Issued: April 26, 2006

Southwest Climate Outlook

The University of Arizona.

Source: U.S. Fish and Wildlife Service

Photo Description: Desert Mallow (*Sphaeralcea ambigua*) is a species of flowering plant found in many habitats in the southwestern United States and other areas of North America. It has been known to grow as high as five feet tall, but is typically one to two feet tall. Desert Mallow is extremely drought resistant. Its growing season is from March to June. It is often called "Hierba Muy Mala" in Spanish, because it is highly allergenic. There are more than10 different species of *Sphaeralcea* in the Southwest with varying flower color and leaf shape.

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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AZ Drought

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Short-term drought conditions are extreme throughout most of the state, except for a narrow strip along the western and northern borders, where severe drought exists. Some precipitation received from storms in March and early April helped ease the short-term moisture deficits...

Fire Summary

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The Southwest Coordination Center (SWCC) reports that 925 fires—nearly all of them caused by humans—have burned 250,726 acres of land so far this year in Arizona and New Mexico (Figure 9a). This is nearly three times the average number of fires by the end of April...

Fire Outlook

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A dry winter in the Southwest has increased the risk of wildfires this spring and summer. The outlook issued by the National Interagency Coordination Center (NICC) for April shows above-average fire potential for southeast Arizona and parts of New Mexico...

April Climate Summary

Drought – Most of the Southwest remains in severe or extreme drought due to the long-term precipitation deficits.

- Drought conditions are expected to persist throughout most of the Southwest. Some improvement is expected in western New Mexico and southern and eastern Arizona.
- The extremely low snowpack in most of the basins in Arizona and New Mexico has led to a streamflow forecast of well below average for 2006.
- Reservoir conditions are improved from last year, but the large Colorado River reservoirs and important New Mexico reservoirs remain below average.

Fire Danger – The long-term moisture deficits and the abundant fine dry fuels point to a very active fire season from grassland into higher elevation timber.

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

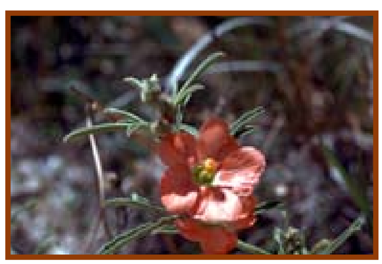
Precipitation – Almost all of the Southwest has been drier than average since the start of the water year, despite some rain and snow in March and April.

Climate Forecasts – Experts predict increased chances of warmer-than-average temperatures through September and equal chances of precipitation through June.

El Niño – Ongoing La Niña conditions are expected to continue over the next one to three months.

The Bottom Line – Drought is likely to persist over most of the Southwest. Hydrological drought continues to affect streamflow and some large reservoir levels, and agricultural drought conditions have persisted throughout the region.

We need your photos!



The Desert Mallow is kicking off our new cover design, but now we need your photos. If you would like to have your favorite image of a wild fire, low water levels at Lake Heron, snow on top of Mt. Lemmon, waterflow in a wash, or some other depiction of climate in the Southwest featured on our cover, please send an email to knelson7@email.arizona.edu for consideration. In your email be sure to state that you would like your photo used in the *Southwest Climate Outlook*, include a detailed caption, and attach your high resolution digital image. Your photo must have been shot in the southwestern United States and should depict some aspect of Southwest climate. Please send no more than one original image per month. Compensation will not be offered for submitted photos, but the photographer's name will be credited.

Send your photo to knelson7@email.arizona.edu...

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This work is published by the Climate Assessment for the Southwest (CLIMAS) project and the University of Arizona Cooperative Extension; and is funded by CLIMAS, Institute for the Study of Planet Earth, and the Technology and Research Initiative Fund of the University of Arizona Water Sustainability Program through the SAHRA NSF Science and Technology Center at the University of Arizona.

Rising temperatures bump up risk of wildfires

Global warming adds firefighting challenges in both forest and desert

by Melanie Lenart

The Grand One looks doomed. The world's largest recorded saguaro, it stood its ground on a hillside near Phoenix while last year's Cave Creek Complex fire raced through on knee-high grasses and, worse, lingered in nearby shrubs. Now yellow lines radiate up several of its roughly dozen arms as the magnitude of the event sinks in (Figure 1).

It may soon join the list of casualties from wildfire—a list expected to grow longer with the days of summer as the southwestern climate continues to warm. The input of greenhouse gases mainly from burning oil, coal, and gas has temperatures on the upswing around the globe, including the southwestern United States.

The ancient saguaro looks worse than it did even a few months before, range and watershed specialist Carol Engle said on a day in late March. Now she has doubts about whether it will pull through, as she and many others had been hoping. She pointed out splits where insects could penetrate its massive trunk, larger than a refrigerator at the base. Between the trunk and an arm, bubbles of black char look like a belated attempt to form protective bark. Or, to use Engle's analogy, like a marshmallow that's toasted for too long.

Singed during a record Arizona fire year that burned more than 700,000 acres in 2005, The Grand One could serve as a poster illustration about how wildfires could worsen with global warming and related changes. 2005 nearly tied 1998's record for world's warmest year since instrumental records became relatively reliable in the late nineteenth century. While the fire raged, Phoenix set its own record lows for humidity and highs for temperatures.

When it's hot

Climbing temperatures are expected to bring more raging infernos, in desert, grasslands, and forests alike—and the homes constructed among them. The 47,000 acre forest fire around Los Alamos, New Mexico ruined about 260 homes and required the evacuation of about 20,000 people in 2000. The 468,000 acre Rodeo-Chediski forest fire in northern Arizona destroyed about 400 homes and forced 30,000 people to evacuate in 2002.

In both cases, high temperature extremes in the three months leading up to the fire ranked right up there with low precipitation extremes (Table 1).

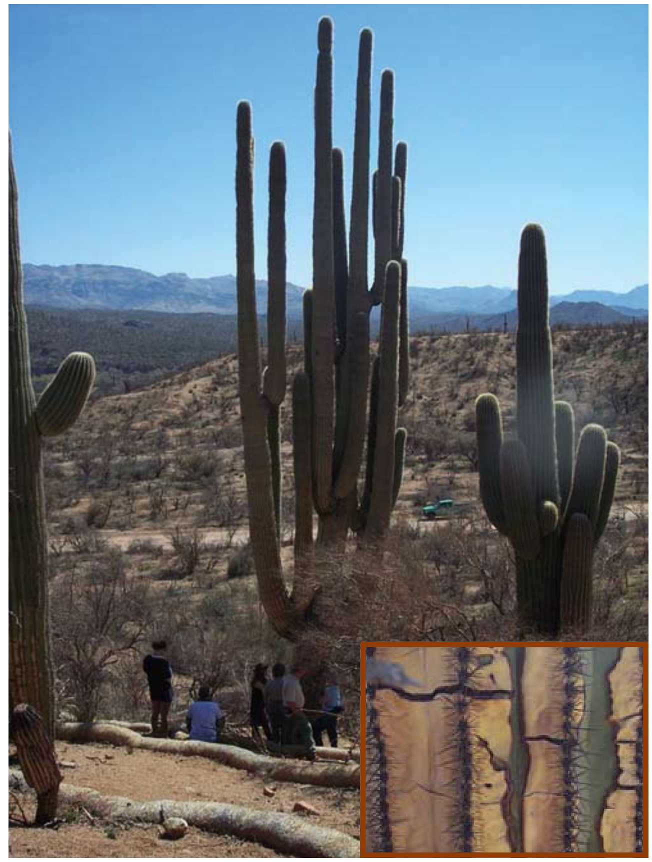

Figure 1. The world's largest recorded saguaro was damaged last year during a fire near Phoenix, Arizona. The lower righthand inset shows a close up of the fire damage. Source: Stephanie Doster, Institute for the Study of Planet Earth

Firefighters managed to shield homes in the Scottsdale area of Phoenix from the 248,000 acre Cave Creek Complex fire, which torched about two-thirds of the 50,000 acres of Sonoran Desert that burned in 2005. This important ecosystem features the saguaro cactuses (*Carnegiea giganetea*) exclusive to the southwestern United States and northern Mexico.

Some researchers suspect warming temperatures and an early spring are aiding and abetting the invasive grasses that helped carry last year's fires into saguaro territory (*Southwest Climate Outlook*, April 2005). Although native grasses and wildflowers can also carry fire following rainy winters, their clumpy, uneven cover proves less efficient at carrying fire than an even, continuous cover of monocultural grasses.

After wet winters like 2005, even normal southwestern temperatures in May and June soon convert invasive and native grasses alike into what firefighters call "fine fuels"—dried-out stalks that feed a surface fire.

Tonto National Forest fire manager Gary Daniel provided an example of how temperatures affect fine fuels, referring to his work on prescribed burns. If grasses remain moist after the cool of evening, he and his crew had an easy solution: "We just let the sun beat on it a little more, let the ambient air temperature dry out, and we're ready," Daniel recalled. "An hour in full sunlight would have a tendency to dry that grass out."

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Wildfire risk, continued

Forest drying

In the forest, it takes about 40 hot, dry days (roughly a thousand hours) to convert fallen branches on the forest floor into flammable material that will magnify a fire's heat—perhaps enough to ignite live saplings. These saplings, in turn, can become ladders to lift the flames into the crowns of established trees. Branches and logs from three to six inches in diameter are the "thousand-hour fuels" that firefighters worry about when gauging forest fire danger and evaluating whether a surface fire might transform into a crown fire.

Woody materials are likely to remain dry longer as the climate warms, Timothy Brown of the Desert Research Institute in Nevada and colleagues projected, based on the expected impact of warmer temperatures and their influence on relative humidity (*Climatic Change*, January 2004). Their modeling experiment focused on forests, comparing conditions for two decades through 1996 to those projected for two decades through 2089 using a global warming scenario.

"The key thing was an increase in the number of days of high fire danger," Brown said. "We basically found throughout the West that the number of days increased by about two to three weeks."

In another analysis, of 11 western states, New Mexico and Arizona were among the most sensitive to temperature effects on the annual "area-burned"—the amount of land crossed by fire in a given year. U.S. Forest Service researcher Donald McKenzie and colleagues found higher temperatures led to a "sharp increase" in area-burned in the historical record, using data for the years 1916 through 2002 (*Conservation Biology*, August 2004). New Mexico's annual area-burned fluctuates with spring temperatures in particular, the analysis by McKenzie and colleagues showed.

Similarly, research by The University of Arizona's Michael Crimmins and Andrew Comrie found low-elevation fires in southern Arizona increased during warm springs when they followed wet winters (*International Journal of Wildland Fire*, 2004).

The results fit the pattern for the Southwest fire season to start during the dry days of May and June and end within weeks of the summer's monsoon season arrival, usually in July. It also sparks concern for those anticipating the continuation of global warming, as spring temperatures in New Mexico and Arizona are rising as are temperatures in other seasons (Figure 2).

It's the heat *and* humidity

Temperature has an established link with fire danger on several fronts. Fires light more readily when the sun is beating down and raising daily temperatures. Lightning bolts fly more often with higher temperatures, too, providing more opportunities for fire ignitions. And fires can spin out of control more easily when overlying air is warm, especially in the absence of cool nights that help the fire to "lay down."

Fire event	Temperature rank (highest)	Precipitation rank (lowest)	State
Los Alamos (2000)	2	1	New Mexico
Rodeo-Chediski (2002)	4	3	Arizona
Hayman (2002)	12	2	Colorado
Biscuit (2002)	17	15	Oregon

Table 1. While seasonal precipitation tended to rank among the lowest during three months leading up to major western fires, temperatures tended to rank among the highest. Climate records go back to 1895. Source: Data from Western Regional Climate Center.

Some of these factors combined in 2005 in the Phoenix-area Cave Creek Complex fire, the union of several lightning-started fires. Local daytime temperatures in the "hundred and teens" and relative humidity levels that dipped as low as 2 percent turned the grass-invaded desert into a sea of flames, reported Jeff Whitney, a natural resource manager who helped battle the blaze. Even at night, relative humidity only rose to about 9 percent, well within the 20 percent range that firefighters peg as dangerous.

"We've usually got a better opportunity to work on suppressing the fire at night," Whitney said. "But we didn't have those conditions during the Cave Creek Complex—it burned through the night."

Air temperature wields an important effect on relative humidity. Hot air can hold more moisture than cool air, which is partly why higher daytime temperatures are linked to higher evaporation rates. Conversely, when air cools during the night, its relative humidity increases, sometimes to the point of saturation. If the air drops down to the "dewpoint temperature" some of the moisture it contains will condense into dew, fog, or some other form of precipitation.

Whether moisture condenses or not, higher relative humidity levels reduce fire danger, Daniel noted.

"In the evening, temperatures will go down and the humidity levels will start to increase again. We call it a recovery. If we have not much of a recovery at all at night, we can have active burning during the night and this can also make it worse the next day," he said.

Both global warming and the urban heat island effect tend to boost nighttime temperatures more than daytime temperatures. That's because greenhouse

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Wildfire risk, continued

gases and concrete both absorb solar radiation. After a long day of solar heating, they release some of the energy they've collected as infrared radiation—i.e., heat. This is most noticeable at night, once the sun's direct rays are out of the picture.

Hot air

Warm air tends to be more "unstable" than cool air in a meteorological sense, too, explained Charles Maxwell, fire weather program manager for the Southwest Coordination Center.

"If you have warmer surface temperatures, the atmosphere is more unstable. That's more conducive to strong convection and to blow-up fires" like the Rodeo-Chediski, Maxwell said. "Instead of having a fire driven by the wind and environment, the fire becomes a lot more powerful and controls the environment and dictates the weather. It's very similar to a thunderstorm, the way it works," Maxwell said.

A warm surface, whether caused by a fire or a mountainside baking in the hot summer sun, will lift air parcels up into the atmosphere. A fire tends to do so faster, which adds to the instability. The ascent of these air parcels leaves a void that surrounding air quickly moves to fill. These winds further fan the flames.

As with thunderstorms, the air parcels uplifted by fires often become clouds as they rise and cool. These clouds, known as pyrocumulus, contain moisture they extracted from fuel, soil, and especially living trees, Maxwell noted.

Alex McCord, a longtime Arizona Division of Emergency Management hazards officer, elaborated on this, noting that combustion also contributes moisture by converting stored carbohydrates in trees back into carbon dioxide and water.

"Even if it's bone dry, there's moisture in the wood," McCord said. When this

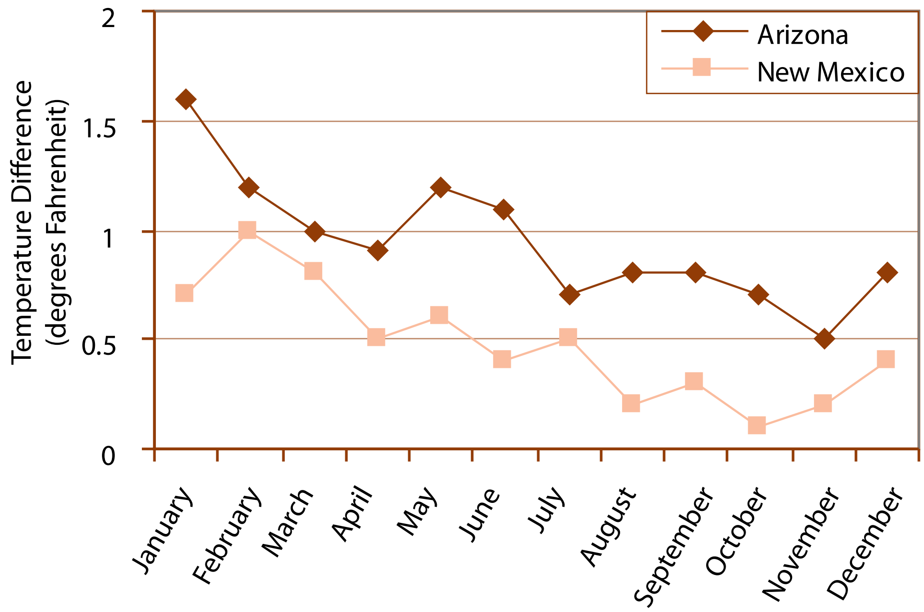

Figure 2. The graphic above shows how much hotter the average monthly temperature is during recent decades (1976-2005) compared to the entire record (1895-2005) for Arizona and New Mexico. In both states, winter and spring temperatures tend to be rising slightly faster than summer and fall temperatures for this period. Source: Western Regional Climate Center.

wood "blows up" into the clouds, it can form raindrops. "It used to be wood but now it's rain," he added.

Like the updrafts that helped form the clouds, downdrafts can accompany pyrocumulus rainfall. These sudden, erratic winds further vex firefighters by spreading flames in unpredictable directions.

Warmer air also tends to increase the incidence of lightning, which causes about 80 percent of the fire starts in the West. However, lightning strikes remain relatively unpredictable despite their importance in igniting western wildfires.

The fuel factor

Seasonally, fire danger fluctuates with the moisture condition of grasses and downed wood, respectively known as fine and heavy fuels in firefighter parlance. At longer time scales, explosive growth of saplings makes southwestern forests more prone to large-scale crown fires (*Southwest Climate Outlook*, February 2005).

"A lot of our landscapes are primed," as Whitney observed. Like many fire managers and historians, he noted that ongoing efforts to smother most blazes as upstarts means the ones that do manage to mature generally have loads of material to fuel their flames. Nationwide, only about an eighth of the acreage that would naturally burn each year typically escapes suppression efforts, according to an analysis by U.S. Forest Service researcher Ron Neilson and others.

The bark beetles and drought that killed millions of pines in recent years appear to have contributed to reducing fire risk—at least temporarily—by reducing the amount of flammable foliage in the forest. At an August 2005 water summit in Flagstaff, Northern Arizona University researcher Neil Cobb reported that the ponderosa and pinyon that had succumbed to bark beetles in 2003 and 2004 retained only about 13 percent of their needles, on average.

"If you don't have a canopy—all you have is dead sticks sitting up there—you probably decrease the risk of catastrophic crown fires," Cobb told

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Wildfire risk, continued

the group. However, once the beetle-killed trees start falling to the ground, their wood will join the thousand-hour fuels that can potentially ignite future conflagrations.

Management efforts to thin forest stands or clear out invasive grasses can reduce fire danger locally. Tree-thinning projects in forests in Arizona's White Mountains and Flagstaff reduce fire hazards in sections of pine forest. Not surprisingly, efforts focus on areas where forests border communities.

However, climate variability and change also influences fuel build-up to an extent that makes it difficult for people to reduce fire danger on the regional scale without allowing a return to the natural fire regime. Global warming is likely to increase climate variability, with larger swings from wet to dry and back again. Some project global warming will increase the magnitude of events associated with El Niño and La Niña (*Southwest Climate Outlook*, January 2006).

Records compiled from historic observations, tree rings, and charcoal deposits all indicate large climate swings boost the potential for severe fires in highland forests. Wet periods encourage abundant growth in forests—many small trees pop up to celebrate the moisture. This increases the risk of stand-level drought during dry periods that follow, with a multitude of tree stems drawing from the same pool, like too many straws in a drink.

Back in the desert

In lowland systems like grasslands and desert, wildflowers and grasses tend to flourish following above-average winter rainfall, which typically coincides with El Niño events, U.S. Geological Survey researcher Janice Bowers has found (*Southwest Climate Outlook*, September 2005). Ironically, this often increases fire danger because grasses soon dry out to become fuel loads.

Evidence indicates some invasive grasses can load conditions even more than native grasses. For instance, the invasive buffelgrass yields a longer-lasting fuel than many native grasses. Buffelgrass is sensitive to winter lows, so the warmer temperatures that come with global warming may be encouraging its spread.

Another invasive grass, red brome, appears to gain a stronger foothold based on an aspect of global warming— higher carbon dioxide levels. Rising atmospheric carbon dioxide levels account for about 60 percent of the modern warming. They also tend to boost plant growth, favoring some plants more than others.

In one experiment considering the effect of futuristic carbon dioxide levels, red brome grew 50 percent bigger and more dense on average than three native grasses found in the Sonoran Desert (*Nature*, November 2000). Atmospheric carbon dioxide levels in the experiment were roughly double the pre-industrial level of 280 parts per million, while today's levels are about one-third higher than pre-industrial levels.

An invasion of red brome helped carry fire into the desert areas torched by the Cave Creek Complex fire last year. During a March visit to a 30-degree slope that tapers down to the Verde River, the desert area touched by the fire was sprouting flowers again.

From afar, the classic Sonoran Desert landscape looked less damaged than the charred oak scrub nearby. But up close, many of the cactuses looked scarred. Past experience indicates that many of the saguaros straddling this steep slope could take another five years before they realize they're dead, researchers indicate.

Research on the effects of fires in saguaro territory remains limited, so it's unclear exactly what it would take to bring this system down. However, fire has a well-documented role in promoting grasslands over woody plants like juniper and mesquite (*Southwest Climate Outlook*, February 2006). Saguaros are also woody plants, as their ribbed remains on the desert floor indicate.

Some vegetation models of global warming effects predict grasslands will encroach upon major expanses of southwestern desert, given an increase in precipitation as well as temperature. For instance, in one climate change scenario considered by the Mapped Atmosphere-Plant-Soil System project, a rise in average temperature of 12 degree Fahrenheit with an increase of average precipitation of 22 percent in the model led to grasslands taking over deserts in most of southern Arizona and some of southern New Mexico (*Pacific Northwest Research Station Science Update*, January 2004).

The Sonoran Desert may be starting to head in that direction already, if 2005 is any indication of what warmer temperatures will bring during wet years. With help from invasive grasses, wildfires can fly across low-elevation grasslands and even deserts, as during this record-setting year in Arizona. Meanwhile, warmer temperatures during dry years can help set the high-elevation forests ablaze. Dense thickets of saplings can feed the conflagrations, as in the Rodeo-Chediski and Los Alamos fires.

Management efforts to defuse forests through thinning projects and protect deserts by weeding grasses and shrubs around saguaros can help. But unless there's a quantum leap in the number of acres treated through such efforts, southwesterners should brace themselves for longer, potentially severe fire seasons in years to come as the climate continues to warm.

Melanie Lenart is a postdoctoral research associate with the Climate Assessment for the Southwest (CLIMAS). The SWCO feature article archive can be accessed at the following link: http://www.ispe.arizona.edu/climas/forecasts/swarticles.html

Temperature (through 4/19/06)

Source: High Plains Regional Climate Center

Since the start of the water year on October 1, 2005, temperatures across most of the Southwest have been 0–4 degrees Fahrenheit above average (Figure 1a–b). Some small areas in northwestern New Mexico, east-central Arizona, and western Arizona have been cooler than average by 0–2 degrees Fahrenheit. Average temperatures have ranged from the middle to upper 60 degrees F in southwest Arizona to the low 30s in north-central New Mexico and north-central Arizona. Temperatures over the last 30 days generally have been 2–6 degrees F above average over most of New Mexico, and in eastern and southeastern Arizona. Central Arizona generally has been 0–2 degrees F above average, while most of the western side of Arizona experienced temperatures from 0–2 degrees cooler than average (Figure 1c–1d).

Figure 1a. Water year '05–'06 (through April 19, 2006) average temperature.

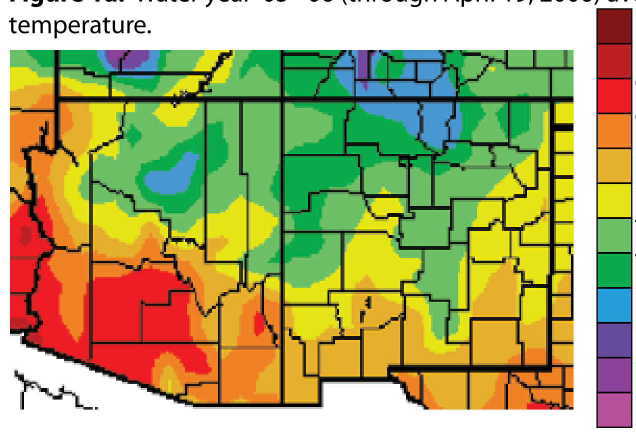


Figure 1b. Water year '05–'06 (through April 19, 2006) departure from average temperature.

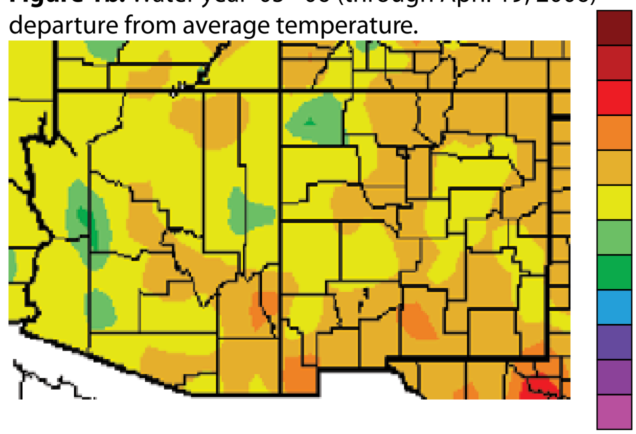


Figure 1c. Previous 30 days (March 21–April 19, 2006) departure from average temperature (interpolated).

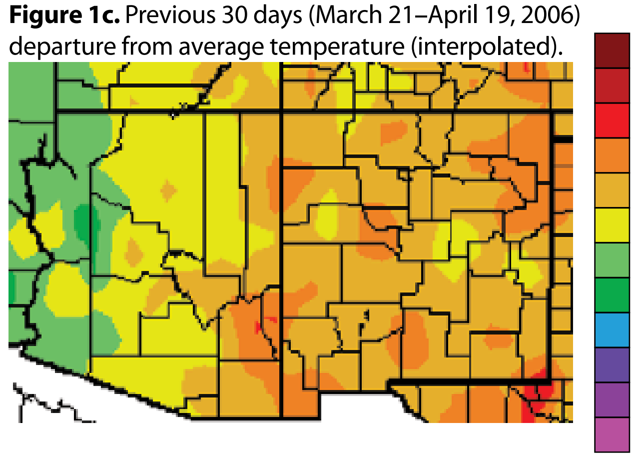
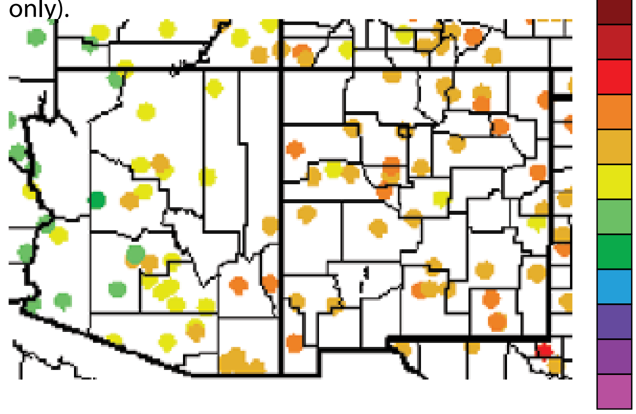


Figure 1d. Previous 30 days (March 21–April 19, 2006) departure from average temperature (data collection locations only).



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

Precipitation (through 4/19/06)

Source: High Plains Regional Climate Center

Despite the rain and snow delivered by a series of storms in March, precipitation in the Southwest remains far below average since the start of the water year on October 1, 2005 (Figures 2a–d). Precipitation has been less than 50 percent of average for most of the Southwest, and much of the area is below 25 percent of average. In some far northern and southern portions of the Southwest, precipitation has been closer to average, ranging from 50 percent of average to near-average in parts of southeastern New Mexico, some portions of northern New Mexico along the Colorado border, northwestern Arizona, and in parts of far southern Arizona. Some small areas in extreme northwestern Arizona and extreme southeastern New Mexico have received slightly above-average precipitation since the water year began. Precipitation for the last 30 days has also been below average for most of the region. About half of the Southwest has received less than 50 percent of average precipitation, particularly southern Arizona and most of New Mexico. Northwestern Arizona and part of central Arizona along the New Mexico border received well above-average precipitation with a few March storms, along with some smaller areas in northeastern Arizona, and in northwestern and south-central New Mexico.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2005 we are in the 2006 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 '05–'06 through April 19, 2006 percent of average precipitation (interpolated).

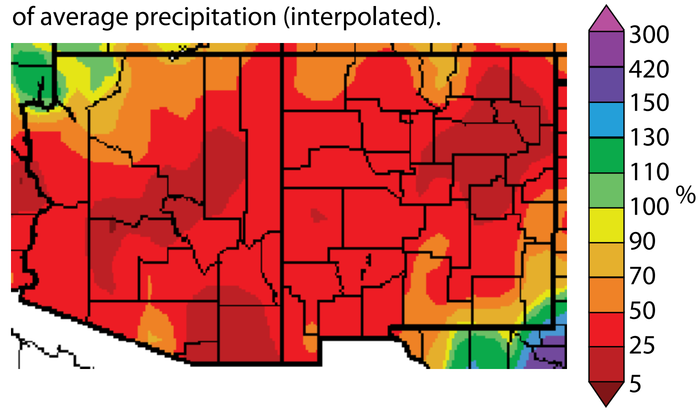


Figure 2b. Water year '05–'06 through April 19, 2006 percent of average precipitation (data collection locations only).

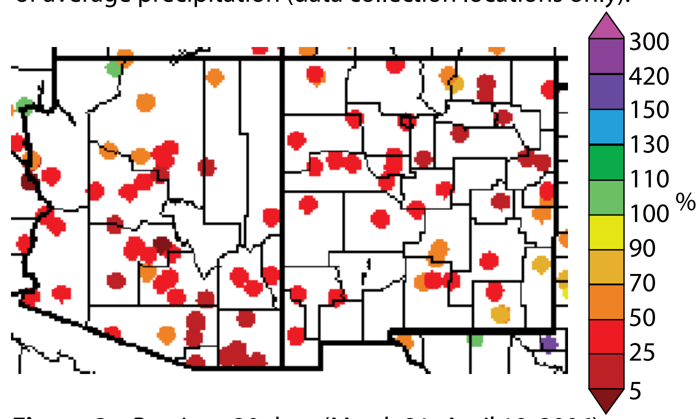


Figure 2c. Previous 30 days (March 21–April 19, 2006) percent of average precipitation (interpolated).

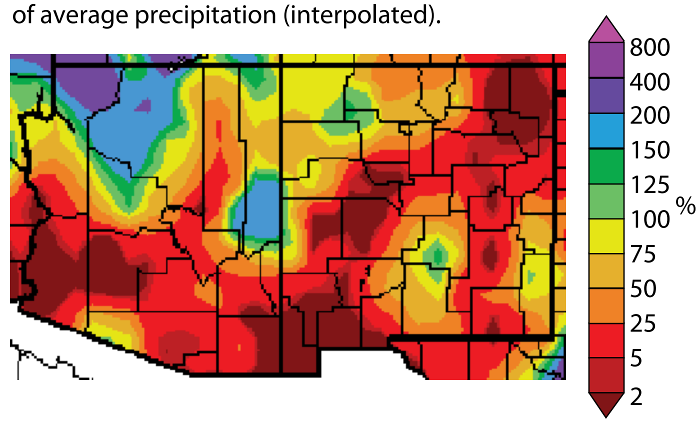
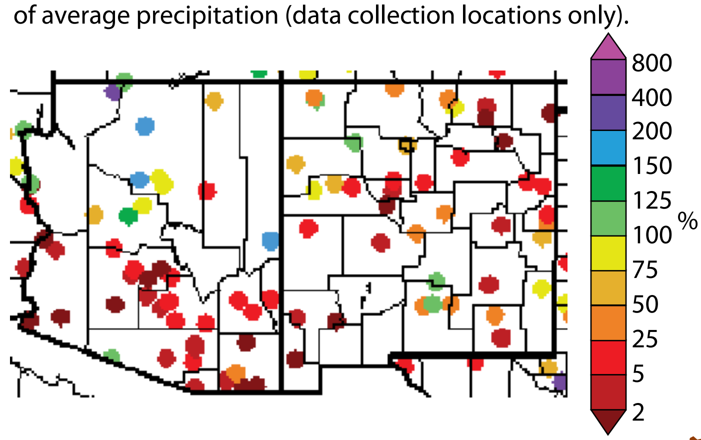


Figure 2d. Previous 30 days (March 21–April 19, 2006) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 4/20/06)

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

Drought conditions in much of the Southwest have changed only slightly since this time last month. The Southwest has experienced much below-average precipitation since the water year began on October 1, 2005. Even though some precipitation was received around the region as a few storm systems moved through, drought conditions remained generally intact due to the long-term snow and rain deficits, and the entire Southwest remains in some level of drought or abnormal dryness (Figure 3). In far southeastern New Mexico drought conditions have improved slightly from moderate drought to abnormally dry. Drought eased slightly in a small area in central Arizona from extreme drought to moderate, while moderate drought expanded in central New Mexico.

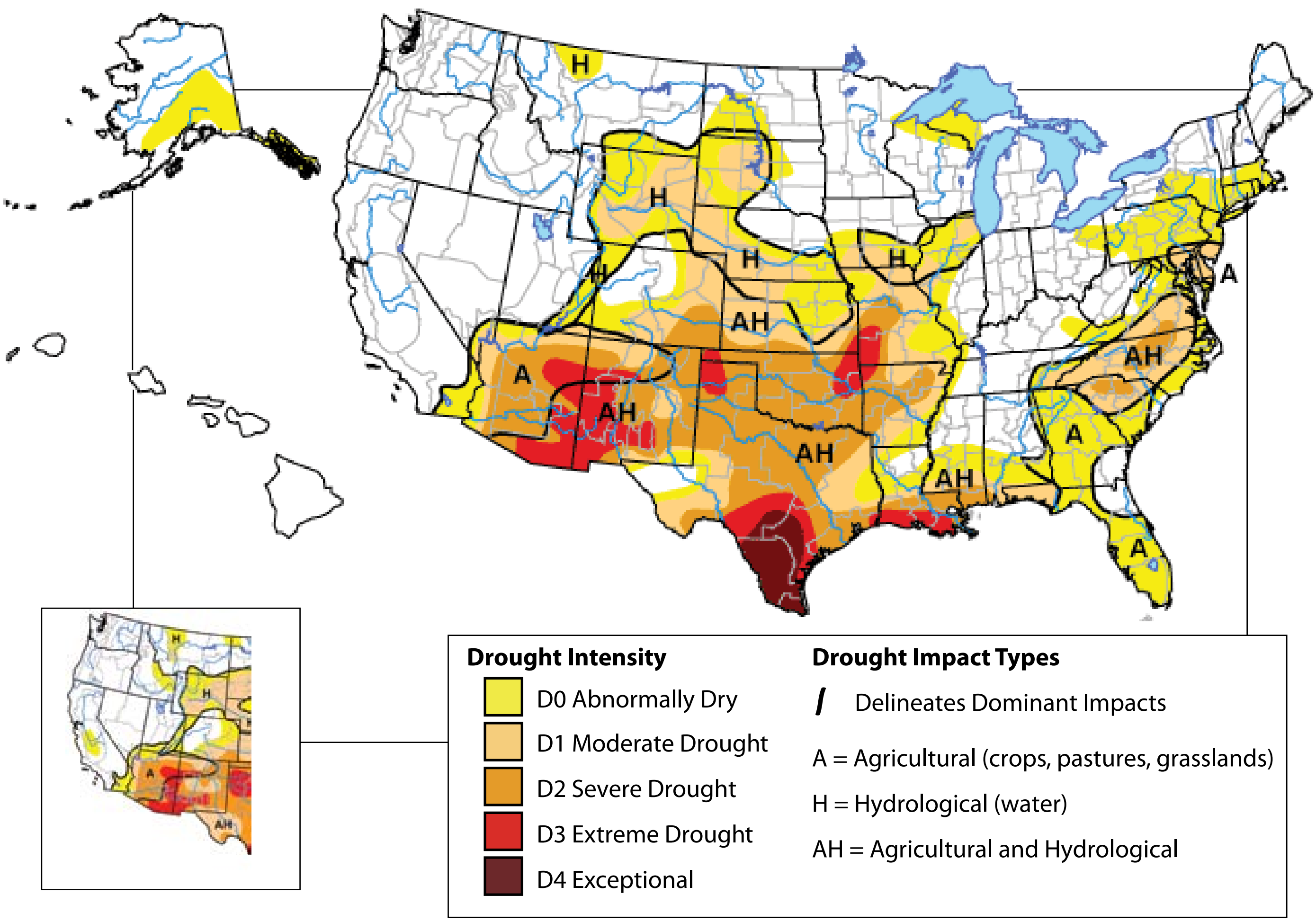
The area of extreme drought in west-central New Mexico near the Arizona border expanded eastward into central New Mexico. The entire Southwest is considered to be in agricultural drought, with impacts on crops, pastures, and grasslands. Southeastern Arizona and most of New Mexico are also being impacted by hydrologic drought, which leads to decreased river discharges and declining water levels in lakes and groundwater aquifers.

Notes:

The U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The inset (lower left) shows the western United States from the previous month's map.

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of the several agencies; the author of this monitor is Rich Tinker, CPC/NCEP/NWS/NOAA.

Figure 3. Drought Monitor released April 20, 2006 (full size) and March 16, 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 3/16/06)

Source: Arizona Department of Water Resources

Short-term drought conditions are extreme throughout most of the state, except for a narrow strip along the western and northern borders, where severe drought exists (Figure 4a). Some precipitation received from storms in March and early April helped ease the short-term moisture deficits in the north, but rainfall over the last 30 days has been below average for most of the rest of the state.

Since the start of the water year on October 1, 2005, precipitation has been well below average over almost all of the state, except for some small areas in the extreme northwest corner. The long-term drought picture for Arizona indicates that virtually all of the state is in some level of drought or abnormal dryness, except for some areas in the southwestern parts of the state in Yuma and La Paz Counties near the Colorado River (Figure 4b). Abnormally dry conditions exist in most of the western half of the state, and all along the northern border with Utah. Most of the eastern half of the state is in severe long-term drought status, while the Santa Cruz River Basin in southern Arizona is in extreme drought. The Verde River basin in central Arizona is in moderate long-term drought status, along with Whitewater Draw in far southeastern Arizona. The long-term drought situation is mitigated somewhat in central Arizona by the large reservoirs replenished by the abundant rain and snow received in the wet winter of 2004–2005. However, that same wet winter produced an abundant crop of grasses, much of which is still around, and now constitutes a carpet of fine dry fuels, leading to the probability of an active, severe fire season.

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 March 2006.

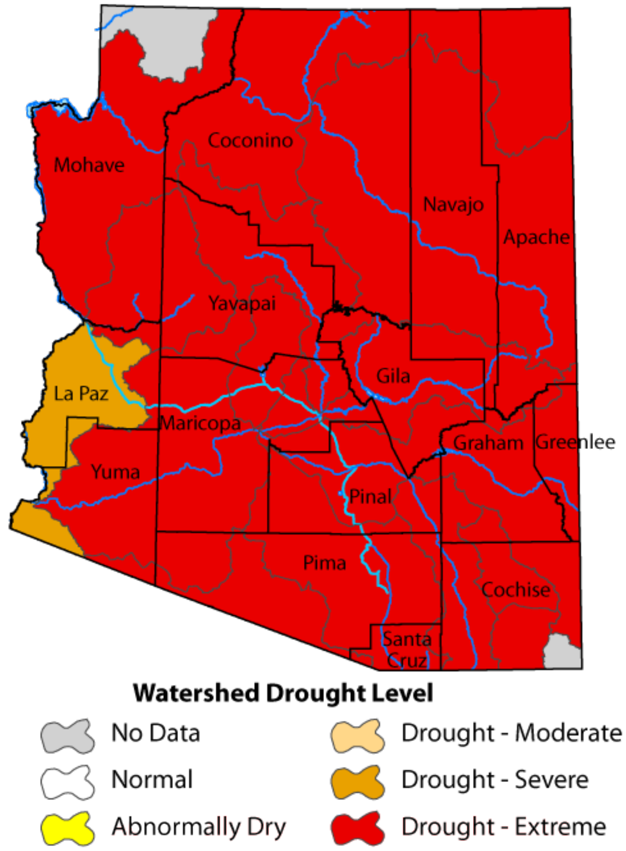
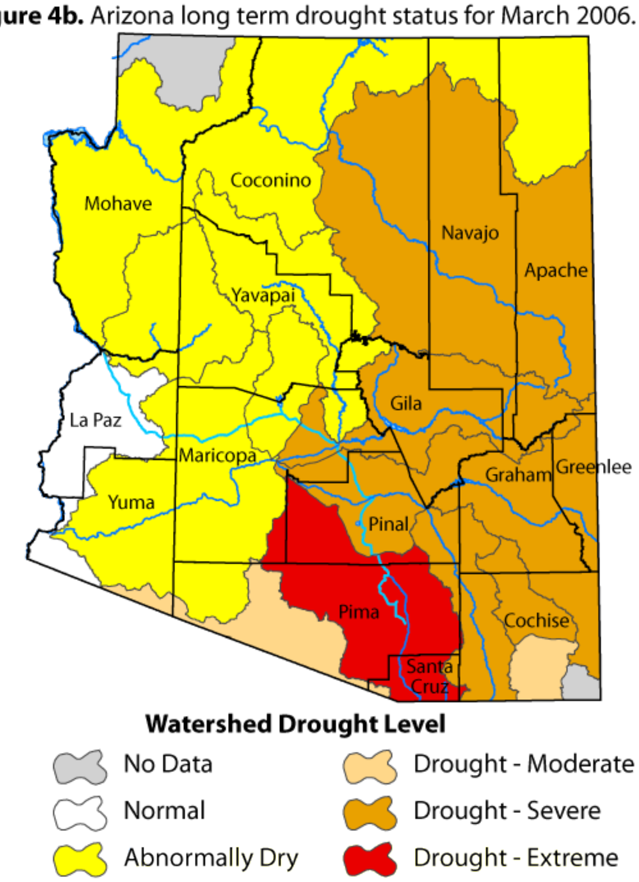


Figure 4b. Arizona long term drought status for March 2006.



New Mexico Drought Status

(through 3/17/06)

Source: New Mexico Natural Resources Conservation Service

Drought conditions still prevail throughout most of New Mexico, despite some precipitation received in March (Figures 5a–b). As of April 14 almost all of the state is in some level of short-term (meteorological) drought, except for a small area in the extreme southeastern part of the state, which is in drought advisory condition. Most parts of central and western New Mexico are in moderate drought status, with a few areas in severe status. Like last month, most of the state is also experiencing long-term hydrological drought. According to the National Weather Service Albuquerque Office, precipitation since last October has been extremely low, with the 5-month period of November through March ranking as one of the driest such periods in New Mexico since record-keeping began. For many localities in the state, that period ranks as the very driest in the record. Precipitation since the start of the water year on October 1, 2005 has been about 50 percent of average, but much of that precipitation fell in the first half of October. Precipitation since the start of the calendar year has been even lower (45 percent of average) with climate division 5, receiving only 12 percent of average. Only 13 percent of the range and pasture land is considered to be in good or excellent condition. Fire danger is high to extreme over most of New Mexico. The combination of abundant dry, fine fuels (mainly grasses produced during the wet winter of 2004–2005), and the drying larger fuels has produced conditions favorable for an active, severe fire season.

Notes:

The New Mexico drought status maps are produced monthly by the New Mexico Drought Monitoring Workgroup. 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 New Mexico drought status map, visit:
http://www.nm.nrcs.usda.gov/snow/drought/drought.html

Information on Arizona drought can be found at:
http://www.azwater.gov/dwr/default.htm

Figure 5a. Short-term drought map based on meteorological conditions as of March 17, 2006.

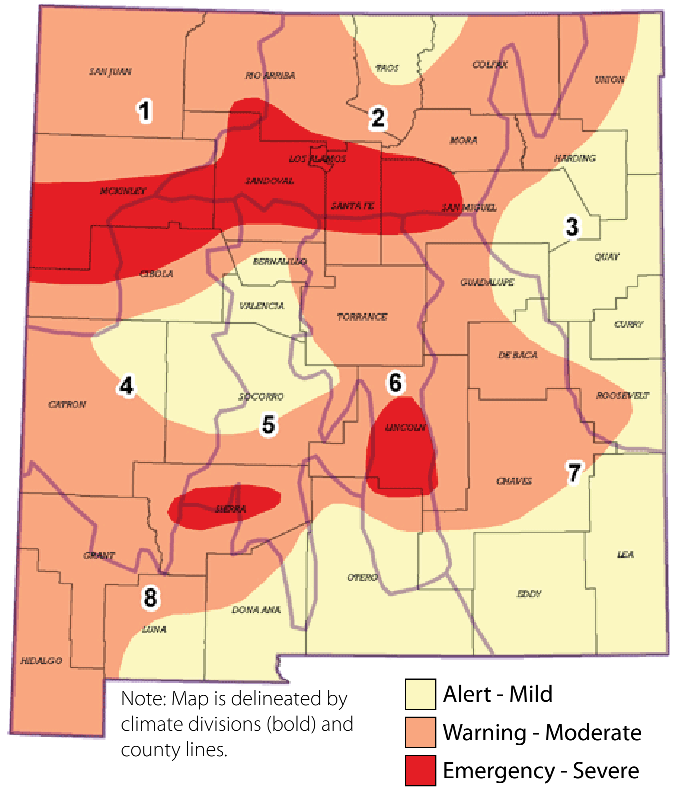
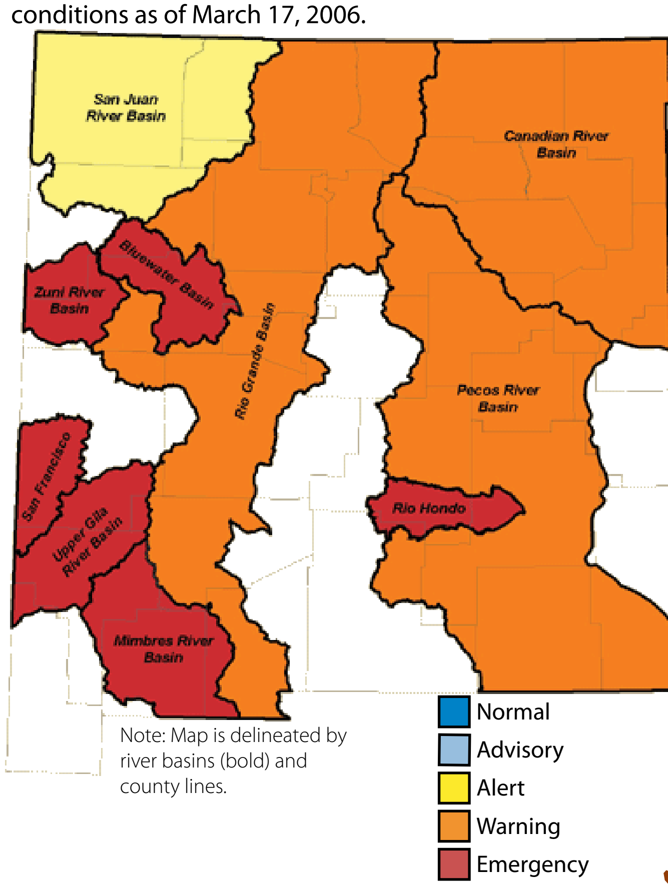


Figure 5b. Long-term drought map based on hydrological conditions as of March 17, 2006.



Arizona Reservoir Levels

(through 3/31/06)

Source: National Water and Climate Center

Arizona's reservoir storage held fairly constant over the last month, with most lakes declining by less than one percent of capacity. The San Carlos reservoir on the Gila River declined by one percent of capacity, while Lyman Lake remained steady at 27 percent of capacity. Note that the cup that reflects Show Low Lake on the map (Figure 6) is colored gray because no data were reported at that site in March. On the Colorado River, Lakes Mohave and Havasu rose by two and three percent, respectively, while the two largest reservoirs, Lakes Mead and Powell, both declined slightly by less than one percent of capacity, leading to a slight decline in total storage on the Colorado River of about 0.4 percent of capacity.

Storage on the Colorado River remains at below-average levels due to long-term precipitation deficits in the Upper Colorado River Basin, even though Lake Powell has risen by 11 percent of capacity relative to last year. Like last month, storage on the three largest reservoirs within the state has declined since this time last year. This is the result of continuing severe drought conditions since the replenishment of those reservoirs during the wet winter and spring of 2004–2005. The Salt River system has declined by 12 percent of capacity since a year ago, but remains at well above-average level.

In contrast, the Verde River system and the San Carlos reservoir now hold less than half the amount of water they did a year ago, having declined by 56 percent and 31 percent of capacity, respectively, and are both now well below long-term average levels.

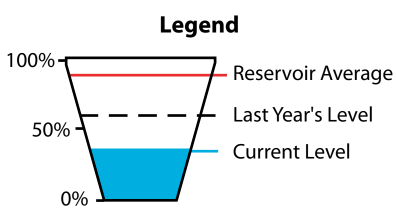
Notes:

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).

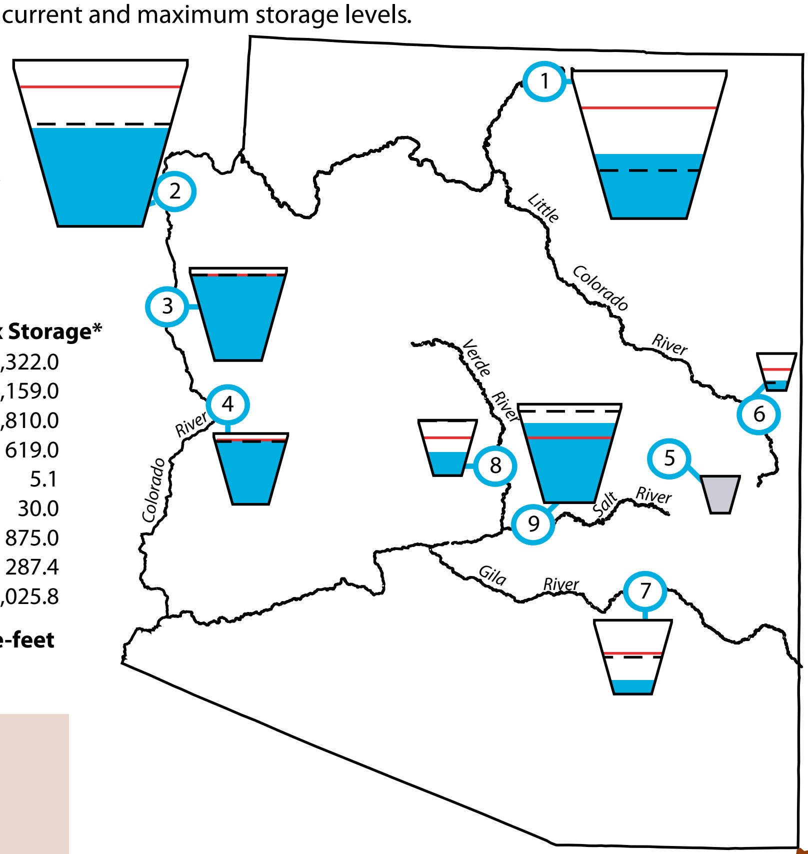
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir.

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 (tpagano@wcc.nrcs.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 March 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	44%	10,704.0	24,322.0
2. Lake Mead	59%	15,337.0	26,159.0
3. Lake Mohave	92%	1,664.7	1,810.0
4. Lake Havasu	91%	563.9	619.0
5. Show Low Lake	NO DATA REPORTED FOR March		5.1
6. Lyman Reservoir	27%	8.1	30.0
7. San Carlos	19%	163.1	875.0
8. Verde River System	43%	124.3	287.4
9. Salt River System	81%	1,636.3	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 3/31/06)

Source: National Water and Climate Center

Reservoir storage in New Mexico declined slightly since last month. Some reservoirs rose by a few percent of capacity, while others fell slightly (Figure 7). The largest decline was on Lake Avalon on the lower Pecos River, which fell by 23 percent of capacity. Also on the Pecos River, Brantley and Sumner reservoirs rose by 5 percent and 2 percent, respectively, while Santa Rosa held steady at 15 percent of capacity. On the Rio Grande, Costilla rose by three percent of capacity, while Abiquiu and Caballo rose by two and one percent, respectively. Heron fell by four percent, and the largest reservoir in the state, Elephant Butte on the lower Rio Grande, declined by two percent of capacity. Navajo Reservoir on the San Juan River, again declined slightly, by 0.6 percent of capacity. Conchas on the Canadian River fell by one percent.

Overall storage in New Mexico continues to be considerably better than it was a year ago, because of the abundant moisture and snowpack received during the wet winter and spring of 2004–2005. The current reservoir storage is 77 percent of the long-term average, compared to only 58 percent this time last year. Storage in most of the systems near the Colorado border is above average, including Navajo, Abiquiu, El Vado, and Costilla reservoirs. In the east, storage in Santa Rosa and Brantley reservoirs is still above average, but all other major storage systems in central and southern New Mexico remain below average. Elephant Butte, which was at 25 percent of the long-term average a year ago, has improved considerably but is still at only 36 percent of average. Caballo, which stood at 35 percent of average a year ago, is now in even worse shape at only 23 percent.

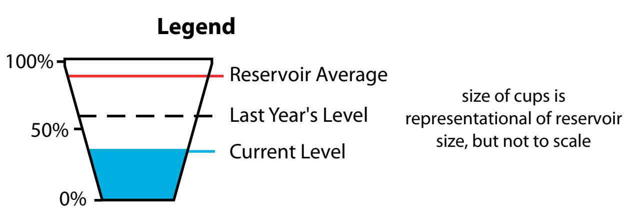
Notes:

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.

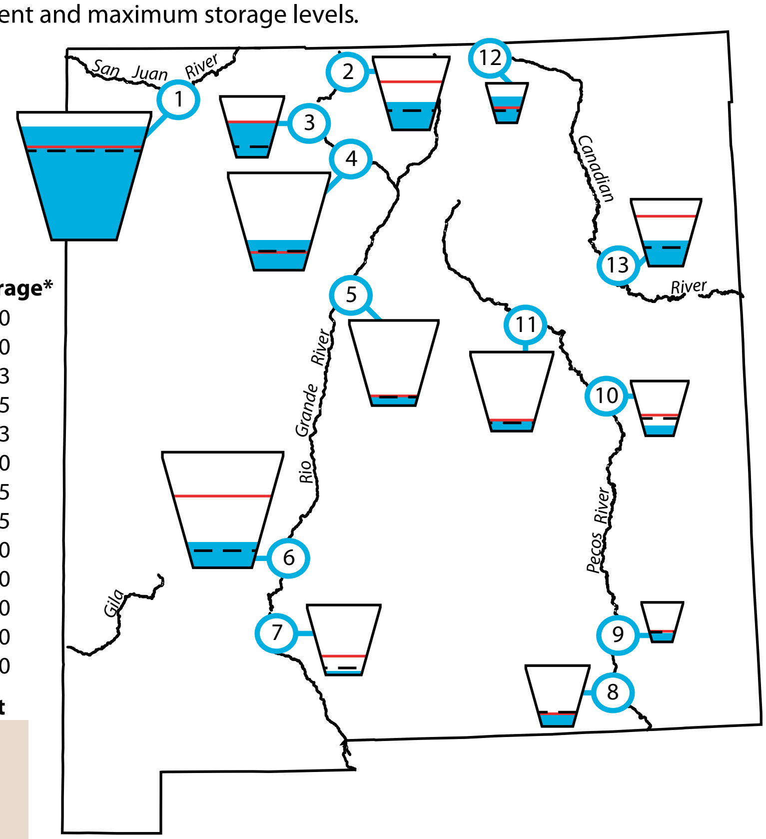
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) 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 March 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	89%	1,503.4	1,696.0
2. Heron	38%	152.6	400.0
3. El Vado	59%	110.0	186.3
4. Abiquiu	31%	169.3	554.5
5. Cochiti	10%	50.5	502.3
6. Elephant Butte	22%	454.9	2,065.0
7. Caballo	6%	21.3	331.5
8. Brantley	23%	33.2	147.5
9. Lake Avalon	22%	1.3	6.0
10. Sumner	19%	19.3	102.0
11. Santa Rosa	15%	65.9	447.0
12. Costilla	66%	10.6	16.0
13. Conchas	38%	96.6	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

Southwest Snowpack

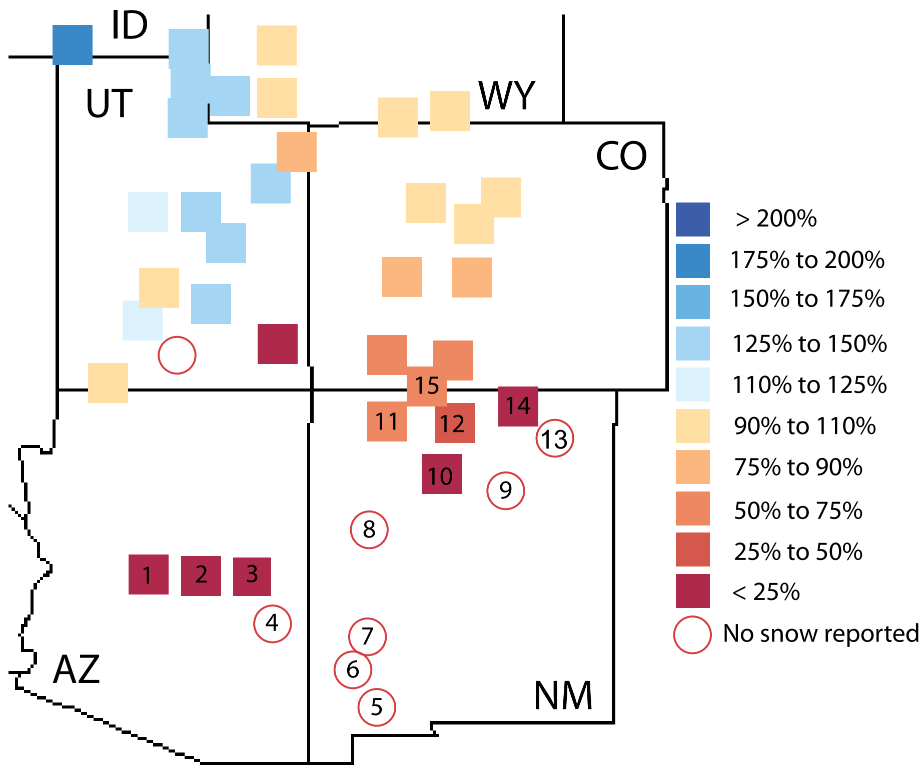
(updated 4/20/06)

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

Snowpack for the 2005–2006 winter in the Southwest has been one of the worst on record. Despite some improvement from precipitation in March, snowpack levels in all basins throughout Arizona and New Mexico are well below average, and some have no snow at all (Figure 8). The remaining snowpack is melting out, and the prospect for a satisfactory spring snowmelt continues to look very remote. In New Mexico the best snowpack is in the northern mountains within roughly 50 miles of the Colorado border, where some sites are reporting about 60 percent of average snow water content (SWC). Throughout the rest of the Southwest, SWC is well below 50 percent at all SNOTEL sites, and generally less than 20 percent at most of them, particularly in Arizona and southern New Mexico. Some basins, including the Pecos, Cimarron, and Rio Hondo have no snow at all. According to the National Weather Service Albuquerque Office, conditions over the southern half of the Sangre de Cristo Mountains are the worst on record, and conditions over the mountains farther south are also "generally as bad as they've been since records were started."

The very low snowpack will contribute to low soil moisture levels in Southwestern forests this spring and summer. These low moisture content levels in forest fuels are likely to exacerbate the already high fire danger this season. The lack of snow has also had a serious impact on the tourist and ski industries in both states, resulting in the loss of many millions of dollars of income in that sector.

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of April 20, 2006.



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

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

Notes:

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

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

On the Web:

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

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

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

Southwest Fire Summary

(updated 4/23/06)

Source: Southwest Coordination Center

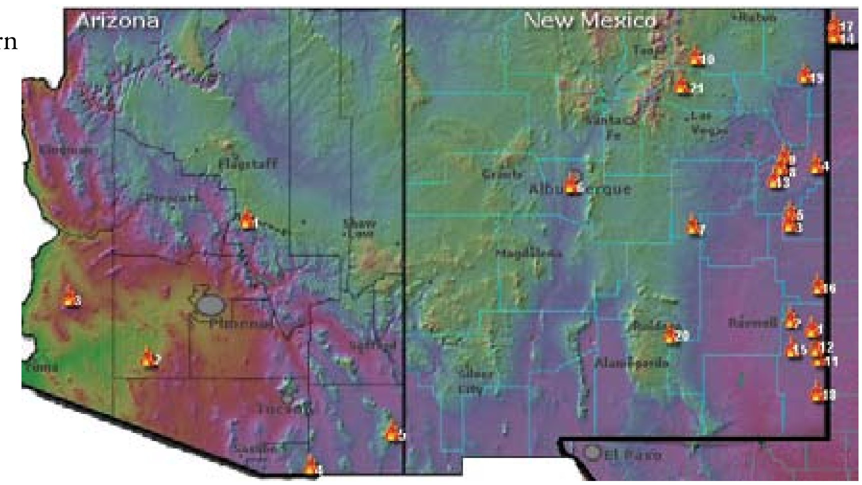
The Southwest Coordination Center (SWCC) reports that 925 fires—nearly all of them caused by humans—have burned 250,726 acres of land so far this year in Arizona and New Mexico (Figure 9a). This is nearly three times the average number of fires by the end of April, and more than nine times the average acreage by this time of year. More than half of these fires occurred in New Mexico, accounting for more than 90 percent of the acreage burned. New Mexico has been battling fires since the beginning of January, mostly in the eastern plains part of the state where the combination of abundant dry grasses, high temperatures, and low rainfall have caused very severe fire conditions. The numbers above do not include prescribed fires, which are set to prevent larger fire potential or to promote ecosystem health, nor wildland fire use, in which natural fires are allowed to burn as long as they pose no threats. Agencies have reported 97 prescribed fires burning 35,844 acres in the Southwest, and no wildland fire use to date according to SWCC.

A total of 31 large fires (greater than 100 acres) has accounted for more than 90 percent of the acreage so far this year (Figure 9b). Arizona has had six large fires, compared to 21 in New Mexico. A single fire near the Texas border in southeastern New Mexico, known as the McDonald fire, charred over 92,000 acres in March. On average, the Southwest has only nine large fires by the end of April.

Figure 9a. Year-to-date fire information for Arizona and New Mexico as of April 23, 2006.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	388	8,266	6	8	394	8,274
NM	537	242,460	9	99	546	242,559
Total	925	250,726	15	107	940	250,833

Figure 9b. Year-to-date wildland fire location. Map depicts large fires of greater than 100 acres burned as of April 13, 2006.



Wildland Fires

Arizona

1. February, TNF, 2/6–2/19
2. Saddle, PHD, 2/11–2/13
3. Hope, HVR, 2/18–2/20
4. Montezuma 1, CNF, 2/27–3/1
5. Burro, CNF, 3/25–4/1
6. N. 105th Ave., PMA, 4/9-

New Mexico

1. Tatum East, N5S, 1/1–1/2
2. Tatum West, N5S, 1/1–1/2
3. 476mm6, N5S, 1/11
4. Bowen, N4S, 2/5
5. Jones, N5S, 2/5
6. Isleta, SPA, 2/03–2/15
7. Anderson, N5S, 2/15
8. Sheep, N4S, 2/16
9. Walker, N4S, 2/16
10. Casa, N2S, 3/1–3/3
11. Flowers, N5S, 3/10
12. Harkey #1, N5S, 3/10
13. Hudson, N4S, 3/11
14. Newby, CIF, Oklahoma, 3/12
15. McDonald, N5S, 3/12–3/14
16. Lingo, N5S, 3/12
17. Windy, CIF, Oklahoma, 3/12–3/13
18. Billywalker, N5S, 3/12
19. Clapham, N2S, 3/12–3/13
20. Red Lake, MEA, 4/5–4/10
21. Ojo Feliz, N4S, 4/12–

Wildland Fire Use

Arizona

None to Date

New Mexico

None to Date

Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2005. The figures include information both for current fires and for fires that have been suppressed. Figure 9a shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. Figure 9b indicates the approximate location of past and present "large" wildland fires and prescribed burns. A "large" fire is defined as a blaze covering 100 acres or more in timber and 300 acres or more in grass or brush. The red symbols indicate wildfires ignited by humans or lightning. The green symbols are prescribed fires started by fire management officials. The name of each fire is provided next to the symbol.

On the Web:

These data are obtained from the Southwest Area Wildland Fire Operations website:

http://www.fs.fed.us/r3/fire/swapredictive/swaintel/daily/ytd-daily-state.htm
http://www.fs.fed.us/r3/fire/swapredictive/swaintel/daily/ytd-large-map.jpg

Temperature Outlook
(May–October 2006)
Source: NOAA Climate Prediction Center (CPC)

The NOAA–CPC temperature outlook calls for above-average temperatures for the Southwest through October 2006 (Figure 10a–10d). The May–July outlook indicates increased chances of warmer-than-average temperatures throughout the southern tier of states from the West Coast to the southern East Coast, and for increased chances for cooler-than-average temperatures in the Upper Midwest states (Figure 10a). The area with highest probabilities for above above-average temperatures (greater than 50 percent) is centered over Arizona and New Mexico, and includes parts of neighboring states. As the outlook period progresses through summer into October, the cooler-than-average anomaly in the Upper Midwest disappears, and the area of greatest likelihood for warm temperatures (greater than 50 percent) shifts westward and northward to include western New Mexico, Arizona, Utah, and most of Nevada.

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 May–July 2006.

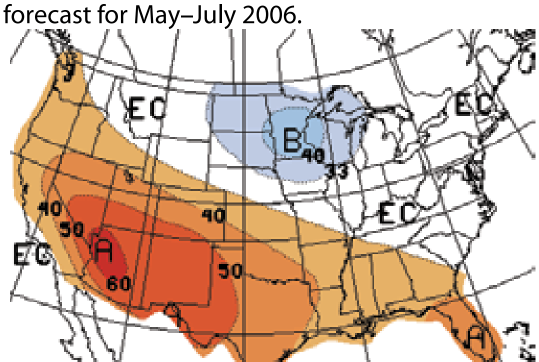


Figure 10b. Long-lead national temperature forecast for June–August 2006.

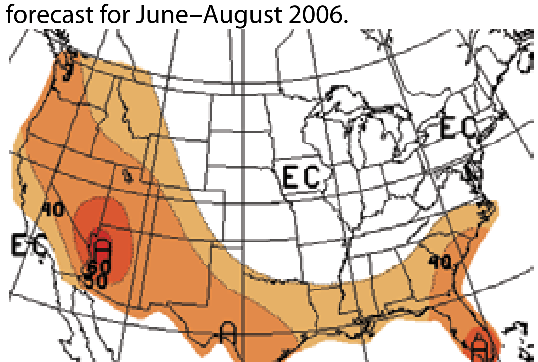


Figure 10c. Long-lead national temperature forecast for July–September 2006.

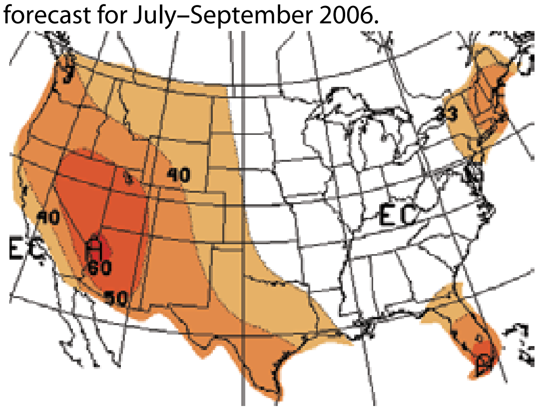
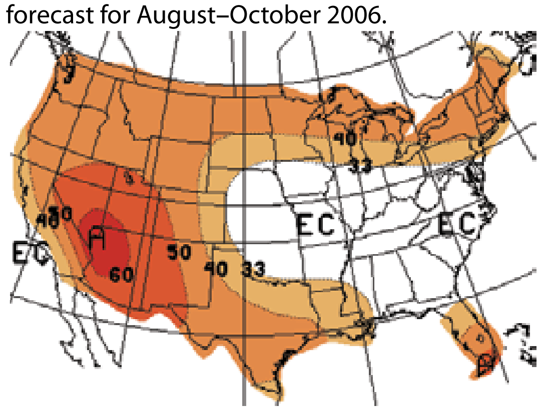


Figure 10d. Long-lead national temperature forecast for August–October 2006.



A= Above
- 60.0–69.9%
- 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

(May–October 2006)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC precipitation outlook for May–July 2006 is for below-average precipitation for a wide band extending from the Texas Gulf Coast to the Canadian border from Washington to Montana, and including most of New Mexico except for a narrow strip along the Arizona border (Figure 11a). The area of highest probability (greater than 40 percent) extends from central Texas across parts of eastern New Mexico into southeastern Wyoming. Wetter-than-average conditions are forecast in the Upper Midwest states along the Canadian border from eastern North Dakota through Minnesota to Wisconsin and the Upper Peninsula of Michigan. In the Southwest, the outlook is for equal chances for precipitation being below-average, near-average, or above-average in Arizona and in western New Mexico along the Arizona border. The longer-lead forecasts, from June into October, call for equal chances for the entire Southwest (Figure 11b–11d).

Notes:

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

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

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

Equal Chances (EC) indicates areas where 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 May–July 2006.

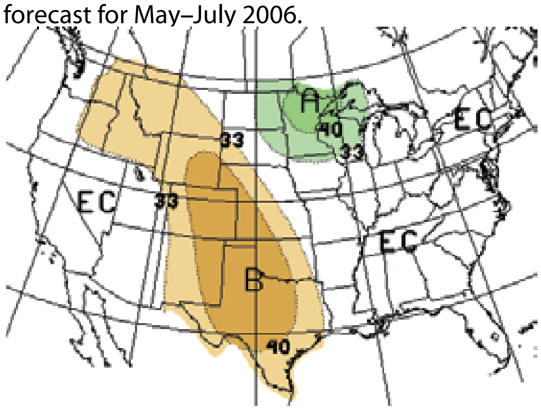


Figure 11b. Long-lead national precipitation forecast for June–August 2006.

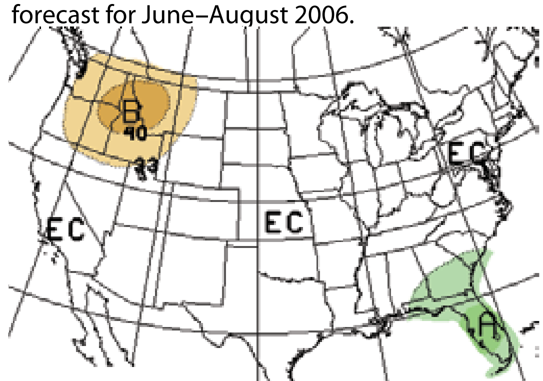


Figure 11c. Long-lead national precipitation forecast for July–September 2006.

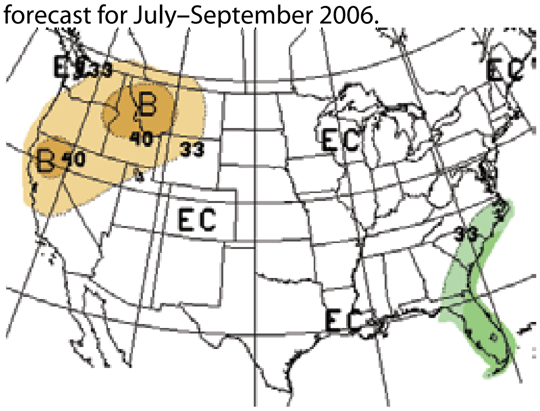
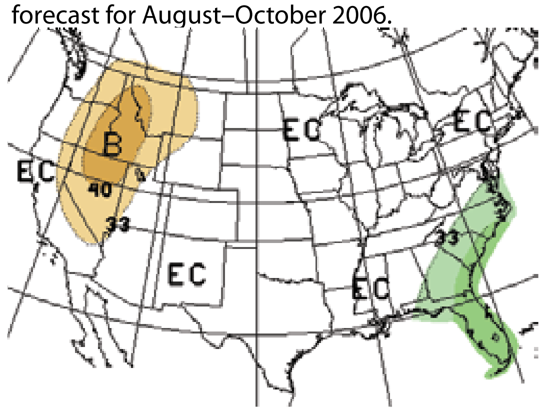


Figure 11d. Long-lead national precipitation forecast for August–October 2006.



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 July 2006)

Source: NOAA Climate Prediction Center (CPC)

The U.S. drought outlook through July 2006 calls for drought conditions to persist in northern and western Arizona and most of New Mexico and Texas northward into Nebraska. The outlook calls for some improvement in drought conditions in Arizona and western New Mexico, contingent on the arrival of adequate summer monsoon rains (Figure 12). The rain and snow received in Arizona and New Mexico from storms in March and April provided some temporary drought relief, but with the dry season starting in the Southwest, coupled with predictions for above-average temperatures in the Southwest and below-average precipitation in New Mexico, little relief is likely before the start of the monsoon rainy season (see Figures 10–11).

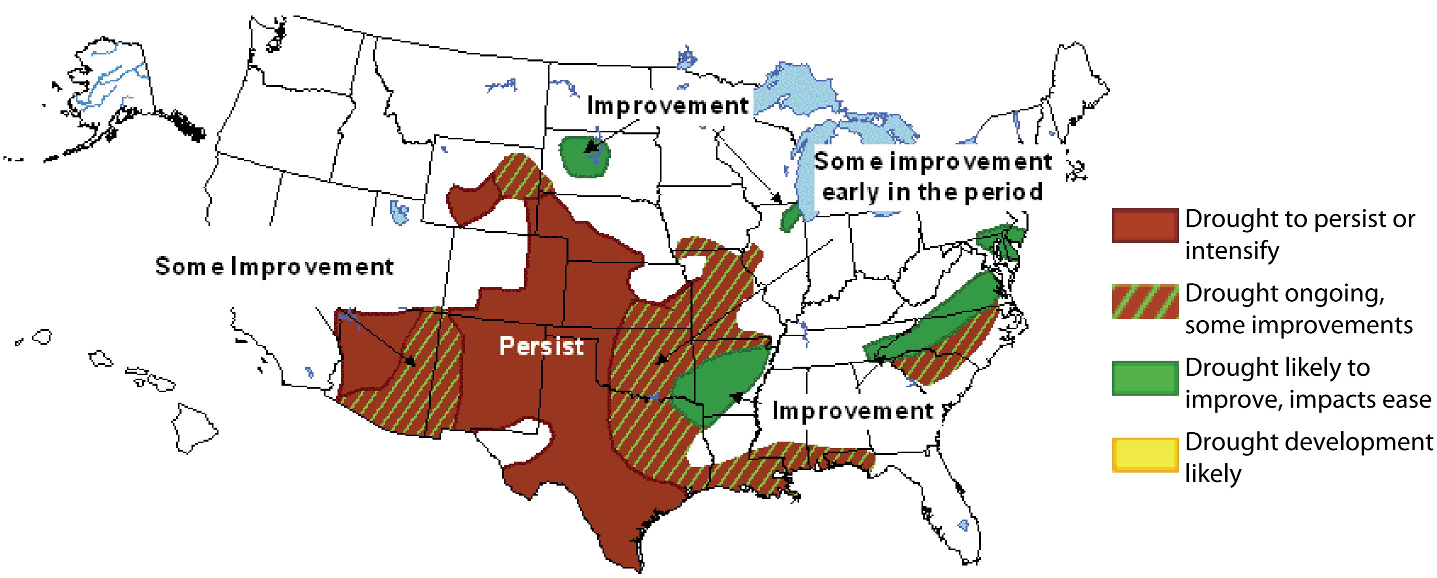
Elsewhere, drought is expected to persist from the Texas Gulf Coast northward into parts of Nebraska and Wyoming, through much of the Midwest into Arkansas and Missouri, and in parts of the Gulf Coast to the Florida panhandle. Some improvement early in the period extends from east Texas into Missouri, and along the Gulf Coast. Improvement is expected in western South Dakota, most of Arkansas, and along the Appalachian states from Tennessee into Virginia and Maryland. Only temporary improvement is expected in the Carolinas.

Persistence or intensification of drought conditions will likely contribute to elevated fire risks across the Southwest through the spring and into the summer season. According to the Southwest Coordination Center, the fire danger through April is higher than average across southeast Arizona and the southern and eastern halves of New Mexico. There is an abundance of fine dead fuels across the region, combined with below-average moisture levels in existing larger dead and live fuels. As a result, fire potential is expected to be above average across all elevations and fuel types over the majority of the region during May and June, with particularly high potential in the higher elevation timber fuel types.

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 July 2006 (release date April 20, 2006).



On the Web:

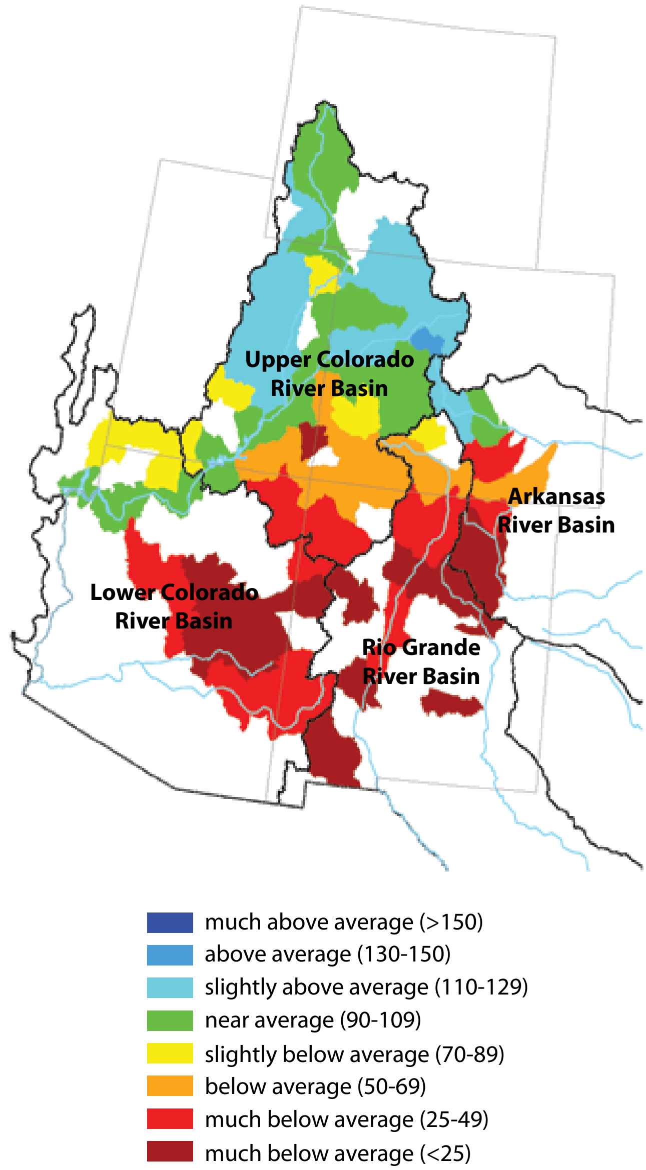
For more information, visit:
http://www.drought.noaa.gov/

Streamflow Forecast
(for spring and summer)
Source: National Water and Climate Center

The streamflow forecast for rivers in the Southwest continues to be bleak, despite some rain and snow received in March and April. Well below-average flows are forecast for the spring and summer in all Arizona and New Mexico rivers (Figure 13), while flow on the Colorado River is expected to be near average. The very poor snowpack is expected to produce runoff of less than 50 percent of average in most Southwestern rivers, and less than 75 percent of average near the Colorado border in northwest New Mexico, where some late season snowpack finally developed. Many of the basins in Arizona and New Mexico are expected to produce less than 30 percent of average streamflow. According to the National Weather Service Albuquerque Office, the Canadian and Pecos River basins will produce some of the lowest flows on record. The situation is somewhat better along the Colorado River in Arizona. The snowpack in the Upper Colorado River Basin is generally near to above average for this time of year, and the inflow to Lake Powell is expected to be about 97 percent of average.

The Southwest is entering the predictably dry period of late spring and early summer, making it unlikely that the region will receive much more snow or rain over the next few months, and increasing the probability of a very poor runoff season for the Southwest. Also tied to the streamflow forecast are temperature and precipitation forecasts. The long-lead outlook for the Southwest is for continued below-average precipitation and above-average temperatures over the next few months. Continued measurement of these factors that influence runoff leads to improved streamflow forecasts later in the season. Therefore the Natural Resources Conservation Service, which produces the forecasts, cautions that early forecasts generally undergo greater changes than late-season forecasts.

Figure 13. Spring and summer streamflow forecast as of April 1, 2006 (percent of average).



Notes:
The forecast information provided in Figure 13 is updated monthly by the National Water and Climate Center, part of the U.S. Department of Agriculture's Natural Resources Conservation Service. Unless otherwise specified, all streamflow forecasts are for streamflow volumes that would occur naturally without any upstream influences, such as reservoirs and diversions. The USDA-NRCS only produces streamflow forecasts for Arizona between January and April, and for New Mexico between January and May.

The NWCC provides a range of forecasts expressed in terms of percent of average streamflow for various statistical exceedance levels. The streamflow forecast presented here is for the 50 percent exceedance level, and is referred to as the most probable streamflow. This means there is at least a 50 percent chance that streamflow will occur at the percent of average shown in Figure 13.

On the Web:
For state river basin streamflow probability charts, visit:
http://www.wcc.nrcs.usda.gov/cgibin/strm_cht.pl

For information on interpreting streamflow forecasts, visit:
http://www.wcc.nrcs.usda.gov/factpub/intrpret.html

For western U.S. water supply outlooks, visit:
http://www.wcc.nrcs.usda.gov/water/quantity/westwide.html

Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

A dry winter in the Southwest has increased the risk of wildfires this spring and summer. The outlook issued by the National Interagency Coordination Center (NICC) for April shows above-average fire potential for southeast Arizona and for the southern and eastern halves of New Mexico (Figure 14a). The above-average fire potential extends into southern Texas, northward into eastern Colorado and most of Kansas, and includes Florida and parts of the Southeast and Atlantic Seaboard states. The Southwest has an abundant carryover of fine fuels (mostly grasses) from the wet winter of 2004–2005. "Greenup" of new growth was occurring in early April, and the current fine fuel moisture condition varies from green to cured (dried out) across the region (Figure 14b). As the fine fuels continue to cure and moisture content continues to drop in the larger fuel classes, the fuel loading is expected to reach near-record levels, producing a continuous fuel bed for rapid fire growth. By May the fire potential is expected to escalate rapidly through all fuel types from grass to timber. Significant fire potential is expected to remain high in much of Arizona through mid-July, but should be mitigated by seasonal monsoon moisture across the remainder of the Southwest by then.

Figure 14a. National wildland fire potential for fires greater than 100 acres (valid April 1–30, 2006).

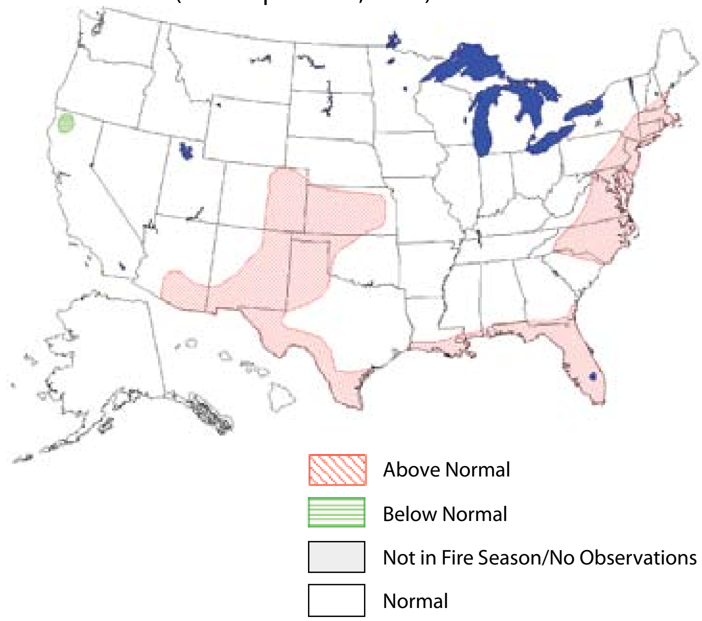


Figure 14b. Current fine fuel condition and live fuel moisture status in the Southwest.

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

Live Fuel Moisture	Percent of Average
Ponderosa Pine	89–117
Douglas Fir	102–178
Piñon	86–108
Juniper	78–98
Sagebrush	127–149
1000-hour dead fuel moisture	**8–17**
Average 1000-hour fuel moisture for this time of year	**10–14**

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces monthly wildland fire outlooks. The forecasts (Figure 14a) consider climate forecasts and surface-fuels conditions in order to assess fire potential for fires greater than 100 acres. They are subjective assessments, based on synthesis of regional fire danger outlooks.

The Southwest Area Wildland Fire Operations produces monthly fuel conditions and outlooks. Fuels are any live or dead vegetation that are capable of burning during a fire. Fuels are assigned rates for the length of time necessary to dry. Small, thin vegetation, such as grasses and weeds, 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 Area Wildland Fire Operations (SWCC) web page:
http://www.fs.fed.us/r3/fire/

El Niño Status and Forecast

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

La Niña conditions are expected to continue for the next one to three months, according to the NOAA-CPC. Sea surface temperatures (SSTs) are cooler than average by more than 0.5 degrees Celsius across most of the central equatorial Pacific Ocean, and stronger-than-average low-level equatorial easterly winds persist across the central Pacific. The Southern Oscillation Index (SOI) has shown a generally steady increase since last spring, and is now well into the La Niña range (Figure 15a). According to experts at CPC, there is some variation among different ENSO model forecasts (not shown). This indicates some uncertainty in the outlooks for the later half of the year, but conditions in the tropical Pacific Ocean indicate the continuation of weak La Niña conditions during the next one to three months, followed by a return to ENSO-neutral conditions later in the year. The probabilistic forecast issued by the IRI is somewhat different, predicting that there is an 80 percent chance of returning to ENSO-neutral conditions during the next three months (April–June) 2006 (Figure 15b).

Historically, La Niña conditions tend to favor warmer-than-average temperatures in Arizona and New Mexico during March–May and lower-than-normal precipitation in New Mexico and eastern Arizona during that time period.

Notes:

Figure 15a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through March 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 15b 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 15a. The standardized values of the Southern Oscillation Index from January 1980–March 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).

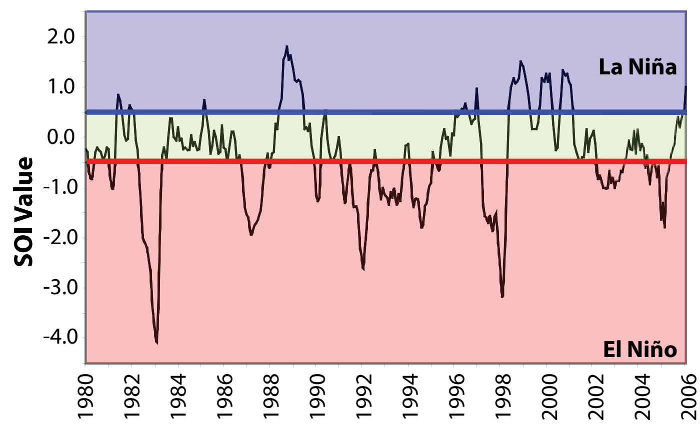
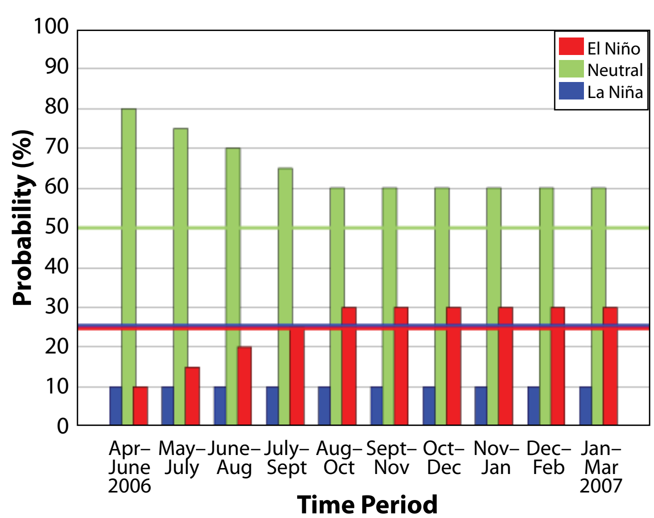


Figure 15b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released April 20, 2006). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



On the Web:

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

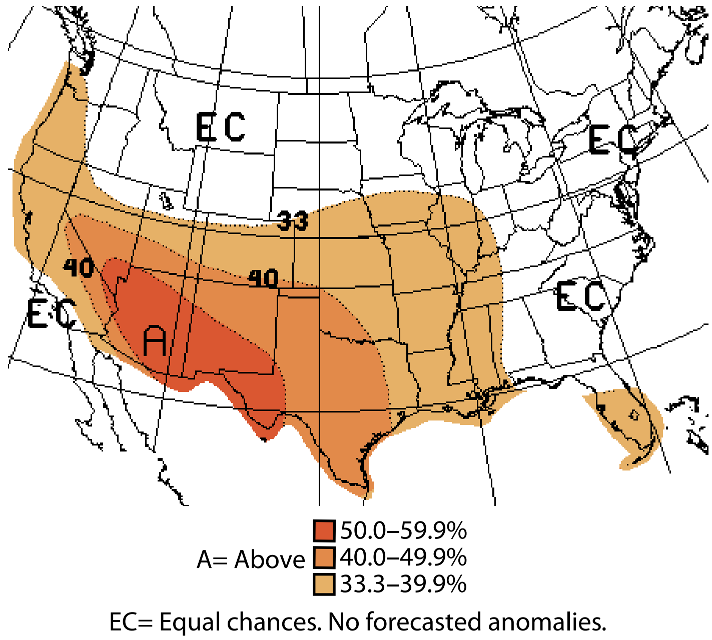
For more information about El Niño and to access graphics similar to the figures on this page, visit:
http://iri.columbia.edu/climate/ENSO/

Temperature Verification
(January–March 2006)

Source: NOAA Climate Prediction Center (CPC)

The long-range outlook for January–March 2006 from the NOAA-CPC predicted above-average temperatures extending from the West Coast throughout the Southwest, into much of the Midwest and South west of Alabama, and in southern Florida. The areas of highest probability were over the Southwest, from Arizona through southern New Mexico into west Texas (Figure 16a). Forecasters withheld judgment for the rest of the country. Observed temperatures across most the central part of the nation ranged from 0–8 degrees Fahrenheit above average, with the warmest anomalies near the Canadian border (Figure 16b). Most of the West Coast and western states from Idaho south to western and northeastern Arizona ranged from 0–2 degrees F below average, along with southern Florida. The outlook performed well in predicting the above-average temperatures from New Mexico across Texas into the Midwest, but poorly in predicting above-average temperatures from Arizona to the West Coast, and in southern Florida, where cooler-than-average temperatures prevailed.

Figure 16a. Long-lead U.S. temperature forecast for January–March 2006 (issued December 2005).



Notes:

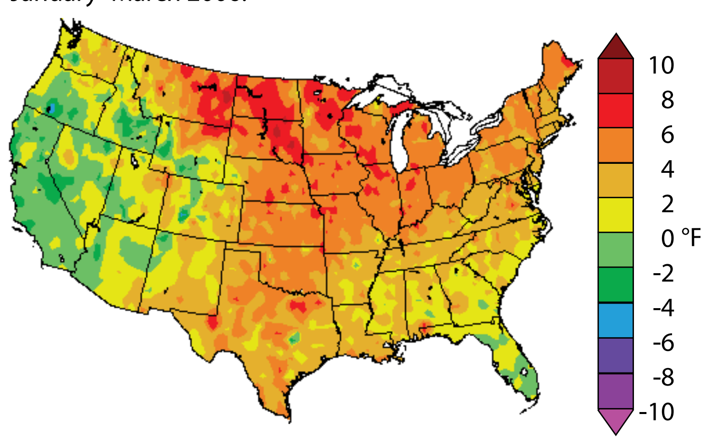
Figure 16a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months January–March 2006. This forecast was made in December 2005.

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

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average temperature. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 16b shows the observed departure of temperature (degrees F) from the average for the January–March 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.

Figure 16b. Average temperature departure (in degrees F) for January–March 2006.



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

(January–March 2006)

Source: NOAA Climate Prediction Center (CPC)

The long-range outlook from the NOAA-CPC for January–March 2006 predicted increased chances for below-average precipitation for most of the far southern tier of states from southern California through Arizona, New Mexico, Texas and Oklahoma, and along the Gulf and Atlantic portions of the Southeast (Figure 17a). The areas of highest probability were centered over southern Arizona and New Mexico, and southwest Texas (greater than 40 percent), and in Florida (greater than 50 percent). Observed precipitation across most of the Southwest was much below average, particularly in Arizona and New Mexico, and in southern Texas, ranging generally from less than 5 percent to less than 50 percent of average (Figure 17b). Precipitation in the Southeast was also generally below average. Precipitation was above average from west Texas eastward and northward into the Midwest. Most of the northwestern part of the country also experienced above-normal precipitation. The forecast performed well in predicting dry conditions in the Southwest and Southeast, but did not predict the wet conditions from Texas to Mississippi.

Figure 17a. Long-lead U.S. precipitation forecast for January–March 2006 (issued December 2005).

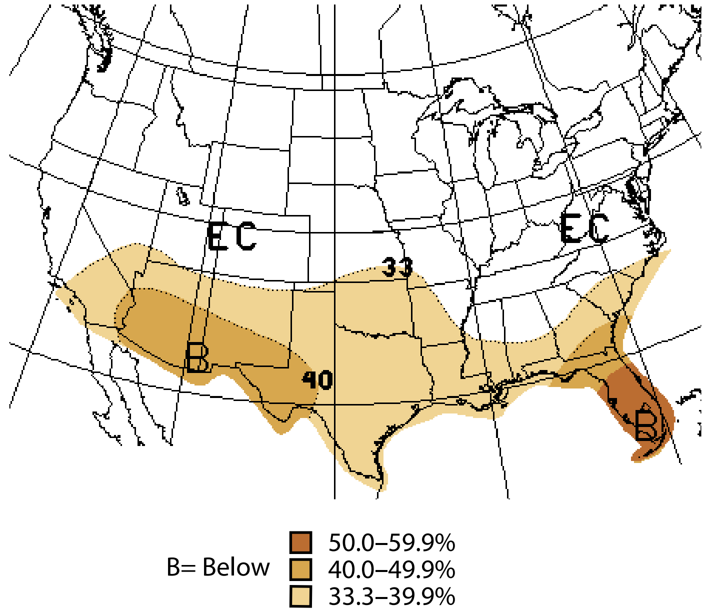
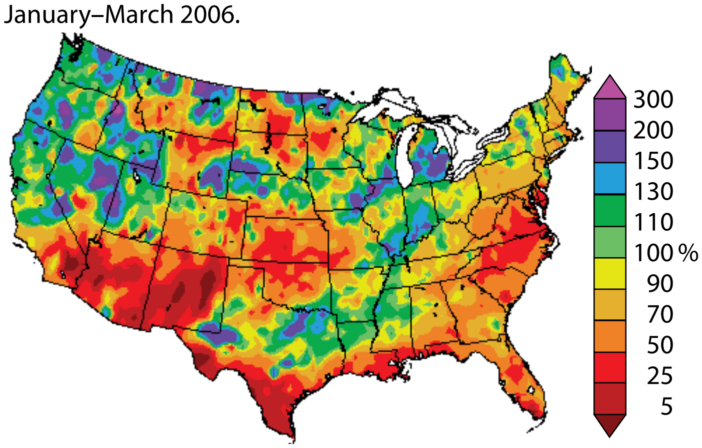


Figure 17b. Percent of average precipitation observed from January–March 2006.



Notes:

Figure 17a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months January–March 2006. This forecast was made in December 2005.

The outlook predicts the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average precipitation. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 17b shows the observed percent of average precipitation for January–March 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