Issued: July 22, 2008

Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: Zack Guido

Photo Description: This photograph of monsoon rainfaill was taken on the Colorado Plateau near Springerville, AZ in August 2007.

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...

Monsoon
page 14

True to form, the monsoon has been highly variable. While several areas of New Mexico have experienced greater than 6 inches of rain, parts of the Navajo Nation have received less than 0.1 inches...

Fire Outlook
page 18

The seasonal wildland fire outlook predicts increasing fire potential in southeastern New Mexico during August through October. The outlook, which was released on July 1, does not account for substantial recent precipitation in southeastern New Mexico...

ENSO
page 19

The National Oceanic and Atmospheric Administration (NOAA) reports that ENSO-neutral conditions are present in the equatorial Pacific Ocean. NOAA also states that equatorial sea surface temperatures in the central Pacific Ocean have returned to near average...

July Climate Summary

Drought – Above-average monsoon rainfall in the last month has substantially reduced drought severity in southern and southeastern Arizona and New Mexico.

Temperature – Temperatures across western and central Arizona have been 2–6 degrees F above average, while temperatures around central and southeastern New Mexico have been 0–2 degrees F cooler than average.

Precipitation – In the past 30 days, most of southern New Mexico and southern Arizona have received 200–800 percent of average precipitation.

Monsoon – Intense monsoon storms have generated above-average precipitation for nearly all of Arizona and New Mexico.

ENSO – Sea-surface temperatures in the central Pacific Ocean are near-average. ENSO-neutral conditions have returned.

Climate Forecasts – The long-lead forecast made by the Climate Prediction Center for April through June matched well with the observations of below-average precipitation and slightly warmer-than-average temperatures in the Southwest.

The Bottom Line – Thanks to a wet, early monsoon season, predicted by forecasters, Arizona could escape the summer relatively unscarred by fire. Although the monsoon rains have been welcome by fire managers, who are now diverting most Arizona fire-fighting resources to other parts of the country, severe weather from intense storms will continue to create hazards such as flash floods, high winds, and dust storms.

Online Monsoon Briefings

Interested in the daily monsoon activity? Concerned about the flash flood potential? Curious if hiking on the sky islands may be wet? The Department of Atmospheric Sciences at The University of Arizona (UA) is currently hosting online and in person monsoon briefings each weekday. The meetings target interested natural resource managers, university faculty, and citizens; they begin at 11:30 a.m. MST and normally last approximately 30 minutes.

The briefings are led by several professors. The format is interactive, with a short presentation on monsoon activity followed by a brief discussion period. The presentation includes graphics and animations from numerous meteorological sources. The presenters explain precipitation maps, water vapor trends, Doppler radar animations, and wind speeds, among other important monsoon data, to provide a picture of the possible evolution of the monsoon for the current day as well as forecasts over one to two days and three to five days. The briefings will continue through early August.

For more information visit: www.atmo.arizona.edu

Table of Contents:

SWCO Staff:

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Understanding the southwestern monsoon

Rain, lightning, fire and what is in store for the future

By Zack Guido

While hikers on Mount Lemmon witness the clouds coalescing, pedestrians in downtown Tucson wisely dodge the sun in the shade of buildings and street-lined trees. People high in the mountains feel a nervous tinge in their stomach with the first thunderous rumble while those in the valleys wish for the splash of rain.

The monsoon season is a showcase of dramatic weather that brings relief and danger. It suppresses the hot summer temperatures and resuscitates vegetation, but it also delivers intense rain, large hail, powerful winds, whirling dust, and a startlingly high number of lightning strikes.

The monsoon is highly anticipated each year, yet experts see no clear-cut trends in monsoon activity over the last 100 years. This begs the question: will the monsoon strengthen or weaken in the future?

The Nuts and Bolts of the Monsoon

The engine of the monsoon is the sun. As summer progresses, solar radiation warms the land and Pacific Ocean at different rates, inciting a tug-of-war with the winds. Until the land sufficiently warms, air flow maintains a westerly flow. When the winds do an about-face, the monsoon begins.

The monsoon first begins in northern Mexico in May. The summer sun evaporates water from the Gulfs of Mexico and California and creates humid conditions over the land which produce rain. Vegetation begins to grow and moves water from the soils back to the air in the form of vapor in a process called evapotranspiration. Humidity rises, fueling more rain and more transpiration. Then a pressure difference between the hot, parched southwestern air and cooler Mexican air pulls the moisture-laden air north to Arizona and New Mexico.

In Arizona and New Mexico, monsoon storms typically begin in early July after several complex and dynamic weather phenomena collide. By July, the Four Corners region has baked in the sun for months. Air has risen like a helium balloon, creating a low pressure trough in the lower atmosphere. Off the coast of Baja California, the sun's energy has boosted ocean temperatures to around 85 degrees Fahrenheit. But the ocean has a moderating effect on the air and has kept it at temperatures below those over the deserts of the Southwest. This temperature imbalance becomes large enough that a change in the high and low altitude atmospheric movement occurs. The winds high over the Southwest, near an altitude of 30,000 feet, take a U-turn westward, opposite their trajectory for nine months. They carry with them moisture from the Gulf of Mexico. At approximately the same time, the near-surface air over the Gulf of California rushes northward into Arizona and New Mexico, carrying with it moisture from the gulf.

The moist air flowing into Arizona and New Mexico hits the mountains and rises. As the air ascends, it expands and cools. The air temperature decreases, falling below the dew point temperature—the temperature below which the air can not hold all the moisture and condenses to form rain. Thunderstorms begin, vegetation grows, and humidity increases over land. Then more rain falls, creating a cycle that continues until the temperature difference between the land and sea is reduced, sometime in early fall.

The Monsoon in the Southwest

Until this year, the National Weather Service (NWS) declared that the monsoon season began on the first of three consecutive days when the average dew point temperature was greater than 54 degrees Fahrenheit in Tucson and 55 F degrees in Phoenix. The average monsoon start date in Tucson was July 3, according to statistics compiled by the NWS for 1949 to 2007. The earliest onset occurred in 2000 on June 17. In Phoenix, the average start date was July 7 and the earliest onset similarly occurred on June 17, 2000. Unlike Arizona, New Mexico has not quantitatively defined the onset of the monsoon.

The dew point temperature, however, is just one of several indicators of the monsoon, and it is typically the last index to suggest that the monsoon has arrived, said Eric Pytlak, science and operations manager at the NWS in Tucson.

In June, for example, numerous monsoon storms occurred around Tucson while the dew point remained below 54 degrees F. For this reason, and to allow the media to more effectively communicate to the public when the monsoon storms are likely to form, the NWS in Arizona has designated June 15 as the official monsoon start date.

Arizona and New Mexico receive up to half of their annual precipitation during the monsoon season. The monsoon's wild winds and driving rains are most dramatic in Tucson and in western New Mexico, tapering off in Phoenix and Yuma (Figure 1). On average, the monsoon delivers approximately 6.1 inches of rain a year to Tucson compared to 2.8 inches to Phoenix.

But the monsoon is variable. Everything from the timing of storms to the production of lightning, changes from region to region and from year to year. If the amount of rainfall is the basis for judging a summer, then it is common to have good summers and bad summers within the same city.

The character of the monsoon has not changed in the past 100 years, said

continued on page 4

Monsoon, continued

Pytlak. The monsoon in the 1930s and 1940s is just as variable as it is today.

Similarly, the Las Cruces region "has not seen any trends in the precipitation of the North American Monsoon," said Dave Novlan, meteorologist for the NWS in El Paso.

A close look at the monsoon precipitation in Tucson and Phoenix supports Pytlak's assertions (Figure 2). Since 1895, precipitation has neither generally increased nor decreased.

Despite no clear-cut trends in precipitation, people often claim that the monsoon is either weakening or strengthening. People still cite the 2006 monsoon season, in which rain fell in near records amounts, as evidence that the monsoon rains are intensifying. But people tend to remember more vividly extreme years, said Pytlak.

How is the monsoon shaping up this summer?In June, rains were below average in both Tucson and Phoenix. It is too early to judge the monsoon season, however, and predicting it is difficult. This year may be especially tricky because two monsoon-enhancing and two monsoon-damping forces are at work.

La Niña, although weakening, is still at hand, said Tom Evans, Warning Coordination Meteorologist at the NWS in Tucson. A La Niña event increases easterly air flow, which tends to bring more moisture from the Gulf of Mexico, Evans said. In addition, the tropical Pacific Ocean has heightened convection, known in the meteorology world as an active Madden-Julian Oscillation (MJO). This year's energetic MJO can help push more moisture into the Southwest from the Gulf of California. However, the Midwest has not been hot and the Rocky Mountains have seen an above-average snowpack this past winter; both factors act to decrease monsoon activity. Which of these forces will ultimately win out has yet to be seen.

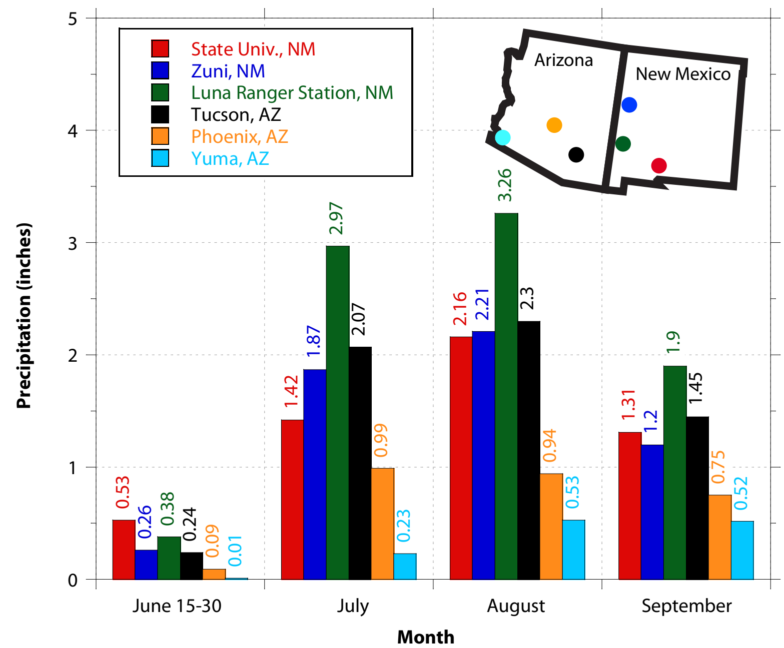


Figure 1. Monsoon precipitation in the Southwest. The data for Arizona was obtained from the NWS Tucson; New Mexico data was compiled from the Western Regional Climate Center.

Monsoon Lightning

Regardless of which monsoon shows up this summer, one thing is for certain: dangerous weather will leave its mark. In the Southwest, flash floods, dust storms, strong winds, hail, excessive heat, and fires injure people and property, said Evans. Of these, lightning has the potential to cause the greatest damage.

For most of the Southwest, the monsoon season is also the fire season. On June 21, lightning zapped Pima County 46 times, shooting electromagnetic pulses for each strike more than 400 miles across the landscape. Each pulse passed through a network of sensors that pinpointed where the lightning touched down. For one strike, sensors were not needed, as smoke began billowing from the Rincon Mountains east of Tucson. The blaze, called the Distillery Fire, burned more than 8,500 acres in eight days before monsoon rains helped extinguish it. A day later, Pima County lit-up with another 218 strikes, a large fraction of the 928 cloud-to-ground strikes that occurred on June 22 in the entire state of Arizona. Two of these ignited the Apache-Sitgreaves National Forest near Clifton and Alpine, starting the Hot Air and Bear Mountain fires that charred more than 10,000 acres. In New Mexico, the eastern half of the state was bombarded with 8,024 ground strikes on June 24. Fortunately, only one ignited a fire.

In the ramp-up phase of the monsoon, from mid-June to early July, the landscape is more susceptible to large and uncontrollable fires because little precipitation has typically fallen since April and vegetation is desiccated. According the Tucson NWS website, isolated thunderstorms develop over the mountains in the afternoon. But because moisture from the Gulf of California has yet to flow into Arizona and New Mexico, the lower levels of the atmosphere are dry and the rain evaporates as it falls to the Earth. Lightning, however, reaches the ground, sometimes igniting wildfires, and the storms often bring gusty winds that fan the fires.

In the Southwest, lightning has ignited more than 2,300 fires annually since

continued on page 5

Monsoon, continued

2001, burning on average approximately 277,000 acres per year. Those figures, however, represent a mere fraction of the number of lightning strikes.

Between 1996 and 2005, an average of 673,320 lightning bolts touched down in Arizona each year, according to Ron Halle, meteorologist and consultant for Vaisala Inc., a company that monitors lightning.

During July and August, Arizona receives a similar number of lightning strikes as Florida, Halle said. With a lightning season that stretches more than six months—at least twice as long as Tucson's—Florida is considered the lightning capital of the United States.

A look ahead

Will the monsoon respond in a predictable manner to higher future temperatures? The monsoon rains, in conjunction with winter precipitation, are vital for sustaining the unique Sonoran vegetation. It also helps replenish water supplies and aids agricultural production. Changes in the monsoon can have dramatic effects, especially given rapid population growth in the region.

In the Southwest, climate and society are tightly connected, said Joellen Russell, assistant professor of biochemical dynamics at The University of Arizona.

"We're living in one of the fastest growing populations in one of the most vulnerable ecosystems," she said.

At the moment, researchers do not know how the monsoon will respond to future temperature changes. The best educated guesses come from 19 general circulation models, or GCMs, used in the 2007 Intergovernmental Panel on Climate Change Fourth Assessment Report. These models, however, are not very good at capturing the monsoon. Only two of the models simulate monsoon precipitation, and one predicts an increase in future rains while the other predicts a decrease.

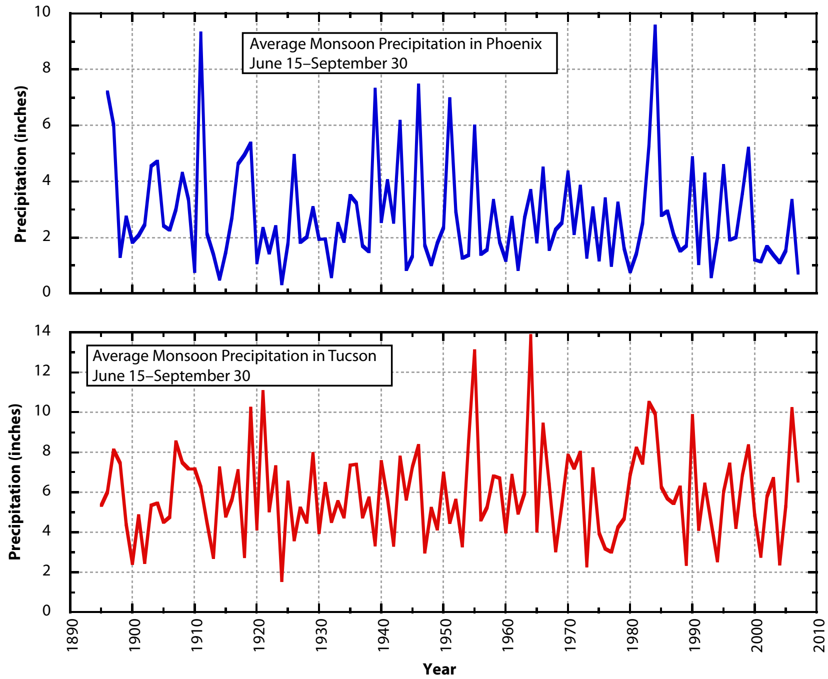


Figure 2. Average monsoon precipitation (June 15 through September 31) since 1895 for Tucson and 1896 for Phoenix. This data was obtained from the National Weather Service in Tucson.

One reason that most of the models fail to capture the monsoon is because they grid the globe into squares with an area of roughly 4,900 square miles. Each grid is assigned an average elevation. This eliminates small scale topography, such as Mount Lemon, and in the process eliminates the important role mountains play in generating thunderstorms.

Why do the two models that generate monsoon rains simulate it differently? Russell's group hypothesizes that for the model with enhanced future monsoon activity, the dominant climatic influence is a larger temperature gradient between the Four Corners region and the tropical east Pacific Ocean. For the model with suppressed monsoon activity, the controlling influence may result from higher air temperatures that reduce the number of days in which the air temperature falls below the dew point temperature.

To this point, the observed increase in global temperature, for which humans bear some responsibility, has not had a clear impact on the monsoon. Russell added, however, that if she had to bet on the character of the future monsoon, she'd gamble that it will strengthen.

The Southwest may get bigger monsoons because the temperature difference between the land and the Pacific Ocean will be greater, she said. But, she continued, it may take 10 to 15 years to understand the links between increasing temperatures and the monsoon activity.

Come September

Earth moves farther from the sun each day. With every 24 hours, solar radiation strikes the Southwest at more of an obtuse angle. The temperature difference shrinks between the waters off the coast of Baja California and the land in the Four Corners region. The winds aloft change direction and flow east. Soils dry. Humidity drops. Thunderstorms and lightning become rare. The dramatic and powerful monsoon wanes, officially ending on September 30. And hiking on Mount Lemmon or on the other Sky Islands in the afternoon becomes a safer, drier outing.

Temperature (through 7/16/08)

Source: High Plains Regional Climate Center

Since the start of the water year on October 1, temperatures on the Colorado Plateau in Arizona and across all of northern and central New Mexico have averaged between 30 and 55 degrees Fahrenheit, with the colder temperatures occurring at the higher elevations (Figure 1a). The southern deserts of Arizona have averaged between 60 and 75 degrees F, while southern New Mexico has generally averaged between 55 and 65 degrees F. These temperatures have been within 1 degree F of the 30-year average temperature across most of both states (Figure 1b). In southeastern and southwestern New Mexico and the higher elevations of east central Arizona, temperatures have been 1 to 4 degrees F warmer than the 30-year average. In north central New Mexico, temperatures have been 1 to 2 degrees F below average. The La Niña winter brought cold, dry air to northern New Mexico and warm, dry air to southern New Mexico, while much of the snow fell in Arizona. In the past 30 days, temperatures across western and central Arizona have been 2–6 degrees F above average (Figures 1c–d). Eastern Arizona and northwestern New Mexico have been 0–2 degrees F above average, while central and southeastern New Mexico have been 0–2 degrees F cooler than average.

For the month of July, Albuquerque has been 3.5 degrees F cooler than average. The cooler temperatures are the result of numerous thunderstorms bringing much needed rainfall to southern 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 July 16, 2008) average temperature.

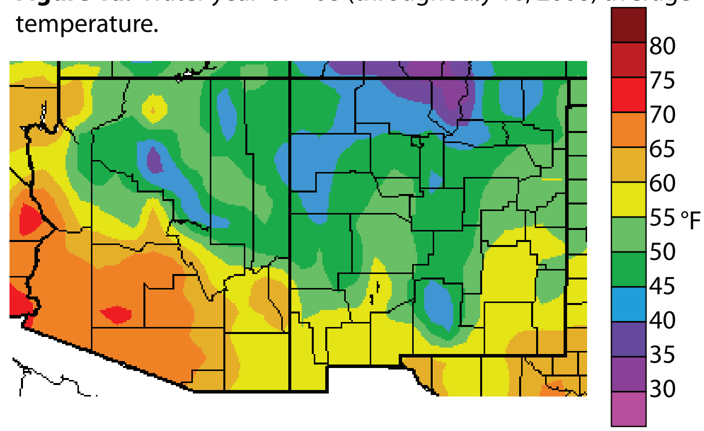


Figure 1b. Water year '07–'08 (through July 16, 2008) departure from average temperature.

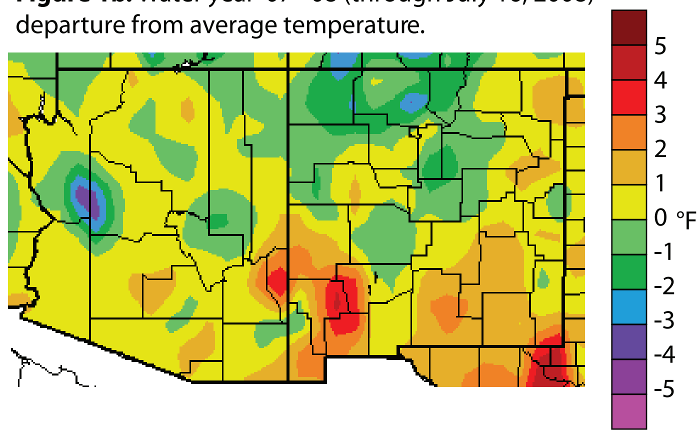


Figure 1c. Previous 30 days (June 17–July 16, 2008) departure from average temperature (interpolated).

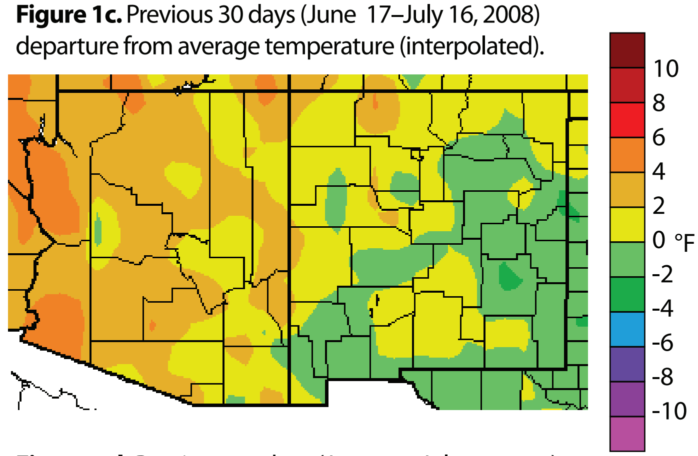
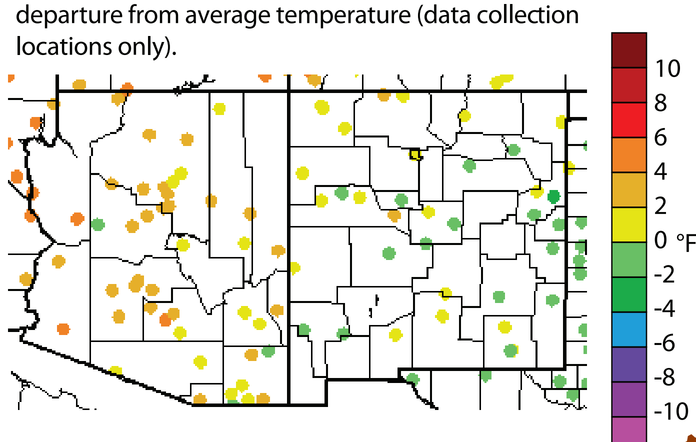


Figure 1d. Previous 30 days (June 17–July 16, 2008) departure from average temperature (data collection locations only).



Precipitation (through 7/16/08)

Source: High Plains Regional Climate Center

Precipitation for the water year beginning October 1 has been 100–175 percent of average across central and south-central Arizona (Figures 2a–b). Western New Mexico has received 110–130 percent of average precipitation. The southeast and southwest corners of both states, northeastern and central New Mexico, and north-central Arizona, continue to be dry, with average precipitation for the water year below 70 percent of average. The patchy pattern is due to unusual storm tracks during the La Niña winter and the wet spring. A number of winter storms swept through Arizona from the southwest to the northeast, moving into Colorado along the Rocky Mountains and skirting most of New Mexico.

In the past 30 days, most of southern New Mexico and southern Arizona have received 200–800 percent of average precipitation, as did the higher elevations in the northern half of both states (Figures 2c–d). Some localized dry pockets, especially in north-central and northwest Arizona, have recorded only 2–50 percent of average precipitation in early summer.

Precipitation amounts are likely to increase in southwestern New Mexico and southeastern and north-central Arizona as the monsoon expands to the east. Central New Mexico may also receive more precipitation if the subtropical high pressure center moves further east over Texas, allowing moisture from Mexico to push northeast into 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 July 16, 2008) percent of average precipitation (interpolated).

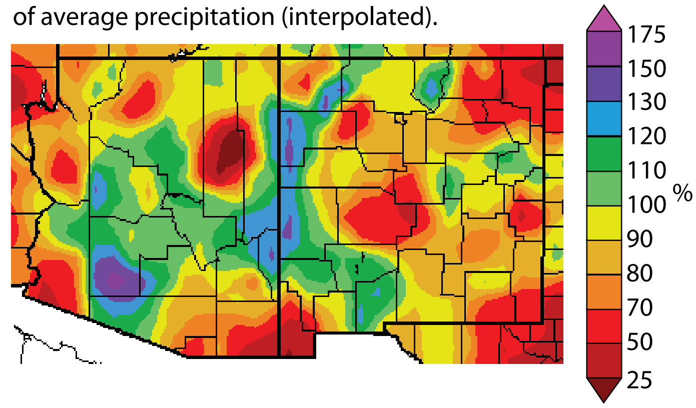


Figure 2b. Water year '07–'08 (through July 16, 2008) percent of average precipitation (data collection locations only).

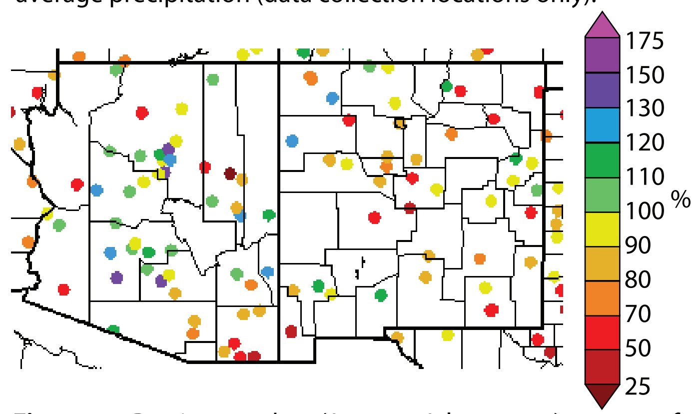


Figure 2c. Previous 30 days (June 17–July 16, 2008) percent of average precipitation (interpolated).

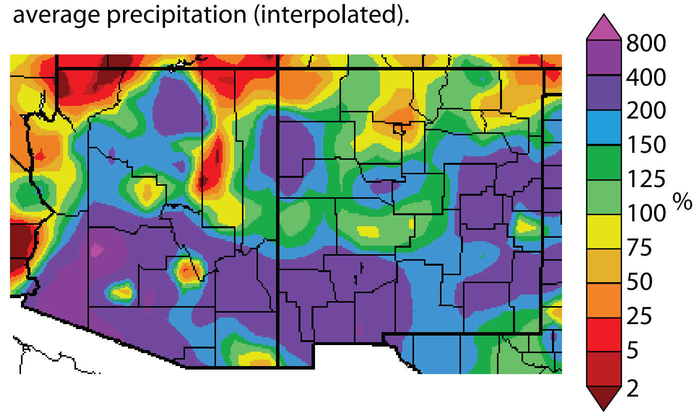
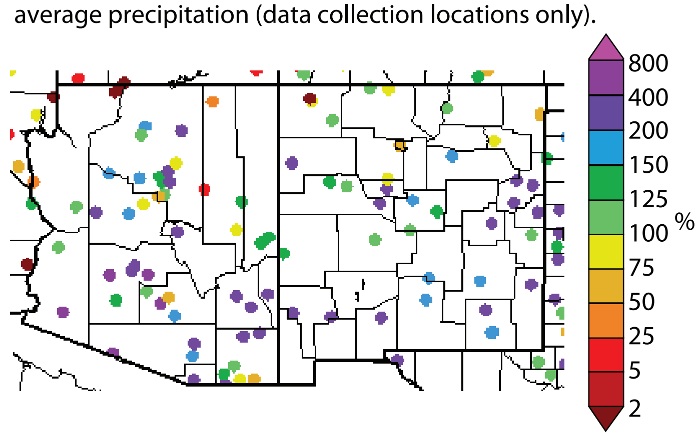


Figure 2d. Previous 30 days (June 17–July 16, 2008) percent of average precipitation (data collection locations only).



U.S. Drought Monitor
(released 7/17/08)

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

Drought severity has been reduced substantially in southern and southeastern Arizona and New Mexico due to monsoon rainfall during the last several weeks (Figure 3). Fort Sumner, New Mexico, received 5.87 inches between July 7 and 9. Phoenix and Tucson have each received more than 2 inches of precipitation since June 15. These heavy rains have caused flood damage in the border city of Nogales, Arizona, and flooding in other parts of the region.

In drought-related news, St. Johns, Arizona, adopted an ordinance to improve proactive water conservation (wmicentral.com June 27). The ordinance calls for water restrictions during certain times of day, prohibits wasting water, and penalizes violators. The ordinance does not affect irrigation or landscape watering for homeowners using private wells.

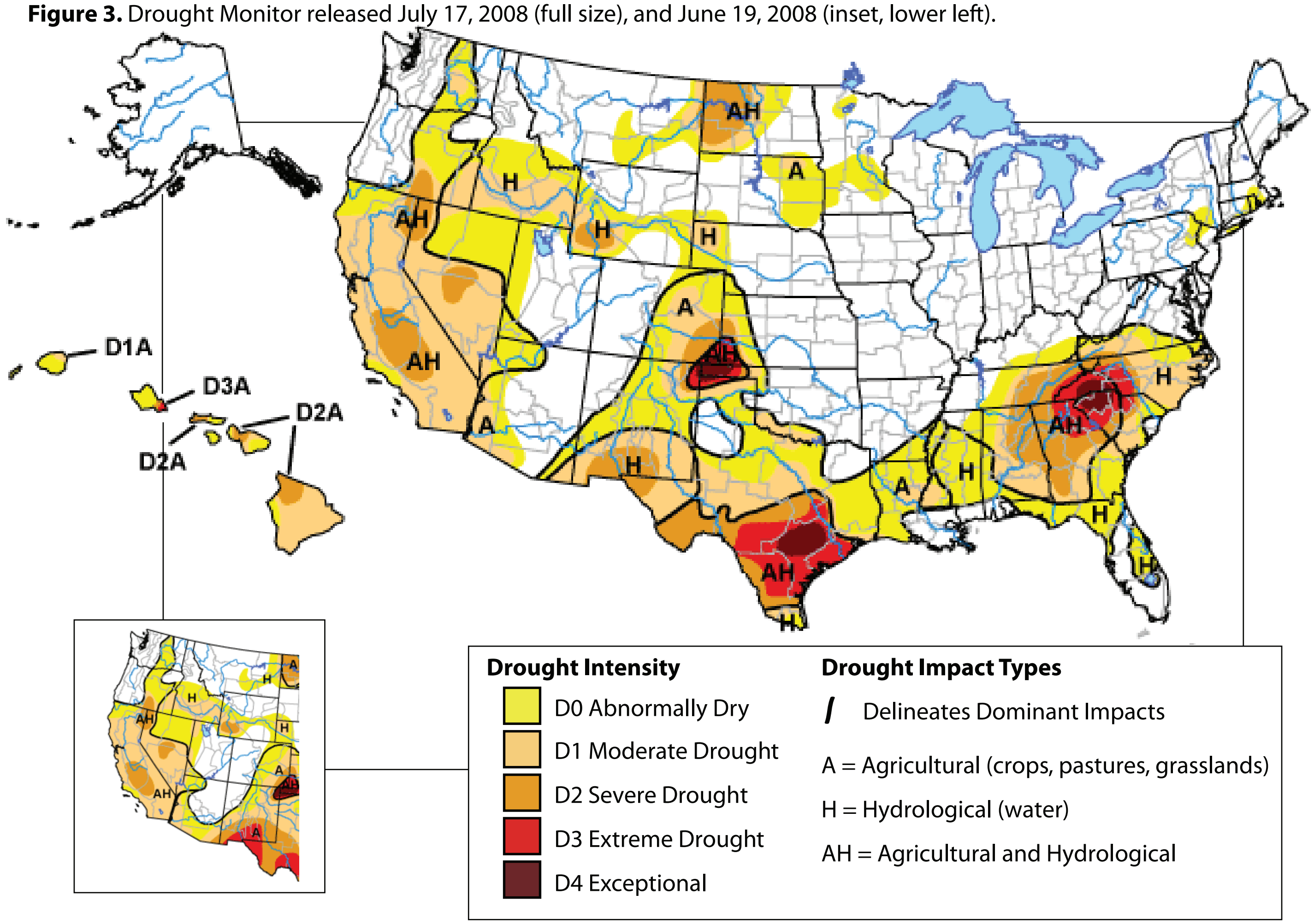
Legislation to settle the Navajo Nation's water rights claims to the San Juan River in New Mexico is included in an omnibus package introduced by New Mexico's senators (*Gallup Independent*, July 14). However, Arizona Senator Jon Kyl will not support the bill in its present form because it does not resolve the issue of supplying water to Window Rock, Arizona.

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 Brad Rippey, USDA.

Figure 3. Drought Monitor released July 17, 2008 (full size), and June 19, 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 5/31/08)

Source: Arizona Department of Water Resources

In May, precipitation in Arizona was variable, resulting primarily from two strong and late winter storms. Precipitation ranged between 0.75 inches less than average to more than 1.5 inches above average, translating into a range of less than 5 percent of normal to more than 200 percent of normal. Much of central and southern Arizona received average to well-above average amounts, improving the drought status in the Willcox Playa and Whitewater Draw basins by one category, from moderate drought to abnormally dry (Figure 4a). The Santa Cruz River basin is an exception to this trend and was downgraded one status category from abnormally dry to moderate drought. In northwest and northern Arizona, less-than-average rainfall fell in May, causing the drought status in the watersheds of the Upper Colorado and Little Colorado rivers to be downgraded by one category, from normal to abnormally dry.

Winter storms at the end of May briefly elevated streamflow in many watersheds. However, the storms did not last long enough to increase the average streamflow for May and therefore did not significantly influence short-term drought conditions.

Long-term drought status (Figure 4b) is updated quarterly. Current long-term drought status was determined using data through March 31. The next update will be in the August *Southwest Climate Outlook*.

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

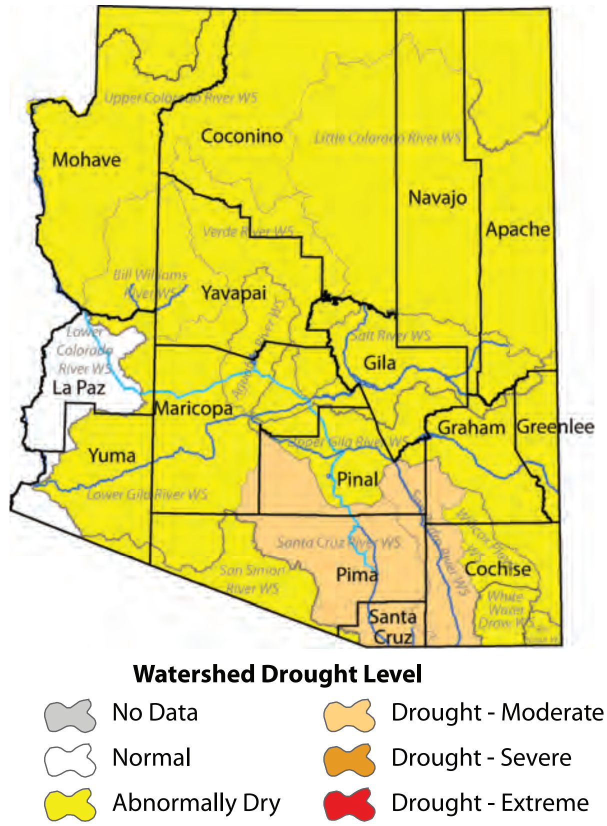
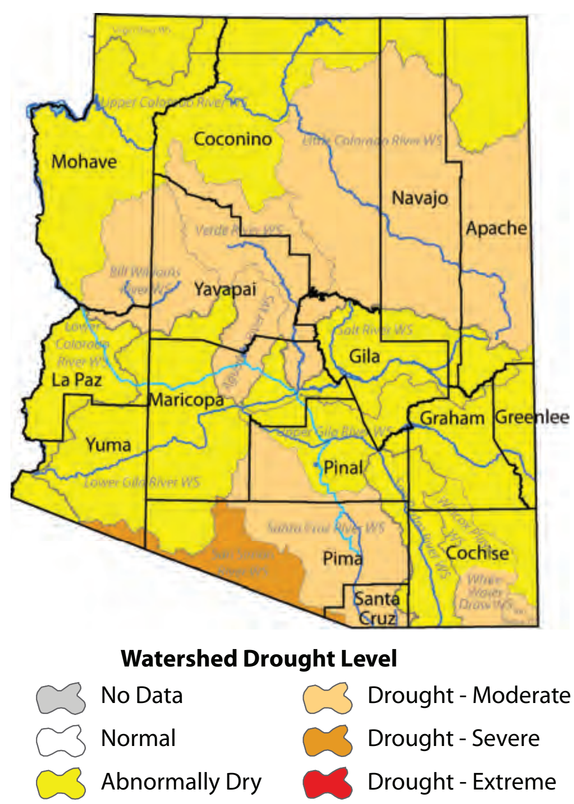


Figure 4b. Arizona long-term drought status for June 2008.



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

New Mexico Drought Status

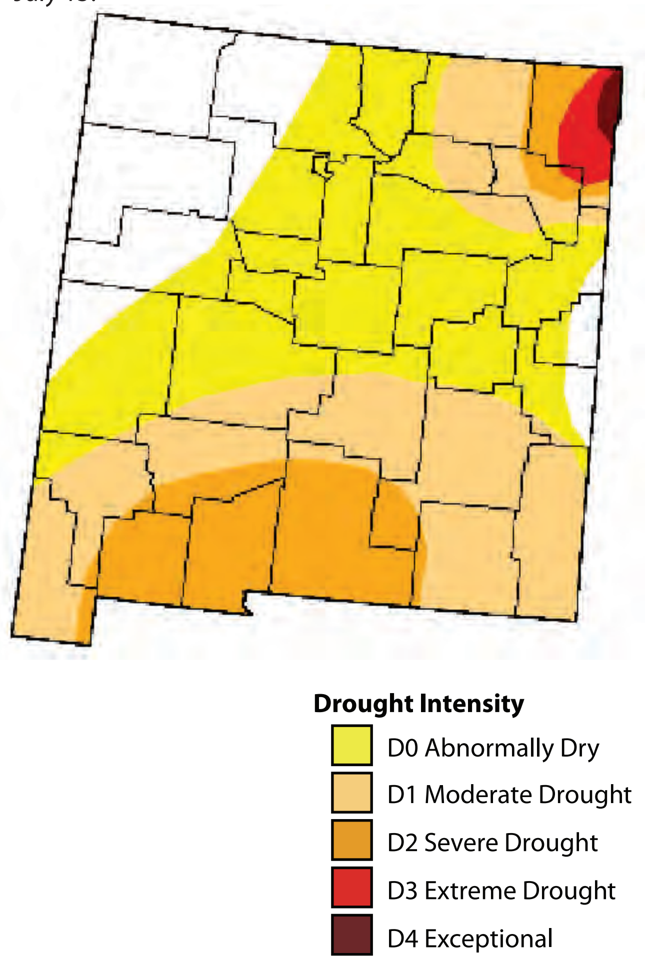
(released 7/17/08)

Source: New Mexico State Drought Monitoring Committee

Drought conditions in New Mexico have generally improved over the last month (Figure 5). Precipitation amounts between June 17 and July 16 at most stations were between normal and 3 inches above normal. During the same period, temperatures hovered within one to two degrees F of average.

A significant portion of south-central New Mexico that was experiencing extreme drought conditions has since been downgraded to either severe or moderate drought conditions. The remaining western and eastern parts of southern New Mexico have seen a similar one-category improvement as well. The northern half of the state either improved one category to abnormally dry or remained free of any drought designation. A small section in the northeastern corner, however, remains in exceptional drought; this section covers only approximately 0.4 percent of New Mexico.

Figure 5. New Mexico drought map based on data through July 15.



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

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.

Arizona Reservoir Levels

(through 6/30/08)

Source: National Water and Climate Center

Reservoir storage in Lake Powell increased by more than 2.1 million acre-feet during the last month (Figure 6). The July 6 elevation of Lake Powell was 3,632 feet above sea level, and the lake level is expected to peak at 3,635 feet in August. The most recent prediction of inflow to Lake Powell, for the period between April and July, is 8.8 million acre-feet (maf), equal to 111 percent of average. Since last month, storage in the San Carlos Reservoir, which reflects storage in the watersheds of the Salt, Verde, and Gila rivers, declined slightly but still remains substantially higher than one year ago.

In water news, the U.S. Army Corps of Engineers suspended its designation of two stretches of the Santa Cruz River (Pima and Santa Cruz Counties, Arizona) as a navigable stream (*Arizona Daily Star*, July 10). The change in designation may make it easier for builders and mining operations to discharge materials or alter the river or its tributaries

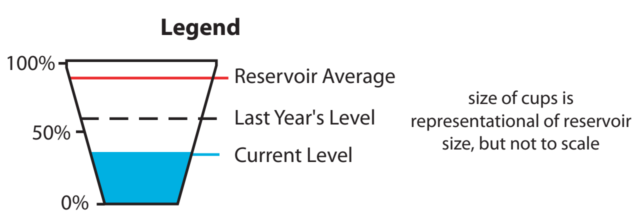
Notes:

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.

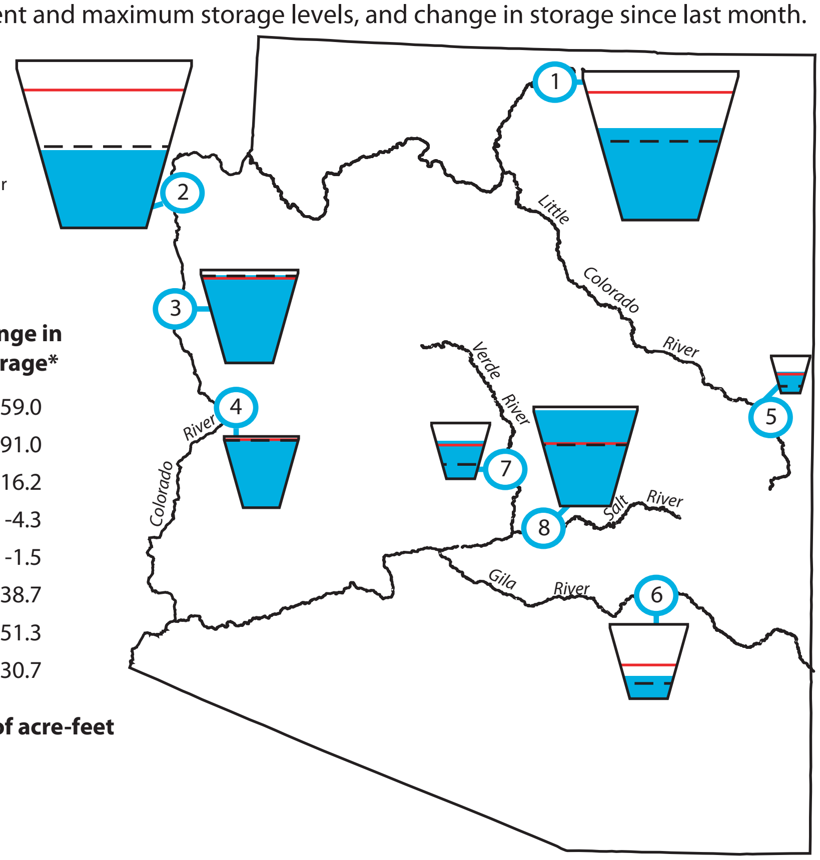
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for June 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	62%	14,971.0	24,322.0	2,159.0
2. Lake Mead	46%	11,941.0	26,159.0	-191.0
3. Lake Mohave	94%	1,708.6	1,810.0	-16.2
4. Lake Havasu	96%	592.0	619.0	-4.3
5. Lyman Reservoir	57%	17.2	30.0	-1.5
6. San Carlos	30%	266.6	875.0	-38.7
7. Verde River System	68%	196.4	287.4	-51.3
8. Salt River System	96%	1,942.1	2,025.8	-30.7

*** 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 6/30/08)

Source: National Water and Climate Center

New Mexico total reservoir storage increased slightly during the last month (Figure 7). Only four of the 13 major reservoirs have increased storage in the past year. During the last month, Heron and Elephant Butte reservoirs showed the largest increases, while Navajo and Santa Rosa reservoirs showed the largest decreases.

In water news, Las Cruces, New Mexico, land became part of the first expansion of the Elephant Butte Irrigation District (EBID) since the district's creation over 100 years ago (*Las Cruces Sun-News*, July 10). The expansion is part of a plan to use river water to meet the needs of the city's rapidly expanding population. Las Cruces is now consolidating city owned or leased water rights.

The Carlsbad Irrigation District increased water allotments to members by 0.7 acre-feet, which will help irrigators in southeastern New Mexico (*Current-Argus*, July 10).

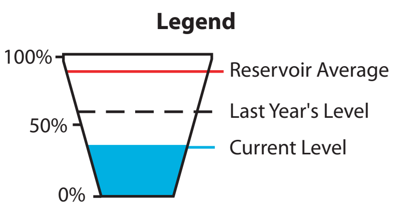
Notes:

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.

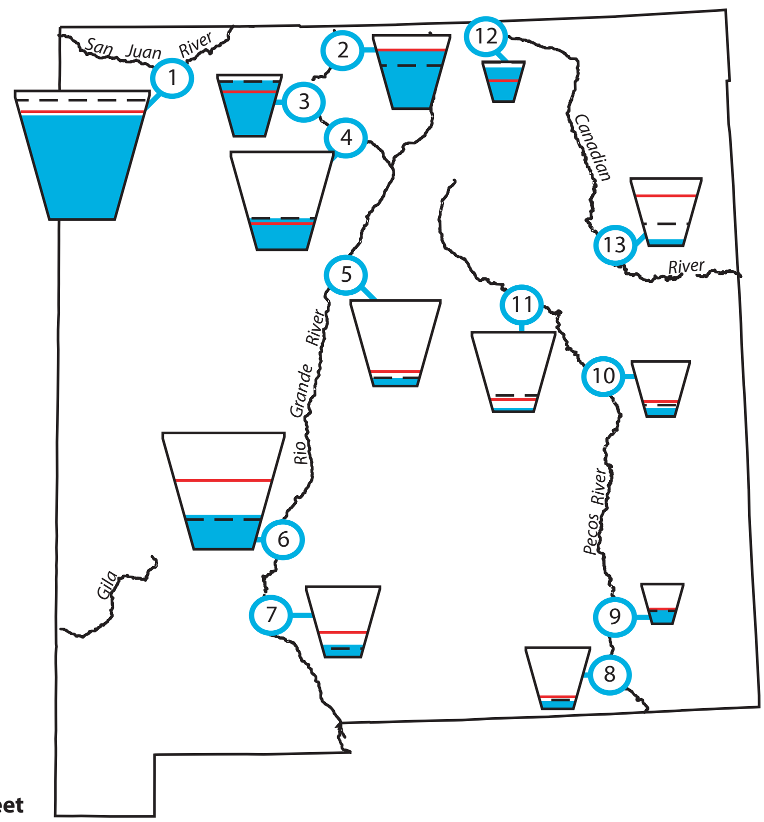
Figure 7. New Mexico reservoir levels for June 2008 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



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

Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	81%	1,370.5	1,696.0	-52.8
2. Heron	79%	314.7	400.0	48.4
3. El Vado	91%	177.4	195.0	-1.1
4. Abiquiu	32%	176.1	554.5	-7.8
5. Cochiti	10%	51.2	491.0	1.0
6. Elephant Butte	29%	628.2	2,195.0	20.3
7. Caballo	17%	57.8	332.0	11.6
8. Brantley	13%	18.6	147.5	2.5
9. Lake Avalon	40%	1.6	4.0	0.5
10. Sumner	15%	15.7	102.0	-2.8
11. Santa Rosa	5%	23.8	438.3	-24.8
12. Costilla	86%	13.8	16.0	-0.9
13. Conchas	10%	26.0	254.2	-6.5

*** 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 7/17/08)

Source: Southwest Coordination Center

More than 80,000 acres in Arizona and more than 330,000 acres in New Mexico have burned thus far this year. Total acres burned in Arizona are less than average, but the New Mexico total is above average. Recently observed national fire danger rating status (not shown) is low to moderate throughout most of Arizona and New Mexico, with the exception of the Yuma, Arizona, area and the "Arizona Strip" along Arizona's northwestern border with Utah. Low-modeled moisture content in dead fuels in the 3 to 8 inch diameter class and the layer of the forest floor below the surface (the 1,000-hour fuels index) is primarily a concern in southwestern Arizona and along the northern borders of Arizona and New Mexico.

Recent rainfall and high humidity has helped firefighters in Arizona and New Mexico contain or snuff most fires. The Southwest Coordination Center notes that most national firefighting resources from the Southwest region are now committed to firefighting efforts elsewhere in the United States, and prescribed fire projects in the region will need to be conducted with only local resources.

Since the beginning of 2008, more than 3 million acres have burned in the United States, including more than a half million acres in northern California. This is above the 10-year national average for totals through mid-July, but one million acres below 2004 and 2006 totals for the same period. Northern California is still reporting 16 large fires, some of which have reportedly burned more than 80,000 acres. For comparison, the 2003 Aspen Fire, near Tucson, burned 84,750 acres, and the 2002 Ponil Fire in northern New Mexico burned 92,194 acres.

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 8a shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. Figures 8b and 8c 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 8a. Year-to-date wildand fire information for Arizona and New Mexico as of July 8, 2008.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	790	51,545	281	28,943	1,071	80,488
NM	608	262,157	259	78,776	867	340,933
Total	1,398	313,702	540	107,719	1,938	421,421

Figure 8b. Arizona large fire incidents as of July 17, 2008.

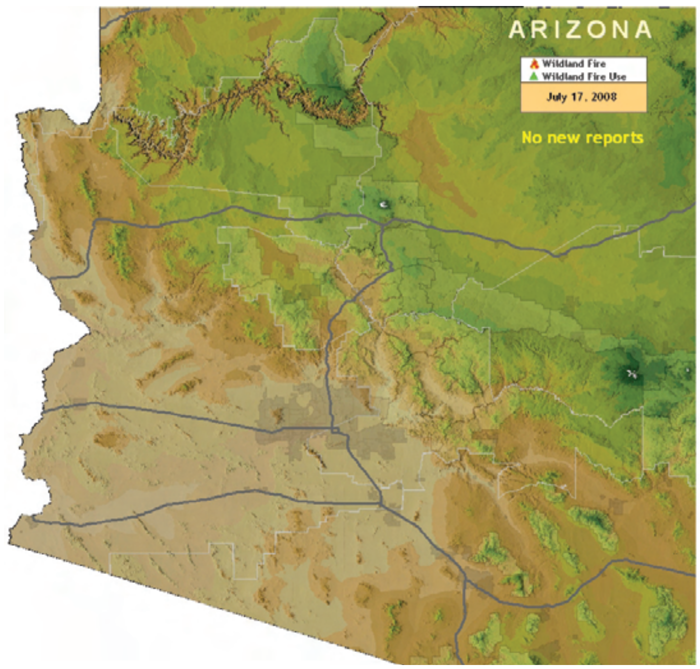


Figure 8c. New Mexico large fire incidents as of July 17, 2008.

Monsoon Summary
(through 7/15/2008)

Source: Western Regional Climate Center

True to form, the monsoon has been highly variable (Figure 9a). While several areas of New Mexico have experienced greater than 6 inches of rain, parts of the Navajo Nation have received less than 0.1 inches.

In the first half of July, monsoon precipitation for most of Arizona and New Mexico has been above average (Figure 9b–c). The National Weather Service in Tucson (NWS-T), for example, reports that 2.43 inches of rain has fallen at The University of Arizona, 0.36 inches greater than the historical average for the entire month of July. The story is similar in Phoenix. Precipitation as of July 17 at Sky Harbor International Airport is already 2.14 inches, surpassing the historical average of 0.99 inches, according to NWS-T.

A good portion of Phoenix's July precipitation occurred on July 13, when parts of the metropolitan area experienced the most intense rainfall event since 1995. At the Sky Harbor airport, 1.3 inches of rain fell, while a rain gauge located at the residence of a participant in the UA's Rainlog.org project recorded an astounding 3.24 inches of rain in less than an hour.

On July 19, intense late-night precipitation flooded parts of the Tucson metro area. In some areas, more than 1.5 inches of rain was recorded at numerous Rainlog.org monitoring sites.

To better inform the public on daily monsoon activity, the UA's Department of Atmospheric Sciences is hosting a monsoon briefing each weekday. To learn more, see the article on the bottom of page 2.

Figure 9a. Total precipitation in inches July 1–July 15, 2008.

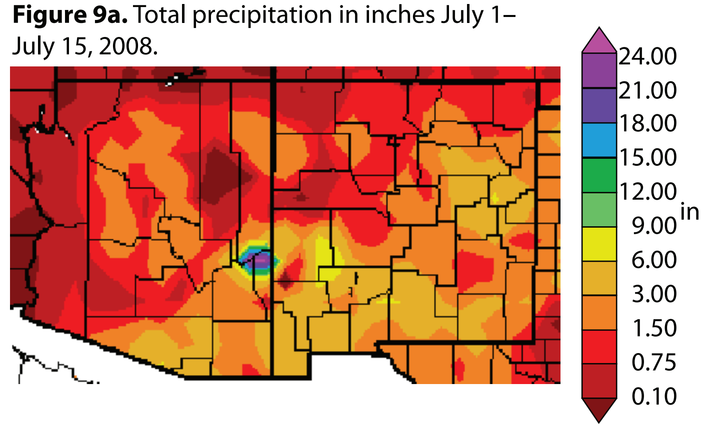


Figure 9b. Departure from average precipitation in inches July 1–July 15, 2008.

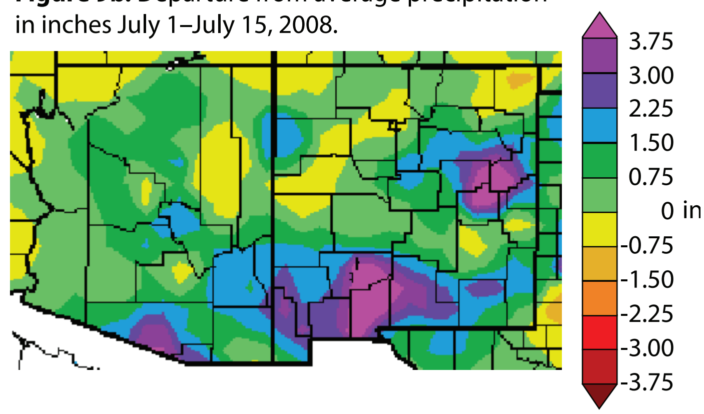
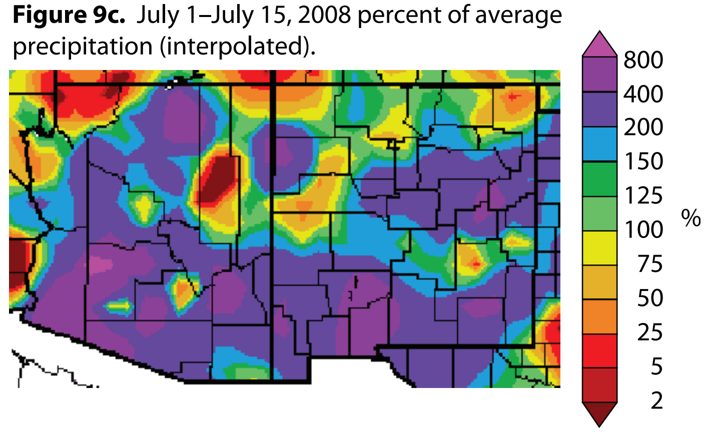


Figure 9c. July 1–July 15, 2008 percent of average precipitation (interpolated).



Notes:

The 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.

The continuous color maps (Figures 9a–c) 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 data used to create these maps is provisional and have not yet been subjected to rigorous quality control.

On the Web:

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

Temperature Outlook
(August 2008–January 2009)
Source: NOAA Climate Prediction Center (CPC)

The latest Climate Prediction Center (CPC) long-lead temperature forecasts for the Southwest are predicting slightly increased chances of above-average temperatures for most of the region through the rest of the summer and through fall (Figures 10a–d). The influence of the recent strong La Niña has weakened substantially as equatorial Pacific sea surface temperatures have moved toward neutral ENSO conditions. These forecasts, therefore, are based primarily on the expectation that long-term trends in above-average temperatures experienced throughout the Southwest will persist through the remainder of the summer and through the fall.

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 10a. Long-lead national temperature forecast for August–October 2008.

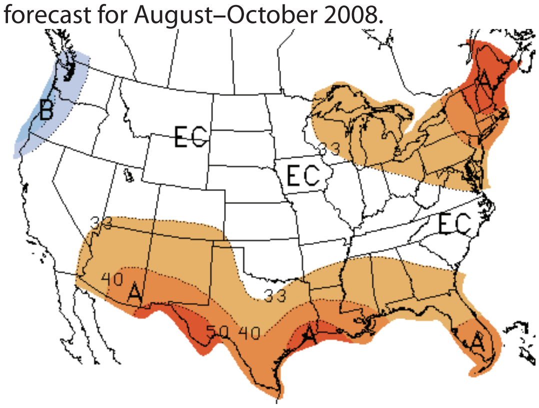


Figure 10b. Long-lead national temperature forecast for September–November 2008.

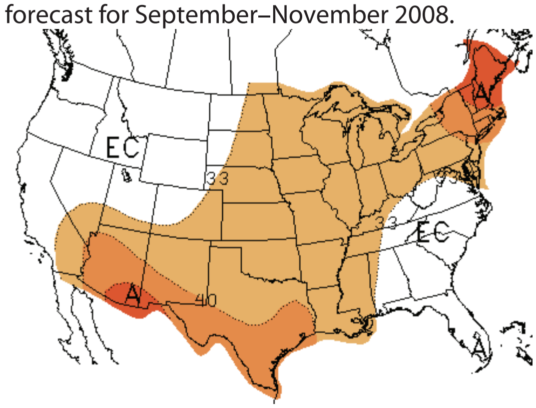


Figure 10c. Long-lead national temperature forecast for October–December 2008.

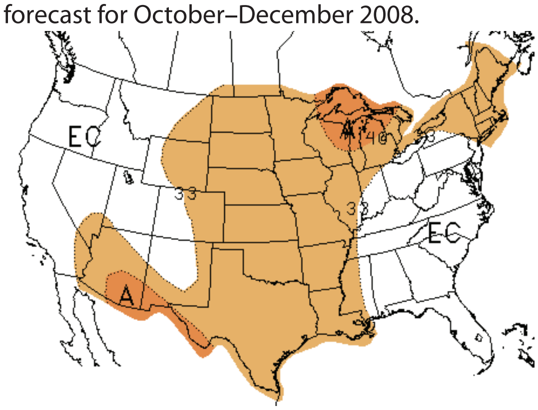
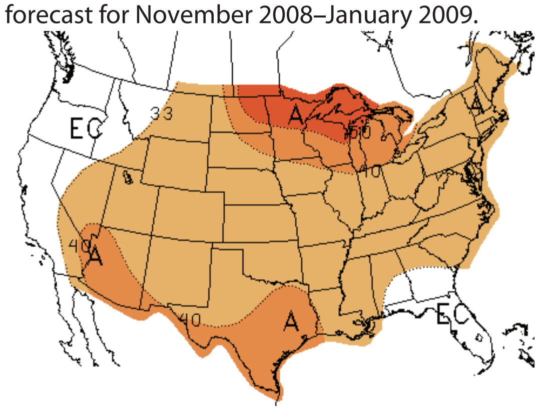


Figure 10d. Long-lead national temperature forecast for November 2008–January 2009.



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
(August 2008–January 2009)
Source: NOAA Climate Prediction Center (CPC)

The three-month precipitation outlook beginning in early August indicates a greater probability of below-average precipitation over the Pacific Northwest through October. A slightly increased probability of above-average precipitation is predicted for the Midwest, Southeast, and Northeast (Figures 11a–11b). Throughout Arizona and New Mexico, the forecast calls for equal chances (EC) of above-, near-, and below-average precipitation through November, with a shift to a slightly increased probability of below-average precipitation in southern Arizona and southwest New Mexico in early winter (Figures 11c–11d). With ENSO conditions moving toward a neutral state, these forecasts are primarily based on long-term climate trends.

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 11a. Long-lead national precipitation forecast for August–October 2008.

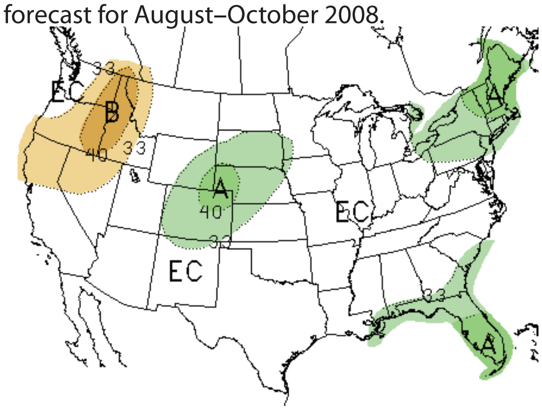


Figure 11b. Long-lead national precipitation forecast for September–November 2008.

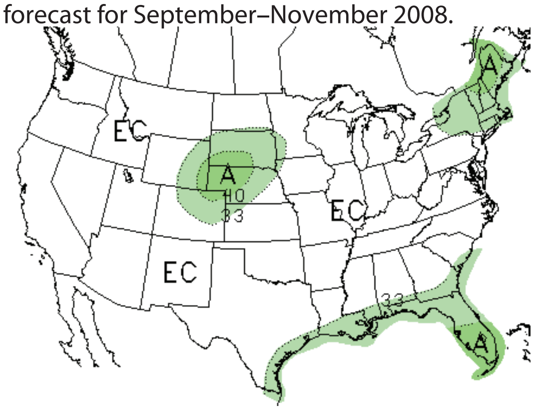


Figure 11c. Long-lead national precipitation forecast for October–December 2008.

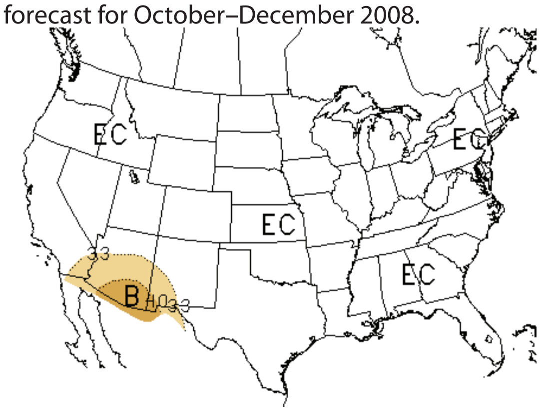
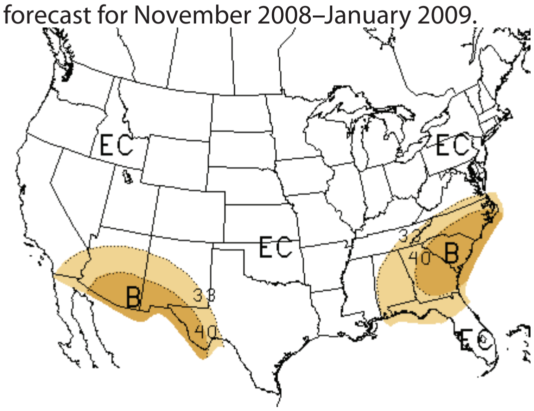


Figure 11d. Long-lead national precipitation forecast for November 2008–January 2009.



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.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 October 2008)
Source: NOAA Climate Prediction Center (CPC)

Drought conditions will generally improve in the Southwest and Southeast, persist for much of California, Nevada, and Hawaii, and develop in parts of the Northwest and Hawaii (Figure 12). This outlook is based predominantly on subjective synthesis of recent conditions and two-week and seasonal forecasts.

In the Southwest, above-average monsoon precipitation in July will likely bring drought improvements to southern New Mexico, southwestern Texas, and southeastern Arizona.

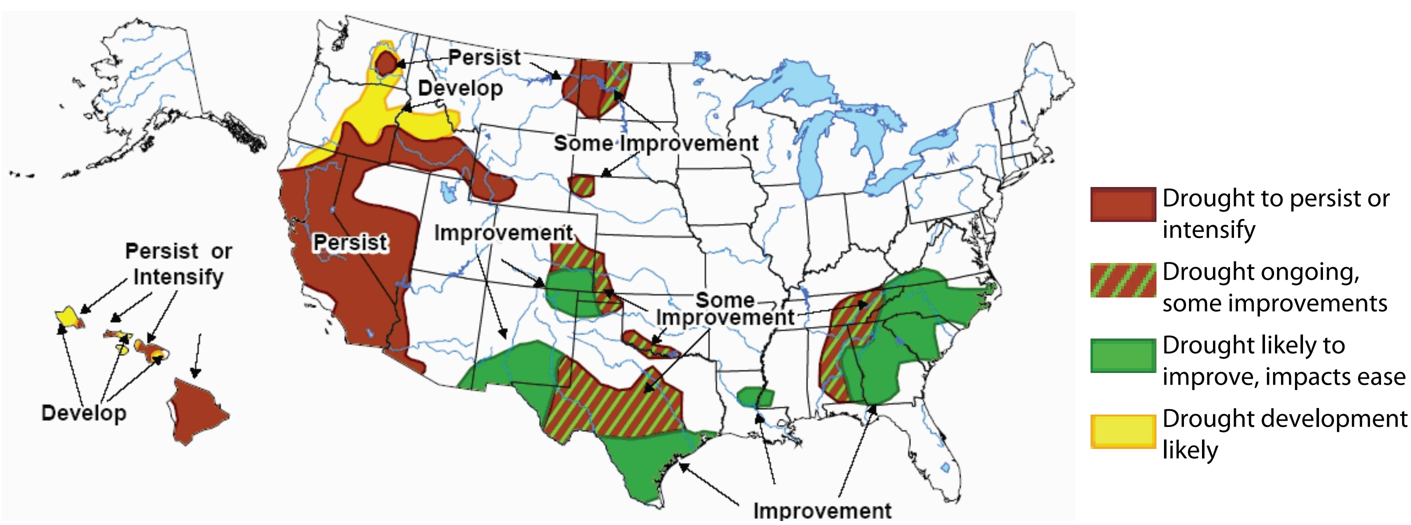
For Texas, drought improvement is likely. In southern Texas, beneficial rains in the first half of July stopped the formation of drought conditions in that part of the state. In addition, extended-range forecasts suggest an upper air pattern that will be favorable for drought improvement and rain from tropical activity. Although modest improvements are projected for central Texas, principally due to the odds favoring increased soil moisture, no major improvements to the water supply should occur unless a tropical weather system adds significant precipitation.

Official forecasts for California show little rainfall for all modeled forecast periods, and it is unlikely that the state will experience significant improvements during the ongoing dry season. As a result, it is likely that the area of drought over the West will expand northward in California and southern Oregon/southwestern Montana, and southward into southwestern Idaho.

In the Southeast, forecasts of short-term rain and above-average precipitation in the medium range and the increased possibility of tropical storms later in the summer will likely lead to drought improvements near coastal areas and into the Piedmont region of the Carolinas.

Notes:
The delineated areas in the Seasonal Drought Outlook (Figure 12) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 12. Seasonal drought outlook through October 2008 (released July 17, 2008).



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

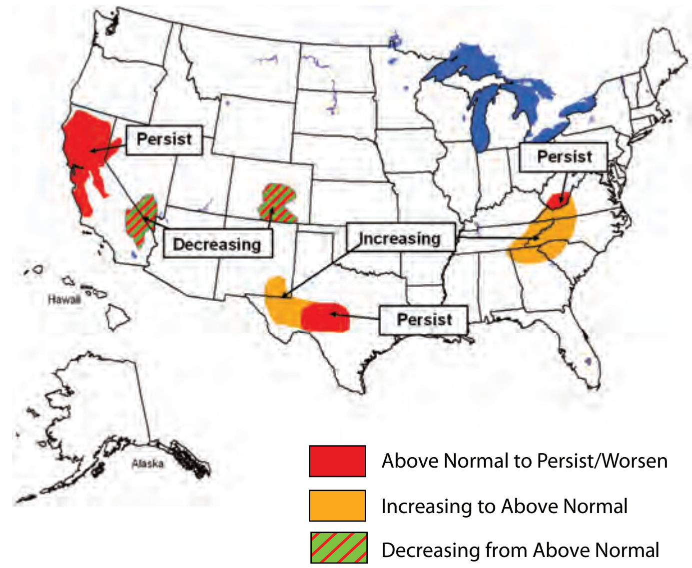
Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

The seasonal wildland fire outlook predicts increasing fire potential in southeastern New Mexico during August through October (Figure 13a). The outlook, which was released on July 1, does not account for substantial recent precipitation in southeastern New Mexico, which may reduce increasing fire potential. The Southwest Coordination Center's monthly outlook for July (not shown) predicts normal fire potential throughout most of Arizona and New Mexico, with above-normal potential in western Arizona through mid-July. Most of western Arizona has not received substantial precipitation for several months; hot and dry conditions are still a concern for fire managers in that region.

Major national firefighting concerns include northern California, central Texas, and the Appalachian Mountains in North Carolina, Virginia, and West Virginia. Recent large fires in coastal Virginia and North Carolina have burned more than 4,000 and 40,000 acres, respectively.

Figure 13a. National wildland fire potential for fires greater than 100 acres (valid August–October 2008).



Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. The forecasts (Figure 13a) 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 13b. 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	

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 ENSO-neutral conditions are present in the equatorial Pacific Ocean. NOAA also states that equatorial sea surface temperatures (SSTs) in the central Pacific Ocean have returned to near average, while positive SST anomalies continue to increase and expand westward into the east-central Pacific.

The current El Niño Southern Oscillation conditions are characterized by below-average SSTs, with these temperatures only occurring in a small region near the dateline in the central equatorial Pacific. During the past two weeks, low-level zonal wind anomalies along the equatorial Pacific and the Southern Oscillation Index (SOI) have been near average (Figure 14a). In addition, convection continues to be suppressed in the central equatorial Pacific and slightly enhanced over the far western Pacific. Finally, the equatorial heat content is above average in the central and eastern equatorial Pacific, and this has helped maintain somewhat above-average SSTs in the eastern one-third of the equatorial Pacific. Collectively, these atmospheric and oceanic characteristics are consistent with a return from La Niña to ENSO-neutral conditions.

The International Research Institute for Climate and Society (IRI) states that the probability of maintaining ENSO-neutral conditions during the July through September season is 75 percent (Figure 14b). The IRI also states that the probability for La Niña and El Niño conditions is 10 percent and 15 percent, respectively. These probabilities are based on forecasts from a large set of dynamical and statistical forecast models and current observations of the ocean surface and subsurface.

Notes:

Figure 14a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through May 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 14b shows the International Research Institute for Climate and Society (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, the coolest 25 percent of Niño 3.4 SSTs; and neutral conditions where SSTs fall within the remaining 50 percent of observations. The IRI probabilistic ENSO forecast is a subjective assessment of current model forecasts of Niño 3.4 SSTs that are made monthly. The forecast takes into account the indications of the individual forecast models (including expert knowledge of model skill), an average of the models, and other factors.

On the Web:

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

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

Figure 14a. The standardized values of the Southern Oscillation Index from January 1980–June 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).

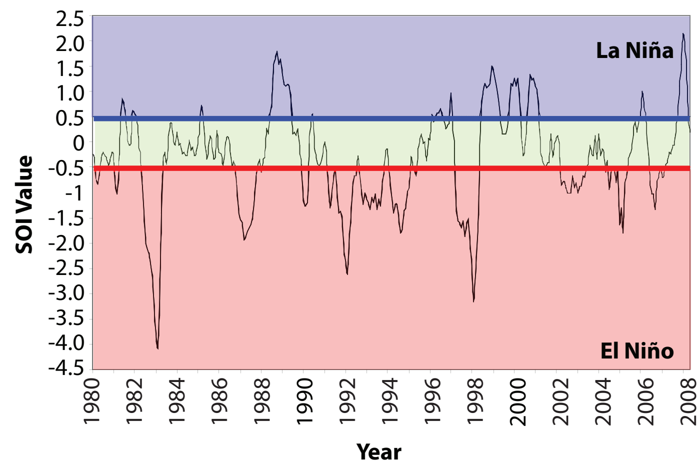
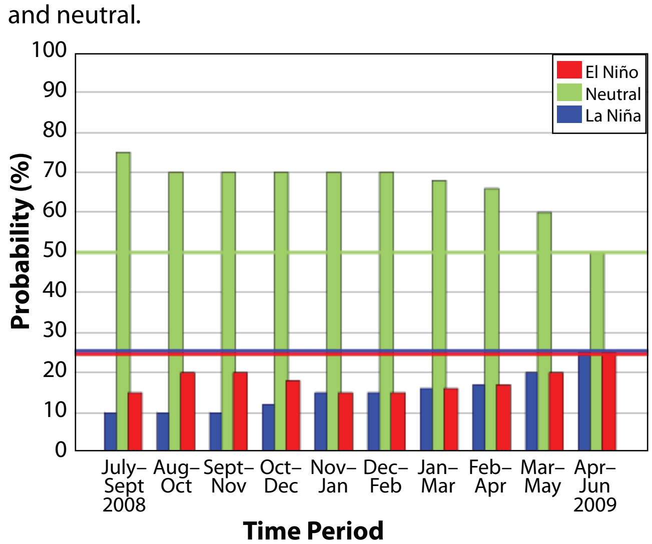


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released July 17, 2008). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(April–June 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal temperature outlook for April–June 2008 predicted increased chances of above-average temperatures for most of the western and southern U.S., including probabilities of above-average temperatures throughout the Southwest (Figure 15a). 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 pattern of observed temperatures from April through June was consistent with the CPC prediction. However, observed temperatures in the region were only slightly above the long-term average. Observations recorded slightly cooler to near-average temperatures in most of the Pacific Northwest and Rocky Mountain west and slightly warmer-than-average temperatures from California across much of the Southwest, the South, and up through the Atlantic Coast (Figure 15b).

Figure 15a. Long-lead U.S. temperature forecast for April–June 2008 (issued March 2008).

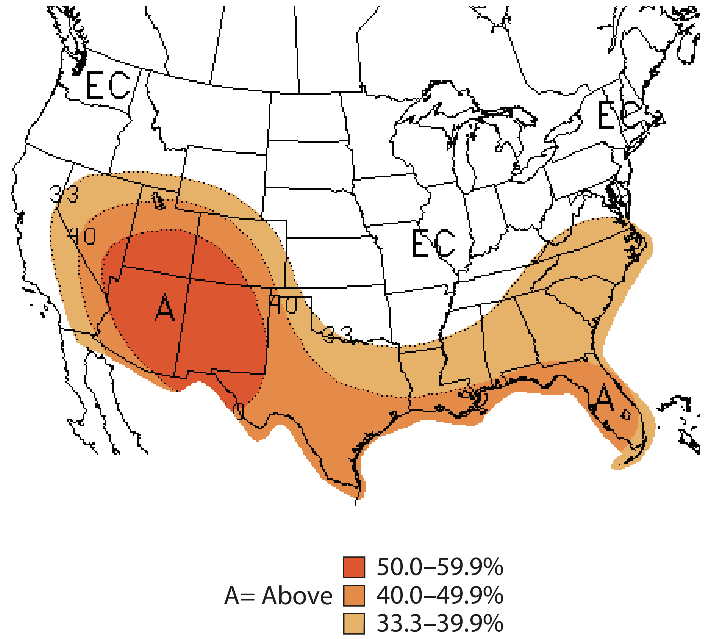
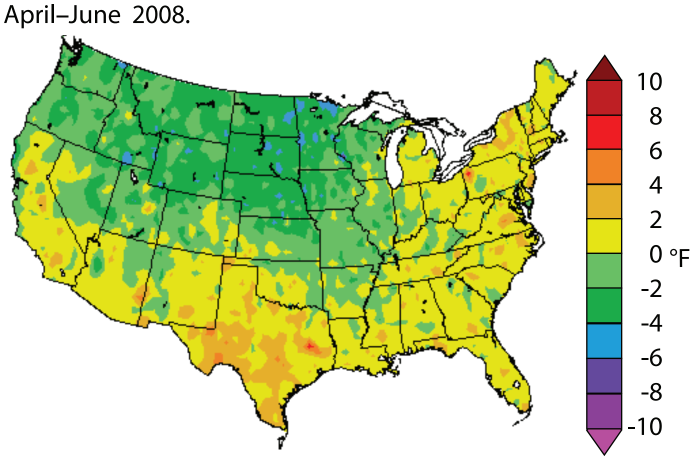


Figure 15b. Average temperature departure (in degrees F) for April–June 2008.



Notes:

Figure 15a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months April–June 2008. This forecast was made in March 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 15b shows the observed departure of temperature (degrees F) from the average for the April–June 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:

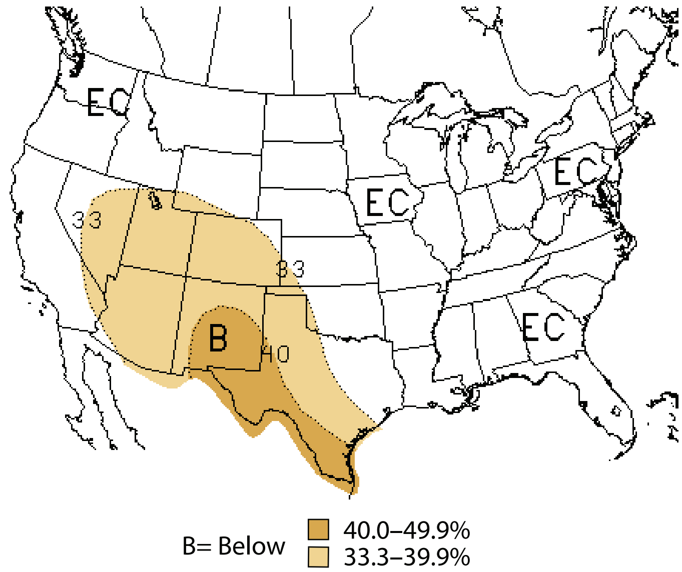
For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Precipitation Verification
(April–June 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal precipitation outlook for April–June 2008 predicted moderately increased probabilities of below-average precipitation in the Southwest and into West Texas (Figure 16a). 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 16b). Much of Arizona and New Mexico received precipitation that was far below normal. The exception in the observed record was in southwest Arizona, where precipitation exceeded the average; however a single event could bring about this result given the extremely low average precipitation in this region. The Midwest received above-average precipitation, with some regions receiving up to 400 percent of normal precipitation through the spring. Overall, the observed precipitation pattern in the Southwest and through the Midwest was 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 into parts of the Northeast.

Figure 16a. Long-lead U.S. precipitation forecast for April–June 2008 (issued March 2008).



EC= Equal chances. No forecasted anomalies.

Notes:

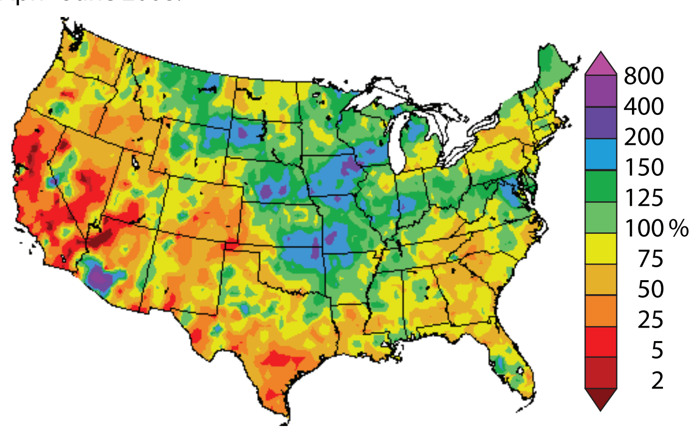
Figure 16a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the monthsApril–June 2008. This forecast was made in March 2008.

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 16b shows the observed percent of average precipitation for April–June 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 16b. Percent of average precipitation observed from April–June 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