October 27, 2011

Southwest Climate Outlook

Vol. 10 Issue 10

Credit: CLIMAS

The issue features the summaries of the 2011 water year, which began on October 1, 2010 and ended on September 30, 2011. It was marked by changes in reservoir storage, drought, and many other climate and weather conditions.

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In this issue...

October Climate Summary

Drought- The drought situation has changed very little across the Southwest over the past 30 days, with all of Arizona and almost all of New Mexico still experiencing some level of drought. More than 40 percent of Arizona and 85 percent of New Mexico are experiencing severe or more intense drought.

Temperature- It has been a cooler-than-average start to the water year in northern Arizona and New Mexico. Southeastern New Mexico continues to be hot.

Precipitation- The past 30 days have been wetter than average in parts of the northern tier of Arizona and New Mexico, but dry conditions continue in the southern part of both states.

ENSO- Confidence has increased that the La Niña event will stick around this winter and likely deliver below-average precipitation to most of Arizona and New Mexico for the second consecutive year.

Climate Forecasts- Seasonal forecasts call for increased chances for above-average temperatures and below-average precipitation through the winter.

The Bottom Line- Drought conditions currently grip most of the Southwest and there is little indication this will change in the coming months. A pool of cold water beneath the sea surface in the tropical Pacific Ocean likely will maintain at least a weak La Niña event through the winter. Because La Niña conditions often cause winter storms to track north of the Southwest, precipitation forecasts call for below-average rain and snow and drought is expected to expand and intensify across the region. La Niña events often enable the jet stream to meander more in a north-south direction, which can cause Arctic air to flow into the Southwest. This occurred in February 2011 when record-cold weather froze plants and pipes throughout the region.

A Multi-Level Government Approach to Climate Change Benefits All

Climate change affects everyone on the globe, from people living in industrial nations to rural subsistence farmers in developing regions. Such a global issue might seem to require a global response. Indeed, nations that are party to the United Nations Framework Convention on Climate Change are working to promote an international response to climate change and are developing national policies, although substantial progress remains slow, particularly in the U.S.

Does this mean that anything less than global- and national-level efforts isn't worthwhile? Definitely not. *Navigating Climate Change Policy: the Opportunities of Federalism*, a new book published by the University of Arizona Press, argues that our federal system of government, in which power is divided among a national government and state and regional governments, is actually well-suited to address the challenges of climate change because it allows for policy responses at multiple scales—from the national to the local. *Navigating Climate Change Policy* demonstrates that climate change policy need not be an either/or matter —either federal or state—and explores policy-making processes that draw upon the strength of multiple levels of government. While a coordinated effort sufficient to combat global warming has yet to materialize, significant reductions in greenhouse gas emissions—which play a dominant role in global warming—can indeed be made at local, state, and regional levels.

Read more about *Navigating Climate Change Policy* on the Southwest Climate Change Network Blog: http://www.southwestclimatechange.org/blog/12902

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2011 Water Year in Review

Introduction

The 2011 Water Year in Review is a summary of the information presented in the Southwest Climate Outlook between October 1, 2010, and September 30, 2011. The water year is a standard period of measurement used in hydrology because the natural seasonal groundwater recharge and discharge cycles are more aligned with the October–September period than the calendar year due to precipitation and evaporation. This review highlights precipitation, temperature, reservoir levels, drought, wildfire, and El Niño–Southern Oscillation (ENSO) conditions.

The 2011 water year may be best remembered for extreme events, fueled in part by the presence of a moderate to strong La Niña. At the beginning of the water year, Arizona and New Mexico were largely drought-free. By the end of the water year, however, about 25 percent of Arizona was classified with extreme drought and 36 percent of New Mexico fell into the exceptional drought category. Extreme and exceptional droughts occur, on average, once in every 20 and 50 years, respectively. These dry conditions set the stage for widespread and intense fires, which burned at record levels in both states. The fires, in turn, facilitated flash floods in the summer as rains streamed off denuded landscapes. The dry conditions continued in the summer with a generally lackluster monsoon, particularly in southeastern New Mexico where a persistent high-pressure zone inhibited monsoon storms. Temperatures also soared during the monsoon—Arizona and New Mexico endured their hottest August on record. To top it off, enormous dust storms, or haboobs, plowed through central Arizona throughout the monsoon with greater-than-average frequency.

But not all the news was grim. Copious winter snows in the Upper Colorado River Basin helped fill the region's most important reservoirs, likely postponing water conservation measures that seemed imminent just one year ago.

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Top 5 headlines of the water year

1 Scant Winter Rain and Snow Precious rain and little snow fell in Arizona and New Mexico between November 2010 and March 2011. The five-month total for Arizona ranked as the 28th driest winter in the last 117 years, while New Mexico had the 5th driest, receiving an average of only 1.36 inches of rain and snow. The driest conditions blanketed the southern tier of both states. The lack of winter precipitation set the stage for expansive fires and widespread drought.

2 Record-Setting Fire Season Until the monsoon began in early July, parts of Arizona and New Mexico had not received a drop of rain for more than 90 days. The dry weather combined with hot temperatures and wind to create the perfect firestorm. More than 1 million acres burned in each state between January 1 and September 30. More than 538,000 acres alone burned in Arizona's largest wildfire, the Wallow Fire.

3 Storage Jumps in Lakes Powell and Mead While Arizona and New Mexico experienced a dry winter, the mountains in the Upper Colorado River Basin (UCRB) were blanketed in snow. As a result, combined water storage in Lakes Mead and Powell increased by about 5.2 million acre-feet (maf) during the water year and currently stands at about 61 percent of capacity. Unregulated flow into Lake Powell for the water year, which is used to gauge water delivery in the UCRB, will likely be around 16.8 maf, or about 140 percent of average.

4 Drought Expands and Intensifies Almost all of Arizona and New Mexico experienced below-average precipitation during the water year. A dry winter followed by a generally drier-than-average monsoon caused drought conditions to expand and intensify. In Arizona, moderate or more severe drought expanded by about 50 percent during the water year. New Mexico experienced a jump of about 96 percent—more than 36 percent of the state went from no drought to exceptional drought.

5 La Niña Sticks Around A moderate to strong La Niña event developed in August 2010 and played a major role in delivering dry conditions to the region during the winter. After a brief hiatus this summer, La Niña returned in September and likely will bring continued dry weather to the region. Moderate and strong La Niña events often persist for consecutive winters.

WYIR, continued

Precipitation

Precipitation across nearly the entire Southwest was below average for the water year, causing drought conditions to expand and intensify. Northwest Arizona, which was slammed with a strong winter storm in December that helped boost precipitation totals, was one of only a few regions to receive copious rain and snow. Precipitation ranged from 4 inches above average in northwestern Arizona to 8 inches below average across the rest of the state and most of New Mexico (*Figure 1a*). The southeastern half of New Mexico experienced the driest conditions, receiving 8–16 inches below average precipitation. This is a substantial shortfall—the region typically receives an average of 16–24 inches of rain and snow. Northwestern Arizona, the only region with above-average precipitation, received 100–150 percent of average rain and snowfall (*Figure 1b*). The Colorado Plateau in Arizona, the eastern border of Arizona, and the northwestern quarter of New Mexico received 50–90 percent of average precipitation. The driest spots were southwestern Arizona and the entire southeastern half of New Mexico, where precipitation totaled less than 50 percent of average. A few isolated locations in Eddy and Lea counties and southern Grant County in New Mexico received less than 25 percent of average. In the major southwestern cities, only Flagstaff received above-average rain and snowfall, while Albuquerque and El Paso received less than half of their average precipitation (*Table 1*).

The lack of precipitation was in part due to the La Niña event, which helped steer winter storms north of the region. The monsoon also produced spotty and generally below-average rainfall. The dry water year is particularly devastating to groundwater aquifers and streamflow ,as the lack of consistent precipitation reduces the soil moisture and inhibits recharge even when rain does fall.

Figure 1a. Water year 2011 (October 1, 2010 through September 30, 2011) departure from normal precipitation.*

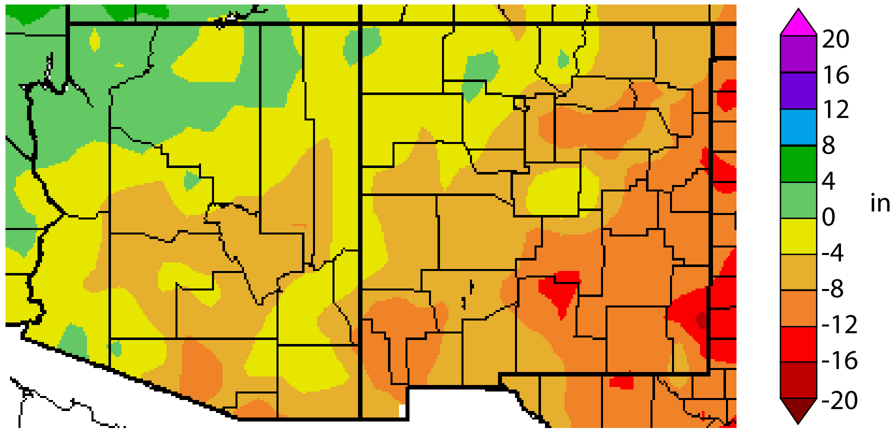
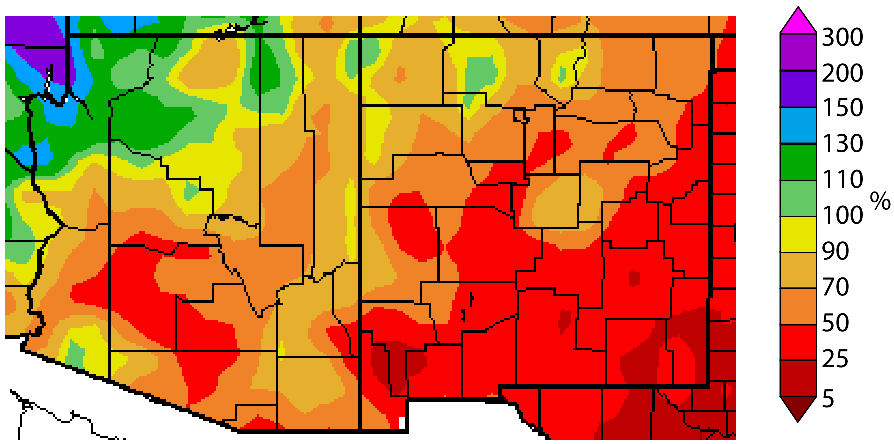


Figure 1b. Water year 2011 (October 1, 2010 through September 30, 2011) percent of average precipitation.*



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

Table 1. Water year 2011 precipitation values (in inches) for select cities.

City	WY 2011 Precipitation	Average WY Precipitation	2011 Departure from Average	2010 Departure from Average
Phoenix, AZ	4.38	8.03	-3.56	-0.41
Tucson, AZ	10.09	11.59	-1.50	-1.48
Douglas, AZ	7.12	13.10	-5.98	-0.68
Flagstaff, AZ	22.80	22.19	0.61	0.80
Yuma, AZ	1.67	3.56	-1.89	1.36
Albuqu.,NM	3.26	9.47	-6.21	-0.16
Winslow, NM	6.03	7.40	-1.37	-2.31
El Paso, TX	4.63	9.83	-5.20	-1.08

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WYIR, continued

Temperature

Only a handful of areas in Arizona and New Mexico saw the mercury dip to below-average temperatures during the 2011 water year. The southwest deserts of Arizona were 60—75 degrees Fehrenheit, while the Colorado Plateau and the northern two-thirds of New Mexico were 40—60 degrees F (*Figure 2a*). In Arizona, the dividing line between the warmer temperatures to the south and the cooler temperatures to the north followed the elevation changes of the Mogollon Rim. In New Mexico the temperature gradient reflected both the paths of winter storms and the Continental Divide—temperatures are generally warmer east of the divide.

Temperatures were generally 1 degree F warmer than average across northern Arizona and between 1 and 2 degrees F warmer than average in the southern half of the state (*Figure 2b*). The Phoenix metropolitan area recorded temperatures between 2 to 4 degrees warmer than average. The warmer urban temperatures were largely due to the urban heat island. The area around Bagdad in west-central Arizona that appears to be 2–4 degrees colder than average is caused by a station location change rather than cold conditions.

More dramatic warm conditions settled over the eastern third of New Mexico, including Lincoln and Otero counties, where temperatures were 4–5 degrees F warmer than average.

A major cause of the warmer conditions across both states was the La Niña event that persisted during the 2010–2011 winter. The moderate to strong La Niña caused cold winter storms to remain north of Arizona and New Mexico. The general lack of summer rain also contributed to above-average temperatures. This was particularly evident in eastern New Mexico, where a persistent ridge of high pressure inhibited monsoon storms. The high pressure created clear skies and the lack of cooling rainfall kept nighttime temperatures high, sustaining warmer daytime temperatures.

Figure 2a. Water year 2011 (October 1, 2010 through September 30, 2011) average temperature.*

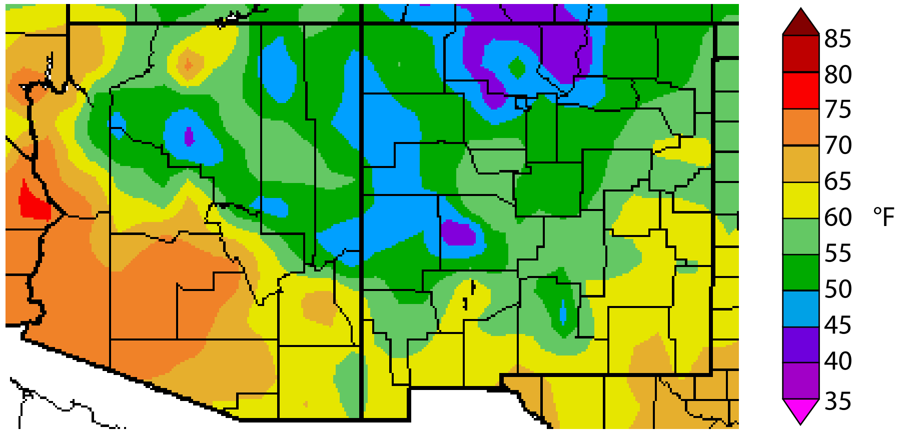
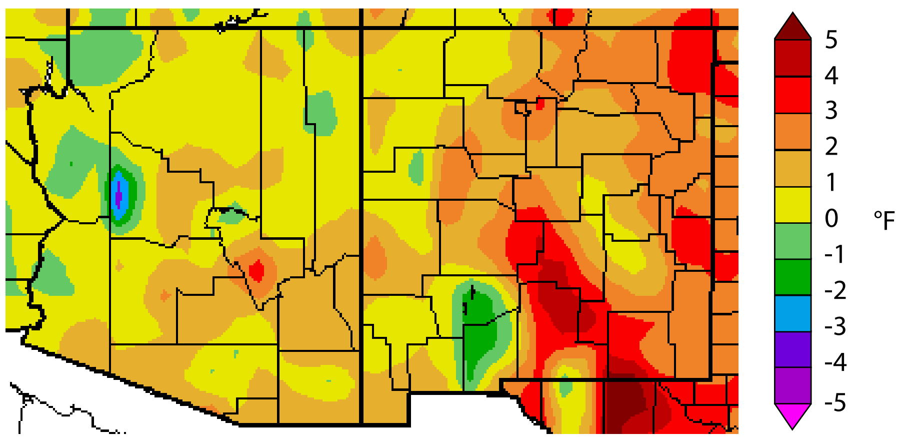


Figure 2b. Water year 2011 (October 1, 2010 through September 30, 2011) departure from average temperature*



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

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WYIR, continued

Reservoirs

Arizona. Total reservoir storage in the three large reservoir systems within Arizona's borders—San Carlos Reservoir on the Gila River and the Salt and Verde river reservoir systems—decreased by about 951,000 acre-feet during the 2011 water year. Levels in the San Carlos Reservoir decreased substantially during the water year (*Table 1*). On the Colorado River, combined storage in Lakes Powell and Mead increased by 5.28 million acre-feet (maf-*Figure 3a*) due to substantial snowpack in the northern part of the Upper Colorado River Basin. In April, based on the projected elevation of Lake Powell at the end of the water year, the U.S. Bureau of Reclamation will allow more than 8.23 maf of water to be released from Lake Powell during the water year. This has resulted in substantial increases in storage in Lake Mead.

New Mexico. Total storage in New Mexico reservoirs was about 351,000 acre-feet less than one year ago, not including changes in the storage for El Vado and Heron reservoirs, which had no report for September 2011. Navajo Reservoir, in the San Juan River Basin, decreased by almost 66,000 acre-feet. Pecos River Reservoir storage decreased by more than 58,000 acre-feet. The 2010–2011 La Niña winter is in part to blame for decreasing water storage. Storage also declined by 195,300 acre-feet in the Rio Grande Basin (*Table 2*), partially the result of average to below-average snowpack in most of the Rio Grande headwaters. New Mexico's largest reservoir, Elephant Butte, declined by almost 172,000 acre-feet. Combined storage in Elephant Butte and Caballo reservoirs, used to determine water restrictions set forth in the Rio Grande Compact, approached restriction levels in the spring. Without substantial snowpack in the headwaters of the Rio Grande this winter, restrictions likely will be implemented in 2012.

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Figure 3a. Combined storage in Lakes Mead and Powell

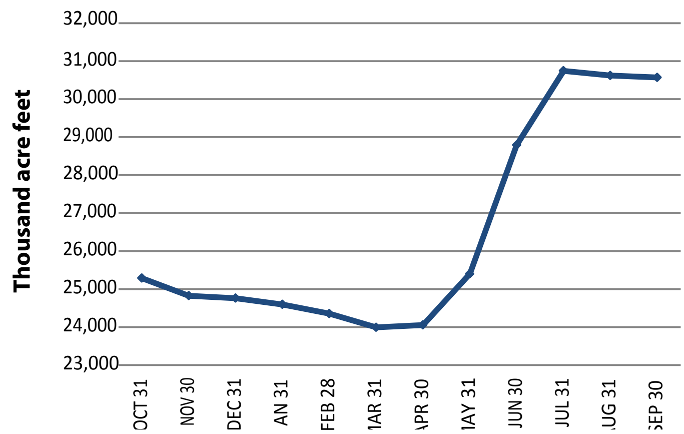


Table 1. Selected Arizona reservoirs' water year statistics.

Reservoir	Oct. 10 Percent full	Sept. 11 Percent full	WY Peak Percent	Peak Month
Powell	63	72	77	July
Mead	38	50	50	September
Gila	14	1	14	November
Verde	60	30	53	March
Salt	90	74	94	March

Table 2. Selected New Mexico reservoirs' water year statistics.

Reservoir	Oct. 10 Percent full	Sept. 11 Percent full	WY Peak Percent	Peak Month
Navajo	82	78	86	June
Heron	64	60*	75	July
Elephant Butte	17	9	23	February
Conchas	9	8**	9	October
Santa Rosa	10	2**	10	October
Brantley	2	1	3	March

* based on estimated value
** based on unofficial data

WYIR, continued

Drought

Arizona and New Mexico were in good shape, drought-wise, at the beginning of the 2011 water year thanks to a wet winter and decent monsoon.

On October 1, 2010, moderate or more severe drought covered only 19 percent of Arizona, and New Mexico was drought-free. By November 16, drought conditions in Arizona decreased, blanketing a mere 7 percent of the state (*Figure 4a*). A few very strong and wet early-season winter storms pounded northwest Arizona in December, causing flooding and shrinking the short-term drought conditions that were present in this region.

But while the rains fell, a moderate to strong La Niña event was building, ultimately casting a dry winter shadow over the region. The La Niña, which began to form in the summer of 2010 and peaked in February 2011, pushed most storms north of Arizona and New Mexico for much of the remainder of the winter and early spring. A few areas, including northern Arizona, received enough precipitation to keep local drought conditions at bay, but drought spread and intensified elsewhere. Some stations in far southeast Arizona and southern New Mexico received no precipitation between October and March. Most of Arizona and almost all of New Mexico were experiencing at least moderate drought by late spring; extreme and exceptional drought, which are droughts that occur, on average, once in every 20 and 50 years, respectively, covered much of New Mexico by May 2011 (*Figures 4b–c*). During intense monsoon rainfall in August and September, some localized areas flooded, bringing some drought relief, particularly in southeast Arizona (*Figure 4d*). Overall, however, the region experienced below-average summer rainfall, and severe to exceptional drought remained entrenched at the end of the water year.

Figure 4a. Drought Monitor released November 18, 2010.*

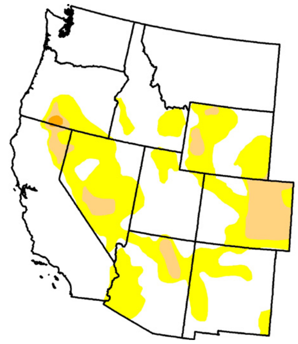


Figure 4b. Drought Monitor released February 17, 2011.*

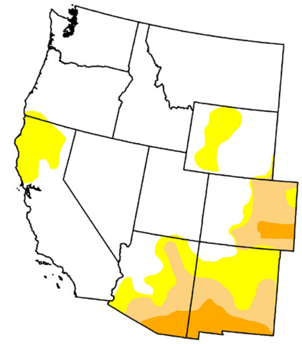


Figure 4c. Drought Monitor released May 19, 2011.*

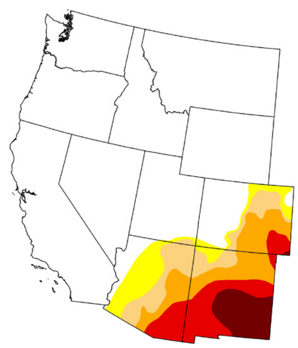
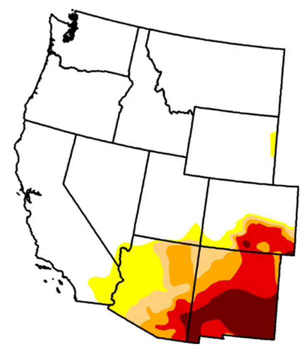


Figure 4d. Drought Monitor released August 18, 2011.*



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.*

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WYIR, continued

Wildfire

The 2011 fire season was record-setting, with more than 1 million acres burning in Arizona and New Mexico between January 1 and September 30. The stage for a devastating fire season was set last winter when a La Niña event helped push storm tracks north of the Southwest. The dry conditions desiccated soils and live fuels such as grasses, shrubs, and trees by the spring. A cold snap in February also contributed to the build-up of fuels because the hard freezes killed many plants. In the spring and summer the dry conditions combined with persistently strong winds to amplify the fire risk and inhibit efforts to quell wildfires.

In part because of the La Niña event, Predictive Services at the Southwest Geographic Area Coordination Center correctly forecasted above-normal significant fire potential across most of the region. Significant fire potential is the likelihood that a wildland fire event will require additional fire management resources from outside the region where the fire originated. Southeast New Mexico and southwest Arizona experienced the most fire activity (*Figures 5a–b*). Approximately 1.1 million acres burned in New Mexico this year, more than 4.5 times the state's average of approximately 242,000 acres (*Table 1*). In Arizona, slightly more than 1 million acres burned, more than 5.5 times the state average of approximately 182,000 acres.

In Arizona, almost half of the damage was caused by the Wallow Fire, which began on May 29 in the White Mountains. The blaze consumed more than 538,000 acres spanning Apache, Navajo, Graham, and Greenlee counties in Arizona and Catron County in New Mexico. It replaced the Rodeo-Chediski Fire, which burned almost 470,000 acres in 2002, as Arizona's largest wildfire on record. The onset of the monsoon occurred around its historical onset date in early July, helping firefighters control many other large fires and reducing the number of new fire starts.

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Table 1. Ten Largest Southwest fires in 2011.

Fire Name	State	Acres Burned
Wallow	AZ & NM	538,049
Horshoe 2	AZ	222,954
Las Conchas	NM	156,593
Donaldson	NM	101,563
Miller	NM	88,835
Murphy Complex	AZ	68,079
Enterprise	NM	64,936
Last Chance	NM	53,342
Baton Rouge Complex	NM	35,165
Windy	NM	32,437

Figure 5a. Locations of Arizona fires larger than 100 acres as of August 31, 2011.

Figure 5b. Locations of New Mexico fires larger than 100 acres as of September 22, 2011.

WYIR, continued

El Niño

Sea Surface Temperatures

The 2011 water year began with a moderate to strong La Niña event (*Figures 6a–b*). Very cool water temperatures—as low as2 degrees below-average were present across much of the central and eastern Pacific Ocean. The cool sea surface temperatures (SSTs) helped reinforce already stronger-than-average easterly winds along the equator in the Pacific Ocean basin, which helped maintain La Niña conditions during the winter. In response to the La Niña event, a high pressure system developed along the West Coast of the United States, which consistently steered winter storms into the mainland between central California and the Pacific Northwest. This northern trajectory of storms left much of the Southwest and south-central U.S. in a persistently dry weather pattern between January and March.

Between April and June, SSTs warmed and La Niña's strength started to wane. National Oceanic and Atmospheric Administration (NOAA) declared an end to the event in June when neutral ENSO conditions returned. The atmosphere, however, lagged behind the SST's and continue to have enhanced easterly winds, characteristic of La Niña. The persistence of stronger-than-average easterly winds signaled neutral conditions likely would be short lived. True to form, the easterly winds helped drag colder-than-average water to the surface in the eastern Pacific through August and September, ushering back weak La Niña conditions. The 2010–2011 water year ended as it started: in the grips of La Niña.

Southern Oscillation Index

Positive values for the Southern Oscillation Index (SOI)—an indicator of the strength of the winds—shows that a moderate to strong La Niña event was well entrenched during most of the 2011 water year. SOI values were very high at 1.8 in October, indicating the atmosphere had started to shift its large-scale circulation pattern across the entire Pacific Ocean basin at the beginning of the water year. Values continued to climb through the winter as the event became more organized, peaking at 3.2 in December. These high SOI values continued throughout the remainder of the winter season and into the spring, when the event began to weaken. SOI values dropped to 1.9 in April and plunged to 0.4 in May. These values remained low until August and September, when they began to rise again, indicating the atmosphere was again strongly responding to La Niña conditions.

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.

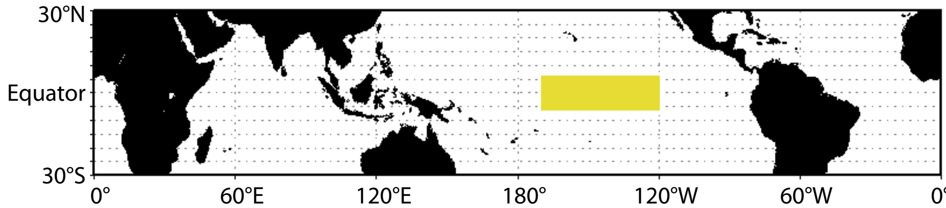
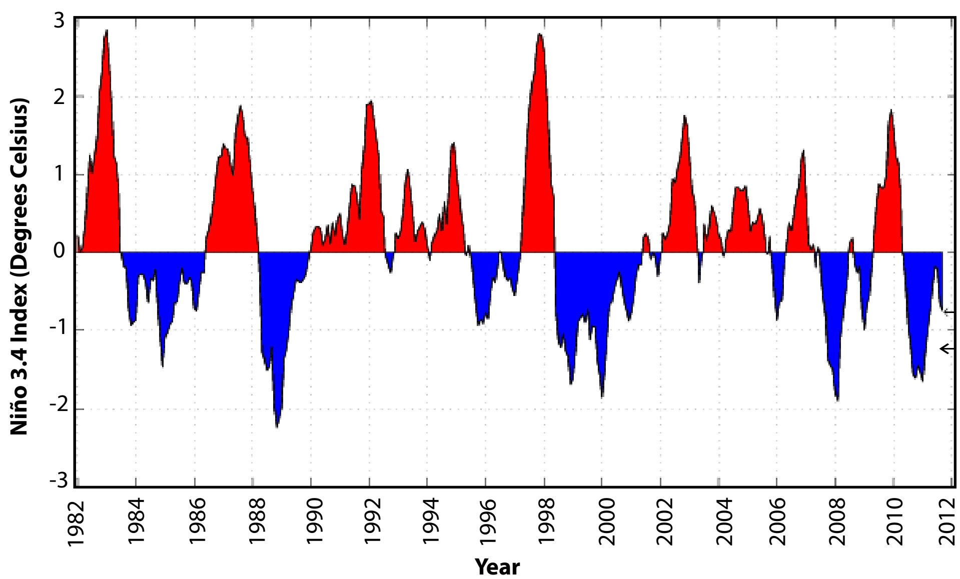


Figure 6b. Sea surface temperature anomaly index from Niño 3.4 region. Red areas indicate positive or warm SST anomalies while blue indicates negative or cool anomalies. Graphic credit: International Research Institute for Climate and Society.



Temperature (through 10/19/11)

Data Source: High Plains Regional Climate Center

Temperatures since the water year began on October 1 have averaged between 45 and 60 degrees Fahrenheit on the Colorado Plateau and across the northwestern half of New Mexico (*Figure 1a*). Temperatures in southwestern and eastern New Mexico have been between 60 and 70 degrees F, while the southwestern deserts of Arizona have been between 70 and 80 degrees F. The highest elevations in New Mexico have been cooler, between 40 and 45 degrees F. Temperatures have been 1–4 degrees F colder than average on the Colorado Plateau in Arizona and south-central New Mexico; 1–5 degrees F colder than average in northwestern New Mexico; and 2–4 degrees F above average in southeastern New Mexico, northeast New Mexico, and southeast Arizona (*Figure 1b*).

Temperatures during the past 30 days have been mostly above average (*Figures 1c–d*). There are only a few cooler-than-average pockets in the Southwest, most notably in west-central New Mexico, where Cibola and McKinley counties were 0–2 degrees cooler than average.

Notes:

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

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

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

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

On the Web:

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

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

Figure 1a. Water year 2011 (October 1 through October 19) average temperature.

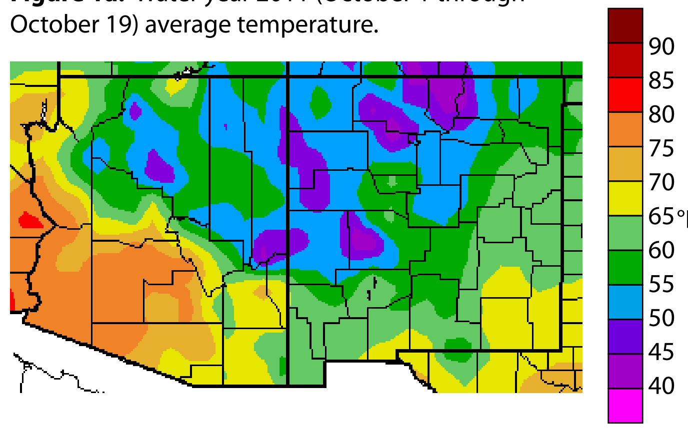


Figure 1b. Water year 2011 (October 1 through October 19) departure from average temperature.

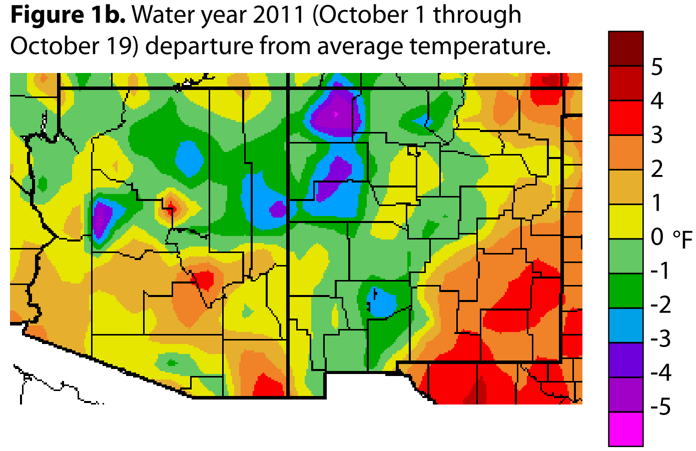


Figure 1c. Previous 30 days (September 20–October 19) departure from average temperature (interpolated).

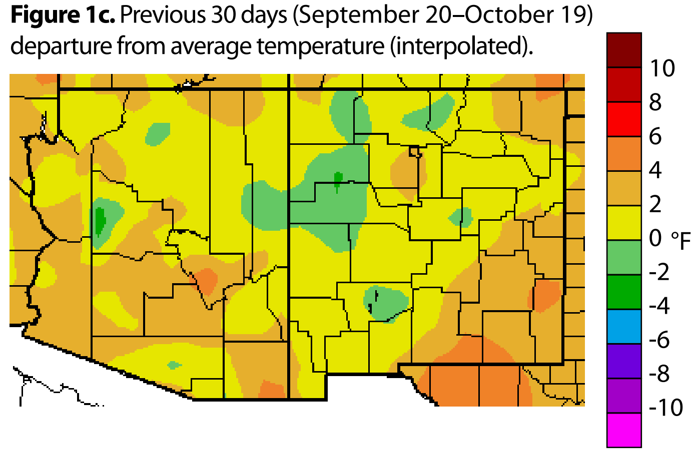
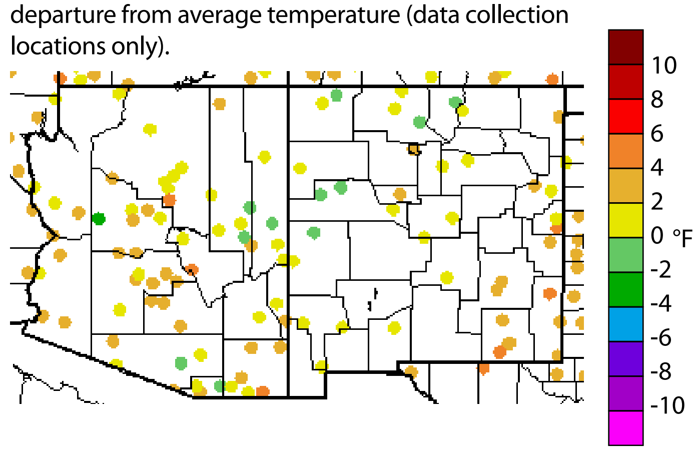


Figure 1d. Previous 30 days (September 20–October 19) departure from average temperature (data collection locations only).



Precipitation (through 10/19/11)

Data Source: High Plains Regional Climate Center

Precipitation since the water year began on October 1 has been variable, with above-average rainfall in the north and below-average rainfall in the south (*Figures 2a–b*). Northwestern Arizona and northern New Mexico have received 150–800 percent of average precipitation, while southern Arizona and southern New Mexico have received less than 50 percent. Yuma, La Paz, and Santa Cruz counties in Arizona and Lea, Eddy, Doña Ana, and Union counties in New Mexico have been the driest, receiving less than 2 percent of average precipitation.

In the past 30 days, early fall storms have brought rain to Southern California but they generally have not moved across Arizona and New Mexico (*Figures 2c–d*). The exception is in northwestern New Mexico, where the past 30-day precipitation is 100–150 percent of average. In Arizona, eastern Maricopa County has received less than 2 percent of average precipitation in the last month.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2011, we are in the 2012 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year.

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

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

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

On the Web:

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

For National Climatic Data Center monthly 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 2011 (October 1 through October 19) percent of average precipitation (interpolated).

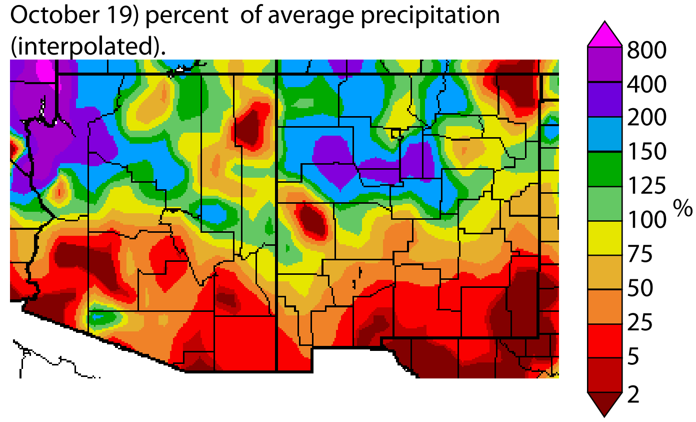


Figure 2b. Water year 2011 (October 1 through October 19) percent of average precipitation (data collection locations only).

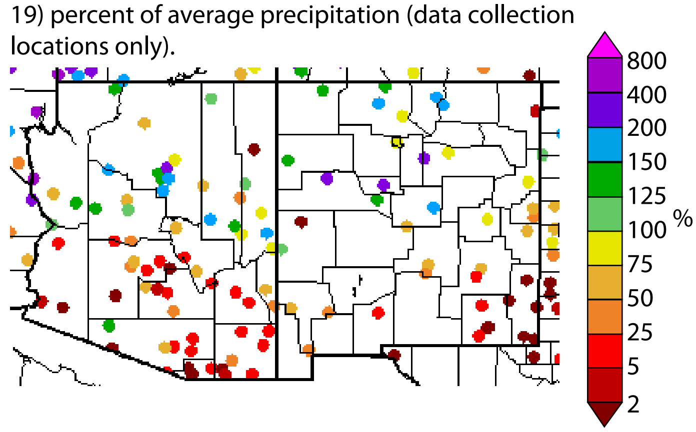


Figure 2c. Previous 30 days (September 20–October 19) percent of average precipitation (interpolated).

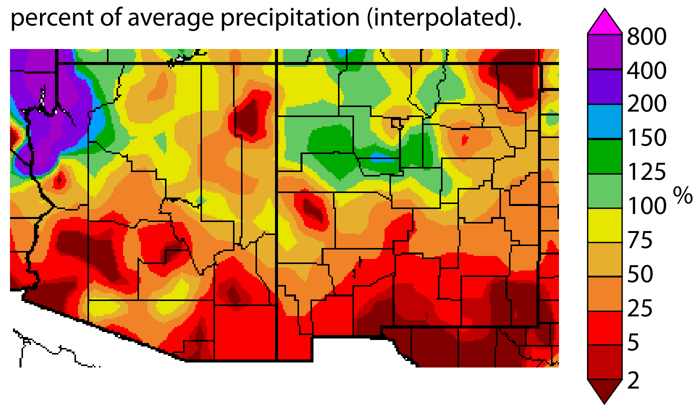
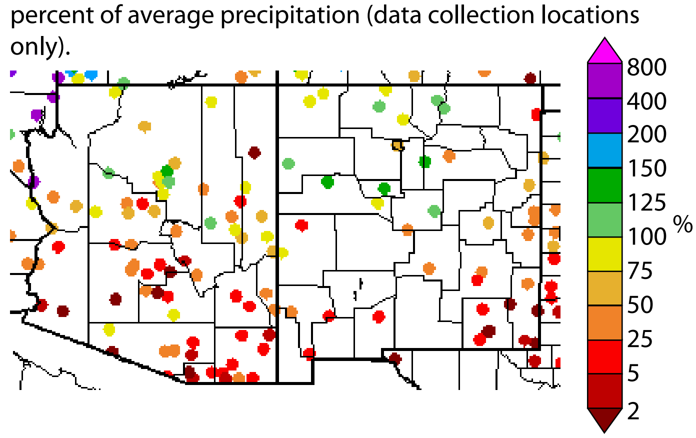


Figure 2d. Previous 30 days (September 20–October 19) percent of average precipitation (data collection locations only).



U.S. Drought Monitor (data through 10/18/11)

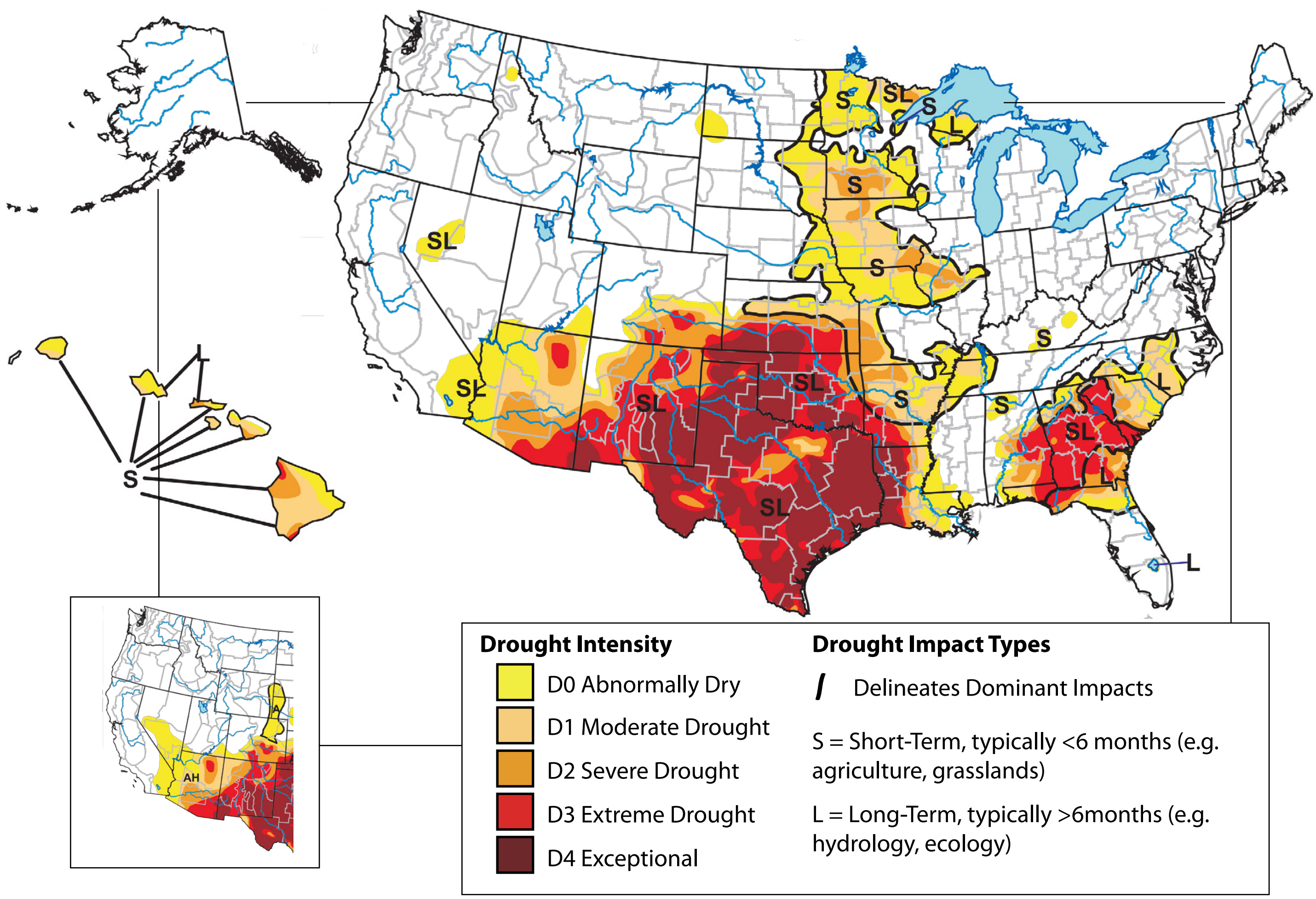
Data Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

There were very few changes in the extent and intensity of drought across the western United States during the past 30 days (*Figure 3*). The October 18 update of the U.S. Drought Monitor has drought confined to the Southwest U.S., with the remainder of the western U.S classified as drought-free. The minor changes that did occur were on the northern edge of the drought extending across the Southwest. An early winter storm interacting with subtropical moisture leftover from the monsoon produced widespread precipitation across Nevada, northern Arizona, New Mexico, and Colorado. This brought some limited short-term relief and reduced abnormally dry conditions that had crept in across much of Nevada. Moderate to exceptional drought continues to plague much of Arizona and New Mexico and a portion of Colorado. Little relief is expected during the winter, as this region braces for a second consecutive La Niña winter.

Notes:

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

Figure 3. Drought Monitor data through October 18, 2011 (full size), and September 13, 2011 (inset, lower left).



On the Web:

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website http://www.drought.gov/portal/server.pt/community/current_drought/208

Arizona Drought Status

(data through 10/18/11)

Data Source: U.S. Drought Monitor

The coverage and intensity of drought conditions across Arizona have changed very little from conditions one month ago, according to the October 18 update of the U.S Drought Monitor (*Figure 4a*). Some early winter storm activity reinforced by leftover monsoon subtropical moisture brought precipitation to parts of northern Arizona early in the month, but this did little to improve the well-ensconced drought conditions gripping the state. About 69 percent of Arizona is presently under some level of drought, with 42 percent at the severe to exceptional levels (*Figure 4b*). The driest areas continue to be southeastern Arizona, but drought conditions are worsening in the northwest as precipitation deficits continue to mount. With La Niña present for a second consecutive winter, drought conditions will likely spread and intensify in many regions, particularly in southern portions of both Arizona and New Mexico.

Figure 4a. Arizona drought map based on data through October 18.

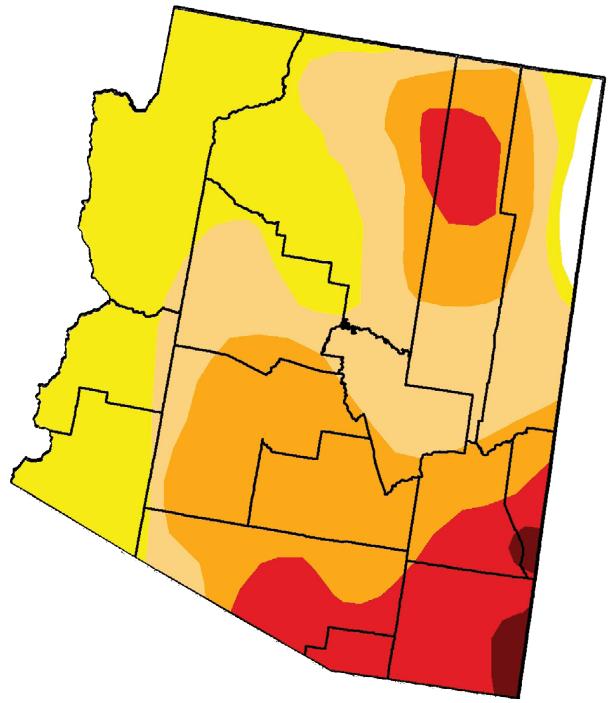


Figure 4b. Percent of Arizona designated with drought conditions based on data through October 18.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.43	98.57	68.57	42.81	15.12	1.24
Last Week (10/11/2011 map)	0.89	99.11	69.11	42.81	15.12	1.24
3 Months Ago (07/19/2011 map)	11.15	88.85	60.35	37.15	14.28	4.83
Start of Calendar Year (12/28/2010 map)	31.40	68.60	32.45	0.00	0.00	0.00
Start of Water Year (09/27/2011 map)	0.02	99.98	69.76	42.81	15.34	1.67
One Year Ago (10/12/2010 map)	39.75	60.25	8.75	3.23	0.00	0.00

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

(data through 10/18/11)

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

Drought conditions remain largely unchanged across most of New Mexico compared with one month ago (*Figure 5a*). The exception is in the northwest quarter of the state, where substantial improvements have occurred. More than 90 percent of New Mexico is classified with moderate or more severe drought, with about 85 percent at the severe to exceptional level, according the U.S. Drought Monitor (*Figure 5b*). This is slightly better than last month, when drought covered 96 percent of the state, with 90 percent classified as severe to exceptional drought. Almost all of the improvements were observed in the northwest part of the state, which benefitted from a few early winter season storms at the beginning of October. Despite the limited improvements, drought impacts continue to emerge across the state. Cotton crops across eastern New Mexico have been hit hard by short-term drought conditions that have persisted since last winter (*The Portales News Tribune*, October 20). Cotton farmers are just now starting to harvest crops and are reporting less than half of average yields. Cotton prices remain high, which will temper the large losses expected to hit farmers this season.

Figure 5a. New Mexico drought map based on data through October 18.

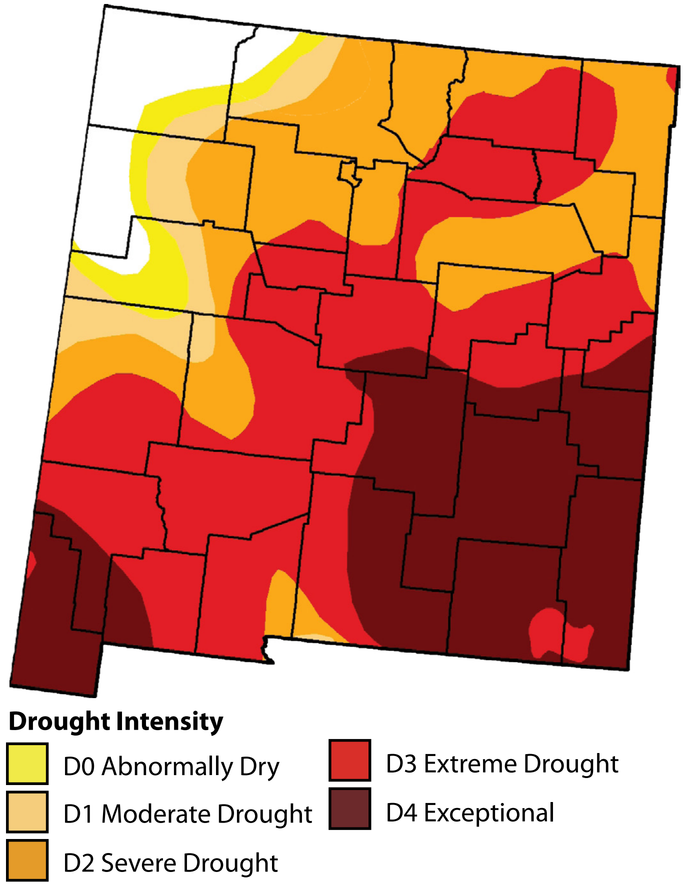


Figure 5b. Percent of New Mexico designated with drought conditions based on data through October 18.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	6.24	93.76	90.71	85.90	63.02	26.35
Last Week (10/11/2011 map)	2.44	97.56	93.25	87.07	63.02	26.35
3 Months Ago (07/19/2011 map)	0.00	100.00	100.00	93.24	79.00	48.10
Start of Calendar Year (12/28/2010 map)	6.16	93.84	40.40	0.00	0.00	0.00
Start of Water Year (09/27/2011 map)	0.00	100.00	96.40	88.99	69.61	35.13
One Year Ago (10/12/2010 map)	76.66	23.34	0.00	0.00	0.00	0.00

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 9/30/11)

Data Source: National Water and Climate Center

Combined storage in Lakes Mead and Powell decreased slightly in September, falling by about 50,000 acre-feet, which is typical for this time of year. The U.S. bureau of Reclamation is currently increasing storage in Lake Mead in accordance with the rules developed in the landmark 2007 Interim Guidelines for the Lower Basin Shortages and the Coordinated Operations of Lake Powell and Lake Mead. Storage in other reservoirs within Arizona's borders decreased by more than 140,000 acre-feet in September (*Figure 6*). Salt River Basin system reservoirs, which supply the Phoenix metropolitan area, are at a healthy 74 percent of capacity.

In water-related news, Prescott-area government officials are dissatisfied with the ability of a U.S. Geological Survey groundwater flow model to accurately simulate the impact of future population growth scenarios on groundwater systems and flow in the Verde River Basin (*Prescott Courier*, October 10).

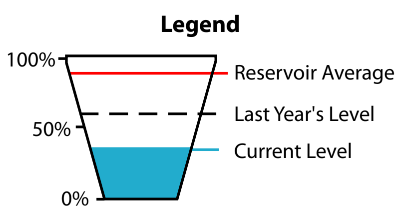
Notes:

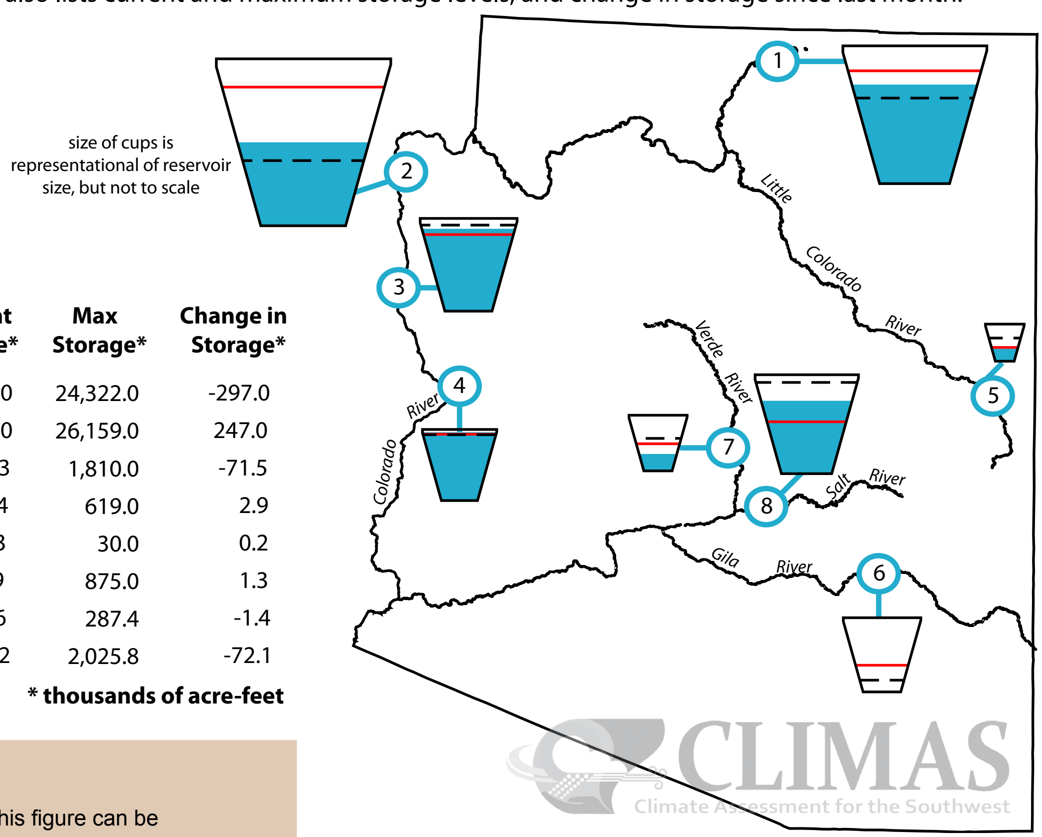
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total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

Figure 6. Arizona reservoir levels for September 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	72%	17,593.0	24,322.0	-297.0
2. Lake Mead	50%	12,977.0	26,159.0	247.0
3. Lake Mohave	89%	1,610.3	1,810.0	-71.5
4. Lake Havasu	95%	585.4	619.0	2.9
5. Lyman Reservoir	34%	10.3	30.0	0.2
6. San Carlos	1%	4.9	875.0	1.3
7. Verde River System	30%	85.6	287.4	-1.4
8. Salt River System	74%	1,491.2	2,025.8	-72.1

*** thousands of acre-feet**

On the Web:

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

New Mexico Reservoir Levels

(through 9/30/11)

Data Source: National Water and Climate Center

Total storage in New Mexico reservoirs at the end of September was virtually unchanged from the previous month, excluding the Heron and El Vado reservoirs, which did not report data in September (*Figure 7*). Elephant Butte, New Mexico's third largest reservoir, contained only about 200,000 acre-feet of water, which is about 13 percent of capacity. Storage in the Pecos River reservoirs was also very low.

In water-related news, the Navajo-Gallup Water Supply Project, which will benefit 250,000 Native Americans, was selected by the Obama administration as one of just a few infrastructure projects to undergo an expedited permit process (*New Mexico Independent*, October 11). The project is expected to be completed in 2024 and will pump 37,375 acre-feet of water per year from the San Juan River Basin. Also, the New Mexico Department of Game and Fish is conducting a $300,000 fish habitat restoration project along the San Juan River to reduce the impacts on trout from expected lower flows. (*Farmington New Mexico Daily Times*, October 6).

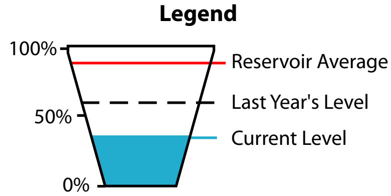
Notes:

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).

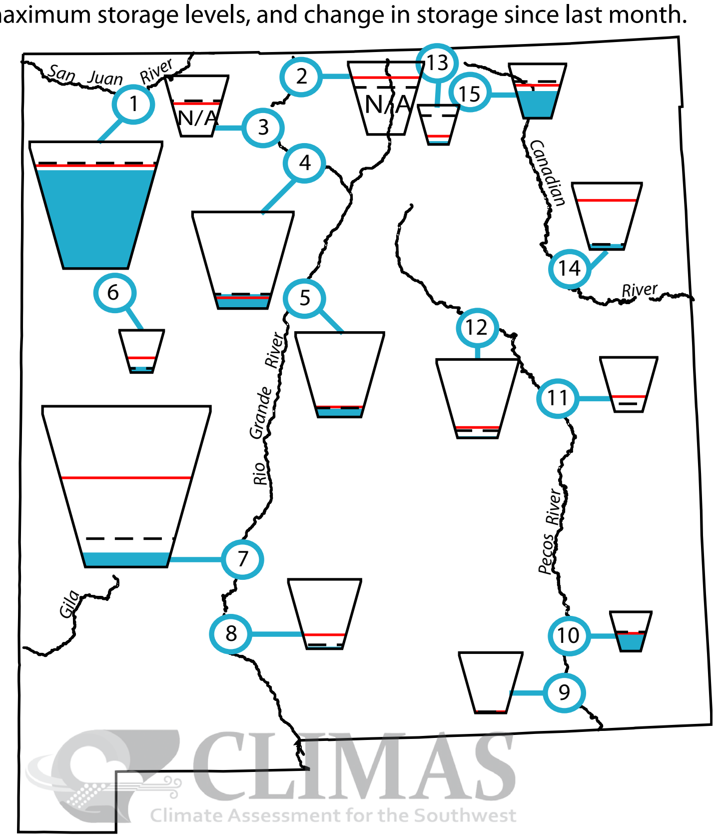
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 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).

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



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	78%	1,325.7	1,696.0	-30.3
2. Heron	N/A**	N/A**	400	N/A**
3. El Vado	N/A**	N/A**	190.3	N/A**
4. Abiquiu	15%	179.5	1192.8	16.0
5. Cochiti	10%	49.7	491.0	0.2
6. Bluewater	13%	5.1	38.5	-0.2
7. Elephant Butte	9%	201.0	2195.0	0.2
8. Caballo	3%	8.5	332.0	1.5
9. Brantley	1%	6.1	1008.2	-1.1
10. Lake Avalon	43%	1.7	4.0	0.4
11. Sumner	2%	2.3	102.0	-0.4
12. Santa Rosa	2%	9.9	438.3	1.4
13. Costilla	8%	1.2	16.0	-0.1
14. Conchas	8%	20.7	254.2	13.0
15. Eagle Nest	50%	39.3	79.0	-0.9



* thousands of acre-feet **NRCS has not reported reservoir storage

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 2011–January 2012)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA-Climate Prediction Center (CPC) in October call for increased chances for temperatures to be similar to those of the warmest 10 years of the 1981–2010 for the November–January and December–February periods in Arizona (*Figures 8a–b*). Odds for warmer-than-average conditions are only slightly higher than equal chances; the CPC assigns an equal chance that conditions will be above, below, or near average for Arizona for the January–March and February–April periods (*Figures 8c–d*). In New Mexico, the odds are slightly higher for conditions to be similar to the warmest 10 years in the climatological period for each of the four seasons indicated (*Figures 8a*). The highest odds are for the next three months, and forecasts suggest a 40–50 percent chance of warmer-than-average temperatures. While odds diminish to slightly above equal chances for most of the state through the winter and early spring, they persist in southeast New Mexico.

Notes:

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

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1981–2010 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

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

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

Figure 8a. Long-lead national temperature forecast for November 2011–January 2012.

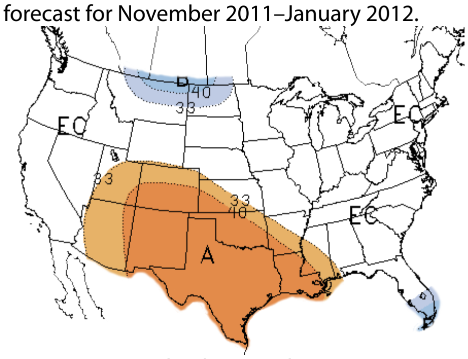


Figure 8b. Long-lead national temperature forecast for December 2011–February 2012.

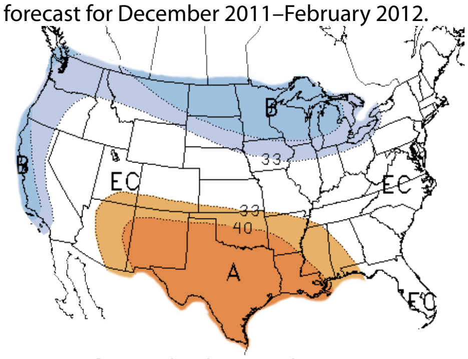


Figure 8c. Long-lead national temperature forecast for January–March 2012.

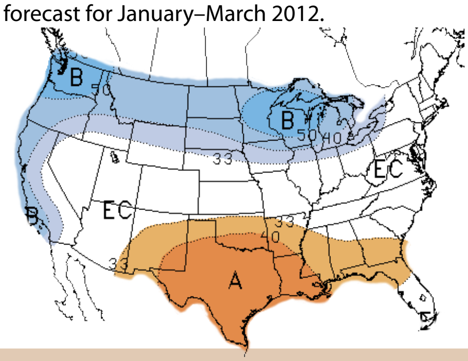
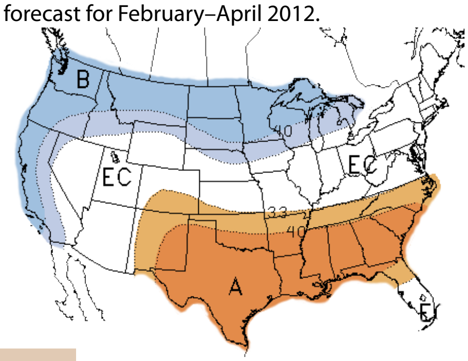


Figure 8d. Long-lead national temperature forecast for February–April 2012.



A= Above: 50.0–59.9% / 40.0–49.9% / 33.3–39.9%

B=Below: 40.0–49.9% / 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit http://www.cpc.ncep.noaa.gov/products/predictions//multi_season/13_seasonal_outlooks/color/churchill.php

For seasonal temperature forecast downscaled to the local scale, visit http://www.weather.gov/climate/l3mto.php

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

Precipitation Outlook
(November 2011–January 2012)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (CPC) in October call for increased chances that precipitation will be similar to the driest 10 years of the 1981–2010 period through the winter and spring (*Figures 9a–d*). A primary driver for these forecasts is the La Niña event, which likely will persist for the next six months. La Niña events historically bring dry conditions to the southern tier of the U.S., including Arizona and New Mexico, and wetter-than-average conditions to the Pacific Northwest. Southern areas of both states have more than a 50 percent chance of seeing dry conditions during the November–January, December–February, and January-March periods.

Notes:

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

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1981–2010 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

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

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

Figure 9a. Long-lead national precipitation forecast for November 2011–January 2012.

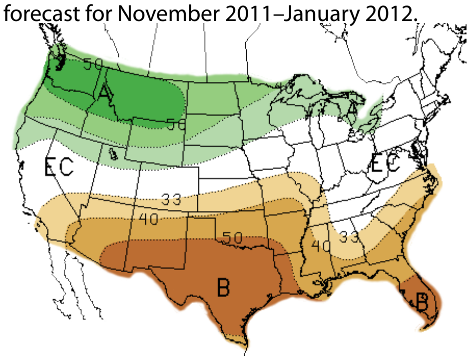


Figure 9b. Long-lead national precipitation forecast for December 2011–February 2012.

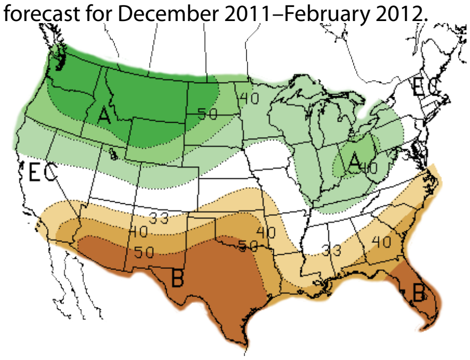


Figure 9c. Long-lead national precipitation forecast for January–March 2012.

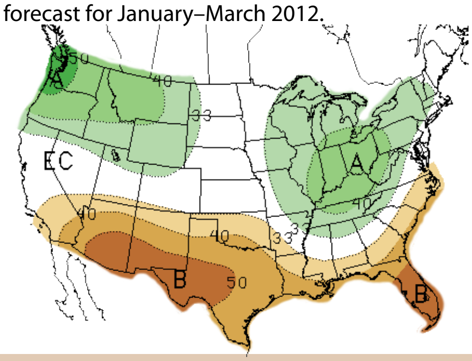
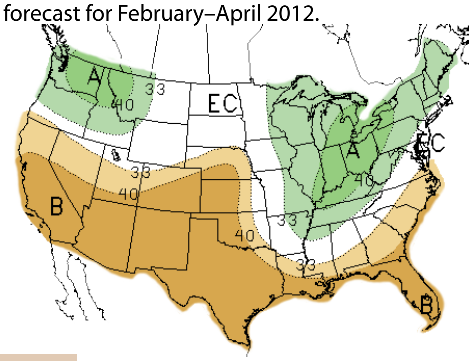


Figure 9d. Long-lead national precipitation forecast for February–April 2012.



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 March load slowly on your computer)

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

Seasonal Drought Outlook

(through January)

Data Source: NOAA–Climate Prediction Center (CPC)

This summary is partially excerpted and edited from the October 20 Seasonal Drought Outlook technical discussion produced by the NOAA-Climate Prediction Center (CPC) and written by forecaster R. Tinker.

Monsoon rainfall provided only some drought relief to eastern Arizona and western New Mexico during the summer, leaving most of the region in need of copious rain and snow to improve conditions. About 69 and 91 percent of Arizona and New Mexico, respectively, are classified with moderate drought or a more severe drought category (see pages 13 and 14). However, with the expectation that the newly developed La Niña event will persist for the next six months—which will likely deliver below-average rainfall to the Southwest—the outlook favors the persistence or intensification of drought across nearly all of Arizona and New Mexico (*Figure 10*). Drought is also expected to develop in western Arizona and Southern California.

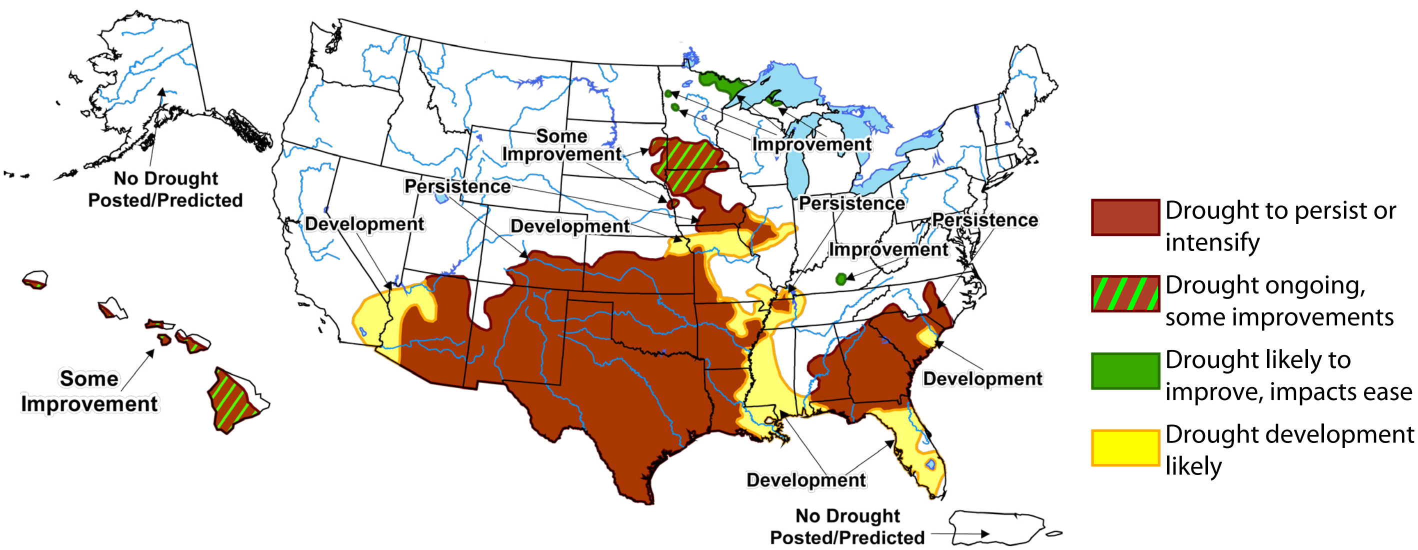
Elsewhere, drought is expected to continue and expand across the southern tier of the U.S. and in the central Plains, as most mid-range and longer forecasts suggest dry conditions.

There is some indication that wet conditions may occur in the next 6–10 days in the central Rockies, parts of the Plains, and Texas, but likely not enough to improve drought conditions. Drought development was omitted in parts of Alabama and Mississippi, where longer-term forecasts for dry conditions were less confident and where Tropical Storm Lee dropped 5–12 inches of rain in early September. In addition, drought development is absent from parts of Florida that received 8–15 inches of rain in early October. The CPC has high confidence in these forecasts.

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 (released October 20).



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

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

A La Niña Advisory issued by the NOAA-Climate Prediction Center (CPC) continues this month as weak La Niña conditions expand and gain strength across the eastern equatorial Pacific Ocean. Sea surface temperatures (SSTs) are about 0.8 degrees Celsius below average in the east-central Pacific, or about 1.4 degrees F, a temperature that marks a weak La Niña event. Water temperatures just below the surface, however, continue a cooling trend and are more widespread this month. The expectation is that this pool of colder-than-average water will surface during the next couple of months and maintain at least weak La Niña conditions. The Southern Oscillation Index (SOI) value is +1, indicating the atmosphere is fully engaged with the current La Niña SST pattern (*Figure 11a*). As a result, stronger-than-average easterly winds are occuring along the equator along with suppressed convection in the eastern Pacific.

Official forecasts issued by the International Research Institute for Climate and Society (IRI) indicate La Niña conditions have more than a 75 percent chance of persisting through the October–December period. La Niña is expected to weaken by the end of the winter season. Chances for a return of neutral conditions increase to 50 percent by the March–May period (*Figure 11b*). It's expected that a return of La Niña will bring dry conditions and seasonal precipitation forecasts issued by NOAA-CPC reflect this, calling for most of Arizona and New Mexico to experience below-average precipitation through April.

Figure 11a. The standardized values of the Southern Oscillation Index from January 1980–September 2011. 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).

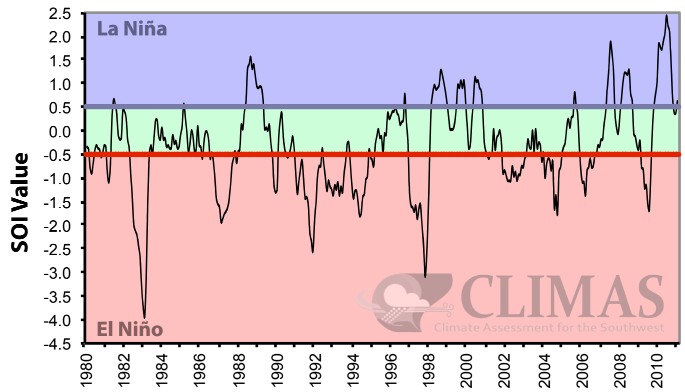
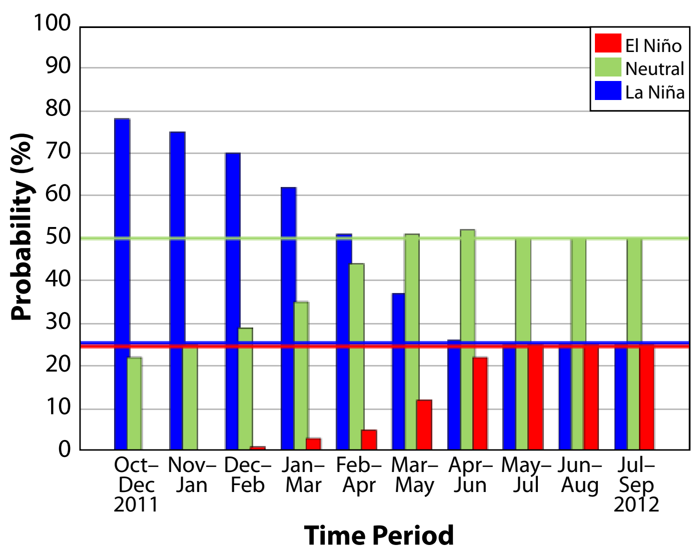


Figure 11b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released October 20). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through September 2011. The SOI measures the atmospheric response to SST changes across the Pacific Ocean basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

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

On the Web:

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

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