Issued: June 27, 2008

Southwest Climate Outlook

Source: Gregg Garfin

Photo Description: This aerial photograph was taken from an airplane traveling from Tucson, Arizona to Kansas City Kansas in June 2008.

Would you like to have your favorite photograph featured on the cover of the *Southwest Climate Outlook*? For consideration send a photo representing Southwest climate and a detailed caption to: knelson7@email.arizona.edu

In this issue...

June Climate Summary

Drought – March and April were extremely dry across Arizona, causing short-term drought status to be downgraded one category for most of the state's watersheds.

Temperature – In the past month, temperatures in western Arizona and northwestern New Mexico have been slightly colder than average, while temperatures in southeastern Arizona and southwestern and north central New Mexico have been slightly above average.

Precipitation – In the past thirty days, precipitation has been localized and isolated in both states, typical of convective thunderstorms. Many regions in Arizona have received greater than 200 percent of the average precipitation; some isolated storms have caused precipitation to be greater than 800 percent of the average values.

ENSO – A transition from La Niña to ENSO-neutral conditions is underway. Sea surface temperatures (SSTs) in the central and east-central equatorial Pacific Ocean have warmed since mid-February. The atmospheric manifestation of La Niña is also weakening. Most forecast models indicate ENSO-neutral SSTs during the coming June–August season.

Climate Forecasts – Temperature forecasts for the Southwest predict increased chances of above-average temperatures for most of the region through December. The precipitation outlook for Arizona and New Mexico calls for equal chances of above-, near-, and below-average precipitation through December.

The Bottom Line – Temperatures continued to be above average for much of the Southwest. This trend is expected to continue. Precipitation was variable. The amount of monsoon rain, though difficult to predict, may provide drought relief in some areas.

Monsoon season has a new start date

For Arizona, the monsoon season this year officially kicked off on June 15 and will end on September 30. The change from past years, when the monsoon onset was tied to average dew point temperatures, came after National Weather Service offices in Tucson, Phoenix, and Flagstaff, agreed that bracketing the monsoon season with specific calendar dates simplifies communication to the public about when the monsoon storms are likely to start and what the hazards may be.

New Mexico does not define a monsoon season, but in Arizona, the beginning of the summer rains has been a moving target from year to year and from location to location. Historically, the monsoon season in Tucson began when three consecutive days had average dew point temperatures that surpassed 54 degrees F. In Phoenix, that threshold was 55 degrees F. The new start date will alert people that hazards, such as flash floods, dust storms, lightning strikes, strong winds, hail, and high heat may occur.

For more info:
http://www.wrh.noaa.gov/twc/monsoon/monsoon_tracker.php

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The wet winter and the basins' bathtubs

A look at winter precipitation and the future of the Colorado River reservoirs

By Zack Guido

It wasn't supposed to be like this. Not amid a La Niña event. This winter snow and rain fell, and fell often, in parts of the West and Southwest, turning dry winter precipitation forecasts for 2007–08 upside down. Fears that water supplies would continue to dwindle melted like the snow that ultimately feeds the Colorado River.

So what does this past winter mean for the Southwest, especially in light of the prolonged drought that has gripped the region and dire projections for the future of Lakes Powell and Mead?

An unanticipated wet winter

The Colorado River carves a nearly 1,500-mile course from the tips of Wyoming peaks to the Gulf of California, along the way sculpting the Grand Canyon. The river supplies water to 27 million people in seven states and Mexico, making it a critical resource in the region and a liquid lifeline for the arid Southwest.

Most of the water streaming down the Colorado River is born as snow in the mountains of Colorado, Wyoming, and Utah. When the first flakes began to fall this past winter, many southwesterners paid keen attention to the Rockies, their optimism rising for spring water supplies and water storage in the Colorado River Basin's reservoirs.

Near Silverton, Colorado, in the heart of the San Juan Mountains, snow accumulated steadily and without major storms. At the end of November, 16 inches fell, followed by 12 inches in mid-December, 21 inches in early January, 14 inches three weeks later, and another foot in mid-February. In between, it seemed like every night some precipitation graced the ground; snow fell 60 days between the first of October and the last day of March. Contrary to expectations, a steady stream of snow covered many of the basin's mountains this past winter, depositing the snow needed to create that most crucial and vital western resource—water.

"Historically, La Niña has been a slam dunk for drier-than-usual conditions" said Tom Pagano, water supply forecaster for the National Resource Conservation Service. Yet, in South Mineral Creek, slightly north and west of Silverton, the snowpack's accumulated water content surpassed its 1971 to 2000 average a few days into December.

This story was repeated throughout most of the Upper Colorado River Basin. On February 15, measurements of snow water equivalent, the depth of water that would result from melting a specific volume of snowpack, set records in the headwaters of the Rio Grande as well as many locations in the San Juan Mountains. A month later, records were again observed in those locations and also to the north in the mountains surrounding the town of Aspen. Even on April 15, a dry month-and-a-half after the weather began behaving more like climatologists had predicted, snow water equivalent records were set all over Colorado.

The early season snow accumulation in the upper basins of the Colorado River gave water planners and users hope that relief from the ongoing drought had arrived. Even though La Niña's desiccating touch returned around the first of March, the National Oceanic and Atmospheric Administration (NOAA) forecast streamflow to be 118 percent of average at Lake Powell from May through September.

Average precipitation for the entire Upper Colorado River Basin this winter was the second highest it has been in the last 10 years (Figure 1). For the Rio Grande, an important water source for New Mexico, the picture is even rosier. Winter precipitation in the headwaters of the river was the highest it has been in the last 20 years.

The snow in Colorado may not have much influence on Arizona. Reservoirs on the Colorado River were built precisely to smooth natural variability so users have a reliable supply regardless of wet or dry winters. However, the more important and long-term answer is that this winter reverses the declining water-level trend and, for the moment, takes us farther from the low reservoir level that would create a declaration of shortage to users in the lower basin.

Is a collective sigh in order? No. According to Terry Fulp, the U.S. Bureau of Reclamation's Deputy Regional Director of the Lower Colorado Region, we will have to wait and see if the drought of the last eight years is waning. Fulp cautioned that history has shown that a few wet years are common among strings of drier years.

Colorado River storage

Between October 1, 1999, and September 30, 2007, storage in Colorado River reservoirs decreased from 55.8 million acre-feet (maf) to 32.1 maf , or about 94 percent of capacity to about 54 percent. Not since the late 1960s has Lake Mead's water level been as low as it has been in the last several years, and that was when demand was much lower (Figure 2). The past eight years have been the driest eight-year stretch in the 1906–2008 recorded history and have nailed into the collective consciousness the vulnerability of western water supplies. For most of these years, people witnessed the addition of white bathtub rings on the red and black reservoir rocks. Much like counting tree rings and measuring their widths to

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Wet winter, continued

understand precipitation, the rings are a visual reminder that the water balance is tipped in the draining direction. Although this winter may have submerged some of the rings around Lake Powell, the questions still remain: is the Colorado River storage system resilient to lower future water flows? How will future climate change impact the system?

Dire predictions

Is the Colorado River over allocated? Yes, say many water mangers, including Fulp. When will Lake Mead go dry? It's difficult to imagine that water managers will let this happen, said Mike Dettinger, a researcher for the U.S. Geologic Survey and Scripps Institution of Oceanography at the University of California in San Diego. In fact, a recent environmental impact statement completed by the Bureau of Reclamation as part of a public process to develop new river operating guidelines presents a strategy to prevent exhausting the storage capacity. In spite of this, a recent article that was written by Tim Barnett and David Pierce and appeared in the journal *Water Resource Research* proclaimed that, under current conditions, a water budget analysis showed a "10 percent chance that live storage in Lakes Mead and Powell will be gone by about 2013 and a 50 percent chance that it will be gone by 2021 if no changes in water allocation from the Colorado River system are made."

Barnett and Pierce, researchers at the Scripps Institution of Oceanography, set out to answer a fundamental question that is also the paper's title: "When Will Lake Mead Go Dry?" Given the important subject, the alarming conclusions, and the media frenzy that accompanied the paper's release, it is not surprising that the headlines from Fox News and *The New York Times* respectively read, "Adios, Las Vegas: Lakes Mead, Powell May Run Dry by 2021" and "Lake Mead Could Be Within a Few Years of Going Dry, Study Finds."

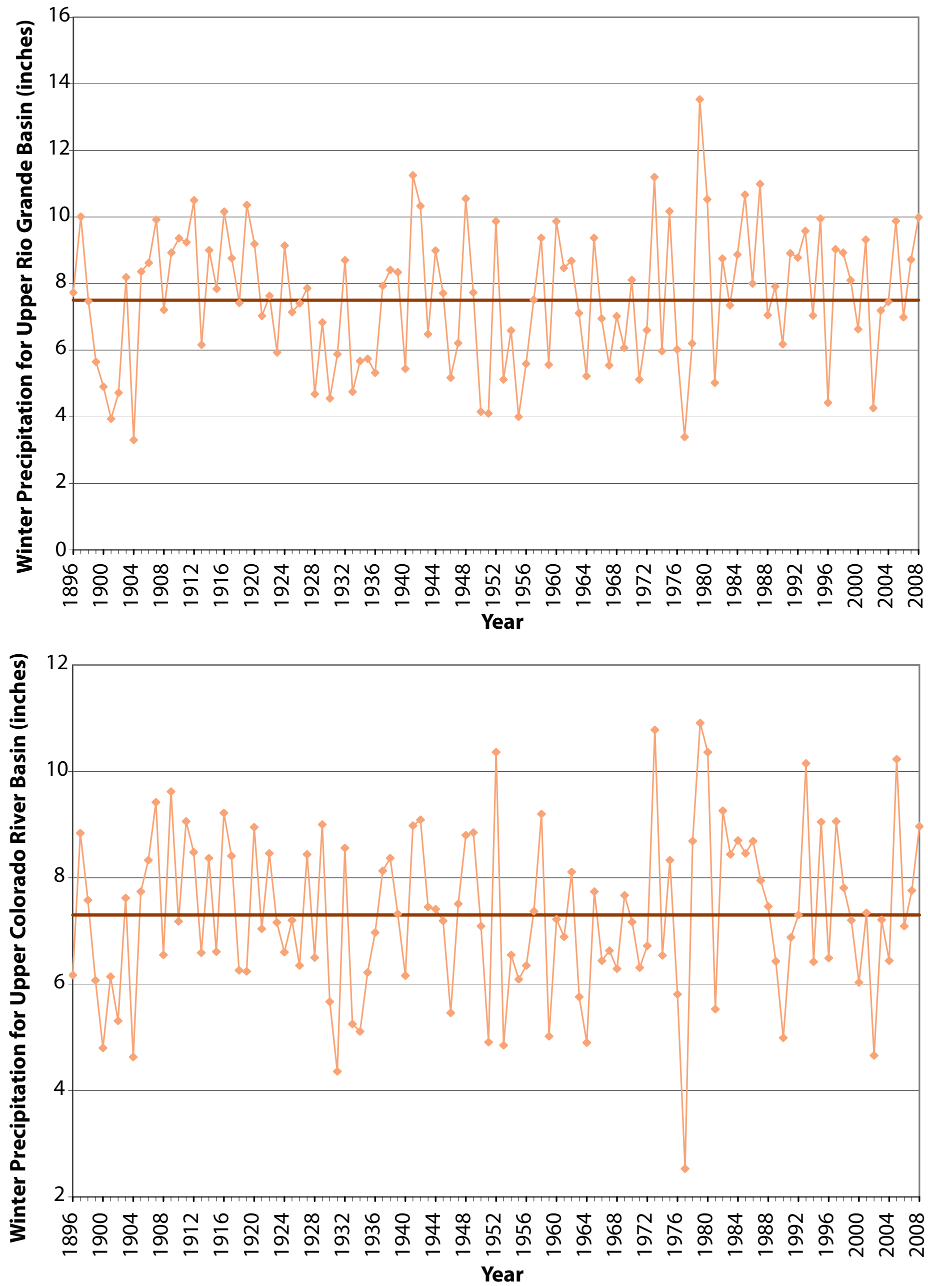

Figure 1. Total winter precipitation (October 1– March 31) for the Upper Rio Grande Basin and Upper Colorado River Basin. The two time-series are based on PRISM data which uses point measurements at many locations and an algorithm that interpolates between the measurement sites. The brown line is the 1896–2007 average. The 2008 value is preliminary.

The methodology and conclusions in Barnett and Pierce's paper have drawn strong criticism from water managers and researchers and have stimulated much discussion.

"There's nothing wrong with sparking debate, and Tim Barnet certainly did that," Fulp said.

The study's model

The study used a water balance model that added the inflows of the water system to the current total reservoir storage and then subtracted the outflows. The model used the total current storage in both Lakes Mead and Powell of 25.7

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Wet winter, continued

maf, which was reported by Reclamation in June 2007. To the total storage, the model added stream discharge predictions that were based on the 1906–2005 observed streamflow record and a 1,250-year record reconstructed from tree-rings. In order to analyze the many different and possible scenarios of future annual streamflows, both in magnitude and order, the model produced 10,000 annual river flows using several different statistical techniques. This is why the conclusions were expressed in probability. Scientists don't know which scenario is going to happen, and because all possibilities are based on past observations, each is possible.

Summing the storage and streamflow for each year produced the projected inflows to the system. From this, the estimated future water supply for each

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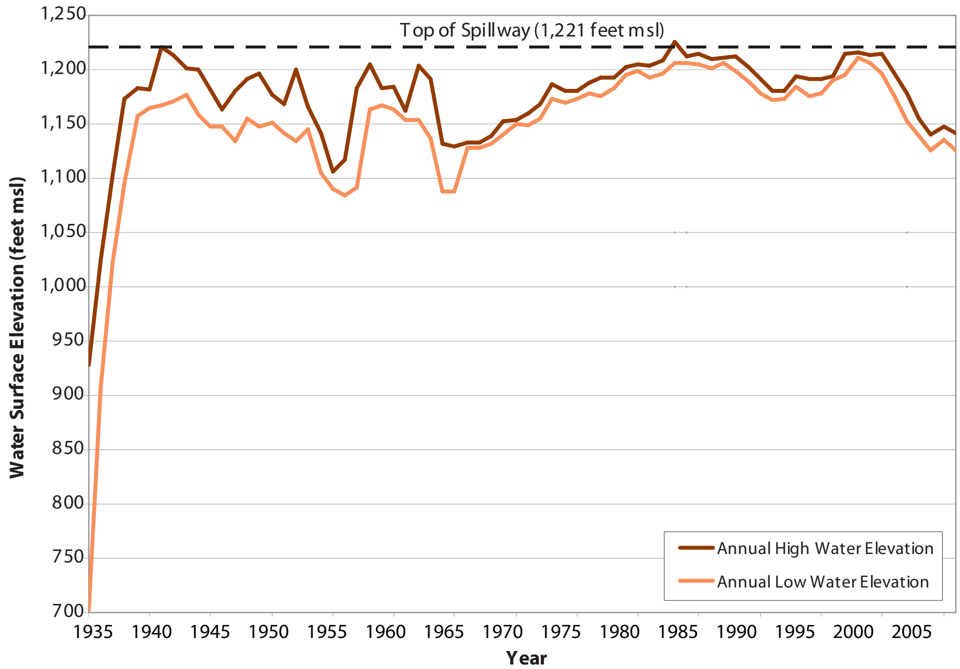


Figure 2. . Historic annual water level elevations in Lake Mead. The solid blue line is the maximum annual water elevation; the solid red line is minimum annual water elevation. *Source: Bureau of Reclamation's Final Environmental Impact Statement, 2007*

Model Type	Inflow	Outflows			Results	
	Streamflows	Evaporation/ infiltration (maf)[a]	Climate Change Option: reduction in stramflow by 2058	Management Option: supply decrease when storage capacity <15 maf[a]	10% chance to deplete storage by year	50% chance to deplete storage by year
Probalitic Model	Variable	1.7	Yes, 20%	No	2014	2028
	Variable	1.7	Yes, 20%	Yes, 25%	2025	2048
Net Inflow Model	'-1.0 maf/yr[b]	1.7	Yes, 20%	No	2013	2021
	'-1.0 maf/yr[b]	1.7	No	No	2014	2028

[a]maf = million acre-feet
[b]the model begins with a 2008 net water deficit of 1.0 maf/yr and extends that value into the future.

Table1. Summary of the results presented in the study by Barnett and Pierce (2008) and the corresponding water inflows and outflows from their models.

Wet winter, continued

year was subtracted. The Bureau of Reclamation estimated that the demand by the upper basin states (Colorado, Utah, Wyoming, and New Mexico) will continually increase, while demand by the lower basin states (Arizona, Nevada, and California) and Mexico will remain constant. In addition, the model subtracted from the sum of storage and streamflow 1.7 maf each year due to the estimated water loss from evaporation and infiltration. The authors also built into the model a management strategy that reduces the water supply when the reservoirs drain to less than 15 maf. Finally, the authors allowed the model to simulate the impacts of climate-driven reductions in streamflow that reflect estimated reductions in basin-wide precipitation (Table 1). The model predicts a 50 percent chance that Lake Mead will run dry as soon as 2021 or as late as 2048. The date of storage depletion changes depending on the streamflow quantification method, management strategy, and climate change. The earliest prediction is startlingly soon. However, the model is oversimplified and, according to Dettinger, does not capture in a meaningful way the management of the Colorado River system. At best, the results emphasize the importance of proper water management and use. At worst, some researchers say, the study could prompt managers to ignore future academic input.

Stakeholders' response

In addition to the news headlines, the paper's abstract and a press release issued by the American Geophysical Union about the study emphasized the dire projections: the press release states, "50 percent probability that storage in Lakes Mead and Powell will be gone by 2021 if climate changes as expected and future water usage is not curtailed." As the public relations office at the Bureau of Reclamation's Lower Colorado Regional Office points out, it is important to keep this issue in the forefront of people's minds. However, Fulp does not agree that current climate projection models present the kind of information with which to make such definitive projections of future water supplies.

Fulp and the Bureau of Reclamation say the study does not take into account the management of the Colorado River under shortage conditions. In fact, Reclamation recently concluded a two-and-a-half year study that led to the environmental impact statement for determining and allocating lower basin water shortages and coordinating operation of Lakes Powell and Mead under a wide range of conditions. The guidelines specify that water deliveries in the lower basin will be reduced by 0.33, 0.417, and 0.5 maf per year when the water level of Lake Mead drops below 1,075, 1,050, and 1,025 feet above mean sea level, respectively. The guidelines include a provision that reconvenes state and federal water mangers and other interested parties if the water level in Lake Mead dips below 1,025 feet. This action would be taken to develop further management strategies to reduce the likelihood of draining these two large reservoirs. This management strategy would further reduce the probability of Barnett and Pierce's study becoming a reality. The primary assumption in the study is that water will continually be taken out of the system without regard for management and the evolving water supply, Dettinger said. A better analysis, he continued, "would have been to follow the management strategy of the Bureau of Reclamation to the T."

The study also does not account for additions to the system below Lakes Mead and Powell, according to Reclamation. Although the amount is small, it is an important contribution to the water balance, Fulp said. The authors of the paper tally water consumption in 2008 to be 15.2 maf, representing withdrawals of 13.5 maf for the upper basin, lower basin, and Mexico, and 1.7 maf in evaporative and infiltration losses. They also calculate supply to be 15.05 maf, creating a net deficit of 0.15 maf. However, if the contribution of tributaries in the lower basin is included, then the river is not in a net deficit. This accounting would change the authors' results for the models that analyze the system in terms of net inflows.

The study uses a 20 percent reduction in streamflow that results from climate change. This assumption is the most difficult for management because the state-of-the-art models predict reductions in precipitation between 5 and 50 percent. Furthermore, the models make these estimates over large spatial scales that exclude important, finer-resolution details. For Fulp, it is difficult to make management decisions based on one scenario that adopts a 20 percent reduction in streamflow from climate change. Climate change may have a significant impact on future flows. But before explicit reductions in streamflows from climate change can be included in decision making, resource managers need proper downscaling of the global models to regional scales and better quantification of the uncertainty in the precipitation estimates. Fortunately, collaboration between organizations like Reclamation and the academic science communities continues with these ends in mind.

The bottom line

The deep snowpack this winter in the upper basin does not mean that the water supply concerns will disappear. Similarly, the alarming headlines portending the emptying of the reservoir system do not mean that we are doomed. The reality is somewhere in between. According to Fulp, the challenge is to conduct prudent water management, a concept that encompasses water conservation, multi-sector collaboration, and adaptive management. However, that does not mean that the responsibility for water resides solely with people in high places. According to researchers and water managers, everyone living in the seven states should treat water as a precious resource and use it wisely.

Temperature (through 6/18/08)

Source: High Plains Regional Climate Center

Since the start of the water year on October 1, temperatures in Arizona and New Mexico have varied with both elevation and latitude. The southern deserts in both states have seen temperatures ranging from 60 to 70 degrees Fahrenheit, while the highest mountains have had temperatures in the 30s (Figures 1a–b). The southern mountains have had more moderate average temperatures, between 40 and 60 degrees F. Persistent high pressure systems in the west have steered the cold low pressure systems north of Arizona and New Mexico since mid-February. The southern half of both states continues to be 0–2 degrees F above average, while the northern and higher elevation areas remain 0–2 degrees F below average. In the past thirty days, temperatures across western Arizona and northwestern New Mexico generally have been 0–2 degrees F colder than average (Figures 1c–d). Southeastern Arizona and southwestern and north central New Mexico are 0–6 degrees F warmer than average, and eastern New Mexico is 2–6 degrees F warmer than average. The slightly below-average temperatures in western and central Arizona are due to two weak, cold, low pressure systems that moved through in late May and early June. High pressure over Texas blocked those systems from bringing cooler air to eastern New Mexico.

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 '07–'08 (through June 18, 2008) average temperature.

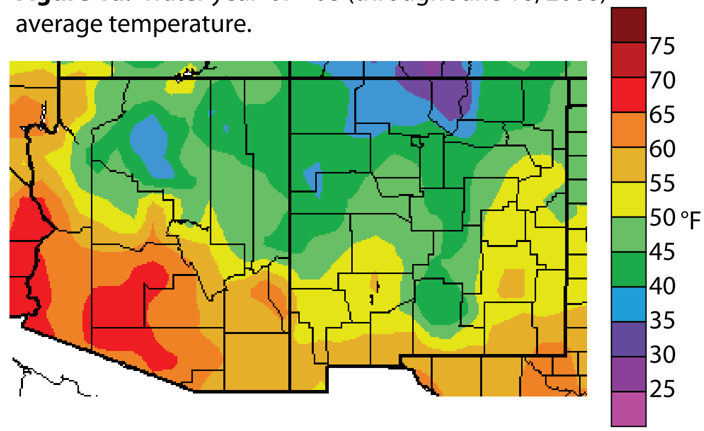


Figure 1b. Water year '07–'08 (through June 18, 2008) departure from average temperature.

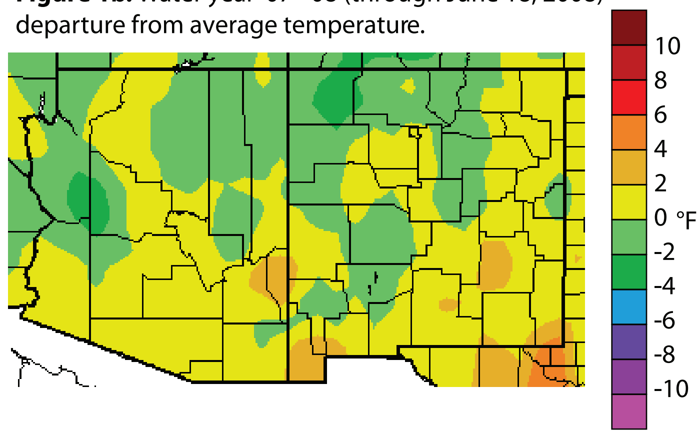


Figure 1c. Previous 30 days (May 20–June 18, 2008) departure from average temperature (interpolated).

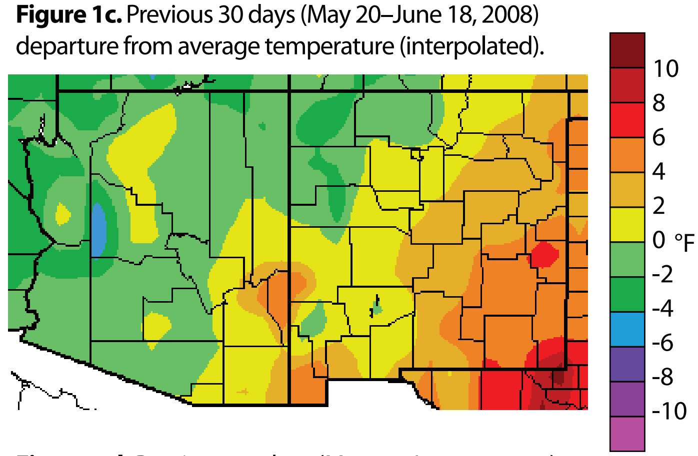
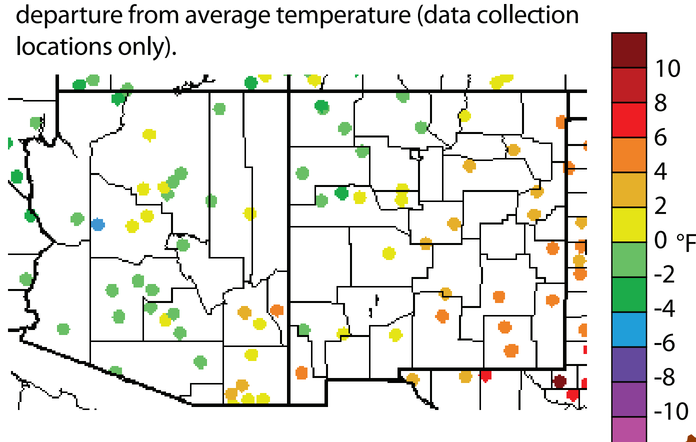


Figure 1d. Previous 30 days (May 20–June 18, 2008) departure from average temperature (data collection locations only).



Precipitation (through 6/18/08)

Source: High Plains Regional Climate Center

Precipitation for the water year beginning October 1 generally has been up to 50 percent of average across the southeastern two-thirds of New Mexico and southeastern Arizona (Figures 2a–b). Other parts of both states have received between 80 and 110 percent of average precipitation. The Gila Bend area in southwestern Arizona has received more than 150 percent of average precipitation due to a single strong thunderstorm that brought 2.2 inches of rain near the end of May. The dry conditions since February have been especially hard on southern and eastern New Mexico and southeastern Arizona. In the past thirty days, precipitation has been localized and isolated in both states, typical of convective thunderstorms (Figures 2c–d). May is the driest month in Arizona, so when Bullhead City in northwestern Arizona received 0.12 inches of rain on May 24, that was 800 percent of average precipitation for the thirty-day period. A few other locations in central Arizona have received more than 100 percent of average precipitation, all due to two storm systems that moved through on May 22–24 and June 5. The summer thunderstorm season has begun, and storms are predicted to begin early in the season this year, which should bring relief to the driest areas of southeastern Arizona and southern New Mexico.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2007, we are in the 2008 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 '07–'08 (through June 18, 2008) percent of average precipitation (interpolated).

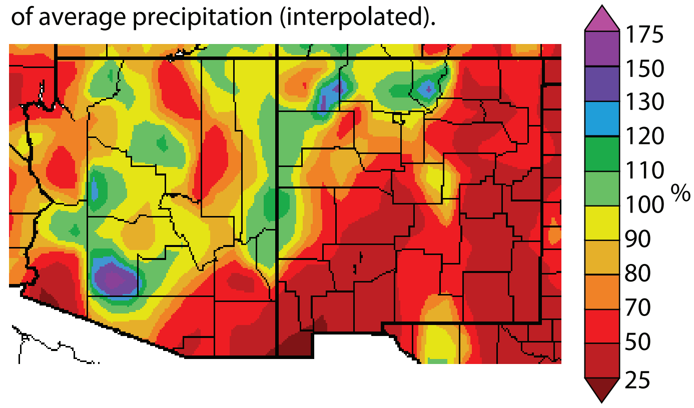


Figure 2b. Water year '07–'08 (through June 18, 2008) percent of average precipitation (data collection locations only).

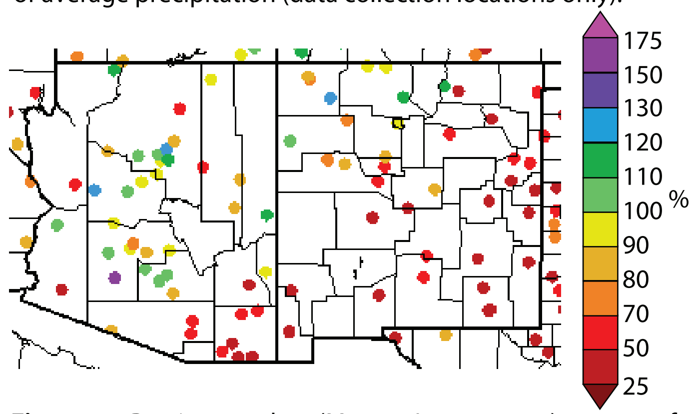


Figure 2c. Previous 30 days (May 20–June 18, 2008) percent of average precipitation (interpolated).

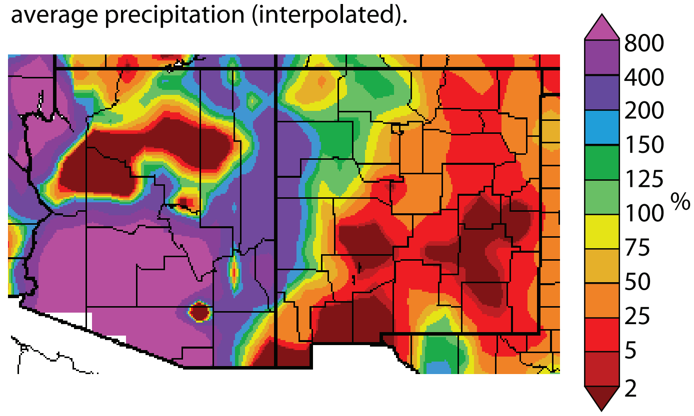
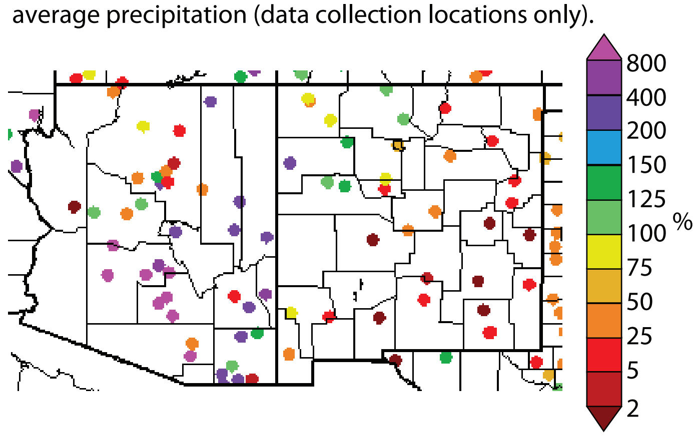


Figure 2d. Previous 30 days (May 20–June 18, 2008) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 6/19/08)

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

Compared with one month ago, drought severity increased in most of New Mexico (Figure 3). In particular, drought levels reached the extreme category in southern New Mexico and exceptional in the northeastern corner of the state. In addition to the lack of precipitation in these regions during the current water year, temperatures have been exceedingly warm in southern New Mexico, where warm winds also added to stress on ecosystems and non-irrigated agricultural lands. Southeastern Arizona, which also suffered lower-than-average winter precipitation, reached severe drought status.

In drought-related news, officials in Portales, New Mexico, are asking water customers to voluntarily conserve water (*Portales News-Tribune*, June 13). The city's water storage tanks are down to three million gallons, compared to their combined capacity of nine million gallons.

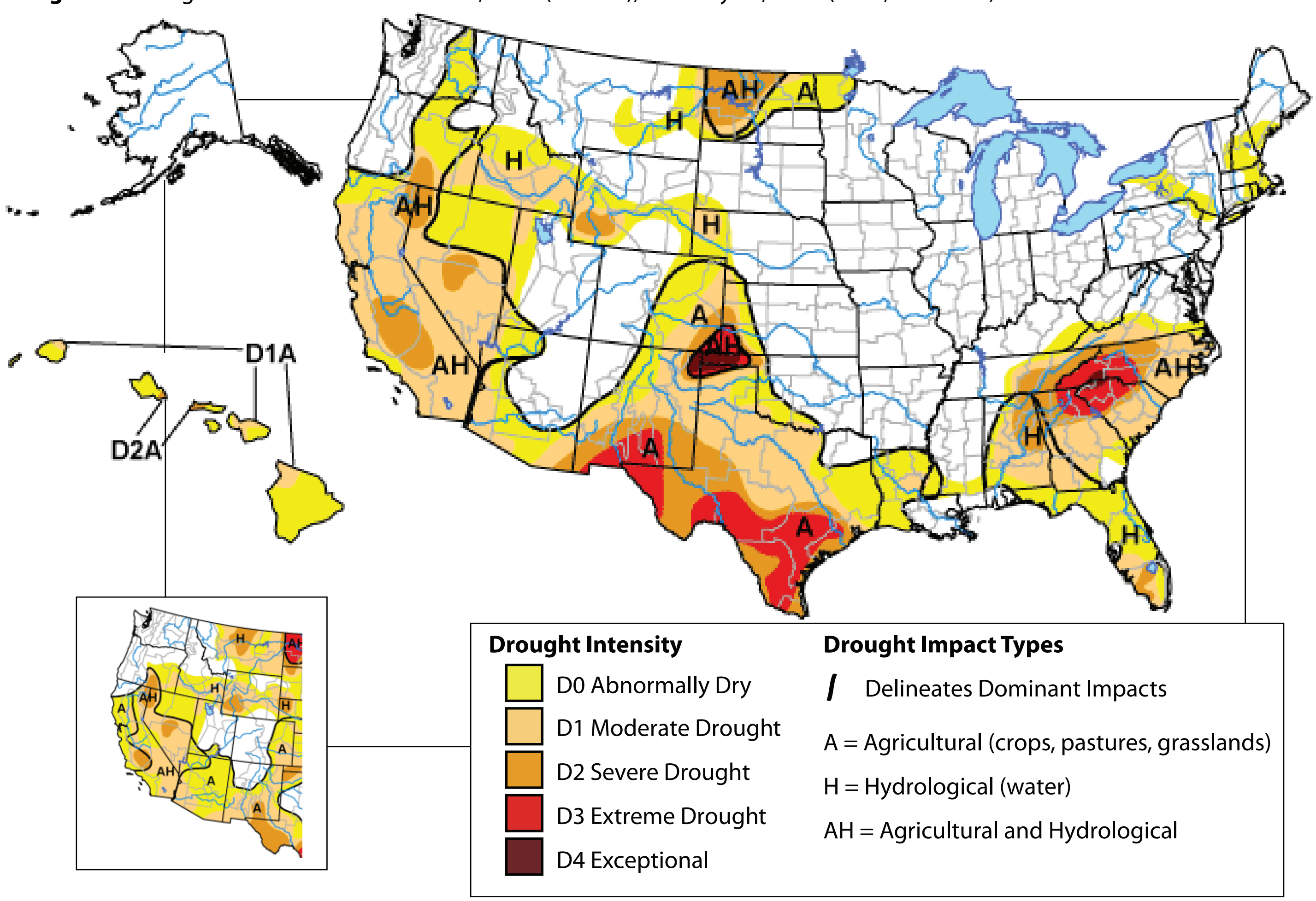
Pima County, Arizona, has declared stage one drought (www.pima.gov/drought). The public is urged to voluntarily reduce water use, and restaurants are asked to provide water on request only.

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 the several agencies; the author of this monitor is Rich Tinker, CPC/NOAA.

Figure 3. Drought Monitor released June 19, 2008 (full size), and May 15, 2008 (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
(through 4/30/08)

Source: Arizona Department of Water Resources

March was extremely dry across the entire state, and April followed suit. As a result, short-term drought status was downgraded one category for most of the state's watersheds to abnormally dry (Figure 4a). However, the drought status remained unchanged along the northern Arizona border, registering a normal designation. Another notable exception was the Willcox Playa watershed in the southeast, where the drought status remained moderate. The southeast, including parts of Pima, Santa Cruz, and Cochise counties, represents the largest area of the state that has had short-term conditions worse than abnormally dry since January 2008.

The summer rainy season typically begins in late June or early July, and short-term drought status will improve, worsen, or remain unchanged depending on the amount and extent of precipitation. Short-term drought status may improve once the monsoon rains begin.

Long-term drought status is updated quarterly (Figure 4b). The current long-term drought status was determined using data through March 31 and therefore remains the same as last month. The next update will be available in August.

Notes:
The Arizona drought status maps are produced monthly by the Arizona Drought Preparedness Plan Monitoring Technical Committee. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 4a shows short-term or meteorological drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months). Figure 4b refers to long-term drought, sometimes known as hydrological drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfall (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, and groundwater). These maps are delineated by river basins (wavy gray lines) and counties (straight black lines).

On the Web:
For the most current Arizona drought status maps, visit:
http://www.azwater.gov/dwr/drought/DroughtStatus.html

Figure 4a. Arizona short-term drought status for May 2008.

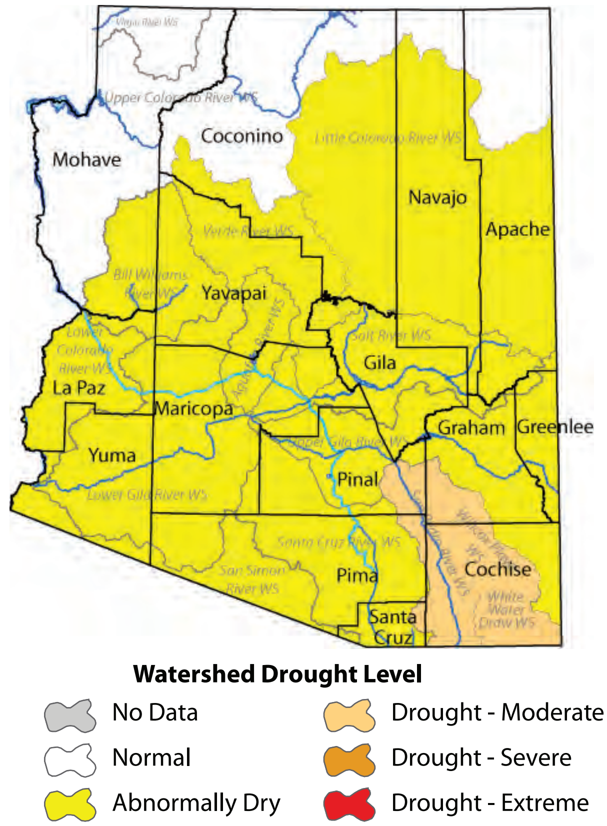
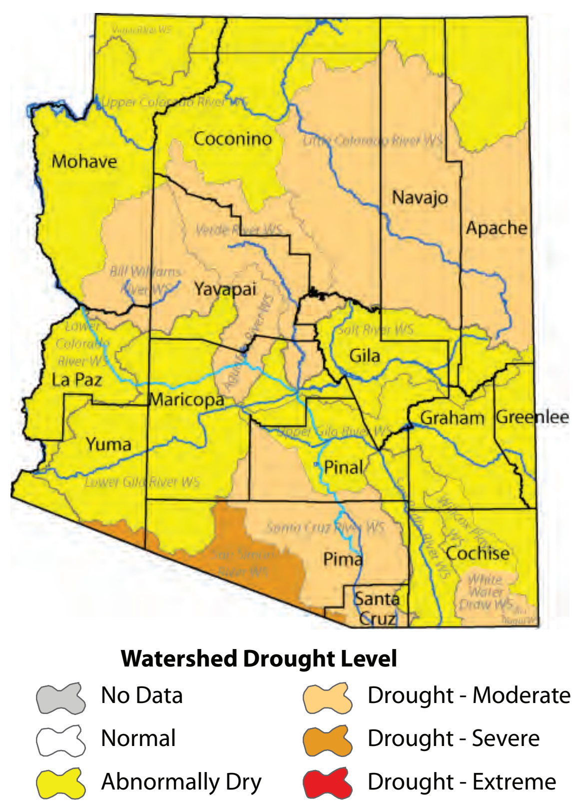


Figure 4b. Arizona long-term drought status for May 2008.



New Mexico Drought Status
(released 6/19/08)

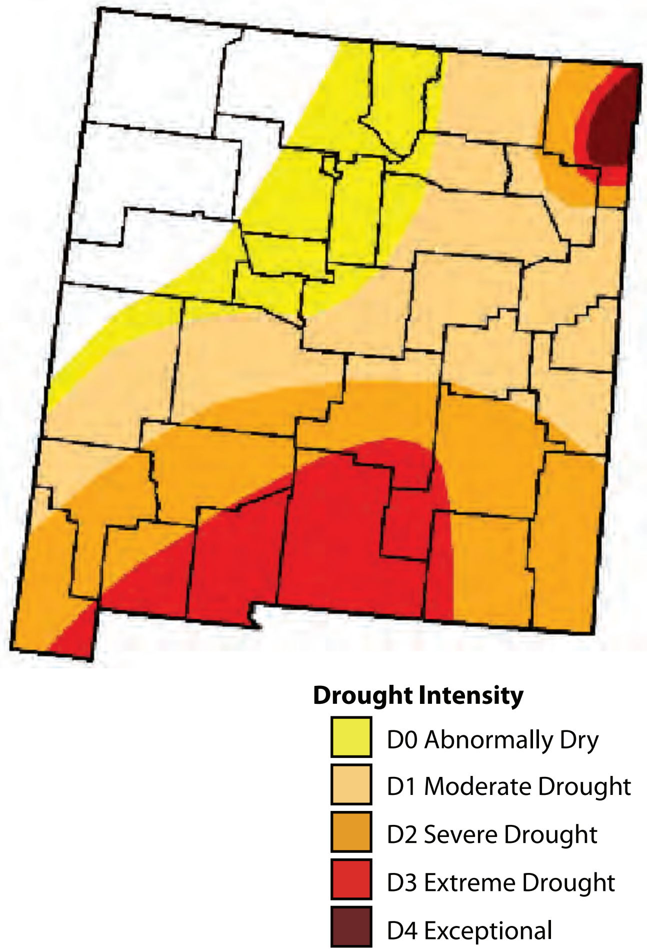
Source: New Mexico State Drought Monitoring Committee

In the last month, drought severity increased across almost all of New Mexico (Figure 5). USDA topsoil moisture (not shown) registered 83 percent in the short to very short category which means that normal crop growth and development would be curtailed and, in occasions, stopped. Only 17 percent registered in the adequate category where Seed germination and crop growth and development would be unhindered, based on subjective measurements by agricultural experts as of June 15. Range and pasture conditions (not shown) indicate that 66 percent of the rangelands and pasturelands are in poor to very poor conditions and only 4 percent are in good to excellent conditions.

Snowmelt-driven streamflow has peaked in New Mexico and flows are beginning to recede. The San Juan, Upper Rio Grande, Upper Canadian, Upper Pecos, and Gila River basins had average to above-average streamflows, ranging from 92 to 175 percent of average, according to New Mexico U.S. Geological Survey experts. The Lower Canadian and Lower Pecos streamflows were well below average, ranging from 13 to 69 percent of average flow.

Many state and federal entities have deployed drought preparedness measures. Restrictions on fireworks, smoking, campfire, and open fires apply to all non-federal, non-municipal, and non-tribal lands in the 23 counties east of Interstate 25. Most of the Lincoln National Forest in southeast New Mexico is closed to the public. Also closed are the Bureau of Land Management Fort Stanton area lands adjacent to the Lincoln National Forest and the Sevilleta National Wildlife Refuge south of Belen. High fire danger is motivating these closures. In addition, the Navajo Nation has established fire restrictions on the reservation in northwest New Mexico. Campfires are permitted only in developed recreation areas. Smoking and fireworks are prohibited. Stage 1 fire restrictions are in effect on the Sandia, Mountainair, Magdalena, and Mt. Taylor Ranger Districts. Campfires are restricted to campgrounds only. Many New Mexico pueblos have also enacted stage 1 fire restrictions.

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



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 the 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 5/31/08)

Source: National Water and Climate Center

Reservoir storage in Lake Powell increased by more than 1.6 million acre-feet during the last month (Figure 6). The June 9 elevation of Lake Powell was 3,619.18 feet above sea level. Combined storage in Lakes Powell and Mead is expected to increase by the end of the water year. Since last month, storage in the Salt and Verde River watersheds declined slightly.

In water news, the free swimming larvae of invasive quagga mussels have been detected in the Central Arizona Project Canal, Phoenix, and Tucson (*New York Times*, June 17). The mussels, detected in Lakes Mead and Pleasant, have also wreaked havoc on Great Lakes ecology during the last decade. Perhaps most alarming is that the mussels, which filter and concentrate toxins, are associated with avian botulism and huge bird die-offs as birds eat the tainted mussels. Around Lake Mead, bald eagles may be threatened.

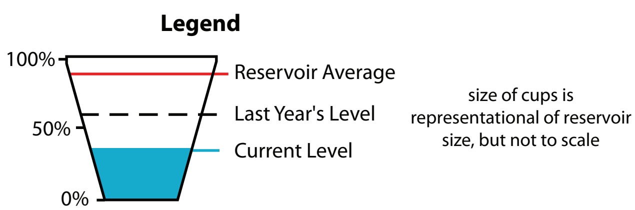
Notes:

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

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

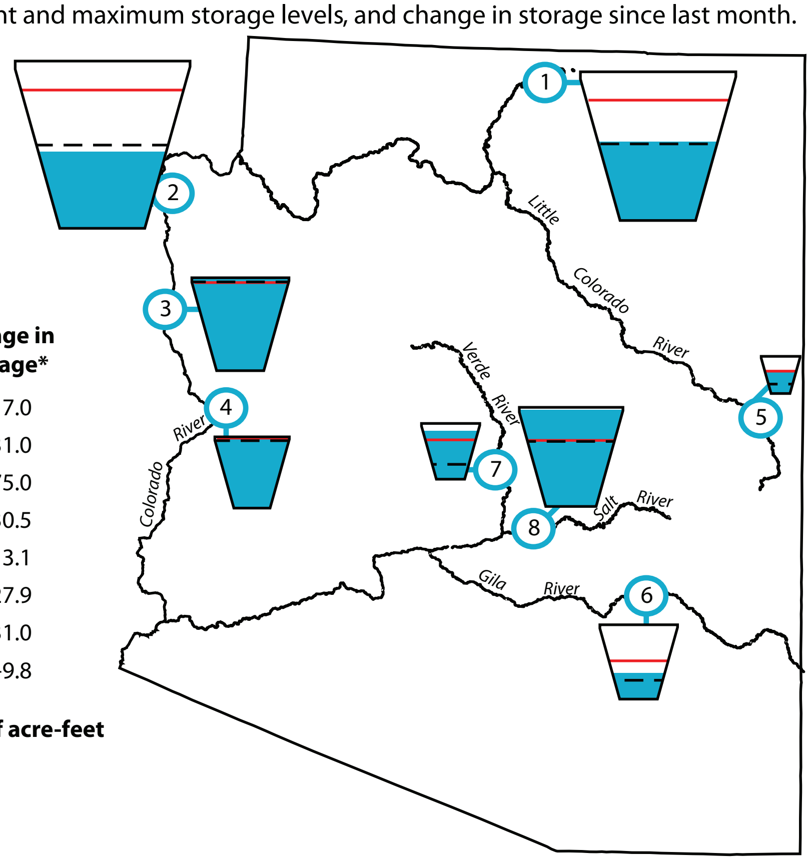
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for May 2008 as a percent of capacity. The map also 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	53%	12,812.0	24,322.0	1617.0
2. Lake Mead	46%	12,132.0	26,159.0	-331.0
3. Lake Mohave	100%	1,724.8	1,810.0	1075.0
4. Lake Havasu	96%	596.3	619.0	30.5
5. Lyman Reservoir	62%	18.7	30.0	3.1
6. San Carlos	35%	305.3	875.0	-27.9
7. Verde River System	86%	247.7	287.4	-31.0
8. Salt River System	97%	1,972.8	2,025.8	-9.8

*** 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 5/31/08)

Source: National Water and Climate Center

New Mexico total reservoir storage increased by 254,000 acre-feet during the last month (Figure 7). Nevertheless, statewide total storage is less than it was at this time last year. During the last month, reservoir storage declined in some reservoirs in the southern and eastern parts of the state (Brantley, Caballo, Sumner, and Conchas). El Vado and Elephant Butte reservoir storage increased by the greatest amounts (more than 70,000 acre-feet each), and El Vado reservoir registered a 40 percent increase in storage.

In water news, the final segment of underground pipeline has been completed for the San Juan-Chama Project to bring drinking water to Albuquerque (Associated Press, June 10). Water from the San Juan River will be diverted to a water treatment plant now under construction. Water delivery to homes and businesses is expected by early 2009.

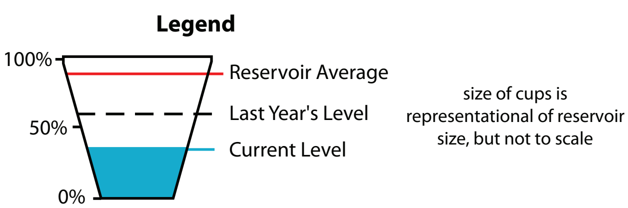
Notes:

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

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

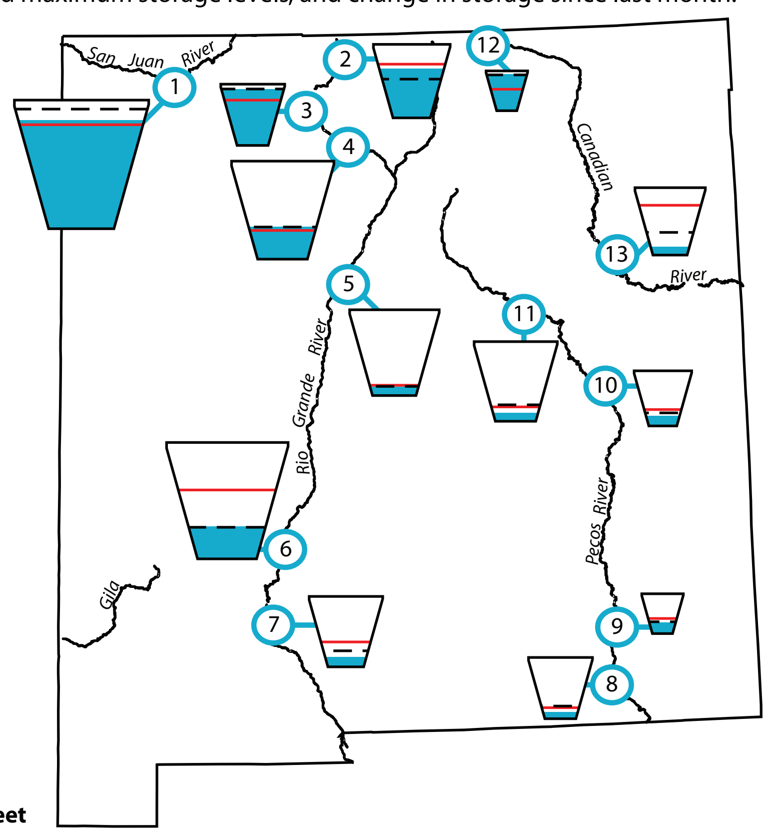
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Richard Armijo, Richard.Armijo@nm.usda.gov.

Figure 7. New Mexico reservoir levels for May 2008 as a percent of capacity. The map also 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	84%	1,423.3	1,696.0	63.1
2. Heron	67%	266.3	400.0	41.2
3. El Vado	92%	178.5	195.0	78.7
4. Abiquiu	33%	183.9	554.5	3.5
5. Cochiti	10%	50.2	491.0	-0.5
6. Elephant Butte	28%	607.9	2,195.0	72.0
7. Caballo	14%	46.2	332.0	-4.7
8. Brantley	11%	16.1	147.5	-7.3
9. Lake Avalon	28%	1.1	4.0	0.0
10. Sumner	18%	18.5	102.0	-1.6
11. Santa Rosa	11%	48.6	438.3	12.1
12. Costilla	92%	14.7	16.0	3.0
13. Conchas	13%	32.5	254.2	-5.9

*** 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 Snowpack

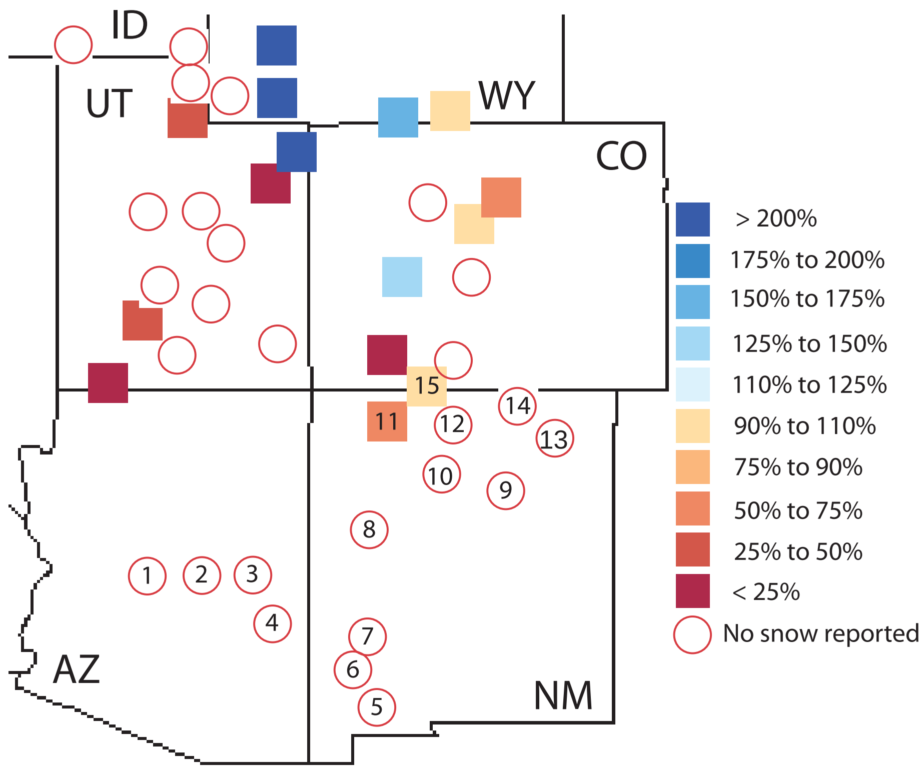
(updated 6/19/08)

Sources: National Water and Climate Center, Western Regional Climate Center

With summer here, snow water content (SWC) observations remain above average in only the upper-most reaches of the Colorado River system (Figure 8). With the exception of the headwaters of the San Juan River in northern New Mexico, SWC monitoring stations in the Southwest are no longer reporting the presence of snow. Notably, mid-May SWC in the Cimarron River basin in northeast New Mexico topped 100 percent of average, but by mid June the measuring station in this location was reporting no snow.

CLIMAS will continue to include recent snowpack observations in the Southwest Climate Outlook as long as sites relevant to water resources in the Southwest are reporting SWC.

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of June 19, 2008.



Arizona Basins
1 Verde River Basin
2 Central Mogollon Rim
3 Little Colorado - Southern Headwaters
4 Salt River Basin

New Mexico Basins
5 Mimbres River Basin
6 San Francisco River Basin
7 Gila River Basin
8 Zuni/Bluewater River Basin
9 Pecos River
10 Jemez River Basin
11 San Miguel, Dolores, Animas, and San Juan River Basins
12 Rio Chama River Basin
13 Cimarron River Basin
14 Sangre de Cristo Mountain Range Basin
15 San Juan River Headwaters

Notes:

Snowpack telemetry (SNOTEL) sites are automated stations that measure snowpack depth, temperature, precipitation, soil moisture content, and soil saturation. A parameter called snow water content (SWC) or snow water equivalent (SWE) is calculated from this information. SWC refers to the depth of water that would result by melting the snowpack at the SNOTEL site and is important in estimating runoff and streamflow. It depends mainly on the density of the snow. Given two snow samples of the same depth, heavy, wet snow will yield a greater SWC than light, powdery snow.

Figure 8 shows the SWC for selected river basins, based on SNOTEL sites in or near the basins, compared to the 1971–2000 average values. The number of SNOTEL sites varies by basin. Basins with more than one site are represented as an average of the sites. Individual sites do not always report data due to lack of snow or instrument error.

On the Web:

For color maps of SNOTEL basin snow water content, visit: http://www.wrcc.dri.edu/snotelanom/basinswe.html

For a numeric version of the map, visit: http://www.wrcc.dri.edu/snotelanom/basinswen.html

For a list of river basin snow water content and precipitation, visit: http://www.wrcc.dri.edu/snotelanom/snotelbasin

Southwest Fire Summary
(updated 6/19/08)

Source: Southwest Coordination Center

So far this year, New Mexico already has exceeded the annual median (128,235 acres) and average acres burned (221,909 acres) (Figure 9a). Most of the scorched acres are on New Mexico State Forest lands (Figure 9c). Arizona acres burned are well below average thus far (Figure 9b).

Relatively recent fire activity in Arizona includes the Frye Mesa fire (3,100 acres) on the north side of the Pinaleño Mountains in southeastern Arizona. Recent New Mexico fires include the Dripping Springs fire (1,843 acres) in southern New Mexico's Organ Mountains and the Rocky fire (5,000 acres) in southern New Mexico's Lincoln National Forest.

Since the beginning of 2008, fire managers have been able to burn more than 170,000 acres in Arizona and more than 135,000 acres in New Mexico through prescribed fires despite substantial winter precipitation and spring wind events in some areas. These totals far exceed average prescribed fire acreage in Arizona (110,708 acres) and New Mexico (79,805 acres). One of the many goals of prescribed fires is to reduce the likelihood of catastrophic fires that get into the upper canopy of the forest trees, destroy entire forest stands, burn hot, and devastate soils, making them resistant to absorbing water. Expanded prescribed burning this year should improve forest and watershed health and reduce catastrophic fire risk.

Notes:
The fires discussed here have been reported by federal, state, or tribal agencies during 2008. The figures include information both for current fires and for fires that have been suppressed. Figure 9a shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. Figures 9b and 9c 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/outlooks/monthly/swa_monthly.htm

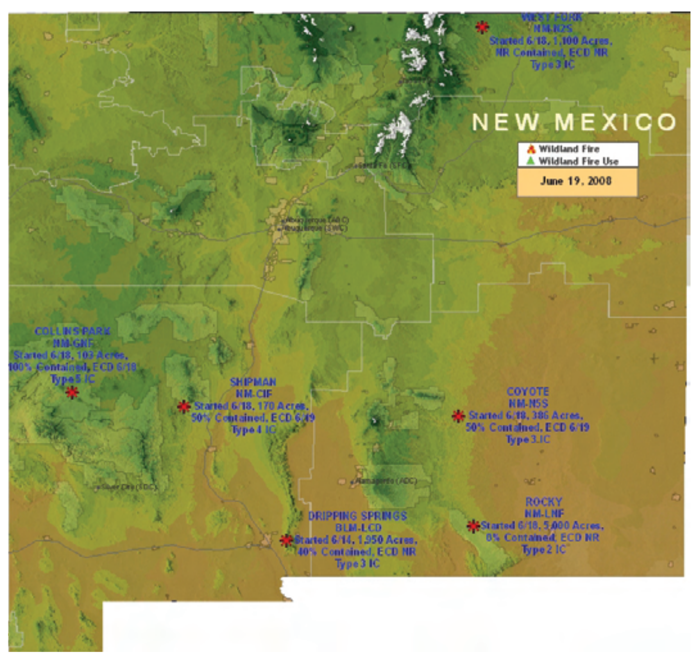
http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_large.htm

Figure 9a. Year-to-date wildland fire information for Arizona and New Mexico as of June 18, 2008.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	676	28,494	23	36	699	28,530
NM	545	254,777	48	8,835	593	263,612
Total	1221	283,271	71	8,871	1,292	292,142

Figure 9b. Arizona large fire incidents as of June 19, 2008.

Figure 9c. New Mexico large fire incidents as of June 19, 2008.



Monsoon Summary
(through 6/19/2008)

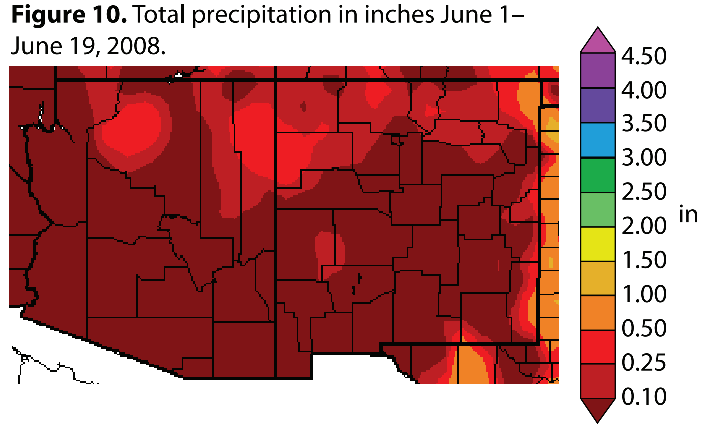
Source: Western Regional Climate Center

In Arizona, the start of the monsoon season officially began on June 15 (see page 2). New Mexico does not designate the active summer thunderstorms as monsoon storms, and therefore doesn't have official dates for the rainy season. Regardless of how the precipitation is classified, rain has not yet arrived in the Southwest. In June, most of Arizona and New Mexico have received less than 1.0 inches of rain and in no location has rain surpassed 0.5 inches (Figure 10).

In the past 58 years, the earliest monsoon start date in both Tucson and Phoenix occurred on June 17, 2000. The latest monsoon start date for both cities occurred on July 25, 1987. Since 2000, the average monsoon start date has been July 7.

Although the monsoon storms have not yet materialized, some forecasters predict that the Southwest will have a more active early monsoon season; late season activity is currently harder to forecast. Contributing to this outlook is the current La Niña and an active Madden Julian Oscillation, both of which tend to enhance the monsoon season. The pre-monsoon weather could also experience a greater number of lightning strikes, increasing the hazard risk for firefighters and citizens. Forecasters from NOAA, on the other hand, offer an equal chance that the upcoming monsoon precipitation will be greater or less than average. More information on the North American Monsoon outlook is available as a web briefing at www.climas.arizona.edu.

Figure 10. Total precipitation in inches June 1–June 19, 2008.



Notes:

The continuous color map (Figures 10) is derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

On the Web:

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

Temperature Outlook
(July–December 2008)
Source: NOAA Climate Prediction Center (CPC)

The latest Climate Prediction Center (CPC) temperature forecasts for the Southwest are predicting increased chances of above-average temperatures for most of the region through December 2008 (Figures 11a–d). The chance of above-average temperatures through all of Arizona for the period of July through September exceeds 50 percent relative to average or below-average temperatures. The temperature outlook for New Mexico suggests a 33 to 60 percent chance of above-average temperatures for the same period. These forecasts are based primarily on the expectation that long-term trends in above-average temperatures experienced throughout the Southwest will persist through the summer and into fall 2008.

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 the reliability (i.e., 'skill') of the forecast is poor; 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 temperature forecast for July–September 2008.

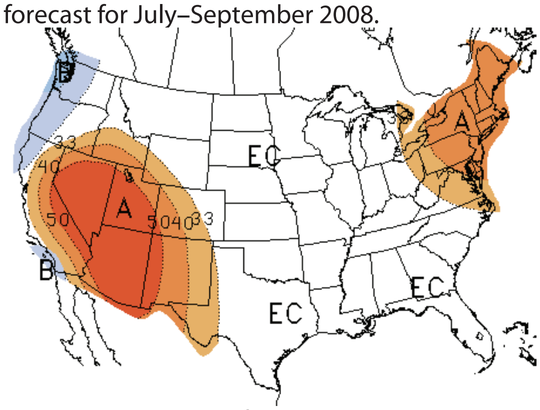


Figure 11b. Long-lead national temperature forecast for August–October 2008.

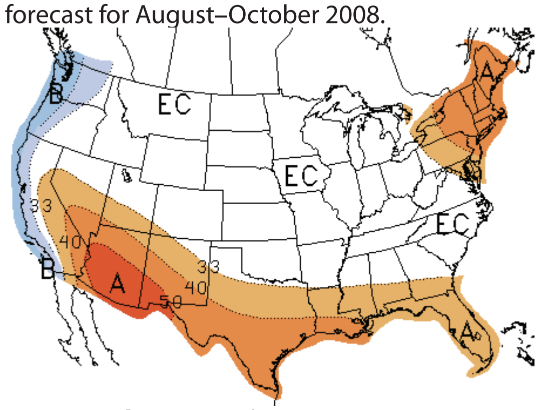


Figure 11c. Long-lead national temperature forecast for September–November 2008.

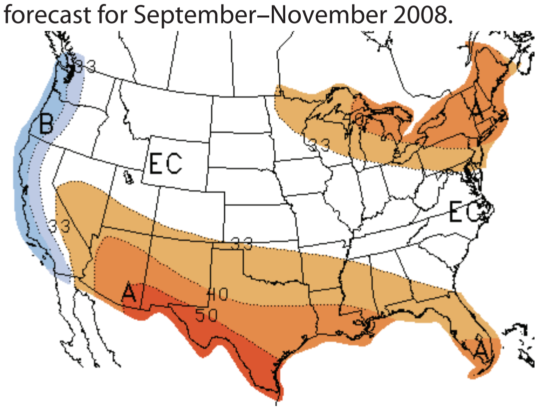
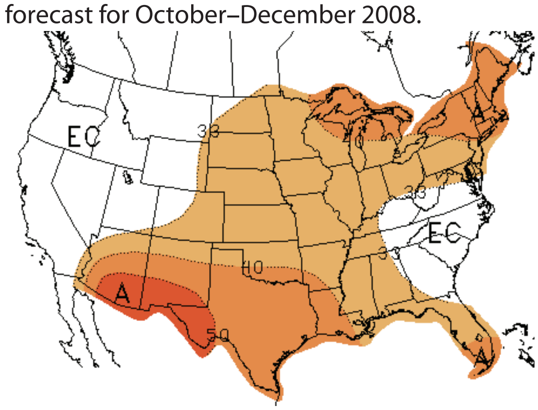


Figure 11d. Long-lead national temperature forecast for October–December 2008.



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.html
(note that this website has many graphics and may load slowly on your computer)

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

Precipitation Outlook

(July–December 2008)

Source: NOAA Climate Prediction Center (CPC)

The precipitation outlook throughout the summer and into fall 2008 indicates a greater probability of below-average precipitation over the Pacific Northwest (Figures 12a–b). Throughout Arizona and New Mexico, the forecast calls for equal chances (EC) of above-, near-, and below-average precipitation through December. The EC designation for the Southwest is based on historically poor summer monsoon predictability of precipitation. Weakening La Niña conditions do not play a significant role in the precipitation outlook for the West.

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 the reliability (i.e., 'skill') of the forecast is poor; 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 12a. Long-lead national precipitation forecast for July–September 2008.

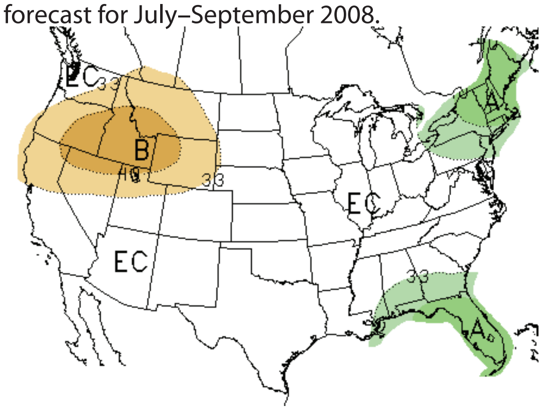
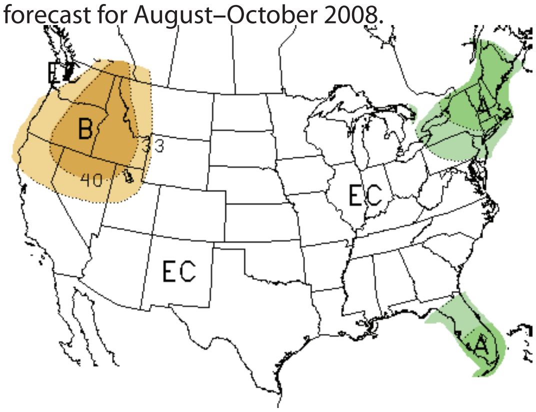


Figure 12b. Long-lead national precipitation forecast for August–October 2008.



B= Below: 33.3–39.9%; 40.0–49.9%

Figure 12c. Long-lead national precipitation forecast for September–November 2008.

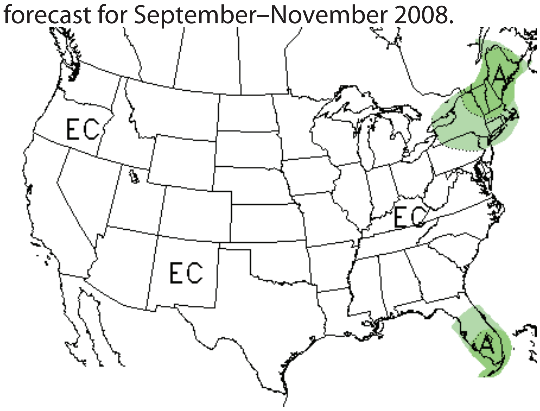
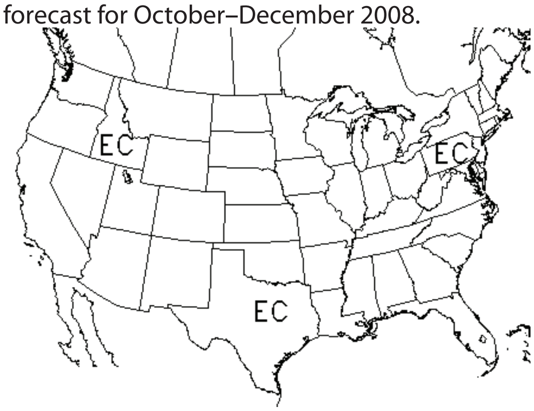


Figure 12d. Long-lead national precipitation forecast for October–December 2008.



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.html
(note that this website has many graphics and may load slowly on your computer)

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

Seasonal Drought Outlook
(through September 2008)
Source: NOAA Climate Prediction Center (CPC)

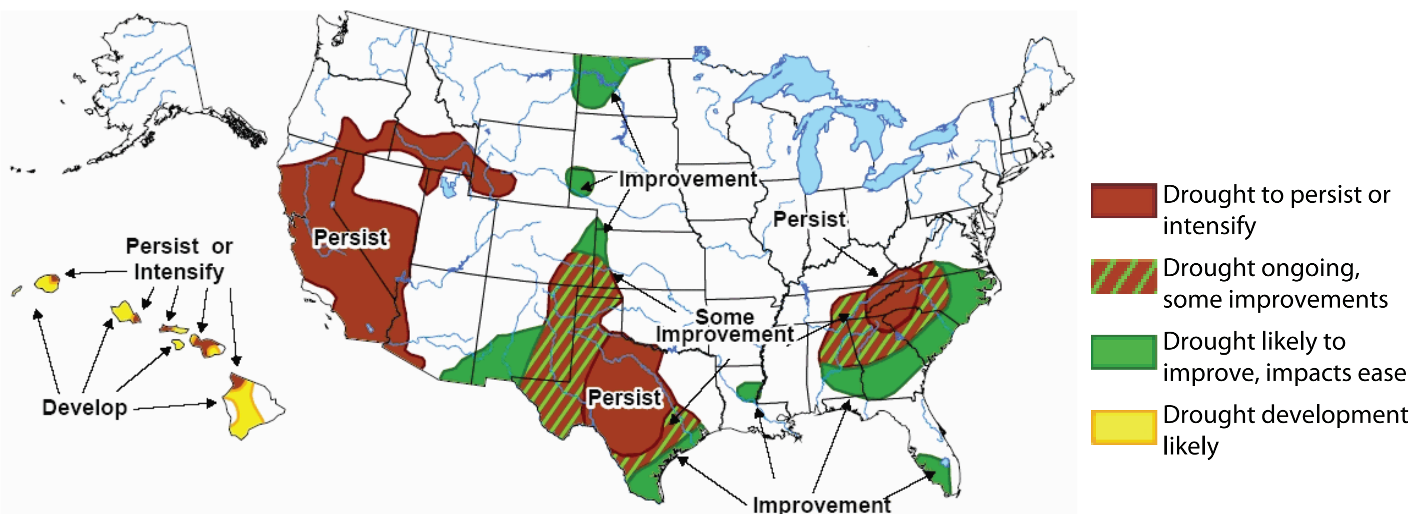
Drought conditions in southeast Arizona and southern New Mexico are expected to improve over the next few months while the recent and widespread expansion of drought in California is expected to continue and possibly worsen this summer (Figure 13). This forecast is made largely on the expectation that monsoon rains will moisten Arizona and New Mexico while California will receive little precipitation.

In Texas, the hot, dry weather in June sharply reduced soil moisture and caused drought conditions to expand and intensify over much of the state. Current moderate to extreme drought is expected to persist there, with some improvement mostly in the far western parts of the state.

The ongoing drought in the southeastern U.S. is expected to improve along the coast and either persist or worsen inland.

Notes:
The delineated areas in the Seasonal Drought Outlook (Figure 13) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 13. Seasonal drought outlook throughSeptember 2008 (released June 19, 2008).



On the Web:
For more information, visit:
http://www.drought.noaa.gov/

Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

The seasonal fire outlook for the Southwest for July through September 2008 shows increasing significant fire potential for southern Arizona and decreasing significant fire potential for most of southern and eastern New Mexico (Figure 14a). The major factors contributing to the outlook include expected dry conditions and dry lightning outbreaks, which will increase fire potential in areas with cured and abundant grass fuels in southern Arizona prior to the monsoon, and an expectation that the arrival of monsoon moisture in eastern New Mexico will substantially decrease fire activity during the July–September time frame. Cured grass fuels in Arizona and much of New Mexico include cured new herbaceous growth in areas that received abundant winter rain, and grass fuels that persisted from previous wet seasons, such as the very wet 2006 monsoon season in New Mexico.

According to the Southwest Coordination Center, the greatest need for firefighting resources is expected for the areas lacking heavy timber, south of the Mogollon Rim in Arizona, and on the east side of northern New Mexico mountains; the latter area is currently exceedingly dry. Observed fire danger (not shown) is extreme for the Southern Arizona-New Mexico border region, with heavy fuel (1,000-hour) moistures below 5 percent.

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. The forecasts (Figure 14a) 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.

The Southwest Coordination Center produces monthly fuel conditions and outlooks. Fuels are any live or dead vegetation that are capable of burning during a fire. They are assigned fuel moisture values for the length of time necessary to dry. Small, thin vegetation, such as grasses and shrubs, are 1-hour and 10-hour fuels , while 1000-hour fuels are large-diameter trees. The top portion of Figure 14b indicates the current condition and amount of growth of fine (small) fuels. The lower section of the figure shows the moisture level of various live fuels as percent of average conditions.

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

Figure 14a. National wildland fire potential for fires greater than 100 acres (valid July–September 2008).

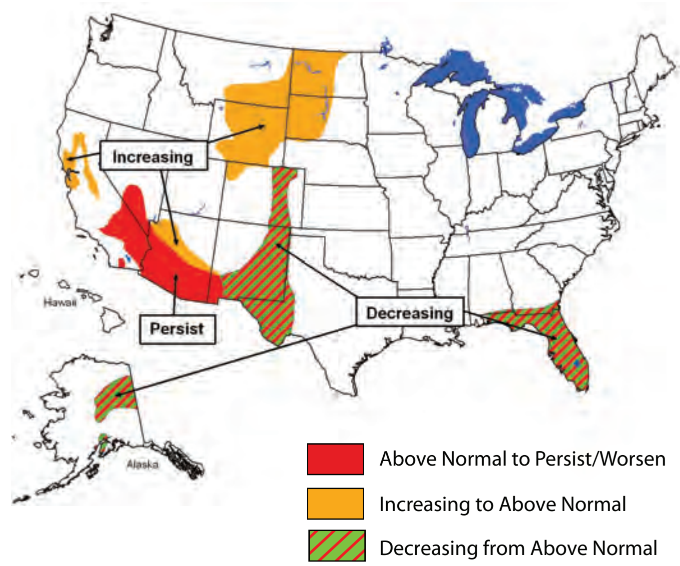


Figure 14b. Current fine fuel condition and live fuel moisture status in the Southwest as of June 1, 2008.

Current Fine Fuels						
Grass Stage	Green	X	Cured	X		
New Growth	Sparse		Normal	X	Above Normal	X

Live Fuel Moisture	Percent of Average
Arizona	
Douglas Fir	81
Juniper	65
Piñon	n/a
Ponderosa Pine	86
Sagebrush	n/a
New Mexico	
Douglas Fir	80
Juniper	79
Piñon	90
Ponderosa Pine	93
Sagebrush	184

El Niño Status and Forecast

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

The National Oceanic and Atmospheric Administration (NOAA) reports that a transition from La Niña to ENSO-neutral conditions is underway in the equatorial Pacific Ocean. Equatorial sea surface temperatures (SSTs) in the central Pacific Ocean remain below average, but negative departures over the central and east-central equatorial Pacific Ocean have weakened considerably since mid-February. The current patterns of tropical convection and winds, however, continue to reflect those typical of La Niña.

Providing additional evidence of the waning La Niña is that the equatorial heat content is increasing in the central and eastern equatorial pacific and the thermocline slope index is positive. In addition, the standardized Southern Oscillation Index (SOI) fell from 0.6 in April to -0.3 in May, suggesting steady weakening of the atmospheric manifestation of La Niña. This is the third consecutive month of decreasing SOI values (Figure 15a). This trend is also reflected in the three-month moving mean which began to decrease in February.

The IRI states that most of the dynamical and statistical forecast models indicate ENSO-neutral SSTs during the coming June–August season. Based on the models and current ocean observations, IRI forecasts a a 75 percent probability that ENSO-neutral conditions will return in the June–August season (Figure 15b). NOAA also states that ENSO-neutral conditions are expected during June–July. Longer term predictions by IRI suggest that ENSO-neutral conditions will maintain a 60 percent probability into spring 2009, while La Niña and El Niño conditions have a 20 percent probability of returning (not shown).

Notes:

Figure 15a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through April 2008. The SOI measures the atmospheric response to SST changes across the Pacific Ocean Basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

Figure 15b 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 15a. The standardized values of the Southern Oscillation Index from January 1980–May 2008. 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).

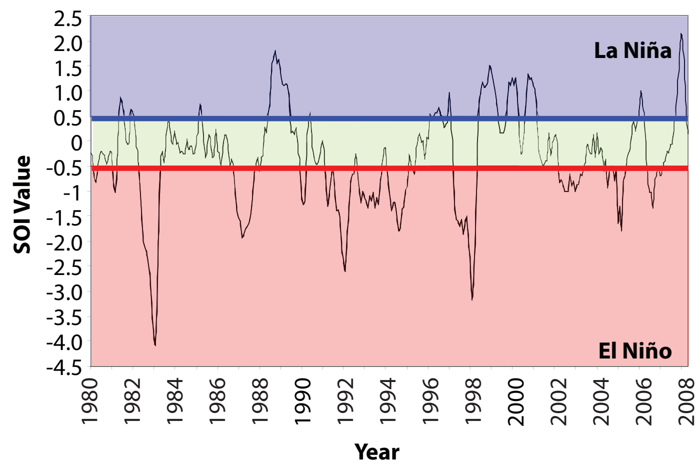
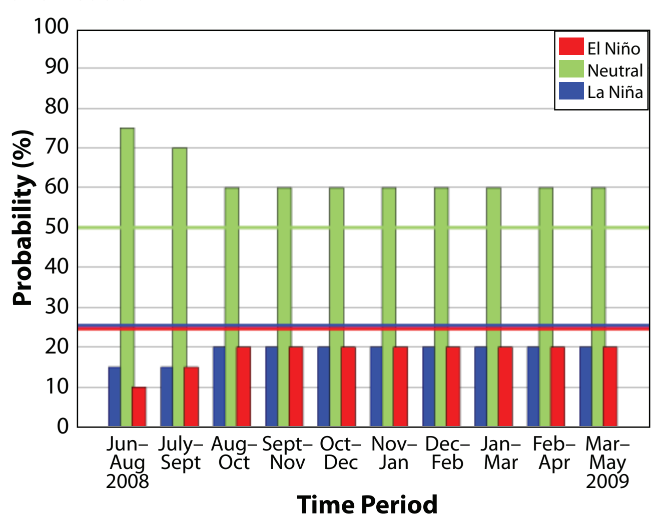


Figure 15b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released June 19, 2008). Colored lines represent average historical probability of El Niño, La Niña, and neutral.

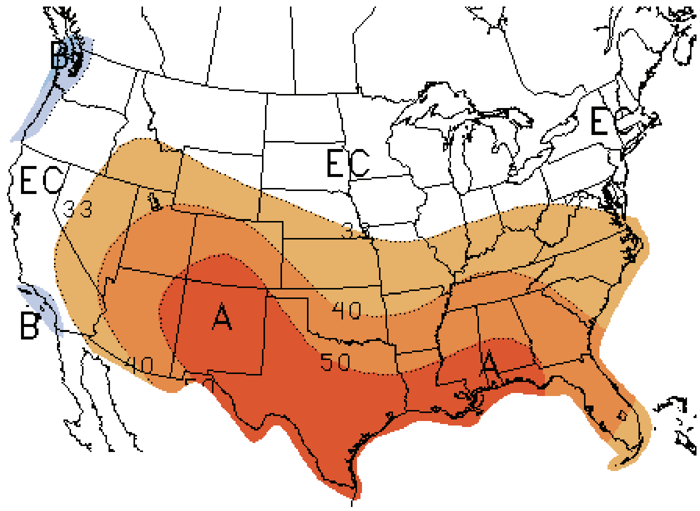


Temperature Verification
(March–May 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal temperature outlook for March–May 2008 predicted increased chances of above-average temperatures for most of the United States, including probabilities of above-average temperatures throughout the Southwest (Figure 16a). These predictions were based on a combination of long-term temperature trends and expected effects associated with a moderate to strong La Niña episode in the Pacific Ocean. The overall pattern of temperatures from March through May was fairly close to the CPC prediction. Observations recorded slightly cooler to near-average temperatures through most of the Pacific Northwest and Rocky Mountain west and warmer-than-average temperatures in Texas and in much of the South and the Atlantic Coast (Figure 16b). Temperatures in much of Arizona and New Mexico were close to average.

Figure 16a. Long-lead U.S. temperature forecast for March–May 2008 (issued February 2008).

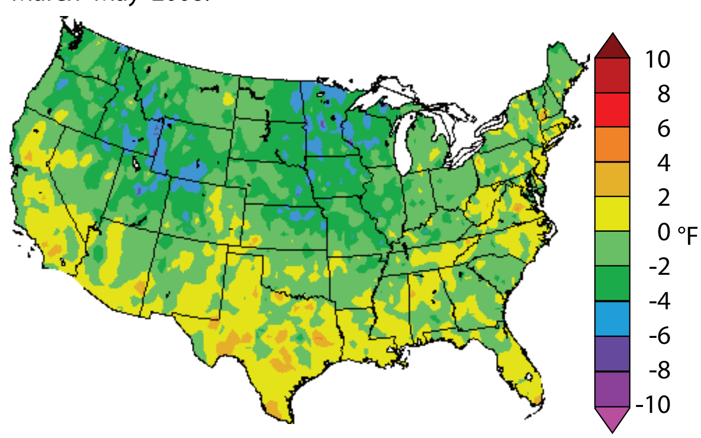


B=Below: 40.0–49.9%, 33.3–39.9%

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

EC= Equal chances. No forecasted anomalies.

Figure 16b. Average temperature departure (in degrees F) for March–May 2008.



Notes:

Figure 16a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months March–May 2008. This forecast was made in February 2008.

The outlook predicts 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.

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average temperature. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is 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. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 16b shows the observed departure of temperature (degrees F) from the average for the March–May 2008 period. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps. The temperature departures do not represent probability classes as in the forecast maps, so they are not strictly comparable. They do provide us with some idea of how well the forecast performed. In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

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.html

Precipitation Verification

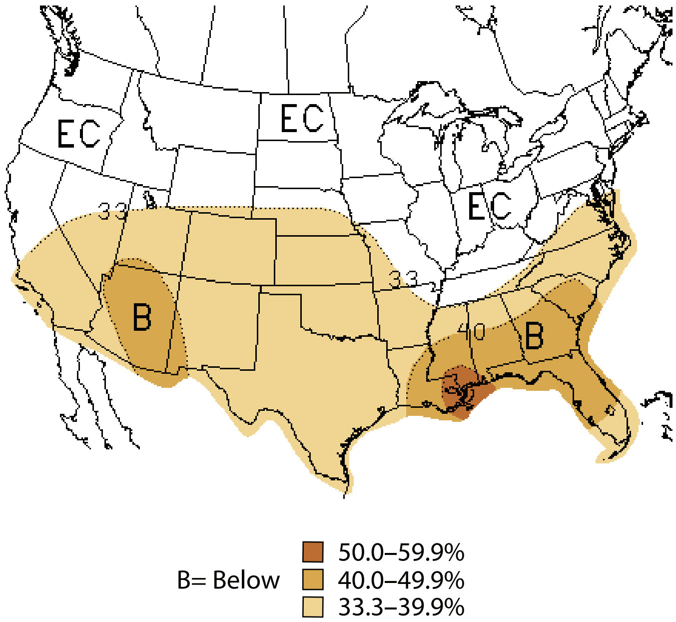
(March–May 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal precipitation outlook for March–May 2008 predicted moderately increased probabilities of below-average precipitation in the Southwest, central and southern California, the central and southern Great Plains, and most of the South (Figure 17a). The outlook also predicted equal chances of below-, near-, and above-average precipitation for the rest of the U.S.

Observed precipitation revealed mostly below-average precipitation throughout most of the West, including the Pacific Northwest (Figure 17b). Much of Arizona and New Mexico received precipitation that was greater than 70 percent below normal. The Midwest received above-average precipitation, with some regions receiving up to 200 percent of normal precipitation through the spring. Overall, the observed precipitation pattern in the Southwest and through the Midwest is close to what the CPC outlook predicted, with below-average precipitation in the Southwest typical of La Niña conditions and above-average precipitation through much of the Midwest and Northeast.

Figure 17a. Long-lead U.S. precipitation forecast for March–May 2008 (issued February 2008).



EC= Equal chances. No forecasted anomalies.

Notes:

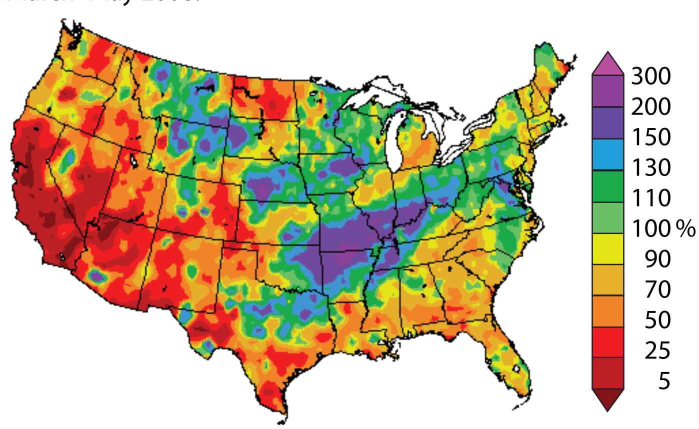
Figure 17a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months March–May 2008. This forecast was made in February 2008.

The outlook predicts 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. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average precipitation. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is 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. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 17b shows the observed percent of average precipitation for March–May 2008. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps. The observed precipitation amounts do not represent probability classes as in the forecast maps, so they are not strictly comparable, but they do provide us with some idea of how well the forecast performed.

In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

Figure 17b. Percent of average precipitation observed from March–May 2008.



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.html