Issued: May 23, 2007

# Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.

*Photo Source: Malcolm Comeaux*

**Photo Description:** This photo of a dust wall,the leading edge of a dust storm, was taken in Tempe, Arizona in the late 1970s from a residential roof with the photographer facing South. Dust storms such as these appear throughout the Southwest during windy times of year such as the months of April and May.

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

## In this issue...

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# May Climate Summary

**Drought –** Drought conditions continue to plague much of Arizona. West-central parts of the state are hardest-hit in the short term, while central southeastern Arizona faces the most severe conditions over the long term. Meanwhile, most of New Mexico remains drought-free.

**Temperature –** New Mexico's temperatures have been running below-normal while Arizona's temperatures have been registering above-normal. This pattern emerged during the water year that began October 1, and continued to be apparent over the past thirty days.

**Precipitation –** Precipitation patterns helped explain both the temperature and drought differences between Arizona and New Mexico. Sunny days warmed and dried Arizona, while clouds provided relief to New Mexico. Southern New Mexico received double or more the usual precipitation in the past month, while western Arizona lacked any measurable precipitation.

**Climate Forecasts –** Judging from temperature forecasts, Arizona remains vulnerable to continued drought. Predictions for above-average summer temperatures in the West center on Arizona and also include New Mexico. No forecasts covering the Southwest have been issued for precipitation, but drought conditions in Arizona are projected to improve slightly over the summer with the expected arrival of the annual monsoonal rains.

**The Bottom Line –** High temperatures and low precipitation have maintained drought conditions in much of Arizona, while the opposite conditions have helped most of New Mexico stay drought-free. Still, the southern portions of both states are projected to face above-normal fire risk through at least the end of May. The risk is greatest in lower and middle elevations where grasses can quickly dry into tinder.

## Hold on to your hat!

"In like a lion, out like a lamb" is an old weather proverb describing the blustery conditions of March giving way to the relative tranquility of April. This proverb obviously wasn't written by someone living in the Southwest. April and May are actually the windiest months across Arizona and New Mexico. New Mexico's average wind speed, calculated from station observations across the state, is 11.6 and 10.9 miles per hour for April and May, respectively. This compares to an annual average wind speed of 9.6 mph. Arizona's average wind speeds are slightly lower, but follow the same pattern. The average wind speed is 8.6 mph for April and 8.5 mph for May; the annual state average is 7.2 mph. The transition from winter to spring weather in April and May creates north-south gradients in both temperatures and surface pressures. As the atmosphere works to bring things back into balance, it creates consistent blustery conditions during the spring.

For more wind data visit the WRCC on the web: http://wrcc.dri.edu/htmlfiles/westwind.final.html...

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# How tree rings can help reconstruct streamflow

## A series of technical workshops for water manager and stakeholders

By Jeff Lukas & Connie Woodhouse

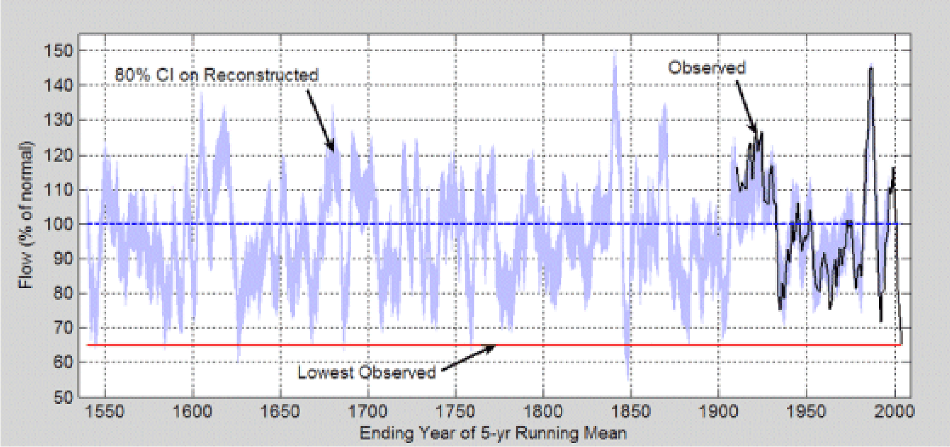

**Figure 1:** A reconstruction of streamflow for the Colorado River at Lees Ferry (5-year running mean, with the 80 percent confidence interval shown as a purple band) is compared with the observed streamflow record (5-year running mean in black). The severity of the 2000–2004 drought (red line) is likely to have been exceeded at least once in the previous 500 years. Image courtesy of David Meko.

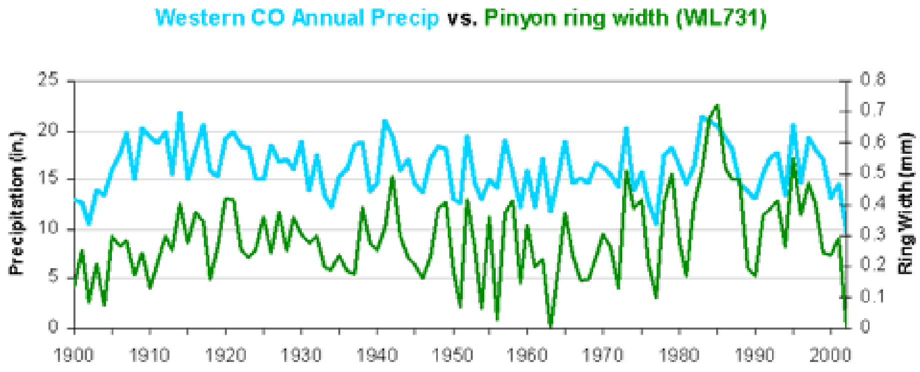

**Figure 2:** The growth of a pinyon pine sampled in western Colorado near the Delta explains about 70 percent of the variability in annual precipitation for western Colorado. The strong moisture signal recorded in the trees is the basis for robust tree-ring reconstructions of streamflow in the region.

Records from the annual growth rings of many trees in the U.S. West can be used to extend, or reconstruct, streamflow records based on gaged measurements. These streamflow reconstructions can provide water managers and stakeholders with a much longer window—300 years and more—into the past hydrologic variability of a river system, and have the potential to inform sustainable management of water resources.

Successfully applying these paleohydrologic data to water management depends on sustained interaction between the scientists who develop the data and the managers who have interest in using them, with each group coming to better understand the operational environment and methodologies of the other. To this end, the Western Water Association (WWA) began presenting a series of workshops for water managers and stakeholders in 2006, with some contributions from the Climate Assessment for the Southwest (CLIMAS). The initial planning workshop was held in Tucson in May 2005.

The goal of these technical workshops is to comprehensively cover the methods of generating reconstructed streamflow from tree rings, so that water managers interested in applying these data have a better basis of understanding from which to work. The core of the all-day workshop is a multi-section instructional presentation, interspersed with hands-on activities, lab tours, and group discussions. Participants respond to a pre-workshop survey so that each workshop's content can be tailored to meet the needs and interests of the specific group. Some points from the workshops are described on page 4.

The first workshop was held in Alamosa, Colorado, in late April 2006, following interest expressed by the Rio Grande Water Conservation District the previous year. The participants—San Luis Valley water managers and natural resource managers—grasped the tree-ring data as an important means to convey to water users and stakeholders in the San Luis Valley the need to constrain demand, particularly groundwater pumping, to accommodate the inevitable sustained dry periods.

A half-day field trip to the foothills west of Boulder to demonstrate field techniques for extracting tree-ring cores from living trees was part of the second workshop in Colorado, held in May 2006. The 14 participants represented a broad spectrum of water agencies and interests in Colorado and the Colorado River basin. The workshop included discussion of applications of the tree-ring data, with each of the participants briefly describing their current and intended use of the data. Some examples are given in Figures 1 and 2.

**continued on page 4**

## Streamflow reconstruction, continued

An October 2006 workshop and field trip in Tucson attracted water managers from across the Southwest and even one from Canada to The University of Arizona's Institute for Study of Planet Earth. Researchers from CLIMAS and the UA Laboratory of Tree-Ring Research also helped out. The workshop featured presentations by Chris Cutler of the U.S. Bureau of Reclamation, Charlie Ester of the Salt River Project, and Bill Girling of Manitoba Hydro on their respective uses of the streamflow reconstructions for management purposes.

Participants' feedback indicates the workshops have fulfilled their objective of conveying relevant information about the tree-ring data. They have also been a venue for water managers to share information with each other about applications of the data, and for researchers to learn more about water management in the region.

Researchers have filled the role of providing data and technical assistance, while the managers and their consultants are developing particular application methodologies (e.g., disaggregating annual tree-ring data into daily time steps for model input). The workshops clearly have enhanced the communication needed to bridge research data and management applications.

Future workshops will continue to mix instruction with discussion of applications as dictated by the participants' needs and backgrounds. A half-day workshop in Durango, Colorado, will be held on May 31, and other 2007 workshops could include Albuquerque, Las Vegas, and southern California.

As a companion to the workshops, web pages hosted by WWA feature the instructional presentations as well as the applications presentations given by water managers. The pages also describe several applications of the streamflow reconstructions to water resource planning, list the water agencies currently using tree-ring reconstructions for management purposes, and provide links to archived reconstruction data for the western United States. The web pages are available at: http://wwa.colorado.edu/resources/paleo/.

*Jeff Lukas of the University of Colorado and Connie Woodhouse of The University of Arizona both are affiliated with the Western Water Assessment (WWA). Anyone interested in participating in a future workshop can email lukas@colorado.edu. This article was originally published in the April issue of the Intermountain West Climate Summary, available at http://wwa.colorado.edu/products/forecasts_and_outlooks/intermountain_west_climate_summary/*

## 7 things western water managers should know about tree-ring reconstructions of streamflow

Adapted from an article by Jeff Lukas & Connie Woodhouse

1) The science behind streamflow reconstructions has a long history. In the 1930s, researchers first began to quantify the close relationship between tree-ring growth and the amount of water flowing in rivers and streams (streamflow) in the western United States. In the 1960s, researchers began to employ computers and modern multiple linear regression techniques to develop tree-ring reconstructions of streamflow. Techniques have been progressively refined since then.

2) Tree growth in the West is closely associated with moisture variability, leading to high-quality streamflow reconstructions. In semi-arid climates, the same two climate factors generally control both the growth of moisture-limited trees and the amount of runoff trickling into streams. Precipitation is obviously important. The other important climate factor is evapotranspiration, which refers to water evaporated from the landscape and transpired through plants. Several widespread conifer species such as ponderosa pine, pinyon pine, and Douglas-fir are particularly responsive to the variability of moisture from one year to the next. This sensitivity is even greater when they grow on dry, rocky sites like those found on many western mountainsides (Figure 4). Thus, the trees that are most likely to show annual changes in tree-ring size from annual changes in moisture levels are not the ones growing closest to rivers, but the ones eking out a living on steep slopes in the surrounding watersheds. Because of this, the relationship between tree growth and streamflow is not direct. Instead, tree growth and streamflow are robustly linked by the regional climate that influences both.

3) Combining samples from many trees into one "chronology" improves the moisture signal from a site. At each site, researchers collect pencil-sized core samples from living trees (usually 20 to 30) to maximize the common climate signal. After preparing and sanding the cores so every ring is visible under a microscope, researchers use sophisticated equipment to measure each annual growth ring. Next, they compare the growth patterns among the trees

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# 7 things about streamflow reconstruction, continued

for a given site, crossdating them to account for any missing or false rings and assigning an exact year to each annual ring. Then, measured ring widths from multiple trees for each site are averaged into a timeline showing the ups and downs of annual growth, which serves as the site chronology. Finally, multiple tree-ring chronologies from the region are combined to reconstruct streamflows for a particular stream gage.

4) The reconstruction assumes the documented relationships between specific trees' growth and streamflow extends back in time. Researchers use several statistical methods to find the chronologies that best reflect streamflow measurements of a specific gage on the river in question. The chronologies that perform the best in estimating the gaged flows are selected to reconstruct earlier flows. The multiple linear regression equation derived from the relationship between tree growth and streamflow serves as the reconstruction model. After creating the model, researchers evaluate its skill by testing it on independent data or on data that had been left out of the model specifically so it could be used for these calibration purposes. Scientists then apply the model to the full tree-ring record, using the reconstruction to extend the streamflow record back hundreds of years.

5) Trees generally do well at estimating streamflow, but there is always uncertainty around the reconstructed flow. Streamflow reconstructions in the West generally explain about 50 to 80 percent of the variance observed in the gaged record. They also capture the important features, particularly droughts, of the gaged record. But trees are imperfect recorders of streamflow. About 20 to 50 percent of streamflow typically relates to factors that are not reflected by the growth of trees in the sampled areas. Researchers can assess the statistical uncertainty in the model by comparing the differences between the reconstructed flows and the gaged flows. They use this information to generate "confidence intervals." For example, an 80 percent confidence interval suggests there is an 80 percent chance the values fall within the illustrated range (Figure 1). In effect, this represents each year's reconstructed flow as a range of plausible flows, with the most probable value in the middle. In addition to the uncertainty shown by the confidence intervals, there is an undefined amount of uncertainty relating to the choices made in data treatment and modeling approaches.

6) By providing a longer window into the past, the tree-ring reconstructions describe the natural variability of climate more completely than gaged records. The tree-ring record clearly shows that the streamflow variability of the 20th century does not simply repeat itself moving back in time. Reconstructions indicate the existence of longer and more severe droughts than those measured in the gaged record—and longer and more pronounced wet periods, too. They also demonstrate that the mean annual streamflow has changed over past centuries. While human activities exert a stronger influence on climate, the influence is superimposed on natural variability. Climate models project that the range of hydroclimatic variability will likely increase in the future relative to the recent past as seen in the instrumental record. Thus the greater variability seen in the multi-century tree-ring reconstructions of streamflow may be a useful analogue for increased future variability. Using the reconstructed flows rather than just the gaged record as the frame of reference for water management planning can help reduce the number of "surprises" that will arise as we head into a climatically uncertain future.

7) Water managers can apply the streamflow reconstructions in different ways, depending on their needs and capabilities. The uses of tree-ring reconstruction of streamflow fall into three general categories:

1. An informal guide for water managers, stakeholders and decision makers.

2. A quantitative assessment of long-term hydrologic variability. For example, assessing the reconstructed frequency of droughts of a given duration and/or severity.

3. A direct input into hydrologic models of a water system. This allows water managers to model system performance using the reconstructed streamflow as they would the gaged measurements. This typically requires additional processing of the reconstruction, which provides annual values, into the monthly, weekly, or daily time steps required by the system model.

*A similar article by Jeff Lukas and Connie Woodhouse was published in the April issue of the Intermountain West Climate Summary. Jeff Lukas of the University of Colorado and Connie Woodhouse of the University of Arizona are affiliated with the Western Water Assessment (WWA).*

*The article published here was adapted by Melanie Lenart, Climate Assessment for the Southwest Research Associate.*

# Temperature (through 5/16/07)

Source: High Plains Regional Climate Center

The Southwest's recent split personality with respect to temperature continues through this past month. Temperatures have been generally below normal across New Mexico and above-normal across Arizona since the beginning of the water year on October 1, 2006 (Figures 1a–1b). Temperature departures were 1–2 degrees Fahrenheit below the long-term average across much of New Mexico with some upper elevation stations in the western portions of the state recording departures up to 5 degrees F below average. Arizona was almost the mirror opposite since October 1, with temperatures generally 1–3 degrees F above-average. In the past thirty days much of Arizona experienced 2–4 degrees F above-average temperatures and most of central and southern New Mexico saw temperatures 2–4 degrees F below average (Figures 1c–1d).

April and May have been active weather periods, helping to set the stage for the battle of the temperature departures between Arizona and New Mexico. A persistent broad trough across the western United States has brought storm activity through Arizona and New Mexico all winter and into the spring. New Mexico has been in a favorable position to tap moisture and precipitation, with more cool and cloudy wet days. The cold air to the north has even sneaked into New Mexico from the northeast with unusual meteorological events called backdoor cold fronts. According to the National Weather Service in Albuquerque, several of these backdoor cold fronts moved through the state in early April, suppressing temperatures and bringing a mix of much needed rain and snow.

## 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 May 16, 2007) average temperature.

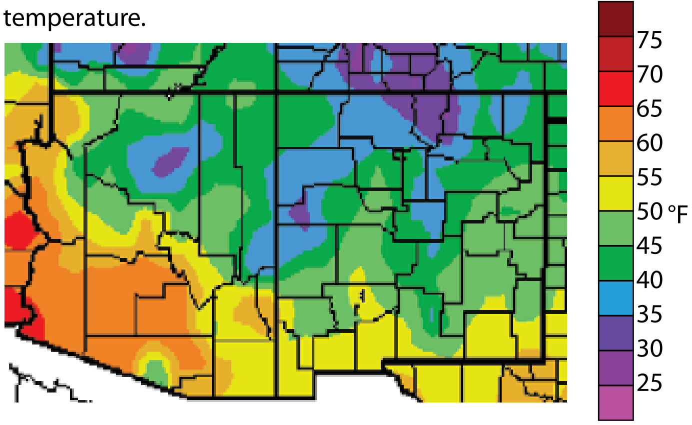


**Figure 1b.** Water year '06–'07 (through May 16, 2007) departure from average temperature.

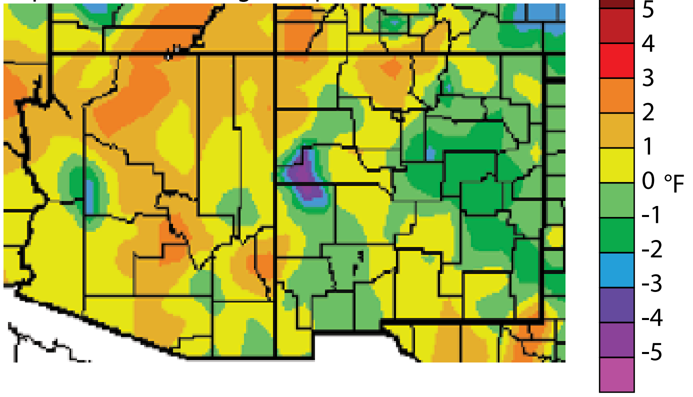


**Figure 1c.** Previous 30 days (April 17–May 16, 2007) departure from average temperature (interpolated).

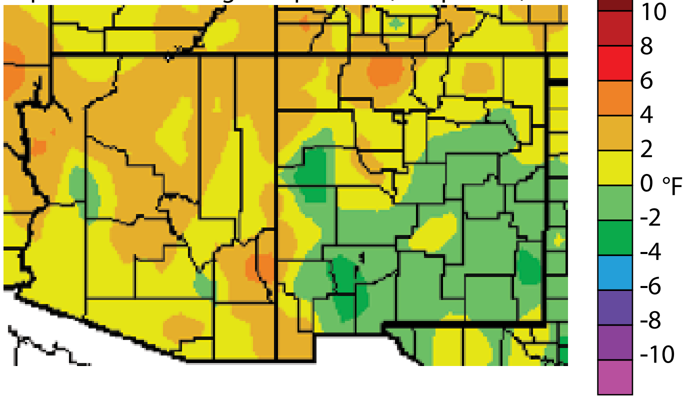
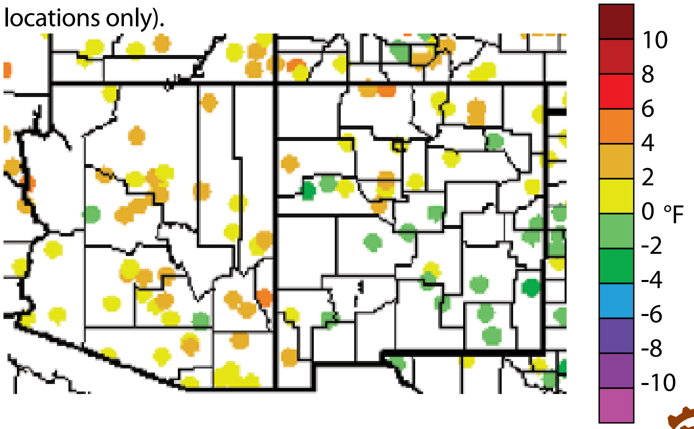


**Figure 1d.** Previous 30 days (April 17–May 16, 2007) departure from average temperature (data collection locations only).



# Precipitation (through 5/16/07)

Source: High Plains Regional Climate Center

The pattern of above-average Arizona and below-average New Mexico temperatures is evident and closely linked to the patterns in precipitation observed since October 1 and over the past thirty days. A striking gradient in percent of normal precipitation from eastern New Mexico to western Arizona is evident on Figure 2a. Portions of eastern New Mexico have observed over 200 percent of average precipitation since the beginning of the water year, while much of western Arizona has observed only 25–50 percent of average. This pattern is even starker when looking at observations from the past thirty days (Figures 2c–2d). Southern New Mexico has been inundated with 2–4 inches of precipitation while western Arizona hasn't received any measurable precipitation.

A persistent trough across the western U.S. and a stubborn storm-track have brought above-average precipitation to New Mexico and left precipitation just out of reach for Arizona through most of the winter and spring. Many storm systems moved across the Southwest throughout the winter and spring, drawing moisture up from the south and east into New Mexico, leaving Arizona on the sunny, windy, and dry sides of passing low pressure systems. The lack of winter and spring precipitation has exacerbated drought conditions across Arizona, with most of the state under severe to extreme drought designations, according to the National Drought Monitor (see Figure 3).

## 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 May 16, 2007) percent of average precipitation (interpolated).

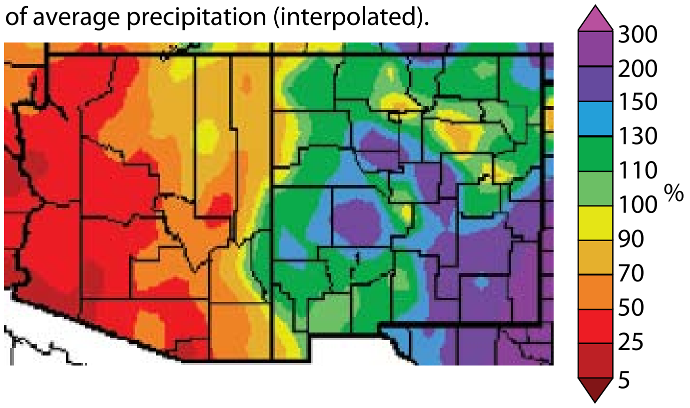


**Figure 2b.** Water year '06–'07 (through May 16, 2007) percent of average precipitation (data collection locations only).

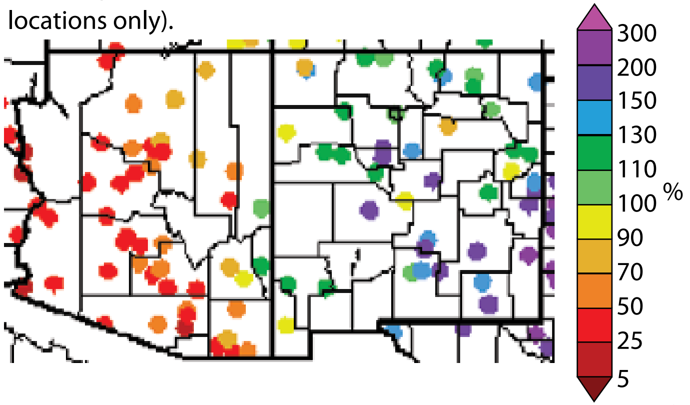


**Figure 2c.** Previous 30 days (April 17–May 16, 2007) percent of average precipitation (interpolated).

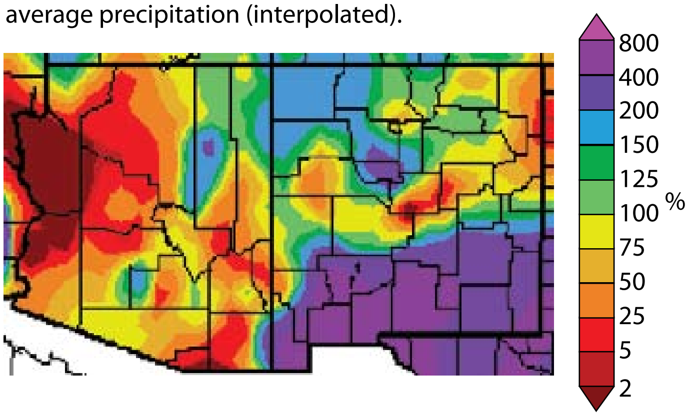
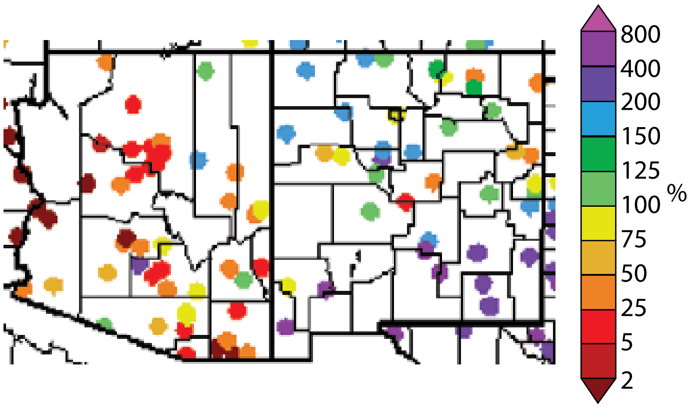


**Figure 2d.** Previous 30 days (April 17–May 16, 2007) percent of average precipitation (data collection locations only).



# U.S. Drought Monitor

**(released 5/17/07)**

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

The National Drought Monitor paints a bleak picture for Arizona, with drought conditions potentially creeping into western portions of New Mexico. All of Arizona is designated as experiencing drought conditions including extreme in southwestern areas and severe in most of the remainder of the state. Extreme southeast Arizona is designated as only abnormally dry due to some late winter precipitation from storms that delivered above-average precipitation to New Mexico. Most of New Mexico is drought-free due to above-average summer precipitation in 2006 and wet winter conditions. Drier conditions and increasing temperatures over the past several weeks have exacerbated short-term drought conditions over the far western portions of the state.

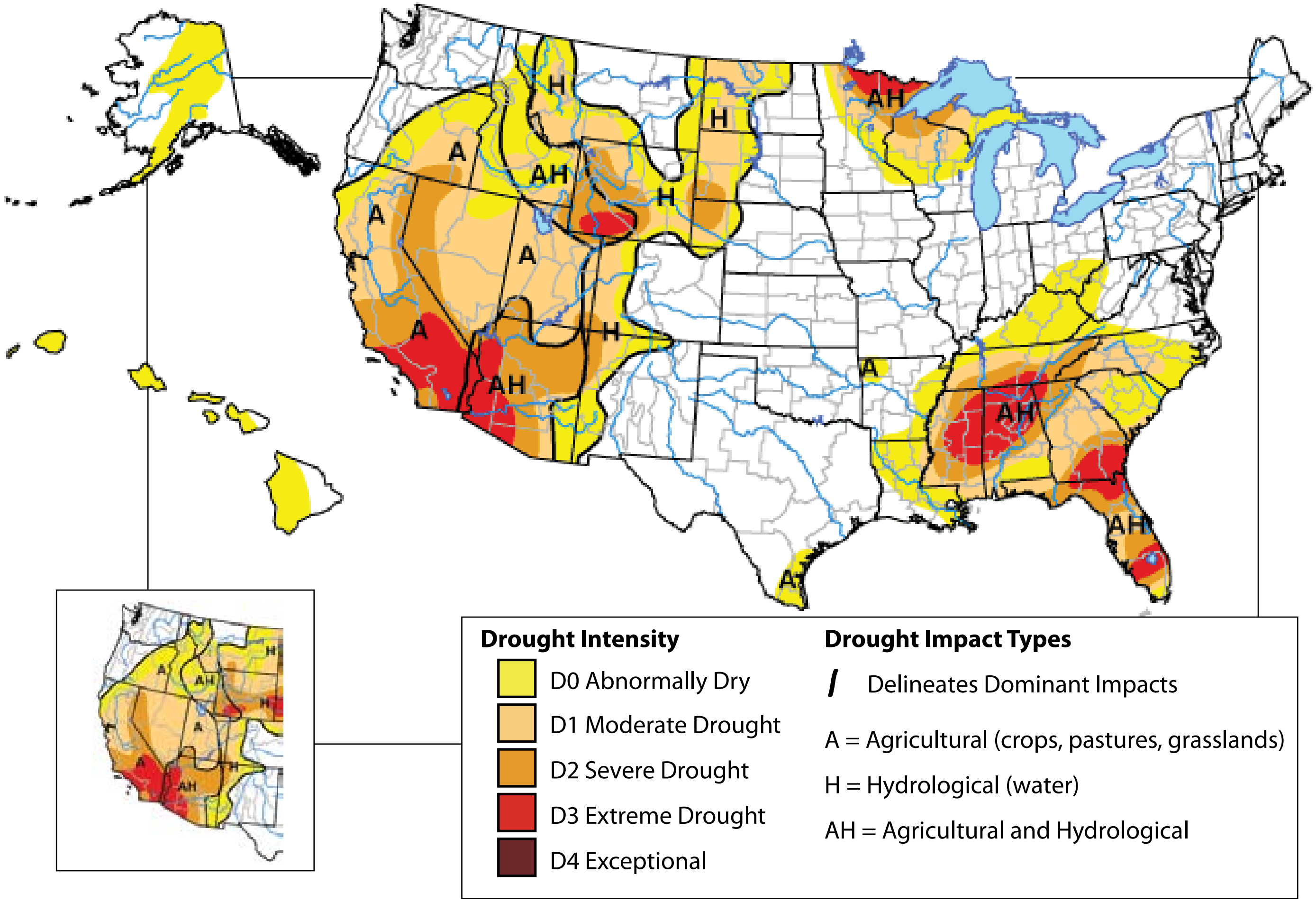
Despite the dramatic improvement of New Mexico drought conditions, some local cities and villages are planning for the return of dry conditions. Ruidoso village councilors have identified the need to develop a water budget to manage growth as part of their Water Conservation and Drought Contingency Plan (*Ruidoso News*, May 10). The water budget will be developed over the next year with shorter-term action on the development of ordinances pertaining to landscape watering, emergency water uses, and water rights transfers.

## 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 Mark Svoboda, National Drought Mitigation Center.

**Figure 3.** Drought Monitor released May 17, 2007 (full size) and April 19, 2007 (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 3/31/07)

Source: Arizona Department of Water Resources

Dry conditions continue to plague the state at both short and long timescales. The short-term drought status map remains unchanged relative to the March update (Figure 4a). Western watersheds are hardest hit under moderate drought conditions. The Bill Williams watershed stands out, with severe drought conditions in the short-term due to below-average three- to twelve-month precipitation. The long-term drought status across the state also remains unchanged since the March update, but shifts the pattern of drought with respect to the short-term status (Figure 4b). Severe drought conditions exist in the Santa Cruz and San Simon watersheds in the southern part of the state while western watersheds are only abnormally dry to normal. This pattern in long-term drought conditions represents precipitation patterns over the past several years. Wet conditions favored western Arizona during the winter of 2004–05, while below-average precipitation plagued the southern watersheds.

Drought impact information reported by volunteers in Yavapai County depicts worsening rangeland conditions. Reports indicate that dry grass remains from last year, but no new grass is germinating or greening up. Some ranchers have had to irrigate pastures to green up grasses for livestock feed. Drought impact reports also indicate that oak and ponderosa pine stands are showing signs of stress due to the lack of adequate winter precipitation.

## 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 April 2007.

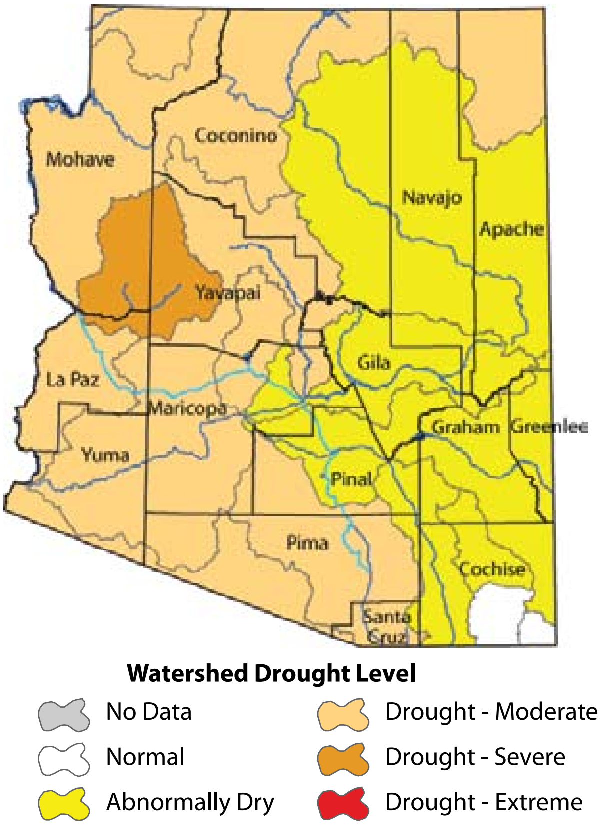
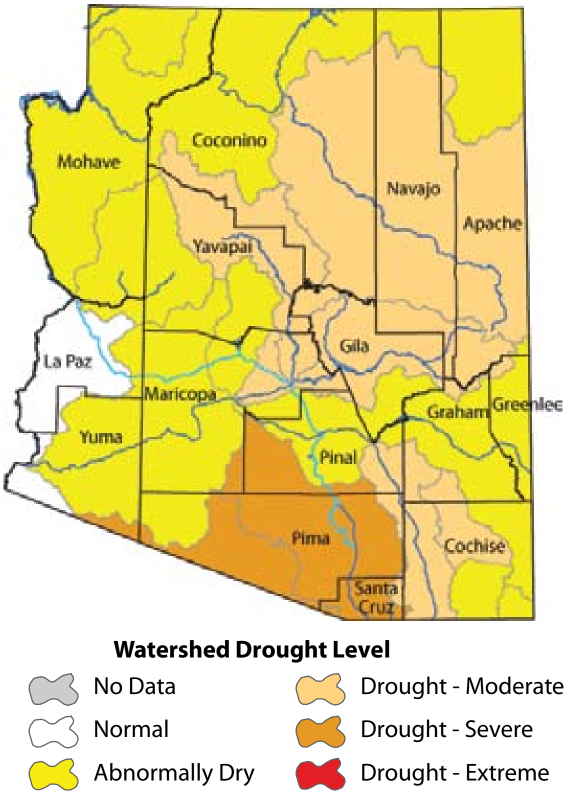


**Figure 4b.** Arizona long-term drought status for April 2007.



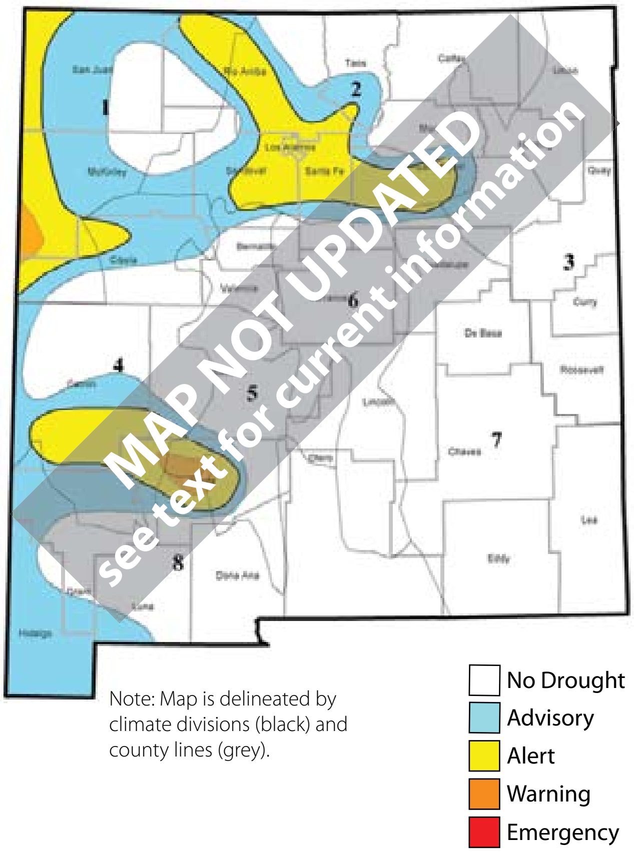
# New Mexico Drought Status

## (through 5/31/07)

Source: New Mexico Natural Resources Conservation Service

The wet winter of 2006–07 and wet summer of 2006 have helped free New Mexico of drought conditions for the time being. Most of the state is drought free, according to the March state drought status update and National Drought Monitor (see Figure 3). Late winter storms brought below-average temperatures and a mix of rain and snow to most of the state during April, improving a brief, but alarming, decrease in snowpack during an unusual March heat wave. April storms halted a 'snowpack freefall', but maybe not in time (*The Albuquerque Journal*, May 11). The early season loss in snowpack is leading to below-average streamflow forecasts. Even with recent above-average precipitation, drought conditions could be just around the corner. The May 15 update of the National Drought Monitor map brings abnormally dry to moderate drought into extreme western portions of the state due to recent above-average temperatures and below-average precipitation.

**Figure 5.** Short-term drought map based on meteorological conditions for March 2007.



Note: Map is delineated by climate divisions (black) and county lines (grey).

**Notes:**

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

Figure 5 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).

**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

# Arizona Reservoir Levels

## (through 4/30/07)

**Source: National Water and Climate Center**

Along the Colorado River, Lake Mead decreased by 2 percent of capacity level since last month (Figure 6). Lake Powell storage increased slightly, due to early snowmelt runoff in the Upper Colorado River Basin. In-state reservoir storage decreased slightly, notably at San Carlos Reservoir, but San Carlos is still far above levels during the worst of the drought.

A warm and dry March stimulated snowpack loss through sublimation (direct loss of snowpack moisture to the atmosphere) and early snowmelt. Recent warmer temperatures have affected snow runoff and inflow to reservoirs. The early meltwaters, including a recent surge in Colorado streamflow, will soon reach reservoirs. Lake Powell is currently 99 feet below full pool elevation. The water surface elevation of Lake Powell reached a seasonal low of 3,597.4 feet on March 16, according to Tom Ryan of the U.S. Bureau of Reclamation. The current inflow forecast (see Figure 13) projects that Lake Powell will reach a seasonal peak elevation of 3,606 feet in June.

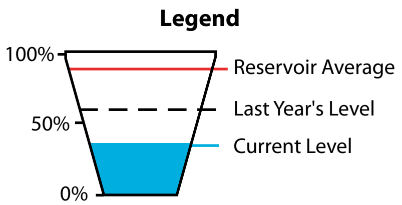
### Notes:

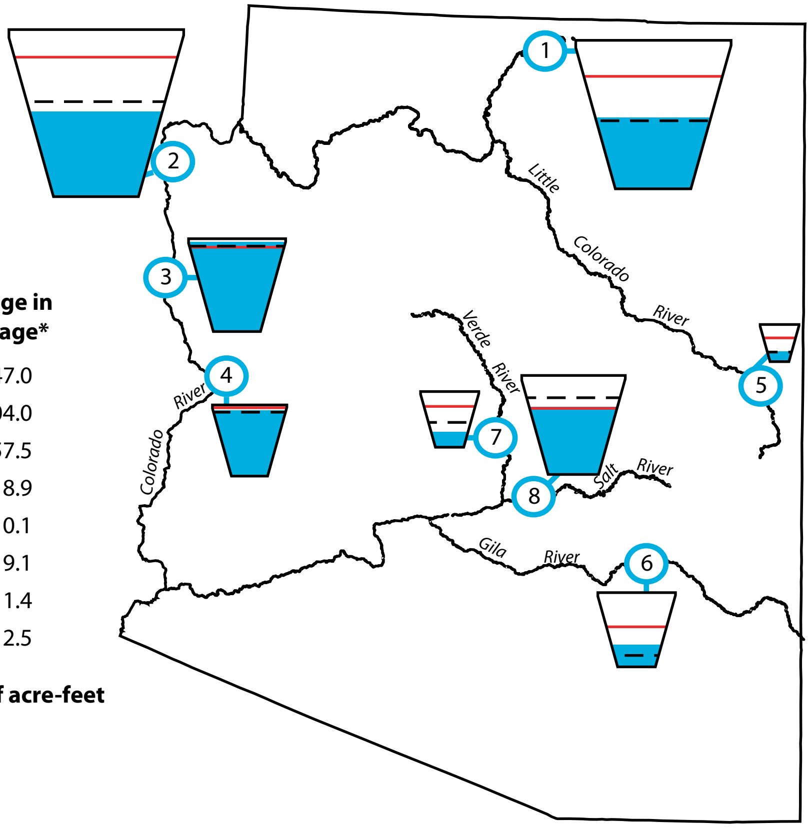
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. 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 April 2007 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.





| Reservoir Name | Capacity Level | Current Storage* | Max Storage* | Change in Storage* |
|---|---|---|---|---|
| 1. Lake Powell | 48% | 11,784.0 | 24,322.0 | 147.0 |
| 2. Lake Mead | 51% | 13,426.0 | 26,159.0 | -504.0 |
| 3. Lake Mohave | 96% | 1,742.3 | 1,810.0 | 57.5 |
| 4. Lake Havasu | 92% | 571.1 | 619.0 | 8.9 |
| 5. Lyman Reservoir | 28% | 8.4 | 30.0 | 0.1 |
| 6. San Carlos | 30% | 261.6 | 875.0 | -19.1 |
| 7. Verde River System | 28% | 79.8 | 287.4 | 1.4 |
| 8. Salt River System | 68% | 1,376.4 | 2,025.8 | -12.5 |

*** thousands of acre-feet**

### On the Web:

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

# New Mexico Reservoir Levels

## (through 4/30/07)

Source: National Water and Climate Center

Percent of capacity increased in most northern New Mexico reservoirs over the past month (Figure 7). El Vado reservoir storage increased by 27 percent and Navajo Reservoir, the second largest in the state, increased by 2 percent. Storage dropped for most reservoirs in the Pecos River drainage, including a 12 percent decrease in Lake Avalon. Other southern New Mexico reservoirs experienced storage decreases.

Good winter snowpack and winter and spring precipitation put northern New Mexico reservoirs in far better shape than last year. However, storage in Elephant Butte, the state's largest reservoir, decreased. The state engineer is confident that it will remain above the 400,000 acre-foot trigger level specified in the Rio Grande Compact, an agreement between Colorado, New Mexico, and Texas that apportions the waters of the Rio Grande Basin among the three states (*Albuquerque Journal*, May 1).

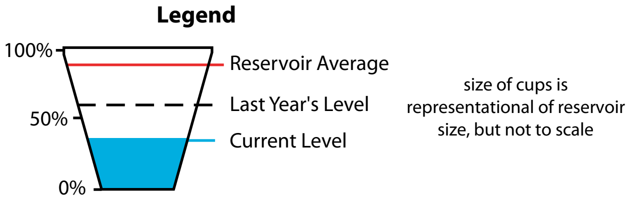
## Notes:

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. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

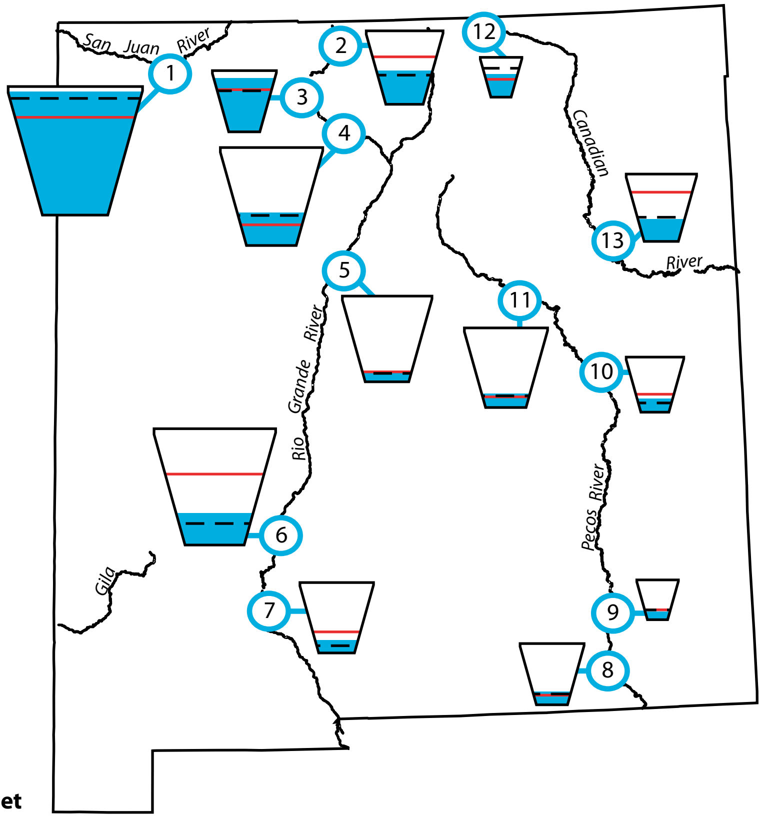
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tom.pagano@por.usda.gov; 503-414-3010) 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 April 2007 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



| Reservoir Name | Capacity Level | Current Storage* | Max Storage* | Change in Storage* |
|---|---|---|---|---|
| 1. Navajo | 96% | 1,622.0 | 1,696.0 | 21.8 |
| 2. Heron | 46% | 182.3 | 400.0 | 13.4 |
| 3. El Vado | 88% | 163.4 | 186.3 | 49.1 |
| 4. Abiquiu | 33% | 182.3 | 554.5 | 3.8 |
| 5. Cochiti | 10% | 52.5 | 502.3 | -0.5 |
| 6. Elephant Butte | 27% | 557.9 | 2,065.0 | -52.6 |
| 7. Caballo | 18% | 60.9 | 331.5 | 42.1 |
| 8. Brantley | 22% | 32.0 | 147.5 | -9.5 |
| 9. Lake Avalon | 20% | 1.2 | 6.0 | -0.7 |
| 10. Sumner | 25% | 25.9 | 102.0 | -1.4 |
| 11. Santa Rosa | 17% | 75.0 | 447.0 | 5.5 |
| 12. Costilla | 58% | 9.2 | 16.0 | 1.6 |
| 13. Conchas | 33% | 84.8 | 254.0 | -1.8 |

*** thousands of acre-feet**



## On the Web:

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

# Southwest Snowpack

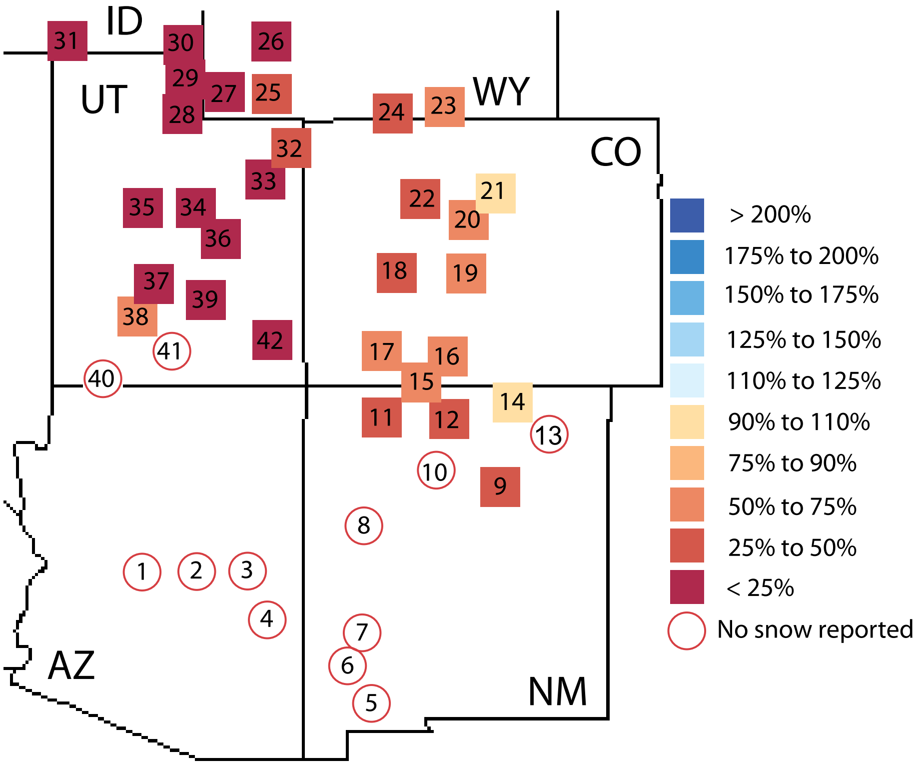
**(updated 5/17/07)**

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

Snowpack is below-average across almost all of the Southwest, with most stations reporting less than 50 percent of average (Figure 8). There were no observations from Arizona stations due to either no snow being reported or lack of data to calculate a long-term average for mid-May. Some New Mexico stations are reporting snowpack of less than 50 percent average for mid-May. Poor snowpack levels are leading to poor streamflow forecasts into the spring (see Figure 13). Streamflows are only expected to be 50–75 percent of average in the upper Rio Grande. Upper Colorado River basin streamflows are also only expected to be 50–75 percent of average into the spring.

The Sante Fe River in northern New Mexico was recently named America's most endangered river by the Washington D.C.-based non-profit advocacy group, American Rivers. The Associated Press reported that the non-profit group moved the Sante Fe to the top of its 2007 list to drum up support for returning a regular water flow to the river. The group stated that the interaction of over-exploitation and drought poses the greatest threat to the river.

**Figure 8.** Average snow water content (SWC) in percent of average for available monitoring sites as of May 17, 2007.



**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 5/17/07)

**Source: Southwest Coordination Center**

Based on daily National Fire Danger Rating System measurements (not shown), current observed fire danger is high to very high across the western two-thirds of Arizona and moderate to low across the rest of Arizona and New Mexico. Dead fuel moisture is exceedingly low in western Arizona, which can experience substantial fires in riparian, grass, brush, and mesquite-dominated ecosystems, as well as in the timbered areas of northwestern Arizona.

Arizona's most serious fire so far this season was the Promontory fire on the Tonto and Apache-Sitgreaves national forests in northern Arizona (Associated Press, May 18). As of May 18, the four-square-mile fire had forced about fifty people to evacuate the area, with evacuees asked to go to a church shelter in Payson, Arizona, some eighteen miles west of the fire. More than six hundred firefighters were battling the fire, which is believed to be human-caused.

The fire season is expected to be around normal east of the Rio Grande in northern New Mexico, according to Santa Fe National Forest acting fire management officer Nando Lucero (*Santa Fe New Mexican*, April 26). Based on a 10-year average, normal could mean about 167 fires in the national forest. West of the Rio Grande, in the Jemez Mountains as well as across northern New Mexico to the Four Corners region, wildfire conditions are already greater than normal, and fire managers are bracing for an increased number of summer fires sparked by lightning.

### Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2007. The figures include information both for current fires and for fires that have been suppressed. Figure 9a shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. Figures 9b and 9c indicate the approximate locations of past and present "large" wildland fires and prescribed burns in Arizona and in New Mexico. A "large" fire is defined as a blaze covering 100 acres or more in timber or 300 acres or more in grass or brush. The name of each fire is provided next to the symbol.

### On the Web:

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

http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_daily_state.htm
http://gacc.nifc.gov/swcc/predictive/intelligence/situation/swa_fire.htm

**Figure 9a.** Year-to-date fire information for Arizona and New Mexico as of May 15, 2007.

| State | Human Caused Fires | Human caused acres | Lightning caused fires | Lightning caused acres | Total Fires | Total Acres |
|---|---|---|---|---|---|---|
| AZ | 441 | 12,606 | 28 | 360 | 469 | 12,966 |
| NM | 299 | 19,200 | 39 | 2,497 | 338 | 21,697 |
| Total | 740 | 31,806 | 67 | 2,857 | 807 | 34,663 |

**Figure 9b.** Arizona large fire incidents as of May 17, 2007.

**Figure 9c.** New Mexico large fire incidents as of May 17, 2007.

# Temperature Outlook

## (June–November 2007)

**Source: NOAA Climate Prediction Center (CPC)**

The NOAA-CPC long-lead forecast is predicting greater probabilities for above-average temperatures through November for the Southwest, centered over Arizona (Figures 10a–10d). The prediction for greater chances of above-average temperatures for the Southwest during the summer is of concern, especially for much of Arizona where drought conditions have persisted. Most of New Mexico has observed cooler temperatures and above-average precipitation during the winter in association with El Niño conditions; Arizona has not. Above-average temperatures through the summer may increase the risk for wildfires as reflected in the latest National Wildland Fire Outlook (see Figure 14a).

Into late summer and early fall, the forecast is calling for greater chances of above-average temperatures for the majority of the United States (Figure 10b).

### 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 June–August 2007.

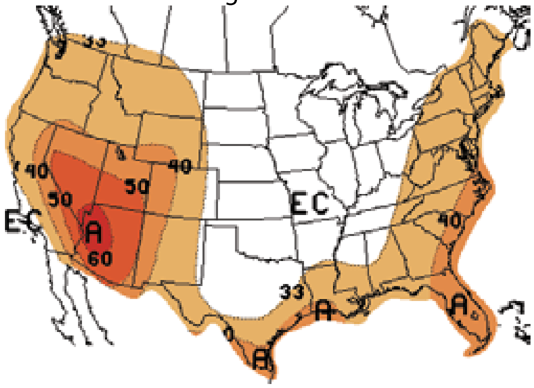


**Figure 10b.** Long-lead national temperature forecast for July–September 2007.

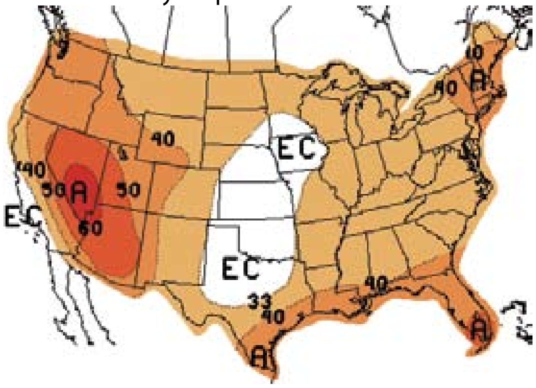


**Figure 10c.** Long-lead national temperature forecast for August–October 2007.

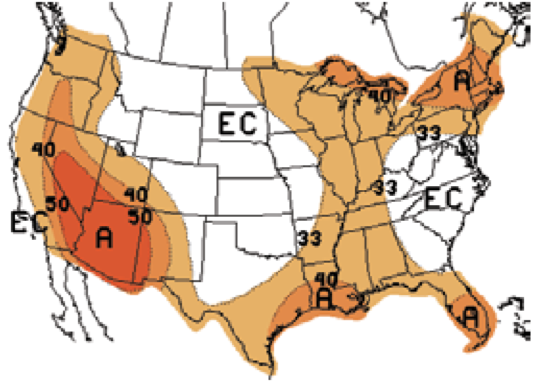
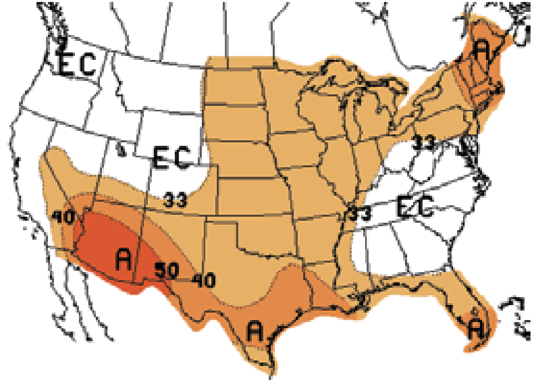


**Figure 10d.** Long-lead national temperature forecast for September–November 2007.



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

### (June–November 2007)

**Source: NOAA Climate Prediction Center (CPC)**

The NOAA-CPC long-lead precipitation forecast is calling for greater chances of below-average precipitation over the northwestern U.S. through October 2007 (Figures 11a–11c). Equal chances of below-average, average, or above-average precipitation are predicted for the rest of the country through August. However, greater chances of above-average precipitation are predicted for the Gulf and Atlantic coast from the end of summer through the fall (Figures 11b–11d). Statistical models are leaning on a recent trend towards wetter summers over the Southeast as well as a recent shift in inter-decadal variability towards more Atlantic hurricane activity.

In the Southwest, equal chances of below-average, average, or above-average precipitation are predicted. The "equal-chances" designation reflects a lack of climate signal on which to make a forecast.

## 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 June–August 2007.

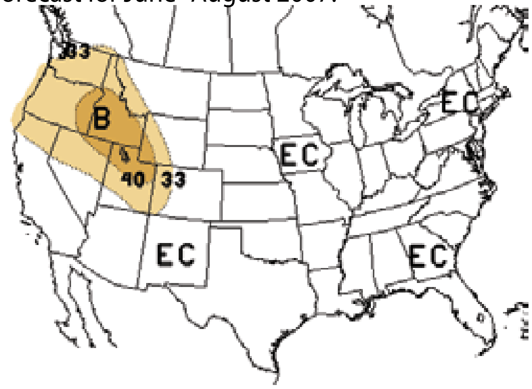


**Figure 11b.** Long-lead national precipitation forecast for July–September 2007.

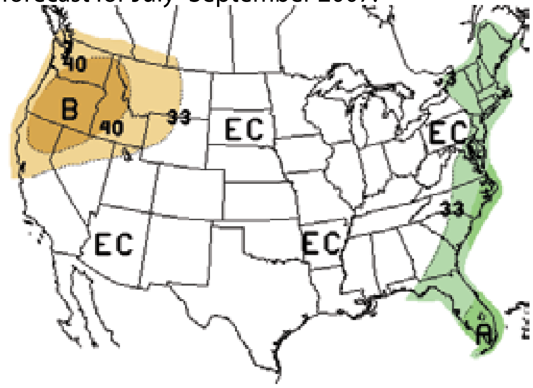


**Figure 11c.** Long-lead national precipitation forecast for August–October 2007.

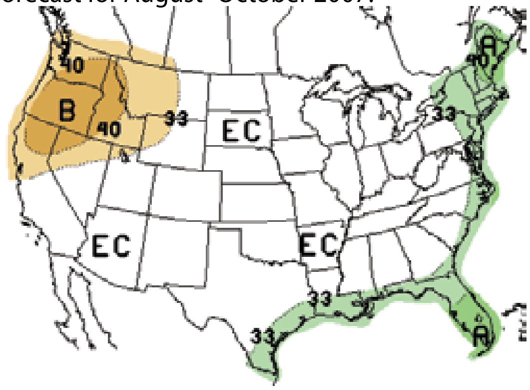
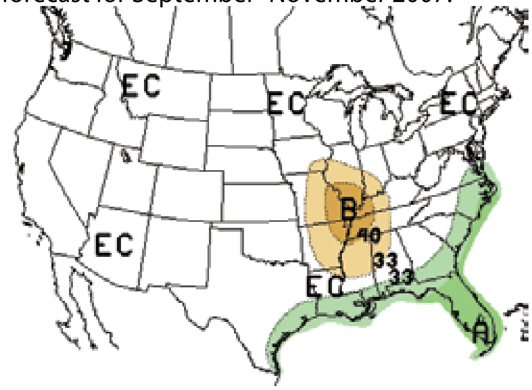


**Figure 11d.** Long-lead national precipitation forecast for September–November 2007.



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 August 2007)

Source: NOAA Climate Prediction Center (CPC)

The summer thunderstorm season running from July into September should bring some drought relief to Arizona, according to the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center. New Mexico soil moisture is currently above the five-year average, and northern New Mexico's reservoirs are mostly above average and are well above levels from this time last year.

The Chihuahuan Desert straddling the U.S.-Mexican border is suffering from drought and intensive farming and overgrazing, according to a recent report by the Intergovernmental Panel on Climate Change, an authoritative body of 2,500 scientists. The Chihuahuan Desert is North America's largest desert.

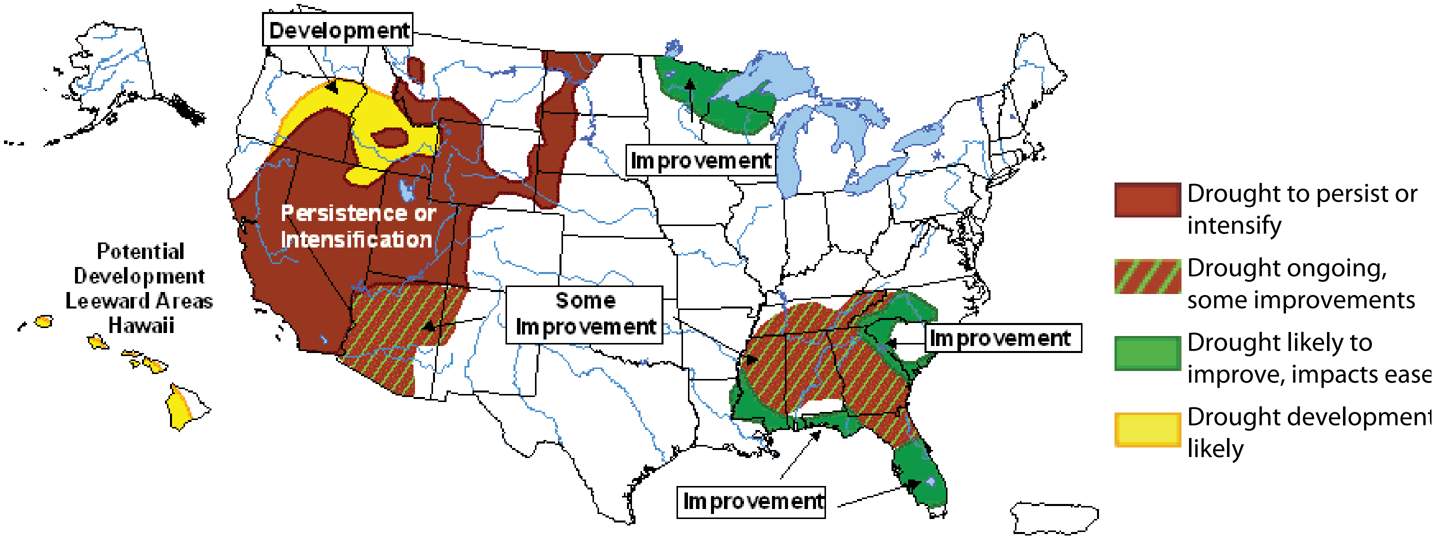
In response to the recent drought severity, residents of Green Valley, Arizona, recently petitioned the Pima County Board of Supervisors to declare a crisis and stop the overpumping of groundwater. The residents fear that growth and local businesses will deplete their water supply (*Tucson Citizen*, May 4). In another drought-related step, Oro Valley, Arizona, has banned outdoor watering for residents and businesses from 7 a.m. to 7 p.m., when evaporation is greatest. The outdoor ban is part of a package of otherwise voluntary conservation measures that the Oro Valley Town Council adopted last November as part of a drought response plan (*Arizona Daily Star*, May 4).

The NOAA Climate Prediction Center soon will increase the frequency of scheduled issuances of the U.S. Drought Outlook. Beginning June 7, the outlook will be issued on the first and third Thursdays of each month with the goal of providing an improved and more consistent level of service.

**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 August 2007 (release date May 17, 2007).



**On the Web:**

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

# Streamflow Forecast

## (for spring and summer)

**Source: National Water and Climate Center**

Only two Arizona basins, the Virgin and the Colorado, receive seasonal streamflow forecasts after April, and neither look good. Due to below-average snowpack, warm spring temperatures, and early snowmelt, the most probable inflow to the Colorado River at Lake Powell for April through July is 50 percent of average. Virgin River April–July streamflow is expected to be 25 percent of average. Low inflow to Lake Powell will likely result in the seventh year of below-average streamflow in the last eight years.

Below-average streamflow is also predicted for most New Mexico basins. The forecast for the Rio Grande at Otowi Bridge north of Albuquerque is for 59 percent of average March–July streamflow. Near Jemez, the Jemez River is expected to receive 70 percent of average March–July streamflow, and the Santa Fe River near Santa Fe is expected to receive 59 percent of average March–July flow.

Nevertheless, recent snowmelt has boosted flows in northern New Mexico. "Whitewater rafters have a shot at a good season through June," (*Santa Fe New Mexican*, May 10). Flows at locations on the Rio Grande are about twice what they were last year at this time, according to the article.

Farmers in the Middle Rio Grande Conservancy District are currently benefiting from a warm March that melted snow early, pushing El Vado reservoir to above-average levels (see Figure 7). However, the predictions of below-average Rio Grande flows may still affect this region. Irrigation allocations are dependent, in part, on the status of Elephant Butte reservoir and trigger levels specified in the Rio Grande Compact. The compact assures Texas of a substantial portion of Rio Grande flows.

Unusually heavy seasonal rains caused flooding in southeastern New Mexico (*Current Argus*, May 8). No serious damage was reported, although some homes flooded in Carlsbad and Eddy County.

### 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

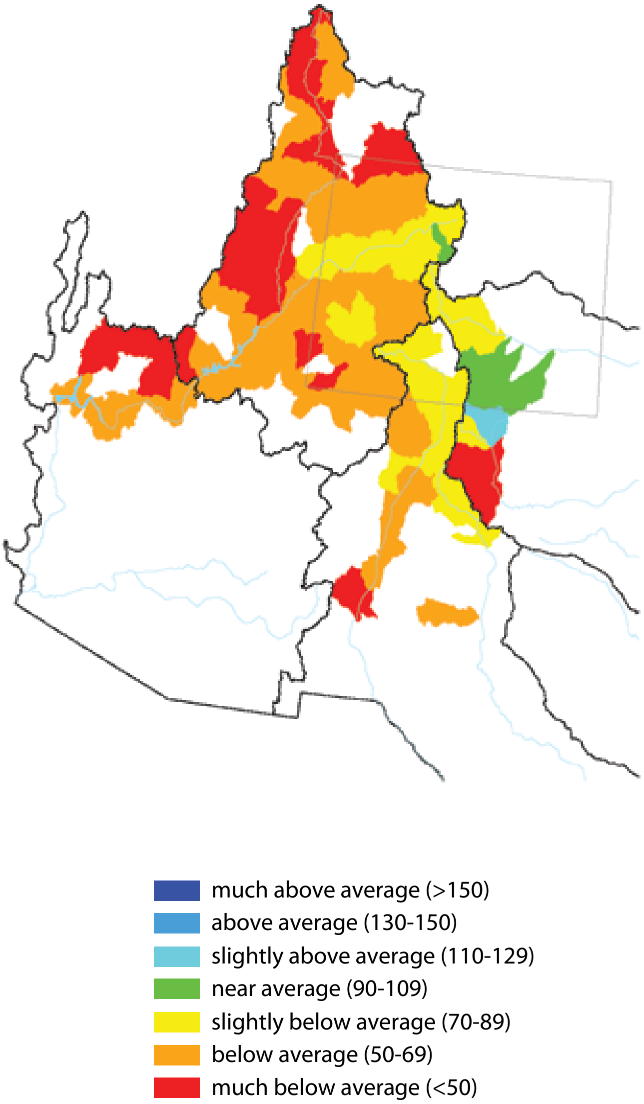


**Figure 13.** Spring and summer streamflow forecast as of May 1, 2007 (percent of average).

### 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.

# Wildland Fire Outlook

**Sources: National Interagency Coordination Center, Southwest Coordination Center**

Above-normal significant fire potential is expected across parts of southern New Mexico, southern and west-central Arizona, and southwestern Texas, with generally normal potential elsewhere. (Significant fire potential refers to the projected need to bring in fire suppression resources from outside the Southwest geographic area.) Above-normal fire potential is expected across the southern half of Arizona and New Mexico, due to the combination of seasonally strong winds, persistent drought, and abundant fine herbaceous fuels, such as grasses. The greatest potential for fire is expected at middle and lower elevations.

Fire experts at the Southwest Coordination Center (SWCC) anticipate increased fire-fighting challenges from an unusually dynamic May weather pattern. They note that prescribed fire projects planned for eastern New Mexico and west Texas can expect a rapid transition from the seasonal green-up of vegetation to cured (dried out vegetation) conditions. They also note high "fine-fuel loading"—an abundance of dry grasses and other herbaceous material—in this region.

Before the end of May, the SWCC experts expect to see several fires greater than 300 acres in grass and brush, and greater than 100 acres in timber environments. However, they expect resource needs for these incidents to fall within normal range for this time of the year.

## 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/

**Figure 14a.** National wildland fire potential for fires greater than 100 acres (valid May 1–31, 2007).

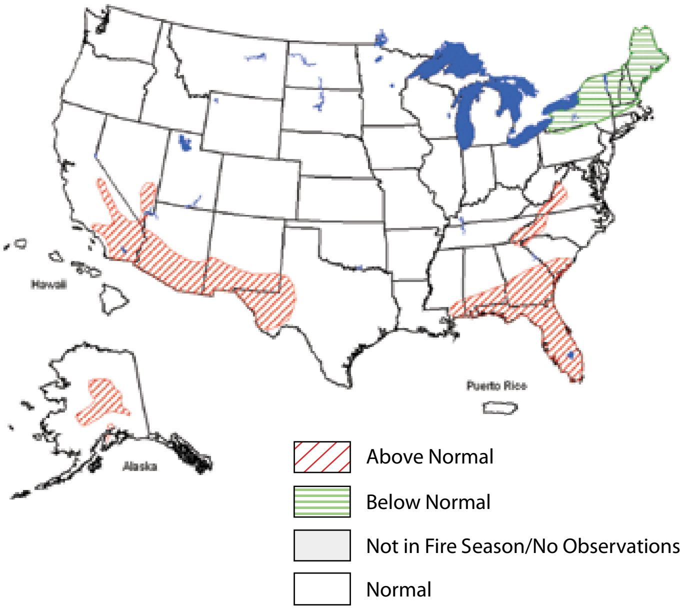


**Figure 14b.** Current fine fuel condition and live fuel moisture status in the Southwest.

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

| Live Fuel Moisture | |
|---|---|
| | **Percent of Average** |
| Douglas Fir | 87 |
| Juniper | 80 |
| Piñon | 90 |
| Ponderosa Pine | 92 |
| Sagebrush | |
| **1000-hour dead fuel moisture — AZ** | **12** |
| **1000-hour dead fuel moisture — NM** | **17** |
| **Average 1000-hour fuel moisture for this time of year** | **11–16** |

# El Niño Status and Forecast

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

The El Niño conditions in the tropical Pacific of the 2006–07 winter have subsided and current El Niño Southern Oscillation (ENSO) conditions are neutral (Figure 15a). Cooler-than-average sea surface temperatures (SSTs) are developing in the eastern tropical Pacific and along the coast of Peru. Statistical and dynamical models are hinting at the development of weak La Niña conditions through the fall, but are conflicted on how the event may play out. Experts at the NOAA-CPC note that statistical models, which project future conditions based on what has happened under similar circumstances in the past, indicate conditions are likely to remain neutral in the near future. However, these models are not sensitive to subsurface dynamics. Dynamical models tend to show La Niña conditions are likely to develop, based in part on projections accounting for conditions below the sea surface. However, the dynamical models overestimated the rate at which the system might switch to La Niña conditions earlier this year. Official ENSO forecasts from the NOAA-CPC and IRI blend both dynamical and statistical model outputs to suggest the development of La Niña conditions, but lean toward statistical models that suggest the event will be slow to develop and weak. Forecasters note that spring ENSO forecasts are exceptionally difficult to make given the complications associated with transition season atmospheric and oceanic dynamics and statistical and dynamical model sensitivities. IRI statistical model results are indicating over a 50 percent chance of La Niña conditions developing through the summer (Figure 15b). There is also just under a 50 percent chance that neutral ENSO conditions will persist through the summer; the probability for neutral conditions increases towards the winter and spring of 2008.

ENSO conditions have a strong influence on winter precipitation in the Southwest, with El Niño favoring wetter-than-average and La Niña favoring drier-than-average conditions.

## Notes:

Figure 15a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through April 2007. 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.

### On the Web:

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

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

**Figure 15a.** The standardized values of the Southern Oscillation Index from January 1980–April 2007. 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).

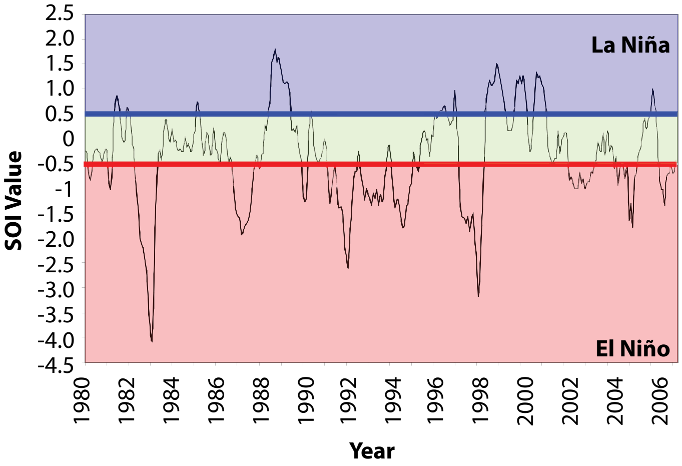
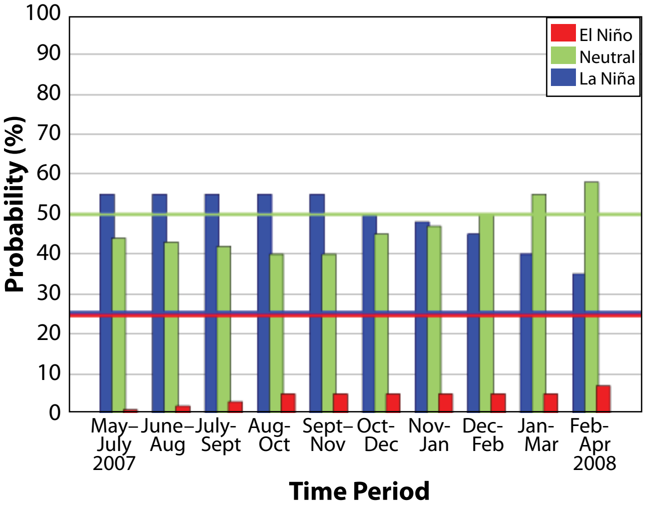


**Figure 15b.** IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released May 17, 2007). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



# Temperature Verification

## (February–April 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal outlook for February–April 2007 predicted increased chances of above-average temperatures across most of the northern United States (Figure 16a). Near-normal temperatures were predicted for most of the southeastern quarter of the country in association with lingering El Niño conditions in the tropical Pacific. Elsewhere, forecasters reserved judgment (EC indicates equal chances of below-average, average, or above-average temperatures). The forecast did not match observations in the Midwest and Great Lakes region, where observed temperatures were 0–6 F below average (Figure 16b). After a generally mild winter, February brought severe cold across the Midwest and Northeast. Across most of the Southeast, observed temperatures within 2 degrees F of average matched the forecast for near-normal temperatures. Across most of the West, observed above-average temperatures agreed with the forecast. Above-average temperatures also occurred in southern California and Arizona, where equal chances were predicted. The northern and central Rockies experienced very warm conditions, including some record high temperatures during the week of March 12–18.

### Notes:

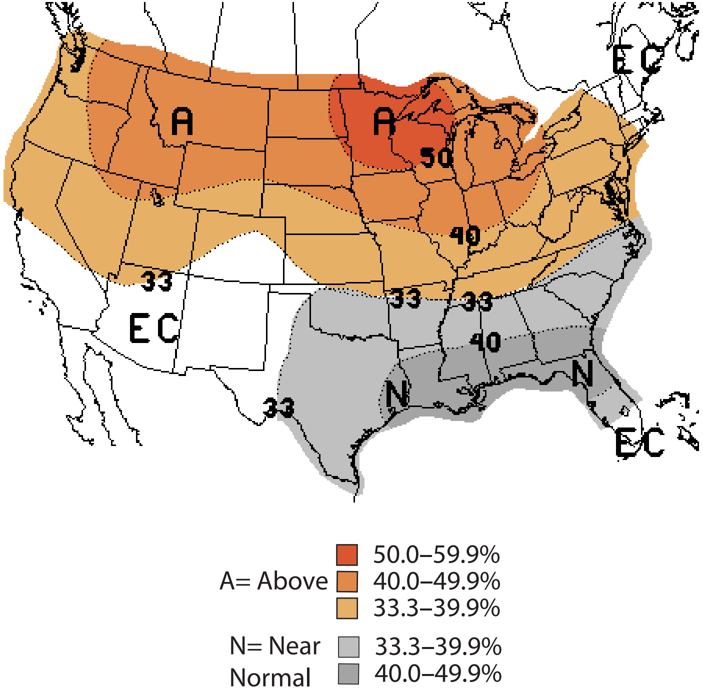
Figure 16a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months February–April 2007. This forecast was made in January 2007.

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.

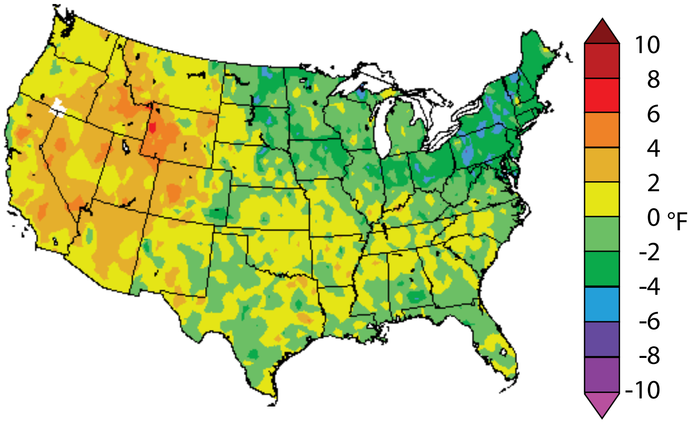
Figure 14b shows the observed departure of temperature (degrees F) from the average for the February–April 2007 period. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps. The temperature departures do not represent probability classes as in the 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 16a.** Long-lead U.S. temperature forecast for February –April 2007 (issued January 2007).



EC= Equal chances. No forecasted anomalies.

**Figure 16b.** Average temperature departure (in degrees F) for February–April 2007.



### 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

## (February–April 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal precipitation outlook for February–April 2007 predicted increased chances of above-average precipitation for the southern U.S., and increased chances of below-average precipitation for the Northern Rockies, Ohio River Valley, and central Great Lakes states (Figure 17a). The greatest chances for above-average precipitation centered on southern New Mexico and southwestern Texas, where the forecast closely matched 150–400 percent of average observed precipitation totals (Figure 17b). Storms brought rain to western Texas and even early April snowfall to Midland, Texas. In contrast to predictions, drought persisted over the Florida peninsula. In general, total precipitation for February–April was 25–75 percent of average over most of the Southeast. Some northern Rocky Mountain locations, such as western Wyoming and southern Idaho, received 25–75 percent of average precipitation, in agreement with the forecast. Much of Montana received 100–200 percent of average precipitation, which is attributed to a series of storm systems that brought heavy snow in early April and heavy rain toward the end of the month. Most of New Mexico, central Colorado, and the central Plains states received average to above-average precipitation, as predicted. Spring tends to be dry for most of New Mexico; however, Albuquerque measured two record rainfall events: 0.19 inches in late March and 0.65 inches in mid-April.

## Notes:

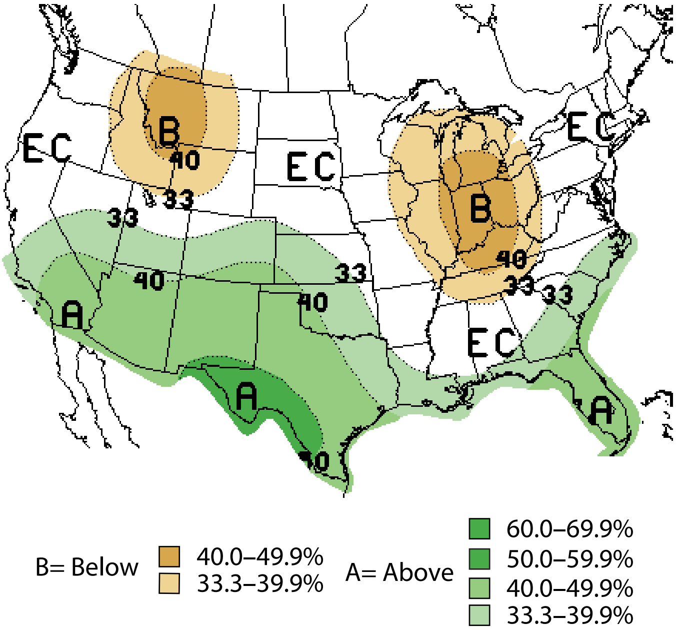
Figure 17a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months February–April 2007. This forecast was made in January 2007.

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 February–April 2007. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps. The observed precipitation amounts do not represent probability classes as in the forecast maps, so they are not strictly comparable, but they do provide us with some idea of how well the forecast performed.

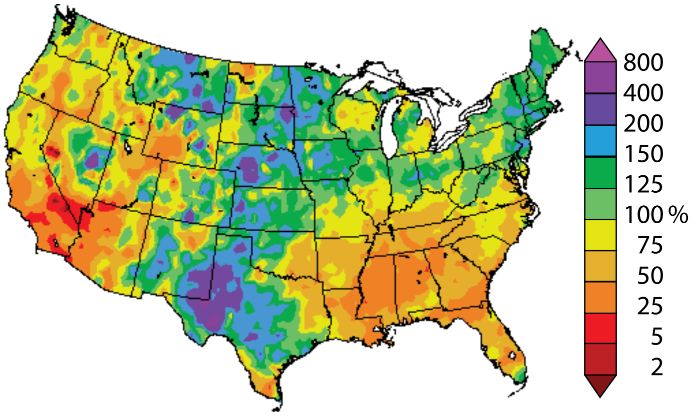
In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

**Figure 17a.** Long-lead U.S. precipitation forecast for February–April 2007 (issued January 2007).



EC= Equal chances. No forecasted anomalies.

**Figure 17b.** Percent of average precipitation observed from February–April 2007.



## 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