Issued: October 24, 2006

Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.

Source: http://www.nmfma.org

Photo Description: A flash flood in Alamogordo, New Mexico on June 22, 2006. According to the New Mexico Floodplain Managers Association, "Late in the afternoon of June 22, 2006, a heavy thunderstorm struck at least the lower part of Marble Canyon, one of three major canyons on the west side of the Sacramento Mountains that created the alluvial fans upon which Alamogordo is built. The storm resulted in sudden, dangerous flooding in the southeastern part of the city."

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

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The U.S. drought outlook through January 2007 calls for drought conditions to show some improvement from far northwestern New Mexico across most of northern Arizona, southward along the western border of Arizona, and eastward along much of the Mexican border...

El Niño

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El Niño conditions have persisted in the tropical Pacific Ocean this fall and are expected to continue into spring 2007. Positive equatorial sea surface temperature anomalies greater than 1 degree Fahrenheit have been observed in most of the equatorial Pacific since early September...

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October Climate Summary

Drought – Drought conditions have continued to improve in the Southwest, and New Mexico is nearly drought free. Longer-term relief for the Southwest will depend on adequate winter rain and snow.

- Drought conditions are expected to continue to improve in Arizona over the next few months.
- Reservoirs in Arizona and New Mexico changed little since last month.

Temperature – Since the start of the water year on October 1, temperatures over most of the Southwest have been above average.

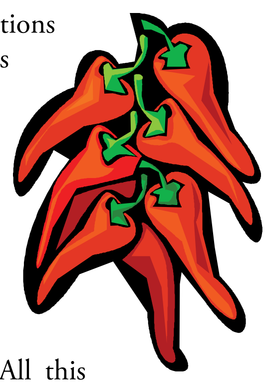
Precipitation – Since the start of the water year precipitation has been above average across most of the Southwest, but below average in southwestern Arizona.

Climate Forecasts – Experts predict increased chances of warmer-than-average temperatures and above-average precipitation for most of the Southwest during the upcoming winter.

El Niño – El Niño conditions have persisted this fall and are expected to continue into spring 2007.

The Bottom Line – Welcome drought relief has occurred due to abundant rains in the monsoon season and in the early fall, particularly in New Mexico, but that relief may be limited to short-term impacts due to the accumulated effects of long-term, multi-year precipitation deficits.

Hatch chiles survive monsoon flooding



The monsoon rains went a long way in easing drought conditions in the Southwest, but the wet weather brought flood disasters to the region, including the famous chile-producing area around Hatch, New Mexico, on the southern Rio Grande. Hatch chiles are known around the globe for their excellent quality, but it looked for a time that there might be a chile shortage due to flooding, something chile-lovers never want to see. Flooding was widespread around Hatch; some chili fields flooded, more than four hundred homes were damaged in the area, and hundreds of families were forced to evacuate, leading to an acute labor shortage in the fields. All this caused concern that the chile crop might fail because of the combination of flood damage and not enough workers to harvest them. Fortunately, fewer fields were flooded than had been feared initially, and enough workers were able to return to save the harvest. The latest word is that the chile crop is safe and the chile trucks will roll.

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2006 SWCO water year in review

Introduction

The Southwest Climate Outlook 2006 Water Year in Review offers a summary of the information presented in each month's outlook during the 2006 water year. This review provides an overview of precipitation, temperature, reservoir and streamflow levels, drought, wildfire, and El Niño conditions.

The water year begins on October 1 and ends on September 30 of the following year, so this review covers October 1, 2005 through September 30, 2006. As of October 1, 2006, we are in the 2007 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than the standard calendar year.

Overall, the 2006 water year in the Southwest was marked by extremes in precipitation. The year began with one of the driest six-month stretches on record and ended with an early and active monsoon season that brought flooding to parts of the region and substantial short-term drought relief to much of New Mexico. The heavy rains also suppressed most wildfire activity by late August, and played a role in cooler-than-average summer temperatures in areas of the Southwest. Temperatures across the region otherwise were generally warmer-than-average.

Before the heavy monsoon precipitation arrived, weak La Niña conditions in the tropical Pacific Ocean contributed to an almost complete lack of snowpack and rainfall. The dry winter in the region stressed vegetation, wildlife, the ski and cattle industries, and surface water supplies. With low streamflow and inflow to reservoirs, statewide water storage in Arizona generally fell, and most of New Mexico's reservoirs remain below-average. El Niño conditions, which returned in September, are forecast to persist through the 2006–07 winter season.

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Top 5 headlines of the water year

1) **Winter drought:** October 2005 through March 2006 was one of the driest winters on record for many parts of the Southwest. The lack of precipitation and virtually non-existent snowpack had far-reaching impacts on water supplies, the ski industry, the ranching industry, vegetation, and wildlife. In Phoenix, a new record was set of 143 consecutive days with no measurable precipitation. Near Santa Fe, only 16 percent of normal snow water equivalent was recorded through March.

2) **Spring Wildfires:** Due in part to the extreme drought conditions through the winter, the Southwest experienced an active fire season until monsoon moisture suppressed most fire activity by late August. As of September 13, 5,320 fires in Arizona and New Mexico had burned 754,519 acres of land.

3) **Summer Monsoon:** An early and active monsoon thunderstorm season this summer brought much-needed short-term drought relief to the region. In Tucson, the 2006 monsoon season officially began on June 28, five days before the average start date of July 3, and ended as the sixth wettest on record. In Albuquerque, a record-tying 3.74 inches of rain were recorded in August.

4) **Summer Flooding:** A negative consequence of the heavy monsoon rainfall was severe flooding. In Albuquerque, notable flooding occurred August 13–14 when more than two inches of rain fell in a 23-hour period. In Tucson, roads, trails, and visitor facilities were damaged by flooding and erosion in Sabino Canyon in the Santa Catalina Mountains.

5) **Return of El Niño:** In September 2006, sea-surface temperatures in the tropical Pacific indicated a return to El Niño conditions. In the Southwest, El Niño conditions are associated with an increased chance of above-average winter precipitation while La Niña events are typically associated with drier-than-average conditions. The extremely dry 2005–06 winter coincided with a La Niña event. Although the current El Niño is relatively weak, seasonal forecasts are predicting a slightly increased chance of above-average winter precipitation which would help offset long-term precipitation deficits.

WYIR, continued

Precipitation

Water Year 2006 was one of extremes in the Southwest in terms of precipitation. The water year began with one of the driest six-month periods ever recorded and ended with record-setting monsoon season precipitation. Most of Arizona received 0–4 inches below-normal precipitation, though areas in the central part of the state and in northern New Mexico were 8–12 inches below normal (Figure 1a). Even with the heavy summer thunderstorms, there was insufficient moisture to offset the severe precipitation deficits accumulated during the winter and precipitation for much of the region was below average (Figure 1b).

October 2005 through March 2006 will go down as one of the driest stretches on record in the Southwest. Dry conditions were associated with a La Niña event in the tropical Pacific Ocean which pushed North American winter storm tracks on a more northerly course, bypassing the Southwest. Winter 2005–06 was characterized by virtually non-existent snowpack in Arizona and New Mexico that stressed vegetation and wildlife and aided in the depletion of surface water supplies.

An early onset monsoon brought much needed short-term drought relief to the area. In Tucson, the monsoon ended as the sixth wettest on record and the June–August summer was the second wettest summer (8.91 inches), behind only 1955 (13.06 inches). Southern and central New Mexico also received well-above-average summer precipitation, especially during August (Table 1).

Along with the record rainfall in the Southwest came extensive flooding. Severe floods caused millions of dollars in damage to homes, roads, canals, and other infrastructure, and forced the evacuation of hundreds of families.

Figure 1a. Water year 2005–2006 through September 30, 2006 departure from normal precipitation.*

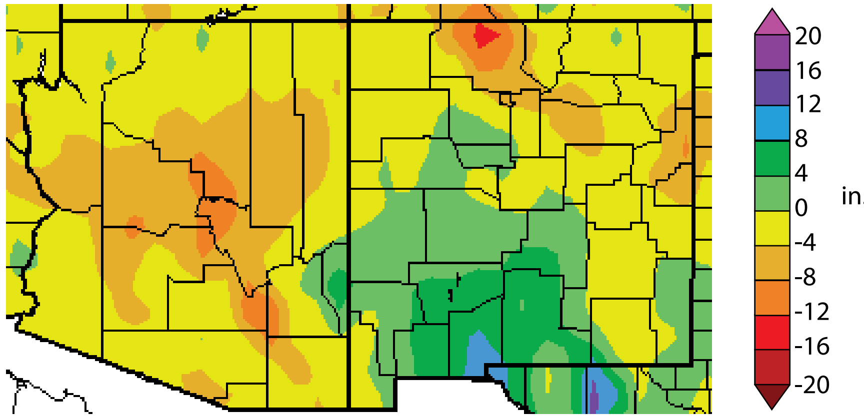
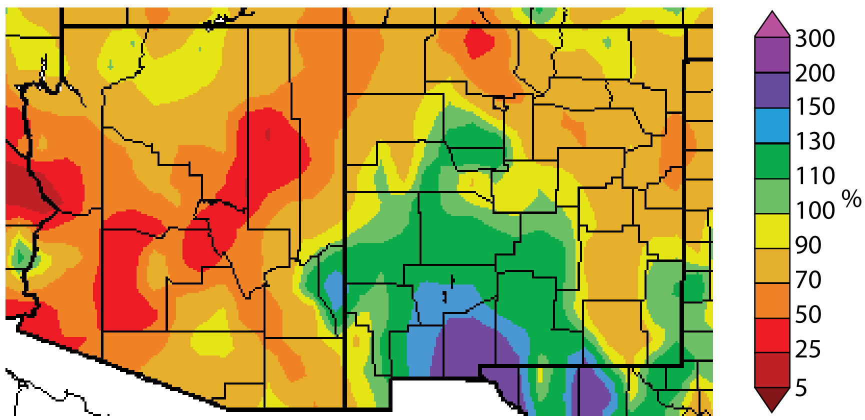


Figure 1b. Water year 2005–2006 through September 30, 2006 percent of average precipitation.*



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

Table 1. Record-setting precipitation in Arizona and New Mexico.

Location	Record Description	Date	Record	Old Record	Old Record Date
Phoenix, AZ	Consecutive days with no precipitation	10/18/05–3/11/06	143 days	101 days	2000
Santa Fe, NM	Driest January–May	1/1/06–5/31/06	0.72 inches	0.84 inches	1/1/02–5/31/02
Albuquerque, NM	Driest November–February	11/05–2/06	0.14 inches	0.30 inches	11/03–2/04
	Wettest July	7/06	3.55 inches	3.33 inches	7/68
	Wettest August	8/06	3.74 inches	2.51 inches	7/17/05
Tucson, AZ	Driest combined fall, winter, and spring on record	9/2/05–5/31/06	0.78 inches	1.95 inches	9/1/73–5/31/74

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WYIR, continued

Temperature

Figure 2a. Water year 2005–2006 through September 30, 2006 average temperature.*

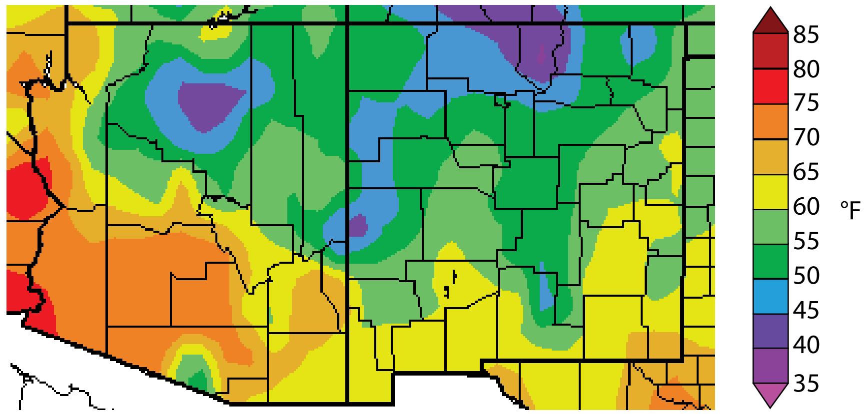
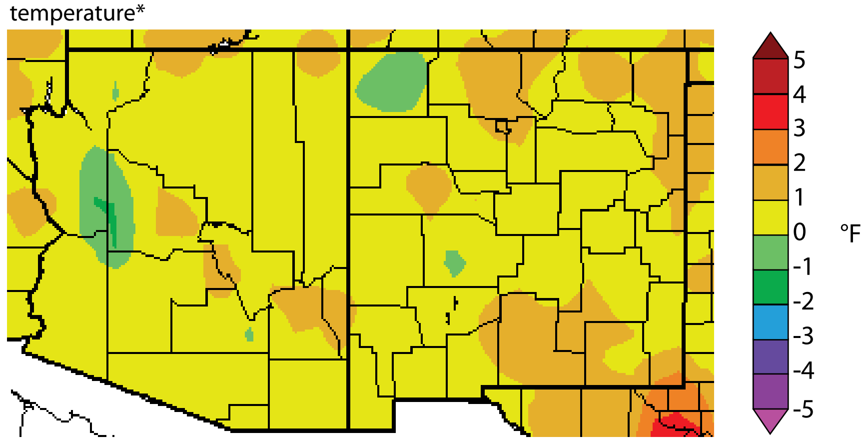


Figure 2b. Water year 2005–2006 through September 30, 2006 departure from normal temperature*



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

Average temperatures in the Southwest for Water Year 2006 ranged from 75–80 degrees Fahrenheit in southwestern Arizona to 35–40 degrees Fahrenheit in the higher elevations of northern New Mexico (Figure 2a). These temperatures were 0–3 degrees Fahrenheit warmer-than-average for most of the region (Figure 2b), which is consistent with recent observed warming trends across the United States and in many parts of the world over the past several decades. In combination with long-term drought conditions and growing populations in the region, warmer temperatures could increase stress on water supplies and natural habitats.

For much of the Southwest, October and November bring relief from hot summer temperatures, but according to the National Climatic Data Center (NCDC), 2005 saw the twenty-seventh warmest October and the twelfth warmest November on record for the region (the NCDC includes Arizona, New Mexico, Utah, and Colorado in the Southwest). These above-average temperatures during the fall were not extraordinary, but they foreshadowed the warm, record dry winter and spring to follow.

The transition to 2006 was also warmer than average in the Southwest. In Tucson, the December–February winter was the third warmest on record with an average temperature of 55.7 degrees F. Also, the average high temperature of 70.8 degrees F was the warmest ever recorded. In Albuquerque, the January 2006 average maximum temperature was 51.5 degrees F, 3.9 degrees above average and the twelfth warmest January on record since 1893. Warmer winter temperatures could affect water resources in the Southwest if more precipitation falls as rain than as snow. More rain than snow could limit snow accumulation at higher altitudes. This would change the timing and quantity of spring runoff which is important for replenishing reservoir supplies.

In March, temperatures in Arizona and New Mexico were generally cooler than average, but above-average temperatures returned in April and May. In Albuquerque, April was the sixth warmest on record and May the third warmest with average temperatures of 60.5 and 70.0 degrees F, respectively. In Tucson, the March–May spring season was the thirteenth warmest on record with an average temperature of 68.8 degrees F. These above-average temperatures combined with record dry conditions created elevated levels of wildfire risk for many areas in the Southwest.

For the nation as a whole, summer 2006 saw deadly heat waves in the northern Plains and upper Midwest and was the second warmest summer on record behind the Dust Bowl year of 1936. In the Southwest, temperatures were a bit more variable. In Tucson, 2006 logged the sixth warmest summer on record and saw a record highest low temperature of 89 degrees F on July 22. Elsewhere in the Southwest, temperatures were cooler than average, partly due to the active monsoon season. In Albuquerque, a record for coolest average maximum temperature (83.1 degrees F) was set for August. This was also the first time since March 2005 that a below-average monthly temperature in Albuquerque was recorded.

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WYIR, continued

Reservoirs & Streamflow

Arizona

Water storage declined somewhat in most reservoirs in Arizona during Water Year 2006. Total statewide storage is about 5 percent lower than the levels recorded at the end of September 2005. Weak La Niña conditions in the tropical Pacific Ocean contributed to an almost complete lack of snowpack and rainfall in the Southwest during the winter, resulting in very low streamflow and inflow to reservoirs. Total storage statewide declined from 56 percent of capacity to 53 percent over the water year. Storage on the three major reservoir systems within the state (Salt River, Verde River, and San Carlos Reservoir on the Gila River) declined from a total of 66 percent of capacity one year ago to 55 percent at the end of Water Year 2006.

Some unexpected replenishment of the in-state reservoirs occurred as a result of the unusually strong monsoon rains during the summer. In most years the monsoon season rains produce very little inflow to reservoirs, but this year the rains were strong enough to raise the total in-state storage from 48 percent of capacity at the end of July to 55 percent by the end of September.

On the Colorado River, lakes Powell and Mead, the two largest reservoirs in the state, are at only 49 and 53 percent of capacity, respectively. They make up more than 90 percent of Arizona's maximum storage capacity, so low levels in Powell and Mead have a greater adverse effect on statewide storage levels than low levels in other reservoirs (Figure 3a).

The maximum storage in Lake Mead was in late February, coinciding with the end of the period of winter release from Lake Powell. Water levels declined in Lake Mead for the remainder of the year due to normal water use—mainly, releases to meet agricultural and Central Arizona Project (CAP) water demands.

Figure 3a. Water year 2006 storage at Lakes Mead (pink) and Powell (brown) in Arizona.

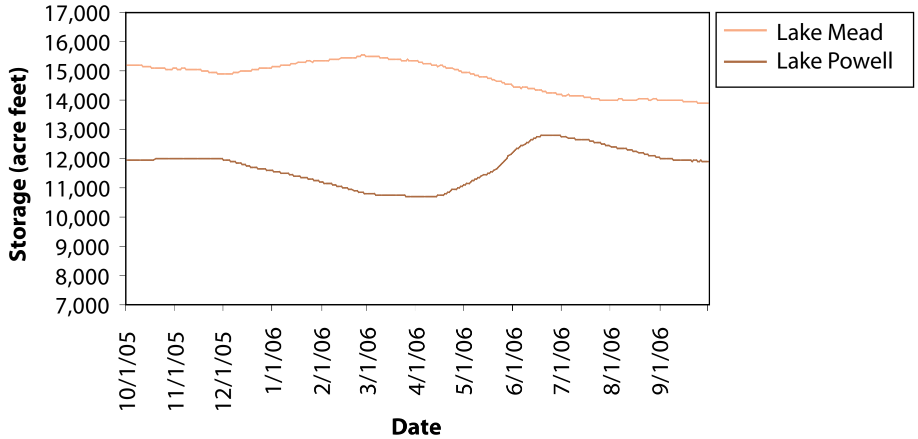
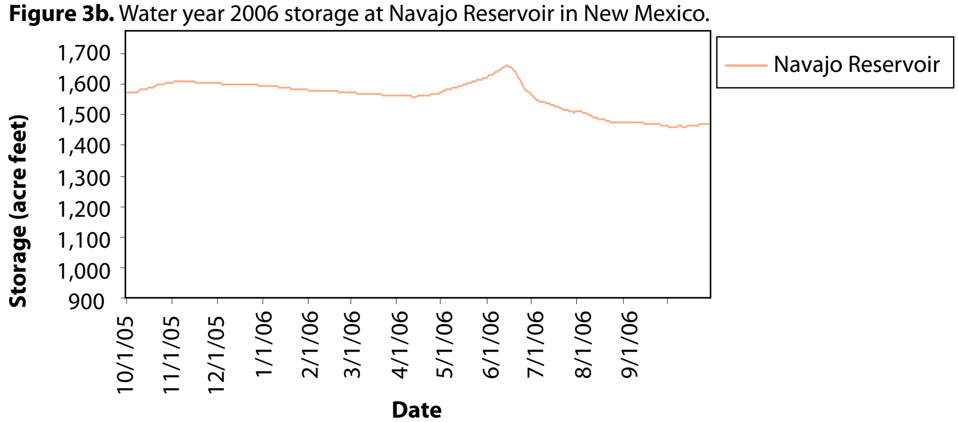


Figure 3b. Water year 2006 storage at Navajo Reservoir in New Mexico.



The minimum storage on Lake Powell occurred during March and April, following the winter releases.

New Mexico

Reservoir storage in New Mexico also declined during the water year, with the statewide total dropping from 41 to 37 percent of capacity. While some reservoirs are at or above average levels, others are much below average. Navajo Reservoir on the San Juan, the second-largest in the state, is at 102 percent of average, but declined in acre feet since the start of the water year (Figure 3b). Avalon and Santa Rosa lakes on the Pecos are at 121 percent and 109 percent of average, respectively. Abiquiu and Costilla reservoirs on the upper Rio Grande are at 118 and 120 percent of average, respectively. Most other reservoirs in New Mexico are at below-average levels. Sumner reservoir on the Pecos is at only 18 percent of average, and the largest reservoir in the state—Elephant Butte on the lower Rio Grande—is at only 27 percent of average.

The record-breaking monsoon season in New Mexico helped streamflow and replenished reservoirs around the state, particularly in the south, where rainfall was heaviest. Elephant Butte, which was down to 9 percent of capacity, nearly doubled in storage to 16 percent. Despite the help from the summer rains, most of New Mexico's reservoirs remain at below-average storage due to the lingering impact of the long-term drought conditions.

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WYIR, continued

Drought

Water Year 2006 was a roller coaster in the Southwest. Taking a birds-eye view of drought, Arizona and New Mexico began the water year with very moderate drought and abnormally dry conditions covering the eastern quarter of Arizona and the western half of New Mexico. Drought steadily increased through the winter and spring months, reaching a maximum extent in mid-June (Figure 4a) as a result of near-record-low precipitation between November and April. During that winter half-year, Arizona logged its fourth lowest statewide precipitation total, while New Mexico saw its second lowest statewide winter precipitation in 111 years of records.

Early July rain brought some relief, but it was not until late-July through mid-September that the monsoon really punched a hole in the drought. The mid-summer deluge caused damaging floods throughout much of the Southwest and raised reservoir levels in New Mexico. Ironically, drought severity increased across the western quarter of Arizona while other parts of the Southwest recorded record streamflows. At present, drought lingers across Arizona, especially near the Four Corners, while much of New Mexico received substantial relief from summer rains (Figure 4b).

During the dry winter, skiing tourism suffered as a result of record low snowpacks in many Southwest mountain ranges. At lower elevations, range and pasture conditions deteriorated dramatically during the winter and spring. In May, as drought severity intensified, the USDA designated drought disaster status to fourteen Arizona counties and six New Mexico counties.

The winter-spring drought significantly affected wildlife habitat, populations, and demography. During the spring, wildlife officials noted severe declines in deer fawns and a subsequent decrease in hunting licenses—a drought impact that costs millions of dollars annually in matching federal contributions. Throughout the spring and into the summer, as woodland food sources withered, large mammals, such as black bears, were reported at lower elevations, crossing interstate highways (*Albuquerque Journal*, May 11) or appearing at airports (*Arizona Daily Star*, September 5).

Figure 4a. Drought Monitor released June 15, 2006.

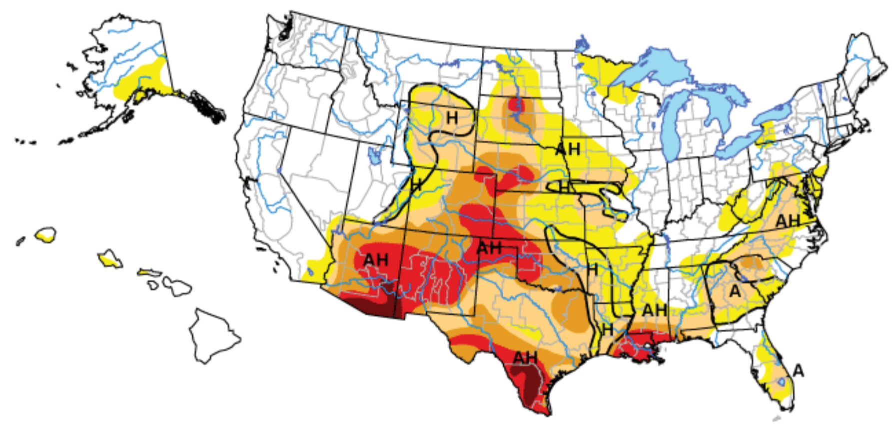
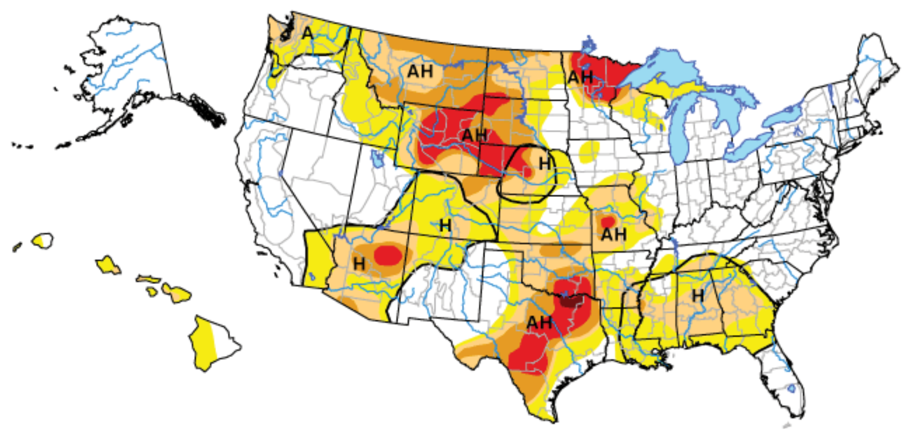


Figure 4b. Drought Monitor released September 28, 2006.



Drought Intensity

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

Drought Impact Types

/ Delineates Dominant Impacts

A = Agricultural (crops, pastures, grasslands)

H = Hydrological (water)

AH = Agricultural and Hydrological

Good news at the end of Water Year 2006 includes some groundwater recharge from summer rains and an improved U.S. Drought Monitor that allows users to zoom in on current drought conditions for their state (http://www.drought.unl.edu/dm/monitor.html).

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WYIR, continued

Wildfire

In 2006, Arizona registered below-average area burned (144,258 acres), while about three times the average area burned (610,261 acres) in New Mexico, not including wildland fire use (WFU). The 2006 Southwest fire season was almost a reverse of the 2005 season, when Arizona acres burned were even greater than the record-breaking 2002 fire season (see the October 2005 Southwest Climate Outlook).

The fire season began early in both states, as predicted by the Southwest Coordination Center. The early onset of the fire season was chiefly due to an extremely dry La Niña winter, combined with an abundance of grass and shrub fuels that carried over from the wet 2004–05 winter in the Southwest. In fact, some of the largest fires of 2006 occurred in January in New Mexico, including the Tatum East, West, and Buckeye Fires; together, these three fires burned more than 60,000 acres.

The 4,243-acre "February Fire" in Arizona's Tonto National Forest had state emergency managers worried that the fire season would be one of the busiest ever. A series of March and April storms delivered just enough precipitation to lower Arizona fire risk. In addition, by mid-spring 2006, the large 2004–05 grass crop was flattened and posed a lower risk for fire spread (Figure 5a).

In contrast, New Mexico received scant precipitation in March, and the occurrence of large fires—fires that burn more than 50 acres—continued virtually nonstop through the end of June. In March, the McDonald Fire, the largest wildfire of New Mexico's season, torched 92,390 acres in Lea County, and the Casa Fire burned 26,525 acres in Colfax County in north-central New Mexico (Figure 5b). May and June brought major lightning-caused fires to the state, including the Adobe Fire (25,460 acres; Grant County), the Gladstone Complex (23,500 acres; Union County), and the Bear Fire (51,307 acres; Catron County).

Arizona fire activity revived in June with large lightning-caused blazes like the Warm Fire (58,630 acres; Kaibab National Forest) and the Black Mountain Complex, which burned 12,637 acres in Mohave County. The Warm Fire affected Grand Canyon tourism because it temporarily closed the only road leading to the North Rim. The Brins Fire (4,317 acres), which started in mid-June, drew a lot of attention because it threatened recreation and resorts in Oak Creek Canyon and because the terrain was exceedingly steep and rugged. The fire shut down Arizona Highway 89A, a scenic route between Flagstaff and Sedona. Brins Fire suppression costs exceeded $6 million.

Copious summer monsoon precipitation put a rapid end to New Mexico's fire season. Arizona sustained several large fires in July, notably in the northern part of the state.

Prescribed fire and WFU activity—the use of natural fires to achieve land management objectives when the fires pose no threat to communities or structures—bear testimony to this fire season's exceedingly high fire potential. Prescribed fire and WFU activity in Arizona through mid-September 2006 was just more than one-third of the average. New Mexico fire managers managed only two-thirds of average prescribed fire and WFU activity during a year built for Southwest wildfire.

Figure 5a. Locations of Arizona fires larger than 50 acres.

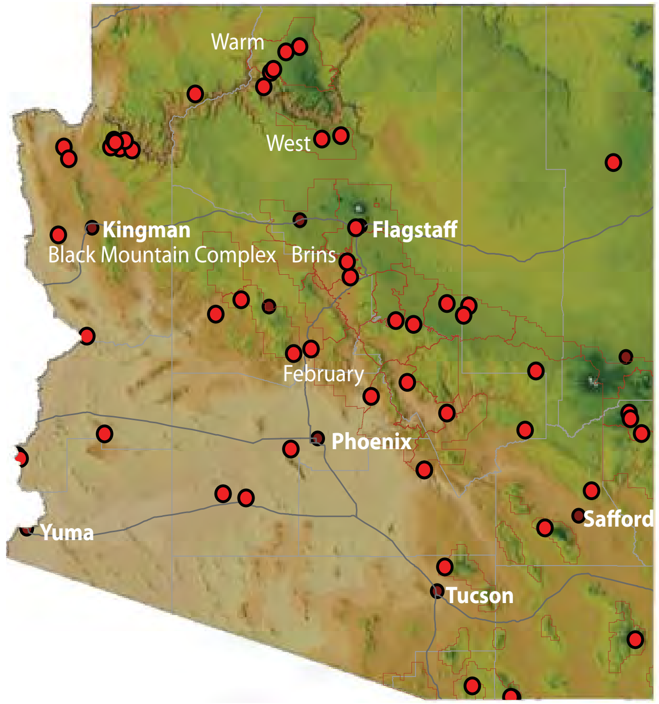
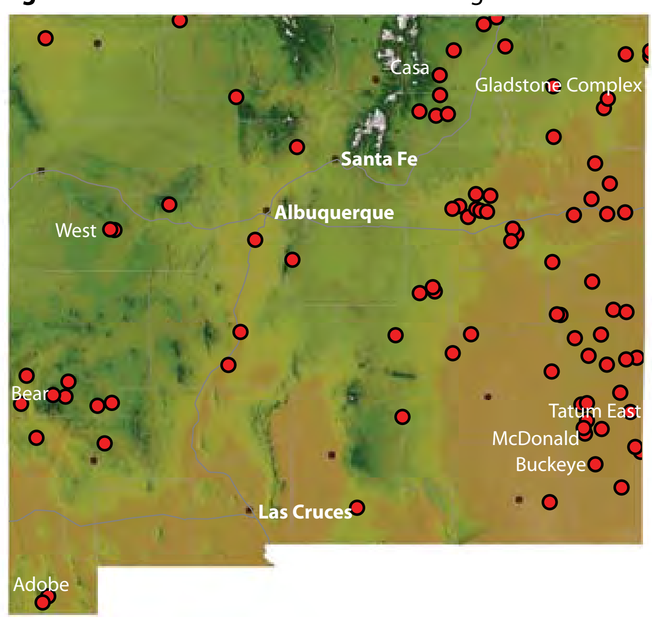


Figure 5b. Locations of New Mexico fires larger than 50 acres.



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WYIR, continued

El Niño

Sea Surface Temperatures

Water Year 2006 was a period of major changes across the equatorial Pacific with a weak La Niña episode giving way to the development of a weak El Niño episode over this past fall. Sea surface temperature (SST) anomalies in the Niño 3.4 monitoring region quickly progressed from near zero (neutral conditions) in October 2005 to near -1 degree Celsius in January 2006, as La Niña, which is connected with dry winters in the Southwest, developed (Figure 6a).

These cooler-than-average SSTs grew in spatial extent across the Pacific basin towards the international dateline through the winter season of 2006, as La Niña strengthened and robbed the East Pacific of the moisture and energy needed for the development of winter storms in the Southwest (Figure 6b). Since an abrupt reversal in April 2006, SSTs have warmed across the Pacific, indicating a trend towards the development of weak El Niño conditions. Warmer-than-average SSTs (positive anomalies) first appearing in the mid-Pacific basin in spring 2006 have spread towards the South American coast during the past several months. Niño 3.4 SSTs have continued to warm since May and are presently close to 0.75 degrees C. This meets the official criteria for weak El Niño conditions, which are forecast to persist through winter 2006–07.

Southern Oscillation Index

Monthly values of the Southern Oscillation Index (SOI), an index of the atmospheric component of El Niño and La Niña activity, were highly variable during the early part of Water Year 2006. Values swung between -0.5 and 2.9 from October 2005 through January 2006. Through this period, positive SOI values reflected the weak atmospheric response to cooler-than-average SST anomalies associated with La Niña. The development of the weak La Niña episode impacted the Southwest by pushing the dominant storm track north, dramatically limiting the amount of winter precipitation across the region. The SOI reversed to persistent negative values beginning in May and continuing through the present. The shift to negative SOI values reflects atmospheric pressure changes associated with the shift towards warmer-than-average SSTs beginning in spring 2006. The SOI was as low as an El Niño-like -2.7 in August, but increased to -1.1 in September.

The SOI is used as an indicator of the atmospheric response to SST anomalies generated during El Niño and La Niña events. Large negative SOI (El Niño) or positive SOI (La Niña) values are indicative of large atmospheric responses to warm or cold SST anomalies. Circulation anomalies, such as shifts in storm tracks, which can impact winter precipitation patterns in the Southwest, usually develop when SOI values are very negative or positive.

The late developing La Niña during Water Year 2006 was weak and may have been only one of many complex factors that led to the record dry winter across the Southwest. Weak La Niña and El Niño episodes can interact with other winter weather factors across the Southwest, leading to complex patterns in the total precipitation received at a given location.

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

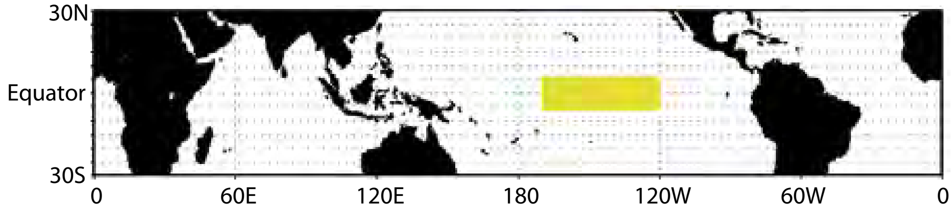
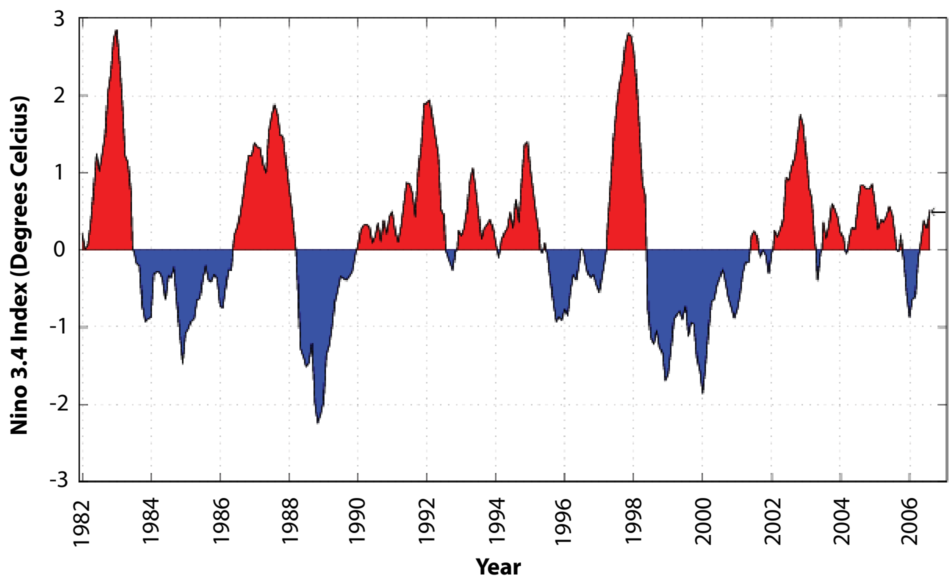


Figure 6b. Sea surface temperature anomaly index from Niño 3.4 region. Red areas indicate positive or warm SST anomalies while blue indicates negative or cool anomalies. Graphic credit: International Research Institute for Climate and Society.



Temperature (through 10/18/06)

Source: High Plains Regional Climate Center

A new water year started on October 1, so the temperatures and departure from average temperatures reflect only the first three weeks of the month (Figures 1a–b). Average temperatures for the new 2007 water year range from the low 40 degrees Fahrenheit in north-central New Mexico to the upper 70 degrees F in southwestern Arizona. Much of the Southwest has been from 0–2 degrees above average, with the largest positive anomalies occurring in southeastern New Mexico and northeastern Arizona. Much of western Arizona and parts of central New Mexico have been 0–2 degrees below average so far for the water year. Temperatures across the Southwest over the last 30 days have been fairly close to average. The northern part of the region has been generally 0–2 degrees below average, with some areas as cool as 4 degrees below average. Parts of the southern portion of the Southwest have been 0–2 degrees above average. September in New Mexico was considerably cooler than average, ranking as the fourth coolest September of the past 112 years, according to the National Climatic Data Center.

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/products/current.html

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

Figure 1a. Water year '06–'07 (through October 18, 2006) average temperature.

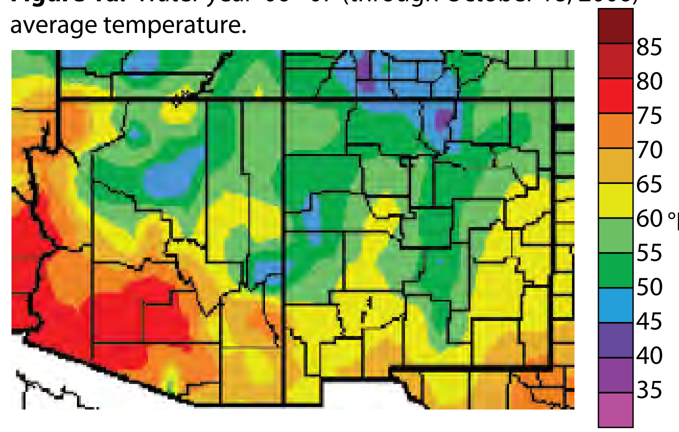


Figure 1b. Water year '06–'07 (through October 18, 2006) departure from average temperature.

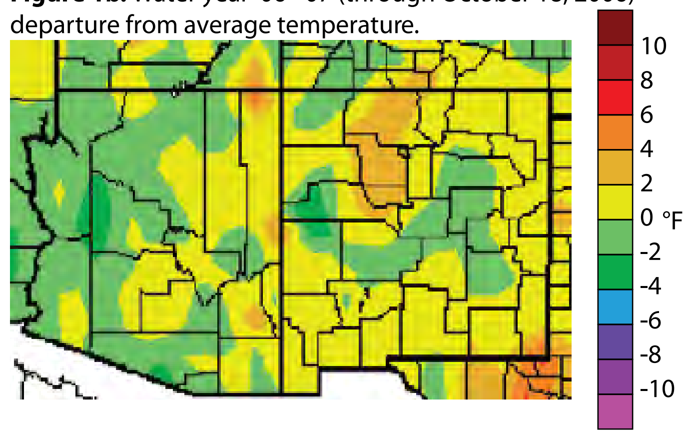


Figure 1c. Previous 30 days (September 19–October 18, 2006) departure from average temperature (interpolated)

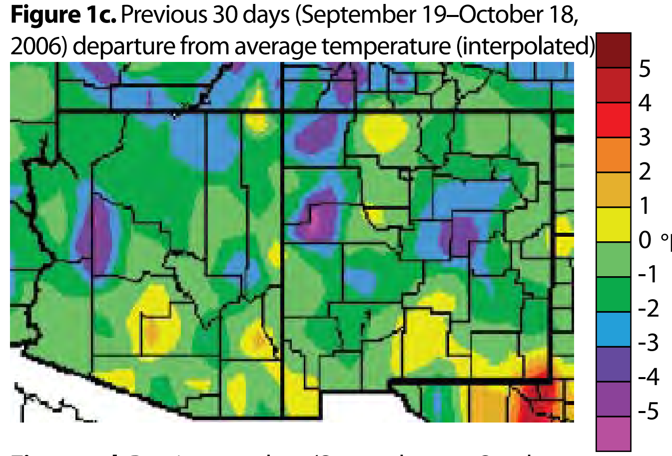
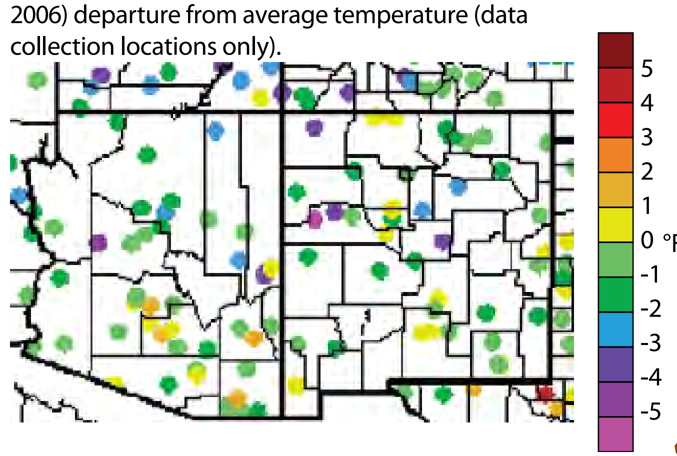


Figure 1d. Previous 30 days (September 19–October 18, 2006) departure from average temperature (data collection locations only).



Precipitation (through 10/18/06)

Source: High Plains Regional Climate Center

Stormy weather in early October has made the new water year wetter than average for most of the Southwest, except for much of southern and southwestern Arizona and parts of eastern New Mexico (Figure 2a–b). Precipitation for most of the Southwest has ranged from 100 to 400 percent of average, with some parts of northwestern Arizona receiving more than 800 percent of average. Southern and southwestern Arizona had generally less-than-average rainfall, with some areas along the Mexican border receiving less than 2 percent of average. In eastern New Mexico rainfall ranged mostly from 25 to150 percent of average. Over the last 30 days rainfall has been above average in northern Arizona and in central and western New Mexico, but below average in eastern New Mexico and in most of southern and southwestern Arizona (Figure 2c–d). Rainfall in central and western New Mexico ranged generally from 100 to 200 percent of average, with some areas in central and northwestern New Mexico receiving 200 to 400 percent of average. A small section of northwestern Arizona ranked above 400 percent of average. According to the National Weather Service Albuquerque Office, September was the twenty-fifth wettest September of the past 112 years in New Mexico.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2006, we are in the 2007 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/products/current.html

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 '06–'07 through October 18, 2006 percent of average precipitation (interpolated).

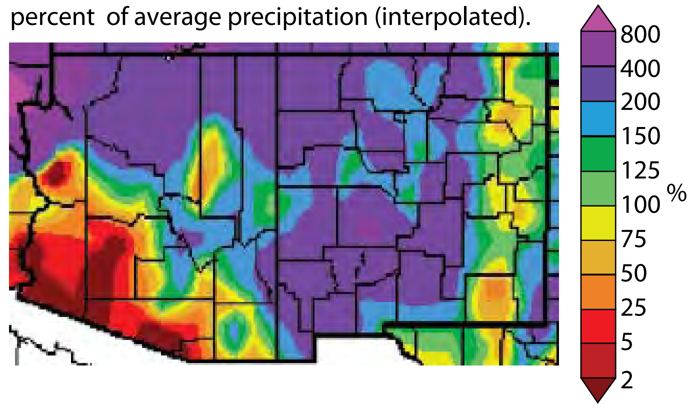


Figure 2b. Water year '06–'07 through October 18, 2006 percent of average precipitation (data collection locations only).

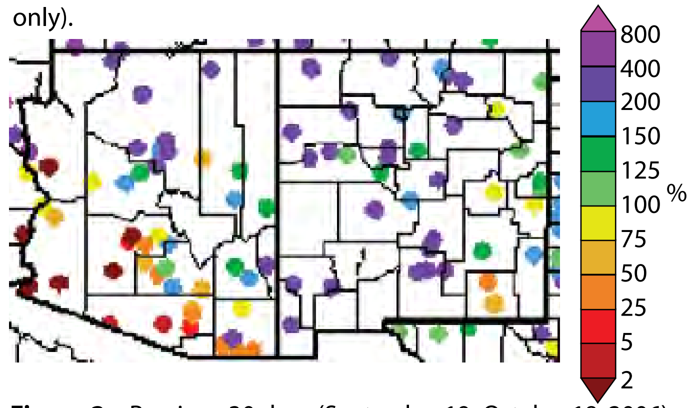


Figure 2c. Previous 30 days (September 19–October 18, 2006) percent of average precipitation (interpolated).

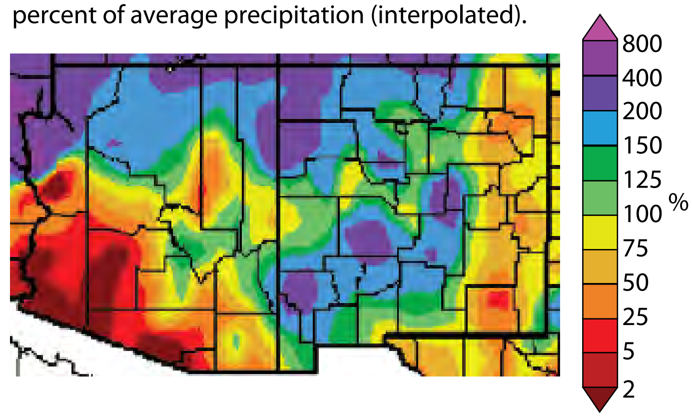
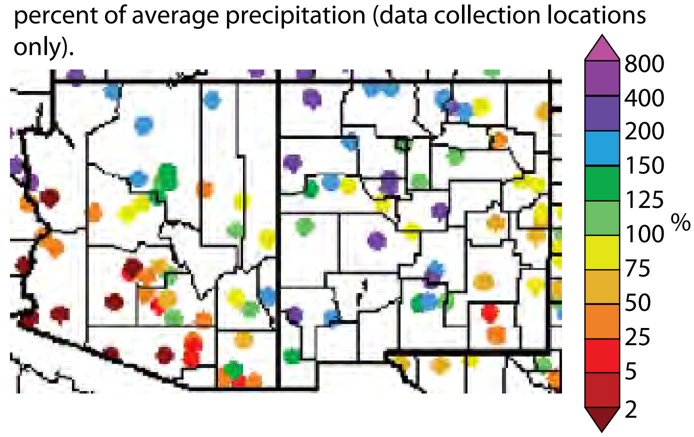


Figure 2d. Previous 30 days (September 19–October 18, 2006) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 10/19/06)

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

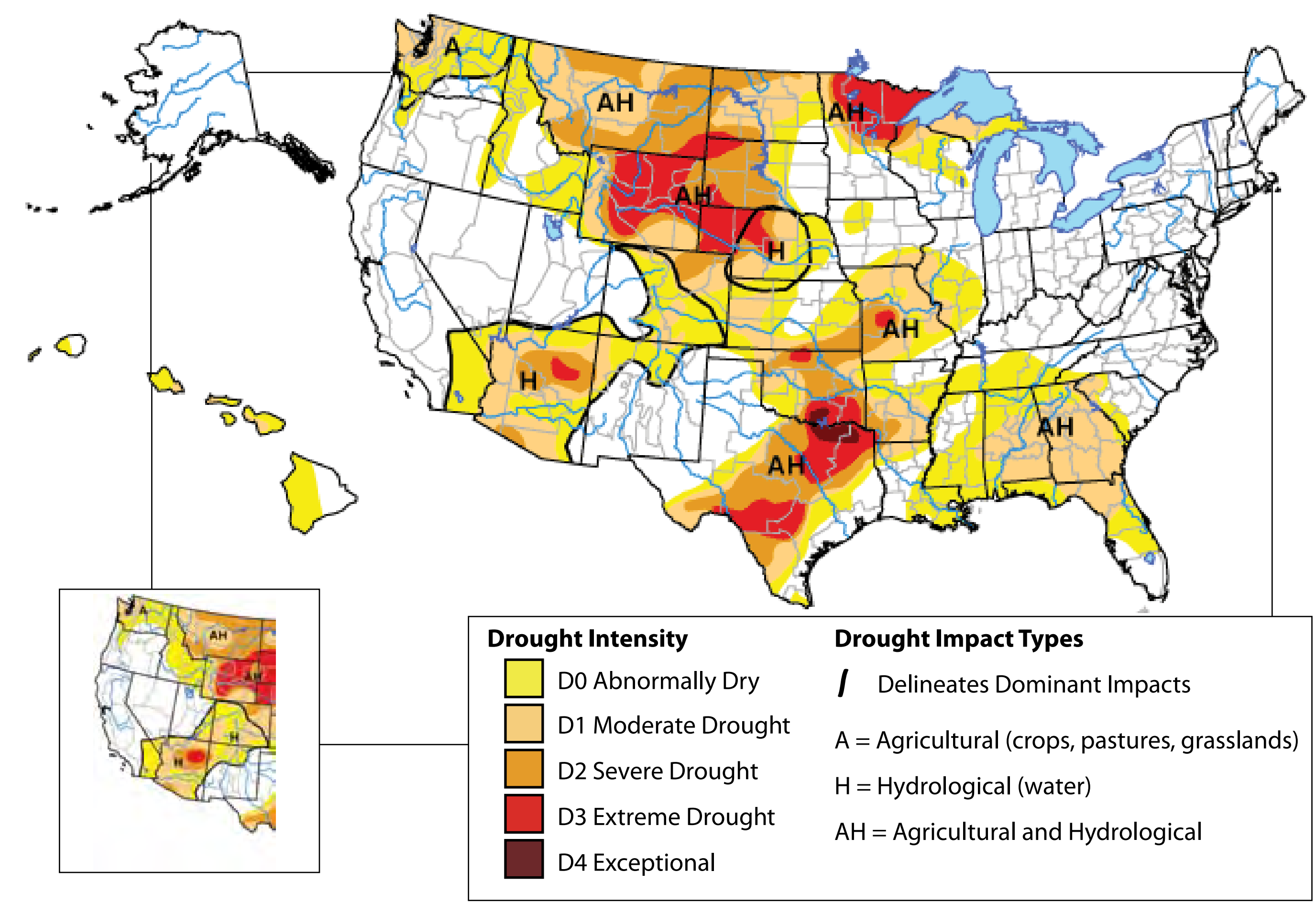
The U.S. Drought Monitor has continued to show some improvement in parts of the Southwest, particularly in the northern part of the region (Figure 3), with two storms from the autumn storm track in early October helping to ease drought conditions. According to the National Weather Service Albuquerque Office, a number of locations received from 1.50 inches to 2.50 inches of rain between October 5 and 10. In New Mexico abnormally dry conditions retreated farther north along the Rio Grande Valley, so that most of the state is now depicted as being drought-free except for parts of northwestern and north-central New Mexico, where most of the moderate drought areas have improved to abnormally dry. Conditions also have improved in northern Arizona, where the area of severe drought has contracted significantly and the area of extreme drought in northeastern Arizona has shrunk to less than half its size a month ago. Despite the improvement in northern Arizona, nearly all of the state remains in some level of drought or abnormal dryness due to the lingering effects of long-term precipitation deficits. Only the far southeastern corner of Arizona is depicted as being drought-free.

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 authors of this monitor are Ned Guttman and Liz Love-Brotak, NOAA/NESDIS/NCDC.

Figure 3. Drought Monitor released October 19, 2006 (full size) and September 21, 2006 (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 9/30/06)

Source: Arizona Department of Water Resources

Short-term drought conditions have remained fairly constant throughout most of Arizona since last month, although there was some improvement in northern Arizona thanks to moisture from storms in early October. The severe drought conditions that had persisted in the Agua Fria and Bill Williams watersheds in central and western Arizona have improved to moderate status, so that no part of the state is in worse status than moderate drought or abnormal dryness (Figure 4a). Most of western Arizona is in moderate drought status, except for some areas along the Lower Colorado River and along the Mexican border, which are in abnormally dry status. Most of eastern Arizona is in abnormally dry status, except for the Upper Colorado River watershed, which is in moderate drought. Soil moisture conditions in Arizona have continued to improve since last month, with only 35 percent of the pasture and range land rated in "poor" to "very poor" condition. This time one year ago, 52 percent of the pasture and range land was in "poor" to "very poor" condition.

Compared to conditions in early summer, the Arizona drought situation has improved dramatically due to the extremely wet and persistent summer monsoon season. Total precipitation in Arizona over the last twelve months remains well below average, and has been insufficient to alleviate the effects of long-term, multi-year precipitation deficits. The long-term drought picture shows most of the eastern part of Arizona in severe drought status, abnormal dryness in the north and northwest, moderate drought in the center of the state, and generally no long-term drought in southwestern Arizona (Figure 4b).

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/Content/Hot_Topics/Agency-Wide/Drought_Planning/

Figure 4a. Arizona short term drought status for September 2006.

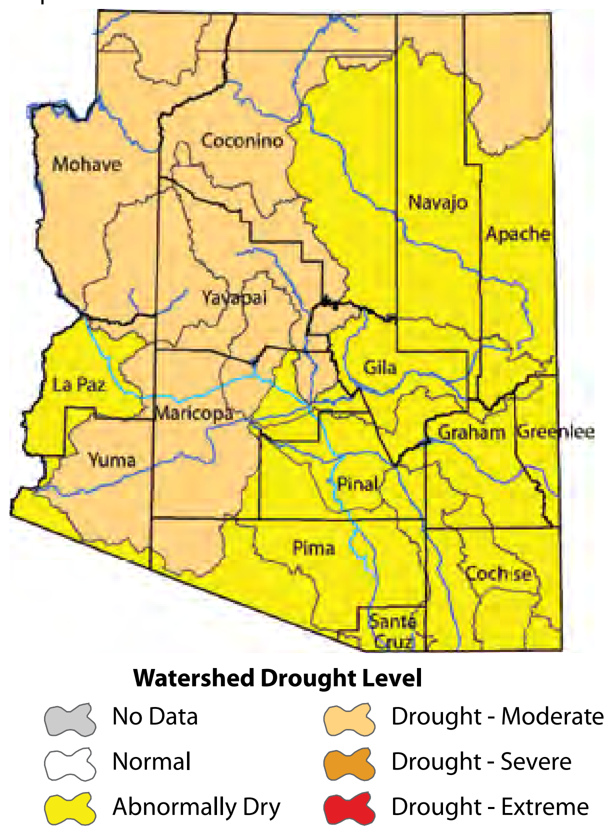
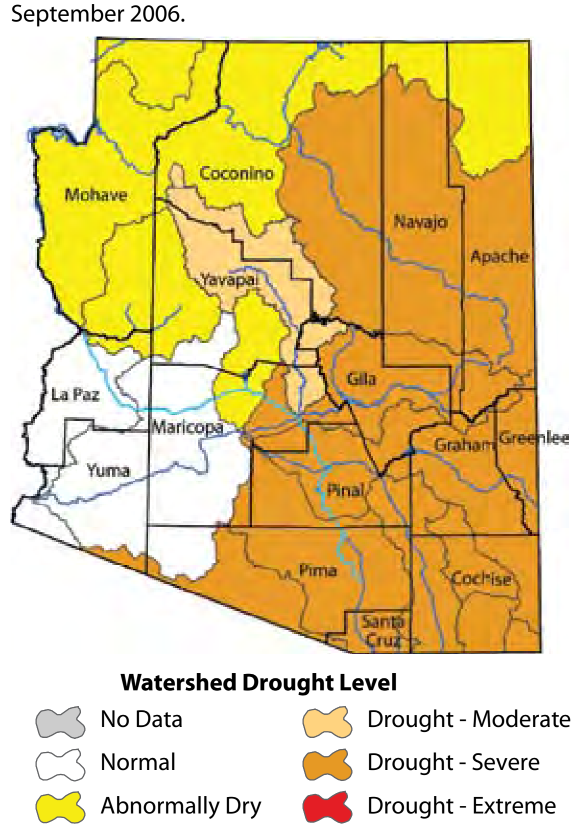


Figure 4b. Arizona long term drought status for September 2006.



New Mexico Drought Status

(through 9/30/06)

Source: New Mexico Natural Resources Conservation Service

New Mexico has continued to show dramatic improvement in the short-term drought status for the third month in a row (Figure 5a), thanks to storms in early October (see Figures 2c–d). Most of the state is now in drought-free status, and warning drought status lingers in only two small areas in north-central and northwestern New Mexico. Portions of the north-central and northwestern part of the state are in alert or advisory status, and some areas in southern New Mexico are in advisory status. The rain and cool temperatures brought by two autumn storms between October 5 and 10 helped alleviate the short-term drought conditions. The long-term (hydrological) drought status map (Figure 5b) is unchanged since last month, with most of the eastern and southern part of the state in alert status, and most of western New Mexico in advisory status. Soil moisture conditions in New Mexico are still generally good, although they have deteriorated slightly since last month, with 21 percent of the pasture and range land in "poor" or "very poor" condition, up from the 17 percent reported last month. As of mid-October, 57 percent of the pasture and range land was in "good" or "excellent" condition, compared to 60 percent last month. The National Weather Service Albuquerque Office continues to caution that the lingering impacts of the long-term drought over northern New Mexico will require significant winter precipitation and spring snowmelt runoff before they are ameliorated.

Notes:

The New Mexico drought status maps are produced monthly by the New Mexico State Drought Monitoring Committee. When near-normal conditions exist, they are updated quarterly. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 5a 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 5b refers to long-term drought, sometimes known as *hydrological* drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfalls (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, groundwater). This map is organized by river basins—the white regions are areas where no major river system is found.

On the Web:

For the most current meteorological drought status map, visit:
http://www.srh.noaa.gov/abq/feature/droughtinfo.htm

For the most current hydrological drought status map, visit:
http://www.nm.nrcs.usda.gov/snow/drought/drought.html

Figure 5a. Short-term drought map based on meteorological conditions for September 2006.

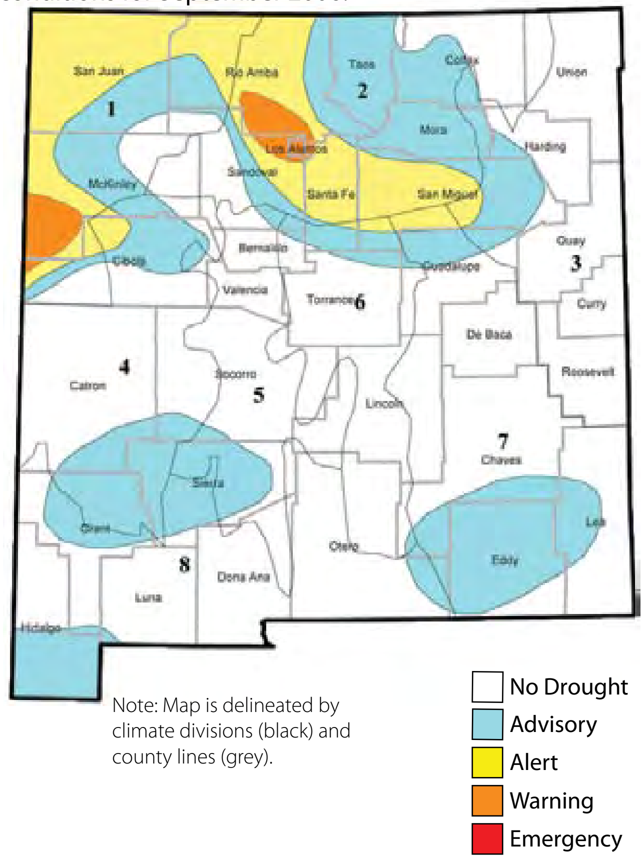
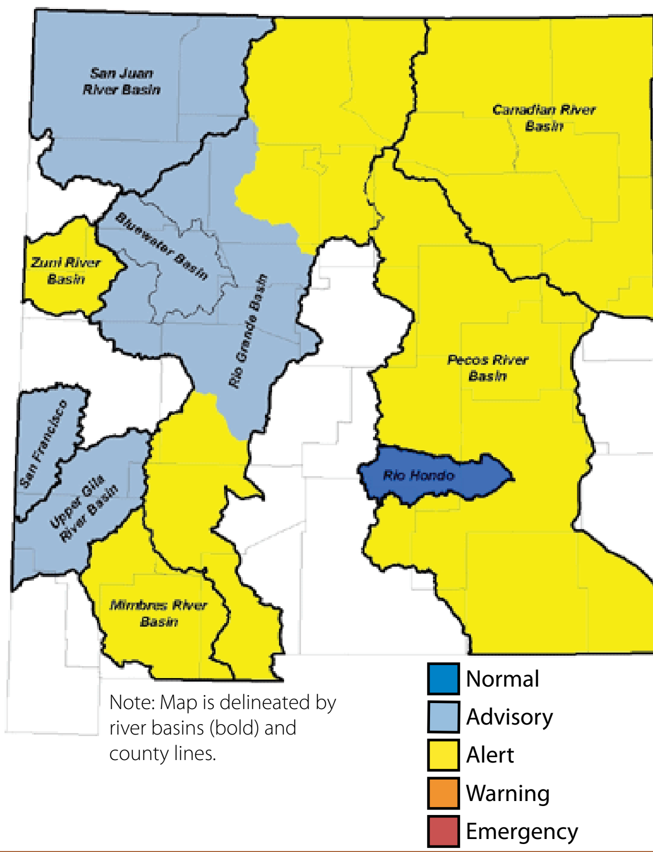


Figure 5b. Long-term drought map based on hydrological conditions for September 2006.



Arizona Reservoir Levels
(through 9/30/06)

Source: National Water and Climate Center

The total water storage in Arizona declined by less than one percent of capacity since last month (Figure 6). The total in-state storage remains at 54 percent of capacity. Storage on the Salt River fell from 68 to 66 percent, while lake levels on the Verde River system rose from 49 to 50 percent of capacity. The San Carlos Reservoir on the Gila River rose by 5 percent. Total storage on the Colorado River fell slightly, from 53.5 percent last month to 52.8 percent of capacity. The two largest reservoirs, Lake Powell and Lake Mead, declined by less than one percent each, while Lake Mohave and Lake Havasu fell by 6 percent and 4 percent, respectively. Total storage on the in-state reservoirs is lower than it was one year ago, when it stood at 66 percent of capacity after having been replenished by the abundant rain and snow received during the 2004–05 winter. Despite the depletion caused by the virtual absence of rain and snowpack during the winter of 2005–06, the total in-state water storage is currently at about 114 percent of the long-term average.

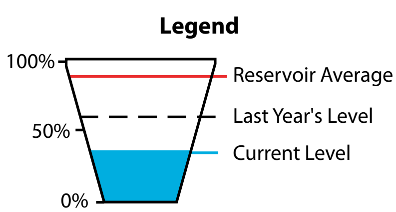
The Bureau of Reclamation, which oversees the lower Colorado River, has announced the beginning of a series of experiments designed to improve water supply from the river by reducing waste and improving efficiency on the Colorado (*Arizona Republic*, September 27). Key proposals in the plan include a test to restart the desalination plant at Yuma to remove salt from agricultural runoff, construction of a small reservoir near Yuma along the All-American Canal to temporarily store water allocated for farmers' use that can't be immediately used, and a program to pay some California farmers to leave some land unplanted, allowing the saved water to remain in Lake Mead.

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.

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. For additional information, contact Tom Pagano at the National Water Climate Center (tom.pagano@por.usda.gov; 503-414-3010) or Larry Martinez, Natural Resource Conservation Service, 3003 N. Central Ave, Suite 800, Phoenix, Arizona 85012-2945; 602-280-8841; Larry.Martinez@az.usda.gov).

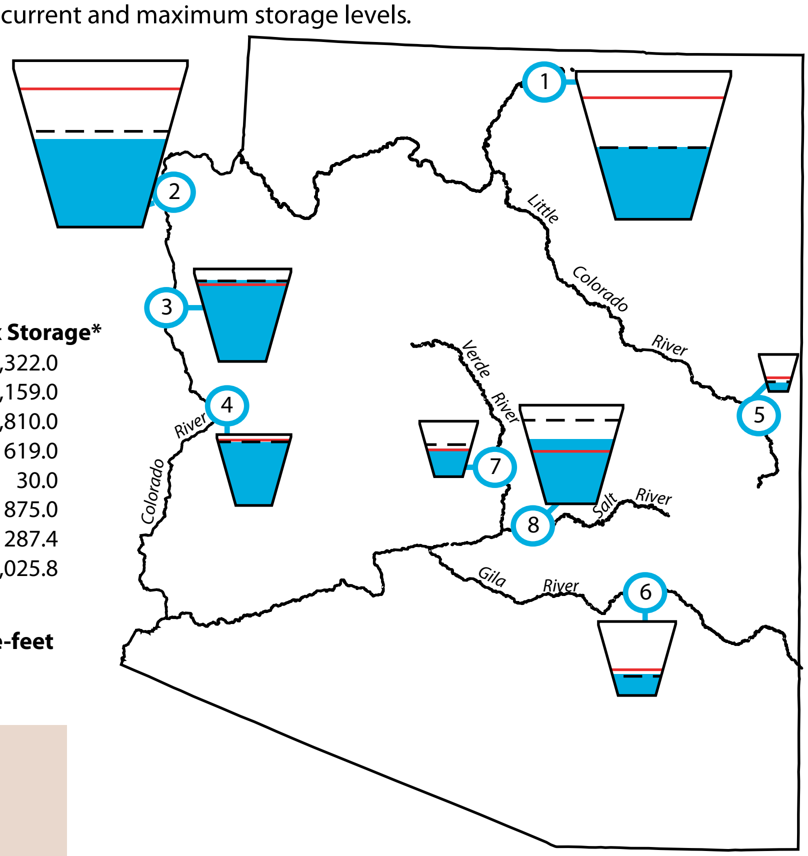
Figure 6. Arizona reservoir levels for September 2006 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table also lists current and maximum storage levels.



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

Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Lake Powell	49%	11,917.0	24,322.0
2. Lake Mead	53%	13,887.0	26,159.0
3. Lake Mohave	88%	1,584.4	1,810.0
4. Lake Havasu	90%	555.0	619.0
5. Lyman Reservoir	24%	7.3	30.0
6. San Carlos	29%	252.5	875.0
7. Verde River System	50%	144.2	287.4
8. Salt River System	66%	1,343.7	2,025.8

*** 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 9/30/06)

Source: National Water and Climate Center

Total reservoir storage in New Mexico remained steady at 37 percent of capacity since last month. Changes on individual reservoirs varied around the state, with some gaining and some declining (Figure 6). The largest losses were on Costilla and Caballo Reservoirs on the Rio Grande, which fell by 7 and 5 percent of capacity, respectively, and at Lake Avalon on the Pecos, which declined 28 to 22 percent. Other reservoirs on the Pecos gained, with the largest one, Santa Rosa Reservoir, rising by 4 percent. Elephant Butte Reservoir on the Rio Grande, the largest in the state, rose by 1 percent, while Navajo Reservoir on the San Juan remained steady at 84 percent of capacity. Summer rainfall benefited reservoir storage in New Mexico, but the total storage around the state has declined by about 2 percent from the level one year ago, due to the nearly complete lack of winter rain and snowpack during the 2006 water year. Total reservoir storage in New Mexico is at about 70 percent of the long-term average, as a result of the ongoing multi-year drought in the Southwest.

Scientists met in Colorado last month at a meeting sponsored by the Geological Society of America to discuss problems related to drought and water scarcity in the U.S. (*Arizona Republic*, September 30). The presentations at the meeting carried a strong theme of change, focusing on warming temperatures, declining snowpack conditions, and increasing demands on already stressed water resources by an ever-increasing population. The focus of the meeting was "identifying successful strategies for drought and water scarcity management, and on developing a clear and decisive action plan." A scientist from Australia urged Americans to treat drought as the norm rather than as an emergency.

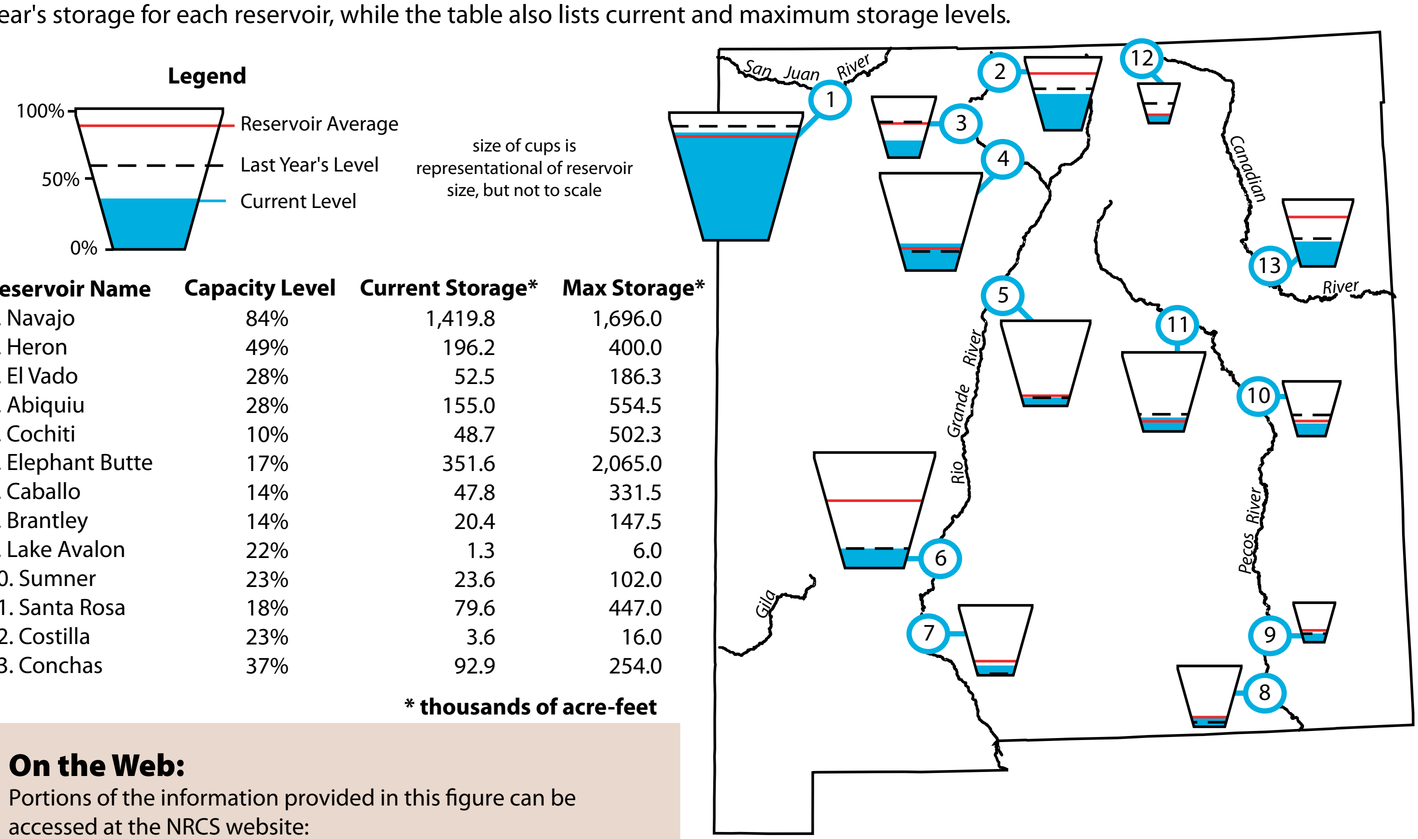
Notes:

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.

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. For additional information, contact Tom Pagano at the National Water Climate Center (tom.pagano@por.usda.gov; 503-414-3010) or Dan Murray, NRCS, USDA, 6200 Jefferson NE, Albuquerque, NM 87109; 505-761-4436; Dan.Murray@nm.usda.gov).

Figure 7. New Mexico reservoir levels for September 2006 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table also lists current and maximum storage levels.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Navajo	84%	1,419.8	1,696.0
2. Heron	49%	196.2	400.0
3. El Vado	28%	52.5	186.3
4. Abiquiu	28%	155.0	554.5
5. Cochiti	10%	48.7	502.3
6. Elephant Butte	17%	351.6	2,065.0
7. Caballo	14%	47.8	331.5
8. Brantley	14%	20.4	147.5
9. Lake Avalon	22%	1.3	6.0
10. Sumner	23%	23.6	102.0
11. Santa Rosa	18%	79.6	447.0
12. Costilla	23%	3.6	16.0
13. Conchas	37%	92.9	254.0

*** 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

Temperature Outlook
(November 2006–April 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC temperature outlook calls for increased chances of above-average temperatures for the Southwest through February 2007, and for the northern part of the region through April (Figures 8a–d). The outlook for November–January is for warmer-than-average temperatures for most of the West and the Midwest into parts of the Northeast. The area with the highest probabilities for warmer-than-average temperatures (greater than 50 percent) is in the northern Great Plains centered over the Dakotas and western Nebraska, with the anomaly shifting farther to the east through March and April. The outlook also calls for near-normal temperatures in a band along the Gulf Coast states from far eastern Texas to southern South Carolina, and including most of the Florida peninsula.

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 8a. Long-lead national temperature forecast for November 2006–January 2007.

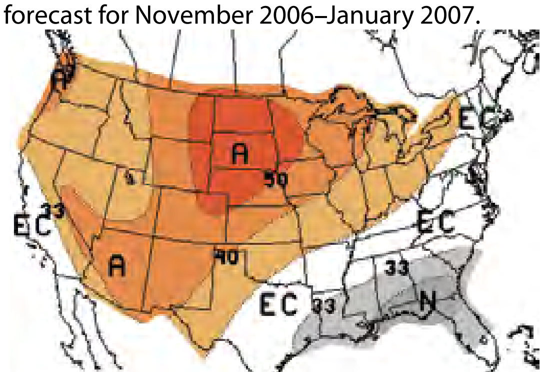


Figure 8b. Long-lead national temperature forecast for December 2006–February 2007.

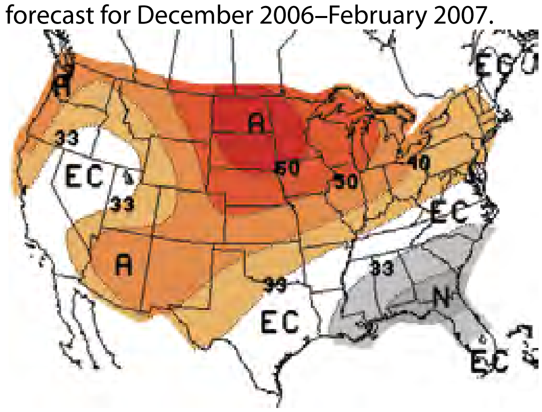


Figure 8c. Long-lead national temperature forecast for January–March 2007.

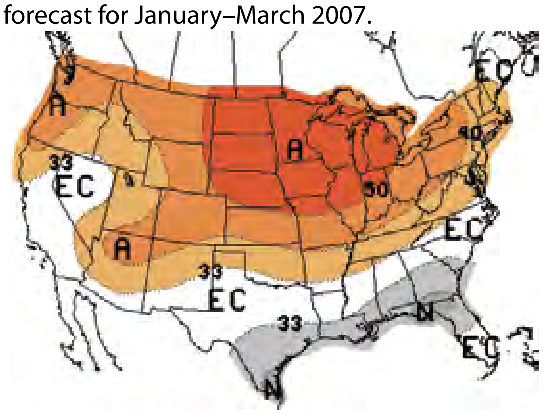
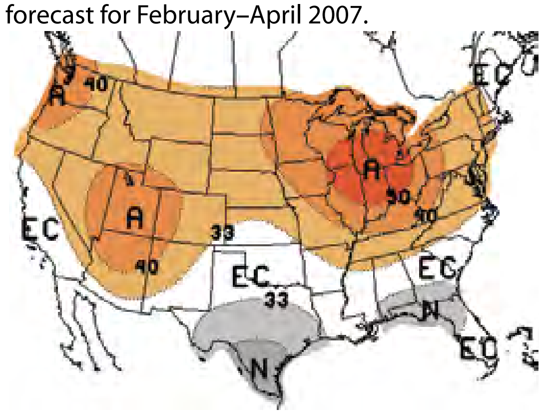


Figure 8d. Long-lead national temperature forecast for February–April 2007.



N= Near Normal
- 33.3–39.9%
- 40.0–49.9%

A= Above
- 60.0–69.9%
- 50.0–59.9%
- 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

(November 2006–April 2007)

Source: NOAA Climate Prediction Center (CPC)

Long-lead precipitation outlooks from the NOAA-CPC call for increased chances of above-average precipitation in southern New Mexico and southeastern Arizona during November–January, and for wetter-than-average conditions to extend westward and northward during the winter and spring to include the entire Southwest during January–April (Figure 9a–d). The area of greatest probability of above-average precipitation (greater than 40 percent) is expected to be along the Mexican border, gradually moving from southern Texas in the fall towards the West to include much of southern New Mexico and southern Arizona during the winter and spring. Wetter-than-average conditions are also expected to prevail in Florida and parts of the Southeast through early spring. Below-average precipitation is expected in the Pacific Northwest and parts of the Midwest and Southeast during November–April.

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 9a. Long-lead national precipitation forecast for November 2006–January 2007.

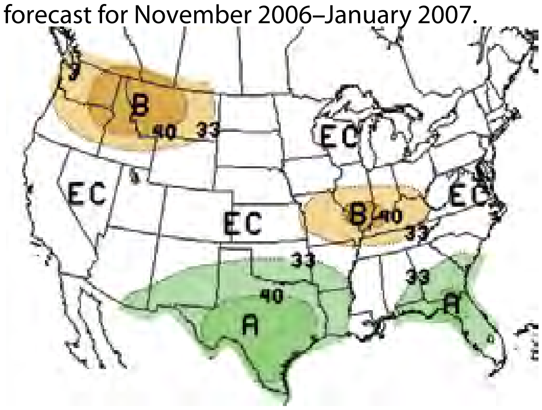


Figure 9b. Long-lead national precipitation forecast for December 2006–February 2007.

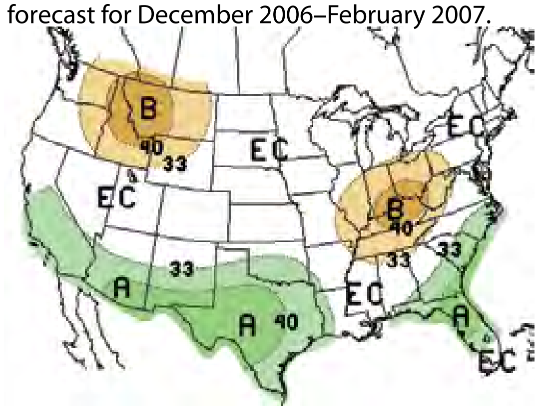


Figure 9c. Long-lead national precipitation forecast for January–March 2007.

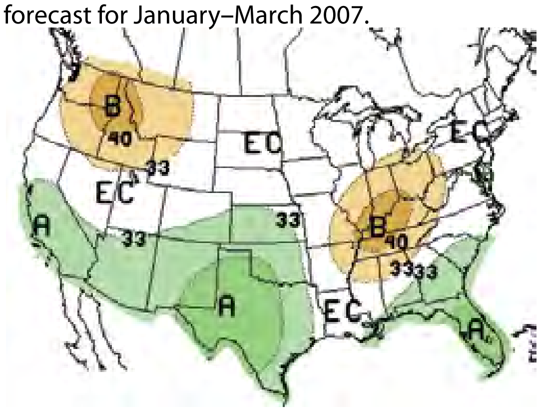
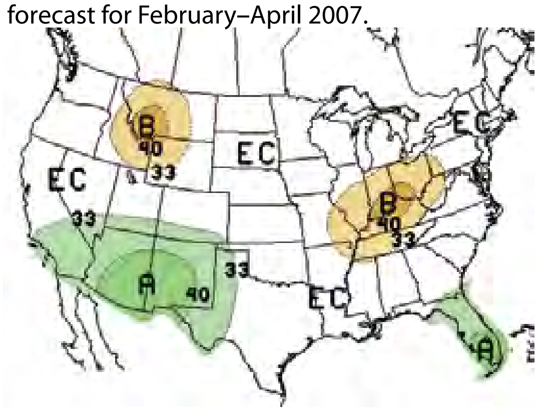


Figure 9d. Long-lead national precipitation forecast for February–April 2007.



A= Above: 40.0–49.9%, 33.3–39.9%

B= Below: 33.3–39.9%, 40.0–49.9%

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 January 2007)

Source: NOAA Climate Prediction Center (CPC)

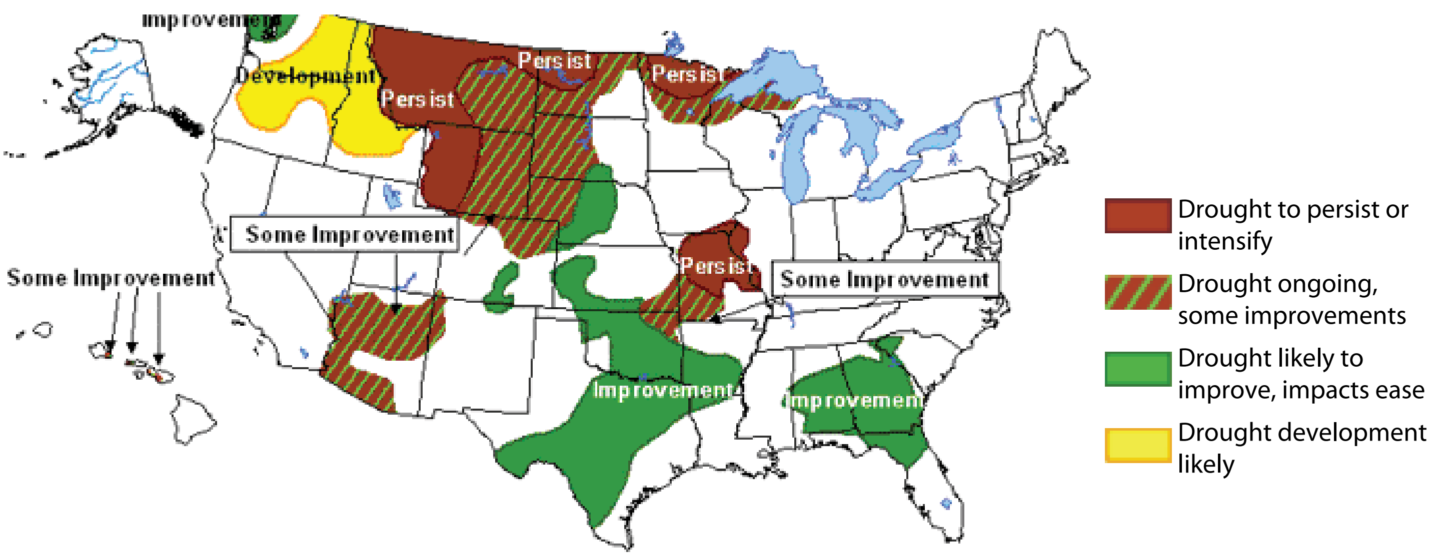
The U.S. drought outlook through January 2007 calls for drought conditions to show some improvement from far northwestern New Mexico across most of northern Arizona, southward along the western border of Arizona, and eastward along much of the Mexican border in Arizona (Figure 10).

The intensifying El Niño should help bring above-average moisture to the southern tier of the United States this winter, and drought conditions are expected to improve in the Southeast and in the southern Plains where drought has been persistent. Drought improvement also is expected in central and eastern Texas into Oklahoma, northern Louisiana, and southern Arkansas, and in southern and western Kansas, south-central Colorado, and central Nebraska. At least some improvement should occur in the drought areas in the central and northern Plains and upper Midwest, including parts of northeastern Colorado, eastern Wyoming and western Nebraska, western South Dakota, southeastern Montana, and much of North Dakota eastward through parts of Minnesota into northern Wisconsin and the upper Michigan peninsula. Drought is likely to persist with only minimal improvement in northern Minnesota, and is expected to persist in a band extending from western Wyoming through western and central Montana, and eastward along the Canadian border in northeastern Montana into northwestern North Dakota. Some drought improvement can be expected in southwestern Missouri and adjacent parts of Oklahoma and Kansas, but drought in northern and central Missouri is likely to continue. In the Northwest, where the winter precipitation outlook is for below-average rain and snow, drought is likely to develop in Idaho, northern Oregon, and southern and eastern Washington State. In northwestern Washington, the typical heavy autumn and early winter precipitation should bring drought improvement to that area, despite the outlook for less-than-average precipitation amounts.

Notes:

The delineated areas in the Seasonal Drought Outlook (Figure 10) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 10. Seasonal drought outlook through January 2007 (release date October 19, 2006).



On the Web:

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

El Niño Status and Forecast

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

El Niño conditions have persisted in the tropical Pacific Ocean this fall and are expected to continue into spring 2007. Positive equatorial sea surface temperature (SST) anomalies greater than 1 degree Fahrenheit have been observed in most of the equatorial Pacific since early September, with departures exceeding 2 degrees F in the central Pacific. The latest SST departures in all of the Niño regions are currently greater than 1 degree F.

In September the Southern Oscillation Index (SOI) was negative for the fifth consecutive month, with the three–month running mean now at –1.0 for the second month in a row (Figure 11a). According to CPC, these collective oceanic and atmospheric anomalies are consistent with the early stages of warm-episode (El Niño) conditions in the tropical Pacific. Over the past several months most of the other ENSO model forecasts (not shown) have trended toward warmer conditions in the tropical Pacific and are favoring El Niño conditions through the winter into spring 2007.

The probabilistic forecast issued by the IRI is in agreement, predicting an approximately 80 percent chance of El Niño conditions through February 2007, followed by a gradual return to ENSO-neutral conditions late in the spring or early in the summer (Figure 11b). According to the CPC, typical El Niño effects are likely to develop over North America during the upcoming winter season, including warmer-than-average conditions over western and central Canada and over the northern and western United States; wetter-than-average conditions in the southern tier of states including the Southwest and parts of the U.S. Gulf Coast and Florida; and drier-than-average conditions in the Ohio Valley and the Pacific Northwest.

Notes:

Figure 11a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through September 2006. 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 11b shows the International Research Institute for Climate Prediction (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.

Figure 11a. The standardized values of the Southern Oscillation Index from January 1980–September 2006. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).

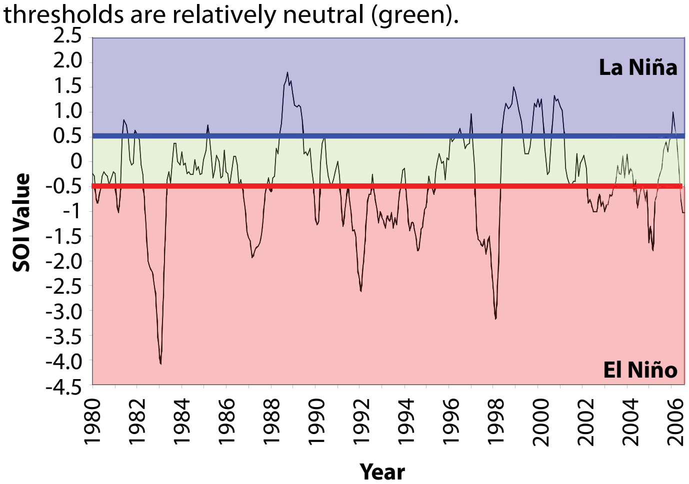
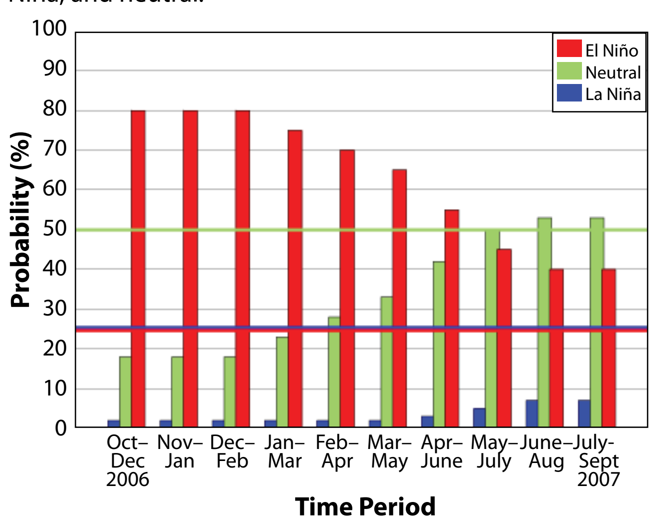


Figure 11b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released October 19, 2006). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



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/

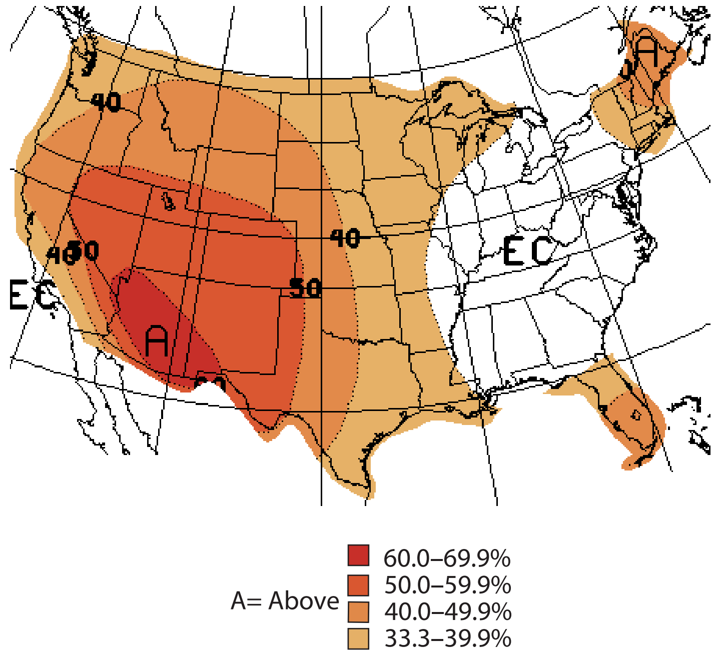
Temperature Verification

(July–September 2006)

Source: NOAA Climate Prediction Center (CPC)

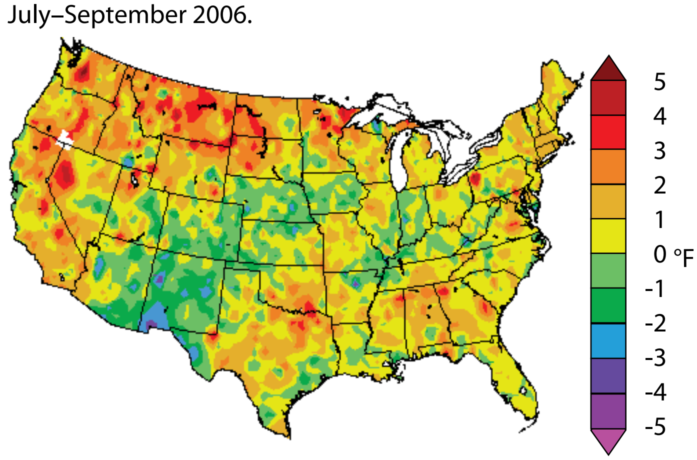
The long-range outlook for July–September 2006 from the NOAA-CPC predicted above-average temperatures in the western and central United States, and in Florida and New England (Figure 12a). The anomaly in the West extended from most of the West Coast eastward to Louisiana and northeastward to the Upper Midwest. The area of highest probability (greater than 60 percent) extended from southwestern New Mexico across most of Arizona into far southeastern Nevada. Observed temperatures agreed fairly well with the forecast in that they were warmer than average across most of the nation, particularly in the Northwest and North (Figure 12b). Most of the Southwest was cooler than average, but the highest probabilities for warmer-than-average had been forecast. The observed cool anomaly extended from the Mexican border region of West Texas, New Mexico, and central Arizona northeastward across the central Great Plains and into the Ohio Valley. The forecast performed generally well in predicting warmer-than-average temperatures in Florida and New England, but was only partly successful in the West.

Figure 12a. Long-lead U.S. temperature forecast for July–September 2006 (issued June 2006).



EC= Equal chances. No forecasted anomalies.

Figure 12b. Average temperature departure (in degrees F) for July–September 2006.



Notes:

Figure 12a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months July–September 2006. This forecast was made in June 2006.

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 12b shows the observed departure of temperature (degrees F) from the average for the July–September 2006 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

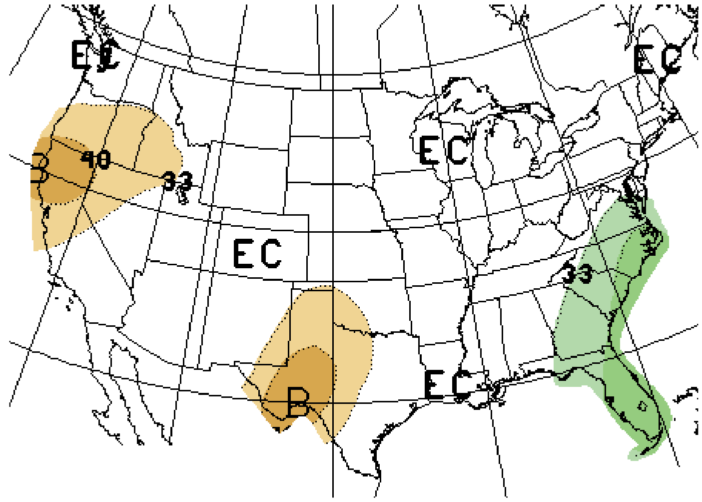
Precipitation Verification

(July–September 2006)

Source: NOAA Climate Prediction Center (CPC)

The long-range outlook from the NOAA-CPC for July–September 2006 called for drier-than-average conditions in western Texas and adjacent parts of southeastern New Mexico and southwestern Oklahoma, with the highest probability (greater than 60 percent) in western Texas (Figure 13a). Below-average precipitation was also indicated in northern California and Oregon, and in adjacent parts of Nevada and Idaho, while above-average precipitation was called for from Florida along the southern Atlantic Seaboard to Virginia. Elsewhere in the country the outlook was for equal chances of below-average, average, or above-average precipitation. Observed precipitation matched the outlook fairly well in western Texas, where precipitation was generally below average, although some areas in the western part of the forecast anomaly were wetter than average (Figure 13b). The outlook did very well in the Northwest, with below-average precipitation occurring throughout the far West. Results were not as successful in the Southeast, where some areas matched the above-average prediction, but most areas were drier than average.

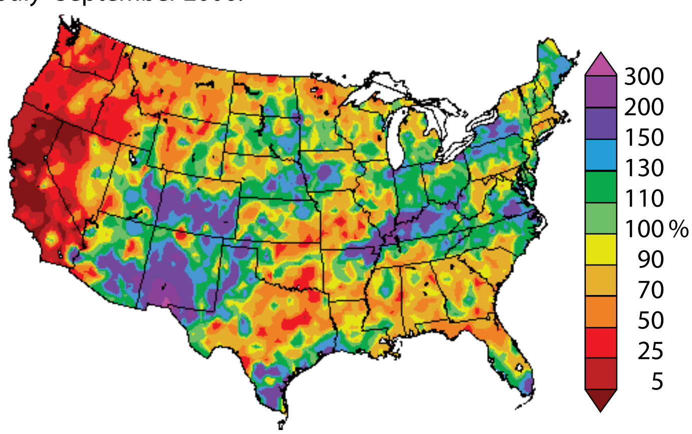
Figure 13a. Long-lead U.S. precipitation forecast for July–September 2006 (issued June 2006).



B= Below: 40.0–49.9%, 33.3–39.9%
A= Above: 40.0–49.9%, 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

Figure 13b. Percent of average precipitation observed from July–September 2006.



Notes:

Figure 13a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months July–September 2006. This forecast was made in June 2006.

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 13b shows the observed percent of average precipitation for July–September 2006. 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.

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