August 25, 2010

Southwest Climate Outlook

Vol. 9 Issue 8

Source: Daniel Griffin, Laboratory of Tree-Ring Research.

Photo Description: Lightning strikes the Tucson Mountains during an intense monsoon thunderstorm on the evening of July 17, 2010. This photo is a composite of two images captured approximately 30 seconds apart. ©Daniel Griffin, 2010.

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In this issue...

CLIMAS Climate Assessment for the Southwest

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August Climate Summary

Drought– Monsoon precipitation helped improve short-term drought conditions across western New Mexico and southeastern Arizona. However, drought expanded across much of western Arizona, where monsoon precipitation has been below average.

Temperature– Cooler-than-average temperatures since the water year began on October 1 continue to prevail in spite of a warmer-than-average summer.

Precipitation– Monsoon storms finally delivered wet conditions to much of Arizona and northeastern New Mexico.

ENSO– The NOAA–Climate Prediction Center has issued a La Niña Advisory, which means that La Niña conditions are present across the equatorial Pacific Ocean and are expected to continue. Many forecast models project either persisting or strengthening La Niña conditions through the fall.

Climate Forecasts– Precipitation outlooks largely reflect the La Niña event currently underway and suggest that the Southwest has a higher probability of experiencing drier-than-average conditions for the remainder of the monsoon season and early fall. Temperature forecasts show high probabilities for above-average temperatures in the next few months.

The Bottom Line– Monsoon rainfall finally picked up in the last 30 days and delivered copious rains to many parts of eastern Arizona and New Mexico, reducing drought conditions in both states. However, the La Niña event became official, and many forecast models predict it will continue through the winter. This will likely reduce winter rain and snow, as storm tracks from the Pacific Ocean will likely follow a more northerly route. While La Niña events often cause drier-than-average winter conditions in Arizona and New Mexico, the Rocky Mountains are not as strongly influenced. Since water levels in Lake Mead are the lowest they have been in 54 years—only 12 feet above the water elevation that triggers rationing—the Colorado River Basin needs a hefty snowpack to mollify water shortage fears.

Water level in Lake Mead dips to 54-year low

The water level in Lake Mead has been in a near-constant nose dive since 2000, dropping nearly 125 feet to 1,087 feet above sea level. The good news: Lake Mead remains more than half full. The bad news: if the water level drops another 12 feet it will reach the first threshold that triggers water allocation cutbacks in Arizona and Nevada.

If the lake level reaches an elevation of 1,075 feet above sea level, water deliveries below Lake Mead are reduced by about 10 percent, with more drastic decreases occurring when the lake level touches 1,050 and 1,025 feet, respectively. The brunt of the first stage of water rationing would be borne by Arizona, which would absorb 96 percent of any water reduction, while Nevada would absorb the remaining 4 percent (*Arizona Republic*, August 12).

There is reason for concern. The lake's water level is projected to fall another 3 feet by the end of the year, and a La Niña event has taken hold in the tropical Pacific Ocean. La Niña events often bring drier-than-average November–March conditions to Arizona, New Mexico, and Utah. Colorado, on the other hand, does not have a strong La Niña winter climate signal.

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Introducing the Moisture Balance Drought Index

This article was compiled by MBDI researcher Melanie Lenart and principal investigator Andrew Ellis.

It's less flashy than a flood and more subtle than an earthquake. Yet drought actually takes a bigger economic toll in the United States than other natural disasters. Drought losses average billions of dollars a year. In the Southwest, drought is anathema to water and fire managers, ranchers, farmers, and many others who fear lower reservoir levels and parched landscapes.

Monitoring drought, however, is not easy. Drought is not simply the absence of precipitation; if January and July receive about the same precipitation, for example, the landscape is usually drier in the summer, when temperatures are warmer and the sun shines for more hours, sucking more moisture from the landscape. Drought also varies over large regions, with active weather monitoring networks too sparsely located to provide detailed information to meet the needs of many people.

There are several products available to help managers and citizens understand drought conditions, including the Palmer Drought Severity Index (PDSI), the Standardized Precipitation Index (SPI), and the Arizona Drought Monitor. Recently, researchers at Arizona State University and the University of Arizona have developed another tool: the Moisture Balance Drought Index (MBDI), designed to suit the arid climate of the Southwest. Among other things, the MBDI offers this advantage: Internet users can readily access drought index results at a variety of spatial scales using the tools available on the MBDI website.

In addition, the MBDI presents information at a finer scale than the PDSI, and it allows users to specify the area and time period over which to assess drought conditions. Unlike the SPI, it considers the influence of evaporative demand as well as precipitation.

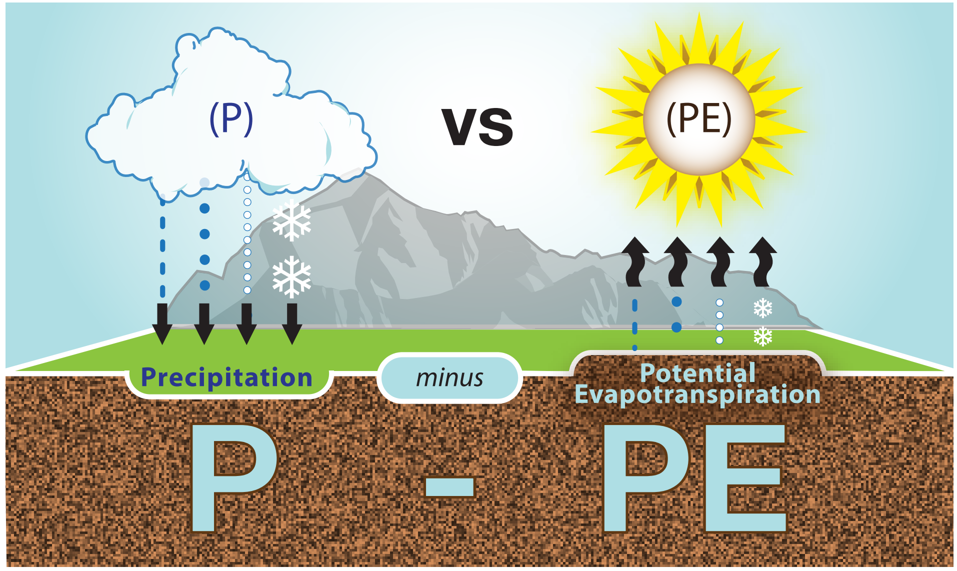

Figure 1. Potential evapotranspiration (PE) is subtracted from precipitation (P) to yield the values used to calculate the Moisture Balance Drought Index. Potential Evapotranspiration is the water that could be lifted from the landscape (evaporation) and plants (transpiration) into the air if moisture were available. Graphic design by Jorge Arteaga.

The Nuts and Bolts of MBDI

The essence of the MBDI is that it assesses the difference between precipitation and potential evapotranspiration (PE), the amount of water that has the potential to move from the Earth's surface into the air. In economic terms, this would be an analysis of the supply and demand for a good. While drought is most simplistically defined as a decline in precipitation for an area compared to its long-term average, looking solely at precipitation is not the whole story. Evaporation also has an effect.

In 2001 in Payson, Arizona, for example, 2.77 inches of precipitation fell in January, while 2.60 inches of rain fell in July. However, average temperatures were starkly different, registering 37.8 degrees F in January and 74.8 degrees F in July. Daylight also extends about four hours longer in July. These two months thus register vast differences in the amount of moisture that can potentially evaporate from the landscape and plants.

Using the MBDI approach, the hotter and longer days caused July to have a moisture deficit of about 4.06 inches, which means there was not enough precipitation to meet the moisture demand. January, on the other hand, had a surplus of moisture to the tune of 1.97 inches. That's the equivalent of about 6 inches difference on the moisture balance—all from the same amount of precipitation.

Supply and demand of moisture

The ultimate impact of drought depends not only on precipitation but also on evaporation rates, and thus temperature. Both precipitation rates and temperature, in turn, vary from the average across a landscape based on various factors, most notably elevation. So the first step in assessing drought level involves interpolating these climate factors across the landscape. Fortunately, the PRISM (Parameter-elevation Regressions on Independent Slopes Model) data set does this.

The PRISM data set contains estimates for monthly precipitation and temperature for every location in the United States, in some cases at a resolution as small as 800 acres. The MBDI bases its assessments on PRISM data for roughly 4,000-acre squares, with each side of the square measuring 4 kilometers, or about 2½ miles.

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Drought Index, continued

The formula to calculate the MBDI starts with precipitation, as logic would dictate. Capturing the influence of evaporation is slightly more challenging. Water evaporates not only from the landscape following the laws of physics but also from plants, in a biological process known as transpiration. Together, these evaporative processes are known as evapotranspiration.

The MBDI uses the Hamon method to estimate potential evapotranspiration. The method was developed based on studies of how much water evaporates from well-watered turf using established relationships among temperature and day length (Figure 2).

Even though natural landscapes in the Southwest rarely have this much available moisture, taking PE into consideration accounts for the additional stress on plants as high temperatures boost the evaporative pull (Figure 3). By accounting for PE, the MBDI also recognizes that water supplies, such as canals and reservoirs, that are exposed to air face much higher evaporation rates in summer than winter.

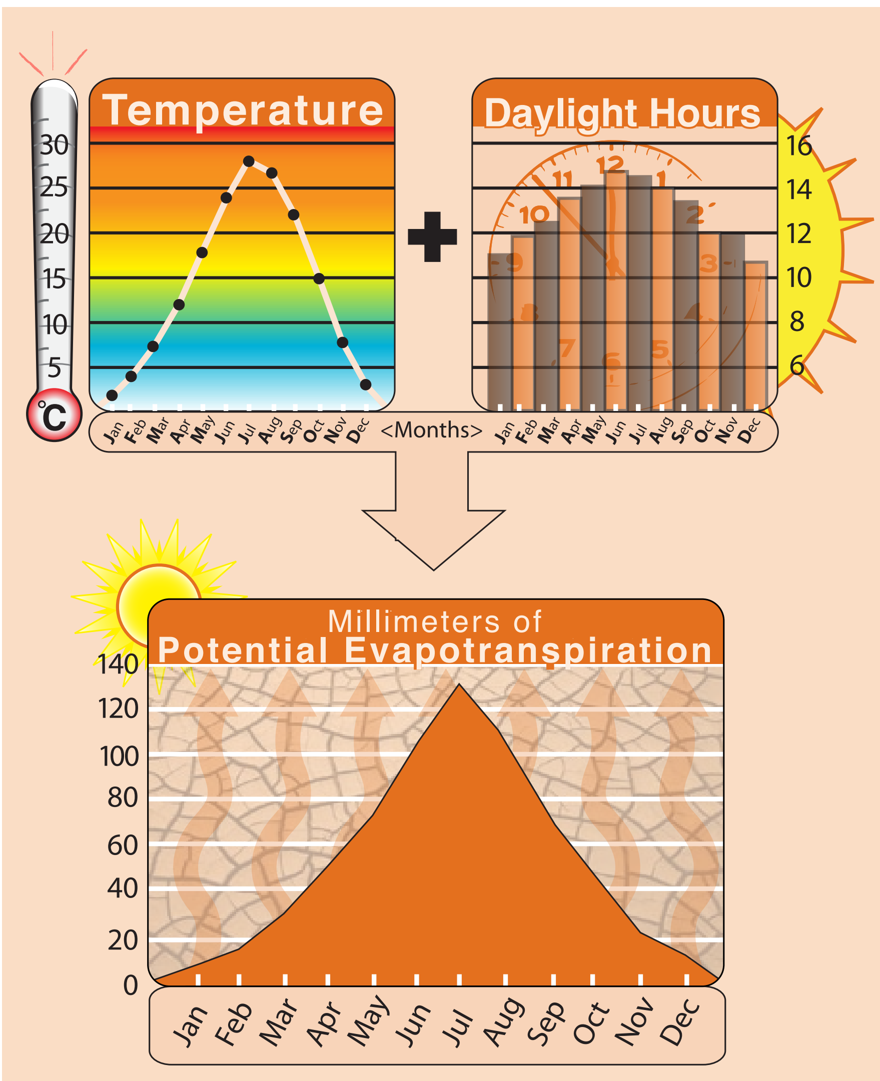


Figure 2. Temperature and the number of daylight hours drive evaporation from the surface and transpiration from plants under the Hamon method, which uses these two factors to derive values for potential evapotranspiration (shown here in millimeters of water). These graphics show average values for the Colorado Plateau based on the climate from 1950–1999. Graphic design by Jorge Arteaga.

Dimensions of drought impacts

The complexity of drought creates the need for multiple ways to interpret its occurrence or future likelihood for management purposes. The MBDI considers the effects of drought at a variety of scales, from one month to four years.

Reservoir levels are more likely to be affected by a longer-term drought, often on the scale of years. Meanwhile, the overall greenness or health of vegetation as measured by satellite imagery tends to reflect shorter-term climatic conditions of about six months.

A recent analysis led by Andrew Ellis of Arizona State University found groundwater levels in 16 studied wells in Arizona correlated best with the drought indices at the scale of three to four years (36 to 48 months)

Reservoir levels were best predicted with medium-range values of the MBDI. These levels were considered in a case study comparing two adjacent Arizona sub-basins that together provide nearly half of the water supply for metropolitan Phoenix: the Salt and Verde reservoirs. For most months, the Verde storage was best predicted using a time scale of 12 months, while the Salt was best predicted using a time scale of 24 to 36 months, according to the study. These differences likely relate to differences in size of the two reservoirs, as the Salt system holds about seven times more water than the Verde system.

The best time frames for considering streamflow, the amount of water flowing in rivers, were shorter than for groundwater and reservoirs. Differences related in part to the geographic locations of the studied basins—eight Colorado River Basin watersheds—from 1948 to 2007.

In the southerly basins—the Upper Gila, Little Colorado, Salt, and Verde—time

continued on page 5

Drought Index, continued

frames from one to 12 months work best at explaining variability year-round. In the northerly basins—the Animas, Tomichi, Yampa and Virgin—the optimum time frames for predicting river flow clustered around six to 12 months for spring and summer but 12 to 48 months for winter, the study concluded.

Another study, led by University of Arizona researchers, is testing how well MBDI values compare to greenness of the landscape. The preliminary results indicate the MBDI does best at predicting greenness using a six-month or 12-month scale, although the three-month scale also worked reasonably well.

The comparison of MBDI values to greenness is based on comparisons of 17 sites in Arizona between 1989 and 2007, with greenness values calculated from satellite imagery using the Normalized Difference Vegetation Index (NDVI). Spring greenness is the most variable in the Southwest, especially in lowland desert.

Scales of drought

Because drought operates at varying spatial and time scales, the MBDI takes different time frames into consideration using cumulative comparisons. For example, the one-month time frame would compare August conditions to conditions during every previous August of record.

Each month in the record is then given a rank that indicates where it falls in the historical line-up during the MBDI period of record, from 1895 to the present. The driest years will fall into the lowest rank, such as the 25th percentile, while the wettest years will rank within the top 75th percentile.

These various monthly values can be tallied together into various time frames and ranked as a unit in comparison to similar time frames—for example, for all six-month periods ending in June.

This approach acknowledges that it's possible for an area to be extremely wet for that month compared to the average amid a two-year drought, for instance. The opposite also can be true.

Using the MBDI

On the MBDI website, users can highlight the grid cells or watersheds to consider index values in their area of interest. Web users have the option of considering which time scales best characterize the drought impacts of their particular interest, such as fire occurrence, fluctuations in wildlife populations, and reservoir levels.

Because of space limitations, the website provides only the past 15 years of data, but researchers interested in considering longer time frames are encouraged to contact the MBDI developers.

The researchers who developed the index and related website, a team led by Andrew Ellis of Arizona State University and Gregg Garfin of the University of Arizona, are interested in hearing about and helping with independent efforts involving the MBDI. The hope is that the research community can use this tool to further refine the growing understanding of how drought affects land and society at a variety of scales.

More details can be found on the MBDI website at http://azclimate.asu.edu/mbdi. Researchers and managers interested in using the MBDI for comparisons of their own interest can contact Arizona State University climatologist Andrew Ellis (Andrew.W.Ellis@asu.edu) for more details and longer datasets.

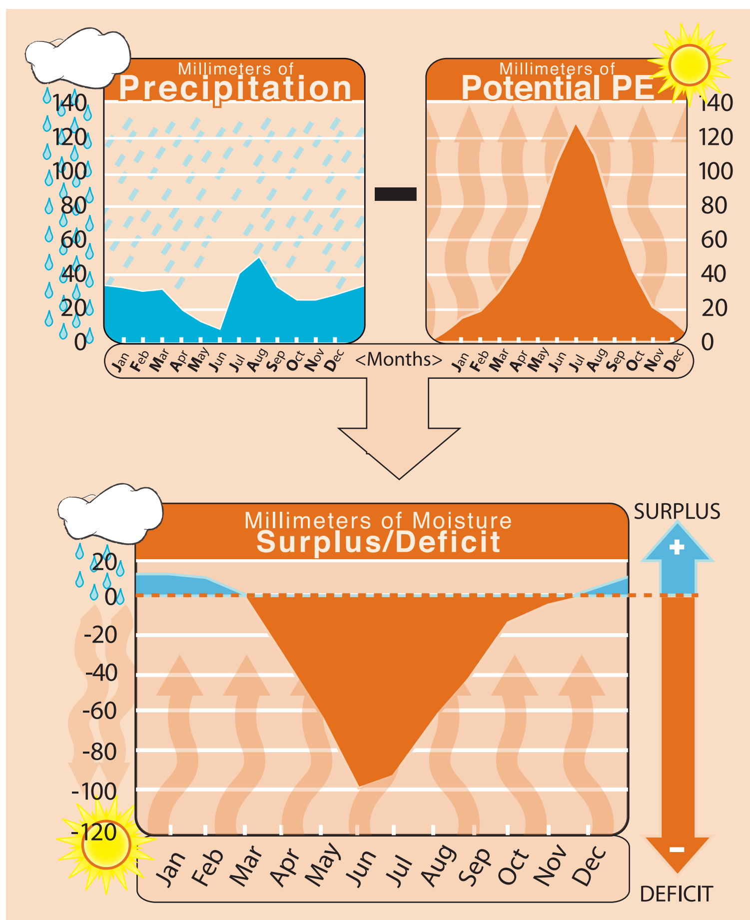


Figure 3. Monthly precipitation rates (top left) do not compensate for monthly rates of potential evapotranspiration (top right) in much of the Colorado River Basin. These results for a section of the Colorado Plateau show only cool months typically have surplus moisture (bottom). Graphic design by Jorge Arteaga, based on a figure by Kirsten Ironside

Temperature (through 8/18/10)

Source: High Plains Regional Climate Center

Warm summer temperatures are increasing the average water year temperatures, which began on October 1, particularly on the Colorado Plateau where temperatures mostly ranged from 45 to 55 degrees Fahrenheit (Figure 1a). Elsewhere, the northern half of New Mexico remains between 40 and 55 degrees F and the high elevations of the Sangre de Cristo Mountains in northern New Mexico remain the coolest in the region, hovering between 35 and 40 degrees F. The southwest deserts of Arizona have averaged between 60 and 75 degrees F, while temperatures along the southern border of New Mexico have been between 55 and 65 degrees F. In many regions, warm nighttime temperatures caused by increased humidity have been responsible for warm average summer temperatures. Amazingly, however, these temperatures are still 0–3 degrees F cooler than average across the entire southwestern United States (Figure 1b). The southeastern corner of Arizona and the White Mountains have been the lone holdouts, seeing 1–3 degrees F warmer-than-average temperatures. The cooler-than-average water year temperatures reflect the influence of the cold and wet El Niño event during last winter.

During the past 30 days, temperatures throughout New Mexico and across southern Arizona have been 0–2 degrees F above average (Figures 1c–d). The warmest conditions have been in northeastern New Mexico, while parts of central and northern Arizona have been than average. These cooler temperatures are the result of monsoonal thunderstorms that have been quite isolated, leaving southeastern Arizona uncharacteristically dry in recent weeks.

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 '09–'10 (October 1 through August 18) average temperature.

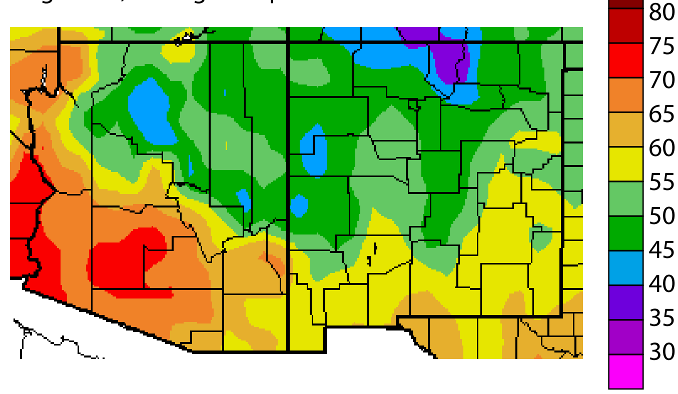


Figure 1b. Water year '09–'10 (October 1 through August 18) departure from average temperature.

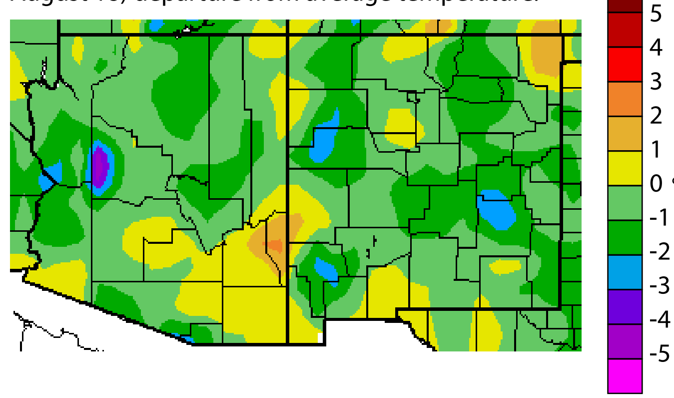


Figure 1c. Previous 30 days (July 20–August 18) departure from average temperature (interpolated).

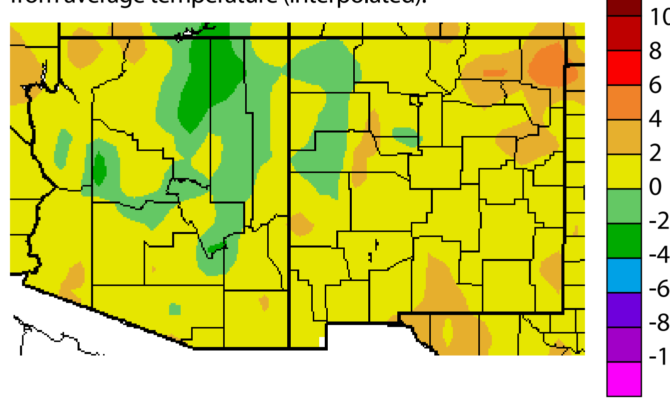
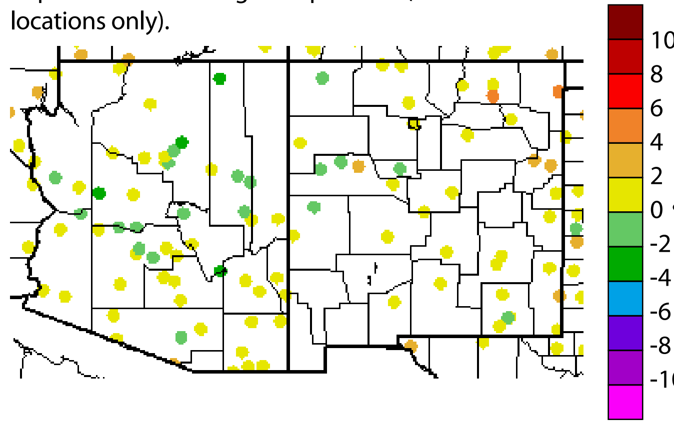


Figure 1d. Previous 30 days (July 20–August 18) departure from average temperature (data collection locations only).



Precipitation (through 8/18/10)

Source: High Plains Regional Climate Center

Precipitation since the water year began on October 1 has been patchy across most of Arizona and western and northern New Mexico (Figures 2a–b). The higher elevations of southeastern and northern Arizona and southwestern and the eastern half of New Mexico have been much wetter than average, with average precipitation ranging between 100 and 150 percent. A few isolated locations in New Mexico and the southwest corner of Arizona have received between 150 to 300 percent of average precipitation, including the lower Colorado River Valley on the western Arizona border. However, during the summer and particularly the past month, the lower Colorado River Valley has been quite dry.

During the last 30 days, the northeast corner of Arizona in the Virgin River watershed has been extremely wet, as has the Colorado Plateau and the eastern half of Arizona and northwestern New Mexico (Figures 2c–d). On the other hand, most of southern New Mexico has been very dry in the past month, receiving less than 70 percent of average precipitation. Summer precipitation is typically quite isolated and the recent wet conditions in southeastern Arizona are helping to make up the winter deficit of precipitation in this region. Unfortunately, the rainfall deficit in south-central New Mexico is continuing to grow as the monsoon activity remains to the west along the Arizona-New Mexico border.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2009, we are in the 2010 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

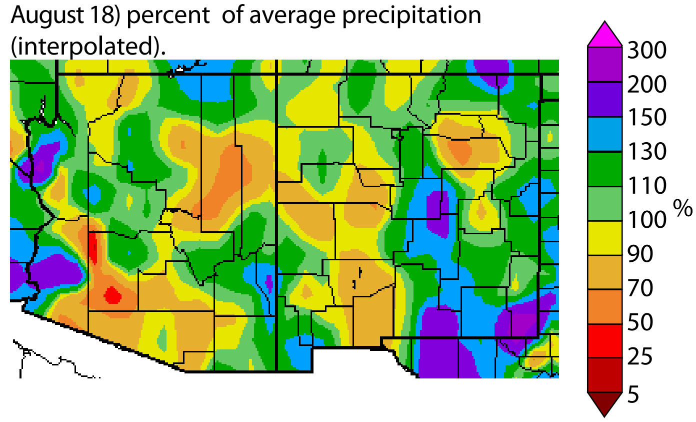


Figure 2a. Water year '09–'10 (October 1 through August 18) percent of average precipitation (interpolated).

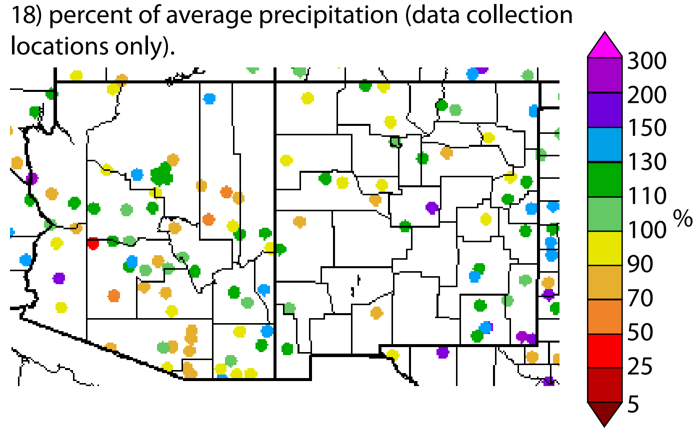


Figure 2b. Water year '09–'10 (October 1 through August 18) percent of average precipitation (data collection locations only).

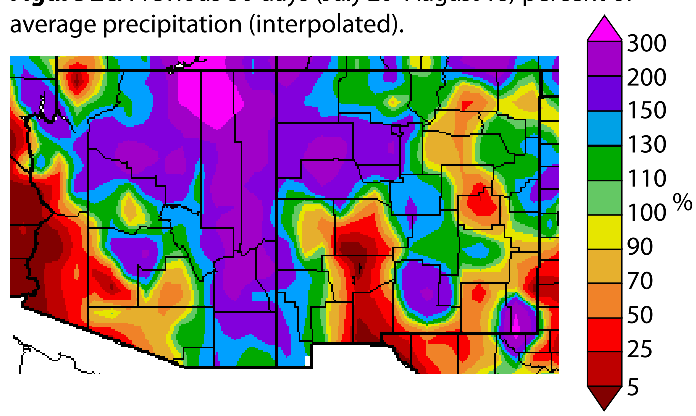


Figure 2c. Previous 30 days (July 20–August 18) percent of average precipitation (interpolated).

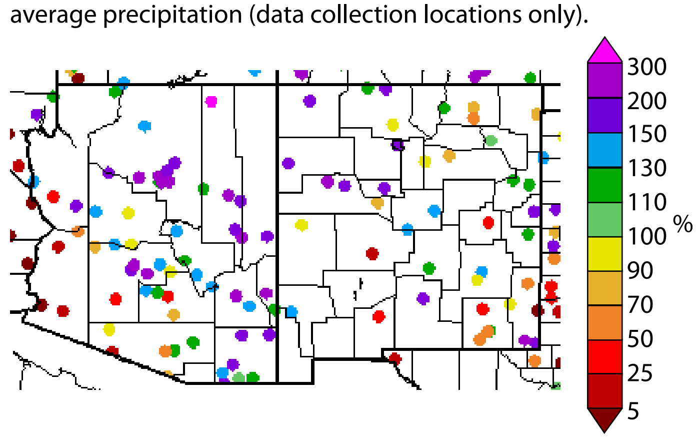


Figure 2d. Previous 30 days (July 20–August 18) percent of average precipitation (data collection locations only).

U.S. Drought Monitor

(data through 8/17/10)

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

The coverage and extent of drought conditions in the western U.S. has not substantially changed during the past 30 days (Figure 3). Currently, only 25 percent of the region is experiencing drought conditions, a decrease of about three percent from one month ago.

Moderate drought is still a concern across much of northern California and small parts of the intermountain West where impacts are expected to predominantly affect water and agriculture resources. Also, abnormally dry conditions cover parts of Nevada and Arizona, although monsoon rains have helped alleviate drought conditions in these areas. However, monsoon rains have been confined largely to higher elevation areas in the Southwest and also in Utah and Colorado. This has helped promote some improvements in short-term drought conditions in Utah and Colorado as well.

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 Brian Fuchs, National Drought Mitigation Center.

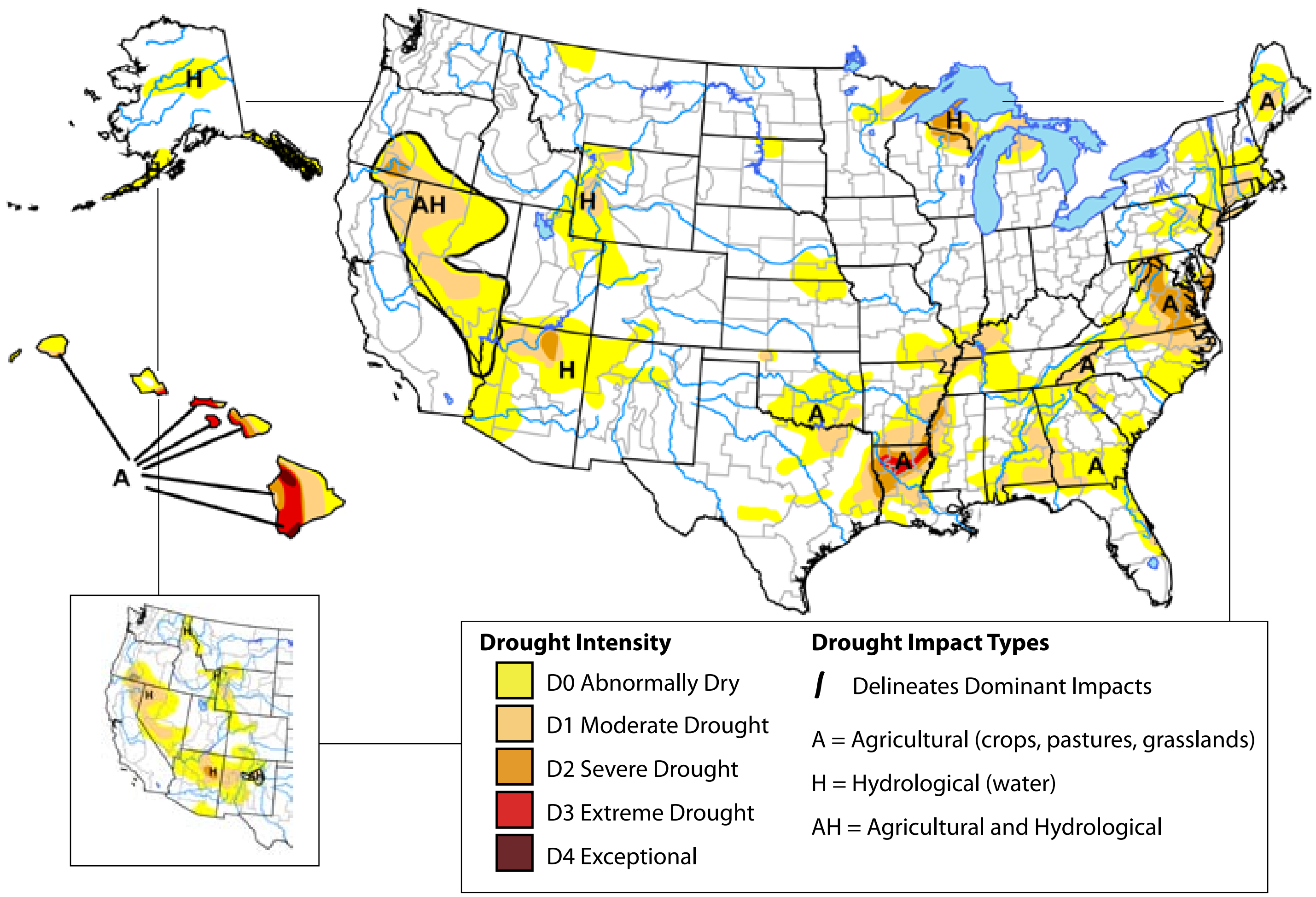


Figure 3. Drought Monitor data through August 17 (full size), and July 13 (inset, lower left).

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
(data through 8/17/10)

Source: U.S. Drought Monitor

Monsoonal rainfall has helped ease drought conditions in parts of Arizona, but some areas have experienced less precipitation than average, prompting the return of short-term drought conditions. Currently, 60 percent of Arizona is abnormally dry or worse, an increase of about 2 percent from one month ago. Drought conditions have improved since mid-July across all of southeast Arizona, according to the August 17 update of the U.S. Drought Monitor (Figures 4a–b). This area experienced near to above-average precipitation in late July, which helped promote the retreat of short-term drought conditions. However, monsoon storms have had trouble moving west into the low deserts, leaving much of western Arizona with below-average precipitation. This has caused an area of abnormally dry conditions to expand from northern Arizona down to the southwestern corner of the state.

Drought impacts reported in Arizona DroughtWatch have documented poor range conditions and the need for water hauling for livestock and wildlife across western Arizona. More drought impact reports can be viewed on Arizona Droughtwatch's webpage at http://azdroughtwatch.org/.

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

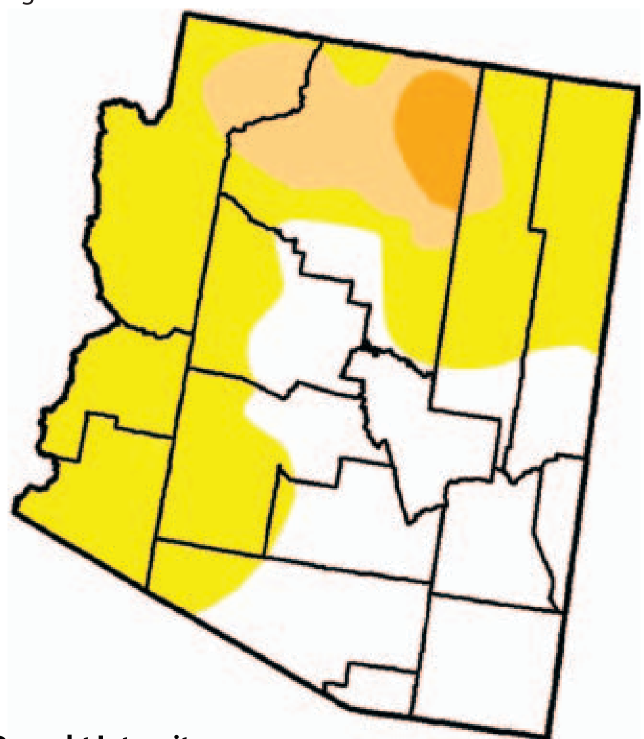


Figure 4b. Percent of Arizona designated with drought conditions based on data through August 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	40.0	60.0	12.4	2.7	0.0	0.0
Last Week (08/10/2010 map)	40.0	60.0	13.4	2.7	0.0	0.0
3 Months Ago (05/25/2010 map)	63.4	36.6	14.4	2.7	0.0	0.0
Start of Calendar Year (01/05/2010 map)	0.0	100.0	97.2	71.1	5.1	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 (08/18/2009 map)	10.4	89.6	4.3	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

(data through 8/17/10)

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

Drought conditions have dramatically improved across northwestern New Mexico during the past 30 days, according to the August 17 update of the U.S. Drought Monitor. Currently, only 20 percent of the state is classified as abnormally dry, down from about 50 percent in mid-July (Figures 5a–b). In addition, no region is classified with drought conditions worse than abnormally dry, whereas about 17 percent of New Mexico had moderate drought conditions one month ago.

Monsoon precipitation has helped improve drought conditions in the state, particularly in northwestern and west-central New Mexico. In these regions, precipitation during the last month has been generally more than 150 percent of average, helping to overcome the sluggish start to the monsoon season.

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

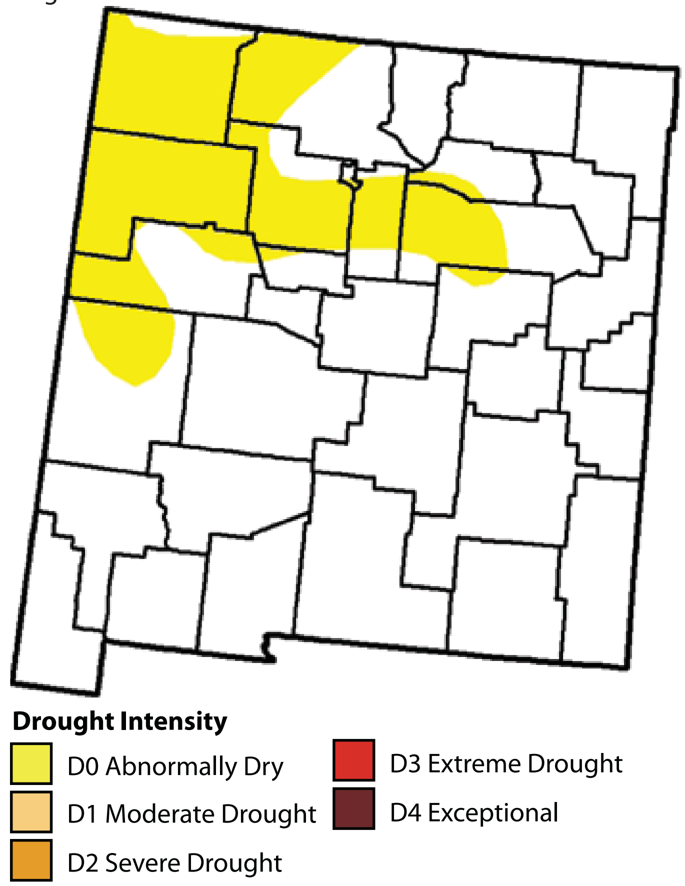


Figure 5b. Percent of New Mexico designated with drought conditions based on data through August 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	80.0	20.0	0.0	0.0	0.0	0.0
Last Week (08/10/2010 map)	79.5	20.5	0.0	0.0	0.0	0.0
3 Months Ago (05/25/2010 map)	82.0	18.0	0.0	0.0	0.0	0.0
Start of Calendar Year (01/05/2010 map)	56.9	43.1	10.1	2.3	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 (08/18/2009 map)	63.5	36.5	8.6	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 7/31/10)

Source: USDA-NRCS, National Water and Climate Center

Overall storage in the Colorado River Basin as of August 10 was 57.4 percent of capacity, according to the U.S. Bureau of Reclamation. During the last month, storage in both Lake Mead and Lake Powell decreased by about 450,000 acre-feet; Lake Mead is at its lowest level in 54 years. (Figure 6). The combined water storage now hovers around 51.4 percent of capacity, about 2.3 percent less than a year ago. The April through July unregulated inflow to Lake Powell was 5.8 million acre-feet, which was 73 percent of average. Storage in other reservoirs within Arizona's borders decreased in July by more than 120,000 acre-feet. However, storage in the Salt and Verde river basins is greater than average and greater than they were in July last year.

In water-related news, the Payson Town Council is considering awarding a contract to design a $1.5 million system to put Blue Ridge Reservoir water into the town's aquifer (*Payson Roundup*, August 3). This will help offset declines in Payson's aquifer caused by groundwater pumping.

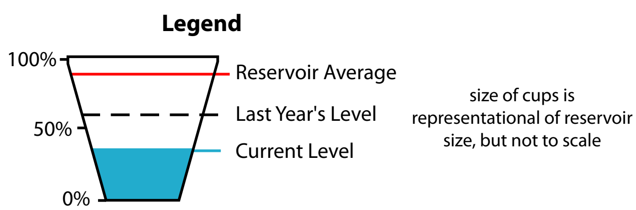
Notes:

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.

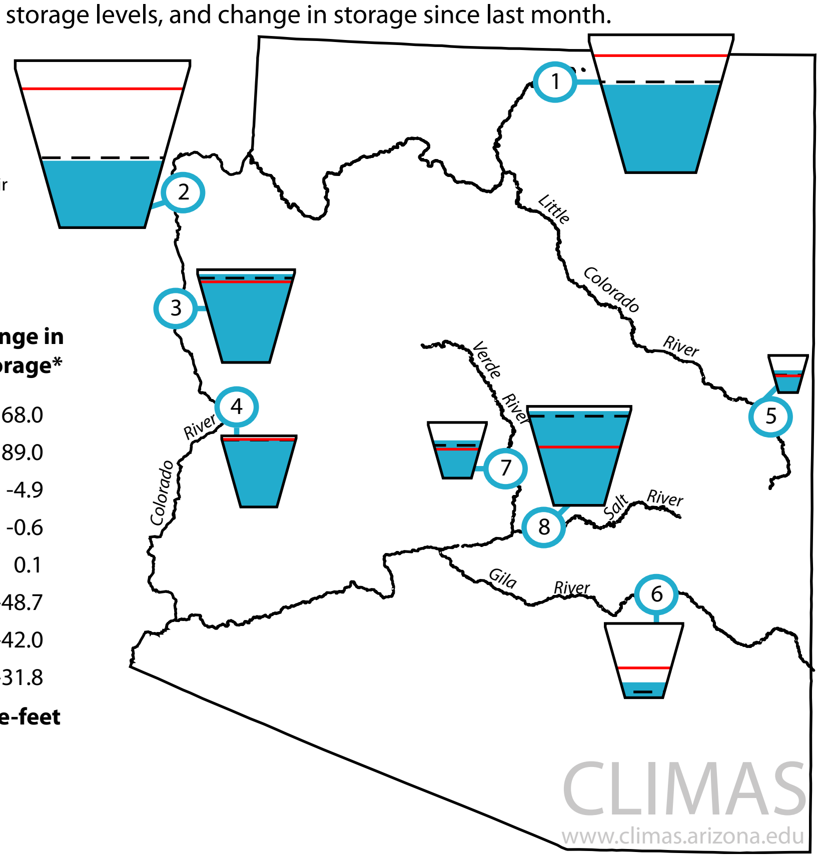
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for July 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%	15596.0	24,322.0	-268.0
2. Lake Mead	40%	10357.0	26,159.0	-189.0
3. Lake Mohave	95%	1714.4	1,810.0	-4.9
4. Lake Havasu	96%	591.8	619.0	-0.6
5. Lyman Reservoir	60%	18.0	30.0	0.1
6. San Carlos	21%	180.2	875.0	-48.7
7. Verde River System	68%	196.8	287.4	-42.0
8. Salt River System	95%	1922.7	2,025.8	-31.8

*** thousands of acre-feet**



On the Web:

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

New Mexico Reservoir Levels

(through 7/31/10)

Source: USDA-NRCS, National Water and Climate Center

The total reservoir storage in New Mexico decreased by about 207,000 acre-feet in July (Figure 7). Storage in the two largest New Mexico reservoirs—Navajo and Elephant Butte—decreased by nearly 160,000 acre-feet. While Navajo reservoir storage stands at about 87 percent of capacity, Elephant Butte is hovering around 20 percent. The largest change in storage capacity from one year ago has been in Santa Rosa and Conchas, where water levels have risen 77 and 65 percent above last year's July totals, respectively.

In water related news, Santa Fe city officials are considering saving additional water for homes and businesses or releasing it into the Santa Fe River (*Santa Fe New Mexican*, August 2). The trade off is between saving more reservoir water, which decreases city costs for pumping groundwater from wells, and letting water flow in the river to enrich the ecosystem and provide recreational value. Winter rains boosted to river flows, but the prospect of a dry winter is fueling the debate.

Notes:

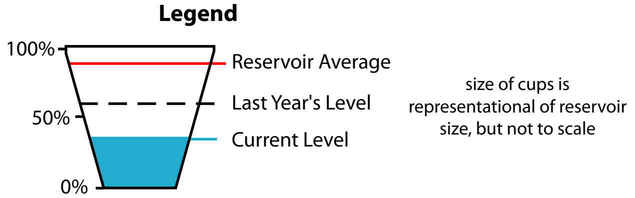
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total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

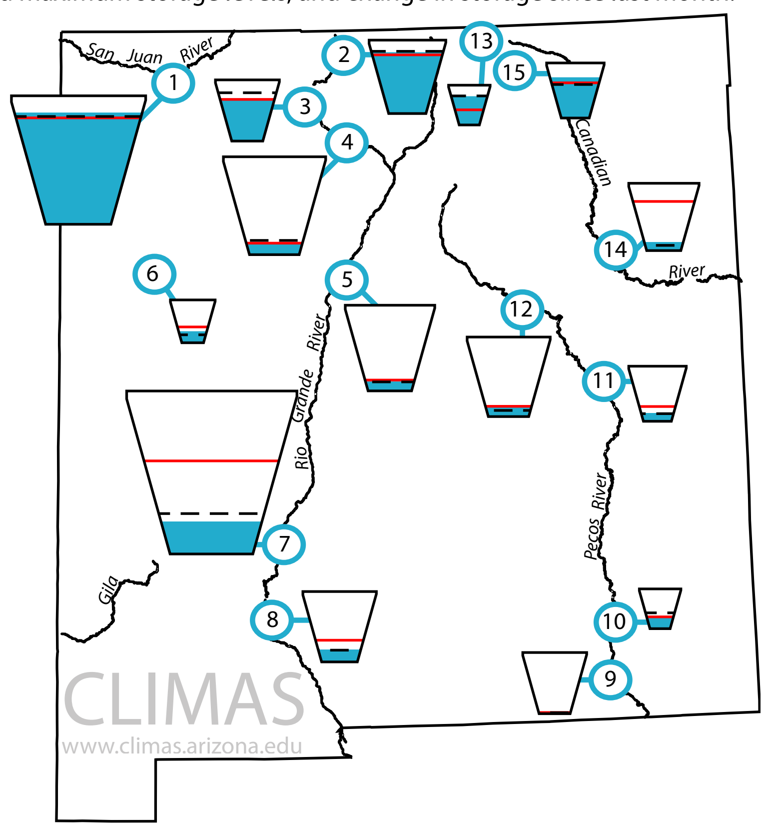
Figure 7. New Mexico reservoir levels for July as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	87%	1,473.9	1,696.0	-70.1
2. Heron	83%	333.0	400.0	0.8
3. El Vado	68%	130.2	190.3	-41.5
4. Abiquiu	12%	148.0	1,192.8	-8.5
5. Cochiti	11%	52.3	491.0	-0.4
6. Bluewater	27%	10.4	38.5	-8.5
7. Elephant Butte	20%	444.3	2,195.0	-86.1
8. Caballo	18%	60.8	332.0	7.9
9. Brantley	3%	25.6	1,008.2	9.8
10. Lake Avalon	30%	1.2	4.0	-0.2
11. Sumner	15%	15.6	102.0	0.5
12. Santa Rosa	13%	58.2	438.3	-1.8
13. Costilla	72%	11.5	16.0	-2.6
14. Conchas	13%	32.9	254.2	-4.6
15. Eagle Nest	74%	58.2	79.0	-1.8

*** thousands of acre-feet**



On the Web:

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

Southwest Fire Summary

(updated 8/11/10)

Source: Southwest Coordination Center

Wildfire activity has tapered off during the last month due to an increase in monsoon precipitation across most of the Southwest in the latter part of July. Monthly rainfall for July generally totaled more than 100 percent of average in most of Arizona and New Mexico, with the exceptions of western Arizona, southwestern New Mexico, and a few other areas. In the areas with above-average precipitation, temperatures were around 2–4 degrees Fahrenheit below average, while areas with average to below-average precipitation levels were warmer than average.

In the Southwest, more than 153,000 acres have burned in Arizona and New Mexico between January 1 and August 10. Fires charred more than 60,000 acres in Arizona and almost 93,000 acres in New Mexico and lightning has caused about 60 percent of the wildfires in both states (Figure 8a). The total number of acres burned in the Southwest is drastically less than the annual average of approximately 414,000 acres. This year, the below-average fire season was due in part to a wet winter and spring, which increased soil and fuel moisture levels.

Currently, there are no new reports of large wildfires in the Southwest, and all existing wildfires have been contained or are being monitored (Figures 8b–c). The observed fire danger class for most of Arizona and New Mexico is low to moderate, according to the Wildland Fire Assessment System (WFAS).

Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2010. The figures include information both for current fires and for fires that have been suppressed. The top figure shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. The bottom two figures indicate the approximate locations of past and present "large" wildland fires and prescribed burns in Arizona and in New Mexico. A "large" fire is defined as a blaze covering 100 acres or more in timber or 300 acres or more in grass or brush. The name of each fire is provided next to the symbol.

On the Web:

These data are obtained from the Southwest Coordination Center website:

http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_all_wf_by_state.pdf

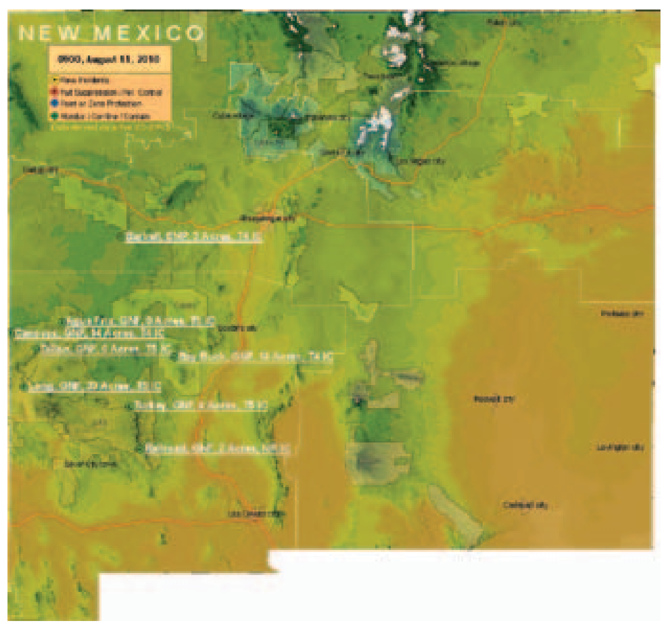
http://gacc.nifc.gov/swcc/predictive/intelligence/maps/wf/swa_fire_combined.htm

Figure 8a. Year-to-date wildland fire information for Arizona and New Mexico as of August 10, 2010.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	743	26,963	388	33,318	1,131	60,281
NM	464	33,592	338	59,186	802	92,778
Total	1,207	60,555	726	92,504	1,933	153,059

Figure 8b. Arizona large fire incidents as of August 11, 2010.

Figure 8c. New Mexico large fire incidents as of August 11, 2010.



Monsoon Summary
(through 8/13/2009)

Source: Western Regional Climate Center

Vigorous monsoon activity in many parts of the Southwest during late July and early August has helped make up for a dry start to the season and has helped alleviate drought conditions in many parts of both Arizona and New Mexico. Since mid-July, northern and eastern Arizona and northwestern New Mexico have received more than 150 percent of average rainfall (Figure 9a). In Payson, Arizona, July storms dumped a record-setting 3.8 inches of rain, according to the National Weather Service. Only southwestern Arizona and southern New Mexico have experienced dry conditions. Since the monsoon officially began on June 15 in Arizona (New Mexico does not have an official start date), precipitation totals have been between 2 and 6 inches in most of Arizona, and 2 and 10 inches in New Mexico (Figure 9b). Rain storms in the last month have boosted rainfall totals to above-average levels in the eastern portion of Arizona and many parts of New Mexico (Figure 9c). Despite copious rains in many regions, the Colorado River corridor in western Arizona, and particularly in southwest Arizona, has been parched. Many areas in this section have seen less than 5 percent of average rainfall.

The remainder of the monsoon season is more likely to be dry in northern regions of Arizona. The NOAA–Climate Prediction Center's (CPC) September precipitation forecast calls for drier conditions in the northern regions, while the forecast calls for equal chances of below-, above-, or near-average rainfall in southern portions of the Southwest. The CPC seasonal forecast for the September–November period calls for drier-than-average conditions in all areas of Arizona and New Mexico. The dominant influence on these forecasts is the La Niña event that has taken hold in the tropical Pacific Ocean and is expected to strengthen and continue into 2011. La Niña events often cause winter storm tracks to waft north of the Southwest.

Figure 9a. Percent of average precipitation (interpolated) for June 15–August 13, 2010.

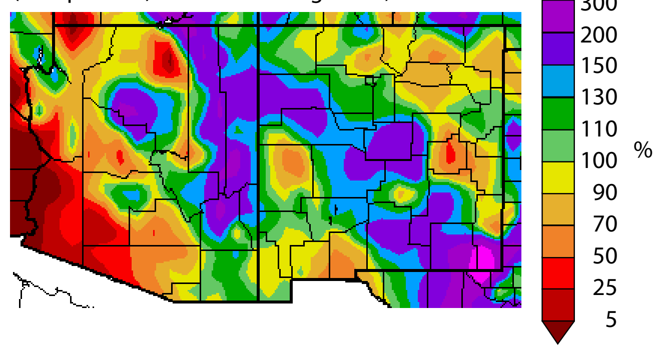


Figure 9b. Total precipitation in inches (June 15–August 13, 2010).

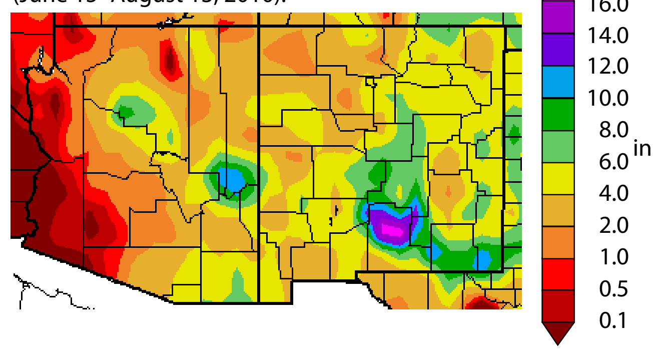
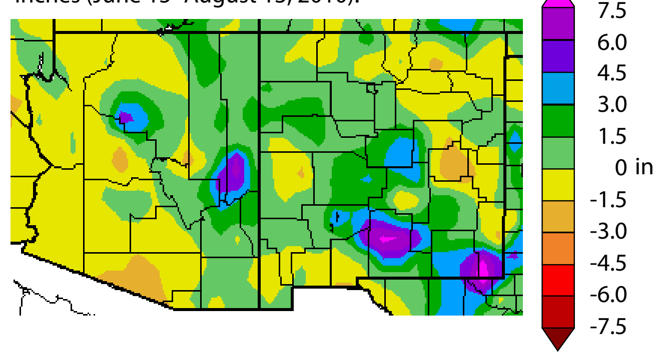


Figure 9c. Departure from average precipitation in inches (June 15–August 13, 2010).



Notes:

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

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

On the Web:

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

Temperature Outlook

(September 2010–February 2011)

Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA–Climate Prediction Center (CPC) in August are nearly identical to those issued last month. CPC outlooks show greater than a 50 percent probability that temperatures will be above average in all of Arizona and western New Mexico for the remainder of the monsoon season and into early fall (Figure 10a). The CPC also indicates that temperatures have greater than a 50 percent chance of being above average for most of the Southwest into early 2011 (Figures 10b–10c). Both the expectation of La Niña conditions and decadal warming trends contribute to the enhanced probability of above-average temperatures in the West.

Notes:

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

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

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

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

Figure 10a. Long-lead national temperature forecast for September–November 2010.

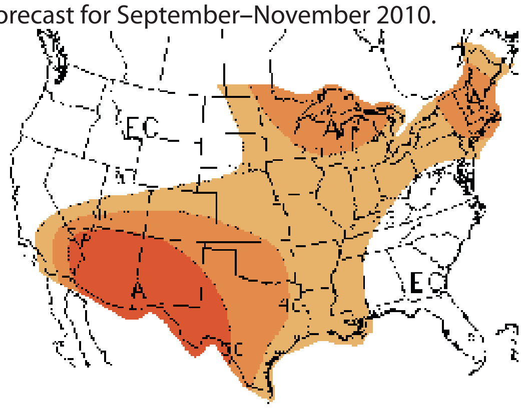
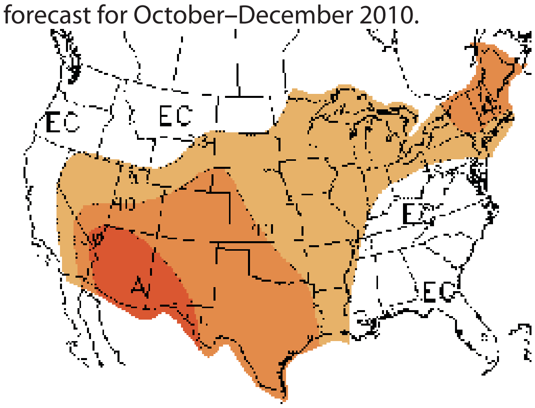


Figure 10b. Long-lead national temperature forecast for October–December 2010.



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 10c. Long-lead national temperature forecast for November 2010–January 2011.

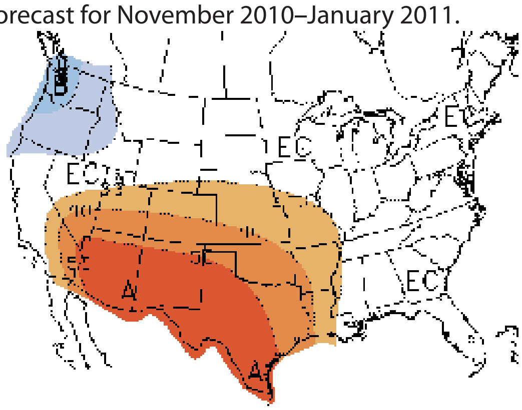
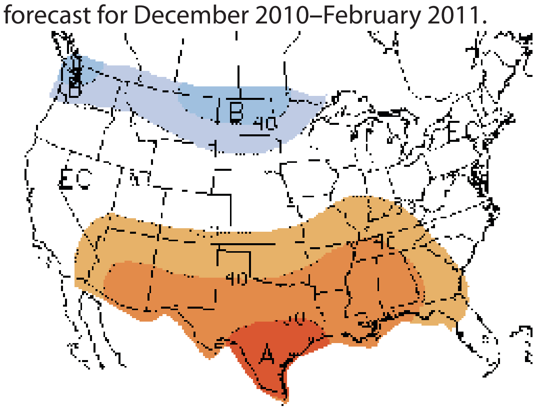


Figure 10d. Long-lead national temperature forecast for December 2010–February 2011.



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

(September 2010–February 2011)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (CPC) precipitation outlooks suggest drier-than-average conditions for the remainder of the monsoon season and early fall for all of Arizona and western New Mexico, with Arizona experiencing the greatest tilt in the odds toward drier conditions (Figure 11a). This outlook is influenced heavily by the La Niña event, and the CPC recently issued a La Niña Advisory, which means that La Niña conditions have been observed and are expected to continue (see page 19). La Niña conditions historically favor below-median precipitation from the September–November period in the Southwest. Seasonal outlooks for the winter also favor drier-than-average conditions in the Southwest, strongly reflecting the effect La Niña has on winter precipitation in the Southwest (Figures 11b–11d).

Notes:

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

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

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

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

Figure 11a. Long-lead national precipitation forecast for September–November 2010.

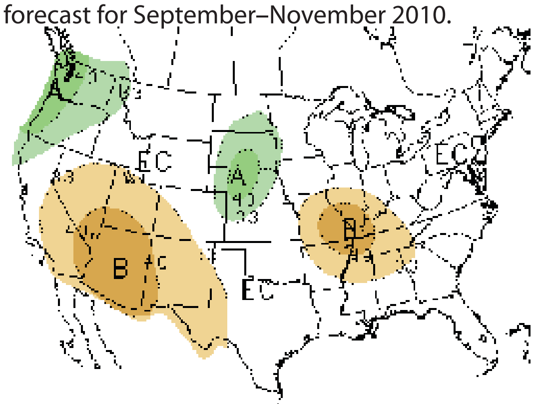


Figure 11b. Long-lead national precipitation forecast for October–December 2010.

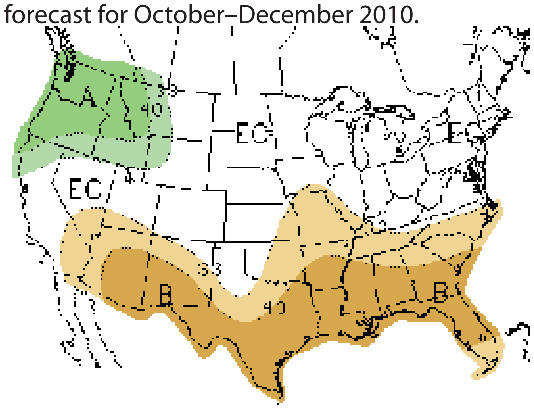


Figure 11c. Long-lead national precipitation forecast for November 2010–January 2011.

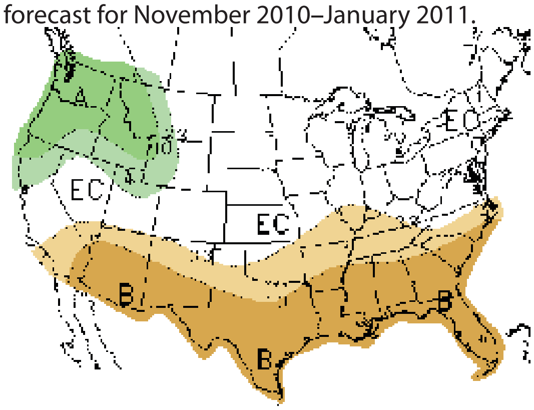
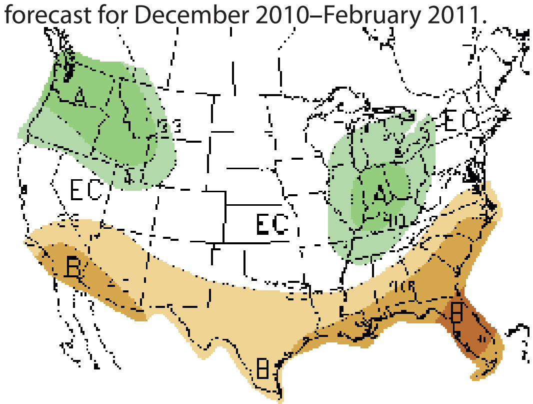


Figure 11d. Long-lead national precipitation forecast for December 2010–February 2011.



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 August load slowly on your computer)

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

Seasonal Drought Outlook

(through November)

Source: NOAA-Climate Prediction Center (CPC)

This summary is excerpted and edited from the July 15 Seasonal Drought Outlook technical discussion produced by the NOAA–Climate Prediction Center and written by forecasters A. Loconto and R. Tinker.

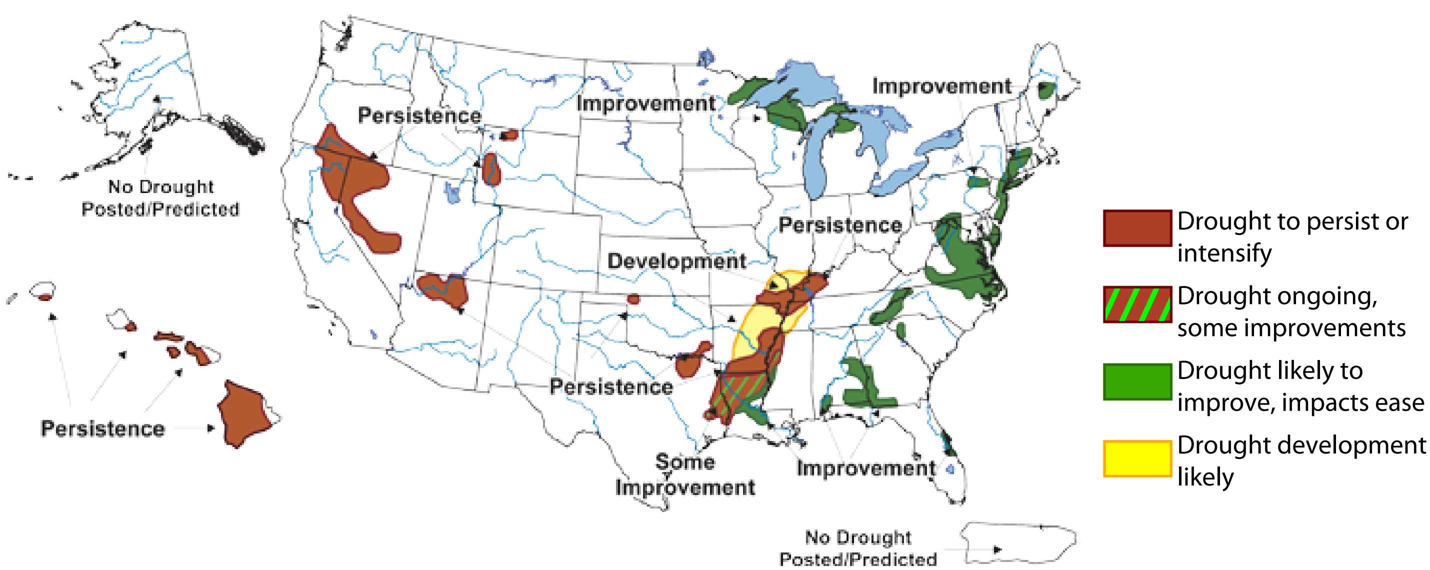
In the Southwest, an active monsoon circulation since mid-July has improved drought conditions across the region, although an area of abnormally dry and moderate drought persists in northern Arizona (Figure 12). In this area, rainfall totals in the past several months have been low. Even though NOAA–Climate Prediction Center's six to ten- and eight to fourteen-day forecasts suggest that additional monsoon rains are possible in parts of this region through the remainder of August, rainfall is expected to become less likely as the North American Monsoon season ends in September. This indicator, and CPC's long-lead seasonal forecasts, which also show a tilt in the odds toward dry conditions for the September–November period, suggests that drought will persist in northwestern Arizona. The CPC has moderate confidence in this forecast.

Elsewhere, an increase in late-spring precipitation in the northern Rockies and the Great Basin improved drought conditions. Across northern and central Louisiana ongoing drought continues and ranges in severity from abnormally dry in central Louisiana to severe drought in northern Louisiana. Heavy rainfall from the remnants of Tropical Depression #5 has led to some reduction in drought over central Louisiana in the past week. A substantial mid- to late-July heat wave, combined with spotty rainfall, has expanded drought from the mid-Mississippi Valley and lower Ohio Valley southward into southern Arkansas, while in the upper Mississippi Valley and Great Lakes long-term drought has diminished in severity and coverage due to several rainfall episodes this summer.

Notes:

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

Figure 12. Seasonal drought outlook through November (released August 19).



On the Web:

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

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

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

Wildland Fire Outlook
(September–November 2010)

Sources: National Interagency Coordination Center, Southwest Coordination Center

This will be the last Wildfire Outlook until April 2011.

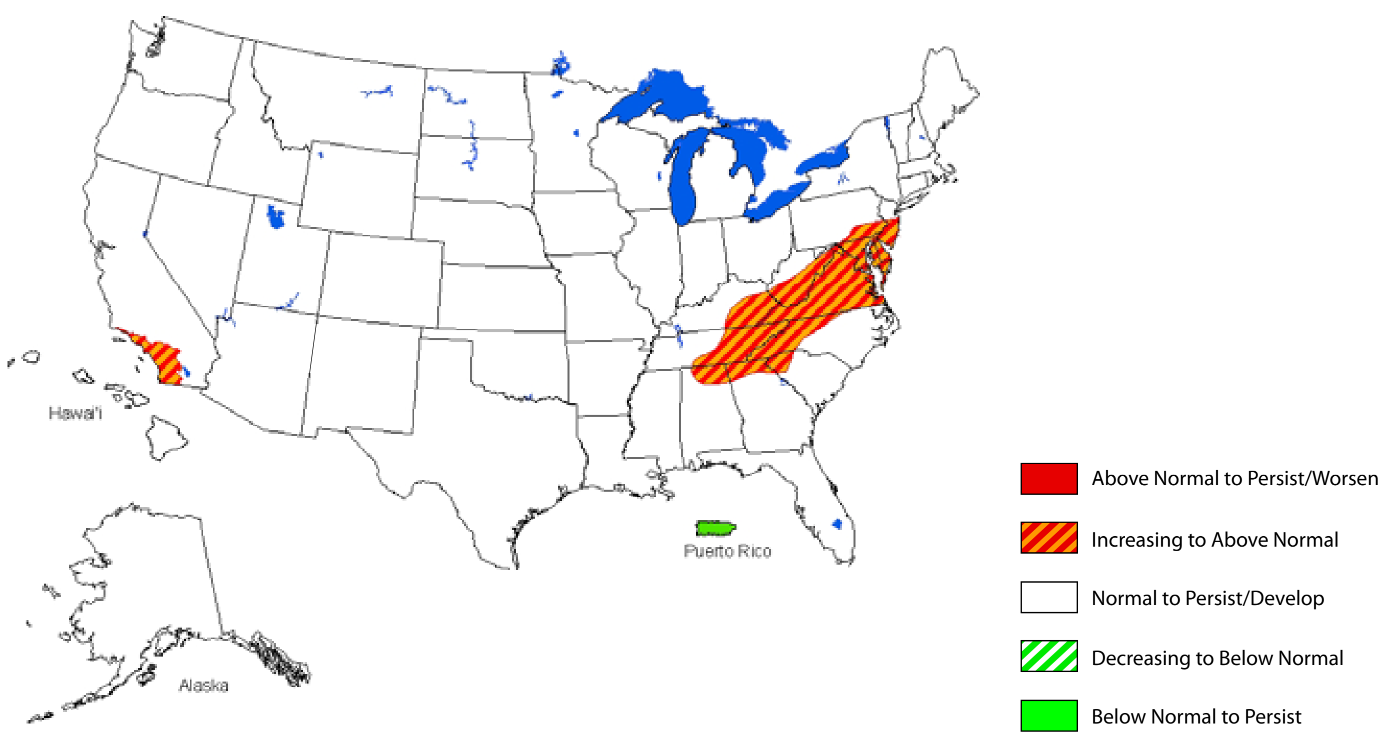
Fire activity is past its prime in the Southwest. Nonetheless, fires occur during fall, and the National Interagency Fire Center calls for normal fire potential in the Southwest during the August–November period (Figure 13).

Periodic precipitation events associated with monsoon activity should help maintain moist conditions in southern parts of Arizona during the remainder of August. However, drier-than-average conditions may become prevalent in western and northern Arizona during the rest of August, which could result in localized bursts of above-normal fire potential in these regions. Also, the La Niña event that is gaining strength in the tropical Pacific Ocean may cause the monsoon to end early, reducing soil moisture and fuel moisture levels. The influence of the La Niña event is captured in the latest NOAA–Climate Prediction Center (CPC) seasonal outlooks (see Figures 10 and 11). They show increased chances for above-average temperatures and below-average precipitation for the September–November period. While normal fire activity is expected, there is reason to believe that that short periods of above-normal fire potential could occur in Arizona and the northwestern portion of New Mexico during the fall months.

Notes:

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

Figure 13. National wildland fire potential for fires greater than 100 acres (valid September–November 2010).



On the Web:

National Wildland Fire Outlook web page:
http://www.nifc.gov/news/nicc.html

Southwest Coordination Center web page:
http://gacc.nifc.gov/swcc/predictive/outlooks/outlooks.htm

El Niño Status and Forecast

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

The NOAA–Climate Prediction Center (CPC) has issued a La Niña Advisory, which means that a La Niña event has been observed and is expected to continue. In the last month, La Niña conditions continued to strengthen across the equatorial Pacific Ocean. Sea surface temperatures (SSTs) are now 1 degree Fahrenheit below average across the eastern Pacific Ocean, indicating a weak event is underway. The Southern Oscillation Index (SOI) rocketed to a value of 2 in July from a meager 0.1 in June (Figure 14a). This large swing in SOI values is evidence that the atmosphere has noticed the shift towards cooler SSTs in the Pacific Ocean and is responding with large-scale shifts in circulation patterns across the region. Winds from the east also have strengthened along the equator, driving more upwelling of cold water in the eastern tropical Pacific Ocean, which is serving to further strengthen the event.

Forecasts issued by the International Research Institute for Climate and Society (IRI) show a high probability that La Niña conditions will continue to persist and possibly strengthen over the next several months. The chance of the current La Niña event continuing through the upcoming winter season exceeds 90 percent, while there is only a 1 percent chance than an El Niño event will return during this period (Figure 14b). Seasonal precipitation forecasts issued by the CPC reflect the high probability for the La Niña event to continue this winter and show increased chances of drier-than-average conditions across all of Arizona and New Mexico.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from August 1980 through December 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 14a. The standardized values of the Southern Oscillation Index from January 1980–June 2010. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).

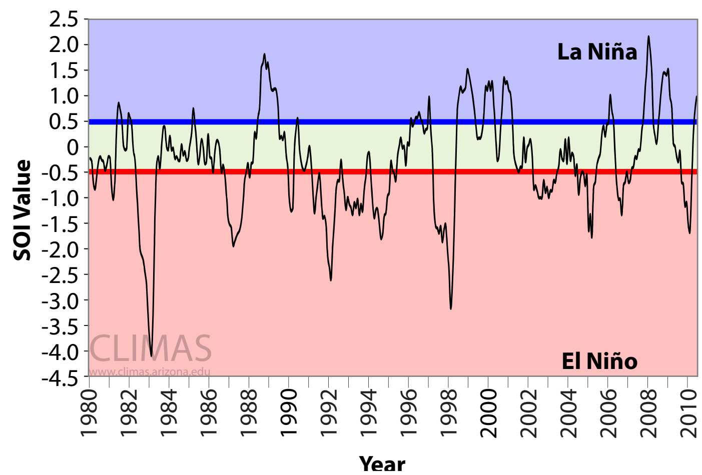
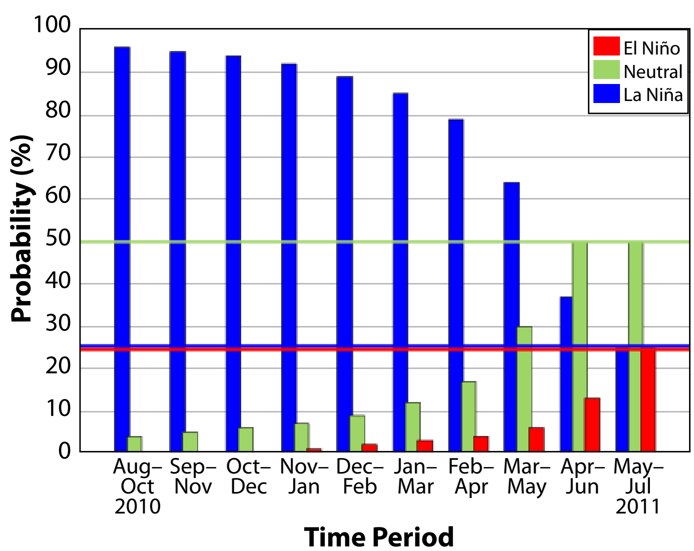


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released August 19). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(September 2010–February 2011)

Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed temperatures for September–November to forecasts issued in August for the same period suggest that in southern and western Arizona forecasts have been more accurate than an equal chances forecast, while forecast accuracy for all of New Mexico has been similar to an equal chances forecast (Figure 15a). Forecast skill—a measure of the accuracy of the forecast—is highest in the southern and western regions of Arizona. Skill for the two-month lead time forecasts for October–December increases in all of New Mexico and remains more accurate than equal chances in southeastern and northwestern Arizona (Figure 15b). The three-month lead time forecasts have the most accurate forecasts in southern areas of the Southwest (Figure 15c). However, the four-month lead time forecast has been historically less accurate than equal chances in all of the Southwest, suggesting that forecasts for these periods are less likely to occur (Figure 15d). While bluish hues denote more accurate forecasts, caution is advised to users of the seasonal forecasts for regions with reddish colors.

Notes:

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

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

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

Figure 15a. RPSS for September–November 2010.

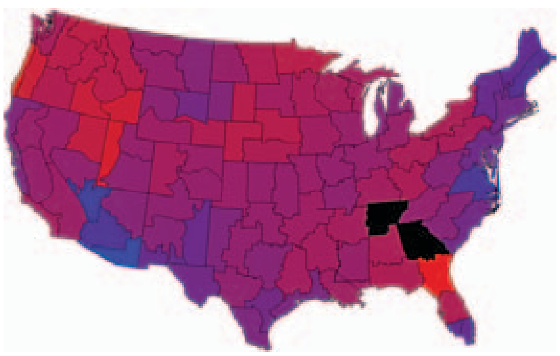


Figure 15b. RPSS for October–December 2010.

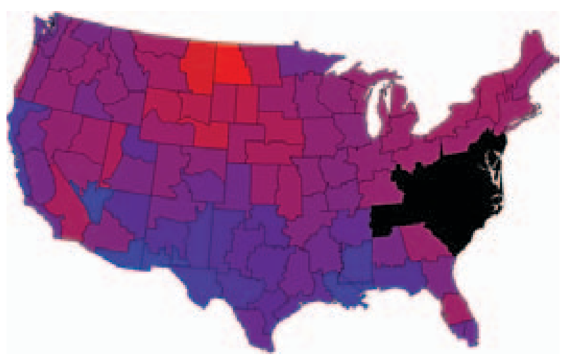


Figure 15c. RPSS for November 2010–January 2011.

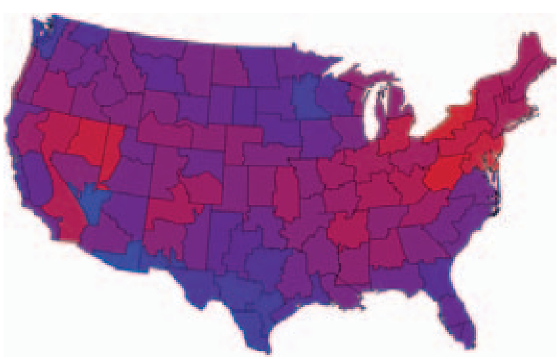
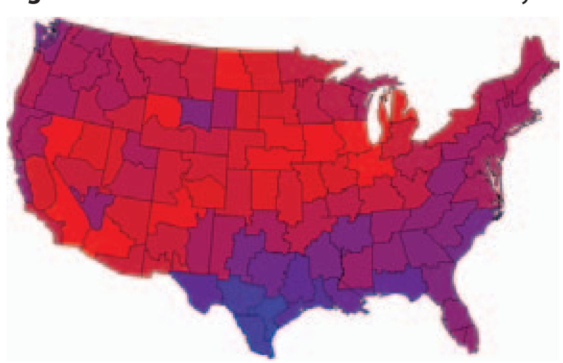
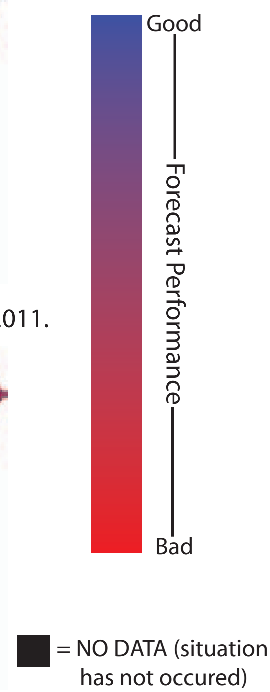


Figure 15d. RPSS for December 2010–February 2011.





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
(September 2010–February 2011)

Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed precipitation for September–November to forecasts issued in August for the same period suggest that forecasts have been slightly more accurate than forecasting equal chances in southeast Arizona (i.e., 33 percent chance that rain will be above-, below-, or near-average). This largely reflects the area of Arizona most influenced by the monsoon (Figure 16a). Currently, the NOAA–Climate Prediction Center (CPC) forecasts slightly below-average precipitation for the southern region. This forecast has never been issued for this period for southern New Mexico, reflected in the black "no data" color. Outside of southeast Arizona, forecast skill—a measure of the accuracy of the forecast—is similar to an equal chances forecast. For the October–December period, forecasts have been better than equal chances only in southeast Arizona, while forecasts have been less accurate than equal chances in northern Arizona and all of New Mexico (Figure 16b). As the year progresses into the winter, forecast skill is either less accurate than equal chances or only a slight improvement upon an equal chances forecast in most of New Mexico and northern Arizona (Figures 16c–d).

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 16a. RPSS for September–November 2010.

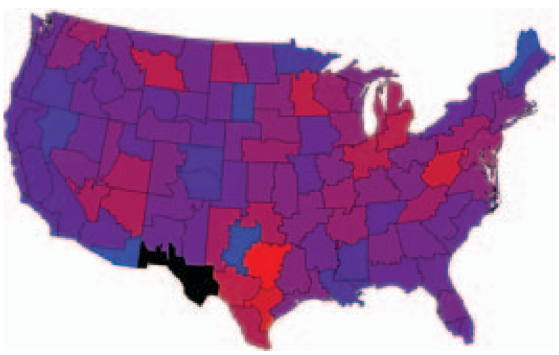


Figure 16b. RPSS for October–December 2010.

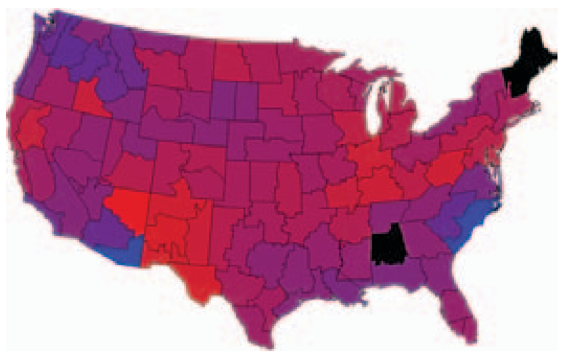


Figure 16c. RPSS for November 2010–January 2011.

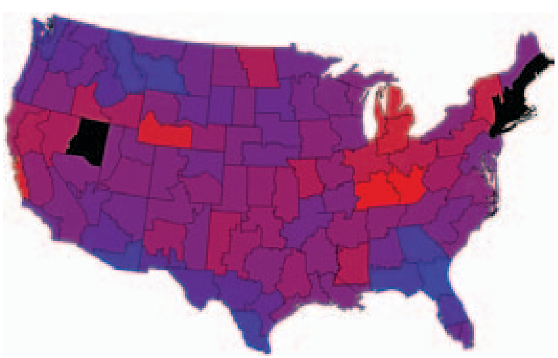
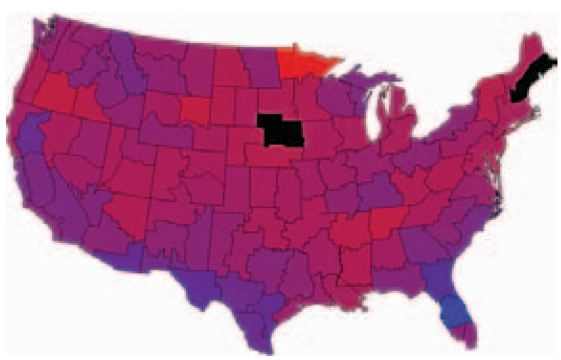
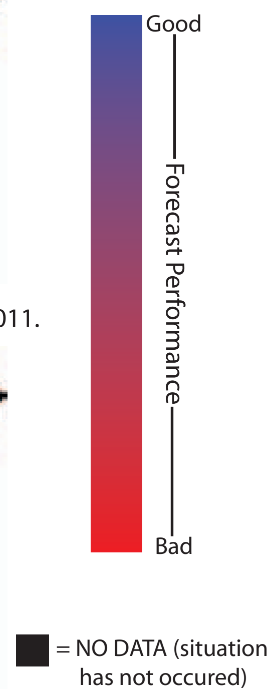


Figure 16d. RPSS for December 2010–Febuary 2011.





On the Web:

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