may have some funds available to help complete ongoing studies. To read the proposal, visit: http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/091016_fifteen_adwr.pdf.

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, *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, 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.

2009 SWCO water year in review

Introduction

The 2009 Water Year in Review offers a summary of the information presented in Southwest Climate Outlook during the 2009 water year, which began October 1, 2008, and ended September 30, 2009. This review provides an overview of precipitation, temperature, reservoir levels, drought, wildfire, and El Niño conditions.

In general, the year was dry in the Southwest. Arizona and New Mexico experienced their seventh and ninth driest water years since 1896, respectively. El Niño–Southern Oscillation (ENSO) played a large role in the below-average winter and summer precipitation.

In December early winter snow and rain pummeled parts of the Southwest despite the formation of a La Niña event, which often delivers below-average winter precipitation to the region. A soggy December, however, gave way to dry La Niña conditions in January.

As spring transitioned into summer, La Niña weakened into ENSO-neutral conditions, and soon thereafter an El Niño event formed. Summer rains came early in parts of the Southwest, but didn't last; El Niño weakened the subtropical high and intensified the Jet Stream, suppressing moisture flow into the region. Arizona and New Mexico experienced their fourth and fifth driest August since 1896, respectively.

The dry conditions have caused drought to expand in the Southwest, and nearly all of Arizona was deemed abnormally dry or worse as Water Year 2009 ended. But the El Niño event may help reduce drought conditions and pack high elevations with snow in the coming months. Current forecasts project a moderate El Niño through the winter, which often delivers above-average winter snow and rain to the region.

continued on page 4

Top 5 headlines of the water year

1) **Monsoon season a dud:** Early monsoon storms that delivered above-average rainfall to parts of Arizona and New Mexico didn't last long. By mid-July, El Niño helped suppress moisture flow into the region, and Arizona and New Mexico experienced the fourth and fifth driest August they have had since 1896, respectively. Totals for the monsoon season in most parts of both states were less than 90 percent of average.

2) **Drought returns to Arizona:** The 2009 water year was the seventh driest in Arizona since 1896, causing the state's drought conditions to deteriorate. More than 96 percent of the state was classified as abnormally dry or worse at the end of September. One year ago, only 4 percent was abnormally dry or worse. ENSO had a heavy hand in bringing back drought, as La Niña contributed to a dry spring and El Niño suppressed monsoon rains.

3) **Water levels in Lake Mead lowest since about 1965:** The water level in Lake Mead stood at 1,094 feet above sea level at the end of the water year, about 8 feet lower than it was last year. Not since 1965 have water levels been this low. The ongoing drought since 2000 and the over-allocation of Colorado River water have contributed to declines in storage nine of the last 10 years, with the sole exception occurring in 2008.

4) **Wet early winter in spite of La Niña:** Snows fell early and often in the Salt and Verde river watersheds in Arizona despite La Niña conditions, which tend to suppress winter precipitation. In December, 4.3 inches of precipitation helped fill the Salt reservoir system. Storage in Roosevelt Reservoir was topped off in March for the first time in its history.

5) **Rapid spring snowmelt:** Early winter precipitation gave way to a dry late winter. The average snow water equivalent (SWE) at Snow Telemetry (SNOTEL) sites in Arizona was about 50 percent above average in mid-February. Warm temperatures in late February and March, however, devoured the extra snow pack. After the first week of March, SWE conditions remained below average for the duration of the spring.

WYIR, continued

Precipitation

The 2009 water year was the seventh and ninth driest on record in Arizona and New Mexico, respectively. Most of Arizona received less than 80 percent of average precipitation, with a few exceptions located along the lower Colorado River Valley and the White Mountains on the eastern border (Figures 1a–b). Much of the Colorado Plateau in Arizona was particularly dry, experiencing between 25 to 70 percent of average precipitation. New Mexico fared slightly better. Only the mountains of north-central and east-central New Mexico received above-average precipitation since October 1, 2008. Precipitation in southwestern New Mexico, like southern Arizona, was below 70 percent of average.

Similar to the 2008 water year, this water year began with moderate La Niña conditions in the eastern Pacific Ocean, which tend to bring dry winter weather. Unlike last year, however, this La Niña resulted in a drier-than-average winter. La Niña's dry touch established itself in January, after a wetter-than-average December. The dry pattern continued throughout the winter and spring, leading to lower-than-average spring streamflows. In the spring, a weak El Niño took form. Precipitation forecasts called for a wetter-than-average summer, with an early start to the monsoon. While monsoon rains did begin early in southeastern Arizona, they didn't last long. The foci of storms shifted east to southwestern and west-central New Mexico. Dry conditions persisted in most of Arizona through September 30. Phoenix experienced the 10th driest monsoon season on record, while Tucson had the 11th driest and Douglas and Stafford, both in southeastern Arizona, saw the second driest they have had on record. Yuma was the only major city in the Southwest to receive above-average rainfall, due principally to the remnants of Hurricane Jimena that moved north through the Gulf of California in early September (Table 1).

continued on page 5

Figure 1a. Water year 2008–2009 through September 30, 2009 departure from normal precipitation.*

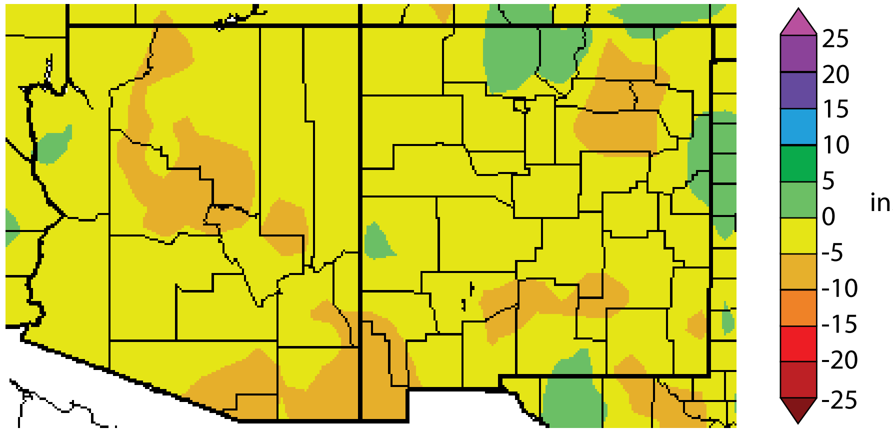
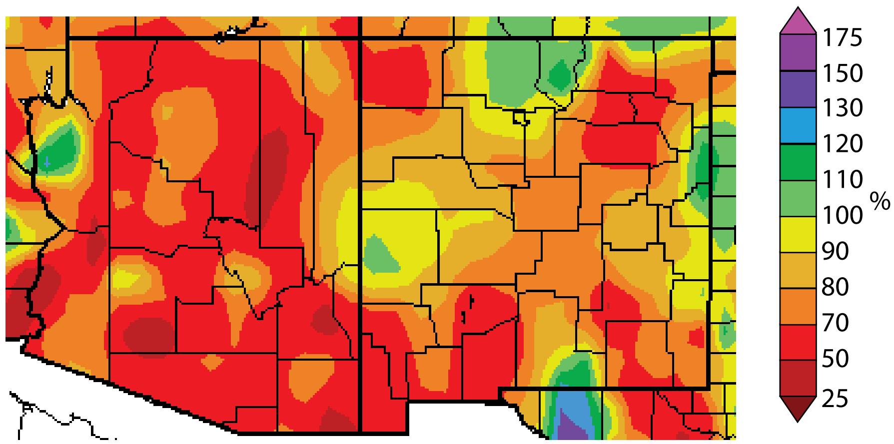


Figure 1b. Water year 2007–2009 through September 30, 2009 percent of average precipitation.*



** See "Notes" section on page 11 for more information on interpreting these figures.*

Table 1. Water Year 2009 precipitation values (in inches) for select cities.

City	WY 2008 Precipitation	Average WY Precipitation	2008 Departure from Average	2007 Departure from Average
Phoenix, AZ	4.24	8.29	-4.05	+2.21
Tucson, AZ	6.51	12.17	-5.66	-3.24
Douglas, AZ	5.73	13.76	-8.03	-4.31
Albuquerque, NM	7.23	9.47	-2.24	-1.82
Winslow, NM	3.37	8.03	-4.66	-3.37
Flagstaff, AZ	13.38	22.91	-9.53	-13.14
Yuma, AZ	5.19	3.05	+2.14	-0.91
El Paso, TX	7.26	9.43	-2.17	N/A

WYIR, continued

Temperature

Temperatures during the 2009 water year were 1–2 degrees Fahrenheit above average for most of Arizona and New Mexico (Figures 2a–b). The warmest areas were central Arizona and south-central New Mexico, which averaged 2–3 degrees F above average. Hot spots in northeastern New Mexico and northwestern Arizona, and cold spots in west-central and east-central Arizona were isolated to a single measuring station in each area and are therefore believed to be caused by changes in station location rather than actual temperature differences.

Figure 2a. Water year 2008–2009 through September 30, 2009 average temperature.*

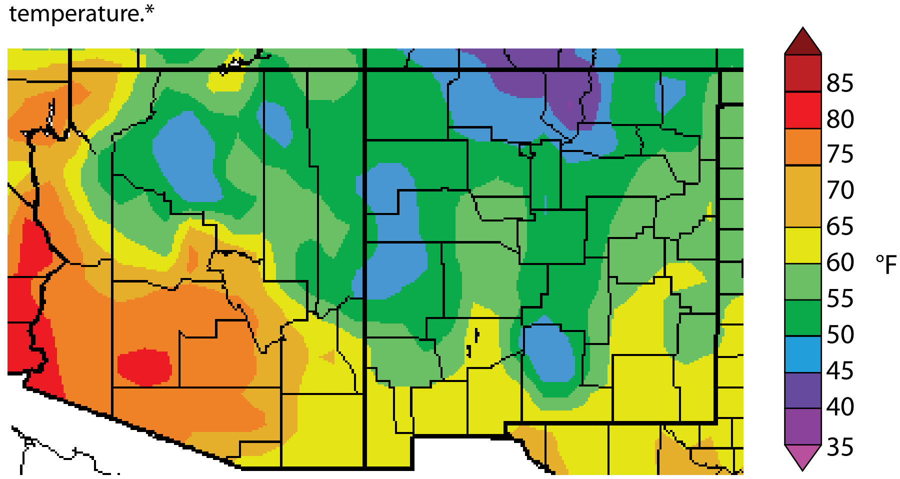
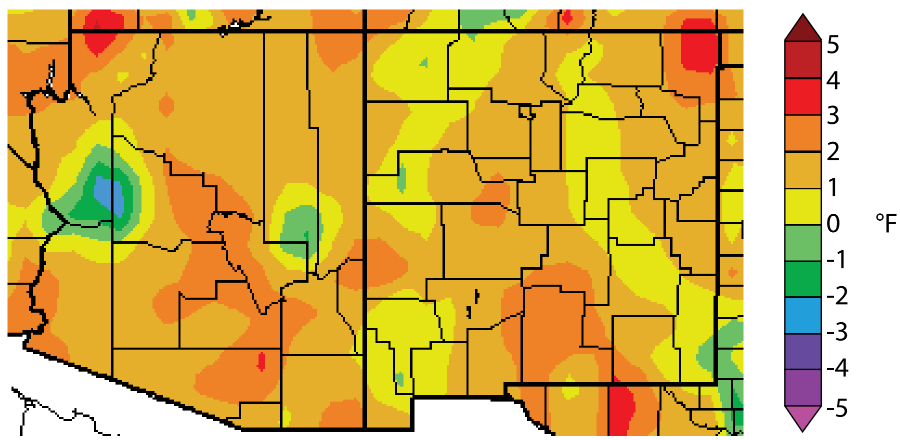


Figure 2b. Water year 2008–2009 through September 30, 2009 departure from average temperature*



** See "Notes" section on page 10 for more information on interpreting these figures.*

The summer months in the Southwest were particularly warmer than average. Phoenix, for example, had its fourth warmest May on record, while Flagstaff and Tucson endured their second warmest May. Between May 6 and 19, Phoenix experienced 14 consecutive days at or above 100 degrees F, setting a new record for the month. In total, Phoenix experienced 19 days at 100 degrees F or hotter. The warm summer months significantly contributed to the above-average temperatures for the water year. In Tucson and Phoenix, average temperatures in May, July, August, and September all ranked among the top 10 warmest for the respective months in 115 years of data. In Flagstaff, May and July ranked in the top 10.

Winter storms this water year remained well north of Arizona, sliding across southern Utah and into Colorado and the northern border of New Mexico. Conditions remained clear, dry, and warm for most of the year. The monsoon was restricted to northern Mexico most of the summer, as the high pressure ridge stayed well south of the Four Corners region, causing a dry, westerly flow in the upper atmosphere across Arizona and New Mexico. This suppressed the northward movement of moisture from Mexico. In addition, the circulation in the lower atmosphere was northerly, bringing dry air south from Utah, further suppressing storm development. The clear, dry conditions allowed daytime temperatures to remain very high. Fortunately, the lack of moisture and clouds allowed nighttime cooling, so the minimum temperatures remained near average values in most locations.

continued on page 6

WYIR, continued

Reservoirs

Arizona. Total reservoir storage in Arizona declined by about 617,000 acre-feet during the 2009 water year. While Lake Powell gained 955,000 acre-feet, Lake Mead declined by 1.08 million acre-feet (MAF). The imbalance resulted from new management guidelines for the coordinated operations of the lakes. This year, due to April 1 streamflow projections for the end of the water year, Lake Powell released 8.23 MAF to Lake Mead. However, April 1 projections underestimated the actual end-of-water year total flow. As a result, it is more likely that Lake Powell will release about 9.3 MAF next year. The water in Lake Mead is currently at its lowest level since 1965 and is only 18 feet above the level in which some shortage restrictions go into effect (Figure 3a). The declining water level in Lake Mead reflects the ongoing drought since about 2000 as well as the new management guidelines. The other major reservoirs also experienced storage declines (Table 2).

New Mexico. The runoff season for northern New Mexico got off to a great start, with above-average December 2008 precipitation. However, warmth and high winds throughout much of the late winter and spring quickly melted snowpack, resulting in lower-than-forecasted spring streamflow in parts of the state such as the Upper Pecos River Basin and some of the streams that feed the Rio Grande.

At the end of the water year, New Mexico total reservoir storage declined by approximately 174,000 acre-feet. Storage declined in every major river basin in the state (Table 3). Combined water storage in Elephant Butte and Caballo reservoirs (Figure 3b) declined to within 100,000 acre-feet of restriction levels in Article VII, which states that upper Rio Grande reservoirs such as Lake Heron cannot increase in storage capacity, and irrigation allocations have the potential to be restricted when Article VII is in effect. These restrictions were last implemented in December 2007.

Table 3. Selected New Mexico reservoirs' water year statistics.

Reservoir	Oct. 07 Percent full	Sept. 08 Percent full	WY Peak Percent	Peak Month
Navajo	77	77	89	May
Heron	72	68	85	June
Elephant Butte	27	20	30	May
Conchas	9	11	11	September
Santa Rosa	7	5	12	June

Figure 3a. Elevation of Lake Mead in Arizona during the 2009 water year. The line at 1,075 feet is the threshold for Lower Colorado River Basin shortage.

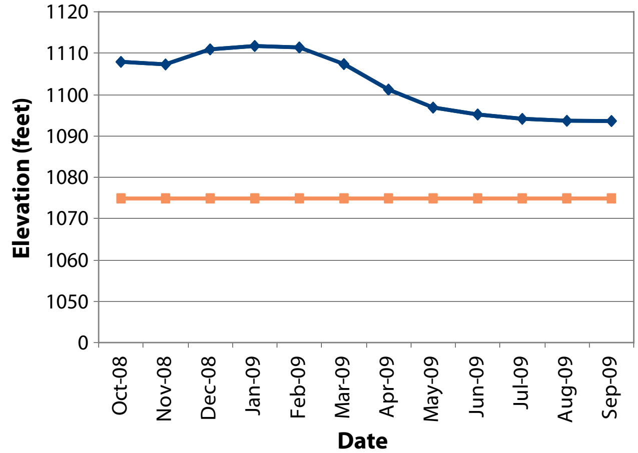
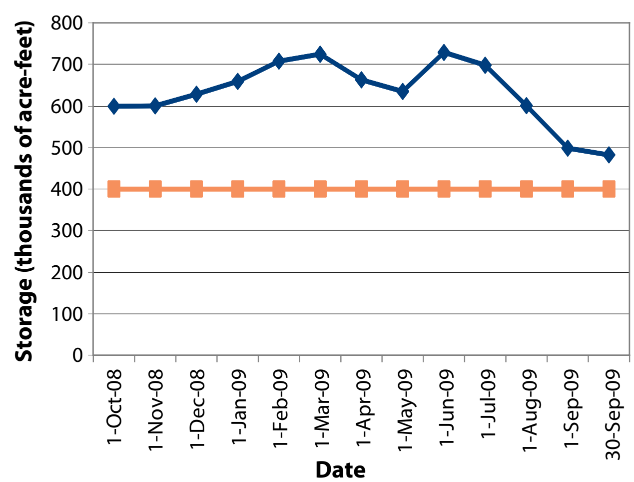


Table 2. Selected Arizona reservoirs' water year statistics.

Reservoir	Oct. 07 Percent full	Sept. 08 Percent full	WY Peak Percent	Peak Month
Powell	58	64	66	July
Mead	47	42	48	January
Gila	24	3	26	February
Verde	38	54	79	March
Salt	90	81	100	March

Figure 3b. Combined water storage of Elephant Butte and Caballo reservoirs in New Mexico during the 2009 water year. The line at 400,000 acre-feet is the threshold for Rio Grande Compact Article VII restrictions.



continued on page 7

WYIR, continued

Drought

The evolution of drought conditions in Arizona and New Mexico was a tale of two states during the 2009 water year. Both states began the water year mostly drought free. But by the end, on September 29, more than 95 percent of Arizona had abnormally dry conditions or worse, while only about 30 percent of New Mexico was classified with drought conditions. The summer monsoon played a large role in this juxtaposition.

At the beginning of the water year, the November 11, 2008, U.S. Drought Monitor showed only small areas of abnormally dry conditions in northwest Arizona and northeast New Mexico (Figure 4a). Winter brought near-average seasonal precipitation across central and southern Arizona and drier conditions across northern Arizona and much of eastern New Mexico. By mid-February abnormally dry conditions covered much of eastern and southern New Mexico due to below-average precipitation in December and January (Figure 4b). These dry conditions persisted through March and April and expanded to include much of Arizona. Winter storm activity quickly tailed off in late February, leaving Arizona and New Mexico in a warm and dry weather pattern for much of the spring. February through April precipitation totals were less than 50 percent of average across the region.

Figure 4a. Drought Monitor released November 11, 2008.*

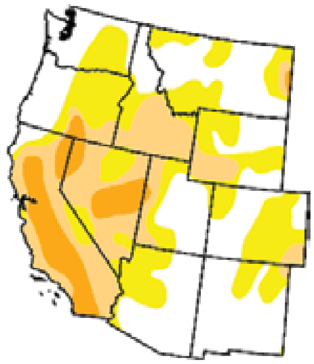


Figure 4b. Drought Monitor released February 10, 2009.*

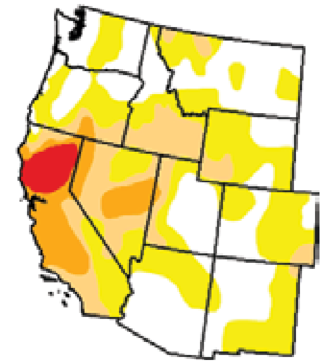


Figure 4c. Drought Monitor released May 12, 2009.*

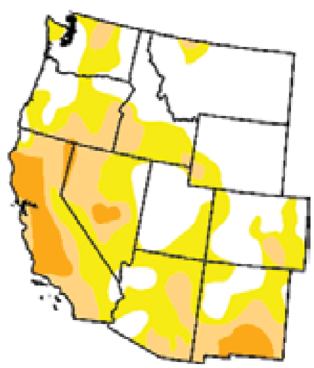
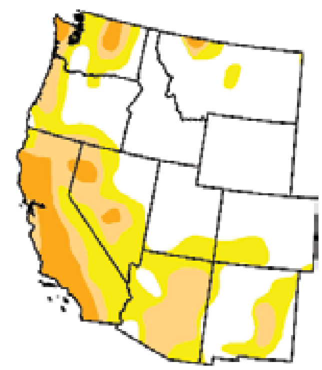


Figure 4d. Drought Monitor released August 25, 2009.*



Drought Intensity

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

** See "Notes" section on page 12 for more information on interpreting these figures.*

The unusually dry spring led to further expansion and intensification of short-term drought conditions across both Arizona and New Mexico. By mid-May, moderate drought had expanded to eastern Arizona and the southern half of New Mexico, with severe drought conditions developing in several southern New Mexico counties (Figure 4c). As a result, these counties were declared federal disaster areas, which enabled the U.S. Department of Agriculture to provide assistance to drought impacted farmers and ranchers in the region.

The summer monsoon season brought significant relief to New Mexico but left Arizona hot and dry with worsening short-term drought conditions. Near-average to above-average precipitation was plentiful across New Mexico during July and August, which helped isolate drought conditions to a smaller portion of eastern New Mexico (Figure 4d). By late August, severe drought conditions had subsided and only a small area of moderate and abnormally dry conditions remained. The opposite was true for Arizona. A very weak monsoon pattern limited the flow of moisture into Arizona for most of July and August, leaving much of it with less than 50 percent of average precipitation. This led to the expansion of moderate drought conditions to cover most of the state by late August.

continued on page 8

WYIR, continued

Wildfire

In May 2009 the Southwest Coordination Center (SWCC) predicted above-normal fire potential for late May to early June in most of New Mexico and the central and southeast portions of Arizona. At this time, the elevated fire potential was due to hot and dry conditions in the area and the abundance of dry fine fuels, predominantly grasses. In mid-July, SWCC estimated that fire potential across the region would be moderated by the monsoon season. Monsoon rains in the beginning of June did tamp down some early summer flames; nevertheless, 63 fires—nearly twice as many as the 1990–2008 average of 38—each burned more than 100 acres during the monsoon season.

During the 2009 fire season to date (January 1 through October 5), more than 206,000 acres had burned in Arizona (Figure 5a), surpassing the 1990–2008 yearly average of 180,000 acres. Two fires that each burned more than 20,000 acres occurred this season in the state. The Elk Horn fire, which was human-caused, was the largest. It began in mid-June and charred more than 23,000 acres near the Baboquivari Peak Wilderness Area, about 50 miles southwest of Tucson.

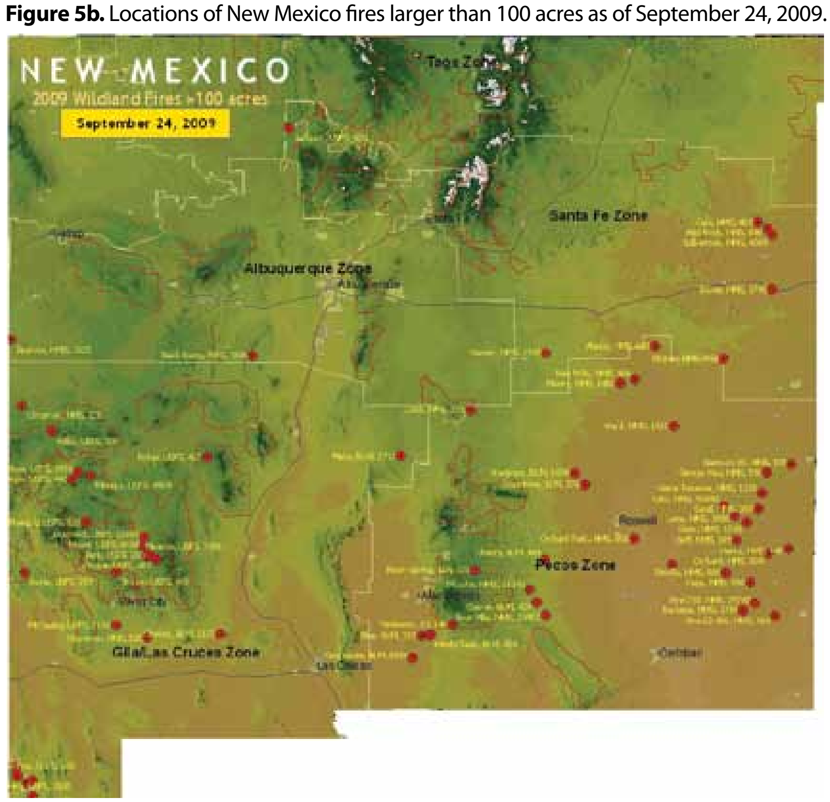
More than 362,000 acres burned since the beginning of the year in New Mexico, exceeding the 1990–2008 state yearly average of approximately 235,000 acres (Figure 5b). Five fires charred more than 20,000 acres each. The largest, the Pasco fire, was sparked by lightning in mid-June near Lordsburg in Hidalgo County and scorched more than 93,000 acres. Other large fires burned from March through August across southwestern Arizona and the southern portion of New Mexico (Table 4).

Table 4. Top 10 Southwest fires in 2009.

Fire Name	State	Acres Burned
Pasco	NM	93,029
Cato	NM	55,080
Four Mile	NM	29,952
Fire 238	NM	25,747
Elk Horn	AZ	23,440
Diamond	NM	22,000
Bear Canyon	AZ	20,029
Picacho	NM	16,141
Skeleton	AZ	9,800
Willow	NM	8,850

Figure 5a. Locations of Arizona fires larger than 100 acres as of September 24, 2009.

Figure 5b. Locations of New Mexico fires larger than 100 acres as of September 24, 2009.



continued on page 9

WYIR, continued

El Niño

Sea Surface Temperatures

El Niño-Southern Oscillation (ENSO) had a heavy hand in the Southwest during the 2009 water year. ENSO began the year quietly, with near-average sea surface temperatures (SSTs) across the basin along the equator, indicating ENSO-neutral conditions (Figure 6a). A shift occurred in December as SSTs cooled to marginal La Niña levels. By January, the NOAA–Climate Prediction Center (NOAA–CPC) had declared an official, although weak, La Niña as temperatures in parts of the central Pacific dipped to 2 degrees Celsius below average. Weak La Niña conditions persisted for another couple of months and contributed to warm late-February through April temperatures, which caused earlier-than-average snowmelt. In April, La Niña quickly dissipated into short-lived ENSO-neutral conditions. By late June, NOAA–CPC officially declared an El Niño watch, which left forecasters unsure whether the second half of the monsoon was going to be drier or wetter than average. Early monsoon rains brought above-average precipitation to some parts of the Southwest, but the fledgling El Niño suppressed rains from mid-July through September, particularly in Arizona, by weakening the subtropical high and intensifying the Jet Stream. Despite an increased number of tropical Pacific storms, which can bring more rain to the Southwest, only Hurricane Jimena steered into the region. Although the dry side of El Niño prevailed this monsoon season, El Niño events tend to enhance winter precipitation in the Southwest. If El Niño stays put into early next year, which forecasters suggest is likely, much-needed winter rains will help ease drought concerns.

Figure 6a. Map of the El Niño 3.4 region. The yellow box outlines the region. Graphic credit: International Research Institute for Climate and Society.

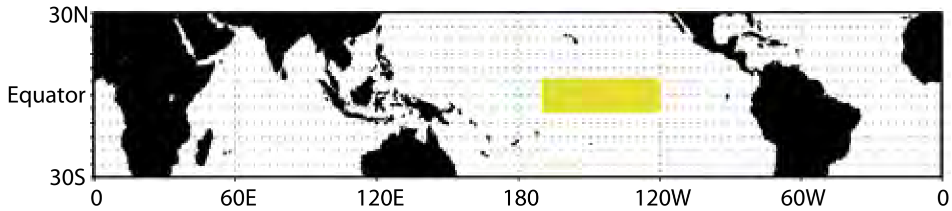
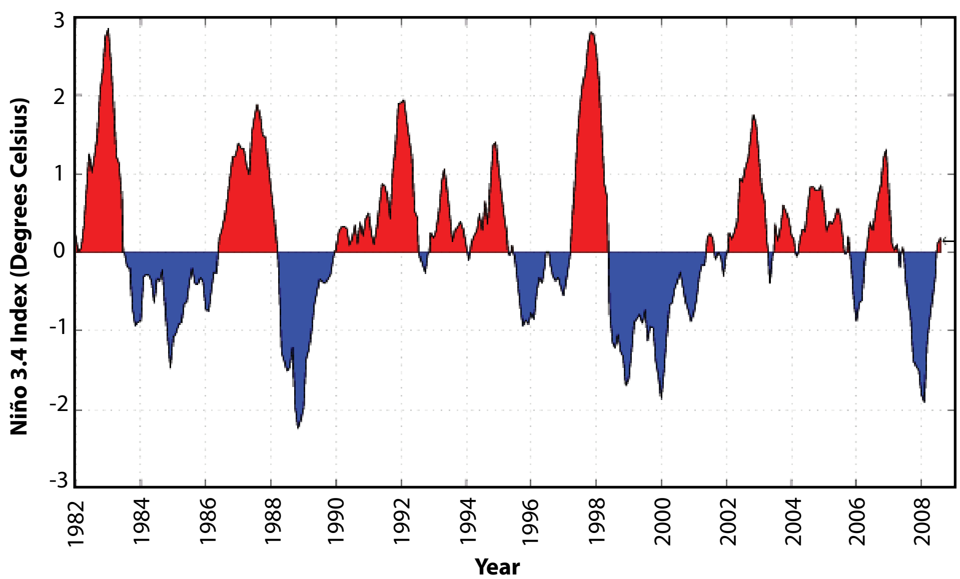


Figure 6b. Sea surface temperature anomaly index from Niño 3.4 region. Red areas indicate positive or warm SST anomalies while blue indicates negative or cool anomalies. Graphic credit: International Research Institute for Climate and Society.



Southern Oscillation Index

The Southern Oscillation Index (SOI)—a measure of the air pressure fluctuations in the equatorial Pacific Ocean—had high values (1.5) at the start of the water year in October 2008 (Figure 6b). High values typically indicate a strong atmospheric response to below-average SSTs in the Pacific Ocean associated with a La Niña event. However, the International Research Institute for Climate and Society (IRI) noted that SSTs were near average across the basin, and therefore the high SOI value was caused by seasonal variability in circulation patterns. Through the winter months, SOI values remained high as SSTs cooled and La Niña conditions developed. By February, the SOI had peaked at 1.8, lagging behind the waning La Niña event.

The strong atmospheric response to La Niña conditions had direct implications for Arizona and New Mexico. By late February, winter storm activity moved north—typical during La Niña winters—and March was unusually dry in the Southwest. As SSTs warmed through April and May, SOI values fell. By the end of May, the SOI was at -0.4, which was consistent with a neutral ENSO state. In August, the SOI fell to -0.7, indicating a weak atmospheric connection to the developed El Niño event. The atmospheric response to El Niño likely helped weaken the monsoon high and reduced its normal northward expansion from Mexico into the Southwest. Instead of establishing itself over the Four Corners region as is typical, the high hovered over central and sometimes southern Arizona, blocking moisture flow into these regions.

Temperature (through 10/14/09)

Source: High Plains Regional Climate Center

The beginning of the 2010 water year, which began on Oct. 1, is off to a cold start, a refreshing change of pace from the hotter-than-average summer. In the s outhwestern deserts of Arizona, temperatures have been between 70–75 degrees Fahrenheit (Figure 1a). In southeastern Arizona and southern New Mexico, temperatures have been 60–70 degrees F. The higher elevations in northern New Mexico and northwestern and northeastern Arizona have experienced chillier average temperature averaging between 40 to 55 degrees F. These temperatures have been 0–3 degrees below average across the eastern third of Arizona and north-central New Mexico (Figure 1b). The western half of Arizona and the higher elevations of northern and eastern New Mexico have seen temperatures between 3 and 6 degrees below average. The lower Colorado River valley has been extremely cool, averaging 6–9 degrees below average. The colder temperatures were the result of a strong upper level low pressure system that moved slowly across the West in early October.

The past 30 days have been 0–2 degrees cooler than average across most of Arizona and the southern half of New Mexico (Figures 1c–d). The cooling trend that began in October is quite significant, and follows a September that was the seventh warmest on record in central and southern Arizona. The northern half of New Mexico averaged between 2 and 4 degrees cooler than average.

Figure 1a. Water year '08–'09 (through October 14, 2009) average temperature.

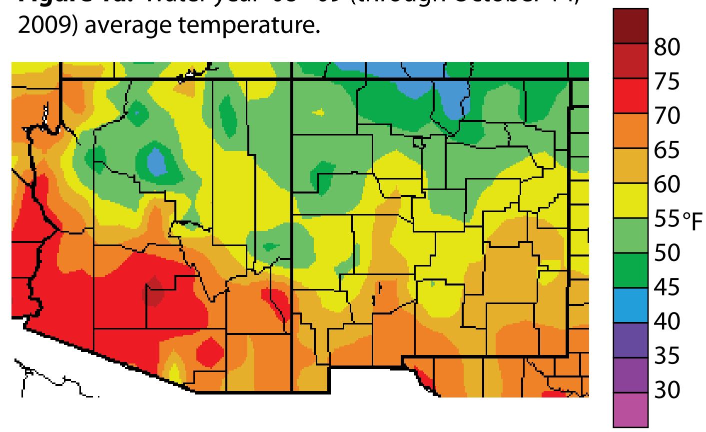


Figure 1b. Water year '08–'09 (through October 14, 2009) departure from average temperature.

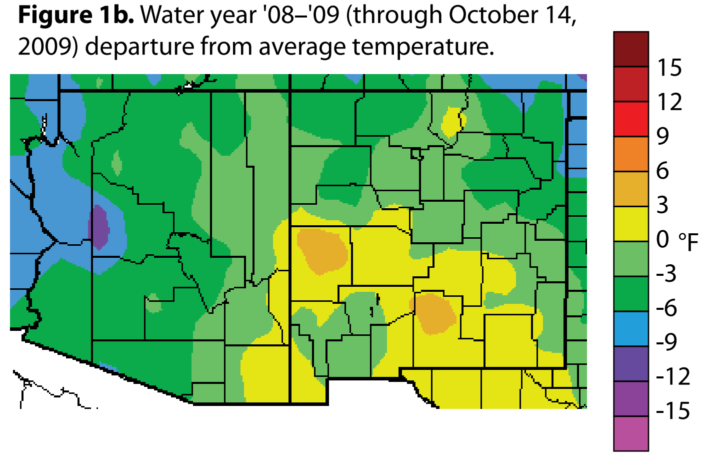


Figure 1c. Previous 30 days (September 15–October 14, 2009) departure from average temperature (interpolated).

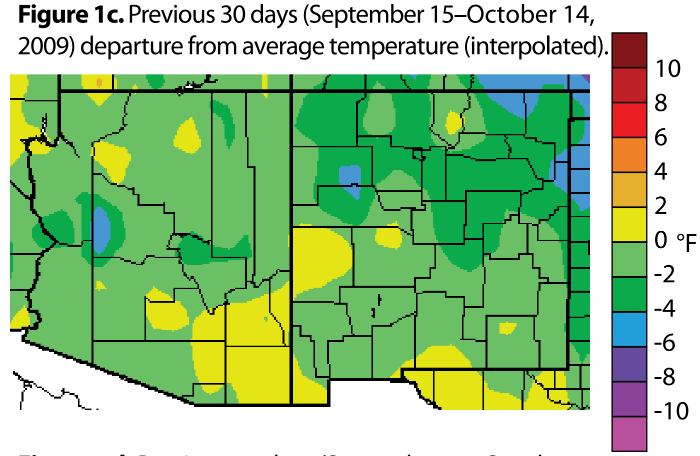
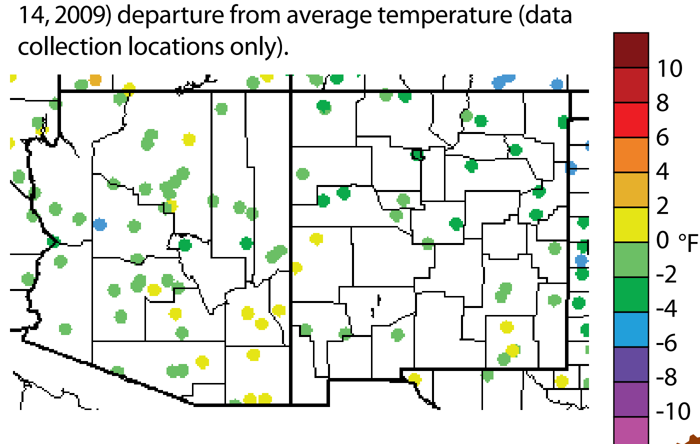


Figure 1d. Previous 30 days (September 15–October 14, 2009) departure from average temperature (data collection locations only).



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 10/14/09)

Source: High Plains Regional Climate Center

The 2010 water year, which began Oct. 1, is off to a dry start (Figures 2a–b). Southwestern and south-central Arizona and central New Mexico have received less than 2 percent of average precipitation. In Arizona, only the north rim of the Grand Canyon and the southern border near Douglas have received more than 50 percent of average rainfall. Most of New Mexico has faired better. Southern New Mexico has received 0–50 percent of average precipitation. The northern third of the state, however, has received between 50 and 100 percent, and the Sangre de Cristo Mountains in north-central New Mexico have received between 100 and 150 percent of average precipitation. The few areas with above-average precipitation benefitted from a strong cold front that moved across Utah, Colorado, and northern New Mexico at the beginning of October.

The past 30 days have been extremely dry across all of Arizona—a continuation of a very dry monsoon (Figures 2c–d). New Mexico, on the other hand, saw more moisture during the summer and the past 30 days. Since mid-September, moisture from the Southwest has flowed across central New Mexico, causing rainfall amounts totaling 100–200 percent of 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 October 14, 2009) percent of average precipitation (interpolated).

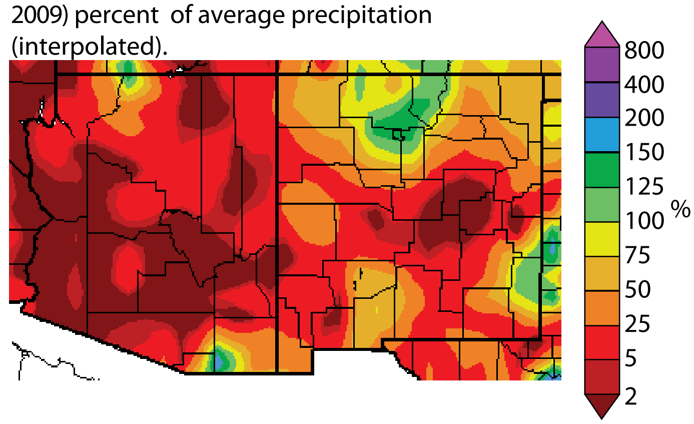


Figure 2b. Water year '08–'09 (through October 14, 2009) percent of average precipitation (data collection locations only).

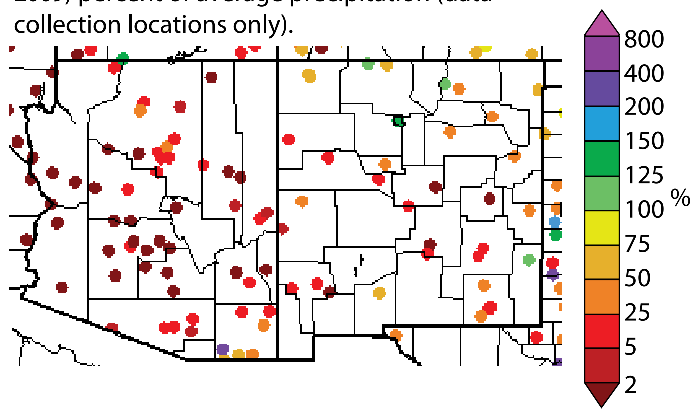


Figure 2c. Previous 30 days (September 15–October 14, 2009) percent of average precipitation (interpolated).

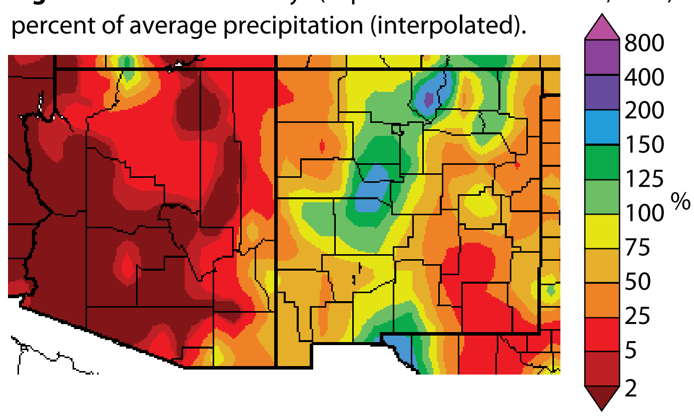
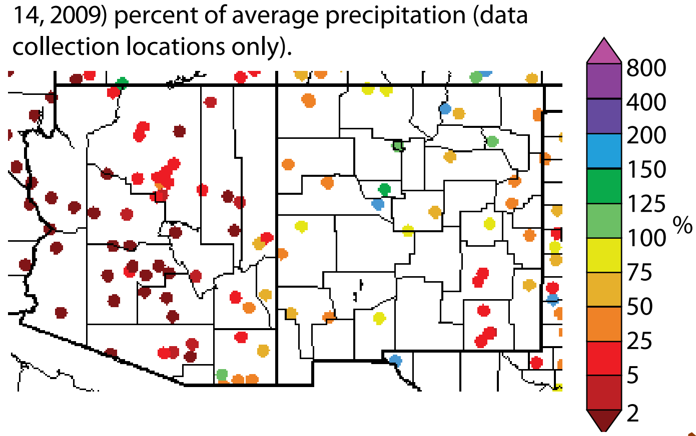


Figure 2d. Previous 30 days (September 15–October 14, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 10/15/09)

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

Moderate to severe drought conditions persisted again this month in many parts of the West, with severe drought expanding dramatically across Arizona due to impacts from an exceptionally dry summer monsoon season (Figure 3). The area of western states impacted by drought conditions has risen steadily over the past several months, from near 45 percent in mid-July to more than 58 percent in mid-October. Abnormally dry conditions or worse blanket Washington, Oregon, and California and include much of Nevada and all of Arizona. The interior West, including Utah, Wyoming, Idaho, Montana, and Colorado, is largely devoid of drought conditions, as above-average spring and summer precipitation helped keep short-term drought conditions at bay.

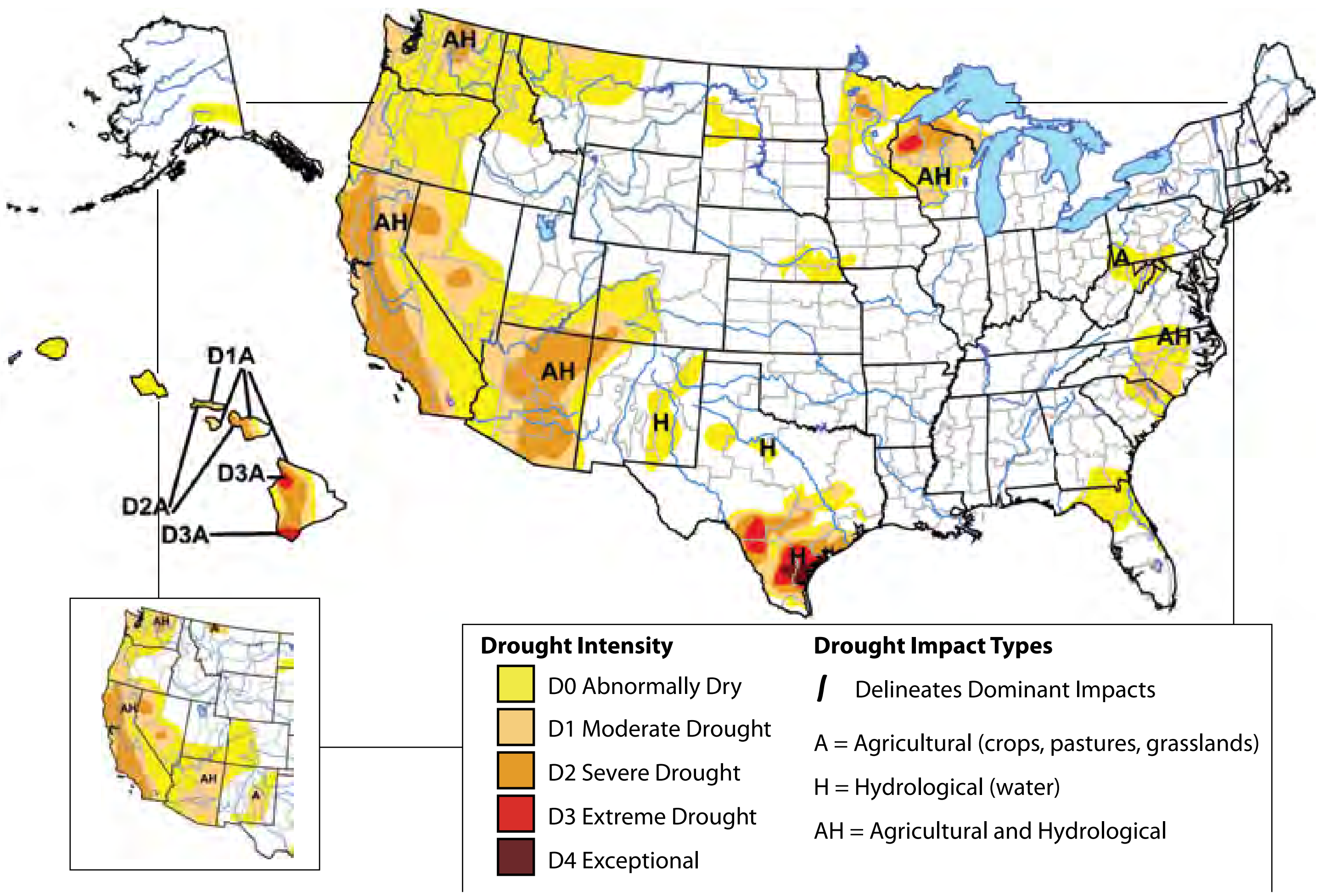
In drought-related news, a coastal storm that pummeled the San Francisco Bay area with more than 10 inches of rain in some places helped bring some drought relief to California but didn't erase current drought conditions (*San Francisco Chronicle*, October 15). A California Department of Water Resources meteorologist said the recent storm did not do much for the state's water supply, which currently stands at 72 percent of average capacity.

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 Rich Tinker, CPC/NCEP/NWS/NOAA.

Figure 3. Drought Monitor released October 15, 2009 (full size), and September 17, 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 10/15/09)

Source: U.S. Drought Monitor

Unusually dry conditions persisted again this past month and worsened short-term drought conditions across Arizona (Figure 4a). The October 13 update of the U.S. National Drought Monitor shows a dramatic expansion in moderate and severe drought conditions across the state since last month. All of Arizona is experiencing some level of drought, and more than 50 percent is classified in the severe drought category (Figure 4b). The rapid expansion of severe drought conditions across eastern Arizona reflects the lack of summer monsoon precipitation from July through September; Arizona experienced the fourth driest August since 1896.

Numerous drought impacts have been reported in recent months on the online reporting system "Arizona DroughtWatch." Many effects are located in southeast Arizona, where summer rainfall was less than 70 percent of its historical average in many places. Several resource managers in this region report that many perennial streams have very low flows or are completely dry, which is unusual for this time of year. Ranchers also report impacts, noting that drought has reduced forage nutritional quality and quantity and desiccated stock ponds. The conditions have caused some ranchers to sell livestock. Rangeland experts also report that seed production of grasses was lower than normal due to drought stress, which could impact the recovery of range conditions next summer. Crop production in this region was also impacted, with local farmers reporting below-average yields, poor crop quality, and unusual levels of crop damage from wildlife.

Figure 4a. Arizona drought map based on data through October 13, 2009.

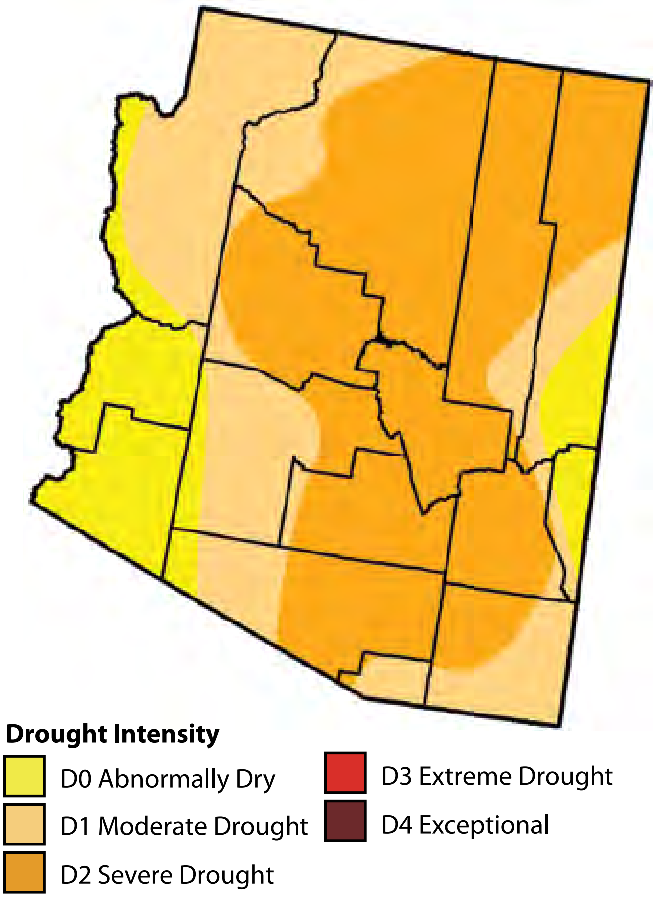


Figure 4b. Percent of Arizona designated with drought conditions based on data through October 13, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	84.6	53.5	0.0	0.0
Last Week (10/06/2009 map)	1.4	98.6	80.3	10.7	0.0	0.0
3 Months Ago (07/21/2009 map)	45.8	54.2	0.0	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 (10/06/2009 map)	1.4	98.6	80.3	10.7	0.0	0.0
One Year Ago (10/14/2008 map)	83.1	16.9	1.0	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

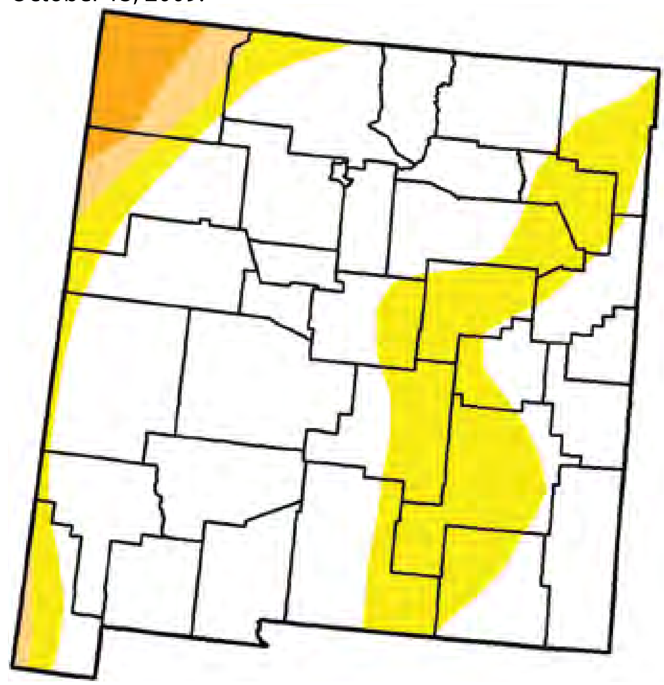
New Mexico Drought Status
(released 10/15/09)

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

New Mexico continues to be mostly drought free due to decent monsoon precipitation during the summer months and above-average precipitation across western parts of the state during the past 30 days (Figure 5a). The October 13 update of the National Drought Monitor reports that about 71 percent of the state is absent of a drought classification, an approximately 7 percent increase of drought-free area from last month (Figure 5b). However, a small band of abnormally dry conditions lingers over eastern New Mexico, and a small area of moderate to severe drought conditions is emerging across the far northwestern corner of the state, due to scant summer precipitation. This area has observed less than 50 percent of average precipitation over the past 90 days.

In water-related news, developers in western states including New Mexico are rethinking lawns in new planned communities (*Wall Street Journal*, October 13). Lush lawns that require thousands of gallons of water each month are difficult to justify in the Southwest US, where water scarcity is a concern. Through rebate programs, water agencies are helping encourage existing home owners to take radical water conservation measures by tearing out their existing lawns and landscaping with drought-tolerant plants.

Figure 5a. New Mexico drought map based on data through October 13, 2009.



Drought Intensity

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

Figure 5b. Percent of New Mexico designated with drought conditions based on data through October 13, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	70.7	29.3	5.5	2.7	0.0	0.0
Last Week (10/06/2009 map)	72.2	27.8	3.4	0.0	0.0	0.0
3 Months Ago (07/21/2009 map)	56.5	43.5	20.7	3.8	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 (10/06/2009 map)	72.2	27.8	3.4	0.0	0.0	0.0
One Year Ago (10/14/2008 map)	80.6	19.4	1.6	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 9/30/09)

Source: NRCS, National Water and Climate Center

Water storage in Lake Powell dropped 246,000 acre-feet in September to 64 percent of capacity. The level of Lake Mead declined slightly to about 1,094 feet above sea level, lowering it to within 18 feet of the first stage of water allocation reductions. Water levels in all eight Arizona reservoirs reported below declined during September (Figure 6). San Carlos Reservoir currently holds only 3 percent of its capacity—a level not experienced since 2004. Although storage in the Salt and Verde river basin systems declined in September, they are still well above average.

In water-related news, Mesa, Ariz., has asked 350 homeowners associations and 200 apartment communities to conserve water by limiting or eliminating lawn overseeding, which means sowing seed over existing grass in order to fill in the bare patches (abc15.com, October 3). City officials estimate that voluntary overseeding reductions can save approximately 40 million gallons of water, enough to serve 1,700 homes.

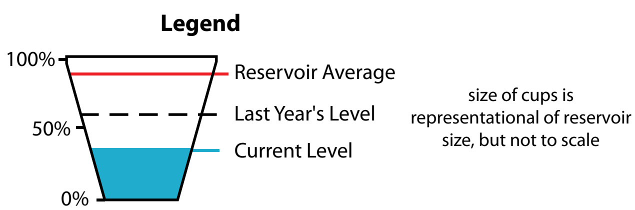
Notes:

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.

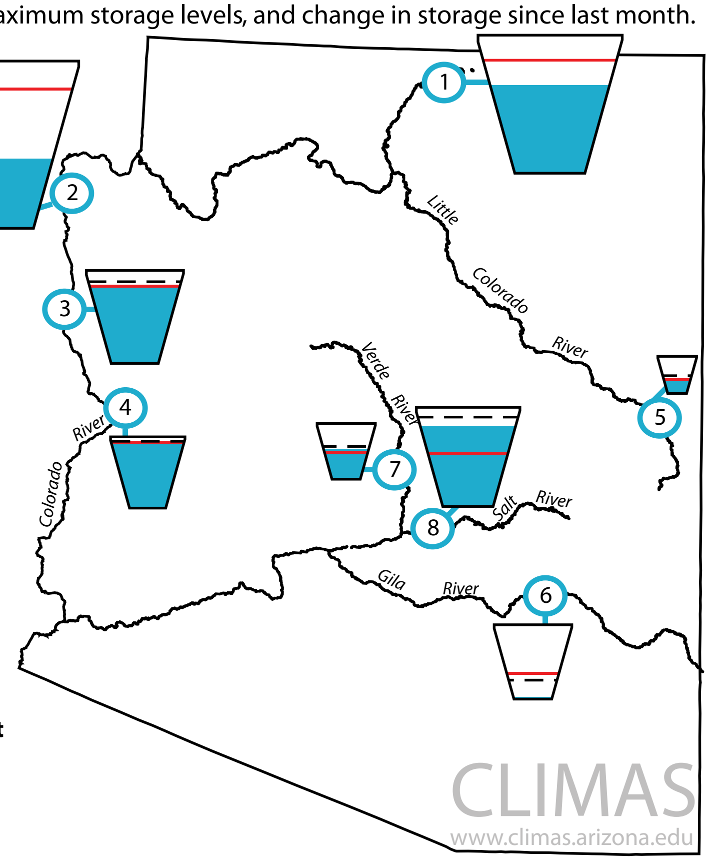
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for September 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	64%	15,464.0	24,322.0	-246.0
2. Lake Mead	42%	10,933.0	26,159.0	-5.0
3. Lake Mohave	83%	1,501.3	1,810.0	-167.4
4. Lake Havasu	91%	564.1	619.0	-19.6
5. Lyman Reservoir	37%	11.1	30.0	-0.8
6. San Carlos	3%	25.5	875.0	-11.1
7. Verde River System	54%	156.0	287.4	-8.5
8. Salt River System	81%	1,642.8	2,025.8	-75.4

*** 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 9/30/09)

Source: NRCS, National Water and Climate Center

The total reservoir storage in New Mexico declined by about 88,000 acre-feet in September. Heron Reservoir levels had the largest drop, falling 45,000 acre-feet. Elephant Butte Reservoir, which declined by more than 18,000 acre-feet, is currently only at 20 percent of capacity, well below its historical September average of 55 percent (Figure 7). Eastern New Mexico reservoirs—Brantley, Sumner, and Conchas—reported increases in storage.

In water-related news, the $216 million Buckman Direct Diversion project aimed at reducing reliance on Santa Fe River reservoirs is progressing as planned and within budget (*Santa Fe New Mexican*, October 5). The project diverts water from the Rio Grande to provide drinking water to Santa Fe and the surrounding county.

Notes:

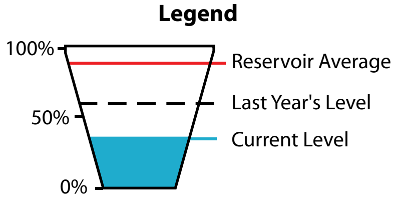
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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.

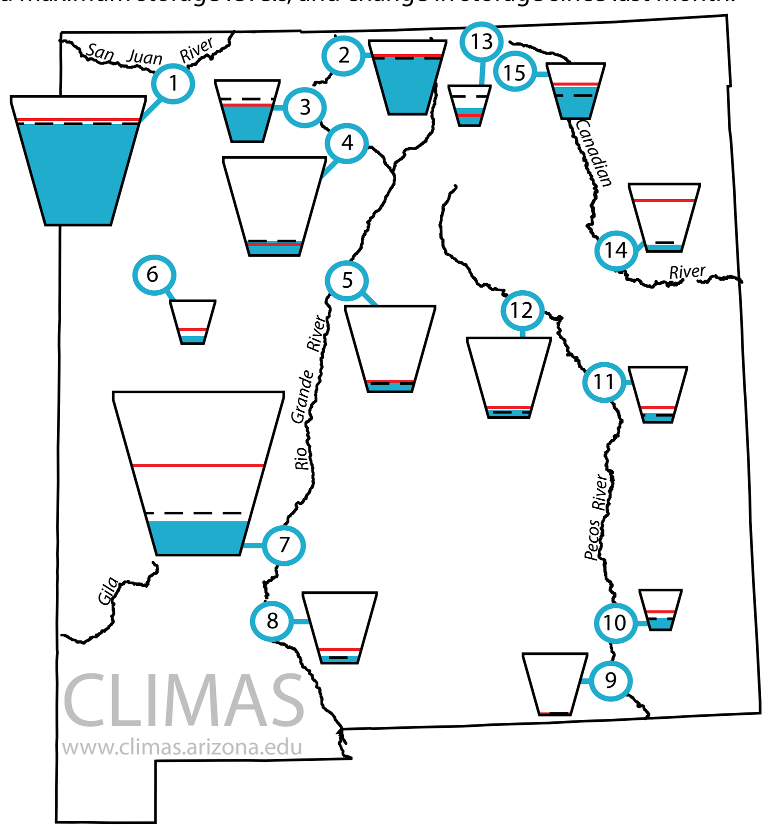
Figure 7. New Mexico reservoir levels for September 2009 as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



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

Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	77%	1314.1	1,696.0	-33.2
2. Heron	68%	273.6	400.0	-45.0
3. El Vado	68%	128.8	190.3	8.6
4. Abiquiu	15%	181.6	1192.8	0.9
5. Cochiti	11%	52.7	491.0	0.4
6. Bluewater	19%	7.4	38.5	0.7
7. Elephant Butte	20%	448.4	2,195.0	-18.4
8. Caballo	10%	33.4	332.0	-7.0
9. Brantley	2%	16.5	1008.2	1.4
10. Lake Avalon	30%	1.2	4.0	-0.5
11. Sumner	16%	16.4	102.0	5.3
12. Santa Rosa	10%	44.6	438.3	-0.7
13. Costilla	34%	5.5	16.0	-1.5
14. Conchas	11%	27.8	254.2	1.5
15. Eagle Nest	56%	44.6	79.0	-0.7



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

Temperature Outlook

(November 2009–April 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 temperatures throughout the rest of fall and into winter. For Arizona, the forecast through January calls for a slight chance that temperatures will be similar to those of the warmest 10 years of the 1971–2000 observed record (Figure 8a). As the forecast proceeds into winter, there is still an increased probability that the Southwest will experience warmer-than-average temperatures, although the forecast for much of southern Arizona and southern New Mexico moves to equal chances of above-, below-, and near-normal temperatures from December through the spring (Figures 8b–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 8a. Long-lead national temperature forecast for November 2009–January 2010.

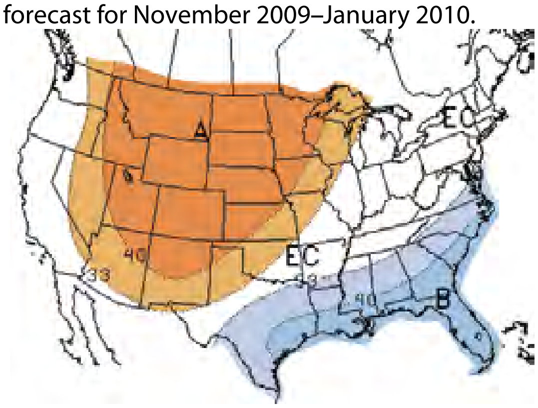
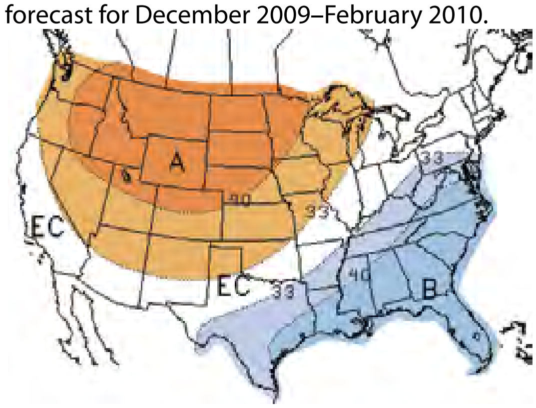


Figure 8b. Long-lead national temperature forecast for December 2009–February 2010.



A= Above

50.0–59.9%
40.0–49.9%
33.3–39.9%

B=Below

40.0–49.9%
33.3–39.9%

Figure 8c. Long-lead national temperature forecast for January–March 2010.

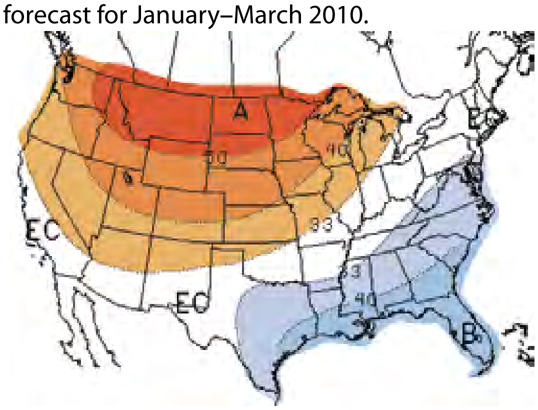
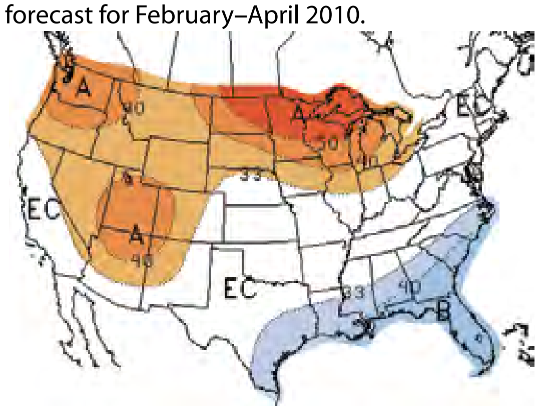


Figure 8d. Long-lead national temperature forecast for February–April 2010.



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
(November 2009–April 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (NOAA–CPC) long-lead precipitation outlooks through April 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 (Figures 9a–d). These outlooks rely heavily on the expected impacts of the current El Niño event, which typically brings wetter winter conditions to the southern part of the US and drier conditions to the Northwest and Ohio and Mississippi valleys.

For Arizona and New Mexico, the forecast through the end of 2009 and into January 2010 indicate equal chances of above-, below-, and near-average precipitation (Figure 9a). The outlook through April for the southern portions of 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.

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.

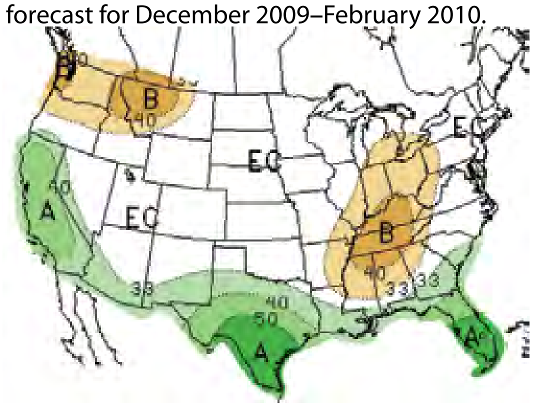
The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with 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 9a. Long-lead national precipitation forecast for November 2009–January 2010.

Figure 9b. Long-lead national precipitation forecast for December 2009–February 2010.



B= Below
33.3–39.9%
40.0–49.9%

Figure 9c. Long-lead national precipitation forecast for January–March 2010.

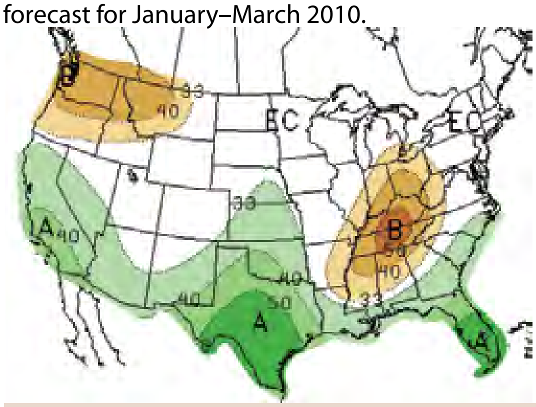
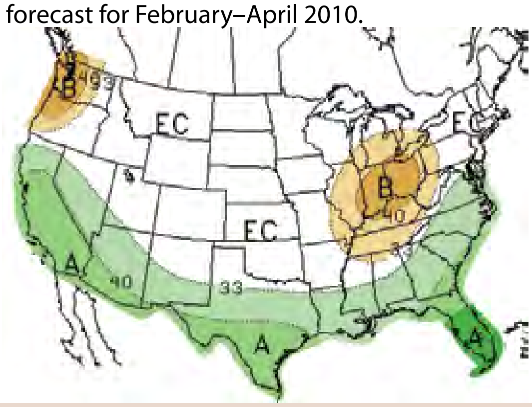


Figure 9d. Long-lead national precipitation forecast for February–April 2010.



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 January 2010)

Source: NOAA-Climate Prediction Center (CPC)

This summary is excerpted and edited from the October 15 Seasonal Drought Summary produced by the CPC and written by forecaster Anthony Artusa.

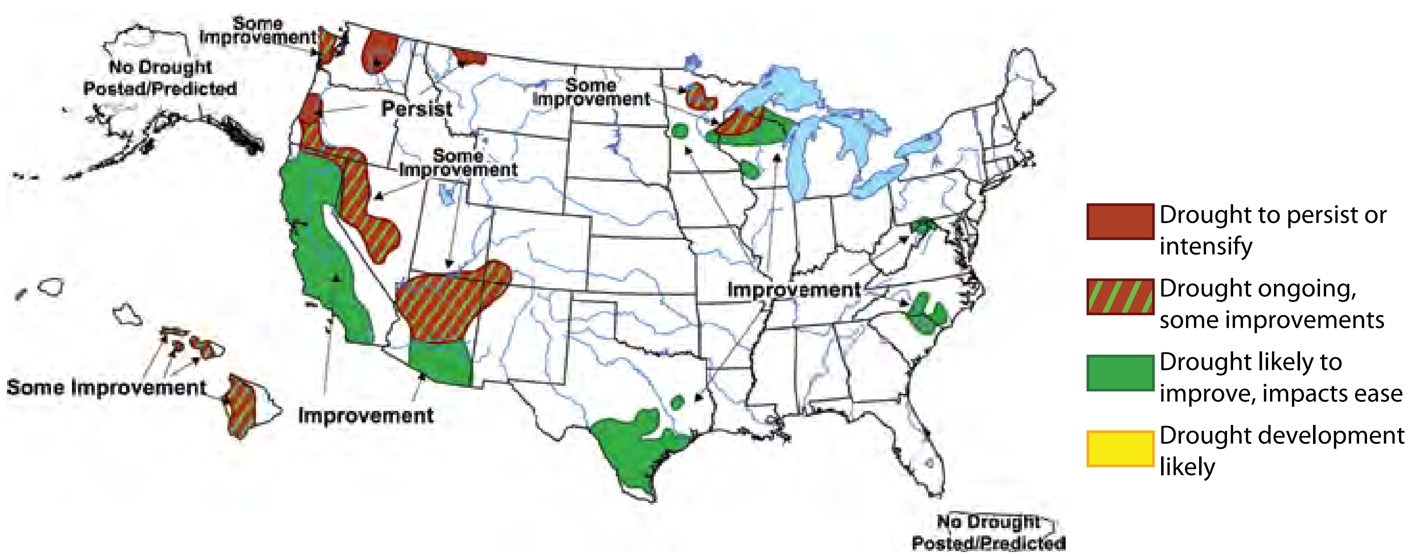
Across the Southwest drought has expanded and intensified during the summer and early fall. For the past 90 days, the weak summer monsoon rainfall caused rainfall deficits of 2 to 6 inches in many parts of the Southwest. For most of Arizona, this corresponds to 25 to 50 percent of average rainfall. Northern Arizona in particular received only 10 to 25 percent of its average rainfall in the past three months. Current predictions suggest the drought will continue through November and even January. A consensus of various soil moisture models and analytical tools provides reasonable—but not unanimous—support for the current drought outlook that suggests improvement for California and southern Arizona (Figure 10). The forecast also tilts the odds in favor of some improvement for central and northern Arizona. However, forecasters have low to moderate confidence in these outlooks.

Elsewhere in the US, heavy rains and mountain snows during the first half of October brought significant relief to many of the drought areas across the country, especially California. Short-term drought conditions in much of Texas have been eliminated due to recent rains. However, longer-term hydrologic impacts will remain for awhile, especially in southern Texas. Elsewhere, a series of frontal systems brought heavy rains to the East Coast, resulting in substantial mitigation of drought conditions. The same is true of the upper Midwest, although long-term drought areas in northwestern Wisconsin and northern Minnesota still need significant rain or snow. West of the Continental Divide in the Rocky Mountains, forecasts call for some drought improvement for northwest Nevada and Washington's Olympic Peninsula. Despite precipitation expected during the last half of October, drought persistence is indicated for central Washington and northwest Montana.

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 10. Seasonal drought outlook through January 2010 (released October 15, 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)

Weak El Niño conditions were present again this month, according to the NOAA–Climate Prediction Center (NOAA–CPC). Sea surface temperatures (SSTs) in the eastern Pacific Ocean cooled slightly to 0.83 degrees Celsius above average from 0.9 degrees C last month, but were still warm enough to be classified as a weak El Niño. Intermittent bursts of westerly winds during the past month have pushed warm water eastward along the equator, helping maintain the above-average SSTs in the eastern Pacific Ocean. The Southern Oscillation Index (SOI) was near zero again this month, indicating that the atmosphere has yet to respond to the current El Niño event (Figure 11a). The International Research Institute for Climate and Society states that the warm water areas are patchy and have not amassed into a structured unit, which may be delaying an atmospheric response. The IRI also states that this pattern is unfavorable for a strengthening of El Niño conditions in the short-term, but a powerful storm system could boost the strength of the El Niño event in the next few months.

Almost all forecast models indicate that at least weak El Niño conditions will persist through next spring. IRI's probabilistic forecast shows at least an 85 percent chance that El Niño conditions will persist through the January–March season (Figure 11b). The chance that an El Niño event will persist through the March–May period falls to 50 percent, and a return to neutral conditions becomes more probable by March. In the meantime, weak to moderate El Niño conditions likely will bring an increased chance of above-average precipitation during late fall and early winter across southern Arizona and New Mexico.

Notes:

The first figure 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.

The second figure shows the International Research Institute for Climate and Society (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, 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 11a. The standardized values of the Southern Oscillation Index from January 1980–September 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).

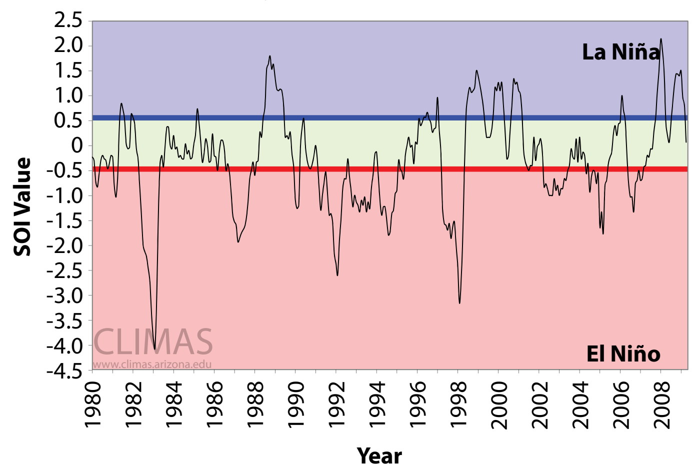
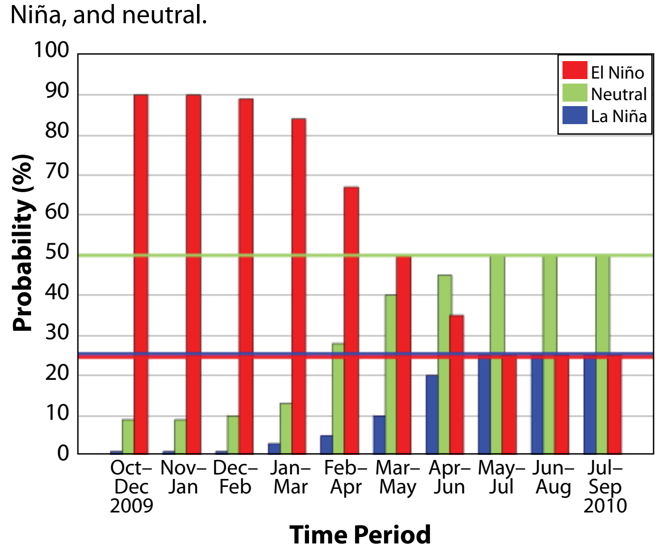


Figure 11b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released October 15, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(November 2009–April 2010)

Source: Forecast Evaluation Tool

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

Comparisons of observed temperatures for November–January to forecasts issued in October for the one-month lead time covering the same period suggest that forecasts are most reliable in southeast and northwest Arizona and southern New Mexico (Figure 12a). Forecast skill—a measure of the accuracy of the forecast—for 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 October for December–February) suggest that for most of Arizona and New Mexico, forecasts have been slightly more accurate than the equal chances forecast (Figure 12b). The most accurate forecasts for this time period have again been for northwestern Arizona. The three-month lead time forecast has been more accurate than equal chances in all regions of Arizona and New Mexico (Figure 12c). Regions with bluish hues suggest that the NOAA–Climate Predictions Center (NOAA–CPC) forecasts have historically been more accurate than equal chances. However, 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 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.

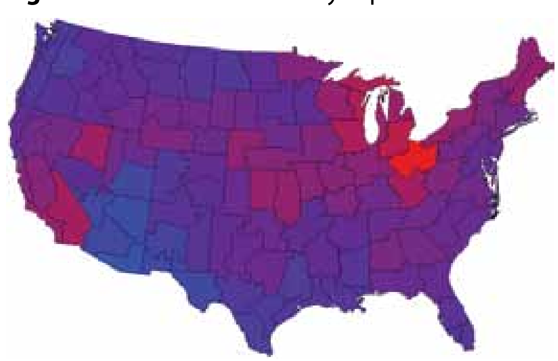
The RPSS is calculated by comparing all the forecasts made since December 1994 for particular seasons and specified lead times to the actual weather of the season.

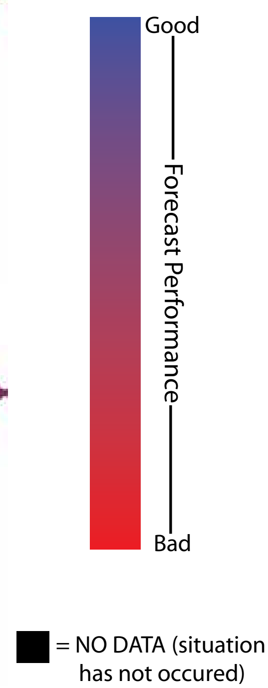
Figure 12a. RPSS for November 2009–January 2010.

Figure 12b. RPSS for December 2009–February 2010.

Figure 12c. RPSS for January–March 2010.

Figure 12d. RPSS for February–April 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
(November 2009–April 2010)

Source: Forecast Evaluation Tool

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

Comparisons of observed precipitation for November–January to forecasts issued in October for the one-month lead time covering the same period suggest that forecast skill—a measure of the accuracy of the forecast—is only slightly better than equal chances for most of Arizona and New Mexico, and worse than equal chances in northern New Mexico (Figure 13a). Forecasts issued in October for the two-month lead time (the December–February period), however, have been better than equal chances in all of the Southwest, with the most accurate forecasts corresponding to southeast Arizona and southwest New Mexico (Figures 13b). For the three-month forecasts covering January–March, historical forecasts have been most accurate in southeast Arizona and southwest New Mexico (Figure 13c). The four-month lead forecasts spanning February to April have displayed skill in all regions except northern New Mexico (Figure 13d). At all lead times in Arizona, October forecasts have displayed the highest skill in southeast Arizona (Figures 13a–d). NOAA–Climate Predictions Center (NOAA–CPC) forecasts have historically been more accurate than equal chances. However, 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 13a. RPSS for November 2009–January 2010.

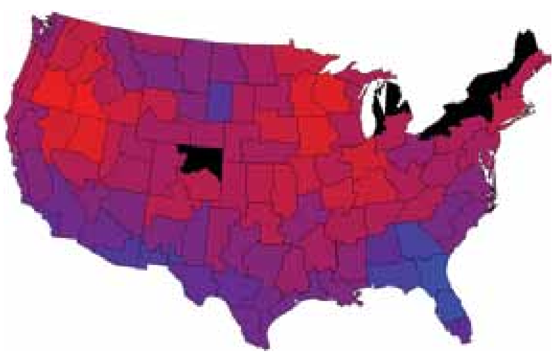


Figure 13b. RPSS for December 2009–February 2010.

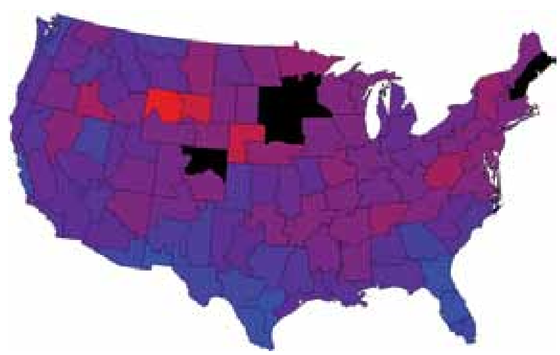


Figure 13c. RPSS for January–March 2010.

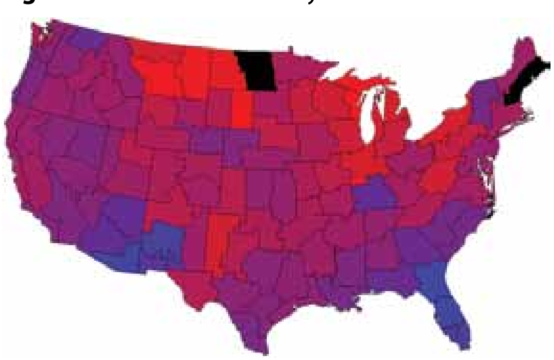
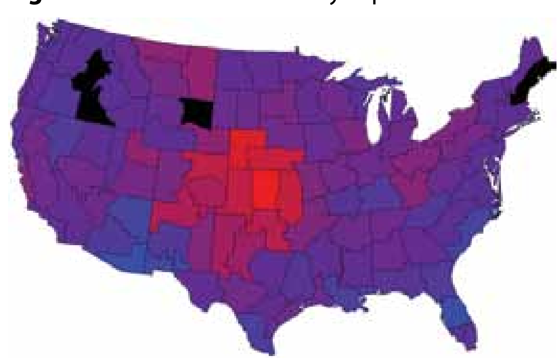
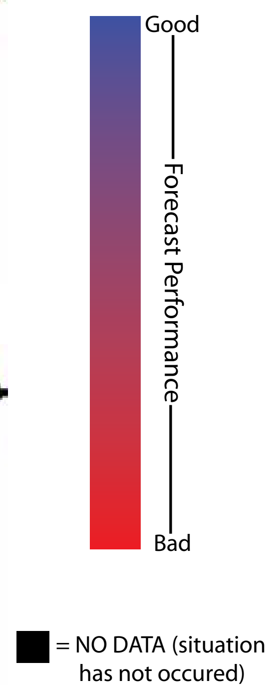


Figure 13d. RPSS for February–April 2010.





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